# TEAPAC *Complete*
# Tutorial/Reference Manual

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## ACKNOWLEDGMENTS

The TEAPAC program was developed by Dennis W. Strong of Strong Concepts, with the initial module of TEAPAC first developed in 1974.

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CHAPTER 1

# Introduction

Chapter 1 Topics

The TEAPAC program provides quick, accurate, consistent and integrated analysis and design of a wide range of transportation- and traffic-engineering problems. TEAPAC is an acronym for Traffic Engineering Application PACkage, and more than a dozen integrated application functions are included in TEAPAC, as described below.

The Signal Analysis (SIG) functions in TEAPAC (previously known as SIGNAL2000) are designed to aid in the analysis and optimized design of intersection control based on factors such as approach geometry, lane usage, phasing and pedestrian constraints. The methodology uses the auto-mode capacity analysis procedures documented in the Transportation Research Board 2000 and 2016 *Highway Capacity Manuals* for signalized intersections and urban streets. The functions can be used to analyze existing conditions or to design for future conditions.

The Traffic Impact Analysis (TIA) functions in TEAPAC (previously known as SITE) are designed to aid in performing trip generation and distributions for developments. The assignments paths can be specified by either the user or the software, or a combination of the two, which allows complete control of routing traffic to and from a development site. Once the assignments have been entered, it is possible to quickly test different development scenarios and then perform the other functions of TEAPAC such as its signal analysis or export functions.

The Count Analysis (COU) functions in TEAPAC (previously known as TURNS and WARRANTS) are designed to aid in reducing, summarizing and analyzing traffic counts. The program accepts up to twelve turning movements per intersection with cumulative or reduced counts. The program is capable of generating reports for fifteen- and sixty-minute count intervals as well as calculating and graphing the peaks which occurred during the count period and performing signal warrant and multi-way stop warrant analyses.

The Progression Analysis (PRG) functions in TEAPAC (previously known as NOSTOP) are designed to aid in the analysis of simplified bandwidth progression for arterial signal systems. The program provides a fast and effective means of evaluating the variation of progression efficiency for a range of cycle lengths and progression speeds, and the PRENOSTOP application in TEAPAC can interface these progression analysis functions with all of the other applications of TEAPAC.

The Export and Import (EXP) functions in TEAPAC are designed to integrate TEAPAC with other transportation programs. These include seamless interfaces with HCS, HCS+, HCS+T7F, HCS2010 and HCS7 (previously included in SIGNAL2000); TRANSYT and TRANSYT-7F (previously PRETRANSYT); PASSER-II (previously PREPASSR); NETSIM and CORSIM (previously PRENETSIM); SYNCRHO and SIMTRAFFIC (previously PRESYNCHRO); TRU-TRAFFIC and TS/PP-DRAFT (previously PRETSPPD); VISSIM (previously PREVISSIM); and numerous electronic traffic counting devices such as Jamar, TimeMark, NuMetrics, TimeLapse and Titan. These functions are designed to aid in the use of the third-party programs by preparing input files for and running the programs directly from the data entered in TEAPAC, as well as importing the results of any optimized decision variables back into TEAPAC. In the case of traffic counting devices, the traffic counts can be imported directly into the count database of TEAPAC, and in the case of SYNCHRO, the entire network of data can be imported into TEAPAC.

The SCENARIO (SCN) function in TEAPAC allows for the creation and management of multi-variable, multi-issue scenario analyses for any of the TEAPAC functions, and thereby for any of the third-party programs for which TEAPAC creates data files. The key to the value of TEAPAC's scenario management function is that all of the data files for the multi-variable analyses are maintained without any duplication of data, as opposed to the typical use of File-SaveAs which creates a myriad of data files with vast amounts of duplicated data and complex file naming schemes.

In order to illustrate these features, initial examples for each of the six main TEAPAC functions described above have been created. By following the step-by-step instructions contained in Chapter 2 of this manual, you will become familiar with the basic command dialogs and procedures of the program. In this chapter, and subsequent chapters where application-specific discussions are appropriate, the chapters are sub-divided into separate sections which are identified by and contain information specific to each individual application function.

## Chapter 1 Topics:



## Structure and Organization

This document, the *TEAPAC Tutorial/Reference Manual*, explains the data entries and procedures necessary to use the TEAPAC program. The organization is as follows. Chapters 1 through 7 serve as the program Tutorial Manual. The tutorial steps through simple example problems and then discusses the specific analysis techniques and procedures of the program. The attached appendices form the program Reference Manual which provides easy look-up of detail on the program's inputs, operation and output. The following briefly describes each chapter.

This chapter, Chapter 1, discusses the overall structure of the tutorial/reference manual and the conventions used throughout (see the outline in Table 1-1). It also contains a brief explanation of the basic procedures of TEAPAC.

In order to illustrate the features and basic procedures of TEAPAC, Chapter 2 presents "hands-on" example problems with detailed step-by-step instructions on how to execute a simple analysis using each of TEAPAC's primary application functions. This chapter provides an opportunity to use the program and observe the results for each individual application function, with a separate sub-section for each application function.

Chapter 3 discusses the analysis techniques and procedures which should be used with the different TEAPAC applications, as illustrated by the examples presented in the previous chapter. After reading this section, it should be possible to perform simple analyses using the program. This chapter is sub-divided by the primary application functions of TEAPAC.

Chapter 4 provides a summary of each of the action and entry dialogs used by TEAPAC, organized by function (details are in Appendix B). This includes a summary of the basic TEAPAC housekeeping actions and entries. More detail on these basic TEAPAC housekeeping functions can be found in Appendix B and the Advanced Chapters 6 and Chapter 7.

Chapter 5 discusses advanced techniques for using the individual TEAPAC applications which will improve the efficiency of conducting analyses (sub-divided by application function). These techniques require a working familiarity with the basic principles of using TEAPAC, as described in Chapters 1-4.

Chapter 6 discusses the details of the analysis techniques and procedures which are used regardless of the application function being performed, as illustrated by the examples presented in the Chapter 2. After reading this section, the user will understand the underlying general concepts and procedures of using TEAPAC for a more advanced appreciation of the detailed operation of the program.

Chapter 7 discusses advanced techniques for using TEAPAC which will improve the efficiency of conducting analyses. These techniques require a working familiarity with the basic principles of using TEAPAC, as described in Chapters 1-6.

Attached to this tutorial are eight appendices (A through H) which form the TEAPAC Reference Manual. Each is designed and ordered in a manner that provides quick lookup of answers to questions which may arise during the use of TEAPAC. These appendices provide detail on program actions, entries, methods and formulae used in calculating results, program reports, error messages, operating system conventions and addenda. The introduction at the front of the appendices briefly describes each appendix and how to use it as a reference document. An index is provided at the end for the combined Tutorial/Reference Manual.

**Table 1-1**
**Organization of the TEAPAC Tutorial**

Chapter 1 - INTRODUCTION
- Structure and Organization
- Conventions
- Overview of TEAPAC Procedures

Chapter 2 - INITIAL EXAMPLES (one example for each major application function)
- Description of Example Problem
- Data Entry
- Data Review
- Analysis
- Evaluation
- Exiting the Program
- Additional Concerns

Chapter 3 - ANALYSIS PROCEDURES (sub-divided by application function)
- Input Requirements
- Analysis Procedures

Chapter 4 - ACTIONS AND ENTRY PARAMETERS
- RESULTS Dialogs
- PARAMETERS Dialogs
- Basic TEAPAC Housekeeping Dialogs

Chapter 5 - ADVANCED APPLICATION PROCEDURES (sub-divided by application function)
- Sharing Data Between All TEAPAC Applications
- Application-Specific Advanced Procedures

Chapter 6 - ADVANCED ANALYSIS PROCEDURES
- Data Entry
- Data Review
- Analysis
- Evaluation
- Additional TEAPAC Features

Chapter 7 - ADVANCED TEAPAC PROCEDURES
- Manipulation of Heading Information
- Redirecting Report Output to Disk Files
- Command Entry Options
- Simplified Use of Files
- Advanced Use of Files
- Control Files
- User Variables and Calculations

## Conventions

Due to the interactive nature of the TEAPAC program, the tutorial contains sections which provide "hands-on" program instructions. When reading these sections, it is recommended that each step be executed as shown in the documentation. The information described below will help in understanding the conventions and terms used in these examples, as well as the entire document.

Sub-topics for this section:

- Definition of Terms
- Intersection Approach and Movement Data Entry
- Arterial Progression Data Entry
- Phasing Sequence Codes
- Version Number
- Input Modes
- Example Data Entries
- Parameter Symbols

### Definition of Terms

Important terms which are used throughout the documentation are defined in Table 1-2. It is helpful to be familiar with these terms prior to using the tutorial/reference manual.

**Table 1-2**
**Definition of Terms**

**Program Control Menu.** The TEAPAC program starts up in the Normal View of the Visual Mode by first displaying the Main Menu. From this menu, all program options can be selected and executed, including the Tabular View and the Manual Mode.

**Menu Line Item.** A Menu Line Item is one of the options displayed in any drop-down menu, or in a lower-level menu. It can be selected and executed to display a dialog box to enter data or execute a function.

**Dialog Box.** When a Menu Line Item is selected or the ASK command is used, a dialog box is displayed. In this display, data entries can be easily viewed, entered and changed, and calculations can be initiated, by simple cursor and/or mouse movements.

**Command.** A Command is the keyword used to identify a dialog box, and is the first word of an Input Line which identifies the kind of action to be performed by the program. These actions are either to enter data or to perform analyses.

**Parameter Values.** Parameter Values are data entries found in a dialog box, or which follow a Command on an Input Line. These values define the data being entered or control the analysis to be performed. Most dialog boxes have at least one Parameter Value associated with it.

**Default Value.** When the program is run initially, all parameter values take on pre-assigned default values. These are reasonably typical values. Default Values can be restored using the File-New menu or the RESET command.

**Command Level Prompt.** The Command Level Prompt, "→", is displayed in the Manual Mode when ready to accept a Command Input Line from the keyboard.

**Input Line.** An Input Line consists of a Command keyword and its Parameter Values. An Input Line may be entered in either the Tabular View or Manual Mode, or LOADed from a data file.

**Group Name.** Groups Names are used to identify sets of commands which share a common function. These commands can be referenced together as a group by using the Group Name enclosed in square brackets, e.g. [Basic].

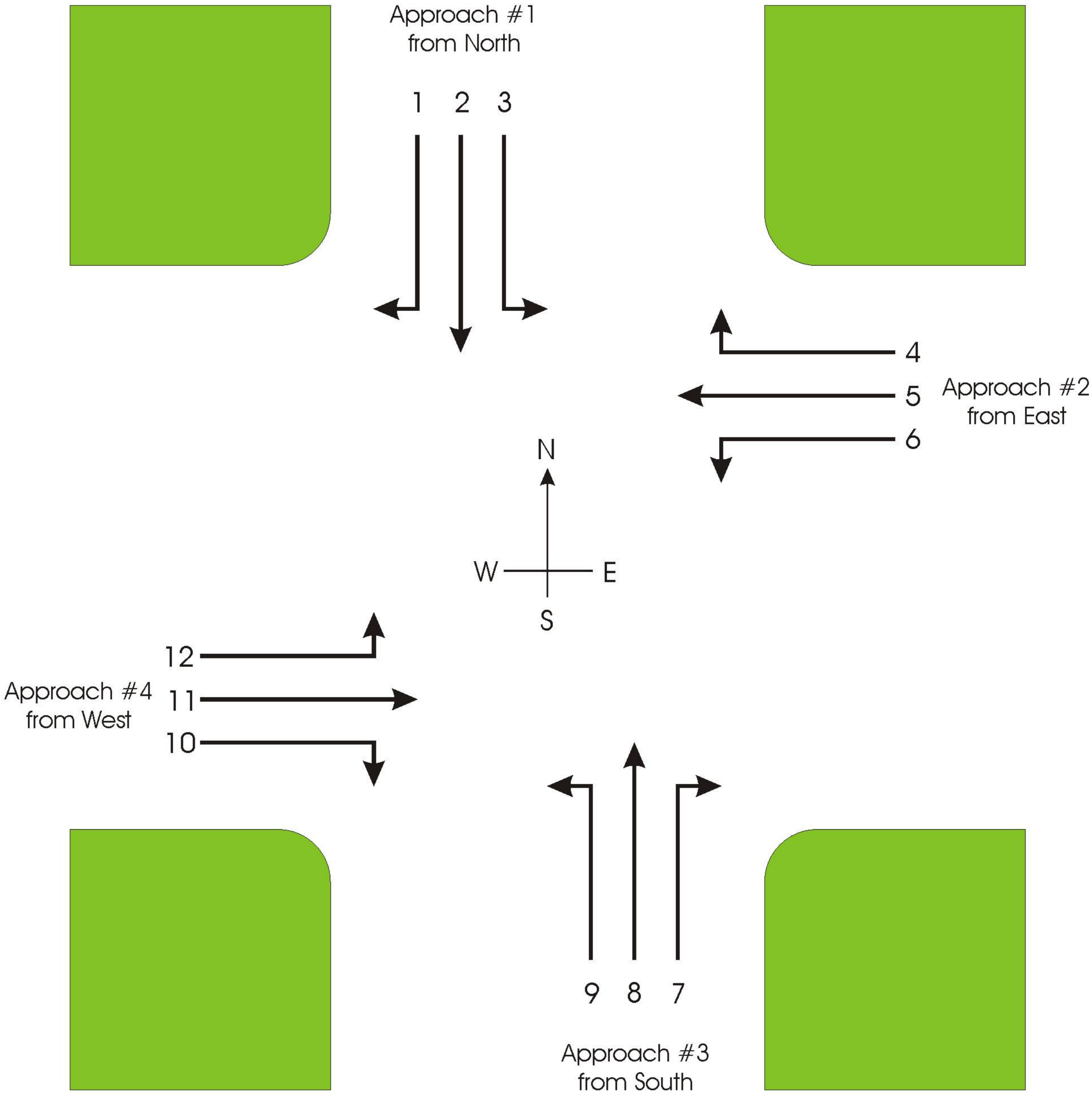
**File.** A file is a place on a permanent storage disk where program entry information is stored. This information can be either input data information (a data file), commands to direct computations (a control file), or a combination of both.

## Intersection Approach and Movement Data Entry

TEAPAC enters intersection approach and movement data in a standard order, starting from the north and moving clockwise around the intersection. These conventions should be understood when entering intersection data, as described below and as illustrated in Figure 1-1.

Approach Data - When approach information is required and four parameter values are to be entered, one for each approach, data will be entered starting with the north approach followed by the east, south and west approaches (approach numbers 1, 2, 3, and 4). When data is required for a specific approach, the approach should be specified using the cardinal direction codes North, East, South, and West, meaning from the North, from the East, etc.

Turning Movement Data - When movement information is required and twelve parameter values are to be entered, one for each movement, data will be entered starting with the right-turn movement on the north approach followed by the through movement and left-turn movements on the north approach, then continuing with the right, through, and left on the east, south, and west approaches (movement numbers 1, 2, 3, up to movement 12). When data is required for a specific movement, the movement should be specified using numbers 1 through 12.




Intersection approach and turning movement data should be entered in the order shown in this figure.

**Figure 1-1**
**Intersection Approach and Turning Movement Conventions**

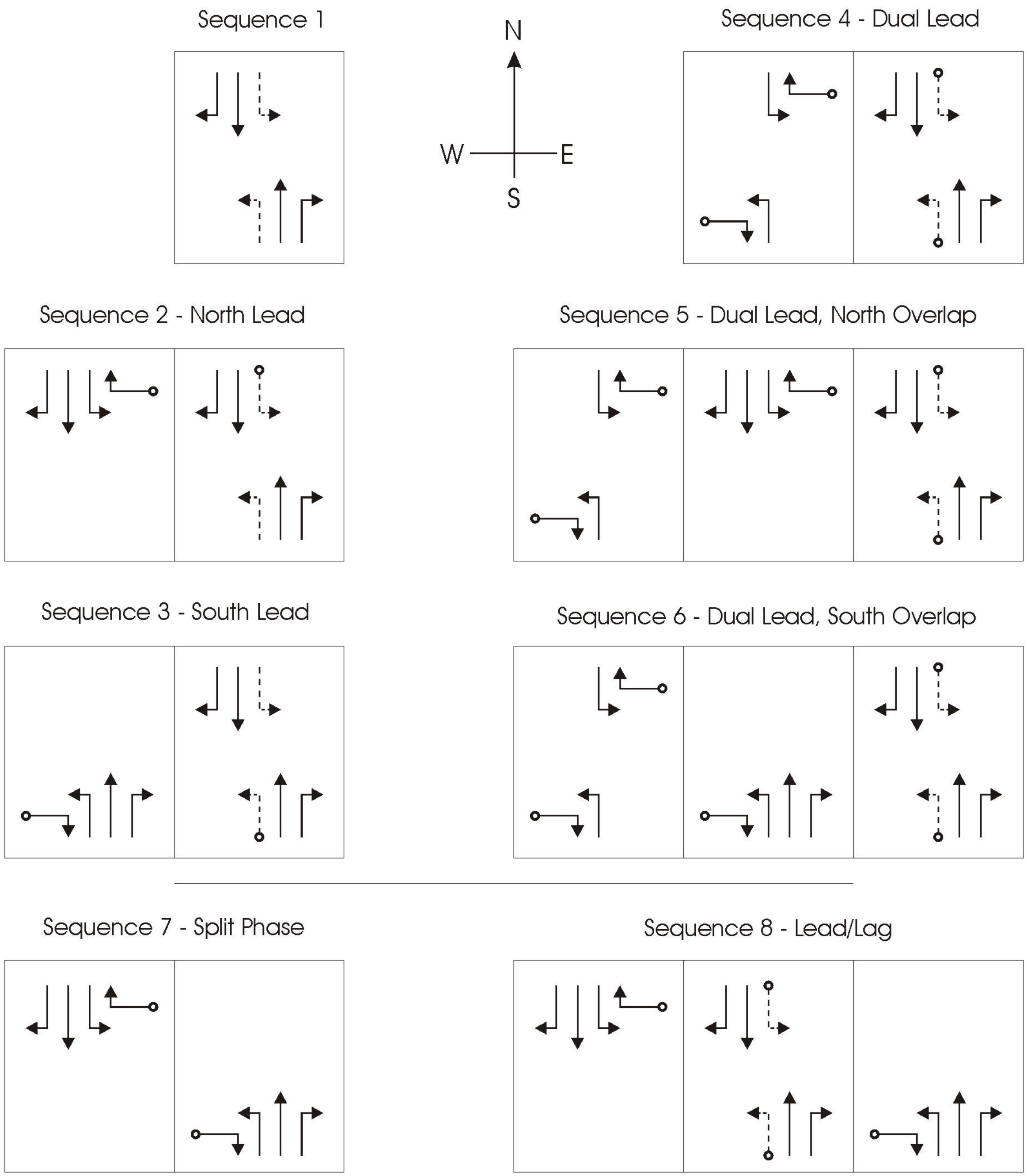
## Arterial Progression Data Entry

Much of the input information for a progression analysis is entered sequentially for each intersection along the arterial or for each link on the arterial. When this is the case, the information is always entered from left-to-right along the arterial. For example, if the PRG-SIZE of the arterial is three intersections, then intersection #1 is designated as the leftmost intersection and intersection #3 is the rightmost intersection. Information such as through PRG-SPLITS are entered first for intersection #1, then #2, then #3. Information such as progression PRG-SPEEDS and PRG-DISTANCES are entered first for link #1-2, then for link #2-3. This order is designated left-to-right. This designation is most apparent if a time-space diagram is PLOTSIMPLEd and the results are viewed with the distance axis at the bottom of the diagram. For this reason, it is recommended that arterials be set up and entered from the south to the north or from the west to the east.

When information is required for vehicles moving in the right-to-left direction, such as PRG-SPEEDS, these right-to-left values are entered in order from left-to-right. For example, the speed from intersection #2 to #1 is entered before the speed from intersection #3 to #2. Review the example problem in Chapter 2 both in the manual and with the program for further clarification of this convention.

## Phasing Sequence Codes

TEAPAC uses a simple phasing code on the SEQUENCES entry to represent complex phasing schemes with two-digit codes. The first digit represents the type of phasing for the north/south movements, while the second digit represents the type of phasing for the east/west movements. The phase codes allowed for the north/south and east/west directions are identical, the east/west codes simply being the north/south code rotated clockwise 90 degrees. This basic phasing code can be augmented by entries to change the order of the basic sequence code (LEADLAGS), by adding permitted left turns before or after exclusive left turn phases (PERMISSIVES), and by adding right turns which overlap into the other direction's phases (OVERLAPS). Figure 1-2 illustrates each of the eight basic phase types, with an example of how they are combined to create a SEQUENCES phasing code.




Rotate diagrams clockwise 90 degrees for sequence types of East/West movements. Use PERMISSIVES to allow optional left turns shown with "o" symbols. Use OVERLAPS to allow optional right turns shown with "o" symbols (where exclusive right turn lanes exist). Use LEADLAGS to reverse the order of a sequence type. Sequence types are combined for both directions to create a SEQUENCES code. E.g., SEQUENCES 53 is a Dual Lead, North Overlap (5) for North/South movements, followed by a West Lead (3) for the East/West movements.

Figure 1-2
Phasing Codes for TEAPAC

## Version Number

The version number (x.yz) and date describe what revision of the program is being used. Minor revisions of the program increment the z-part of the version number, with more significant changes affecting the y-part of the version number. The version number itself (x) changes when major program changes are made. The date reflects when the given version of the program was introduced. The version number and date of the program is displayed using the Help-About menu. It is also displayed in each printed report title. This information should match the title page of any printed program documentation or the Help-Version menu of the on-screen documentation. If this is not the case, check by using the Help-RecentChanges menu for addenda which explain changes which have been implemented since your documentation was prepared. These addenda should be printed and inserted in Appendix H in the back of the manual for future off-line reference.

## Input Modes

The Main Menu of the Visual Mode is the first display. This is where all program actions can be initiated, including data entry and computations. Each line of a menu uses a command keyword to describe what that menu line selection will allow the user to accomplish. For sub-menus, a ‘group name’ is used to label the primary menu line.

Menu selections can be made with the mouse, or with the underlined Alt keys (and the Enter key, if required). When this is done, a dialog box is displayed which allows entry or editing of current data values, or execution of action dialogs with the Execute button. Dialog boxes can be terminated with the OK button, the Close button, or the ESCape key.

The Main Menu can be used to select the Tabular View as an alternate input environment using the View menu. In Tabular View displays, each line of the display is preceded by a command keyword which describes the contents of the command line. The bottom line of the dialog provides HELP on how to use this command. If this command is an action command it requires use of the Execute button to perform the action. The Help (?) button can be used to access context-sensitive on-screen help. The Tabular View can also be toggled using the F3 key.

The Main Menu can also be used to select the Manual Mode as another alternate input environment using the Options menu. This mode allows quick entry of the same command lines of the Tabular View, but without the rigid structure of the Tabular View dialog box. The Manual Mode is indicated by the presence of the command prompt in the Manual Mode window, as shown below:

→

When a command prompt is displayed, the program is ready to accept command keyword input. Input is the same as a line of the Tabular View display, but must be preceded by the command (or abbreviation) which is to be used for the input. The Manual Mode can also be toggled using the F4 function key.

## Example Data Entries

When executing the "hands-on" examples in this manual, actual entries to be made by the user are shown here in **BOLDFACE CAPITAL LETTERS**. The information which precedes these values indicates what command keyword should be used, showing both the menu line group name and the command name. In the Visual Mode, the menu group name in square brackets [xxx] can either be found in the Edit menu to change data entries, or the command keyword can be found in the Results menu to execute actions. In the Manual Mode, only the command keyword and parameter values need to be entered after the command prompt, followed by the OK button or ENTER key. For example, consider the entry below which might be found in the manual.

[Basic] → **VOLUMES 225 665 165** ...

In the Visual Mode, Basic should be selected from the Edit menu, then the VOLUMES item should be selected and the values entered, each followed by TAB, then the OK button. In the Manual Mode, following the command prompt, simply enter the "VOLUMES 225 665 165" information followed by a single ENTER key or the OK button. The result is the same in either case: VOLUMES values are set to the three values listed.

When an ellipsis "..." appears in this document, this indicates that the additional input fields which are displayed in the Visual Mode need not be entered, thus using any current (or default) values which are displayed. In the Manual Mode, the ellipsis is ignored (and should not be typed), thus retaining any current/default values which may exist. If an asterisk "*" appears separated from other characters, this means to skip over the input field for the asterisk to use/retain that field's current/default value.

## Parameter Symbols

When discussing the use of TEAPAC entries in the documentation or in using HELP in the program, descriptions of parameter values to be entered for each command will be shown enclosed by the angle bracket symbols, "<" and ">". A typical command keyword and parameter value HELP line is shown below:

FILES 5*<File Name>

In this example, FILES is the command keyword or menu selection to be used. The "5*" indicates that up to five <File Name> parameter values may be entered in the Visual Mode or on an input line. In the Manual Mode, these follow a typed FILES command, each separated by at least one blank. The number preceding the asterisk (five in this example) indicates the number of parameter values that may be entered on an input line for the command. In some cases, all parameter values must be entered, while in others only some are required. If all values are not entered, the ones not entered will remain unchanged.

Similar HELP information is provided at the bottom of each dialog box for immediate on-screen HELP for the entry field currently selected in the display. The F1 key or the Help button can be used to bring up the associated part of the on-screen manual. The Advanced chapters 6 and 7 give extensive detail on how to enter parameter values in either the Visual or Manual Mode.

## Overview of TEAPAC Procedures

Before beginning any of the example problems in Chapter 2, it is worthwhile to review the basic procedures of running TEAPAC. There are four basic steps of an analysis using TEAPAC: Data Entry, Data Review, Analysis and Evaluation. This section briefly describes each step of this procedure. Additional detail can be found in Chapter 3 and Chapter 5.

Sub-topics for this section:

- Data Entry
- Data Review
- Analysis
- Evaluation

### Data Entry

The first step in using TEAPAC is to enter the data required to describe the problem. This is normally accomplished using the Edit Menu and its various sub-menus. Data may also be loaded from a disk data file (created earlier with the save options of the File menu) by using the Open option of the File menu. If a multi-scenario structure has been created in the file by the scenario management function, then a specific scenario case can be retrieved with the GetScenarioCase option of the File menu after the file has been opened. TEAPAC contains default values for many of the parameter values; however, there are some parameter values which must be entered for each analysis to adequately define the problem. The dialog box displays of all the Edit Menu options shows all of these default values.

Data entry may also be accomplished in the Manual Mode, particularly when a known and small group of command keywords are to be used. In this mode, the HELP command is useful in identifying those commands which can be used to enter these necessary parameter values. The commands can be entered directly with their parameters, or the ASK command can be used to generate a custom input/editing session with a specified sequence of dialog boxes (Normal View) or a specified list of input lines (Tabular View).

Before entering the detailed data described above, the analysis network can be created on-screen in the main window with the use of the mouse. Creating the network in this manner replaces the need to do it using the Edit menu (as described above), and the network data can be edited further by additional mouse actions in the main window, or with the Edit menu. After the network is entered, the data for each intersection can be entered by right-clicking the intersection and using the same menus which appear in the Edit menu described above.

A network is created with the mouse by first clicking anywhere in the main window to reveal a grid with 500' spacing, then clicking the 'Create Link' button in the Edit Mode section of the left-side toolbar. In the Create Link mode, simply click down at the location of the beginning of the link (street), drag the mouse to the position of the end of the link, and release the mouse. A link terminated by two 'dummy' nodes will be shown. Any time a created link crosses an existing link, a 'real' analysis intersection is created and numbered in increasing order starting from #1. Dummy nodes are numbered in decreasing order starting from #6999. Use the Setup button in the main window to change these starting numbers. In the 'Select Intersection' mode, the intersection which is clicked becomes the 'current' intersection for which any subsequent entered data will belong or results may pertain. The current intersection can also be selected with the Intersection dialog of the Edit menu or the Select Intersection toolbar button under the main menu (or with the ^-Home key combination). When dragging the mouse, the status bar at the bottom of the window shows the coordinate location of the mouse cursor, as well as the distance of the cursor from the 'current' intersection. Using the Pan & Zoom buttons allows the user to move around the network, as necessary.

If a bitmap file (.bmp) of appropriate resolution exists for the study area (for example, an aerial photograph or map), that bitmap can first be identified and calibrated with the Setup button on the left-side toolbar. The file must be in the same folder that the data file (will) reside(s) in. If the data file already exists, and the bitmap has the same primary file name, then entering '*' as the bitmap file name will connect the two files automatically. When creating a network from scratch, it is best to first calibrate the bitmap scale by entering a known distance and the number of pixels in the bitmap that represent that distance. The Click button to the right of the bitmap distance entry can be a convenient way to establish the pixel distance. For example, if the distance between two intersections on the bitmap is known, type that distance in the known distance field and use the mouse to click and drag a box with opposite corners located at those two intersections. A base point for the coordinate system can also be established with the translational relationship entries found in the top portion of the dialog. Once a network has been created, its shift and scaling can be modified by use of the options presented by the Coord Sys button in the Setup dialog. The way the network is displayed can be adjusted with the Anchor and Stretch buttons in the Adjust Display left-side toolbar or the main window. Normally the scaling parameters defined in the Setup dialog should not be changed once any part of the network has been drawn; the Coord Sys button should be used instead. A practical maximum bitmap file size is 30,000 x 30,000 pixels with a gray-scale bit depth of 8 bits or a color bit depth of 8 or 24 bits.

Once a network has been created, the 'Move Intersection' Edit Mode button can be used to relocate any intersection or dummy node. By default, the link distance for all links connected to the moved node will be modified according to the move made. If the move is simply to better match the underlying bitmap and the link distances have already been entered and verified, the Adjust NETWORK checkbox in the Setup dialog should be unchecked to prevent the existing distances from being changed. (Each time the program is first run, this option is set to the selected status.) The 'Insert Bend Node' Edit Mode button can be used to create a dummy node on the link nearest to the click location so the network more precisely reflects curves in the network.

When creating legs to any intersection, use care to meet the standard TEAPAC requirement that each intersection can have only 4 legs and understand that these legs will be assigned to the four positions, North, East, South and West, regardless of their actual orientation. If two skewed legs might be interpreted by the program to have an approach angle which assigns them both to the same leg of the intersection, initially create the legs with angles such that they do not conflict, then Move the upstream external or bend node to correctly orient the leg visually.

## Data Review

Once data has been entered, it should be checked for accuracy and correctness. In the Visual Mode, or when using the ASK command for input in the Manual Mode, this process is direct and immediate, since all of the current values of the entered commands are displayed immediately. The View-Summary menu is also a quick way to see all current data entries. In the Manual Mode, the TEAPAC commands DATA and SUMMARIZE are used for data review. These commands display the current parameter values contained in the program. If no data has been entered for a command, its current values will be the default (RESET) values. If incorrect data is detected, it may be corrected using either of the data entry techniques described above. In the Manual Mode, the ASK command is frequently a good way to check data integrity, since it displays all values, and also allows immediate re-entry in the dialog box display if an error is found.

## Analysis

The third step in program execution is to perform an analysis using the current parameter values. When satisfied with the accuracy of the program data, it is possible to use one or more of the commands in the Results Menu ([Results] commands) to perform an analysis. The [Results] commands cause the program to act on the current data. These commands typically produce a report which displays the results of the analysis. Since more than one analysis may be required to generate the desired results, several [Results] commands may be used at this step in the procedure.

Action commands can be executed by first selecting the Results Menu. If the parameter values need to be changed first, they should be entered in the dialog, then the Execute button is pressed to execute the selected function.

In the Manual Mode, the action command need only be typed at the command prompt, followed by any desired parameter values to control the action, then the ENTER key or OK button.

## Evaluation

After executing an action function(s), the results contained in the report(s) must be evaluated for reasonableness and to determine if subsequent analyses are required. Additional analyses may be necessary for a variety of reasons. One of the most common reasons for further analyses is to test adjustments to the input conditions. These could be in the form of simulated before and after studies or testing multiple scenarios. Another type of evaluation might be a sensitivity analysis to refine initial results or identify how a specific parameter value impacts the overall results. In any of these cases, the methods described in the three previous sections for data entry, review and analysis should be used.

CHAPTER 2
# Initial Examples

Chapter 2 Topics

In order to illustrate some of the basic commands and procedures essential to using TEAPAC, as well as to provide some experience using them and observing the program's responses, example problems have been developed which can be analyzed with each of the major application functions of the TEAPAC program. These areas include Signal Analysis, Traffic Impact Analysis, Count Analysis, Progression Analysis, Export and Import, and Scenario Management.

## Chapter 2 Topics:



## Chapter 2 Topics (for Signal Analysis):



## Description of Example Problem (for Signal Analysis)

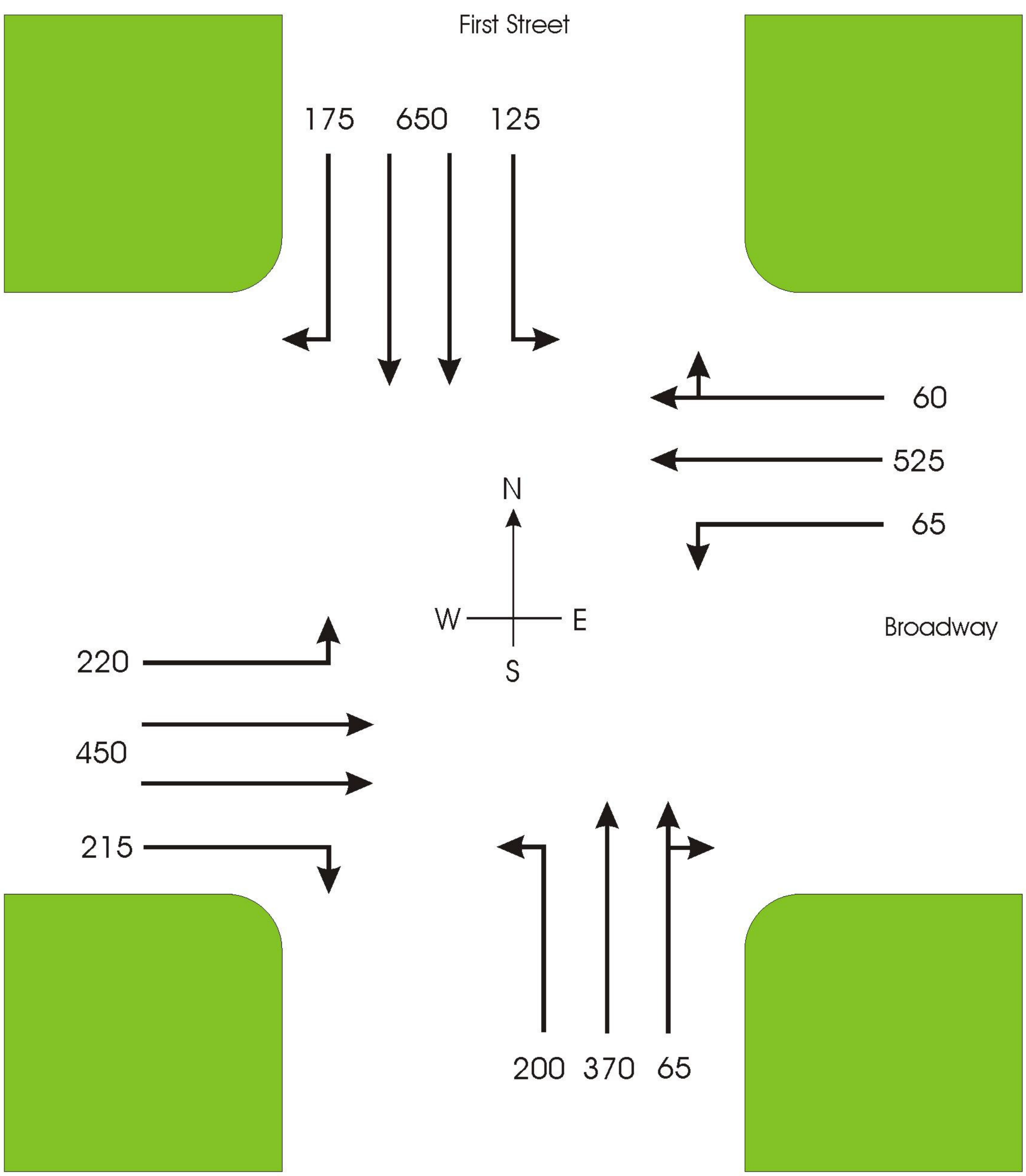
[The UrbanStreet function of TEAPAC is best illustrated with a multi-signal arterial, so the reader is directed to the Initial Example (for Export and Import) which contains three signals, found later in this chapter. After entering the data, use the URBANSTREET command to produce a coordinated signal analysis displaying performance measures such as travel speed, stop rate and level of service for the street segments and facility as a whole.]

A small shopping center is to be constructed near an existing intersection. You are to analyze the existing P.M. peak hour conditions and determine the existing intersection and critical movement delay, as well as the best possible delay which could be achieved by adjusting the timings and/or the phasing. Then analyze the intersection to determine the impact on intersection and critical movement delay of the additional traffic generated by the shopping center. Assume an existing fifty-fifty split of a 120 second cycle (fixed-time), two-phase operation, with 4-second change and clearance times.

Existing turning movement counts have been taken for the P.M. peak hour conditions at the intersection. The existing volumes and available lane widths are shown in Table 2-1. The volumes added by the shopping center are indicated by the values appearing after the plus signs (+) in Table 2-1. Figure 2-1 shows the intersection lane configuration with existing movement volumes. Assume each lane is 12 feet wide.

**Table 2-1 (SIG)**
**Peak Hour Volumes & Lane Group Widths For Example Problem (for Signal Analysis)**

| Approach | Movement | Volumes | Width | Approach | Movement | Volumes | Width |
|---|---|---|---|---|---|---|---|
| From North | Right Turn | 175 | 12 | From South | Right Turn | 65+ 60 | 0 |
| | Through | 650 | 24 | | Through | 370 | 24 |
| | Left Turn | 125+ 60 | 12 | | Left Turn | 200 | 12 |
| From East | Right Turn | 60+ 60 | 0 | From West | Right Turn | 215 | 12 |
| | Through | 525+ 20 | 24 | | Through | 450+120 | 24 |
| | Left Turn | 65+ 60 | 12 | | Left Turn | 220 | 12 |




Movement volumes (vph) and lane usage (12' lanes)

Figure 2-1 (SIG)
Schematic Diagram of Example Problem (for Signal Analysis)

## Data Entry (for Signal Analysis)

[The UrbanStreet function of TEAPAC is best illustrated with a multi-signal arterial, so the reader is directed to the Initial Example (for Export and Import) which contains three signals, found later in this chapter. After entering the data, use the URBANSTREET command to produce a coordinated signal analysis displaying performance measures such as travel speed, stop rate and level of service for the street segments and facility as a whole.]

If you are not currently running the TEAPAC program, do so according to the way it was installed on your computer (see Appendix G). The program will display the main window along with important licensing information. As described in Chapter 1, two input modes can be used to manipulate the program. In the examples below, the Edit menu line to select in the Visual Mode is shown in square brackets, "[XXX]", and the command line to move to is shown following the arrow, "→". To enter the desired parameter values, move the cursor to the appropriate display area and type the value in, followed by the TAB key. Use the OK button when done entering data to return to the Main Menu. To display more entries on a single dialog box, first select the Tabular View in the View menu before entering data using the Edit menu.

To use the Manual Mode for this tutorial, select the Manual Mode from the Options menu, or simply press F4. Once the program is ready to accept input, it will display the command prompt arrow. To enter the desired parameter values, enter the command keyword and parameter values, each separated by a space, all followed by the ENTER key or the OK button. If the Visual Mode is desired at any point, simply press the F4 function key.

If you wish, you can use the drag-and-drop graphical network creation method to create your analysis network in the main window before entering detailed data. To do this, follow the instructions in the Data Entry section of Chapter 1. In this case, for a single intersection, simply draw two intersecting street segments. After the network is created, the additional detailed data described below can be entered by right-clicking on the intersection, including a check of the data already created by the drag-and-drop network creation. The intersection can also be re-numbered with a right-click option.

The first step in using TEAPAC is to enter the data required to describe the problem to be solved. This is accomplished using commands designated as [Parameters] commands, such as VOLUMES and WIDTHS. The Commands option of the Help menu can be used to display help for all commands.

The Help-Commands menu displays all commands, along with information on how to use each. Note the number of parameters for each command and their associated default values. For example, the VOLUMES command requires volumes for the twelve (12*) possible movements at the intersection.

Since a lot of commands exist, getting HELP for a smaller group might be appropriate. The [Basic] group consists of only those commands which are essential to solving basic problems with TEAPAC. The [SignalAnalysis] group consists of those commands which are related to performing signal analyses. These commands can be viewed by issuing the following commands from the Manual Mode.

→ **HELP [Basic]**

→ **HELP [SignalAnalysis]**

If help for only one command is needed, the HELP command will display the same detailed HLP file information for that command which is produced by the Help buttons in Visual Mode dialogs. For example, use the following Manual Mode entry to obtain complete help for the VOLUMES entry to be made in the next paragraph.

→ **HELP VOLUMES**

Now let's enter the information needed to describe the problem. The first entry should be the list of valid node numbers for any intersections we will be working with (the NODELIST). This may be a system of connected signals in a network, or multiple conditions we want saved in a single file. In any case, each intersection we study with TEAPAC must have a unique number in the NODELIST. For this example, we'll just set up one intersection in the list and call it #1.

[Basic] → **NODELIST 1**

The entries below describe the conditions at each individual intersection in the NODELIST. Note that the INTERSECTION command selects which intersection of the NODELIST the data that follows applies to. In the Tabular View, INTERSECTION is an active command which needs to be executed with the Execute button in order to change the screen's values to the new intersection.

[Basic] → **INTERSECTION 1**

Now we can enter the data which describes intersection 1. The first data entry could be the traffic volumes. When entering the VOLUMES parameters in the Visual and Manual Modes, TEAPAC expects the data to be entered starting with the North approach right-turns and proceeding clockwise around the intersection as shown below. See Chapter 1 - Conventions for more detail.

[Basic] → **VOLUMES 175 650 125 60 525 165 65 370 200 215 450 220**

As with VOLUMES, the WIDTHS parameters also correspond to the twelve turning movements. In this case, note that if right- or left-turning movements do not have exclusive turn lanes, the WIDTH entry is zero and the turning volumes are automatically assigned to shared through lanes. If a turning movement has an exclusive lane in addition to a shared lane, see the discussion in Appendix B for dual optional turn lanes as entered by the GROUPTYPES command. Also note that the width given is for all lanes in each lane group. The number of lanes is deduced from these values on the LANES command.

[Basic] → **WIDTHS 12 24 12 0 24 12 0 24 12 12 24 12**

As an efficiency aid, one can move to the next dialog box in sequence as shown in the Edit menu with the Next button instead of using the menu each time. Thus, instead of pressing the OK button after the VOLUMES entry above and using the Edit menu to select WIDTHS, simply press the Next button.

The phase sequence is entered with the single SEQUENCES code for two-phase operation from Figure 1-2.

[Basic] → **SEQUENCE 11**

The GREENTIMES, YELLOWTIMES and REDCLEARTIMES are entered in seconds for each of the controller phases, clockwise around the intersection, with the north phase times first. In this analysis a 50/50 split has been assumed with four-second change and clearance times. The CYCLE length need not be entered since the timings are given in seconds.

[Basic] → **GREENTIMES 56 0 56 0 56 0 56 0**

[Basic] → **YELLOWTIMES 3 0 3 0 3 0 3 0**

[Phasing] → **REDCLEARTIMES 1 0 1 0 1 0 1 0**

In order to illustrate the HCM 2016 actuated methodology to its fullest, we should make the signal a fully-actuated signal using ACTUATIONS and setting all twelve movements to an actuated status. This is the quickest way to define an actuated movement (and one that automatically sets the PASSAGETIME to the HCM default), but by no means a complete way. In general it is more appropriate to carefully set all of the actuated parameter inputs for each actuated movement so they properly reflect conditions in the field. When entering timings for actuated movements, the GREENTIMES entries represent the maximum timings for the associated actuated controller phase.

[Basic] → **ACTUATIONS Y Y Y Y Y Y Y Y Y Y Y Y**

In order to display NEMA phase numbers in the signal phasing that is either analyzed or optimized, the NEMAPHASES entry can be made using a typical scheme found on many signal controllers. This entry defines what controller phase numbers will be assigned for any protected phases which are provided.

[Movement] → **NEMAPHASES 0 4 7 0 6 1 0 8 3 0 2 5**

Lastly, we will define an initial queue of 10 vehicles for the through movements on the north and south legs of the intersection so that the example illustrates the effect that standing queues at the start of the analysis period can have on the results.

[Movement] → **INITIALQUEUE 0 10 0 0 0 0 0 10 0 0 0 0**

The Tabular View is a particularly efficient data entry mode when lots of data is to be entered, but lacks some of the dialog box cues that the Normal View provides. Use the View menu (or the F3 key) and the Edit menu to explore this view and see the data values you have entered. If you have entered a value improperly, simply re-enter the proper value. The next section shows how you can verify all entries, particularly if you are using the Manual Mode.

## Data Review (for Signal Analysis)

Once data has been entered, it should be checked for accuracy and completeness. In the Visual Mode, this process is simply a matter of reviewing the data entered in each dialog, since this reflects the actual current values. In the Manual Mode, DATA and SUMMARIZE are used for this data review. Either of these commands may be used to display the current parameter values for the data entries. SUMMARIZE provides a formatted summary report for all of the command parameter values, while DATA displays only the parameter values for the list of commands requested. To illustrate this operation, in either the Visual or Manual Modes, enter the following. Note that again, since this is an active command, the Visual Mode requires that the Execute button be used to execute the command. The View-Summary menu can also be used.

[DataFiles] → **SUMMARIZE**

The current values of all input commands are listed with the values just entered, as well as any default values which were not entered. Note that the MOVEMENT parameters, such as VOLUMES, WIDTHS and LANES, have approach and movement labels and a report title is displayed. The DATA command only displays the information, without any special formatting.

[DataFiles] → **DATA VOLUMES WIDTHS**

The program displays the current parameter values for only the VOLUMES and WIDTHS commands. Note that no other command's values are listed, nor are there any headings. Since DATA accepts other commands as parameter values, DATA can be requested for only one, several or all commands, where SUMMARIZE always gives all values. This makes DATA quicker to use, but less clear for others to review other than on the computer display.

The most efficient way to check input from the Manual Mode is to use the ASK command. This displays the current values of the commands "ASKed for" in a dialog box display which provides on-screen HELP and allows the user to move the cursor among the data fields and even change any values desired (just like the Visual Mode). Try the following from the Manual Mode, both in the Normal and Tabular Views (use F3 to toggle between views):

→ **ASK [Basic]**

Review the data values listed using any of the methods described above. Note that there is an error in the VOLUMES entered. The left turn on the east approach should be 65, not 165. To correct this, re-enter the VOLUMES entry with the proper value using either of the entry modes, Visual or Manual.

[Basic] → **VOLUMES * * * * * 65** ...

Note that in either mode, only the value to be changed need be entered. In the Visual Mode, the cursor is moved to the field with the 165 value and the 65 is typed right over the 165, followed by TAB or ENTER. In the Manual Mode, the VOLUMES command is typed followed by 5 asterisks used as place holders to skip the first five entries.

It is frequently desirable to print the summary of input values, both as a document to use in the input checking process, as well as a physical record of the input data used in subsequent analyses. Use of the printer is easy. Simply use the File-Print menu of the output window (or Ctrl-P) to direct the output to the default printer. Various available printers and printer options can be selected using the Setup options in the File menu, and the last produced output can be printed from the File menu of the main window. If your printer is connected, perform the above sequence for the SUMMARIZE command to get a printed summary of input, then recheck all the data input for proper values before proceeding.

## Analysis (for Signal Analysis)

[The UrbanStreet function of TEAPAC is best illustrated with a multi-signal arterial, so the reader is directed to the Initial Example (for Export and Import) which contains three signals, found later in this chapter. After entering the data, use the URBANSTREET command to produce a coordinated signal analysis displaying performance measures such as travel speed, stop rate and level of service for the street segments and facility as a whole.]

The third step in program execution is to perform an analysis of the current data. Once satisfied with the accuracy of the input data, use the ANALYZE command in the Results menu to execute a TEAPAC signal analysis.

[Results] → **ANALYZE**

The Capacity Analysis Summary report summarizes the basic input parameters as well as the results of the analysis. Note that the intersection Control Delay listed at the top of the report is quite high at 120 seconds. This represents a weighted average for the total intersection, and individual approaches or movements operate with different delays. Note that the left turns on the North and South have considerably higher delay (over 600 and 1,200 seconds), with v/c and LOS suggesting completely inadequate capacity to pass the entered demand. Clearly improvements are needed.

If more detail is desired for this analysis, the *Highway Capacity Manual* worksheets can be produced by the ANALYZE command if preceded by the OUTPUT command to select worksheet output. These options can be found in the Edit and Results menus, as before.

[Basic] → **OUTPUT SIGNAL FULL** ...

[Results] → **ANALYZE**

Note how the same results as before are produced, but with a much higher level of detail. Let's turn the worksheet output back off so we don't create too much output for the remainder of the examples.

[Basic] → **OUTPUT SIGNAL NONE** ...

An important function of the TEAPAC program for signal analysis is the design or optimization of intersection control. This is accomplished by checking many combinations of signal phasing and cycle length, producing optimum green times for each combination, and checking the level of service of the critical movements. The DESIGN command is used to perform this optimization of phasings and timings. First setting the SEQUENCES list of allowed phasings to ALL (or the code AA) allows DESIGN to optimize and rank all possible phasings. The CYCLES command should be used to scan a wide range of possible cycle lengths. Note that the demo version of TEAPAC will only allow 16 sequences rather than 64, and the cycles cannot be changed.

[Basic] → **SEQUENCES 11 ALL**

[Basic] → **CYCLES 60 120 30**

Since optimization of the HCM 2016 actuated method can be time-consuming, the example can be simplified by limiting the SEQUENCES to '11 BB' instead of '11 ALL' (or '11 AA'), and limiting the CYCLES to '60 120 60' instead of '60 120 30' (results will be slightly different than noted below). Use of these entries will test all 'normal' actuated phasings, but exclude split phase and lead-lag phasing, and for a more limited range of possible cycle lengths. An even faster optimization could be illustrated by limiting the phasings to only those 'normal' actuated phasings that protect all left turns, and for a single cycle using '11 CC' and '120 120 30'.

[Results] → **DESIGN** ...

Two reports are generated by this DESIGN command, an Optimum Phasings summary and a Capacity Analysis Summary. The Optimum Phasing summary is a listing of the performance of 64 different phase operations ranked in the order of performance from best to worst. The Capacity Analysis Summary contains the results of the analysis for the first or "best" SEQUENCE in the Optimum Phasings summary, SEQUENCE 44 (operating as SEQUENCE 66 when the actual overlaps are considered). When reviewing the Capacity Analysis Summary, note that the intersection control delay has now been reduced to 25.4 seconds, and that the critical movements operate with a balanced amount of delay around 32 seconds, a much better solution than previously, and achieved only by changing the phasing and timings.

It may be of interest to know how well the intersection will operate if timed best with the existing phasing. This is easily done by selecting the optimum TIMINGS already DESIGNed for the existing phasing and producing a capacity analysis. This is done with the following commands.

[Results] → **TIMINGS 11** ...

[Results] → **ANALYZE**

Review the Capacity Analysis Summary. Note that the intersection delay is 46.9 seconds, and that the critical movements delay is over 100 and 400 seconds. This is clearly better than the original timings, but the critical movements are not as good as when controlled under the best possible phasing. This illustrates the importance of keeping our focus on critical movement delay, not intersection delay.

## Evaluation (for Signal Analysis)

One powerful aspect of TEAPAC is the capability to quickly test multiple scenarios or conditions in an interactive environment. To test the impact on the intersection due to the increase in traffic generated by the new shopping center, use the new optimum timings (which are currently in the GREENTIMES and YELLOWTIMES commands) for the existing phasing with the new volumes.

[Basic] → **VOLUMES 175 650 185 120 545 125 125 370 200 215 570 220**

[Results] → **ANALYZE**

With the addition of the shopping center traffic, the intersection delay went up to 62.7 seconds and the critical movements have delays as high as 150, 350 and 400 seconds. Since the ANALYZE command was used, no changes were made to the GREENTIMES from the previous analysis. On the other hand, it is possible to use the DESIGN command to generate new timings and phasings which would improve the operation under the new traffic volumes. This can be easily accomplished by using the DESIGN command again.

[Results] → **DESIGN** ...

The result is now sequence 44 with intersection delay of 29 seconds, but the critical movements' delay is now equalized at around 35 seconds.

While the example problem is over-simplified, it does demonstrate that TEAPAC's interactive analysis and design techniques allow many conditions to be tested quickly and efficiently. In addition, printed reports can be produced to document the analysis, and analysis conditions can be saved at any time, as illustrated below.

At this point of the analysis, we may feel we have an adequate solution to the problem, and wish to SAVE the data values which created the final results for future use. The typical Save/SaveAs options of the File menu are normally used, but the [DataFiles] commands of the File menu also offer these capabilities by first defining the disk FILE name to be used for storage, then issuing the SAVE command to save the parameter values.

[DataFiles] → **FILES SAMPLE/N** ...

[DataFiles] → **SAVE 1 1** ...

Note that the file name "SAMPLE" has a "/N" switch added to its name the first time it is used to indicate to TEAPAC that you expect to create a new file. This is not required, but saves the steps of responding to the new file creation query. When used, an error will be produced only if this file name already exists. Other such switches and file name conventions are discussed in Appendix G, as they relate to your operating system. Also note that as many as five files can be named at any given time, and that the SAVE command describes which of these five files are to be used. The SAVE command can also tell the program where in the file to save information, allowing different scenarios to be stacked one after the other in the same file. The LOAD command is used to retrieve the information at a later date. All of these options relate to advanced file manipulation capabilities such as batch control file scripts and multiple scenarios, described in detail in Chapter 7.

## Chapter 2 Topics (for Traffic Impact Analysis):



## Description of Example Problem (for Traffic Impact Analysis)

A new commercial complex will be constructed near the intersection of two major arterials. The proposed development includes 600,000 square feet of gross leasable area (GLA). The peak hour inbound and outbound trip generation rates are 1.9 and 2.1 vehicles per 1,000 square feet, respectively. Figure 2-1 shows the location of the intersection in relationship to the proposed development as well as the location of access points to the site. In addition, Figure 2-1 shows the inbound and outbound trip distributions for the traffic accessing the development and the existing traffic using the arterials.

For purposes of intersection geometrics, assume that the two arterials have one 12' lane in each direction, except at the main intersection which widens to two 12' through lanes and an exclusive 12' left turn lane on each approach. The access points all use the same geometrics with exclusive 12' turn lanes into and out of the site. For purposes of network and spatial relationships of the intersections, use the distances between intersections shown on the diagram, assume 30 mph speeds on all links, and use an arbitrary grid system to identify the coordinates of the nodes and site.

Using the TEAPAC program, calculate the projected traffic volumes of each movement at the intersection and access driveways. Next, determine the total number of site-oriented trips at each location generated by inbound and outbound traffic for the proposed development. Finally, determine the impact increasing the scope of the development to 750,000 square feet GLA.

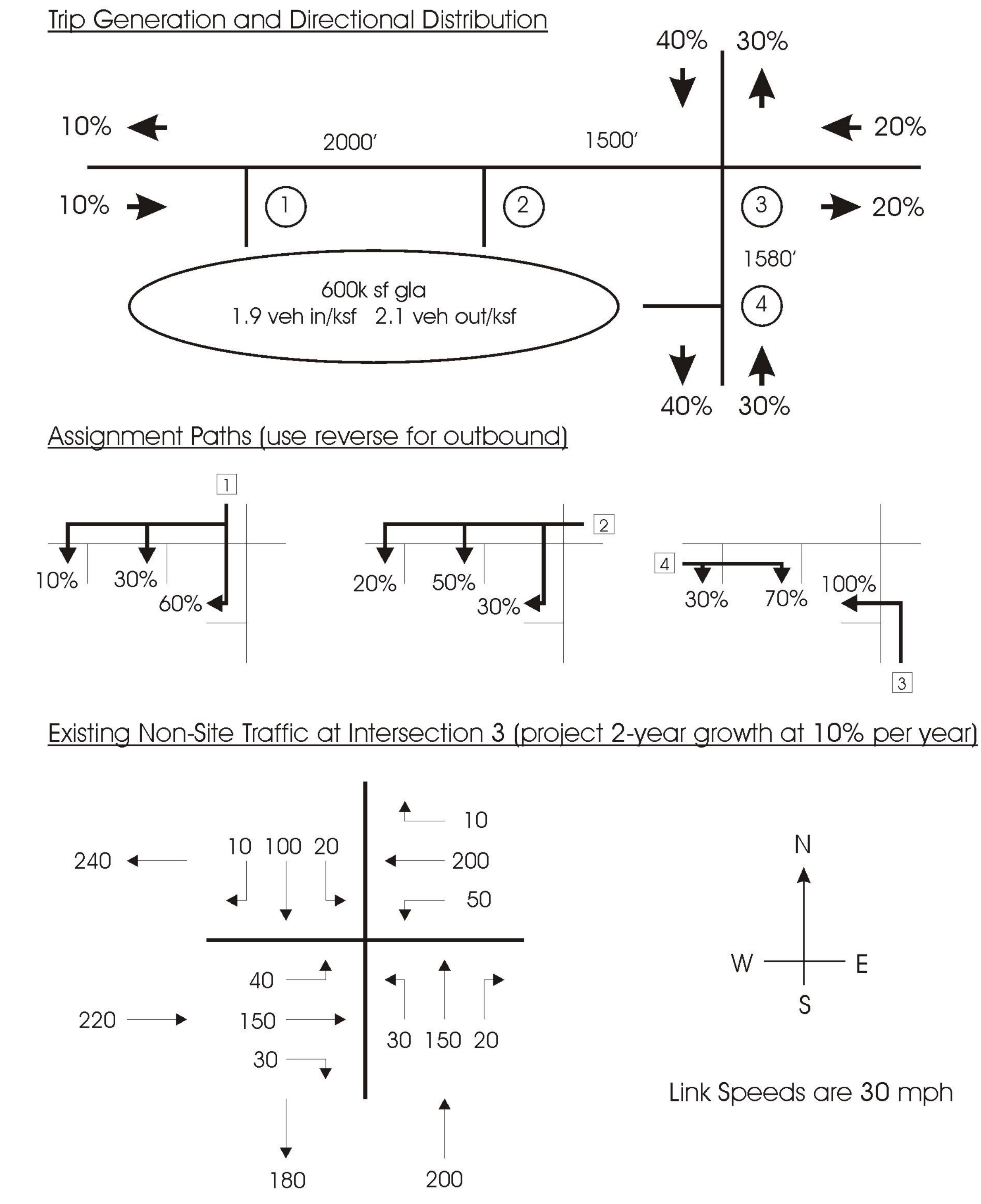



Figure 2-1 (TIA)
Schematic Diagram of Example Problem (for Traffic Impact Analysis)

## Data Entry (for Traffic Impact Analysis)

If you are not currently running the TEAPAC program, do so according to the way it was installed on your computer (see Appendix G). The program will display the main window along with important licensing information. As described in Chapter 1 - Input Modes, two input modes can be used to manipulate the program. In the examples below, the Edit menu line to select in the Visual Mode is shown in square brackets, "[XXX]", and the command line to move to is shown following the arrow, "→". To enter the desired parameter values, move the cursor to the appropriate display area and type the value in, followed by the TAB key. Use the OK button when done entering data to return to the Main Menu. To display more entries on a single dialog box, first select the Tabular View in the View menu before entering data using the Edit menu.

To use the Manual Mode for this tutorial, select the Manual Mode from the Options menu, or simply press F4. Once the program is ready to accept input, it will display the command prompt arrow. To enter the desired parameter values, enter the command keyword and parameter values, each separated by a space, all followed by the ENTER key or the OK button. If the Visual Mode is desired at any point, simply press the F4 function key.

If you wish, you can use the drag-and-drop graphical network creation method to create your analysis network in the main window before entering detailed data. To do this, follow the instructions in the Data Entry section of Chapter 1, working from left-to-right and top-to-bottom so that the intersections that are created are numbered as shown in the figure. Use the displayed 500' grid and the “distance from the current node” information in the status bar to get your intersection spacings correct (approximate is adequate for the example). After the network is created, the additional detailed data described below can be entered by right-clicking on the appropriate intersection, including a check of the data already created by the drag-and-drop network creation.

The first step in using the TEAPAC program is to enter the data required to describe the problem to be solved. This is accomplished using commands designated as [Parameters] commands, such as VOLUMES and LANES. The Commands option of the Help menu can be used to display help for all commands.

The Help-Commands menu displays all commands, along with information on how to use each. Note the number of parameters for each command and their associated default values. For example the SITESIZE command requires the two generator types to be considered in the analysis. If a number with an asterisk such as 5* is shown, this indicates that up to five similar parameter values may be entered. The default values for the size are shown as 0.

Since a lot of commands exist, getting HELP for a smaller group might be appropriate. The [Basic] group consists of only those commands which are essential to solving basic problems with TEAPAC. The [TrafficImpact] group consists of those commands which are related to performing traffic impact analyses. These commands can be viewed by issuing the following commands from the Manual Mode.

→ **HELP [Basic]**

→ **HELP [TrafficImpact]**

If help for only one command is needed, the HELP command will display the same detailed HLP file information for that command which is produced by the Help buttons in Visual Mode dialogs. For example, use the following Manual Mode entry to obtain complete help for the SITESIZE entry to be made in the next paragraph.

→ **HELP SITESIZE**

Now let's enter the information needed to describe the problem. The first entry should be the size of the analysis, indicating eight distribution types, the first four of which are inbound distributions. Note that in the Tabular View, SITESIZE is an active command which must be "executed" in order to take effect. Use the OK button to execute the SITESIZE command after its parameter values are entered.

[TrafficImpact] → **SITESIZE 8 4**

The next entry should be the list of valid node numbers for any intersections we will be working with (the NODELIST). Each intersection we study with TEAPAC must have a unique number in the NODELIST. This list should have been created with the drag and drop network creation method described earlier, and can be seen in the following entry.

[Basic] → **NODELIST 1 2 3 4**

The entries below describe the conditions at each individual intersection in the NODELIST. Note that the INTERSECTION command selects which intersection of the NODELIST the data that follows applies to (you can also just click on the desired intersection in the network display). In the Tabular View, INTERSECTION is an active command which needs to be executed with the Execute button in order to change the screen's values to the new intersection.

[Basic] → **INTERSECTION 1**

The INTERSECTION command is used to define the "current" intersection for which other intersection commands which are subsequently entered will apply. It also labels the intersections for output reports. To enter the intersection information for each intersection, enter the following commands. Note that in the Tabular View, INTERSECTION is also an active command which must be executed with the Execute button. Note also that the NODELOCATION and NETWORK entries have already been populated by the earlier network creation process (using the coordinate system of that process).

[Basic] → **INTERSECTION** **1 Northwest Access Drive**
[Basic] → **NODELOCATION** **500 3000**
[Basic] → **NETWORK** **EAST 2000 30 2** ...

[Basic] → **VOLUMES** **0 0 0 0 240 0 0 0 0 0 220 0**
[Basic] → **VOLFACTORS 2 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1**
[Basic] → **LANES** **0 0 0 0 1 1 1 0 1 1 1 0**

As an efficiency aid, one can move to the next dialog box in sequence as shown in the Edit menu with the Next button instead of using the menu each time. Thus, instead of pressing the OK button after the NODELOCATION entry above and using the Edit menu to select NETWORK, simply press the Next button.

[Basic] → **INTERSECTION** **2 Northeast Access Drive**
[Basic] → **NODELOCATION** **2500 3000**
[Basic] → **NETWORK** **EAST 1500 30 3** ...
[Basic] → **NETWORK** **WEST 2000 30 1** ...
[Basic] → **VOLUMES** **0 0 0 0 240 0 0 0 0 0 220 0**
[Basic] → **VOLFACTORS 2 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1**
[Basic] → **LANES** **0 0 0 0 1 1 1 0 1 1 1 0**

[Basic] → **INTERSECTION** **3 Main Intersection**
[Basic] → **NODELOCATION** **4000 3000**
[Basic] → **NETWORK** **SOUTH 1580 30 4** ...
[Basic] → **NETWORK** **WEST 1500 30 2** ...
[Basic] → **VOLUMES** **10 100 20 10 200 50 20 150 30 30 150 40**
[Basic] → **VOLFACTORS 2 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1**
[Basic] → **LANES** **0 2 1 0 2 1 0 2 1 0 2 1**

[Basic] → **INTERSECTION** **4 Southeast Access Drive**
[Basic] → **NODELOCATION** **3500 1500**
[Basic] → **NETWORK** **NORTH 1580 30 3** ...
[Basic] → **VOLUMES** **0 180 0 0 0 0 0 200 0 0 0 0**
[Basic] → **VOLFACTORS 2 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1**
[Basic] → **LANES** **1 1 0 0 0 0 0 1 1 1 0 1**

If data from this analysis will be used by other TEAPAC application functions, such as signal analysis for capacity analysis of projected volumes, most of these functions will also require WIDTHS entries in addition to the LANES entries described above, so 12' entries should be made for each lane in the WIDTHS selection of the [Basic] menu.

The BASE and GENERATION commands define the size of the development and trip generation rates, as well as the node numbers and legs of the intersections which provide access to the site. Enter the following:

[TrafficImpact] → **BASE 600** ...
[TrafficImpact] → **GENERATION IN 1.9 1S 2S 4W** ...
[TrafficImpact] → **GENERATION OUT 1.2 1S 2S 4W** ...

In order to give a schematic target area for the development area in the network display, the BASE command can be used to define the SW and NE corners of such a rectangular target area, as follows. This can also be accomplished by holding the Shift key while dragging to mark the target area in the network display window.

[TrafficImpact] → **BASE 600 200 1200 3300 2750**

The PATHDISTRIBUTION and PATHASSIGNMENT commands are used to distribute the inbound and outbound site-generated traffic to the various external nodes of the network and then define the assignment paths which these vehicles will take to get to and from the site. Note that like the INTERSECTION command, PATHDISTRIBUTION defines the "current" distribution type for which subsequent PATHASSIGNMENT commands apply, and is an active command which needs to be executed with the Execute button in the Tabular View.

In the Visual Mode, the "+" and "-" buttons can be used at any time to increment and decrement the distribution type (or the intersection number) displayed in the dialog. The Ctrl-PageUp and Ctrl-PageDown keys (^Page-Up/Down) may also be used as shortcut keys, as long as no changes have been made to input fields in the dialog. If a change is made, first TAB to the next field, then use ^Page-Up/Down.

Note also that the list of nodes supplied for the PATHASSIGNMENT entry is entered in a single field with each of the nodes separated by spaces and/or a comma. In the Manual Mode, the commands can be abbreviated in any reasonable fashion, such as PATHD and PATHA. Enter the PATH commands for the four inbound distribution types as follows, noting that the first numeric part of each line shown here is not entered in the Visual Mode, but is displayed as part of the input dialog:

[TrafficImpact] → **PATHDISTRIBUTION 1 40 3 N In from the North**
[TrafficImpact] → **PATHASSIGNMENT 1 60 3 4**
[TrafficImpact] → **PATHASSIGNMENT 2 30 3 2**
[TrafficImpact] → **PATHASSIGNMENT 3 10 3 2 1**

[TrafficImpact] → **PATHDISTRIBUTION 2 20 3 E In from the East**
[TrafficImpact] → **PATHASSIGNMENT 1 50 3 2**
[TrafficImpact] → **PATHASSIGNMENT 2 30 3 4**
[TrafficImpact] → **PATHASSIGNMENT 3 20 3 2 1**

[TrafficImpact] → **PATHDISTRIBUTION 3 30 4 S In from the South**
[TrafficImpact] → **PATHASSIGNMENT 1 100 4**

[TrafficImpact] → **PATHDISTRIBUTION 4 10 1 W In from the West**
[TrafficImpact] → **PATHASSIGNMENT 1 70 1 2**
[TrafficImpact] → **PATHASSIGNMENT 2 30 1**

Now enter the PATH commands for the four outbound distribution types.

[TrafficImpact] → **PATHDISTRIBUTION 5 30 3 N Out to the North**
[TrafficImpact] → **PATHASSIGNMENT 1 60 4 3**
[TrafficImpact] → **PATHASSIGNMENT 2 30 2 3**
[TrafficImpact] → **PATHASSIGNMENT 3 10 1 2 3**

[TrafficImpact] → **PATHDISTRIBUTION 6 20 3 E Out to the East**
[TrafficImpact] → **PATHASSIGNMENT 1 50 2 3**
[TrafficImpact] → **PATHASSIGNMENT 2 30 4 3**
[TrafficImpact] → **PATHASSIGNMENT 3 20 1 2 3**

[TrafficImpact] → **PATHDISTRIBUTION 7 40 4 S Out to the South**
[TrafficImpact] → **PATHASSIGNMENT 1 100 4**

[TrafficImpact] → **PATHDISTRIBUTION 8 10 1 W Out to the West**
[TrafficImpact] → **PATHASSIGNMENT 1 70 2 1**
[TrafficImpact] → **PATHASSIGNMENT 2 30 1**

The Tabular View is a particularly efficient data entry mode when lots of data is to be entered, buts lacks some of the dialog box cues that the Normal View provides. Use the View menu (or the F3 key) and the Edit menu to explore this view and see the data values you have entered. If you have entered a value improperly, simply re-enter the proper value. The next section shows how you can verify all entries, particularly if you are using the Manual Mode.

## Data Review (for Traffic Impact Analysis)

Once data has been entered, it should be checked for accuracy and completeness. In the Visual Mode, this process is simply a matter of reviewing the data entered in each dialog, since this reflects the actual current values. In the Manual Mode, DATA and SUMMARIZE are used for this data review. Either of these commands may be used to display the current parameter values for the traffic impact analysis entries. SUMMARIZE provides a formatted summary report for all of the command parameter values, while DATA displays only the parameter values for the list of commands requested. To illustrate this operation, in either the Visual or Manual Modes, enter the following. Note that again, since this is an active command, the Visual Mode requires that the Execute button be used to execute the command. The View-Summary menu can also be used.

[DataFiles] → **SUMMARIZE**

The current values of all input commands are listed with the values just entered, as well as any default values which were not entered. Note that the intersection and assignment parameters have helpful column headings and a report title is displayed. The DATA command only displays the information, without any special formatting.

[DataFiles] → **DATA SITESIZE GENERATION**

The program displays the current parameter values for only the SITESIZE and GENERATION commands. Note that no other command's values are listed, nor are there any headings. Since DATA accepts other commands as parameter values, DATA can be requested for only one, several or all commands, where SUMMARIZE always gives all values. This makes DATA quicker to use, but less clear for others to review other than on the computer display.

The most efficient way to check input from the Manual Mode is to use the ASK command. This displays the current values of the commands "ASKed for" in a dialog box display which provides on-screen HELP and allows the user to move the cursor among the data fields and even change any values desired (just like the Visual Mode). Try the following from the Manual Mode, both in the Normal and Tabular Views (use F3 to toggle between views):

→ **ASK [TrafficImpact]**

Review the data values listed using any of the methods described above. Note that there is an error in the GENERATION data entered. The generation rate for outbound traffic should be 2.1, not 1.2. To correct this, re-enter the GENERATION OUT entry with the proper value using either of the entry modes, Visual or Manual.

[TrafficImpact] → **GENERATION OUT 2.1** ...

Note that in either mode, only the value to be changed need be entered. In the Visual Mode, the cursor is moved to the field with the 1.2 value and the 2.1 is typed right over the 1.2, followed by TAB or ENTER. In the Manual Mode, the GENERATION command is typed only up to the value needed.

It is frequently desirable to print the summary of input values, both as a document to use in the input checking process, as well as a physical record of the input data used in subsequent analyses. Use of the printer is easy with TEAPAC. Simply use the File-Print menu of the output window (or Ctrl-P) to direct the output to the default printer. Various available printers and printer options can be selected using the Setup options in the File menu, and the last produced output can be printed from the File menu of the main window. If your printer is connected, perform the above sequence for the SUMMARIZE command to get a printed summary of input, then recheck all the data input for proper values before proceeding.

## Analysis (for Traffic Impact Analysis)

The third step in program execution is to perform an analysis of the current data. Once satisfied with the accuracy of the input data, use the COMPUTEPATHS command in the Results menu to execute a traffic impact analysis computation.

[Results] → **COMPUTEPATHS** ...

The COMPUTEPATHS command first generates a summary of the input parameters used to calculate the intersection movement volumes. In this example, the Intersection Movement Volumes include the both the traffic accessing the proposed development as well as the existing traffic (expanded by 10% per year growth compounded for 2 years). It is possible to limit the distribution types considered during the calculations using the COMPUTEPATHS command parameters. Note that the COMPUTEPATHS command has two parameter values, <RESET/CUMULATE> and <List of Distribution Types>. The default used for the <List of Distribution Types> parameter in the first analysis was ALL; therefore, all types were used to calculate the Intersection Movement Volumes. In order to limit the analysis to site-specific trips to the proposed development, type the following COMPUTEPATHS command:

[Results] → **COMPUTEPATHS RESET 1 2 3 4 5 6 7 8**

This generates the same type of results as the previous command, but includes only the trips defined by distribution types 1, 2, 3, 4, 5, 6, 7 and 8 (trips destined to or originating from the site). By comparing the volumes calculated in the first COMPUTEPATHS with these new volumes, it is possible to determine the impact of inbound site trips to the total movement volume.

## Evaluation (for Traffic Impact Analysis)

One powerful aspect of TEAPAC is the capability to quickly test multiple scenarios or conditions in an interactive environment, for example, to test the impact of increasing the development size from 600,000 to 750,000 GLA.

Enter the following to demonstrate an increase in the size of the site to 750,000 square feet of GLA. We can also use the FINDPATHS command to help make the definition of our PATHASSIGNMENTs an easier task. These options can be found in the Edit menu and the Results menu, as before.

[TrafficImpact] → **BASE 750** ...

The SHOWPATHS command of the Results menu can be used to display a printable schematic diagram of the network and assignment paths, and the COMPUTEPATHS command can be re-executed to determine the volumes after these changes. Try using these commands to observe the results.

[Results] → **SHOWPATHS** ...

[Results] → **COMPUTEPATHS** ...

By comparing the new volumes with the results from the first COMPUTEPATHS, it is possible to determine the change in intersection movement volumes caused by increasing the development size to 750,000 square feet GLA.

You can also experiment with the FINDPATHS command in the Results menu to see how TEAPAC can assist in the initial definition of the PATHASSIGNMENT commands. By letting TEAPAC find the shortest paths into and out of the site, the user need only enter the percentage of the total distributed traffic which will follow this path. Outbound assignments can also be made automatically by reversing the inbound assignments.

While the example problem is over-simplified, it does demonstrate that TEAPAC's interactive analysis and design techniques allow many conditions to be tested quickly and efficiently. In addition, printed reports can be produced to document the analysis, and analysis conditions can be saved at any time, as illustrated below.

At this point of the analysis, we may feel we have an adequate solution to the problem, and wish to SAVE the data values which created the final results for future use. The typical Save/SaveAs options of the File menu are normally used, but the [DataFiles] commands of the File menu also offer these capabilities by first defining the disk FILE name to be used for storage, then issuing the SAVE command to save the parameter values.

[DataFiles] → **FILES SAMPLE/N** ...

[DataFiles] → **SAVE 1 1** ...

Note that the file name "SAMPLE" has a "/N" switch added to its name the first time it is used to indicate to TEAPAC that you expect to create a new file. This is not required, but saves the steps of responding to the new file creation query. When used, an error will be produced only if this file name already exists. Other such switches and file name conventions are discussed in Appendix G, as they relate to your operating system. Also note that as many as five files can be named at any given time, and that the SAVE command describes which of these five files are to be used. The SAVE command can also tell the program where in the file to save information, allowing different scenarios to be stacked one after the other in the same file. The LOAD command is used to retrieve the information at a later date. All of these options relate to advanced file manipulation capabilities such as batch control file scripts and multiple scenarios, described in detail in Chapter 7.

## Chapter 2 Topics (for Count Analysis):

Chapter 2 Topics
Description of Example Problem (for Count Analysis)
Data Entry (for Count Analysis)
Data Review (for Count Analysis)
Analysis (for Count Analysis)
Evaluation (for Count Analysis)

## Description of Example Problem (for Count Analysis)

Vehicle counts were conducted at an intersection for the twelve turning and straight through movements. These 15-minute counts were taken between the hours of 6:30 - 8:30 AM. The cumulative counts for each movement are shown in Table 2-1, showing the count recorded at each time listed. Using the TEAPAC program, tabulate the counts and leg totals and determine the morning intersection peak hour based on the total intersection volume. In addition, determine the peak hour factors for each of the twelve movements.

**Table 2-1 (COU)**
**Traffic Count Data for Example Problem (for Count Analysis)**

| Begin | From North | | | From East | | | From South | | | From West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| 06:30 | 0 | 205 | 67 | 25 | 73 | 3 | 2 | 86 | 11 | 45 | 145 | 0 |
| 06:45 | 1 | 349 | 142 | 42 | 121 | 3 | 4 | 144 | 21 | 80 | 265 | 1 |
| 07:00 | 1 | 523 | 201 | 78 | 201 | 4 | 6 | 245 | 38 | 113 | 442 | 1 |
| 07:15 | 3 | 703 | 258 | 119 | 337 | 11 | 8 | 339 | 59 | 158 | 689 | 1 |
| 07:30 | 6 | 915 | 350 | 165 | 541 | 17 | 11 | 477 | 76 | 206 | 980 | 2 |
| 07:45 | 8 | 1135 | 438 | 215 | 748 | 21 | 12 | 601 | 103 | 257 | 1254 | 2 |
| 08:00 | 9 | 1350 | 513 | 266 | 969 | 30 | 15 | 713 | 120 | 311 | 1574 | 3 |
| 08:15 | 9 | 1516 | 587 | 321 | 1153 | 41 | 25 | 813 | 142 | 373 | 1845 | 3 |
| 08:30 | 11 | 1700 | 649 | 359 | 1325 | 60 | 36 | 896 | 155 | 420 | 2073 | 4 |

## Data Entry (for Count Analysis)

If you are not currently running the TEAPAC program, do so according to the way it was installed on your computer (see Appendix G). The program will display the main window along with important licensing information. As described in Chapter 1, two input modes can be used to manipulate the program. In the examples below, the Edit menu line to select in the Visual Mode is shown in square brackets, "[XXX]", and the command line to move to is shown following the arrow, "→". To enter the desired parameter values, move the cursor to the appropriate display area and type the value in, followed by the TAB key. Use the OK button when done entering data to return to the Main Menu. To display more entries on a single dialog box, first select the Tabular View in the View menu before entering data using the Edit menu.

To use the Manual Mode for this tutorial, select the Manual Mode from the Options menu, or simply press F4. Once the program is ready to accept input, it will display the command prompt arrow. To enter the desired parameter values, enter the command keyword and parameter values, each separated by a space, all followed by the ENTER key or the OK button. If the Visual Mode is desired at any point, simply press the F4 function key.

If you wish, you can use the drag-and-drop graphical network creation method to create your analysis network in the main window before entering detailed data. To do this, follow the instructions in the Data Entry section of Chapter 1. In this case, for a single intersection, simply draw two intersecting street segments. After the network is created, the additional detailed data described below can be entered by right-clicking on the intersection, including a check of the data already created by the drag-and-drop network creation. The intersection can also be re-numbered with a right-click option.

The first step in using the TEAPAC program is to enter the data required to describe the problem to be solved. This is accomplished using commands designated as [Parameters] commands, such as COUNTTYPE and PERIODS. The Commands option of the Help menu can be used to display help for all commands.

The Help-Commands menu displays all commands, along with information on how to use each. Note the number of parameters for each command and their associated default values. For example, the PERIODS command requires the length of the count intervals and the start and end times of each count period. The 5* associated with the start and end times indicates that up to five count periods may be entered. The default value for the count interval is fifteen minutes. There are no default values for the <Start Time> and <End Time> parameters of the PERIODS command. It should be noted that times must be entered in 24-Hour (military) time (0000 - 2400).

Since a lot of commands exist, getting HELP for a smaller group might be appropriate. The [Basic] group consists of only those commands which are essential to solving basic problems with TEAPAC. The [CountAnalysis] group consists of those commands which are related to performing traffic count analyses. These commands can be viewed by issuing the following commands from the Manual Mode.

→ **HELP [Basic]**

→ **HELP [CountAnalysis]**

If help for only one command is needed, the HELP command will display the same detailed HLP file information for that command which is produced by the Help buttons in Visual Mode dialogs. For example, use the following Manual Mode entry to obtain complete help for the COUNTTYPE entry to be made in the next paragraph.

→ **HELP COUNTTYPE**

Now let’s enter the information needed to describe the problem. The first entry should be the list of valid node numbers for any intersections we will be working with (NODELIST). This may be a system of connected signals in a network, or multiple conditions we want saved in a single file. In any case, each intersection we study with TEAPAC must have a unique number in the NODELIST. For this example, we’ll just set up one intersection in the list and call it #1.

[Basic] → **NODELIST 1**

The entries below describe the conditions at each individual intersection in the NODELIST. Note that the INTERSECTION command selects which intersection of the NODELIST the data that follows applies to. In the Tabular View, INTERSECTION is an active command which needs to be executed with the Execute button in order to change the screen's values to the new intersection.

[Basic] → **INTERSECTION 1**

Now we can enter the data which describes intersection 1. The first data entries should be the COUNTTYPE and the count PERIODS.

[CountAnalysis] → **COUNTTYPE CUMULATIVE** ...

A cumulative count means that the counting device is not reset to zero each time a count is recorded, thus the counter cumulates the vehicles counted during the course of the counted period. Some cumulative counters can be reset to zero to start the count, others cannot. In either case, the first count entered for TEAPAC is the reading on the counter at the start of the count, and each subsequent entry is the cumulative count at the time the count is recorded. One last recording of the counter reading at the end of the count is made, resulting in N+1 entries for a count with N intervals. Cumulative recording is the most reliable type of manual recording system, and is highly recommended.

[CountAnalysis] → **PERIODS 15 630 830** ...

As an efficiency aid, one can move to the next dialog box in sequence as shown in the Edit menu with the Next button instead of using the menu each time. Thus, instead of pressing the OK button after the COUNTTYPE entry above and using the Edit menu to select PERIODS, simply press the Next button.

This entry means that the cumulative count was started at 6:30 A.M. and ended with the last recorded entry at 8:30 A.M. This is an eight interval count which requires nine entries of cumulative data. If the counter had been reset to zero at the start of each count interval, resulting in a reduced count, the last PERIODS entry would be 815 rather than 830 and only eight entries of reduced data would be made. In that case, the first entry (the 630 entry) would be the actual count for the interval from 630 to 645, as recorded at 645. Note that in the Tabular View, PERIODS is an active command which must be executed with the Execute button. The Tabular View is a particularly efficient data entry mode when lots of data is to be entered, buts lacks some of the dialog box cues that the Normal View provides.

When entering VEHICLECOUNTS data, TEAPAC will accept data for each count interval (time) or for each movement. If the data is entered by count interval in the Visual or Manual Modes, TEAPAC expects the data to be entered starting with the North approach right-turns and proceeding clockwise around the intersection, as shown below. See Chapter 1 - Conventions for more detail. If data is entered by movement, the program expects the data to be entered in chronological order, e.g. the interval beginning at 6:30, then 6:45, then 7:00, etc. This can only be done in the Manual Mode or in the Tabular View. Enter the following information:

[CountAnalysis] → **VEHI 630 0 205 67 25 73 3 2 86 11 45 145 0**

[CountAnalysis] → **VEHI 645 1 349 142 42 121 3 4 144 21 80 265 0**

[CountAnalysis] → **VEHI 700 1 523 201 78 201 4 6 245 38 113 442 1**

[CountAnalysis] → **VEHI 715 3 703 258 119 337 11 8 339 59 158 689 1**

[CountAnalysis] → **VEHI 730 6 915 350 165 541 17 11 477 76 206 980 2**

[CountAnalysis] → **VEHI 745 8 1135 438 215 748 21 12 601 103 257 1254 2**

[CountAnalysis] → **VEHI 800 9 1350 513 266 969 30 15 713 120 311 1574 3**

[CountAnalysis] → **VEHI 815 9 1516 587 321 1153 41 25 813 142 373 1845 3**

[CountAnalysis] → **VEHI 830 11 1700 649 359 1325 60 36 896 155 420 2073 4**

In the Manual Mode, the vehicle counts can also be entered by movement, which is most convenient for many count forms. Thus, an equivalent way to enter the same data would be as follows:

→ **VEHICLECOUNTS 1 0 1 1 3 6 8 9 9 11**

In order to speed up data entry in the Manual Mode, it is possible to abbreviate the VEHICLECOUNTS command to VEHI. Enter the following information to complete the data necessary for the initial problem.

→ **VEHI 2 205 349 523 703 915 1135 1350 1516 1700**

→ **VEHI 3 67 142 201 258 350 438 513 587 649**

→ **VEHI 4 25 42 78 119 165 215 266 321 359**

→ **VEHI 5 73 121 201 337 541 748 969 1153 1325**

→ **VEHI 6 3 3 4 11 17 21 30 41 60**

→ **VEHI 7 2 4 6 8 11 12 15 25 36**

→ **VEHI 8 86 144 245 339 477 601 713 813 896**

→ **VEHI 9 11 21 38 59 76 103 120 142 155**

→ **VEHI 10 45 80 113 158 206 257 311 373 420**

→ **VEHI 11 145 265 442 689 980 1254 1574 1845 2073**

→ **VEHI 12 0 0 1 1 2 2 3 3 4**

This order of input can also be used in the Tabular View by using the down arrow between entries to enter vertical columns of data

Use the View menu (or the F3 key) and the Edit menu to explore the Tabular View and see the data values you have entered. If you have entered a value improperly, simply re-enter the proper value. The next section shows how you can verify all entries, particularly if you are using the Manual Mode.

## Data Review (for Count Analysis)

Once data has been entered, it should be checked for accuracy and completeness. In the Visual Mode, this process is simply a matter of reviewing the data entered in each dialog, since this reflects the actual current values. In the Manual Mode, DATA and SUMMARIZE are used for this data review. Either of these commands may be used to display the current parameter values for the TEAPAC entries. SUMMARIZE provides a formatted summary report for all of the command parameter values, while DATA displays only the parameter values for the list of commands requested. To illustrate this operation, in either the Visual or Manual Modes, enter the following. Note that again, since this is an active command, the Visual Mode requires that the Execute button be used to execute the command. The View-Summary menu can also be used.

[DataFiles] → **SUMMARIZE**

The current values of all input commands are listed with the values just entered, as well as any default values which were not entered. Note that the count parameters, VEHICLECOUNTS, have approach and movement labels and a report title is displayed. The DATA command only displays the information, without any special formatting.

[DataFiles] → **DATA PERIODS VEHICLECOUNTS**

The program displays the current parameter values for only the PERIODS and VEHICLECOUNTS commands. Note that no other command's values are listed, nor are there any headings. Since DATA accepts other commands as parameter values, DATA can be requested for only one, several or all commands, where SUMMARIZE always gives all values. This makes DATA quicker to use, but less clear for others to review other than on the computer display.

The most efficient way to check input from the Manual Mode is to use the ASK command. This displays the current values of the commands "ASKed for" in a dialog box display which provides on-screen HELP and allows the user to move the cursor among the data fields and even change any values desired (just like the Visual Mode). Try the following from the Manual Mode, both in the Normal and Tabular Views (use F3 to toggle between views):

→ **ASK [CountAnalysis]**

Review the data values listed using any of the methods described above. Note that there is an error in the VEHICLECOUNTS entered. The 6:45 count for the left turn on the west approach should be 1, not 0. To correct this, re-enter the VEHICLECOUNTS entry with the proper value using either of the entry modes, Visual or Manual.

[CountAnalysis] → **VEHICLECOUNTS 645 * * * * * * * * * * * 1**

or

→ **VEHI 12 * 1**

Note that in either mode, only the value to be changed need be entered. In the Visual Mode, the cursor is moved to the field with the 0 value and the 1 is typed right over the 0, followed by TAB or ENTER. In the Manual Mode, the VEHICLECOUNTS command is typed followed by an asterisk used as a place holder to skip the first entry.

It is frequently desirable to print the summary of input values, both as a document to use in the input checking process, as well as a physical record of the input data used in subsequent analyses. Use of the printer is easy with TEAPAC. Simply use the File-Print menu of the output window (or Ctrl-P) to direct the output to the default printer. Various available printers and printer options can be selected using the Setup options in the File menu, and the last produced output can be printed from the File menu of the main window. If your printer is connected, perform the above sequence for the SUMMARIZE command to get a printed summary of input, then recheck all the data input for proper values before proceeding.

## Analysis (for Count Analysis)

The third step in program execution is to perform an analysis of the current data. Once satisfied with the accuracy of the input data, use the COUNTTABULATE command in the Results menu to execute a tabulation.

[Results] → **COUNTTABULATE** ...

The COUNTTABULATE command summarizes both the 15-minute and 60-minute volumes by count interval for the entire count period. The 15-minute flow rates represent each 15-minute count multiplied by four, while the 60-minute volumes represent the sum of the four 15-minute intervals beginning at the time shown. Therefore, the last three 60-minute totals are not complete hours since they contain one or more 15-minute intervals with zero value(s), thus they appear with an asterisk at the end of each such row.

Note that all tables of the output come in two parts: the first part is for each of the twelve movements, while the second part contains the total approach and exit volumes. Both have the total intersection count in the last column. As an example, see that the 6:30-6:45 count for the North approach movements is 1, 144 and 75 for the right, through and left movements, respectively. These add up to the 220 which is shown for the North approach total in the next table. The 76 for the North exit represents the traffic exiting the intersection on the same leg (but in the opposite direction) and is the sum of the 17, 58 and 1 counts from the first line of the first table.

Furthermore, note that the 144 count for the North through movement is expanded to 576 as the flow rate in vehicles per hour during the 6:30-6:45 time interval. This compares to the 60-minute volume of 710 which is shown in the following table, which is the sum of the 144, 174, 180 and 212 counts from 6:30-7:30. Another comparison of the 15-minute flow rate versus the 60-minute volume would be for the entire intersection. Note that the highest 15-minute flow rate is at 7:45-8:00 with a rate of 4316 vehicles per hour. On the other hand, the highest total hour counted is from 7:15-8:15 with 4143 vehicles per hour. Note that the 15-minute rate is higher and occurs at a different time.

The PEAKANALYZE command can be used to perform a peak hour analysis of any time range selected, in a fashion similar to the visual search of the 60-minute volumes just made. The default is to search for A.M., midday and P.M. peaks between certain pre-specified times. To search all of the counts made, specify the range as below using the Results menu.

[Results] → **PEAKANALYZE 630 815** ...

The intersection peak hour is determined based on the highest total intersection volume. Note that the same peak we found visually, 4143 vehicles, is found as the peak intersection total in the last row of the table, occurring at 7:15 as shown in the row above the last row. This is the total of the volumes shown in the top row. The top row of volumes is designated as the Design Hour Volumes (DHV) for the peak period, these to be used as demand volumes for other calculations. The distribution percentages are calculated for the DHVs. For example, there are 29% left turns on the North approach, 28% of the total traffic approach the intersection from the North, and only 16% of the traffic exits to the North. Peak hour factors are also calculated for each of the movements and totals.

Notice that the tables of the peak hour analysis are followed by a schematic diagram of the intersection showing the peak hour volumes and percentages. This is the output of the PEAKSUMMARY command which can be toggled on and off with the third parameter of the PEAKANALYZE command. The same diagram output can be produced by issuing the PEAKSUMMARY command and giving the starting time.

[Results] → **PEAKSUMMARY 715**

In the PEAKANALYZE results, the peak time and volume (last two rows of output) indicate when an individual movement peaks and the volume occurring at that time. For example, the through movement on the North approach has a volume of 813 vehicles per hour when the intersection peaks at 7:15, but that movement itself peaks 15 minutes earlier at 7:00 with a volume of 827 vehicles per hour. Although this difference is not much in this case, this analysis can be useful for identifying important individual peaking characteristics.

The PEAKANALYZE command has two time parameter values, <Start Time> and <End Time>. The values used in the first analysis were 630 and 815 which directs the program to analyze the entire two hour count period. These parameters can be used to control the length of the period to be analyzed. The following command limits the analysis to a single hour between 7:00 and 8:00 A.M.

[Results] → **PEAKANALYZE 700 700** ...

Note, this command generates an analysis for the hour between 7:00 - 8:00 A.M. and does not consider any other available data outside the specified time period. The first entry means to start the peak hour search with the hour which begins at 7:00, whereas the second entry means to end the peak hour search with the hour which begins at 7:00 also. While the report format is identical, the result is different. All movements peak at 7:00, since this is the only 1-hour period to explore, thus the top and bottom rows are the same. This type of analysis is useful if a given 1-hour period's volumes are needed, regardless of total intersection peaking times.

## Evaluation (for Count Analysis)

One powerful aspect of TEAPAC is the capability to quickly test multiple scenarios or conditions in an interactive environment. For example, to calculate the effect various seasonal adjustment factors might have on the intersection's volumes, the VOLFACTORS command can be used to factor all twelve movements individually. The factor is applied directly to the turning movement counts; therefore, a factor greater than one increases the volume and a factor less than one reduces the volume.

Enter the following VOLFACTORS and COUNTREPORTS commands to demonstrate the impact of a 10 percent increase in all traffic volumes, due either to a seasonal adjustment or projected growth. These options can be found in the Edit and Results menus, as before.

[Basic] → **VOLFACTORS 1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1**

[Results] → **COUNTREPORTS 60**

See that the new 15-minute flow rate for the North through movement at 6:30 is 632, up 10% from 576. The 60-minute intersection volume between 6:30 and 7:30 is up from 3084 to 3394, and the highest 60-minute volume is up from 4143 to 4556. These numbers are not increased by exactly 10% since each individual movement is increased by 10% and rounded to the nearest vehicle, then the rates and volumes are computed. The same factor is applied to the PEAKANALYZE command, as illustrated below.

[Results] → **PEAKANALYZE** ...

Note that since the VOLFACTORS command is applied individually to each movement, there may be a change in when the intersection peak hour occurs. In this case, the peak intersection volume is the 4556 noted above and the Design Hour Volumes (DHV) have been increased by 10 percent uniformly.

The PEAKANALYZE command will also produce an estimate of average daily traffic (ADT) if the ADTFACTOR command is entered as a non-zero number. For example, if it was determined that the ADT volume was about 10 times the two-hour count volume, the following produces an estimate of ADT volumes.

[CountAnalysis] → **ADTFACTOR 10**

[Results] → **PEAKANALYZE** ...

The variation of traffic counts over the entire period can also be displayed in graphical form by using the COUNTGRAPH command. This plots the total intersection count for each count period, and shows, for example, how abrupt or gradual the peak period is.

[Results] → **COUNTGRAPH** ...

In the graph it can be seen quickly that three 15-minute counts for the intersection at 7:15, 7:30 and 7:45 are about the same value, as well as why the peak was determined starting at 7:15, not 7:00. Note also that the numbers in the graph reflect the 10% factors used.

A signal warrant analysis and multi-way stop warrant analysis can be performed with the WARRANTS command. This command checks all of the volume-oriented warrants of the *Manual on Uniform Traffic Control Devices* (MUTCD) and produces a concise warrant analysis. In the case of this example, since we have only a two-hour count, most of the warrants cannot be met since they require four or eight hours of data, but issuing the WARRANTS command does show that the volume elements of the one-hour Peak Hour Warrants (3A and 3B) are met by this data.

[Results] → **WARRANTS** ...

Notice in this report, even though a two-hour count was conducted, three hours were found to meet each of Warrants 3A and 3B, since the first and last half-hours of the count were enough to satisfy the warrant. The warrant analysis searches the count data to find the greatest number of one-hour periods which meet each warrant, and lists the hours found from high to low based on the minor street volume. If too few hours were found that meet the warrant, the highest minor street volumes are also shown so the analyst can see how close to the warrants these hours are. In order for these warrants to be completely met, additional non-volume conditions must also be satisfied. Notably, for any warrant to be met, a signal must not disrupt progression on the main street, and for warrant 3A the measured stop sign delay must be at least 4 veh-hours. These and other specific intersection conditions which affect the warrant analysis can be entered with the CONDITIONS command. These conditions are listed in the first table of the warrant analysis. Enter the 6th and 9th conditions for progression and delay, and check the warrants again to see that Warrants 3A and 3B are now fully met.

[CountAnalysis] → **CONDITIONS * * * * * Yes * * 7**

[Results] → **WARRANTS** ...

While the example problem is over-simplified, it does demonstrate that TEAPAC's interactive analysis techniques allow many conditions to be tested quickly and efficiently. In addition, printed reports can be produced to document the analysis, and analysis conditions can be saved at any time, as illustrated below.

At this point of the analysis, we may feel we have an adequate solution to the problem, and wish to SAVE the data values which created the final results for future use. The typical Save/SaveAs options of the File menu are normally used, but the [DataFiles] commands of the File menu also offer these capabilities by first defining the disk FILE name to be used for storage, then issuing the SAVE command to save the parameter values.

[DataFiles] → **FILES SAMPLE/N** ...

[DataFiles] → **SAVE 1 1** ...

Note that the file name "SAMPLE" has a "/N" switch added to its name the first time it is used to indicate to TEAPAC that you expect to create a new file. This is not required, but saves the steps of responding to the new file creation query. When used, an error will be produced only if this file name already exists. Other such switches and file name conventions are discussed in Appendix G, as they relate to your operating system. Also note that as many as five files can be named at any given time, and that the SAVE command describes which of these five files are to be used. The SAVE command can also tell the program where in the file to save information, allowing different scenarios to be stacked one after the other in the same file. The LOAD command is used to retrieve the information at a later date. All of these options relate to advanced file manipulation capabilities such as batch control file scripts and multiple scenarios, described in detail in Chapter 7.

## Chapter 2 Topics (for Progression Analysis):

Chapter 2 Topics

## Description of Example Problem (for Progression Analysis)

Six intersections form a linear traffic signal system which needs initial offsets for implementation. Figure 2-1 shows the configuration of the system and Table 2-1 lists the basic information on the system including the available green time at each intersection. Use the TEAPAC program to determine the optimum cycle length for the system and intersection offsets assuming an operating speed of 35 mph. In addition, determine the optimum cycle length and offsets if the operating speed is increased to 45 mph.

**Table 2-1 (PRG)**
**Data for Example Problem (for Progression Analysis)**

| Cross-Street | Main Street Green (Percent) | Distance (Feet) | Speed (Mph) |
|---|---|---|---|
| First Street | 59.0 | 2130 | 35 |
| Second Street | 68.0 | 780 | 35 |
| Third Street | 64.0 | 1180 | 35 |
| Fourth Street | 68.0 | 1930 | 35 |
| Fifth Street | 82.0 | 640 | 35 |
| Sixth Street | 74.0 | -- | -- |

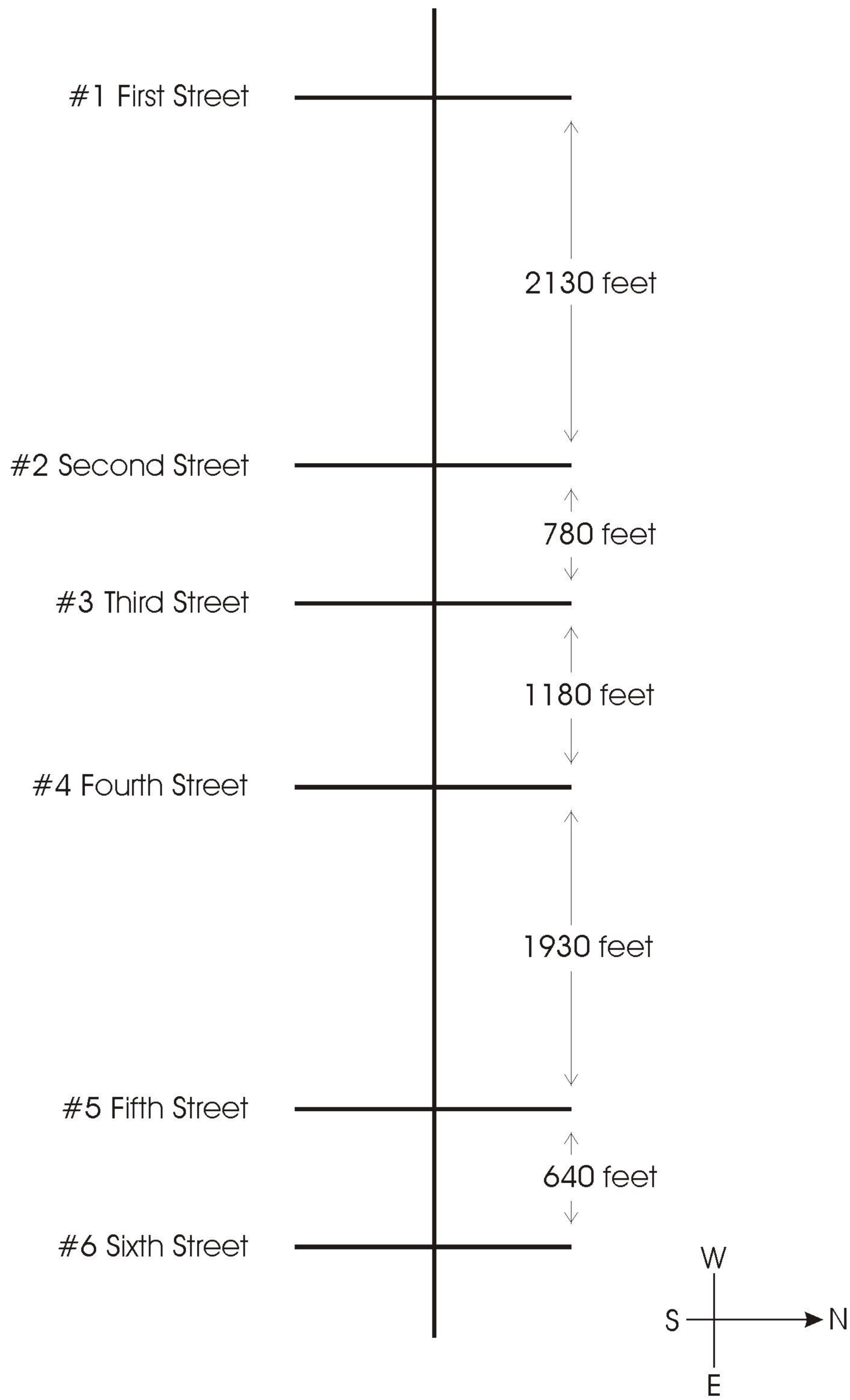



Figure 2-1 (PRG)
Schematic Diagram of Example Problem (for Progression Analysis)

## Data Entry (for Progression Analysis)

If you are not currently running the TEAPAC program, do so according to the way it was installed on your computer (see Appendix G). The program will display the main window along with important licensing information. As described in Chapter 1, two input modes can be used to manipulate the program. In the examples below, the Edit menu line to select in the Visual Mode is shown in square brackets, "[XXX]", and the command line to move to is shown following the arrow, "→". To enter the desired parameter values, move the cursor to the appropriate display area and type the value in, followed by the TAB key. Use the OK button when done entering data to return to the Main Menu. To display more entries on a single dialog box, first select the Tabular View in the View menu before entering data using the Edit menu.

To use the Manual Mode for this tutorial, select the Manual Mode from the Options menu, or simply press F4. Once the program is ready to accept input, it will display the command prompt arrow. To enter the desired parameter values, enter the command keyword and parameter values, each separated by a space, all followed by the ENTER key or the OK button. If the Visual Mode is desired at any point, simply press the F4 function key.

The first step in using the TEAPAC program is to enter the data required to describe the problem to be solved. This is accomplished using commands designated as [Parameters] commands, such as PRG-SIZE and PRG-DISTANCES. The Commands option of the Help menu can be used to display help for all commands.

The Help-Commands menu displays all commands, along with information on how to use each. Note the number of parameters for each command and their associated default values. For example, the PRG-DISTANCES command requires link distances for up to twenty-four (24*) possible links in the system.

Since a lot of commands exist, getting HELP for a smaller group might be appropriate. The [Basic] group consists of only those commands which are essential to solving basic problems with TEAPAC. The [Progression] group consists of those commands which are related to performing progression analyses. These commands can be viewed by issuing the following commands from the Manual Mode.

→ **HELP [Basic]**

→ **HELP [Progression]**

If help for only one command is needed, the HELP command will display the same detailed HLP file information for that command which is produced by the Help buttons in Visual Mode dialogs. For example, use the following Manual Mode entry to obtain complete help for the PRG-SIZE entry to be made in the next paragraph.

→ **HELP PRG-SIZE**

Now let's enter the information needed to describe the problem. The first entry should be the PRG-SIZE of the arterial system, that is, the number of signals in the system to be studied. This value is six for the example problem.

[Progression] → **PRG-SIZE 6**

Now that the PRG-SIZE of the arterial is defined we can enter information for each intersection and link in the system. The first entries could be the PRG-NAMES of each intersection cross street. When entering the intersection and link parameters for progression analysis, TEAPAC expects the data to be entered starting with the leftmost intersection and proceeding to the right as shown below. See Chapter 1 - Conventions for more detail.

[Progression] → **PRG-NAMES 1ST 2ND 3RD 4TH 5TH 6TH** ...

As with PRG-NAMES, the PRG-SPLITS parameters also correspond to each of the intersections from left-to-right. These values indicate how much split time (in percent of cycle) is available for through movements in both directions.

[Progression] → **PRG-SPLITS 59 68 64 68 82 74** ...

As an efficiency aid, one can move to the next dialog box in sequence as shown in the Edit menu with the Next button instead of using the menu each time. Thus, instead of pressing the OK button after the PRG-NAMES entry above and using the Edit menu to select PRG-SPLITS, simply press the Next button.

Now we can enter link information, also moving from left-to-right in the system. The PRG-DISTANCES are the distance between centers of intersections, starting with link #1-2, followed by #2-3, up to #5-6.

[Progression] → **PRG-DISTANCES 2130 870 1180 1930 640** ...

As with PRG-DISTANCES, the PRG-SPEEDS parameters also correspond to each of the links from left-to-right. These values indicate the target progression speeds on the arterial. One set of entries is for each link in the left-to-right direction and the other is for each link in the right-to-left direction. In either case, the order of entry is from left-to-right along the arterial, as described in Chapter 1 - Conventions.

[Progression] → **PRG-SPEEDS LR 35 35 35 35 35** ...

[Progression] → **PRG-SPEEDS RL 35 35 35 35 35** ...

In the Visual Mode, the "+" and "-" buttons can be used at any time to increment and decrement the starting intersection number displayed in the dialog. This is important when more than six intersections of data is to be entered in the [Progression] dialogs. The Ctrl-PageUp and Ctrl-PageDown keys (^Page-Up/Down) may also be used as shortcut keys, as long as no changes have been made to input fields in the dialog. If a change is made, first TAB to the next field, then use ^Page-Up/Down.

Finally, the range of PRG-CYCLES lengths we want to explore is entered, using the smallest acceptable cycle, the largest cycle, and the increment to be used to step from the smallest to the largest. To try 60, 70, 80, 90,...,120, enter the following.

[Progression] → **PRG-CYCLES 60 120 10**

The Tabular View is a particularly efficient data entry mode when lots of data is to be entered, buts lacks some of the dialog box cues that the Normal View provides. Use the View menu (or the F3 key) and the Edit menu to explore this view and see the data values you have entered. If you have entered a value improperly, simply re-enter the proper value. The next section shows how you can verify all entries, particularly if you are using the Manual Mode.

## Data Review (for Progression Analysis)

Once data has been entered, it should be checked for accuracy and completeness. In the Visual Mode, this process is simply a matter of reviewing the data entered in each dialog, since this reflects the actual current values. In the Manual Mode, DATA and SUMMARIZE are used for this data review. Either of these commands may be used to display the current parameter values for the progression analysis entries. SUMMARIZE provides a formatted summary report for all of the command parameter values, while DATA displays only the parameter values for the list of commands requested. To illustrate this operation, in either the Visual or Manual Modes, enter the following. Note that again, since this is an active command, the Visual Mode requires that the Execute button be used to execute the command. The View-Summary menu can also be used.

[DataFiles] → **SUMMARIZE**

The current values of all input commands are listed with the values just entered, as well as any default values which were not entered. Note that the intersection and link parameters, such as splits, distances and speeds, have column headings and a report title is displayed. The DATA command only displays the information, without any special formatting.

[DataFiles] → **DATA PRG-DISTANCES PRG-SPEEDS**

The program displays the current parameter values for only the PRG-DISTANCES and PRG-SPEEDS commands. Note that no other command's values are listed, nor are there any headings. Since DATA accepts other commands as parameter values, DATA can be requested for only one, several or all commands, where SUMMARIZE always gives all values. This makes DATA quicker to use, but less clear for others to review other than on the computer display.

The most efficient way to check input from the Manual Mode is to use the ASK command. This displays the current values of the commands "ASKed for" in a dialog box display which provides on-screen HELP and allows the user to move the cursor among the data fields and even change any values desired (just like the Visual Mode). Try the following from the Manual Mode, both in the Normal and Tabular Views (use F3 to toggle between views):

→ **ASK [Progression]**

Review the data values listed using any of the methods described above. Note that there is an error in the PRG-DISTANCES entered. The link distance for intersection #2-3 should be 780, not 870. To correct this, re-enter the PRG-DISTANCES entry with the proper value using either of the entry modes, Visual or Manual.

[Progression] → **PRG-DISTANCES * 780** ...

Note that in either mode, only the value to be changed need be entered. In the Visual Mode, the cursor is moved to the field with the 870 value and the 780 is typed right over the 870, followed by TAB or ENTER. In the Manual Mode, the PRG-DISTANCES command is typed followed by an asterisk used as place holder to skip the first entry.

It is frequently desirable to print the summary of input values, both as a document to use in the input checking process, as well as a physical record of the input data used in subsequent analyses. Use of the printer is easy with TEAPAC. Simply use the File-Print menu of the output window (or Ctrl-P) to direct the output to the default printer. Various available printers and printer options can be selected using the Setup options in the File menu, and the last produced output can be printed from the File menu of the main window. If your printer is connected, perform the above sequence for the SUMMARIZE command to get a printed summary of input, then recheck all the data input for proper values before proceeding.

## Analysis (for Progression Analysis)

The third step in program execution is to perform an analysis of the current data. Once satisfied with the accuracy of the input data, use the PROGRESSION command in the Results menu to execute a progression analysis.

[Results] → **PROGRESSION**

The Graph of Efficiency versus Cycle report displays the relationship of the optimum progression efficiency for every cycle length tested. It shows that the best cycle length of 80 or 90 seconds is 68 percent efficient, and 13.4 points or 24 percent more efficient than the worst cycle length of 60 seconds. This clearly indicates which cycles are preferable for progression and which are not.

Normally the next step in a progression analysis is to select a cycle length and obtain the optimum offsets and other pertinent data for this cycle length. In our example, we might select the best cycle as 80 seconds, if no other information precludes its use. An analysis with the signal analysis capacity analysis functions of TEAPAC would be instructive at this point, identifying what the minimum cycle length is and what cycle lengths produce good levels of service. A signal analysis in TEAPAC would normally be run prior to the progression analysis to optimize the phasings and timings (for a middle-range cycle length) so that a good estimate of the through PRG-SPLIT can be used as input to the progression analysis.

To get the optimum information for a single cycle length, the PRG-CYCLES range is limited to the cycle length desired, as shown below.

[Progression] → **PRG-CYCLES 80 80** ...

[Results] → **PROGRESSION**

Note how the same results as before are produced, but now only for the selected 80 second cycle length, and in much greater detail. Of primary importance are the Optimum Main Street Offsets. The other information which is produced is described in detail in Appendix D.

An important function of the progression analysis function is to plot a simplified time-space diagram for the optimum results, showing the optimum offsets for the selected cycle length. This is produced automatically after a PROGRESSION optimization, but can be accomplished at any time with the PLOTSIMPLE command. The <Scale> option of PLOTSIMPLE can be used to generate a diagram that fits well on the printed output. For example, the example problem will fit nicely on an 8-1/2" x 11" page with a scale of 200 feet per output line. The <Scale> can also be used to better fit time-space diagrams on the video display. Leaving the scale at its default value of 0 will automatically scale the plot to fit on a single output page. Try using a scale of 400 to see the diagram on the display, then try a scale of 0.

[Results] → **PLOTSIMPLE 400**

[Results] → **PLOTSIMPLE 0**

The time-space diagram shows the relative spacing of the intersections, the optimum offsets and splits for the selected cycle length, and the progressive bands which have been created. This information, in conjunction with the previous tabular information, completes the progression analysis.

## Evaluation (for Progression Analysis)

One powerful aspect of TEAPAC is the capability to quickly test multiple scenarios or conditions in an interactive environment. To test the impact on the arterial due to increasing the progression speed from 35 to 45 miles per hour, the PRG-SPEEDS need only be changed to 45 and the previous analysis can be quickly repeated. The PRG-ADJUST command can simply be entered as 1.286 and the PRG-SPEEDS values will be automatically adjusted by that factor. Then the PRG-CYCLES range can be re-tested, as shown below.

[Progression] → **PRG-ADJUST 1.286**

[Progression] → **PRG-CYCLES 60 120** ...

[Results] → **PROGRESSION**

Note that the shape of the efficiency curve has changed substantially, and that 80-90 seconds is no longer the optimal cycle length. In fact, the optimum cycle is now 110 seconds.

While the example problem is over-simplified, it does demonstrate that TEAPAC's interactive progression analysis and design techniques allow many conditions to be tested quickly and efficiently. In addition, printed reports can be produced to document the analysis, and analysis conditions can be saved at any time, as illustrated below.

At this point of the analysis, we may feel we have an adequate solution to the problem, and wish to SAVE the data values which created the final results for future use. The typical Save/SaveAs options of the File menu are normally used, but the [DataFiles] commands of the File menu also offer these capabilities by first defining the disk FILE name to be used for storage, then issuing the SAVE command to save the parameter values.

[DataFiles] → **FILES SAMPLE/N** ...

[DataFiles] → **SAVE 1 1** ...

Note that the file name "SAMPLE" has a "/N" switch added to its name the first time it is used to indicate to TEAPAC that you expect to create a new file. This is not required, but saves the steps of responding to the new file creation query. When used, an error will be produced only if this file name already exists. Other such switches and file name conventions are discussed in Appendix G, as they relate to your operating system. Also note that as many as five files can be named at any given time, and that the SAVE command describes which of these five files are to be used. The SAVE command can also tell the program where in the file to save information, allowing different scenarios to be stacked one after the other in the same file. The LOAD command is used to retrieve the information at a later date. All of these options relate to advanced file manipulation capabilities such as batch control file scripts and multiple scenarios, described in detail in Chapter 7.

## Chapter 2 Topics (for Export and Import):

Evaluation (for Export and Import)

## Description of Example Problem (for Export and Import)

The three-signal arterial system shown in Figure 2-1 is to be timed using the TRANSYT model (TRANSYT serves as an example of the various third-party programs which are supported by TEAPAC's export and import functions). The TEAPAC program is to be used as a pre-processor to the TRANSYT model. The system currently has timings for each isolated intersection, but no system offsets. The phase diagrams and timings are shown in Figure 2-2. Table 2-1 contains the demand volumes to be used for each intersection, while Table 2-2 contains the saturation flow rate for each lane group shown in Figure 2-1. Both tables are organized by approach, the way all input to TEAPAC is performed, as described in Chapter 1. The task is to generate a TRANSYT input file, produce a report which shows the phasings and timings, and plot a time-space diagram using the existing splits and offsets. In addition, use the TRANSYT-generated offsets to re-plot the time-space diagram.

**Table 2-1 (EXP)**
**Demand Volumes for Example Problem (for Export and Import)**

| Approach | From North | | | From East | | | From South | | | From West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intersectn | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| #13 Monroe | 122 | 216 | 80 | 79 | 722 | 187 | 212 | 310 | 198 | 139 | 660 | 134 |
| #14 Main | 150 | 813 | 244 | 0 | 1296 | 589 | 0 | 0 | 0 | 386 | 620 | 0 |
| #15 Water | 0 | 0 | 0 | 466 | 780 | 0 | 386 | 135 | 453 | 0 | 573 | 291 |

**Table 2-2 (EXP)**
**Saturation Flow Rates for Example Problem (for Export and Import)**

| Approach | From North | | | From East | | | From South | | | From West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intersectn | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| #13 Monroe | 0 | 2410 | 0 | 0 | 2771 | 1433 | 0 | 2337 | 1433 | 0 | 2525 | 1448 |
| #14 Main | 0 | 5296 | 0 | 0 | 3041 | 2606 | 0 | 0 | 0 | 1448 | 2634 | 0 |
| #15 Water | 0 | 0 | 0 | 1359 | 3387 | 0 | 1345 | 4402 | 0 | 0 | 2486 | 1300 |

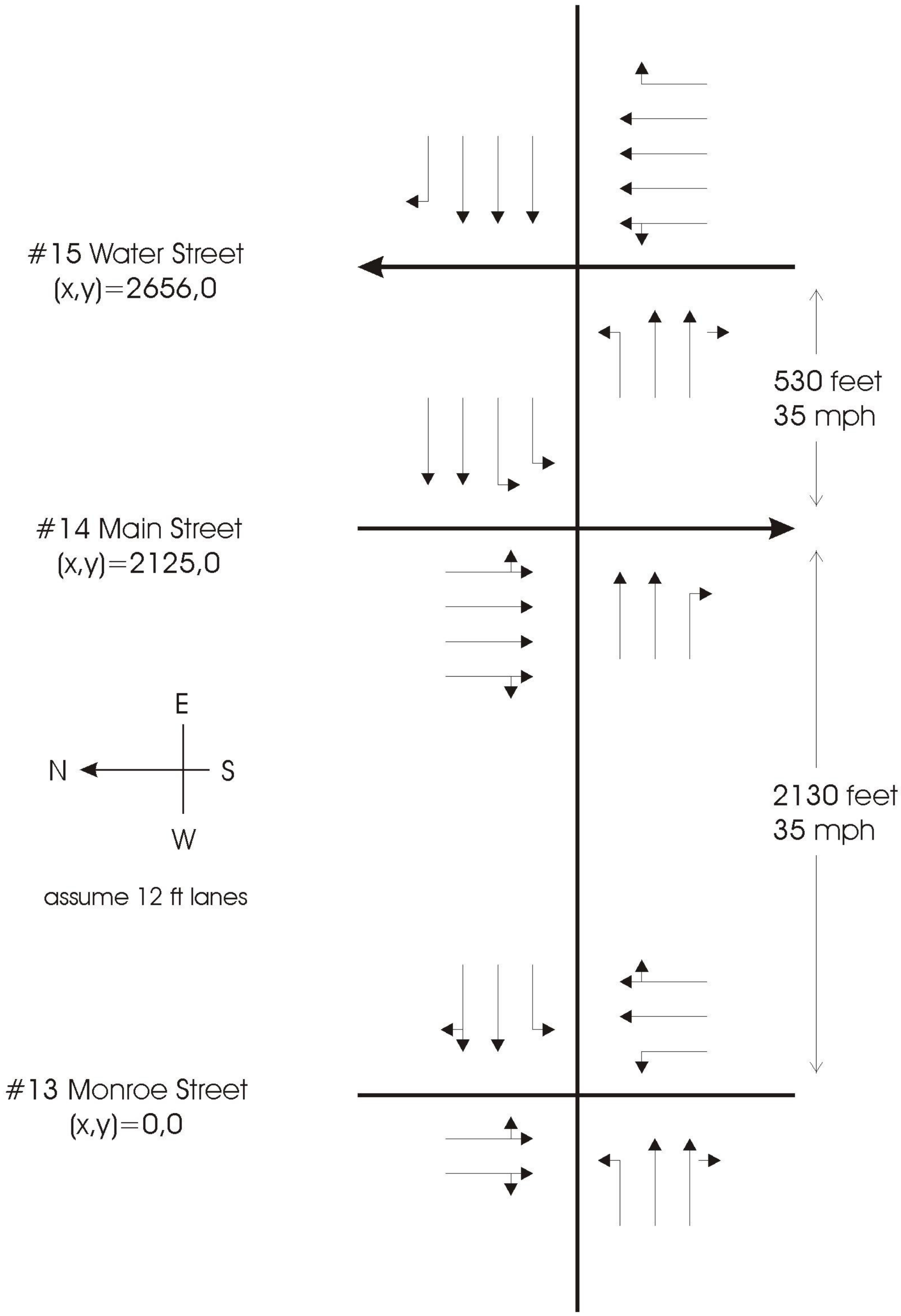



Figure 2-1 (EXP)
Intersection Geometrics for Example Problem (for Export and Import)

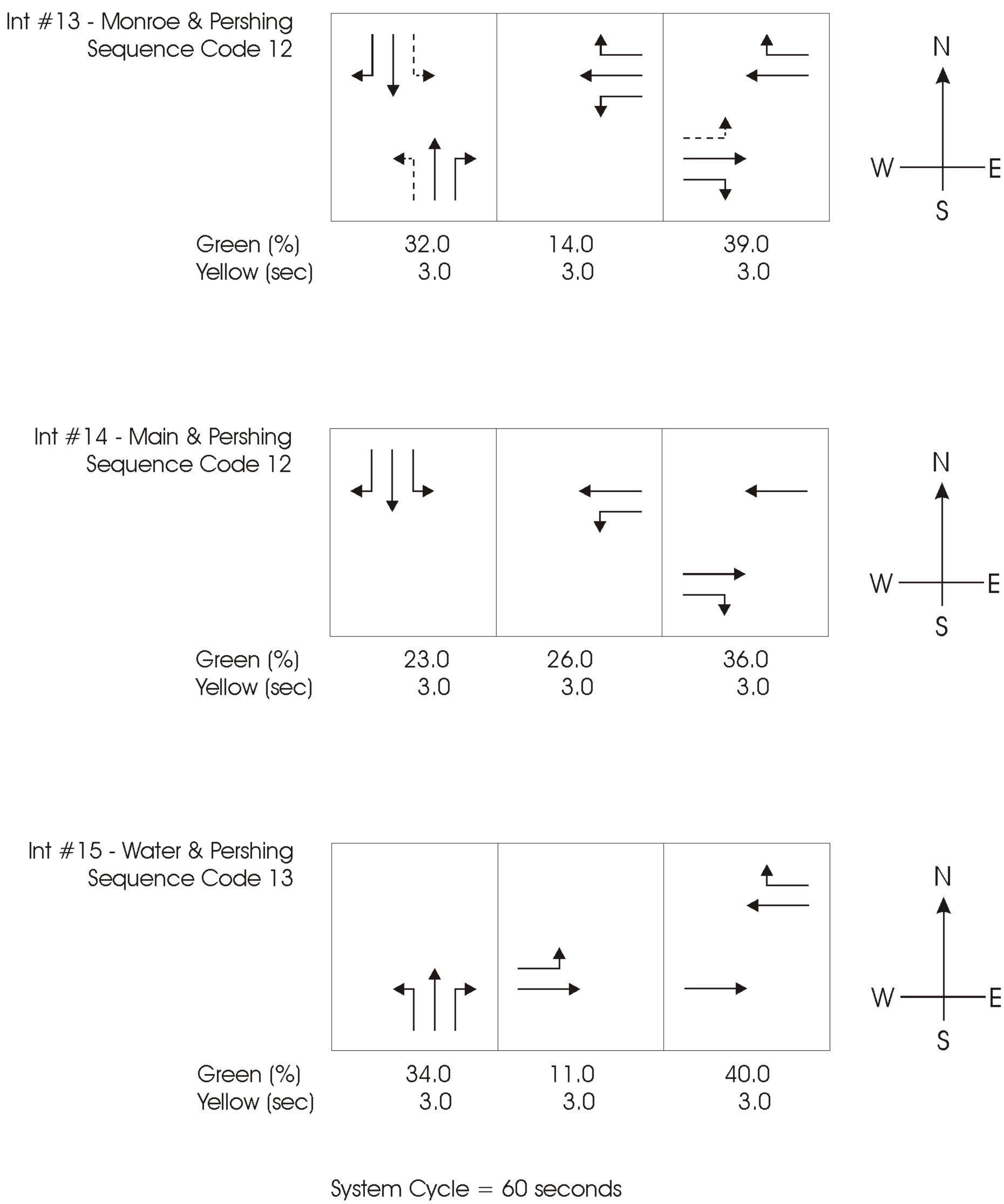



**Figure 2-2 (EXP)**
**Signal Phasings and Timings for Example Problem (for Export and Import)**

## Data Entry (for Export and Import)

If you are not currently running the TEAPAC program, do so according to the way it was installed on your computer (see Appendix G). The program will display the main window along with important licensing information. As described in Chapter 1, two input modes can be used to manipulate the program. In the examples below, the Edit menu line to select in the Visual Mode is shown in square brackets, "[XXX]", and the command line to move to is shown following the arrow, "→". To enter the desired parameter values, move the cursor to the appropriate display area and type the value in, followed by the TAB key. Use the OK button when done entering data to return to the Main Menu. To display more entries on a single dialog box, first select the Tabular View in the View menu before entering data using the Edit menu.

To use the Manual Mode for this tutorial, select the Manual Mode from the Options menu, or simply press F4. Once the program is ready to accept input, it will display the command prompt arrow. To enter the desired parameter values, enter the command keyword and parameter values, each separated by a space, all followed by the ENTER key or the OK button. If the Visual Mode is desired at any point, simply press the F4 function key.

If you wish, you can use the drag-and-drop graphical network creation method to create your analysis network in the main window before entering detailed data. To do this, follow the instructions in the Data Entry section of Chapter 1, working from left-to-right so that the intersections that are created are numbered in the correct order. Use the “distance from the current node” information in the status bar to get your intersection spacings correct (approximate is adequate for the example). After the network is created, the additional detailed data described below can be entered by right-clicking on the appropriate intersection, including a check of the data already created by the drag-and-drop network creation. The intersections can also be re-numbered to the numbers used here with a right-click option.

The first step in using the TEAPAC program is to enter the data required to describe the problem to be solved. This is accomplished using commands designated as [Parameters] commands, such as VOLUMES and WIDTHS. The Commands option of the Help menu can be used to display help for all commands.

The Help-Commands menu displays all commands, along with information on how to use each. Note the number of parameters for each command and their associated default values. For example, the VOLUMES command requires volumes for the twelve (12*) possible movements at the intersection.

Since a lot of commands exist, getting HELP for a smaller group might be appropriate. The [Basic] group consists of only those commands which are essential to solving basic problems with TEAPAC. The [ExportImport] group consists of those commands which are related to performing export and import analyses. These commands can be viewed by issuing the following commands from the Manual Mode.

**→ HELP [Basic]**

→ **HELP [ExportImport]**

If help for only one command is needed, the HELP command will display the same detailed HLP file information for that command which is produced by the Help buttons in Visual Mode dialogs. For example, use the following Manual Mode entry to obtain complete help for the NODELIST entry to be made in the next paragraph.

→ **HELP NODELIST**

Now let's enter the information needed to describe the problem. The first entry should be the list of valid node numbers for the system (NODELIST).

[Basic] → **NODELIST 13 14 15**

This information sets up the system data, while the entries below describe the conditions at each individual intersection. Note that the INTERSECTION command identifies which intersection the data that follows applies to. In the Tabular View, INTERSECTION is an active command which needs to be executed with the Execute button in order to change the screen's values to the new intersection. Also, when entering the movement parameters in the Manual Mode, TEAPAC expects the data to be entered starting with the North approach right-turns and proceeding clockwise around the intersection, as shown below. See Chapter 1 - Conventions for more detail. The Visual Mode entry order is the same, as shown in the dialog box. Enter the following information for intersection 13.

[Basic] → **INTERSECTION 13 MONROE**

[Basic] → **NODELOCATION 0 0**

As an efficiency aid, one can move to the next dialog box in sequence as shown in the Edit menu with the Next button instead of using the menu each time. Thus, instead of pressing the OK button after the INTERSECTION entry above and using the Edit menu to select NETWORK, simply press the Next button.

[Basic] → **NETWORK EAST 2130 35 14** ...

[Basic] → **VOLUMES 122 216 80 79 722 187 212 310 198 139 660 134**

[Basic] → **WIDTHS 0 24 0 0 24 12 0 24 12 0 24 12**

[Basic] → **SEQUENCE 12**

[Basic] → **CYCLES 60 60** ...

[Basic] → **GREENTIMES 0.32 0.00 0.58 0.14 0.32 0.00 0.39 0.00**

[Basic] → **YELLOWTIMES 3.0 0.0 3.0 3.0 3.0 0.0 3.0 0.0**

[Basic] → **OFFSET 0 2** ...

[Movement] → **SATFLOWS 0 2410 0 0 2771 1433 0 2337 1433 0 2525 1448**

[Movement] → **NEMAPHASES 0 4 7 0 6 1 0 8 3 0 2 5**

[Movement] → **REQCHANGE+CLEARS 0 3 3 0 3 3 0 3 3 0 3 3**

The NODELOCATION command is used to provide the X,Y coordinates of the intersection. The NETWORK command is used to connect each intersection to adjacent intersections by indicating which intersection node number is upstream of each approach. It also indicates the distance between these two nodes and the average speed at which vehicles travel this distance. In the case of the WIDTHS entries, note that if right- or left-turning movements do not have exclusive turn lanes, the WIDTH entry is zero. Also note that the width given is for all lanes in each lane group. The phasing for each intersection is given by the SEQUENCE code according to the codes listed in Figure 1-2. The timings for each phase are entered with the CYCLES, GREENTIMES and YELLOWTIMES commands for the controller phases, in order clockwise around the intersection, starting with the north phases. Since no offsets are provided, we'll enter an arbitrary value of 0 (zero) for the OFFSET to the first main street phase (phase 2).

The SATURATIONFLOWS values are given for each non-zero lane group WIDTH, and these entries must be made from the [Movement] menu since SATURATIONFLOWS is not part of the [Basic] group/menu. In order to display NEMA phase numbers in the signal phasing that is either analyzed or optimized, the NEMAPHASES entry can be made using a typical scheme found on many signal controllers. This entry defines what controller phase numbers will be assigned for any protected phases which are provided, and is also made from the [Movement] menu.

In order to maintain internal consistency with our entered timing data, it is necessary to also set the REQCHANGE+CLEARS entries so they are consistent with the amount of change and clearance time provided (YELLOWTIMES + REDCLEARANCES).

Now use the INTERSECTION command to change to the next intersection and enter the following information for intersection 14.

[Basic] → **INTERSECTION 14 MAIN**

[Basic] → **NODELOCATION 2125 0**

[Basic] → **NETWORK EAST 530 35 15** ...

[Basic] → **NETWORK WEST 2130 35 13** ...

[Basic] → **VOLUMES  150 813 244  0 1296 589  0 0 0  386 620 0**

[Basic] → **WIDTHS  0 48 0  0 24 24  0 0 0  12 24 0**

[Basic] → **SEQUENCE  12**

[Basic] → **CYCLES  60 60** ...

[Basic] → **GREENTIMES  0.23  0.23  0.67  0.26  0.00  0.00  0.36  0.00**

[Basic] → **YELLOWTIMES  3.0  3.0  3.0  3.0  0.0  0.0  3.0  0.0**

[Basic] → **OFFSET  0  2** ...

[Movement] → **SATFLOWS  0 5296 0  0 3041 2606  0 0 0  1448 2634 0**

[Movement] → **NEMAPHASES  0 4 7  0 6 1  0 8 3  0 2 5**

[Movement] → **REQCHANGE+CLEARS  0 3 3  0 3 3  0 3 3  0 3 3**

Finally, select intersection 15 and enter its information, as follows.

[Basic] → **INTERSECTION  15  WATER**

[Basic] → **NODELOCATION  2656 0**

[Basic] → **NETWORK  WEST  530 35  14** ...

[Basic] → **VOLUMES  0 0 0  366 780 0  386 135 453  0 573 291**

[Basic] → **WIDTHS  0 0 0  12 36 0  12 48 0  0 24 12**

[Basic] → **SEQUENCE  13**

[Basic] → **CYCLES  60 60** ...

[Basic] → **GREENTIMES  0.00  0.00  0.40  0.00  0.34  0.34  0.56  0.11**

[Basic] → **YELLOWTIMES  0.0  0.0  3.0  0.0  3.0  3.0  3.0  3.0**

[Basic] → **OFFSET  0  2** ...

[Movement] → **SATFLOWS  0 0 0  1359 3387 0  1345 4402 0  0 2486 1300**

[Movement] → **NEMAPHASES 0 4 7 0 6 1 0 8 3 0 2 5**

[Movement] → **REQCHANGE+CLEARS 0 3 3 0 3 3 0 3 3 0 3 3**

The Tabular View is a particularly efficient data entry mode when lots of data is to be entered, buts lacks some of the dialog box cues that the Normal View provides. Use the View menu (or the F3 key) and the Edit menu to explore this view and see the data values you have entered. If you have entered a value improperly, simply re-enter the proper value. The next section shows how you can verify all entries, particularly if you are using the Manual Mode.

## Data Review (for Export and Import)

Once data has been entered, it should be checked for accuracy and completeness. In the Visual Mode, this process is simply a matter of reviewing the data entered in each dialog, since this reflects the actual current values. In the Manual Mode, DATA and SUMMARIZE are used for this data review. Either of these commands may be used to display the current parameter values for the TEAPAC entries. SUMMARIZE provides a formatted summary report for all of the command parameter values, while DATA displays only the parameter values for the list of commands requested. To illustrate this operation, in either the Visual or Manual Modes, enter the following. Note that again, since this is an active command, the Visual Mode requires that the Execute button be used to execute the command. The View-Summary menu can also be used.

[DataFiles] → **SUMMARIZE**

The current values of all input commands are listed with the values just entered, as well as any default values which were not entered. Note that the movement parameters, such as VOLUMES and WIDTHS, have approach and movement labels and a report title is displayed. The DATA command only displays the information, without any special formatting.

[DataFiles] → **DATA INTERSECTION VOLUMES WIDTHS**

The program displays the current parameter values for only the INTERSECTION, VOLUMES and WIDTHS commands of the current intersection. Note that no other command's values are listed, nor are there any headings. Since DATA accepts other commands as parameter values, DATA can be requested for only one, several or all commands, where SUMMARIZE always gives all values. This makes DATA quicker to use, but less clear for others to review other than on the computer display.

Note also that the VOLUMES and WIDTHS listed are only for the "current" intersection, as defined by the current value of the INTERSECTION command. To review information for any given intersection, precede the data command with the proper INTERSECTION command, or click on the desired intersection in the network view, as below.

[Basic] → **INTERSECTION 13** ...

[DataFiles] → **DATA VOLUMES WIDTHS**

[Basic] → **INTERSECTION 15** ...

[DataFiles] → **DATA VOLUMES WIDTHS**

The most efficient way to check input from the Manual Mode is to use the ASK command. This displays the current values of the commands "ASKed for" in a dialog box display which provides on-screen HELP and allows the user to move the cursor among the data fields and even change any values desired (just like the Visual Mode). Try the following from the Manual Mode, both in the Normal and Tabular Views (use F3 to toggle between views):

→ **ASK [ExportImport]**

In the Visual Mode, the "+" and "-" buttons can be used at any time to increment and decrement the intersection number displayed in the dialog, according to the order defined in the NODELIST. The Ctrl-PageUp and Ctrl-PageDown keys (^Page-Up/Down) may also be used as shortcut keys, as long as no changes have been made to input fields in the dialog. If a change is made, first TAB to the next field, then use ^Page-Up/Down. Try this as the quickest way to review and/or edit data input for each intersection.

Review the data values listed using any of the methods described above. Note that there is an error in the VOLUMES entered for intersection 15. The right turn on the east approach should be 466, not 366. To correct this, re-enter the VOLUMES entry with the proper value using either of the entry modes, Visual or Manual, first making sure intersection 15 is the current node.

[Basic] → **INTERSECTION 15** ...

[Basic] → **VOLUMES * * * 466** ...

Note that in either mode, only the value to be changed need be entered. In the Visual Mode, the cursor is moved to the field with the 366 value and the 466 is typed right over the 366, followed by TAB or ENTER. In the Manual Mode, the VOLUMES command is typed followed by 3 asterisks used as place holders to skip the first three entries.

It is frequently desirable to print the summary of input values, both as a document to use in the input checking process, as well as a physical record of the input data used in subsequent analyses. Use of the printer is easy with TEAPAC. Simply use the File-Print menu of the output window (or Ctrl-P) to direct the output to the default printer. Various available printers and printer options can be selected using the Setup options in the File menu, and the last produced output can be printed from the File menu of the main window. If your printer is connected, perform the above sequence for the SUMMARIZE command to get a printed summary of input, then recheck all the data input for proper values before proceeding.

## Analysis (for Export and Import)

The third step in program execution is to perform an analysis of the current data. Once satisfied with the accuracy of the input data, use the TIMINGPLAN command in the Results menu to execute an analysis.

[Results] → **TIMINGPLAN** ...

The TIMINGPLAN command produces a report which summarizes the current timings and calculates the offsets to the beginning-of-green and beginning-of-yellow for all phases. These calculations are not provided by the TRANSYT model and can be useful in implementing the timings in the field. A complete phase diagram is also displayed to clarify which phase each timing belongs to.

The PLOTTSD command is another useful command which displays a time-space diagram for the selected nodes in the NODELIST. As an example of this option, type the following.

[Results] → **PLOTTSD 500** ...

The PLOTTSD command generates a time-space diagram for the current timings. The horizontal axis represents time in both percent of cycle and seconds, and the vertical axis is distance in feet. In this case we can see the initial offsets making all of the first main-street phases start simultaneously and producing relatively balanced bands in each direction. Note that the PLOTTSD command has two parameter values, <Scale> and <List of Nodes>. In the above analysis, the time-space diagram was plotted for all nodes in the node list at a scale of 500 feet per line.

The EXPORT command is used to create an input data file for the host TRANSYT model (or any of the supported third-party programs). The OPTIMIZE command instructs EXPORT as to what type of optimization is desired by the third-party program, if any.

[ExportImport] → **OPTIMIZE OFFSETS** ...

[Results] → **EXPORT TRANSYT AUTO YES** ...

Note that the program displays on the screen what is being written into the file. The file is ready to be used with the TRANSYT model or it can be edited using any ASCII editor. It can also be edited directly within TRANSYT using the dialog boxes or the View-RecordTypes menu. If TRANSYT is referenced properly in the Options-Setup menu of TEAPAC, the AUTO option selected above will launch TRANSYT automatically with the created file open and running.

## Evaluation (for Export and Import)

One powerful aspect of TEAPAC is the capability to quickly analyze various scenarios or conditions in an interactive environment. For example, to manually input the offsets generated by a run of the TRANSYT model, simply use the following command entries.

[Basic] → **INTERSECTION 13** ...

[ExportImport] → **OFFSET 45.0 2**

[Basic] → **INTERSECTION 14** ...

[ExportImport] → **OFFSET 54.0 2**

[Basic] → **INTERSECTION 15** ...

[ExportImport] → **OFFSET 1.0 2**

TRANSYT-7F optimized results are always output to a disk file, so IMPORT can read this file to import the optimized timings directly into TEAPAC without the need for the manual inputs illustrated above. For example, to import the optimum timings from the example EXPORT TRANSYT AUTO run above, type the following:

[Results] → **IMPORT TRANSYT AUTO YES**

Now the optimum timings and time space diagram can be reviewed with the TIMINGPLAN and PLOTTSD commands.

[Results] → **TIMINGPLAN** ...

[Results] → **PLOTTSD 500** ...

Compare the new time-space diagram to the original diagram. Note that in the first diagram the offsets were zero and balanced progression was achieved, while in the second diagram there is a definite wider band of progression in the westbound direction, which is the direction that TRANSYT has discovered has the higher through-traffic flows.

While the example problem is over-simplified, it does demonstrate that TEAPAC's interactive analysis and design techniques allow many conditions to be tested quickly and efficiently. In addition, printed reports can be produced to document the analysis, and analysis conditions can be saved at any time, as illustrated below.

At this point of the analysis, we may feel we have an adequate solution to the problem, and wish to SAVE the data values which created the final results for future use. The typical Save/SaveAs options of the File menu are normally used, but the [DataFiles] commands of the File menu also offer these capabilities by first defining the disk FILE name to be used for storage, then issuing the SAVE command to save the parameter values.

[DataFiles] → **FILES SAMPLE/N** ...

[DataFiles] → **SAVE 1 1** ...

Note that the file name "SAMPLE" has a "/N" switch added to its name the first time it is used to indicate to TEAPAC that you expect to create a new file. This is not required, but saves the steps of responding to the new file creation query. When used, an error will be produced only if this file name already exists. Other such switches and file name conventions are discussed in Appendix G, as they relate to your operating system. Also note that as many as five files can be named at any given time, and that the SAVE command describes which of these five files are to be used. The SAVE command can also tell the program where in the file to save information, allowing different scenarios to be stacked one after the other in the same file. The LOAD command is used to retrieve the information at a later date. All of these options relate to advanced file manipulation capabilities such as batch control file scripts and multiple scenarios, described in detail in Chapter 7.

## Chapter 2 Topics (for Scenario Management):



## Description of Example Problem (for Scenario Management)

The three-signal arterial system shown in Figure 2-1 is to be analyzed for both existing and projected volume conditions. The scenario management function is to be used to create and manage the scenario condition data files. The system has known phase timings for each intersection. The phase diagrams and timings are shown in Figure 2-2. Table 2-1 contains the existing demand volumes to be used for each intersection, while Table 2-2 contains the projected demand volumes. Both tables are organized by approach, the way all input to TEAPAC is performed, as described in Chapter 1. The task is to generate a set of data files to be used by other TEAPAC application functions for conducting the scenario analysis for both sets of volumes.

**Table 2-1 (SCN)**
**Existing Demand Volumes for Example Problem (for Scenario Management)**

| Approach | From North | | | From East | | | From South | | | From West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intersectn | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| #13 Monroe | 122 | 216 | 80 | 79 | 722 | 187 | 212 | 310 | 198 | 139 | 660 | 134 |
| #14 Main | 150 | 813 | 244 | 0 | 1296 | 589 | 0 | 0 | 0 | 386 | 620 | 0 |
| #15 Water | 0 | 0 | 0 | 466 | 780 | 0 | 386 | 135 | 453 | 0 | 573 | 291 |

**Table 2-2 (SCN)**
**Projected Demand Volumes for Example Problem(for Scenario Management)**

| Approach | From North | | | From East | | | From South | | | From West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intersectn | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| #13 Monroe | 132 | 226 | 90 | 89 | 822 | 197 | 222 | 320 | 208 | 149 | 760 | 144 |
| #14 Main | 160 | 823 | 254 | 0 | 1396 | 599 | 0 | 0 | 0 | 396 | 630 | 0 |
| #15 Water | 0 | 0 | 0 | 476 | 880 | 0 | 396 | 145 | 463 | 0 | 673 | 301 |

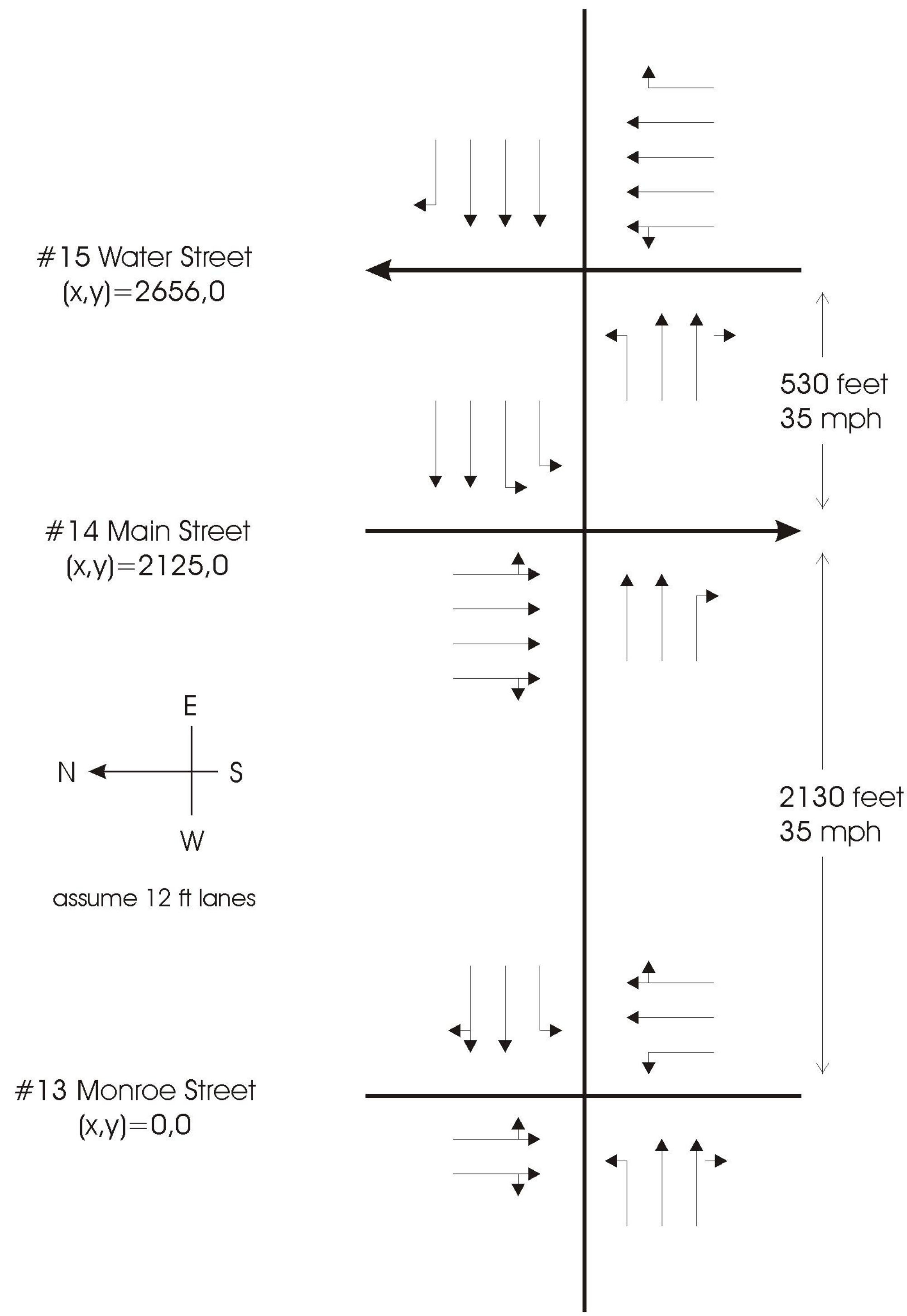



Figure 2-1 (SCN)
Intersection Geometrics for Example Problem (for Scenario Management)

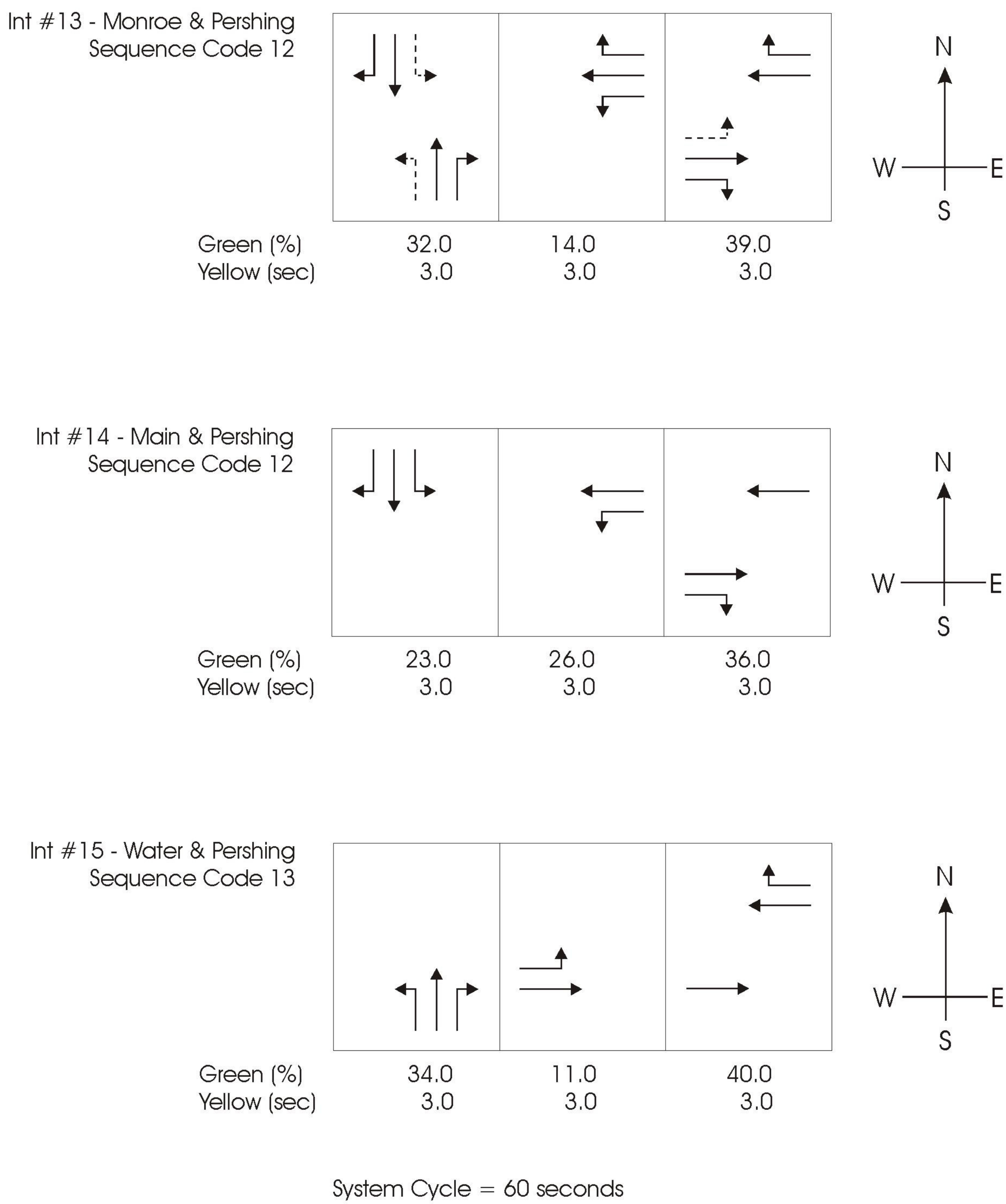



Figure 2-2 (SCN)
Signal Phasings and Timings for Example Problem (for Scenario Management)

## Data Entry (for Scenario Management)

If you are not currently running the TEAPAC program, do so according to the way it was installed on your computer (see Appendix G). The program will display the main window along with important licensing information.

Sub-topics for this section:

Creating the Scenario (for Scenario Management)
Entering the Data (for Scenario Management)

### Creating the Scenario (for Scenario Management)

Before a scenario can be defined, a file name needs to established so this name can be used as the prefix for the auxiliary files which will be created during the scenario creation process. The simplest way to do this is to save the initial default values of the program in a file using the File-Save menu. Short file names are suggested, but not required, by TEAPAC. In this chapter, it will be assumed that the file name SAMPLE is used.

If a demo version of the program is being used which cannot do any save functions, none of the scenario creation actions described here will be retained. To get a better idea of what would result from a real scenario definition activity, open the example data file called Scenario.tpc provided with the program and stored in the folder where the TEAPAC example files were installed (this is C:\TEAPAC Data\Example Files, by default). This will display a dialog populated with data similar to the Chapter 2 example, and various Cases can be selected using the Get Scenario Case option of the File menu.

The basic dialog for creating and modifying scenario definitions is accessed from the Edit menu of the program using the Create or Edit Scenario menu selection. This initially opens a dialog window with nothing defined, so the button labeled Add an Issue should be pressed. In the scenario management function, an Issue is the term used to describe the data values which are changing between scenario analyses. In our example, the variable of concern is traffic volumes, so the first Issue created here (Issue A) should be labeled “Traffic Volumes”. Then the data entry dialog which is used to enter volumes needs to be attached to this Issue using the Assign button. In the Assignment dialog which opens, make sure Issue A Traffic Volumes is selected, then locate and click the VOLUMES entry in the list of available data on the left side of the dialog and press the Add to Issue button. The advisory message which pops up addresses converting prior data files to the scenario management format, or when subsequently changing scenario definitions at a later time, so it has no bearing here - just press OK. You now see VOLUMES moved to the right list indicating that it has been assigned to Issue A. Click OK to close the Assignment dialog and go back to the main scenario dialog.

Now we need to define the various Conditions which will be analyzed for Issue A. For this problem, there are two Conditions - Existing Volumes and Projected Volumes. These can be created and labeled one after the other by pressing the Add a Condition button twice and entering the descriptions of each. With this simple definition process the entire scenario analysis has been set up and should be saved with the File-Save menu after the dialog is closed.

## Entering the Data (for Scenario Management)

Now we can start entering the data for the problem, but first need to select which condition we will start working with. Use the File-GetScenarioCase menu to select Existing Volumes as the desired condition for Issue A. In combination with the data in the main SAMPLE data file, the A01 condition data creates what is called a Case, so as outlined here, the current case is now A01 - Existing Volumes when the OK button is pressed, and any data we enter will be saved either in the SAMPLE file or the SAMPLE_A01 file, as directed by the current scenario definition.

As described in Chapter 1, two input modes can be used to manipulate the program. In the examples below, the Edit menu line to select in the Visual Mode is shown in square brackets, "[XXX]", and the command line to move to is shown following the arrow, "→". To enter the desired parameter values, move the cursor to the appropriate display area and type the value in, followed by the TAB key. Use the OK button when done entering data to return to the Main Menu. To display more entries on a single dialog box, first select the Tabular View in the View menu before entering data using the Edit menu.

To use the Manual Mode for this tutorial, select the Manual Mode from the Options menu, or simply press F4. Once the program is ready to accept input, it will display the command prompt arrow. To enter the desired parameter values, enter the command keyword and parameter values, each separated by a space, all followed by the ENTER key. If the Visual Mode is desired at any point, simply press the F4 function key.

If you wish, you can use the drag-and-drop graphical network creation method to create your analysis network in the main window before entering detailed data. To do this, follow the instructions in the Data Entry section of Chapter 1, working from left-to-right so that the intersections that are created are numbered in the correct order. Use the “distance from the current node” information in the status bar to get your intersection spacings correct (approximate is adequate for the example). After the network is created, the additional detailed data described below can be entered by right-clicking on the appropriate intersection, including a check of the data already created by the drag-and-drop network creation. The intersections can also be re-numbered to the numbers used here with a right-click option.

The first step in using the TEAPAC program is to enter the data required to describe the problem to be solved. This is accomplished using commands designated as [Parameters] commands, such as VOLUMES and WIDTHS. The Commands option of the Help menu can be used to display help for all commands.

The Help-Commands menu displays all commands, along with information on how to use each. Note the number of parameters for each command and their associated default values. For example, the VOLUMES command requires volumes for the twelve (12*) possible movements at the intersection.

Since a lot of commands exist, getting HELP for a smaller group might be appropriate. The [Basic] group consists of only those commands which are essential to solving basic problems with the scenario management function. These commands can be viewed by issuing the following command from the Manual Mode.

→ **HELP [Basic]**

If help for only one command is needed, the HELP command will display the same detailed HLP file information for that command which is produced by the Help buttons in Visual Mode dialogs. For example, use the following Manual Mode entry to obtain complete help for the NODELIST entry to be made in the next paragraph.

→ **HELP NODELIST**

Now let's enter the information needed to describe the problem. The first entry should be the list of valid node numbers for the system (NODELIST).

[Basic] → **NODELIST 13 14 15**

This information sets up the system data, while the entries below describe the conditions at each individual intersection. Note that the INTERSECTION command identifies which intersection the data that follows applies to. In the Tabular View, INTERSECTION is an active command which needs to be executed with the Execute button in order to change the screen's values to the new intersection. Also, when entering the movement parameters in the Manual Mode, TEAPAC expects the data to be entered starting with the North approach right-turns and proceeding clockwise around the intersection, as shown below. See Chapter 1 - Conventions for more detail. The Visual Mode entry order is the same, as shown in the dialog box. Enter the following information for intersection 13.

[Basic] → **INTERSECTION 13 MONROE**

[Basic] → **NODELOCATION 0 0**

As an efficiency aid, one can move to the next dialog box in sequence as shown in the Edit menu with the Next button instead of using the menu each time. Thus, instead of pressing the OK button after the INTERSECTION entry above and using the Edit menu to select NETWORK, simply press the Next button.

[Basic] → **NETWORK EAST 2130 35 14** ...

[Basic] → **VOLUMES 122 216 80 79 722 187 212 310 198 139 660 134**

[Basic] → **WIDTHS 0 24 0 0 24 12 0 24 12 0 24 12**

[Basic] → **SEQUENCE 12**

[Basic] → **CYCLES 60 60** ...

[Basic] → **GREENTIMES 0.32 0.00 0.58 0.14 0.32 0.00 0.39 0.00**

[Basic] → **YELLOWTIMES 3.0 0.0 3.0 3.0 3.0 0.0 3.0 0.0**

The NODELOCATION command is used to provide the X,Y coordinates of the intersection. The NETWORK command is used to connect each intersection to adjacent intersections by indicating which intersection node number is upstream of each approach. It also indicates the distance between these two nodes and the average speed at which vehicles travel this distance. In the case of the WIDTHS entries, note that if right- or left-turning movements do not have exclusive turn lanes, the WIDTH entry is zero. Also note that the width given is for all lanes in each lane group. The phasing for each intersection is given by the SEQUENCE code according to the codes listed in Figure 1-2. The timings for each phase are entered with the CYCLES, GREENTIMES and YELLOWTIMES commands for the controller phases, in order clockwise around the intersection, starting with the north phases.

Now use the INTERSECTION command to change to the next intersection and enter the following information for intersection 14.

[Basic] → **INTERSECTION 14 MAIN**

[Basic] → **NODELOCATION 2125 0**

[Basic] → **NETWORK EAST 530 35 15** ...

[Basic] → **NETWORK WEST 2130 35 13** ...

[Basic] → **VOLUMES 150 813 244 0 1296 589 0 0 0 386 620 0**

[Basic] → **WIDTHS 0 48 0 0 24 24 0 0 0 12 24 0**

[Basic] → **SEQUENCE 12**

[Basic] → **CYCLES 60 60** ...

[Basic] → **GREENTIMES 0.23 0.23 0.67 0.26 0.00 0.00 0.36 0.00**

[Basic] → **YELLOWTIMES 3.0 3.0 3.0 3.0 0.0 0.0 3.0 0.0**

Finally, select intersection 15 and enter its information, as follows.

[Basic] → **INTERSECTION 15 WATER**

[Basic] → **NODELOCATION 2656 0**

[Basic] → **NETWORK WEST 530 35 14** ...

[Basic] → **VOLUMES 0 0 0 366 780 0 386 135 453 0 573 291**

[Basic] → **WIDTHS 0 0 0 12 36 0 12 48 0 0 24 12**

[Basic] → **SEQUENCE 13**

[Basic] → **CYCLES 60 60** ...

[Basic] → **GREENTIMES 0.00 0.00 0.40 0.00 0.34 0.34 0.56 0.11**

[Basic] → **YELLOWTIMES 0.0 0.0 3.0 0.0 3.0 3.0 3.0 3.0**

The Tabular View is a particularly efficient data entry mode when lots of data is to be entered, buts lacks some of the dialog box cues that the Normal View provides. Use the View menu (or the F3 key) and the Edit menu to explore this view and see the data values you have entered. If you have entered a value improperly, simply re-enter the proper value. The next section shows how you can verify all entries, particularly if you are using the Manual Mode.

## Data Review (for Scenario Management)

Once data has been entered, it should be checked for accuracy and completeness. In the Visual Mode, this process is simply a matter of reviewing the data entered in each dialog, since this reflects the actual current values. In the Manual Mode, DATA and SUMMARIZE are used for this data review. Either of these commands may be used to display the current parameter values for the scenario entries. SUMMARIZE provides a formatted summary report for all of the command parameter values, while DATA displays only the parameter values for the list of commands requested. To illustrate this operation, in either the Visual or Manual Modes, enter the following. Note that again, since this is an active command, the Visual Mode requires that the Execute button be used to execute the command. The View-Summary menu can also be used.

[DataFiles] → **SUMMARIZE**

The current values of all input commands are listed with the values just entered, as well as any default values which were not entered. Note that the movement parameters, such as VOLUMES and WIDTHS, have approach and movement labels and a report title is displayed. The DATA command only displays the information, without any special formatting.

[DataFiles] → **DATA INTERSECTION VOLUMES WIDTHS**

The program displays the current parameter values for only the INTERSECTION, VOLUMES and WIDTHS commands of the current intersection. Note that no other command's values are listed, nor are there any headings. Since DATA accepts other commands as parameter values, DATA can be requested for only one, several or all commands, where SUMMARIZE always gives all values. This makes DATA quicker to use, but less clear for others to review other than on the computer display.

Note also that the VOLUMES and WIDTHS listed are only for the "current" intersection, as defined by the current value of the INTERSECTION command. To review information for any given intersection, precede the data command with the proper INTERSECTION command, as below.

[Basic] → **INTERSECTION 13** ...

[DataFiles] → **DATA VOLUMES WIDTHS**

[Basic] → **INTERSECTION 15** ...

[DataFiles] → **DATA VOLUMES WIDTHS**

The most efficient way to check input from the Manual Mode is to use the ASK command. This displays the current values of the commands "ASKed for" in a dialog box display which provides on-screen HELP and allows the user to move the cursor among the data fields and even change any values desired (just like the Visual Mode). Try the following from the Manual Mode, both in the Normal and Tabular Views (use F3 to toggle between views):

→ **ASK [Basic]**

In the Visual Mode, the "+" and "-" buttons can be used at any time to increment and decrement the intersection number displayed in the dialog, according to the order defined in the NODELIST. The Ctrl-PageUp and Ctrl-PageDown keys (^Page-Up/Down) may also be used as shortcut keys, as long as no changes have been made to input fields in the dialog. If a change is made, first TAB to the next field, then use ^Page-Up/Down. Try this as the quickest way to review and/or edit data input for each intersection.

Review the data values listed using any of the methods described above. Note that there is an error in the VOLUMES entered for intersection 15. The right turn on the east approach should be 466, not 366. To correct this, re-enter the VOLUMES entry with the proper value using either of the entry modes, Visual or Manual, first making sure intersection 15 is the current node.

[Basic] → **INTERSECTION 15** ...

[Basic] → **VOLUMES * * * 466** ...

Note that in either mode, only the value to be changed need be entered. In the Visual Mode, the cursor is moved to the field with the 366 value and the 466 is typed right over the 366, followed by TAB or ENTER. In the Manual Mode, the VOLUMES command is typed followed by 3 asterisks used as place holders to skip the first three entries.

It is frequently desirable to print the summary of input values, both as a document to use in the input checking process, as well as a physical record of the input data used in subsequent analyses. Use of the printer is easy with TEAPAC. Simply use the File-Print menu of the output window (or Ctrl-P) to direct the output to the default printer. Various available printers and printer options can be selected using the Setup options in the File menu, and the last produced output can be printed from the File menu of the main window. If your printer is connected, perform the above sequence for the SUMMARIZE command to get a printed summary of input, then recheck all the data input for proper values before proceeding.

Now when all of this data is saved using the File-Save menu, everything except the VOLUMES will be saved in the main (base data) file called SAMPLE, but the VOLUMES will be saved in the Condition file SAMPLE_A01 since A01 (Existing Volumes) is the currently-selected case. Then we can select case A02 using the File-GetScenarioCase menu and enter our projected volumes. When we use File-Save these volumes will be automatically saved in a file named SAMPLE_A02 (because that is the current Case), while the rest of the conditions (which do not belong to Issue A) will be saved in the base SAMPLE file. After selecting Case A02, do this as directed below:

[Basic] → **INTERSECTION 13...**

[Basic] → **VOLUMES 132 226 90 89 822 197 222 320 208 149 760 144**

[Basic] → **INTERSECTION 14...**

[Basic] → **VOLUMES 160 823 254 0 1396 599 0 0 0 396 630 0**

[Basic] → **INTERSECTION 15...**

[Basic] → **VOLUMES 0 0 0 476 880 0 396 145 463 0 673 301**

Now the data entry is complete for both scenario conditions and the analyst can proceed to the next section to conduct the actual analysis.

## Analysis (for Scenario Management)

The third step in program execution is to perform an analysis of the current data. Once satisfied with the accuracy of the input data, the data is ready for direct analysis with one of the TEAPAC applications. While performing the analyses, the File-GetScenarioCase menu can be used to move about among the various defined scenarios, including saving into these files any time a data value changes which needs to be saved. The user should simply return to the Edit-Scenario menu if changes are desired in the scenario definition, such as adding new Conditions, adding (or removing) data tags from an Issue, or adding new Issues which are mutually exclusive from the Issues already defined. More is discussed on these subjects in Chapter 5.

You can also simulate the effect of making various Case selections by just using the summary of data values produced by the View-Summary menu or the SUMMARIZE command.

[DataFiles] → **SUMMARIZE** ...

The SUMMARIZE command produces a report which summarizes all of the current data values which have been read into the program from the data files, and will illustrate that the proper volumes are loaded when either of the Conditions are selected. Note also that when a Case is selected, the NOTE line of the analysis titles (displays as line 3 at the bottom of the main window) is automatically set to a value which describes which Case is presently loaded. This NOTE will be displayed in all subsequent output which is either printed or displayed on screen.

## Exiting the Program

Additional experiments may be conducted at this point. When finished, the Exit option of the File menu can be used. In the Manual Mode, the STOP (or QUIT) command can also be used.

[Control] → **STOP** ...

Control of the computer is returned to the operating system. This step is not necessary if you will continue with the examples of Chapter 3.

## Additional Concerns

The procedures and commands presented in this chapter are representative of the many functions which can be performed using the program. A number of important aspects were not presented in the interest of simplifying the example problems. Specifically, default values were used for many of the possible parameter values of the program. These parameter default values may not be appropriate for the conditions to be studied and thus may require modification.

For example, one default parameter not addressed in detail by the example for signal analysis in TEAPAC was the CYCLES command. This command controls the range of cycle lengths tested in the DESIGN function. The CYCLES command default values are such that only cycle lengths of 60, 90 and 120 seconds are tested. Multiple iterations, varying the range of cycles and the increment, are typically required to determine the optimal cycle length for an intersection.

One powerful aspect of the TEAPAC program not demonstrated by the initial problem for traffic impact analysis, is the ability to cumulate the results of several different COMPUTEPATHS calculations. The COMPUTEPATHS command allows this feature using the CUMULATE keyword. Final computations can also be rounded in the output to any degree of precision, such as the nearest 5 or 10 vehicles, using the ROUND command.

One powerful aspect of the program not demonstrated by the initial problem for count analysis is the ability to tabulate and analyze several different time periods (up to five in a given day) in a single run of the program. Both the PEAKANALYZE and COUNTREPORTS commands allow for the generation of A.M., Midday and P.M. peaks from a single set of VEHICLECOUNTS data. Another is the ability to import data directly from electronic counter devices such as the Jamar and TimeMark traffic counters, and the ability to reconfigure count data with the COUNTRECONFIG command when data has inadvertently been entered for the wrong movement.

These procedures, as well as other important elements of the complete use of the program, are discussed in detail in Chapter 3, Chapter 4 and Chapter 5, and should be addressed as soon as you are comfortable with the basic elements discussed in these initial examples. Chapter 6 describes the underlying details of many of the generic actions which were demonstrated in this chapter, while Chapter 7 offers many ways to further expedite analyses with advanced file management and automation control files for scripting procedures in advance.

CHAPTER 3

# Analysis Procedures

Chapter 3 Topics

Having stepped through the example problems in Chapter 2, it is now possible to discuss in greater detail the actual procedures and entries used to perform analyses using the program. This chapter discusses the minimum input requirements to conduct a reasonable analysis, as well as practical limitations of the program. Then appropriate analysis procedures are explained. Each of these discussions is made for each of the major application functions of the program. This chapter is designed to fully explain the operational procedures of the program and provide additional understanding of the examples shown in Chapter 2.

## Chapter 3 Topics:

Chapter 3 Introduction
Analysis Procedures (for Signal Analysis)
Analysis Procedures (for Traffic Impact Analysis)
Analysis Procedures (for Count Analysis)
Analysis Procedures (for Progression Analysis)
Analysis Procedures (for Export and Import)

## Chapter 3 Topics (for Signal Analysis):

Chapter 3 Topics
Input Requirements (for Signal Analysis)
Analysis Procedures (for Signal Analysis)

## Input Requirements (for Signal Analysis)

This section discusses the basic input requirements for a signal analysis. It begins with a discussion of the minimum input requirements to produce various reports, and then discusses the limitations to data input which exist. This section is quite important in that it sets the minimum information for valid results, as well as the limitations of the program.

Sub-topics for this section:

Minimum Input Requirements (for Signal Analysis)

Input Limitations (for Signal Analysis)

## Minimum Input Requirements (for Signal Analysis)

Many of the input parameter values have defaults which eliminate the need to enter data for every parameter. After the program is started or the File-New menu or RESET [Parameters] command is issued, these default values can be viewed in any of the input dialogs of the Visual Mode or with the DATA or ASK commands in the Manual Mode. The default values of each command are also listed in the right-hand section of the HELP displays which are generated by the Help-Commands menu or the HELP command in the Manual Mode.

On the other hand, there are several commands for which it is necessary to input data in order to produce legitimate results. The most obvious of these are the VOLUMES and WIDTHS commands to describe the demand volumes and lane geometries. Values for these commands are needed to do most any signal analysis function of the program. As such, examples of these inputs were illustrated in the initial example of Chapter 2. For a planning level analysis, this may be adequate to describe the situation which is to be analyzed. For a more detailed operations analysis, the other commands which describe intersection conditions should be used, although each has a preset default value which is frequently usable in an analysis. Each of the input parameters for these commands should be reviewed to check the appropriateness of the default values.

The signal analysis function of TEAPAC has three basic modes of operation, one for a capacity analysis of an urban street facility, one where a capacity analysis of a complete set of given conditions for an individual signal is desired, and the third where an optimum operation of the signalized intersection is desired. These are commonly referred to as the URBANSTREET, ANALYZE and DESIGN modes, following the names of the basic commands which are used in these modes. The input requirements for these three modes are noticeably different, and thus are discussed below in separate sections.

In the ANALYZE and DESIGN modes, if an intersection has been selected with the INTERSECTION entry as we did previously, the actions requested will be performed for that intersection only. If all intersections have been selected by selecting INTERSECTION 0, then the actions requested will be performed for all intersections in the NODELIST, one by one in the order listed in the NODELIST. If a SUBSYSTEM entry has been made, then when INTERSECTION 0 is selected the actions will be performed only for the SUBSYSTEM intersections and in the order these intersections are found in the NODELIST.

In the URBANSTREET mode, all intersections will be analyzed as a single street facility, subject to the maximum number of signals allowed, unless a SUBSYSTEM has been defined, in which case only those signals in the SUBSYSTEM will define the street to be analyzed.

**URBANSTREET Inputs.** The URBANSTREET mode means that a complete set of conditions is given in order for the program to produce a capacity analysis of a coordinated signal system consisting of a linear group of signals. The minimum input requirements are essentially the same as the ANALYZE mode described in the next section for each signal, combined with the EXPORT mode inputs described in Analysis Procedures (for Export and Import) for the link/segment conditions.

**ANALYZE Inputs.** The ANALYZE mode means that a complete set of conditions is given in order for the program to produce a capacity analysis. This means that in addition to the basic intersection conditions mentioned above, including the VOLUMES and WIDTHS, the signal phasing and timings must be specified. This requires that the SEQUENCES command be used to specify the phasing according to the sequence code method discussed in Chapter 1, and that GREENTIMES and YELLOWTIMES be given for each phase. If either the GREENTIMES and YELLOWTIMES are given in proportions of the cycle time (all entries with numbers less than 1.00), then the cycle length must be explicitly stated on the CYCLES command (as the first parameter). When timings are all given in seconds, no cycle time entry is required since the cycle time will be computed as the sum of all phase's GREENTIMES, YELLOWTIMES and REDCLEARTIMES.

The EVALUATE command can be used in the same fashion as the ANALYZE command described above, and requires exactly the same inputs as ANALYZE. The only difference is in the type of results which are computed. The HCSEXPORT command also has the same input requirements as ANALYZE, with the exception that if certain information is missing, it will simply be omitted from the HCS file that is created, and this information can be entered later in HCS, if needed. VOLUMES and WIDTHS are still required in order that TEAPAC can create a meaningful data file for HCS.

Three other commands can be used in the same fashion as ANALYZE, when phasings and timings are known. These are the QUEUECALCS, SERVICEVOLUMES and GOVERCS commands. QUEUECALCS computes queue lengths using a variety of published methods for the specified phasing and timing. SERVICEVOLUMES computes the saturation flow rates (in vehicles per hour of green, e.g., for 100% green time) for every defined lane group, assuming the specified phasing and timing. GOVERCS computes the greentime required by each lane group to satisfy each specified LEVELOFSERVICE. This calculation is done internally for each DESIGN command, and can be used to perform manual designs for complicated situations TEAPAC cannot handle directly.

**DESIGN Inputs.** The DESIGN mode means that any of the phasing, cycle length and phase timing parameters may be unknowns, and that TEAPAC is to optimize these parameter values within the stated constraints of the inputs. When the DESIGN command is used, any input GREENTIMES, YELLOWTIMES and REDCLEARTIMES are completely ignored and the optimum greens, yellows and all-reds are determined by TEAPAC. These optimum timings are constrained by the MINIMUMS, PEDWALKS, PEDFDWS, REQCHANGE+CLEARS and REQYELLOWS command values which place these timing requirement constraints on the determination of the optimum timings.

If the cycle length is a known value, the CYCLES command should show this as both the minimum and maximum cycle length to be DESIGNed, in which case the DESIGN command will determine the best possible timings for that cycle length. If a range of cycle lengths is acceptable, this range should be denoted on the CYCLES command prior to the DESIGN, using an appropriate cycle increment, in which case DESIGN will attempt optimizations for all of the cycles allowed.

If the phasing is a known sequence, the SEQUENCES command should show this as the only sequence to be DESIGNed, in which case the DESIGN command will determine the best possible timings for that sequence of operation, as well as the allowed range of cycles. If a number of sequences are allowed, as in the case of an actuated controller or the design of a new controller, the allowed sequences should be listed in the SEQUENCES command, and DESIGN will optimize all of the sequences for the allowed range of cycles. If the single keyword ALL is used on the SEQUENCES command, DESIGN will optimize every possible sequence code for the allowed range of cycles. Additional shortcuts are allowed with SEQUENCES to specify typical lists of phasings which should be allowed; see the Appendix B listing for SEQUENCES for details.

Thus, the DESIGN command can be used to optimize timings for a known phasing and cycle length as well as a complete range of phasings and cycles, as controlled by the SEQUENCES and CYCLES commands.

Two other inputs also control the DESIGN process. These are the LEVELOFSERVICE and EXCESS commands. The LEVELOFSERVICE command describes the desired level of service, delay or v/c which DESIGN will attempt to achieve for the critical movements. If this level of performance is achieved, the additional time which is available is defined as excess time, and its allocation to the phases is defined by the EXCESS entry. The EXCESS command provides the movement numbers which are to receive any excess time which may be available. If no movement numbers are given, the default is to assign any excess time to all phases in proportion to the required time for each phase. If the desired level of performance is not met, the EXCESS command is ignored.

**Other Commands.** Two other commands fall into a utility category, being usable at almost any time during the course of an analysis. These are DIAGRAMS and MAP. DIAGRAMS produces a phasing diagram for the specified phasing code, and only requires that the proper VOLUMES and WIDTHS be entered so that it can display an arrow in any phase where the movement exists and is allowed. MAP displays the input values of the VOLUMES, WIDTHS, LANES, SEQUENCE, LEADLAGS, PERMISSIVES and OVERLAPS commands, and as such, these inputs should be made prior to its use.

## Input Limitations (for Signal Analysis)

The signal analysis functions of TEAPAC are designed to analyze and optimize the operation of as many as 500 typical four-legged intersections using the techniques described in the *Highway Capacity Manual* as a basis for the analyses. In accomplishing this objective, certain limitations in the input and use of the program exist. These are described in this section. In some instances, references to Chapter 5 are made where techniques are described to get around some of these limitations. None of these limitations constrain the basic use of the program for most situations, however, and this section should not be viewed as diminishing the usability of the program, but merely documenting the limitations which should be observed in its use.

Usage Level 3 of TEAPAC allows the definition of up to 500 intersections for analysis. Smaller problems can also be defined with this large version of TEAPAC. Usage Level 2 of TEAPAC will allow the definition of up to 100 intersections for a single analysis, and Usage Level 1 of TEAPAC will allow the definition of up to 12 intersections for a single analysis. All usage levels allow up to 9 intersections to be analyzed with the URBANSTREET command.

As many as four approaches can be analyzed for each intersection as long as they generally follow the geometric layout of two two-way streets which cross each other. The primary concern here is that the designated left turns conflict with through movements on the opposite approach as in a normal four-way intersection, since these are what the pre-coded sequences address. Additional legs of a multi-leg intersection can be handled through use of special techniques described in Chapter 5.

Sixty-four distinct phasings can be handled automatically through use of the TEAPAC phase sequence numbering scheme described in Chapter 1. When these phasing codes are used, all facets of the program can be used without limitation. Through use of negative sequence codes (-1 thru -9) and the PHASEMOVEMENTS command, completely arbitrary phasings can be handled by the ANALYZE and EVALUATE commands, as long as the rules of describing the phasing are followed for the PHASEMOVEMENTS command (the detailed rules are in Appendix B in the Notes section for the PHASEMOVEMENTS command). The DESIGN and HCSEXPORT commands will not function when negative SEQUENCE codes are used.

In terms of input parameter limits, those limits which are described in the *Highway Capacity Manual* are specifically allowed for each parameter value. In some cases, greater input limits are allowed and the methods of the *Highway Capacity Manual* are extrapolated, as appropriate, sometimes with advisory warning messages. Specific input limitations for each command input are described in Appendix B under each of the command names used for the input.

## Analysis Procedures (for Signal Analysis)

When using TEAPAC for signal analysis, it is important to understand the fundamentals of how the data entries and actions are used together in order to get results in an efficient and accurate manner. In the example in Chapter 2, certain processes produced specific results. In this section, these steps are reviewed and discussed in detail to provide a more complete understanding of the program functions. First the basic analysis procedures are outlined, then more specialized procedures are described. Chapter 5 describes unique ways that these basic and special procedures can be combined to solve unusual problems related to signal analysis.

Sub-topics for this section:

Basic Analysis Procedures (for Signal Analysis)
Special Analysis Procedures (for Signal Analysis)

## Basic Analysis Procedures (for Signal Analysis)

As described earlier, TEAPAC's signal analysis functions have three primary analysis modes, URBANSTREET, ANALYZE and DESIGN. Since these modes of use differ greatly, each is discussed individually below.

**URBANSTREET Procedures.** In performing a capacity analysis for an urban street facility, the basic method of doing the analysis is to enter the parameters which describe the intersection and link conditions, including phasing and timings, as described in the Input Requirements above, then follow this with the URBANSTREET command. These entries and actions are done with the Edit and Results menus, respectively.

**ANALYZE Procedures.** In performing a capacity analysis, the basic method of doing the analysis is to enter the parameters which describe the intersection conditions, phasing and timings, as described in the Input Requirements above, then follow this with the ANALYZE command. If HCM worksheets are desired, the ANALYZE command should be preceded by the OUTPUT command. These entries and actions are done with the Edit and Results menus, respectively.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

If an intersection has been selected with the INTERSECTION entry, the ANALYZE actions will be performed for that intersection only. If all intersections have been selected by selecting INTERSECTION 0, then the actions will be performed for all intersections in the NODELIST or SUBSYSTEM, as described earlier.

**DESIGN Procedures.** In performing a phasing and/or timing optimization, two basic methods of doing the design can be used. In either case, the parameters which describe the intersection conditions should be entered as described above for the ANALYZE mode and in the Input Requirements section above. This input should then be followed by the DESIGN command using its single controlling parameter input. The two design modes are defined by whether the DESIGN parameter is zero or not. When the DESIGN parameter is greater than 0 (usually 1, the default), this instructs TEAPAC to optimize all combinations of the CYCLES and SEQUENCES, to pick out the "best" phasing(s) and to produce a capacity analysis of the best timings for that phasing(s). The number of phasings for which capacity analyses will be produced is the number entered as the DESIGN parameter. This is commonly referred to as the Intersection Design Study mode, or IDS mode, of DESIGN, where the actual phasing which is selected is not as important as the capacity analysis of the "best" phasing. This DESIGN mode will work for either a specific INTERSECTION, or for all intersections (INTERSECTION 0).

If the DESIGN parameter value is zero, no capacity analyses are performed. In this case, only the DESIGN is performed for every combination of CYCLES and SEQUENCES, with a progress report of the DESIGN as the result. This process should be followed up with a SORT command which will detail the DESIGN results, also listing the sequences designed in order from best to worst. From this list, the preferred sequence can be selected with the TIMINGS command, which automatically "selects" the preferred sequence by placing it first in the SEQUENCES list and dumping the best GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CRITICALS values into the corresponding commands for subsequent use by the ANALYZE, EVALUATE, QUEUECALCS or HCSEXPORT commands. When the selection of the real "best" phasing is crucial, this use of DESIGN 0 is preferred, since it gives the user control over the identification of the optimum phasing, giving consideration to non-quantifiable selection criteria TEAPAC cannot consider. The use of INTERSECTION 0 (for all intersections) can be used with DESIGN 0 as long as its result is the only DESIGN result desired. If DESIGN 0 is to be followed by SORT and/or TIMINGS, the DESIGN 0 must be done for a single intersection since the DESIGN 0 function will only ‘remember’ the last DESIGN which it has performed.

In summary, when phasings and/or timings are being DESIGNed, two methods can be employed. 1) When the determination of the best phasing is not crucial, the quickest way to perform a DESIGN is by entering a DESIGN 1 or DESIGN 2 command, thereby producing a capacity analysis of the best timings for the best 1 or 2 phasings with a single command. In this case, the only output is the sorted list of sequences and the capacity analysis, with or without the worksheets, as directed by the OUTPUT command. When this method is used, the sorted list should be reviewed to make sure the program’s selection of the "best" phasing has merit. INTERSECTION 0 may be used effectively under this method. 2) When the selection of the best phasing is more important, the same process can be executed in a step-by-step fashion, using in sequence, the DESIGN 0, SORT, TIMINGS and ANALYZE commands. In this case, the selected phasing from the SORT list is used on the TIMINGS command. After execution of the TIMINGS command, the SEQUENCES, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CRITICALS values are updated automatically, putting the user in a position to execute any of the other ANALYZE mode commands, such as ANALYZE, EVALUATE, QUEUECALCS and HCSEXPORT. HCSEXPORT sends the optimized information to a data file to perform a comparable HCS capacity analysis of the TEAPAC-optimized phasings and timings. These entries and actions are done with the Edit and Results menus, respectively. INTERSECTION 0 may not be used under this method, except when DESIGN 0 is the only result required.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

## Special Analysis Procedures (for Signal Analysis)

TEAPAC also has several special signal analysis computations which can be performed. These computations can augment the basic ANALYZE and DESIGN procedures described above. Each is discussed below. Remember that means of using TEAPAC for signal analysis computations relevant to solving unusual problems and situations are described in Chapter 5. This section merely describes additional signal analysis computations which can be performed directly by TEAPAC.

**Saturation Flow Calculations.** When saturation flow calculations are the only result needed, these computations can be performed without the need to produce a complete capacity analysis. This can be particularly convenient in that a capacity analysis requires that every worksheet be produced in order to get the saturation flow worksheet (which is all that is desired in this case). Using the SERVICEVOLUMES command will produce a single table of computed saturation flows for every defined lane group. This command can be executed at any time that the intersection conditions have been input, in much the same way that ANALYZE can be used. Input phasings and timings are required since the saturation flow rates computed can depend on these values.

**Required G/C Calculations.** The GOVERCS (pronounced gee-over-seez as in g/C's) command can be issued at any time intersection conditions have been input to estimate the amount of greentime which is required to meet the desired levels of service. These computations are performed for every LEVELOFSERVICE specified. These computations can be quite useful when trying to solve capacity problems at an intersection, or for generating optimum timings for a non-standard phasing for which DESIGN will not function. This command can be used anytime use of the ANALYZE command would be valid.

## Chapter 3 Topics (for Traffic Impact Analysis):



## Input Requirements (for Traffic Impact Analysis)

This section discusses the basic input requirements for a traffic impact analysis. It begins with a discussion of the minimum input requirements to produce various reports, and then discusses the limitations to data input which exist. This section is quite important in that it sets the minimum information for valid results, as well as the limitations of the program.

Sub-topics for this section:

## Minimum Input Requirements (for Traffic Impact Analysis)

Many of the input parameter values have defaults which eliminate the need to enter data for every parameter. After the program is started or the File-New menu or RESET [Parameters] command is issued, these default values can be viewed in any of the input dialogs of the Visual Mode or with the DATA or ASK commands in the Manual Mode. The default values of each command are also listed in the right-hand section of the HELP displays which are generated by the Help-Commands menu or the HELP command in the Manual Mode.

On the other hand, for most commands it is necessary to input data in order to produce legitimate results. The most obvious of these are the BASE, GENERATION and PATHASSIGNMENT commands to describe the traffic generation and assignment characteristics. Values for these commands are needed to do most any traffic impact analysis function with the program. As such, examples of these inputs were illustrated in the initial example of Chapter 2. For a planning level analysis, this may be adequate to describe the situation which is to be analyzed. For a more detailed analysis, the other commands should be used as well, although each has a preset default value which is frequently usable in an analysis. Each of the input parameters for these commands should be reviewed to check the appropriateness of the default values using the View-Summary menu or the dialog boxes of the Edit menu.

The TEAPAC program has two basic modes of operation for traffic impact analysis, one where assignment paths are entered manually by the user, the other where assignment paths are suggested by the program. These are commonly referred to as the PATHASSIGNMENT and FINDPATHS modes, following the names of the two basic commands which are used in these modes. The input requirements for the FINDPATHS mode builds upon that of the more basic PATHASSIGNMENT mode, and thus is discussed in a separate, subsequent section.

**PATHASSIGNMENT Inputs.** The PATHASSIGNMENT mode means that the user will enter all aspects of the trip assignments, without aid from the program. This means that SITESIZE of the study must be entered (first), then the basic INTERSECTION conditions (VOLUMES, LANES and NETWORK), the development size and generation rates (BASE and GENERATION), and the path definitions (PATHDISTRIBUTION and PATHASSIGNMENT) must all be entered. For the NETWORK entries, only the source node number is required for each link; link speeds and distances may be left at the default values of 0. Coordinates are also not needed for the BASE entry. This information provides enough data for TEAPAC to calculate and assign trips to each intersection, following the designated paths and adding in non-site volumes.

**FINDPATHS Inputs.** The FINDPATHS mode means that TEAPAC will use the input conditions to ascertain the shortest paths to and from the development site for each of the external path distribution points. In order to do this, the intersection coordinates (NODELOCATION) and the speed/distance for each link of the study NETWORK must be entered in addition to the information required for the PATHASSIGNMENT mode described above. It is also advised that the coordinates of the development area itself be entered on the BASE command for this mode of use.

The SHOWPATHS command can also be used when enough information has been entered for the FINDPATHS mode. SHOWPATHS produces a schematic diagram of the study network, and will optionally display the defined PATHASSIGNMENTs, regardless of whether they were defined by manual PATHASSIGNMENTs or automated FINDPATHS.

## Input Limitations (for Traffic Impact Analysis)

The traffic impact analysis functions are designed to compute the projected intersection turning movement volumes for the network of a typical traffic impact study. In accomplishing this objective, certain limitations in the input and use of the program exist. These are described in this section. In some instances, references to Chapter 5 are made where techniques are described to get around some of these limitations. None of these limitations constrain the basic use of the program for most situations, however, and this section should not be viewed as diminishing the usability of the program, but merely documenting the limitations which should be observed in its use.

TEAPAC is available in three sizes, the Usage Level 1 size which handles up to 12 intersections in the network for analysis, the Usage Level 2 size which handles up to 100 intersections, and the Usage Level 3 size which handles up to 500 intersections. The number of intersections in the actual study area is defined by the number of entries in the NODELIST command.

In Usage Level 3, TEAPAC can define up to 150 distribution points, or types. Typically, up to 75 of these types are used to describe the external nodes and distribution percentages for inbound traffic, the remaining 75 being used for the reverse outbound assignments. This is not a requirement, but if the "reverse assignment" option of the FINDPATHS command is used, there must exist a precise 1-to-1 correspondence between the inbound and outbound distribution types. In other words, to use the reverse assignment option in a study network, the number of distribution types must be even, the first half of the types must define the inbound trips, and the last half must define outbound trips and use the same external nodes as the corresponding inbound types. Usage Level 2 is limited to 100 distribution types and Usage Level 1 is limited to 50 distribution types.

For every distribution type, up to five PATHASSIGNMENTs may be used to define how trips travel between the external node associated with the PATHDISTRIBUTION type and one of the site access nodes. The maximum length of a path is 16 intersections. If the distribution type is for inbound trips, the PATHASSIGNMENT must start with the proper external node of the PATHDISTRIBUTION command and must end with a defined inbound access node. The reverse is true for outbound trips. The sum of the percentages for each of the five possible paths must sum to 100 percent (or zero percent).

Each intersection may have up to four approaches linked to other intersections via the NETWORK command. The source intersection for the links defined by each of these NETWORK entries can define up to four movements which supply traffic to the link.

## Analysis Procedures (for Traffic Impact Analysis)

When using TEAPAC for traffic impact analysis, it is important to understand the fundamentals of how the data entries and actions are used together in order to get results in an efficient and accurate manner. In the example in Chapter 2, certain processes produced specific results. In this section, these steps are reviewed and discussed in detail to provide a more complete understanding of the program functions. First the basic analysis procedures are outlined, then more specialized procedures are described. Chapter 5 describes unique ways that these basic and special procedures can be combined to solve unusual problems related to traffic impact analysis.

Sub-topics for this section:



## Basic Analysis Procedures (for Traffic Impact Analysis)

As described earlier, TEAPAC has two primary traffic impact analysis modes, PATHASSIGNMENT and FINDPATHS. Since FINDPATHS requires additional inputs beyond those of PATHASSIGNMENT, it is discussed in a section following PATHASSIGNMENT below.

**PATHASSIGNMENT Procedures.** In performing projected site traffic computations, the basic method of doing the analysis is to enter the parameters which describe the intersection, generator and assignment conditions, as described in the Input Requirements above, then follow this with the COMPUTEPATHS command. The size of the study area must always be entered first, since very little additional information can be entered before NODELIST and SITESIZE. Following this, a logical sequence of entry is to first define the data for each intersection, then describe the basic generator information, then finally each of the distribution points with their corresponding assignments. The intersection information can be entered last, if desired, but not if the FINDPATHS mode described below is used, and the access points of the generator information must be entered before any assignments can be made. These entries and actions are done with the Edit and Results menus, respectively.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

**FINDPATHS Procedures.** In performing a FINDPATHS procedure, the same process described above is performed, with the exception of entering the PATHASSIGNMENT commands. Instead of manually entering PATHASSIGNMENTs, FINDPATHS is initiated after all other inputs, and the program prompts the user with displays of the shortest paths which connect each of the external distribution points with the site access points. In response to each path, the user enters a percentage of total traffic between the external node and the site which will use this path. This process is repeated five times for the five shortest paths for the distribution type(s) requested on FINDPATHS. If FINDPATHS is used for type 0, all distribution types are done in sequence. After using FINDPATHS to select candidate assignment paths, the PATHASSIGNMENTs which were created by the procedure can be modified manually as in the PATHASSIGNMENT mode, and can be displayed with the SHOWPATHS command. After settling on final assignments, the COMPUTEPATHS command can be used to calculate the projected traffic, as described above.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

## Special Analysis Procedures (for Traffic Impact Analysis)

TEAPAC has several special computational techniques which can be performed for traffic impact analysis. These techniques augment the basic COMPUTEPATHS procedures described above. Each is discussed below. Remember that means of using TEAPAC for traffic impact computations relevant to solving unusual problems and situations are described in Chapter 5. This section merely describes additional computations which can be performed directly by TEAPAC.

**Changing Distribution Percentages.** It is frequently necessary to change the assumed PATHDISTRIBUTION percentages, either in response to changed distribution assumptions or to test alternative distributions. Rather than execute the PATHDISTRIBUTION command for each distribution to be changed, a quicker way can sometimes be to use the DISTRIBUTION command. This command lists the distribution percentages for each of the distribution types in order from the first type to the last. In the Visual Mode, this process will only work effectively if there are 10 or less distribution types, in which case each of these percentages are displayed and can be changed. In the Manual Mode, any number of percentages can be entered and/or changed, using the "*" null value to skip over values to remain the same. If the list of percentages exceeds the width of the screen (80 characters maximum), the & line continuation function can be used to continue entering the list on the next input line.

**Cumulative Calculations.** When more than one land use is to be analyzed for a given development, or several sites in the same study area are to be combined in a single analysis, the CUMULATE option of the COMPUTEPATHS command is quite useful. Normally the computations start with a zero traffic volume for each of the 12 movements at each intersection. The successive additions of traffic contributed by each distribution type and non-site traffic, as listed on the COMPUTEPATHS command, are added into the total traffic until all traffic is accounted for. This is the default "RESET" option of COMPUTEPATHS.

When the CUMULATE option is selected, the intersection volumes of the previous COMPUTEPATHS are not zeroed prior to the current computations, thus producing a cumulative total of the current computations and the previous. This, in effect, allows an unlimited number of land uses or sites to be cumulated together into a single result. This is most useful when a multi-use site is being explored, since much of the information for each individual computation is identical. In many cases, the only change between computations is the BASE development size, the GENERATION rates, and possibly the PATHDISTRIBUTION percentages for each external node. Thus the assignments of the first land use can be re-used for the additional land uses, without the need for re-entry, and quick work can be made of the multi-use computations. The previous computation results are only retained if the program is not terminated between the previous and the cumulated computations. Also, the positions of the nodes in the NODELIST cannot change from one computation to the next when cumulating results. See the discussion of this subject for important considerations about rounding and background traffic in Chapter 5.

**Exporting Calculations.** If another program is to be used to determine the level of service which the projected volumes create, TEAPAC can be directed to export the calculated VOLUMES to a data file for direct use by these programs. This allows the third-party program to use the volumes from the file rather than requiring that the volumes be re-entered manually by reading from the displayed or printed output, . The OUTPUT command is used for this function, using the keyword FILE (or BOTH) to direct the computed output to the given file number of the FILES command. When this is specified before the COMPUTEPATHS command is issued, each of the computed VOLUMES for each of the intersections, in the order of the intersection numbers, is written to the file, preceded by the current NOTE command and terminated by a RETURN command. Other programs may need an interface program to convert the data and file format before being used. Note that the VOLADDITIONALS feature supported in saved data files provides the greatest flexibility for transferring calculated volumes to other programs (see discussion in Chapter 5).

## Chapter 3 Topics (for Count Analysis):



## Input Requirements (for Count Analysis)

This section discusses the basic input requirements for a count analysis. It begins with a discussion of the minimum input requirements to produce various reports, and then discusses the limitations to data input which exist. This section is quite important in that it sets the minimum information for valid results, as well as the limitations of the program.

Sub-topics for this section:

## Minimum Input Requirements (for Count Analysis)

Many of the input parameter values have defaults which eliminate the need to enter data for every parameter. After the program is started or the File-New menu or RESET [Parameters] command is issued, these default values can be viewed in any of the input dialogs of the Visual Mode or with the DATA or ASK commands in the Manual Mode. The default values of each command are also listed in the right-hand section of the HELP displays which are generated by the Help-Commands menu or the HELP command in the Manual Mode.

On the other hand, there are several commands for which it is necessary to input data in order to produce legitimate results. The most obvious of these are the PERIODS and VEHICLECOUNTS commands to describe the time periods that have been counted and what these counts are. Values for these commands are needed to do any of the practical functions of a count analysis. As such, examples of these inputs were illustrated in the initial example of Chapter 2.

Depending on the type of traffic count performed, the COUNTTYPE command may also be needed for TEAPAC to understand the count input which is given. If the traffic counts are cumulative, that is, each recorded number is cumulatively larger than the previous with the difference between recorded numbers being the actual count, the COUNTTYPE command must define the VEHICLECOUNTS as CUMULATIVE. On the other hand, if each count recorded is the actual count for the given time interval, the COUNTTYPE command must define the VEHICLECOUNTS as REDUCED (the default).

Thus, the minimum inputs for a basic traffic count include the COUNTTYPE, the PERIODS for which the counts were made, and the VEHICLECOUNTS themselves. Other entries exist whose default values are frequently appropriate to perform a count analysis with TEAPAC.

In either mode, if an intersection has been selected with the INTERSECTION entry as we did previously, the actions requested will be performed for that intersection only. If all intersections have been selected by selecting INTERSECTION 0, then the actions requested will be performed for all intersections in the NODELIST, one by one in the order listed in the NODELIST. If a SUBSYSTEM entry has been made, then when INTERSECTION 0 is selected the actions will be performed only for the SUBSYSTEM intersections and in the order these intersections are found in the NODELIST.

## Input Limitations (for Count Analysis)

TEAPAC is designed to tabulate and analyze the peak hours for as many as 500 typical four-legged intersection using traditional traffic engineering techniques. In accomplishing this objective, certain limitations in the input and use of the program exist. These are described in this section. In some instances, references to Chapter 5 are made where techniques are described to get around some of these limitations. None of these limitations constrain the basic use of the program for most situations, however, and this section should not be viewed as diminishing the usability of the program, but merely documenting the limitations which should be observed in its use.

TEAPAC is available in three sizes, the Usage Level 1 size which handles up to 12 intersections in the network for analysis, the Usage Level 2 size which handles up to 100 intersections, and the Usage Level 3 size which handles up to 500 intersections.

As many as four approaches can be analyzed for each intersection as long as they generally follow the geometric layout of two two-way streets which cross each other. Additional legs of a multi-leg intersection can be handled through use of special techniques described in Chapter 5.

Traffic count input can be in either 15-minute or 60-minute intervals, the default and normal practice being 15-minute intervals. Up to five distinct traffic count periods can be defined during the course of a single day of counts, none of which overlap each other. A maximum of 97 15-minute count entries per movement can be made. This is designed to accommodate an entire day's worth of 15-minute counts. Each count entry can include all vehicles counted for each time interval, either with or without a separate value to count trucks, or separate count values can be entered for both trucks and non-truck vehicles. Specific input limitations for each data entry are described in Appendix B under each of the command names used for the input.

## Analysis Procedures (for Count Analysis)

When using TEAPAC for count analysis, it is important to understand the fundamentals of how the data entries and actions are used together in order to get results in an efficient and accurate manner. In the example in Chapter 2, certain processes produced specific results. In this section, these steps are reviewed and discussed in detail to provide a more complete understanding of the program functions. First the basic analysis procedures are outlined, then more specialized procedures are described. Chapter 5 describes unique ways that these basic and special procedures can be combined to solve unusual problems related to count analysis.

Sub-topics for this section:

- Basic Analysis Procedures (for Count Analysis)
- Special Analysis Procedures (for Count Analysis)

## Basic Analysis Procedures (for Count Analysis)

In performing either tabulations, peak hour analyses or warrant analyses, the basic method of doing the analysis is to enter the parameters which describe the traffic count data and conditions (COUNTTYPE, PERIODS, VEHICLECOUNTS and CONDITIONS) as described in the Input Requirements above, then follow this with any of the COUNTTABULATE, PEAKANALYZE, PEAKSUMMARY, COUNTGRAPH or WARRANTS commands. COUNTTABULATE will provide various tabulations of the count data, PEAKANALYZE will perform a peak hour analysis, PEAKSUMMARY will provide a schematic diagram showing hourly volumes, COUNTGRAPH will display a graphical plot of the total intersection counts for all the time periods counted throughout the day, and WARRANTS will perform a signal warrant analysis and a multi-way stop warrant analysis. These entries and actions are done with the Edit and Results menus, respectively.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK commandcan be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

If an intersection has been selected with the INTERSECTION entry, the analysis actions will be performed for that intersection only. If all intersections have been selected by selecting INTERSECTION 0, then the actions will be performed for all intersections in the NODELIST or SUBSYSTEM, as described earlier.

## Special Analysis Procedures (for Count Analysis)

TEAPAC also has several special count analysis procedures which can be performed. These computations can augment the basic procedures described above. Each is discussed below. Remember that means of using TEAPAC for count analysis computations relevant to solving unusual problems and situations are described in Chapter 5. This section merely describes additional count analysis procedures which can be performed directly by TEAPAC.

**Importing Data from Electronic Traffic Counters.** If data has been collected with various electronic traffic counters, such as Jamar or TimeMark, the COUNTIMPORT command can be issued from within TEAPAC, naming the electronic count file, such as .DFL, and the electronic data is immediately loaded into TEAPAC. An option allows display of the data as it is being imported. At that point, any of the TEAPAC analyses can be executed, and/or the data can be SAVEd as a standard TEAPAC data file.

If the count is a PETRA turning movement count file, the file must be exported by PETRA to the DFL (IMC) file format before importing. The user should then select the COUNTIMPORT option describing whether the "special key" counts should be added to the adjacent right turn counts as right-turn-on-red counts. On this type of COUNTIMPORT, the PERIODS entry is updated automatically to match the turning movement count made. A turning movement count import imports all twelve movements at a time, replacing any count data for the PERIODS entry that may have existed prior to the import.

If the count being imported is a machine count (such as a TAS file), the user needs to select several COUNTIMPORT options. The first is how to handle multi-channel counts. The default is to import only the first channel (A) encountered. Other options are to import the second channel (B), the sum of the two channels (A+B) or the difference of the two channels (A-B or B-A). Further, the user must designate which movement for the current TEAPAC intersection should receive the imported data, and if a multi-day count was made, which of these days should be imported. On this type of COUNTIMPORT, the PERIODS entry is entered separately by the user, and only count data from the import file which matches the PERIODS entry will be imported. A machine count import imports a single movement at a time, leaving other movement data unchanged.

**Reconfiguring Count Data.** On occasion an analyst will find that count data has inadvertently been entered in the wrong "columns", that is, a right turn has been recorded as a left turn or vice versa, etc. The COUNTRECONFIG command makes easy work of correcting this type of error. This command enters a list of movement numbers from 1 to 12 which designate where each column of counts (movement) should be reconfigured to. Specifically, the first number given tells where the current movement #1 should be moved to, the second number is where the current movement #2 should move to, etc. For example, if the left turn from the north (movement #3) has been switched with the right turn from the east (movement #4), then COUNTRECONFIG * * 4 3 will swap the counts for these two positions (the other movements will remain unchanged). If a movement's counts are to be removed from the data, putting a zero in its position takes care of that in short order. For example, COUNTRECONFIG * * 0 would remove the left turn on the north approach.

**Factoring Traffic Counts.** Several conditions may cause the need for the counted traffic to be factored in one fashion or another. This can be accomplished easily through use of the VOLFACTORS command. The two most common occurrences of this need are when the count is performed during an unusually low or high traffic period, or when a projection of traffic growth is needed. In either case, if factors are entered for each movement on the VOLFACTORS command, every count number entered will be multiplied by these factors (and rounded to the nearest whole vehicle) before any of the tabulations or analyses are performed. Thus, when a seasonal factor or growth factor needs to be applied to the original count, this is accomplished swiftly and painlessly by first using the VOLFACTORS command.

Another means of factoring count data is to estimate 24-hour volumes, or average daily traffic (ADT). The ADTFACTOR command can be used to enter the factor which will be used to expand the entire traffic count to a 24-hour estimate of ADTs. The PEAKANALYZE command will produce this report when its default values are used and the ADTFACTOR is non-zero. COUNTREPORTS can also be used to produce this result.

**Incorporating Truck Counts.** Truck counts can be handled in TEAPAC in one of two ways. First, all vehicles including trucks can be entered on the VEHICLECOUNTS command. Additionally, the specific truck counts can be entered on the TRUCKCOUNTS command so that truck percentages can be computed in the peak hour analysis report. In this fashion, the VEHICLECOUNTS command is the only command used to determine total vehicle demand and the TRUCKCOUNTS command is the only command used to determine truck activity. This provides a simple way to separate the two counting efforts with multiple count personnel, guaranteeing that no vehicles slip through the total count because of differing definitions of what constitutes a "truck". This method of input is the default and recommended input procedure.

Secondly, all non-trucks can be recorded on the VEHICLECOUNTS command and all trucks can be recorded on the TRUCKCOUNTS command. This method requires that the second parameter of the COUNTTYPE command be entered as the keyword "SEPARATE" to indicate that the counts are being entered separately. When this method is used, the TRUCKCOUNTS are first added to the VEHICLECOUNTS before any other computations are performed, then all tabulations are done for the combined TRUCKCOUNTS and VEHICLECOUNTS.

For either method of entry of TRUCKCOUNTS, the output reports are always for all vehicles, including trucks. An optional truck-only table of 15-minute counts can be produced if the fourth parameter of the OUTPUT command is selected with the keyword "YES".

**Exporting Peak Hour Volumes.** Frequently, the results of the peak hour analysis provided by the PEAKANALYZE command are to be used by many other programs. This is primarily in the form of the design hour volumes, and possibly truck percentages and peak hour factors. Because of the common nature of this requirement, the sharing of these results can be accomplished automatically through use of the OUTPUT command, as described below.

Each time the PEAKANALYZE command is executed, design hour volumes are determined as the volumes for the twelve movements which add up to the highest 60-minute volume at the intersection during the time period scanned. An option of the OUTPUT command also provides the capability to search for the highest 15-minute flow rates. It is these volumes that will frequently be used by other programs as input in combination with other inputs. These volumes might be used as the demand volumes for a capacity analysis of existing conditions. The peak hour factors might also be used, though with less confidence than the volumes due to their sensitivity to errors in the count process. Another option of OUTPUT determines whether or not the peak hour factors will be exported, and if so, to what degree of computational accuracy.

If the second keyword of the OUTPUT command is set to "FILE", these results of the PEAKANALYZE command will be output to the file of the FILES command whose number appears on the OUTPUT command. These results can then be used directly by any other program which needs them. The results of PEAKANALYZE will output both to the display screen and the file if the keyword "BOTH" is used on OUTPUT.

The information which is placed in the output file consists of the current DESCRIPTION command, a NOTE command which identifies the time when the peak volumes occurred, the current INTERSECTION command, a PEAKHOURFACTORS command with the calculated peak hour factors, a VOLUMES command holding the peak hour volumes which have been determined, and a RETURN command to terminate the reading process. If the input data included TRUCKCOUNTS, the percentage of trucks is also output via the TRUCKPERCENTS command. An example of what this file output looks like for the sample data peak hour analysis is shown below, assuming four peak hour factors were requested:

```
DESCRIP    Lincoln Avenue & Main Street
NOTE       Evening Peak Hour Traffic Data @ 1615 hours
INTERSE    16    Lincoln Avenue & Main Street
PEAKHOU    0.89           0.94           0.79           0.95
VOLUMES    203 172 144    59 340 214     189 76 64      78 536 181
TRUCKPE    9 18 19        22 3 10        12 9 17        22 4 12
```

RETURN

Most traffic software requires that if a movement is allowed at an intersection, the movement volume must be entered with a number greater than 0. Conversely, when a value of 0 is entered, many programs assume that the movement does not exist and/or is not allowed. In some instances, however, an allowed/existing low-volume movement may actually be counted with zero activity during any specific 15- or 60-minute period. If this zero value is exported to other programs, an inaccurate impression may be given about the existence or allowance of that movement. To prevent this problem from occurring, the export of the PEAKANALYZE command performs the following check. If a volume to be exported has a value of zero, the entire movement is first checked for any count activity before the zero is exported. If any activity exists for the movement at any time during the count, a volume of 1 will be exported rather than the 0 so that a non-zero value represents the allowable movement.

The output is directed to the file starting at the "next" line number of the file, as designated by the NEXTLINES command. After each such output, the "next" line of the file is updated so the next file output will be "stacked" after the previous in the file. By this means, multiple peak hour analyses for an intersection can be stacked in a single file, or peak hour analyses for multiple intersections can be stacked, or a combination of both, as desired by the user. The actual output to the file can be observed as it happens by first turning the ECHO command option to YES before executing the PEAKANALYZE command.

## Chapter 3 Topics (for Progression Analysis):



## Input Requirements (for Progression Analysis)

This section discusses the basic input requirements for a simplified progression analysis. It begins with a discussion of the minimum input requirements to produce various reports, and then discusses the limitations to data input which exist. This section is quite important in that it sets the minimum information for valid results, as well as the limitations of the program.

Sub-topics for this section:



## Minimum Input Requirements (for Progression Analysis)

Many of the input parameter values have defaults which eliminate the need to enter data for every parameter. After the program is started or the File-New menu or RESET [Parameters] command is issued, these default values can be viewed in any of the input dialogs of the Visual Mode or with the DATA or ASK commands in the Manual Mode. The default values of each command are also listed in the right-hand section of the HELP displays which are generated by the Help-Commands menu or the HELP command in the Manual Mode.

On the other hand, there are several commands for which it is necessary to input data in order to produce legitimate results. The most obvious of these are the PRG-DISTANCES and PRG-SPEEDS commands to describe the distances between intersections and link speeds. Values for these commands are needed to do most any progression analysis function of the program. As such, examples of these inputs were illustrated in the initial example of Chapter 2. For a planning level analysis, this may be adequate to describe the situation which is to be analyzed. For a more detailed operations analysis, the other commands which describe intersection conditions should be used, although each has a preset default value which is frequently usable in an analysis. Each of the input parameters for these commands should be reviewed to check the appropriateness of the default values using the View-Summary menu or the dialogs in the Edit menu.

The progression analysis functions of the program have two basic modes of operation, one where a full optimization of offsets is desired, the other where a time-space diagram of given offsets is desired. These are commonly referred to as the PROGRESSION and PLOTSIMPLE modes, following the names of the two basic commands which are used in these modes. The input requirements for these two modes are noticeably different, and thus are discussed below in separate sections.

**PROGRESSION Inputs**. The PROGRESSION mode means that the program is to determine the offsets which maximize the progression of traffic on the arterial, usually in both directions. To accomplish this, at a minimum, the PRG-SIZE command must first be entered to define the number of intersections in the arterial, then the PRG-SPLITS must be given for each intersections and the PRG-SPEEDS and PRG-DISTANCES must be given for each link between intersections.

If a system cycle length is already known, it must be entered as both the lower and upper limits of the PRG-CYCLES command, otherwise the default range to be tested can be used or a user-input range can be entered.

**PLOTSIMPLE Inputs**. The PLOTSIMPLE mode is designed to display a simplified time-space diagram for the defined arterial, using PRG-OFFSETS either created by a previous PROGRESSION command or entered by the user. If the PLOTSIMPLE command follows a PROGRESSION, ample information has already been entered so only the PLOTSIMPLE command is needed. This is because PROGRESSION will set the PRG-OFFSETS command with the optimum offsets it determines.

If a PLOTSIMPLE is to be done without a prior PROGRESSION command, usually to produce a diagram of an existing set of offsets, then after the PRG-SIZE is entered, the PRG-CYCLE and PRG-OFFSETS must be entered along with the PRG-SPLITS, PRG-SPEEDS and PRG-DISTANCES. See the Procedures section below for proper inclusion of other inputs in the PLOTSIMPLE mode.

## Input Limitations (for Progression Analysis)

Usage Level 1 of TEAPAC can handle up to 12 intersections for any analysis, while Usage Level 2 and 3 can handle up to 25 intersections for progression analysis. The PRG-CYCLES range can create a single analysis which will design and graph up to 21 different cycle lengths in Usage Level 1, with up to 41 cycles in Usage Level 2 and 3. The PRG-TOLERANCE command can create a single analysis which will design and tabulate up to 11 different speeds in Usage Level 1, with up to 21 speeds in Usage Level 2 and 3.

Cross street intersection names can be represented with up to 12 characters. Progression speeds can be entered with separate values for each direction on each link of the system. Multi-phase control of various types can be entered for the main street, while the side street is represented by a single red-phase for main street traffic. A single clearance time can be entered for all main street green phases at each intersection. Distance and speed data can be entered in either English or Metric units, depending on the setting of the PRG-UNITS command.

## Analysis Procedures (for Progression Analysis)

When using TEAPAC for progression analysis, it is important to understand the fundamentals of how the data entries and actions are used together in order to get results in an efficient and accurate manner. In the example in Chapter 2, certain processes produced specific results. In this section, these steps are reviewed and discussed in detail to provide a more complete understanding of the program functions. First the basic analysis procedures are outlined, then more specialized procedures are described. Chapter 5 describes unique ways that these basic and special procedures can be combined to solve unusual problems related to progression analysis.

Sub-topics for this section:

Basic Analysis Procedures (for Progression Analysis)
Special Analysis Procedures (for Progression Analysis)

## Basic Analysis Procedures (for Progression Analysis)

As described earlier, simplified progression analysis in TEAPAC has two primary analysis modes, PROGRESSION and PLOTSIMPLE. Since these modes of use differ greatly, each is discussed individually below.

**PROGRESSION Procedures**. In performing an arterial optimization, the basic method of doing the analysis is to enter the parameters which describe the arterial conditions, as described in the Input Requirements above, then follow this with the PROGRESSION command. If the cycle length is known, it is first entered on the PRG-CYCLES command and the complete design is produced (which is followed automatically by a time-space PLOTSIMPLE as described below). If the cycle length is not known, an appropriate range is entered on the PRG-CYCLES command and the PROGRESSION produces a graph of efficiencies which each cycle produces. From this graph an optimal cycle is selected and input on the PRG-CYCLES command so another PROGRESSION command can produce the complete design, as described above. These entries and actions are done with the Edit and Results menus, respectively.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

**PLOTSIMPLE Procedures**. Two basic methods of producing a simplified time-space diagram can be followed. In either case, the parameters which describe the arterial should be entered as described above for the PROGRESSION mode and in the Input Requirements section above.

The most common use of PLOTSIMPLE is to re-produce a time-space diagram for the optimal design just created by the PROGRESSION command (a time-space diagram is automatically produced at the end of each PROGRESSION analysis). In this case, the PLOTSIMPLE command is simply issued some time after the PROGRESSION command, since the PROGRESSION process will load the PRG-OFFSETS command with the optimal offsets and all other internal calculations required by PLOTSIMPLE are done by the PROGRESSION.

The other use of PLOTSIMPLE is to produce a simplified time-space diagram for a user set of PRG-OFFSETS. In the most basic use of PLOTSIMPLE, the minimum inputs described above are simply entered, with the addition of the user PRG-OFFSETS. After these parameters are entered, the PLOTSIMPLE command is issued to produce the time-space diagram. If more than the basic inputs are entered prior to a PLOTSIMPLE for user PRG-OFFSETS, the special procedures described in the following section should be used.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

## Special Analysis Procedures (for Progression Analysis)

Progression analysis also has several special computations which can be performed. These computations can augment the basic PROGRESSION and PLOTSIMPLE procedures described above. Each is discussed below. Remember that means of using TEAPAC for progression analysis computations relevant to solving unusual problems and situations are described in Chapter 5. This section merely describes additional computations which can be performed directly by TEAPAC.

**Speed Variation in PROGRESSION.** It is commonly accepted that even though a precise speed limit or progression speed is known, most drivers will not hold their speed to precisely this value. It is also possible that TEAPAC will be able to achieve a substantially better progression with only a minor change to the progression speed. As a result, it is a good practice to allow TEAPAC some latitude in the progression PRG-SPEEDS input by the user. This feature is available through use of the PRG-TOLERANCE command. PRG-TOLERANCE defines a percentage of speed variation which will be tolerated in the PROGRESSION both above and below the input PRG-SPEEDS. For example, if the PRG-SPEEDS inputs are 30 miles per hour (mph) and the PRG-TOLERANCE is entered as 5 percent, TEAPAC will test progression speeds ranging from 28.5 to 31.5 mph. The second parameter of PRG-TOLERANCE defines how small the increments of speed should be between the lower and upper speeds tested. In the example above, a PRG-TOLERANCE increment of 0.5 mph would test 28.5, 29.0, 29.5,... mph. When this option is invoked, the graph of optimum efficiencies is preceded by a table of optimum efficiencies for every speed/cycle combination. As with the basic procedures described above, the cycle length desired after this analysis must be selected with the PRG-CYCLES command. Furthermore, the speed must also be selected. This can be done by re-entering the PRG-SPEEDS command, or more easily by entering the PRG-ADJUST factor for speeds. This entry should match the speed factor from the Optimum Table for the selected speed, after which all entered PRG-SPEEDS will be adjusted by the input PRG-ADJUST factor.

The speed variation option may also be used for a broader range of speed tolerance when it is desired to know the impact of a substantial change in the progression speed on the arterial progression possibilities.

**Detailed Inputs for PLOTSIMPLE of User PRG-OFFSETS.** The basic procedure described above for plotting simplified time-space diagrams applied when the user inputs included only the PRG-SIZE, PRG-CYCLE, PRG-DISTANCES, PRG-SPEEDS, PRG-SPLITS and PRG-OFFSETS command entries. That procedure would also apply if the PRG-ALLREDS entry in made. If any other parameters entry is made, such as PRG-AVAILABLE, PRG-LEADLAGS, PRG-NONCONCURRENT, etc., the PLOTSIMPLE command will not calculate the effects of these additional commands, and thus will not be performed properly. In order to take into account these additional parameters, the PRG-CYCLES command should be set to the desired value along with the other entries, and a PROGRESSION performed for that cycle. This will properly account for all the input values. Then the user PRG-OFFSETS can be entered and plotted with PLOTSIMPLE.

## Chapter 3 Topics (for Export and Import):



## Input Requirements (for Export and Import)

This section discusses the basic input requirements for export and import, using TRANSYT as an example of a typical third-party host program. It begins with a discussion of the minimum input requirements to produce various reports, and then discusses the limitations to data input which exist. This section is quite important in that it sets the minimum information for valid results, as well as the limitations of the program.

Sub-topics for this section:

Minimum Input Requirements (for Export and Import)
Input Limitations (for Export and Import)

## Minimum Input Requirements (for Export and Import)

Many of the input parameter values have defaults which eliminate the need to enter data for every parameter. After the program is started or the File-New menu or RESET [Parameters] command is issued, these default values can be viewed in any of the input dialogs of the Visual Mode or with the DATA or ASK commands in the Manual Mode. The default values of each command are also listed in the right-hand section of the HELP displays which are generated by the Help-Commands menu or the HELP command in the Manual Mode.

On the other hand, there are a number of commands for which it is necessary to input data in order to produce legitimate results. The most obvious of these are the VOLUMES, WIDTHS and SEQUENCE commands to describe the intersections under study and their phasings. Values for these commands are needed to do most any export function of TEAPAC. As such, examples of these inputs were illustrated in the initial example of Chapter 2. For an approximate modeling effort, only a few of these commands may be needed. For a more detailed operations analysis, the other commands which describe intersection conditions completely should be used, although each has a preset default value which may be usable in an analysis. Each of the input parameters for these commands should be reviewed to check the appropriateness of the default values using the View-Summary menu or the dialog boxes of the Edit menu.

The TEAPAC program has three basic modes of operation for export and import, one where an export (or import) of input values is desired, another where phasing and timing diagrams for each intersection is desired, and a third where a time-space diagram of input conditions is desired. The input requirements for these three modes are noticeably different, and thus are discussed below in separate sections.

**EXPORT Inputs.** The EXPORT mode means that a complete set of conditions are given in order for the program to code these inputs for the host program and produce a complete and valid host model. This means that the NODELIST command must be entered for the system to define the intersection numbers which will be used. Then for each INTERSECTION, the NETWORK, VOLUMES, WIDTHS, SATURATIONFLOWS and SEQUENCES commands must be entered. After defining for which INTERSECTION the following inputs will apply, the NETWORK command describes the speed and distance relationship of the intersections, the VOLUMES describes the demand volumes for each of the 12 possible turning movements, and the WIDTHS and SATURATIONFLOWS describes the lane use configuration and capacities of each. The SEQUENCES command is used to specify the phasing according to the sequence code method discussed in Chapter 1.

If a simulation of given conditions is desired, this is indicated with the OPTIMIZE command (NONE, a simulation, is the default), and GREENTIMES and YELLOWTIMES must be given for each phase, as well as the CYCLE and OFFSET. Only GREENTIMES and YELLOWTIMES are required if only the offsets will be optimized, but if splits will also be optimized, as indicated by the OPTIMIZE command, then the GREENTIMES and YELLOWTIMES are not needed and the MINIMUMS, PEDWALKS, PEDFDWS and REQCHANGE+CLEARS are required. If a version of the host program other than the most current version is to be used, this must be indicated with the OUTPUT command.

Optional inputs include the SIMULATION command to set parameters which define the type of simulation to be performed, and the MASTERNODE command to define which intersection represents the master node. The NODELOCATION, RIGHTTURNONREDS, LANES, GROUPTYPE, TRUCKPERCENTS, PEAKHOURFACTORS, ACTUATIONS, STARTUPLOST, ENDGAIN, STORAGE, LEADLAGS, PERMISSIVES, OVERLAPS and PHASEMOVEMENTS commands may also be used to further define the intersection coordinates, movement's RTOR, lanes, lane group types, heavy vehicles, peak hour factors, actuated, startup lost time, end gain time and storage conditions, and the SEQUENCE of operation at each signal. Route entries may also be used to define specific arteries in the system, especially if the PROS optimization is to be used in TRANSYT. If a subset of the entire NODELIST is to be analyzed, this can be done conveniently by using the SUBSYSTEM command.

**Timing Diagrams Inputs.** In order to produce phasing and timing diagrams for each intersection, virtually the same basic inputs are required as for a simulation EXPORT, as described above, including the GREENTIMES, YELLOWTIMES and OFFSET inputs. The major exception is that the NETWORK, WIDTHS and SATURATIONFLOWS are not required, nor are any of the optional inputs described above, such as SIMULATION, etc. Note that VOLUMES are required in order to display the proper arrows in the phasing diagram. The special phasing commands may be used to further define the SEQUENCE used, and SUBSYSTEM may be used to see a subset of the NODELIST.

**Time-Space Inputs.** In order to produce time-space diagrams, the input requirements are the same as the timing diagrams inputs, except that the NETWORK inputs are required and the VOLUMES inputs are not.

## Input Limitations (for Export and Import)

TEAPAC is designed to export to simulate and optimize the operation of as many as 500 four-legged intersection using any of the third-party host programs supported. In accomplishing this objective, certain limitations in the input and use of the program exist. These are described in this section. In some instances, references to Chapter 5 are made where techniques are described to get around some of these limitations. None of these limitations constrain the basic use of the program for most situations, however, and this section should not be viewed as diminishing the usability of the program, but merely documenting the limitations which should be observed in its use.

Usage Level 2 of TEAPAC allows the definition of up to 100 intersections for analysis; Usage Level 3 handles up to 500 intersections. Smaller systems can also be defined with these large versions of TEAPAC. Usage Level 1 of TEAPAC will only allow the definition of up to 12 intersections for a single analysis.

As many as four approaches can be analyzed for each intersection as long as they generally follow the geometric layout of two two-way streets which cross each other. The primary concern here is that the designated left turns conflict with through movements on the opposite approach as in a normal four-way intersection, since these are what the pre-coded sequences address. Sixty-four phasings can be handled automatically through use of the standard TEAPAC phase sequence numbering scheme described in Chapter 1. Through use of sequence codes less than 0 and the PHASEMOVEMENTS command, completely arbitrary phasings can be handled, as long as the rules of describing the phasing are followed for the PHASEMOVEMENTS command.

The host models can be very comprehensive models, and all options of the models inevitably cannot be coded directly with TEAPAC. This includes such things as modeling shared stop lines, link-specific adjustment factors, and the like. When these options are desired, the EXPORTed host input file can be modified to include these. This allows TEAPAC to perform the bulk of the third-party input effort and the user to exercise the more detailed aspects of the model.

## Analysis Procedures (for Export and Import)

When using TEAPAC for export and import, it is important to understand the fundamentals of how the data entries and actions are used together in order to get results in an efficient and accurate manner. In the example in Chapter 2, certain processes produced specific results. In this section, these steps are reviewed and discussed in detail to provide a more complete understanding of the program functions. First the basic analysis procedures are outlined, then more specialized procedures are described, both using TRANSYT as an example of a typical third-party host program. Chapter 5 describes unique ways that these basic and special procedures can be combined to solve unusual problems related to export and import.

Sub-topics for this section:

- Basic Analysis Procedures (for Export and Import)
- Special Analysis Procedures (for Export and Import)
- Printing and Saving Export Results (for Export and Import)

## Basic Analysis Procedures (for Export and Import)

In performing any of the export and import functions of TEAPAC, the basic method of using the program is to enter the parameters which describe the signalized system conditions, as described in the Input Requirements above, then follow this with the either the EXPORT, TIMINGPLAN or PLOTTSD commands. These entries and actions are done with the Edit and Results menus, respectively. If properly installed, the AUTO option of EXPORT can be used to link directly to the host program. The Results menu allows the direct IMPORT of the host's results and manipulation of the commonly changed values which follow an analysis, such as OFFSETS, as well as either the TIMINGPLAN or PLOTTSD commands.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. Chapter 6 describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

## Special Analysis Procedures (for Export and Import)

TEAPAC can also be used in a sequential manner for the typical steps of a signal timing effort. If existing timings for a network are known, it is usually desirable to simulate these timings prior to a network optimization, then optimize the network so the simulated before and after conditions can be compared. This is done easily using TEAPAC, as described below using TRANSYT as an example third-party program.

First, all of the known timing and phasing information should be entered for each intersection along with the basic geometric, demand and capacity information, as described in the Minimum Requirements section above. Then the PLOTTSD command can be issued to draw a time-space diagram of these existing conditions. The TIMINGPLAN command can also be issued to document the complete timing and phasing information which was entered. Then the EXPORT command is used to create a simulation run of TRANSYT, using the SIMULATION command to detail the simulation parameters. This run of TRANSYT can also be used to check the resultant TRANSYT model for validity and reasonableness.

Following a successful simulation with TRANSYT, the same data can be EXPORTed to TRANSYT, preceded by the OPTIMIZE command to describe what TRANSYT will be allowed to optimize (only offsets, both splits and offsets, or the cycle and splits and offsets). When TRANSYT finishes, the resultant timings can be IMPORTed into TEAPAC to define the final timings and interactive time-space diagrams can be plotted to observe the results on screen or on the printer. The TIMINGPLAN command can again be used to document in a clear manner what the final timings are.

From this point, it is common to speculate what would happen if certain changes to the timings are made which are intuitively "better" than those produced by TRANSYT. This is typically the result of looking at the time-space diagrams and speculating small changes in offsets which appear to improve the progression of traffic (which TRANSYT doesn't really consider). These changes can be made easily within TEAPAC and re-plotted with PLOTTSD to observe the apparent results. When a satisfactory change has been entered, these inputs can again be exported to TRANSYT in the simulation mode so that the simulation of these timings can be compared to TRANSYT's "optimized" timings. In addition, the TRANSYT optimized timings can be enhanced by initializing the TRANSYT optimization by first optimizing with another program like TEAPAC's progression, PASSER or SYNCHRO. This is easily done by exporting to TEAPAC's progression, PASSER or SYNCHRO and importing the optimized results (usually just the offsets) in the manner described above, followed by a TRANSYT optimization. When completed, the final results can be analyzed by the signal analysis techniques of TEAPAC or by exporting to CORSIM or VISSIM for further assessment by simulation. Using this technique, a final set of timings can be arrived at in a quick and definitive fashion, documented with final PLOTTSD and TIMINGPLAN reports, and stored in the final TEAPAC data file.

The same process can be executed for SUBSYSTEMs of the entire network to assess the potential impact of running the entire system as several independent subsystems.

## Printing and Saving Export Results (for Export and Import)

If the AUTO option of EXPORT is used to make runs of a third-party program directly from TEAPAC, the results of the third-party program must be printed separately if the printed results are desired. This can be done from the third-party program directly, as desired. The name of the file group used is TMPxxx stored in the data subdirectory defined by Options-Setup and the TEAPAC.CFG file.

If these files are to be retained for future review or archival purposes, they must be copied elsewhere or renamed to something different than the TMPxxx name before the next EXPORT with the AUTO option is executed, or they will be over-written by that EXPORT.

CHAPTER 4

# Actions and Entry Parameters

Chapter 4 Topics

This chapter provides a summary description of all of the actions and entry parameters of the program. The usage format of each command dialog and associated parameter values are provided along with a functional description of the command dialog. The dialogs are grouped and presented in the following three logical categories:

- [Results] Dialogs - action commands found in the Results menu which are specific to the act of solving the traffic problems addressed by TEAPAC, and used to control the type of analysis performed.

- [Parameters] Dialogs - entry commands found in the Edit menu which are specific to the process of entering data for the traffic problems to be solved by TEAPAC.

- Basic TEAPAC Housekeeping Dialogs - entry and action commands of the program which are used to manipulate and control the program actions. These are found primarily in the DataFiles and Control sub-menus of the File menu.

Table 4-1 describes the detailed organization of how each of the dialogs is presented in this chapter, according to these categories.

**Table 4-1**
**Organization of Command Discussions**

RESULTS Dialogs
- RESULTS Dialogs (for Signal Analysis)
- RESULTS Dialogs (for Traffic Impact Analysis)
- RESULTS Dialogs (for Count Analysis)
- RESULTS Dialogs (for Progression Analysis)
- RESULTS Dialogs (for Export and Import)

PARAMETERS Dialogs
- Commands to Enter Basic Data
- Commands to Enter System Data
- Commands to Enter Intersection Data
- Commands to Enter Approach Data
- Commands to Enter Movement Data
- Commands to Enter Phasing Data
- Commands to Enter Traffic Impact Analysis Data
- Commands to Enter Count Analysis Data
- Commands to Enter Progression Analysis Data

Basic TEAPAC Housekeeping Dialogs
- Commands to Aid Interactive Input of Data
- Commands to Label Output
- Commands to Control Operation of Program
- Commands to Access Data Stored in Files
- Commands to Control Program Execution

For each command dialog discussed, the basic usage format is provided, as shown in the sample format below:

**COMMAND <Parameter Value> 5*<Another Parameter>**

The Command part shows the word label which is used to identify the dialog in the top caption of the dialog box. It is also the word which is selected from the Results or Edit menu to display the dialog, as well as the 'command' word which can be used to make equivalent entries in the manual mode. Parameter names which are enclosed by angle brackets, "<" and ">", indicate that the bracketed description is to be replaced by a parameter value, as described. If a command requires more than one parameter value of the same type, this is represented by an asterisk, "*", preceded by the number of entries expected or allowed. In the example above, as many as five of <Another Parameter> can be entered. This command header is then followed by a summary which describes the main purpose of the command. **Details of the command's usage are found in Appendix B**.

Remember that each dialog has been classified into one or more "groups" which share functional similarities. Appendix A provides a tabular summary of all command dialogs assigned to each command group. Appendix B provides a detailed table of information for each command, listed in alphabetical order by command/dialog name. Appendices A and B can be used as reference documents when questions arise regarding any given group or command.

## Chapter 4 Topics:



## Results Dialogs (for Signal Analysis)

Part of the [Results] dialogs consists of the active command dialogs which perform the various analyses specific to the purpose of the signal analysis functions of TEAPAC. These commands are summarized in this section. All the details about each command dialog can be found alphabetically in Appendix B. The data entry values which must be made prior to using the active commands are listed in the following section.

**URBANSTREET --**
Perform an urban street facility capacity analysis of specified conditions for the current SUBSYSTEM or all intersections.

**DESIGN <Number of Sequences to Analyze>**
Perform an operational design to optimize timings for each sequence of the SEQUENCES command and each cycle of the CYCLES command for the current intersection or all intersections.

**SORT <Priority> <Output>**
Display the DESIGNed sequence codes and performance levels in order from best to worst performance as previously DESIGNed for the current intersection.

**TIMINGS <Sequence Code> <Output>**
Retrieve the optimum timings for the sequence code specified from previously DESIGNed results for the current intersection.

**ANALYZE --**
Perform a capacity analysis of a specified phasing and timings for the current intersection or all intersections.

**EVALUATE --**

Display a performance evaluation for a specified phasing and timings for the current intersection or all intersections.

**QUEUECALCS --**
Display a wide variety of various published queue calculations for a specified phasing and timings for the current intersection or all intersections, including the 2000 and 2016 *Highway Capacity Manual* queue model.

**GOVERCS --**
Compute g/C's required to make each movement operate at specified levels of service for the current intersection or all intersections.

**SERVICEVOLUMES --**
Compute the saturation flow rate (previously called service volumes) for each movement for the current intersection or all intersections.

**DIAGRAMS <Sequence Code>**
Display a phase movement diagram for the specified sequence code for the current intersection.

**MAP --**
Display a schematic intersection diagram of the intersection identifying the twelve turning movement volumes as well as widths and lanes for the current intersection or all intersections.

## Results Dialogs (for Traffic Impact Analysis)

Part of the [Results] dialogs consists of the active command dialogs which perform the various analyses specific to the purpose of the traffic impact analysis functions of TEAPAC. These commands are summarized in this section. All the details about each command dialog can be found alphabetically in Appendix B. The data entry values which must be made prior to using the active commands are listed in the following section.

**FINDPATHS <Distribution Type #>**
Display the five shortest paths for the selected distribution type, prompting for input of the percentage of total distribution type traffic to be assigned to each path.

**SHOWPATHS <Distribution Type #>**
Display a schematic diagram of the development site and network, including defined assignment paths.

**COMPUTEPATHS <Cumulation Function> <List of Distribution Types>**
Calculate the trips generated for each listed distribution type and assign them to the network according to the defined assignments.

## Results Dialogs (for Count Analysis)

Part of the [Results] dialogs consists of the active command dialogs which perform the various analyses specific to the purpose of the count analysis functions of TEAPAC. These commands are summarized in this section. All the details about each command dialog can be found alphabetically in Appendix B. The data entry values which must be made prior to using the active commands are listed in the following section.

**COUNTIMPORT <Data File> <Output> <Special Keys>**
Read the contents of an electronic traffic counter data file and enter its counts in appropriate places within the program.

**COUNTRECONFIG 12*<Destination Movement #>**
Reorganize the positions of movements in the count.

**COUNTTABULATE <Report Option>**
Tabulate 15-minute counts and 60-minute rates and volumes by 15-minute intervals.

**PEAKANALYZE <Start Time> <End Time> <Map Output>**
Compute and display peak hour data for the intersection and each movement between specified times.

**COUNTREPORTS <List of Reports>**
Perform the selected tabulations and/or analyses in the order specified.

**PEAKSUMMARY <Start Time>**
Display a schematic intersection diagram showing hourly volumes and distribution percentages.

**COUNTGRAPH <Maximum Count on Plot>**
Display a graph of total intersection counts for each of the 15-minute count intervals.

**WARRANTS <MUTCD Version> <Warrant Type> <56% Rule>**
Perform a signal warrant analysis and/or multi-way stop warrant analysis using the methods prescribed in the *Manual on Uniform Traffic Control Devices* (MUTCD).

## Results Dialogs (for Progression Analysis)

Part of the [Results] dialogs consists of the active command dialogs which perform the various analyses specific to the purpose of the progression analysis functions of TEAPAC. These commands are summarized in this section. All the details about each command dialog can be found alphabetically in Appendix B. The data entry values which must be made prior to using the active commands are listed in the following section.

**PROGRESSION <Distance Scale>**

Optimize the through-phase offsets to achieve the maximum progressive efficiency for the system and display a simplified time-space diagram for the optimized system.

**PLOTSIMPLE <Distance Scale>**
Display a simplified time-space diagram for the system using the simplified offsets which are presently set with the PRG-OFFSETS command.

## Results Dialogs (for Export and Import)

Part of the [Results] dialogs consists of the active command dialogs which perform the various analyses specific to the purpose of the export and import functions of TEAPAC. These commands are summarized in this section. All the details about each command dialog can be found alphabetically in Appendix B. The data entry values which must be made prior to using the active commands are listed in the following section.

**HCSEXPORT <File name/AUTO>**
Create an HCS-compatible input data file from the current data values for the current intersection, with an optional automatic link to HCS.

**EXPORT <Host> <File/AUTO/STACK> <Display Output> <Auto Option>**
Create a third-party host input data file from the current data values, with an optional automatic link to the host program.

**IMPORT <Host> <File/AUTO> <Display Output> <Import Scope>**
Import signal timings from a host program's output file which was created by a TEAPAC Export, or optionally import an entire network from SYNCHRO.

**PLOTTSD <Scale> <List of Nodes>**
Plot a detailed time-space diagram for the nodes specified.

**TIMINGPLAN <List of Nodes>**
Display the phasing and timings defined for each intersection in the list of nodes, including the system offset value.

## Parameters Dialogs

[Parameters] dialogs are the data entry command dialogs used to enter the parameter values which are specific to the purpose of the analysis. Each is summarized in the following paragraphs. First, those [Parameters] command dialogs for the most basic entries are described. These dialogs are frequently the only ones needed to describe intersection conditions completely, particularly for signal analysis, using the defaults for the remaining [Parameters] dialogs. The remaining [Parameters] command dialogs are then described, organized by the type of inputs they represent, including the basic dialogs. All the details about each command dialog can be found alphabetically in Appendix B.

Sub-topics for this section:

- Dialogs to Enter Basic Data
- Dialogs to Enter System Data
- Dialogs to Enter Intersection Data
- Dialogs to Enter Approach Data
- Dialogs to Enter Movement Data
- Dialogs to Enter Phasing Data
- Dialogs to Enter Traffic Impact Analysis Data
- Dialogs to Enter Count Analysis Data
- Dialogs to Enter Progression Analysis Data

## Dialogs to Enter Basic Data

The following are the command dialogs which are used to enter the basic data to describe the problem to be solved. These commands represent the essential data which is typically required to create a valid signal analysis, and many of these entries are also required in addition to those listed later in this section for a traffic impact analysis, a count analysis later and an export and import analysis.

**NODELIST 500*<Node Number>**
Enter the list of nodes to be studied, as well as the order of the analysis.

**OUTPUT <Function> <Additional OUTPUT Parameters>**
Enter flags regarding output options for different specific functions of the program.

**INTERSECTION <Node #> <Description>**
Select from the NODELIST the node number of the "current" intersection, and optionally enter an intersection description.

**NODELOCATION <X-Y Coordinates>**
Enter the X and Y coordinates of the current intersection.

**NETWORK <Direction> <Distance> <Speed> <Node #> 4*<Movement #> <Assignment Method> <Curvature> <Manual Distance>**
Enter the current intersection's relative location in the system network, including spatial and speed parameters.

**METROAREA <Location>**
Enter the location of the current intersection within the metropolitan area.

**APPLABELS 4*<Approach Label>**
Enter labels for each approach of the current intersection.

**PARKINGSIDES 4*<Parking Location>**

Enter parking conditions on each approach of the current intersection.

**PARKVOLUMES 4*<Parking Volume>**
Enter the number of parking maneuvers per hour on each side of each approach of the current intersection.

**MOVLABELS 12*<Movement Label>**
Enter abbreviated labels for each movement of the current intersection.

**VOLUMES 12*<Design Hour Volume>**
Enter the turning and through movement volumes for each of the movements of the current intersection.

**VOLFACTORS <# Years> 12*<Adjustment Factor>**
Enter number of times to compound and each multiplier used for each movement to adjust the volume or count data entered at the current intersection.

**VOLADDITIONALS <AddFactor> 12*<Additional Volume>**
Enter the factor and additional volume to be added for each movement of the current intersection.

**WIDTHS 12*<Lane Group Width>**
Enter the width of the lane group for each movement of the current intersection.

**LANES 12*<Number of Lanes>**
Enter the number of lanes which are assigned for use by each of the twelve movements of the current intersection

**TRUCKPERCENTS 12*<Truck-Through Bus Percentage>**
Enter the truck and through bus (heavy vehicle) traffic percentage for each movement of the current intersection.

**PEAKHOURFACTORS 12*<Peak Hour Factor>**
Enter the peak hour factor for each movement of the current intersection.

**ARRIVALTYPES 12*<Quality of Progression>**
Enter the quality of progression for each movement of the current intersection.

**ACTUATIONS 12*<Actuated Movement>**
Enter the type of phase module present, actuated or non-actuated, for each movement of the current intersection for use in the determination of the HCM Delay Calibration Term (k).

**MINIMUMS 12*<Minimum Green Time>**
Enter the minimum green time requirements for each of the twelve movements of the current intersection.

**REQCHANGE+CLEARS 12*<Required Change & Clearance>**
Enter the change and clearance times required for each movement of the current intersection.

**SEQUENCES <Sequence Code> <List of Possible Sequence Codes>**
Enter the desired and allowed phasings of the traffic signal of the current intersection according to the codes defined in Figure 1-2 of Chapter 1.

**CYCLES <Minimum Cycle> <Maximum Cycle> <Cycle Increment>**
Enter the range and precision of cycle length scanning for the current intersection for optimization, as well as the given cycle length for analysis of given conditions.

**GREENTIMES 8*<Phase Green Time>**
Enter the duration of green for each of the phases of a specified phase sequence, or optionally for each of the movements, of the current intersection.

**YELLOWTIMES 8*<Phase Yellow Time>**
Enter the yellow change interval at the end of each phase of a specified phase sequence, or optionally for each of the movements, of the current intersection.

## Dialogs to Enter System Data

The following are command dialogs which can be used to describe the system which is being analyzed. Each of these commands has parameters which apply to the entire system. Some of these commands were also included in the Basic Data discussed above.

**NODELIST 500*<Node Number>**
Enter the list of nodes to be studied, as well as the order of the analysis.

**SUBSYSTEM 500*<Node Number>**
Enter the subset of the NODELIST for which subsequent actions should be taken.

**ROUTE <Route #> <List of Artery Nodes>**
Enter a list of node numbers which represent the intersections on the artery for the given route number.

**MASTERNODE <Master Node #>**
Enter the node number of the intersection which is the master node location for the system or subsystem.

**QUEUEMODELS <Model #> <Percentile> <Auto> <Truck>**
Enter parameters which control the queue model calculations used for all intersections under study.

**SIMULATION <Steps/Cycle> <Analysis Period> <Stop Penalty>
<Link Numbering Method> <Model Actuated>**

**<Assignment Method>**
Enter simulation control parameters, including the length of the analysis period for all intersections under study.

**OPTIMIZE <Optimization Type> <Step Size List>**
Enter the type of system optimization to be performed by a third-party host program.

**OUTPUT <Function> <Additional OUTPUT Parameters>**
Enter flags regarding output options for different specific functions of the program.

## Dialogs to Enter Intersection Data

The following are command dialogs which can be used to describe the current intersection. Each of these commands has parameters which apply to the entire intersection. Some of these commands were also included in the Basic Data discussed above.

**INTERSECTION <Node #> <Description>**
Select from the NODELIST the node number of the "current" intersection, and optionally enter an intersection description.

**NODELOCATION <X-Y Coordinates>**
Enter the X and Y coordinates of the current intersection.

**NETWORK <Direction> <Distance> <Speed> <Node #> 4*<Movement #> <Assignment Method> <Curvature> <Manual Distance>**
Enter the current intersection's relative location in the system network, including spatial and speed parameters.

**METROAREA <Location>**
Enter the location of the current intersection within the metropolitan area.

**LEVELOFSERVICE <Target Delay/LOS> <Max Delay/LOS> <Delay Incr> <Target v/c> <Max v/c> <v/c Incr>**
Enter the range of delay (or level of service) and v/c which should be tested by a DESIGN optimization and GOVERCS for the current intersection.

**EXCESS <List of Priority Movement Numbers>**
Enter the movements to which the TIMINGS command will assign available excess portions of the cycle length for the current intersection.

## Dialogs to Enter Approach Data

The following are command dialogs which can be used to describe each approach of the current intersection. Each of these commands has four parameters, each applying to all traffic on each of the intersection's approaches. The order of entry is clockwise, starting at the north approach, e.g., first from the North, then from the East, then from the South, then from the West. Some of these commands were also included in the Basic Data discussed above.

**APPLABELS 4*<Approach Label>**
Enter labels for each approach of the current intersection.

**GRADES 4*<Grade of Approach>**
Enter the grade of each approach of the current intersection.

**PEDLEVELS 4*<Pedestrian Interference>**
Enter the level of pedestrian interference for right turns on each approach of the current intersection.

**PEDWALKS <PedMin Factor> 4*<Ped Walk Time>**
Enter the overall pedestrian minimum factor, and the required pedestrian walk time for each approach of the current intersection.

**PEDFDWS 4*<Ped Clearance (FDW) Time>**
Enter the required pedestrian clearance time (FDW, flash don't walk) for each approach of the current intersection.

**BIKEVOLUMES 4*<Conflicting Bicycles>**
Enter the volume of conflicting bicycles for right turns on each approach of the current intersection.

**PARKINGSIDES 4*<Parking Location>**
Enter parking conditions on each approach of the current intersection.

**PARKVOLUMES 4*<Parking Volume>**
Enter the number of parking maneuvers per hour on each side of each approach of the current intersection.

**BUSVOLUMES 4*<Stopping Bus Volume>**
Enter the volumes of stopping buses which stop on each approach of the current intersection.

**RIGHTTURNONREDS 4*<Right Turn on Red Volume>**
Enter the right turn on red volume for the right turns on each approach of the current intersection.

**RTINFLUENCES 4*<Right Turn Influence>**
Enter the right turn influence condition for the right turns on each approach of the current intersection.

**UPSTREAMVC 4*<Upstream v/c Ratio>**
Enter the v/c ratio of the upstream intersection for each approach of the current intersection.

## Dialogs to Enter Movement Data

The following are command dialogs which can be used to describe each movement of the current intersection. Each of these commands has twelve parameters (except APPLABELS), each applying only to traffic on each of the intersection's individual movements. The order of entry is clockwise, starting with the right turn on the north approach, e.g., first RT from the North, then TH from the North, then LT from the North, then RT from the East, etc., up to the LT from the West. Some of these commands were also included in the Basic Data discussed above.

**APPLABELS 4*<Approach Label>**
Enter labels for each approach of the current intersection.

**MOVLABELS 12*<Movement Label>**
Enter abbreviated labels for each movement of the current intersection.

**VOLUMES 12*<Design Hour Volume>**
Enter the turning and through movement volumes for each of the movements of the current intersection.

**VOLFACTORS <# Years> 12*<Adjustment Factor>**
Enter number of times to compound and each multiplier used for each movement to adjust the volume or count data entered at the current intersection.

**VOLADDITIONALS <AddFactor> 12*<Additional Volume>**
Enter the factor and additional volume to be added for each movement of the current intersection.

**WIDTHS 12*<Lane Group Width>**
Enter the width of the lane group for each movement of the current intersection.

**LANES 12*<Number of Lanes>**
Enter the number of lanes which are assigned for use by each of the twelve movements of the current intersection

**GROUPTYPES 12*<Lane Group Type>**
Enter the special lane group type for each possible lane group of the current intersection, such as dual-optional lanes, free-flow lanes and sign-controlled lanes.

**UTILIZATIONS 12*<Lane Utilization Factor>**
Enter the lane utilization factor for each movement of the current intersection.

**TRUCKPERCENTS 12*<Truck-Through Bus Percentage>**
Enter the truck and through bus (heavy vehicle) traffic percentage for each movement of the current intersection.

**PEAKHOURFACTORS 12*<Peak Hour Factor>**

Enter the peak hour factor for each movement of the current intersection.

**ARRIVALTYPES 12*<Quality of Progression>**
Enter the quality of progression for each movement of the current intersection.

**ACTUATIONS 12*<Actuated Movement>**
Enter the type of phase module present, actuated or non-actuated, for each movement of the current intersection for use in the determination of the HCM Delay Calibration Term (k).

**FIRSTDETECTS 12*<First Detection>**
Enter the position of first detection for each movement of the current intersection.

**LASTDETECTS 12*<Last Detection>**
Enter the position of last detection for each movement of the current intersection.

**MINIMUMS 12*<Minimum Green Time>**
Enter the minimum green time requirements for each of the twelve movements of the current intersection.

**REQCHANGE+CLEARS 12*<Required Change & Clearance>**
Enter the change and clearance times required for each movement of the current intersection.

**REQYELLOWS 12*<Required Yellow Change>**
Enter the yellow change time required for each movement of the current intersection.

**STARTUPLOST 12*<Startup Lost Time>**
Enter the length of the lost time at the beginning of a movement's green period for each of the twelve movements of the current intersection.

**ENDGAIN 12*<End Gain Time>**
Enter the length of time that vehicles effectively extend the green period into the yellow and all-red period for each of the twelve movements of the current intersection.

**STORAGE 12*<Storage Distance>**
Enter the amount of storage distance for queued vehicles for each of the twelve movements of the current intersection.

**INITIALQUEUE 12*<Initial Queue Size>**
Enter the number of vehicles queued at the intersection at the start of the analysis period for each of the twelve movements of the current intersection.

**IDEALSATFLOWS 12*<Ideal Saturation Flow Rate>**
Enter the base (ideal) saturation flow rate for each movement of the current intersection.

**FACTORS 12*<Satflow Adjustment Factor>**

Enter satflow adjustment factors for each movement of the current intersection to adjust *Highway Capacity Manual* satflow computations.

**DELAYFACTORS 12*<Delay Adjustment Factor>**
Enter factors for each movement of the current intersection used to adjust the delay calculations, for example, to match delays obtained from a network simulation model.

**NSTOPFACTORS 12*<Stops Adjustment Factor>**
Enter twelve factors used to adjust the number of stops calculations of the EVALUATE report of the current intersection, for example, to match the number of stops obtained from a network simulation model.

**NEMAPHASES 12*<NEMA Phase Designation>**
Enter the NEMA phase number designation for each movement of the current intersection.

**SATURATIONFLOWS 12*<Stream Saturation Flow>**
Store the results of saturation flow rate computations of the current intersection. When computational commands of the Analysis Mode like ANALYZE, EVALUATE, QUEUECALCS, GOVERCS and SERVICEVOLUMES are executed, the calculated saturation flows are dumped into this command dialog.

## Dialogs to Enter Phasing Data

The following are command dialogs which can be used to describe the phasing at the current intersection. Some of these commands were also included in the Basic Data discussed above.

**SEQUENCES <Sequence Code> <List of Possible Sequence Codes>**
Enter the desired and allowed phasings of the traffic signal of the current intersection according to the codes defined in Figure 1-2 of Chapter 1.

**PERMISSIVES 4*<Permissive Left>**
Enter an option for each approach of the current intersection identifying the permissibility of left-turning traffic to turn on a through phase following or preceding an exclusive left turn phase (e.g. a protected-permitted left-turn or a permitted-protected left-turn, also referred to as compound left-turn phasing).

**OVERLAPS 4*<Right Turn Overlap>**
Enter how right turn overlaps are to be handled for each approach of the current intersection.

**LEADLAGS 2*<Lead-Lag Phasing>**
Enter the order of the phases, particularly in multiphase operation, of the current intersection.

**GAPOUTS 2*<Gapout Status>**
Enter the status of the simultaneous gapout setting for each direction of phasing at the current intersection.

**DALLASLEFTS 2*<Dallas Left Operation>**
Enter the status of Dallas left operation for each direction of phasing at the current intersection.

**CYCLES <Minimum Cycle> <Maximum Cycle> <Cycle Increment>**
Enter the range and precision of cycle length scanning for the current intersection for optimization, as well as the given cycle length for analysis of given conditions.

**GREENTIMES 8*<Phase Green Time>**
Enter the duration of green for each of the phases of a specified phase sequence, or optionally for each of the movements, of the current intersection.

**YELLOWTIMES 8*<Phase Yellow Time>**
Enter the yellow change interval at the end of each phase of a specified phase sequence, or optionally for each of the movements, of the current intersection.

**REDCLEARTIMES 8*<Phase All-Red Time>**
Enter the red clearance interval (all-red time) at the end of each phase of a specified phase sequence, or optionally for each of the movements, of the current intersection.

**PASSAGETIMES <Min Include Factor> 8*<Nema Extension Time>**
Enter the vehicle extension time (passage time) for each Nema movement of the current intersection, as well as a factor to include extension time in minimums.

**RECALLS 8*<Nema Recall Status>**
Enter the phase recall status for each Nema movement of the current intersection.

**DUALENTRYS 8*<Nema Dual Entry Status>**
Enter the phase dual entry status for each Nema movement of the current intersection.

**GREENAVERAGES 8*<Phase Average Green Time>**
Enter/store the average duration of green for each of the phase movements of the current intersection.

**CRITICALS 8*<Critical Movement Number>**
Enter the movement which is critical for each phase of the phase sequence of operation of the current intersection.

**PEDTIME <Exclusive Pedestrian Phase Time> <Phase Number>**
Enter the time for an exclusive pedestrian scramble phase of the current intersection.

**OFFSET <Offset> <Phase Number>**
Enter the coordinated offset for a phase of the phase sequence of the current intersection.

**PHASEMOVEMENTS <Phase Number> <List of Movements>**

Enter the movements permitted during each phase for a non-standard phasing of the current intersection.

## Dialogs to Enter Traffic Impact Analysis Data

The following are command dialogs which can be used to describe additional data required to conduct a traffic impact analysis. These are in addition to many of the Basic Data inputs described above which are also required in order to set up the network for a traffic impact analysis. See Table A-2 in Appendix A for a breakdown of all commands which affect a traffic impact analysis.

**SITESIZE <# of Distribution Types> <# of Inbound Types>**
Enter the number of distribution types to be used to describe the inbound and outbound traffic generation.

**ROUND <Precision of Totals>**
Enter the precision to be used in computing the traffic impact analysis results.

**BASE <Generation Base> <X-Y Coord LL> <X-Y Coord UR>**
Enter the base development size for generating trips as it relates to the generation rates used for the development.

**GENERATION <Direction> <Generation Rate> 10*<Node-Dir>**
Enter the traffic generation rates and access points and access directions for the development.

**PATHDISTRIBUTION <Distr Type #> <Distr %> <Node #> <Node Dir> <Descr>**
Enter and set the current distribution type number, and enter its related distribution percentage, external node, and description.

**PATHASSIGNMENT <Path #> <Path %> <Path List>**
Enter a path (list of intersections) which vehicles of the current distribution type follow when traveling to and from the development.

**ASSIGNMENT <Type #> <Intersection #> 12*<<Movement #> <Assignment Factor>>**
Enter the percentage of a distribution type to be assigned to the movements at an intersection. This is only used to define special assignment situations, and is not normally used for typical site traffic assignment situations.

## Dialogs to Enter Count Analysis Data

The following are command dialogs which can be used to describe additional data required to conduct a count analysis. These are in addition to many of the Basic Data inputs described above which are also required in order to set up the network for a count analysis. See Table A-2 in Appendix A for a breakdown of all commands which affect a count analysis.

**COUNTTYPE <Type of Data> <Type of Truck Counts> <Count Description>**
Enter the type of count data which is to be supplied to the program at the current intersection, and to provide a description of the count.

**PERIODS <Count Interval> 5*< <Start Time> <Stop Time> >**
Enter the count interval and the beginning and ending times for each count period for which subsequent data will be entered at the current intersection.

**CONDITIONS <Major Direction> <# N-S Lanes> <# E-W Lanes>**
**<High Speed> <Low Population>**
**<Progression Impact> <Remedial Actions Failed>**
**<# Accidents for Signal> <Stop Sign Delay>**
**<# Accidents for Stop> <Minor Street Delay>**
**<Extra Warrants>**
Enter intersection conditions which affect the conduct of a Warrant Analysis at the current intersection.

**ADTFACTOR <Factor to Expand Counts to 24 Hour Volumes>**
Enter a factor which will be used to estimate 24-hour volumes from partial day's counts at the current intersection.

**VEHICLECOUNTS <Movement or Time> <List of Counts>**
Enter the count of vehicles for a count interval or movement number at the current intersection.

**TRUCKCOUNTS <Movement or Time> <List of Counts>**
Enter the count of trucks for a count interval or movement number at the current intersection.

## Dialogs to Enter Progression Analysis Data

The following are the command dialogs which are used to enter the data to describe a progression analysis problem to be solved. These commands are independent of any of the other commands which are used to describe a network with TEAPAC, as described earlier in this chapter. Any entries made here will be saved with the rest of the data for the network. These inputs can also be generated from the data for the entire network using the Export dialog and selecting the NOSTOP host.

**PRG-SIZE <Number of Signals>**
Enter the number of signals on the arterial to be progressed.

**PRG-BASE <Base Intersection Number> <Base Offset>**
Enter the base intersection location to which all offsets will be related, as well as the absolute offset which the base location must have.

**PRG-CLEARANCES <System Clearance Time>**

Enter the clearance interval time to be used at the end of all through phases in the system.

**PRG-DIRECTIONS <Progression Designation>**
Enter the number of directions of traffic flow to be progressed on the route.

**PRG-UNITS <Measurement System>**
Enter the system of measurement to be used for the units of the input parameters.

**PRG-NAMES 25*<Cross Street Name>**
Enter the descriptive information which labels the cross street for input and output identification purposes.

**PRG-SPLITS 25*<Through Split>**
Enter the percentage of time available for through traffic movement in both directions at each intersection.

**PRG-DISTANCES 24*<Link Distance>**
Enter the distances between intersections.

**PRG-SPEEDS <Direction> 24*<Link Speed>**
Enter the desired progression speed in either or both directions for each link of the system.

**PRG-CYCLES <Minimum Cycle> <Maximum Cycle> <Cycle Increment>**
Enter the range of cycles to be considered in the design of the progressive system.

**PRG-TOLERANCE <Speed Tolerance> <Speed Increment>**
Enter the permitted variation of progression speeds around the entered PRG-SPEEDS.

**PRG-RATIO <Band Ratio>**
Enter the desired ratio between the sizes of the directional progressive bands.

**PRG-ADJUST <Speed Factor>**
Enter the factor by which all link speeds entered on the PRG-SPEEDS command will be adjusted.

**PRG-ALLREDS 25*<All-Red Clearance Time>**
Enter the amount of all-red clearance time used at each intersection in the system.

**PRG-NONCONCURRENT 25*<Nonconcurrent Condition>**
Enter the nonconcurrent mainline green indicator at each intersection in the system (split phase).

**PRG-AVAILABLE 25*<Lead/Lag Phase Direction>**
Enter the locations where the optimum timings should include all of the available time for leading or lagging turning phases which will not shrink the through band.

**PRG-LEADLAG <Direction> 25*<Lead/Lag Phase Time>**
Enter the specific lead/lag left-turn phase timings for each intersection in the system.

**PRG-OFFSETS <Direction> 25*<Through Phase Offset>**
Enter the offsets for the through phase at each intersection.

**PRG-FINETUNE <Finetune Indicator>**
Enter the indicator which instructs the design procedure to perform a second iteration of optimization.

**PRG-LINKNODEDATA <Intersection Number> <List of Link-Node Data>**
Enter all parameter values for an intersection and its adjacent link.

## Basic TEAPAC Housekeeping Dialogs

The following are the command dialogs which allow the user to perform many basic 'housekeeping' tasks in TEAPAC. These commands control interactive functions, output labeling, program operation, permanent data storage and program execution, and many can also be performed by the typical Windows menus options. These commands are summarized in this section. All the detail about these commands is found alphabetically in Appendix B of this manual with the other commands of the program discussed previously.

Sub-topics for this section:
- Dialogs to Aid Interactive Input of Data
- Dialogs to Label Output
- Dialogs to Control Operation Of Program
- Dialogs to Access Data Stored In Files
- Dialogs to Control Program Execution

## Dialogs to Aid Interactive Input of Data

The command dialogs described below have functions related to the interactive use of the program. These commands control on-screen help functions as well as provide the means to review program data. Many of these commands act on a set of commands as their parameter values.

**MESSAGES <Level of Messages>**
Display messages concerning changes made to the program since the last printing of the tutorial/reference manual.

**HELP <List of Commands>**
Display the command names, parameter descriptions, and default values for each command listed.

**ASK <List of Commands>**

Produce a dialog box display for each of the listed commands.

**RESET** **<List of Commands>**
Reset the parameters of the specified commands to their default values.

**DATA** **<List of Commands>**
Display the current parameter values for the specified commands.

**SUMMARIZE** **--**
Display a formatted summary of all [Parameters] values. It has no parameters.

## Dialogs to Label Output

The four command dialogs described below control the report headings of the program. Report headings are used to identify the conditions of an analysis. Report headings are critical when multiple analyses are performed and documentation of various conditions analyzed is required.

**PROJECT** **<First Title Line>**
Enter the first line of information used to identify the situation being analyzed.

**DESCRIPTION** **<Second Title Line>**
Enter the second line of information used to identify the situation being analyzed.

**NOTE** **<Third Title Line>**
Enter the third line of information used to identify the situation being analyzed.

**HEADING** **<Number of Lines>**
Display the current title heading lines.

## Dialogs to Control Operation of Program

The following command dialogs control various aspects of program operation.

**ECHO** **<Input/Output Echo Condition>**
Enter the echo condition flag indicating whether or not command information should be displayed after being input from or output to a file.

**IODEVICES** **<Visual View> <Page #> <Lines/Pg> <Last Line #>**
Set the visual view style for dialogs, as well as the page number and the size of the output medium (i.e., paper).

**NEWPAGE** **<Page Advance Option>**
Enter a flag indicating that the next output report should begin with title headings at the top of the next page.

## Dialogs to Access Data Stored In Files

The following command dialogs are used when analysis data and/or commands are to be stored in permanent data files for later use.

**FILES 5*<File Name>**
Enter the names of the permanent storage file areas where information is to be LOADed and SAVEd.

**SAVE <Line Number> <File Number> <List of Commands>**
Save the current parameter values of the listed commands in permanent storage locations specified by the FILES command, for future retrieval with the LOAD command.

**LOAD <Line Number> <File Number> <LOAD Type> <# Blocks>**
Input commands and parameters from permanent storage locations specified by the FILES command.

**RETURN --**
Return to the source of input which was being used when the last LOAD command was encountered. It has no parameters.

**NEXTLINES 5*<Next Line of File>**
Enter the default next line to be accessed in each of the five files.

## Dialogs to Control Program Execution

The following command dialogs are used to direct program control. Typically, these commands are used within "control" files to execute a series of program steps.

**STOP <Next Program>**
Stop running the current program and optionally run a new program.

**REPEAT <Variable Name> <First Val> <Last Val> <Increment>**
Initiate a loop in a control file so that the set of commands which follow will be repeated a finite number of times.

**GOTO <Destination>**
Divert the input stream within a file by providing the next location to be LOADed from that file.

**CALCULATE <Algebraic Expression>**
Perform a calculation for the given expression and optionally assign the integer result to a user variable.

CHAPTER 5

# Advanced Application Procedures

Chapter 5 Topics

Chapters 1 through 4 covered the basic methods and commands required to use TEAPAC to solve most problems which will be encountered. The advanced application procedures discussed in this chapter can greatly increase efficiency in solving problems with TEAPAC, as well as provide insights into how to use the program to solve unusual problems. These discussions are sub-divided by the major application functions included in TEAPAC. Before beginning this section, it is necessary to have a good understanding of the material covered in the previous chapters. If this is not the case, please review this material prior to continuing. Chapters 6 and 7 can also be used to discover generic advanced analysis procedures which can be used by all TEAPAC application functions.

## Sharing Data Between All TEAPAC Applications

A major element in the design of TEAPAC is the ability to share both input and output data amongst all TEAPAC application functions which can make valid use of the data. A rather obvious case of this 'sharing' is when any user change to a data value simply becomes available to any and all application functions which are subsequently executed. This 'sharing' is particularly helpful and not as obvious when the data value being 'shared' is the result of one function's computations which then becomes an input to the next application function. Examples of circumstances where this exchange of results might occur are illustrated below:

**Signal Analysis Results**

- Computed HCM-compliant SATURATIONFLOWS become available to **Export** functions for use by PASSER, TRANSYT, CORSIM, SYNCHRO, TRU-TRAFFIC or TS/PP-DRAFT.
- HCM-optimized SEQUENCES, GREENTIMES and YELLOWTIMES become available to **Export** functions for use by NOSTOP, PASSER, TRANSYT, CORSIM, VISSIM, SYNCHRO, TRU-TRAFFIC or TS/PP-DRAFT for various forms of coordinated operation assessment and/or optimization.

**Traffic Impact Analysis Results**

- Projected added volumes (VOLADDITIONALS) become available to **Signal Analysis** functions for HCM-compliant capacity analysis, HCM phasing/timing optimization or intersection design which must be performed for the Traffic Impact Analysis.
- Projected added volumes (VOLADDITIONALS) become available to **Export** functions for use by PASSER, TRANSYT, CORSIM, VISSIM, SYNCHRO, TRU-TRAFFIC or TS/PP-DRAFT to further model or optimize the projected Traffic Impact Analysis.

**Count Analysis Results**

- Peak 15-minute or 60-minute VOLUMES (and possibly TRUCKPERCENTS and/or PEAKHOURFACTORS) become available to **Signal Analysis** functions for HCM-compliant capacity analysis, HCM phasing/timing optimization or intersection design for the counted conditions.
- Peak 15-minute or 60-minute VOLUMES (and possibly TRUCKPERCENTS and/or PEAKHOURFACTORS) become available to **Export** functions for use by PASSER, TRANSYT, CORSIM, VISSIM, SYNCHRO, TRU-TRAFFIC or TS/PP-DRAFT to further model or optimize the counted conditions.
- Peak 15-minute or 60-minute VOLUMES become available to **Traffic Impact Analysis** functions as background traffic for projecting total traffic conditions.

**Export and Import Results**

- Imported optimized OFFSETS (and possibly GREENTIMES) become available to **Signal Analysis** functions or other **Export** functions for evaluation, graphical rendition, simulation, animation or further optimization.

Traffic volumes are an important element either determined by or used by virtually all application functions of TEAPAC, thus a discussion here of how volume information flows among all the TEAPAC applications will be helpful. Analysis volumes in TEAPAC applications are the additive combination of VOLUMES and VOLADDITIONALS entries. Thus, for any given movement, the VOLUMES entry for that movement is added to the VOLADDITIONALS entry for that movement to arrive at the analysis volume for that movement. For added flexibility, VOLUMES entries can be factored up or down by corresponding VOLFACTORS entries (with the additional possibility of compounded growth applied to those factors) and VOLADDITIONALS entries can be factored up or down by a separate factor. Normally, VOLUMES will be either entered by the user or set automatically by peak period analysis in a Count Analysis (consistent with the then-current VOLFACTORS entries). Normally, VOLADDITIONALS will be either entered by the user or set automatically by traffic generation computations in a Traffic Impact Analysis (consistent with the then-current VOLUMES and VOLFACTORS entries). The user is directed to the specific formulas for analysis volume determination described in detail in Appendix C.

## Chapter 5 Topics:

## Chapter 5 Topics (for Signal Analysis):



## Multi-Leg Intersections (for Signal Analysis)

TEAPAC can be used to perform capacity analyses of multi-leg intersections, that is, intersections with more than four approach legs. These are typically, but not limited to, five and six leg intersections. TEAPAC can also be used in an iterative fashion to optimize timings for multi-leg intersections. All of this is described below.

Sub-topics for this section:



## Capacity Analysis (for Signal Analysis)

The secret to using TEAPAC for multi-leg intersection analysis is use of the PEDTIME command, which is normally used to define an all-red time for a pedestrian scramble phase. In this case, PEDTIME is used to hold time for the legs of the intersection which cannot be included in the analysis. To do this, the four primary legs of the intersection should be identified, which hopefully use a phasing which is similar to one of the standard phasings of TEAPAC. These legs should be entered into TEAPAC as an intersection, using the normal data entry methods. The only difference is that a PEDTIME command should be used to define the period of time during the cycle when the other movements which are not included in the analysis receive a green indication. This time will be completely removed from the cycle and the capacity analysis of the entered movements will be correct. The remaining movements should then be entered into TEAPAC as a separate intersection, again using PEDTIME to define the period of the cycle used by the movements of the first analysis. As before, these movements should be entered such that a standard TEAPAC phasing can be used. In this entry process, at least one movement must exist for a North-South phase and one for an East-West phase, so a dummy movement with 1 vehicle per hour may need to be defined to meet this requirement, or legs of the previous analysis can be re-used.

## Timing Optimization (for Signal Analysis)

If the above analysis can be conducted using a standard phasing code, then the DESIGN command can be used to optimize timings for the entire intersection, using a small bit of iterative analysis. If the cycle length to be used is known, a guess at the "pedtime" for each intersection part must be made and subsequently revised until the desired balance between the performance of each part is obtained. If the cycle length is not known in advance, this guesswork is a bit more complex since the PEDTIME entry is made in seconds and must be related to a percentage of the cycle length which is not yet know. In this case, simply guess also at the cycle length which might result before guessing at the "pedtime", and iterate. If the phasing cannot be represented by a standard sequence code, then use a similar sequence code so the GOVERCS command can be used to determine the G/C requirements for each movement at each level of service. Then the GREENTIMES used can be assigned manually to phases of the non-standard phasing using these results as a guide.

## Dual-Optional Turn Lane Analysis (for Signal Analysis)

When a shared lane allows turns which also move in an adjacent exclusive turn lane, computation of saturation flow and delay is not explicitly covered by the 2000 *Highway Capacity Manual*, in that the number of turns in the shared lane must be determined. Use of the DUALOPTIONAL option of the GROUPTYPES command provides an automated solution to this problem in an approximate manner by computing the turns in the shared lane in a manner that approximately balances the v/c ratios in the affected lane groups (without also exceeding the designated lane utilization inputs). Frequently this solution is adequate. The following is a method which allows more complete analysis of this condition, if desired.

The basic method is to determine what turning volume is likely to turn from the shared lane, and to adjust the saturation flow rate computations to reflect this number. The analysis proceeds specifying to TEAPAC a single exclusive turn lane and the through lane not being shared with this turn lane. A phasing and G/C estimates are also entered. The GOVERCS command is then used to determine how much G/C is required by the two adjacent lane groups, the exclusive turn lane and the through lane group. By comparing these G/C requirements at the level of service expected to be experienced, the number of turning vehicles operating from the through lane group can be deduced. This is then accounted for by using the FACTORS command for the two lane groups to increase the capacity of the single exclusive turn lane (to effectively account for the additional capacity gained from turners in the through lane group) and to decrease the capacity of the through lane group. The following formulas can be used to determine these factors.

$$F_{trn} = K / G_{th}$$

$$F_{th} = K / G_{trn}$$

$$K = \frac{(V_{th} * G_{trn}) + (V_{trn} * G_{th})}{\quad}$$

$V_{th} + V_{trn}$

where:
- $F_{trn}$ = factor to apply to calculation of turning lane saturation flow rate
- $F_{th}$ = factor to apply to calculation of through lane group saturation flow rate
- $K$ = constant for calculations
- $G_{trn}$ = G/C required for turning lane at target level of service, determined from GOVERCS command
- $G_{th}$ = G/C required for through lane group at target level of service, determined from GOVERCS command
- $V_{trn}$ = demand volume for turning lane group
- $V_{th}$ = demand volume for through lane group

If $F_{trn}$ is calculated as less than 1.00, no use of the through lanes will be made by the turning vehicles and the analysis should not be modified any further. Consideration of removing the dual-optional lane usage of an existing condition should be considered if this is the case.

If $F_{trn}$ is calculated as more than about 1.80, the analysis should be re-specified as an exclusive dual turning lane and one less lane in the through lane group, since the added capacity effect of the shared turn-through lane clearly cannot exceed 2.00 -- this would be roughly the same as having exclusive dual turning lanes.

Note that when a dual-optional lane group is operated, it must be limited to a phasing that only allows both the turning traffic and the through traffic to operate together during a single phase indication. This is usually a split-phase operation, sequence type 7.

After the FACTORS are applied, the analysis should be checked to observe roughly the same amount of delay to both the single turn lane group and the adjacent through lane group. Furthermore, to be precise about the analysis, if the level of service of these two lane groups and/or the initial G/C estimates are not the same as assumed when using the G/C values from the GOVERCS command, new FACTORS should be calculated using the new expected level of service G/C values and the process should be iterated until all the results are in agreement with the initial assumptions. This normally requires at least one additional set of computations.

## Sharing Data Between All TEAPAC Applications (for Signal Analysis)

The introduction of this chapter described in general the types of data sharing which normally occur between the various application functions of TEAPAC - Signal Analysis, Traffic Impact Analysis, Count Analysis, and Export and Import. The following discussion provides further application-specific notes about data file sharing for Signal Analysis.

Sub-topics for this section:

## Input Data from Count Analysis and Traffic Impact Analysis (for Signal Analysis)

TEAPAC's signal analysis functions can provide capacity analyses and timing/phasing optimizations for traffic volumes which are either tabulated from TEAPAC's count analysis functions, or estimated from TEAPAC's traffic impact analysis functions.

For existing conditions, TEAPAC's count analysis can provide useful results for its signal analysis. After the turning movement count summaries and peak-period analyses are completed, the peak-period VOLUMES entries which are created are normally used as existing traffic volumes for capacity analyses. The VOLUMES results of the peak-period analyses are automatically placed in the VOLUMES dialogs so they are immediately available for these purposes. Note also that these VOLUMES can be easily factored by using the individual VOLFACTORS entries, as well as the global entry of VOLFACTORS when intersection 0 (all intersections) is selected.

For planning analyses of projected volumes, TEAPAC's traffic impact analysis can be used in exactly the same manner as its count analysis, creating a set of projected VOLADDITIONALS, allowing an additional analysis to be performed on projected volumes, as well as existing volumes. With the DESIGN feature of the signal analysis, this allows immediate optimization of projected conditions, making TEAPAC a perfect tool for applying the *Highway Capacity Manual* operations method to planning analyses without the need for the more approximate planning method of the *Highway Capacity Manual*. This optimization can also be used to quickly assess the value of various mitigation improvement alternatives for an impact study. Note also that these VOLADDITIONALS can be easily factored by using the individual VOLADDITIONALS factor entry, as well as the global entry of the factor when intersection 0 (all intersections) is selected. Another use of the factor, including its global entry, is to temporarily disable the VOLADDITIONALS by using a factor of 0.

## Using Results for Export (for Signal Analysis)

TEAPAC's signal analysis functions can provide a number of relevant analyses for typical arterial and network signal timing studies with PASSER, TRANSYT, NETSIM/CORSIM, VISSIM, SYNCHRO/SIMTRAFFIC, TRU-TRAFFIC, TS/PP-DRAFT and NOSTOP. For existing conditions, they can provide a complete and comprehensive capacity analysis (including computation of saturation flow rates and average green times) strictly according to the methods of the *Highway Capacity Manual* (HCM). When optimizing the signal timings of each signal in an arterial, TEAPAC will consider HCM level of service, virtually every possible phasing combination (for both the major street and the cross street), and will completely consider the effects which right turns, clearance intervals, minimums, target delays and movement priorities have on the best timings. These optimized conditions are automatically placed in the appropriate dialogs for SEQUENCE, CYCLE, GREENTIMES, YELLOWTIMES and REDCLEARTIMES and are immediately available for any of TEAPAC's export functions. This virtually eliminates any additional input at all for these functions, using all of the data already entered and optimized from the signal analysis.

Also, if the SATURATIONFLOWS and GREENAVERAGES computed by the signal analysis are to be used by the export, they appear automatically in the appropriate dialogs after using the ANALYZE or SERVICEVOLUMES commands.

These features allow the immediate and joint use of TEAPAC's HCM capacity analysis and HCM delay optimization, TEAPAC's bandwidth optimization, PASSER's bandwidth optimization, TRANSYT's simulation and optimization, TRU-TRAFFIC's or TS/PP-DRAFT's time-space platoon progression diagram, SYNCHRO's simulation and optimization, and CORSIM's or VISSIM's simulation and animation for the data input only once into TEAPAC.

## Analysis Period and the Use of PEAKHOURFACTORS (for Signal Analysis)

Peak hour factors (PHF) are always applied to the input demand volume to determine the "adjusted volume" for use in the saturation flow, v/c, and delay calculations. This adjusted volume is, in fact, an estimate of the flow rate of each movement during the peak 15-minute period for the intersection, since this is the base analysis period which the HCM expects the user to analyze. A much better procedure is to determine the peak 15-minute period for the intersection from the count data and simply use the 15-minute flow rates during this period in combination with a PHF of 1.0 for each movement. The 15-minute flow rates are simply the peak 15-minute counts multiplied by 4.

If the actual peak 15-minute flow rates are not used, caution should be exercised in calculating peak hour factors from traffic counts, particularly on a movement-by-movement basis, since this calculation may not be statistically stable, especially for low volume movements. Furthermore, if the PHF is determined for each movement, it is most likely that all of these peaks for each movement do not occur at the same time, thus their application in computing "adjusted volumes" for each movement will result in a volume condition which never exists, but instead represents the highest 15-minute flow rate during the hour for each movement lumped together into a single hypothetical 15-minute period. A better alternative to using the peak 15-minute flow rates would be to use the intersection PHF for each movement, or at worst, calculate a PHF for each approach and use this value for all movements on that approach.

The 2016 *Highway Capacity Manual* method explicitly requires that the same peak hour factor be used by all movements to avoid this inappropriate analysis.

## Using ACTUATIONS and MINIMUMS (for Signal Analysis)

An area that deserves special consideration is when optimizing timings for actuated signals. It is important to recognize that the 2000 HCM analysis is a fixed-time representation of the actuated controller, so the optimization represents the average phase time which should occur over the course of the analysis period. It is quite possible for low volume movements which are not actuated every cycle that the average phase length is considerably less than the normal

MINIMUM which is desired for each cycle the movement is actuated. Thus for design purposes, the MINIMUMS entry for actuated movements could be a small number less than the normal MINIMUMS entry. An entry value of 1.0 is recommended for most cases. A similar reduction of pedestrian timing requirements can apply to the entries made for PEDWALKS and PEDFDWS, and this can be accomplished conveniently by adjusting the factor entry of PEDWALKS.

The 2016 HCM explicitly models the actuated behavior of a signal, so these considerations are not relevant when the 2016 HCM method has been selected.

## Field Calibration of SATURATIONFLOWS with FACTORS (for Signal Analysis)

The FACTORS command of TEAPAC provides a simple way of performing field calibration on a sample of lane groups and then extrapolating this sample for all lane groups of an analysis. The key to this process is recognizing that a survey of saturation flow rate in the field is a survey of adjusted satflows rather than ideal satflows. The TEAPAC calibration method is to survey the adjusted satflow in the field and then use the normal HCM procedures in TEAPAC to estimate the same adjusted satflow. The ratio of the two values will create a FACTORS entry which can be used for all similar lane groups which are not surveyed, and which will succinctly represent the adjustment which has been made to calibrate the HCM procedures to local conditions.

## Proper Use of RIGHTTURNONREDS (for Signal Analysis)

The prescribed technique in the HCM for treating right turns on red (RTOR) is to subtract these vehicles from the demand volume before continuing the analysis, with a limitation that except when "shadowed" by a protected left turn phase, RTOR should not be used unless an actual RTOR volume has been counted. The assertion that RTOR should be removed from the analysis suggests that these vehicles have no delay of their own, nor do they cause any delay for other vehicles, neither of which is true. Although RTOR has a beneficial effect on traffic flow, this model of these benefits is wholly inadequate and inappropriate. In light of this limitation, we suggest RTOR volumes be used only with great caution in an HCM analysis.

## Chapter 5 Topics (for Traffic Impact Analysis):



## Multi-Use and Multi-Site Developments (for Traffic Impact Analysis)

TEAPAC's traffic impact analysis functions can be used quite effectively for the study of multi-use and/or multi-site developments. In either case, the key situation to recognize is that the traffic generation, distribution and assignment characteristics of more than one single-use development need to be modeled for a common network of intersections. The primary tool of the traffic impact analysis to address these multiple conditions is the CUMULATE option of the COMPUTEPATHS command.

Normally, when the default RESET option of COMPUTEPATHS is used, TEAPAC sets the traffic volumes at each intersection to all zeroes before any of the distribution types listed on the COMPUTEPATHS command are calculated and added in to the total traffic assigned to each intersection. That is, each intersection starts out with no traffic, and the contribution of each distribution type is successively added to each intersection until the total projected traffic is obtained. The CUMULATE option prevents this zeroing from occurring, with the result of the "current" computations being added to the final results of a previous computation. This allows an unlimited number of developments to be cumulated together on the subject network, whether located in the same geographic site (a multi-use development), or in several sites located at various places within the network. The only requirements are that 1) the program is not terminated between the previous and the cumulated computations, and 2) that the positions of the nodes in the NODELIST do not change from one computation to the next when cumulating results.

A good example application of this type of use of TEAPAC is a development with two distinctly different land uses, say residential and commercial. Two independent sets of traffic impact analysis computations would be created, one for each land use. The results of each would be the total trips assigned to the same network for each land use. These development scenarios could be defined as a TEAPAC multi-scenario analysis, SAVEd in separate data files, or stacked one after the other in the same data file. In any case, in order to compute the total volumes for the entire development, the first land use data would be opened and computed using the default RESET option of COMPUTEPATHS. Then the second land use data would be opened, completely wiping out the first data in memory, but having no effect on the total traffic previously computed, this information still being retained by the COMPUTEPATHS command. Now the COMPUTEPATHS command is issued for the second set of data, but the CUMULATE option is used so that the initial computations are still retained and the results are the cumulative effects of both sets of data. A message to this effect is displayed at the bottom of the table of intersection volumes. If the second COMPUTEPATHS was done with the RESET option, the results would only represent the total traffic from the second set of data, frequently as desirable piece of information in and of itself.

In the event that the VOLUMES commands are used at each intersection to represent non-site traffic, as is normally the case, care must be taken that the contribution of non-site traffic to the total cumulated result is only counted once, and specifically not once for each individual computation. This can be accomplished as follows -- the <List of Types> entry for the first COMPUTEPATHS can be used to specify only the site-related distribution types, omitting the non-site VOLUMES from the calculations. This is easily done by simply using Type –1. Another way to accomplish this objective is to set the growth VOLFACTORS for the non-site VOLUMES to 0.0 prior to the first COMPUTEPATHS. By doing this, the 0.0 factor will be displayed in the output, making it clear that no VOLUMES have been included. In either case, the VOLUMES are re-enabled in the second COMPUTEPATHS so they are included once and only once in the final cumulated results.

In some instances, it may also be appropriate to make computations which include only the non-site VOLUMES, and then exclude them from any other site-related computations. This can be done by using just Type 999 (non-site traffic) on COMPUTEPATHS.

Another option can be used quite effectively when cumulating a series of land-uses or developments. This is a combination of the NONE option of the OUTPUT command and using Type 0 for the list of the COMPUTEPATHS command. If a large number of computations will be cumulated, it may not be desirable to produce output for each computation, but only the for the totals. The NONE option of OUTPUT provides this capability. Each of the computations can be performed with cumulation after selecting OUTPUT * NONE, and the result will be a complete cumulation with no output. In order to see the results, the Type 0 option of COMPUTEPATHS CUMULATE can be used after selecting OUTPUT * WINDOW (or FILE or BOTH). This does a computation function, but adds no trips to the already cumulated total. Better yet, if Type –1 is used for each of the scenario cumulations to exclude non-site traffic, the last computation can be done with type 999 to add the non-site traffic (see note following example below). The ROUND value can also be set prior to this last computation to round the final displayed results to the desired accuracy (see next section). Type 0 should also be used prior to beginning the cumulation process to zero out the intersection values, e.g., using COMPUTEPATHS RESET 0. The following series of commands illustrates a complete combination of how this procedure can be executed (in the form of a Control File), assuming five different land-use scenarios to be cumulated are stacked one after the other in file #2 and final output is to be exported to file #3.

```
SITESIZE  0 0                  / set # types to zero, no types
OUTPUT  SIT  NONE              / select no output for next COMPUTEPATHS
COMPUTEPATHS  RESET 0          / initialize intersection vols to 0
FILE       * DATA RESULTS      / open desired files for data & results
NEXTLINES  * 1    1            / initialize the default next lines
REPEAT SCENARIO 1 5            / loop for each of 5 scenarios
   LOAD  * 2                      / get next scenario from file #2
   ROUND  1                       / over-ride ROUND value just LOADed
   OUTPUT  SIT  NONE              / over-ride OUTPUT value just LOADed
   COMPUTEPATHS  CUMULATE -1      / cumulate contribution of scenario only
   GOTO SCENARIO                  / go back for next scenario
ROUND  10                      / round total results to 10 vehicles
OUTPUT  SIT  BOTH 3            / next COMPUTEPATHS to screen & file #3
COMPUTEPATHS  CUMULATE 999     / add non-site, rounded & displayed
RETURN                         / end of control file
```

If the VOLADDITIONALS feature of TEAPAC is being used to transfer cumulated computed volumes to other applications, it is essential that the last (and only the last) COMPUTEPATHS CUMULATE command should include non-site traffic (Type 999) so that the non-site traffic (VOLUMES and VOLFACTORS) is known and omitted from the VOLADDITIONALS, all of which are then saved for use by another application. This important aspect is illustrated in the example above.

## Rounding and Cumulating Results (for Traffic Impact Analysis)

The ROUND command provides a mechanism so that the volumes tabulated by the COMPUTEPATHS command are rounded to the desired precision. This is a feature primarily designed to avoid the implication of gross levels of accuracy in the results of the traffic estimation process. For example, if the final volumes should not be represented as being more accurate than to the nearest 10 vehicles, the ROUND 10 entry will do this rounding in the computations. It might be appropriate that all computations prior to a final cumulated tabulation (see discussion above) be done to the nearest whole vehicle so that no cumulative error occurs by rounding each of the distribution type calculations, as described below.

An important consideration in the cumulated computations described above is the effect which the ROUND factor will have on the results. If each individual computation is rounded, say to the nearest 10 vehicles, then cumulative error will occur in the final result, this being the cumulative sum of several rounded computations. This cumulative error can be avoided by setting the ROUND factor to 1 for all but the last computations, setting it then to the desired value. On the other hand, if separate tables of projected volumes from each land use will be published and these values are rounded, their totals will not likely match the final total using this last technique. Some judgment should be made as to the intended purposes of the various computations which will be made to avoid these dilemmas to the degree possible. The example above illustrates the former alternative, where intermediate computations are not rounded.

In order to provide the COMPUTEPATHS results to other TEAPAC applications, the VOLADDITIONALS entries for each intersection in the NODELIST will always be updated with the computed results, excluding the VOLUMES entries as factored according to the VOLFACTORS entries (see Appendix C). Note that when computed results are ROUNDed, VOLADDITIONALS will absorb the effect of the rounding, including locations where no additional volumes were actually computed as a result of the site traffic generation scenario presented. Further, the resulting VOLADDITIONALS entry for an individual movement may take on a negative value if little or no new volume is assigned to that movement and the final volume is rounded down. This is appropriate, and to be expected.

## Sharing Data Between All TEAPAC Applications (for Traffic Impact Analysis)

The introduction of this chapter described in general the types of data sharing which normally occur between the various application functions of TEAPAC - Signal Analysis, Traffic Impact Analysis, Count Analysis, and Export and Import. The following discussion provides further application-specific notes about data file sharing for Traffic Impact Analysis.

Sub-topics for this section:

- Input Data from Count Analysis and Signal Analysis (for Traffic Impact Analysis)
- Using Results for Signal Analysis and Export (for Traffic Impact Analysis)

## Input Data from Count Analysis and Signal Analysis (for Traffic Impact Analysis)

TEAPAC's count analysis functions can provide useful results for its traffic impact analysis functions. After the turning movement count summaries and peak-period analyses are completed, the peak-period VOLUMES entries which are created are normally used as existing traffic volumes for the initial capacity analyses, and as background, non-site traffic for a traffic impact analysis. The VOLUMES results of the peak-period analyses are automatically placed in the VOLUMES dialogs so they are immediately available for these purposes. Note also that these VOLUMES can be easily factored by using the individual VOLFACTORS entries, as well as the global entry of VOLFACTORS when intersection 0 (all intersections) is selected.

TEAPAC's signal analysis functions can provide a number of relevant analyses for a typical traffic impact analysis. It is frequently desired to know the level of service of signalized intersections under conditions which might prevail without the new development, as well as under the new intersection loadings which the development causes. For existing conditions, TEAPAC can provide a basic capacity analysis according to the methods of the *2000* or *2016 Highway Capacity Manual*. For projected conditions, TEAPAC's powerful phasing and timing optimization can determine the best combination of phasing and timing for a projected condition, and the best level of service which can be attained. In order to accomplish this, the analysis network is first entered in detail and analyzed with the signal analysis functions for the existing conditions. This includes the entry of VOLUMES, WIDTHS, LANES and NETWORK inputs which are subsequently needed by the traffic impact analysis. Then the additional trip generation, distribution and assignment information is added, analyzed and saved in the same file. In this analysis, the VOLUMES entered for the initial signal analysis are used as background traffic for the projected traffic estimation. Thus, both the signal analysis and traffic impact analysis functions are performed with the same data.

## Using Results for Signal Analysis and Export (for Traffic Impact Analysis)

In the same fashion that TEAPAC's signal analysis and traffic impact analysis functions will be able to use the peak-period VOLUMES from its count analysis functions for existing conditions, the signal analysis will require the input of the projected volumes from the traffic impact analysis in order to determine the best possible level of service at each intersection under the projected conditions. The signal analysis can also be used to quickly test various possible mitigation improvement scenarios by virtue of its phasing and timing optimization. In order for these to function efficiently, the signal analysis simply uses the projected VOLADDITIONALS which are computed by COMPUTEPATHS. VOLADDITIONALS are simply the total computed volumes at each intersection with the factored VOLUMES removed – the signal analysis will re-combine the factored VOLUMES with the VOLADDITIONALS during its analyses. Note also that these VOLADDITIONALS can be easily factored by using the individual VOLADDITIONALS factor entry, as well as the global entry of the factor when intersection 0 (all intersections) is selected. Another use of the factor, including its global entry, is to temporarily disable the VOLADDITIONALS by using a factor of 0.

## Chapter 5 Topics (for Count Analysis):



## Multi-Legged Intersections (for Count Analysis)

When an intersection with more than four legs is counted, two techniques can be used to aid the process of count analysis. The first involves the way the count is conducted, the second in how it is tabulated.

Sub-topics for this section:



### Combining Movements (for Count Analysis)

Multi-leg intersections have many more than twelve movements, since there are normally several right and left turns which can be made from each approach. Because of signal phasing and conflicts, it is frequently not important to differentiate which of the several right turns or left turns are being made. Rather, all right turns from an approach can be counted together, particularly if they move together on the same signal phase. If count personnel are so instructed, then all right turns can be entered in the right turn slots for each approach and all left turns can be entered in the left turn slots, making the normal three movements per approach used by TEAPAC.

If this procedure is not followed, each movement can be entered in an arbitrary movement column and the MOVLABELS and APPLABELS can be entered appropriately to help identify each of the movements. In this case, some of the tabulated values such as approach and exit totals will not be accurate and should be ignored or deleted.

### Making Multiple Runs (for Count Analysis)

Regardless of how movements are or are not combined, as described above, a multi-leg intersection by definition will have more than four approaches, requiring more than one run to complete the tabulations and analysis. If movements are combined as above, the best way to accomplish this is to first identify the two major streets and enter the traffic counts for these two streets as a single intersection. Then the remaining approaches should be entered as part of a second intersection, frequently with less than four approaches, so that the remaining count information is tabulated. For example, with a six legged intersection where a minor street intersects with two major streets, all right turns could be combined on each approach as could left turns, and the major street approaches could be entered as a standard TEAPAC intersection. The minor street approaches would then be entered as a second intersection of say North and

South approaches, leaving the East and West approaches as zeros. Now a COUNTGRAPH of these two "intersections" will help identify the peak times for each "intersection" and make it relatively easy to identify the combined peak for both.

If movements are not combined as above, the same procedure of making multiple runs for two "intersections" can be performed, simply taking care to look only at columns which contain valid numbers (particularly ignoring approach and exit totals).

## 30-Minute Counts (for Count Analysis)

In some instances counts may be recorded every 30 minutes, rather than the normal 15 or 60 minutes. If the count is set up properly, TEAPAC can still be used to tabulate and analyze this type of data. The first requirement is that the counts are reduced counts, not cumulative. TEAPAC should then be told to expect 15-minute intervals, but the user enters data only for every other 15-minute interval.

When this is the case, every other 15-minute interval is all zeros, making for the possibility of cluttered reports. To alleviate this problem, when 30-minute counts are detected by TEAPAC, the output is shortened accordingly by skipping every other count interval. In addition, the peak hour search is limited to only the counted half-hours, and, as with 60-minute counts, the 15-Minute Flow Rate report and the calculation of peak hour factors are suppressed since neither has any meaning for 30-minute counts.

## Sharing Data Between All TEAPAC Applications (for Count Analysis)

The introduction of this chapter described in general the types of data sharing which normally occur between the various application functions of TEAPAC - Signal Analysis, Traffic Impact Analysis, Count Analysis, and Export and Import. No further suggestions in this regard are offered here.

## Chapter 5 Topics (for Export and Import):



## Sharing Data Between All TEAPAC Applications (for Export and Import)

The introduction of this chapter described in general the types of data sharing which normally occur between the various application functions of TEAPAC - Signal Analysis, Traffic Impact Analysis, Count Analysis, and Export and Import. The following discussion provides further application-specific notes about data file sharing for Export and Import.

Sub-topics for this section:

Input Data from Signal Analysis (for Export and Import)
Input Data from Count Analysis and Traffic Impact Analysis (for Export and Import)

## Input Data from Signal Analysis (for Export and Import)

TEAPAC's signal analysis functions can provide a number of relevant analyses for typical arterial and network signal timing studies with PASSER, TRANSYT, NETSIM/CORSIM, VISSIM, SYNCHRO/SIMTRAFFIC, TRU-TRAFFIC, TS/PP-DRAFT and NOSTOP. For existing conditions, they can provide a complete and comprehensive capacity analysis (including computation of saturation flow rates and average green times) strictly according to the methods of the *2000* and *2016 Highway Capacity Manual* (HCM). When optimizing the signal timings of each signal in an arterial, TEAPAC will consider HCM level of service, virtually every possible phasing combination (for both the major street and the cross street), and will completely consider the effects which right turns, clearance intervals, minimums, target delays and movement priorities have on the best timings. These optimized conditions are automatically placed in the appropriate dialogs for SEQUENCE, CYCLE, GREENTIMES, YELLOWTIMES and REDCLEARTIMES and are immediately available for any of TEAPAC's export functions. This virtually eliminates any additional input at all for these functions, using all of the data already entered and optimized from the signal analysis.

Also, if the SATURATIONFLOWS and GREENAVERAGES computed by the signal analysis are to be used by the export, they appear automatically in the appropriate dialogs after using the ANALYZE or SERVICEVOLUMES commands.

These features allow the immediate and joint use of TEAPAC's HCM capacity analysis and HCM delay optimization, TEAPAC's bandwidth optimization, PASSER's bandwidth optimization, TRANSYT's simulation and optimization, TRU-TRAFFIC's or TS/PP-DRAFT's time-space platoon progression diagram, SYNCHRO's simulation and optimization, and CORSIM's or VISSIM's simulation and animation for the data input only once into TEAPAC.

In another joint use scenario, a common effort is to use the optimized results of PASSER as a starting point for a TRANSYT optimization. In order to accomplish this easily, the PASSER optimized results should be imported into TEAPAC, then EXPORTed immediately to TRANSYT where the PASSER timings will serve as the starting point for the TRANSYT optimization.

## Input Data from Count Analysis and Traffic Impact Analysis (for Export and Import)

For existing conditions, TEAPAC's count analysis can provide useful results for its export functions. After the turning movement count summaries and peak-period analyses are completed, the peak-period VOLUMES entries which are created are normally used as existing traffic volumes for additional analyses by third-party software. The VOLUMES results of the peak-period analyses are automatically placed in the VOLUMES dialogs so they are immediately available to export for these purposes. Note also that these VOLUMES can be easily factored by using the individual VOLFACTORS entries, as well as the global entry of VOLFACTORS when intersection 0 (all intersections) is selected.

For planning analyses of projected volumes, TEAPAC's traffic impact analysis can be used in exactly the same manner as its count analysis, creating a set of projected VOLADDITIONALS, allowing an additional analysis to be performed on projected volumes, as well as existing volumes. Note also that these VOLADDITIONALS can be easily factored by using the individual VOLADDITIONALS factor entry, as well as the global entry of the factor when intersection 0 (all intersections) is selected. Another use of the factor, including its global entry, is to temporarily disable the VOLADDITIONALS by using a factor of 0.

CHAPTER 6

# Advanced Analysis Procedures

Chapter 6 Topics

Having stepped through the example problems in Chapter 2 and described basic analysis procedures in Chapter 3, it is now possible to discuss in greater detail the entries, procedures and techniques used to perform analyses using TEAPAC. This chapter is designed to fully explain the generic operation of the TEAPAC program, and to provide additional understanding of the examples and discussions in Chapters 2 and 3. Chapter 7 describes more advanced generic procedures which can be used, especially as they relate to multi-scenario problems and automation with control files.

As illustrated in Chapter 2, there are four distinct steps in the execution of a TEAPAC analysis. These steps are: Data Entry, Data Review, Analysis and Evaluation. The first two steps set up the problem to be analyzed while the Analysis and Evaluation steps are used to determine the solution to the problem, often in an iterative manner. Procedural techniques which can be used to execute each of these steps are discussed in the following four sections. This is followed by a detailed description of additional features which can be used in TEAPAC, all independent of any specific TEAPAC application. These features are illustrated with examples using a very basic application of the signal analysis functions of TEAPAC.

In order to illustrate the various examples of this chapter, use the main graphics display window to create a single intersection for analysis. Do this by selecting the Create Link button from the left-side toolbar (in the Edit Mode section) and draw two street segment which cross each other using your mouse with two click-drag-drop sequences. This creates and selects intersection #1 for the subsequent analyses. Alternatively, you can use the Edit-System-Nodelist menu to enter node number 1 as the only intersection in the list, then use the Edit-Intersection-Intersection menu to select that intersection for subsequent analysis.

## Chapter 6 Topics:

Additional TEAPAC Features

## Data Entry

TEAPAC is an interactive program where data is entered discretely one parameter at a time. Data representing certain common information is grouped together in an input dialog, or alternatively on an input line which consists of a command followed by the parameter values required by the command. The command name is a word which reflects the type of data which is in the dialog or on the input line, and is also used to label the corresponding input dialog box. This section discusses the procedures which should be used for data entry, including some methods designed to speed up data input.

Sub-topics for this section:

- Visual Mode, Tabular View and Manual Mode
- Mouse Navigation and Special Keys
- On-screen Help
- Parameter Values
- Default Values and the RESET Command
- Immediate Error Checking
- Command Abbreviations
- Parameter Value Separators
- ASK Command

### Visual Mode, Tabular View and Manual Mode

Three modes of data entry exist in TEAPAC – 1) the Visual Mode - Normal View, 2) the Visual Mode - Tabular View, and 3) the Manual Mode. The program first starts up in mode 1) the Normal View of the Visual Mode. The View menu or F3 key can be used to toggle in and out of the Tabular View of the Visual Mode, and the Options menu or F4 key can be used to toggle in and out of the Manual Mode.

The Visual Mode - Normal View is the easiest way to learn how to use TEAPAC. The menus describe clearly what options the program has, and the dialog displays for input/editing clearly depict the data values required and their defaults. The Tabular View of the Visual Mode is a more compact dialog display of the same information found in the Normal View, allowing increased efficiency due to less mouse navigation requirements. The Manual Mode can make the input and operation of the program even quicker and easier, particularly after the commands and input requirements used in the Visual Mode are learned by the user.

Some of the discussions which follow apply to all of the input modes, while others apply to only specific modes. When the discussion applies to only one or two modes, this point will be made. Otherwise, it can be assumed that it applies to all modes. The choice of mode is up to the user, depending on their familiarity and comfort level with the program.

## Mouse Navigation and Special Keys

In the Visual and Manual Modes, certain mouse actions and special keys can or must be used to manipulate the menus and the data input/editing process. This section describes these actions and keys.

Visual Mode (Normal View). In the Visual Mode, the mouse is usually used to select a menu, then to select the function (and possibly a sub-function) of the menu to execute. First the menu is pointed to and clicked, then the function is clicked and it is executed. If the menu function has an arrow pointing to the right, it will open a sub-menu from which the desired function is selected and clicked. If the menu function has an ellipsis to its right like Edit-Titles-Project... it will open a dialog box either to enter data or to execute a function. Menus can also be selected via the keyboard using the Alt-key in combination with the character which appears underlined in the menu item. For example, Edit-Titles-Project can be selected by first pressing Alt-E, then pressing Alt-T, then Alt-P. This Alt-key function is also available for various underlined indications within dialog boxes. Further, certain common menu selections have associated shortcut keys which invoke the function immediately without the need to make any menu selections with the mouse. These shortcut keys are indicated in the menus to the right of the menu item. For example, File-Open can be executed immediately by pressing the Ctrl key in combination with the O key (Ctrl+O). Some of these shortcut keys also have toolbar icon buttons in the toolbar directly below the menu line which can be pressed to execute the same functions.

When a dialog box is displayed, the TAB keys can be used to navigate through the various parameter entry options and buttons in the prescribed order, or the mouse can be used to select a specific parameter entry or button by clicking on the corresponding field or button. Normal editing keys like Backspace, Delete and the arrow keys can be used with typed characters to adjust the value in a given field. Double-clicking or dragging the mouse cursor across an entry will highlight it so a typed value will replace the highlighted value. Drop-down list values and radio button selections can be made with the mouse, or using the keyboard and the underlined character of the selection desired (usually the first character of the desired keyword). Action buttons in a dialog can be pressed by clicking them with the mouse or by using the Alt-key in conjunction with the underlined character listed on the button. Further, a button with a dotted line surrounding its keyword can be pressed by using the space bar on the keyboard, and a button surrounded by a dark shadow border can be pressed by using the Enter key.

Visual Mode (Tabular View). A Tabular View dialog of the Visual Mode is initiated the same way as a Normal View using the menu system described above. The difference is that all of the entries of the selected menu or sub-menu are included in a single dialog with the entry cursor positioned in the first field of the selected menu item. Navigation through the dialog is the same as in the Normal View.

Manual Mode. The Manual Mode is manipulated entirely through keyboard entries. The up/down arrow keys can be used to recall any of the last ten commands entered which can then be re-used as before, or modified to create a new command entry.

## On-screen Help

TEAPAC provides various degrees of immediate on-screen help, depending on the input mode which is being used.

Visual Mode (Normal View). In the Visual Mode, the bottom line (status line) of most windows displays a line of helpful information about the current position of the cursor. Tool-tip help also pops up after a slight delay when the cursor hovers over most buttons and entry fields. If a menu is being displayed, the status line describes what action that menu selection will produce. If a dialog box display is present, the status line describes what data values are expected for the entry field, or what action will be performed by the button located under the cursor. Most dialog boxes also contain a Help button which takes the user directly to the section of the complete, on-screen manual which pertains to the dialog which is open. Pressing the F1 function key will also perform the same function as a Help button. In the menu of the main window, the Help menu offers the option to open the main table of contents of the entire on-screen manual (Contents), from which any part of the manual can be viewed, or to read the Windows description of how to use the help system (Help on Help). The toolbar icon button with a question mark performs the same Contents help function, as does the F1 key, and the F2 key performs the Help on Help function.

In an output window, the Help menu also contains a link to the part (or a nearby part) of the manual which describes the output being displayed, and in an error message the Help button links to a detailed discussion of the error message being displayed. The left side of the main program window also has a "Startup Help?" button which provides a quick summary of the basic steps and mechanics of using the program.

Visual Mode (Tabular View). On-screen help in the Tabular View is essentially the same as the Normal View, with the single exception that a separate Help button is available for each entry line of the dialog and is labeled with a question mark "?".

Manual Mode. In the Manual Mode, the HELP command can be used to display a brief one-line summary help line, either for a list of commands or a designated group of commands. In this case HELP will display the parameter descriptions, units of entry, and default value for the parameters of each command. If HELP is requested for a single command, the detailed help window produced by the Help buttons of the Visual Mode is produced. Any command or group of commands may be requested. If no specific commands are requested, the default list of commands is all data entry commands, the [Parameters] group. For example enter the following commands in the Manual Mode (F4). In the Visual Mode, this is done from the Help-Commands menu for an alphabetical list of all commands.

→ **HELP** ...

→ **HELP VOLUMES WIDTHS**

→ **HELP DESIGN**

In the list of displayed help, note that the command name is at the left of the display, the required parameter values are in the middle, and the default values are at the right. The HELP command can be used to determine the parameters to enter, the order of their entry or their default values for a given command or group of commands.

Access to the full Visual Mode (either view) and its associated on-screen help is easily obtained from the Manual Mode simply by using the ASK command and a list of the desired entries (see discussion later in this chapter). For example, the following would produce a Visual Mode dialog for the VOLUMES, WIDTHS and DESIGN commands, including all Help buttons:

→ **ASK VOLUMES WIDTHS DESIGN**

(Before trying to enter any data in these dialogs, create an intersection for analysis as described in the first section of this chapter.)

## Parameter Values

Most TEAPAC entries require one or more parameter values to define the data being input (entry commands) or the analysis to be performed (active commands). Parameter values may be either numbers (numeric) or words (strings). In the VOLUMES commands shown below, the numeric parameter values are 100, 200 and 300. In the HELP command, the two commands VOLUMES and WIDTHS represent string parameters. Before trying to enter this data, create an intersection for analysis as described in the first section of this chapter. As in Chapter 2, the [Basic] in the examples below indicates which Edit menu selection to make in the Visual Mode to find the VOLUMES dialog, and the arrow → indicates an entry to make in the Manual Mode.

[Basic] → **VOLUMES 100 200 300** ...

→ **HELP VOLUMES WIDTHS**

Many parameter values have defined limits. A numeric parameter value may be limited to a number between 1 and 5, or a string value may be limited to keywords such as YES and NO. Often these limits and keywords can be determined using the Help Button (Visual Mode) or HELP command (Manual Mode). If not contained in the HELP command listing, the limits can be found in Appendix B listed under the command to which the parameter belongs. Appendix B discusses each individual command and associated parameter values and the Appendix B information is what is displayed by the Help button. If inputs are made which do not fall within the accepted limits, an error is usually displayed immediately after the entry is made, as described below.

For numeric fields, the value held by a user variable can be entered by preceding the variable name with the = equal sign. For example, if the "V" variable has a value of 120, as set by either the CALCULATE or REPEAT commands, the variable could be used to set the volume of the right turn on the north approach to 120, as follows. Try this in either the Visual or Manual mode. See Chapter 7 for more details about user variables.

[Control] → **CALCULATE V=120**

[Basic] → **VOLUMES =V** ...

In the Normal View of the Visual Mode, keyword string value entries such as YES and NO are frequently displayed with lists or drop-down lists where the selection can be made with a mouse. The first letter of the keyword can also be used to make a selection.

## Default Values and the RESET Command

TEAPAC assumes initial (or default) values for all entry parameters. Default values are set for each command at the start of the program. These default values are designed to speed up the data entry and analysis of a problem. Most default values are "reasonable" values for an initial analysis, or zeros if the data is problem-specific and must be entered. For example, the VOLUMES and WIDTHS commands have default values of zero and must be entered, while the MINIMUMS command has default values of 5 seconds which can be used without making any entries, if appropriate. In some of the more complex TEAPAC analyses, default values are necessary to reduce the data input requirements of the analysis. However, when default values are used, familiarity with these values is critical since certain conditions may require that these values be modified. The default values for each parameter value of a command are shown in the dialog box Help button displays, as well as the right-hand column of the HELP command display described above.

In the Visual Mode, the File-New menu (or the equivalent toolbar icon button) can be used to reset the parameters of all command dialogs back to their default values. In addition, the RESET command in the File-DataFiles menu can be used to return a specific command's parameters to its default values during a session. It resets the parameter values of the listed command(s) to their default values. For example, try the following (making sure an intersection has first been created and selected, as described at the start of this chapter):

[Basic] → **VOLUMES 100 200 300** ...

[DataFiles] → **DATA** ...

[DataFiles] → **RESET VOLUMES**

[DataFiles] → **DATA** ...

Note that after the first DATA command, the values of the VOLUMES command are set as input, but after the RESET command is executed, the VOLUMES are reset back to their default values of zeroes. This is why the zeroes are sometimes described as the RESET values of the VOLUMES command, as well as their default values. The RESET command can be issued for any given command or group of commands. If no list of commands is provided, the RESET command will act on all data entry commands (the [Parameters] group), much like the File-New menu of the Visual Mode.

The RESET command is automatically executed for all commands (File-New) at the start of the program session, so each command always starts with its RESET values. Use of the RESET command (or File-New) between analysis problems is a very good way to be confident that no parameter values from one analysis accidentally get into a subsequent analysis. This procedure is highly recommended for the novice user of TEAPAC.

## Immediate Error Checking

As soon as the TAB or ENTER key has been pressed after an input is made (or the cursor is moved via the mouse to another field), the program performs error checking on the data entered. In the Manual Mode, the command or command abbreviation is first checked for validity. Then, in any mode, each parameter value is checked for potential errors. If the program is able to detect an error, it will immediately display an error message describing the type of error.

This feature of TEAPAC is useful since it reduces the potential of entering and analyzing obviously wrong data. The following types of errors are detected immediately upon entry of a command. These errors are discussed in detail in Appendix F.

- Too many parameter values entered (parameter counting).
- Numeric parameter value out-of-range (minimums and maximums).
- Invalid numeric entry (e.g., 3HUNDRED).
- Invalid command or string parameter value (keywords).

When parameter value errors are detected, TEAPAC automatically responds with a Visual Mode dialog for the command with the error so that the current parameter value(s) can be viewed along with the related Help information, and an adjusted entry can be made for any or all of the parameters. If no ‘correct’ entry can be made, the ESCape key should be used. In either case, when the error correction process is completed, the program will return to the input mode in use prior to the error.

As an example of this function, intentionally enter the following invalid entry from each input mode and observe the program’s response.

[Basic] → **LANES 3 4 3** ...

[Basic] → **LANES 1 TWO 1** ...

Note that the second entry "TWO" was an invalid numeric value meant to be a "2", and thus was not accepted and was ignored. If in the Manual Mode, the program automatically entered the Visual Mode for the LANES command to allow the entry to be fixed. This was done by typing

"2" in the proper entry field. Note that you did not have to re-specify the LANES command, since the program already knew LANES was being processed.

## Command Abbreviations

When entering a command in the Manual Mode, the command does not have to be entered in its complete form in response to the command level prompt. Any command can be abbreviated in almost any way desired when entered, as long as the following three rules are obeyed.

- The first character of the command abbreviation must be the first character of the actual command.
- The characters in the abbreviation must appear in actual command and in the order they would appear if the entire command was entered.
- The abbreviation must identify one and only one program command.

Using this technique, command abbreviations can be used to speed Manual Mode command entry. Try the following in the Manual Mode, checking first to see if all three rules are being followed.

→ **VOLMS 300 960 410** ...

→ **LNS 1 2 1** ...

→ **OLUMES 500 500 500** ...

→ **LNAS 2 2 2** ...

→ **SUMM**

→ **VOLS 300 960 410** ...

In the examples above, three command abbreviations (OLUMES, LNAS and VOLS) caused error messages. The OLUMES entry violated Rule 1 since the abbreviation did not begin with the first letter of the VOLUMES command. The LNAS command violated Rule 2 because the characters were out of order as they would appear in the command. The VOLS command abbreviation generated an ambiguous command error message since VOLUMES and VOLFACTORS both contain the abbreviation "VOLS", a violation of rule 3.

It should be noted that the use of command abbreviations does not eliminate the problem of misspellings. If the characters in the command abbreviation are not in the correct order the program will not identify the correct command. While some commands could be abbreviated to a single character, it is recommended that three or four characters be used to reduce the potential of ambiguous commands. Use of the first four characters or the first three consonants are common abbreviation techniques.

String parameters can be abbreviated following the same rules as command entry. As an example, the HELP command previously illustrated might have been abbreviated as follows.

→ **HELP VOLMS WDTH**

## Parameter Value Separators

When entering commands in the Manual Mode, commands are usually followed by a list of parameter values. In the Visual Mode Normal View these values are displayed on a graphical dialog in meaningful positions, and in the Tabular View, these values are listed and entered in easy-to-view columns. In the Manual Mode, TEAPAC is capable of accepting parameter values in a "free format." Free-format entry speeds data entry since no strict rules must be followed concerning specific columns or the number of decimal places used. When entering an input line, parameter values must be separated by one or more spaces and/or a single comma. Use of spaces rather than commas is recommended under normal circumstances. Type the following in the Manual Mode to demonstrate the free format data input (the actual number of spaces between parameters is not important).

→ **VOLUMES 300 900 400** ...

→ **LANES 1,2,1** ...

→ **DATA VLMS**

→ **VOLUMES 320 , 960 , 410** ...

→ **DATA VLMS**

→ **VOLUMES 300 900 , 400** ...

→ **DATA VLMS**

Note that all of the above entries are valid. Remember, parameter values may be separated by one or more spaces and/or by a single comma when entered in the Manual Mode.

## ASK Command

ASK is a command which can be used in the Manual Mode to create a Visual Mode dialog. Use of ASK provides all of the powerful attributes of these modes with the swiftness provided by the Manual Mode, but without the clutter of menus which tend to slow down the more seasoned user. In other words, if the user knows the VOLUMES and WIDTHS commands need to be entered, then either of the following ASK commands can be entered in the Manual Mode to make these entries without first selecting a menu.

→ **ASK VOLUMES WIDTHS**

**→ ASK VLMS WDTH**

A Visual Mode dialog, either Normal View or Tabular View, is created for the current VOLUMES and WIDTHS parameter values and allowing entry of any or all of the values, with the normal Help support. This is 100 percent equivalent to selecting the Edit-Basic menu, but without the overhead of menu selection.

Like the DATA and HELP commands, ASK accepts a list of commands as its own parameter values. This list can consist of either individual commands, groups of commands, or a combination of both. If no commands are listed, the ASK command prompts for all program-specific data entry commands, the [Parameters] group. Although this would be a very long and tedious set of dialogs, using this technique would make sure that input for every possible command dialog is entered, limiting the possibility of forgetting a command input, as illustrated above.

Another more powerful application of this concept is to combine commands which normally appear in different menu selections. For example, a normal process with TEAPAC for a signal analysis would be to make changes to either VOLUMES or WIDTHS, then re-issue the DESIGN command, as illustrated in Chapter 2. This was done using the Edit-Basic menu followed by the Results menu. In the Manual Mode, the following single entry would accomplish this entire process.

**→ ASK VLMS WDTH DSGN**

By doing this single command in the Manual Mode, no menu selections are required (rather than two) and the DESIGN command can be executed immediately after entry of the desired VOLUMES and/or WIDTHS. This process can be extended to almost any arbitrary combination and order of commands included in the ASK list, allowing complete customization of input dialogs presented to the user. Also, by using the Up/Down arrow keys described earlier, recent ASK commands can be repeated over and over without any further entry, so a well-planned ASK list can make a tremendous improvement in the productivity of an interactive session. Use of the pre-defined group names described in Appendix A can further enhance productivity.

## Data Review

Even though TEAPAC performs a variety of error checking functions, these functions are limited to testing the "reasonableness" of the data rather than the accuracy or correctness. As long as a parameter value is entered within the allowable range and in the proper format, TEAPAC will assume the values are correct. Therefore, prior to performing any analysis of program data, it is appropriate to check all the data for accuracy and correct any errors. The section discusses the procedures which should be used for such a data input review, as well as saving data.

Sub-topics for this section:

## SUMMARIZE and DATA Commands

In the Visual Mode, the data review process can take place almost simultaneously with the data entry process, since the current data values for every entry are displayed immediately after they are entered on the dialog. As such, when using the Visual Mode or the ASK command, it is recommended that each dialog display is reviewed for proper entries prior to terminating the display. The Tabular View is particularly useful for this type of review, since errant entries are most easily recognized in the context of a complete display of input values, and can be corrected on the same dialog.

In the Manual Mode, it is important to explicitly review the entries made prior to using them for analysis. Except when using the ASK command to enter data from the Manual Mode, the SUMMARIZE and DATA commands are the primary tools used to perform the data review. The SUMMARIZE command has no parameter values and is used to generate a formatted output of all the data currently in the program. The summary report generated not only lists the input parameters, but labels each parameter value. This report is useful when you are unfamiliar with each of the command's parameter values, as well as producing a printed report of the input parameters for future reference. The SUMMARIZE output can also be generated quickly from the Visual Mode using the View-Summary menu.

The DATA command provides selective control over which data is reviewed. It requires a list of commands as its parameter values. Either individual commands, lists of commands, or groups of commands may be used as parameter values for the DATA command. The DATA command lists only the command and its current parameter values, without additional column and report headings.

Both DATA and SUMMARIZE can be used effectively during the Manual Mode data entry process to review the data as it is entered into the program. Typically, the DATA command is used to review data during the entry process since the data displayed can be easily controlled. For example, try typing the following series of commands for the selected intersection in the Manual Mode.

→ **VOLUMES 100 300 200** ...

→ **WIDTHS 0 24 12** ...

→ **SUMMARIZE**

→ **DATA**

→ **DATA VOLUMES**

Note that there is no control on the amount of output generated by the SUMMARIZE command. It will always display the current values of all parameters of all unique entry commands. The default of the DATA command is the same, although with less cosmetic labeling and organization. The DATA command, however, can also display the current values of only a selected group of commands, the VOLUMES command in the example. This feature can be very helpful and time-saving, especially since there are many commands whose data are displayed by the SUMMARIZE command.

At this point the data which has been displayed can be reviewed to determine if it has been entered correctly. Let's assume that the WIDTHS desired were actually "0 24 11", but were entered as "0 24 12" by mistake, as illustrated above. This review shows the error clearly, and can be corrected and reviewed again by simply entering the following commands.

→ **WIDTHS 0 24 11** ...

→ **DATA WIDTHS**

This process can be executed in the review of any command's values, including those which may have initially used default values but actually require specific input values. This example shows a typical data review session in the Manual Mode to check and correct entries before analysis.

## Null Entries

Frequently, when adjusting the data values attached to any given command in the Manual Mode, as illustrated above, only one or two of the parameter values of the command need to be changed. It is possible to skip over the correct parameter values to the value which needs to be corrected using null entries. These are represented by the star or asterisk character, "*". A null entry is a way of leaving a current parameter value unchanged using only a single keystroke, rather than retyping the complete parameter value. When there are multiple parameter values for a command, such as in VOLUMES, it may be cumbersome to re-enter the entire set of numbers when only a few values need to be changed. For example, first enter the following commands in the Manual Mode.

→ **VOLUMES 300 700 400** ...

→ **DATA**

→ **VOLUMES 300 800 400** ...

→ **DATA**

Note that only one of the three movement volumes was changed. An equivalent way of accomplishing this would be the following.

→ **VOLUMES 300 700 400** ...

→ **DATA**

→ **VOLUMES * 800 *** ...

→ **DATA**

Notice that in the above example, only the second entry changed when the second VOLUMES command was entered. The first and third values remained unchanged because null entries were entered in the first and third parameter slots. When using null characters, they must be treated like other parameter values. This means that they should also be separated from other parameter values, including other null entries, by one or more spaces and/or a single comma. It is also important to keep careful count of the number of null characters entered since position in an input line is critical.

If a line of input for a command is not completed, that is, fewer parameter entries are made than are allowed or expected, the remaining parameters which are not entered act as if null entries have been made. As an example, try the following.

→ **DATA VLMS**

→ **VLMS 250** ...

→ **DATA VLMS**

Note that only the first parameter value was changed, and the remaining parameter values were unchanged since no entry was made for those values. Null entries can also be used in the initial data entry stage to skip over acceptable default values. Null entries can also be used in any Visual Mode dialog, although not normally necessary since the fields can be skipped with the TAB key or by mouse selection.

## Saving Information for Future Use

The discussion so far has involved the repeated keying of entry commands to input information. Information can, however, be saved and retrieved from disk files to avoid the need to re-key information which has been previously entered. This not only decreases the time required to perform repeat analyses, but improves the accuracy of data entry for these additional analyses. After the data review described above has been completed, saving the data in a disk file is most appropriate. The following describes the most fundamental methods of saving data under both the Visual and Manual Modes. More details about this discussion, as well as more advanced techniques, appear in Chapter 7.

In the Visual Mode, the normal Windows procedures are usually used for file saving and retrieval. Current values are saved to a file using the File-Save or File-SaveAs menus and retrieved using the File-Open menu. File-Save uses the same file name previously opened or saved, while File-SaveAs allows the option to name a new file or storage location. Data is retrieved from a previously saved file using the File-Open menu. Shortcut keys and toolbar buttons can also be used, as described earlier. In the Manual Mode, the following procedures are used to perform the same functions. These procedures can also be performed from the File-DataFiles menu of the Visual Mode and from control files (see Chapter 7 for more on control files).

The three basic commands which are needed for Manual Mode file access are the FILES, SAVE and LOAD commands. In the Visual Mode, these commands also reside in the [DataFiles] sub-menu of the Files menu. The FILES command is used to set up the location on the disk where data is to be stored and retrieved. SAVE actually writes the current data values into this file, and LOAD is used to retrieve the SAVEd information at a later time.

Appendix G describes in detail the specific way which files should be referenced for your given operating system, but it normally requires the name of the disk drive (e.g., C:) followed by the file name (e.g., SAMPLE) as the file name. If the file name does not exist already on the disk, you may additionally append "/N" to the file name to indicate that a "new" file is desired. For example, typing the following command should open a new data file on your C: disk. If the file SAMPLE has already been created by the example in Chapter 2 and it is okay to overwrite that information, enter the following command without the "/N" option. If you would like to keep the earlier SAMPLE file unchanged, replace the name SAMPLE in this exercise with another name of your choice. Check with Appendix G to make sure this is appropriate for your system.

[DataFiles] → **FILES C:SAMPLE/N** ...

Now the location to be used on the disk for data storage and retrieval has been identified. Note specifically that no data has been transferred. Only the location on the disk for subsequent SAVE and LOAD commands has been defined. The SAVE command is used to transfer the current contents of each of the commands to the file on the disk for future use. The first parameter of the SAVE command should be used to indicate where in the file this transfer should start, normally line 1. Additional parameters seen in the Visual Mode dialogs can be ignored at this point. These are described in detail in Chapter 7 and Appendix G.

For example, if the previous FILES command worked properly on your system, enter the following.

[DataFiles] → **DATA** ...

[DataFiles] → **SAVE 1** ...

[DataFiles] → **DATA** ...

[DataFiles] → **ECHO YES**

[DataFiles] → **SAVE 1** ...

[DataFiles] → **ECHO NO**

After the first SAVE command you should get a message indicating that many lines of data have been saved starting at line 1 of the file. This indicates that data has been stored in your disk file called SAMPLE within the data lines listed. This information can be retrieved at a later date with the LOAD command, as illustrated in the next paragraphs. Note that the data values in the program still remain intact, as illustrated by the second DATA command. Only a copy of the data values has been transferred to the file. Note also that use of the ECHO YES option prior to the second SAVE command causes each of the saved lines to be listed as they are saved, giving visual clarity to the SAVE process which is being performed.

Information can be retrieved back from the disk file at a later time with minimal effort and greater accuracy than attempting to re-enter the necessary data. Follow the example below to illustrate this process.

[DataFiles] → **RESET** ...

[DataFiles] → **DATA** ...

[DataFiles] → **FILE C:SAMPLE** ...

[DataFiles] → **DATA** ...

[DataFiles] → **LOAD 1** ...

[DataFiles] → **DATA** ...

[DataFiles] → **ECHO YES**

[DataFiles] → **LOAD 1** ...

[DataFiles] → **ECHO NO**

In this example, several important points are illustrated about the use of files. First, since the file already exists, the use of the "/N" option on the file name is not appropriate. Its use would produce an error message since the desire to open a new file with a name that already exists is not possible. Not using any option indicates that the file is expected to already exist, which is the normal situation. The RESET command is used here at the outset to intentionally reset all of the commands' parameters to their default values, to remove any knowledge of a previous analysis. This is verified by the first DATA command. Note also that the second DATA command illustrates that simply specifying the FILES command does not perform any data transfer. The LOAD command performs the actual retrieval of information.

As before, the line number where the LOAD operation is to begin is specified as line 1, since that is where the SAVE operation was started. The LOAD operation continues reading data from the file until the end of the SAVEd information is reached, as indicated by the RETURN command at the end of the data. As with the SAVE example, all of this is clarified by temporary use of the ECHO YES option during the LOAD operation. You can begin to see that the LOAD function is simply the entry of commands from a file, in exactly the same manner that commands are entered from the keyboard in the Manual Mode. This understanding is not important in the early stages of using TEAPAC, but unlocks the door to some of the tremendous file manipulation powers which TEAPAC possesses. Chapter 7 goes into much greater detail on how this function can be used to great advantage in setting up batch functions and scripted control files.

## Analysis

Once the data has been entered, checked, corrected and saved, an analysis can be performed. The execution of an analysis in TEAPAC is accomplished using one of the active commands of the program, normally found in the Results menu. In earlier examples, the DESIGN command was the active command used to perform a signal analysis. This section discusses the procedures which should be used for analysis.

Sub-topics for this section:

- Active Commands
- Parameters of Active Commands
- Report Headings
- Directing Output to a Printer

### Active Commands

A simple execution of basic signal analysis example illustrates the use of an active command to perform analyses. For purposes of illustration and simplicity of entry, we'll only consider through volumes and two-phase control in this example. Enter the following commands.

[Basic] → **VOLUMES 0 275 0 0 875 0 0 375 0 0 590 0**

[Basic] → **WIDTHS 0 12 0 0 12 0 0 12 0 0 12 0**

[Basic] → **SEQUENCES 11 11**

[DataFiles] → **DATA [Basic]**

[Results] → **DESIGN 1**

Note that the input data values were entered and checked, then the active command DESIGN was used to display the analysis results. In the Visual Mode the DATA command is superfluous since the input values can be checked directly on the input dialog. This process is typical. The data entry commands are used to enter the input data for the problem, then the inputs are reviewed, then the analysis is executed.

The DESIGN command is an active command which must be formally "executed". In the Visual Mode this is done using the Execute button in the DESIGN dialog box. In the case of the entry commands, VOLUMES, WIDTHS and SEQUENCES, the input data values are merely entered with the TAB or ENTER keys and no action needs to be executed. In the case of the DESIGN command, its parameter values first need to be entered prior to executing the DESIGN. The entry of the data values is done with the TAB key, like other entry parameters, then the DESIGN is executed with the Execute button.

In the Manual Mode, no distinction is made between entry and active commands. All commands, whether entry or active, are issued using the ENTER key or the OK button. In the case of active commands, any parameters supplied with the active command are first processed before the active command is actually executed.

## Parameters of Active Commands

Often an active command has no associated parameter values. However, some active commands require one or more parameters. DESIGN in the example above is an active command with one possible parameter. Like other commands, active commands which require parameter values have default values for these parameters. These default values are usually set to a reasonable value for executing an analysis. The existence of default values for active commands speed up the analysis process since parameter values often need not be specified for the command. In the preceding example, the use of the DESIGN command could have made use of the default value of 1 for the number of optimized phasings to analyze, as below.

[Results] → **DESIGN** ...

Active command parameter values generally do not specify input data values, as in the case of entry commands. Instead, these parameters typically specify analysis options or control values which define special output formats or analysis techniques.

A very important concept surrounds the parameter values of active commands. This is that the <u>values entered as the active parameters are not retained for the next time the active command is issued</u> – the parameter values of an active command are always RESET to their default values at the end of their execution. For example, issue the DESIGN command using an output option of 0, then re-select the DESIGN command in the Visual Mode and look at the output option which will be used if DESIGN is executed again without any parameter entry.

[Results] → **DESIGN 0**

[Results] → **DESIGN** ...

See that the default value is set back to 1. In the Manual Mode, try the following to illustrate the same point.

→ **DESIGN 0**

→ **DESIGN ***

Note that in the second of these two DESIGN commands the output option was "1" for a final capacity analysis, not the "0" used in the previous command. The rule is simple: the parameter values of an active command are always RESET to their default values at the end of their execution. Prior values are never remembered as they are for entry commands. This convention may not seem important or necessary at this point, but time will show that always knowing what parameter values will be used by default on active commands can be very important and useful.

## Report Headings

In each of the examples above you should have noted with some concern that although you were changing the analysis each time you entered a DESIGN command, no method had been illustrated where you could label the intent of each result. In fact, the labeling of computer output can be one of the most important aspects of maintaining an organized set of computer results which can be used sensibly after the fact. Different conditions which are being analyzed, as well as varying scenarios and design options which are being tested must be identified quickly on the output, or unnecessary and time-consuming effort will be expended trying to sort out what's what in the resulting pile of printed output.

TEAPAC contains three output-labeling commands which can be used to enter report labeling information. The values of the three commands are displayed at the top of each output report produced by the program. The PROJECT command defines the first title line of a report; the DESCRIPTION and NOTE commands define the second and third lines, respectively. Note that in the analyses conducted previously, the title display area at the top of the results window is virtually empty, except for the date and time of the analysis. To change this, try the following.

[Titles] → **PROJECT Tutorial Sample Problem**

[Titles] → **DESCRIPTION Intersection Analysis**

[Titles] → **NOTE Sample Data**

[Results] → **DESIGN** ...

Note that now the DESIGN report is labeled by three lines of descriptive information at the top of the report. This information describes what is in the output window, and is also used to label printed reports so that varying conditions which were analyzed can be clearly identified by the titles when reviewed at a later date. Normally, the name of the project is placed on the PROJECT command, and does not change throughout a given session. The NOTE information, on the other hand, should contain the details of each individual analysis performed, and will normally be different for each analysis. The DESCRIPTION will normally describe different discrete portions of the analysis, such as each intersection or scenario being studied. These uses of the [Titles] commands are only suggestions; any use which adequately describes the analyses made is appropriate.

### Directing Output to a Printer

Since TEAPAC is an interactive program where screen output is imperative, all output normally is displayed on the screen for immediate review and assessment. This output can be immediately directed to the default printer by selecting the Print option of the File menu in the output window. The printer can first be selected, including certain printer options, by selecting the File-PrintSetup or File-SetupandPrint menus. If the output window has been closed, the last output can be printed by selecting File-Print from the main menu or by using the appropriate toolbar icon button. The shortcut key Ctrl+P can also be used.

## Evaluation

Once an analysis has been performed, it is frequently appropriate to review the results and determine if subsequent analyses are required. The subsequent analyses may be necessary for a variety of reasons. Assuming there are no data errors, one of the most common reasons for additional analyses are to test potential changes in the analysis conditions. This could be in the form of a before/after analysis, or testing multiple phases of development. Another type of evaluation might be a sensitivity analysis designed to refine the initial results or to identify how a specific parameter impacts the results. This section discusses the procedures which can be used for the evaluation phase of a TEAPAC analysis.

Sub-topics for this section:
- Multiple Conditions
- Sensitivity Analysis
- ASK Command for Iterative Evaluation

### Multiple Conditions

Multiple iterations of an analysis are often required when several scenarios or conditions need to be analyzed for a given situation. These results are often then compared to one another to determine, for example, the phased impact of changing scenario conditions or the comparative before/after effects of certain improvements. In such analyses, it is important to maintain consistency in the analysis techniques and basic assumptions among the alternatives. TEAPAC can easily be used in such a consistent manner, since only those parameters which change between alternatives need to be re-entered for each analysis. By repeating the procedures explained above for data entry, data review and analysis, many alternatives can be quickly and accurately analyzed.

When testing multiple conditions, it is important to use the three title lines of the output (the PROJECT, DESCRIPTION, and NOTE commands) to identify which alternative is currently being tested. Most often, the NOTE command is used to identify the changing element of the conditions. The PROJECT command is typically held constant to describe the project being analyzed, while the DESCRIPTION command might be used to define which discrete element of the project is under scrutiny. A brief example should be helpful in understanding this convention, again using only through movements and two-phase control for the selected intersection to limit the inputs required. Try the following.

[Titles] → **PROJECT Tutorial Sample Problem**

[Titles] → **DESCRIPTION Intersection #5 - Main & South**

[Titles] → **NOTE Existing Geometric Conditions**

[Basic] → **VOLUMES 0 275 0 0 875 0 0 375 0 0 1290 0**

[Basic] → **WIDTHS 0 12 0 0 12 0 0 12 0 0 12 0**

[Basic] → **SEQUENCES 11 11**

[Results] → **DESIGN** ...

[Titles] → **NOTE Proposed Geometric Conditions**

[Basic] → **WIDTHS * * * , * 24 * , * * * , * 24** ...

[Results] → **DESIGN** ...

In this example, the NOTE command was used to describe each of the two scenario conditions, existing geometrics and proposed geometrics, while the PROJECT and DESCRIPTION commands were used to describe the project being conducted and the intersection being analyzed. Only the two parameters on the WIDTHS command needed to be changed in the example to depict the changing conditions, while all of the other parameter values remained unchanged for the multiple condition analysis. This is illustrated by the use of null entries (asterisks) in the second WIDTHS entry. Commas are also used to separate the entries for each approach, for visual clarity. In the Visual Mode, the TAB key or mouse would be used to skip over the unchanged entries. Use of this process guarantees that all other parameters remain unchanged, making the input data and analysis methods completely consistent between the two scenarios.

## Sensitivity Analysis

At times, the sensitivity of the analysis results to changes in various input parameters must be obtained. In a manner similar to the multiple conditions described above, sensitivity analyses can be quickly accomplished using TEAPAC since only the variable to be tested need be re-entered for each analysis. Once the parameter value has been changed, the analysis can be performed using the appropriate active command. For example, the sensitivity of signal timing and performance to changes in the volume of traffic on the north approach can be tested simply by changing the first parameter of the VOLUMES command and re-issuing the DESIGN command, preferably with a quick NOTE entry to identify each sensitivity check. Following the DESIGN, it is possible to compare the levels of service for each volume condition tested.

As another example, the effect of the cycle length on critical movement delay can be tested quickly with repeated CYCLES and DESIGN commands. Again, additional NOTE entries would be helpful in sorting out any printed results at a later date. The Manual Mode is also useful for this type of analysis. Try the following.

[Titles] → **NOTE Low Cycle**

[Basic] → **CYCLES 60 60** ...

[Results] → **DESIGN** ...

[Titles] → **NOTE Medium Cycle**

[Basic] → **CYCLES 90 90** ...

[Results] → **DESIGN** ...

[Titles] → **NOTE Long Cycle**

[Basic] → **CYCLES 120 120** ...

[Results] → **DESIGN** ...

You have thus quickly assessed the impact of the cycle length on the performance of this hypothetical intersection, noting that although under the improved geometry plan the critical level of service could be maintained at LOS C for all cycles, the critical delays consistently increased as the cycle length was increased.

## ASK Command for Iterative Evaluation

The ASK command used in the Manual Mode provides a viable alternative method for analyzing the multiple conditions and sensitivity analyses described above. As a simple example, let's assume that the same analysis is desired as in the Multiple Conditions section above, but that in addition the user would like to make intermediate calculations regarding the cycle length to use in the DESIGN. In the Manual Mode, the ASK command can be issued to create a sequence of dialog boxes (Normal View) or a single, compact dialog (Tabular View) which meets the specific requirements of the current analysis. For example, try the following in the Manual Mode (F4) with Normal View (F3) selected.

→ **ASK PRJCT DSCRPT NOTE VLMS WDTH SEQNC CYCL CALCULATE DESIGN**

The user is presented with a sequence of dialog boxes which allows complete view, manipulation and execution of all of the commands listed on the ASK command, in the order listed. With this display, each of the entries listed in the Multiple Conditions section of this chapter can be executed from an appropriate dialog box without the need to navigate between the Edit and Results menus. Furthermore, the CALCULATE command dialog has been inserted before the DESIGN command, in sequence of where it should be executed, eliminating the need to visit the File-Control menu. To terminate this display, use the OK button or the ESCape key.

Creating this display can be simplified substantially by using some of the standard options of TEAPAC. For example, less typing and less chance of misspelling the commands listed on the ASK command can be achieved by using abbreviations, as illustrated. Also, Menu/Group names can be used to replace several commands in the list. Each of the following commands are completely equivalent to the entry described above. Try some of these variations to get a feel for the flexibility ASK offers, adding your own options if you like. Also, first select the Tabular View and notice the difference and inherent efficiency generated by placing all the entries in a single dialog.

→ **ASK PROJ DESC NOTE VLMS WDTH SEQ CYCL CALC DGN**

→ **ASK [Titles] VLMS WDTH SEQ CYCL CALC DGN**

→ **ASK [Ttl] [Bsc] CALC DGN**

If the sequence of commands listed on the ASK command needs modification, close the dialog(s) with the OK button, adjust the ASK command list and re-issue the ASK command. When combined with some experience and creativity, this option of TEAPAC can become one of the most powerful attributes the program has to offer the user for productivity increases in their TEAPAC analyses.

## Additional TEAPAC Features

The following section describes more of the basic features found in TEAPAC. These features include using commands as parameters, on-screen program update messages, additional data entry options, exiting the program, and more. Chapter 7 also includes other more advanced features which TEAPAC possesses.

Sub-topics for this section:

- Commands As Parameters
- Program Update Messages

Line Continuations
Exiting the Program
More Advanced Procedures

## Commands As Parameters

Command keywords may be used as parameters in certain TEAPAC commands. These commands require a list of commands as parameters values. The five commands which use commands as parameter values are: ASK, DATA, HELP, RESET and SAVE. Typically, these are the commands where group names can be used to speed up data entry. Abbreviations can be used for either the command or group names.

When using group names, the total number of commands in the expanded list cannot exceed the total number of commands in the program. Therefore, if the group name [AllCommands] is used, all other group names will be ignored as extra entries. The default value for each of the five commands is the group name [Parameters].

## Program Update Messages

The MESSAGES command is used to list recent modifications which have been made to the program (and installed on the computer being used). The messages will be displayed in reverse chronological order beginning with the most recent changes. MESSAGES is important when updates are made to the program which are not included in the printed documentation. Try the MESSAGES command from the Manual Mode; from the Visual Mode, use the Help-ListRecentInstalledChanges menu.

→ **MESSAGES** ...

The first line of the display lists the current version number and date of the program, which should agree with the information listed in the Help-About display. The displayed paragraphs list those changes which have been made to the program in its most recent installed version. This information is especially important when a new program update is obtained to note those changes from the previous version. Other historic changes which have been made are also listed. If the first version displayed by MESSAGES is later than that of a printed manual, the results of the MESSAGES command should be printed and placed in Appendix H of the manual for future off-line reference.

MESSAGES has an optional parameter which controls the amount of text displayed. The default is 3, indicating the greatest amount of text for all versions documented in the messages file. Option 2 is the same information, but only for the most current update of the program. Option 1 provides only a brief summary of the changes made to the current version, and option 0 simply displays the current version of the messages. To use this option, use the Manual Mode for the MESSAGES command or for the ASK MESSAGES command. The ListRecentInstalledChanges option of the Help menu always uses the 3 option.

## Line Continuations

TEAPAC allows a maximum of 80 characters per line of input in the Manual Mode. Occasionally, an input line may require more than 80 characters to complete the entire parameter value list for a specific command. To enter all of this information on one command, a line continuation must be used, as indicated by the line continuation character "&". Like any parameter value, a continuation character must be separated from other parameter values by one or more spaces and/or a single comma. When a line continuation character is used, the program will prompt for the continuation of parameter entries for the previous command on the next input line as if it were an extension of the previous line of input; do not re-enter the command on the second line of input. The Manual Mode prompt contains the "&" character to indicate it is expecting continuation input of parameter values. Multiple continuation lines may be entered, as necessary. After the last parameter has been entered, simply use the ENTER key or the OK button without a continuation character to terminate the entire command, as usual.

All information following a line continuation character is ignored in the same manner as when the line termination character "/" is used (see Chapter 7). Note that the command name being entered should not be re-entered on the continuation lines since the next expected entry is a parameter of the command, not the command itself. Although we have only explored limited commands where line continuations are somewhat unnecessary, the following is an example of the line continuation function of the Manual Mode.

→ **VOLUMES 100 200 300 400 500 600** ...

→ **DATA VLMS**

→ **VOLUMES 111 222 333 &**

&→ **444 555 666** ...

→ **DATA VLMS**

Although the use of the line continuation was not necessary, this illustrates how a long list of parameter values can be extended from one line to the next, with a virtually limitless length of allowable input for every command in the TEAPAC program.

## Exiting the Program

The File-Exit menu or the STOP command is used to exit TEAPAC, as illustrated in the earlier example. The STOP command can also be used to immediately run another program. This is used as a matter of convenience to start up another program without returning to the operating system. It is accomplished by simply following the STOP command with the name of the next program to run. STOP terminates the current program and then runs the next program. As an example, when you are ready to exit the TEAPAC program, enter the following.

[Control] → **STOP TEAPAC**

Note that the currently running program (TEAPAC) was terminated, and that the named program (also TEAPAC) was run, as indicated by the re-starting of the TEAPAC program. One would normally put the name of another program that the operating system can find (include a file path, if necessary) on the STOP command to immediately run that program. If the next program to run can accept a data file on the command line (like TEAPAC can), this file name can also be added as part of the STOP command entry. The best way to learn about this function is to experiment and/or read your operating-specific instructions found in Appendix G of this manual.

## More Advanced Procedures

This chapter has discussed the details of the basic analysis procedures which are used in TEAPAC. Necessarily, certain more advanced procedures have been omitted in the interest of developing clear and concise discussions which are of immediate use to the novice user. On the other hand, many extensions to these basic procedures exist. These advanced procedures typically relate to developing more efficient analyses, and commonly relate in some way to the advanced use of data files to store procedural steps as well as data.

These advanced procedures are discussed with extensive examples in Chapter 7. They include such advanced functions as the use of control files for scripted "batch" operations, the use of the REPEAT command for repeated operations, and use of the CALCULATE command and related procedures. All of these functions presume relatively solid knowledge of the basic procedures presented in this chapter. As such, this chapter should be absorbed as much as possible before embarking on Chapter 7.

CHAPTER 7

# Advanced TEAPAC Procedures

Chapter 7 Topics

Chapters 1 through 4 covered the basic methods and commands required to use TEAPAC for all of its application functions, while Chapters 5 and 6 delved into the details of both the TEAPAC application functions (Chapter 5) and the generic aspects of TEAPAC procedures (Chapter 6). The advanced procedures discussed in this chapter can greatly increase efficiency in solving problems with TEAPAC, as well as provide insights into how to use TEAPAC to solve unusual problems. Before beginning this section, it is necessary to have a good understanding of the material covered in the previous chapters. If this is not the case, please review this material prior to continuing.

## Chapter 7 Topics:

Chapter 7 Introduction
Manipulation of Heading Information
Redirecting Report Output to Disk Files
Command Entry Options
Simplified Use of Files
Advanced Use of Files
Control Files
User Variables and Calculations

## Manipulation of Heading Information

Report headings are an important part of any computer analysis, since these headings will be the only convenient way to identify the purpose of a printed analysis any time after it was produced. The information presented in this section shows ways to handle special situations which are likely to arise in the production of printed reports.

Sub-topics for this section:

Page Numbers on Output Reports
Overlaying Text in Report Titles

## Page Numbers on Output Reports

The report headings at the top of each page or display of output normally consist of the information from the three [Titles] commands (PROJECT, DESCRIPTION and NOTE) and the date and time the report was produced. A page number can also be placed below the date and time in these headings, if desired. The second parameter of the IODEVICES command is set to zero by default, indicating that page numbers are not desired. If this <Page Number> parameter is set to any non-zero number, then each printed output page which is produced will be numbered with successive page numbers, starting with the page number entered.

For example, if three DESIGNs are to be done and the results are to be printed, these reports can be numbered as pages 1, 2 and 3 by simply entering the following IODEVICES command prior to any of the analyses.

[Control] → **IODEVICES * 1** ...

Note that the <Page Number> parameter of IODEVICES is incremented automatically whenever pages are actually printed, so only the initial page number need be entered. The page numbering can be eliminated at any time by setting the <Page Number> parameter back to its default value of 0. If <Page Number > is -1, the date and time will also be omitted from the output.

## Overlaying Text in Report Titles

The PROJECT, DESCRIPTION and NOTE commands are used to enter the text which will be used to label each output report, as described earlier. This provides three lines of information which can be used to describe each output. In complex analyses, these three lines may not seem adequate. Although no more than the three lines can be used, they can be sub-divided in such a way as to provide any number of heading sections to describe the analysis. For example, if the PROJECT is used to describe the project being studied and the DESCRIPTION is used to describe the subarea which is being analyzed, then the NOTE is all that is available to describe any remaining scenario conditions. If the conditions reflect both alternative volumes and alternative geometrics, the NOTE command can be sub-divided so the first half describes which volumes are being used and the second half describes the geometrics.

In the Visual Mode, the cursor can be placed anywhere on the NOTE entry and the sub-division can be accomplished directly on the visual display. In the Manual Mode, any entry of a NOTE command will completely overwrite the previous NOTE, unless the first character of the NOTE entered is a plus sign, "+". If this is the case, the two-digit column number where the new NOTE information should be <u>added</u> is given after the "+". For example, the following command sequence would first place the "Existing Volumes" string in the NOTE, regardless of its previous contents, then <u>add</u> the "Existing Lanes" note to the "Existing Volumes" starting in column 20.

[Titles] → **NOTE Existing Volumes**

[Titles] → **NOTE +20Existing Lanes**

Following an analysis with this composite NOTE, the future volumes might be entered and analyzed, requiring a minor adjustment to the NOTE rather than re-entering all the information, as below.

[Titles] → **NOTE +01Future Volumes ;**

Observe that since the "Future Volumes" string is shorter than the original "Existing Volumes" string, extra spaces need to be added at the end, delineated by the ";" terminator. Also note that the column number for the new note information is "01", not just "1".

This technique can be used on any of the three [Titles] lines, and can also be used in the Visual Mode if desired (although not typically).

## Redirecting Report Output to Disk Files

Results displayed in a report output window can be directed to a disk file using several techniques. The most basic is to use the File-SaveAsText menu in the output window. This will create an ASCII text file which contains the text of the output window. This file can be opened by any text editor or word processor. Also, a section of the text output window (selected by dragging the mouse) can be copied to the Windows clipboard with the Edit-Copy menu so it can be pasted directly into any Windows application using normal Windows Copy and Paste techniques. The entire text output window can be copied to the clipboard with the Edit-SelectAll menu followed by the Edit-Copy menu without the need to select any of the output manually.

The entire graphics (formatted) output window can be copied to the clipboard as a bitmap image with the Edit-CopyWindowToClipboard menu. This can be Pasted into any Windows application that can accept bitmap graphics images.

## Command Entry Options

Certain options exist which are useful when entering commands in the Manual Mode, and more importantly in Control Files (which are discussed in a later section of this chapter). These options are presented in this section.

Sub-topics for this section:
- Blank Lines
- Line Terminators and Comments

### Blank Lines

TEAPAC ignores the entry of blank lines. In the Manual Mode this would occur when ENTER or the OK button is pressed without any non-blank characters in the entry field. The program ignores this entry and re-issues the command level prompt. If information is being read from a data file and a blank line is encountered, the program will simply skip to the next line of the file, ignoring the blank line. Typically, blank lines are used to separate blocks of data and comments in data files and control files.

### Line Terminators and Comments

In the Manual Mode, the parameter list of an input line is typically terminated by the ENTER key or the OK button. However, it is possible to terminate the data values by using a slash "/" prior to the end of the line. Once a slash is entered, the remaining characters on the input line are ignored by the program. A slash as a line terminator must be separated from other parameter values by one or more spaces and/or a single comma. Slashes are primarily useful in data or control files to separate a command and its associated parameter values from descriptive comments. If desired, an entire input line can be used for a comment line by beginning the line with a slash. The following is an example of a typical input sequence in the Manual Mode.

```
→ VOLUMES  0 275 0  0 875 0  0 375 0  0 1290 0
→ SEQUENCES  11  11
→ NOTE  Existing Geometrics
→ WIDTHS  0 12 0  0 12 0  0 12 0  0 12 0
→ DESIGN
→ NOTE  Proposed Geometrics
→ WIDTHS  * * * , * 24 * , * * * , * 24 ...
→ DESIGN
```

The following sequence of commands produces identical results, but would be clearer to someone first learning how to use the software, particularly if this information was stored in a file (a control file), as described in a following section (see Figure 7-1).

```
→ / An example of using comments and blank lines in input:
→ VOLUMES  0 275 0  0 875 0  0 375 0  0 1290 0          / these are the base volumes
→ SEQUENCES  11  11                                      / this is the allowed phasing
→
→ NOTE Existing Geometrics
→ WIDTHS  0 12 0  0 12 0  0 12 0  0 12 0                 / 1-lane approaches everywhere
→ DESIGN
→
→ NOTE Proposed Geometrics
→ WIDTHS  * * * , * 24 * , * * * , * 24 ...              / try adding 1 lane on N & S
→ DESIGN
```

## Simplified Use of Files

Many first-time users of TEAPAC are familiar only with very simplistic file saving and retrieval techniques used in other software. This familiarity is usually based on the saving and retrieving of a single scenario of information for each data file used, each action transferring a complete scenario of information to or from the data file. As this section will reveal, TEAPAC can accomplish this simplistic approach, but also go far beyond, giving the user almost unlimited flexibility in options for file storage and retrieval.

In the Visual Mode, the simplified approach described above is accomplished using normal Windows procedures: current values are saved to a file using the File-Save or File-SaveAs menus and retrieved using the File-Open menu. Shortcut keys and toolbar buttons can also be used, as described earlier. In the Manual Mode, the following procedures are used to perform the same simplified functions (these procedures can also be performed from the File-DataFiles menu of the Visual Mode).

A single-scenario-per-file program, as most software reflects, needs merely to initiate a save or a load process, each time identifying the name of the file where the action is to take place. This is very easy to understand, but imposes great limitations on what can be accomplished in multi-scenario analyses. Not the least of these limitations is in the creativity required of the user in naming data files, since each scenario must have a unique file name, and one that is meaningful in future months when the information needs to be accessed again. If the line # and file # parameters of the SAVE and LOAD commands are always set to values of "1", the Manual Mode can mimic the single-scenario-per-file strategy with ease. The only notable difference is that the data file is first named by using the FILES command, then either the **SAVE 1 1** or the **LOAD 1 1** command is issued. By naming the file once at the beginning, its successful location or creation can be assured before any further access is attempted. Then there is no possibility of accidentally using the wrong file with subsequent SAVEs and LOADs. These commands are all located in the [DataFiles] sub-menu of the File menu, as illustrated below.

To save the current data values of the program in a file called SAMPLE:

[DataFiles] → **FILE SAMPLE** ...

[DataFiles] → **SAVE 1 1** ...

Then at a later time to retrieve the same data values from the file:

[DataFiles] → **FILE SAMPLE** ...

[DataFiles] → **LOAD 1 1** ...

The default location for user data files is defined in the Options-Setup dialog. The Options-Setup dialog changes as the user navigates through the File-Open and File-SaveAs dialogs, and the current location can be saved in the program's .CFG file by pressing the Save button in the Options-Setup dialog. This will cause this saved location to be the default location the next time the program is run.

The default file extension is ".tpc", which is used unless another extension is placed after the file name. See the detailed discussion of program installation and CFG files in Appendix G and the notes for the FILES command in Appendix B for further information.

## Advanced Use of Files

In order to provide considerable more flexibility than the single-scenario-per-file logic described above, TEAPAC has the ability to access any number of data blocks from a single file, and can have as many as five data files open simultaneously. Furthermore, the data accessed need not be complete sets of data input, although this is the default. This allows, for example, existing and proposed geometrics to be stored in one data file while existing and future volumes can be stored in another file. This saves disk space and eliminates potentially dangerous duplication of information.

It is important to note that many multi-scenario capabilities can be handled automatically with the Scenario Management functions provided by the Edit-CreateOrEditScenario menu. These functions are available for all TEAPAC application functions without the need for knowledge about the advanced use of files described here, and as described with the detailed example problem for Scenario Management in Chapter 2. Many of the examples provided here in Chapter 7 could also be handled solely with these pre-programmed multi-scenario capabilities, and many users will find these capabilities adequate and much easier to use. The additional capabilities described here could be used in conjunction with or in place of these pre-programmed capabilities, and their illustration here with multi-scenario examples should not be interpreted as the only application of the capabilities – many other advanced applications are possible with the procedures described here which are not possible with the scenario management functions.

The flexibility of TEAPAC's advanced use of files is accomplished simply by having all file access commands (such as LOAD and SAVE) use line numbers and file numbers to describe where the file access is to take place. The file number describes which of the five possible FILES should be used and the line number describes where in that file to begin the access. For example, the simplified syntax of the LOAD command is: **LOAD <Line Number> <File Number>**. In order to LOAD the proper information from the data file, the proper <Line Number> and <File Number> must be specified. These values can be specified using any of the input modes (Visual and Manual Modes), but these values cannot be specified using the normal Windows file procedures such as File-Save, File-SaveAs and File-Open. Each of these parameters are discussed below.

Sub-topics for this section:

- Line Numbers and Stacking Multiple Scenarios in Files
- File Numbers and Use of Multiple Files

### Line Numbers and Stacking Multiple Scenarios in Files

Each line of data SAVEd in a file is numbered starting at line 1. The <line number> input of a command like SAVE or LOAD describes where in the file the access should begin. If a new file has been opened to SAVE information, the line number should be line 1 to start at the beginning of the file. When this information is to be retrieved, line 1 should be used for the LOAD command. If only one set of information is to be stored in the file, line 1 should always be used for every SAVE and LOAD performed, as illustrated above.

On the other hand, information may also be stacked in files sequentially, that is, one set of conditions following immediately after another. For example, if the data for a simple signal analysis is SAVEd starting at line 1 of a file and takes up 143 lines of the file, another scenario can be SAVEd starting at line 144 of the file. If it also takes 143 lines, as reported by the SAVE command, this information will be stored in lines 144-286. In order to retrieve the second set of information, line 144 should be used as the starting line number of the LOAD command. If the first scenario is desired again, simply LOAD starting at line 1 again. This process is illustrated below, first with sequential SAVEs, then sequential LOADs performed at a later time.

<enter scenario 1 data>

[DataFiles] → **FILE SAMPLE** ... / define SAMPLE as file #1

[DataFiles] → **SAVE 1 1** ... / save scenario 1 data starting at line 1 of file #1

<enter scenario 2 data>

[DataFiles] → **SAVE 144 1** ... / save scenario 2 data starting at line 144 of file #1

The data can be retrieved and analyzed at a later time, as follows.

[DataFiles] → **FILE SAMPLE** ... / define SAMPLE as file #1

[DataFiles] → **LOAD 1 1** ... / get scenario 1 data starting at line 1 of file #1

[Results] → **DESIGN** ... / do DESIGN calculations using scenario 1 data

[DataFiles] → **LOAD 144 1** ... / get scenario 2 data starting at line 144 of file #1

[Results] → **DESIGN** ... / do DESIGN calculations using scenario 2 data

Any number of scenarios or conditions may be SAVEd and LOADed to and from a file, simply by knowing at which line number the information starts. The only limit is that the line number cannot exceed 32,767. When SAVing information, it is important to either re-SAVE starting at the same line number as previously used, or to SAVE starting at the next available line number of the file. When re-SAVing information, make sure the same information is SAVEd as previously used so that it takes up the same number of lines used previously. If more lines are used, they will overwrite the beginning of the next information (if it exists), and if less lines are used they will not erase the end of the previously SAVEd information.

After any file access is completed, such as a LOAD or a SAVE, the default line number for that file remains at the "next line" of the file until another file access command is executed for that file or another file is opened in its place. For example, after the first SAVE above taking 143 lines of the file, the default line number for the next file access command will be line 144. If another scenario is to be SAVEd, the default line number may be used without explicitly entering it. This line number is displayed in the dialog box of the file access commands. In the Manual Mode or in Control Files described later, the null entry ("*") may be used in place of the <Line Number> parameter to use this default without the need to know its value. For example, the following produces the same result as the previous example, but using the underlined "*" value for the second SAVE and LOAD.

<enter scenario 1 data>

[DataFiles] → **FILE SAMPLE** ... / define SAMPLE as file #1

[DataFiles] → **SAVE 1 1** ... / save scenario 1 data starting at line 1 of file #1

<enter scenario 2 data>

[DataFiles] → **SAVE <u>*</u> 1** ... / save scenario 2 data starting at <u>next line</u> (144) of #1

The data can be retrieved and analyzed at a later time, with a similar technique:

[DataFiles] → **FILE SAMPLE** ... / define SAMPLE as file #1

[DataFiles] → **LOAD 1 1** ... / get scenario 1 data starting at line 1 of file #1

[Results] → **DESIGN** ... / do DESIGN calculations using scenario 1 data

[DataFiles] → **LOAD <u>*</u> 1** ... / get scenario 2 data starting at <u>next line</u> (144) of #1

[Results] → **DESIGN** ... / do DESIGN calculations using scenario 2 data

This procedure allows use of the default line number for repeated access of SAVEd scenarios in the same order they were SAVEd. The first scenario from above can be LOADed starting at line 1 and analyzed, then subsequent scenarios can be LOADed starting at the default line numbers (144, 287, 430,...) without remembering what they are. The default next line value for each of the five possible data files can be observed and/or changed with the NEXTLINES command. For example, a good way to make sure a series of LOAD * commands will start at line one of file #1 is to initialize that line number with NEXTLINES, as shown below.

[DataFiles] → **NEXTLINES 1** ...

[DataFiles] → **LOAD * 1** ...

[DataFiles] → **LOAD * 1** ...

Since the entry of "1" is the **first** parameter of NEXTLINES, it sets the next line value for the **first** file (#1) to 1, then the first LOAD * 1 starts at line 1 and the second LOAD * 1 starts immediately where the first LOAD ended.

Another line number that is remembered by the program is the "last line" that was used as an entry point for the file by any file access command. This line number is designated as line 0 of the file. For example, if information from the second scenario above was LOADed (starting at either line 144 or line *) and the analysis determined that are error in the input existed, it could be corrected and re-SAVEd using line number 0. Since the previous file access command (LOAD) started at line 144, whether by default or actual input, the following SAVE 0 command will start at line 144 again, effectively re-SAVing the information over the previous information with the corrections. In this sense, a repeated series of **LOAD *** and **SAVE 0** commands will LOAD the next information from the file, then re-SAVE any changes made before LOADing the next information, as illustrated below.

[DataFiles] → **FILE SAMPLE** ... / define SAMPLE as file #1

[DataFiles] → **LOAD 1 1** ... / get scenario 1 starting at line 1 of file #1

<perform analysis, identifying error in input data>

<correct input data>

[DataFiles] → **SAVE <u>0</u> 1** ... / re-save corrected scenario 1 at <u>last line</u> (line 1)

[DataFiles] → **LOAD <u>*</u> 1** ... / get scenario 2 starting at <u>next line</u> (line 144) of #1

<perform analysis, identifying error in input data>

<correct input data>

[DataFiles] → **SAVE <u>0</u> 1** ... / re-save corrected scenario 2 at <u>last line</u> (line 144)

One last special line number condition is the use of negative line numbers. It is not used very often, but it refers to a move backwards in a file. For example, if the next line of a file is 144, as described above, a LOAD -143 would be the same as LOAD 1 (since 1=144-143). Very specialized applications of the control files described later in this chapter can make use of this feature.

## File Numbers and Use of Multiple Files

The file numbers used in file access commands such as SAVE and LOAD refer to the position in which the file name desired exists on the current FILES command. The FILES command can carry up to five files simultaneously and the file number assigned to each is the position of the file name in the FILES list. For example, if existing conditions for an analysis are stacked sequentially in a file called EXIST and optimized conditions are to be stored in a file called OPTIM, each could be open at the same time by using the following command. Remember, these same sorts of scenarios can be handled entirely with the Scenario Management features of the program which do not require knowledge of advanced use of files – these examples of multi-scenario activities are simply illustrative examples of the advanced file capabilities.

[DataFiles] → **FILES EXIST OPTIM** ... / EXIST is file #1, OPTIM is file #2

Since EXIST is the first file in the file list, it will then be referred to as file number 1 by subsequent file access commands. OPTIM is the second file name in the list, so subsequent file access commands will use file number 2 for optimized conditions.

For example, using this situation, each scenario of existing conditions would be retrieved by using the LOAD commands below and each set of optimized conditions would be **SAVE**d by using the SAVE commands below.

[DataFiles] → **NEXTLINES 1 1** ... / start the next file access at line 1 in each file

[DataFiles] → **LOAD * 1** ... / retrieve first existing condition from file #1

[Results] → **DESIGN** ... / optimize results

[DataFiles] → **SAVE * 2** ... / save first existing condition results in file #2

[DataFiles] → **LOAD * 1** ... / retrieve second existing condition from file #1

[Results] → **DESIGN** ... / optimize results

[DataFiles] → **SAVE * 2** ... / save second existing condition results in file #2

If the optimized conditions are to be retrieved while the same FILES command is in effect, the first and subsequent scenarios would be retrieved and viewed by the LOAD and SUMMARIZE commands shown below.

[DataFiles] → **NEXTLINES * 1** ... / start the next file access at line 1 in file #2

[DataFiles] → **LOAD * 2** ... / retrieve first optimized condition from file #2

[DataFiles] → **SUMMARIZE** / view first optimized condition

[DataFiles] → **LOAD * 2** ... / retrieve second optimized condition from file #2

[DataFiles] → **SUMMARIZE** / view second optimized condition

The file number used only applies to the current FILES list in effect, and need not be the same every time the files are used. For example, if the above optimized scenarios are to be retrieved on another day and the existing conditions are of no concern, the OPTIM file can be opened as file #1 and the optimized scenarios can be retrieved with LOAD * 1 commands as shown below.

[DataFiles] → **FILES OPTIM** ...

[DataFiles] → **LOAD * 1** ... / retrieve first optimized condition from file #1

[DataFiles] → **SUMMARIZE** / view first optimized condition

[DataFiles] → **LOAD * 1** ... / retrieve second optimized condition from file #1

[DataFiles] → **SUMMARIZE** / view second optimized condition

Furthermore, since file number 1 is the default file number when executed from the keyboard and the "next" line number is always the default line number, the entire default "LOAD * *" command, or simply "LOAD", can be used, making the LOADing as easy as possible.

[DataFiles] → **FILES OPTIM** ...

[DataFiles] → **LOAD** ... / retrieve first optimized condition from file #1

[DataFiles] → **SUMMARIZE** / view first optimized condition

[DataFiles] → **LOAD** ... / retrieve second optimized condition from file #1

[DataFiles] → **SUMMARIZE** / view second optimized condition

In general, the default file number of any file access command is designated as the "next file". If the keyboard is considered as file #0, this means the default file number when a LOAD command is executed from the keyboard is file #1, as described earlier (1=0+1). If a LOAD command appears within file #1 (as in the case of a control file in the next section), the default file number will be #2 (2=1+1), and so on. Examples of the use of multiple files and file numbers can be found in the following section, Control Files. Although these examples are discussed in the context of being executed as control files, all of the commands could be just as easily executed from the keyboard, in either the Visual Mode or the Manual Mode.

## Control Files

Active commands, up to this point, have been entered exclusively through menu selections, dialogs and the keyboard. However, just as data in the form of entry commands may be LOADed from a file, active commands may also be placed in files and LOADed, thereby "executing" the active commands. This section discusses the use of files as a way of executing analyses by using a set of active commands in a file, thereby increasing the efficiency of problem solving. This discussion is clarified by first observing how "normal" data files are SAVEd.

The process of SAVing data in a file is typically a mysterious thing in most programs. If one were to view the contents of most software's data files, one would see what appears to be nearly random garbage (binary data), with the host program being the only entity which can typically make sense of the contents. This is not the case with TEAPAC. In fact, data files are stored in an immediately obvious format, which simply reflects the Manual Mode commands which are required to enter the data as it currently exists. This condition should become immediately obvious by entering and saving a small problem statement using the ECHO option, making an important, intentional error in the input. Use either the Visual or Manual Mode to enter the following.

[Titles] → **PROJECT  Example Data File**

[Titles] → **DESCRIPTION  Intersection #1**

[Titles] → **NOTE  PM Peak Hour**

[Basic] → **VOLUMES  100 200 3000**

[Basic] → **VOLUMES  * * 300**

[Basic] → **WIDTHS  0 24 12**

[DataFiles] → **FILES  SAMPLE** ...

[DataFiles] → **ECHO  YES**

[DataFiles] → **SAVE  1 1** ...

```
1:     1  /:: TEAPAC ...
1:     2  PROJECT Example Data File
1:     3  DESCRIP Intersection #1
1:     4  NOTE    PM Peak Hour
1:     5  RESET   [Parameters]
1: ...
1:    54  VOLUMES   100  200  300 ...
1: ...
1:    57  WIDTHS      0   24   12 ...
1: ...
1:   143  RETURN
```

143 lines SAVEd from Line  1 to 143 in File #1: SAMPLE

Because of the ECHO YES option, the output echoes a copy of every line of information which is written into the SAMPLE data file, as depicted above (lines unrelated to this discussion are omitted). It can be clearly observed that the lines of "data" that are SAVEd are really the Manual Mode commands which are required to enter the "current" parameter values of every [Parameters] command. Note specifically that only one VOLUMES command line is SAVEd, although two VOLUMES entries were made. The VOLUMES saved only reflect its current parameter values; any previous entries have been simply discarded.

The lesson of this example is simple, but incredibly important: When data is LOADed from a file, what the program is actually doing is simply reading Manual Mode commands out of the designated file, rather than from the keyboard! The SAVE command knows this, of course, so SAVE writes the current command information in the file in its equivalent Manual Mode form. With this lesson learned, one simple extension unlocks virtually unlimited power from TEAPAC: When LOAD reads commands from a file, it doesn't matter if the command is an entry command or an active command! The data files you've been working with to this point consist primarily of entry commands, but this is not a limitation, merely what the SAVE command normally creates. Nothing prevents you from putting active commands in a file, or mixing active and entry commands, as the following paragraphs will illustrate.

A file which contains active commands is called a control file. Their primary advantage is that they can be "executed" and left to proceed in an unattended mode. Control files are initiated using the LOAD command, in the same way data files are LOADed. As a simple example, the command sequence described in the Line Terminators and Comments section above could be placed in a file and executed with the LOAD command. Figure 7-1 shows what this simple control file would look like.

```
/ An example of using comments and blank lines in input:

VOLUMES  0 275 0  0 875 0  0 375 0  0 1290 0        / these are the base volumes
SEQUENCES  11  11                                   / this is the allowed phasing

NOTE  Existing Geometrics
WIDTHS  0 12 0  0 12 0  0 12 0  0 12 0              / 1-lane approaches everywhere
DESIGN

NOTE  Proposed Geometrics
WIDTHS  * * * , * 24 * , * * * , * 24 *             / try adding 1 lane on N & S
DESIGN
RETURN
```

**Figure 7-1**
**Simple Control File**

The following is all that would be needed to execute the control file shown in Figure 7-1, if its name was CONTROL.

[DataFiles] → **FILES CONTROL** ...

[DataFiles] → **LOAD 1 1** ...

Line 1 of the control file would be ignored since it starts with a slash (a comment); line 2 would also be ignored since it has nothing on it; and lines 3 and 4 would be like entering VOLUMES and SEQUENCES commands in the Manual Mode to set the VOLUMES and SEQUENCES accordingly. Similarly, line 5 would do nothing and lines 6 and 7 would enter a NOTE and WIDTHS values, then line 8 would execute a DESIGN command, using the newly entered VOLUMES, SEQUENCES and WIDTHS values. Immediately after this design the NOTE and WIDTHS would be changed to new values because of the commands on lines 10 and 11 and another DESIGN is executed from line 12. The RETURN command on line 13 signifies that no more commands should be read from the file, and control of input is RETURNed to the keyboard, which is where the process began.

All of these DESIGN results would be displayed in an output window that could be viewed and/or printed. Although this is a trivial example, it should now be clear how both entry and active commands can be LOADed from disk files, greatly expanding the capabilities of TEAPAC.

Sub-topics for this section:

- Useful Tools for Control Files
- Loops in Control Files
- Parallel File Structures
- Nested REPEAT Loops

## Useful Tools for Control Files

The TEAPAC Editor, formerly a stand-alone program known as TED, is designed (among other things) to create and edit control files for all TEAPAC application functions. It can also be used to review TEAPAC data files, and even edit their contents, if desired. TED presents itself as a simple edit window within TEAPAC with normal, simple Windows edit features such as found in NotePad, but conforms to the required file structure required by TEAPAC. This is to say, NotePad can be used to <u>view</u> the contents of any TEAPAC data or control file, but cannot be used to <u>change</u> these contents without destroying the required file structure. TED can be used to create the control file example in Figure 7-1 simply by using the File-Edit menu when no file is currently open. Use the File-Close menu to make sure no files are open, then use the File-Edit menu to open up a blank edit window into which the example lines of Figure 7-1 can be entered. When done, use the File-SaveAs menu of the edit window to save the contents under the name CONTROL.tpc.

Since the TEAPAC data files (and control files) are really just fixed-length record ASCII text files, control files can also be created by other software, text editors and word processors (such as NotePad) if the editor used can create each "line" of the .tpc control file with exactly 254 characters, plus an Enter character and a Line Feed character (for a total of 256 characters in each line). At the present time, only the first 80 characters of each line can contain real data; the rest of each line should be filled with blanks. If this is the case, then control files can be created and managed just as well with that editor. If this is not the case, the files can still be created as variable-length record ASCII files (this is the case for most editors, such as NotePad), then converted to TEAPAC format by simply opening them into the TEAPAC edit window and saving with File-Save.

When first using control files, it is useful to see exactly what is happening when the control file is "executed". In a previous section, the ECHO YES option was used to see on-screen each command line as it was SAVEd into a data file. In the same manner, ECHO YES can be used to see on-screen each command line as it is LOADed from a data file. If you were able to create the control file of Figure 7-1, execute it with the commands described below, including the ECHO YES option.

[DataFiles] → **FILES CONTROL** ...

[DataFiles] → **ECHO YES**

[DataFiles] → **LOAD 1 1** ...

You can see that each of the 13 lines of the control file are displayed on the screen when the are read and executed from the file. This option can be especially helpful when a control file has been created which is not doing what you expect it to. By observing each command line as it is read from the file, including the file number and line number it came from, the problem in a control file usually jumps out at you immediately and can be quickly corrected. Then the ECHO NO option should be used to turn the echo off for future LOAD and SAVE commands. You can also observe the echo process just as well by LOADing with the ECHO YES option any data file which has been previously SAVEd.

Another feature which has already been illustrated to some degree is use of the NEXTLINES command to initialize the default line number which is assigned to any of the opened FILES. Any time a file is opened in place of another file, its next line value is set to line 1. Frequently, however, it is necessary to re-start a control file process after starting it once and aborting for any number of reasons. To do this, the NEXTLINES command can be used to reset the next line defaults to the appropriate line numbers (usually 1 1 1 1 1) and the LOAD command is simply re-issued. NEXTLINES commands can also be used in a powerful way within control files for similar purposes, as illustrated in some of the following examples.

## Loops in Control Files

One of the most powerful aspects of control files is their ability to perform a specified series of commands repeatedly. This option relieves the user of the need to "baby-sit" the computer during such repetitive procedures. Such repetitive procedures are also typically very tedious and boring, which is a sure setup for mistakes and related problems. Use of control files removes this drudgery and these error-prone conditions.

The simplest way to conceive of a repetitive control file is with the most basic form of the GOTO command. In Figure 7-2, a control file similar to that of Figure 7-1 is shown, with the notable exception of line 11. This GOTO command tells TEAPAC to execute the command on line 9 next, instead of line 12, which the normal sequential process would dictate. In other words, the program will set up the standard [Titles] to be used and enter the starting SEQUENCE, WIDTHS and VOLUMES, then prompt the user in the Visual Mode to enter any desired changes to the NOTE, WIDTHS and VOLUMES. When the OK button is pressed for this display, TEAPAC would continue the control file with the DESIGN command of line 10, then re-execute the ASK command of line 9 because of the GOTO 9 on line 11. The problem with this control file is that this process will continue forever before any output is observed in the results window. Do not do this example, as it WILL go on forever because there is no way to abort it. Although this example is impractical in this form, it does depict a good conceptual example of how a loop in a control file can easily create a repetitive process. Now we can see the need for a more controlled loop process in the control file.

```
 1  PROJECT  Example of Infinite Loop Control File
 2  DESCRIPTION  Intersection Sensitivity Analysis with Control File
 3  /
 4  SEQUENCES  11  11
 5  WIDTHS      0 12 0 ,   0 24 0 ,   0 12 0 ,   0 24 0
 6  VOLUMES  0 275 0 , 0 875 0 , 0 375 0 , 0 590 0
 7  /
 8  / the following line is the start point for the continuous loop
 9    ASK NOTE WIDTHS VOLUMES
10    DESIGN
11    GOTO 9
12  /
13  RETURN
```

**Figure 7-2**
**Infinite Loop Control File**

The example of Figure 7-2 shows what might be termed an infinite loop where the GOTO command creates an repeated execution which never terminates itself, but goes on forever. A more useful option of TEAPAC is the controlled loop process which is directed by the REPEAT command. This command can be used to repeat a set of commands a specified number of times, rather than continue forever. For example, if we wanted to do the sensitivity analysis of Figure 7-2 only five times, we would insert only two changes, an additional REPEAT command and reference to this REPEAT command with the GOTO command. These changes are shown in bold print in Figure 7-3.

```
PROJECT  Example of REPEAT Loop Control File
DESCRIPTION  Intersection Sensitivity Analysis with Control File
/
SEQUENCES  11  11
WIDTHS     0 12 0 ,  0 24 0 ,  0 12 0 ,  0 24 0
VOLUMES  0 275 0 , 0 875 0 , 0 375 0 , 0 590 0
/
REPEAT TRY 1 5          / this is the start point for the controlled loop
  ASK NOTE WIDTHS VOLUMES
  DESIGN
  HEADING –1            / force an update of the output window to see DESIGN results
  GOTO TRY              / go back to REPEAT line until loop is completed
/
RETURN
```

**Figure 7-3**
**REPEAT Loop Control File**

In the REPEAT command, a user variable (TRY) is used to count the progress of the REPEAT loop, starting at the first number given (1) and ending with the last number given (5). In other words, the commands between the REPEAT and GOTO commands will executed first while TRY=1, then again while TRY=2, and so on, until a fifth time is executed while TRY=5. Then the REPEAT loop terminates itself and the next command after the GOTO is executed, allowing the control file to get out of the loop and finally execute the RETURN command, which brings control back to the keyboard. The HEADING -1 line is added so that the results of the preceding DESIGN command can be seen immediately rather than when the control file finishes. This control file is identical in function to the previous infinite loop control file, with the exception that it will only prompt the user for the NOTE, WIDTHS and VOLUMES five times, then terminate normally.

By using REPEAT loops that terminate themselves, multiple tasks can be included in a control file, including a series of sequential commands or even a series of sequential REPEAT loops. REPEAT loops can also be "nested" within each other, so that the internal loop is executed completely for each pass through the external loop. Figure 7-4 illustrates fragment (incomplete) examples of both sequential and nested REPEAT loops, now using many of the features described in this chapter.

**Sequential REPEAT Loops:**

```
VOLMS    0 275 0 , 0 950 0 , 0 375 0 , 0 670 0
WIDTHS  0 12 0 ,   0 12 0 ,   0 12 0 ,   0 12 0
NEXTLINES  * 16 32 16
/
REPEAT A 1 10  / 10 sets starting at line 16 of file # 2
  LOAD * 2
  DESIGN
  GOTO A
/
REPEAT B 5 0 -1  / 6 sets starting at line 32 of file # 3
  LOAD * 3
  DESIGN
  GOTO B

REPEAT C -5 0 2  / 3 sets starting at line 16 of file # 4
  LOAD * 4
  DESIGN
  GOTO C
RETURN
```

**Nested REPEAT Loops:**

```
REPEAT INTERSECTION 1 10  / 10 intersections of information stacked sequentially
  REPEAT SCENARIO 1 5   / retrieve 5 sets of sequentially saved data for each int.
    LOAD * 2            / all data stored sequentially in one file opened as file #2
    DESIGN
    GOTO SCENARIO       / get next scenario
  GOTO INTERSECTION     / get next intersection
RETURN
```

**Figure 7-4**
**Examples of Control Files with Sequential and Nested REPEAT Loops**

In the Sequential Loop example at the top of Figure 7-4 the VOLUMES and WIDTHS are first set to starting values and the starting lines of the FILES designated for files #2, #3 and #4 are initialized. Then ten alternative scenarios are LOADed and DESIGNed, as dictated by the contents of file #2, six scenarios are LOADed and DESIGNed, as dictated by the contents of file #3, and three scenarios are LOADed and DESIGNed, as dictated by the contents of file #4. In this exercise, files 2-4 might have, for example, alternative VOLUMES and/or WIDTHS for scenarios A, B and C, as noted by the variable names chosen for the three REPEAT loops. Each of these would be properly described by [Titles] commands in the various files. All of these files would typically be created by prior sequential SAVE commands from TEAPAC. Note also how the NEXTLINES has been used to start the sequential LOAD * commands for each file, and how some of the alternative counting schemes for REPEAT are used (see Appendix B for a full description of the REPEAT parameters).

The bottom of Figure 7-4 illustrates an example of nested REPEAT loops. In this case, 50 sets of data have been SAVEd sequentially in the file designated as file #2. As the variables of the REPEAT loops indicate, this consists of 10 intersections, with five scenario conditions stored for each. In other words, the first five SAVEs made in the data file (#2) are the five scenarios for the first intersection, the next five are the scenarios for the second intersection, and so on. By executing this single seven-line control file, the results of 50 design optimizations can be performed. This can be started with a single LOAD 1 1 command and the rest will take care of itself.

## Parallel File Structures

With all of these tools in place, we can now see some examples of how they can actually be used to solve typical traffic engineering problems. Of course, we will use the simplistic TEAPAC examples we've been describing previously to illustrate these solutions, but the extensions to real analyses for any of the TEAPAC application functions should be obvious, since they are all driven by the same mechanisms described here. Remember, these same sorts of scenarios can be handled entirely with the Scenario Management features of the program which do not require knowledge of advanced use of files – these examples of multi-scenario activities are simply illustrative examples of the advanced file capabilities, and for the automation aspects of control files, in particular.

It is not uncommon in traffic engineering problems to be presented with several different sets of conditions to be analyzed and compared to each other. The use of parallel file structures can be used to simplify the analysis process and allow the "batch" processing of data. The example discussed below explains a parallel file structure.

Let's assume an intersection project has three different development phases and two geometric designs have been proposed. Approach volumes have been estimated for each of the development phases. The problem is to determine whether the various combinations of volumes and geometrics will be adequate for traffic flow, and which geometric proposal is superior from a critical level of service perspective.

For this example, the four files of Figure 7-5 are used. A control file will be used to execute the analysis – notice that this control file does not have any data entries, just action directives. A base condition file will contain the traffic volumes for the three development phases and two additional files will contain the geometric design alternatives. All of these files can be created with sequential saves using the <List of Commands> option of the SAVE command, except for the control file, which must be created in the TED edit window as described previously. The data files (#2, #3 and #4) can also be created in the TED edit window.

**Control File - File #1:**

```
NEXTLINES * 1 1
REPEAT YEAR 1 3
  LOAD * 2
  LOAD * 3
  DESIGN
  GOTO YEAR
STOP
```

**Base Condition Volumes - File #2:**

```
PROJECT  Example Parallel Files
DESCRIPTION  Example Intersection
NOTE Base Condition VOLUMES - Year 1
VLMS  0 275 0 , 0 875 0 , 0 375 0 , 0 590 0
RETURN
/
NOTE Base Condition VOLUMES - Year 2
VLMS 0 380 0 , 0 985 0 , 0 440 0 , 0 695 0
RETURN
/
NOTE Base Condition VOLUMES - Year 3
VLMS 0 480 0 , 0 1050 0 , 0 495 0 , 0 750 0
RETURN
```

**Alternative 1 Widths - File #3:**

```
NOTE +35Alt 1 WIDTHS - Year 1
WDTH 0 12 0 , 0 12 0 , 0 12 0 , 0 12 0
RETURN
/
NOTE +35Alt 1 WIDTHS - Year 2
WDTH 0 12 0 , 0 24 0 , 0 12 0 , 0 24 0
RETURN
/
NOTE +35Alt 1 WIDTHS - Year 3
WDTH 0 24 0 , 0 24 0 , 0 24 0 , 0 24 0
RETURN
```

**Alternative 2 Widths - File #3:**

```
NOTE +35Alt 2 WIDTHS - Year 1
WDTH 0 12 0 , 0 24 0 , 0 12 0 , 0 24 0
RETURN
/
NOTE +35Alt 2 WIDTHS - Year 2
WDTH 0 24 0 , 0 24 0 , 0 24 0 , 0 24 0
RETURN
/
NOTE +35Alt 2 WIDTHS - Year 3
WDTH 0 24 0 , 0 36 0 , 0 24 0 , 0 36 0
RETURN
```

**Figure 7-5**
**Parallel File Structure Example**

The control file will execute the analysis by first LOADing the information contained in the Base Conditions File, #2, then LOADing the width configurations from one of the two Width Alternative Files, #3. Once the data is LOADed, the program will perform a DESIGN. In order to test both lane configuration alternatives, the FILES command is issued twice, followed by LOADing the control file at line 1. Assuming the files shown in Figure 7-5 exist in the default file path, the following commands would be entered from the keyboard to perform the necessary analysis.

[DataFiles] → **FILES CONTROL BASE WIDTH1** ...

[DataFiles] → **LOAD 1 1** ...

[DataFiles] → **FILES * * WIDTH2** ...

[DataFiles] → **LOAD 1 1** ...

The structure of the WIDTH1 and WIDTH2 files contains different lane configurations for each phase of the development, but every entry in the WIDTH1 file has a corresponding entry in the WIDTH2 file, and each of these files has a section to LOAD for every section of the BASE file. This is why they are called parallel files -- the structure of each data file parallels the structure of each other so they can be uniformly LOADed by the control file and produce meaningful results. A comparison of the results can be used to determine which of the geometric designs is most appropriate for a given development phase, and the entire process was executed with only four commands.

## Nested REPEAT Loops

Control files containing nested REPEAT Loops can be used to make efficient use of TEAPAC to handle typical traffic problem situations. This is accomplished by using the LOAD command within loops that are nested inside each other. In the parallel file example, two sections from two different files were LOADed and the combined condition was analyzed. With nested loops, a section of one file is LOADed and then multiple LOADs are made from a second file. Each condition is analyzed and then another section of the first file is LOADed and the process is repeated with the second file. Figure 7-6 illustrates a similar example using nesting.

**Control Commands - File #1:**

```
PROJECT Example of Nested REPEAT Loops
NEXTLINES * 1
/
REPEAT LANS 1 3
  LOAD * 2
  NEXTLINES * * 1
  /
  REPEAT VOLS 1 4
    LOAD * 3
    DESIGN
    GOTO VOLS
  /
  GOTO LANS
/
RETURN
```

**Base Conditions Widths - File #2:**

```
DESCRIPTION Sample Intersection
NOTE Alternate 1 WIDTHS
WDTH 0 12 0 , 0 24 0 , 0 12 0 , 0 24 0
RETURN
/
NOTE Alternate 2 WIDTHS
WDTH 0 24 0 , 0 24 0 , 0 24 0 , 0 24 0
RETURN
/
NOTE Alternate 3 WIDTHS
WDTH 0 24 0 , 0 36 0 , 0 24 0 , 0 36 0
RETURN
```

**Volumes Data - File #3:**

```
NOTE +20Year 1 VOLUMES
VOLS 0 275 0 , 0 875 0 , 0 375 0 , 0 590 0
RETURN
/
NOTE +20Year 2 VOLUMES
VOLS 0 380 0 , 0 985 0 , 0 440 0 , 0 695 0
RETURN
/
NOTE +20Year 3 VOLUMES
VOLS 0 480 0 , 0 1050 0 , 0 495 0 , 0 750 0
RETURN
/
NOTE +20Year 4 VOLUMES
VOLS 0 545 0 , 0 1110 0 , 0 520 0 , 0 810 0
RETURN
```

**Figure 7-6**
**Nested Control Files**

For this example, similar to the parallel file example, assume three different geometric conditions have been proposed by three agencies, all of which need to be analyzed and compared for the same four volume conditions. For this example, the geometrics are placed in a WIDTHS file of base conditions, and the volumes are placed in a separate file. The control file contains the nested REPEAT loop which LOADs a geometric design and then each one of the sets of volume data sequentially.

The entire analysis is performed by the following two commands.

[DataFiles] → **FILES CONTROL WIDTHS VOLUMES** ...

[DataFiles] → **LOAD 1 1** ...

In the control file, note how the NEXTLINES command is used to make sure each REPEAT loop starts at the beginning of the proper file. This is particularly critical for file #3 which starts its LOADing at line 1 three different times for each of the WIDTHS configurations.

In addition, if a new set of volumes are proposed, a new volumes file can be created similar to the one described above, and then repeat the analysis substituting the new volumes file name in the FILES command.

## User Variables and Calculations

In TEAPAC the user has the ability to define values for up to 26 unique variables. These variables are named with the letters of the alphabet, A through Z. Values for user variables can be set in one of two ways, by using the CALCULATE command or the REPEAT command. Variables which have been defined in this manner can then be used in one of two ways. The variables can be used in other CALCULATE commands or as numeric parameter values. The following paragraphs describe these applications.

Sub-topics for this section:
- Defining User Variable Values
- User Variables as Parameter Values

### Defining User Variable Values

The CALCULATE command can be used in a number of ways to make and save calculations. In its simplest form, the user enters a simple expression using numbers separated by the operators +, -, * and / (addition, subtraction, multiplication and division). Examples of such simple calculations are shown below. Normal operator evaluation order (precedence) for algebra applies; that is, multiplication and division are evaluated first (left to right) and addition and subtraction are evaluated last.

[Control] → **CALCULATE 6 + 12 - 8**

ANSWER: 10.0000

[Control] → **CALCULATE 3 * 12 + 9 * 8**

ANSWER: 108.0000

More complex expressions can make the use of nested parentheses, particularly in order to change the normal order of operator evaluation.

[Control] → **CALCULATE 3 * (12 + 9) * 8**

ANSWER: 504.0000

[Control] → **CALCULATE 2 * ((3 + 4) / 9)**

ANSWER: 1.5556

The rounded integer value of a calculation can be assigned as a value of any of the 26 user variables by putting the variable and an equal sign ahead of the expression in equation form. For example, the previous calculation shown above can be assigned to the variable "A" by the following command.

[Control] → **CALCULATE A = 2 * ((3 + 4) / 9)**

ANSWER: 1.5556
A= 2

Note that the fractional result of 1.5556 is rounded up to the nearest integer value of 2 and assigned to the variable A. Now "A" can be used in another calculation, as shown below. If a user variable which has not been defined is used in a CALCULATE command, its value will be zero.

[Control] → **CALCULATE 5 * A**

ANSWER: 10.0000

[Control] → **CALCULATE B = 5 * A**

B= 10

In a control file, a REPEAT command also defines incremental values for user variables, which can then be used in CALCULATE commands in the same fashion described above. By using REPEAT and CALCULATE commands in this fashion in a control file, a crude form of a programmable calculator function can be created, as illustrated below.

```
CALCULATE  L = 10            / lost time is always 10 seconds
REPEAT C 60 120 10                          / try all cycles from 60 to 120 seconds, by tens
  CALCULATE G = 0.35 * (C - L)              / green time is 35% of available time
```

```
  CALCULATE R = C - G                / red time is remainder of cycle time
  CALCULATE Q = 2 * 900/3600 * R     / queue is twice arrivals on red for volume = 900
  GOTO C                             / get next cycle to try
```

This little example calculates the queue length for cycles ranging from 60 to 120 seconds, assuming 10 seconds of lost time per cycle and a split using 35 percent of the available green time. In these types of calculations, care must be taken to make sure that the rounding of the results when assigned to the variable values maintains adequate accuracy.

## User Variables as Parameter Values

User variable values can also be used as input values for numeric parameters in any command of the program. This is done by simply using the variable name for the parameter entry, preceded by an equal sign. For example, if a traffic volume on the North approach of an intersection had been calculated with some kind of a growth factor or assignment factor, "F", then that volume could be input on the VOLUMES command with the variable rather than by re-typing the actual number, as shown below. Since the value of F must be an integer (no fractional part), its value might be stored as ten times its actual value (e.g., F=12 to represent 1.2), so this is reflected in the calculation.

[Control] → **CALCULATE V = 656 * F / 10**

[Basic] → **VOLUME =V * *** ...

[Results] → **DESIGN** ...

In a more powerful application, the complex calculations illustrated in the control file above could be combined with the use of a variable as an input parameter, using the "C" variable as the cycle length for the DESIGN command. Only the CYCLES and DESIGN command lines (bold) have been added to the control file above for this result.

```
CALCULATE  L = 10        / lost time is always 10 seconds
REPEAT C 60 120 10                   / try all cycles from 60 to 120 seconds, by tens
  CYCLES  =C  =C                     / set the cycle range for the current cycle variable
  DESIGN ...                         /   then do a DESIGN for the current cycle length
  CALCULATE G = 0.35 * (C - L)       / green time is 35% of available time
  CALCULATE R = C - G                / red time is remainder of cycle time
  CALCULATE Q = 2 * 900/3600 * R     / queue is twice arrivals on red for volume = 900
  GOTO C                             / get next cycle to try
```

This is only a small example of the power that the use of user variables provides, when combined with the powerful CALCULATE and REPEAT commands and the use of user variables as input parameters. The rest is left to the imagination and ingenuity of the user.

APPENDICES

# Reference Manual

The following appendices form the TEAPAC Reference Manual. This manual is designed to provide detailed information regarding various aspects of the program. The information in the appendices is ordered such that easy reference access is possible. Each of the appendices is described briefly below.

## Appendix A
## ABBREVIATED DESCRIPTION OF ACTIONS AND ENTRIES

Appendix A lists all command dialogs by group name. This appendix is designed for quick reference regarding group names and command hierarchy. The single line descriptions are identical to the descriptions provided by the Help-Commands menu and the HELP command. The descriptions identify the names and number of parameter values along with any default values.

## Appendix B
## DETAILED DESCRIPTION OF ACTIONS AND ENTRIES

Appendix B provides complete detail regarding the command dialogs and their associated parameter values. All command dialogs are listed in this section. Five categories of information are provided for each command: 1) Format, 2) Function, 3) Parameters, 4) Group Names and 5) Notes. This appendix provides specific details on how to use a dialog and what, if any, limitations exist on the associated parameter values. The Notes category provides useful "hints" on the use of each command.

## Appendix C
## ANALYSIS METHODS AND FORMULATIONS

Appendix C discusses the methods and formulae used by each application function to calculate results. Using the procedures discussed in this appendix, it is possible to manually recreate the results calculated by the program. This appendix is sub-divided by each of the major application functions found in TEAPAC.

## Appendix D
## <u>REPORT DESCRIPTIONS AND EXAMPLES</u>

Appendix D describes all the output reports generated by the TEAPAC program. In addition, sample output is provided for each type of report generated by the program. The elements of each report are described in detail. This appendix is sub-divided by each of the major application functions found in TEAPAC.

## Appendix E
## <u>ERROR MESSAGES AND TROUBLE SPOTS</u>

Appendix E describes application-specific error messages of the TEAPAC program, the potential cause of such errors and potential solutions. Application errors are identified by three letters which indicate which application the error applies to, followed by a two-digit error number. For example, signal analysis errors are identified by the letters "SIG" followed by a two-digit number. In addition, potential trouble spots associated with using each application function are outlined. This appendix is useful for identifying application-specific causes for certain problems in the use of the program, as well as preventing future errors. This appendix is sub-divided by each of the major application functions found in TEAPAC.

## Appendix F
## <u>TEAPAC SYSTEM ERROR MESSAGES</u>

Appendix F describes error messages which are common to all TEAPAC activities. TEAPAC error or warning messages are identified by the letters "TPC" followed by a two digit number. This appendix discusses each TEAPAC error and potential causes and solutions.

## Appendix G
## <u>OPERATING SYSTEM MESSAGES AND INSTALLATION NOTES</u>

Appendix G discusses the unique aspects of the installation of the TEAPAC program on a particular operating system. Operating system dependent functions such as error messages, file specification procedures and output control features are discussed. Special function keys, such as control characters, are also discussed.

## Appendix H
## <u>ADDENDA</u>

Appendix H provides a location for recent release notes and addenda which may be published after the official release of the published documentation. This appendix can also be used to store printed copies of new release notes for updated versions of TEAPAC, as produced by the Help-RecentChanges menu or the MESSAGES command, for off-line reference.

APPENDIX A

# Abbreviated Description of Actions and Entries

Appendix A Topics

Appendix A is designed as a quick reference to the program's command dialogs and their associated parameter values. This appendix is also useful for identifying what specific Group Names exist in the program and which are sub-sets of other groups (Table A-1), which command dialogs can be found in each group (Table A-2), and an alphabetical list of commands (Table A-3). The command-specific summary information contained in this appendix can be accessed interactively using the HELP command.

Each TEAPAC command dialog has been classified into one or more "groups", each of which consist of a subset of all command dialogs. Each group contains commands which share functional similarities. The Group Name associated with each group describes the function shared by the commands, and in many cases define the first-level Edit menu contents. The Group Names form a hierarchical command structure, as outlined in Table A-1.

Group names are useful when assessing what command dialog entries affect the various basic analysis functions of TEAPAC. They are also useful when using one of the five commands which requires a list of commands as a parameter value. These five commands are RESET, ASK, DATA, HELP and SAVE. Group names make it possible to list a complete set of commands using a single parameter value. In order to use a group name as a parameter value, it is necessary to enclose the group name in square brackets, "[XXX]", as shown in this appendix.

**Table A-1**
**Group Name Structure**

```
[GROUP NAME] - Types of Commands Included in Group
_____________________________________________________________

[AllCommands] - All of the TEAPAC commands, alphabetically

   [Info]       - help & information about updates

   [DataFiles] - data and file management

   [Titles]     - enter the headings for report output

   [Control]    - control program execution environment

   [Results]    - perform analysis-specific actions

   [Parameters] - enter analysis-specific data

      [SignalAnalysis]  - enter signal analysis data

         [Basic]            - enter essential data requirements

         [System]           - enter network-wide system data

         [Intersection]     - enter intersection data

         [Approach]         - enter approach-specific data

         [Movement]         - enter movement-specific data

         [Phasing]          - enter phasing and timing data

      [TrafficImpact]   - enter traffic impact analysis data

      [CountAnalysis]   - enter count analysis data

      [Progression]     - enter progression analysis data

      [ExportImport]    - enter export and import analysis data
```

## Appendix A Topics:



## Command and Group Organization

Table A-2 provides a cross-reference between each of the commands and the group names. Abbreviated group names appear across the top of the table and commands along the left side. An "X" in the table indicates that the command to the left is included in the group name above. An "=" in the table indicates that the command is included in the group, but that its entries are only the result of analyses, not input to those analyses. An "o" in the table indicates the active [Results] commands related to the application functions of TEAPAC, but that these commands are not specific elements of their associated groups. This table also allows a quick view of the relationship between group names and commands. Three legacy commands documented in Appendix B which are no longer members of any group are DISTRIBUTION, LINKLIST and TYPE.

The group name [AllCommands] contains every possible TEAPAC command. This group is organized in alphabetical order. The [AllCommands] group is divided into six sub-groups. These are [Info], [DataFiles], [Titles], [Control], [Results], and [Parameters]. The first four are used primarily for the basic housekeeping chores needed for program manipulation, such as on-screen help, data manipulation, file handling, output labeling, printer control, and control file actions. The last two sub-groups contain commands specific to defining and executing various traffic analyses with the program. The first, [Results], consists of active commands which produce specific results – these appear in the Results menu. The other, [Parameters], consists of all of the commands which can be used to enter the data values which describe the conditions to be analyzed by the [Results] commands – these appear in the Edit menu of TEAPAC, as described below.

The [Parameters] group is first sub-divided into five basic groups representing the major analysis functions of TEAPAC – [SignalAnalysis], [TrafficImpact], [CountAnalysis], [Progression] and [ExportImport].

[SignalAnalysis] contains all those commands pertaining to a signal analysis, some of which are also used by the other analysis functions to describe the essential analysis network. Since the [SignalAnalysis] group is thus quite large, it is further sub-divided into six groups which appear in the Edit menu. The subset groups are [Basic], [System], [Intersection], [Approach], [Movement], [Phasing]. The [Basic] group consists of those important and necessary commands needed as a minimum to describe the data for a basic signal analysis, or any other TEAPAC analysis. The commands in [Basic] are also wholly contained in the remaining subset groups for [SignalAnalysis], as follows. The [Intersection] commands are used to input those parameters which affect the entire intersection, such as metropolitan area. The [Approach] commands are used to enter those parameters specific to each of the four approaches. The [Movement] commands are used to enter data specific to each of the twelve movements. The [Phasing] commands describe the signal phasing and timing parameters.

[TrafficImpact] contains all those commands which are needed to fully describe a traffic impact analysis, and [CountAnalysis] contains all those commands which are needed to fully describe a count analysis. The Edit menus for these two groups only display the commands of these groups which have not already been included in the preceding [SignalAnalysis] sub-menus. [Progression] is a group which contains all of the commands pertaining to a progression analysis, all of which are independent of all other commands previously described, so appear in total in the Edit menu. [ExportImport] contains all those commands for an export and import analysis, all of which are included in the [SignalAnalysis] group, no separate Edit menu exists for [ExportImport].

**Table A-2**
**Cross-Reference of Commands and Groups**

| Command | ALL | INF | DAT | TIT | CON | RES | PAR | BAS | SYS | INT | APR | MOV | PHA | SIG | TIA | COU | PRG | EXP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MESSAGES | X | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| HELP | X | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| RESET | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| DATA | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| SUMMARIZE | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| FILES | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| NEXTLINES | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| ECHO | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| LOAD | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| SAVE | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| ASK | X | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| PROJECT | X | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| DESCRIPTION | X | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| NOTE | X | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| STOP | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| IODEVICES | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| NEWPAGE | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| HEADING | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| CALCULATE | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| REPEAT | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| GOTO | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| RETURN | X | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| URBANSTREET | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | o |
| DESIGN | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| SORT | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| TIMINGS | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| ANALYZE | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| EVALUATE | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| QUEUECALCS | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| GOVERCS | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| SERVICEVOLUMES | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| DIAGRAMS | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| MAP | X | . | . | . | . | X | . | . | . | . | . | . | . | o | . | . | . | . |
| FINDPATHS | X | . | . | . | . | X | . | . | . | . | . | . | . | . | o | . | . | . |
| SHOWPATHS | X | . | . | . | . | X | . | . | . | . | . | . | . | . | o | . | . | . |
| COMPUTEPATHS | X | . | . | . | . | X | . | . | . | . | . | . | . | . | o | . | . | . |
| COUNTIMPORT | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| COUNTRECONFIG | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| COUNTTABULATE | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| PEAKANALYZE | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| COUNTREPORTS | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| PEAKSUMMARY | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| COUNTGRAPH | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| WARRANTS | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | o | . | . |
| PROGRESSION | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . | o | . |
| PLOTSIMPLE | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . | o | . |
| HCSEXPORT | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | o |
| EXPORT | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | o |
| IMPORT | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | o |
| PLOTTSD | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | o |
| TIMINGPLAN | X | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . | . | o |

**Table A-2 (continued)**
**<u>Cross-Reference of Commands and Groups</u>**

Groups:

| Command | ALL | INF | DAT | TIT | CON | RES | PAR | BAS | SYS | INT | APR | MOV | PHA | SIG | TIA | COU | PRG | EXP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NODELIST | X | . | . | . | . | . | X | X | X | . | . | . | . | X | X | X | . | X |
| SUBSYSTEM | X | . | . | . | . | . | X | . | X | . | . | . | . | X | . | . | . | X |
| ROUTE | X | . | . | . | . | . | X | . | X | . | . | . | . | X | . | . | . | X |
| MASTERNODE | X | . | . | . | . | . | X | . | X | . | . | . | . | X | . | . | . | X |
| QUEUEMODELS | X | . | . | . | . | . | X | . | X | . | . | . | . | X | . | . | . | . |
| SIMULATION | X | . | . | . | . | . | X | . | X | . | . | . | . | X | . | . | . | X |
| OPTIMIZE | X | . | . | . | . | . | X | . | X | . | . | . | . | . | . | . | . | X |
| OUTPUT | X | . | . | . | . | . | X | X | X | . | . | . | . | X | X | X | . | X |
| INTERSECTION | X | . | . | . | . | . | X | X | . | X | . | . | . | X | X | X | . | X |
| NODELOCATION | X | . | . | . | . | . | X | X | . | X | . | . | . | X | X | . | . | X |
| NETWORK | X | . | . | . | . | . | X | X | . | X | . | . | . | X | X | . | . | X |
| METROAREA | X | . | . | . | . | . | X | X | . | X | . | . | . | X | . | . | . | . |
| LEVELOFSERVICE | X | . | . | . | . | . | X | . | . | X | . | . | . | X | . | . | . | . |
| EXCESS | X | . | . | . | . | . | X | . | . | X | . | . | . | X | . | . | . | . |
| APPLABELS | X | . | . | . | . | . | X | X | . | . | X | X | . | X | X | X | . | . |
| GRADES | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | . |
| PEDLEVELS | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | . |
| PEDWALKS | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | X |
| PEDFDWS | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | X |
| BIKEVOLUMES | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | . |
| PARKINGSIDES | X | . | . | . | . | . | X | X | . | . | X | . | . | X | . | . | . | . |
| PARKVOLUMES | X | . | . | . | . | . | X | X | . | . | X | . | . | X | . | . | . | . |
| BUSVOLUMES | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | . |
| RIGHTTURNONREDS | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | X |
| RTINFLUENCES | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | . |
| UPSTREAMVC | X | . | . | . | . | . | X | . | . | . | X | . | . | X | . | . | . | . |
| MOVLABELS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | X | X | . | . |
| VOLUMES | X | . | . | . | . | . | X | X | . | . | . | X | . | X | X | = | . | X |
| VOLFACTORS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | X | X | . | X |
| VOLADDITIONALS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | = | . | . | X |
| WIDTHS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | X | . | . | X |
| LANES | X | . | . | . | . | . | X | X | . | . | . | X | . | X | X | . | . | X |
| GROUPTYPES | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | X |
| UTILIZATIONS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| TRUCKPERCENTS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | . | . | . | . |
| PEAKHOURFACTORS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | . | = | . | X |
| ARRIVALTYPES | X | . | . | . | . | . | X | X | . | . | . | X | . | X | . | . | . | . |
| ACTUATIONS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | . | . | . | X |
| FIRSTDETECTS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | X |
| LASTDETECTS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | X |
| MINIMUMS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | . | . | . | X |
| REQCHANGE+CLEARS | X | . | . | . | . | . | X | X | . | . | . | X | . | X | . | . | . | X |
| REQYELLOWS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| STARTUPLOST | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | X |
| ENDGAIN | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | X |
| STORAGE | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | X |
| INITIALQUEUE | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| IDEALSATFLOWS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| FACTORS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| DELAYFACTORS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| NSTOPFACTORS | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| NEMAPHASES | X | . | . | . | . | . | X | . | . | . | . | X | . | X | . | . | . | . |
| SATURATIONFLOWS | X | . | . | . | . | . | X | . | . | . | . | X | . | = | . | . | . | X |

**Table A-2 (continued)**
**Cross-Reference of Commands and Groups**

| Command | ALL | INF | DAT | TIT | CON | RES | PAR | BAS | SYS | INT | APR | MOV | PHA | SIG | TIA | COU | PRG | EXP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEQUENCES | X | . | . | . | . | . | X | X | . | . | . | . | X | X | . | . | . | X |
| PERMISSIVES | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| OVERLAPS | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| LEADLAGS | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| GAPOUTS | X | . | . | . | . | . | X | . | . | . | . | . | . | X | . | . | . | . |
| DALLASLEFTS | X | . | . | . | . | . | X | . | . | . | . | . | . | X | . | . | . | . |
| CYCLES | X | . | . | . | . | . | X | X | . | . | . | . | X | X | . | . | . | X |
| GREENTIMES | X | . | . | . | . | . | X | X | . | . | . | . | X | X | . | . | . | X |
| YELLOWTIMES | X | . | . | . | . | . | X | X | . | . | . | . | X | X | . | . | . | X |
| REDCLEARTIMES | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| PASSAGETIMES | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| RECALLS | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| DUALENTRYS | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| GREENAVERAGES | X | . | . | . | . | . | X | . | . | . | . | . | X | = | . | . | . | X |
| CRITICALS | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | . |
| PEDTIME | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| OFFSET | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| PHASEMOVEMENTS | X | . | . | . | . | . | X | . | . | . | . | . | X | X | . | . | . | X |
| SITESIZE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | X | . | . | . |
| ROUND | X | . | . | . | . | . | X | . | . | . | . | . | . | . | X | . | . | . |
| BASE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | X | . | . | . |
| GENERATION | X | . | . | . | . | . | X | . | . | . | . | . | . | . | X | . | . | . |
| PATHDISTRIBUTION | X | . | . | . | . | . | X | . | . | . | . | . | . | . | X | . | . | . |
| PATHASSIGNMENT | X | . | . | . | . | . | X | . | . | . | . | . | . | . | X | . | . | . |
| ASSIGNMENT | X | . | . | . | . | . | X | . | . | . | . | . | . | . | X | . | . | . |
| COUNTTYPE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | X | . | . |
| PERIODS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | X | . | . |
| CONDITIONS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | X | . | . |
| ADTFACTOR | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | X | . | . |
| VEHICLECOUNTS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | X | . | . |
| TRUCKCOUNTS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | X | . | . |
| PRG-SIZE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-BASE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-CLEARANCES | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-DIRECTIONS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-UNITS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-NAMES | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-SPLITS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-DISTANCES | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-SPEEDS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-CYCLES | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-TOLERANCE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-RATIO | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-ADJUST | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-ALLREDS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-NONCONCURRENT | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-AVAILABLE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-LEADLAG | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-OFFSETS | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-FINETUNE | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |
| PRG-LINKNODEDATA | X | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | X | . |

## All Commands

**Table A-3**
**All Commands Listed Alphabetically**

| Command | Parameter Values | Defaults |
|---|---|---|
| ACTUATIONS | 12*<Actuated Mov't NO/YES or Extension (sec)> | 12*NO |
| ADTFACTOR | <Factor to Expand Counts to 24 Hour Volumes> | 0.0 |
| ANALYZE | - | - |
| APPLABELS | 4*<1-character Approach Label> | N,E,S,W |
| ARRIVALTYPES | 12*<Arrival Type - 1/2/3/4/5/6; PVG; or RP> | 12*3 |
| ASK | <List of Commands> | [PARAM] |
| ASSIGNMENT | <Type#> <Int#> 12*<<Mov#> <Asgn Fctr (%)>> | - - - 12*0 |
| BASE | <Dev Size> <LL X,Y Coord> <UR X,Y Coord> | 0 0 0 0 0 |
| BIKEVOLUMES | 4*<Conflicting Bicycles (bikes/hr)> | 4*0 |
| BUSVOLUMES | 4*<Stopping Bus Volume (bus/hr)> | 4*0 |
| CALCULATE | <Algebraic Expression> | - |
| COMPUTEPATHS | <RESET/CUMULATE> <List of Types> | RESET all |
| CONDITIONS | <MjDr> <LnNS> <LnEW> <SPD> <POP> <PRG> <REM> | 2*<<Acc> <Dly>> |
| COUNTGRAPH | <Maximum Count on Plot> | 0 |
| COUNTIMPORT | <Data File> <Output - N/Y> <Spec. Keys - N/Y> | - NO NO |
| COUNTRECONFIG | 12*<Destination Movement #> | 1..12 |
| COUNTREPORTS | 15MN/60MN/AMPK/MDPK/PMPK/CMPK/MRNOP/EVEOP/ADT | 1 6 A M P ADT |
| COUNTTABULATE | <Report Option - 15/60> | 15 & 60 |
| COUNTTYPE | <Count Type - CUM/RED> <Truck Type - INC/SEP> | RED INC |
| CRITICALS | 8*<Critical Movement Number> | 8*0 |
| CYCLES | <Min Cycle (s)> <Max Cycle (s)> <Increment> | 60 120 30 |
| DALLASLEFTS | 2*<Dallas Left Turn Status - NO/YES> | 2*NO |
| DATA | <List of Commands> | [PARAM] |
| DELAYFACTORS | 12*<Delay Adjustment Factor> | 12*1.00 |
| DESCRIPTION | <Second Title Line> | blanks |
| DESIGN | <# of Sequences to Analyze after DESIGN> | 1 |
| DIAGRAMS | <Sequence Code> | -1 |
| DUALENTRYS | 8*<Nema Phase Dual Entry Status - NO/YES> | 8*NO |
| ECHO | <Input/Output Echo Condition - NO/YES> | NO |
| ENDGAIN | 12*<End Gain Time (sec)> | 12*2.0 |
| EVALUATE | - | - |
| EXCESS | <List of Priority Movement #'s> | 0 |
| EXPORT | <Sel> <Fil>/AUT/STCK <N/Y> <NONE/VIEW/IMPRT/BTH> | AUTO NO VIEW |
| FACTORS | 12*<Capacity Adjustment Factor> | 12*1.00 |
| FILES | 5*<File Name> | 5*blanks |
| FINDPATHS | <Distribution Type #> | all |
| FIRSTDETECTS | 12*<Position of First Detection (ft)> | 12*75.0 |
| GAPOUTS | 2*<Simultaneous Gapout Status - NO/YES> | 2*NO |
| GENERATION | <IN/OUT/BOTH> <Gen Rate> 10*<Node-Dir> | - 0.0 10*(0-) |
| GOTO | <Line #>/<Repeat Variable> | next |
| GOVERCS | - | - |
| GRADES | 4*<Grade of Approach (%)> | 4*0.0 |
| GREENAVERAGES | 8*<Phase Avg Green Time (sec)> | 8*0.0 |
| GREENTIMES | <Meth> 8*<Phase Green Time (sec or sec/sec)> | P 8*0.0 |
| GROUPTYPES | 12*<Lane Group - NORM/FREEFL/DUALOPT/STP/YLD> | 12*NORMAL |
| HCSEXPORT | AUTO/<File Name> | AUTO |
| HEADING | <Number of Lines> | 3 |
| HELP | <List of Commands> | [PARAM] |
| IDEALSATFLOWS | 12*<Ideal Saturation Flow Rate (pcphgpl)> | 12*1900 |
| IMPORT | <Sel> <TRANSYT Output File>/AUTO <Display-NO/YES> | AUTO NO |
| INITIALQUEUE | 12*<Initial Queue (veh)> | 12*0 |
| INTERSECTION | <Node #> <Intersection Description> | 0 BLANKS |

**Table A-3 (continued)**
**All Commands Listed Alphabetically**

| Command | Parameter Values | Defaults |
|---|---|---|
| IODEVICES | <View-NORM/TABL> <Page #> <Lin/Pag> <Lst Lin> | Norm 0 66 63 |
| LANES | 12*<Number of Lanes> | 12*0 |
| LASTDETECTS | 12*<Position of Last Detection (ft)> | 12*5.0 |
| LEADLAGS | 2*<Lead-Lag Phasing - NONE/LEAD/LAG> | 2*NONE |
| LEVELOFSERVICE | <Delay1> <Delay2> <Delay3> <vc1> <vc2> <vc3> | C E 5 90 100 5 |
| LOAD | <Line #> <File #> <PROCESS/SHARE/IGNORE> <#> | next next P 1 |
| MAP | - | - |
| MASTERNODE | <Master Node #> | 0 |
| MESSAGES | <Level - 0/1/2/3> | 3 |
| METROAREA | <Location - CBD/NON-CBD> | NON-CBD |
| MINIMUMS | 12*<Minimum Green Time (sec)> | 12*5.0 |
| MOVLABELS | 12*<2-character Movement Label> | RT,TH,LT |
| NEMAPHASES | 12*<NEMA Phase Designation> | 12*0 |
| NETWORK | N/E/S/W <Dst> <Spd> <Nod> 4*<Mv> <Asg> <Crv> <M> | - 7*0 D N N |
| NEWPAGE | <Page Advance - NO/YES> | YES |
| NEXTLINES | 5*<Next Line of File> | 5*0 |
| NODELIST | 500*<Node # in Optimization Order> | 500*0 |
| NODELOCATION | <X Coordinate> <Y Coordinate> | 0 0 |
| NOTE | <Third Title Line> | blanks |
| NSTOPFACTORS | 12*<Stops Adjustment Factor> | 12*1.00 |
| OFFSET | <Phase Offset (sec or sec/sec)> <Phase #> | 0.0 1 |
| OPTIMIZE | NONE/OFFSTS/SPLTS+OFFS/CYCLE/LIST 15*<Steps> | NONE 15*0 |
| OUTPUT | <Function> <Additional OUTPUT Parameters> | S2K NO YES NO 21 |
| OVERLAPS | 4*<Rt Turn Overlap - NO/YES> | 4*YES |
| PARKINGSIDES | 4*<Location - NONE/RIGHT/LEFT/BOTH> | 4*NONE |
| PARKVOLUMES | 4*<Parking Volume (manuv/hr)> | 4*20 |
| PASSAGETIMES | <MnAddFct> 8*<Nema Veh. Extension Time (sec)> | 0.0 8*3.0 |
| PATHASSIGNMENT | <Path # (1-5)> <Asg %> <Node List - 16 max> | - - - |
| PATHDISTRIBUTION | <Typ #> <Distr %> <Node #> <Dir-N/E/S/W> <Desc> | - 0 0 - - |
| PEAKANALYZE | <Start Time> <End Time> <Map Output - NO/YES> | AM-MID-PM YES |
| PEAKHOURFACTORS | 12*<Peak Hour Factor> | 12*0.90 |
| PEAKSUMMARY | <Start Time> | 0 |
| PEDFDWS | 4*<Ped Clearance (FDW) Time (sec)> | 4*0.0 |
| PEDLEVELS | 4*<Pedestrian Interference (ped/hr)> | 4*0 |
| PEDTIME | <Exclusive Ped-phase Time (sec)> <Phase #> | 0.0 0 |
| PEDWALKS | <PedMin Factor> 4*<Ped Walk Time (sec)> | 1.0 4*0.0 |
| PERIODS | <Count Interval> 5*<<Start Time> <Stop Time>> | 15 - - |
| PERMISSIVES | 4*<Permissive Left - NO/YES> | 4*NO |
| PHASEMOVEMENTS | <Phase #> <List of Movements> | 0 0 |
| PLOTSIMPLE | <Scale (ft/line)> | 0 |
| PLOTTSD | <Scale (ft/line)> <Node List> | 0 nodelist |
| PRG-ADJUST | <Speed Factor> | 1.0 |
| PRG-ALLREDS | 25*<All-Red Time (sec)> | 25*0 |
| PRG-AVAILABLE | 25*<Lead-Lag Availability - NONE/LR/RL/BOTH> | 25*NONE |
| PRG-BASE | <Base Int #> <Base Offset (%)> | 1 0 |
| PRG-CLEARANCES | <System Clearance Time (sec)> | 0 |
| PRG-CYCLES | <Min Cycle> <Max Cycle> <Cycle Increment> | 40 140 5 |
| PRG-DIRECTIONS | <Directional Flow - ONEWAY/TWOWAY> | TWOWAY |
| PRG-DISTANCES | 24*<Link Distance (feet)> | 24*0 |
| PRG-FINETUNE | <Timing Refinement - NO/YES> | NO |
| PRG-LEADLAG | <Direction - LR/RL/BOTH> 25*<Ld-Lg Time (%)> | B 25*0 |
| PRG-LINKNODEDATA | # Nam Dst 2*Spd Splt ARed Avl 2*Ldlg 2*Off NC | - |
| PRG-NAMES | 25*<Cross Street Name> | 25*blanks |
| PRG-NONCONCURRENT | 25*<Split Phase - NO/YES> | 25*NO |
| PRG-OFFSETS | <Direction - LR/RL/BOTH> 25*<Offset (%)> | B 25*0 |

**Table A-3 (continued)**
**All Commands Listed Alphabetically**

| Command | Parameter Values | Defaults |
|---|---|---|
| PRG-RATIO | <Band Ratio (LR/RL)> | 1.0 |
| PRG-SIZE | <Number of Signals> | 0 |
| PRG-SPEEDS | <Direction - LR/RL/BOTH> 24*<Link Speed(mph)> | B 24*0 |
| PRG-SPLITS | 25*<Through Phase Split (%)> | 25*0 |
| PRG-TOLERANCE | <Speed Tolerance (%)> <Speed Increment (mph)> | 0 0 |
| PRG-UNITS | <Input Units - METRIC/ENGLISH> | ENGLISH |
| PROGRESSION | <Scale (ft/line)> | 0 |
| PROJECT | <First Title Line> | blanks |
| QUEUECALCS | - | - |
| QUEUEMODELS | <Model #> <Percentile> <Auto (ft)> <Trk (ft)> | 1 90 25 40 |
| RECALLS | 8*<Nema Phase Recall Status - NO/MIN/MAX/PED> | 8*NO |
| REDCLEARTIMES | <Meth> 8*<Phase Red Clearance Time (sec)> | P 8*0.0 |
| REPEAT | <Variable> <Start> <End> <Increment> | - 1 1 1 |
| REQCHANGE+CLEARS | 12*<Required Change & Clearance (sec)> | 12*4.0 |
| REQYELLOWS | 12*<Required Yellow Change (sec)> | 12*3.0 |
| RESET | <List of Commands> | [PARAM] |
| RETURN | - | - |
| RIGHTTURNONREDS | 4*<Right Turn on Red Volume (vph)> | 4*0 |
| ROUND | <Precision of Totals (Veh)> | 1 |
| ROUTE | <Route #> <List of Node #s> | - 25*0 |
| RTINFLUENCES | 4*<Rt Turn Influence - NO/YES> | 4*YES |
| SATURATIONFLOWS | 12*<Lane Group Saturation Flow (vphg)> | 12*0 |
| SAVE | <Line #> <File #> <List of Commands> | nxt nxt [P] |
| SEQUENCES | <Phasing Code> <List of All possible Codes> | 11 ALL |
| SERVICEVOLUMES | - | - |
| SHOWPATHS | <Distribution Type #> | all |
| SIMULATION | <Stps/Cyc> <Mins> <StpPn> <Links> <Act> <Asgn> | 300 15 -1 T N F |
| SITESIZE | <# Distribution Types> <# Inbound Types> | 0 0 |
| SORT | <Priority - CYCLES/GOVERCS> <Output - NO/YES> | GCS YES |
| STARTUPLOST | 12*<Startup Lost Time (sec)> | 12*2.0 |
| STOP | <Program Name> | - |
| STORAGE | 12*<Storage Distance (feet)> | 12*0 |
| SUBSYSTEM | 500*<Node # of Subsystem> | 500*0 |
| SUMMARIZE | - | - |
| TIMINGPLAN | <Node List> | nodelist |
| TIMINGS | <Seq Code> <Output - NONE/TIMINGS/DIAGRAM> | -1 TIMINGS |
| TRUCKCOUNTS | <Movement #>/<Time> <List of Counts> | 0 |
| TRUCKPERCENTS | 12*<Truck-Thru Bus Percentage (%)> | 12*2.0 |
| UPSTREAMVC | 4*<Upstream v/c Ratio> | 4*0.0 |
| URBANSTREET | - | - |
| UTILIZATIONS | 12*<Lane Utilization Factor> | 12*0.0 |
| VEHICLECOUNTS | <Movement #>/<Time> <List of Counts> | 0 |
| VOLADDITIONALS | <Factor> 12*<Additional Volume> | 0.0 12*0 |
| VOLFACTORS | <# Years> 12*<Count Adjustment Factor> | 1 12*1.00 |
| VOLUMES | 12*<Design Hour Volume (veh/hr)> | 12*0 |
| WARRANTS | <1988/2000/2003/2009> <SIG/STP/BTH> <56%-N/Y> | 2009 BOTH NO |
| WIDTHS | 12*<Lane Group Width (ft)> | 12*0.0 |
| YELLOWTIMES | <Meth> 8*<Phase Yellow Time (sec or sec/sec)> | P 8*0.0 |

APPENDIX B

# Detailed Description of Actions and Entries

Appendix B Topics

Appendix B provides detailed information on each TEAPAC command dialog and any associated parameter values. The dialogs are listed in alphabetical order. Five specific categories of information are provided for each command, as described below:

| **COMMAND** | **<Parameter Name>** | **5*<Another Parameter>** |
|---|---|---|
| Defaults: | [default for <Parameter Name>] | 5*[default for <Another Parameter>] |
| Menus/Groups: | [<menu/group name>] | |

This section shows the proper usage format of the command, including the parameter values and their order of input. The command is in capital letters and parameter names are in angle brackets, "< " and ">". An integer followed by an asterisk, "*", indicates that the parameter can be repeated the specified number of times (five times in the example above).

Below the command line, each of the default values for each parameter is shown, followed by a list of any menu/group names to which the command belongs, other than [AllCommands]. This is followed by a description of the purpose of the command.

For each parameter listed, a separate paragraph provides a complete description of the parameter, its allowed values and its default value.

All of the parameters descriptions are followed by a section of Notes which describe any special information, warnings and other "hints" to insure the proper use of the command.

## Appendix B Topics

## Alphabetical List of Commands

Commands:

ACTUATIONS
ADTFACTOR
ANALYZE
APPLABELS
ARRIVALTYPES
ASK
ASSIGNMENT
BASE
BIKEVOLUMES
BUSVOLUMES
CALCULATE
COMPUTEPATHS
CONDITIONS
COUNTGRAPH
COUNTIMPORT
COUNTRECONFIG
COUNTREPORTS
COUNTTABULATE
COUNTTYPE
CRITICALS
CYCLES
DALLASLEFTS
DATA
DELAYFACTORS
DESCRIPTION
DESIGN
DIAGRAMS
DUALENTRYS
ECHO
ENDGAIN
EVALUATE
EXCESS
EXPORT
FACTORS
FILES
FINDPATHS
FIRSTDETECTS
GAPOUTS
GENERATION
GOTO
GOVERCS
GRADES

GREENAVERAGES
GREENTIMES
GROUPTYPES
HCSEXPORT
HEADING
HELP
IDEALSATFLOWS
IMPORT
INITIALQUEUE
INTERSECTION
IODEVICES
LANES
LASTDETECTS
LEADLAGS
LEVELOFSERVICE
LOAD
MAP
MASTERNODE
MESSAGES
METROAREA
MINIMUMS
MOVLABELS
NEMAPHASES
NETWORK
NEWPAGE
NEXTLINES
NODELIST
NODELOCATION
NOTE
NSTOPFACTORS
OFFSET
OPTIMIZE
OUTPUT
OVERLAPS
PARKINGSIDES
PARKVOLUMES
PASSAGETIMES
PATHASSIGNMENT
PATHDISTRIBUTION
PEAKANALYZE
PEAKHOURFACTORS
PEAKSUMMARY
PEDFDWS
PEDLEVELS
PEDTIME

PEDWALKS
PERIODS
PERMISSIVES
PHASEMOVEMENTS
PLOTSIMPLE
PLOTTSD
PRG-ADJUST
PRG-ALLREDS
PRG-AVAILABLE
PRG-BASE
PRG-CLEARANCES
PRG-CYCLES
PRG-DIRECTIONS
PRG-DISTANCES
PRG-FINETUNE
PRG-LEADLAG
PRG-LINKNODEDATA
PRG-NAMES
PRG-NONCONCURRENT
PRG-OFFSETS
PRG-RATIO
PRG-SIZE
PRG-SPEEDS
PRG-SPLITS
PRG-TOLERANCE
PRG-UNITS
PROGRESSION
PROJECT
QUEUECALCS
QUEUEMODELS
RECALLS
REDCLEARTIMES
REPEAT
REQCHANGE+CLEARS
REQYELLOWS
RESET
RETURN
RIGHTTURNONREDS
ROUND
ROUTE
RTINFLUENCES
SATURATIONFLOWS
SAVE
SEQUENCES
SERVICEVOLUMES

SHOWPATHS
SIMULATION
SITESIZE
SORT
STARTUPLOST
STOP
STORAGE
SUBSYSTEM
SUMMARIZE
TIMINGPLAN
TIMINGS
TRUCKCOUNTS
TRUCKPERCENTS
UPSTREAMVC
URBANSTREET
UTILIZATIONS
VEHICLECOUNTS
VOLADDITIONALS
VOLFACTORS
VOLUMES
WARRANTS
WIDTHS
YELLOWTIMES

## ACTUATIONS 12*<Actuated Movement>

Defaults: 12*NO
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Basic] [Movement]

The purpose of this command is to enter the type of phase module present, actuated or non-actuated, for each movement of the current intersection for use in the determination of the HCM Delay Calibration Term (k).

**<Actuated Movement>** is a keyword describing whether or not the movement is part of an actuated phase, or the unit extension value (sec) of the actuated phase, and can have the values described below:

NO - the movement is not part of an actuated phase (default).
YES - the movement is part of an actuated phase.
0.0-30.0 - unit extension in seconds.

### *Notes*

- ACTUATIONS and PASSAGETIMES are used in conjunction with v/c to determine the Delay Calibration Term, according to Exhibit 16-13 of the 2000 *Highway Capacity Manual*.

- Specifying YES or giving extensions for all non-zero lane groups indicates a fully actuated signal. Specifying NO for all non-zero lane groups indicates a pretimed signal. Specifying YES or giving extensions for some, but not all, non-zero lane groups indicates a semiactuated signal.

- An ARRIVALTYPES value other than 3 may be used for a movement with ACTUATIONS set to something other than NO, but only where it is clear that the coordinated movement is truly actuated when it is also coordinated.

- If a lane group is designated as being actuated by this command entry, then the actuated logic of TRANSYT-7F is implemented for the corresponding link, but only if the TRANSYT run is designated as a SPLIT or CYCLE optimization on the OPTIMIZE command. This allows TRANSYT to recalculate the splits for the corresponding phase according to the actuated methods described in the TRANSYT manual.

- If a unit extension is entered, its value is moved to the corresponding position of the PASSAGETIMES entry and the ACTUATIONS entry is set to YES. Subsequently setting the ACTUATIONS entry to NO will disable the actuated status of the movement without changing the PASSAGETIMES entry so that it is easily set back to YES to re-enable the actuated status with the correct PASSAGETIMES entry.

## ADTFACTOR <Factor to Expand Counts to 24 Hour Volumes>

Defaults: 0.0
Menus/Groups: [Parameters] [CountAnalysis]

The purpose of this command is to enter a factor which will be used to estimate 24-hour volumes from partial day's counts at the current intersection.

**<Factor to Expand Counts to 24 Hour Volumes>** is a factor which, when multiplied by the entire counted traffic, will produce a reasonable estimate of 24-hour traffic volumes, or average daily traffic (ADT). It can be any decimal number from 0.0 to 100.0. Its default value is 0.0.

### *Notes*

- The single factor entered on the ADTFACTOR command is used to multiply the total counted volume of each movement to estimate the 24-hour volume of each movement. This 24-Hour Volume Estimates report is produced at the end of the PEAKANALYZE outputs when the default PEAKANALYZE parameter values are used. It is not produced if a specific time range is selected for the PEAKANALYZE command. The COUNTREPORTS command can also be used to produce the 24-Hour report using the ADT option in the list of reports.

- When the ADTFACTOR is zero, the default value, the 24-Hour Volume Estimates report is omitted under all conditions.

## ANALYZE --

Defaults: --
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to perform a capacity analysis of a specified phasing and timings for the current intersection or all intersections. It has no parameters.

### *Notes*

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CYCLE commands, or the TIMINGS command following a DESIGN.

## APPLABELS 4*<Approach Label>

Defaults: N E S W
Menus/Groups: [Parameters] [SignalAnalysis] [TrafficImpact] [CountAnalysis] [Basic] [Approach] [Movement]

The purpose of this command is to enter labels for each approach of the current intersection.

**<Approach Label>** is a two-character abbreviation for each of the four approaches at the intersection, and can be any two characters. Its default value is N, E, S, & W for each of the approaches, respectively.

### *Notes*

- Alternate labels could be, for example, SB, WB, NB, & EB, respectively, or A, B, C, & D.

- Use of APPLABELS does not change the order of entry – this order is always clockwise starting with the north approach. APPLABELS merely allows each approach to be labeled with the user's choice of characters.

## ARRIVALTYPES 12*<Quality of Progression>

Defaults: 12*3
Menus/Groups: [Parameters] [SignalAnalysis] [Basic] [Movement]

The purpose of this command is to enter the quality of progression for each movement of the current intersection.

**<Quality of Progression>** specifies various types of parameters related to the quality of progression for use in the determination of the Delay Adjustment Factor, and can take on values in the ranges described below:

| | |
|---|---|
| 0 <= Value <= 6 | indicates the actual Arrival Type (0 is the same as 3). |
| 7 <= Value <= 300 | indicates the value entered is the percentage of platoon ratio (RP). |
| -100 <= Value <= -1 | indicates the value entered is the negative of the percentage of all vehicles in the movement arriving during the green phase (PVG). |

Its default value is 3 for all movements.

### *Notes*

- ARRIVALTYPES is used for computing the Progression Adjustment Factor according to Exhibit 16-12 of the 2000 *Highway Capacity Manual*.
- For RP values less than or equal to 6%, use Arrival Type 1.
- Entry of a value of 0 is allowed for upwards-compatibility for data files from prior versions of the program. In these versions, 0 indicated that the HCM defaults should be used, so entries of 0 are changed immediately to values of 3 which is the current default arrival type for the *Highway Capacity Manual*.
- If the value is entered as either PVG or RP, the program will determine the arrival type for a 2000 analysis based on the method outlined in the 2000 *Highway Capacity Manual*. Values 1 through 6 are defined as in Exhibit 16-11 of the manual.
- An ARRIVALTYPES value other than 3 may be used for a movement with ACTUATIONS set to something other than NO, but only where it is clear that the coordinated movement is truly actuated when it is also coordinated.
- Note that although many intersections in a network may be entered into TEAPAC, the arrival type is a user entry and is not determined by the program based on flows from other intersections in the network.

## ASK <List of Commands>

Defaults: [Parameters]
Menus/Groups: [DataFiles]

The purpose of this command is to produce a dialog box display for each of the listed commands.

**<List of Commands>** is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [Parameters] - all nonactive commands for entry of parameters related to the analysis procedures.

### *Notes*

- The ASK command will prompt the user for entry of parameter values for each of the commands in the list. An input dialog for each command (Normal View) or the entire list (Tabular View) will be initiated showing the current DATA values and a line of HELP at the bottom of the dialog.

- When a correctable error is detected in the parameter list of any command entered from the Manual Mode, the ASK command is automatically performed for that command in order to allow re-entry of the parameter(s) in error.

- ASK may only be used from the Manual Mode. It is a powerful way to review current data values and to allow any necessary changes to be made simultaneously. It can also be used to create custom input and action sequence displays.

| **ASSIGNMENT** | **<Type #>** | **<Intersection #>** |
|---|---|---|
| | **12*<<Movement #> <Assignment Factor>>** | |
| Defaults: | - | - |
| | 12*<0 0> | |
| Menus/Groups: | [Parameters] | [TrafficImpact] |

The purpose of this command is to enter the percentage of a distribution type to be assigned to the movements at an intersection. This is only used to define special assignment situations, and is not normally used for typical site traffic assignment situations.

**<Type #>** is the number of the distribution type being assigned, and can be 1-150 (see note below). It has no default value, it must be entered.

**<Intersection #>** is the number of the intersection to which traffic is being assigned as defined on the NODELIST command, and can be 1-9999. It has no default value; it must be entered.

**<Movement #>** is the movement number to which the traffic is being assigned, and can be any integer from 0 to 12, as described below:

1-12 - one of the turning movements.

0 - designates that a list of assignments for all 12 movements will follow, in order for the movements from 1 to 12.

It has no default value; it must be entered.

**<Assignment Factor>** is the percentage of the traffic of the distribution type being assigned that is assigned to the specified movement, and can be 0-100 percent. Its default value is 0.

### *Notes*

- The purpose of this command is to give the greatest degree of freedom in assigning traffic for a given distribution type to a given intersection. When this technique is used, COMPUTEPATHS cannot check that the entered values are consistent with upstream and downstream assignments, as is the case when using the PATHASSIGNMENT command. As such, ASSIGNMENT should only be used in those rare instances when the PATHASSIGNMENT command cannot achieve the desired special-purpose assignment. It can also be used when using old SITE data files which were created before the PATHASSIGNMENT command was available.

- <Type#> may not exceed the limit previously set with the SITESIZE command, and <Intersection #> must represent a node included in the NODELIST command.

- Movement numbers begin with the north leg right-turn as movement number 1, and proceed clockwise around the intersection to movement number 12.

- Multiple pairs of movement numbers and their associated assignment factors may be entered on one ASSIGNMENT command. They should be entered one after the other at the end of the ASSIGNMENT command.

- A negative percentage can be entered (up to -100%) for any movement to create a reduction of total traffic by the generated value rather than the normal increase in traffic. This can be used, for example, to reduce traffic on a given movement to account for passby trips or diverted trips that are already on the network, as a percentage of the total trips for the distribution type.

| BASE | <Generation Base> | <X-Y Coord LL> | <X-Y Coord UR> |
|---|---|---|---|
| Defaults: | 0 | 0 0 | 0 0 |
| Menus/Groups: | [Parameters] [TrafficImpact] | | |

The purpose of this command is to enter the base development size for generating trips as it relates to the generation rates used for the development.

**<Generation Base>** is the base development size to which the traffic generation rates are applied, and can be any integer from -9999 to 32767. Its default value is 0.

**<X-Y Coord LL>** are the X and Y coordinates of the lower-left (southwest) corner of the site for display in the schematic diagram, and can be any common coordinate system value, as an integer from -2,147,483,647 to 2,147,483,647. Its default value is 0,0.

**<X-Y Coord UR>** are the X and Y coordinates of the upper-right (northeast) corner of the site for display in the schematic diagram, and can be any common coordinate system value, as an integer from -2,147,483,647 to 2,147,483,647. Its default value is 0,0.

### *Notes*

- The coordinate system used for BASE should match that used by each NODELOCATION command.
- In the main network display window, holding the Shift key while dragging the mouse is an alternate way of defining the coordinates of the opposite corners of the site.

## BIKEVOLUMES 4*<Conflicting Bicycles>

Defaults: 4*0
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the volume of conflicting bicycles for right turns on each approach of the current intersection.

**<Conflicting Bicycles>** is the volume of conflicting bicycles, in bikes per hour, for right turns on the approach, and can be any integer from 0 to 2000. Its default value is 0.

### *Notes*

- Entries for bicycle interference should be made for the approach from which the conflicting right turn is made. For example, bicycles crossing the east leg of the intersection interfere with right turns made from the south approach, so the <Conflicting Bicycles> value for that right turn should be input for the south approach.

## BUSVOLUMES 4*<Stopping Bus Volume>

Defaults: 4*0
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the volumes of stopping buses which stop on each approach of the current intersection.

**<Stopping Bus Volume>** is the hourly volume of local buses which stop at the bus stop designated for the approach, and can be any integer from 0 to 250. Its default value is 0, no stopping bus volume.

### *Notes*

## CALCULATE <Algebraic Expression>

Defaults: none
Menus/Groups: [Control]

The purpose of this command is to perform a calculation for the given expression and optionally assign the integer result to a user variable.

**<Algebraic Expression>** is an expression in the form of an algebraic formula or equation, and can be any valid expression containing numeric constants, user variables and valid operators, as described below. It has no default value; it must be entered.

### *Notes*

- The expression entered must be of the form of a normal algebraic expression using any of the four operators +, -, * and / (addition, subtraction, multiplication and division). This means that each operator must have two operands, one on either side of the operator. An operand may be either a numeric constant or one of the 26 1-character user variables A - Z. User variables must have had values assigned to them by a previous CALCULATE command or with a REPEAT command. A minus sign may also be used as a single operand operator to reverse the sign of the following constant or variable.

- Expressions are evaluated from left to right, except that multiplication and division operations always precede addition and subtraction. This order of precedence can be altered by surrounding parts of the expression which should be evaluated first with parentheses.

- If the result of the calculation is to be saved as the value of a user variable (A - Z), the single-character variable name should precede the expression and be separated from the expression with an equal sign, representing a normal algebraic equation. The value assigned to the variable will be rounded to the nearest integer, as described below.

- All internal calculations for the expression are made using 32-bit decimal arithmetic. The result is displayed in a format with four decimal places that can handle numbers less than 10 billion (1 x 10^10) and greater than -1 billion (-1 x 10^9). Regardless of the number of digits shown in the result, only 6-7 digits of accuracy exist; any other digits that are shown may be random.

- When a result is assigned to a user variable, the result is rounded to the nearest integer value. Results assigned to user variables must be less than or equal to 32,767 and greater than or equal to -32,768.

- If a variable is used in a calculation before its value has been assigned by a CALCULATE or REPEAT command, its value will be zero.

## COMPUTEPATHS <Cumulation Function> <List of Distribution Types>

| | | |
|---|---|---|
| Defaults: | RESET | all |
| Menus/Groups: | [Results] for Traffic Impact Analysis | |

The purpose of this command is to calculate the trips generated for each listed distribution type and assign them to the network according to the defined assignments.

**<Cumulation Function>** designates whether previously calculated volumes should be cumulated with the current computations, or if a separate computation should be made, and can be RESET or CUMULATE, as described below:

RESET - remove previous volumes before COMPUTing (default).
CUMULATE - add previous volumes into current computation.

**<List of Distribution Types>** is a list of the distribution type numbers to be computed, and can include any integers from -1 up to the highest defined distribution type number, or 999 for non-site traffic. Its default value is all of the defined distribution types, including non-site traffic.

### *Notes*

- In order to provide the COMPUTEPATHS results to other TEAPAC applications, the VOLADDITIONALS entries for each intersection in the NODELIST will always be updated with the computed results, excluding the VOLUMES entries as factored according to the VOLFACTORS entries (see Appendix C). Note that when computed results are ROUNDed, VOLADDITIONALS will absorb the effect of the rounding, including locations where no additional volumes were actually computed as a result of the site traffic generation scenario presented.

- Distribution type 999 is used to designate non-site traffic estimates in the computations. This type is included in the default list of types.

- Distribution type -1 can be used as the first (and only) entry as a quick way to represent all distribution types except 999, i.e., to compute all of the generated traffic without any non-site traffic.

- If the OUTPUT option is set to FILE or BOTH, the results of the computations will be directed to the data file listed on the OUTPUT command. The volumes will be written to the data file starting at the current NEXTLINES of that file, and will include appropriate commands so that they can be read by other programs.

- If OUTPUT option NONE is selected, the COMPUTEPATHS command is executed without any screen, printer or file output. An entire series of cumulations can be performed without any output. Then a final COMPUTEPATHS CUMULATE 0 (see below) can be done with OUTPUT to WINDOW, FILE or BOTH so the results can be seen and used.

- Type 0 as the first (and only) list entry means that no contributions of either non-site or site-related traffic will be made in the computations – in other words, no additional traffic will be added to intersection volumes as a result of the COMPUTEPATHS command. This function serves several purposes in more advanced applications. For example, if a series of COMPUTEPATHS CUMULATE commands will be issued, the COMPUTEPATHS RESET 0 command can be issued first to reset all intersection counts to zero. Then each contributing computation can be executed with the same COMPUTEPATHS CUMULATE command, since the intersection volumes have already been zeroed. If each of these cumulations are done with the ROUND 1 option to prevent cumulative rounding errors, then after all cumulations are completed, the desired ROUNDing value can be entered and an additional COMPUTEPATHS CUMULATE 0 can be issued simply to round the results (with no additional volumes added). This last COMPUTEPATHS can also be routed to an OUTPUT file, if desired. If VOLADDITIONALS results of the COMPUTEPATHS will be used by other programs, then only the last COMPUTEPATHS CUMULATE command above should include non-site traffic (type 999) so that the non-site traffic is known and omitted from the VOLADDITIONALS. In the example above, the last COMPUTEPATHS command performed with ROUNDing should be COMPUTEPATHS CUMULATE 999 instead of COMPUTEPATHS CUMULATE 0. See Chapter 5 for further discussion about these important topics.

- Two requirements are essential in using the CUMULATE feature successfully. These are that 1) the program is not terminated between the prior and the cumulated computations, and 2) that the positions of the nodes in the NODELIST do not change from one computation to the next.

| | |
|---|---|
| **CONDITIONS** | **<Major Direction> <# N-S Lanes> <# E-W Lanes> <High Speed> <Low Population> <Progression Impact> <Remedial Actions Failed> <# Accidents for Signal> <Stop Sign Delay> <# Accidents for Stop> <Minor Street Delay> <Extra Warrants>** |
| Defaults: | NORTHSOUTH 1 1 NO NO NO NO 0 0 0 0 ---- |
| Menus/Groups: | [Parameters] [CountAnalysis] |

The purpose of this command is to enter intersection conditions which affect the conduct of a Warrant Analysis at the current intersection.

**<Major Direction>** is a keyword which describes whether the major street is counted on the North-South approaches or East-West approaches. It can be any of the following:

NORTHSOUTH - major street counted on North & South approaches (default).
EASTWEST - major street counted on East & West approaches.

**<# N-S Lanes>** is the number of lanes for moving traffic on each of the North and South approaches. It can be any integer from 1 to 4. Its default value is 1.

**<# E-W Lanes>** is the number of lanes for moving traffic on each of the East and West approaches. It can be any integer from 1 to 4. Its default value is 1.

**<High Speed>** is a keyword which describes whether the 85th percentile speed of major street traffic exceeds 40 mph. It can be any of the following:

NO - major street speeds don't exceed 40 (default).
YES - major street speeds exceed 40 mph.

**<Low Population>** is a keyword which describes whether the intersection is in an isolated community with a population less than 10,000. It can be any of the following:

NO - population is not less than 10,000 (default).
YES - population is less than 10,000.

**<Progression Impact>** is a keyword which describes whether a signal installation <u>will not</u> seriously disrupt progressive traffic flow. It can be any of the following:

NO - signal <u>will</u> disrupt progression (default).
YES - signal <u>will not</u> disrupt progression.

**<Remedial Actions Failed>** is a keyword which describes whether trials of less restrictive remedies <u>have</u> failed. It can be any of the following:

NO - other remedies have not failed (default).
YES - other remedies have failed.

**<# Accidents for Signal>** is the number of reported accidents, correctable by traffic signal control, within a 12-month period. It can be any integer number from 0 to 20. Its default value is 0.

**<Stop Sign Delay>** is the number of vehicle-hours of peak hour stop sign delay experienced by traffic on one minor approach of the intersection. It can be any integer from 0 to 20. Its default value is 0.

**<# Accidents for Stop>** is the number of reported accidents, correctable by multi-way stop control, within a 12-month period. It can be any integer number from 0 to 20. Its default value is 0.

**<Minor Street Delay>** is the average peak hour delay experienced by traffic on all minor approaches of the intersection in seconds/vehicle. It can be any integer from 0 to 300. Its default value is 0.

**<Extra Warrants>** is an entry for each of Warrants 4, 5, 6 & 8 which indicates whether these warrants have been analyzed externally (outside of TEAPAC) and whether these warrants have been satisfied. See the Notes below for details.

### *Notes*

- The data entered for the CONDITIONS command are used by the WARRANTS command to describe intersection conditions which affect the warrant levels and conditions which must be met to satisfy the warrants.

- <# N-S Lanes> and <# E-W Lanes> is the number of lanes for moving traffic on each of the North-South and East-West approaches, respectively, and normally does not include exclusive turn lanes. It is the number of lanes on each approach, not the total number of lanes on the street. If the actual number of lanes exceeds the maximum allowed entry of 4, enter 4 (the MUTCD only considers whether there is 1 lane or more than 1 lane).

- <Extra Warrants> is a 4-character entry which indicates 1) if additional warrants have been analyzed externally to TEAPAC, and 2) whether these additional warrants have been satisfied. The four warrants, in order, are Pedestrian, School, Coordination and Network. After 1988 these are numbered #4, 5, 6 & 8; the 1988 numbers are #3, 4, 5 & 7. For each warrant, '-' means that no result for the warrant should be included in the signal warrant summary (the default), 'N' means that the warrant should be listed as Not Met, and 'Y' means that the warrant should be listed as Met. The default entry of '----' (four dashes) means that the warrants have not been analyzed and should not be listed. An entry of '-Y-N' means that the pedestrian warrant has not been analyzed and will not be listed, the school warrant has been analyzed and will be listed as Met, the coordination warrant has not been analyzed and will not be listed, and the network warrant has been analyzed and will be listed as Not Met.

## COUNTGRAPH <Maximum Count on Plot>

Defaults: 0
Menus/Groups: [Results] for Count Analysis

The purpose of this command is to display a graph of total intersection counts for each of the 15-minute count intervals.

**<Maximum Count on Plot>** is the maximum value of the count scale on the plot. It can be any integer from 0 - 9999. Its default value is 0.

### *Notes*

- If the default value of 0 is used for the plot scale maximum, the scale of the graph will be determined automatically to accommodate the largest intersection count for all periods.

- If a plotted value exceeds the largest scale value, its value will be plotted off the scale to reflect the larger number.

- The plot scale option is useful if COUNTGRAPHs are being made for several intersections which are to be compared to each other, in order to force the same scale on all COUNTGRAPHs.

| **COUNTIMPORT** | **<Data File>** | **<Output>** | **<Special Keys>** |
|---|---|---|---|
| Defaults: | - | NO | NO |
| Menus/Groups: | [Results] for Count Analysis | | |

The purpose of this command is to read the contents of an electronic traffic counter data file and enter its counts in appropriate places within the program.

**<Data File>** is the name of the electronic traffic counter data file, and can be any properly named data file. It has no default value; it must be entered. The default extension of the file name is .DFL.

**<Output>** is a keyword which describes whether the specific TEAPAC inputs which are generated by the import process are displayed. It can be any of the following:

NO - TEAPAC inputs are not displayed (default).
YES - TEAPAC inputs are displayed.

**<Special Keys>** is a keyword which describes whether the "special keys" of the electronic counter are to be added into the right turn volumes as a count of right-turn-on-reds. It can be any of the following:

NO - special keys are ignored (default).
YES - special keys added to right turns.

### *Notes*

- If the count is a Jamar turning movement count (a PETRA file), the file must be exported to the DFL (IMC) file format before importing. The user should select the option describing whether the "special key" counts should be added to the adjacent right turn counts as right-turn-on-red counts. On this type of COUNTIMPORT, the PERIODS entry is updated automatically to match the turning movement count made. A turning movement count import imports all twelve movements at a time, replacing any count data for the PERIODS entry that may have existed prior to the import.

- If the count being imported is a Jamar or TimeMark machine count (a TAS file), or an IRD machine count (a PRN file), the user needs to select several options. The first is how to handle multi-channel counts. The default is to import only the first channel (A) encountered. Other options are to import the second channel (B), the sum of the two channels (A+B) or the difference of the two channels (A-B or B-A). Further, the user must designate which movement in the TEAPAC program should receive the imported data, and if a multi-day count was made, which of these days should be imported. On this type of COUNTIMPORT, the PERIODS entry is entered separately by the user, and only count data from the import file which matches the PERIODS entry will be imported. A machine count import imports a single movement at a time, leaving other movement data unchanged.

- If the count being imported is a Numetrics machine count (a CSV file), the user needs to select several options similar to the TAS file described above. As above, on this type of COUNTIMPORT, the PERIODS entry is entered separately by the user, and only count data from the import file which matches the PERIODS entry will be imported. A machine count import imports a single movement at a time, leaving other movement data unchanged. If the same movement is imported more than once, the new data is added to the prior existing data value, e.g., for multi-lane counts adding up to a single movement's value.

- The extra dialog responses for importing machine counts described above can be provided as additional parameters to a manual mode entry or a line in a control file. An additional 99 entry after these parameters will prevent the extra dialog from displaying, allowing the import to be performed unattended. The multi-channel count codes should be entered using 1 for (A), 2 for (B), 3 for (A+B), 4 for (A-B) and 5 for (B-A). For example, an unattended manual mode or control file command for a displayed import without RTOR of an (A+B) count for movement 2 from day 4 in the file would be:

  COUNTIMPORT <file> YES NO 3 2 4 99

- Specifying a folder where an import file is located (either with the <Data File> specificaton or the Browse button in the dialog) does not adjust the folder location where future data file save activities will occur. The location of the last Import file is remembered for use as the default folder for the next Import action, and the default folder for the first Import action is the data folder which is current for the first Import action.

## COUNTRECONFIG 12*<Destination Movement #>

Defaults: 1-12
Menus/Groups: [Results] for Count Analysis

The purpose of this command is to reorganize the positions of movements in the count.

**<Destination Movement #>** is the movement position where each movement's count data should be relocated (see note below). It can be any integer from 0 to 12. Its default value is 1 to 12 for each of the twelve movements, that is, no change in count configuration.

### *Notes*

- On occasion an analyst will find that count data has inadvertently been entered in the wrong "columns", that is, a right turn has been recorded as a left turn or vice versa, etc. The COUNTRECONFIG command enters a list of movement numbers from 1 to 12 which designate where each column of counts (movement) should be reconfigured to. Specifically, the first number given tells where the current movement #1 should be moved to, the second number is where the current movement #2 should move to, etc. For example, if the left turn from the north (movement #3) has been switched with the right turn from the east (movement #4), then COUNTRECONFIG * * 4 3 will swap the counts for these two positions (the other movements will remain unchanged).

- If a movement's counts are to be deleted from the data, putting a zero in its position takes care of that in short order. For example, COUNTRECONFIG * * 0 would delete the left turn on the north approach.

## COUNTREPORTS <List of Reports>

| | |
|---|---|
| Defaults: | 15MIN 60MIN AMPK MDPK PMPK ADT |
| Menus/Groups: | [Results] for Count Analysis |

The purpose of this command is to perform the selected tabulations and/or analyses in the order specified.

**<List of Reports>** is a list of keywords describing the reports and order of output desired, and can be any of the following:

| | |
|---|---|
| 15MIN | Tabulation of 15-minute counts by 15-minute intervals (default). |
| 60MIN | Tabulation of 15-minute volume rates and 60-minute volumes by 15-minute intervals (default). |
| AMPK | A.M. peak hour analysis (default). |
| MDPK | Midday peak hour analysis (default). |
| PMPK | P.M. peak hour analysis (default). |
| CMPK | Composite peak hour analysis. |
| MRNOPK | Morning off peak hour analysis. |
| EVEOPK | Evening off peak hour analysis. |
| ADT | 24-hour ADT estimate (default). |

The default list is 15MIN 60MIN AMPK MDPK PMPK ADT.

The following is the range of beginning and ending times covered for each analysis period in the above list.

| | |
|---|---|
| AMPK | 600 - 945 |
| MDPK | 1000 - 1245 |
| PMPK | 1300 - 1745 |
| CMPK | 000 - 2345 |
| MRNOPK | 000 - 545 |
| EVEOPK | 1800 - 2345 |

### *Notes*

- The use of the COUNTREPORTS command allows greater flexibility in the generation of output reports. The COUNTTABULATE and PEAKANALYZE commands provide quick ways to produce certain results, but the contents of these reports are fixed. Using the COUNTREPORTS command allows the desired reports to be produced, and the order of the reports to be adjusted. The printed output paging can also be adjusted with greater flexibility using COUNTREPORTS since each COUNTREPORTS command will start output at the top of a new page.

## COUNTTABULATE <Report Option>

Defaults: 15- & 60-minute tabulations
Menus/Groups: [Results] for Count Analysis

The purpose of this command is to tabulate 15-minute counts and 60-minute rates and volumes by 15-minute intervals.

**<Report Option>** is an option for which of the 15-minute or 60-minute reports is desired. It can be any of the following:

15 - display only 15-minute reports.
60 - display only 60-minute reports.
* - display both 15- & 60-min. reports (default).

### *Notes*

- Using the default for COUNTTABULATE is equivalent to issuing the COUNTREPORTS 15MIN 60MIN command.

**COUNTTYPE** **<Type of Data>** **<Type of Truck Counts>** **<Count Description>**

| | | |
|---|---|---|
| Defaults: | REDUCED<br>40 blanks | INCLUDED |
| Menus/Groups: | [Parameters] [CountAnalysis] | |

The purpose of this command is to enter the type of count data which is to be supplied to the program at the current intersection, and to provide a description of the count.

**<Type of Data>** is a keyword which defines the type of count data which will be entered on the VEHICLECOUNTS and TRUCKCOUNTS commands, and can be any of the following:

| | |
|---|---|
| CUMULATIVE | The count data entered is the cumulation of traffic counted from the start of the survey. |
| REDUCED | The data entered is the actual volume counted for the count interval (default). |

**<Type of Truck Counts>** is a keyword which defines the type of truck count data which will be entered on the VEHICLECOUNTS and TRUCKCOUNTS commands, and can be any of the following:

| | |
|---|---|
| INCLUDED | VEHICLECOUNTS data includes truck counts entered with the TRUCKCOUNTS command (default). |
| SEPARATE | VEHICLECOUNTS data does not include truck counts entered with the TRUCKCOUNTS command. |

**<Count Description>** is a 40-character description of the count that was conducted, to include such things as the date, weather, count station, etc. The default value is all blanks.

### *Notes*

- If entered data is declared CUMULATIVE, the data entered is the cumulation of traffic counted from the start of the survey, starting at an arbitrary value (sometimes 0). The actual volume will be the subtraction of successive cumulative entries. For REDUCED counts, the data entered is the actual traffic counted for the count interval.

- When truck counts are INCLUDED, the truck counts entered with the TRUCKCOUNTS commands are also included in the VEHICLECOUNTS data values and no adjustments are made by the program. When truck counts are declared SEPARATE, the truck counts entered with the TRUCKCOUNTS commands are not included in the VEHICLECOUNTS data values, so will be added to VEHICLECOUNTS by the program to get total traffic numbers.

## CRITICALS 8*<Critical Movement Number>

Defaults: 8*0
Menus/Groups: [Parameters] [SignalAnalysis] [Phasing]

The purpose of this command is to enter the movement which is critical for each phase of the phase sequence of operation of the current intersection.

**<Critical Movement Number>** is the movement number designating the movement which controls the design of the signal phase, and can be 0-12. Its default value is 0, no critical movement.

### *Notes*

- Designation of a critical movement in any phase will result in that movement appearing in red and with asterisks in the phase movement diagram, particularly for a capacity analysis. This is normally used to represent movements which were used to control a DESIGN. This diagram appears as part of the DIAGRAMS, ANALYZE, EVALUATE and QUEUECALCS reports. If a movement is designated as critical in any phase, the line for that movement in the ANALYZE report is flagged with an asterisk in the LOS column.

- The TIMINGS command automatically implements a CRITICAL command for the phases of the specified sequence which have been DESIGNed.

| **CYCLES** | **<Minimum Cycle>** | **<Maximum Cycle>** | **<Cycle Increment>** |
|---|---|---|---|
| Defaults: | 60 | 120 | 30 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Basic] [Phasing] | | |

The purpose of this command is to enter the range and precision of cycle length scanning for the current intersection for optimization, as well as the given cycle length for analysis of given conditions.

**<Minimum Cycle>** is the smallest cycle length in seconds which should be tested by optimization functions such as DESIGN and EXPORT. This is also the given cycle for analysis of given conditions for functions such as ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES, GOVERCS, HCSEXPORT and EXPORT. It can be any positive integer from 1 to 900 seconds. Its default value is 60 seconds.

**<Maximum Cycle>** is the largest cycle length in seconds which should be tested by optimization (such as DESIGN for operational feasibility), and can be any positive integer equal to or larger than <Minimum Cycle> from 1 to 900 seconds. Its default value is 120 seconds.

**<Cycle Increment>** is the precision to which the specified cycle length range will be investigated as to operational feasibility, i.e., the increment of cycle length which will be added to <Minimum Cycle> until <Maximum Cycle> is exceeded. It can be any positive integer from 1 to 900 seconds. Its default value is 30 seconds.

### *Notes*

- In ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES, GOVERCS and HCSEXPORT, if all of the GREENTIMES or all of the YELLOWTIMES are entered in seconds per second (sec/sec), the <Minimum Cycle> will be used to convert these entries to seconds before proceeding with the analysis.

- The system cycle length for coordinated systems will be equal to <Minimum Cycle> for the intersection referenced by MASTERNODE. If MASTERNODE is 0, or the node number referenced is not in the NODELIST or SUBSYSTEM, <Minimum Cycle> for the first node in the NODELIST or SUBSYSTEM will be used as the system cycle.

- If signals at minor intersections in the system will be run at cycle lengths which are half that of the major intersections, commonly called "double-cycling", the system cycle length entered by the CYCLES entry for the MASTERNODE should be the longer cycle length used at the major intersections. The GREENTIMES, YELLOWTIMES and REDCLEARTIMES for the double-cycled minor intersections should be entered in seconds (not sec/sec) and add up to half of the system cycle and the half-cycle should be entered as the CYCLE for the minor intersections. OFFSETS should also be entered in seconds (not sec/sec).

- <Minimum Cycle> is the cycle length which is used for PLOTTSD and TIMINGPLAN, and for EXPORTing to third-party programs like TRANSYT for simulations.

- When a cycle range is used for a third-party optimization, the same logic as the SPLIT+OFFSET optimization for OPTIMIZE is used, since the host program must optimize splits in order to vary the cycle length. To implement this option, the CYCLE+SPL+OFF option of the OPTIMIZE command must also be used. Although this option of TEAPAC makes the cycle evaluation by the host convenient, it is recommended that this option only be used to select a system cycle. When the cycle is selected, a more robust optimization of splits with TEAPAC should be used, followed by the use of the host only for offset optimization.

- For TRANSYT-7F versions before Release 9, the cycle optimization step size is set for 60 steps for the smallest cycle, forcing TRANSYT to re-calculate the step size for the larger cycles. This results in a consistent 60 steps per cycle for every cycle evaluated. This step size resolution is considerably smaller than recommended in the TRANSYT manual, but research has shown that the larger resolutions are not particularly valid. A Card Type 54 is also generated so that the more aggressive optimization step sizes and sensitivities of the Card Types 4 & 6 are used, rather than the course optimization which TRANSYT normally uses. Due to a bug in versions of TRANSYT-7F earlier than release 7, a card type 50 is used for these versions.

- If a <Cycle Increment> greater than 20 seconds is used, TRANSYT's maximum increment size of 20 seconds will be exported to avoid an error from TRANSYT. This may result in longer optimization times due to a larger number of cycles which may be evaluated.

## DALLASLEFTS 2*<Dallas Left Operation>

Defaults: 2*NO
Menus/Groups: [Parameters] [SignalAnalysis] [Phasing]

The purpose of this command is to enter the status of Dallas left operation for each direction of phasing at the current intersection.

**<Dallas Left Operation>** is a keyword identifying whether Dallas left turn operation is allowed for each direction of phasing for a Nema actuated signal. It can be any of the keywords described below:

| | |
|---|---|
| No | Dallas left operation is not allowed (default). |
| Yes | Dallas left operation is allowed. |

***Notes***

## DATA <List of Commands>

Defaults: [Parameters]
Menus/Groups: [DataFiles]

The purpose of this command is to display the current parameter values for the specified commands.

**<List of Commands>** is a set of commands and/or groups names, and can be any valid commands or group names of the program. It default value is [Parameters] - all non-active commands for entry of parameters related to the analysis procedures.

### *Notes*

- DATA will tabulate a list of the current parameter values of the listed commands. To obtain a formatted list of all data values with column headings and labels, etc., use the View-Summary menu or the SUMMARIZE command.

- In the Manual Mode, use of ASK for the same list of commands will display the current data values, as well as allow any input editing which may be needed, all in a single step.

## DELAYFACTORS 12*<Delay Adjustment Factor>

Defaults: 12*1.00
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter factors for each movement of the current intersection used to adjust the delay calculations, for example, to match delays obtained from a network simulation model.

**<Delay Adjustment Factor>** is the factor to adjust delay calculated for each movement, and can be any number from 0.01 to 9.99. Its default value is 1.00, no adjustment.

### *Notes*

- If delay values have been simulated with a network model such as TRANSYT-7F or NETSIM/CORSIM which does a better job of modeling delay between coordinated signals than the *Highway Capacity Manual* allows, DELAYFACTORS may be used to force the calculations of delay in a TEAPAC signal analysis to the same values. For example, if TEAPAC calculates delay of 20 seconds, but TRANSYT7F estimates a movement delay of 16 seconds, use a DELAYFACTORS of 0.80 for that movement.

## DESCRIPTION <Second Title Line>

Defaults: 80 blanks
Menus/Groups: [Titles]

The purpose of this command is to enter the second line of information used to identify the situation being analyzed.

**<Second Title Line>** is the second of three lines of information displayed at the top of every output report, and can be up to 80 characters of alphabetic or numeric information. Its default value is 80 blanks.

### *Notes*

- If the first character of the DESCRIPTION parameter is a plus sign, "+", the characters entered on this command will be overlaid over those of the previously entered DESCRIPTION command. This overlay will begin at the character position identified by the digits of the first two characters which follow the "+", and will end after the last non-blank character which is entered. See Chapter 7 for further explanation and examples of this feature.

- Entries on this command may be enclosed in 'single quotes' or "double quotes". This option provides the capability to include leading blanks in the entry, which is otherwise not possible. This option can also be used to enter a single blank as the title line using a ' ' or " " entry, thereby blanking out the entire prior contents of the title line.

- The name of the current open file can be inserted anywhere in the title line by placing %F at the desired location of the title line. The file name can be placed at a specific column location in a title line by using the +XX form of a title entry noted above.

## DESIGN <Number of Sequences to Analyze>

Defaults: 1 - 1 capacity analysis of best sequence & cycle follows DESIGN
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to perform an operational design to optimize timings for each sequence of the SEQUENCES command and each cycle of the CYCLES command for the current intersection or all intersections.

**<Number of Sequences to Analyze>** is the number of sequences for which capacity analyses shall be performed based upon optimum timings resulting from the design, and can be 0, 1-64, or -1. Its default value is 1, that is, 1 capacity analysis of the 'best' sequence & cycle follows DESIGN.

### *Notes*

- DESIGN optimizes green times with the default objective that each critical movement will get the same best-possible level of performance (typically minimum delay). Non-critical movements will get at least this level or better. The target level of performance is the first parameter of the LEVELOFSERVICE command. See Appendix C for a complete discussion of the optimization scheme and options used in a TEAPAC signal analysis, such as designating priority movements with the EXCESS command.

- A design criteria based on v/c only may be used by setting the Target Delay parameter of the LEVELOFSERVICE command to 0. This will effectively balance the v/c values of the critical movements. This strategy is used by DESIGN automatically when the highest allowed delay value cannot be achieved. See Appendix C for a complete discussion of the optimization scheme and options used in a TEAPAC signal analysis.

- When a value of 0 is used for <Number of Sequences to Analyze>, DESIGN will produce a table with the critical level of service achieved for each combination of phase sequence and cycle length attempted. Inappropriate sequences will be marked with a dash '-'. If the Detail option of the OUTPUT command is selected, the actual target achieved will also be displayed for each combination in an expanded table of results.

- If a positive value is entered for <Number of Sequences to Analyze>, the list of successful sequences as described above is omitted. This list is replaced by the SORT command output, a list of successful sequences which is sorted in ascending order by target achieved and Required G/C + Y/C. This list also contains the range of cycle lengths which were successful at the target LOS for each sequence. Following the list of sorted sequences are the capacity analyses for the specified number of sequences at the top of the SORTed list, performed automatically by the ANALYZE command.

- If a negative number is entered for <Number of Sequences to Analyze>, the design procedure is completed in the same manner as with a zero (see above), however, no output is generated. Use this for a single intersection only – although functional for a selection of All intersections (INTERSECTION 0), it is of no value since the only meaningful commands which could follow are SORT or TIMINGS, but neither is valid for All intersections.

- Extra output normally displayed with the DESIGN report when OUTPUT is specified will not be displayed when the DESIGN parameter is non-zero, for example, when DESIGN 1 or DESIGN -1 is entered.

- Commands which guide the DESIGN process include MINIMUMS, PEDWALKS, PEDFDWS, REQCHANGE+CLEARS, EXCESS, LEVELOFSERVICE, CYCLES, SEQUENCE and OUTPUT.

## DIAGRAMS <Sequence Code>

Defaults: -1
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to display a phase movement diagram for the specified sequence code for the current intersection.

**<Sequence Code>** is the phasing code number specifying the phase sequence which is to be diagrammed, and can be a standard, special or positional code, as follows:

| | |
|---|---|
| Standard phasing code: | 11, 12, 13, etc. |
| Special phasing code: | 0. |
| Positional codes: | -1, -2, -3, etc. |
| | (default -1, first sequence in SEQUENCES list) |

### *Notes*

- If a negative number is given as a sequence code, this represents the sequence code position in the SEQUENCES list, i.e., minus three will produce a phase diagram for the third sequence code in the SEQUENCES list.

- If an asterisk is given as the sequence code, all codes in the SEQUENCES list will be diagrammed. For example, if SEQUENCE ALL has been specified, DIAGRAMS * will produce a list of all possible phasings considered by TEAPAC in a signal analysis optimization.

- Arrows are shown in the diagram only for movements with non-zero VOLUMES.

## DISTRIBUTION 30*<Distribution Factor>

| | |
|---|---|
| Defaults: | 30*0 |
| Menus/Groups: | none |

The purpose of this command is to enter the percentage of the total traffic generated by the BASE and GENERATION commands for each individual distribution type of traffic.

**<Distribution Factor>** is the percentage of the total traffic generated for each distribution type, and can be -100 to 100 percent. Its default value is 0.

### *Notes*

- The <Distribution Factors> are assigned to each distribution type according to their position on the DISTRIBUTION command, e.g., the third entry on the DISTRIBUTION command sets the distribution value for PATHDISTRIBUTION's type 3 traffic.

- Use of the DISTRIBUTION command is superfluous if the distribution value is entered for each type by the PATHDISTRIBUTION command, which is normally the case. The DISTRIBUTION command is only provided as a means of quickly changing the distribution percentages in the interactive, manual mode rather than needing to type in each PATHDISTRIBUTION command individually.

## DUALENTRYS 8*<Nema Dual Entry Status>

Defaults: 8*NO
Menus/Groups: [Parameters] [SignalAnalysis] [Phasing]

The purpose of this command is to enter the phase dual entry status for each Nema movement of the current intersection.

**<Nema Dual Entry Status>** is a keyword identifying the dual entry status which is set for each Nema actuated movement. It can be any of the keywords described below:

No dual entry is not allowed (default).
Yes dual entry is allowed.

### *Notes*

## ECHO <Input/Output Echo Condition>

Defaults: NO
Menus/Groups: [DataFiles]

The purpose of this command is to enter the echo condition flag indicating whether or not command information should be displayed after being input from or output to a file.

**<Input/Output Echo Condition>** is a keyword describing whether or not file input and output should be echoed, and can be either of the keywords described below.

| | |
|---|---|
| NO | File I/O will not be echoed (default). |
| YES | File I/O will be echoed. |

### *Notes*

- When data is LOADed from or SAVEd to data files, listings of the actual data lines being transferred can be obtained by first setting the ECHO parameter to YES. This is a convenient way to visualize what is happening during LOADs and SAVEs. As such, it is also a powerful tool for debugging complicated batch control file sequences.

- ECHO can also be used to view some other file data transfer functions such as outputting volumes to files from a count analysis or a traffic impact analysis for use by another program.

**ENDGAIN** **12*<End Gain Time>**

Defaults: 12*2.0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Movement]

The purpose of this command is to enter the length of time that vehicles effectively extend the green period into the yellow and all-red period for each of the twelve movements of the current intersection.

**<End Gain Time>** is the number of seconds during the yellow and all-red period which is effectively used as green time, and can be any number from 0.0 to 30.0. Its default value is 2.0.

### *Notes*

- STARTUPLOST time is used in conjunction with ENDGAIN time to calculate the lost time that an individual movement experiences during its green phase(s). The formula used from the *Highway Capacity Manual* is $t_L=l_1+l_2$, where $l_1$ is the startup lost time, $l_2$ is the ending lost time; and $l_2$=Y-e, where e is the endgain time. These values are coded directly on the appropriate RT 29 entries for TRANSYT.

- If the default values of STARTUPLOST and ENDGAIN (both are 2 seconds) are used for a particular movement, the lost time formula simplifies to $t_L$=Y. Since Y values (yellow plus all-red time) are typically in the range of 4-6 seconds, this default condition may result in lost times considerably higher than the default lost time value of 3.0 seconds which was used in the 1985 and 1994 *Highway Capacity Manuals*. When this is the case, users should expect less effective green time for these movements versus those used in comparable 1985 and 1994 analyses, which will result in higher v/c and delay values, and thus likely worse levels of service.

## EVALUATE --

Defaults: --
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to display a performance evaluation for a specified phasing and timings for the current intersection or all intersections. It has no parameters.

### *Notes*

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CYCLE commands or the TIMINGS command.

## EXCESS <List of Priority Movement Numbers>

Defaults: 0
Menus/Groups: [Parameters] [SignalAnalysis] [Intersection]

The purpose of this command is to enter the movements to which the TIMINGS command will assign available excess portions of the cycle length for the current intersection.

**<List of Priority Movement Numbers>** is the movement numbers for the movements which should receive available excess time, and can be 0-12. Its default value is 0, no priority movements.

### *Notes*

- For DESIGN, the <Target Delay/LOS> entry of the LEVELOFSERVICE command sets the target delay (or level of service) which is to be achieved for all critical movements of the intersection. If this target level is achieved with excess time still available at the intersection, then the excess time is assigned to the phases according to the entries on the EXCESS command. If no EXCESS entries have been made, time is allocated proportionally to all phases. However, if EXCESS is used, this provides a means to designate a worst-case delay/LOS performance level for all critical movements and to assign all additional time to the priority movements of the EXCESS command. This is the preferred optimization scheme for the DESIGN function of TEAPAC's signal analysis (see Appendix C for more details).

- The excess time will be allocated to the phases in which the specified movements occur. If the movements specified occur in more than one phase, the excess time will be allocated to each in proportion to the g/C required by each.

- If a specified movement occurs in more than one phase, its excess time phase will be designated as the single phase serving the movement (i.e., if movement 2 is specified with sequence 21, the excess will go to the north-south through phase).

**EXPORT <Host> <File/AUTO/STACK> <Display Output> <Auto Option>**

| | | | | |
|---|---|---|---|---|
| Defaults: | -- | AUTO | NO | VIEW |
| Menus/Groups: | [Results] for Export and Import | | | |

The purpose of this command is to create a third-party host input data file from the current data values, with an optional automatic link to the host program.

**<Host>** is the name of the host program to EXPORT to, and can be any valid host supported by TEAPAC – TRANSYT, PASSER2, CORSIM, SYNCHRO, TRUTRAFF (use for TS/PP-DRAFT), NOSTOP or VISSIM. Its default value is TRANSYT.

**<File/AUTO/STACK>** is the name of the host input data file to EXPORT to, and can be any valid file name or the keywords AUTO or STACK. Its default value is AUTO.

**<Display Output>** is a keyword which describes if the EXPORTed data is to be displayed during the EXPORT process, and can be either NO or YES. Its default value is NO.

**<Auto Option>** is a keyword which describes what action should follow an automatic link to the host. It can be any of the keywords listed below:

| | |
|---|---|
| NONE | no further action. |
| VIEW | view host results onscreen (default). |
| ANIMATE | view CORSIM or VISSIM animation only (default for VISSIM only). |
| BOTH | view host results and CORSIM animation (default for CORSIM only). |

***Notes***

- The default file name extension is .tin for TRANSYT-7F, .dat for PASSER2-02, .trf for CORSIM, .csv for SYNCHRO, .dgt for TRU-TRAFFIC and TS/PP-DRAFT, .for for NOSTOP and .anm for VISSIM.

- A direct linkage to and from the host program can be created which handles the export file naming, running of the host, and optional review of the host's results. This option is selected by entering AUTO as the EXPORT file name. When AUTO is selected, a fourth parameter can be entered to define what actions should be taken after the automatic export. The fourth parameter is ignored if AUTO is not selected. AUTO may not be abbreviated, nor may any file name used start with the four letters A-U-T-O. When the AUTO option is selected, the export file name used is TMPxxx.xxx (depending on the host selected) and the host results are stored in a file with a similar name.

- In order for the AUTO option of EXPORT to function properly, the TEAPAC.CFG file must be configured to properly represent the folders where the host program files are installed (see Options-Setup menu for on-screen editing of the TEAPAC.CFG file).

- The output of the EXPORT command normally starts at the beginning of the file named. For TRANSYT, it can also be stacked behind a previous EXPORT to the same file used by the previous EXPORT so that multiple runs of TRANSYT can be made from a single input data file. This function is performed by using STACK for <File/AUTO/STACK> on the EXPORT command after having previously used a specified file name for an EXPORT. STACK may not be abbreviated, nor may any file name used start with the five letters S-T-A-C-K. Each EXPORT is terminated with a "90" card type, signifying the end of the TRANSYT input. If an EXPORT is stacked behind a previous EXPORT, the "90" card of the previous EXPORT is changed to a "91" to indicate another TRANSYT data set follows.

- If no NODELIST exists, no EXPORT is attempted. This option can be used to establish the name of the export file for subsequent EXPORT STACK commands, particularly if they are in a REPEAT loop where each EXPORT is to be stacked one after the other.

- TRANSYT-7F has a limitation that node numbers must be in the range of 1-99 (hence, with a limitation of no more than 99 nodes in any given run of TRANSYT). Exporting to TRANSYT adjusts the exported node numbers as necessary so that they are always in the range of 1-99. This is accomplished by first using any TEAPAC node numbers in an Export that are already in the range 1-99, then using only the last two digits of any other node numbers which do not conflict with the first group, then finally assigning arbitrary node numbers to the remaining nodes which are to be exported. This provides the best possible consistency between the TEAPAC node numbers and the node numbers which are seen in the TRANSYT results. The actual mappings used can be seen in the exported data file (.tin) which is created for TRANSYT.

- For CORSIM, only the last three digits of external dummy nodes are used when creating their associated entry nodes (which always must be numbered 8xxx). As long as there are less than 1000 dummy nodes in the exported network and none of the external dummy nodes share the same last three digits, this will not be a problem (this is typically the case).

- If the Animate option is selected for VISSIM, control will not return to TEAPAC until the animation in VISSIM is stopped. To stop the animation, one of the Simulation play buttons in VISSIM may need to be pressed in order to enable the Simulation stop button. If returning to TEAPAC during the animation is desired, select the View option instead of Animate and start the animation manually with the Continuous Simulation play button in VISSIM. Do not attempt to close the Export status message box during the animation or TEAPAC will be closed.

- If VISSIM is started by an Export from TEAPAC and then subsequently closed, TEAPAC may need to be re-started so that it can create another instance of VISSIM with its next Export. This condition can be avoided by making sure not to close VISSIM once it has been opened by TEAPAC until the instance of TEAPAC which started VISSIM has itself been closed.

- When exporting to third-party programs, it is normally the desire to use average timings for actuated signals in these programs, so this is the default action of the EXPORT command. In order to accomplish this, signal timings must be entered By-Movement, and normally the GREENAVERAGES dialog is populated automatically by the ANALYZE or DESIGN commands for a 2016 HCM analysis. For programs which are capable of modeling actuated operation in some fashion from data exported by TEAPAC (such as Synchro, TRANSYT or PASSER), the GREENAVERAGES are exported instead of GREENTIMES (maximum settings) and the actuated operation is disabled by setting recall-to-max, as necessary (ie, Synchro). If the normal actuated model of the third-party program is desired, this should be selected with the <Actuated> setting of the SIMULATION dialog, in which case GREENTIMES will be exported.

- If the GREENAVERAGES values are intended to be used for EXPORT per the discussion above, but the GREENAVERAGES all have values of zero, the GREENTIMES values will be used instead, with a warning message to that effect. Normally this situation can be addressed by using the ANALYZE command for 2016 HCM to compute the average green times prior to EXPORT. However, if the EXPORT is specifically intended to represent maximum timings instead of average phase durations, then the GREENAVERAGES can be set to zero intentionally to achieve this effect.

## FACTORS 12*<Satflow Adjustment Factor>

Defaults: 12*1.00
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter satflow adjustment factors for each movement of the current intersection to adjust *Highway Capacity Manual* satflow computations.

**<Satflow Adjustment Factor>** is an adjustment factor which, when multiplied by satflows obtained from the *Highway Capacity Manual*, produce satflows that more accurately reflect conditions known to exist in the study area. It can be any number from 0.01 to 9.99. Its default value is 1.00, no adjustment.

### *Notes*

- FACTORS are useful in adjusting *Highway Capacity Manual* computations to match surveyed satflows (i.e., field calibration – see Chapter 5).

- FACTORS may also be useful in estimation of special-use lane satflows (i.e., dual-optional turn lanes - see Chapter 5).

## FILES 5*<File Name>

Defaults: 5*nul
Menus/Groups: [DataFiles]

The purpose of this command is to enter the names of the permanent storage file areas where information is to be LOADed and SAVEd.

**<File Name>** is the name of the file to be used, and can be any valid file name (see Appendix G discussion). Its default value is no defined file.

### *Notes*

- FILES can be used so that the program remembers the name of the file to be used by subsequent LOAD and SAVE commands, thus avoiding the file name entry for each LOAD and SAVE.

- The file numbers referenced by the file access commands are determined by the order of the file names in the FILES command. For example, the third file name specified on the FILES command is designated as file #3 for LOAD and SAVE.

- Each time a new file name is specified by a FILES command, the associated "next line" and "last line" values of the file are both reset to point to line 1.

- Appendix G describes details about specifying file names, etc. for your specific operating system. For example, new files that don't presently exist may use the /N suffix to the file name in order to allow the program to create a new file automatically, preventing accidental use of pre-existing files thought not to exist.

- If the /N suffix (switch) described above is not used to indicate the desire to create a New file, but the file named is not found, a message to this effect will be issued. At this point the user will be given the opportunity to say that the file should be created anyway. This action is presented in the form of a warning message, but is a valid way of creating new files without using the /N switch.

- If the /N switch is used, but the file named already exists, a message to this effect is issued and the user is given an option to use the existing file anyway, if desired.

- The default location for user data files is defined in the dialog opened by the Options-Setup menu. The Options-Setup dialog changes dynamically as the user navigates through the File-Open and File-SaveAs dialogs, and the current contents of the dialog can be saved at any time in the program's .CFG file by pressing the Save button in the Options-Setup dialog. This will cause this saved location to be the default file location the next and subsequent times the program is run, until a new location is saved. See the detailed discussion of program installation and CFG files in Appendix G.

## FINDPATHS <Distribution Type #>

| | |
|---|---|
| Defaults: | all defined types |
| Menus/Groups: | [Results] for Traffic Impact Analysis |

The purpose of this command is to display the five shortest paths for the selected distribution type, prompting for input of the percentage of total distribution type traffic to be assigned to each path.

**<Distribution Type #>** is the distribution type number of a specific set of assignment paths which will be displayed on the diagram, and can be any integer from 0 to 30, as described below:

1-150 - a selected type number.
0 - all defined distribution types (default).

### *Notes*

- This command provides a quick way of defining the PATHASSIGNMENTs for one or all distribution types. All that needs be entered is the percentage of the total traffic generated for each distribution type which is to be assigned to the displayed path and the PATHASSIGNMENT command is automatically created to define that path.

- The PATHASSIGNMENTs defined by this process can be reviewed after the fact by using the SHOWPATHS command, and can be edited by inputting new PATHASSIGNMENT commands.

- <Distribution Type #> must not exceed the <# of Distribution Types> previously established by the SITESIZE command.

## FIRSTDETECTS 12*<First Detection>

Defaults: 12*75.0
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter the position of first detection for each movement of the current intersection.

**<First Detection>** is the distance, in feet, upstream of the stop bar where the first detection for a movement is made, and can be any number from 0.0 to 600.0. Its default value is 75.0.

### *Notes*

## GAPOUTS 2*<Gapout Status>

Defaults: 2*NO
Menus/Groups: [Parameters] [SignalAnalysis] [Phasing]

The purpose of this command is to enter the status of the simultaneous gapout setting for each direction of phasing at the current intersection.

**<Gapout Status>** is a keyword identifying the simultaneous gapout status which is set for each direction of phasing for a Nema actuated signal. It can be any of the keywords described below:

| | |
|---|---|
| No | simultaneous gapout is not allowed (default). |
| Yes | simultaneous gapout is allowed. |

### *Notes*

| **GENERATION** | **<Direction>** | **<Generation Rate>** | **10*<Node-Dir>** |
|---|---|---|---|
| Defaults: | - | 0.000 | 10*<0-> |
| Menus/Groups: | [Parameters] | [TrafficImpact] | |

The purpose of this command is to enter the traffic generation rates and access points and access directions for the development.

**<Direction>** is a keyword which describes whether the following information applies to inbound, outbound or both directions of trip generation, and can be any keyword, as described below:

IN - data applies to inbound trips only.
OUT - data applies to outbound trips only.
BOTH - data applies to inbound & outbound trips (Manual Mode only).

It has no default value; it must be entered.

**<Generation Rate>** is the trip generation rate to be applied to the generation base, and can be any number, which when multiplied by the BASE development size, yields the total vehicle trips generated, from -9.99 to 99.99. Its default value is 0.000.

**<Node-Dir>** is the node number and leg direction providing the access to the development site. For example, a 1N entry means the north leg of node 1 provides access to the site. The Node part of the entry can be 0-9999 and its default value is 0 - at least one access node is required. The Dir part of the entry is a character which describes the leg of the intersection which provides access to the site, can be either N, E, S, or W, and has no default value; it must be entered for every non-zero Node entry.

### *Notes*

- The Node part of <Node-Dir> must be included in the list of intersections previously established with the NODELIST command.

- If a previously entered list of access nodes must be shortened, the entry of Node number 0 anywhere in the list will erase all nodes and directions from that point to the end of the list.

## GOTO <Destination>

Defaults: next
Menus/Groups: [Control]

The purpose of this command is to divert the input stream within a file by providing the next location to be LOADed from that file.

**<Destination>** is a number which defines the next line number which will be LOADed from the current file, or a variable name associated with a REPEAT loop, and can be any valid line number of the current file less than or equal to 32767 (positive, negative or zero), or any REPEAT loop variable name that is currently in use. Its default value is the line number which follows the line which contains the GOTO command.

### *Notes*

- A REPEAT loop variable name can be used with GOTO if the same variable name is in active use by a REPEAT command. In addition, the GOTO command can only be encountered when its associated REPEAT command is the most active REPEAT command. This means that REPEAT loops must not partially overlap one another - i.e., one must be entirely contained within the other (nested), or they must be completely separate from each other (sequential).

- A negative line number of -n will divert input to a point in the current file n lines before the line which follows the GOTO command - i.e., GOTO -5 sets up a loop which will continue to LOAD the four lines prior to the GOTO.

## GOVERCS --

Defaults: --
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to compute g/C's required to make each movement operate at specified levels of service for the current intersection or all intersections. It has no parameters.

### *Notes*

- The levels of service for which the g/C's will be computed are specified by the LEVELOFSERVICE command.

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CYCLE commands or the TIMINGS command.

## GRADES 4*<Grade of Approach>

Defaults: 4*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the grade of each approach of the current intersection.

**<Grade of Approach>** is the grade of the approach, in percent, either positive or negative, and can be any number from -10 to 10. Its default value is 0.

### *Notes*

- Approaches that run uphill into the intersection have a positive grade for this input. Downhill approaches have a negative grade.

## GREENAVERAGES 8*<Phase Average Green Time>

| | |
|---|---|
| Defaults: | 8*0.0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Phasing] |

The purpose of this command is to enter/store the average duration of green for each of the phase movements of the current intersection. When computational commands like ANALYZE and DESIGN are executed for a 2016 HCM analysis, the computed average phase durations are dumped into this command dialog.

**<Phase Average Green Time>** is the average duration of green for the phase movement, given in seconds, and can be any number from -99.9 to 900. Its default value is 0.0 seconds.

### *Notes*

- This command has no effect on any capacity analysis calculations. It is present only to receive values from a 2016 HCM capacity analysis for export to a file in order to use these values in other third-party programs, particularly PASSER-II, TRANSYT, CORSIM, SYNCHRO, TRU-TRAFFIC and TS/PP-DRAFT.

- When exporting to third-party programs, it is normally the desire to use average timings for actuated signals in these programs, so this is the default action of the EXPORT command. The same is true for PLOTTSD. In order to accomplish this, signal timings must be entered By-Movement, and normally the GREENAVERAGES dialog is populated automatically by the ANALYZE or DESIGN commands for a 2016 HCM analysis. For programs which are capable of modeling actuated operation in some fashion from data exported by TEAPAC (such as Synchro, TRANSYT or PASSER), the GREENAVERAGES are exported instead of GREENTIMES (maximum settings) and the actuated operation is disabled by setting recall-to-max, as necessary (ie, Synchro). If the normal actuated model of the third-party program is desired, this should be selected with the <Actuated> setting of the SIMULATION dialog, in which case GREENTIMES will be exported.

- If the GREENAVERAGES values are intended to be used for EXPORT per the discussion above, but the GREENAVERAGES all have values of zero, the GREENTIMES values will be used instead, with a warning message to that effect. Normally this situation can be addressed by using the ANALYZE command for 2016 HCM to compute the average green times prior to EXPORT. However, if the EXPORT is specifically intended to represent maximum timings instead of average phase durations, then the GREENAVERAGES can be set to zero intentionally to achieve this effect.

## GREENTIMES 8*<Phase Green Time>

Defaults: 8*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Basic] [Phasing]

The purpose of this command is to enter the duration of green for each of the phases of a specified phase sequence, or optionally for each of the movements, of the current intersection.

**<Phase Green Time>** is the duration of green for the phase or movement, given in either seconds or seconds/second, and can be any number from 0 to 900. Its default value is 0.0 seconds.

### *Notes*

- If the list of GREENTIMES is preceded by the keyword 'Movmt', then each of the entered values will be interpreted as timings for individual through and left turn movements, clockwise around the intersection. If not, or the optional keyword 'Phase' is used, each value is for the phases defined by the SEQUENCE code.

- When entering or viewing controller timings, a Convert button appears on the GREENTIMES dialog which allows the user to select the style of entry or view, either 'By Phase' which is the traditional HCM 2000 method, or 'By Movement' which is the HCM 2016 method and similar to the way timings are used on NEMA and other dual-ring controllers. If any timings are present, they will be converted to the other format at the same time, including YELLOWTIMES and REDCLEARTIMES if the GREENTIMES dialog is displayed, and vice versa. When timings are Converted, the conversion will also include reviewing the allowed SEQUENCES list and moving the appropriate sequence code to the top of the list according to the timings present.

- It is important to make sure that YELLOWTIMES, REDCLEARTIMES and REQCHANGE+CLEARS entries are always kept consistent with each other, especially when converting Timings by Phase to Timings by Movement and when exporting to third-party, ring-based software.

- Allowing timings 'By Movement' makes it apparent that for certain overlap phases, phase lengths which are apparently negative in the 'By Phase' method are, in fact, perfectly valid timings for dual-ring controllers, as long as the negative value of the overlap phase greentime does not exceed the yellowtime of that same phase. This permits a wider range of timings to be represented by the traditional 'By Phase' (HCM) methodology.

- 'By Movement' timings are not allowed when special phasings represented by negative SEQUENCE codes are used.

- If green times are entered in seconds/second, the first cycle length of the CYCLES command will be used to convert the phase times to seconds. If all entries are greater than or equal to 1.0, they are assumed to be seconds; if all entries are less than 1.0, they are assumed to be seconds/second.

- GREENTIMES can be generated by a TIMINGS command which was preceded by a DESIGN command. These GREENTIMES are provided in seconds.

- If entering GREENTIMES by phase, they must be entered in the order of the phases as specified by the SEQUENCES code and the LEADLAGS command.

- To prevent division by zero errors, all phases except overlap phases must have non-zero GREENTIMES. To analyze a phase with a greentime which is effectively zero, use 0.01 seconds. This will display as zero, but prevent division by zero errors.

- When EXPORTing to TRANSYT for a split or cycle optimization, the input of GREENTIMES is not required, since they will be ignored by TRANSYT. If a zero or negative time for an overlap phase is used, this is permitted by TEAPAC, although 1 second is used for TRANSYT since TRANSYT will not allow a zero-time phase. In the event that an overlap phase's green and yellow times are both zero, the clearance time is set to the minimum value of 1 second rather than the 4-second default.

- If a signal is to be double-cycled, GREENTIMES, YELLOWTIMES, REDCLEARTIMES (and OFFSETS) must be entered in seconds (not sec/sec) which sum to 1/2 the system cycle.

## GROUPTYPES 12*<Lane Group Type>

Defaults: 12*NORMAL
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Movement]

The purpose of this command is to enter the special lane group type for each possible lane group of the current intersection, such as dual-optional lanes, free-flow lanes and sign-controlled lanes.

**<Lane Group Type>** is a keyword describing the type of lane group being used, and can be any of the following:

| | |
|---|---|
| NORMAL | - normal lane group (default). |
| FREEFLOW | - free-flow lane group not controlled by the signal. |
| DUALOPTIONAL | - dual-optional lane group. |
| STOP | - stop sign controlled lane group (used only for exporting). |
| YIELD | - yield sign controlled lane group (used only for exporting). |

### *Notes*

- Free-flow lane groups are not controlled by the signal, having 100% greentime indications. By using the FREEFLOW option, the volume of free-flow traffic can be counted and recorded in TEAPAC's inputs, but the volume will not affect TEAPAC's capacity analysis or signal timing optimization.

- Free-flow movements can be defined by selecting FreeFlow for any lane groups not under signal control and not impaired in their movement through the intersection by other movements (Yield). If selected, the movement is defined as protected in every phase of TRANSYT's RT 2X and is displayed in the phasing diagram of TIMINGS. A SATURATIONFLOWS entry can be entered to control the free-flow discharge rate, or it can be left zero and 1800 vphgpl will be assumed.

- Dual-optional is a lane configuration where an exclusive turn lane exists and the adjacent lane group can be optionally used for turns as well (a shared lane group). This input condition is defined by flagging the exclusive turn lane group as a DUALOPTIONAL lane group. This triggers a process which approximates the number of turning vehicles in the optional lane, re-calculates the turn percentages and truck percentages in the shared lane, and removes these vehicles from the exclusive turn lane group (adding them to the adjacent shared lanes). The number of turns in the optional lane is calculated by determining the number of turns in the shared lane which would approximately balance the v/c of the two adjacent lane groups without exceeding the designated lane utilization factor for the shared lane group.

- Dual-optional lane groups defined by GROUPTYPES are identified in the output reports by placing a plus sign "+" next to the number of lanes in the turn lane group and a minus sign "-" next to the number of lanes for the shared lane group, since in effect the dual-optional status increases the amount of turning lane group capacity and reduces the shared lane group capacity.

- In the DESIGN process, the only phasing which is allowed for a dual-optional lane group is split phase (sequence 7) or an unopposed single phase (sequence 1).

- If an intersection includes lane groups controlled by signs as defined by GROUPTYPES, TEAPAC's signal analysis will process the information, but will skip any analysis of the intersection, with an advisory warning to this effect.

- Stop sign-controlled movements can be defined by selecting Stop for any lane groups controlled by a stop sign. When this is selected, RT 1X for TRANSYT is adjusted to show all intersection movements in a single phase, and the sign-controlled movements are defined to use the permitted model, with RT 29 indicating the opposed movements for the type of movement under sign-control. Yield sign-controlled movements are modeled by the same method.

- Stop and Yield sign-controlled movements can be defined by selecting Stop or Yield for any lane groups controlled by these signs. When this is selected, RT 35 and 36 for CORSIM are adjusted to show the designated sign control.

## HCSEXPORT <File name/AUTO>

Defaults: --
Menus/Groups: [Results] for Export and Import

The purpose of this command is to create an HCS-compatible input data file from the current data values for the current intersection, with an optional automatic link to HCS.

**<File Name/AUTO>** is the name of the HCS data file to export to, and can be any valid file name, or the keyword AUTO. Its default value is AUTO.

### *Notes*

- The SEQUENCES, CYCLES, GREENTIMES, YELLOWTIMES and REDCLEARTIMES commands must first be input to TEAPAC before the HCSEXPORT command. Normally, HCSEXPORT will be executed following the DESIGN, SORT, TIMINGS sequence of commands, or the DESIGN 1 command for optimization of timings and phasings by TEAPAC.

- To perform computations with HCS comparable to the ANALYZE command of TEAPAC using an EXPORTed file, simply select the HCS File-Open menu and select the name of the file EXPORTed.

- The default file name extension is.xus for HCS2010. The export will be created for HCS2010 if any file name extension other than XHS, XHU, HCS, HC9 or SIG is used. Use of .XHS or .XHU will cause an HCS+ export, .HCS will cause an HCS2000 export (also useable by HCS Release 3), .HC9 will cause a Release 2.4 export, and .SIG will cause a Release 1.x export.

- If <File/AUTO> is the name of a file that does not (or should not) already exist, the automatic creation queries can be avoided by using the normal TEAPAC file name switch, "/N", as described in the Appendix G discussion. If it doesn't matter if the file exists or not, the "/O" switch can be used.

- A direct linkage to HCS2010 Streets can be created which handles the export file naming and running of HCS2010. This option is selected by entering AUTO as the HCSEXPORT file name. AUTO may not be abbreviated, nor may any file name used start with the four letters A-U-T-O. When the AUTO option is selected, the export file name used is TMPHCS.xus for the Streets module of HCS2010.

- In order for the AUTO option of HCSEXPORT to function properly, the TEAPAC.CFG file must be configured to properly represent the folders where the HCS files are installed (see Options-Setup menu for on-screen editing of the TEAPAC.CFG file).

- The "street names" for HCS come from the INTERSECTION command. The north/south street name is assumed to be anything preceding an "&" and the east/west name is anything after the "&". The "analysis time" for HCS comes from the first 30 characters of the NOTE command, the "analysis year" comes from the second 30 characters of the NOTE, and the "analysis date" comes from the system clock. . The "analysis by" field for HCS comes from characters 61-80 of the NOTE command. The "project description" comes from the first 60 characters of the PROJECT command. The "intersection name" come from the first 30 characters of the DESCRIPTION command (which will normally not be a description of the intersection), and the "jurisdiction" comes from the second 30 characters of DESCRIPTION.

- For HCS versions prior to HCS+, do not use the double quote character (") or the ampersand character (&) anywhere in character entries such as [Titles] or INTERSECTION, as this will cause data values in the exported file which cannot be read properly by HCS. The exception to this rule is the user should specifically use ampersand (&) to separate the street names in the INTERSECTION entry.

- The pedestrians are assumed to walk during the phase with the adjacent through movement if the ped volume is not zero. The minimum phase time for those peds is taken as the minimum for that through movement. Ped buttons are always set to "N" since this is not a TEAPAC input.

- In versions of HCS prior to HCS+ the HCS parking flag is set on only if parking exists on the right side of an approach, since these earlier versions of HCS do not treat left side parking.

- HCS.SIG files for Releases 1.x do not save utilization factors used in the analysis. Thus, it may be necessary to re-enter utilizations in the HCS analysis to match those used in the TEAPAC analysis.

- For conversion to HCS.SIG input for Releases 1.x, the arrival type of the through movement in TEAPAC is used for the approach arrival type in HCS.

- The heavy vehicle percentage used for each HCS.SIG approach is the weighted average percentage of heavy vehicles given for the individual movements in TEAPAC.

## HEADING <Number of Lines>

Defaults: 3
Menus/Groups: [Control]

The purpose of this command is to display the current title heading lines.

**<Number of Lines>** is the number of lines of the three-line heading which are to be displayed, and can be any number from 0 to 3, either positive or negative. Its default value is 3.

### *Notes*

- The lines which will be displayed are identified by counting the number of lines requested starting at the last line of the heading, i.e., an entry of 1 will display only the last line of the heading -- the NOTE.

- In an appended output window, or within a script/control file, use of HEADING 0 will force a page break at that point in the output stream.

- HEADING -1 in a script/control file will force the update of the output window so that progressive results can be observed before the control file completes.

## HELP <List of Commands>

Defaults: [Parameters]
Menus/Groups: [Info]

The purpose of this command is to display the command names, parameter descriptions, and default values for each command listed.

**<List of Commands>** is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [Parameters] - all non-active commands for entry of parameters related to the analysis procedures.

### *Notes*

- HELP provides a brief, 1-line summary for each of the listed commands, including the parameters and values expected and their default values.

- The Help-Commands menu produces the same result as using HELP [AllCommands], an alphabetical list of all commands, as found in Appendix A. The Manual Mode must be used for any of the other HELP command options.

- If HELP is requested for one command, the detailed help of the Help button or the F1 key found in any Visual Mode dialog is displayed, as found in Appendix B.

## IDEALSATFLOWS 12*<Ideal Saturation Flow Rate>

Defaults: 12*1900
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter the base (ideal) saturation flow rate for each movement of the current intersection.

**<Ideal Saturation Flow Rate>** is the base saturation flow rate of a single lane under ideal conditions, in pcphgpl, and can be any integer value from 0 to 3000. Its default value is 1900.

***Notes***

| **IMPORT** | **<Host>** | **<File/AUTO>** | **<Display Output>** | **<Import Scope>** |
|---|---|---|---|---|
| Defaults: | -- | AUTO | NO | TIMINGS |
| Menus/Groups: | [Results] for Export and Import | | | |

The purpose of this command is to import signal timings from a host program's output file which was created by a TEAPAC Export, or optionally import an entire network from SYNCHRO.

**<Host>** is the name of the host program to IMPORT from, and can be any valid host supported by TEAPAC – TRANSYT, PASSER2, SYNCHRO, TRUTRAFF (use for TS/PP-DRAFT) or NOSTOP. Its default value is TRANSYT. No action is taken for a CORSIM or VISSIM IMPORT since CORSIM and VISSIM only simulate and make no changes to decision variables.

**<File/AUTO>** is the name of the host program output file to import from, and can be any valid file name or the keyword AUTO. Its default value is AUTO.

**<Display Output>** is a keyword which describes if the IMPORTed data is to be displayed during the IMPORT process and can be either NO or YES. The default value is NO.

**<Import Scope>** is a keyword for a SYNCHRO Import which describes if the IMPORT should include just the optimized timings defined by the OPTIMIZE dialog, or an entire network defined by a SYNCHRO UTDF file set, and can be either TIMINGS or NETWORK. The default value is TIMINGS.

### *Notes*

- When a host program's results are saved in an output file after an EXPORT, this output file can be read by IMPORT and the CYCLE length and OFFSETs are set directly into the TEAPAC program for each intersection as if manually entered. If the OPTIMIZE command is set to SPLITS+OFFSETS when the IMPORT is performed, each intersection's GREENTIMES, YELLOWTIMES and REDCLEARTIMES are entered as well.

- If <File/AUTO> is entered as AUTO, then the automatic file name (TMPxxx.xxx) used by the automatic EXPORT option is used (see EXPORT). AUTO may not be abbreviated, nor may any file name used start with the four letters A-U-T-O.

- The default filename extension is .tof for TRANSYT, .p2o for PASSER2, .csv for SYNCHRO, .dgt for TRU-TRAFFIC and TS/PP-DRAFT and .log for NOSTOP.

- IMPORT should not be used for a cycle evaluation run of TRANSYT since final timings are not produced, except for a Genetic optimization in Release 9 and higher.

- TRANSYT's results can only be imported from Release 6 and higher versions of TRANSYT-7F. The release of the output file is determined and compared to the OUTPUT command to make sure the intended version is compatible with that used, otherwise a warning message is issued. Other warning conditions are also detected and displayed using codes which are defined in Appendix E.

- When Importing optimized results from TRANSYT, the mapping of real vs. temporary node numbers used is first read from the .tin data file which corresponds to the the .tof results file which is being imported. This means that when TEAPAC node numbers greater than 99 are being used, the .tin data file created by the TEAPAC Export must be present when performing a subsequent TEAPAC Import.

- The data files expected by IMPORT from SYNCHRO use the UTDF data file format supported by SYNCHRO. This can be a single- or multi-file organization containing the various pieces of the network exported. All of the files start with the name of the file specified by <File> above, with various necessary file name suffixes appended to complete the file naming, as necessary. For example, when AUTO is used for SYNCHRO Ver 7, the implied <File> entry is 'TMPSYN' and the single file name used will be TMPSYN.CSV. In Ver 6, the multiple file names used will be: TMPSYN_Layout.CSV, TMPSYN_Lanes.CSV, TMPSYN_Phasing.CSV and TMPSYN_Timing.CSV. For Version 5, the same multiple file names with the .DAT extension are used. These files should be written by the SYNCHRO program with the Transfer-DataAccess menu. In Ver 7, write the one CSV file with the 'Save Combined Data File' option. In Ver 6, use the Write button of each dialog. In order to avoid leaving prior data in files by these names, prior files should be deleted first. All UTDF files must be present, even when Importing only optimized Timings.

- If the SYNCHRO network being Imported contains diagonal legs, a MOVEMENTS.DAT file must be created which defines the movement labels used by SYNCHRO for the diagonal legs. See the discussion for error #EXP99 in Appendix E for details on how to create this file.

- Specifying a folder where an import file is located (either with the <Data File> specificaton or the Browse button in the dialog) does not adjust the folder location where future data file save activities will occur. The location of the last Import file is remembered for use as the default folder for the next Import action, and the default folder for the first Import action is the data folder which is current for the first Import action.

## INITIALQUEUE 12*<Initial Queue Size>

Defaults: 12*0
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter the number of vehicles queued at the intersection at the start of the analysis period for each of the twelve movements of the current intersection.

**<Initial Queue Size>** is the number of vehicles queued at the start of the analysis period due to unsatisfied demand in the previous analysis period, and can be any integer from 0 to 999. Its default value is 0.

### *Notes*

- If the initial queue is observed in the field, it should be the queue observed at the end of a green phase at the start of the analysis period. This observation will reflect unsatisfied demand. The queue should not be observed at the end of a red phase, since this would be a queue which also included the significant effects of cyclical queueing, not just unsatisfied demand. The observer should also take care that the observed queue is typical of other cycles at the end of green and near the start of the analysis period, and not unduly influenced by random fluctuations in demand.

- If a non-zero initial queue value is entered, TEAPAC's signal analysis will compute the additional $d_3$ delay term and adjust the $d_1$ term as appropriate according to the methods of the *Highway Capacity Manual*. The analyst should be aware that an analysis period with an initial queue value may generate more delay per vehicle than another analysis period which has higher volume but no initial queue. Thus, it may be appropriate to investigate any time periods which follow over-saturated periods (and thus have initial queue values) to see if the delay in these periods exceeds the over-saturated time period(s).

- If an initial queue cannot be observed where it is known (by observation or analysis) that a given time period is over-saturated, it is possible to estimate the initial queue for a given period by assessing the unsatisfied demand of a previous time period. This unsatisfied demand is displayed near the bottom of the Level of Service Worksheet, as well as the Initial Queue Delay Worksheet, and is labeled Final Queue. If this method of estimating the initial queue value is used, care should be exercised in recognition of the accumulated error which might exist each time an estimated Final Queue value is transferred to the next analysis period as an Initial Queue.

## INTERSECTION <Node Number> <Description>

| | | |
|---|---|---|
| Defaults: | 0 | -- |
| Menus/Groups: | [Parameters] [SignalAnalysis] [TrafficImpact] [CountAnalysis] [ExportImport] [Basic] [Intersection] | |

The purpose of this command is to select from the NODELIST the node number of the "current" intersection, and optionally enter an intersection description.

**<Node Number>** is a unique intersection number assigned to the intersection, and can be any positive integer from 0 to 9999, or a negative integer no larger than the length of the NODELIST. Its default value is 0, for all intersections selected.

**<Description>** is the information describing the intersection, and can be up to 30 alphanumeric characters. Its default value is all blanks.

### *Notes*

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- The node number entry made on the INTERSECTION command defines the "current" intersection for which subsequent intersection entry commands will apply to. The INTERSECTION command must be issued prior to any of these entry commands. The node number used must be a number already listed in the NODELIST.

- The convention which should be used for describing the intersection name is to place the North-South street name first, followed by the East-West name, both separated by an ampersand, "&". Use of this convention is expected by various element in TEAPAC, and is strongly suggested.

- If INTERSECTION 0 is specified, this selects all intersections in the NODELIST/SUBSYSTEM for many subsequent actions of the program, such as DESIGN, ANALYZE and COUNTTABULATE. In addition, if RESET is used, the commands which are RESET will be reset for all intersections. For example, INTERSECTION 0 followed by RESET VOLUMES will reset the VOLUMES to zero for all intersections in the NODELIST.

- In a Visual Mode dialog that includes INTERSECTION or intersection data, the "+" button, "-" button, ^Page-Up key and ^Page-Down key can be used to, in effect, dynamically issue an INTERSECTION command for the next and previous intersection in the NODELIST. If data values are changed on a screen display, the ^Page keys should not be used before the data is first entered with the TAB key.

- Other commands (e.g., HCSEXPORT) assume certain conventions for describing intersections. For example, this should be the north-south street name first, separated from the east-west street name by an ampersand, "&".

- If a negative <Node Number> entry is made, this selects the current node by its position in the NODELIST. For example, if an entry of -3 is made, this selects the third node of the NODELIST as the current intersection. This can be used to great advantage in a control file by using the value of a REPEAT loop as the intersection selection pointer.

| **IODEVICES** | **<Visual View>** | **<Page #>** | **<Lines/Pg>** | **<Last Line #>** |
|---|---|---|---|---|
| Defaults: | NORMAL | 0 | 66 | 63 |
| Menus/Groups: | [Control] | | | |

The purpose of this command is to set the visual view style for dialogs, as well as the page number and the size of the output medium (i.e., paper).

**<Visual View>** is a keyword representing view of the Visual Mode which will be used, and can be either keyword described below.

| | |
|---|---|
| NORMAL | the normal view of the Visual Mode (default). |
| TABULAR | the tabular view of the Visual Mode. |

**<Page #>** is the number of the next page to be printed, and can be zero, -1, or any positive integer up to 32767. Its default value is 0 - do not display page number on output.

**<Lines/Pg>** is the number of printable lines on each page of output, and can be zero, or any positive integer up to 32767. Its default value is 66, the typical size of printed output on 8-1/2 x 11 paper at 6 lines per inch.

**<Last Line #>** is the number of lines, counting from the top of the page, which are to be used for printing, and can be zero, or any positive integer less-than or equal to <Lines/Pg>. Its default value is 63, which normally allows a half-inch margin at the bottom of a 66-line page.

### *Notes*

- Printers normally print 6 lines per inch, thus an 11-inch page is 66 lines and an 8 1/2-inch page is 51 lines. Normally <Last Line #> is 3 less than <Lines/Pg> to allow a 1/2-inch margin.

- Every time a <Line/Pg> entry is made, <Last Line #> is re-calculated as 3 lines less than <Lines/Pg>. This usually provides a 1/2" margin at the bottom of each page of output. As a result, unless a different bottom margin is desired, <Last Line #> need not be entered.

- Use of <Lines/Pg> and <Last Line #> are primarily for the purposes of batch operations or any commands which generate multiple pages of output.

- If the <Page #> entry is greater than zero, this number will used to label the page number of the next printed page of output. Every time this occurs, the <Page #> is incremented so that the next printed page will be automatically numbered with the page number. If <Page #> is zero, no page number will be displayed on the printed output. If <Page #> is -1, the date and time will also be omitted from the output.

**LANES** **12*<Number of Lanes>**

Defaults: 12*0

Menus/Groups: [Parameters] [SignalAnalysis] [TrafficImpact] [ExportImport] [Basic] [Movement]

The purpose of this command is to enter the number of lanes which are assigned for use by each of the twelve movements of the current intersection.

**<Number of Lanes>** is the number of lanes which are allocated for use by each movement, and can be any integer from 0 to 10. Its default value is 0.

### *Notes*

- Values for this command are automatically generated each time a new lane width is given on a WIDTHS command. The number of lanes generated is defined by the tens digit of the approach width (in feet). Approach widths of less than ten feet and greater than zero are assumed to have one lane. Thus, usage of the LANES command is necessary only for those lanes where this assumption of number of lanes is not appropriate.

- Turning movements which turn from both exclusive turn lanes and shared through lanes should make use of the GROUPTYPES entry to define this condition which TEAPAC calls dual optional lane usage.

## LASTDETECTS 12*<Last Detection>

Defaults: 12*5.0
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter the position of last detection for each movement of the current intersection.

**<Last Detection>** is the distance, in feet, upstream of the stop bar where the last detection for a movement is made, and can be any number from 0.0 to 250.0. Its default value is 5.0.

### *Notes*

## LEADLAGS 2*<Lead-Lag Phasing>

Defaults: 2*NONE
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Phasing]

The purpose of this command is to enter the order of the phases, particularly in multiphase operation, of the current intersection.

**<Lead-Lag Phasing>** is a keyword which, in multi-phase operation, specifies whether the exclusive phase(s) (usually turning phase) precede(s) or follow(s) the through phase, and can be any of the following:

| | |
|---|---|
| NONE | no exclusive turn phase(s) exist, or if they do, they will LEAD (default). |
| LEAD | exclusive turn phase(s) precede(s) the through phase. |
| LAG | exclusive turn phase(s) follow(s) the through phase. |

### *Notes*

- The first <Lead-Lag Phasing> is used for the north-south movements, the second for east-west movements.

- In split phase or lead-lag operation (SEQUENCE codes 7 and 8) NONE or LEAD indicates the north (east) movement precedes the south (west) movement. LAG indicates the south (west) precedes the north (east).

| **LEVELOFSERVICE** | **<Target Delay/LOS>**<br>**<Target v/c>** | **<Max Delay/LOS>**<br>**<Max v/c>** | **<Delay Incr>**<br>**<v/c Incr>** |
|---|---|---|---|
| Defaults: | 35:C | 80:E | 5 |
| | 90 | 100 | 5 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [Intersection] | | |

The purpose of this command is to enter the range of delay (or level of service) and v/c which should be tested by a DESIGN optimization and GOVERCS for the current intersection.

**<Target Delay/LOS>** is the desired or target delay (or level of service) of operation of the critical movements, and can be any integer delay from 0 to 300 seconds, or a level of service grade A, B, C, D, or E. Its default value is 35 seconds of delay (LOS C).

**<Max Delay/LOS>** is the worst amount of delay (or level of service) to be considered before a v/c optimization is attempted, and can be any integer delay from 0 to 300 seconds, or a level of service grade A, B, C, D, or E. Its default value is 80 seconds of delay (LOS E).

**<Delay Incr>** is the increment of delay which should be used to reach the <Max Delay/LOS> if the <Target Delay/LOS> cannot be achieved by a DESIGN, and can be any integer delay from 1 to 100 seconds. Its default value is 5 seconds.

**<Target v/c>** is the desired or target v/c of operation of the critical movements, and can be any integer v/c from 0 to 300 percent. Its default value is 90 percent (v/c = 0.90).

**<Max v/c>** is the worst amount of v/c to be considered before an optimization is abandoned and a solution is forced, and can be any integer v/c from 0 to 300 percent. Its default value is 100 percent (v/c = 1.00).

**<v/c Incr>** is the increment of v/c which should be used to reach the <Max v/c> if the <Target v/c> cannot be achieved by a DESIGN. Its default value is 5 percent.

### *Notes*

- For DESIGN, the <Target Delay/LOS> entry of the LEVELOFSERVICE command sets the target delay (or level of service) which is to be achieved for all critical movements of the intersection. If this target level is achieved with excess time still available at the intersection, then the excess time is assigned to the phases according to the entries on the EXCESS command. If no EXCESS entries have been made, time is allocated proportionally to all phases. However, if EXCESS is used, this provides a means to designate a worst-case delay/LOS performance level for all critical movements and to assign all additional time to the priority movements of the EXCESS command. This is the preferred optimization scheme for the DESIGN function of TEAPAC's signal analysis (see Appendix C for more details).

- The <Max Delay/LOS> must be a worse level or the same level as the <Target Delay/LOS>.

- If <Target Delay/LOS> is set to zero, any attempt to balance delays among the critical movements is skipped and the optimization starts with an attempt to meet the <Target v/c> value for all critical movements.

## LINKLIST 200*< <Node Number> <Direction> >

Defaults: <all possible links>
Menus/Groups: none

The purpose of this command is to enter the simulation order for each link in the network, primarily for earlier versions of TRANSYT.

**<Node Number>** is the number assigned to each intersection as identified on the NODELIST command, and can be any integer from 0 to 327. Its default value is 0, it must be specified.

**<Direction>** is the direction from which the traffic is approaching the node, and can be the keyword NORTH, EAST, SOUTH or WEST. It has no default value, and must be entered.

### *Notes*

- The use of the LINKLIST is not required except a) when a version of TRANSYT earlier than version 7 is used, in which case a LINKLIST is required by TRANSYT, or b) if a special list of links to be included in a simulation/optimization is desired. In normal applications of current version of TRANSYT, the LINKLIST is not needed or used. The links to be simulated/optimized in this case is every possible link TEAPAC generates.

- In earlier versions of TRANSYT (prior to version 7), before a link can be simulated, all links that directly feed into it must either be simulated, assumed to be uniform random arrivals, or identified as a dummy link. When dummy links are required, they are indicated by using negative node numbers in the LINKLIST.

- If only offsets will be optimized with TRANSYT, the LINKLIST command may be used to define only internal links between intersections. In this case, TEAPAC will create any necessary external links which feed the internal links, thus minimizing the total number of links simulated, and thus reducing the optimization time.

## LOAD <Line Number> <File Number> <LOAD Type> <# Blocks>

| | | | | |
|---|---|---|---|---|
| Defaults: | next | next | PROCESS | - |
| Menus/Groups: | [DataFiles] | | | |

The purpose of this command is to input commands and parameters from permanent storage locations specified by the FILES command.

**<Line Number>** is the first line number in the specified file from which commands will be obtained, and can be any valid line number of the file less than or equal to 32767 (positive, negative or zero). Its default value is the "next line" of the file.

**<File Number>** is the order number of the desired file on the FILES command, and can be any integer from 1 to 5. Its default value is the "next file" in the file list.

**<LOAD Type>** is a keyword describing whether all commands from the file should be processed, or if some or all commands should be ignored, and can be any keyword described below.

| | |
|---|---|
| PROCESS | process all commands (default). |
| SHARE | ignore unrecognized commands, e.g., share a data file from another program. |
| IGNORE | ignore all commands in the file up to the next RETURN, e.g., skip a data block. |

**<# Blocks>** is the number of data blocks in the file which should be SHAREd or IGNOREd, and can be any positive integer from 1 to 999. Its default value is 1.

### *Notes*

- Upon initiation of a LOAD command, commands will be obtained from the specified file starting at the specified line number and continuing with successive line numbers until a RETURN command is encountered. SAVE automatically places a RETURN command at the end of SAVEd information for future LOADs.

- The "next line" default is defined as the line number following the line of the file which was last accessed. This is usually the line number which follows the last information LOADed. When a FILES command is given, the "next line" for the specified file is automatically set equal to one. The "next line" can be changed by use of the NEXTLINES command.

- The "next file" default is defined as the file whose number is one greater than the file number currently in use. The keyboard should be considered file 0 for this purpose. Thus, the default file number for a LOAD from the keyboard is file #1. If a LOAD command is encountered in file #1, its "next file" default is file #2, etc.

- If <Line Number> is entered as 0, the LOAD will start at the "last line". The "last line" is defined as the last point in the file where file access was previously initiated. For example, LOAD 10 followed later by LOAD 0 will re-execute the LOAD 10, effectively a re-LOAD. LOAD 10 followed later by SAVE 0 will re-SAVE the LOADed parameters (see the detailed discussion of this subject in Chapter 7).

- A negative <Line Number> of -n will start the LOAD at a point in the designated file n lines before the default "next line" of the file - i.e., LOAD -5 will start the LOAD five lines prior to the current "next line" of the file.

- The SHARE/IGNORE option is only in effect during the LOAD where the option was used (do not use embedded LOADs with the SHARE option). Use of the SHARE option not only ignores commands which it does not recognize, but also ignores any RESET commands encountered during the current LOAD. It is used to share files created by earlier TEAPAC programs. IGNORE ignores all commands in the file up to the next RETURN command.

- SHARE is automatic when the program detects a data file from a different TEAPAC program, or is unable to determine the source of the data file.

- The <# Blocks> indicates how many successive LOADs should be done, using the current SHARE or IGNORE option, as a result of the single LOAD command that was issued. This option does not apply to the PROCESS keyword.

## MAP --

| | |
|---|---|
| Defaults: | -- |
| Menus/Groups: | [Results] for Signal Analysis |

The purpose of this command is to display a schematic intersection diagram of the intersection identifying the twelve turning movement volumes as well as widths and lanes for the current intersection or all intersections. It has no parameters.

### *Notes*

- The schematic display also includes the phasing and related parameters defined for the intersection.

## MASTERNODE <Master Node #>

Defaults: 0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [System]

The purpose of this command is to enter the node number of the intersection which is the master node location for the system or subsystem.

**<Master Node #>** is the node number of the intersection which acts as the master location for the system, and can be any valid node number from 0 to 9999. Its default value is 0, no master node defined.

### *Notes*

- The system cycle length for coordinated systems will be equal to <Minimum Cycle> for the intersection referenced by MASTERNODE. If MASTERNODE is 0, <Minimum Cycle> for the first node in the NODELIST will be used as the system cycle.

- The node number entered need not be the actual location of the master controller. This entry simply indicates that the offset which is entered for the master intersection will not be changed by TRANSYT, PASSER or NOSTOP during the exported optimization process.

- If the node number given is not included in the current NODELIST/SUBSYSTEM, the master node input for TRANSYT or PASSER will be omitted to prevent an error in the TRANSYT and PASSER runs.

## MESSAGES <Level of Messages>

Defaults: 3
Menus/Groups: [Info]

The purpose of this command is to display messages concerning changes made to the program since the last printing of the tutorial/reference manual.

**<Level of Messages>** is the level of detail desired for the update messages, and can be any integer from 0 to 3, as described below.

- 0 display only the current version/level of the program.
- 1 display a summary of changes made in the last revision of the program.
- 2 display detailed discussions of each change made in the last revision of the program.
- 3 display detailed discussions of all recent revisions to the program (default).

### *Notes*

- The Help-RecentChanges menu uses message level 3 by default. The Manual Mode must be used for any of the other options.

- Messages concerning changes, bugs, fixes, etc., in the program will be displayed. For option 3, the version/level number and date of each revision of the program will be displayed at the start of each message listing. For this option, different version/levels of the program are listed in reverse chronological order, with the most current version first.

- All messages for versions of the program after the version shown on the title page of the tutorial/reference manual should be printed and inserted in Appendix H of the manual as addenda to the manual. These changes will not be referenced anywhere in that release of the manual.

## METROAREA <Location>

| | |
|---|---|
| Defaults: | NON-CBD |
| Menus/Groups: | [Parameters] [SignalAnalysis] [Basic] [Intersection] |

The purpose of this command is to enter the location of the intersection within the metropolitan area of the current intersection.

**<Location>** is a keyword describing the location of the intersection within the metropolitan area, and can be any of the following:

| | |
|---|---|
| CBD | central business district. |
| NON-CBD | any area other than CBD (default). |

### *Notes*

- Entry of any keyword other than CBD will generate a NON-CBD entry, since this is the only area location distinction made by the *Highway Capacity Manual* computations. The other keywords are allowed for compatibility with previous versions of TEAPAC (SIGNAL2000, SIGNAL97, SIGNAL94, SIGNAL85 and SIGNAL). Only the CBD and NON-CBD keywords are SAVEd in a data file.

## MINIMUMS 12*<Minimum Green Time>

Defaults: 12*5.0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Basic] [Movement]

The purpose of this command is to enter the minimum green time requirements for each of the twelve movements of the current intersection.

**<Minimum Green Time>** is the number of seconds which, as a minimum, must be received by the movement in order to satisfy requirements of safety and driver reaction, and can be any number from 0 to 99.9. Its default value is 5.0.

### *Notes*

- This command is useful in establishing operational minimums for vehicular safety. Pedestrian crossing times should be defined with a combination of the PEDWALKS and PEDFDWS entries.

- Yellow and all-red clearance times should not be included in the <Minimum Green Time> entries.

- Use of MINIMUMS is only important for an export if the host program will be allowed to optimize the split times at each intersection. This includes a CYCLE+SPLIT+OFFSET optimization. In this case, MINIMUMS must be entered very carefully to control the limits to which the host will be allowed to go when optimizing the splits. See notes below.

- The minimums which are used by PASSER must include change and clearance time. In TEAPAC, the MINIMUMS only apply to green periods. Thus, since clearance times in PASSER are defined by the input lost times, the minimums created by an EXPORT for PASSER are the sum of a given MINIMUM and the change & clearance time values.

- Since TRANSYT uses a limited facility for controlling phase minimums in its optimization, TEAPAC is necessarily limited in the same fashion when exporting to TRANSYT. The difficulty is that TRANSYT applies minimums for individual defined phases, whereas traffic signals and timing policies apply these minimums for individual movements or phase modules. This creates a conflict between the two methods when movements occur in more than one phase, resulting in what one might call a phase overlap. In this case, the minimum desired is actually for more than one phase, but TRANSYT only allows it to be defined for individual phases. In complex, multi-phase (eight-phase) controllers or when unusual movements such as right turns control the timings, this can lead to notorious problems.

- The method used by TEAPAC to address the difficulty described above is simple and straightforward. When phases other than the major through phase exist, they exist primarily to serve one or two special movements, usually left turns. In these cases, the minimum applied to that phase is the largest minimum for only those special movements. Other movements which exist in that phase are ignored. Conversely, the minimum for the main through phase is the largest minimum for the movements in that phases, excluding any special movements which were accommodated with minimums in other phases. The minimum for the middle overlap phases of sequences 5 and 6 is always set for the yellow time plus one second. Right turn block overlaps are ignored, as if they existed only in their primary through phase. As one can tell, the inherently bad method of constraining split optimizations in TRANSYT should cause people to be wary of using TRANSYT for this purpose. Setting the splits with a TEAPAC optimization and optimizing offsets-only with TRANSYT may be preferred.

## MOVLABELS 12*<Movement Label>

Defaults: 4*(RT TH LT)
Menus/Groups: [Parameters] [SignalAnalysis] [TrafficImpact] [CountAnalysis] [Basic] [Movement]

The purpose of this command is to enter abbreviated labels for each movement of the current intersection.

**<Movement Label>** is a two-character abbreviation used to identify each of the twelve movements at the intersection, and can be any pair of printable characters. Its default value is RT, TH, LT, for the right turns, throughs, and left turns of each approach, respectively.

### *Notes*

- Use of MOVLABELS does not change the order of entry -- this order is always clockwise starting with the north approach. MOVLABELS merely allows each movement to be labeled with the user's choice of characters.

## NEMAPHASES 12*<NEMA Phase Designation>

Defaults: 12*0
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter the NEMA phase number designation for each movement of the current intersection.

**<NEMA Phase Designation>** is the NEMA phase number which is used to control the specific movement and which will be displayed in the phasing diagrams for both input dialogs and output reports, and can be any number from 0 to 8. Its default value is 0, no display of NEMA phase numbers.

### *Notes*

- The <NEMA Phase Designation> should be for the NEMA controller phase number which would control a protected phase for the designated movement, if such a protected phase existed. Making such an entry for a movement (for example, left turns in particular) does not define a protected phase for the movement (this is done with the SEQUENCES entry), and will only be displayed if the phasing being displayed provides a protected phase for the specific movement. This allows the NEMAPHASES entry to be entered for a standard NEMA numbering scheme which is independent of the specific phasing being used, and one which will adjust as needed to the actual phasing displayed after the phasing has been optimized.

**NETWORK** **<Direction> <Distance> <Speed> <Node #> 4*<Movement #> <Assignment Method> <Curvature> <Manual Distance>**

| | | | | | |
|---|---|---|---|---|---|
| Defaults: | -- | 0 | 0 | 0 | 4*0 |
| | Default | | None | | |
| Menus/Groups: | [Parameters] [SignalAnalysis] [TrafficImpact] [ExportImport] [Basic] [Intersection] | | | | |

The purpose of this command is to enter the current intersection's relative location in the system network, including spatial and speed parameters.

**<Direction>** is the approach to the intersection for which the following data applies, and can be NORTH, EAST, SOUTH, or WEST. There is no default value for this parameter, it must be entered.

**<Distance>** is the distance, in feet, from the closest upstream node for the approach specified, and can be any number from 0 to 32000. Its default value is 0.

**<Speed>** is the travel speed, in miles per hour, approaching the node for the approach specified, and can be any number from 0 to 65. Its default value is 0 (see HCM2016 note below).

**<Node #>** is the upstream node number for the approach specified, and can be any node number defined in the system and usually, but not necessarily, in the specified node list, from 0 to 9999. Its default value is 0.

**<Movement #>** is the movement number at the specified upstream node which provides traffic flow to the subject intersection, and can be 0 or 1-12. Its default value is 0 (see discussion below).

**<Assignment Method>** is the method to be used to assign upstream volumes to downstream links, and can be DEFAULT, FULL or LIMITED. Its default value is DEFAULT.

**<Curvature>** is curvature of the link from the perspective of the driver approaching the intersection, and can be NONE, RIGHT or LEFT. Its default value is NONE.

**<Manual Distance>** is a flag which identifies if the upstream distance above has been entered manually and is intentionally inconsistent with the network scale, and can be NO or YES. Its default value is NO.

### *Notes*

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- If approach speeds are included, EVALUATE will calculate approximate fuel consumption and CO emissions for acceleration, deceleration and idle conditions. Further, if distances are included, fuel and CO are calculated for link travel as well. When approach speeds are not entered, the HCM2016 methodology will use a speed of 35 mph instead of 0 mph to estimate such elements of the analysis like the maximum allowable headway.

- If no <Movement #> is entered, movement numbers are calculated when needed assuming a rectangular network relationship. That is, if no <Movement #> is entered for the north approach, the movement numbers of the upstream node which are assumed to feed the downstream node are 2, 6 and 10.

- Default <Assignment Method> means to use the default upstream-downstream assignment method defined on the SIMULATION entry (the default method is Full). Full means that all upstream volumes are distributed to downstream links in full proportion to the downstream link volumes, without limitation. Limited means that upstream turns can only appear downstream on through movements (equivalently, downstream turns can only come from upstream through movements). Historically Full has been the method used by TEAPAC and suggested by original TRANSYT manuals. Limited might be more appropriate for specific situations such as diamond interchanges where high proportions of upstream turns are unlikely to go to downstream turns which also have high proportions. Where either or both upstream and downstream turn proportions are relatively low, the importance of this entry value is diminished. The current TRANSYT-7F manual suggests usage of the Limited option. This option is only observed by Exports to TRANSYT and CORSIM.

- None for <Curvature> means that the link has no curvature, Right means that traffic approaching the intersection travel on a curve to the right (clockwise in plan view), and Left means that traffic approaching the intersection travel on a curve to the left (counter-clockwise in plan view). If curvature is defined, CORSIM will determine the radius of the curve based on the coordinates of the link endpoints and the given length of the link on the NETWORK entry.

- If <Manual Distance> is set to YES, the upstream distance for this link will be excluded from the calculation of the average network scale factor, as well as any checks for consistency between the link's apparent scale factor (based on its endpoint coordinates) and the rest of the network. A value of NO is recommended, but if an upstream distance is intentionally inconsistent with the coordinate values and real network scale factor, YES should be used to prevent that condition from improperly affecting the calculation of the average network scale factor and related contingency checks for network connections which are made.

## NEWPAGE <Page Advance Option>

Defaults: YES
Menus/Groups: [Control]

The purpose of this command is to enter a flag indicating that the next output report should begin with title headings at the top of the next page.

**<Page Advance Option>** is a keyword identifying whether or not the next report should be forced onto the next page of output even if it will fit on the remaining portion of the current page, and can be either of the keywords described below.

| | |
|---|---|
| NO | do not force a new page with the next report. |
| YES | advance to a new page with the next report output (default). |

### *Notes*

- If the page length is set to zero with IODEVICES, titles will be printed at the current page location without a page advance (continuous printing). Use of NEWPAGE is primarily oriented towards the batch mode, using control files.
- In the batch mode, if a report is too large to fit on the remaining portion of the designated report length on the current page (as designated on the IODEVICES command), it will be placed on a new page regardless of the condition specified by the NEWPAGE command.
- If the first command to reset on the RESET command is [Parameters], a NEWPAGE YES command is automatically invoked. Thus, any report produced following a RESET command will be forced to the top of the next page. This feature can be defeated by use of a NEWPAGE NO following the RESET command.

## NEXTLINES 5*<Next Line of File>

Defaults: 5*next
Menus/Groups: [DataFiles]

The purpose of this command is to enter the default next line to be accessed in each of the five files.

**<Next Line of File>** is the line number of the default next line to be accessed in the file, and can be zero or any positive number less than or equal to the last line of the file and less than or equal to 32767. Its default value is the line number after the last line accessed for each file.

### *Notes*

- The "next line" of a file is automatically set each time a RETURN command is encountered in a file. In this case, the "next line" of that file is set to the line number of the line which follows the RETURN command.

- The "next line" of a file is automatically set to 1 each time a file is opened with the FILES command.

- This command is particularly useful to initialize repeated execution of sets of commands which use the default value of <Line Number> for the LOAD command.

## NODELIST 500*<Node Number>

Defaults: -
Menus/Groups: [Parameters] [SignalAnalysis] [TrafficImpact] [CountAnalysis] [ExportImport] [Basic] [System]

The purpose of this command is to enter the list of nodes to be studied, as well as the order of the analysis.

**<Node Number>** is a unique number assigned to each intersection on the INTERSECTION command, and can be any integer from 0 to 9999. Its default value is 0, and thus must be entered.

### *Notes*

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- The order that the nodes are specified in the NODELIST is the order they are analyzed when INTERSECTION 0 is selected for all intersections.

- The order that the nodes are specified in the NODELIST is the order they are optimized during the hillclimb process.

- In Usage Level 1 versions of the program the NODELIST can only be 12 nodes in length. In Usage Level 2 versions, the NODELIST can be as many as 100 nodes in length, and in Usage Level 3 versions, the NODELIST can be as many as 500 nodes in length.

- When in the Visual Mode or using the ASK command to enter the NODELIST, the actual list can be entered only once. After this entry, the list must be modified one intersection at a time with the edit buttons of the NODELIST dialog. When entering the NODELIST this first time, type no more than 80 characters per entry, using ampersands (&) to continue long entries to subsequent entry lines.

## NODELOCATION <X-Y Coordinates>

Defaults: 0, 0
Menus/Groups: [Parameters] [SignalAnalysis] [TrafficImpact] [ExportImport] [Basic] [Intersection]

The purpose of this command is to enter the X and Y coordinates of the current intersection.

**<X-Y Coordinates>** is the X and Y coordinates of the intersection, and can be any common coordinate system value, as integers from -2,147,483,647 to 2,147,483,647. Its default value is 0, 0.

### *Notes*

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- This input has no effect on any calculations, but appears to permit the display of the network diagram on-screen and for export to other graphic display programs like CORSIM, VISSIM and SYNCHRO.

## NOTE <Third Title Line>

Defaults: 80 blanks
Menus/Groups: [Titles]

The purpose of this command is to enter the third line of information used to identify the situation being analyzed.

**<Third Title Line>** is the third of three lines of information, generally used to note further conditions identifying the situation being analyzed, displayed at the top of every output report., and can be up to 80 characters of information. Its default value is 80 blanks.

### *Notes*

- If the first character of the NOTE parameter is a plus sign, "+", the characters entered on this command will be overlaid over those of the previously entered NOTE command. This overlay will begin at the character position identified by the digits of the first two characters which follow the "+", and will end after the last non-blank character which is entered. See Chapter 7 for further explanation and examples of this feature.

- Entries on this command may be enclosed in 'single quotes' or "double quotes". This option provides the capability to include leading blanks in the entry, which is otherwise not possible. This option can also be used to enter a single blank as the title line using a ' ' or " " entry, thereby blanking out the entire prior contents of the title line.

- The name of the current open file can be inserted anywhere in the title line by placing %F at the desired location of the title line. The file name can be placed at a specific column location in a title line by using the +XX form of a title entry noted above.

## NSTOPFACTORS 12*<Stops Adjustment Factor>

Defaults: 12*1.00
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter twelve factors for the current intersection used to adjust the number of stops calculations of the EVALUATE report, for example, to match the number of stops obtained from a network simulation model.

**<Stops Adjustment Factor>** is the factor to adjust number of stops calculated for each movement, and can be any number from 0.01 to 9.99. Its default value is 1.00, no adjustment.

### *Notes*

- If number of stops have been simulated with a network model such as TRANSYT-7F or NETSIM/CORSIM which does a better job of modeling flow between coordinated signals than the *Highway Capacity Manual* allows, NSTOPFACTORS may be used to force the calculations of number of stops in EVALUATE to the same values. For example, if EVALUATE calculates 20 stops for a movement, but TRANSYT-7F estimates 16 stops, use an NSTOPFACTORS of 0.80 for that movement.

## OFFSET <Offset> <Phase Number>

| | | |
|---|---|---|
| Defaults: | 0.00 | 0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Phasing] | |

The purpose of this command is to enter the coordinated offset for a phase of the phase sequence of the current intersection.

**<Offset>** is the coordinated offset in seconds or seconds/second, and can be zero, or any positive number less than or equal to 900. Its default value is 0.00.

**<Phase Number>** is the phase for which the offset is specified, and can be 0-6. Its default value is 0, indicating an un-coordinated signal. An entry greater than 0 indicates a coordinated signal.

### *Notes*

- An offset greater than or equal to 1.0 is assumed to be in seconds; less than 1.0 is assumed to be in seconds/second.
- If a signal is to be double-cycled the OFFSET must be entered in seconds (not sec/sec).
- The offset is included in the capacity analysis summary and performance evaluation reports of ANALYZE and EVALUATE, respectively, as well as for TIMINGPLAN, in order to provide a complete record of all timings at an intersection. The offsets are calculated for all phases with the data provided by OFFSET.
- A <Phase Number> of 0 (zero) indicates that a signal is un-coordinated, and this will adjust the way that phase durations are estimated vs. a coordinated signal. Entry of 0 will also prevent the display of any offset information in the reports of ANALYZE and EVALUATE. For TIMINGPLAN, a <Phase Number> of 0 is interpreted as phase 1.

| **OPTIMIZE** | **<Optimization Type>** | **<Step Size List>** |
|---|---|---|
| Defaults: | NONE | 15*0 |
| Menus/Groups: | [Parameters] [ExportImport] | [System] |

The purpose of this command is to enter the type of system optimization to be performed by the third-party host program.

**<Optimization Type>** defines the values that are to be optimized by programs like TRANSYT or PASSER, and can be any of the following keywords:

| | |
|---|---|
| NONE | No optimization, only a simulation of input (default). |
| OFFSETS | Optimize offsets only. |
| SPLITS+OFFSETS | Optimizes splits and offsets. |
| CYCLE+SPL+OFF | Optimizes cycle, split and offset. |
| LIST | Allows user to specify the step sizes used in the TRANSYT hillclimb optimizing process. |

**<Step Size List>** defines up to 15 step sizes to be used by TRANSYT when the LIST option is selected above, or defines the DI, PI, PROS/DI, optimization type and multi-cycle options of card type 5x when LIST is not selected. It can be any valid step sizes or option values for the TRANSYT model, from -3 to 99. Its default value is 0 0 0 2 0 which assumes the LIST option is not selected.

### *Notes*

- If CYCLE optimization is selected, the CYCLES command must also specify a cycle range with more than one cycle.

- If the LIST option of OPTIMIZE is not used, then the first three step size values input are used to designate the 2nd, 3rd and 4th fields of the TRANSYT 5X card. These are, respectively, the definition of the disutility index (DI), the definition of the performance index (PI), and the relative weight of PROS for the PROS/DI performance index. The default values of 0 for these fields perform the normal minimization of delay and stops, but these entries can be used to conduct other optimizations, with the PROS model being the one of greatest interest.

- If the LIST option of OPTIMIZE is not used, then the fourth step size value input is used to designate the 8th field of the TRANSYT 5X card, the optimization algorithm -- 2 for Hillclimb, 1 for Genetic non-elitist, and 0 for Genetic elitist.

- If the LIST option of OPTIMIZE is not used, then the fifth step size value input is used to designate whether a single-cycle (0) or multi-cycle (1) simulation will be performed by TRANSYT, as defined by the X-value of the 5X card. If multi-cycle is selected, step-wise simulation will be forced.

- If LIST is used, then when a zero value is entered as a step size anywhere except the first field, this will zero out the remainder of the step size list.

| **OUTPUT** | **<Function>** | **<Additional OUTPUT Parameters>** |
|---|---|---|
| Defaults: | SIGNAL | -- |
| Menus/Groups: | [Parameters] [SignalAnalysis] [TrafficImpact] [CountAnalysis] [ExportImport] [Basic] [System] | |

The purpose of this command is to enter flags regarding output options for different specific functions of the program.

**<Function>** is the TEAPAC function for which the OUTPUT values are to be provided, and can be any valid TEAPAC program name. Its default value is SIGNAL.

## For <Function> = SIGNAL for Signal Analysis

The purpose of this command is to enter flags regarding whether or not to display ANALYZE/EVALUATE/QUEUECALCS worksheets, warning messages and additional DESIGN/EVALUATE information.

**<Worksheets>** is a keyword which identifies which, if any, HCM capacity analysis worksheets should be displayed, and can be any of the following:

| | |
|---|---|
| NONE | No HCM worksheet display (default). |
| INPUT | Display HCM Input worksheet only. |
| BASIC | Display only basic HCM worksheets. |
| FULL | Display all HCM worksheets (same as YES). |

**<Messages>** is a keyword which identifies whether or not messages such as excessive turning movement percentages in through lanes should be displayed, and can be any of the following:

| | |
|---|---|
| NO | No warning message output. |
| YES | Warning message output (default). |

**<Design/Evaluate>** is a keyword which identifies whether or not additional output regarding the operational design of each sequence or evaluation should be displayed, and can be any of the following:

| | |
|---|---|
| NONE | No additional DESIGN or EVALUATE output (default). |
| DETAIL | Detailed DESIGN output for each combination of cycle & sequence. |
| EXTRA | Additional DESIGN or EVALUATE output (not recommended). |

**<HCM Method>** is a keyword which identifies which Highway Capacity Manual (HCM) method to use, and can be any of the following:

| | |
|---|---|
| 2000 | 2000 Highway Capacity Manual. |
| 2016 | 2016 Highway Capacity Manual, $6^{th}$ Edition (default). |

### *Notes*

- Capacity Analysis Worksheets which match those of the 2000 and 2016 *Highway Capacity Manual* can be produced any time the ANALYZE, EVALUATE and QUEUECALCS commands are used. This option is selected with the <Worksheets> parameter.

- Certain warning messages can be suppressed with the NO option for the <Messages> flag. For example, each time turning movement percentages in through lanes are determined to exceed 50% of all volumes in that stream, a message to that effect is displayed.

- When requesting EXTRA output regarding the DESIGN of each phase sequence using the <Design/Evaluate> option, it is suggested that a minimal number of cycles be tested. This is due to the fact that a considerable amount of output is generated for each cycle length tested. The output generated from this selection is self-evident and not documented anywhere, and is not generally recommended.

## For <Function> = PRETRANSYT, PREPASSR or PRENETSIM for Export/Import

**<Version>** is the version of the third-party program to be used, and can be any of the following keywords shown. Its default value is shown in **bold**.

| | | |
|---|---|---|
| PRETRANSYT | 6. | TRANSYT-6 |
| | 7. | TRANSYT-7 |
| | 7M | TRANSYT-7M |
| | 7F2 | TRANSYT-7F Release 2 |
| | 7F3 | TRANSYT-7F Release 3 |
| | 7F4 | TRANSYT-7F Release 4 |
| | 7F5 | TRANSYT-7F Release 5 |
| | 7F6 | TRANSYT-7F Release 6 |
| | 7F7 | TRANSYT-7F Release 7 |
| | 7F8 | TRANSYT-7F Release 8 |
| | 7F9 | TRANSYT-7F Release 9 |
| | 7F10 | TRANSYT-7F Release 10 |
| | **7F11** | **TRANSYT-7F Release 11** |
| PREPASSR | 287 | PASSER-II 87 |
| | 290 | PASSER-II 90 |
| | **202** | **PASSER-II 02** |
| PRENETSIM | 4.2_NET | NETSIM Ver. 4.2, |
| | 5.0_NET | NETSIM Ver. 5.0, |
| | **CORSIM** | **CORSIM** |

**<Type>** is the different types of TRANSYT output desired, and it can be any of the following keywords:

| | |
|---|---|
| FINAL | Final output only. |
| SETTINGS | FINAL plus the signal settings (default). |
| INITIAL | SETTINGS plus the simulation of initial signal settings. |
| DATA/CYCLE | INITIAL plus input data and final timings for each cycle tested. |

**For <Function> = SITE for Traffic Impact Analysis**

**<Output Location>** is the physical location to which output is to be directed, and can be any keyword, as described below:

| | |
|---|---|
| WINDOW | the normal output window (default). |
| FILE | a designated disk file only. |
| BOTH | both the output window and the file. |
| NONE | no output is produced. |

**<Output File #>** is the relative file number of the disk file in the FILES command to which output is to be directed, and can be 0-5. Its default value is 0.

### *Notes*

- In all cases, the VOLADDITIONALS entries for each intersection in the NODELIST will be updated with the computed results, excluding the VOLUMES entries as factored according to the VOLFACTORS entries (see Appendix C), regardless of the OUTPUT instructions. Note that when computed results are ROUNDed, VOLADDITIONALS will absorb the effect of the rounding, including locations where no additional volumes were actually computed as a result of the site traffic generation scenario presented.

- If FILE or BOTH is selected, the relative file number must be input to designate which of the disk files in the FILES command will be used for output of the resultant volumes. The format of the information in the OUTPUT file is such that the volumes can be input by other third-party programs.

- If NONE is selected, all of the normal actions of the COMPUTEPATHS command proceed as normal, with the exception of any form of output, either window, printer or disk file. In order for the results to be observed, an additional COMPUTEPATHS with the CUMULATE 0 option and OUTPUT directed somewhere must be used. This is frequently done after a series of cumulations without output and/or to ROUND previously computed results to a desired accuracy.

**For <Function> = TURNS or WARRANTS for Count Analysis**

**<Output Option>** is a keyword which specifies where output from the PEAKANALYZE command will be directed, and can be any of the following:

| | |
|---|---|
| WINDOW | Output displayed in the normal output window (default). |
| FILE | Output written into a specified file only (see <File Number> below). |
| BOTH | Output displayed in the output window and written into specified file. |

**<File Number>** is the number of the file in the FILES command where file output is to be directed, and can be any number from 0 to 5. Its default value is 0 (no separate disk file output).

**<Truck Tabulation>** is a keyword which describes whether a separate tabulation of TRUCKCOUNTS is desired, and can be any of the following:

| | |
|---|---|
| NO | no separate truck count tables (default). |
| YES | display separate truck tables. |

**<Peak Minutes>** is the number of minutes which are to be included in the peak period when searching for a peak period with PEAKANALYZE. It can be any of the following:

| | |
|---|---|
| 15 | find highest 15-minute flow rate. |
| 60 | find highest 60-minute volume (default). |

**<# Peak Hour Factors>** is the number of peak hour factors (PHF) which are to be used to write to the PEAKHOURFACTORS entry and to export to the output file. It can any of the following:

| | |
|---|---|
| 0 | don't write/export any PHF values except for 15-minute flow rates (default). |
| 1 | calculate one PHF for the entire intersection and write/export this value for each movement. |
| 4 | calculate a PHF value for each of the four approaches of the intersection and write/export these values for each movement on those approaches. |
| 12 | calculate and export a PHF value for each movement of the intersection (see caution in Notes below). |

### *Notes*

- In all cases, the VOLUMES entries for each intersection PEAKANALYZEd will be updated with the computed results, with the effect of the VOLFACTORS entries removed (see Appendix C), regardless of the OUTPUT instructions. TRUCKPERCENTS will also be updated if TRUCKCOUNTS exist, regardless of the OUTPUT option selected (see note below). PEAKHOURFACTORS will also be updated according to the OUTPUT option selected (see note below).

- The first two OUTPUT options apply only in conjunction with a PEAKANALYZE command. When FILE or BOTH are selected the output file will receive a copy of the current DESCRIPTION and NOTE commands along with the computed VOLUMES, PEAKHOURFACTORS and TRUCKPERCENTS (if counted).

- The output to the file number indicated on the OUTPUT command will begin at the NEXTLINE of the designated file. This location can be modified by entering the proper line number on the NEXTLINES command. The NEXTLINE value is updated automatically each time a PEAKANALYZE output is written to the file, thus automatically stacking the PEAKANALYZE output in the destination file.

- When the truck tabulation option is selected as YES, the COUNTTABULATE command will produce an extra table of truck-only counts for the 15-Minute Counts report. This is also produced by the COUNTREPORTS 15MIN command.

- When PEAKANALYZE results are written/exported to a data file and 15-minute flow rates are selected, the 15-minute flow rate is written/exported along with a peak hour factor of 1.0, allowing continued analysis of the peak 15-minute period by other programs.

- When it is desired that the surveyed PHFs are to be exported, an entry of 1, 4 or 12 may be used to direct the program as to how to calculate the PHFs which are to be written/exported. A value of 1 will use the intersection's overall PHF value for each movement, while a value of 4 will use an approach's PHF value for each movement on that approach. Either of these is preferred to using a value of 12 which will calculate and export a separate PHF value for each movement. The most appropriate method is usually to select a value of 15 for <Peak Minutes> above and not write/export a calculated PHF value for any movement (PHF=1.0 for this case).

- In no case will a PHF less than 0.50 be written/exported. If a movement does not exist, a PHF value of 1.00 will be written/exported.

- If a truck percentage value of 100% is calculated, a value of 99% will be written/exported since this is the largest value allowed by TEAPAC.

## OVERLAPS 4*<Right Turn Overlap>

Defaults: 4*YES
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Phasing]

The purpose of this command is to enter how right turn overlaps are to be handled for each approach of the current intersection.

**<Right Turn Overlap>** is a keyword which describes whether right turns will be added to the standard phasings in overlap phases where exclusive right turn lanes exist, and can be any of the following:

| | |
|---|---|
| NO | don’t allow right turn overlap under any condition. |
| YES | allow right turn overlap into adjacent phases if an exclusive right turn lane exists (default). |

### *Notes*

- The default is YES for each right turn, meaning that if an exclusive right turn lane exists and the phasing would allow a non-conflicting overlap to be added as an extension of the normal right turn indication, it will be added. The extension will be to an adjacent phase only. The other option, NO, will prevent the addition of a right turn in an overlap phase, regardless of the turn lane or phasing conditions.

- Note that some controllers may allow a right turn overlap to be used in the field where the overlap phase is not adjacent to the normal right turn indication (through phase), but that the fundamental assumptions of the delay formulation in the 2000 *Highway Capacity Manual* do not permit the calculations of delays for movements with two distinct green indications each cycle (with the single exception of compound left turn phasing - see PERMISSIVES), so this is not allowed in TEAPAC.

## PARKINGSIDES 4*<Parking Location>

Defaults: 4*NONE
Menus/Groups: [Parameters] [SignalAnalysis] [Basic] [Approach]

The purpose of this command is to enter parking conditions on each approach of the current intersection.

**<Parking Location>** is a keyword which describes, from the driver's point of view, the parking conditions on the approach, and can be any of the following:

| | |
|---|---|
| NONE | - no parking (default). |
| LEFT | - parking on the left side. |
| RIGHT | - parking on the right side. |
| BOTH | - parking on both sides. |

### *Notes*

- PARKVOLUMES must be used in conjunction with PARKINGSIDES to define the number of parking maneuvers each hour. The default PARKVOLUMES is 20, but if PARKINGSIDES is NONE, PARKVOLUMES is ignored.

- Parking conditions only apply to the lane group to which they are adjacent.

## PARKVOLUMES 4*<Parking Volume>

Defaults: 4*20
Menus/Groups: [Parameters] [SignalAnalysis] [Basic] [Approach]

The purpose of this command is to enter the number of parking maneuvers per hour on each side of each approach of the current intersection.

**<Parking Volume>** is the number of parking maneuvers per hour, and can be any integer from 0 to 180. Its default value is 20.

### *Notes*

- PARKVOLUMES must be used in conjunction with PARKINGSIDES to define the number of parking maneuvers each hour. The number entered is for one side of the approach only. If parking exists on both sides of a 1-way approach, the average number of maneuvers on each side should be entered. If one lane group is adjacent to both sides of parking, the number entered will be doubled to calculate the parking adjustment factor.

- The default PARKVOLUMES is 20, but if PARKINGSIDES is NONE, PARKVOLUMES is ignored.

## PASSAGETIMES <Min Include Factor> 8*<Nema Extension Time>

Defaults: 0.0 8*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [Phasing]

The purpose of this command is to enter the vehicle extension time (passage time) for each Nema movement of the current intersection, as well as a factor to include extension time in minimums.

**<Min Include Factor>** is a factor which when multiplied by a given <Nema Extension Time> gives the amount of extension time which will be added to minimum times when optimizing splits. It can be any number from 0.0 to 3.0. Its default value is 0.0.

**<Nema Extension Time>** is the duration of the unit extension period (passage time) for each Nema movement in seconds, and can be any number from 0.0 to 30.0. Its default value is 0.0 seconds, which means to use the default extension of the HCM method which has been selected (3.0 for HCM 2000 and 2.0 for HCM 2016).

### *Notes*

- ACTUATIONS and PASSAGETIMES are used in conjunction with v/c to determine the Delay Calibration Term, according to Exhibit 16-13 of the 2000 *Highway Capacity Manual*.

- If a unit extension is entered for the ACTUATIONS, its value is moved to the corresponding position of the PASSAGETIMES entry and the ACTUATIONS entry is set to YES. Subsequently setting the ACTUATIONS entry to NO will disable the actuated status of the movement without changing the PASSAGETIMES entry so that it is easily set back to YES to re-enable the actuated status with the correct PASSAGETIMES entry.

- When <Min Include Factor> is 0.0, split optimization in TEAPAC, PASSER and TRANSYT will only be required to meet entered MINIMUMS values. If <Min Include Factor> is greater than 0.0, then this factor will be multiplied by the <Nema Extension Time> to determine how much additional time will be added to the MINIMUMS. A typical entry value of 1.0 would require that a green time equal to at least the MINIMUMS entry plus one extension is provided, a requirement imposed by some controllers. The ACTUATIONS entry must not be set to NO for any additional time to be added.

- The default value for a PASSAGETIMES entry has been changed from 3 to 0 to indicate the desire to use a default value as defined by the selected HCM method. For HCM 2000, this default is 3.0 seconds, while for HCM 2016 the default is 2.0 seconds. For data files which have already been created, if a self-selecting default value of 0 is desired, it will need to be entered manually since the prior default of 3.0 will be what is found in the file. It is recommended that a non-zero value be entered when the option to include a portion of passage time in the minimums is selected.

| **PATHASSIGNMENT** | **<Path #>** | **<Path %>** | **<Path List>** |
|---|---|---|---|
| Defaults: | 0 | 0 | 8*0 |
| Menus/Groups: | [Parameters] | [TrafficImpact] | |

The purpose of this command is to enter a path (list of intersections) which vehicles of the current distribution type follow when traveling to and from the development.

**<Path #>** is the path number which determines which of the five possible paths is to be defined for the current distribution type, and can be 1-5 - a selected path number. It has no default value; it must be entered.

**<Path %>** is the percentage of total trips generated for the current distribution type which is to be assigned to the following path, and can be 0 - 100 percent. Its default value is 0.

**<Path List>** is a list of intersection node numbers, separated by spaces, through which vehicles generated by the site for the current distribution type, in the order they occur in the path, and not to exceed 16 intersections in length. Each entry can be any valid intersection number (see note below). Its default value is 0; it must be entered.

### *Notes*

- The first and last node numbers of the <Path List> must agree with the external node number of the current PATHDISTRIBUTION type and one of the access points of the GENERATION command. If the distribution type is an inbound type, the first node number must be the external node of the current distribution type and the last node number must be an inbound access node. If the distribution type is outbound, the reverse applies.

- Bend nodes can be omitted from the path list of a PATHASSIGNMENT entry, thus permitting a significantly longer actual path to be included by the maximum path length of 16 nodes. In no case should external dummy nodes be included in the path list.

- Previously entered path lists on the PATHASSIGNMENT command can be deleted by entering a zero percentage for the list. This completely removes the list of intersections, which is readily apparent in the Visual Mode, and also ignores any list which may be entered following the zero percentage. This allows the removal of an unneeded list of intersections.

- If a previously entered PATHASSIGNMENT list must be shortened, the entry of node number 0 anywhere in the list will erase all nodes from that point to the end of the list. If the entire path is to be discarded, either replace it with a new path or use 0 percent so that the path is effectively ignored -- at this point an entire path cannot be eliminated from the PATHASSIGNMENT command.

- Intersection node numbers in <Path List> must match intersections previously established with the NODELIST command.

| **PATHDISTRIBUTION** | **<Distr Type #>**<br>**<Descr>** | **<Distr %>** | **<Node #>** | **<Node Dir>** |
|---|---|---|---|---|
| Defaults: | -<br>30-blanks | 0 | 0 | - |
| Menus/Groups: | [Parameters] [TrafficImpact] | | | |

The purpose of this command is to enter and set the current distribution type number, and enter its related distribution percentage, external node, and description.

**<Distr Type #>** is the number of the distribution type for which the following distribution information applies, and which will become the current distribution type #. It can be any integer from 0-150 (see note below). Its default value is 0; it must be entered.

**<Distr %>** is the percentage of total trips generated by the site which are distributed to this distribution type, and can be -100 to 100 percent. Its default value is 0; it must be entered.

**<Node #>** is the external node number through which all traffic for this distribution type enters or exits the study network, and can be 0-9999. Its default value is 0; it must be entered.

**<Node Dir>** is the approach of the external intersection which connects the study network to the external road network, and can be the keyword NORTH, EAST, SOUTH or WEST. It has no default value; it must be entered.

**<Descr>** is a set of words which describe what type of traffic is defined by this distribution type, usually including whether it is inbound or outbound traffic and which point of the compass or primary travel route the external point of the trips are destined, and can be any 30 alphabetic or numeric characters. Its default value is 30 blanks.

### *Notes*

- The PATHDISTRIBUTION command must first be used to define the "current" distribution type before the PATHASSIGNMENT command can be used to describe travel paths for the "current" distribution type.

- All PATHDISTRIBUTIONs must be defined before the FINDPATHS command can be used to assist in the definition of PATHASSIGNMENTs.

- <Distribution Type #> must not exceed the limit previously established by the SITESIZE command, and <Node #> must be an intersection included in the current NODELIST command.

- In a Visual Mode dialog that includes PATHDISTRIBUTION or distribution type data, the "+" button, "-" button, ^Page-Up key and ^Page-Down key can be used to, in effect, dynamically issue a PATHDISTRIBUTION command for the next and previous type numbers. If data values are changed on a screen display, the ^Page keys should not be used before the data is first entered with the TAB key.

| **PEAKANALYZE** | **<Start Time>** | **<End Time>** | **<Map Output>** |
|---|---|---|---|
| Defaults: | <AM, MID & PM Start and Stop Times> | | YES |
| Menus/Groups: | [Results] for Count Analysis | | |

The purpose of this command is to compute and display peak hour data for the intersection and each movement between specified times.

**<Start Time>** is the beginning time for the first interval of the analysis period on a 24 hour clock and can be any valid time between 0 - 2400 hours, or -1. Its default value is -1, which represents the designated start time for each of the AM, MID & PM periods as described below.

**<End Time>** is the beginning time for last interval of the analysis period on a 24 hour clock, and can be any valid time between 0 - 2400 hours, or -1. Its default value is -1, which represents the designated end time for each of the AM, MID & PM periods as described below.

**<Map Output>** is a keyword describing if a schematic diagram of the peak hour volumes should be produced with the tabulated analysis. It can be any of the following:

NO - no schematic diagram produced.
YES - schematic diagram will be produced (default).

### *Notes*

- In order to provide the PEAKANALYZE results to other TEAPAC applications, the VOLUMES entries for each intersection ANALYZEd will always be updated with the computed results, with the effect of the VOLFACTORS entries removed (see Appendix C). TRUCKPERCENTS will also be updated if TRUCKCOUNTS exist, and PEAKHOURFACTORS will be updated according to the OUTPUT option selected.

- The times given represent the start time of a 60-minute interval to be searched for a peak. For example, if counts made between the hours of 6:30 and 8:30 are to be searched in their entirety, the start time should be 630 for the hour starting at 6:30 and the end time should be 730 for the hour starting at 7:30 (and ending at 8:30).

- If a single 1-hour period is to be analyzed, such as getting the volumes for the 7:00 - 8:00 interval, the start and end times should be the same, 700 for the above example. This limits the peak hour search to the single hour starting at 7:00.

- If the default times of -1 are used for the PEAKANALYZE command, the program automatically computes peak hour data for three time periods: AM, MIDday, and PM. The AM period covers from 6:00 to 9:45 AM. The MIDday period covers from 10:00 to 12:45 PM. The PM period covers from 1:00 to 7:45 PM. If no count data exists during any of these periods, the entire report is skipped for that period.

- An option of the OUTPUT command permits the peak hour volumes found by PEAKANALYZE to be exported to an output file which can then be subsequently used by other traffic programs.

- Most traffic software requires that if a movement is allowed at an intersection, the movement volume must be entered with a number greater than 0. Conversely, when a value of 0 is entered, many programs assume that the movement does not exist and/or is not allowed. In some instances, however, an allowed/existing low-volume movement may actually be counted with zero activity during any specific 15- or 60-minute period. If this zero value is exported to other programs, an inaccurate impression may be given about the existence or allowance of that movement.

- To prevent the above problem from occurring, the export of the PEAKANALYZE command performs the following check. If a volume to be exported has a value of zero, the entire movement is first checked for any count activity before the zero is exported. If any activity exists for the movement at any time during the count, a volume of 1 will be exported rather than the 0 so that a non-zero value represents the allowable movement.

## PEAKHOURFACTORS 12*<Peak Hour Factor>

| | |
|---|---|
| Defaults: | 12*0.90 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [CountAnalysis] [ExportImport] [Basic] [Movement] |

The purpose of this command is to enter the peak hour factor for each movement of the current intersection.

**<Peak Hour Factor>** is the peak hour factor for the movement, and can be in the range of 0.50 - 1.00. Its default value is 0.90.

### *Notes*

- Peak hour factors are applied to the input demand volume to determine the "adjusted volume" for use in the saturation flow, v/c, and delay calculations. As such, caution should be used in arbitrarily applying peak hour factors much less than 0.90 since "adjusted volumes" substantially higher than the hourly volumes will be generated.

- Caution should be exercised in calculating peak hour factors from traffic counts, particularly on a movement-by-movement basis, since this calculation may not be statistically stable, especially for low volume movements. Further, use of movement-by-movement peak hour factors in the 2000 *Highway Capacity Manual* method suggests that all of the computed "adjusted volumes" occur at the same time, which is not likely the case. The 2016 *Highway Capacity Manual* method explicitly requires that the same peak hour factor be used by all movements to avoid this inappropriate analysis.

- Entered demand VOLUMES will always be adjusted by the entered PEAKHOURFACTORS as a means of estimating the peak flow rate during the analysis period. When the analysis period is the default of 15 minutes (0.25 hours, set on the SIMULATION command), this means that an entered volume divided by the peak hour factor will estimate the flow rate during the peak 15 minute analysis period for each movement. If 15-minute data is available directly (e.g., from count data), using this 15-minute data (the 15-minute count times 4) with peak hour factors of 1.00 is preferred over making the approximation using a peak hour factor. In particular, if different peak hour factor data is entered for each individual movement, the estimate will likely produce a fictitious set of analysis flow rates which may represent flow conditions which never occur since all the movements may not peak at the same time.

## PEAKSUMMARY <Start Time>

Defaults: 0
Menus/Groups: [Results] for Count Analysis

The purpose of this command is to display a schematic intersection diagram showing hourly volumes and distribution percentages.

**<Start Time>** is the beginning of the 1-hour time interval for which volumes are to be displayed. It can be any valid time from 0 - 2400. Its default value is 0.

### *Notes*

- The PEAKSUMMARY output is also included as an optional output of the PEAKANALYZE command, so that peak hour volumes which are found can be displayed in graphical form, as well as the normal tabular form.

## PEDFDWS 4*<Ped Clearance (FDW) Time>

Defaults: 4*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the required pedestrian clearance time (FDW, flash don't walk) for each approach of the current intersection.

**<Ped Clearance (FDW) Time>** is amount of time, in seconds, that the Flashing DON'T WALK signal should be displayed, and can be any number from 0.0 to 99.9. Its default value is 0.0.

### *Notes*

- PEDWALKS entries, in combination with PEDFDWS entries, will be used as minimum time constraints for optimization of phases which handle the through movement running parallel with and adjacent to the pedestrian crossing. For example, pedestrians crossing the east leg of the intersection cross the intersection with through movement vehicles on the south approach, so the pedestrian timing value for that pedestrian movement should be input for the south approach and will constrain the timing provided for the south through movement.

- PEDWALKS and PEDFDWS timing entries will be factored by the <PedMin Factor> entry which is made as part of the the PEDWALKS entry. By setting this factor to 0.0, pedestrian timing requirements will be ignored without actually removing the timing entries which have been made. Setting the factor back to 1.0 re-enables the complete pedestrian timing requirements. <PedMin Factor> can also be set to other values to test the sensitivity of the signal's vehicular performance to varying degrees of pedestrian timing constraints. This factor may also be useful for properly representing pedestrian timing contraints on actuated performance defined by the ACTUATIONS entry.

- If an exclusive pedestrian phase is defined with the PEDTIME entry, PEDWALKS and PEDFDWS should be set to zero since there should be no pedestrian movement with vehicular traffic during vehicle phases.

## PEDLEVELS 4*<Pedestrian Interference>

Defaults: 4*0
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the level of pedestrian interference for right turns on each approach of the current intersection.

**<Pedestrian Interference>** is the volume of conflicting pedestrians, in peds per hour, for right turns on the approach, and can be any integer from 0 to 5000. Its default value is 0.

### *Notes*

- Entries for pedestrian interference should be made for the approach from which the conflicting right turn is made. For example, pedestrians crossing the east leg of the intersection interfere with right turns made from the south approach, so the <Pedestrian Interference> value for that right turn should be input for the south approach.

- Under certain phasing conditions, pedestrian interference can also affect the left turns coming from the opposite approach than the right turns described in note 1. above. For example, pedestrians crossing the east leg of the intersection may also interfere with left turns made from the north approach. The <Pedestrian Interference> value for this left turn should be input for the opposite (south) approach as in the case of the right turns in note 1. above.

- Versions of TEAPAC prior to SIGNAL2000 (SIGNAL97, SIGNAL94, etc.) permitted the use of certain keywords to represent typical ped volume conditions. To permit upwards-compatibility of data files from these earlier programs, TEAPAC will convert these keywords in the same manner as the earlier programs using the following relationships between the number of conflicting pedestrians and the keyword used: LOW=50, MODERATE=200 and HIGH=400. These numeric values will be the values saved if this data is subsequently saved by TEAPAC.

- If an exclusive pedestrian phase is defined with the PEDTIME entry, PEDLEVELS should be set to zero since there should be no pedestrian interference with vehicular traffic during vehicle phases.

| **PEDTIME** | **<Exclusive Pedestrian Phase Time>** | **<Phase Number>** |
|---|---|---|
| Defaults: | 0.0 | 0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Phasing] | |

The purpose of this command is to enter the time for an exclusive pedestrian scramble phase for the current intersection.

**<Exclusive Pedestrian Phase Time>** is the length of time in seconds to be allocated to an exclusive pedestrian phase (all red for vehicles), and can be any number from 0 to 900 and less than the cycle length for the phasing. Its default value is 0.0.

**<Phase Number>** is the number of the phase which the exclusive pedestrian phase follows, and can be any number from 0 to 6 and less than or equal to the number of phases in the sequence of operation. Its default value is 0 for no exclusive ped phase, or position in phasing is not important (placed at end of phasing).

### *Notes*

- If an exclusive pedestrian phase is defined with the PEDTIME entry, PEDLEVELS should be set to zero since there should be no pedestrian interference with vehicular traffic during vehicle phases.

- PEDTIME can also be used to hold aside time for any sort of interruption in the cycle, not just a ped phase. For example, legs of the intersection not included in the four legs of the analysis or certain types of pre-emption.

## PEDWALKS <PedMin Factor> 4*<Ped Walk Time>

Defaults: 1.0 4*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the overall pedestrian minimum factor, and the required pedestrian walk time for each approach of the current intersection.

**<PedMin Factor>** is the factor which adjusts all <Ped Walk Time> and <Ped Clearance (FDW) Time> entries. Its default value is 1.00.

**<Ped Walk Time>** is the amount of time, in seconds, that the WALK signal should be displayed, and can be any number from 0.0 to 99.9. Its default value is 0.0.

### *Notes*

- PEDWALKS entries, in combination with PEDFDWS entries, will be used as minimum time constraints for optimization of phases which handle the through movement running parallel with and adjacent to the pedestrian crossing. For example, pedestrians crossing the east leg of the intersection cross the intersection with through movement vehicles on the south approach, so the pedestrian timing value for that pedestrian movement should be input for the south approach and will constrain the timing provided for the south through movement.

- PEDWALKS and PEDFDWS timing entries will be factored by the <PedMin Factor> entry which is made as part of the the PEDWALKS entry. By setting this factor to 0.0, pedestrian timing requirements will be ignored without actually removing the timing entries which have been made. Setting the factor back to 1.0 re-enables the complete pedestrian timing requirements. <PedMin Factor> can also be set to other values to test the sensitivity of the signal's vehicular performance to varying degrees of pedestrian timing constraints. This factor may also be useful for properly representing pedestrian timing contraints on actuated performance defined by the ACTUATIONS entry.

- If an exclusive pedestrian phase is defined with the PEDTIME entry, PEDWALKS and PEDFDWS should be set to zero since there should be no pedestrian movement with vehicular traffic during vehicle phases.

| **PERIODS** | **<Count Interval>** | **5*< <Start Time> <Stop Time> >** |
|---|---|---|
| Defaults: | 15 | 5*<- -> |
| Menus/Groups: | [Parameters] [CountAnalysis] | |

The purpose of this command is to enter the count interval and the beginning and ending times for each count period for which subsequent data will be entered at the current intersection.

**<Count Interval>** is the interval, in minutes, between each count entry, and can be either 15 or 60 minutes. Its default value is 15 minutes.

**<Start Time>** is the time for each count period when the count was started, on a 24-hour clock, and can be any valid time between 0 - 2400 hours. It has no default value, and at least one <Start Time> must be entered.

**<Stop Time>** is the time for each count period when the count was stopped, on a 24-hour clock, and can be any valid time between 0 - 2400 hours. It has no default value , and at least one <Stop Time> must be entered.

### *Notes*

- As many as five pairs of start and stop times can be given after the <Count Interval> for various periods which were counted during the same day.

- If counts are already reduced (e.g., not cumulative from interval to interval), one count will exist for each interval counted. For example, one hour of 15-minute counts will have four intervals, say with a start time of 1600 hours and an end time of 1645 hours. If counts are cumulative, an additional interval will exist for each period counted (e.g., 1600 to 1700 hours for the above example).

- All times are for the interval starting at the time stated. If reduced counts are being entered, these time entries are the start time of each interval counted. If cumulative counts are being entered, the times entered are the actual times each count number is recorded. For example, a cumulative count from 4:00 P.M. to 5:00 P.M. would record the first count at 1600, then again at 1615, 1630, 1645, and at the end of the count at 1700.

- If counts for a location are made on separate days, it is suggested that they be input and summarized as separate runs of the program, even if their time periods do not overlap. It is not possible to SUMMARIZE, COUNTTABULATE, or PEAKANALYZE overlapping time periods for different days; two runs are necessary.

- The PERIODS command values are used to set up the values of other commands such as VEHICLECOUNTS and TRUCKCOUNTS which will be accepted as input. As such, the PERIODS command is active and must be executed. This sets up the new limits of the counts and opens up the required VEHICLECOUNTS and TRUCKCOUNTS commands in the full-screen displays.

- If <Start Time> and <Stop Time> values of zero are entered for a given time period, all subsequent time periods in the list are deleted.

## PERMISSIVES 4*<Permissive Left>

Defaults: 4*NO
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Phasing]

The purpose of this command is to enter an option for each approach of the current intersection identifying the permissibility of left-turning traffic to turn on a through phase following or preceding an exclusive left turn phase (e.g. a protected-permitted left-turn or a permitted-protected left-turn, also referred to as compound left-turn phasing).

**<Permissive Left>** is a keyword which identifies whether or not left turns are allowed to turn on through phases following or preceding exclusive left turn phases (compound left-turn phasing), and can be any of the following:

NO - compound left-turn phasing not allowed (default).
YES - compound left-turn phasing allowed, but restricted to non-trap and single-lane turn lane conditions.
TRAPOK - compound left-turn phasing allowed, even in so-called 'left-turn trap' conditions which are otherwise considered unsafe, but not for multi-lane turn lane conditions.
MULTIOK - compound left-turn phasing allowed, even when the left turn lane consists of more than one lane (multi-lane), but not for left-turn trap conditions. Permitted left operations will also be allowed for multi-lane turn lanes in a single phase when this is selected.
UNRESTRICTED - compound left-turn phasing allowed under any conditions, including left-turn trap and multi-lane conditions.

### *Notes*

- A left-turn trap is a condition where the through movement opposing a left turn continues moving after the left turn's permitted phase ends, possibly leaving a left-turning vehicle stranded in the intersection facing a red indication, or causing the potentially stranded left-turner to think the opposing traffic phase is also ending and making the left turn directly into oncoming traffic. Selecting TRAPOK or UNRESTRICTED allows the program to set the phasing so such a trap condition exists, with the presumption that the analyst is satisfied that the otherwise unsafe condition will be handled safely on the street.

- See Appendix C for a discussion of how permissive left turns are modeled for various versions of TRANSYT.

## PHASEMOVEMENTS <Phase Number> <List of Movements>

| | | |
|---|---|---|
| Defaults: | -- | 0 0 0 0 0 0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Phasing] | |

The purpose of this command is to enter the movements permitted during each phase for a non-standard phasing for the current intersection.

**<Phase Number>** is the number of the phase within the sequence of phases for the following list of movements, and can be 0-6. There is no default for <Phase Number>, it must be entered.

**<List of Movements>** is the movement number occurring during the specified phase, and can be 0-12, -3, -6, -9 or -12. Its default value is 0.

### *Notes*

- This is used for phasings that are not included in the standard sequence codes. SEQUENCES -1 through -9 must be used in order for PHASEMOVEMENTS entries to be recognized.

- Operational DESIGNs and HCSEXPORTs cannot be performed for a sequence defined by the PHASEMOVEMENTS. Capacity Analysis and Evaluation can be performed with ANALYZE and EVALUATE, however, when data is presented in a proper manner.

- Movements must receive only one constant green indication during each cycle.

- All movements in a common direction, e.g., North-South, must appear in adjacent phases which do not overlap the beginning and end phases.

- Negative movement numbers should be used only to indicate permitted lefts following or preceding protected left phases. Negative movement numbers should not be used if the only phase the movement is allowed is permitted/opposed.

- The order of input of phases for PHASEMOVEMENTS is not important. The number of phases in the final phasing is determined by the last phase which has a non-zero number of movements in it. Extra phases can be eliminated by entering a movement number 0 as the first movement in the phase. This erases all following movement numbers for that phase and any phases which follow.

- The DIAGRAMS command can and should be used to review the phasing designated by PHASEMOVEMENTS before further analysis.

## PLOTSIMPLE <Distance Scale>

Defaults: 0
Menus/Groups: [Results] for Progression Analysis

The purpose of this command is to display a simplified time-space diagram for the system using the simplified offsets which are presently set with the PRG-OFFSETS command.

**<Distance Scale>** is the number of feet or meters for each line of distance display in the time-space diagram. It can be any number greater than or equal to zero. Its default value is 0 (automatic scale to fit the PLOTSIMPLE on one page).

### *Notes*

- The PLOTSIMPLE command is normally used to plot a time-space diagram for PRG-OFFSETS generated automatically by the PROGRESSION bandwidth optimization. User PRG-OFFSETS can also be entered and plotted, following the conditions described for the PRG-OFFSETS command.

- A PLOTSIMPLE automatically follows any form of PROGRESSION optimization, either with or without a PRG-CYCLES range and/or a PRG-SPEEDS or PRG-TOLERANCE. The time-space diagram which results is always for the optimum cycle/speed combination, as shown in the PROGRESSION results.

- A PLOTSIMPLE following a PROGRESSION displays the progression bands, since these bands were created by the PROGRESSION process. If PRG-OFFSETS are changed by the user, the best possible bands are displayed, but only in the graphical output (not in the text-only output). If other pertinent information is changed, these changes will not be reflected in the time-space diagram. To reflect these changes, do a PROGRESSION after the changes, then enter the desired PRG-OFFSETS (see PRG-OFFSETS).

## PLOTTSD <Scale> <List of Nodes>

| | | |
|---|---|---|
| Defaults: | 0 | <Nodelist> |
| Menus/Groups: | [Results] for Export and Import | |

The purpose of this command is to plot a detailed time-space diagram for the nodes specified.

**<Scale>** is the scale of the plot in feet per line of output, and can be any integer from 0 to 10,000. Its default value is 0 feet per line (automatic scale to fit the PLOTTSD on one page).

**<List of Nodes>** is the list of node numbers to be plotted, and can be any node numbers in the specified NODELIST, or the negative value of any defined ROUTE number. The default value is all nodes in the NODELIST or SUBSYSTEM, in the specified order.

### *Notes*

- The NETWORK, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and OFFSET commands must be specified for each node which is to be plotted.

- The output on a printer is normally six lines per inch. When determining the scale to be used for the time-space diagram, this print pitch should be taken into account. For example, if a 600 feet per inch is desired on such a printer, a PLOTTSD scale of 100 (= 600/6) feet per line of output should be used. Similar computations can be made for other combinations of scales and print pitches. The <Scale> of the diagram can also be adjusted in many cases so that the entire time-space diagram will fit into the available screen display or on one page of output (the default).

- The time-space diagram will display approximate speed slope lines in the right margin of the text-only time-space diagram so that the slopes can be copied into the actual diagram at a later time by the analyst. This is not necessary for the graphics output since the actual bands with proper speed slopes are already displayed in the output.

- Route numbers can be referenced by use of negative numbers on the PLOTTSD command to quickly identify routes for analysis. For example, if ROUTE 1 is defined by an appropriate ROUTE command, a PLOTTSD for this route can be created through the use of the PLOTTSD * -1 command. This option of the PLOTTSD command can be used even if Release 7 is not the target program.

- <List of Nodes> is limited to 25 intersections in Usage Levels 2 and 3, and limited to 12 intersections in Usage Level 1.

## PRG-ADJUST <Speed Factor>

Defaults: 1.00
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the factor by which all link speeds entered on the PRG-SPEEDS command will be adjusted.

**<Speed Factor>** is a multiplier used to adjust the desired link speeds. It can be any positive number greater than 0 and less than 10. Its default value is 1.00.

### *Notes*

- This command is useful when performing a final PROGRESSION bandwidth optimization where the base PRG-SPEEDS must be adjusted to the value(s) determined as optimal by a previous PROGRESSION with an allowed speed PRG-TOLERANCE. For example, if an initial PROGRESSION optimization produces an optimal result with speeds 5 percent higher than those entered on PRG-SPEEDS (as allowed by the PRG-TOLERANCE entry) and optimum PRG-OFFSETS are desired for this condition, PRG-ADJUST can be set to 1.05 rather than re-entering all link speeds with a new PRG-SPEEDS command.

- All speeds specified on the PRG-SPEEDS command will be adjusted by the one factor of the PRG-ADJUST command. Thus, speeds can only be expanded or reduced by a single percentage through use of this command.

- The PRG-SPEEDS command entries themselves are not changed by the PRG-ADJUST command. Merely, each time they are used, they are first adjusted by the specified factor.

## PRG-ALLREDS 25*<All-Red Clearance Time>

Defaults: 25*0
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the amount of all-red clearance time used at each intersection in the system.

**<All-Red Clearance Time>** is the amount of all-red clearance time, in seconds, used at an intersection. It can be any number from 0 to 20. Its default value is 0.

### *Notes*

- Both system PRG-CLEARANCES time and PRG-ALLREDS time are included in the PRG-SPLITS time for each intersection. Progressive bands will go through the PRG-CLEARANCE period, but not the PRG-ALLREDS period.

- The values specified on the PRG-ALLREDS command are used only to determine the offsets to the start of the side street phase, and have no affect on the optimization results.

## PRG-AVAILABLE 25*<Lead/Lag Phase Direction>

| | |
|---|---|
| Defaults: | 25*NONE |
| Menus/Groups: | [Parameters] [Progression] |

The purpose of this command is to enter the locations where the optimum timings should include all of the available time for leading or lagging turning phases which will not shrink the through band.

**<Lead/Lag Phase Direction>** is a keyword describing the direction of travel at an intersection where the maximum available lead or lag turn phase time should be included in the optimum timings output. It can be any of the keywords described below:

| | |
|---|---|
| NONE | - No turning phases desired (default). |
| LEFTRIGHT | - Left to right turning phase desired. |
| RIGHTLEFT | - Right to left turning phase desired. |
| BOTH | - Turning phases desired in both directions. |

### *Notes*

- Use of the PRG-AVAILABLE command will not change the through band widths and does not specify whether designated turning phases will lead or lag.

- In order to specify the actual amount of turning phase time, as well as the leading or lagging position of the phase, use the PRG-LEADLAG command.

- Since the use of this option can cause conflicts with the PRG-LEADLAG option, and it has no real impact on the bands or timings, it has been disabled. The available time is always reported in the detailed PROGRESSION results.

| **PRG-BASE** | **<Base Intersection Number>** | **<Base Offset>** |
|---|---|---|
| Defaults: | 1 | 0 |
| Menus/Groups: | [Parameters] [Progression] | |

The purpose of this command is to enter the base intersection location to which all offsets will be related, as well as the absolute offset which the base location must have.

**<Base Intersection Number>** is the order number of the intersection designated as the base location. It can be any integer from 1 to 25, but not larger than the PRG-SIZE entry. Its default value is 1.

**<Base Offset>** is the offset, in percent, for the through phase of the base intersection. It can be any number from 0 to 999.9. Its default value is 0.

### *Notes*

- Use of the PRG-BASE command allows the user to specify the actual offset for a single location within the linear system being studied. With this technique, several linear systems in an open system (no closed network loops) may be coordinated to a single master sync pulse.

## PRG-CLEARANCES <System Clearance Time>

Defaults: 0
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the clearance interval time to be used at the end of all through phases in the system.

**<System Clearance Time>** is the through-phase clearance interval time, in seconds, used at all intersections in the system (excluding all-reds). It can be any number from 0 to 20. Its default value is 0.

### *Notes*

- The specified system clearance time is included in each through-split time designated by the PRG-SPLITS command.

- The program is designed to progress traffic through the yellow clearance interval. Thus, the specification of a system clearance is used only to determine the offsets to the end of the through-green indication. This is sometimes useful in implementing PROGRESSION timings on traffic controllers in the field.

## PRG-CYCLES <Minimum Cycle> <Maximum Cycle> <Cycle Increment>

| | | | |
|---|---|---|---|
| Defaults: | 40 | 140 | 5 |
| Menus/Groups: | [Parameters] [Progression] | | |

The purpose of this command is to enter the range of cycles to be considered in the design of the progressive system.

**<Minimum Cycle>** is the minimum cycle length, in seconds, to be tested. It can be any positive number less than or equal to 900 seconds. Its default value is 40.

**<Maximum Cycle>** is the maximum cycle length, in seconds, to be tested. It can be any number greater than or equal to the <Minimum Cycle> and less than or equal to 900 seconds. Its default value is 140.

**<Cycle Increment>** is the increment, in seconds, used to step from the <Minimum Cycle> to the <Maximum Cycle>. It can be any positive number less than or equal to 900 seconds. Its default value is 5.

### *Notes*

- A maximum of 21 cycle lengths is allowed in Usage Level 1. A maximum of 41 cycles is allowed in Usage Levels 2 and 3. If the increment is too small and more than the maximum number of cycle lengths are within the specified range, the increment will be adjusted to create the maximum number of cycle lengths within the range.

- <Maximum Cycle> and <Cycle Increment> are ignored in a one-way system. The <Minimum Cycle> is used as the actual system cycle length.

## PRG-DIRECTIONS <Progression Designation>

Defaults: TWOWAY
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the number of directions of traffic flow to be progressed on the route.

**<Progression Designation>** is a keyword describing the number of directions for which progression is sought. It can be any of the keywords described below:

ONEWAY - Progression in one direction only (left to right).
TWOWAY - Progression in both directions (default).

### *Notes*

- If ONEWAY progression is specified, the traffic will be progressed in the direction in which the intersections are listed (left to right).

- If ONEWAY progression is specified, the minimum cycle length of the PRG-CYCLES command will be used as the system cycle length and the PRG-ADJUSTed speeds of the PRG-SPEEDS command will be the progression speed. Cycle and speed variation is disabled for one-way systems.

- If ONEWAY progression is specified, PRG-SPEEDS must still be entered in BOTH directions, since the geometric mean speed of progression is used for the initial optimization process.

## PRG-DISTANCES 24*<Link Distance>

Defaults: 24*0
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the distances between intersections.

**<Link Distance>** is the distance, in feet or meters, to the next intersection. It can be any number greater than or equal to 50 and less than 10,000. Its default value is 0, so it must be entered.

### *Notes*

- The distance specified by the $i^{th}$ parameter of the command refers to the distance from the $i^{th}$ to the $(i+1)^{th}$ intersection. Thus, in a system of PRG-SIZE n, only (n-1) distances can be included.

- The units of distance between intersections must agree with those specified by the PRG-UNITS command.

- At offset intersections, the distance entered should be the average distance between centers of intersections.

## PRG-FINETUNE <Finetune Indicator>

Defaults: NO
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the indicator which instructs the design procedure to perform a second iteration of optimization.

**<Finetune Indicator>** is a keyword which specifies if a second design iteration is desired. It can be any of the keywords described below:

NO - Second iteration is not desired (default).
YES - Second iteration is desired.

### *Notes*

- The accuracy of progression afforded by the second level of optimization has applications mostly in research-type projects. It is virtually impossible to attain in the field the accurate control of speeds which is implied by the precision of the second iteration results. Due to this and the additional time required to conduct the procedure, use of the second iteration is not recommended.

- Due to the recommendation above and minor inconsistencies which can appear between the cycle/speed limiting procedures of the first and second iterations, this option has been disabled.

## PRG-LEADLAG <Direction> 25*<Lead/Lag Phase Time>

| | | |
|---|---|---|
| Defaults: | BOTH | 25*0 |
| Menus/Groups: | [Parameters] | [Progression] |

The purpose of this command is to enter the specific lead/lag left-turn phase timings for each intersection in the system.

**<Direction>** is a keyword describing the direction(s) of travel for which the lead/lag timings are specified. It can be any of the keywords described below:

LEFTRIGHT - Timings for left-turn phase coming from the left.
RIGHTLEFT - Timings for left-turn phase coming from the right.
BOTH - Timings for left-turn phase coming from both directions (default).

**<Lead/Lag Phase Time>** is the time, in percent, which is to be given as a lead or lag turning phase. It can be any number from 0 to 99.9 and less than the specified through split. Its default value is 0.

### *Notes*

- This option should be used with caution. The program is designed to first optimize the through bands without consideration of turn phases, then to insert specified leading or lagging green times. If a time specified by the PRG-LEADLAG command is more than the available green, the through band will be bent and/or narrowed.
- The time specified for PRG-LEADLAG is included in the time specified by the PRG-SPLITS command.
- The BOTH option is only usable in the Manual Mode. In the Visual Mode, PRG-LEADLAG entries must be made for each direction of travel separately.
- This entry defines the length of the lead or lag left turn phase to be included, but does not define if the phase is a lead or a lag. TEAPAC will place the phase in the least disruptive location.
- The PLOTSIMPLE command may not display the lead or lag phase completely, since its emphasis is to display bands, not phasing.

## PRG-LINKNODEDATA <Intersection Number> <List of Link-Node Data>

| | | |
|---|---|---|
| Defaults: | - | <see below> |
| Menus/Groups: | [Parameters] [Progression] | |

The purpose of this command is to enter all parameter values for an intersection and its adjacent link.

**<Intersection Number>** is the intersection order number. It can be any non-zero number less than or equal to the system size. Its default value is 0; it must be entered.

**<List of Link-Node Data>** is a list of the twelve parameters which describe the characteristics of an intersection and its adjacent link. These include the following parameters, in order:

| | |
|---|---|
| a | - cross street name |
| b | - distance to next intersection to the right in feet or meters. |
| clr,crl | - directional link speeds, in mph or kmph, to and from the next intersection |
| d | - through split, in percent |
| e | - all red time, in seconds |
| f | - available lead/lag inclusion |
| glr,grl | -specified lead/lag times, in seconds |
| hlr,hrl | -offsets, in percent |
| i | - non-concurrent mainline green |

The allowed values of these parameters are:

| | |
|---|---|
| a | - any character string, up to 12 characters - no embedded blanks. |
| b | - any number greater than 0 and less than 10,000. |
| clr,crl | - any two numbers greater than 0 and less than 100. |
| d | - any number greater than 0 and less than 100. |
| e | - 0-20. |
| f | -NONE/LEFTRIGHT/RIGHTLEFT/BOTH |
| glr,grl | - any two numbers from 0 to 99.9 and less than split time |
| hlr,hrl | - any two numbers from 0 to 99.9. |
| i | - NO/YES |

The default values of these parameters are:

| | |
|---|---|
| a | - 12 blanks |
| b | - 0 |
| clr,crl | - 0,0 |
| d | - 0 |
| e | - 0 |
| f | - NONE |
| glr,grl | - 0,0 |

| | |
|---|---|
| hlr,hrl | - 0,0 |
| i | - NO |

### *Notes*

- This command exists primarily to provide an easy way to summarize in a table the parameter values for a given intersection, and for SAVing this table of data in files. Its use is limited mostly to interactive updating of file data. It does also provide an alternative means of entering data in the Visual Mode for systems with a PRG-SIZE greater than 12.

- The parameter values which are allowed are the same as those for each of the corresponding commands, since the PRG-LINKNODEDATA command duplicates the entries made by these other commands. It is not necessary to use this command if the corresponding commands are used.

## PRG-NAMES 25*<Cross Street Name>

Defaults: 25*blanks
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the descriptive information which labels the cross street for input and output identification purposes.

***<Cross Street Name>*** is the name of the cross street at each intersection, or any other descriptor for each intersection. It can be any string of up to 12 non-blank characters. Its default value is 12 blanks.

### *Notes*

- No embedded blanks are allowed in the cross street names. Use dashes or underscores to separate words, if desired.

## PRG-NONCONCURRENT 25*<Nonconcurrent Condition>

Defaults: 25*NO
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the nonconcurrent mainline green indicator at each intersection in the system (split phase).

**<Nonconcurrent Condition>** is a keyword describing the existence of split phase mainline green operation at an intersection. It can be any of the keywords described below:

NO - Nonconcurrent operation does not exist (default).
YES - Nonconcurrent operation exists.

### *Notes*

- If the through band is larger than half the available green time at an intersection, the band will be narrowed. Bands may also be bent, resulting in unreasonable progression speeds in both directions. Use this command with caution.

## PRG-OFFSETS <Direction> 25*<Through Phase Offset>

| | | |
|---|---|---|
| Defaults: | BOTH | 0 |
| Menus/Groups: | [Parameters] | [Progression] |

The purpose of this command is to enter the offsets for the through phase at each intersection.

**<Direction>** is a keyword describing the direction(s) of travel which is (are) served by the phases with the specified offsets. It can be any of the keywords described below:

LEFTRIGHT - Offsets for through traffic traveling from left to right.
RIGHTLEFT - Offsets for through traffic traveling from right to left.
BOTH - Offsets for through traffic traveling in both directions (default).

**<Through Phase Offset>** is the offset to the through phase, in percent. It can be any number from 0 to 99.9. Its default value is 0.

### *Notes*

- The BOTH option is only available in the Manual Mode. In the Visual Mode, PRG-OFFSETS must be entered separately for each direction of travel.

- This command allows the entry of an original set of offsets which are to be PLOTSIMPLEd in a time-space diagram. When displaying a time-space diagram with PLOTSIMPLE using user PRG-OFFSETS, the time-space diagram will display best progression band identifiable since the location of the band is unknown for an arbitrary set of offsets. The PROGRESSION command automatically implements a PRG-OFFSETS command containing the optimum offsets for its subsequent PLOTSIMPLE.

- If only PRG-SPLITS, PRG-ALLREDS, PRG-DISTANCES and PRG-OFFSETS are entered, a PLOTSIMPLE can be produced without first doing a PROGRESSION. If other link/node parameters are also used, a PROGRESSION must first be performed to calculate the effect of these variables, then the user PRG-OFFSETS can be entered and PLOTSIMPLEd.

## PRG-RATIO <Band Ratio>

Defaults: 1.00
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the desired ratio between the sizes of the directional progressive bands.

**<Band Ratio>** is the ratio of the left-to-right through band width to the right-to-left through band width. It can be any number greater than 0 and less than 100. Its default value is 1.00.

### *Notes*

- The optimization procedure selects initial offsets based upon equal-maximum bandwidths in each direction. Following this procedure, the offsets are adjusted to achieve the desired band ratio, if possible. The smaller band will be decreased in size to achieve the desired ratio only if the larger band increases in size by the same amount.

- PRG-RATIO is useful to create an intentionally unbalanced two-way progression. This is commonly performed to increase the bandwidth in a peak-flow direction while still maintaining a band in the other direction. The PRG-RATIO entry is commonly set to the ratio of the actual through volumes on the arterial.

## PRG-SIZE <Number of Signals>

Defaults: 0
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the number of signals on the arterial to be progressed.

**<Number of Signals>** is the number of signals on the route being analyzed. It can be any integer from 0 to 25, but only 2-25 is meaningful. Its default value is 0, so it must be entered.

### *Notes*

- The PRG-SIZE entry must be entered prior to any other intersection or link information is entered.
- In the Usage Level 1, the maximum PRG-SIZE is 12 intersections. In Usage Levels 2 and 3, the maximum is 25.
- When a PRG-SIZE greater than 12 is used, the Manual Mode must be used to enter information for intersections beyond intersection 12. The Visual Mode only allows for up to 12 intersections. Alternatively, the PRG-LINKNODEDATA command dialog can be used in either Mode to enter up to the maximum number of intersections, although this may be confusing at first. One way to become accustomed to the PRG-LINKNODEDATA command is to enter the first few intersections using the normal Visual Mode options, then enter the remaining intersections using PRG-LINKNODEDATA. This shows where the first entries appear, making it clear where to enter the remaining values.

## PRG-SPEEDS <Direction> 24*<Link Speed>

| | | |
|---|---|---|
| Defaults: | BOTH | 24*0 |
| Menus/Groups: | [Parameters] | [Progression] |

The purpose of this command is to enter the desired progression speed in either or both directions for each link of the system.

**<Direction>** is a keyword describing the directions for which link speeds are given. It can be any of the keywords described below:

LEFTRIGHT - Speeds given for left-to-right movement.
RIGHTLEFT - Speeds given for right-to-left movement.
BOTH - Speeds given for both directions (default).

**<Link Speed>** is the desired speed of progression between intersections, in MPH or KMPH. It can be any number greater than 0 and less than 100. Its default value is 0, so it must be entered.

### *Notes*

- The BOTH option is only available in the Manual Mode. In the Visual Mode, PRG-SPEEDS must be entered separately for each direction of travel.
- The first speed given always occurs between intersections #1 and #2 regardless of the direction of flow (left-to-right or right-to-left).
- For a system with n intersections, only (n-1) link speeds may be entered.
- Non-zero speeds must be entered for both directions, even for one-way systems. This is because the geometric mean speed for both directions on a link is used for the initial optimization effort.
- PRG-SPEEDS are entered in MPH or KMPH according to the entry made on the PRG-UNITS command. The default is MPH.

## PRG-SPLITS 25*<Through Split>

Defaults: 25*0
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the percentage of time available for through traffic movement in both directions at each intersection.

**<Through Split>** is the proportion of the cycle, in percent, for through traffic in both directions at an intersection. It can be any number greater than or equal to 5 and less than 100. Its default value is 0, so it must be entered.

### *Notes*

- The through split includes the system yellow time specified by the PRG-CLEARANCES command, the all-red time specified by the PRG-ALLREDS command, and any turning movement time specified by the PRG-LEADLAG command.

- If lead or lag phases exist and are not being coded with the PRG-LEADLAG command (this is the recommended practice), it is best to specify only the amount of time which is used by both through movements. It may then be desirable to adjust the results manually to accommodate the actual green splits and lead/lag phases.

## PRG-TOLERANCE <Speed Tolerance> <Speed Increment>

| | | |
|---|---|---|
| Defaults: | 0 | 0 |
| Menus/Groups: | [Parameters] [Progression] | |

The purpose of this command is to enter the permitted variation of progression speeds around the entered PRG-SPEEDS.

**<Speed Tolerance>** is the maximum allowable speed adjustment, in percent, on either side of the desired speed. It can be any number greater than or equal to 0 and less than 100. Its default value is 0.

**<Speed Increment>** is the increment of speed, in MPH or KMPH, used to step from the desired speed to the largest speed tolerance. It can be any number greater than or equal to 0 and less than 100. Its default value is 0.

### *Notes*

- If speeds differ from link to link, <Speed Increment> will be used only on links having the same speed as link 1-2. Other links will use increments with the same proportion of change.

- Usage Level 1 allows a maximum of 11 speeds to be tested by the PRG-TOLERANCE entry. If the range and increment cause more than 11 speeds to result, the increment will be adjusted so that only 11 speeds span the entire range specified.

- Usage Level 2 allows a maximum of 21 speeds to be tested by the PRG-TOLERANCE entry. If the range and increment cause more than 21 speeds to result, the increment will be adjusted so that only 21 speeds span the entire range specified. When more than 11 speeds are used, the normal 80-column display will not accommodate all the speeds tested, so either a wider display mode must be selected or the results can only be reviewed on printed or disk file output.

## PRG-UNITS <Measurement System>

Defaults: ENGLISH
Menus/Groups: [Parameters] [Progression]

The purpose of this command is to enter the system of measurement to be used for the units of the input parameters.

**<Measurement System>** is a keyword identifying the units of measure used in defining the system. It can be any of the keywords described below:

ENGLISH - Units of Feet and MPH (default).
METRIC - Units of Meters and KMPH.

### *Notes*

- Setting the PRG-UNITS entry affects the input units of the PRG-SPEEDS, PRG-TOLERANCE, PRG-DISTANCES and PLOTSIMPLE entries only.

## PROGRESSION <Distance Scale>

Defaults: none
Menus/Groups: [Results] for Progression Analysis

The purpose of this command is to optimize the through-phase offsets to achieve the maximum progressive efficiency for the system and to display a simplified time-space diagram for the optimized system

### *Notes*

- If more than one cycle length is permitted in the design by the PRG-CYCLES command, a plot of cycle length versus system efficiency is produced. This plot is a useful tool in establishing the various cycle lengths which provide optimum progression in a two-way system.

- If more than one progression speed is permitted in the design by the PRG-TOLERANCE command, a matrix of system efficiencies is displayed for each speed/cycle combination. This matrix is augmented by a density plot which is useful in visualizing the relative merits of various progressive speeds, particularly in a system where the cycle length is somewhat fixed, or where speeds have not been established.

- If only one cycle and progression speed are allowed by the PRG-CYCLES and PRG-TOLERANCE commands, the optimum timing data is produced in detail for the specified conditions. This report is not provided when more than one cycle or speed is allowed.

- Following the output of the PROGRESSION results, the PLOTSIMPLE command is issued automatically to display a time-space diagram of the optimum design.

## PROJECT <First Title Line>

Defaults: 80 blanks
Menus/Groups: [Titles]

The purpose of this command is to enter the first line of information used to identify the situation being analyzed.

**<First Title Line>** is the first of three lines of information, generally used for the project name, displayed at the top of every output report, and can be up to 80 characters of alphabetic or numeric information. Its default value is 80 blanks.

### *Notes*

- If the first character of the PROJECT parameter is a plus sign, "+", the characters entered on this command will be overlaid over those of the previously entered PROJECT command. This overlay will begin at the character position identified by the digits of the first two characters which follow the "+", and will end after the last non-blank character which is entered. See Chapter 7 for further explanation and examples of this feature.

- Entries on this command may be enclosed in 'single quotes' or "double quotes". This option provides the capability to include leading blanks in the entry, which is otherwise not possible. This option can also be used to enter a single blank as the title line using a ' ' or " " entry, thereby blanking out the entire prior contents of the title line.

- The name of the current open file can be inserted anywhere in the title line by placing %F at the desired location of the title line. The file name can be placed at a specific column location in a title line by using the +XX form of a title entry noted above.

## QUEUECALCS --

Defaults: --
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to display a wide variety of various published queue calculations for a specified phasing and timings for the current intersection or all intersections, including the 2000 and 2016 *Highway Capacity Manual* queue models. It has no parameters.

### *Notes*

- The formulations for the various queue calculations are discussed in Appendix C. Queue model parameters are entered using the QUEUEMODELS command.

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CYCLE commands or the TIMINGS command.

| **QUEUEMODELS** | **<Model #>** | **<Percentile>** | **<Auto>** | **<Truck>** |
|---|---|---|---|---|
| Defaults: | 1 | 90 | 25 | 40 |
| Menus/Groups: | [Parameters] | [SignalAnalysis] | [System] | |

The purpose of this command is to enter parameters which control the queue model calculations used for all intersections under study.

**<Model #>** is the number of the preferred queue model as computed by the QUEUECALCS command, and can be any integer from 1 to 10, but not 2 or 5. Its default value is 1.

| | |
|---|---|
| 1 - HCM | 2000 or 2016 HCM, MBQ, Worst Lane. XXth Percentile Queue |
| 3 - ARRB | ARRB, MBQ, Worst Lane, 95th Percentile Queue |
| 4 - HCM | 2000 or 2016 HCM, MBQ, Worst Lane, Average Queue |
| 6 - MBQ | Historical MBQ, Average Lane, Average Queue |
| 7 - S97E+ | SIGNAL97 Evaluate+, MQL, Average Lane, XXth Percentile Queue |
| 8 - S97A+ | SIGNAL97 Analyze+, MQL, Average Lane, XXth Percentile Queue |
| 9 - S97E | SIGNAL97 Evaluate, MQL, Average Lane, 90th Percentile Queue |
| 10 - S97A | SIGNAL97 Analyze, MQL, Average Lane, 90th Percentile Queue |

**<Percentile>** is the percentile value desired to be estimated by the queue models, and can be any integer from 50 to 99. Its default value is 90.

**<Auto>** is the average queue spacing between front bumpers of queued automobiles, in feet, and can be any integer from 5 to 100. Its default value is 25.

**<Truck>** is the average queue spacing between front bumpers of queued trucks, in feet, and can be any integer from 5 to 100. Its default value is 40.

### *Notes*

- The <Model #> defines the preferred queue model which will be used to calculate queues represented in the ANALYZE and EVALUATE results, as well as the bottom of the QUEUECALCS report.

- See Appendix C for a complete description of each of the queue models which can be computed by TEAPAC's signal analysis functions.

- All models do not support the calculation of any specified percentile value. For example, only a limited set of percentile values can be selected for the HCM model, the ARRB model always uses the 95th percentile, and the original SIGNAL97 models always uses the 90th percentile (see Appendix C for details).

- All models do not support the calculation of an entered length of autos and trucks. For example, the lengths of autos and trucks for the original SIGNAL97 models always use 25 and 40 feet, respectively (see Appendix C for details).

- Average lane Models 2 & 5 are no longer separately defined by the 2000 HCM.

## RECALLS 8*<Nema Recall Status>

Defaults: 8*NONE
Menus/Groups: [Parameters] [SignalAnalysis] [Phasing]

The purpose of this command is to enter the phase recall status for each Nema movement of the current intersection.

**<Nema Recall Status>** is a keyword identifying the type of phase recall which is set for each Nema actuated movement. It can be any of the keywords described below:

| | |
|---|---|
| None | no recall is set (default). |
| Min | recall to the minimum setting. |
| Max | recall to the maximum setting. |
| Ped | recall to the pedestrian minimum setting. |

### *Notes*

## REDCLEARTIMES 8*<Phase All-Red Time>

Defaults: 8*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [Phasing]

The purpose of this command is to enter the red clearance interval (all-red time) at the end of each phase of a specified phase sequence, or optionally for each of the movements, of the current intersection.

**<Phase All-Red Time>** is the duration of the red clearance interval (all-red) after each phase or movement in seconds, and can be any number from 0.0 to 30.0. Its default value is 0.0 seconds.

### *Notes*

- If the list of REDCLEARTIMES is preceded by the keyword 'Movmt', then each of the entered values will be interpreted as timings for individual through and left turn movements, clockwise around the intersection. If not, or the optional keyword 'Phase' is used, each value is for the phases defined by the SEQUENCE code.

- When entering or viewing controller timings, a Convert button appears on the REDCLEARTIMES dialog which allows the user to select the style of entry or view, either 'By Phase' which is the traditional HCM 2000 method, or 'By Movement' which is the HCM 2016 method and similar to the way timings are used on NEMA and other dual-ring controllers. If any timings are present, they will be converted to the other format at the same time, including YELLOWTIMES and REDCLEARTIMES if the GREENTIMES dialog is displayed, and vice versa. When timings are Converted, the conversion will also include reviewing the allowed SEQUENCES list and moving the appropriate sequence code to the top of the list according to the timings present.

- It is important to make sure that YELLOWTIMES, REDCLEARTIMES and REQCHANGE+CLEARS entries are always kept consistent with each other, especially when converting Timings by Phase to Timings by Movement and when exporting to third-party, ring-based software.

- 'By Movement' timings are not allowed when special phasings represented by negative SEQUENCE codes are used.

- If entering REDCLEARTIMES by phase, they must be entered in the order of the phases as specified in the SEQUENCES and LEADLAGS commands.

- All-red time may be included in the YELLOWTIMES command, or entered separately in the REDCLEARTIMES command.

- If a signal is to be double-cycled, GREENTIMES, YELLOWTIMES, REDCLEARTIMES (and OFFSETS) must be entered in seconds (not sec/sec) which sum to 1/2 the system cycle.

| **REPEAT** | **<Variable Name>** | **<First Val>** | **<Last Val>** | **<Increment>** |
|---|---|---|---|---|
| Defaults: | - | 1 | 1 | 1 |
| Menus/Groups: | [Control] | | | |

The purpose of this command is to initiate a loop in a control file so that the set of commands which follow will be repeated a finite number of times.

**<Variable Name>** is the name of the variable to be associated with the loop, and can be any character string beginning with a letter. It has no default value; a variable name must be provided.

**<First Val>** is the value which will be assigned to the loop variable the first time through the loop, and can be any integer from -32767 to 32767. Its default value is 1.

**<Last Val>** is the last value which the loop variable will be allowed to have in the loop, and can be any integer from -32767 to 32767. Its default value is 1.

**<Increment>** is the value which will be added to the loop variable for each pass of the loop in order to increment from <First Val> to <Last Val>, and can be any non-zero integer from -32767 to 32767. Its default value is 1.

### *Notes*

- The end of a REPEAT loop is defined by a GOTO command which has <Variable Name> as its <Destination>.
- Although any character string is allowed as a variable name, only the first letter is used as the actual variable. All following non-blank characters are ignored. If another loop is currently active, its associated loop variable may not be used.
- A REPEAT loop will terminate when the value of the loop variable exceeds the specified <Last Val>. When a loop terminates, the loop variable will have the same value as <Last Val>.
- A negative value for <Increment> is allowed, in which case the loop variable will be decremented until it is less than <Last Val>.
- A limit of five REPEAT loops may be active at any one time (i.e., nested). Any number of sequential loops may be used (i.e., un-nested).
- See the detailed discussion of the various possible uses of the REPEAT loops and control files in Chapter 7.

## REQCHANGE+CLEARS 12*<Required Change & Clearance>

Defaults: 12*4.0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport]
[Basic] [Movement]

The purpose of this command is to enter the change and clearance times required for each movement of the current intersection.

**<Required Change & Clearance>** is the change and clearance time required for each movement in seconds, and can be any number from 0 to 99.9. Its default value is 4.0.

### *Notes*

- Required change and clearance times are used only by DESIGN and EXPORT to determine how much change and clearance time is needed to terminate each phase. This change and clearance time includes both yellow change and all-red clearance (red-clearance. The amount of the REQCHANGE+CLEARS entry that should be displayed as yellow is defined by the REQYELLOWS entry. ANALYZE and EVALUATE use the change and clearance times specified on the YELLOWTIMES and REDCLEARTIMES commands, regardless of the values on REQCHANGE+CLEARS.

- It is important to make sure that YELLOWTIMES, REDCLEARTIMES and REQCHANGE+CLEARS entries are always kept consistent with each other, especially when converting Timings by Phase to Timings by Movement and when exporting to third-party, ring-based software.

## REQYELLOWS 12*<Required Yellow Change>

Defaults: 12*3.0
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter the yellow change time required for each movement of the current intersection.

**<Required Yellow Change>** is the portion of the required change and clearance time (REQCHANGE+CLEARS) which should be yellow (the remainder being all-red red clearance) for each movement in seconds, and can be any number from 0.0 to 30.0. Its default value is 3.0.

### *Notes*

- Making a REQYELLOWS entry does not impose an additional constraint on timing optimization beyond that which is already defined by the REQCHANGE+CLEARS entry. Rather, it merely defines how much of the REQCHANGE+CLEARS entry should be displayed as yellow and forcing the remainder of the REQCHANGE+CLEARS time to be displayed as all-red.

- Setting a REQYELLOWS entry to 0.0 will disable the use of all-red red clearance for that particular movement and result in all of the REQCHANGE+CLEARS time to be displayed as yellow.

- Typically, of the two change and clearance timing parameters (yellow change time and red clearance time), the yellow change time is the value defined by local policy which may not be specifically related to the intersection under study. E.g., the total change and clearance time is defined by the intersection geometry and approach speeds, and local policy is to have a yellow display of no more than 3.0 seconds. Implementing REQYELLOWS in the manner described here allows this approach to change and clearance designs, letting the all-red time displayed to adjust according to the total chagne and clearance time provided.

## RESET <List of Commands>

Defaults: [Parameters]
Menus/Groups: [DataFiles]

The purpose of this command is to reset the parameters of the specified commands to their default values.

**<List of Commands>** is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [Parameters] - all non-active commands for entry of parameters related to the analysis procedures.

### *Notes*

- The File-New menu does a RESET for [AllCommands].

- When a RESET [Parameters] command is given, the NEWPAGE YES condition is automatically set. This can be subsequently disabled by the NEWPAGE NO command.

- RESET is not executed when it is encountered during a LOAD which uses the SHARE option or use when using the File-OpenMerge/Shared menu.

## RETURN --

Defaults: --
Menus/Groups: [Control]

The purpose of this command is to return to the source of input which was being used when the last LOAD command was encountered. It has no parameters.

### *Notes*

- The RETURN command will cause control (the source of input) to be changed from its current location (a file) to the source of the last LOAD command. If the last LOAD was from a file, control is given to the line which follows the LOAD command which caused a source change. If the previous LOAD command was the result of a menu selection, a dialog box selection or a keyboard entry, control will return to the keyboard.

- If an end-of-file is encountered control is returned to the keyboard, in a similar fashion to a RETURN command. Control is always returned to the keyboard in these cases, however, as this is considered an abnormal condition.

## RIGHTTURNONREDS 4*<Right Turn on Red Volume>

| | |
|---|---|
| Defaults: | 4*0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Approach] |

The purpose of this command is to enter the right turn on red volume for the right turns on each approach of the current intersection.

**<Right Turn on Red Volume>** is the volume, in vehicles per hour, of right turns being made on red, and can be any integer from 0 to 300. Its default value is 0.

### *Notes*

- The volume entered will be used to reduce the capacity analysis right turn volume before any other adjustments are made, with the limitation that the right turn volume will never be reduced below 1 vph.

- Note that in the HCM, the RTOR entry describes exactly how many right turn on red movements are made, but in TRANSYT, CORSIM and SYNCHRO the number of RTOR movements are estimated by the model. Thus, the only meaning a RTOR entry has in TEAPAC for export to these models is that a non-zero entry indicates that RTOR is permitted and that the host program should model conditions that way. Conversely, a RTOR entry of zero indicates RTOR is not permitted and will be modeled as such.

- It is important to note that in early versions of PRENETSIM, the RTOR model was always turned on for all movements exported to CORSIM because there was no RTOR indicator in PRENETSIM. With the current entry of RIGHTTURNONREDS in TEAPAC and its intended compatibility with the Highway Capacity Manual, this is no longer the case. The default RTOR entry in the HCM is zero RTOR, so by default the RTOR model will be always turned off if not specifically selected. This is the opposite of the prior behavior and needs to be recognized by the user.

## ROUND <Precision of Totals>

Defaults: 1
Menus/Groups: [Parameters] [TrafficImpact]

The purpose of this command is to enter the precision to be used in computing the traffic impact analysis results.

**<Precision of Totals>** defines the precision of rounding of assignment totals for each intersection movement, and can be any integer from 1 to 1000. Its default value is 1.

### *Notes*

- All computations are calculated to the nearest vehicle until the last computation is completed. At this point, the results for each intersection are rounded to the nearest whole multiple of the rounding precision entered on the ROUND command.

- If multiple computations are being CUMULATED by the COMPUTEPATHS command, successive rounding errors can be eliminated by making all the initial calculations and cumulations to the nearest 1 vehicle, except the last, which should be ROUNDed to the desired precision.

- When results are ROUNDed, the VOLADDITIONALS entry for an individual movement which results may take on a negative value if little or no new volume is assigned to that movement and the final volume is rounded down. This is appropriate, and to be expected.

## ROUTE <Route #> <List of Artery Nodes>

Defaults: - -
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [System]

The purpose of this command is to enter a list of node numbers which represent the intersections on the artery for the given route number.

**<Route #>** is the number of the route which is defined by the following list of artery nodes, and can be any integer from 1 to 8. It has no default value and must be entered.

**<List of Artery Nodes>** is a list of up to 25 node numbers in the current NODELIST/SUBSYSTEM whose order defines the artery route. It can be any node number in the NODELIST/SUBSYSTEM from 0 to 9999. It has no default value and must be entered.

### *Notes*

- For TRANSYT, card types 42, 43 and 6X will be generated for all routes defined by the ROUTE command, only if the version of TRANSYT-7F being used is Release 7 or higher. If the route turns a corner, exclusive turning links are used, where applicable. The card type 43 produces weightings for each direction on each route based on the average movement volume (not link volume) in each direction on the routes. The left-to-right direction of the first route always gets a 100 percent weight, while the other direction and other routes get weightings in proportion to this base volume. The card types 60 and 61 which are produced request all possible post-analysis summaries of each route, including time-space diagrams, time-location diagrams, flow profiles, platoon-progression diagrams, etc.

- If ROUTE definition are to be used for TRANSYT, they must follow the specific rules presented in the TRANSYT manual regarding routes. For example, a route may be 1-way or 2-way, but may not be partially 1-way and partially 2-way. Many of these checks are performed by TEAPAC when exporting to TRANSYT to validate the route definition, but not all possibilities are checked. The user must retain final responsibility for the proper definitions of routes. One basic check made by TEAPAC is that all nodes of the route exist in the current NODELIST and/or SUBSYSTEM, and that all of the nodes on the route are connected in the proper order.

- Route numbers can be referenced by use of negative numbers on the SUBSYSTEM command to quickly identify routes for analysis. For example, if ROUTE 1 is defined by an appropriate ROUTE command, a subsystem analysis for only this route can be created through the use of the SUBSYSTEM -1 command. Negative route numbers can also be used on the PLOTTSD and TIMINGPLAN commands to list only the nodes in the defined route.

## RTINFLUENCES 4*<Right Turn Influence>

Defaults: 4*YES
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the right turn influence condition for the right turns on each approach of the current intersection.

**<Right Turn Influence>** is a keyword describing the right turn influence condition, and can be any of the following:

| | |
|---|---|
| NO | right turn does not influence gap acceptance of opposing lefts. |
| YES | right turn does influence gap acceptance of opposing lefts (default). |

### *Notes*

- When an exclusive right-turn lane exists on an approach, the analyst can use this input to indicate whether traffic in the right-turn lane influences the permitted left-turn drivers' gap acceptance on the opposite approach. An entry of 'Yes' indicates this influence exists (default). The determination that the exclusive right-turn lane does not influence gap acceptance should be based on knowledge of local driver behavior, traffic conditions and intersection geometry.

## SATURATIONFLOWS 12*<Stream Saturation Flow>

| | |
|---|---|
| Defaults: | 12*0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Movement] |

The purpose of this command is to store the results of saturation flow rate computations for the current intersection. When computational commands like ANALYZE, EVALUATE, QUEUECALCS, GOVERCS and SERVICEVOLUMES are executed, the calculated saturation flows are dumped into this command dialog.

**<Stream Saturation Flow>** is the stream saturation flow resulting from the execution of computational commands such as ANALYZE and SERVICEVOLUMES, and can be any integer from 0 to 9999. Its default value is 0.

### *Notes*

- This command has no effect on any capacity analysis calculations. It is present only to receive values from a capacity analysis for export to a file in order to use these values in other third-party programs, particularly PASSER-II, TRANSYT, CORSIM, SYNCHRO, TRU-TRAFFIC and TS/PP-DRAFT.

- For exclusive left-turn lanes, the saturation flow rate for separate signal control should be used. If no exclusive turn-phase exists, TEAPAC will calculate the appropriate opposed saturation flow rate for TRANSYT7F versions earlier than Release 6.

- Release 3 of TRANSYT7F allows the entry of equivalent number of lanes rather than saturation flow, so TRANSYT can estimate the saturation flow with the system saturation flow rate (in vphg per lane). This is done by entering satflows of 500 or less. In order to prevent enabling the option inadvertently, satflows which are EXPORTed to TRANSYT are limited to be no less than 505 vphg, whether input or calculated as less than 505. In Release 4 and above, the only limit is that satflows must be 50 or greater, so non-zero satflows that are less than 50 are EXPORTed as 50 in Release 4 and above.

| **SAVE** | **<Line Number>** | **<File Number>** | **<List of Commands>** |
|---|---|---|---|
| Defaults: | next | next | [Parameters] |
| Menus/Groups: | [DataFiles] | | |

The purpose of this command is to save the current parameter values of the listed commands in permanent storage locations specified by the FILES command, for future retrieval with the LOAD command.

**<Line Number>** is the line number in the file where the first command in the list is to be saved, and can be any valid line number of the file less than or equal to 32767 (positive, negative or zero). Its default value is the "next line" of the file.

**<File Number>** is the order number of the desired file on the FILES command, and can be any integer from 1 to 5. Its default value is the "next file" in the file list.

**<List of Commands>** is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [Parameters] - all non-active commands for entry of parameters related to the analysis procedures.

### *Notes*

- The "next line" default is defined as the line number following the line of the file which was last accessed. This is usually the line number which follows the last information LOADed or SAVEd. When a FILES command is given, the "next line" for the specified file is automatically set equal to one. The "next line" can be changed by use of the NEXTLINES command.

- The "next file" default is defined as the file whose number is one greater than the file number currently in use. The keyboard and mouse should be considered file 0 for this purpose. Thus, the default file number for a SAVE from the keyboard is file #1. If a SAVE command is encountered in file #1, its "next file" default is file #2, etc.

- If <Line Number> is entered as 0, the SAVE will start at the "last line". The "last line" is defined as the last point in the file where file access was previously initiated. For example, LOAD 10 followed later by SAVE 0 will "re-SAVE" the information LOADed at line 10 (see detailed discussion of this subject in Chapter 7).

- SAVE will always put a RETURN command into the file after the last command of the list for subsequent LOADs.

- If the first parameter in <List of Commands> is [Parameters], then PROJECT, DESCRIPTION, NOTE, and RESET will be saved in the file at the specified line number, before the <List of Commands> and RETURN is saved. This is the case when the default condition is used.

- A negative <Line Number> of -n will start the SAVE at a point in the designated file n lines before the default "next line" of the file - i.e., SAVE -5 will start the SAVE five lines prior to the current "next line" of the file. Thus, SAVE -1 will SAVE <List of Commands> on top of the previously saved RETURN command, effectively appending the newly SAVEd information to the end of the previously SAVEd information.

## SEQUENCES <Sequence Code> <List of Possible Sequence Codes>

| | | |
|---|---|---|
| Defaults: | 11 | ALL |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [Basic] [Phasing] | |

The purpose of this command is to enter the desired and allowed phasings of the traffic signal of the current intersection according to the codes defined in Figure 1-2 of Chapter 1.

**<Sequence Code>** is a sequence code which represents the desired phasing, and can be any valid two-digit code, or -1 through -9. Its default value is 11 - two-phase operation.

**<List of Possible Sequence Codes>** is a list of two-character sequence codes which represent the possible phasings which are allowed, each of which can be any valid two-digit code, a two-character abbreviation for a list of codes, or ALL. Its default value is ALL - all possible sequence codes.

### *Notes*

- A LEADLAGS entry can be used in addition to the SEQUENCES entry for phasings which are not in the same order as shown in Figure 1-2. Use PERMISSIVES to add permitted left turns before or after protected left turn phases. Use OVERLAPS to designate right turn overlaps.

- Special abbreviation characters A-D can be used in place of codes 1-8 as shortcuts to represent common lists of phasing possibilities, as noted below:
  A represents codes 1-8
  B represents codes 1-6
  C represents codes 4-6
  D represents codes 7-8
  Thus, a list of 14 15 16 could be entered as a single code 1C, and a list of 11 21 31 41 51 61 could be entered as simply B1. Use DIAGRAMS * to view all the SEQUENCES listed for a given abbreviation made here.

- The use of SEQUENCES -1 through -9 requires use of PHASEMOVEMENTS to identify the movements for each phase, in which case DESIGN and HCSEXPORT cannot be used.

- SORT and TIMINGS re-arrange the <List of Possible Sequence Codes> so that the best or selected sequence code, respectively, is first, thus appearing as the <Sequence Code> entry. After TIMINGS, this makes the selected sequence code which goes with the phase timings available for a subsequent ANALYZE-type functions, as well as for export functions which require a single phasing and set of timings.

## SERVICEVOLUMES --

Defaults: --
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to compute the saturation flow rate (previously called service volumes) for each movement for the current intersection or all intersections. It has no parameters.

### *Notes*

- The computed saturation flow rates are in vehicles per hour of green time with 100% greentime assumed.

- When the SERVICEVOLUMES command is executed, the calculated saturation flows are entered into the SATURATIONFLOWS command automatically. After this action, the SATURATIONFLOWS can be SAVEd in a data file for use by other functions such as exporting to third-party programs.

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CYCLE commands or the TIMINGS command.

## SHOWPATHS <Distribution Type #>

| | |
|---|---|
| Defaults: | all defined types |
| Menus/Groups: | [Results] for Traffic Impact Analysis |

The purpose of this command is to display a schematic diagram of the development site and network, including defined assignment paths.

**<Distribution Type #>** is the distribution type number of a specific set of assignment paths which will be displayed on the diagram, and can be any integer number from -1 to 30, as described below:

1-150 - a selected type number.
0 - all defined PATHASSIGNMENTs (default).
-1 - display the network only.

### *Notes*

- <Distribution Type #> must not exceed the <# of Distribution Types> previously established by the SITESIZE command.

| | | | |
|---|---|---|---|
| **SIMULATION** | **<Steps/Cycle>** | **<Analysis Period>** | **<Stop Penalty>** |
| | **<Link Numbering Method>** | **<Model Actuated>** | |
| | **<Assignment Method>** | | |
| Defaults: | 300 | 15 | -1 |
| | TEAPAC | NO | |
| | Full | | |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [System] | | |

The purpose of this command is to enter simulation control parameters, including the length of the analysis period for all intersections under study.

**<Steps/Cycle>** is the number of increments each cycle will be divided into in a TRANSYT simulation, and can be any value from -300 to 300. The absolute value of the input is the number of steps per cycle. If the value is negative a step-wise simulation is performed; otherwise a standard link-wise simulation is performed. Its default value is 300. It is used for a TRANSYT export only.

**<Analysis Period>** is the length of the analysis period in minutes, and can be any integer from -999 to 9999. Its default value is 15. It may also be entered as a negative number whose positive value is the number of cycle lengths which define the analysis period. This entry controls both the analysis period of an exported simulation (ie, TRANSYT, CORSIM, etc.), and the analysis period of any capacity analysis which is performed by TEAPAC. The default analysis period prescribed by the *Highway Capacity Manual* is 15 minutes.

**<Stop Penalty>** is the stop penalty to be used in calculating the performance index of the TRANSYT simulation, and can be any value from -1 to 9999. Its default value is -1 to minimize fuel consumption. It is used for a TRANSYT export only.

**<Link Numbering Method>** is a keyword which describes which link numbering method will be used when creating links for TRANSYT, and can be any of the three following keywords:

| | |
|---|---|
| TEAPAC | links will be numbered using TEAPAC's normal numbering scheme, counting clockwise around the intersection starting with the right turn on the north approach (default). |
| TRANSYT | links will be numbered using the scheme described in the TRANSYT-7F user manual. |
| NEMA | links will be numbered using the alternate NEMA scheme described in the TRANSYT-7F user manual. |

**<Model Actuated>** is a keyword which describes whether any of the TRANSYT, PASSER or SYNCHRO actuated models should be used for actuated movements that are exported, and can be NO or YES. Its default is NO.

**<Assignment Method>** is the default method to be used to assign upstream volumes to downstream links if not specified on a NETWORK entry, and can be FULL or LIMITED. Its default value is FULL. It is used for a TRANSYT export only.

### *Notes*

- If the analysis period is anything other than the default of 15 minutes, VOLUMES should be entered as the flow rates in vehicles per hour during this period and PEAKHOURFACTORS should be entered as 1.0.

- Release 6 of TRANSYT-7F requires that if PPD diagrams are to be produced, the "TRANSYT" scheme of numbering links must be used. If PPDs are not used, the link numbering scheme is not important to the TRANSYT model, and the default "TEAPAC" method is recommended. This is not a problem with Release 7 and higher due to the card type 3 introduced in this release.

- If NEMA is used, the "primary network direction" will be assumed East-West for TRANSYT.

- For Release 7 and higher of TRANSYT-7F a card type 3 will be produced to describe the link numbering scheme selected.

- If <Model Actuated> is NO for an Export to Synchro, the Recall-To-Max setting will be used to disable the actuated behavior of Synchro.

- The use of the TRANSYT and PASSER actuated models which are used to simulate actuated movements can be quite confusing, and may lead directly to erroneous results and misinterpretations of the results if not clearly understood by the user. On the other hand, the ACTUATIONS input makes it quite simple to implement these models without knowledge of the consequences. In light of this dilemma, the <Model Actuated> input can be used to disable the TRANSYT and PASSER actuated models, regardless of the ACTUATIONS inputs, and disabling these models is the default and recommended condition.

- When exporting to third-party programs, it is normally the desire to use average timings for actuated signals in these programs, so this is the default action of the EXPORT command. In order to accomplish this, signal timings must be entered By-Movement, and normally the GREENAVERAGES dialog is populated automatically by the ANALYZE or DESIGN commands for a 2016 HCM analysis. For programs which are capable of modeling actuated operation in some fashion from data exported by TEAPAC (such as Synchro, TRANSYT or PASSER), the GREENAVERAGES are exported instead of GREENTIMES (maximum settings) and the actuated operation is disabled by setting recall-to-max, as necessary (ie, Synchro). If the normal actuated model of the third-party program is desired, this should be selected with the <Actuated> setting of the SIMULATION dialog, in which case GREENTIMES will be exported.

- If the GREENAVERAGES values are intended to be used for EXPORT per the discussion above, but the GREENAVERAGES all have values of zero, the GREENTIMES values will be used instead, with a warning message to that effect. Normally this situation can be addressed by using the ANALYZE command for 2016 HCM to compute the average green times prior to EXPORT. However, if the EXPORT is specifically intended to represent maximum timings instead of average phase durations, then the GREENAVERAGES can be set to zero intentionally to achieve this effect.

## SITESIZE <# of Distribution Types> <# of Inbound Types>

| | | |
|---|---|---|
| Defaults: | 0 | 0 |
| Menus/Groups: | [Parameters] [TrafficImpact] | |

The purpose of this command is to enter the number of distribution types to be used to describe the inbound and outbound traffic generation.

**<# of Distribution Types>** is the total number of inbound and outbound distribution types which will be used to define the distribution of trips generated into and out of the site, and can be any integer from 0-150 (see note below). Its default value is 0; it must be entered before any distribution information can be entered.

**<# of Inbound Types>** is how many of the total distribution types are to be used to define those trips which are destined for the site. These will be the first of the total distribution types, the remainder of which will be declared outbound types. It can be any integer from 0-150, and less than or equal to the <# of Distribution Types>. Its default value is 0.

### *Notes*

- The SITESIZE command must be virtually the first command entered when defining a study network and generator, since no generator or assignment commands can be entered until the SITESIZE of the study is defined.

- The maximum size of the study depends on the licensed Usage Level of the program. Usage Level 1 allows up to 50 distribution types, while Usage Level 2 allows up to 100 distribution types, and Usage Level 3 allows up to 150 distribution types.

- In the Manual Mode, <# Inbound Types> does not need to be entered. If it hasn't been entered, its default value will be one-half of the total number of distribution types, set only after <# of Distribution Types> is first entered. Its value cannot exceed the entered <# of Distribution Types>.

- It is possible to declare 0 distribution types on the SITESIZE command so that all subsequent calculations only apply to defined non-site VOLUMES and appropriate growth VOLFACTORS. This is particularly useful when calculating non-site volumes separately from a set of cumulated multi-site volumes, in order to separate the non-site volume definitions completely from any of the site traffic.

- The SITESIZE command can specify that all of the declared distribution types are either all inbound or all outbound. This effectively increases the number of inbound or outbound distribution types in a single calculation from a maximum of 75 to a maximum of 150 (in the largest distribution Usage Level). All types in a given calculation can be inbound, followed by a cumulated calculation of all outbound types.

## SORT <Priority> <Output>

| | | |
|---|---|---|
| Defaults: | GOVERCS | YES |
| Menus/Groups: | [Results] for Signal Analysis | |

The purpose of this command is to display the DESIGNed sequence codes and performance levels in order from best to worst performance as previously DESIGNed for the current intersection.

**<Priority>** is a keyword describing the parameter with the highest priority, and can be any of the following:

CYCLES - minimum successful cycle.
GOVERCS - minimum required G/C (default).

**<Output>** is a keyword describing whether or not output will be displayed, and can be any of the following:

NO - do not display output.
YES - display output (default).

### *Notes*

- A DESIGN must be completed before a SORT command can be implemented.
- The SORT command will re-order the SEQUENCES list according to the order of the sort, thus the sequence code which is SORTed to the top of the list will be the first sequence code displayed in the SEQUENCES input dialog.
- A SORT command can be issued at any time following a DESIGN, even if intervening commands like TIMINGS, ANALYZE, HELP, DATA, etc. have been issued. Since SORT displays more DESIGN information than the DESIGN progress report itself, and is much faster than DESIGN since no new computations are performed, issuing SORT several times at various points following DESIGN is more practical than re-DESIGNing.

## STARTUPLOST 12*<Startup Lost Time>

Defaults: 12*2.0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Movement]

The purpose of this command is to enter the length of the lost time at the beginning of a movement's green period for each of the twelve movements of the current intersection.

**<Startup Lost Time>** is the number of seconds which is not used at the beginning of a movement's green period, and can be any number from 0.0 to 30.0. Its default value is 2.0.

### *Notes*

- STARTUPLOST time is used in conjunction with ENDGAIN time to calculate the lost time that an individual movement experiences during its green phase(s). The formula used from the *Highway Capacity Manual* is $t_L=l_1+l_2$, where $l_1$ is the startup lost time, $l_2$ is the ending lost time; and $l_2=Y-e$, where e is the endgain time. These values are coded directly on the appropriate RT 29 entries for TRANSYT.

- If the default values of STARTUPLOST and ENDGAIN (both are 2 seconds) are used for a particular movement, the lost time formula simplifies to $t_L=Y$. Since Y values (yellow plus all-red time) are typically in the range of 4-6 seconds, this default condition may result in lost times considerably higher than the default lost time value of 3.0 seconds which was used in the 1985 and 1994 *Highway Capacity Manuals*. When this is the case, users should expect less effective green time for these movements versus those used in comparable 1985 and 1994 analyses, which will result in higher v/c and delay values, and thus likely worse levels of service.

**STOP** **<Next Program>**

Defaults: --
Menus/Groups: [Control]

The purpose of this command is to stop running the current program and optionally run a new program.

**<Next Program>** is the name of another program which is to be run following the end of the current program, and can be any valid program name. Its default value is blanks; no program will be run following the end of the current program.

### *Notes*

- <Next Program> may also include a file name to be used by the named program.

- The command QUIT may be used in the Manual Mode as an alias command to represent the STOP command. It cannot be used in any <List of Commands> entries such as with ASK or HELP.

## STORAGE 12*<Storage Distance>

Defaults: 12*0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Movement]

The purpose of this command is to enter the amount of storage distance for queued vehicles for each of the twelve movements of the current intersection.

**<Storage Distance>** is the distance, in feet, which can be used to store a queue of vehicles without obstructing vehicles in other lane groups or at other intersections, and can be any integer from 0 to 9999. Its default value is 0.

### *Notes*

- The storage distance is used to calculate the queue ratios in the *Highway Capacity Manual* back of queue analysis, as well as in the QUEUECALCS calculation of various queue model results. If no storage distances are entered, the queue calculations will report the queues only in terms of vehicles per lane and feet per lane, without storage ratios.

- The appropriate field for the queue capacity entry on TRANSYT's RT 28 is filled in, as calculated from the STORAGE, LANES and TRUCKPERCENTS entries.

- Release 8 and beyond of TRANSYT-7F reduce the queue capacity which is input by 20%, purportedly for consistency with step-wise simulation, but it is not apparent that this reduction is appropriate for link-wise simulation (which is the assumed model for a TRANSYT Export). Thus, the calculated queue capacity is inflated by 20% (divided by 0.80) so that the automatic 20% reduction by TRANSYT results in the correct queue capacity, as input by the user.

- The length of turn bays is coded in the appropriate field of CORSIM's RT 11, as defined by the STORAGE entries. Previously, this field always carried a default value of 250' which is still the default field value if no STORAGE value is entered. The field value is also limited according to CORSIM limits: 20' minimum and 1000' maximum. The user must also be aware of a maximum value called effective link length which is determined by CORSIM at run time.

## SUBSYSTEM 500*<Node Number>

| | |
|---|---|
| Defaults: | 500*0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [ExportImport] [System] |

The purpose of this command is to enter the subset of the NODELIST for which subsequent actions should be taken.

**<Node Number>** is a unique number assigned to each intersection on INTERSECTION command, and can be any integer from 0 to 9999 or the negative value of any defined route number. Its default value is 0.

### *Notes*

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- The SUBSYSTEM command allows a subset of the complete NODELIST to be defined for subsequent analysis. This means that the entire network (up to 500 intersections) may be defined in the TEAPAC network, then only the pertinent signals are ANALYZEd or DESIGNed. This allows for extremely efficient testing of various potential subsystem boundaries when using TRANSYT. Single intersection analyses with TRANSYT may also be executed using SUBSYSTEM to select only one signal.

- Like NODELIST, the entry of a 0 node in the SUBSYSTEM list will terminate the SUBSYSTEM list of nodes and zero out any subsequent nodes in the list.

- In Usage Level 2, SUBSYSTEM can be as many as 100 nodes in length. In Usage Level 3, SUBSYSTEM can be as many as 500 nodes in length. In Usage Level 1 SUBSYSTEM is limited to 12 nodes.

- When in the Visual Mode or using the ASK command to enter the SUBSYSTEM, the actual list can be entered only once. After this entry, the list must be modified one intersection at a time with the edit buttons of the SUBSYSTEM dialog. When entering the SUBSYSTEM this first time, type no more than 80 characters per entry, using ampersands (&) to continue long entries to subsequent entry lines.

- The order of entries on SUBSYSTEM has no effect on the order that the intersections are analyzed. The NODELIST defines this order.

- Route numbers can be referenced by use of a negative number on the SUBSYSTEM command to quickly identify a route for analysis. For example, if ROUTE 1 is defined by an appropriate ROUTE command, a subsystem analysis for only this route can be created through the use of the SUBSYSTEM -1 entry.

## SUMMARIZE --

Defaults: --
Menus/Groups: [DataFiles]

The purpose of this command is to display a formatted summary of all [Parameters] values. It has no parameters.

### *Notes*

- SUMMARIZE is similar in function to DATA, but provides better column organization and section headings, where DATA only lists the current data values for each command. DATA, on the other hand, allows selection of which command's data to view, and can sometimes save time, whereas SUMMARIZE will always display all data values.

## TIMINGPLAN <List of Nodes>

Defaults: <Nodelist>
Menus/Groups: [Results] for Export and Import

The purpose of this command is to display the phasing and timings defined for each intersection in the list of nodes, including the system offset value.

**<List of Nodes>** is a list of node numbers to be displayed, and can be any number in the specified NODELIST, or the negative value of any defined ROUTE number. Its default value is all nodes in the NODELIST or SUBSYSTEM, in the specified order.

### *Notes*

- VOLUMES must be defined for each intersection in order that the phasing diagram which is displayed shows the actual movements which move during each phase. The NETWORK, WIDTHS and SATURATIONFLOWS need not be entered for TIMINGPLAN to operate properly.

- Route numbers can be referenced by use of negative numbers on the TIMINGPLAN command to quickly identify routes for display. For example, if ROUTE 1 is defined by an appropriate ROUTE command, a TIMINGPLAN for this route can be created through the use of the TIMINGPLAN -1 command.

## TIMINGS <Sequence Code> <Output>

| | | |
|---|---|---|
| Defaults: | -1 | TIMINGS |
| Menus/Groups: | [Results] for Signal Analysis | |

The purpose of this command is to retrieve the optimum timings for the sequence code specified from previously DESIGNed results for the current intersection.

**<Sequence Code>** is a two-digit sequence code, and can be either a sequence code or position code, as follows:

Sequence Code: 11, 12, 13 thru 88.
Position Code: -1, -2, -3, etc
(default -1, the first entry of the SEQUENCES list)

**<Output>** is a keyword describing what type of output display is desired, and can be any of the following:

| | |
|---|---|
| NONE | - no output is displayed. |
| TIMINGS | - only timings output displayed (default). |
| DIAGRAM | - display timings & phasing. |

### *Notes*

- The TIMINGS command is the link between the DESIGN and ANALYZE commands. Not only does it display the optimum timings which have been generated by DESIGN, but it also moves the selected phasing to the top of the SEQUENCES list and inputs these timings, in seconds, into the GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CRITICALS commands. This means that TIMINGS xx followed by ANALYZE is a simple way to generate a capacity analysis of optimum timings for sequence xx.

- If a negative sequence code is given, the absolute value of the number is taken to represent the position of the desired sequence code in the SEQUENCES list. Thus, a -3 entry will produce optimum timings for the third sequence code in the SEQUENCES list.

| **TRUCKCOUNTS** | **<Movement or Time>** | **<List of Counts>** |
|---|---|---|
| Defaults: | none | (zeros) |
| Menus/Groups: | [Parameters] [CountAnalysis] | |

The purpose of this command is to enter the count of trucks for a count interval or movement number at the current intersection.

**<Movement or Time>** is the movement number or the beginning time of the time interval for the counts to be entered, and can be any of the following:

1-12 (Movement number), or
0-2400 (Beginning time)

This parameter has no default value, and must be entered each time the TRUCKCOUNTS command is used.

**<List of Counts>** is the list of counted trucks for the specified movement number or time interval, and can be any number from -999 to 9999. Its default value is 0, e.g., it must be entered.

### *Notes*

- Movement numbers begin with the north leg right-turn and proceed clockwise around the intersection. If a movement number is given for the first parameter, the counts should be for that movement only, one for each interval in each of the periods. If a time is given, twelve counts for each of the movements at that time should follow. Use of the movement number option is limited to the Manual Mode only.

- Usually, for capacity analysis purposes, vehicles with 6 or more tires or 3 or more axles should be considered trucks (heavy vehicles).

- All counted trucks entered by this command may either be included or not included in the counts on the VEHICLECOUNTS command. This is determined by the second parameter of the COUNTTYPE command.

- Truck counts may not exceed 9999. Input should always be no more than four digits. If cumulative counts are made with five-digit counters, only enter the last four digits. When cumulative counts are being reduced, if the difference is negative (the counter turned over the 9999 mark to 0000), TEAPAC automatically adds 10,000 to the negative result.

## TRUCKPERCENTS 12*<Truck-Through Bus Percentage>

| | |
|---|---|
| Defaults: | 12*2 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [Basic] [Movement] |

The purpose of this command is to enter the truck and through bus (heavy vehicle) traffic percentage for each movement of the current intersection.

**<Truck-Through Bus Percentage>** is the percentage of trucks and through buses in each movement volume, and can be any number from 0 to 99.9. Its default value is 2.0.

### *Notes*

- TRUCKPERCENTS includes any designated "heavy vehicles", as defined by the *Highway Capacity Manual*.

| TYPE | <Type Number><br><Distribution Factor> | <Generation Base> | <Description> | <Generation Rate> |
|---|---|---|---|---|
| Defaults: | 0 | 1.000 | | 0 |
| | 0 | | 30-blanks | |
| Menus/Groups: | none | | | |

The purpose of this command is to enter the generation and distribution characteristics of each distribution type of traffic to be assigned in the network. This command should only be used to read information from an old version of SITE and then converted immediately to TEAPAC's current input methods. It should not be used for normal input of a new site study.

**<Type Number>** is the number assigned to the traffic TYPE, and can be 0-150 (see note below). It has no default value; it must be entered.

**<Generation Base>** is the base development size to which the traffic generation rate is applied, and can be any integer from -9999 to 32767. Its default value is 0.

**<Generation Rate>** is the trip generation rate to be applied to the generation base, and can be any number from -9.99 to 99.99. Its default value is 1.000.

**<Distribution Factor>** is the percentage of the total traffic created by the generation base and rate that is attributable to this type, and can be -100 to 100 percent. Its default value is 0.

**<Description>** is a 30-character description of the type of traffic defined by this type, and can be any 30 alphabetic or numeric characters. Its default value is 30 blanks.

### *Notes*

- <Type Number> may not exceed the <# of Distribution Types> previously established by the SITESIZE command.

## UPSTREAMVC 4*<Upstream v/c Ratio>

Defaults: 4*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [Approach]

The purpose of this command is to enter the v/c ratio of the upstream intersection for each approach of the current intersection.

**<Upstream v/c Ratio>** is the v/c ratio of the upstream intersection, and can be any number from 0.0 to 3.0. Its default value is 0.

### *Notes*

- Note that although many intersections in a network may be entered into TEAPAC, the upstream v/c is a user entry and is not determined by the program based on conditions in other parts of the network.

## URBANSTREET --

Defaults: --
Menus/Groups: [Results] for Signal Analysis

The purpose of this command is to perform an urban street facility capacity analysis of specified conditions for the current SUBSYSTEM or all intersections.

### *Notes*

- Before this command can be properly executed, the intersection and link/segment conditions, including phasing and timings, must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES, REDCLEARTIMES and CYCLE commands, or the TIMINGS command following a DESIGN. Link/Segment data is entered primarily with the NETWORK entry.

## UTILIZATIONS 12*<Lane Utilization Factor>

Defaults: 12*0.00
Menus/Groups: [Parameters] [SignalAnalysis] [Movement]

The purpose of this command is to enter the lane utilization factor for each movement of the current intersection.

**<Lane Utilization Factor>** allows the specification of non-uniform lane usage, and can be any number from 0.00 to 1.00. Its default value is 0.00 (see below).

### *Notes*

- If an input value of 0.00 is made (the default), this indicates a desire by the user for the *Highway Capacity Manual* default values to be used.

- Specifying a value of 1.00 indicates the desire to evaluate the overall performance of the lane group, not the heaviest-traveled lane of the lane group.

- Lane utilizations are used to determine the adjusted saturation flow rate for use in the v/c and delay calculations, as well as queues. As such, caution should be used in applying lane utilization factors substantially less than 1.00 since in these cases the analysis is only valid for the heaviest-traveled lane (not the entire lane group), and this aspect of the analysis may be overlooked by those looking at the analysis summary.

| **VEHICLECOUNTS** | **<Movement or Time>** | **<List of Counts>** |
|---|---|---|
| Defaults: | none | (zeros) |
| Menus/Groups: | [Parameters] [CountAnalysis] | |

The purpose of this command is to enter the count of vehicles for a count interval or movement number at the current intersection.

**<Movement or Time>** is the movement number or the beginning time of the time interval for the counts to be entered, and can be any of the following:

1-12 (Movement number), or
0-2400 (Beginning time)

This parameter has no default value, and must be entered each time the VEHICLECOUNTS command is used.

**<List of Counts>** is the list of counted vehicles for the specified movement number or time interval, and can be any number from -999 to 9999. Its default value is 0, e.g., it must be entered.

### *Notes*

- Movement numbers begin with the north leg right-turn and proceed clockwise around the intersection. If a movement number is given as the first parameter, the counts should be for that movement only, one for each interval in each of the periods. If a time is given, twelve counts for each of the movements at that time should follow. Use of the movement number option is limited to the Manual Mode only.

- If the truck COUNTTYPE is INCLUDED, all counted vehicles should be included in these entries, including any trucks specified by the TRUCKCOUNTS command. If the truck COUNTTYPE is SEPARATE, VEHICLECOUNTS should be all vehicles except trucks, which will be entered only on the TRUCKCOUNTS command.

- Vehicle counts may not exceed 9999. Input should always be no more than four digits. If cumulative counts are made with five-digit counters, only enter the last four digits. When cumulative counts are being reduced, if the difference is negative (the counter turned over the 9999 mark to 0000), TEAPAC automatically adds 10,000 to the negative result.

## VOLADDITIONALS <AddFactor> 12*<Additional Volume>

| | | |
|---|---|---|
| Defaults: | 0.00 | 12*0 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [TrafficImpact] [ExportImport] [Basic] [Movement] | |

The purpose of this command is to enter the factor and additional volume to be added for each movement at the current intersection.

**<AddFactor>** is the factor which is multiplied by each <Additional Volume> entered to get the total additional volume added to each movement, and can be any number from 0.0 to 20.0. Its default value is 0.00 (no additional volumes added).

**<Additional Volume>** is a volume of additional traffic to be added to the entered volumes, as adjusted by the <AddFactor>, and can be any number from -9999 to 9999. Its default value is 0.

### *Notes*

- Normally <AddFactor> will have a value of 0.0 or 1.0 to disable or enable, respectively, any <Additional Volumes> which have been entered, without the need to actually change the <Additional Volume> entries. This feature makes it easy to add and remove additional volumes from an analysis. <AddFactor> may also be used as a multiplier for the <Additional Volumes> for easy testing of incremental values of additional volumes.

- When results are ROUNDed, the VOLADDITIONALS entry for an individual movement which results may take on a negative value if the original VOLUME entry is rounded down and little or no new volume is assigned to that movement. This is appropriate, and to be expected.

- See the discussion in Appendix C (Calculation of Volumes) for a complete discussion of how VOLUMES, VOLFACTORS, VOLADDITIONALS and PEAKHOURFACTORS are used to generate analysis volumes for various types of analyses within TEAPAC.

**VOLFACTORS <# Years> 12*<Adjustment Factor>**

| | | |
|---|---|---|
| Defaults: | 1 | 12*1.00 |
| Menus/Groups: | [Parameters] [SignalAnalysis] [TrafficImpact] [CountAnalysis] [ExportImport] [Basic] [Movement] | |

The purpose of this command is to enter number of times to compound and each multiplier used for each movement to adjust the volume or count data entered at the current intersection.

**<# Years>** is the number of times (years) to compound each multiplier, and can be any positive integer from 1 to 99. Its default value is 1 (no compounding).

**<Adjustment Factor>** is a multiplier used to adjust the movement volumes or counts input to the program, and can be any number from 0.0 to 9.99. Its default value is 1.00 (no adjustment).

### *Notes*

- If a number greater than one is entered for the <# Years>, the <Adjustment Factor> will be taken as an annual growth factor for entered traffic volumes or counts, applied for each of the years entered. For example, if the growth rate is 2 percent per year over 3 years, a VOLFACTORS 3 1.02 entry would be made to effect a 1.0612 adjustment to entered volumes or counts (=1.02 x 1.02 x 1.02).

- The use of VOLFACTORS will adjust all volumes displayed in the output reports by the specified factors. It will not change the volume or count values entered. This is a convenient way to adjust traffic count data for seasonal variations in count data or to apply a projected growth factor

- VOLFACTORS can also be used to project growth of traffic at the intersection, for example, if the count is several years old and must be used for a current study or to project a future volume condition.

- See the discussion in Appendix C (Calculation of Volumes) for a complete discussion of how VOLUMES, VOLFACTORS, VOLADDITIONALS and PEAKHOURFACTORS are used to generate analysis volumes for various types of analyses within TEAPAC.

## VOLUMES 12*<Design Hour Volume>

Defaults: 12*0
Menus/Groups: [Parameters] [SignalAnalysis] [TrafficImpact] [CountAnalysis] [ExportImport] [Basic] [Movement]

The purpose of this command is to enter the turning and through movement volumes for each of the movements of the current intersection.

**<Design Hour Volume>** is the demand volume for the analysis period, in vehicles per hour, for the movement, and can be any integer from 0 to 9999. Its default value is 0.

### *Notes*

- A volume of 0 indicates the movement is prohibited at the intersection - allowed movements with no measured activity should show at least 1 vehicle per hour.

- Entered demand VOLUMES will always be adjusted by the entered PEAKHOURFACTORS as a means of estimating the peak flow rate during the analysis period. When the analysis period is the default of 15 minutes (0.25 hours, set on the SIMULATION command), this means that an entered volume divided by the peak hour factor will estimate the flow rate during the peak 15 minute analysis period for each movement. If 15-minute data is available directly (e.g., from count data), using this 15-minute data (the 15-minute count times 4) with peak hour factors of 1.00 is preferred over making the approximation using a peak hour factor. In particular, if different peak hour factor data is entered for each individual movement, the estimate will likely produce a fictitious set of analysis flow rates which may represent flow conditions which never occur since all the movements may not peak at the same time.

- See the discussion in Appendix C (Calculation of Volumes) for a complete discussion of how VOLUMES, VOLFACTORS, VOLADDITIONALS and PEAKHOURFACTORS are used to generate analysis volumes for various types of analyses within TEAPAC.

| **WARRANTS** | **<MUTCD Version>** | **<Warrant Type>** | **<56% Rule>** |
|---|---|---|---|
| Defaults: | 2009 | Both | No |
| Menus/Groups: | [Results] for Count Analysis | | |

The purpose of this command is to perform a signal warrant analysis and/or multi-way stop warrant analysis using the methods prescribed in the *Manual on Uniform Traffic Control Devices* (MUTCD).

**<MUTCD Version>** is the version of the MUTCD which is to be used when performing the signal warrant analysis, and can be any of the following:

| | |
|---|---|
| 1988 | 1988 MUTCD signal warrant analysis. |
| 2000 | 2000 MUTCD signal or stop warrant analysis. |
| 2003 | 2003 MUTCD signal or stop warrant analysis. |
| 2009 | 2009 MUTCD signal or stop warrant analysis (default). |

**<Warrant Type>** is the type of warrant analysis to be performed, and can be any of the following:

| | |
|---|---|
| Signal | 1988, 2000, 2003 or 2009 MUTCD signal warrant analysis. |
| Stop | 2000,2003 or 2009 MUTCD multi-way stop warrant analysis. |
| Both | both analyses, if 2000, 2003 or 2009 MUTCD is selected above (default). |

**<56% Rule>** is whether the combination of percentage reductions in the Combination of Warrants (1C) should be allowed for the 2000/2003/2009 MUTCD signal warrant analysis. It can be any of the following:

| | |
|---|---|
| No | do not allow the combination of percentage reductions. |
| Yes | allow the combination of percentage reductions (default). |

### *Notes*

- The warrant analysis is based on the traffic counts which have been entered, as well as the intersection CONDITIONS which have been entered.

- In 2002 FHWA issued a ruling that the intent of the 2000 MUTCD was to eliminate the so-called '56% rule' which was used in the 1988 MUTCD. This situation occurs in a signal warrant analysis when a high-speed or low population approach (70% factor) is analyzed with the Combination of Warrants (1C, 80% factor). In the 1988 MUTCD, the two factors can be combined (56% factor result). FHWA's ruling clarified the intent of the 2000 MUTCD to disallow the combination of factors, however, in the 2003 MUTCD this ruling was reversed, effectively nullifying the change intended in the 2000 MUTCD. The 2009 MUTCD is the same as the 2003 MUTCD in this regard. As such, the default value of <56% Rule> enables the combination of factors under these conditions. Initial versions of WARRANTS2000 did not have this option, and used an implied Yes for

<56% Rule>. If a 2000 MUTCD analysis is to be performed in strict adherence to the intent of the 2000 MUTCD, <56% Rule> should be set to No.

## WIDTHS 12*<Lane Group Width>

Defaults: 12*0
Menus/Groups: [Parameters] [SignalAnalysis] [TrafficImpact] [ExportImport]
[Basic] [Movement]

The purpose of this command is to enter the width of the lane group for each movement of the current intersection.

**<Lane Group Width>** is the width, in feet, of the lane group for each movement, and can be in the range of 0.0 - 60.0 feet. Its default value is 0.0 feet.

### *Notes*

- The <Lane Group Width> entry for a lane group should include the width of pavement that is used by moving traffic, and should not include the width of any pavement which is used exclusively by parked vehicles.

- Widths for turning movements should be entered only if the approach has exclusive turning lanes. If no exclusive turning lanes exist, the turns will be made from the adjacent through lane group.

- Turning movements which turn from both exclusive turn lanes and shared through lanes should make use of the GROUPTYPES entry to define this condition which TEAPAC calls dual optional lane usage.

- Values for LANES are automatically generated each time a new lane width is given on a WIDTHS command. The number of lanes generated is defined by the tens digit of the approach width (in feet). Approach widths of less than ten feet and greater than zero are assumed to have one lane. Thus, usage of the LANES command is necessary only for those lanes where this assumption of number of lanes is not appropriate.

- An error is generated during analysis functions like ANALYZE and DESIGN if the calculated average lane width is less than 8.0 feet. No extrapolation is allowed below this limiting value.

## YELLOWTIMES 8*<Phase Yellow Time>

Defaults: 8*0.0
Menus/Groups: [Parameters] [SignalAnalysis] [ExportImport] [Basic] [Phasing]

The purpose of this command is to enter the yellow change interval at the end of each phase of a specified phase sequence, or optionally for each of the movements, of the current intersection.

**<Phase Yellow Time>** is the duration of the yellow change interval after each phase or movement in seconds or seconds/second, and can be any number from 0 to 900. Its default value is 0.0 seconds.

- If the list of YELLOWTIMES is preceded by the keyword 'Movmt', then each of the entered values will be interpreted as timings for individual through and left turn movements, clockwise around the intersection. If not, or the optional keyword 'Phase' is used, each value is for the phases defined by the SEQUENCE code.

- When entering or viewing controller timings, a Convert button appears on the YELLOWTIMES dialog which allows the user to select the style of entry or view, either 'By Phase' which is the traditional HCM 2000 method, or 'By Movement' which is the HCM 2016 method and similar to the way timings are used on NEMA and other dual-ring controllers. If any timings are present, they will be converted to the other format at the same time, including YELLOWTIMES and REDCLEARTIMES if the GREENTIMES dialog is displayed, and vice versa. When timings are Converted, the conversion will also include reviewing the allowed SEQUENCES list and moving the appropriate sequence code to the top of the list according to the timings present.

- It is important to make sure that YELLOWTIMES, REDCLEARTIMES and REQCHANGE+CLEARS entries are always kept consistent with each other, especially when converting Timings by Phase to Timings by Movement and when exporting to third-party, ring-based software.

- 'By Movement' timings are not allowed when special phasings represented by negative SEQUENCE codes are used.

- If entering YELLOWTIMES by phase, they must be entered in the order of the phases as specified in the SEQUENCES and LEADLAGS commands.

- All-red time may be included in the YELLOWTIMES command, or entered separately in the REDCLEARTIMES command.

- If all YELLOWTIMES are entered in seconds/second, the first cycle length of the CYCLES command will be used to convert the phase clearance times to seconds. Normally, YELLOWTIMES should be entered in seconds. If all entries are greater than or equal to 1.0, they are assumed to be seconds; if all entries are less than 1.0, they are assumed to be seconds/second.

- In order to calculate lost times for each movement, YELLOWTIMES must be available for each phase or movement. If they are not entered, a default lost time of 4 seconds will be used.

- If a signal is to be double-cycled, GREENTIMES, YELLOWTIMES, REDCLEARTIMES (and OFFSETS) must be entered in seconds (not sec/sec) which sum to 1/2 the system cycle.

APPENDIX C

# Analysis Methods and Formulations

Appendix C Topics

The sections which follow describe calculation methods and formulations which are application-specific, as well as computational procedures which the user might perform in using TEAPAC to its fullest potential.

## Appendix C Topics:



## Calculation of Volumes Used In TEAPAC Analyses

Volume is a variable used in virtually all traffic engineering analyses. TEAPAC provides a particularly flexible way of describing volume such that some of the specialized calculations which are often performed can be done quickly, efficiently and accurately. The underlying methods to describe volume that are used by all TEAPAC application functions are described below.

In the simplest form, a user enters volumes (V) for each intersection movement with the VOLUMES dialog and these volumes are used in any subsequent analyses which requires a measure of traffic demand. These volumes are provided in vehicles per hour and frequently they represent the average hourly flow rate (or equivalently, the hourly count) for the hour to be analyzed. Since the *Highway Capacity Manual* (HCM) dictates that the normal analysis period is to be 15 minutes, the PEAKHOURFACTORS entry (PHF) is then used to estimate the flow rate (v) during the peak 15 minutes of the hour for which the average hourly volume is entered.

$v = V / PHF$ (Eq. 1)

where: $v$ = analysis flow rate during peak 15 minutes of the hour (vehicles per hour)
$V$ = entered average hourly VOLUME during the hour (vehicles per hour)
PHF = 15-minute peak hour factor (ratio of average flow to peak 15-minute flow)

If the actual peak 15-minute flow rate (vph) is known and entered as the VOLUMES entry (e.g., a 15-minute count multiplied by four), then the PEAKHOURFACTORS entry should be set to 1.0 so that $v = V$ above and the entered VOLUME will become the analysis flow rate.

In order to facilitate sensitivity and alternative analyses, the VOLUMES entry can be modified by two other related entries. First, the VOLFACTORS entry can be used to multiply each VOLUMES entry by a factor. This is simply a multiplicative factor, either to inflate or deflate the entered volume. It is entered in such a way that it can also be interpreted as a growth factor if such an interpretation is appropriate. First, a number of years (N) is entered which applies to all VOLFACTORS for the intersection, then individual factors ($f_V$) are given for each movement. The entry for number of years (N) is actually the number of times the individual factors ($f_V$) will be compounded, in which case the entered factor ($f_V$) can be more generally interpreted as a periodic growth factor and the number of years (N) can be interpreted as the number of periods which the growth factor ($f_V$) is compounded.

$V' = V * (f_V ** N)$ (Eq. 2)

where: $V'$ = factored average hourly volume for analysis (vehicles per hour)
$V$ = entered average hourly VOLUME during the hour (vehicles per hour)
$f_V$ = entered VOLFACTORS adjustment factor (for each N periods)
$N$ = entered VOLFACTORS number of periods to compound the $f_V$ factor

If a simple inflation or deflation factor is all that is required, the number of years should be entered as N = 1, in which case $V' = V * f_V$ above. In any case, V' is used in place of V in Eq. 1 above.

A second volume adjustment entry can be made via the VOLADDITIONALS dialog. This is an additive value above and beyond the adjustment described above for VOLFACTORS. First, a factor ($f_{add}$) is entered which applies to all additional volumes for the intersection, then individual additional volumes ($V_{add}$) are given for each movement. In its simplest form, the factor entered is either 0 (zero) or 1 (one) to either exclude or include the additional volumes given, respectively. This makes it easy to leave the additional volume entries but remove and/or re-include them in the analysis with a single factor entry. In its broadest application, the entered factor ($f_{add}$) can be used to inflate or deflate the additional volume entries ($V_{add}$) by the factor entered. In any case, as above, V' is used in place of V in Eq. 1 above.

$V' = V + V_{add} * f_{add}$ (Eq. 3)

where: $V'$ = adjusted average hourly volume for analysis (vehicles per hour)
$V$ = entered average hourly VOLUME during the hour (vehicles per hour)

$V_{add}$ = entered VOLADDITIONALS additional volume
$f_{add}$ = entered VOLADDITIONALS adjustment factor

Thus, in the most general form, the demand volumes used for an analysis are determined using the following formula:

$$v = (V * (f_V ** N) + V_{add} * f_{add}) / PHF \quad \text{(Eq. 4)}$$

where:
- $v$ = analysis flow rate during peak 15 minutes of the hour (vehicles per hour)
- $V$ = entered average hourly VOLUME during the hour (vehicles per hour)
- $f_V$ = entered VOLFACTORS adjustment factor (for each N periods)
- $N$ = entered VOLFACTORS number of periods to compound the $f_V$ factor
- $V_{add}$ = entered VOLADDITIONALS additional volume
- $f_{add}$ = entered VOLADDITIONALS adjustment factor
- PHF = 15-minute peak hour factor (ratio of average flow to peak 15-minute flow)

The count analysis functions of TEAPAC can determine peak-hour or peak-15-minute volumes from entered traffic count data using the PEAKANALYZE function. For count analysis functions, entered VOLUMES and VOLADDITIONALS are ignored by PEAKANALYZE and the results of the peak analysis are placed in the VOLUMES entries automatically. VOLFACTORS are applied to the traffic count data as 'growth' or 'seasonal' adjustment factors, thus the resulting automatic VOLUMES entries have these same VOLFACTORS removed so that the calculation of analysis volumes from the general formula above (Eq. 4) will result in the same peak volumes determined by the PEAKANALYZE function. For example, if count data is analyzed with a VOLFACTORS growth factor of 10% ($f_V$ = 1.10 and N = 1) and results in a peak volume of 110 vph, the corresponding VOLUMES entry will be set to 100 vph so that the VOLFACTORS entry will inflate the VOLUME to 110 for analysis. PEAKHOURFACTORS are also set according to the specification of the OUTPUT dialog, as are TRUCKPERCENTS. VOLADDITIONALS entries are unaffected by the PEAKANALYZE results.

The traffic impact analysis functions of TEAPAC can estimate future volumes due to the impact of certain specified development scenarios. For these functions, the VOLUMES entries are used as the background traffic for the complete scenario assessment by the COMPUTEPATHS function, including the effect VOLFACTORS has on these background VOLUMES. VOLADDITIONALS, however, have no effect on the computations, and the results of the traffic impact analysis computations are placed in the VOLADDITIONALS entries automatically (with the contribution of VOLUMES and VOLFACTORS removed) so that the calculation of analysis volumes from the general formula above (Eq. 4) will result in the same volume scenario determined by the COMPUTEPATHS function. For example, if a counted movement VOLUME is 100 and the background traffic growth VOLFACTORS entry is 1.10 ($f_V$ = 1.10 and N = 1), resulting in 110 vph projected background traffic, and the computed total traffic for that movement under a given development scenario is 250 vph, the VOLADDITIONALS entry will be 140 vph (with $f_{add}$ = 1.0) so that the computed analysis volume for subsequent analyses will result in 250 vph.

In summary, analysis volumes are computed for performance assessments and design functions as the combination of entered volumes (VOLUMES), 'growth' factors (VOLFACTORS) and additive volumes (VOLADDITIONALS), and adjusted by peak hour factors (PEAKHOUR-FACTORS). VOLUMES and PEAKHOURFACTORS (and TRUCKPERCENTS) can be determined directly by a count analysis of traffic count data, including the effect of 'growth' or 'seasonal' factors (VOLFACTORS) and ignoring any entered VOLUMES, PEAKHOURFACTORS or VOLADDITIONALS (or TRUCKPERCENTS). VOLADDI-TIONALS can be determined directly by TEAPAC's traffic impact analysis functions for development scenarios, including the effect of 'growth' factors (VOLFACTORS) on any entered VOLUMES and ignoring any entered VOLADDITIONALS. This process makes for a completely seamless integration of all of the TEAPAC application functions with respect to consistent traffic volumes used by each function and the contribution that each function might have to the determination of the components of the total analysis volume.

## Appendix C Topics (for Signal Analysis):



## HCM Calculations (for Signal Analysis)

TEAPAC's signal analysis calculations adhere strictly to the methods, formulations and computational procedures of the 2000 and 2016 *Highway Capacity Manuals* (HCM). This includes the calculation of saturation flow, capacity, v/c, queues, delay, travel speed, stop rate and level of service, with all of their associated factors.

The following sections describe additional calculations above and beyond those described in the *Highway Capacity Manual*, as well as computational procedures which the user might perform in using the program to its fullest potential.

## Important Considerations for HCM 2016 Calculations (for Signal Analysis)

The calculations of the 2016 *Highway Capacity Manual* (HCM) differ significantly from those of prior HCM's, particularly with regard to treatment of actuated behavior. This includes the calculation of saturation flow, capacity, v/c, queues, delay and level of service, with all of their associated factors. It is important that users of earlier versions of the HCM and/or TEAPAC are aware of these differences, especially as to how they affect the calculations differently than before.

## Capacity Analysis

The big change in the HCM 2016 for signals is explicit modeling for actuated signals. The impact of this change in approach on the use of TEAPAC *Complete* 2016 is not insignificant. On the surface, all you have to do to produce a 2016 capacity analysis is select 2016 in the Edit-System-Output dialog for Signals before using Results-Analyze. However, you'll want to strategize a little more about exactly what you want the analysis to produce in relation to what is on the street. Here are some important thoughts on that subject – please read them and try to grasp how this will affect what you see in the results.

First, the HCM 2016 signal model is now inherently an actuated model, so the ACTUATIONS input is paramount. If all ACTUATIONS entries are No, then the analysis will be quite similar to an HCM 2000 analysis – the GREENTIMES entered will be used as phase maximums and Recall-to-Max will be employed to effect the fixed-time operation. However, if any of the ACTUATIONS entries are Yes, then the actuated model will kick in, with significantly different results than with HCM 2000. Primarily, the conditions entered will be used to estimate the average phase durations before delays and queues are computed, and the cycle length entered will be primarily irrelevant (unless GREENTIMES are entered in sec/sec or the signal is coordinated), and the average cycle length will be computed and displayed in the capacity analysis along with the average phase times. This can have a very significant effect on the results as compared to HCM 2000 where the cycle length was always assumed fixed and the average phase times were assumed equal to the timings entered – splits can change considerably due to gapping out, and delays and queues can be reduced dramatically due to lower average cycles. Pay close attention to the average cycle length and average phase durations, especially as they compare to the entered CYCLE and GREENTIMES.

Defaults exist for all of the actuated inputs that are required to model actuated control, but it will be desirable to make sure these defaults make sense and are at least reasonably consistent with conditions in the field or as anticipated. Probably the most important of these is PASSAGETIMES, which defaults to 2.0 sec in HCM 2016 (3.0 sec in HCM 2000). The new default value for PASSAGETIMES in TEAPAC 2016 is 0.0 sec, which tells the program to use the default for the HCM selected, but prior data files may have a non-zero value entered which will override the default and possibly cause inconsistent results in comparison to problems entered from scratch with the new program. Another important consideration in this regard will be the detector size which is entered in the Edit-Movements menu using FIRSTDETECTS and LASTDETECTS.

A signal is designated as an uncoordinated signal in TEAPAC by entering 0 (zero) as the coordination reference phase in the Edit-Phasing-Offset dialog. This is the new default in TEAPAC 2016 – it used to be 1, but really didn't matter in HCM 2000. Now it matters big time! If the signal is coordinated (ref phase >0, and this is probably the case in many old TEAPAC files), then the CYCLE input is assumed to be the coordinated background cycle, and the actuated model will estimate actuated phase durations, with any early release time accumulating in the coordinated phase until the coordinated cycle completes, rather than allowing the next cycle to begin as it does if it is an uncoordinated signal. Thus, the reference phase entry is now crucial in regards to how the average cycle length will be determined and how the average phase durations are distributed in this cycle – check the reference phase entry in Edit-Phasing-Offset and make sure it is appropriate for your conditions!

You'll find a number of new results in the Capacity Analysis Summary (HCM 2016) (see Appendix D example) that will be useful, not the least of which is a graphical bar diagram showing the average green duration distribution for all phases in both rings. For example, the Summary now includes the satflow and capacity. If you want to delve into more details of the analysis you can select the Basic worksheet option in Edit-System-Output for Signals to produce some of the details.

## Optimization

Optimization is as easy for the 2016 HCM as it was for the 2000 HCM - with 2016 selected in the Edit-System-Output dialog for Signals, simply use the Results-Design menu to optimize individual signal timings, as before. However, there are a lot more moving parts in a 2016 capacity analysis as compared to 2000, as described above, so since TEAPAC optimizes critical movement HCM delay with repetitive capacity analyses at the heart of the optimization, there are a lot more things to be aware of that will impact the speed and effectiveness of the optimization. The most significant thing to be aware of is that optimization will invariably take longer for 2016 than users are used to for 2000, so a few simple steps should be taken to produce optimized results as quickly as is practical.

The easiest thing that can be done is to limit the cycles to be tested and to make judicious choices about what phasings to be considered. Especially for a first-cut analysis, start the cycle range with a cycle that is rational and implementable (not too small), and use a coarse cycle increment up to another rational upper bound cycle (not too large). For 2000, a common and rather arbitrary range like 40 to 240 in increments of 5 or 10 seconds was typical; for 2016 something like 60 to 150 in increments of 30, or 80 to 160 in increments of 40 would be a more prudent range to use to significantly reduce the optimization time.

As far as phasing go, several options are available. First, for the 2016 method, there is no distinction between sequence codes 4, 5 & 6, so these are automatically merged into a single optimization for sequence code 4 and the results are then interpreted as either 4, 5 or 6, as appropriate. This immediately reduces the maximum number of phasing to optimize down from 64 to 36 without the need for any user adjustment. Further, if certain phasings are simply not in the realm of consideration, then they can be excluded to save time - this might apply to sequence codes 1, 2 & 3 where protected phasing is not provided to all movements, or to sequence codes 7 & 8 which involve operation that is sometimes considered atypical. On the other hand, it is always useful to optimize these phasings at least once to determine whether they have any merit in contrast to the 'normal' 4, 5 & 6 - it makes good sense to perform an initial optimization that includes all sequences for a broad range of cycles with a coarse cycle increment to get a feeling for what sequences and cycles might make sense to achieve certain critical levels of service, then perform a more precise optimization for a limited range of sequences and cycles. The special sequence code abbreviation characters A, B, C & D can be used effectively in this effort - use AA for all 36 codes, BB to exclude split phase and lead-lag, and CC (or simply 44) to only consider standard, eight-phase, lead-only operation. Read more about the special sequence code abbreviation characters in the manual or help dialog for the Sequences input dialog.

It is also important to be aware of the impact that a number of actuated control input variables can have on interpreting optimization results. For example, for actuated signals that are not coordinated, the cycle length provided for optimization will be for the sum of the maximums in each ring, but the average cycle for operation and the capacity analysis will frequently be less than the sum of the maximums, and the difference between the optimized cycle and the average cycle can have an important impact on interpreting the optimization results. (Remember that a coordinated signal is defined by the existence of a reference phase number for the Offset dialog entry.) Similarly, values input for Recall such as Min or Max can have a profound effect on the ability of the optimizer to achieve the desired target delays and levels of service, much like how input Minimums can have a similar effect for the 2000 method. Another phenomenon to consider is that a low-volume movement may frequently gap out, preventing the optimizer from giving it enough average green time for longer cycles to achieve a desired delay target.

Lastly, since the HCM 2016 method is inherently an iterative procedure that uses many iterations to determine the average phase durations (and thus the additional time required for optimization), there will be circumstances where the capacity analysis iterations can work at cross-purposes against the optimization iterations and prevent the kind of precise target delay optimizations that we've been accustomed to in TEAPAC for the 2000 HCM. We will continue to work to speed up the unique TEAPAC optimizer that allows the user to target specific delay for non-priority critical movements, while at the same time improving the precision that is achieved for the target delay. In the meantime, note that optimization for the HCM 2000 method is still in place, as before, and can be used prior to either an HCM 2000 or HCM 2016 capacity analysis.

## Optimization Scheme (for Signal Analysis)

The default optimization strategy of TEAPAC's signal analysis is to produce an optimized capacity analysis by setting the phase timings such that each of the 'critical' movements of each phase have approximately the same delay values (and thus the same level of service), whenever possible. By accomplishing this, no time can be taken from one phase and given to another without disrupting this balance of delay. One condition which may prevent this objective from being fully achieved is when such optimal green times do not provide enough time to meet designated minimum green times. Another is when the critical movements are over-saturated.

An important observation is that this strategy is not intended to minimize the overall delay of the intersection, and in many cases will not. The reasoning for this is straightforward: In a simple case where a major street intersects a minor street with a two-phase signal, the imbalance in street volumes will inherently favor the main street with regard to the overall intersection delay, and to an extreme which is not appropriate and clearly not "optimal." For example, if the main street has volume of 1,000 vph on it and the side street has 100 vph, an optimization of intersection delay will force the delay value of the side street ten times higher than the main street since the main street volume is ten times higher than the side street and the intersection delay is the weighted-average delay (weighted by volume). Thus, if the main street experienced 20-35 seconds of delay (LOS C), then the optimum side street timing would cause 200-350 seconds of delay for side-street vehicles! Clearly this is not appropriate or optimal. This argument holds true for other "minor" movements at the intersection, such as left turn phases for either the main street or side street. As such, TEAPAC provides a unique optimization strategy that balances the delay of the critical movements, so that this inappropriate allocation of greentime does not occur. This is the default optimization strategy, but others can be selected, as described in a following section.

Sub-topics for this section:



## Defining Priority Movements for an Optimization (for Signal Analysis)

The optimization strategy described above is the default scheme which treats all critical movements with equal priority. As a default, this must be the case, since it is beyond the scope of the program to identify priority movements on its own. On the other hand, quite often it is both desirable and appropriate to specify certain movements within an intersection which are to receive some degree of priority treatment, while maintaining a certain minimum level of performance on all other critical movements which are not priority movements. This process is described below.

The EXCESS command can be used to define movements which are to receive priority treatment during the optimization process. These priority movements are defined simply by listing their movement numbers on the EXCESS command. For example, if the northbound through movement is the most important movement during the P.M. peak, movement 8 can be entered as the EXCESS movement. In this case, if the target delay as defined by the first LEVELOFSERVICE command entry is met for all critical movements, all remaining time will be allocated to the phase which serves movement 8 (the northbound through movement).

If the default LEVELOFSERVICE entry of 35 seconds of delay (LOS C) is used, this means that if all of the critical movements can be operated at LOS C, then the optimum timings will be set such that each critical movement except movement 8 will experience 35 seconds of delay and all remaining time will be allocated to the phase that serves movement 8. This will be reflected in a subsequent capacity analysis showing the intended imbalance in delays among the critical movements, all being nominally 35 seconds except the priority movement 8 having less delay.

The significance here is that the delay of the non-priority critical movements can be specifically targeted, with all extra time beyond that target going to the priority movements. Note that if the target delay is not met, then the EXCESS movement(s) are ignored and all critical movements are allocated time intended to balance the delays of the critical movements at a value worse than the target level of service.

The effect of defining priority movements can be exaggerated by raising the target delay on the LEVELOFSERVICE command. For example, even if LOS C can be achieved for the critical movements but the north and south through movements must be further prioritized, a higher target can be selected with a LEVEL D entry and the movements can be prioritized with a EXCESS 2 8 entry, all followed by DESIGN/SORT/TIMINGS/ANALYZE (or just DESIGN 1). In this case, the phase(s) serving movements 2 and 8 will receive all of the excess time above LOS D performance and the non-priority critical movements will receive nominally 55 seconds of delay (LOS D). This strategy might be used, for example, in a case where additional time is desired for the main street for progression purposes, but a specific limiting delay or level of service is to be established for the minor critical movements (a unique feature of TEAPAC in comparison to other software). This strategy might also be a standard option for signals being timed along a state highway route.

### Oversaturation Considerations (for Signal Analysis)

When conditions are oversaturated at an intersection, the basic objective of balancing delay for the critical movements is frequently not appropriate or even desirable. When this is the case, or any time the maximum delay/LOS of the LEVELOFSERVICE entry is exceeded, TEAPAC reverts to a different optimization policy. The new policy is to balance the v/c values of the critical movements rather than the delay values. The oversaturated design policy is invoked any time the critical movement delay of the DESIGN becomes worse than the maximum delay allowed. This is represented by LOS V or S in the DESIGN and SORT tables. LOS V is when a v/c target is achieved. LOS S is primarily intended to indicate "S"aturation as the design policy when the maximum v/c is exceeded.

It must be recognized, however, that this policy may not produce sensible results, depending on the nature of the oversaturation. For example, if a single left turn at the intersection is substantially oversaturated, say with 350 vehicles in a single left turn lane, but all other movement volumes are well within reasonable limits for their geometrics, all of the other movements will be made to suffer with limited greentime allocation in TEAPAC's attempt to allocate enough greentime to the single offending left turn and to balance either the delay or the v/c. In this case, it may make more logical sense to let the single left turn fail miserably while the remainder of the intersection performs reasonably. This is a strategy which can only be handled by manual optimization by the user. The bottom line here is that no single optimization strategy will make sense for all over-saturated conditions, and the user should review the results of over-saturated optimization carefully to make sure the results are sensible and that all constraints such as minimum green times have been met.

Note also that the user can invoke the v/c balancing optimization policy at any time simply by selecting 0 as the target delay on the LEVELOFSERVICE command.

## Calculation of Queues (for Signal Analysis)

TEAPAC's signal analysis functions calculate queue lengths according to the methods dictated by the 2000 and 2016 *Highway Capacity Manual* (HCM), as well as several other queueing models, as described in this section. Any one of the models described can be selected through use of the QUEUEMODELS command so that its results are displayed in the results produced by the ANALYZE and EVALUATE commands. The results of all of the queue models can be produced side-by-side by using the QUEUECALCS command in a manner that allows quick comparison of all of the models.

The purpose of this QUEUECALCS report is to first illustrate that the queue models which have been used over the years deliver widely varying results, and thus cannot all be valid under all conditions. This is intended to lead the user to the conclusion that a robust queue model is needed that can be relied upon under a wide range of conditions, with the clear suggestion that the 2000 HCM model (now superceded by the 2016 HCM model) is that robust model. In this regard, the HCM queue model takes into account the effects that all of the following conditions have on queueing: volume of demand, actual green time, cycle length, saturation flow, capacity, v/c, maximum extent of queue on pavement, coordinated operation, actuated operation, unbalanced lane utilization, protected-permitted operation, over-saturation, upstream v/c, initial queues, length of analysis period, average storage length of queued vehicles and various percentile estimates.

Secondly, the QUEUECALCS result allows quick comparison of the 2000 and 2016 HCM model results to more familiar, historical models so users can become comfortable with the HCM model in that light. It is anticipated that over time the HCM model will become the model of choice, and as such, the HCM Model #1 is the default model of TEAPAC.

TEAPAC calculates queues using four basic model structures: the 2000 HCM model, the ARRB model, the MBQ model, and the SIGNAL97 model. Several variations of these models are computed, as described below, bringing the number of models calculated to eight. The basis of the variations revolve around whether the average or percentile queue value is calculated, and whether constant or user-input vehicle spacings are used. The following tabulates the characteristics of each of the eight models used, followed by a detailed description of each model.

| | |
|---|---|
| 1 - HCM | 2000 or 2016 HCM, MBQ, Worst Lane. XXth Percentile Queue |
| 3 - ARRB | ARRB, MBQ, Worst Lane, 95th Percentile Queue |
| 4 - HCM | 2000 or 2016 HCM, MBQ, Worst Lane, Average Queue |
| 6 - MBQ | Historical MBQ, Average Lane, Average Queue |
| 7 - S97E+ | SIGNAL97 Evaluate+, MQL, Average Lane, XXth Percentile Queue |
| 8 - S97A+ | SIGNAL97 Analyze+, MQL, Average Lane, XXth Percentile Queue |
| 9 - S97E | SIGNAL97 Evaluate, MQL, Average Lane, 90th Percentile Queue |
| 10 - S97A | SIGNAL97 Analyze, MQL, Average Lane, 90th Percentile Queue |

In the following discussions, the term “maximum back of queue” (MBQ) is used to indicate the maximum extent of queued vehicles back from the stop bar, and the term “maximum queue length” (MQL) is used to indicate the maximum number of vehicles in queue. It must be understood that the MBQ value refers to a point on the pavement where the last queued vehicle is located, and when it is described in vehicles per lane it is meant to describe that position on the pavement ‘as if’ that number of vehicles were actually standing in line from the stop bar back to that point, when in reality it is the only queued vehicle, since all other previously queued vehicles have already re-started. The MBQ inherently occurs at a point in time somewhat after the end of red, since time must pass in order for all prior queued vehicles to depart. In contrast, the MQL inherently occurs exactly at the end of the red period, since this is when the greatest number of queued vehicles will exist. It can also be said that for a given percentile, the MBQ value will always exceed the MQL value.

A variable of general concern in all of the queue models is whether the queue value is determined for the worst lane or the average lane of a multi-lane lane group. The worst lane is the lane of the lane group with the highest volume, as defined by the lane utilization factor. Each model is specifically for one or the other of these conditions.

Another variable of general concern is whether the queue model calculates an average queue value, or a percentile queue value. The average queue means that if the queue of concern was observed in the field N times, the calculated value would be an estimate of the average of those N observations (the sum of all observations divided by N). A percentile queue value means that for all observations, the given percentage of the observations would be equal to or less than the calculated value. For example, in 50 observations, the 90th percentile is the 45th highest observed queue. Some models which predict percentile queues have a fixed percentile value, while others have a limited range of allowed percentiles, and the SIGNAL97 enhanced model allows any percentile.

In some cases the queue value or distance occupied cannot be computed or cannot be displayed for one of several possible reasons. In these cases, asterisks ‘*****’ are displayed. For example, for grossly oversaturated conditions, the calculated length of a given queue (in feet) may exceed the integer arithmetic used which has a maximum of 32,767 feet (over six miles!). Also, in Models 7 & 8 where the Poisson distribution is used, the factorial portion of the formula may exceed the computational limits of the computer when queues approach one mile in length.

Sub-topics for this section:



## 2000 and 2016 HCM Queue Model (for Signal Analysis)

Models 1 and 4 use the maximum back of queue (MBQ) model defined by the 2000 and 2016 *Highway Capacity Manual*, each using different assumed conditions, as follows. Model 1 is the percentile queue for the worst lane in a lane group, and Model 4 is the average queue for the worst lane in a lane group. In both cases, the worst lane is defined by the lane utilization factor used. The complete documentation for this model can be found in Appendix G of the 2000 *Highway Capacity Manual* and Chapter 31 of the 2016 *Highway Capacity Manual*. The 2000 calculations can be observed in the HCM Back of Queue Worksheet which is produced when the worksheet output is selected. The percentile values used are the percentile values allowed by the HCM which are closest to those which are requested by the user. The allowed percentiles are 70%, 85%, 90%, 95% and 98% for 2000 (85%, 90% and 95% for 2016), meaning that when a given percentile is calculated, it is expected that that percentage of all of the observed queues will be the calculated value or less. The distance back from the stop bar is determined using the queued vehicle length inputs made by the user.

Note that the first publication of the 2000 HCM allowed the computation of an average lane queue even if an unequal lane utilization factor was used to calculate saturation flow rates. A published amendment to the 2000 HCM now restricts the computation of a queue to match the lane utilization factor used for saturation flow rates. Previous versions of SIGNAL2000 calculated these queues as Models 2 and 5, which have since been eliminated.

## ARRB Queue Model (for Signal Analysis)

Model 3 uses the maximum back of queue (MBQ) model defined by the Australian Road Research Board, as implemented in the SIDRA5 model. The complete documentation for this model can be found in the SIDRA5 manual. It is the 95th percentile queue for the worst lane in a lane group, meaning that it is expected that 95% of all of the observed queues will be the calculated value or less. The distance back from the stop bar is determined using the queued vehicle length inputs made by the user.

## MBQ Queue Model (for Signal Analysis)

Model 6 uses the maximum back of queue (MBQ) model from standard queueing theory. It is the average queue for the average lane in a lane group, meaning that it is expected that about half of all of the observed queues will be the calculated value or less. The distance back from the stop bar is determined using the queued vehicle length inputs made by the user.

$$Q_n = q * r / (1-v/s) / N$$

where:
- $Q_n$ = number of vehicles in queue per lane
- $q$ = arrival rate (vehicles per second)
  = v/3600
- $v$ = adjusted volume (vehicles per hour)
- $s$ = adjusted saturation flow rate (vehicles per hour of green)
- $r$ = time that is not effectively green (seconds), e.g., "effective red time"
  = C * (1-g/C)
- $C$ = cycle length (seconds)
- $g$ = effective green time (seconds)
- $N$ = number of lanes in lane group

$$Q_l = L_c * T_f * Q_n$$

where:
- $Q_l$ = length of queue per lane(feet)
- $L_c$ = average queued spacing between car front bumpers (feet)

$Q_n$ = number of vehicles in queue per lane (from above)
$T_f$ = truck length factor
= $1 + (L_t/L_c - 1) * HV/100$
$L_t$ = average spacing between truck front bumpers (feet)
HV = percent trucks/heavy vehicles (%)

## SIGNAL97 Queue Model (for Signal Analysis)

Models 7, 8, 9 and 10 use the maximum queue length (MQL) model as defined in the SIGNAL97/TEAPAC program. These models have also appeared in the earlier versions of SIGNAL97: SIGNAL94, SIGNAL85 and SIGNAL. The computations are made according to standard queuing theory, commonly referred to as the "red time formula", since the basis of the model is the calculation of the number of arrivals during the red time of each cycle, q*r. It is the percentile queue for the average lane in a lane group, meaning that it is expected that that percentage of all of the observed queues will be the calculated value or less.

Models 9 and 10 use an adjustment factor of 2.0 as a means of estimating the 90th percentile queue, and the queued distance for automobiles and trucks is assumed to be 25 and 40 feet, respectively. These are the strict models found in SIGNAL97 (S97E and S97A). Models 7 and 8 use the same models as 9 and 10, respectively, but calculate the percentile queue for the percentile input by the user based on actual cumulative Poisson arrival probabilities (not a 2.0 factor), and the queue distances are estimated using the queued vehicle length inputs made by the user (not 25 and 40 feet). Thus, Models 7 and 8 are called the 'Enhanced' SIGNAL97 models (S97E+ and S97A+).

Model 10 is the queue model produced by the SIGNAL97 ANALYZE command and displayed in the Capacity Analysis Summary report of SIGNAL97. This formulation does not account for oversaturated conditions, but merely the number of arrivals expected during the red time. The fixed randomness factor of 2.0 approximates this queue length within a 90 percent level of confidence. The formula used is listed below. Note that in SIGNAL97 the $Q_n$ portion of the model is not on a per-lane basis (divided by N) as it is in TEAPAC. The TEAPAC model divides by N for a per-lane value so it can be compared to the HCM models which are all on a per-lane basis.

$$Q_n = 2.0 * q * r / N$$

where: $Q_n$ = number of vehicles in queue per lane
2.0 = 90th percentile randomness factor (Poisson distribution estimate)
q = arrival rate (vehicles per second)
= v/3600
v = adjusted volume (vehicles per hour)
r = time that is not effectively green (seconds), e.g., "effective red time"
= C * (1-g/C)
C = cycle length (seconds)
g = effective green time (seconds)

$N$ = number of lanes in lane group

When the subject movement is a protected-permitted left turn, the q*r portion of the formula is obtained from the Supplemental Delay Worksheet using the largest such value from the worksheet.

$$Q_l = L_c * T_f * Q_n$$

where:
- $Q_l$ = length of queue per lane(feet)
- $L_c$ = average queued spacing between car front bumpers (feet) = 25 feet, constant for Model 9 and 10
- $Q_n$ = number of vehicles in queue per lane (from above)
- $T_f$ = truck length factor = $1 + (L_t/L_c - 1) * HV/100$
- $L_t$ = average spacing between truck front bumpers (feet) = 40 feet, constant for Model 9 and 10
- HV = percent trucks/heavy vehicles (%)

Model 8 is the same queue model as Model 10 above, with the exception that it calculates the percentile queue for the percentile input by the user based on actual cumulative Poisson arrival probabilities (not a 2.0 factor), and the queue distances are estimated using the queued vehicle length inputs made by the user (not 25 and 40 feet), and thus it is called the 'Enhanced' SIGNAL97 ANALYZE model (S97A+).

Models 9 is the queue model produced by the SIGNAL97 EVALUATE command and displayed in the Evaluation of Intersection Performance report of SIGNAL97. When conditions are undersaturated, the model is the same as Model 10 above. However, when conditions are over-saturated ($X > 1.0$), the following formula is used for $Q_n$ to account for number of over-saturated arrivals in the analysis period. Note that in SIGNAL97 the $Q_n$ portion of the model is not on a per-lane basis (divided by N) as it is in TEAPAC. The TEAPAC model divides by N for a per-lane value so it can be compared to the HCM models which are all on a per-lane basis.

$$Q_n = [2.0 * q * r + T * v * (X-1)] / [X * N]$$

where:
- $Q_n$ = number of vehicles in queue per lane
- 2.0 = 90th percentile randomness factor (Poisson distribution estimate)
- q = arrival rate (vehicles per second) = v/3600
- v = adjusted volume (vehicles per hour)
- r = time that is not effectively green (seconds), e.g., "effective red time" = C * (1-g/C)
- C = cycle length (seconds)
- g = effective green time (seconds)
- T = length of analysis period (hours)
- X = v/c = Volume/Capacity ratio

c = capacity (vehicles per hour)
N = number of lanes in lane group

As with Model 10 (ANALYZE), when the subject movement is a protected-permitted left turn, the q*r portion of the formula is obtained from the Supplemental Delay Worksheet using the largest such value from the worksheet.

Model 7 is the same queue model as Model 9 above, with the exception that it calculates the percentile queue for the percentile input by the user based on actual cumulative Poisson arrival probabilities (not a 2.0 factor), and the queue distances are estimated using the queued vehicle length inputs made by the user (not 25 and 40 feet), and thus it is called the 'Enhanced' SIGNAL97 EVALUATE model (S97E+).

## Important Differences Between SIGNAL85 and SIGNAL2000 (for Signal Analysis)

Several differences between SIGNAL85 and SIGNAL2000 (as well as between SIGNAL85 and both SIGNAL94 and SIGNAL97) are important to note for prior users of SIGNAL85. Further, because of the inherent compatibility between SIGNAL85, SIGNAL94, SIGNAL97 and SIGNAL2000 and the evolution of the 1985 *Highway Capacity Manual* (HCM) to the 2000 HCM, a common effort will be to re-execute analyses that were previously done with SIGNAL85, SIGNAL94 or SIGNAL97 with the SIGNAL2000 program. This is easily accomplished due to the upwards compatibility of data files between the programs using the File-OpenMerge/Shared menu (or the LOAD * SHARE command), but several points are worth making to help guide this process. The following discusses these issues. In this section, the signal analysis functions of TEAPAC can be considered as equivalent to the SIGNAL2000 descriptions.

Sub-topics for this section:

- New Default Values (for Signal Analysis)
- Use of SERVICEVOLUMES and GOVERCS Commands (for Signal Analysis)
- Calculating and Saving Saturation Flow Rates (for Signal Analysis)
- Processing Time for DESIGN (for Signal Analysis)

### New Default Values (for Signal Analysis)

Several input variables have new default values in SIGNAL94, SIGNAL97 and SIGNAL2000 in comparison to SIGNAL85. These new defaults are consistent with the default values suggested by the 1994, 1997 and 2000 HCMs. For a new analysis, these variables take on their new default values automatically when the analysis starts, but this is not true when a SIGNAL85 data file is Opened or LOADed. This is because the default values from SIGNAL85 are stored in the data file along with other user entries, and thus will be LOADed as real data, thus over-riding the SIGNAL2000 defaults. The five command entries which are affected in this way are IDEALSATFLOWS, UTILIZATIONS, ARRIVALTYPES, REQCHANGE+CLEARS and PEDLEVELS. IDEALSATFLOWS now default to 1900 pcphgpl instead of 1800, UTILIZATIONS now default to 0.0 instead of 1.0 so that the HCM defaults are used, ARRIVALTYPES now default to type 3 for all movements (including left turns), REQCHANGE+CLEARS now default to 4.0 seconds instead of 3.0, and PEDLEVELS default to 0 peds per hour instead of LOW (which equals 50 per hour). If the SIGNAL2000 defaults are desired for a SIGNAL85 analysis LOADed from a SIGNAL85 file, they must be specifically set to their default values in some fashion to over-ride the old defaults read from the SIGNAL85 file.

The easiest way to do this is to use the RESET command for the commands whose values are to be set to their 1994/1997/2000 HCM defaults. For example, if the IDEALSATFLOWS and UTILIZATIONS are to be set to 1994/1997/2000 HCM defaults after a SIGNAL85 file is LOADed, issuing the following command will accomplish this:

[DataFiles] → **RESET IDEALS UTILIZ**

## Use of SERVICEVOLUMES and GOVERCS Commands (for Signal Analysis)

Another significant change brought about by the new 1994/1997/2000 HCM methods is that saturation flow rates and g/C requirements can no longer be specified independently of the specific phasing and timings which are being used at an intersection. For example, the satflow of a permitted left turn is now explicitly dependent both on the phasing of the opposing through movement and the timing of that phasing. With regards to SIGNAL2000, this means that the SERVICEVOLUMES and GOVERCS commands are no longer independent of the phasing and timings (as they were in SIGNAL85), and now require specific SEQUENCES, GREENTIMES, YELLOWTIMES and REDCLEARTIMES entries to be made before they can be run. In this sense SERVICEVOLUMES and GOVERCS must be used in the Analyze Mode like ANALYZE and EVALUATE, instead of the Design Mode like DESIGN.

## Calculating and Saving Saturation Flow Rates (for Signal Analysis)

In the same line of discussion as the previous section, saturation flow rates can no longer be calculated by the DESIGN process alone for the SATURATIONFLOWS command to be SAVEd in a file. This is because DESIGN may not know a specific phasing or timings for which these satflows should be calculated, since it is generally optimizing a wide range of phasings and cycle lengths. Thus, now an Analyze Mode command such as ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES or GOVERCS must be issued before new SATURATIONFLOWS are calculated to be used by other functions. Note that the SATURATIONFLOWS which are calculated for left turns reflect the type of phasing used: for protected or protected-permitted phasings the SATFLOWS reflect the protected-phase satflows, while a permitted-only phasing calculates the permitted satflows. This is consistent with the SATFLOW values expected by the export functions of TEAPAC.

## Processing Time for DESIGN (for Signal Analysis)

Prior users of SIGNAL85 may note that SIGNAL2000 can take a considerably longer time to effect a complete DESIGN optimization, particularly when saturated conditions and/or permitted phasings are allowed. This is due to the substantially more complex dependence of optimum phase times on the timing and phasing of other movements at the intersection involved in the 1994/1997/2000 HCM methodology, and is unavoidable. Optimization times will be very manageable on typical computers using current technology, but can be much longer on less modern computers. The following offers several options to speed things up in these cases.

Cycle length limits and increments should be selected judiciously since the amount of optimization time is directly proportional to the number of cycles attempted. Arbitrarily small increments of CYCLES should be avoided unless specifically necessary. For example, 40..140..10 will deliver virtually the same information as 40..140..5 in one half the time.

If permitted-only operation is specifically not acceptable in certain situations for safety and/or policy reasons, optimization time can be significantly improved by eliminating sequence codes 1, 2 and 3 from the SEQUENCES list. For example, in a fully-actuated signal where all left turn phases are expected to be actuated on the average, selecting the following SEQUENCES list will speed up the DESIGN process while at the same time eliminating permitted-only operation on any approach.

[Basic] → **SEQUENCES 44 44 45 46 54 55 56 64 65 66**

or

[Basic] → **SEQUENCES 44 CC**

## Important Differences Between SIGNAL2000 Ver 1 and Ver 2 (for Signal Analysis)

Several differences between SIGNAL2000 Version 1 and Version 2 are important to note for prior users of Version 1. These differences also apply to older SIGNAL programs (SIGNAL85, SIGNAL94, SIGNAL97) if a user has occasion to read these older data files into Version 2. Reading data from any of these older programs, including Version 1, is easily accomplished due to the upwards compatibility of data files between the programs using the File-OpenMerge/Shared menu (or the LOAD * SHARE command), but several points are worth making to help guide this process. The following discusses these issues. In this section, the signal analysis functions of TEAPAC can be considered as equivalent to the SIGNAL2000 Ver 2 descriptions.

Sub-topics for this section:

Processing Time for DESIGN (for Signal Analysis)

## Managing Multiple Intersections (for Signal Analysis)

All prior versions of SIGNAL handled a single intersection in an analysis and File-Save placed this single intersection in a single data file, resulting in a large number of data files and independent analyses for projects with multiple intersections and/or multiple scenario conditions. This was dictated by the methods of the *Highway Capacity Manual* (HCM) and the historical way of managing data for HCM analyses.

SIGNAL2000 Version 2 has a multi-intersection data structure, in that multiple intersections can be entered and stored in a single data file. The list of intersections is managed with a NODELIST entry which lists all the available intersection numbers which have been used, and the INTERSECTION entry which selects the 'current' intersection from the NODELIST. The current intersection is the one for which data entry will be accepted and for which analysis functions like DESIGN and ANALYZE will be made. The current intersection can be selected by clicking on it in the graphical network view, by using the drop down list in the INTERSECTION dialog, or by 'walking' through the NODELIST with the +/- buttons found on the main toolbar and relevant entry dialogs. The current intersection is displayed in the status bar at the bottom of the main window.

New intersections can be added to the network by first adding it with the NODELIST dialog, then selecting it from the INTERSECTION drop-down list (or typing it in the INTERSECTION combo box). As a shortcut, the new intersection number can be typed (with a description) in the INTERSECTION combo box, in which case the user will be prompted with an option to add the intersection to the end of the NODELIST automatically.

INTERSECTION 0 is a selection which represents all intersections in the NODELIST. When this is selected, certain actions like ANALYZE and DESIGN 1 will be performed for all intersections. Certain other actions like SORT, TIMINGS and HCSEXPORT are not valid when INTERSECTION 0 is selected, as these actions can pertain to only a single intersection.

Several additional entries assist in managing the activities which surround multi-intersection analyses. The SUBSYSTEM entry can be used to select a group of intersections which is a subset of the NODELIST for subsequent analysis when INTERSECTION 0 is selected. A ROUTE entry can also be used to define up to 8 predefined subsets, usually, but not limited to arterial routes, which can then be used as shortcuts in the SUBSYSTEM entry by entering the negative route number.

## Merging Multiple Version 1 Files Into a Single Version 2 File (for Signal Analysis)

Since prior versions of SIGNAL2000 (and SIGNAL97, SIGNAL94, etc.) handled a single intersection in each data file, in many cases it will be desirable to merge all of these files into a single file in SIGNAL2000 Version 2. This can be done quite easily by opening each prior file using the File-OpenMerge/Shared menu, as long as each of the intersections loaded uses a different intersection number or no number at all (in which case you will be prompted to enter a number). The list of intersection numbers to be used can be entered in the NODELIST in advance of the OpenMerge/Shared, or the user will be prompted to automatically add each intersection number to the end of the NODELIST as new numbers are encountered. When all intersections have been loaded, use File-SaveAs to save the single combined file into a new file name. If OpenMerge/Shared is not used, the possibility of losing all data previously entered into Version 2 exists due to the way the older versions initialized the older programs; if Version 1 files are being Opened, this condition is detectable and a warning is issued to that effect.

## Processing Time for DESIGN (for Signal Analysis)

LEVELOFSERVICE has been enhanced significantly so that more precise delay targets can be specified, and the incremental delays tested are user-controlled for more precise balancing of the critical delays when the target cannot be met. In addition, if none of the delay targets are met, a more precise incremental v/c testing is also user-controlled. All of this enhanced precision in the optimization results in noticeably superior optimization results, but comes with a price tag in terms of computational time. Further, several important new calculations have been added to portions of the optimization iterations which generate better results, but at the further expense of additional computational time.

On today's faster computers, this additional time may not be significant or even noticeable. On older computers, however, depending on the number of SEQUENCES and CYCLES being tested, as well as the degree of saturation of the intersection's critical movements, certain calculations may take more time than expected or desired. In these cases, judicious selection of the target delay and delay optimization increment (LEVELOFSERVICE), the list of allowed phasings (SEQUENCES) and the cycle optimization increment (CYCLES) can have a noticeable impact on the net optimization time. If it appears an optimization will take longer than desired and flexibility exists for selecting new values for these variables, an optimization can be aborted and re-started after changing the appropriate inputs.

## HCM Sample Problems (for Signal Analysis)

Included in the distribution files for TEAPAC (and stored in C:\TEAPAC Data\Example Files, by default) are data files for the operations method sample calculations from Chapter 16 of the 2000 *Highway Capacity Manual*. The file names are coded as HCMSCx.tpc, where "x" is the sample calculation problem number (1, 2 and 3). For example, HCMSC1.tpc is the data file for HCM Sample Calculation #1. Each one of the data files can be opened and the ANALYZE results will be generated automatically, producing the worksheets and capacity analysis summary which match the results found in the 2000 HCM. HCMSC1X.tpc is an adjustment of HCMSC1.tpc which accounts for an error in an early release of the 2000 HCM sample problems.

## Appendix C Topics (for Traffic Impact Analysis):

## Calculation of Generated Traffic (for Traffic Impact Analysis)

The traffic volume for any given distribution type of traffic on any given intersection movement is computed by TEAPAC's COMPUTEPATHS command for a traffic impact analysis using the following formula:

$$V = \left[ B \times G \times \frac{D}{100} \right] \times \frac{A}{100}$$

where:

V = generated traffic volume on the given intersection movement for the given type of distributed traffic.
B = BASE development size.
G = GENERATION rate, in vehicles per unit of development size, for the given type of traffic, either inbound or outbound.
D = DISTRIBUTION factor, in percent, for the given distribution type of traffic.
A = PATHASSIGNMENT or ASSIGNMENT factor, in percent, for the given distribution type of traffic and intersection movement.

Note that for any distribution type, the product of the first three terms of the equation (shown in brackets) is a constant. This constant represents the total traffic generated for that type of traffic. Multiplying this constant by the ASSIGNMENT factor (either for a given PATHASSIGNMENT or ASSIGNMENT) for any given movement calculates the contribution that this type of traffic makes to total traffic on that movement.

The procedure that the program uses is to compute the total traffic generated by each type of traffic (the constant above), and then to cumulate its contribution to each intersection movement as specified by the PATHASSIGNMENT and ASSIGNMENT commands. If Type 999 is included in the COMPUTEPATHS list, either by default or explicitly, the intersection VOLUMES are also added into the total computations, first multiplied by the growth VOLFACTORS. If the number of years for the growth VOLFACTORS is greater than 1, the input VOLFACTORS are raised to the power of the number of years before being applied to the input VOLUMES.

If the RESET option is selected on the COMPUTEPATHS command (the default condition), the initial volumes for each movement at each intersection are initialized to zero before any contributions to the intersection volumes from each type is added in. If the CUMULATE option is selected, the most recently calculated volumes for the movements at each intersection (from the last COMPUTEPATHS command) are left unchanged, thus allowing the results from the previous COMPUTEPATHS to be added to the current COMPUTEPATHS results. This effectively removes any practical limit on the number of developments which can be included in a final computation of site traffic. When cumulating results, the program must not be terminated between the prior and the cumulated computations, and the positions of the nodes in the NODELIST must not change from one computation to the next.

## Appendix C Topics (for Count Analysis):



## Tabulation and Analysis Methods (for Count Analysis)

The count analysis functions of TEAPAC use normal methods for summarizing, tabulating and analyzing traffic count data, as described below.

In tabulations, approach totals are for all traffic entering the intersection on a given leg of the intersection. Exit totals are for all traffic exiting the intersection on a given leg of the intersection. The intersection totals represent all the vehicles entering the intersection. All raw counts are multiplied by the input adjustment factors to account for seasonal adjustments or projected growth.

Fifteen-minute counts are the entered VEHICLECOUNTS for REDUCED data, or the difference of successive entered values for CUMULATIVE data. The time displayed for all counts is the beginning of the time interval represented. Fifteen-minute flow rates are the fifteen-minute counts multiplied by four to calculate the rate in vehicles per hour during the fifteen-minute interval. Sixty-minute volumes for a given time are the sum of the four successive 15-minute counts starting at the given time. If less than four 15-minute counts exist starting at that time, the incomplete total is computed and flagged in the output.

In peak hour analyses, design hour volumes are the turning movement volumes which exist at the time when the intersection total volume peaks. This is determined by locating the highest 15-minute flow rate or 60-minute volume for the intersection, as described above. Individual movements are likely to peak at different times, sometimes with substantially higher volumes than during the intersection's peak. The time of the 60-minute interval during which each movement and approach total peaks is also determined in the same fashion as the intersection peak.

Movement distributions are the movements' percentage of total approach flow on each leg. Approach and exit distributions are the movements' percentage of total intersection flow. If trucks counts are input separately to the program, a truck percentage is calculated as the truck volume divided by the total traffic volume.

Peak hour factors are computed as the average rate of flow (60-minute volume) during the peak hour divided by the rate of flow during the highest 15-minutes. Peak hour factors for individual movements should be used with caution due to the errors which can be generated by imprecise time keeping in recording of field information combined with the effects of random traffic fluctuations in a single sample of traffic flow. When used in combination with peak hour factors computed for other movements during the same hour, these issues are exacerbated by the likelihood that the peak 15-minute flow rates for the movements do not occur during the same 15-minute periods of the peak hour, thereby making their use together inappropriate.

24-hour volumes are calculated as estimates of average daily traffic (ADT) by multiplying the entire count for each movement by the input ADTFACTOR value.

The Warrant Analysis procedures are taken directly from the *Manual on Uniform Traffic Control Devices* (MUTCD). A unique search procedure is conducted which finds the greatest number of one-hour periods which meet the designated warrant requirements. The hourly volumes which are located are listed in descending order according to the minor street volume. The highest eight hours are always listed, with a notation for each as to whether the warrant levels are met, allowing quick inspection of how close the hours are to meeting the warrants when they are not met.

## Important Differences Between TURNS Ver 3.5 and Ver 3.6 (for Count Analysis)

Several differences between TURNS Version 3.5 and Version 3.6 are important to note for prior users of Version 3.5 (and earlier versions). Reading data from any of these older programs, is easily accomplished due to the upwards compatibility of data files between the programs using the File-OpenMerge/Shared menu (or the LOAD * SHARE command), but several points are worth making to help guide this process. The following discusses these issues. In this section, the count analysis functions of TEAPAC can be considered as equivalent to the TURNS Ver 3.6 descriptions.

Sub-topics for this section:
- Managing Multiple Intersections (for Count Analysis)
- Merging Multiple Version 3.5 Files Into a Single Version 3.6 File (for Count Analysis)

### Managing Multiple Intersections (for Count Analysis)

All prior versions of TURNS handled a single intersection in an analysis and File-Save placed this single intersection in a single data file, resulting in a large number of data files and independent analyses for projects with multiple intersections and/or multiple scenario conditions.

TURNS Version 3.6 has a multi-intersection data structure, in that multiple intersections can be entered and stored in a single data file. The list of intersections is managed with a NODELIST entry which lists all the available intersection numbers which have been used, and the INTERSECTION entry which selects the 'current' intersection from the NODELIST. The current intersection is the one for which data entry will be accepted and for which analysis functions like COUNTTABULATE, PEAKANALYZE and WARRANTS will be made. The current intersection can be selected by clicking on it in the graphical network view, by using the drop down list in the INTERSECTION dialog, or by 'walking' through the NODELIST with the +/- buttons found on the main toolbar and relevant entry dialogs. The current intersection is displayed in the status bar at the bottom of the main window.

New intersections can be added to the network by first adding it with the NODELIST dialog, then selecting it from the INTERSECTION drop-down list (or typing it in the INTERSECTION combo box). As a shortcut, the new intersection number can be typed (with a description) in the INTERSECTION combo box, in which case the user will be prompted with an option to add the intersection to the end of the NODELIST automatically.

INTERSECTION 0 is a selection which represents all intersections in the NODELIST. When this is selected, certain actions like ANALYZE and DESIGN 1 will be performed for all intersections. Certain other actions like SORT, TIMINGS and HCSEXPORT are not valid when INTERSECTION 0 is selected, as these actions can pertain to only a single intersection.

Several additional entries assist in managing the activities which surround multi-intersection analyses. The SUBSYSTEM entry can be used to select a group of intersections which is a subset of the NODELIST for subsequent analysis when INTERSECTION 0 is selected. A ROUTE entry can also be used to define up to 8 predefined subsets, usually, but not limited to arterial routes, which can then be used as shortcuts in the SUBSYSTEM entry by entering the negative route number.

## Merging Multiple Version 3.5 Files Into a Single Version 3.6 File (for Count Analysis)

Since prior versions of TURNS handled a single intersection in each data file, in many cases it will be desirable to merge all of these files into a single file in TURNS Version 3.6. This can be done quite easily by opening each prior file using the File-OpenMerge/Shared menu, as long as each of the intersections loaded uses a different intersection number or no number at all (in which case you will be prompted to enter a number). The list of intersection numbers to be used can be entered in the NODELIST in advance of the OpenMerge/Shared, or the user will be prompted to automatically add each intersection number to the end of the NODELIST as new numbers are encountered. When all intersections have been loaded, use File-SaveAs to save the single combined file into a new file name. If OpenMerge/Shared is not used, the possibility of losing all data previously entered into Version 3.6 exists due to the way the older versions initialized the older programs; if Version 3.5 files are being Opened, this condition is detectable and a warning is issued to that effect.

## Appendix C Topics (for Progression Analysis):



## Optimization Method (for Progression Analysis)

TEAPAC uses the Tschebyscheff Theorem to minimize the maximum deviation of the band axis from the center of the green time in a progression analysis. The complete method used by TEAPAC is documented in an article by the original author of the program, H.R. Leuthardt, entitled "Design of a Progressively Timed Signal System" in Traffic Engineering, Feb, 1975, pp. 11-18.

## Appendix C Topics (for Export and Import):



## TRANSYT Link Creation and Numbering (for Export and Import)

TEAPAC uses a very basic and simple to understand method of creating link numbers for TRANSYT. Wherever a non-zero lane group width exists, a TRANSYT link is created. This means that every exclusive turn lane group will be modeled separately and that all shared lane groups will be modeled as a single link.

The number of the link, say 12305, is a combination of the node number multiplied by 100 added to the standard TEAPAC movement number, by default. In this example, the link is easily recognized as the through movement on the east approach (movement #05) of intersection number 123. This link numbering scheme is the default of TEAPAC. Alternative link numbering schemes can be used, as described in the TRANSYT manual, by coding the fourth parameter of the SIMULATION command.

## TRANSYT Upstream-Downstream Flows (for Export and Import)

TEAPAC uses the methods suggested in the TRANSYT manual to calculate the "upstream-downstream" flows between TRANSYT intersections. That is, all volumes from upstream lane groups (links) that feed downstream lane groups (links) are added together and their percentages of the total upstream flows are calculated. This total flow is then divided up in proportion to the distribution of downstream lane groups (links) which they feed. These resultant downstream flow totals are multiplied by the percentages calculated above to determine how much flow on each downstream lane group (link) comes from each upstream lane group (link). The assignment option of the NETWORK entry can be used to control whether upstream turns are allowed to appear as downstream turns, e.g., to prevent ramp-to-ramp movements at a diamond interchange.

## TRANSYT Permissive Left Turns (for Export and Import)

For versions of TRANSYT earlier than Release 6 of TRANSYT7F, permissive left turns following exclusive phases are modeled for TRANSYT by TEAPAC by adding a 4 second lag time to the end of the exclusive green interval to effect the "sneakers" that will probably get through during the permissive phase. For left turns that are never protected, an internal calculation is made to estimate the saturation flow of the unprotected movement. This calculation uses the methods of Chart 17A in the "Leisch Charts", basing the capacity on a critical-movement-type capacity of 1200 vehicles per hour of green. Although not a perfect model for permissive left turns, it is the best that can be done in a generic way in versions of TRANSYT that do not explicitly handle permissive left turns.

When EXPORTing for Release 6 of TRANSYT7F, the permissive left turn model which was implemented in Release 5 of the TRANSYT7F program is used automatically. The extended green modeling technique used for permissive left turns for previous versions of TRANSYT is not used, and the appropriate entries are made to the card types 2X (negative link number), 28 (zero saturation flow), and 29 (sneakers, link number of opposing flow and permissive model number). Note that in order to properly determine which of TRANSYT's permissive left turn models to use, external links with speeds of 40 mph or higher must have their speeds entered on the NETWORK command. This model is used for the permissive phase of both permissive-only and exclusive-permissive left turns. The extended green modeling technique can still be used by specifying 7F5 on the OUTPUT command, then using the EXPORTed file for Release 6 of TRANSYT.

When EXPORTing for Release 7 or higher of TRANSYT-7F, a similar method to that described above is used, but the "negative" model numbers of Release 7 are used. These are based solely on the number of opposing lanes provided (speed no longer enters the picture).

## Basic CORSIM Assumptions (for Export and Import)

Buffer node numbers are created by starting at node #6999 and working backwards, as needed for external approaches to the network. Two one-way "buffer links" between the buffer node and real node are created as needed. An entry node is created for each buffer node by adding 8000 to the buffer node number. If a buffer node has a node number greater than 999, only the last three digits are used when creating its associated entry node (which always must be numbered 8xxx). As long as there are less than 1000 dummy nodes in the exported network and none of the external dummy nodes share the same last three digits, this will not be a problem (this is typically the case). A one-way "entry link" is created from the entry node to the buffer node if needed.

Simulation fill time is coded as 99 minutes. This is intended to make sure the fill time reaches equilibrium before the actual simulation without the option of an abort if it does not reach equilibrium. When equilibrium is reached prior to the 99-minute period, the fill time is aborted automatically. Simulation start time is always 0:00.

Any exclusive turn lane is defined as a 250' turn pocket if the STORAGE is not input by the user. This length may need to be adjusted to better reflect reality. The 250' assumption will be reduced to the length of the link if the link length is less than 250'.

All through lanes are assumed to be "full" lanes the entire length of the link, and are assumed to not be assigned for exclusive use of turning traffic at the intersection. Thus no NETSIM channelization is defined anywhere, except for an approach which does not have any through lanes, such as at a "T" intersection.  In this case, the largest exclusive turn lane(s) is assumed to be a channelized through lane and no left turn pocket is coded.

A 1:1 lane alignment is assumed between all links.  Approach grade is assumed 0%.  Truck percentages are assumed 2%.  Turning movement and graphic display outputs are always requested.

The saturation flow rate entered for the through movement is used to calculate the discharge headway for all movements on that approach on a per-lane basis.  If a through lane doesn’t exist, the largest exclusive turn lane is used instead.

The length of buffer links is assumed 1320' unless an external link length is entered on the NETWORK entry.  Reverse flow buffer links are assumed to be the same length and number of lanes as their associated buffer links, if they exist, otherwise their data comes from the opposite approach of the intersection.

Phasings are entered on CT 35 & 36 with the North-South phases first, without regard to which phase is the main street green.  The offset entered on CT 35 is to the first North-South phase.

Random seeds are created from the system clock.  This will create a different set of seeds each time EXPORT is used, creating a different random run of NETSIM each time.  The user can edit the seeds to a desired value after the EXPORT is done, including blanking out the seed to get the default NETSIM seeds.

The time period simulated is controlled by the SIMULATION entry.  Only one reporting period is used for the simulation time period.

The name of the EXPORT file used will have a .TRF extension added if one is not provided and it will always be placed in the data subdirectory named by the .CFG file.

APPENDIX D

# Report Descriptions and Examples

Appendix D Topics

This appendix describes each of the major output reports which can be produced by the TEAPAC program. The reports are discussed, followed by an example output, in the order indicated in Tables D-1, one table for each of the major application functions in TEAPAC. The tables includes the report title and the primary command associated with the contents of the report.

Each of the outputs presented in this appendix was created using the example data included in the sample file listed in the paragraph before the example output. These results can be re-created by first opening this file (found in the example files folder, C:\TEAPAC Data\Example files, by default) and then executing a LOAD command with default parameters from the File-DataFiles menu.

Opening the file reads in the basic data for the examples of this appendix. The LOAD command will produce the output reports contained in this appendix by reading a control file script stacked in the file after the input data. This procedure is a good way to verify the operation of the program, as well as to create a starting point for further experimentation with the TEAPAC program. The data used in the example outputs is summarized in the first output example, Summary of Parameter Values (XXX). Each report description that follows includes all of the commands which can be used to generate the report.

**Table D-1**
**Report Descriptions and Examples (for Signal Analysis)**

| Report Title | Keyword |
|---|---|
| Summary of Parameter Values (SIG) | SUMMARIZE |
| HCM2016 Urban Street Analysis | URBANSTREET |
| Optimized Phase Sequences | DESIGN |
| Optimum Phasings Ranked by Delay | SORT |
| Optimum Phase Timings | TIMINGS |
| Optimum Phase Timings (HCM 2016) | TIMINGS |
| 2000 Highway Capacity Manual Worksheets | ANALYZE |
| - HCM Input Worksheet | ANALYZE |
| - HCM Volume Adjust & Satflow Worksheet | ANALYZE |
| - HCM Supplemental LT-Factor Worksheet | ANALYZE |
| - HCM Ped-Bike LT Effects Worksheet | ANALYZE |
| - HCM Ped-Bike RT Effects Worksheet | ANALYZE |
| - HCM Capacity and LOS Worksheet | ANALYZE |
| - HCM Supplemental Uniform Delay Worksheet | ANALYZE |
| - HCM Initial Queue Delay Worksheet | ANALYZE |
| - HCM Back of Queue Worksheet | ANALYZE |
| Capacity Analysis Summary (HCM 2000) | ANALYZE |
| Capacity Analysis Summary (HCM 2016) | ANALYZE |
| Evaluation of Intersection Performance | EVALUATE |
| Queuemodel Calculations | QUEUECALCS |
| Required g/Cs and LT Clearance Cycles | GOVERCS |
| Satflow Rates and LT Clearance Cycles | SERVICEVOLUMES |
| Display of Intersection Parameters | MAP |
| Diagram of Signal Phasing | DIAGRAMS |

**Table D-1**
**Report Descriptions and Examples (for Traffic Impact Analysis)**

| Report Title | Keyword |
|---|---|
| Summary of Parameter Values (TIA) | SUMMARIZE |
| Schematic Diagram | SHOWPATHS |
| Distribution Types and Factors | COMPUTEPATHS |
| Intersection Movement Volumes | COMPUTEPATHS |

**Table D-1**
**Report Descriptions and Examples (for Count Analysis)**

| Report Title | Keyword |
|---|---|
| Summary of Parameter Values (COU) | SUMMARIZE |
| 15-Minute Counts | COUNTTABULATE |
| 15-Minute Flow Rates | COUNTTABULATE |
| 60-Minute Volumes | COUNTTABULATE |
| Peak Hour Summary | PEAKANALYZE |
| 24-Hour Volume Estimates | PEAKANALYZE |
| Display of Intersection Volumes | PEAKSUMMARY |
| Plot of Traffic Counts | COUNTGRAPH |
| MUTCD Warrant Analysis | WARRANTS |
| Imported IMC Count Data | COUNTIMPORT |

**Table D-1**
**Report Descriptions and Examples (for Progression Analysis)**

| Report Title | Keyword |
|---|---|
| Summary of Parameter Values (PRG) | SUMMARIZE |
| Table of Efficiency versus Speed and Cycle | PROGRESSION |
| Graph of Efficiency versus Cycle | PROGRESSION |
| Optimum Progression Data | PROGRESSION |
| Time-Space Diagram | PROGRESSION |

**Table D-1**
**Report Descriptions and Examples (for Export and Import)**

| Report Title | Keyword |
|---|---|
| Summary of Parameter Values (EXP) | SUMMARIZE |
| TRANSYTxxx Formatted Input | EXPORT |
| Time-Space Diagram for Cycle = XX sec | PLOTTSD |
| Timing Plan for Intersection XX | TIMINGPLAN |
| TRANSYT-7F Imported Data | IMPORT |

## Appendix D Topics:



## Appendix D Topics (for Signal Analysis):

## TEAPAC - Summary of Parameter Values (SIG)

The Summary of Parameter Values (SIG) report generated by the SUMMARIZE command is a compilation of data pertinent to analyzing intersection capacity by lane group, recognizing all of the quantifiable parameters as described in the *Highway Capacity Manual*. The parameters are discussed below by the groups in which they appear. If all intersections are selected (INTERSECTION 0), then the initial portion of the report lists all the system parameters, followed by the parameters for each intersection in the system. If a single intersection is selected, only the parameters for that intersection are listed.

### System Parameters

This section lists parameters which apply to the entire system. The Queuemodels entries list, in order, the selected queue model number, the percentile queue desired, the storage length of queued automobiles, and the storage length of queued trucks. The Output entries list, in order, the selected level of capacity analysis worksheet output, whether certain warning messages will be displayed, and the selected level of DESIGN and EVALUATE output. The simulation period is the length of the analysis period used for each intersection. It is followed by parameters for exporting to other programs, but of no consequence for TEAPAC's signal analysis, regarding simulation steps, use of the actuated model, the link assignment, and optimization type. This is followed by the list of intersections in the network, the master node number, and any intersections in a defined subsystem and any defined routes.

### Intersection Parameters

This section lists parameters which apply to the entire intersection, including the intersection number and description and its location within the metropolitan area. The level of service target entries identify the desirable operating levels of performance for critical movements (delay in seconds and v/c in percent), and the worst levels to be tested, as well as the optimization increments. The priorities list the movements which get priority treatment if the level of performance target is met. The network location lists, in order, the distance (feet), speed (mph) and upstream node number for each approach of the intersection. The next four numbers of the network location identify which movement numbers of the upstream nodes supply traffic to the subject intersection. The last three network entries describe the upstream link assignment method, the link curvature, and if the link distance has been manually entered. The node location lists the X and Y coordinates, respectively, of the intersection's location in the system network.

### Approach Parameters

These are the parameters which apply uniquely to each of the four approaches. They include individual approach labels, percent of approach grade (negative numbers are downhill approaches), pedestrian interference levels for right turns on each approach (in peds per hour), pedestrian minimum factor, pedestrian walk and flash-don't-walk time requirements, bicycle volumes interfering with right turns on each approach (in bikes per hour), parking location and volume on each leg of the intersection, bus stop frequency (in buses per hour), how many right turns are made on a red indication per hour, and the v/c of the upstream intersection.

## Movement Parameters

These are the parameters which are applied individually to each of the 12 movements. They include movement labels, traffic demand volumes (vehicles per hour), lane group width (feet), number of lanes in each lane group and factors indicating the lane utilization for each movement. Widths and lanes given for turning movements indicate exclusive turning lanes; widths for through directions are used by straight vehicles as well as turning vehicles without exclusive tuning lanes. Each movement's group type indicates any special lane group type such as dual-optional turn lanes and free-flow lanes. Utilization values of 0.0 indicate that the HCM default values will be used. Also listed are truck percentages, peak hour factors, arrival types and actuated condition of each possible movement. Arrival types are usually the types 1-6, but may also represent the HCM-defined PVG or RP values. Required change & clearance times, required yellow times and minimum timings for green indications are listed, as well as startup lost times and end gain times, all in seconds. The length of storage available for queued vehicles is listed, in feet, and the initial number of queued vehicles at the start of the analysis period is listed. The ideal saturation flows are listed by movement, as are the adjustment factors used for calibrating the satflow, delay and stops calculations. The calculated saturation flow rate in vphg is also listed; left turn satflows assume protected phasing if the left turn is a protected-permitted operation.

## Phasing Parameters

The last section of the report lists parameters which relate to the phasing of the intersection. First the basic phasing sequence code is listed, either as a specific phasing, a list of possible phasings, or the keyword AA representing all possible phasings being allowed. When AA is shown, the primary phasing code is also shown. The next entries indicate if left turns are permitted on a green ball following or preceding an exclusive phase (permitted left condition) and whether right turns are allowed to overlap into adjacent protected left turn phases when exclusive right turn lanes exist.

Following this is the cycle length and range to be used for cycle optimization. If phase timings are provided in seconds/second, then the first cycle value is used to convert these timings to seconds before analysis (otherwise it is ignored in an analysis). In a cycle optimization, the first cycle is the lowest cycle to be tested, the second is the highest cycle to be tested, and the third entry is the increment of cycle time to be used to move from the lowest to the highest cycle. Individual phases green times, yellow times and all-red times are then listed in seconds or seconds/second, for each phase, in the order of the phasing specified. If the timings are listed By-Phase, this is indicated with a 'P' before the timings. Timings listed By-Movement are shown with an 'M' before the timings. The critical movements used for designing timings for each phase are also listed, if they have been determined. The right side of this section identifies whether the sequence codes appear in their normal order (LEAD or NONE), or are reversed (LAG), as well as the system offset and exclusive pedestrian phase time (scramble phase). The offset indicates which phase has the given offset, and the ped phase shows which phase the exclusive ped phase follows.

The following is an example of the Summary of Parameter Values (SIG) report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - Summary of Parameter Values (SIG)**

System Parameters

Queues: Model # 1, Percentile 90, Auto spacing 25, Truck spacing 40
Output: Worksheets-None Messages-Yes Design details-None

Simulation Period of 15 minutes, 300 Steps per TRANSYT Cycle
Use T7F/PSR actuated model? No, Default link assignment method: Full
T7F/PSR Optimization Type: None w/ 0 0 0 2 0 0 0 0 0 0 0 0 0 0

List of Intersection #'s in Network: (Master Node is 1)
1 999 998 997 996

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - Summary of Parameter Values (SIG)**

Intersection Parameters for Int # 1 - Lincoln Avenue & Main Street

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MetroArea | NonCBD | | | Network | North | 388 | 30 | 999 | 2 | 6 | 10 | 0 | Def | N | N |
| LOS Targets | 35 | 80 | 5 | Network | East | 287 | 30 | 998 | 5 | 9 | 1 | 0 | Def | N | N |
| | 90 | 100 | 5 | Network | South | 273 | 30 | 997 | 8 | 12 | 4 | 0 | Def | N | N |
| Priorities | 0 0 0 | 0 0 0 | | Network | West | 241 | 30 | 996 | 11 | 3 | 7 | 0 | Def | N | N |
| | | | | NodeLocation | | | | 0 | | | | 0 | | | |

Approach Parameters

| | | | | |
|---|---|---|---|---|
| AppLabels | N | E | S | W |
| Grades | 0.0 | 0.0 | 0.0 | 0.0 |
| PedLevels | 0 | 0 | 0 | 0 |
| PedWalks (1.00) | 0.0 | 0.0 | 0.0 | 0.0 |
| PedFDWs | 0.0 | 0.0 | 0.0 | 0.0 |
| BikeVolumes | 0 | 0 | 0 | 0 |
| ParkingSides | None | None | None | None |
| ParkVolumes | 20 | 20 | 20 | 20 |
| BusVolumes | 0 | 0 | 0 | 0 |
| RightTurnOnReds | 0 | 0 | 0 | 0 |
| UpstreamVC | 0.00 | 0.00 | 0.00 | 0.00 |

Movement Parameters

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MovLabels | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| Volumes | 175 | 650 | 125 | 60 | 525 | 65 | 65 | 370 | 200 | 215 | 450 | 220 |
| Widths | 12.0 | 24.0 | 12.0 | 0.0 | 24.0 | 12.0 | 0.0 | 24.0 | 12.0 | 12.0 | 24.0 | 12.0 |
| Lanes | 1 | 2 | 1 | 0 | 2 | 1 | 0 | 2 | 1 | 1 | 2 | 1 |
| GroupTypes | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm |
| Utilizations | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TruckPercents | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| PeakHourFactors | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 |
| ArrivalTypes | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Actuations | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| ReqChange+Clears | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| ReqYellows | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimums | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| StartupLost | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| EndGain | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Storage | 100 | 1000 | 200 | 0 | 1000 | 200 | 0 | 1000 | 200 | 100 | 1000 | 200 |
| InitialQueue | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| IdealSatflows | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Factors | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| DelayFactors | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| NstopFactors | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| SaturationFlows | 1583 | 3547 | 909 | 0 | 3571 | 894 | 0 | 3543 | 728 | 1583 | 3547 | 778 |

Phasing Parameters

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sequences | 11 | | | | | | | | | |
| Permissives | | No | No | No | No | | LeadLags | | None | None |
| OverLaps | | Yes | Yes | Yes | Yes | | Offset | | 0.00 | 0 |
| Cycle(s) | | 60 | 120 | 30 | | | PedTime | | 0.0 | 0 |
| GreenTimes | M | 56.00 | 0.00 | 56.00 | 0.00 | 56.00 | 0.00 | 56.00 | 0.00 | |
| YellowTimes | M | 3.00 | 0.00 | 3.00 | 0.00 | 3.00 | 0.00 | 3.00 | 0.00 | |
| RedClearTimes | M | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | |
| Criticals | | 0 | 0 | 0 | 0 | 0 | 0 | | | |

## TEAPAC - HCM2016 Urban Street Analysis

The HCM2016 Urban Street Analysis report, generated by the URBANSTREET command, provides a summary of the capacity analysis for the overall arterial facility and all segments in each direction of the defined arterial, as well as the intersection thru movements of all intersections. The capacity analysis methodology used for each segment and the overall facility follows the procedures presented in the 2016 *Highway Capacity Manual*.

### Facility Performance

The performance of the overall facility is provided for each direction of travel, including the following.

**Base Free-Flow Speed.** The overall base free-flow speed calculated for the entire facility, in miles per hour.

**Travel Time.** The overall travel time through the entire facility, in seconds, including control delay at each downstream signal.

**Travel Speed.** The overall travel speed through the entire facility, in miles per hour, based on the estimated travel time.

**% of Base Free-Flow Speed.** The travel speed as a percentage of the base free-flow speed, in percent.

**Level of Service (w/o v/c).** The level of service of the facility, without including a critical v/c > 1 condition that causes an otherwise acceptable travel speed to be declared level of service F. It is based only on the travel speed described above, according to Exhibit 16-3 of the 2016 *Highway Capacity Manual*.

**Stop Rate.** The average number of stops per vehicle.

**Spatial Stop Rate.** The average number of stops per mile.

**Critical Thru v/c.** The worst v/c for through vehicles in a given direction of travel.

**Level of Service (incl v/c).** The level of service of the facility, including a critical v/c > 1 condition that causes an otherwise acceptable travel speed to be declared level of service F. It is based on both the travel speed and the critical thru v/c described above, according to Exhibit 16-3 of the 2016 *Highway Capacity Manual*.

### Segment Performance

The performance of each arterial segment is provided, first for the Left-Right direction of travel, then for the Right-Left direction of travel, including the following. The first segment listed is for the link between the first and second intersection of the arterial, these being identified in more detail in the Intersection Performance section which follows this section.

**Segment Length.** The length of the segment, from stop-bar to stop-bar (including the width of the intersection), in feet.

**Segment Speed Limit.** The posted speed limit of the segment, in miles per hour.

**Free-Flow Speed.** The free-flow speed calculated for the segment, in miles per hour.

**Base Free-Flow Speed.** The base free-flow speed calculated for the segment, in miles per hour.

**Running Time.** The time to travel the length of the segment in seconds, not including the control delay from the signal at the end of the segment.

**Running Speed.** The speed of travel on the segment in miles per hour, not including slower speeds and wait time caused by the signal at the end of the segment.

**Travel Speed.** The travel speed through the segment, in miles per hour, based on the estimated travel time, which includes control delay at the downstream signal.

**% of Base Free-Flow Speed.** The travel speed as a percentage of the base free-flow speed, in percent.

**Level of Service (w/o v/c).** The level of service of the segment, without including a thru v/c > 1 condition that causes an otherwise acceptable travel speed to be declared level of service F. It is based only on the travel speed described above, according to Exhibit 16-3 of the 2016 *Highway Capacity Manual*.

**Thru Delay.** The control delay caused by the downstream signal for through vehicles passing through that signal.

**Thru Stop Rate.** The average number of stops per vehicle for downstream thru traffic on the segment.

**Spatial Stop Rate.** The average number of stops per mile for downstream thru traffic on the segment.

**Downstream Thru v/c.** The v/c for through vehicles at the downstream signal.

**Level of Service (incl v/c).** The level of service of the segment, including a thru v/c > 1 condition that causes an otherwise acceptable travel speed to be declared level of service F. It is based on both the travel speed and the thru v/c described above, according to Exhibit 16-3 of the 2016 *Highway Capacity Manual*.

## Intersection Performance

The performance of through traffic for each arterial signal is provided.

**Approach.** The approach of the signal for which through traffic performance is reported.

**Thru Volume.** The volume of through traffic passing through the signal on the designated approach, in vehicles per hour.

**Thru Satflow.** The saturation flow rate provided to through traffic on the designated approach, in vehicles per hour of green.

**Thru Capacity.** The capacity to handle through traffic on the designated approach, in vehicles per hour.

**Thru v/c.** The volume-to-capacity ratio for through vehicles on the designated approach.

The following is an example of the HCM2016 Urban Street Analysis report using the Export-Import.tpc sample data file.

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 9.00.02] - HCM2016 Urban Street Analysis**

| Facility Performance | EB | WB |
|---|---|---|
| Base Free-Flow Speed, mph | 42.0 | 42.0 |
| Travel Time, s | 88.1 | 63.3 |
| Travel Speed, mph | 20.6 | 28.7 |
| % of Base Free-Flow Speed, % | 49.0 | 68.2 |
| Level of Service (w/o v/c) | D | B |
| | | |
| Stop Rate, stops/veh | 1.32 | 0.52 |
| Spatial Stop Rate, stops/mi | 2.61 | 1.02 |
| Critical Thru v/c | 0.76 | 0.45 |
| Level of Service (incl v/c) | D | B |

Segment Performance

| EB Direction (L-R) | Seg1 | Seg2 | Seg3 | Seg4 | Seg5 | Seg6 | Seg7 | Seg8 |
|---|---|---|---|---|---|---|---|---|
| Segment Length, ft | 2130 | 530 | | | | | | |
| Segment Speed Limit, mph | 35 | 35 | | | | | | |
| Free-Flow Speed, mph | 40.8 | 35.0 | | | | | | |
| Base Free-Flow Speed, mph | 42.0 | 42.0 | | | | | | |
| Running Time, s | 37.4 | 13.7 | | | | | | |
| Running Speed, mph | 38.8 | 26.5 | | | | | | |
| Travel Speed, mph | 23.2 | 14.2 | | | | | | |
| % of Base F-Flow Speed, % | 55.1 | 33.8 | | | | | | |
| Level of Service (w/o v/c) | C | E | | | | | | |
| | | | | | | | | |
| Thru Delay, s/veh | 25.3 | 11.8 | | | | | | |
| Thru Stop Rate, stops/veh | 0.79 | 0.53 | | | | | | |
| Spatial Stop Rate, stops/mi | 1.95 | 5.30 | | | | | | |
| Downstream Thru v/c | 0.756 | 0.318 | | | | | | |
| Level of Service (incl v/c) | C | E | | | | | | |

| WB Direction (R-L) | Seg1 | Seg2 | Seg3 | Seg4 | Seg5 | Seg6 | Seg7 | Seg8 |
|---|---|---|---|---|---|---|---|---|
| Segment Length, ft | 2130 | 530 | | | | | | |
| Segment Speed Limit, mph | 35 | 35 | | | | | | |
| Free-Flow Speed, mph | 40.8 | 35.0 | | | | | | |
| Base Free-Flow Speed, mph | 42.0 | 42.0 | | | | | | |
| Running Time, s | 37.5 | 13.8 | | | | | | |
| Running Speed, mph | 38.8 | 26.1 | | | | | | |
| Travel Speed, mph | 30.7 | 22.6 | | | | | | |
| % of Base F-Flow Speed, % | 73.1 | 53.7 | | | | | | |
| Level of Service (w/o v/c) | B | C | | | | | | |
| | | | | | | | | |
| Thru Delay, s/veh | 9.8 | 2.2 | | | | | | |
| Thru Stop Rate, stops/veh | 0.43 | 0.09 | | | | | | |
| Spatial Stop Rate, stops/mi | 1.05 | 0.91 | | | | | | |
| Downstream Thru v/c | 0.447 | 0.407 | | | | | | |
| Level of Service (incl v/c) | B | C | | | | | | |

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 9.00.02] - HCM2016 Urban Street Analysis**

Intersection Performance

| Intersection: 1 (# 13) - MacArthur & Pershing | | | | |
|---|---|---|---|---|
| Approach: | EB | WB | NB | SB |
| Thru Volume, vph | 733 | 810 | 344 | 240 |
| Thru Satflow, vphg | 1863 | 1863 | 1863 | 1863 |
| Thru Capacity, vph | 1088 | 1814 | 615 | 416 |
| Thru v/c | 0.673 | 0.447 | 0.559 | 0.578 |

| Intersection: 2 (# 14) - Main & Pershing | | | | |
|---|---|---|---|---|
| Approach: | EB | WB | NB | SB |
| Thru Volume, vph | 652 | 942 | 0 | 903 |
| Thru Satflow, vphg | 1863 | 1863 | 0 | 1863 |
| Thru Capacity, vph | 863 | 2317 | 0 | 1006 |
| Thru v/c | 0.756 | 0.407 | 0.000 | 0.898 |

| Intersection: 3 (# 15) - Water & Pershing | | | | |
|---|---|---|---|---|
| Approach: | EB | WB | NB | SB |
| Thru Volume, vph | 612 | 867 | 150 | 0 |
| Thru Satflow, vphg | 1863 | 1863 | 1863 | 0 |
| Thru Capacity, vph | 1927 | 1945 | 1641 | 0 |
| Thru v/c | 0.318 | 0.446 | 0.091 | 0.000 |

## TEAPAC - Optimized Phase Sequences

As the program proceeds with the operational design of each of the specified phasings, the Optimized Phase Sequences report is produced by the DESIGN command to inform the user of the progress of the design. Each phasing is tested at all specified cycle lengths in an attempt to make the critical movements of the phasing work at the best possible balanced level of service.

In the short report, a table of the critical movement levels of service is produced where each row represents all of the critical levels of service achieved for each phasing at the listed cycle length. The column heading at the top shows each two-digit phasing code below which are the levels of service achieved for that phasing at each cycle length. The order of the phasings across the top of the table are not significant, except that they are listed in the order in which they are solved, as taken from the SEQUENCES command. If the SEQUENCES 11 ALL entry is used, the table will be in numerical order from 11 to 88. The columns of results in this table are always listed in groups of eight for ease of reading.

A more detailed report can be selected with the OUTPUT * * DETAIL command. This report also lists the target design value which was achieved for each combination of sequence and cycle, and reverses the axes of the table to accomplish this for as many as 11 cycle columns in each table. As many tables as needed are produced to accommodate the requested cycle range and increment.

Either report format is terminated with a list of the design criteria which were used in the DESIGN. This includes the target delay (seconds), the maximum delay, the delay increment, the target v/c (percent), the maximum v/c and the v/c increment.

Additional calculations may be shown in this report by using the OUTPUT * * EXTRA command. These describe how the optimization is achieved with detailed timing requirements for each of the standard phase types. This output is normally not generated.

The following is an example of the Optimized Phase Sequences report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - Optimized Phase Sequences**

Intersection # 1 - Lincoln Avenue & Main Street

| | Seq (**/**) 111111 | 222222 | 333333 | 444444 | 777777 | 888888 |
|---|---|---|---|---|---|---|
| Cyc | 123478 | 123478 | 123478 | 123478 | 123478 | 123478 |
| 60 | SSSSSS | SSSSSS | SSSSSS | CCDDDD | DDDEEE | CCDDDD |
| 90 | SSSSSS | SSSSSS | SSSSSS | CCDDDD | DDDDDD | CCDDDD |
| 120 | SSSSSS | SSSSSS | SSSSSS | DDDDDD | DDDDDD | DDDDDD |

Design Criteria: 35 80 5 90 100 5

## TEAPAC - Optimized Phasings Ranked by Crit Delay

The Optimized Phasings report generated by the SORT command, provides a valuable tool which can be used in making phasing selections and cycle selection. This report is also an optional (default) output of the DESIGN command. The sorted order reflects a powerful way of identifying which phasings have the highest probability of being successful - those with the lowest overall percentage of cycle time required at the best critical movement level of service and target delay achieved. This is the order in which the sequences are sorted - first by critical LOS achieved, then by target delay achieved within this LOS, then by required G/C + Y/C. If two sequences have the same required G/C + Y/C at the same level, they are further sorted by the best cycle length found and then the number of phases. All of this information is documented for each sequence code which is feasible. Infeasible sequences are listed in a matrix at the end of the report. This means that the phasing is considered unsafe and/or inappropriate for the specified input conditions.

When a phasing will not work at the maximum delay allowed, v/c balancing is attempted with the target v/c range provided. In this case a critical LOS of V is displayed along with the target v/c (%). If a solution is still not found, the phasing is listed with a critical LOS of S indicating that a saturated design was performed. This means that the design was forced based on the last v/c tested. "Optimum" timings can be obtained for these LOS S phasings, but should be inspected carefully to make sure that an appropriate balance of time and delay has been provided. The required G/C + Y/C for LOS S conditions indicates the v/c ratio of the critical movements which can be achieved by the design, similar to the critical v/c calculation of the HCM.

The minimum cycle length which accommodates the phasing and all minimums is listed. The range of cycles which were found to be successful at the specified level of service is documented as the last item in the report. The column heading for this information shows the range and increment of cycles tested.

The report is terminated with a list of the design criteria which were used in the DESIGN. This includes the target delay (seconds), the maximum delay, the delay increment, the target v/c (percent), the maximum v/c and the v/c increment.

The following is an example of the Optimized Phasings Ranked by Crit Delay report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - Optimized Phasings Ranked by Crit Delay**

Intersection # 1 - Lincoln Avenue & Main Street

| Seq **/** | Crit LOS | Crit Targ | Req'd G/C+Y/C | Best Cycle | No. of Phases | Min Cycle | Succ--Cycles 60..120(30) |
|---|---|---|---|---|---|---|---|
| 42 | C | 35 | 0.918 | 90 | 4 | 36 | 60.. 90 |
| 82 | C | 35 | 0.918 | 90 | 5 | 36 | 60.. 90 |
| 41 | C | 35 | 0.921 | 60 | 3 | 27 | 60.. 90 |
| 81 | C | 35 | 0.921 | 60 | 4 | 27 | 60.. 90 |
| 44 | D | 40 | 0.913 | 120 | 4 | 36 | 60..120 |
| 84 | D | 40 | 0.913 | 120 | 5 | 36 | 60..120 |
| 47 | D | 40 | 0.914 | 120 | 4 | 36 | 60..120 |
| 43 | D | 40 | 0.917 | 120 | 4 | 36 | 60..120 |
| 83 | D | 40 | 0.917 | 120 | 5 | 36 | 60..120 |
| 48 | D | 40 | 0.922 | 120 | 5 | 36 | 60..120 |
| 88 | D | 40 | 0.922 | 120 | 6 | 36 | 60..120 |
| 71 | D | 40 | 0.940 | 60 | 3 | 27 | 60..120 |
| 87 | D | 40 | 0.941 | 120 | 5 | 36 | 60..120 |
| 72 | D | 40 | 0.942 | 90 | 4 | 36 | 60..120 |
| 74 | D | 45 | 0.914 | 120 | 4 | 36 | 90..120 |
| 73 | D | 45 | 0.914 | 120 | 4 | 36 | 60..120 |
| 78 | D | 45 | 0.914 | 120 | 5 | 36 | 90..120 |
| 77 | D | 45 | 0.925 | 120 | 4 | 36 | 90..120 |
| 22 | S | 100 | 1.057 | 60 | 4 | 36 | |
| 24 | S | 100 | 1.065 | 60 | 4 | 36 | |
| 32 | S | 100 | 1.065 | 60 | 4 | 36 | |
| 23 | S | 100 | 1.065 | 60 | 4 | 36 | |
| 27 | S | 100 | 1.065 | 60 | 4 | 36 | |
| 28 | S | 100 | 1.065 | 60 | 5 | 36 | |
| 12 | S | 100 | 1.072 | 60 | 3 | 27 | |
| 21 | S | 100 | 1.072 | 60 | 3 | 27 | |
| 37 | S | 100 | 1.073 | 60 | 4 | 36 | |
| 33 | S | 100 | 1.073 | 60 | 4 | 36 | |
| 34 | S | 100 | 1.073 | 60 | 4 | 36 | |
| 38 | S | 100 | 1.073 | 60 | 5 | 36 | |
| 31 | S | 100 | 1.080 | 60 | 3 | 27 | |
| 14 | S | 100 | 1.080 | 60 | 3 | 27 | |
| 17 | S | 100 | 1.080 | 60 | 3 | 27 | |
| 13 | S | 100 | 1.080 | 60 | 3 | 27 | |
| 18 | S | 100 | 1.080 | 60 | 4 | 27 | |
| 11 | S | 100 | 1.087 | 60 | 2 | 18 | |

Design Criteria: 35 80 5 90 100 5

## TEAPAC - Optimum Phase Timings

The Optimum Phase Timings report generated by the TIMINGS command provides a list of the optimum phase times which have been generated by the DESIGN command. These phase times are shown in both seconds (G and Y+R) and seconds per second (G/C) for the cycle length shown. The optimum phase times have been adjusted so that the total G/C + Y/C equals 1.0 by allocating excess time (if any exists) to the defined priority movements. The critical movement in each phase is indicated in the phase diagram with asterisks in the movement arrows (also shown in red). The sequence code for the phasing is listed in the upper-left corner of the results, with the Lead/Lag conditions below, if any. If a phase's green time is controlled by a vehicle minimum, this is indicated by the letter 'm' in the lower left corner of the phase. If a phase's green time is controlled by a pedestrian minimum, this is indicated by the letter 'p' in the lower left corner of the phase. If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

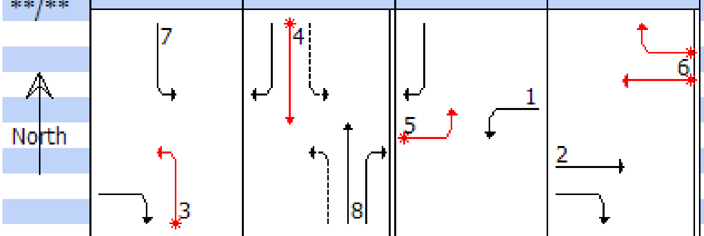
The following is an example of the Optimum Phase Timings report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.10.09] - Optimum Phase Timings

Intersection # 1 - Lincoln Avenue & Main Street

| Sq 44 **/** | Phase 1 | Phase 2 | Phase 3 | Phase 4 |
|---|---|---|---|---|
| C= 60" | G/C= 0.093<br>G= 5.6"<br>Y+R= 4.0" | G/C= 0.236<br>G= 14.2"<br>Y+R= 4.0" | G/C= 0.205<br>G= 12.3"<br>Y+R= 4.0" | G/C= 0.200<br>G= 12.0"<br>Y+R= 4.0" |



## TEAPAC - Optimum Phase Timings (HCM 2016)

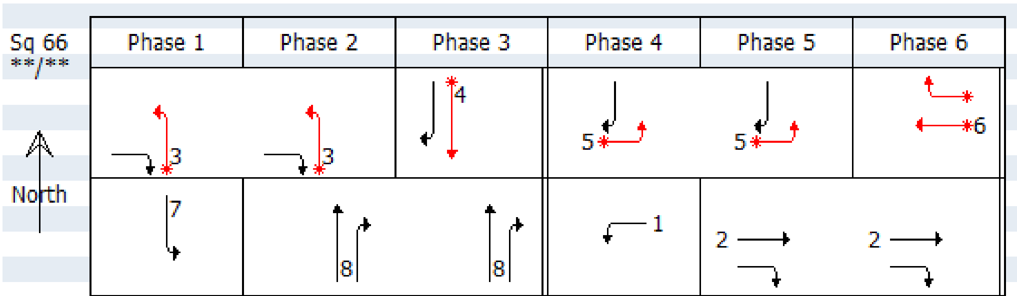
The Optimum Phase Timings (HCM2016) report generated by the TIMINGS command provides a list of the optimum phase times which have been generated by the DESIGN command. These phase times are shown in both seconds (Gmax and Y+Rc) and seconds per second (G/C) for the cycle length shown. The optimum phase times have been adjusted so that the total G/C + Y/C equals 1.0 by allocating excess time (if any exists) to the defined priority movements. The critical movement in each phase is indicated in the phase diagram with asterisks in the movement arrows (also shown in red). The sequence code for the phasing is listed in the upper-left corner of the results, with the Lead/Lag conditions below, if any. If a phase's green time is controlled by a vehicle minimum, this is indicated by the letter 'm' in the lower left corner of the phase. If a phase's green time is controlled by a pedestrian minimum, this is indicated by the letter 'p' in the lower left corner of the phase. If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

The following is an example of the Optimum Phase Timings (HCM 2016) report using the Signal-Analysis.tpc sample data file.

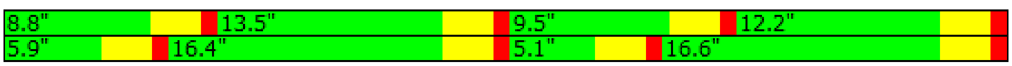
Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 9.00.02] - Optimum Phase Timings (HCM 2016)**

Intersection # 1 - Lincoln Avenue & Main Street




| | | | | | | |
|---|---|---|---|---|---|---|
| Cmax= 60" | Gmax= 8.8" G/C=0.146 Y+Rc= 4.0" | | Gmax= 13.5" G/C=0.225 Y+Rc= 4.0" | Gmax= 9.5" G/C=0.159 Y+Rc= 4.0" | | Gmax= 12.2" G/C=0.203 Y+Rc= 4.0" |
| | Gmax= 5.9" G/C=0.098 Y+Rc= 4.0" | Gmax= 16.4" G/C=0.273 Y+Rc= 4.0" | | Gmax= 5.1" G/C=0.085 Y+Rc= 4.0" | Gmax= 16.6" G/C=0.277 Y+Rc= 4.0" | |



## TEAPAC - HCM Input Worksheet

The 2000 *Highway Capacity Manual* describes nine worksheets for simplifying and organizing capacity analysis calculations. Replicas of these worksheets may be produced by the ANALYZE, EVALUATE or QUEUECALCS commands by first setting the first OUTPUT parameter to FULL. A limited set of only the basic HCM worksheets can be produced by setting the first OUTPUT parameter to BASIC. Worksheets may also be produced by DESIGN with the same OUTPUT setting if a capacity analysis has been requested following the design.

Each worksheet is discussed individually in the succeeding pages and an example of each is included.

The HCM Input Worksheet is the first HCM 2000/2016 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. The worksheet is also produced when BASIC worksheet OUTPUT is selected. This worksheet lists the input conditions used for the capacity analysis, as described below.

**Intersection Name.** The node number and name of the intersection.

**Area Location Type.** The location of the intersection within the metropolitan area, either CBD or NONCBD.

### Schematic Diagram

Volumes, widths and lanes are shown on a schematic diagram of the intersection, along with certain phasing parameters, as described below. For each traffic movement, the top or left-most entry is the volume, the middle entry is the lane group width and the bottom or right-most entry is the number of lanes.

**Volumes.** The actual demand volume of vehicles, in vehicles per hour, for each of the twelve movements of the intersection.

**Widths.** The amount of roadway width, in feet, which has been allocated for each lane group at the intersection.

**Lanes.** The number of lanes which have been striped for each of the specified lane group widths. Movements which are part of dual-optional lane groups are represented with a plus sign next to the turning lane and a minus sign next to the shared lanes.

**Sequence.** The phasing sequence code for the phasing of the intersection, using the standard TEAPAC phasing codes described in Chapter 1 of the manual.

**Permissive.** The permissive flags (NO or YES) indicate if left turns are permitted on a green ball following or preceding an exclusive left turn phase (permitted left condition) for each of the four left turns.

**Overlap.** The overlap flags (NO or YES) indicate whether right turns are allowed to overlap into adjacent protected left turn phases when exclusive right turn lanes exist, for each of the four right turns.

**Leadlag.** The leadlag entries identifies whether the phasing for the sequence code appears in its normal order (LEAD or NONE), or is reversed (LAG).

## Tabulated Parameters

Additional parameters for the analysis are displayed in tabular format, with each column of the table representing the twelve movements of the intersection (upper portion of table) and the four approaches of the intersection (lower portion of table).

**Heavy Vehicles.** The percentage of trucks and through buses for each movement.

**Peak Hour Factor.** The peak hour factor for each movement of the intersection.

**Pretimed or Actuated.** A P or A indicating whether a movement is Pretimed or part of an Actuated phase module. If all entries are P, every movement is analyzed as a fixed-time lane group. If entries for all non-zero lane groups are A, every movement is analyzed as a full-actuated lane group. Otherwise a semi-actuated analysis is done.

**Startup Lost Time.** The amount of time at the start of a phase which is effectively lost due to startup delays, for each movement.

**Extension of Effective Green.** The amount of time at the end of a phase by which vehicles effectively extend the green into the clearance time, for each movement.

**Arrival Type.** A value from 1 to 6 quantifying the quality of progression of each movement, 6 indicating nearly perfect progression.

**Pedestrian Volume.** The volume of pedestrians interfering with right turns on each approach, in pedestrians per hour. For certain phasings, this pedestrian volume may also conflict with left turns on the approach opposite to these right turns.

**Bicycle Volume.** The volume of bicycles interfering with right turns on each approach, in bikes per hour.

**Parking Location.** The location of parking on each approach, if it exists. If parking exists, the entry is either RIGHT, LEFT or BOTH to indicate which side of the approach the parking is on. If no parking exists, the entry is NONE.

**Parking - Maneuvers.** The number of parking maneuvers per hour on one side of an approach. If the value in the Parking Location row (see above) is NO, the number of Parking Maneuvers is ignored, and thus has no impact on any calculations. This is commonly the case when the Parking Maneuvers entry uses the default of 20 maneuvers per hour, but there is no parking, as indicated by a NONE in the Parking Location column.

**Bus Stops.** The hourly volume of local buses which stop at a bus stop on each approach, in buses per hour.

**Grade.** The percent grade of each approach, with a negative number representing a down-grade approach.

## Phase Sequence

**Signal Phasing.** The signal phasing that is analyzed is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows with asterisks indicate the critical movements in the phasing, if specified (also shown in red). North (or the direction assumed by the user to be north) is always up in the diagrams, as indicated by the North arrow at the left. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded phase sequence number appears at the top of the phase diagram along with specified lead/lag conditions, if any (otherwise ** is shown). If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

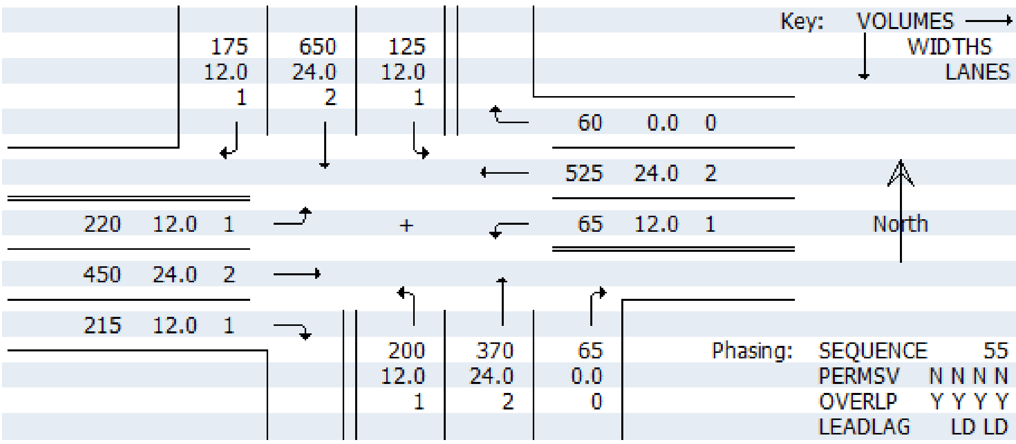
**Timings.** The signal timings used for the capacity analysis are given in terms of the cycle length (C) in seconds, the green time for each phase (G) in seconds, and the yellow time plus all-red for each phase (Y+R) in seconds. If a phase's green time is controlled by a minimum, this is indicated by the letter 'm' in the lower left corner of the phase. If a phase's green time is controlled by a pedestrian minimum, this is indicated by the letter 'p' in the lower left corner of the phase.

The following is an example of the HCM Input Worksheet report using the Signal-Analysis.tpc sample data file.

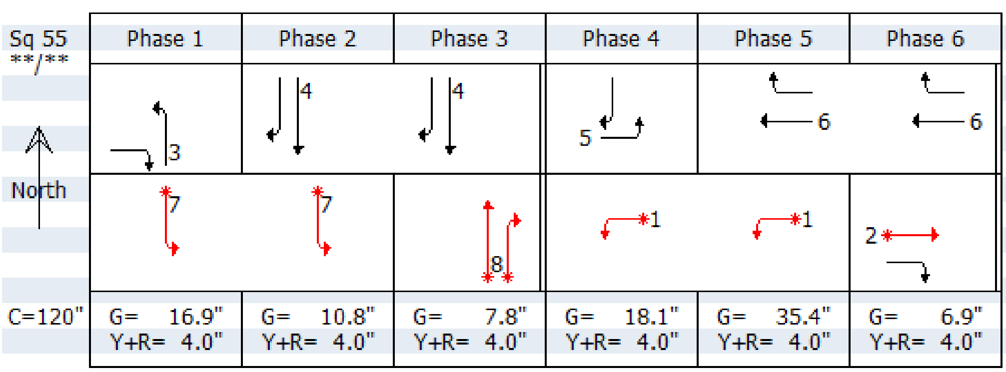
Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - HCM Input Worksheet**

Intersection # 1 - Lincoln Avenue & Main Street Area Location Type: NONCBD




| | N RT | N TH | N LT | E RT | E TH | E LT | S RT | S TH | S LT | W RT | W TH | W LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy veh, %HV | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Pk-hr fact, PHF | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 |
| Pretimed or Act | A | A | A | A | A | A | A | A | A | A | A | A |
| Strtup lost, l1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Ext eff grn, e | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Arrival typ, AT | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Ped vol, vped | | 0 | | | 0 | | | 0 | | | 0 | |
| Bike vol, vbic | | 0 | | | 0 | | | 0 | | | 0 | |
| Parking locatns | | NO | | | NO | | | NO | | | NO | |
| Park mnvrs, Nm | | 0 | | | 0 | | | 0 | | | 0 | |
| Bus stops, NB | | 0 | | | 0 | | | 0 | | | 0 | |
| Grade, %G | | .0 | | | .0 | | | .0 | | | .0 | |



## TEAPAC - HCM Volume Adjust & Satflow Worksheet

The HCM Volume Adjust & Satflow Worksheet is the second HCM 2000 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. The worksheet is also produced when BASIC worksheet OUTPUT is selected. This worksheet first lists the adjustment to input volumes made for the capacity analysis, then lists the factors and calculations made for the estimated saturation flows, as described below.

### Volume Adjustment

**Approach and Movement Labels.** The one- or two- character approach and movement name designations.

**Volume.** The actual demand volume of vehicles, in vehicles per hour, for each movement.

**Peak Hour Factor.** The peak hour factor for each movement.

**Adjusted Movement Flow Rate.** The rate of vehicular flow, in vehicles per hour, during the peak 15 minute period. Flow rates are calculated by dividing the movement Volumes by the movement Peak Hour Factors above.

**Lane Groups.** The movements included in each lane group. Lane groups that include a through movement will always be displayed in the through movement column in the table for an approach. Vacant columns indicate that a movement is not itself a lane group but is part of another lane group, if it exists at all.

**Adjusted Lane Group Flow.** The rate of vehicular flow, in vehicles per hour, that is included in the lane group. This combines all the flow rates for the movements included in the designated lane group.

**Proportion of Left Turns.** The decimal percentage of left turns in the lane group. If the lane group consists of an exclusive left turn lane, the Proportion of Left Turns will be 1.00 (100%). If the lane group consists of an exclusive right turn lane, the Proportion of Left Turns will be 0.00.

**Proportion of Right Turns.** The decimal percentage of right turns in the lane group. If the lane group consists of an exclusive right turn lane, the Proportion of Right Turns will be 1.00 (100%). If the lane group consists of an exclusive left turn lane, the Proportion of Right Turns will be 0.00.

### Saturation Flow Rate

**Approach and Movement Labels.** The one- or two- character approach and movement name designations.

**Base Saturation Flow.** The base (ideal) saturation flow rate per lane for each lane group in passenger cars per hour of green per lane (pcphgpl).

**Number of Lanes.** The number of lanes in each lane group.

**Lane Width Factor.** The adjustment factor for lane width determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. Extrapolation is allowed, with warning messages to the user.

**Heavy Vehicle Factor.** The adjustment factors for heavy vehicles determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Grade Factor.** The adjustment factors for grades determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Parking Factor.** The adjustment factors for parking determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Bus Blockage Factor.** The adjustment factors for bus blockage determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Area Type Factor.** The adjustment factors for area location type determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Lane Utilization Factor**. The adjustment factors for how balanced each of the individual lanes in a lane group are utilized determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Left Turn Factor.** The adjustment factors for left turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. See the Supplemental LT-Factor Worksheet section for a discussion of how left turn factors are calculated when a permitted left turn phase is present. When a protected-permitted left turn is present, this line of the table lists the satflow adjustment factor for the permitted phase, while additional lines below show the left turn factor and resultant satflow calculated for the protected phase.

**Right Turn Factor.** The adjustment factors for right turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Ped-Bike Left Turn Factor.** The adjustment factors for the effect of pedestrians on left turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. See the Ped-Bike LT Effects Worksheet section for a discussion of how ped-bike left turn factors are calculated when pedestrian interference is present for left turns.

**Ped-Bike Right Turn Factor.** The adjustment factors for the effect of pedestrians and bicycles on right turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. See the

Ped-Bike RT Effects Worksheet section for a discussion of how ped-bike right turn factors are calculated when pedestrian and/or bicycle interference is present for right turns.

**Local Adjustment Factor.** A user-defined adjustment factor used like the other saturation flow rate factors to adjust the base saturation flow rate by multiplication, normally used to calibrate the HCM satflow estimate to measured local conditions.

**Adjusted Saturation Flow.** The resultant saturation flow adjusted for all of the factors described above, in vehicle per hour of green.

**Protected Left Turn Factor.** When a protected-permitted left turn is present, this line of the table lists the left turn adjustment factors for the protected phase determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

**Protected Left Turn Saturation Flow.** When a protected-permitted left turn is present, this line of the table lists the resultant saturation flow for the protected left turn phase adjusted for all of the factors described above, in vehicle per hour of green.

The following is an example of the HCM Volume Adjust & Satflow Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.10.00] - HCM Volume Adjust & Satflow Worksheet**

| Volume Adjustment | N RT | N TH | N LT | E RT | E TH | E LT | S RT | S TH | S LT | W RT | W TH | W LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Volume, V | 175 | 550 | 125 | 60 | 425 | 65 | 65 | 370 | 200 | 215 | 450 | 220 |
| Pk-hr fact, PHF | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 | .90 |
| Adj mv flow, vp | 194 | 611 | 139 | 67 | 472 | 72 | 72 | 411 | 222 | 239 | 500 | 244 |

| Volume Adjustment | N RT | N TH | N LT | E RT | E TH | E LT | S RT | S TH | S LT | W RT | W TH | W LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane group, LG | RT | TH | LT | | RT+TH | LT | | RT+TH | LT | RT | TH | LT |
| Adj LG flow, v | 194 | 611 | 139 | | 539 | 72 | | 483 | 222 | 239 | 500 | 244 |
| Prop LT, PLT | .000 | .000 | 1.00 | | .000 | 1.00 | | .000 | 1.00 | .000 | .000 | 1.00 |
| Prop RT, PRT | 1.000 | .000 | .000 | | .124 | .000 | | .149 | .000 | 1.000 | .000 | .000 |

| Saturation Flow Rate | N RT | N TH | N LT | E RT | E TH | E LT | S RT | S TH | S LT | W RT | W TH | W LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Base satflo, so | 1900 | 1900 | 1900 | | 1900 | 1900 | | 1900 | 1900 | 1900 | 1900 | 1900 |
| Number lanes, N | 1 | 2 | 1 | | 2 | 1 | | 2 | 1 | 1 | 2 | 1 |
| Lane width, fW | 1.000 | 1.00 | 1.00 | | 1.000 | 1.00 | | 1.000 | 1.00 | 1.000 | 1.00 | 1.00 |
| Heavy veh, fHV | .980 | .980 | .980 | | .980 | .980 | | .980 | .980 | .980 | .980 | .980 |
| Grade, fg | 1.000 | 1.00 | 1.00 | | 1.000 | 1.00 | | 1.000 | 1.00 | 1.000 | 1.00 | 1.00 |
| Parking, fp | 1.000 | 1.00 | 1.00 | | 1.000 | 1.00 | | 1.000 | 1.00 | 1.000 | 1.00 | 1.00 |
| Bus block, fbb | 1.000 | 1.00 | 1.00 | | 1.000 | 1.00 | | 1.000 | 1.00 | 1.000 | 1.00 | 1.00 |
| Area type, fa | 1.000 | 1.00 | 1.00 | | 1.000 | 1.00 | | 1.000 | 1.00 | 1.000 | 1.00 | 1.00 |
| Lane util, fLU | 1.000 | .952 | 1.00 | | .952 | 1.00 | | .952 | 1.00 | 1.000 | .952 | 1.00 |
| Left-turn, fLT | 1.000 | 1.00 | .280 | | 1.000 | .950 | | 1.000 | .220 | 1.000 | 1.00 | .950 |
| Right-turn, fRT | .850 | 1.00 | 1.00 | | .981 | 1.00 | | .978 | 1.00 | .850 | 1.00 | 1.00 |
| PedBike LT,fLpb | 1.000 | 1.00 | .999 | | 1.000 | 1.00 | | 1.000 | .999 | 1.000 | 1.00 | 1.00 |
| PedBike RT,fRpb | .994 | 1.00 | 1.00 | | 1.000 | 1.00 | | .998 | 1.00 | 1.000 | 1.00 | 1.00 |
| Local adjustmnt | 1.000 | 1.00 | 1.00 | | 1.000 | 1.00 | | 1.000 | 1.00 | 1.000 | 1.00 | 1.00 |
| Adj satflow, s | 1574 | 3547 | 520 | | 3481 | 1770 | | 3461 | 410 | 1583 | 3547 | 1770 |
| Prot LT fLT | .000 | .000 | .950 | | | | | .000 | .950 | | | |
| Prot LT Satflo | 0 | 0 | 1768 | | | | | 0 | 1768 | | | |

## TEAPAC - HCM Supplemental LT-Factor Worksheet

The HCM Supplemental LT-Factor Worksheet is the third HCM 2000 worksheet produced the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and calculations made for the permissive left turns in the capacity analysis, as described below. This worksheet is produced only when at least one approach contains a permitted left turn phase.

The one- or two-character approach and movement name designations for each of the left turns at the intersection appear at the top of the worksheet. The worksheet is divided into two sections, the first section listing the input variables used and the second section listing the calculations. The format of the worksheet is a combination of the worksheets of Exhibits C16-9 and C16-10 in the 2000 *Highway Capacity Manual* so that all four left turns can be included on a single page, regardless of which worksheet is used. This combined worksheet indicates those entries which are specific to the C16-9 multilane worksheet with the notation (multi) and those which are specific to the C16-10 single-lane worksheet with the notation (1lane).

The input variables include Cycle Length, Actual Green Time, Effective Permitted Green Time, Opposing Effective Green Time, Number of Lanes, Number of Opposing Lanes for Exhibit C16-9 only, Adjusted LT Flow Rate, Proportion of LT in Lane Group, Proportion of Opposing LT for Exhibit C16-10 only, Adjusted Opposing Flow Rate, and Normal Movement Lost Time.

The calculations include Left Turns per Cycle, Opposing Lane Utilization, Opposing Flow per Lane per Cycle, Opposing Platoon Ratio, First LT Effective Green, Opposing Queue Ratio, Opposing Queue Effective Green, Unsaturated Effective Green, Maximum Opposing Vehicles, Proportion TH in Opposing, TH Equivalent for LT, Proportion of LT, Opposing TH Equivalent, Minimum Value for fLT, LT Factor for LT, Unusable gq, and LT Factor for Lane Group.

The following is an example of the HCM Supplemental LT-Factor Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.10.00] - HCM Supplemental LT-Factor Worksheet**

| Input/Calculation | N | E | S | W |
|---|---|---|---|---|
| Cycle length, C | 60 | | 60 | |
| Actual green time for LT, G | 23.7 | | 23.7 | |
| Effective perm green time, g | 18.2 | | 18.2 | |
| Opp. effective green time, go | 14.2 | | 14.2 | |
| Number of Lanes, N | 1 | | 1 | |
| Number opp. lanes, No (multi) | 2 | | 2 | |
| Adjusted LT flow rate, vLT | 139 | | 222 | |
| Proportion of LT in LG, PLT | 1.000 | | 1.000 | |
| Prop. of opp. LT (1lane), PLTo | .000 | | .000 | |
| Adjusted opp. flow rate, vo | 483 | | 611 | |
| Normal movement lost time, tL | 4.0 | | 4.0 | |
| Left turns per cycle, LTC | 2.317 | | 3.700 | |
| Opp. Lane Utilization, fLUo | .952 | | .952 | |
| Opp. flow /lane /cycle, Volc | 4.228 | | 5.348 | |
| Opposing platoon ratio, Rpo | 1.000 | | 1.000 | |
| First LT effect. green, gf | .000 | | .000 | |
| Opposing queue ratio, qro | .764 | | .764 | |
| Opp. queue effect. green, gq | 7.517 | | 9.941 | |
| Unsaturated effect. green, gu | 10.661 | | 8.237 | |
| Max. opp. vehicles, n (1lane) | 3.759 | | 4.971 | |
| Prop. TH in opp., PTHo (1lane) | 1.000 | | 1.000 | |
| TH equivalent for LT, EL1 | 2.097 | | 2.375 | |
| Proportion of LT, PL (multi) | 1.000 | | 1.000 | |
| Opp. TH equiv., EL2 (1lane) | 1.000 | | 1.000 | |
| Minimum value for fLT, fmin | .220 | | .220 | |
| LT factor for LT, fm (multi) | .280 | | .220 | |
| Usable gq, gdiff (1lane) | 7.517 | | 9.941 | |
| LT factor for lane group, fLT | .280 | | .220 | |

## TEAPAC - HCM Ped-Bike LT Effects Worksheet

The HCM Ped-Bike LT Effects Worksheet is the fourth HCM 2000 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and calculations made for the effect of pedestrians and bicycles on saturation flows involving left turns, as described below.

**Effective ped green time.** The effective green time, in seconds, used by the pedestrians.

**Conflicting ped volume.** The volume of pedestrians across the intersection leg that conflicts with the left turns, in peds per hour.

**Ped flow rate.** The rate of flow of pedestrians during the effective green period, in peds per hour.

**Avg. ped occupancy.** The average pedestrian occupancy based on the ped flow rate.

**Opposing queue clear time.** The time in seconds it takes the opposing queue to clear from its queued state, in seconds.

**Opposing queue g ratio.** The proportion of the effective ped green time consumed by the opposing queue clear time.

**Ped occupancy after queue.** Pedestrian occupancy after the opposing queue clears.

**Opposing flow rate.** Flow rat eof opposing traffic, in vehicles per hour.

**Relevant occupancy.** The relevant occupancy based on pedestrian occupancy and gap availability.

**# receiving lanes.** The number of receiving lanes for the left turn movement.

**# turning lanes.** The number of turning lanes for the left turn movement.

**Adjustment factor.** The permitted phase pedestrian/bicycle adjustment factor.

**Proportion left turns.** The proportion of left turns in the lane group.

**Prop LT in prot phase.** The proportion of left turns using the protected phase.

**Ped-bike adjust factor.** The resultant pedestrian/bicycle satflow adjustment factor.

The following is an example of the HCM Ped-Bike LT Effects Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.10.00] - HCM Ped-Bike LT Effects Worksheet

| Input/Calculation | N | E | S | W |
|---|---|---|---|---|
| Effective ped green time, gp | 14.2 | 12.0 | 14.2 | 12.0 |
| Conflicting ped volume, Vped | 10 | 0 | 10 | 0 |
| Ped flow rate, Vpedg | 42.318 | .000 | 42.318 | .000 |
| Avg. ped occupancy, OCCpedg | .021 | .000 | .021 | .000 |
| Opposing queue clear time, gq | 7.517 | .000 | 9.941 | .000 |
| Opposing queue g ratio, gq/gp | .530 | .000 | .701 | .000 |
| Ped occ after queue, OCCpedu | .016 | .000 | .014 | .000 |
| Opposing flow rate, Vo | 483 | 0 | 611 | 0 |
| Relevant occupancy, OCCr | .008 | .000 | .006 | .000 |
| # receiving lanes, Nrec | 2 | 2 | 2 | 2 |
| # turning lanes, Nturn | 1 | 1 | 1 | 1 |
| Adjustment factor, ApbT | .995 | 1.000 | .996 | 1.000 |
| Proportion left turns, PLT | 1.000 | 1.000 | 1.000 | 1.000 |
| Prop LT in prot phase, PLTA | .758 | 1.000 | .821 | 1.000 |
| Ped-bike adjust factor, fLpb | .999 | 1.000 | .999 | 1.000 |

## TEAPAC[Ver 8.10.00] - HCM Ped-Bike RT Effects Worksheet

| Input/Calculation | N | E | S | W |
|---|---|---|---|---|
| Effective ped green time, gp | 14.2 | 12.0 | 14.2 | 12.0 |
| Conflicting ped volume, Vped | 10 | 0 | 10 | 0 |
| Conflicting bike volume, Vbic | 0 | 0 | 0 | 0 |
| Ped flow rate, Vpedg | 42.318 | .000 | 42.318 | .000 |
| Avg ped occupancy, OCCpedg | .021 | .000 | .021 | .000 |
| Effective bike green time, g | 14.2 | 12.0 | 14.2 | 12.0 |
| Bike flow rate, Vbicg | .000 | .000 | .000 | .000 |
| Avg bike occupancy, OCCbicg | .000 | .000 | .000 | .000 |
| Relevant occupancy, OCCr | .021 | .000 | .021 | .000 |
| # receiving lanes, Nrec | 2 | 2 | 2 | 2 |
| # turning lanes, Nturn | 1 | 1 | 1 | 1 |
| Adjustment factor, ApbT | .987 | 1.000 | .987 | 1.000 |
| Proportion right turns, PR | 1.000 | .124 | .149 | 1.000 |
| Prop RT in prot phase, PRA | .535 | .000 | .000 | .444 |
| Ped-bike adjust factor, fRpb | .994 | 1.000 | .998 | 1.000 |

## TEAPAC - HCM Ped-Bike RT Effects Worksheet

The HCM Ped-Bike RT Effects Worksheet is the fifth HCM 2000 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and calculations made for the effect of pedestrians and bicycles on saturation flows involving right turns, as described below.

**Effective ped green time.** The effective green time, in seconds, used by the pedestrians.

**Conflicting ped volume.** The volume of pedestrians across the intersection leg that conflicts with the right turns, in peds per hour.

**Conflicting bike volume.** The volume of bicycles across the intersection leg that conflicts with the right turns, in bikes per hour.

**Ped flow rate.** The rate of flow of pedestrians during the effective green period, in peds per hour.

**Avg. ped occupancy.** The average pedestrian occupancy based on the ped flow rate.

**Effective bike green time.** The effective green time, in seconds, used by the bicycles.

**Bike flow rate.** The rate of flow of bicycles during the effective green period, in bikes per hour.

**Avg. bike occupancy.** The average bicycle occupancy based on the bike flow rate.

**Relevant occupancy.** The relevant occupancy based on pedestrian occupancy and bicycle conflict zone occupancy.

**# receiving lanes.** The number of receiving lanes for the right turn movement.

**# turning lanes.** The number of turning lanes for the right turn movement.

**Adjustment factor.** The permitted phase pedestrian/bicycle adjustment factor.

**Proportion right turns.** The proportion of right turns in the lane group.

**Prop RT in prot phase.** The proportion of right turns using the protected phase.

**Ped-bike adjust factor.** The resultant pedestrian/bicycle satflow adjustment factor.

The following is an example of the HCM Ped-Bike RT Effects Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.10.00] - HCM Ped-Bike LT Effects Worksheet

| Input/Calculation | N | E | S | W |
|---|---|---|---|---|
| Effective ped green time, gp | 14.2 | 12.0 | 14.2 | 12.0 |
| Conflicting ped volume, Vped | 10 | 0 | 10 | 0 |
| Ped flow rate, Vpedg | 42.318 | .000 | 42.318 | .000 |
| Avg. ped occupancy, OCCpedg | .021 | .000 | .021 | .000 |
| Opposing queue clear time, gq | 7.517 | .000 | 9.941 | .000 |
| Opposing queue g ratio, gq/gp | .530 | .000 | .701 | .000 |
| Ped occ after queue, OCCpedu | .016 | .000 | .014 | .000 |
| Opposing flow rate, Vo | 483 | 0 | 611 | 0 |
| Relevant occupancy, OCCr | .008 | .000 | .006 | .000 |
| # receiving lanes, Nrec | 2 | 2 | 2 | 2 |
| # turning lanes, Nturn | 1 | 1 | 1 | 1 |
| Adjustment factor, ApbT | .995 | 1.000 | .996 | 1.000 |
| Proportion left turns, PLT | 1.000 | 1.000 | 1.000 | 1.000 |
| Prop LT in prot phase, PLTA | .758 | 1.000 | .821 | 1.000 |
| Ped-bike adjust factor, fLpb | .999 | 1.000 | .999 | 1.000 |

## TEAPAC[Ver 8.10.00] - HCM Ped-Bike RT Effects Worksheet

| Input/Calculation | N | E | S | W |
|---|---|---|---|---|
| Effective ped green time, gp | 14.2 | 12.0 | 14.2 | 12.0 |
| Conflicting ped volume, Vped | 10 | 0 | 10 | 0 |
| Conflicting bike volume, Vbic | 0 | 0 | 0 | 0 |
| Ped flow rate, Vpedg | 42.318 | .000 | 42.318 | .000 |
| Avg ped occupancy, OCCpedg | .021 | .000 | .021 | .000 |
| Effective bike green time, g | 14.2 | 12.0 | 14.2 | 12.0 |
| Bike flow rate, Vbicg | .000 | .000 | .000 | .000 |
| Avg bike occupancy, OCCbicg | .000 | .000 | .000 | .000 |
| Relevant occupancy, OCCr | .021 | .000 | .021 | .000 |
| # receiving lanes, Nrec | 2 | 2 | 2 | 2 |
| # turning lanes, Nturn | 1 | 1 | 1 | 1 |
| Adjustment factor, ApbT | .987 | 1.000 | .987 | 1.000 |
| Proportion right turns, PR | 1.000 | .124 | .149 | 1.000 |
| Prop RT in prot phase, PRA | .535 | .000 | .000 | .444 |
| Ped-bike adjust factor, fRpb | .994 | 1.000 | .998 | 1.000 |

## TEAPAC - HCM Capacity and LOS Worksheet

The HCM Capacity and LOS Worksheet is the sixth HCM 2000 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. The worksheet is also produced when BASIC worksheet OUTPUT is selected. This worksheet first lists the calculations of capacities and v/c's made for the capacity analysis, then lists the calculations of delay and level of service made for the capacity analysis, as described below.

### Capacity Analysis

**Approach and Movement Labels.** The one- or two- character approach and movement name designations.

**Lane Group.** The movements included in each lane group. Lane groups that include a through movement will always be displayed in the through movement column in the table.

**Adjusted Flow.** The adjusted flow rate, in vehicles per hour, for each lane group.

**Saturation Flow.** The adjusted saturation flow, in vehicle per hour of green, for each lane group.

**Lost Time.** The lost time, in seconds, for each lane group.

**Effective Green.** The effective green time, in seconds, for each lane group.

**Green Ratio.** The g/C ratios for each lane group.

**Lane Group Capacity.** The lane group capacity, in vehicles per hour, for each lane group.

**Volume/Capacity Ratio.** The volume/capacity ratio for each lane group.

**Flow Ratio.** The ratio of the Adjusted Flow to the Saturation Flow for each lane group.

**Critical Lane Groups.** The lane groups that are on the critical path as defined by the 2000 *Highway Capacity Manual* are flagged in this row with an asterisk.

**Permitted Phases of Compound Left Turns.** When a left turn is only protected or only permitted, only a single line appears in the worksheet, as described above. When a compound left turn phasing exists (protected-permitted or permitted-protected), the protected phase for the left turn is detailed in the section described above, then each of the same variables are described in a second section for the permitted phases. The totals for the combined phases appear in the Delay and LOS section which follows.

**Sum of the Critical Flow Ratios.** The sum of the Flow Ratios (v/s) for the Critical Lane Groups.

**Total Lost Time Per Cycle.** The time, in seconds, during which the intersection is not used effectively by any movement.

**Critical v/c Ratio.** This is calculated according to the formula for Xc in the 2000 *Highway Capacity Manual*.

## Delay and LOS

**Approach and Movement Labels.** The one- or two- character approach and movement name designations.

**Adjusted Flow.** The adjusted flow rate, in vehicles per hour, for each lane group.

**Lane Group Capacity.** The lane group capacity, in vehicles per hour, for each lane group.

**Volume/Capacity Ratio.** The volume/capacity ratio for each lane group.

**Green Ratio.** The g/C ratio for each lane group. The green ratio for both phases is displayed for protected-permitted left turns.

**Uniform Delay ($d_1$).** The uniform delay term, $d_1$, in seconds per vehicle, as calculated by the 2000 *Highway Capacity Manual* methods.

**Incremental Calibration Term.** The delay calibration term for the incremental delay calculation for an actuated condition as determined in Exhibit 16-13 of the 2000 *Highway Capacity Manual*.

**Incremental Delay ($d_2$).** The incremental delay term, $d_2$, in seconds per vehicle, as calculated by the 2000 *Highway Capacity Manual* methods.

**Queue Delay ($d_3$).** The initial queue delay term, $d_3$, in seconds per vehicle, as calculated by the 2000 *Highway Capacity Manual* methods.

**Uniform Delay ($d_1$*).** The uniform delay term, $d_1$, in seconds per vehicle, as re-calculated by the 2000 *Highway Capacity Manual* methods for the $d_3$ delay term.

**Progression Factor.** The adjustment to be made to the uniform delay calculation for a non-random arrival condition as determined in Exhibit 16-12 of the 2000 *Highway Capacity Manual*.

**Control Delay.** The control delay for each lane group, as the sum of $d_1$ adjusted by the Progression Factor plus $d_2$ plus $d_3$, in seconds per vehicle.

**Lane Group Level of Service.** The Level of Service for the lane group as determined from the lane group control delay and Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the LOS letter.

**Final queue.** The final initial queue (unmet demand) at the end of the analysis period, in vehicles.

**Approach Delay.** The weighted average of lane group Control Delay for all lane groups on an approach, weighted by the volume in each lane group experiencing each different delay value, in seconds per vehicle.

**Approach Level of Service.** The level of service for each approach as determined from the Approach Delay and Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the LOS letter.

**Approach Flow.** The total adjusted flow rate, in vehicles per hour, for all lane groups on each approach.

**Intersection Delay.** The weighted average of Approach Delay for all approaches at the intersection, in seconds per vehicle.

**Intersection Level of Service.** The level of service for the intersection as determined from the Intersection Delay and Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the LOS letter.

The following is an example of the HCM Capacity and LOS Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.10.00] - HCM Capacity and LOS Worksheet**

| Capacity Analysis | N RT | N TH | N LT | E RT | E TH | E LT | S RT | S TH | S LT | W RT | W TH | W LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane group, LG | RT | TH | LT | | RT+TH | LT | | RT+TH | LT | RT | TH | LT |
| Adj Flow, v | 194 | 611 | 139 | | 539 | 72 | | 483 | 164 | 239 | 500 | 244 |
| Satflow, s | 1574 | 3547 | 1768 | | 3481 | 1770 | | 3461 | 1768 | 1583 | 3547 | 1770 |
| Lost time, tL | 4.0 | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Effect green, g | 30.5 | 14.2 | 5.6 | | 12.0 | 12.3 | | 14.2 | 5.6 | 21.5 | 12.0 | 12.3 |
| Grn ratio, g/C | .508 | .236 | .093 | | .200 | .205 | | .236 | .093 | .359 | .200 | .205 |
| LG capacity, c | 799 | 838 | 164 | | 695 | 362 | | 818 | 164 | 568 | 708 | 362 |
| v/c ratio, X | .243 | .729 | .848 | | .776 | .199 | | .590 | 1.00 | .421 | .706 | .674 |
| Flow ratio, v/s | .123 | .172 | .079 | | .155 | .041 | | .140 | .093 | .151 | .141 | .138 |
| Crit lane group | | * | | | * | | | | * | | | * |

| Permitted Phase of Compound LTs | N RT | N TH | N LT | E RT | E TH | E LT | S RT | S TH | S LT | W RT | W TH | W LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adj Flow, v | | | 0 | | | | | | 58 | | | |
| Satflow, s | | | 520 | | | | | | 410 | | | |
| Lost time, tL | | | .0 | | | | | | .0 | | | |
| Effect green, g | | | 18.2 | | | | | | 18.2 | | | |
| Grn ratio, g/C | | | .303 | | | | | | .303 | | | |
| LG capacity, c | | | 158 | | | | | | 124 | | | |
| v/c ratio, X | | | .000 | | | | | | .468 | | | |
| Flow ratio, v/s | | | .000 | | | | | | .142 | | | |
| Crit lane group | | | | | | | | | | | | |
| Sum crit v/s,Yc | | 0.558 | | Total lost, L | | | | 16.0 | | | | |
| Crit v/c, Xc | | .761 | | | | | | | | | | |

| Delay and LOS | N RT | N TH | N LT | E RT | E TH | E LT | S RT | S TH | S LT | W RT | W TH | W LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane group, LG | RT | TH | LT | | RT+TH | LT | | RT+TH | LT | RT | TH | LT |
| Adj Flow, v | 194 | 611 | 139 | | 539 | 72 | | 483 | 222 | 239 | 500 | 244 |
| LG capacity, c | 799 | 838 | 322 | | 695 | 362 | | 818 | 288 | 568 | 708 | 362 |
| v/c ratio, X | .243 | .729 | .432 | | .776 | .199 | | .590 | .771 | .421 | .706 | .674 |
| Grn ratio, g/C | .508 | .236 | .396 | | .200 | .205 | | .236 | .396 | .359 | .200 | .205 |
| Unif delay, d1 | 8.3 | 21.1 | 12.5 | | 22.7 | 19.8 | | 20.3 | 13.6 | 14.5 | 22.4 | 22.0 |
| Incr calib, k | .50 | .50 | .50 | | .50 | .50 | | .50 | .50 | .50 | .50 | .50 |
| Incr delay, d2 | .7 | 5.5 | 4.2 | | 8.3 | 1.2 | | 3.1 | 17.9 | 2.3 | 5.9 | 9.6 |
| Queue Delay, d3 | .0 | 3.8 | .0 | | .0 | .0 | | 2.6 | .0 | .0 | .0 | .0 |
| Unif delay, d1* | .0 | 21.5 | .0 | | .0 | .0 | | 20.6 | .0 | .0 | .0 | .0 |
| Prog factor, PF | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Contrl delay, d | 9.0 | 30.8 | 16.6 | | 31.0 | 21.0 | | 26.4 | 31.5 | 16.8 | 28.2 | 31.7 |
| Lane group LOS | A | C | B | | C | C+ | | C+ | C | B | C | C |
| Final Queue,Qbi | 0 | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| Appr delay, dA | | 24.2 | | | 29.8 | | | 28.0 | | | 26.3 | |
| Approach LOS | | C+ | | | C | | | C | | | C+ | |
| Appr flow, vA | | 944 | | | 611 | | | 705 | | | 983 | |
| Intersection: | Delay | | 26.7 | LOS | | C+ | | | | | | |

## TEAPAC - HCM Supplemental Uniform Delay Worksheet

The HCM Supplemental Uniform Delay Worksheet is the seventh HCM 2000 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and delay calculations made for the protected-permitted left turns in the capacity analysis, as described below. This worksheet is produced only when at least one approach contains a compound left turn phasing (protected-permitted or permitted-protected).

The one- or two-character approach name designations for each of the left turns at the intersection appear at the top of the worksheet. The worksheet is divided into two sections, the first section listing the input variables used and the second section listing the calculations.

The input variables include Adjusted LT Volume, v/c Ratio, Primary Movement Effective Green, Opposing Queue Effective Green, Unsaturated Effective Green, Red Time, Arrival Rate, Primary Satflow Rate, and Secondary Satflow Rate.

The calculations include Permitted v/c Ratio, Protected v/c Ratio, v/c Case Number, Queue at Beginning Green Arrow, Queue at Beginning Unsaturated Green, Residual Queue, and Uniform Delay.

The following is an example of the HCM Supplemental Uniform Delay Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.10.00] - HCM Supplemental Uniform Delay Worksheet

| Input/Calculation | N | E | S | W |
|---|---|---|---|---|
| Adjusted LT volume, v | 139 | | 222 | |
| v/c ratio, X | .432 | | .771 | |
| Primary mov. effect. green, g | 5.6 | | 5.6 | |
| Opp. queue effect. green, gq | 7.517 | | 9.941 | |
| Unsaturated effect. green, gu | 10.661 | | 8.237 | |
| Red time, r | 36.3 | | 36.3 | |
| Arrival rate, qa | .039 | | .062 | |
| Primary satflow rate, sp | .491 | | .491 | |
| Secondary satflow rate, ss | .246 | | .251 | |
| Permitted v/c ratio, Xperm | .267 | | .542 | |
| Protected v/c ratio, Xprot | .592 | | .945 | |
| v/c case number, Case | 1 | | 1 | |
| Queue at beg. green arrow, Qa | 1.400 | | 2.236 | |
| Queue at beg. unsat. grn., Qu | .290 | | .613 | |
| Residual queue, Qr | .000 | | .000 | |
| Uniform delay, d1 | 12.5 | | 13.6 | |

## TEAPAC[Ver 8.10.00] - HCM Initial Queue Delay Worksheet

| Durat, T 0.25 h | | N | | | E | | | S | | | W | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, C 60 s | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| Lane group, LG | RT | TH | LT | | RT+TH | LT | | RT+TH | LT | RT | TH | LT |
| Init queue, Qb | 0 | 10 | 0 | | 0 | 0 | | 10 | 0 | 0 | 0 | 0 |
| Grn ratio, g/C | .508 | .236 | .093 | | .200 | .205 | | .236 | .093 | .359 | .200 | .205 |
| v/c ratio, X | .24 | .73 | .43 | | .78 | .20 | | .59 | .77 | .42 | .71 | .67 |
| Adj capacity, c | 799 | 838 | 322 | | 695 | 362 | | 818 | 288 | 568 | 708 | 362 |
| Durtn unmet, t | .00 | .04 | .00 | | .00 | .00 | | .03 | .00 | .00 | .00 | .00 |
| Case number, i | 1 | 3 | 1 | | 1 | 1 | | 3 | 1 | 1 | 1 | 1 |
| Delay param, u | .00 | .00 | .00 | | .00 | .00 | | .00 | .00 | .00 | .00 | .00 |
| Queue delay, d3 | .0 | 3.8 | .0 | | .0 | .0 | | 2.6 | .0 | .0 | .0 | .0 |
| Unif delay, d1* | .0 | 21.5 | .0 | | .0 | .0 | | 20.6 | .0 | .0 | .0 | .0 |
| Last depart, Tc | .00 | .25 | .00 | | .00 | .00 | | .25 | .00 | .00 | .00 | .00 |
| Final queue,Qbi | 0 | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

## TEAPAC - HCM Initial Queue Delay Worksheet

The HCM Initial Queue Delay Worksheet is the eighth HCM 2000 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and delay calculations made for lane groups which have an initial queue at the start of the analysis period. This worksheet is produced only when at least one approach contains a non-zero initial queue.

**Duration.** The duration of the analysis period, in hours.

**Cycle.** The cycle length, in seconds.

**Approach and Movement Labels.** The one- or two- character approach and movement name designations.

**Lane group.** The movements included in each lane group.

**Initial queue.** The initial queue in each lane group at the start of the analysis period, due to unmet demand from the previous analysis period.

**Green ratio.** The effective g/C ratio for each lane group.

**v/c ratio.** The volume/capacity ratio for each lane group.

**Adjusted capacity.** The capacity of each lane group, in vehicles per hour.

**Duration unmet.** The duration of unmet demand during the analysis period, in hours, for each lane group.

**Case number.** The case number for the determination of $d_3$ for each lane group.

**Delay parameter.** The delay parameter, u, for the determination of $d_3$ for each lane group.

**Queue delay.** The initial queue delay, $d_3$, in seconds, for each lane group.

**Uniform delay.** The adjusted calculation of uniform delay, $d_1$, in seconds, for each lane group.

**Last departure.** The time of the last departure of vehicles which entered the intersection during the analysis period, in hours, measured from the start of the analysis period (the supplemental clearing time).

**Final queue.** The final initial queue (unmet demand) at the end of the analysis period, in vehicles.

The following is an example of the HCM Initial Queue Delay Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.10.00] - HCM Supplemental Uniform Delay Worksheet

| Input/Calculation | N | E | S | W |
|---|---|---|---|---|
| Adjusted LT volume, v | 139 | | 222 | |
| v/c ratio, X | .432 | | .771 | |
| Primary mov. effect. green, g | 5.6 | | 5.6 | |
| Opp. queue effect. green, gq | 7.517 | | 9.941 | |
| Unsaturated effect. green, gu | 10.661 | | 8.237 | |
| Red time, r | 36.3 | | 36.3 | |
| Arrival rate, qa | .039 | | .062 | |
| Primary satflow rate, sp | .491 | | .491 | |
| Secondary satflow rate, ss | .246 | | .251 | |
| Permitted v/c ratio, Xperm | .267 | | .542 | |
| Protected v/c ratio, Xprot | .592 | | .945 | |
| v/c case number, Case | 1 | | 1 | |
| Queue at beg. green arrow, Qa | 1.400 | | 2.236 | |
| Queue at beg. unsat. grn., Qu | .290 | | .613 | |
| Residual queue, Qr | .000 | | .000 | |
| Uniform delay, d1 | 12.5 | | 13.6 | |

## TEAPAC[Ver 8.10.00] - HCM Initial Queue Delay Worksheet

| Durat, T 0.25 h | | N | | | E | | | S | | | W | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, C 60 s | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| Lane group, LG | RT | TH | LT | | RT+TH | LT | | RT+TH | LT | RT | TH | LT |
| Init queue, Qb | 0 | 10 | 0 | | 0 | 0 | | 10 | 0 | 0 | 0 | 0 |
| Grn ratio, g/C | .508 | .236 | .093 | | .200 | .205 | | .236 | .093 | .359 | .200 | .205 |
| v/c ratio, X | .24 | .73 | .43 | | .78 | .20 | | .59 | .77 | .42 | .71 | .67 |
| Adj capacity, c | 799 | 838 | 322 | | 695 | 362 | | 818 | 288 | 568 | 708 | 362 |
| Durtn unmet, t | .00 | .04 | .00 | | .00 | .00 | | .03 | .00 | .00 | .00 | .00 |
| Case number, i | 1 | 3 | 1 | | 1 | 1 | | 3 | 1 | 1 | 1 | 1 |
| Delay param, u | .00 | .00 | .00 | | .00 | .00 | | .00 | .00 | .00 | .00 | .00 |
| Queue delay, d3 | .0 | 3.8 | .0 | | .0 | .0 | | 2.6 | .0 | .0 | .0 | .0 |
| Unif delay, d1* | .0 | 21.5 | .0 | | .0 | .0 | | 20.6 | .0 | .0 | .0 | .0 |
| Last depart, Tc | .00 | .25 | .00 | | .00 | .00 | | .25 | .00 | .00 | .00 | .00 |
| Final queue,Qbi | 0 | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

## TEAPAC - HCM Back of Queue Worksheet

The HCM Back of Queue Worksheet is the ninth HCM 2000 worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and queue calculations made for all lane groups in the capacity analysis, as described below. This worksheet is produced only when the selected queue model is one of the HCM queue models, as defined by the first QUEUEMODELS entry.

**Queues in worst/average lanes.** The HCM queue model can be evaluated for either the average lane in a lane group or the worst lane in a lane group. This is selected by the queue model number of the QUEUEMODELS input. Models 1 & 4 are for the worst lane; models 2 & 5 are for the average lanes. See Appendix C for more on this subject.

**Lane group.** The movements included in each lane group.

**Initial queue.** The initial queue in each lane group at the start of the analysis period, due to unmet demand from the previous analysis period.

**Lane flow.** The total adjusted flow rate per lane, in vehicles per hour per lane, for all lane groups on each approach. This value includes the contribution of initial queue. If a worst-lane analysis has been requested, this value also includes the effect of lane utilization.

**Lane satflow.** The adjusted saturation flow per lane, in vehicle per hour of green per lane, for each lane group.

**Lane capacity.** The capacity of each lane of each lane group, in vehicles per hour per lane.

**Flow ratio.** The ratio of the lane flow to the lane satflow for each lane group.

**v/c ratio.** The ratio of the lane flow to the lane capacity for each lane group.

**Effective green.** The effective green time, in seconds, for each lane group.

**Green ratio.** The effective g/C ratio for each lane group.

**Upstream filter.** The upstream filtering factor for each lane group.

**Green arrivals.** The proportion of vehicles arriving on green for each lane group.

**Platoon ratio.** The platoon ratio for green arrivals in each lane group.

**Progression factor.** The effects of the progression adjustment factor on queueing in each lane group.

**Queue (1st term) .** The first term of the queued vehicles computation.

**Queue factor.** The second term adjustment factor.

**Queue (2nd term).** The second term of the queued vehicles computation.

**Avg queue.** The average number of queued vehicles in each lane group.

**XX% factor.** The percentile back of queue factor for the lane group at the percentile level shown.

**XX% queue.** The percentile back of queue for the lane group at the percentile level shown.

**Avg spacing.** The average queue spacing between front bumpers of queued vehicles, in feet.

**Avail storage.** The available queue storage for queued vehicles in each lane group, in feet.

**Avg distance.** The average distance occupied by queued vehicles in each lane group, in feet.

**Avg ratio.** The average queue storage ratio (average distance / available storage) for each lane group.

**XX% distance.** The percentile distance occupied by queued vehicles in each lane group, in feet, for the percentile level shown.

**XX% ratio.** The percentile queue storage ratio (percentile distance / available storage) for each lane group, for the percentile level shown.

The following is an example of the HCM Back of Queue Worksheet report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.10.00] - HCM Back of Queue Worksheet

| Queues in | | N | | | E | | | S | | | W | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worst Lanes | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| Lane group, LG | RT | TH | LT | | RT+TH | LT | | RT+TH | LT | RT | TH | LT |
| Init queue, QbL | 0 | 5 | 0 | | 0 | 0 | | 5 | 0 | 0 | 0 | 0 |
| Ln flow, vL | 194 | 342 | 139 | | 283 | 72 | | 275 | 222 | 239 | 263 | 244 |
| Ln satflow, sL | 1574 | 1863 | 814 | | 1828 | 1770 | | 1818 | 728 | 1583 | 1863 | 1770 |
| Ln capacity, cL | 799 | 440 | 322 | | 365 | 362 | | 430 | 288 | 568 | 372 | 362 |
| Flow ratio, yL | .123 | .184 | .171 | | .155 | .041 | | .151 | .305 | .151 | .141 | .138 |
| v/c ratio, XL | .243 | .777 | .432 | | .776 | .199 | | .639 | .771 | .421 | .706 | .674 |
| Effect green, g | 30.5 | 14.2 | 23.7 | | 12.0 | 12.3 | | 14.2 | 23.7 | 21.5 | 12.0 | 12.3 |
| Grn ratio, g/C | .508 | .236 | .396 | | .200 | .205 | | .236 | .396 | .359 | .200 | .205 |
| Upstr filter, I | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Grn arrivals, P | .51 | .24 | .40 | | .20 | .20 | | .24 | .40 | .36 | .20 | .20 |
| Platn ratio, Rp | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Prog factr, PF2 | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Queue (1st), Q1 | 1.8 | 5.3 | 1.7 | | 4.5 | 1.0 | | 4.1 | 3.2 | 3.0 | 4.1 | 3.8 |
| Queue factr, kB | .73 | .48 | .39 | | .42 | .42 | | .48 | .36 | .58 | .43 | .42 |
| Queue (2nd), Q2 | .2 | 1.9 | .3 | | 1.3 | .1 | | 1.0 | 1.1 | .4 | 1.0 | .8 |
| Avg queue, Q | 2.1 | 7.2 | 2.0 | | 5.8 | 1.1 | | 5.1 | 4.3 | 3.4 | 5.0 | 4.6 |
| 90% factor, fB | 1.83 | 1.62 | 1.84 | | 1.66 | 1.90 | | 1.68 | 1.71 | 1.75 | 1.68 | 1.70 |
| 90% queue, Qp | 3.8 | 11.7 | 3.6 | | 9.6 | 2.1 | | 8.6 | 7.3 | 6.0 | 8.5 | 7.8 |
| Avg spacing, Lh | 25.3 | 25.3 | 25.3 | | 25.3 | 25.3 | | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 |
| Avail storg, La | 100 | 1000 | 200 | | 1000 | 200 | | 1000 | 200 | 100 | 1000 | 200 |
| Avg distance | 52 | 183 | 50 | | 146 | 28 | | 129 | 109 | 87 | 128 | 116 |
| Avg ratio, RQ | .52 | .18 | .25 | | .15 | .14 | | .13 | .54 | .87 | .13 | .58 |
| 90% distance | 95 | 296 | 92 | | 242 | 53 | | 217 | 186 | 152 | 215 | 197 |
| 90% ratio, RQp | .95 | .30 | .46 | | .24 | .26 | | .22 | .93 | 1.52 | .21 | .98 |

## TEAPAC - Capacity Analysis Summary (HCM 2000)

The Capacity Analysis Summary (2000) report, generated primarily by the ANALYZE command, provides a summary of the capacity analysis for the intersection and all approaches and lane groups of the intersection. This report can also be produced optionally (default) by the DESIGN command. The capacity analysis methodology used for each approach follows the procedures presented in the 2000 *Highway Capacity Manual*. Worksheets presented in the 2000 *Highway Capacity Manual* may be produced optionally by specifying OUTPUT FULL and are discussed previously.

### Intersection Averages

**Intersection Name.** If provided by the user, the node number and name of the intersection appears at the top of the report.

**V/C.** A measure of the overall performance of the intersection is given by the V/C (degree of saturation). It is computed as the weighted-average V/C of all lane groups weighted by the volume of traffic using each lane group. Degree of saturation for an individual lane group is defined as the volume of traffic using the approach divided by the capacity for that approach in vehicles per hour (v/c). Thus, a degree of saturation of 1.00 on any individual approach indicates that an approach is working exactly at saturation (capacity).

**Critical V/C.** A measure of the potential performance of the intersection is given by the critical V/C. It is the V/C ratio which can be achieved for the critical movements if the timings are set such that all of the critical movements have the same V/C, as defined by the HCM. It is not, however, necessarily related to the performance of the actual timings, and thus is a measure of the intersection's potential performance, not necessarily its actual performance.

**Control Delay.** A measure of the average control delay per vehicle in seconds is given for the intersection as a whole. This value is usually much lower than the critical movements of the intersection, who, by definition, have the worst delay values for the intersection.

**Level of Service.** The level of service of the intersection as a whole. It is based on the average intersection delay described above, according to Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the level.

### Signal Phasing and Timing

**Signal Phasing.** The signal phasing that is analyzed is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows with asterisks indicate the critical movements in the phasing (also shown in red). North (or the direction assumed by the user to be north) is always up in the diagrams as shown by the North arrow. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded phase sequence number appears at the top of the phase diagram. If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

**Timings.** The timings used for each phase are given in terms of green time to cycle time ratio (G/C) in seconds per second, green time (G) in seconds, and yellow-change plus red-clearance (all-red) time (Y+R) in seconds. The offset to the beginning of each phase (OFF) is shown in percent of the cycle if the offset phase number has been entered as a number greater than 0. The cycle length and total time allocated to green, yellow, and exclusive pedestrian phases are shown in seconds and percent of cycle below the sequence block. If a phase's green time is controlled by a minimum, this is indicated by the letter 'm' in the lower left corner of the phase. If a phase's green time is controlled by a pedestrian minimum, this is indicated by the letter 'p' in the lower left corner of the phase.

## Capacity Analysis Parameters

Output for the remainder of the Capacity Analysis summary is organized by approach. The top line of each approach's results lists the average delay and level of service for the approach as a whole. The following information is provided for each lane group in that approach.

**Lane Group.** The movements which make up each lane group are specified with a two-letter code. These codes identify the movements as right turns (RT), throughs (TH), and left turns (LT), or as defined by the user.

**Widths/Lanes.** The width of pavement which is used by the specified traffic stream is given in feet. The number of lanes which are operated within this width follows, separated from the width by a slash (/). Movements which are part of dual-optional lane groups are represented with a plus sign next to the turning lane and a minus sign next to the shared lanes.

**g/C Required and Used.** The g/C's which are required to maintain the design level of service and those which are used by the specified timings are given in seconds per second. The design level of service is shown in the first column of the Service Rate section (described below). If the Used g/C is less than the Required g/C, the lane group will operate at a level of service less than that desired, and vice versa.

**Service Rate.** The service flow rates for the design level of service (usually Level of Service C, by default) and for Level of Service E are tabulated in vehicles per hour. These are the maximum volumes which can exist with the specified timings without exceeding the stated level of service. The level of service for each column is listed in the header of the column.

**Adjusted Volume.** The Adjusted Volumes are tabulated for each lane group. They represent the sum of the volumes for all movements which are in the specified lane group, as adjusted by the peak hour factors.

**Volume/Capacity Ratio.** This is the ratio of the adjusted flow rate to the capacity of the lane group.

**HCM Delay.** The estimated control delay per vehicle in seconds, as calculated using the methods of the 2000 *Highway Capacity Manual*.

**Level of Service.** The level of service (LS) at which each traffic stream is operating, assuming the specified timings, widths, and other capacity parameters, is specified for each traffic stream. If an LS entry has an asterisk (*) to its left, this indicates that this movement was a critical design movement during optimization of the timings. The levels of service described in the 2000 *Highway Capacity Manual* have been further subdivided to provide a more accurate reflection of approach performance. The delay range for each level of service is divided in half to produce two sublevels, the better performing half receiving an additional plus notation next to the base level of service. For example, Level of Service D as defined in the Capacity Manual can take on two possible levels in this analysis: D and D+. The D+ represents the better half of performance of the defined Level D, making it a performance closer to Level of Service C than Level D without the +. The Level of Service listed for each movement, approach and the intersection is determined from the following table, consistent with, but more detailed than, the manual suggests:

| Control Delay Per Vehicle (Sec) | Level of Service |
|---|---|
| 0.0 <= d <=10.0 | A |
| 10.0 < d <=15.0 | B+ |
| 15.0 < d <=20.0 | B |
| 20.0 < d <=27.5 | C+ |
| 27.5 < d <=35.0 | C |
| 35.0 < d <=45.0 | D+ |
| 45.0 < d <=55.0 | D |
| 55.0 < d <=67.5 | E+ |
| 67.5 < d <=80.0 | E |
| 80.0 < d | F |

**Queue Model X.** The queue value for each lane group is provided according to the selected queue model. The model used is listed in the column heading as a number from 1 to 10 according to the model number which has been selected by the corresponding QUEUEMODELS entry. Each of the 10 possible queue models is documented in detail in Appendix C. The value listed is always the queue distance, in feet, for a single lane in the lane group. The queue model selected will define what queue formulation is used (MBQ or MQL), whether the queue is for the worst or the average lane, and whether the queue is an average or percentile queue. The default queue model is #1 representing the recommended 2000 *Highway Capacity Manual* MBQ model for the 90th percentile queue in the worst lane using input vehicle lengths.

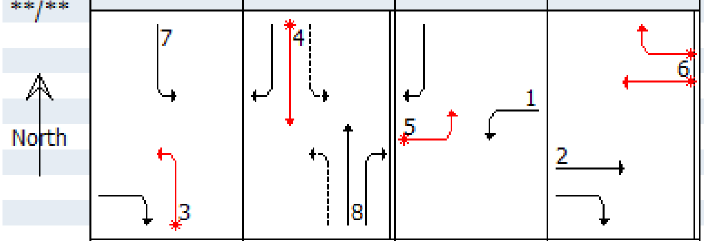
The following is an example of the Capacity Analysis Summary (HCM 2000) report using the Signal-Analysis.tpc sample data file. Worksheets which may be produced when this command is executed with the OUTPUT FULL option appear earlier.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.50.03] - Capacity Analysis Summary (HCM 2000)**

Intersection Averages for Int # 1 - Lincoln Avenue & Main Street
V/C 0.635 (Critical V/C 0.761) Control Delay 26.7 Level of Service C+

| Sq 44 **/** | Phase 1 | Phase 2 | Phase 3 | Phase 4 |
|---|---|---|---|---|




| | Phase 1 | Phase 2 | Phase 3 | Phase 4 |
|---|---|---|---|---|
| | G/C= 0.093 | G/C= 0.236 | G/C= 0.205 | G/C= 0.200 |
| | G= 5.6" | G= 14.2" | G= 12.3" | G= 12.0" |
| | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |

C= 60 sec G= 44.0 sec = 73.3% Y=16.0 sec = 26.7% Ped= 0.0 sec = 0.0%

| Lane Group | Width/ Lanes | g/C Reqd | g/C Used | Service Rate @C (vph) | Service Rate @E | Adj Volume | v/c | HCM Delay | L S | Queue Model 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| **N Approach** | | | | | | | | 24.2 | C+ | |
| RT | 12/1 | 0.182 | 0.508 | 756 | 799 | 194 | 0.243 | 9.0 | A | 95 ft |
| TH | 24/2 | 0.221 | 0.236 | 672 | 817 | 611 | 0.729 | 30.8 | *C | 296 ft |
| LT | 12/1 | 0.027 | 0.093 | 265 | 322 | 139 | 0.432 | 16.6 | B | 92 ft |
| **S Approach** | | | | | | | | 28.0 | C | |
| RT+TH | 24/2 | 0.195 | 0.236 | 651 | 796 | 483 | 0.590 | 26.4 | C+ | 217 ft |
| LT | 12/1 | 0.087 | 0.093 | 234 | 288 | 222 | 0.771 | 31.5 | *C | 186 ft |
| **E Approach** | | | | | | | | 29.8 | C | |
| RT+TH | 24/2 | 0.187 | 0.200 | 586 | 695 | 539 | 0.776 | 31.0 | *C | 242 ft |
| LT | 12/1 | 0.090 | 0.205 | 268 | 362 | 72 | 0.199 | 21.0 | C+ | 53 ft |
| **W Approach** | | | | | | | | 26.3 | C+ | |
| RT | 12/1 | 0.209 | 0.359 | 497 | 568 | 239 | 0.421 | 16.8 | B | 152 ft |
| TH | 24/2 | 0.174 | 0.200 | 599 | 708 | 500 | 0.706 | 28.2 | C | 215 ft |
| LT | 12/1 | 0.192 | 0.205 | 268 | 362 | 244 | 0.674 | 31.7 | *C | 197 ft |

## TEAPAC - Capacity Analysis Summary (HCM 2016)

The Capacity Analysis Summary (2016) report, generated primarily by the ANALYZE command, provides a summary of the capacity analysis for the intersection and all approaches and lane groups of the intersection. This report can also be produced optionally (default) by the DESIGN command. The capacity analysis methodology used for each approach follows the procedures presented in the 2016 *Highway Capacity Manual*. Additional worksheets may be produced optionally by specifying OUTPUT BASIC or FULL.

### Intersection Averages

**Intersection Name.** If provided by the user, the node number and name of the intersection appears at the top of the report.

**V/C.** A measure of the overall performance of the intersection is given by the V/C (degree of saturation). It is computed as the weighted-average V/C of all lane groups weighted by the volume of traffic using each lane group. Degree of saturation for an individual lane group is defined as the volume of traffic using the approach divided by the capacity for that approach in vehicles per hour (v/c). Thus, a degree of saturation of 1.00 on any individual approach indicates that an approach is working exactly at saturation (capacity).

**Critical V/C.** A measure of the potential performance of the intersection is given by the critical V/C. It is the V/C ratio which can be achieved for the critical movements if the timings are set such that all of the critical movements have the same V/C, as defined by the HCM. It is not, however, necessarily related to the performance of the actual timings, and thus is a measure of the intersection's potential performance, not necessarily its actual performance.

**Control Delay.** A measure of the average control delay per vehicle in seconds is given for the intersection as a whole. This value is usually much lower than the critical movements of the intersection, who, by definition, have the worst delay values for the intersection.

**Level of Service.** The level of service of the intersection as a whole. It is based on the average intersection delay described above, according to Exhibit 19-8 of the 2016 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the level.

### Signal Phasing and Timing

**Signal Phasing.** The signal phasing that is analyzed is specified with a box for each phase of the dual-ring Nema signal operation indicating the movements which are allowed during that phase. Movement arrows with asterisks indicate the critical movements in the phasing (also shown in red). North (or the direction assumed by the user to be north) is always up in the diagrams as shown by the North arrow. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded phase sequence number appears at the top of the phase diagram. If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

**Timings.** The timings used for each dual-ring Nema phase are given in terms of maximum green time (Gmax) in seconds, average green time (Gavg) in seconds, and yellow-change plus red-clearance (all-red) time (Y+Rc) in seconds. The maximum cycle length (Cmax) and average cycle length (Cavg) are shown in seconds. If a phase's green time is controlled by a minimum, this is indicated by the letter 'm' in the lower left corner of the phase. If a phase's green time is controlled by a pedestrian minimum, this is indicated by the letter 'p' in the lower left corner of the phase.

## Capacity Analysis Parameters

Output for the remainder of the Capacity Analysis summary is organized by approach. The top line of each approach's results lists the average delay and level of service for the approach as a whole. The following information is provided for each lane group in that approach.

**Lane Group.** The movements which make up each lane group are specified with a two-letter code. These codes identify the movements as right turns (RT), throughs (TH), and left turns (LT), or as defined by the user.

**Widths/Lanes.** The width of pavement which is used by the specified traffic stream is given in feet. The number of lanes which are operated within this width follows, separated from the width by a slash (/). Movements which are part of dual-optional lane groups are represented with a plus sign next to the turning lane and a minus sign next to the shared lanes.

**g/C Max and Avg.** The g/C's which are provided by the maximum timings, and the average g/C's which result from the actuated operation are given in seconds per second.

**Saturation Flow.** The saturation flow rates are tabulated in vehicles per hour for each lane group.

**Capacity.** The capacities are tabulated in vehicles per hour for each lane group.

**Adjusted Volume.** The adjusted volumes are tabulated for each lane group. They represent the sum of the volumes for all movements which are in the specified lane group, as adjusted by the peak hour factors.

**Volume/Capacity Ratio.** This is the ratio of the adjusted flow rate to the capacity of the lane group.

**HCM Delay.** The estimated control delay per vehicle in seconds, as calculated using the methods of the 2016 *Highway Capacity Manual*.

**Level of Service.** The level of service (LS) at which each traffic stream is operating, assuming the specified timings, widths, and other capacity parameters, is specified for each traffic stream. If an LS entry has an asterisk (*) to its left, this indicates that this movement was a critical design movement during optimization of the timings. The levels of service described in the 2016 *Highway Capacity Manual* have been further subdivided to provide a more accurate reflection of approach performance. The delay range for each level of service is divided in half to produce two sublevels, the better performing half receiving an additional plus notation next to the base level of service. For example, Level of Service D as defined in the Capacity Manual can take on two possible levels in this analysis: D and D+. The D+ represents the better half of performance of the defined Level D, making it a performance closer to Level of Service C than Level D without the +. The Level of Service listed for each movement, approach and the intersection is determined from the following table, consistent with, but more detailed than, the manual suggests:

| Control Delay Per Vehicle (Sec) | | V/C | Level of Service |
|---|---|---|---|
| 0.0 <= d <=10.0 | and | <=1.0 | A |
| 10.0 < d <=15.0 | and | <=1.0 | B+ |
| 15.0 < d <=20.0 | and | <=1.0 | B |
| 20.0 < d <=27.5 | and | <=1.0 | C+ |
| 27.5 < d <=35.0 | and | <=1.0 | C |
| 35.0 < d <=45.0 | and | <=1.0 | D+ |
| 45.0 < d <=55.0 | and | <=1.0 | D |
| 55.0 < d <=67.5 | and | <=1.0 | E+ |
| 67.5 < d <=80.0 | and | <=1.0 | E |
| 80.0 < d | or | >1.0 | F |

**Queue Model X.** The queue value for each lane group is provided according to the selected queue model. The model used is listed in the column heading as a number from 1 to 10 according to the model number which has been selected by the corresponding QUEUEMODELS entry. Each of the 10 possible queue models is documented in detail in Appendix C. The value listed is always the queue distance, in feet, for a single lane in the lane group. The queue model selected will define what queue formulation is used (MBQ or MQL), whether the queue is for the worst or the average lane, and whether the queue is an average or percentile queue. The default queue model is #1 representing the recommended 2016 *Highway Capacity Manual* MBQ model for the 90th percentile queue in the worst lane using input vehicle lengths.

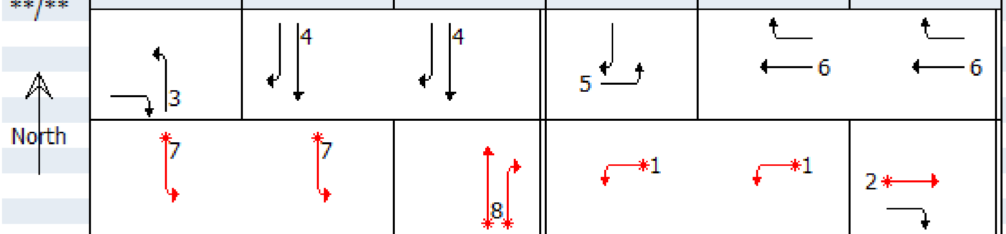
The following is an example of the Capacity Analysis Summary (HCM 2016) report using the Signal-Analysis.tpc sample data file. Worksheets may be produced when this command is executed with the OUTPUT BASIC or FULL option.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

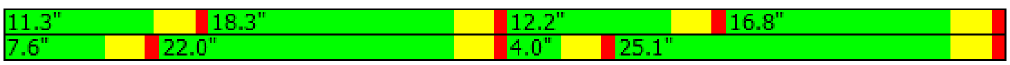
## TEAPAC[Ver 9.00.02] - Capacity Analysis Summary (HCM 2016)

Intersection Averages for Int # 1 - Lincoln Avenue & Main Street
V/C 0.643 (Critical V/C 0.824) Control Delay 27.8 Level of Service C

| Sq 55 **/** | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---|---|---|---|---|---|---|




| | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---|---|---|---|---|---|---|
| Cmax= 120" | Gmax= 16.9" Gavg= 11.3" Y+Rc= 4.0" | Gmax= 22.6" Gavg= 18.3" Y+Rc= 4.0" | | Gmax= 18.1" Gavg= 12.2" Y+Rc= 4.0" | Gmax= 46.3" Gavg= 16.8" Y+Rc= 4.0" | |
| Cavg= 75" | Gmax= 31.7" Gavg= 7.6" Y+Rc= 4.0" | | Gmax= 7.8" Gavg= 22.0" Y+Rc= 4.0" | Gmax= 57.5" Gavg= 4.0" Y+Rc= 4.0" | | Gmax= 6.9" Gavg= 25.1" Y+Rc= 4.0" |




| Lane Group | Width/ Lanes | g/C Max | g/C Avg | SatFlo | Capcty | Adj Volume | v/c | HCM Delay | L S | Queue Model 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| **N Approach** | | | | | | | | 31.7 | C | |
| RT | 12/1 | 0.025 | 0.245 | 1583 | 652 | 194 | 0.297 | 14.9 | B+ | 96 ft |
| TH | 24/2 | 0.189 | 0.245 | 3547 | 888 | 722 | 0.813 | 35.5 | D+ | 270 ft |
| LT | 12/1 | 0.264 | 0.101 | 1774 | 180 | 139 | 0.771 | 35.6 | *D+ | 115 ft |
| **S Approach** | | | | | | | | 27.5 | C | |
| RT+TH | 24/2 | 0.065 | 0.293 | 3543 | 1051 | 483 | 0.459 | 23.3 | *C+ | 325 ft |
| LT | 12/1 | 0.141 | 0.150 | 1774 | 267 | 222 | 0.831 | 36.6 | D+ | 172 ft |
| **E Approach** | | | | | | | | 30.2 | C | |
| RT+TH | 24/2 | 0.386 | 0.225 | 3571 | 804 | 650 | 0.809 | 29.2 | C | 428 ft |
| LT | 12/1 | 0.480 | 0.054 | 1774 | 95 | 72 | 0.754 | 39.6 | *D+ | 63 ft |
| **W Approach** | | | | | | | | 21.9 | C+ | |
| RT | 12/1 | 0.025 | 0.334 | 1583 | 769 | 239 | 0.311 | 11.8 | B+ | 102 ft |
| TH | 24/2 | 0.058 | 0.334 | 3547 | 1188 | 500 | 0.421 | 19.5 | *B | 140 ft |
| LT | 12/1 | 0.151 | 0.163 | 1774 | 290 | 244 | 0.841 | 36.7 | D+ | 187 ft |

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - HCM2010 Summary Worksheet**

| Equil Cycle 75. | | EB | | | WB | | | NB | | | SB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LT | TH | RT | LT | TH | RT | LT | TH | RT | LT | TH | RT |
| HCM Nema # | 5 | 2 | 12 | 1 | 6 | 16 | 3 | 8 | 18 | 7 | 4 | 14 |
| Volume, veh/h | 244 | 500 | 239 | 72 | 583 | 67 | 222 | 411 | 72 | 139 | 722 | 194 |
| Adj SatFlow | 1863 | 1863 | 1863 | 1863 | 1863 | 1900 | 1863 | 1863 | 1900 | 1863 | 1863 | 1863 |
| Capacity, veh/h | 291 | 1190 | 770 | 95 | 722 | 83 | 267 | 889 | 155 | 181 | 871 | 648 |
| Prop Arr Green | .164 | .336 | .336 | .054 | .225 | .225 | .151 | .295 | .295 | .102 | .246 | .246 |
| App Vol, veh/h | | 983.0 | | | 722.0 | | | 705.0 | | | 1055.0 | |
| App Del, s/veh | | 21.9 | | | 30.2 | | | 27.5 | | | 31.7 | |

| Timer # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Case No | 2. | 3. | 2. | 3. | 2. | 4. | 2. | 4. |
| G+Y+Rc, s | 8.02 | 29.06 | 15.26 | 22.34 | 16.24 | 20.84 | 11.60 | 26.00 |
| Y+Rc, s | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| MAH, s | 3.76 | 3.77 | 3.76 | 3.74 | 3.76 | 3.70 | 3.76 | 3.72 |
| LT Movement Data | | | | | | | | |
| Assigned Mvmnt | 1 | 0 | 3 | 0 | 5 | 0 | 7 | 0 |
| SatFlow, veh/h | 1774. | 0. | 1774. | 0. | 1774. | 0. | 1774. | 0. |
| TH Movement Data | | | | | | | | |
| Assigned Mvmnt | 0 | 2 | 0 | 4 | 0 | 6 | 0 | 8 |
| SatFlow, veh/h | 0. | 3547. | 0. | 3547. | 0. | 3204. | 0. | 3019. |
| RT Movement Data | | | | | | | | |
| Assigned Mvmnt | 0 | 12 | 0 | 14 | 0 | 16 | 0 | 18 |
| SatFlow, veh/h | 0. | 1583. | 0. | 1583. | 0. | 367. | 0. | 525. |

| LT Lane Group Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grp Volume, v/h | 72.0 | 0.0 | 222.0 | 0.0 | 244.0 | 0.0 | 139.0 | 0.0 |
| Grp SatFlo, v/h | 1774. | 0. | 1774. | 0. | 1774. | 0. | 1774. | 0. |
| g_s, s | 2.989 | 0.000 | 9.072 | 0.000 | 9.958 | 0.000 | 5.703 | 0.000 |
| Unif d1, s/veh | 35.173 | 0.000 | 31.091 | 0.000 | 30.573 | 0.000 | 33.007 | 0.000 |
| Inc d2, s/veh | 4.464 | 0.000 | 5.547 | 0.000 | 6.079 | 0.000 | 2.628 | 0.000 |
| D3 d3, s/veh | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| TH Lane Group Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grp Volume, v/h | 0.0 | 500.0 | 0.0 | 722.0 | 0.0 | 322.1 | 0.0 | 240.2 |
| Grp SatFlo, v/h | 0. | 1773. | 0. | 1773. | 0. | 1773. | 0. | 1773. |
| g_s, s | 0.000 | 8.143 | 0.000 | 14.400 | 0.000 | 12.840 | 0.000 | 8.252 |
| Unif d1, s/veh | 0.000 | 19.411 | 0.000 | 27.185 | 0.000 | 27.659 | 0.000 | 21.875 |
| Inc d2, s/veh | 0.000 | 0.088 | 0.000 | 3.368 | 0.000 | 1.487 | 0.000 | 0.231 |
| D3 d3, s/veh | 0.000 | 0.000 | 0.000 | 4.900 | 0.000 | 0.000 | 0.000 | 1.201 |

| RT Lane Group Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grp Volume, v/h | 0.0 | 239.0 | 0.0 | 194.0 | 0.0 | 327.9 | 0.0 | 242.8 |
| Grp SatFlo, v/h | 0. | 1583. | 0. | 1583. | 0. | 1798. | 0. | 1770. |
| g_s, s | 0.000 | 6.820 | 0.000 | 6.158 | 0.000 | 12.900 | 0.000 | 8.374 |
| Unif d1, s/veh | 0.000 | 11.757 | 0.000 | 14.846 | 0.000 | 27.683 | 0.000 | 21.891 |
| Inc d2, s/veh | 0.000 | 0.085 | 0.000 | 0.094 | 0.000 | 1.496 | 0.000 | 0.235 |
| D3 d3, s/veh | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.210 |

## TEAPAC - Evaluation of Intersection Performance

The Evaluation of Intersection Performance generated by the EVALUATE command is a report designed to summarize a number of performance measures for each lane group, as well as the roadway conditions and capacities of each group. The emphasis is primarily on the estimated level of each stream's performance, rather than on the parameters which were used to calculate the level, as in the case of the Capacity Analysis Summary. The capacity analysis methodology used for each traffic stream follows the procedures presented in the 2000 *Highway Capacity Manual*. Worksheets presented in the 2000 *Highway Capacity Manual* may be produced optionally by specifying OUTPUT FULL, as described previously.

Each lane group for which performance is calculated is designated by an approach width. When an approach is not available for exclusive use by turning vehicles (width of zero feet for the turning movement), the turning vehicle volume is assumed to turn from the adjacent through lane group. In addition to performance levels for each stream, performance is estimated for each approach leg of the intersection as well as the overall intersection. The specific elements which make up this report are discussed individually below.

### Signal Phasing and Timing

**Intersection Name.** If provided by the user, the node number and name of the intersection appears at the top of the report.

**Signal Phasing.** The signal phasing is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows with asterisks indicate the critical movements in the phasing (also shown in red). North (or the direction assumed to be north by the user) is always up in the diagrams, as shown by the North arrow. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded sequence number appears at the top of the diagram. If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

**Timings.** The timings for each phase are given in terms of green time to cycle time ratio (G/C) in seconds per second, green time (G) in seconds, and yellow-change plus red-clearance (all-red) time (Y+R) in seconds. The offset to the beginning of each phase (OFF) is shown in percent of the cycle if the offset phase number has been entered as a number greater than 0. The cycle length and total time allocated to green, yellow, and exclusive pedestrian phases are shown in seconds and percent of cycle below the sequence block. If a phase's green time is controlled by a minimum, this is indicated by the letter 'm' in the lower left corner of the phase. If a phase's green time is controlled by a pedestrian minimum, this is indicated by the letter 'p' in the lower left corner of the phase.

### Capacity Analysis Parameters

Capacity Analysis parameters are reported only by movement, except for the demand volume which is also reported by approach and intersection total.

**Adjusted Volume.** The adjusted volumes in vehicles per hour are listed for each movement, for each approach, and for the entire intersection.

**Approach Width and Lanes.** The approach width documents the amount of roadway width which has been allocated for each lane group at the intersection. This is followed by a slash (/) and the number of lanes which have been striped for each of the specified approach widths. Movements which are part of dual-optional lane groups are represented with a plus sign next to the turning lane and a minus sign next to the shared lanes.

**g/C Required.** The green time to cycle time ratio required to pass the demand volume through the approach width at the noted level of service. This value is computed only for each lane group with a designated approach width.

**g/C Used.** The portion of the cycle which has been allocated to the traffic stream by the specified phasing and timings, in percent of cycle. This number, when compared to the g/C required, indicates whether or not enough cycle time has been allocated to the stream to allow it to work at the design level of service.

**Service Volume.** The number of vehicles per hour which can be accommodated by the lane group at the noted level of service, given the phasings and timings specified.

## Performance Evaluation Parameters

Performance Evaluation parameters are reported separately first by movement and intersection total, then by approach and intersection total.

**Service Level.** The service level documents the level of service at which each lane group is operating under the specified phasing and timings, according to the delay calculations of the 2000 *Highway Capacity Manual*. The levels of service described in the 2000 *Highway Capacity Manual* have been further subdivided to provide a more accurate reflection of approach performance. The delay range for each level of service is divided in half to produce two sublevels, the better performing half receiving an additional plus notation next to the base level of service. For example, Level of Service D as defined in the Capacity Manual can take on two possible levels in this analysis: D and D+. The D+ represents the better half of performance of the defined Level D, making it a performance closer to Level of Service C than Level D without the +. The Level of Service listed for each movement, approach and the intersection is determined from the following table, consistent with, but more detailed than, the manual suggests. The level described for each approach and the intersection indicate the weighted average of all levels experienced by that group of movements. It is important to note that this level of service is based on 2000 *Highway Capacity Manual* delay calculations not shown in this report, and not on the average delay values shown in this report (see Average Delay discussion below).

| Control Delay Per Vehicle (Sec) | Level of Service |
|---|---|
| 0.0 <= d <=10.0 | A |
| 10.0 < d <=15.0 | B+ |
| 15.0 < d <=20.0 | B |
| 20.0 < d <=27.5 | C+ |
| 27.5 < d <=35.0 | C |
| 35.0 < d <=45.0 | D+ |
| 45.0 < d <=55.0 | D |
| 55.0 < d <=67.5 | E+ |
| 67.5 < d <=80.0 | E |
| 80.0 < d | F |

**Degree of Saturation.** The degree of saturation represents a measure of the Volume/Capacity (v/c) ratio of each lane group, as well as the weighted-v/c's for each approach and the intersection. The degree of saturation is computed as the demand volume divided by the capacity, both described in vehicles per hour. Thus, a degree of saturation for each leg and the intersection are weighted by the volumes of traffic using each lane group.

**HCM Delay.** For each lane group, each approach, and the total intersection, the average delay is determined in seconds per vehicle. This value estimates the average delay caused by the traffic signal which will be experienced by drivers at the intersection according to the 2000 *Highway Capacity Manual*.

**Total Delay.** The sum of the average delays described above for each vehicle which drives through the lane group during the analysis period is calculated as the total delay. This cumulative total delay is converted to vehicle-minutes and represents the total amount of wasted time which is spent at the intersection during the analysis period being studied. Auto occupancies can be applied directly to this value to calculate person-minutes of delay.

**Number Stopped.** The number of vehicles which will be stopped by the signal during the analysis period is calculated. These vehicles are stopped either due to a red indication or a green indication with a queue still dissipating. The number of stopped vehicles can be compared directly to the demand volume during the analysis period to determine the percentage of vehicles which will be stopped (also interpreted as the probability of a vehicle being stopped by the signal).

**Fuel Consumption.** If the approach speed of lane groups is input with the NETWORK command, an estimate of the total fuel consumption in gallons during the analysis period is calculated for the idling time and accel/decel to and from the approach speed. If link distance is also input, the freeflow consumption on this link is added to this calculation, and flagged with an "L" to the right of the displayed results.

**CO Emissions.** If the approach speed of lane groups is input with the NETWORK command, an estimate of the total carbon monoxide (CO) emissions in kilograms during the analysis period is calculated for the idling time and accel/decel to and from the approach speed. If link distance is also input, the freeflow emissions on this link is added to this calculation, and flagged with an "L" to the right of the displayed results.

## Queue Calculations

Queue calculations are reported separately first by movement and intersection total, then by approach and intersection total.

**Queue X.** The queue value for each lane group is reported for the user-selected queue model. The model used is listed in the row heading as a number from 1 to 10 according to the model number which has been selected by the corresponding QUEUEMODELS entry. Each of the 10 possible queue models is documented in detail in Appendix C. The first row of queue displayed is the number of queued vehicles in a single lane of the lane group. The second row is the queue distance, in feet, for that lane. The queue model selected will define what queue formulation is used (MBQ or MQL), whether the queue is for the worst or the average lane, and whether the queue is an average or percentile queue. The default queue model is #1 representing the recommended 2000 *Highway Capacity Manual* MBQ model for a specified percentile queue in the worst lane using specified vehicle lengths. The queue values displayed for each approach and for the intersection are the largest per-lane values for each approach and for the entire intersection.

## Intermediate Calculations

An additional report is produced when the EVALUATE command is executed and OUTPUT * * YES is selected. It shows several of the intermediate calculations making up the values presented in the Evaluation of Intersection Performance report described in this section.

**Saturation Flow.** The saturation flow rate, in vehicles per hour.

**Idling Delay.** The amount of the total Average Delay which is due to idling time at the intersection, in seconds per vehicle.

**Fuel Consumption Components.** The three fuel consumption components which make up the Fuel Consumption, all in gallons per hour. The Fuel Consumption is the sum of the F fuel (freeflow), I fuel (idling) and A fuel (accel/decel).

**CO Emissions Components.** The five CO emissions components which make up the CO Emissions, all in grams per hour. The CO Emissions is the sum of the F emissions (freeflow), I emissions (idling), A emissions (acceleration) and D emissions (deceleration), minus the C emissions (cruise).

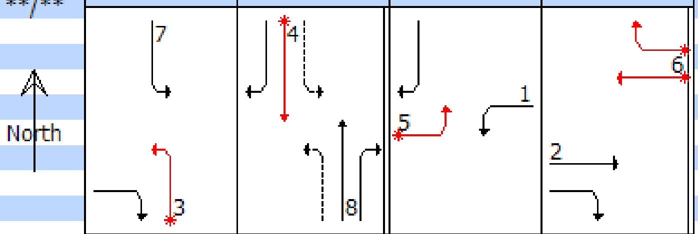
The following is an example of the Evaluation of Intersection Performance report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.10.00] - Evaluation of Intersection Performance

Intersection # 1 - Lincoln Avenue & Main Street

| Sq 44 **/** | Phase 1 | Phase 2 | Phase 3 | Phase 4 |
|---|---|---|---|---|




| | Phase 1 | Phase 2 | Phase 3 | Phase 4 |
|---|---|---|---|---|
| | G/C= 0.093 | G/C= 0.236 | G/C= 0.205 | G/C= 0.200 |
| | G= 5.6" | G= 14.2" | G= 12.3" | G= 12.0" |
| | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
| | Off= 0.0% | Off=15.9% | Off=46.2% | Off=73.4% |

C= 60 sec   G= 44.0 sec = 73.3%   Y=16.0 sec = 26.7%   Ped= 0.0 sec = 0.0%

| MVMT TOTALS | N Approach | | | E Approach | | | S Approach | | | W Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Param:Units | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| AdjVol: vph | 194 | 611 | 139 | 67 | 472 | 72 | 72 | 411 | 222 | 239 | 500 | 244 | 3243 |
| Wid/Ln:ft/# | 12/1 | 24/2 | 12/1 | 0/0 | 24/2 | 12/1 | 0/0 | 24/2 | 12/1 | 12/1 | 24/2 | 12/1 | |
| g/C Rqd@C:% | 18 | 22 | 3 | 0 | 19 | 9 | 0 | 19 | 9 | 21 | 17 | 19 | |
| g/C Used: % | 51 | 24 | 9 | 0 | 20 | 20 | 0 | 24 | 9 | 36 | 20 | 20 | |
| SV @E: vph | 799 | 817 | 322 | 0 | 695 | 362 | 0 | 796 | 288 | 568 | 708 | 362 | 5717 |
| Svc Lvl:LOS | A | C | B | | C | C+ | | C+ | C | B | C | C | C+ |
| Deg Sat:v/c | 0.24 | 0.73 | 0.43 | 0.00 | 0.78 | 0.20 | 0.00 | 0.59 | 0.77 | 0.42 | 0.71 | 0.67 | 0.63 |
| HCM Del:s/v | 9.0 | 30.8 | 16.6 | 0.0 | 31.0 | 21.0 | 0.0 | 26.4 | 31.5 | 16.8 | 28.2 | 31.7 | 26.7 |
| Tot Del:min | 7 | 78 | 10 | 0 | 70 | 6 | 0 | 53 | 29 | 17 | 59 | 32 | 361 |
| # Stops:veh | 27 | 141 | 25 | 0 | 128 | 15 | 0 | 107 | 48 | 45 | 116 | 56 | 708 |
| Fuel: gal | 0.6 | 2.9 | 0.5 | 0.0 | 2.4 | 0.3 | 0.0 | 2.0 | 0.9 | 0.8 | 2.1 | 1.1 | 13.6L |
| CO Em: kg | 0.5 | 3.3 | 0.5 | 0.0 | 2.9 | 0.3 | 0.0 | 2.3 | 1.2 | 0.9 | 2.5 | 1.3 | 15.7L |
| Queue 1:veh | 4 | 12 | 4 | 0 | 10 | 2 | 0 | 9 | 7 | 6 | 8 | 8 | 12 |
| Queue 1: ft | 95 | 296 | 92 | 0 | 242 | 53 | 0 | 217 | 186 | 152 | 215 | 197 | 296 |

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.10.00] - Evaluation of Intersection Performance**

| APPR TOTALS<br>Param:Units | N Approach | E Approach | S Approach | W Approach | Int<br>Total |
|---|---|---|---|---|---|
| AdjVol: vph | 944 | 611 | 705 | 983 | 3243 |
| Svc Lvl:LOS | C+ | C | C | C+ | C+ |
| Deg Sat:v/c | 0.58 | 0.71 | 0.65 | 0.63 | 0.63 |
| HCM Del:s/v | 24.2 | 29.8 | 28.0 | 26.3 | 26.7 |
| Tot Del:min | 95 | 76 | 82 | 108 | 361 |
| # Stops:veh | 193 | 143 | 155 | 217 | 708 |
| Fuel: gal | 4.0 | 2.7 | 2.9 | 4.0 | 13.6L |
| CO Em: kg | 4.3 | 3.2 | 3.5 | 4.7 | 15.7L |
| Queue 1:veh | 12 | 10 | 9 | 8 | 12 |
| Queue 1: ft | 296 | 242 | 217 | 215 | 296 |

## TEAPAC - Queuemodel Calculations

The Queuemodel Calculations generated by the QUEUECALCS command is a report designed to compute and provide side-by-side comparison of eight different queue models for each lane group, including the queue model documented in the 2000 or 2016 *Highway Capacity Manual*. The intent of this report is to allow users to compare the new HCM2000 or HCM2016 queue model to other queue models which have been used historically in order to gain confidence in its use. Worksheets presented in the 2000 *Highway Capacity Manual* may be produced optionally by specifying OUTPUT FULL, as described previously. The specific elements which make up this report are discussed individually below.

## Signal Phasing and Timing

**Intersection Name.** If provided by the user, the node number and name of the intersection appears at the top of the report.

**Signal Phasing.** The signal phasing is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows with asterisks indicate the critical movements in the phasing (also shown in red). North (or the direction assumed to be north by the user) is always up in the diagrams, as shown by the North arrow. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded sequence number appears at the top of the diagram. If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

**Timings.** The timings for each phase are given in terms of green time to cycle time ratio (G/C) in seconds per second, cycle length (C) in seconds, green time (G) in seconds, and yellow-change plus red-clearance (all-red) time (Y+R) in seconds. If a phase's green time is controlled by a minimum, this is indicated by the letter 'm' in the lower left corner of the phase. If a phase's green time is controlled by a pedestrian minimum, this is indicated by the letter 'p' in the lower left corner of the phase.

## Queue Calculations

The first section of the queue calculations gives queue values in terms of the total number of vehicles queued in each lane of each lane group (vehicles per lane). The second section of the queue calculations gives queue values in terms of the total distance occupied by vehicles queued in each lane of each lane group (feet per lane).

In some cases the queue value or distance occupied cannot be computed or cannot be displayed for one of several possible reasons. In these cases, asterisks '*****' are displayed. For example, for grossly oversaturated conditions, the calculated length of a given queue (in feet) may exceed the integer arithmetic used which has a maximum of 32,767 feet (over six miles!). Also, in

Models 7 & 8 where the Poisson distribution is used, the factorial portion of the formula may exceed the computational limits of the computer when queues approach one mile in length.

The six columns of information at the left of each section identifies the details of the queue models used with the following information:

**Model number.** The assigned model number used to identify each of the queue models calculated in this report, 1-10. Models 2 and 5 from the original HCM2000 no longer exist.

**Model name.** The abbreviated model name for each model calculated, as follows. See Appendix C for more details on each of these models.

| | |
|---|---|
| 2000 | 2000 Highway Capacity Manual |
| 2016 | 2016 Highway Capacity Manual |
| ARRB | Australian Road Research Board (SIDRA) |
| MBQ | Maximum back of queue model |
| S97E+ | SIGNAL97 Evaluate, enhanced |
| S97A+ | SIGNAL97 Analyze, enhanced |
| S97E | SIGNAL97 Evaluate |
| S97A | SIGNAL97 Analyze |

**Model form.** The fundamental form of the model, as follows.

| | |
|---|---|
| B | Maximum back of queue (MBQ), the maximum extent of the end of the queue from the stop line. |
| L | Maximum queue length (MQL), the maximum number of vehicles in queue at the end of the red time. |

**Lane of concern.** Which lane of a lane group is the lane for which the queue values apply.

| | |
|---|---|
| W | The worst lane of the lane group due to the effect of unbalanced lane utilization, as defined by the lane utilization factor. |
| A | The average lane of the lane group, without the effect of unbalanced lane utilization. |

**Percentile.** The percentile value which the queue value represents. For example, if 90% is shown, this means that the queue value listed is likely to be exceeded only 10% of the time, or that the value listed is likely to encompass 90% of the cycles which might be observed. If a 50% value is shown, this is meant to indicate that only the average value is computed and no percentile is determined.

**Vehicle lengths.** The average queue spacing between front bumpers of queued vehicles used in the model, first for autos, then for heavy vehicles (auto/heavy), in feet.

At the end of each section, the results for the user-preferred model (Selected Model) are re-displayed for easy reference. The selected model is the one which is displayed in other reports of a TEAPAC signal analysis. In the second section which shows queue distances, the available storage distance, in feet (as input by the user) is also displayed, along with the ratio of the selected model's distances to this available storage (the Queue Storage Ratio).

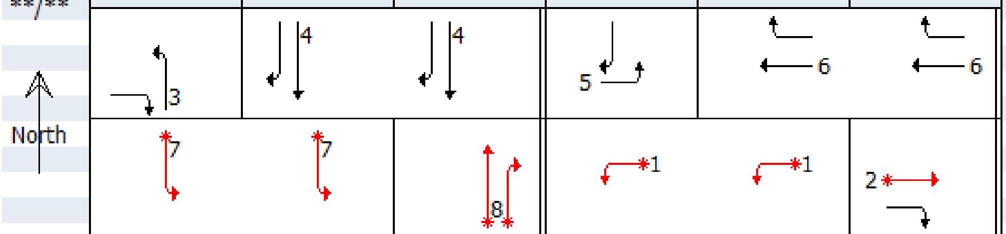
The following is an example of the Queuemodel Calculations report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.51.04] - Queuemodel Calculations

Intersection # 1 - Lincoln Avenue & Main Street

| Sq 55 **/** | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---|---|---|---|---|---|---|




| C=120" | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---|---|---|---|---|---|---|
| G/C= | 0.141 | 0.090 | 0.065 | 0.151 | 0.295 | 0.058 |
| G= | 16.9" | 10.8" | 7.8" | 18.1" | 35.4" | 6.9" |
| Y+R= | 4.0" | 4.0" | 4.0" | 4.0" | 4.0" | 4.0" |

| QUEUES F L % Veh Veh/Ln m n tl Len | N Approach RT | TH | LT | E Approach RT | TH | LT | S Approach RT | TH | LT | W Approach RT | TH | LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 2010 B W 90 25/40 | 4 | 11 | 5 | 0 | 17 | 2 | 0 | 13 | 7 | 4 | 6 | 7 |
| 3 ARRB B W 95 25/40 | 9 | 20 | 8 | 0 | 14 | 3 | 0 | 15 | 15 | 14 | 16 | 16 |
| 4 2010 B W 50 25/40 | 2 | 7 | 3 | 0 | 11 | 1 | 0 | 8 | 4 | 2 | 3 | 5 |
| 6 MBQ B A 50 25/40 | 5 | 12 | 4 | 0 | 8 | 1 | 0 | 9 | 7 | 7 | 9 | 8 |
| 7 97E+ L A 90 25/40 | 6 | 13 | 5 | 0 | 9 | 2 | 0 | 10 | 9 | 8 | 11 | 9 |
| 8 97A+ L A 90 25/40 | 6 | 13 | 5 | 0 | 9 | 2 | 0 | 10 | 9 | 8 | 11 | 9 |
| 9 97E L A 90 25/40 | 8 | 20 | 7 | 0 | 13 | 2 | 0 | 15 | 13 | 12 | 16 | 14 |
| 10 97A L A 90 25/40 | 8 | 20 | 7 | 0 | 13 | 2 | 0 | 15 | 13 | 12 | 16 | 14 |
| Selected Model # 1 | 4 | 11 | 5 | 0 | 17 | 2 | 0 | 13 | 7 | 4 | 6 | 7 |

| QUEUES F L % Veh Ft/Ln m n tl Len | N Approach RT | TH | LT | E Approach RT | TH | LT | S Approach RT | TH | LT | W Approach RT | TH | LT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 2010 B W 90 25/40 | 96 | 270 | 115 | 0 | 428 | 63 | 0 | 325 | 172 | 102 | 140 | 187 |
| 3 ARRB B W 95 25/40 | 238 | 509 | 203 | 0 | 360 | 73 | 0 | 378 | 378 | 351 | 393 | 408 |
| 4 2010 B W 50 25/40 | 53 | 186 | 64 | 0 | 277 | 35 | 0 | 199 | 106 | 57 | 82 | 117 |
| 6 MBQ B A 50 25/40 | 117 | 310 | 94 | 0 | 206 | 33 | 0 | 220 | 184 | 182 | 231 | 203 |
| 7 97E+ L A 90 25/40 | 152 | 329 | 127 | 0 | 228 | 51 | 0 | 253 | 228 | 202 | 278 | 228 |
| 8 97A+ L A 90 25/40 | 152 | 329 | 127 | 0 | 228 | 51 | 0 | 253 | 228 | 202 | 278 | 228 |
| 9 97E L A 90 25/40 | 205 | 494 | 172 | 0 | 336 | 63 | 0 | 381 | 322 | 310 | 397 | 349 |
| 10 97A L A 90 25/40 | 205 | 494 | 172 | 0 | 336 | 63 | 0 | 381 | 322 | 310 | 397 | 349 |
| Selected Model # 1 | 96 | 270 | 115 | 0 | 428 | 63 | 0 | 325 | 172 | 102 | 140 | 187 |
| Available Storage | 100 | 1000 | 200 | 0 | 1000 | 200 | 0 | 1000 | 200 | 100 | 1000 | 200 |
| Queue Storage Ratio | 0.96 | 0.27 | 0.57 | 0.00 | 0.43 | 0.31 | 0.00 | 0.32 | 0.86 | 1.02 | 0.14 | 0.94 |

## TEAPAC - Required g/Cs and LT Clearance Cycles

The Required g/Cs report, generated by the GOVERCS command, identifies the green to cycle time ratios which are required by the adjusted demand volumes in each lane group to maintain each level of service of operation for the given phasing, cycle length and timings. Thus, if a given movement were to receive exactly the g/C shown for a level of service, that movement would operate at exactly that level of service (the service flow rate would equal the adjusted demand volume). This is likely to be an iterative process, since the timings assumed are not likely to be the same as the timings required which are thus calculated.

First the assumed sequence of operation (SEQ=) and assumed cycle length (CYC=) are listed. The adjusted volumes (vehicles per hour) and lane group width assignments (feet) used to calculate the g/C requirements are then listed for each movement. The number of lanes in each lane group follows the width, separated with a slash (/). The required g/C value is displayed, in percent, for each lane group. This value represents the g/C requirement for the protected phase for left turns in protected-permitted operation.

In addition, the maximum cycle length which will allow all left turns to clear the intersection using only the terminating clearance interval is calculated, in seconds (LT Cmax). If the operating cycle length is less than or equal to this cycle length, all of the left turn demand will be able to clear the intersection on clearance intervals, with no time specifically allocated to the left turn (sneakers).

The range of level of service included in this report is controlled by the LEVELOFSERVICE command. This report is also an optional output of the DESIGN command, when extra DESIGN output is requested.

The following is an example of the Required g/Cs and LT Clearance Cycles report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.10.00] - Required g/Cs and LT Clearance Cycles**

Intersection # 1 - Lincoln Avenue & Main Street

| SEQ= 44 | N Approach | | | E Approach | | | S Approach | | | W Approach | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CYC= 60 | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| Volumes | 194 | 611 | 139 | 67 | 472 | 72 | 72 | 411 | 222 | 239 | 500 | 244 |
| Wid/Lan | 12/1 | 24/2 | 12/1 | 0/0 | 24/2 | 12/1 | 0/0 | 24/2 | 12/1 | 12/1 | 24/2 | 12/1 |
| LOS=C | 18.2 | 22.1 | 2.7 | 0.0 | 18.7 | 9.0 | 0.0 | 19.5 | 8.7 | 20.9 | 17.4 | 19.2 |
| LT Cmax | | | 52 | | | 100 | | | 32 | | | 30 |
| LOS=D | 14.6 | 19.3 | 0.8 | 0.0 | 16.1 | 6.1 | 0.0 | 16.4 | 6.8 | 17.1 | 14.8 | 15.7 |
| LT Cmax | | | 52 | | | 100 | | | 32 | | | 30 |
| LOS=E | 12.8 | 18.2 | 0.0 | 0.0 | 14.7 | 5.1 | 0.0 | 15.2 | 5.5 | 15.3 | 13.5 | 14.0 |
| LT Cmax | | | 52 | | | 100 | | | 32 | | | 30 |
| LOS=S | 12.8 | 18.2 | 0.0 | 0.0 | 14.7 | 5.1 | 0.0 | 15.2 | 5.5 | 15.3 | 13.5 | 14.0 |
| LT Cmax | | | 52 | | | 100 | | | 32 | | | 30 |

## TEAPAC - Satflow Rates and LT Clearance Cycles

The Satflow Rates report, generated by the SERVICEVOLUMES command, calculates the saturation flow rates in each lane group for each specified cycle length. The saturation flow rates are given in vehicles per hour of green.

First the assumed sequence of operation (SEQ=) and assumed cycle length (CYC=) are listed. The adjusted volumes (vehicles per hour) and lane group width assignments (feet) used to calculate the saturation flow rates are then listed for each movement. The number of lanes in each lane group follows the width, separated with a slash (/). The saturation flow rates are displayed for each lane group. For left turns, saturation flow rates are given for either the Protected Phase, the Permitted Phase, or both, depending on the type of phasing dictated by the SEQUENCES entry.

The maximum cycle length which will allow all left turns to clear the intersection using only the terminating clearance interval is also calculated, in seconds. If the operating cycle length is less than or equal to this cycle length, all of the left turn demand will be able to clear the intersection on clearance intervals, with no time specifically allocated to the left turn (sneakers).

The following is an example of the Satflow Rates and LT Clearance Cycles report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - Satflow Rates and LT Clearance Cycles**

Intersection # 1 - Lincoln Avenue & Main Street

| SEQ= 55 | N Approach | | | E Approach | | | S Approach | | | W Approach | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CYC=120 | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| Volumes | 194 | 722 | 139 | 67 | 583 | 72 | 72 | 411 | 222 | 239 | 500 | 244 |
| Wid/Lan | 12/1 | 24/2 | 12/1 | 0/0 | 24/2 | 12/1 | 0/0 | 24/2 | 12/1 | 12/1 | 24/2 | 12/1 |
| Protctd | 1583 | 3547 | 1774 | 0 | 3571 | 1774 | 0 | 3543 | 1774 | 1583 | 3547 | 1774 |
| Permitd | | | 0 | | | 0 | | | 0 | | | 0 |
| LT Cmax | | | 52 | | | 100 | | | 32 | | | 30 |

## TEAPAC - Display of Intersection Parameters

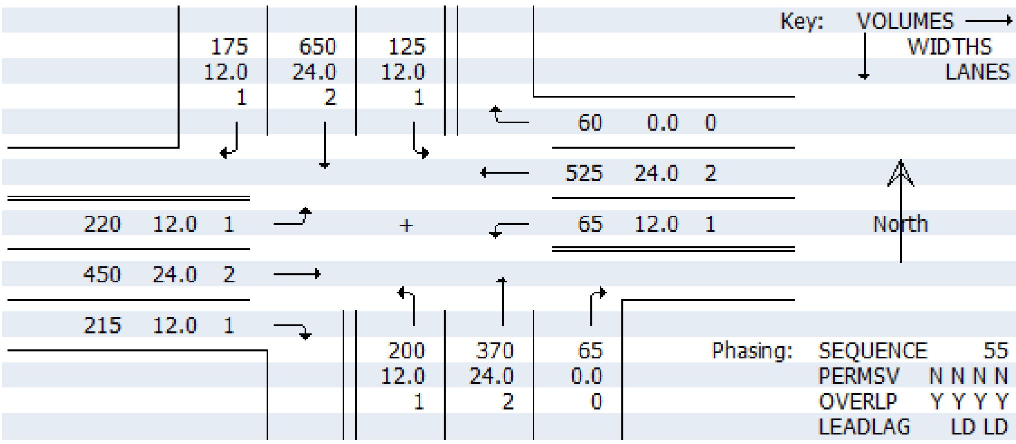
The Display of Intersection Parameters generated by the MAP command, provides a worksheet document which shows the relative positions of the 12 demand volumes on a schematic diagram of the intersection. In addition to the 12 turning movement volumes, the diagram displays the widths of the lane groups and the number of lanes. If movements are part of a dual-optional lane group, the turning lanes show a plus sign (+) and the shared lanes show a minus sign (-). The lower right corner of the display indicates the phase sequence number, whether permissive left turns are allowed after exclusive left turn phases, whether right turns are allowed to overlap into adjacent phases, and if lead or lag phasing is employed for exclusive left turn phases.

The following is an example of the Display of Intersection Parameters report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - Display of Intersection Parameters**

Intersection # 1 - Lincoln Avenue & Main Street



## TEAPAC - Diagram of Signal Phasing

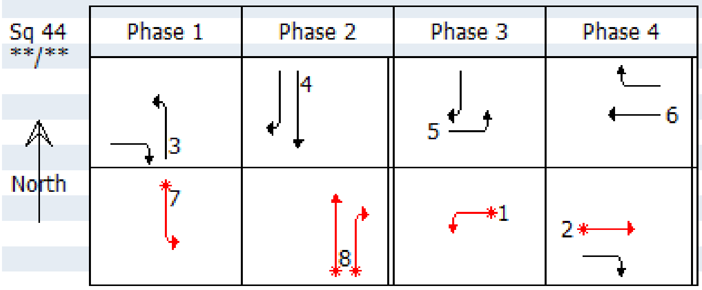
The diagram generated by the DIAGRAMS command provides a graphical representation of a specified phase sequence code number. This diagram is also an integral part of the output for the ANALYZE and EVALUATE commands, and is an optional output of the TIMINGS command. The sequence code which is represented in the diagram is listed at the top of the diagram, followed by the lead-lag conditions for the north-south and east-west phasings, respectively, separated by a slash, (/).

Each phase is designated by a square box with arrows inside indicating the movements which are allowed during that phase. Although a specific set of movements may be implied by a given sequence code, only those movements which have non-zero volumes will be included in the diagram. Movements which have been designated as critical in each phase are so indicated by asterisks in the body of the arrow (also shown in red). Critical movement identification is done automatically by the TIMINGS command or manually by the CRITICALS command. If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase. A North arrow clarifies that North is up in the diagram.

The following is an example of the Diagram of Signal Phasing report using the Signal-Analysis.tpc sample data file.

Intersection Design Study
Lincoln Avenue & Main Street
PM Peak Hour Design Conditions

**TEAPAC[Ver 8.51.04] - Diagram of Signal Phasing**



## Appendix D Topics (for Traffic Impact Analysis):

## TEAPAC - Summary of Parameter Values (TIA)

The Summary of Parameter Values (TIA) report, generated using the SUMMARIZE command, is a compilation of all the data used to perform the site traffic computations. This information includes the basic data regarding the size of the study area, the development size and generation characteristics, the assignment paths and the individual intersection parameters. This information is presented in three basic sections of the report, as described below.

### System and Generator Parameters

The first section of the report defines the magnitude of the traffic impact study area and parameters that apply to the entire generation, distribution and assignment process.

**Development Model Size.** This line lists the total number of traffic distribution types which are used to distribute the traffic to and from the site, and how many of these types are declared as inbound distribution types. The remainder of the types are outbound types.

**Total Traffic Rounded.** The final computations of traffic volumes are rounded to the nearest even multiple of the rounding value shown. Typical rounding values are 1, 5, 10 or 50 vehicles.

**Development Size.** This line shows the size of the development under consideration. The units of the value match the units of the Generation Rates, such that their products result in vehicle trips.

**Location.** This line shows the X,Y coordinates of the lower-left (South West) corner of the site, and the upper-right (North East) corner of the site, for schematic display purposes.

**Inbound/Outbound Generation Rates.** The generation rate, in vehicles trips per unit of development size, is shown for both the inbound and outbound directions. The base development size multiplied by each of the generation rates yields the total inbound and outbound trips for the development, respectively.

**Inbound/Outbound Access Nodes.** As many as ten sets of access node information are shown for both the inbound and outbound directions. Each set of access information describes first the node number which provides access either into or out of the site, followed by the leg of the node (intersection) which provides this access.

### Distribution and Assignment Parameters

The second section of the report defines the distribution and assignment factors which are used to determine the intersection movement volumes from the generated trips for the development.

**Path Factors.** The top line of the PATH factors section first lists the distribution type number and description, followed by how much of the total inbound or outbound traffic is distributed to this set of paths. It also shows the node number of the external intersection through which all of this type of traffic flows, and the external direction which this traffic approaches or exits this intersection.

The table below the top line lists the four possible paths which can be defined for this distribution type, first giving the percentage of the type's total traffic which follows the path, then the list of intersections through which the traffic passes.

**Manual Assignment Factors.** If manual assignment factors are used rather than or in addition to the above PATH Factors (normally not the case, except when using a data file from an old version of SITE), the assignment factors are listed here. The percentage of total distribution type traffic is listed for each individual movement rather than just for a path. These factors are shown for each of the twelve possible movements of each intersection of the network, with the intersection number in the left-hand column and the description of the intersection in the right-hand column.

## Intersection Parameters

The third section of the report defines the parameters which are used to define the conditions at each intersection.

**Intersection #.** The top line of this section lists the intersection node number and a description of the intersection it represents.

**Coordinates.** The top line also shows the X,Y coordinates of the intersection location in the network, for schematic display purposes.

**Demand/Geometry.** This section shows the existing traffic volumes, the approach widths and the number of lanes for each of the possible movements of the intersection. Non-zero widths which are shown for turn lanes represent exclusive turn lanes, while non-zero widths for through movements without adjacent exclusive turn lanes represent shared through-turn lanes.

**Existing Traffic Factor.** This line lists the factors which are used to adjust the input background traffic volumes, usually to represent projected growth of non-site traffic. It also shows how many times this factor is compounded to effect annual growth over several years. If this number of years is one, then the adjustment factor is simply the factor shown. If the number of years is greater than one, then to total adjustment factor is the shown factor raised to the power of the number of years.

**Network Data**. This section describes of the location of the intersection in the network being analyzed. For each approach to the intersection, this includes the distance in feet from the upstream node, the average travel speed from the upstream node, the node number of the upstream node, the movements numbers at the upstream node which supply traffic to the downstream node, the link assignment method for TRANSYT, the link curvature for CORSIM, and if the link distance has been manually entered.

The following is an example of the Summary of Parameter Values (TIA) report using the Traffic-Impact-Analysis.tpc sample data file.

NorthTowne Shopping Center
Proposed Development Scenario A
Base Model Conditions

**TEAPAC[Ver 8.00.00] - Summary of Parameter Values (TIA)**

Development model size is 8 Distribution Types ( 4 Inbound
Total traffic rounded to nearest 1 vehicle(s)

Development size in generation units is 600

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location (X,Y Coordinates) | | 200, | | 1200 (SW) | | | | | | | |
| | | 3300, | | 2750 (NE) | | | | | | | |
| Generation Rates | | Nod-L | Nod-L | Nod-L | Nod-L | Nod-L | Nod-L | Nod-L | Nod-L | Nod-L | Nod-L |
| Inbound | 1.900 | 1-S | 2-S | 4-W | | | | | | | |
| Outbound | 2.100 | 1-S | 2-S | 4-W | | | | | | | |

Path Factors for Type 1 - In from the North

40 % from Node 3-N

| Path | Percent | List of Nodes | | |
|---|---|---|---|---|
| 1 | 60 | 3 | 4 | |
| 2 | 30 | 3 | 2 | |
| 3 | 10 | 3 | 2 | 1 |
| 4 | 0 | | | |
| 5 | 0 | | | |

Path Factors for Type 2 - In from the East

20 % from Node 3-E

| Path | Percent | List of Nodes | | |
|---|---|---|---|---|
| 1 | 50 | 3 | 2 | |
| 2 | 30 | 3 | 4 | |
| 3 | 20 | 3 | 2 | 1 |
| 4 | 0 | | | |
| 5 | 0 | | | |

Path Factors for Type 3 - In from the South

30 % from Node 4-S

| Path | Percent | List of Nodes |
|---|---|---|
| 1 | 100 | 4 |
| 2 | 0 | |
| 3 | 0 | |
| 4 | 0 | |
| 5 | 0 | |

Path Factors for Type 4 - In from the West

10 % from Node 1-W

| Path | Percent | List of Nodes | |
|---|---|---|---|
| 1 | 70 | 1 | 2 |
| 2 | 30 | 1 | |
| 3 | 0 | | |
| 4 | 0 | | |
| 5 | 0 | | |

NorthTowne Shopping Center
Proposed Development Scenario A
Base Model Conditions

**TEAPAC[Ver 8.00.00] - Summary of Parameter Values (TIA)**

Path Factors for Type 5 - Out to the North

30 % to Node 3-N

| Path | Percent | List of Nodes | | |
|---|---|---|---|---|
| 1 | 60 | 4 | 3 | |
| 2 | 30 | 2 | 3 | |
| 3 | 10 | 1 | 2 | 3 |
| 4 | 0 | | | |
| 5 | 0 | | | |

Path Factors for Type 6 - Out to the East

20 % to Node 3-E

| Path | Percent | List of Nodes | | |
|---|---|---|---|---|
| 1 | 50 | 2 | 3 | |
| 2 | 30 | 4 | 3 | |
| 3 | 20 | 1 | 2 | 3 |
| 4 | 0 | | | |
| 5 | 0 | | | |

Path Factors for Type 7 - Out to the South

40 % to Node 4-S

| Path | Percent | List of Nodes |
|---|---|---|
| 1 | 100 | 4 |
| 2 | 0 | |
| 3 | 0 | |
| 4 | 0 | |
| 5 | 0 | |

Path Factors for Type 8 - Out to the West

10 % to Node 1-W

| Path | Percent | List of Nodes | |
|---|---|---|---|
| 1 | 70 | 2 | 1 |
| 2 | 30 | 1 | |
| 3 | 0 | | |
| 4 | 0 | | |
| 5 | 0 | | |

NorthTowne Shopping Center
Proposed Development Scenario A
Base Model Conditions

**TEAPAC[Ver 8.00.00] - Summary of Parameter Values (TIA)**

Intersection # 1 Northwest Access Drive — Coordinates - X: 500 Y: 3000

| Demand/Geometry | North Rt | North Th | North Lt | East Rt | East Th | East Lt | South Rt | South Th | South Lt | West Rt | West Th | West Lt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exist. Volumes | 0 | 0 | 0 | 0 | 240 | 0 | 0 | 0 | 0 | 0 | 220 | 0 |
| Approach Widths | 0.0 | 0.0 | 0.0 | 0.0 | 12.0 | 12.0 | 12.0 | 0.0 | 12.0 | 12.0 | 12.0 | 0.0 |
| Number of Lanes | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| Factor (^ 2 yr) | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |

| Network Data | Dist | Spd | Node | Movements | | | | Asg | Crv | Man |
|---|---|---|---|---|---|---|---|---|---|---|
| N Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| E Approach | 2000 | 30 | 2 | 5 | 9 | 1 | 0 | Def | No | No |
| S Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| W Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |

Intersection # 2 Northeast Access Drive — Coordinates - X: 2500 Y: 3000

| Demand/Geometry | North Rt | North Th | North Lt | East Rt | East Th | East Lt | South Rt | South Th | South Lt | West Rt | West Th | West Lt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exist. Volumes | 0 | 0 | 0 | 0 | 240 | 0 | 0 | 0 | 0 | 0 | 220 | 0 |
| Approach Widths | 0.0 | 0.0 | 0.0 | 0.0 | 12.0 | 12.0 | 12.0 | 0.0 | 12.0 | 12.0 | 12.0 | 0.0 |
| Number of Lanes | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| Factor (^ 2 yr) | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |

| Network Data | Dist | Spd | Node | Movements | | | | Asg | Crv | Man |
|---|---|---|---|---|---|---|---|---|---|---|
| N Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| E Approach | 1500 | 30 | 3 | 5 | 9 | 1 | 0 | Def | No | No |
| S Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| W Approach | 2000 | 30 | 1 | 11 | 3 | 7 | 0 | Def | No | No |

NorthTowne Shopping Center
Proposed Development Scenario A
Base Model Conditions

**TEAPAC[Ver 8.00.00] - Summary of Parameter Values (TIA)**

| Intersection # | 3 | Main Intersection | Coordinates - X: | 4000 |
|---|---|---|---|---|
| | | | Y: | 3000 |

| Demand/Geometry | North | | | East | | | South | | | West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt |
| Exist. Volumes | 10 | 100 | 20 | 10 | 200 | 50 | 20 | 150 | 30 | 30 | 150 | 40 |
| Approach Widths | 0.0 | 24.0 | 12.0 | 0.0 | 24.0 | 12.0 | 0.0 | 24.0 | 12.0 | 0.0 | 24.0 | 12.0 |
| Number of Lanes | 0 | 2 | 1 | 0 | 2 | 1 | 0 | 2 | 1 | 0 | 2 | 1 |
| Factor (^ 2 yr) | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |

| Network Data | Dist | Spd | Node | Movements | | | | Asg | Crv | Man |
|---|---|---|---|---|---|---|---|---|---|---|
| N Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| E Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| S Approach | 1580 | 30 | 4 | 8 | 12 | 4 | 0 | Def | No | No |
| W Approach | 1500 | 30 | 2 | 11 | 3 | 7 | 0 | Def | No | No |

| Intersection # | 4 | Southeast Access Drive | Coordinates - X: | 3500 |
|---|---|---|---|---|
| | | | Y: | 1500 |

| Demand/Geometry | North | | | East | | | South | | | West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt |
| Exist. Volumes | 0 | 180 | 0 | 0 | 0 | 0 | 0 | 200 | 0 | 0 | 0 | 0 |
| Approach Widths | 12.0 | 12.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.0 | 12.0 | 12.0 | 0.0 | 12.0 |
| Number of Lanes | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| Factor (^ 2 yr) | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |

| Network Data | Dist | Spd | Node | Movements | | | | Asg | Crv | Man |
|---|---|---|---|---|---|---|---|---|---|---|
| N Approach | 1580 | 30 | 3 | 2 | 6 | 10 | 0 | Def | No | No |
| E Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| S Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |
| W Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No |

# TEAPAC - Schematic Diagram

The Schematic Diagram report, generated using the SHOWPATHS command, displays the relative spatial relationship of the intersections and the development site, and the links between intersections. In addition, the defined assignment paths to and from the site can be optionally displayed. These two types of schematic diagrams are described in the two sections below.

**Schematic Diagram of Development Network.** This report shows the relative spatial relationship of each of the intersections and the development site, as well as links between intersections and intersection approaches. The display uses the input coordinates for each node and the development area, scaled to fit in the number of columns and rows available on the display screen (as large as 80 x 66). The input coordinate system can be arbitrary, as well as a valid ground coordinate system, but the displayed scale only represents the relative distances between intersections, with no attempt to display a specific scale. Links between intersections are also displayed using characters which will print on any printer or screen, and are thus not perfect representations of the links when they do not display horizontally or vertically. As such, it is common practice to input the coordinates for each intersection and the site in such a manner that the schematic diagram of this report displays clearly, both on the screen and on the printer.

Each intersection in the diagram is represented by an asterisk, '*', and shows the designated intersection node number below and to the right of the node location. Links designated as connectors between intersections are shown with the four characters, |, /, --, and \. Where external approaches exist at intersections, these are displayed with the | or -- characters. A rectangle of 'X' characters is used to provide a rough estimate of the location of the development area itself.

If the box of X's is large enough, it will include a North arrow pointing straight up for orientation purposes.

**Schematic Diagram of Path Assignments.** This report overlays an assignment path on top of the schematic diagram of the network described above, using the v, <, ^ and > characters to represent the links over which the defined path travels. The direction of travel is in the direction of the "point" of the path character, that is a link shown by >>>>> indicates flow from the west to the east.

The bottom line of the diagram indicates which distribution type this path belongs to and which of the four possible assignment paths for this distribution type is being displayed. The percentage of total traffic for this distribution type which follows this path is also displayed.

The following is an example of the Schematic Diagram report using the Traffic-Impact-Analysis.tpc sample data file.

NorthTowne Shopping Center
Proposed Development Scenario A
Base Model Conditions

## TEAPAC[Ver 8.00.00] - Schematic Diagram of Development Network

```
         0 ----------------------------------- 0 ------------------------- 0
           1                                     2                        |  3
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX           |
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX          |
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX         |
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX         |
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX        |
   XXXXXXXXXXXXXXXXXXXXXXXXXX       XXXXXXXXXXXXXXXXXXXXXXXXXXX        |
   XXXXXXXXXXXXXXXXXXXXXXXXXX   ^   XXXXXXXXXXXXXXXXXXXXXXXXXXX       |
   XXXXXXXXXXXXXXXXXXXXXXXXXX   |   XXXXXXXXXXXXXXXXXXXXXXXXXXX      |
   XXXXXXXXXXXXXXXXXXXXXXXXXX North XXXXXXXXXXXXXXXXXXXXXXXXXXX      |
   XXXXXXXXXXXXXXXXXXXXXXXXXX   |   XXXXXXXXXXXXXXXXXXXXXXXXXXX     |
   XXXXXXXXXXXXXXXXXXXXXXXXXX       XXXXXXXXXXXXXXXXXXXXXXXXXXX    |
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    |
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX   0
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     4
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

## TEAPAC[Ver 8.00.00] - Schematic Diagram of Path Assignments

```
         0 ----------------------------------- 0 ------------------------- 0
           1                                     2                        v  3
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX           v
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX          v
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX         v
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX         v
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX        v
   XXXXXXXXXXXXXXXXXXXXXXXXXX       XXXXXXXXXXXXXXXXXXXXXXXXXXX        v
   XXXXXXXXXXXXXXXXXXXXXXXXXX   ^   XXXXXXXXXXXXXXXXXXXXXXXXXXX       v
   XXXXXXXXXXXXXXXXXXXXXXXXXX   |   XXXXXXXXXXXXXXXXXXXXXXXXXXX      v
   XXXXXXXXXXXXXXXXXXXXXXXXXX North XXXXXXXXXXXXXXXXXXXXXXXXXXX      v
   XXXXXXXXXXXXXXXXXXXXXXXXXX   |   XXXXXXXXXXXXXXXXXXXXXXXXXXX     v
   XXXXXXXXXXXXXXXXXXXXXXXXXX       XXXXXXXXXXXXXXXXXXXXXXXXXXX    v
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    v
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX   0
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     4
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Distribution Type  1:  Path # 1 ( 60%)
```

## TEAPAC - Distribution Types and Factors

The Distribution Types and Factors report, generated using the COMPUTEPATHS command, summarizes the information used in the generation, distribution and assignment computations. This report lists each of the distribution types which have been included in the computations.

**Typ - Distribution Type.** The number of the distribution type, all of whose traffic flows through the same external node of the network.

**Base - Generation Base Size.** The base development size to which the inbound and outbound generation rates are applied. Development bases are typically defined in thousands of square feet or number of dwelling units. However, any base units can be used as long as it is comparable to the units of the associated trip generation rate.

**Gener - Generation Rate.** The trip generation rate associated with a development base size. The units of the rate must be comparable to the units of the base. The rate shown is either the inbound rate or the outbound rate, depending on whether the distribution type is defined as an inbound or outbound distribution type.

**Dst - Distribution Factor.** The percent of the total inbound or outbound traffic for the development which is distributed to this distribution type. The total of the inbound and outbound distributions must always equal 0 or 100 percent.

**Trips.** The total number of vehicle trips generated by this distribution type, the product of the Base x Generation x Distribution for the type.

**Description.** This information describes the distribution type, usually describing whether the flow is inbound or outbound and to/from what direction it is oriented.

**Non-Site Traffic.** If non-site traffic is included in the calculations, the last line of the table for this report will show type 999 traffic (described as Non-site traffic).

**Cumulation.** TEAPAC provides a feature which allows the accumulation of results of multiple traffic impact analysis computations. If previous computations have been cumulated with the traffic generated by the current computation, a message to this effect appears at the bottom of the table, indicating that the traffic generation information contained in the table is not the only contributor to the total traffic reported in the Intersection Movement Volumes table that follows.

The following is an example of the Distribution Types and Factors report using the Traffic-Impact-Analysis.tpc sample data file.

NorthTowne Shopping Center
Proposed Development Scenario A
Projected Peak Hour Total Traffic

## TEAPAC[Ver 8.00.00] - Distribution Types and Factors

| Typ | Base | Gener | Dst | Trips | Description |
|---|---|---|---|---|---|
| 1 | 600 | 1.90 | 40 | 456 | In from the North |
| 2 | 600 | 1.90 | 20 | 228 | In from the East |
| 3 | 600 | 1.90 | 30 | 342 | In from the South |
| 4 | 600 | 1.90 | 10 | 114 | In from the West |
| 5 | 600 | 2.10 | 30 | 378 | Out to the North |
| 6 | 600 | 2.10 | 20 | 252 | Out to the East |
| 7 | 600 | 2.10 | 40 | 504 | Out to the South |
| 8 | 600 | 2.10 | 10 | 126 | Out to the West |
| 999 | | | | | Non-site traffic |

## TEAPAC[Ver 8.00.00] - Intersection Movement Volumes

| | North | | | East | | | South | | | West | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Int | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Description |
| 1 | 0 | 0 | 0 | 0 | 378 | 92 | 88 | 0 | 38 | 34 | 346 | 0 | Northwest Access Drive |
| 2 | 0 | 0 | 0 | 0 | 382 | 251 | 239 | 0 | 88 | 80 | 354 | 0 | Northeast Access Drive |
| 3 | 195 | 395 | 24 | 12 | 402 | 129 | 100 | 409 | 36 | 36 | 358 | 199 | Main Intersection |
| 4 | 342 | 218 | 0 | 0 | 0 | 0 | 0 | 242 | 342 | 504 | 0 | 303 | Southeast Access Drive |

## TEAPAC - Intersection Movement Volumes

The Intersection Movement Volumes report, generated using the COMPUTEPATHS command, lists the computed turning movement volumes for all the intersections in the study area. The volumes estimated in this report use the traffic generation information listed in the Assignment Types and Factors report described previously.

**Int - Intersection Number.** The node number of the intersection for which the estimated traffic volumes are listed.

**Traffic Volumes.** The body of the table consists of the traffic volumes, usually in vehicles per hour, for each intersection turning movement. The table includes only the traffic volumes generated by those traffic distribution types listed in the Assignment Types and Factors report, as described above, unless these computations are cumulated with previous computations.

**Int Description.** This section of the report provides a more detailed description of the intersection to which the volumes of each row of the table belong, corresponding to the intersection node number listed in the left-hand column.

**Rounding.** The bottom line of the report indicates what degree of rounding has occurred after all of the volumes have been computed.

The following is an example of the Intersection Movement Volumes report using the Traffic-Impact-Analysis.tpc sample data file.

NorthTowne Shopping Center
Proposed Development Scenario A
Projected Peak Hour Total Traffic

## TEAPAC[Ver 8.00.00] - Distribution Types and Factors

| Typ | Base | Gener | Dst | Trips | Description |
|---|---|---|---|---|---|
| 1 | 600 | 1.90 | 40 | 456 | In from the North |
| 2 | 600 | 1.90 | 20 | 228 | In from the East |
| 3 | 600 | 1.90 | 30 | 342 | In from the South |
| 4 | 600 | 1.90 | 10 | 114 | In from the West |
| 5 | 600 | 2.10 | 30 | 378 | Out to the North |
| 6 | 600 | 2.10 | 20 | 252 | Out to the East |
| 7 | 600 | 2.10 | 40 | 504 | Out to the South |
| 8 | 600 | 2.10 | 10 | 126 | Out to the West |
| 999 | | | | | Non-site traffic |

## TEAPAC[Ver 8.00.00] - Intersection Movement Volumes

| | North | | | East | | | South | | | West | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Int | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Description |
| 1 | 0 | 0 | 0 | 0 | 378 | 92 | 88 | 0 | 38 | 34 | 346 | 0 | Northwest Access Drive |
| 2 | 0 | 0 | 0 | 0 | 382 | 251 | 239 | 0 | 88 | 80 | 354 | 0 | Northeast Access Drive |
| 3 | 195 | 395 | 24 | 12 | 402 | 129 | 100 | 409 | 36 | 36 | 358 | 199 | Main Intersection |
| 4 | 342 | 218 | 0 | 0 | 0 | 0 | 0 | 242 | 342 | 504 | 0 | 303 | Southeast Access Drive |

## Appendix D Topics (for Count Analysis):

## TEAPAC - Summary of Parameter Values (COU)

The Summary of Parameter Values (COU) report, generated using the SUMMARIZE command, summarizes the turning movement traffic counts as entered (either cumulative or reduced). In addition, the summary contains information regarding the intersection counted, the ADT factor, the type of count, the way trucks were counted, the length of the count intervals, the beginning and ending times of each count period, and adjustment factors used. Each is discussed below.

**Intersection.** This shows the designated intersection number and a description of the intersection. Usually the intersection number is a unique number within the study area that is assigned to each intersection.

**ADT Factor.** This is the factor which has been entered to convert the partial day's count into an estimate of a 24-hour volume, or average daily traffic (ADT). Each movement's total count is multiplied by this factor to determine the estimate of 24-hour volumes.

**Type of Count.** This parameter indicates whether the vehicle count data is reduced (the number of vehicles counted for each interval) or cumulative (the sum of the number of vehicles counted from the beginning of the count period).

**Trucks.** This indicates whether any truck counts which have been entered are "included" in the vehicle counts or are "separate" from the vehicle counts.

**Count Interval.** The length of time, in minutes, between recording successive counts. TEAPAC accepts count intervals of 15 or 60 minutes.

**Count Periods.** These entries define the start and end times of each count period. Up to five distinct count periods can be defined with five pairs of start and stop times, all expressed using a 24-hour clock. If the count type is cumulative, the last time for each count period is the time the count period was terminated, and does not represent the start time of a count interval. In this case, all other tabulations will not show this time in their reports, since it is only used to determine the actual count value for the previous count interval.

**Vehicle Counts.** This table displays the actual vehicle counts entered (in either cumulative or reduced form) for each time period and movement. The first column indicates the beginning time for each count interval. The next twelve columns are the counts for each of the twelve movements during that period. The movements are listed in order beginning with the north approach right-turn and proceeding clockwise around the intersection with the twelfth movement being the west approach left-turn, using the input approach and movement labels. Individual count periods are separated by a dashed line. If the default option for truck count entry is used (INCLUDED), then these counts include any truck vehicles which may have been counted.

**Truck Counts.** This table displays the counted truck vehicles for each time period and movement using the same organization and layout as the vehicle counts above.

**Adjust. Factors.** These are the adjustment factors which are applied (multiplied) to each movement's counts in all tabulations and analyses. When these values are not equal to the default value of 1.00, the Summary of Parameter Values (COU) report is the only output report where raw, unadjusted count data is displayed.

The following is an example of the Summary of Parameter Values (COU) report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - Summary of Parameter Values (COU)**

| Intersection | # 16 Lincoln Avenue & Main Street | | ADT Factor | 8.50 |
|---|---|---|---|---|
| Count Type: Red. | Trucks: Sep. | Desc: | | |

| Count Periods: | Start | Stop | Start | Stop | Start | Stop | Start | Stop | Start | Stop |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 min intrvls | 700 | 845 | 1600 | 1745 | 0 | 0 | 0 | 0 | 0 | 0 |

| Vehicle Counts: | | N | | | E | | | S | | | W | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| 700 | 21 | 12 | 17 | 23 | 43 | 20 | 7 | 6 | 2 | 4 | 21 | 7 |
| 715 | 30 | 21 | 17 | 10 | 94 | 26 | 4 | 6 | 3 | 6 | 41 | 10 |
| 730 | 25 | 17 | 11 | 11 | 58 | 16 | 12 | 3 | 1 | 8 | 26 | 4 |
| 745 | 13 | 13 | 14 | 9 | 60 | 15 | 9 | 5 | 0 | 7 | 39 | 15 |
| 800 | 17 | 23 | 22 | 9 | 53 | 33 | 6 | 6 | 0 | 8 | 30 | 14 |
| 815 | 27 | 16 | 23 | 14 | 81 | 23 | 8 | 10 | 3 | 9 | 32 | 7 |
| 830 | 23 | 18 | 16 | 6 | 51 | 18 | 12 | 13 | 6 | 3 | 40 | 19 |
| 845 | 31 | 14 | 13 | 15 | 52 | 27 | 12 | 6 | 4 | 7 | 40 | 7 |
| 1600 | 30 | 30 | 20 | 7 | 52 | 35 | 57 | 11 | 8 | 4 | 64 | 14 |
| 1615 | 45 | 28 | 20 | 4 | 73 | 49 | 37 | 20 | 11 | 9 | 118 | 33 |
| 1630 | 44 | 17 | 28 | 15 | 65 | 45 | 38 | 25 | 14 | 18 | 97 | 46 |
| 1645 | 45 | 37 | 28 | 5 | 70 | 34 | 42 | 11 | 8 | 17 | 113 | 27 |
| 1700 | 33 | 45 | 29 | 16 | 80 | 40 | 34 | 6 | 15 | 9 | 120 | 33 |
| 1715 | 31 | 34 | 19 | 11 | 84 | 42 | 41 | 23 | 6 | 8 | 83 | 45 |
| 1730 | 57 | 39 | 36 | 9 | 64 | 61 | 34 | 14 | 8 | 7 | 107 | 24 |
| 1745 | 31 | 40 | 36 | 19 | 63 | 31 | 46 | 13 | 19 | 12 | 102 | 24 |

| Truck Counts: | | N | | | E | | | S | | | W | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT |
| 700 | 1 | 2 | 7 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 715 | 0 | 1 | 7 | 0 | 4 | 6 | 0 | 0 | 0 | 0 | 1 | 0 |
| 730 | 5 | 7 | 1 | 1 | 8 | 6 | 2 | 0 | 0 | 0 | 6 | 0 |
| 745 | 3 | 3 | 4 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 9 | 5 |
| 800 | 7 | 3 | 2 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 4 |
| 815 | 7 | 6 | 3 | 4 | 1 | 3 | 0 | 0 | 0 | 0 | 2 | 0 |
| 830 | 3 | 8 | 6 | 0 | 1 | 8 | 2 | 3 | 0 | 0 | 0 | 9 |
| 845 | 1 | 4 | 3 | 5 | 2 | 7 | 2 | 0 | 0 | 0 | 0 | 0 |
| 1600 | 0 | 0 | 0 | 0 | 2 | 5 | 7 | 1 | 0 | 0 | 4 | 4 |
| 1615 | 5 | 8 | 0 | 0 | 3 | 9 | 7 | 0 | 1 | 0 | 8 | 3 |
| 1630 | 4 | 7 | 8 | 5 | 5 | 5 | 8 | 5 | 4 | 8 | 7 | 6 |
| 1645 | 5 | 7 | 8 | 0 | 0 | 4 | 2 | 1 | 0 | 7 | 3 | 7 |
| 1700 | 3 | 5 | 9 | 6 | 0 | 0 | 4 | 0 | 5 | 0 | 0 | 3 |
| 1715 | 1 | 4 | 9 | 1 | 4 | 2 | 1 | 3 | 0 | 0 | 3 | 5 |
| 1730 | 7 | 9 | 6 | 0 | 4 | 1 | 4 | 4 | 0 | 0 | 7 | 4 |
| 1745 | 1 | 0 | 6 | 9 | 3 | 1 | 6 | 3 | 9 | 2 | 2 | 4 |
| Adjust. Factors | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 |

## TEAPAC - 15-Minute Counts

The 15-Minute Counts report, generated using either the COUNTTABULATE or COUNTREPORTS command, provides a tabulation of the 15-minute counts for each count interval. If counts were entered in 60-minute intervals this table is not produced. If the counts were cumulative, this report displays the reduced differences between each cumulative count value. The report is divided into two parts: movements counts and approach/exit totals. The first section tabulates the counts for the twelve individual movements ("by Mvmt") while the second section tabulates the approach and exit volumes ("Totals"). Both sections use the input approach and movement labels and include the total intersection counts for all traffic entering the intersection.

The following describes the column entries which appear in each of the four possible output tables.

### Begin Time

Begin Time entries represent the starting time of the count interval for the counts shown on that row of the table. For example, 1615 indicates a 15-minute count interval beginning at 4:15 P.M. and ending at 4:30 P.M. All times are listed in 24-hour clock time.

### Tables of Counts

The type of counts shown in each table are described by the information listed in the title of each report section. These may include tables for all vehicles and for trucks only, and tables by movement and approach/exit totals, as described below.

**All Vehicles.** Tables titled with "All Vehicles" include all vehicles counted, including any counted trucks, even if the trucks were counted and/or tabulated separately.

**Trucks Only.** Tables titled with "Trucks Only" include counts specifically entered as truck counts. This table output is optional, and is generated if truck counts were input and the special truck output report was selected.

**By Movement.** Tables titled with "by Mvmt" show the individual movement counts for the twelve movements, labeled with the input labels, and listed clockwise from the north approach right turn.

**Approach/Exit Totals.** Tables titled with "Totals" show the counts for each of the four approaches to and exits from the intersection, labeled with the input labels, and listed clockwise from the north leg (approach and exit). The approach totals include the three movements which approach the intersection from the direction listed. The exit totals include the three movements which exit the intersection towards the direction listed.

### Intersection Totals

The last column of each table, labeled "Int Total", is the count for all vehicles entering the intersection.

The following is an example of the 15-Minute Counts report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

## TEAPAC[Ver 8.00.00] - 15-Minute Counts: All Vehicles - by Mvmt

Int# 16 Lincoln Avenue & Main Street

| Begin | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| 700 | 24 | 15 | 27 | 29 | 52 | 23 | 8 | 7 | 2 | 5 | 25 | 8 | 225 |
| 715 | 33 | 24 | 27 | 11 | 113 | 37 | 4 | 7 | 3 | 7 | 48 | 11 | 325 |
| 730 | 34 | 27 | 13 | 14 | 76 | 25 | 15 | 3 | 1 | 9 | 37 | 5 | 259 |
| 745 | 17 | 17 | 19 | 10 | 69 | 23 | 10 | 6 | 0 | 8 | 55 | 23 | 257 |
| 800 | 27 | 28 | 26 | 10 | 64 | 41 | 7 | 7 | 0 | 9 | 34 | 21 | 274 |
| 815 | 38 | 25 | 28 | 21 | 94 | 29 | 9 | 11 | 3 | 10 | 39 | 8 | 315 |
| 830 | 28 | 29 | 25 | 7 | 60 | 30 | 15 | 17 | 7 | 3 | 46 | 32 | 299 |
| 845 | 35 | 19 | 17 | 23 | 62 | 39 | 15 | 7 | 4 | 8 | 46 | 8 | 283 |
| 1600 | 33 | 33 | 22 | 8 | 62 | 46 | 71 | 13 | 9 | 5 | 79 | 21 | 402 |
| 1615 | 56 | 40 | 22 | 5 | 87 | 66 | 49 | 22 | 13 | 10 | 145 | 41 | 556 |
| 1630 | 52 | 27 | 40 | 23 | 81 | 58 | 51 | 34 | 19 | 30 | 120 | 60 | 595 |
| 1645 | 56 | 49 | 40 | 6 | 80 | 44 | 48 | 13 | 9 | 28 | 133 | 39 | 545 |
| 1700 | 39 | 56 | 42 | 25 | 92 | 46 | 41 | 7 | 23 | 10 | 138 | 41 | 560 |
| 1715 | 35 | 41 | 31 | 14 | 102 | 50 | 46 | 28 | 7 | 9 | 98 | 58 | 519 |
| 1730 | 71 | 53 | 47 | 10 | 79 | 71 | 41 | 19 | 9 | 8 | 131 | 33 | 572 |
| 1745 | 35 | 44 | 47 | 32 | 75 | 37 | 58 | 17 | 31 | 16 | 119 | 33 | 544 |
| Total | 613 | 527 | 473 | 248 | 1248 | 665 | 488 | 218 | 140 | 175 | 1293 | 442 | 6530 |
| Adjst | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | |

## TEAPAC[Ver 8.00.00] - 15-Minute Counts: All Vehicles - Totals

Int# 16 Lincoln Avenue & Main Street

| Begin | Approach Totals | | | | Exit Totals | | | | Int |
|---|---|---|---|---|---|---|---|---|---|
| Time | N | E | S | W | N | E | S | W | Total |
| 700 | 66 | 104 | 17 | 38 | 44 | 60 | 43 | 78 | 225 |
| 715 | 84 | 161 | 14 | 66 | 29 | 79 | 68 | 149 | 325 |
| 730 | 74 | 115 | 19 | 51 | 22 | 65 | 61 | 111 | 259 |
| 745 | 53 | 102 | 16 | 86 | 39 | 84 | 48 | 86 | 257 |
| 800 | 81 | 115 | 14 | 64 | 38 | 67 | 78 | 91 | 274 |
| 815 | 91 | 144 | 23 | 57 | 40 | 76 | 64 | 135 | 315 |
| 830 | 82 | 97 | 39 | 81 | 56 | 86 | 62 | 95 | 299 |
| 845 | 71 | 124 | 26 | 62 | 38 | 78 | 66 | 101 | 283 |
| 1600 | 88 | 116 | 93 | 105 | 42 | 172 | 84 | 104 | 402 |
| 1615 | 118 | 158 | 84 | 196 | 68 | 216 | 116 | 156 | 556 |
| 1630 | 119 | 162 | 104 | 210 | 117 | 211 | 115 | 152 | 595 |
| 1645 | 145 | 130 | 70 | 200 | 58 | 221 | 121 | 145 | 545 |
| 1700 | 137 | 163 | 71 | 189 | 73 | 221 | 112 | 154 | 560 |
| 1715 | 107 | 166 | 81 | 165 | 100 | 175 | 100 | 144 | 519 |
| 1730 | 171 | 160 | 69 | 172 | 62 | 219 | 132 | 159 | 572 |
| 1745 | 126 | 144 | 106 | 168 | 82 | 224 | 97 | 141 | 544 |
| Total | 1613 | 2161 | 846 | 1910 | 908 | 2254 | 1367 | 2001 | 6530 |

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

## TEAPAC[Ver 8.00.00] - 15-Minute Counts: Trucks Only - by Mvmt

Int# 16 Lincoln Avenue & Main Street

| Begin | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| 700 | 1 | 2 | 8 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 18 |
| 715 | 0 | 1 | 8 | 0 | 5 | 7 | 0 | 0 | 0 | 0 | 1 | 0 | 22 |
| 730 | 6 | 8 | 1 | 1 | 9 | 7 | 2 | 0 | 0 | 0 | 7 | 0 | 41 |
| 745 | 3 | 3 | 4 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 10 | 6 | 32 |
| 800 | 8 | 3 | 2 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 5 | 24 |
| 815 | 8 | 7 | 3 | 5 | 1 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 29 |
| 830 | 3 | 9 | 7 | 0 | 1 | 9 | 2 | 3 | 0 | 0 | 0 | 10 | 44 |
| 845 | 1 | 4 | 3 | 6 | 2 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 26 |
| 1600 | 0 | 0 | 0 | 0 | 2 | 6 | 8 | 1 | 0 | 0 | 5 | 5 | 27 |
| 1615 | 6 | 9 | 0 | 0 | 3 | 10 | 8 | 0 | 1 | 0 | 9 | 3 | 49 |
| 1630 | 4 | 8 | 9 | 6 | 6 | 6 | 9 | 6 | 4 | 9 | 8 | 7 | 82 |
| 1645 | 6 | 8 | 9 | 0 | 0 | 5 | 2 | 1 | 0 | 8 | 3 | 8 | 50 |
| 1700 | 3 | 6 | 10 | 7 | 0 | 0 | 4 | 0 | 6 | 0 | 0 | 3 | 39 |
| 1715 | 1 | 4 | 10 | 1 | 5 | 2 | 1 | 3 | 0 | 0 | 3 | 6 | 36 |
| 1730 | 8 | 10 | 7 | 0 | 5 | 1 | 4 | 4 | 0 | 0 | 8 | 5 | 52 |
| 1745 | 1 | 0 | 7 | 10 | 3 | 1 | 7 | 3 | 10 | 2 | 2 | 5 | 51 |
| Total | 59 | 82 | 88 | 39 | 48 | 74 | 49 | 21 | 21 | 19 | 59 | 63 | 622 |
| Adjst | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | |

## TEAPAC[Ver 8.00.00] - 15-Minute Counts: Trucks Only - Totals

Int# 16 Lincoln Avenue & Main Street

| Begin | Approach Totals | | | | Exit Totals | | | | Int |
|---|---|---|---|---|---|---|---|---|---|
| Time | N | E | S | W | N | E | S | W | Total |
| 700 | 11 | 6 | 0 | 1 | 3 | 9 | 2 | 4 | 18 |
| 715 | 9 | 12 | 0 | 1 | 0 | 9 | 8 | 5 | 22 |
| 730 | 15 | 17 | 2 | 7 | 1 | 10 | 15 | 15 | 41 |
| 745 | 10 | 6 | 0 | 16 | 6 | 14 | 9 | 3 | 32 |
| 800 | 13 | 6 | 0 | 5 | 5 | 2 | 6 | 11 | 24 |
| 815 | 18 | 9 | 0 | 2 | 5 | 5 | 10 | 9 | 29 |
| 830 | 19 | 10 | 5 | 10 | 13 | 9 | 18 | 4 | 44 |
| 845 | 8 | 16 | 2 | 0 | 6 | 5 | 12 | 3 | 26 |
| 1600 | 0 | 8 | 9 | 10 | 6 | 13 | 6 | 2 | 27 |
| 1615 | 15 | 13 | 9 | 12 | 3 | 17 | 19 | 10 | 49 |
| 1630 | 21 | 18 | 19 | 24 | 19 | 26 | 23 | 14 | 82 |
| 1645 | 23 | 5 | 3 | 19 | 9 | 14 | 21 | 6 | 50 |
| 1700 | 19 | 7 | 10 | 3 | 10 | 14 | 6 | 9 | 39 |
| 1715 | 15 | 8 | 4 | 9 | 10 | 14 | 6 | 6 | 36 |
| 1730 | 25 | 6 | 8 | 13 | 9 | 19 | 11 | 13 | 52 |
| 1745 | 8 | 14 | 20 | 9 | 18 | 16 | 3 | 14 | 51 |
| Total | 229 | 161 | 91 | 141 | 123 | 196 | 175 | 128 | 622 |

## TEAPAC - 15-Minute Flow Rates

The 15-Minute Flow Rates report, generated using either the COUNTTABULATE or COUNTREPORTS command, provides a tabulation of the rates of flow for each 15-minute count interval. The actual 15-minute counts are multiplied by four so that they represent the rates of traffic flow during the 15-minute period, given in vehicles per hour. If counts were entered in 60-minute intervals this table is not produced. The report is divided into two parts: movements flow rates and approach/exit total rates. The first section tabulates the flow rates for the twelve individual movements ("by Movement") while the second section tabulates the approach and exit flow rates ("Appr/Exit Totals"). Both sections use the input approach and movement labels and include the total intersection flow rates for all traffic entering the intersection.

The following describes the column entries which appear in each of the two output tables.

### Begin Time

Begin Time entries represent the starting time of the count interval for the flow rates shown on that row of the table. For example, 1615 indicates a 15-minute count interval beginning at 4:15 P.M. and ending at 4:30 P.M. All times are listed in 24-hour clock time.

### Tables of Counts

The type of counts shown in each table are described by the information listed in the title of each report section. These include tables by movement and approach/exit totals, as described below.

**By Movement.** Tables titled with "by Movement" show the individual movement flow rates for the twelve movements, labeled with the input labels, and listed clockwise from the north approach right turn.

**Approach/Exit Totals.** Tables titled with "Appr/Exit Totals" show the flow rates for each of the four approaches to and exits from the intersection, labeled with the input labels, and listed clockwise from the north leg (approach and exit). The approach totals include the three movements which approach the intersection from the direction listed. The exit totals include the three movements which exit the intersection towards the direction listed.

### Intersection Totals

The last column of each table, labeled "Int Total", is the flow rate for all vehicles entering the intersection. The following is an example of the 15-Minute Flow Rates report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

## TEAPAC[Ver 8.00.00] - 15-Minute Flow Rates: by Movement

Int# 16 Lincoln Avenue & Main Street

| Begin | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| 700 | 96 | 60 | 108 | 116 | 208 | 92 | 32 | 28 | 8 | 20 | 100 | 32 | 900 |
| 715 | 132 | 96 | 108 | 44 | 452 | 148 | 16 | 28 | 12 | 28 | 192 | 44 | 1300 |
| 730 | 136 | 108 | 52 | 56 | 304 | 100 | 60 | 12 | 4 | 36 | 148 | 20 | 1036 |
| 745 | 68 | 68 | 76 | 40 | 276 | 92 | 40 | 24 | 0 | 32 | 220 | 92 | 1028 |
| 800 | 108 | 112 | 104 | 40 | 256 | 164 | 28 | 28 | 0 | 36 | 136 | 84 | 1096 |
| 815 | 152 | 100 | 112 | 84 | 376 | 116 | 36 | 44 | 12 | 40 | 156 | 32 | 1260 |
| 830 | 112 | 116 | 100 | 28 | 240 | 120 | 60 | 68 | 28 | 12 | 184 | 128 | 1196 |
| 845 | 140 | 76 | 68 | 92 | 248 | 156 | 60 | 28 | 16 | 32 | 184 | 32 | 1132 |
| 1600 | 132 | 132 | 88 | 32 | 248 | 184 | 284 | 52 | 36 | 20 | 316 | 84 | 1608 |
| 1615 | 224 | 160 | 88 | 20 | 348 | 264 | 196 | 88 | 52 | 40 | 580 | 164 | 2224 |
| 1630 | 208 | 108 | 160 | 92 | 324 | 232 | 204 | 136 | 76 | 120 | 480 | 240 | 2380 |
| 1645 | 224 | 196 | 160 | 24 | 320 | 176 | 192 | 52 | 36 | 112 | 532 | 156 | 2180 |
| 1700 | 156 | 224 | 168 | 100 | 368 | 184 | 164 | 28 | 92 | 40 | 552 | 164 | 2240 |
| 1715 | 140 | 164 | 124 | 56 | 408 | 200 | 184 | 112 | 28 | 36 | 392 | 232 | 2076 |
| 1730 | 284 | 212 | 188 | 40 | 316 | 284 | 164 | 76 | 36 | 32 | 524 | 132 | 2288 |
| 1745 | 140 | 176 | 188 | 128 | 300 | 148 | 232 | 68 | 124 | 64 | 476 | 132 | 2176 |
| Adjst | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | |

## TEAPAC[Ver 8.00.00] - 15-Minute Flow Rates: Appr/Exit Totals

Int# 16 Lincoln Avenue & Main Street

| Begin | Approach Totals | | | | Exit Totals | | | | Int |
|---|---|---|---|---|---|---|---|---|---|
| Time | N | E | S | W | N | E | S | W | Total |
| 700 | 264 | 416 | 68 | 152 | 176 | 240 | 172 | 312 | 900 |
| 715 | 336 | 644 | 56 | 264 | 116 | 316 | 272 | 596 | 1300 |
| 730 | 296 | 460 | 76 | 204 | 88 | 260 | 244 | 444 | 1036 |
| 745 | 212 | 408 | 64 | 344 | 156 | 336 | 192 | 344 | 1028 |
| 800 | 324 | 460 | 56 | 256 | 152 | 268 | 312 | 364 | 1096 |
| 815 | 364 | 576 | 92 | 228 | 160 | 304 | 256 | 540 | 1260 |
| 830 | 328 | 388 | 156 | 324 | 224 | 344 | 248 | 380 | 1196 |
| 845 | 284 | 496 | 104 | 248 | 152 | 312 | 264 | 404 | 1132 |
| 1600 | 352 | 464 | 372 | 420 | 168 | 688 | 336 | 416 | 1608 |
| 1615 | 472 | 632 | 336 | 784 | 272 | 864 | 464 | 624 | 2224 |
| 1630 | 476 | 648 | 416 | 840 | 468 | 844 | 460 | 608 | 2380 |
| 1645 | 580 | 520 | 280 | 800 | 232 | 884 | 484 | 580 | 2180 |
| 1700 | 548 | 652 | 284 | 756 | 292 | 884 | 448 | 616 | 2240 |
| 1715 | 428 | 664 | 324 | 660 | 400 | 700 | 400 | 576 | 2076 |
| 1730 | 684 | 640 | 276 | 688 | 248 | 876 | 528 | 636 | 2288 |
| 1745 | 504 | 576 | 424 | 672 | 328 | 896 | 388 | 564 | 2176 |

# TEAPAC - 60-Minute Volumes

The 60-Minute Volumes report, generated using either the COUNTTABULATE or COUNTREPORTS command, provides a tabulation of the count data for each possible 60-minute count interval. If the count data was originally entered in 15-minute intervals, the 60-minute volumes are the sum of the four 15-minute counts beginning at the time listed for the 60-minute interval. For example, the 4:15 P.M. 60-minute volume includes the four 15-minute counts starting at 4:15, 4:30, 4:45 and 5:00 P.M.

It should be noted that the last three rows for a given count period do not represent complete 60-minute counts. For example, in the count conducted from 4:00 to 6:00 P.M., the value for 5:15 P.M. includes only the three 15-minute counts starting at 5:15, 5:30 and 5:45 P.M. The 5:30 P.M. value only includes the 5:30 and 5:45 counts, and the 5:45 P.M. value only includes the 5:45 count. These three rows are flagged in the output with an asterisk "*" next to the intersection total column, and caution should therefore be used in using these values.

The report is divided into two parts: movements volumes and approach/exit total volumes. The first section tabulates the 60-minute volumes for the twelve individual movements ("by Movement") while the second section tabulates the approach and exit volumes ("Appr/Exit Totals"). Both sections use the input approach and movement labels and include the total intersection volumes for all traffic entering the intersection.

The following describes the column entries which appear in each of the two output tables.

## Begin Time

Begin Time entries represent the starting time of the 60-minute interval for the volumes shown on that row of the table. For example, 1615 indicates a 60-minute interval beginning at 4:15 P.M. and ending at 5:15 P.M. All times are listed in 24-hour clock time.

## Tables of Counts

The type of counts shown in each table are described by the information listed in the title of each report section. These include tables by movement and approach/exit totals, as described below.

**By Movement.** Tables titled with "by Movement" show the individual movement volumes for the twelve movements, labeled with the input labels, and listed clockwise from the north approach right turn.

**Approach/Exit Totals.** Tables titled with "Appr/Exit Totals" show the volumes for each of the four approaches to and exits from the intersection, labeled with the input labels, and listed clockwise from the north leg (approach and exit). The approach totals include the three movements which approach the intersection from the direction listed. The exit totals include the three movements which exit the intersection towards the direction listed.

## Intersection Totals

The last column of each table, labeled "Int Total", is the volume for all vehicles entering the intersection.

The following is an example of the 60-Minute Volumes report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

## TEAPAC[Ver 8.00.00] - 60-Minute Volumes: by Movement

Int# 16 Lincoln Avenue & Main Street

| Begin | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| 700 | 108 | 83 | 86 | 64 | 310 | 108 | 37 | 23 | 6 | 29 | 165 | 47 | 1066 |
| 715 | 111 | 96 | 85 | 45 | 322 | 126 | 36 | 23 | 4 | 33 | 174 | 60 | 1115 |
| 730 | 116 | 97 | 86 | 55 | 303 | 118 | 41 | 27 | 4 | 36 | 165 | 57 | 1105 |
| 745 | 110 | 99 | 98 | 48 | 287 | 123 | 41 | 41 | 10 | 30 | 174 | 84 | 1145 |
| 800 | 128 | 101 | 96 | 61 | 280 | 139 | 46 | 42 | 14 | 30 | 165 | 69 | 1171 |
| 815 | 101 | 73 | 70 | 51 | 216 | 98 | 39 | 35 | 14 | 21 | 131 | 48 | 897* |
| 830 | 63 | 48 | 42 | 30 | 122 | 69 | 30 | 24 | 11 | 11 | 92 | 40 | 582* |
| 845 | 35 | 19 | 17 | 23 | 62 | 39 | 15 | 7 | 4 | 8 | 46 | 8 | 283* |
| 1600 | 197 | 149 | 124 | 42 | 310 | 214 | 219 | 82 | 50 | 73 | 477 | 161 | 2098 |
| 1615 | 203 | 172 | 144 | 59 | 340 | 214 | 189 | 76 | 64 | 78 | 536 | 181 | 2256 |
| 1630 | 182 | 173 | 153 | 68 | 355 | 198 | 186 | 82 | 58 | 77 | 489 | 198 | 2219 |
| 1645 | 201 | 199 | 160 | 55 | 353 | 211 | 176 | 67 | 48 | 55 | 500 | 171 | 2196 |
| 1700 | 180 | 194 | 167 | 81 | 348 | 204 | 186 | 71 | 70 | 43 | 486 | 165 | 2195 |
| 1715 | 141 | 138 | 125 | 56 | 256 | 158 | 145 | 64 | 47 | 33 | 348 | 124 | 1635* |
| 1730 | 106 | 97 | 94 | 42 | 154 | 108 | 99 | 36 | 40 | 24 | 250 | 66 | 1116* |
| 1745 | 35 | 44 | 47 | 32 | 75 | 37 | 58 | 17 | 31 | 16 | 119 | 33 | 544* |
| Adjst | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | 1.10 | 1.10 | 1.10 | 1.15 | 1.15 | 1.15 | |

## TEAPAC[Ver 8.00.00] - 60-Minute Volumes: Appr/Exit Totals

Int# 16 Lincoln Avenue & Main Street

| Begin | Approach Totals | | | | Exit Totals | | | | Int |
|---|---|---|---|---|---|---|---|---|---|
| Time | N | E | S | W | N | E | S | W | Total |
| 700 | 277 | 482 | 66 | 241 | 134 | 288 | 220 | 424 | 1066 |
| 715 | 292 | 493 | 63 | 267 | 128 | 295 | 255 | 437 | 1115 |
| 730 | 299 | 476 | 72 | 258 | 139 | 292 | 251 | 423 | 1105 |
| 745 | 307 | 458 | 92 | 288 | 173 | 313 | 252 | 407 | 1145 |
| 800 | 325 | 480 | 102 | 264 | 172 | 307 | 270 | 422 | 1171 |
| 815 | 244 | 365 | 88 | 200 | 134 | 240 | 192 | 331 | 897* |
| 830 | 153 | 221 | 65 | 143 | 94 | 164 | 128 | 196 | 582* |
| 845 | 71 | 124 | 26 | 62 | 38 | 78 | 66 | 101 | 283* |
| 1600 | 470 | 566 | 351 | 711 | 285 | 820 | 436 | 557 | 2098 |
| 1615 | 519 | 613 | 329 | 795 | 316 | 869 | 464 | 607 | 2256 |
| 1630 | 508 | 621 | 326 | 764 | 348 | 828 | 448 | 595 | 2219 |
| 1645 | 560 | 619 | 291 | 726 | 293 | 836 | 465 | 602 | 2196 |
| 1700 | 541 | 633 | 327 | 694 | 317 | 839 | 441 | 598 | 2195 |
| 1715 | 404 | 470 | 256 | 505 | 244 | 618 | 329 | 444 | 1635* |
| 1730 | 297 | 304 | 175 | 340 | 144 | 443 | 229 | 300 | 1116* |
| 1745 | 126 | 144 | 106 | 168 | 82 | 224 | 97 | 141 | 544* |

## **TEAPAC - Peak Hour Summary**

The Peak Hour Summary report, generated using the PEAKANALYZE or COUNTREPORTS command, displays an analysis of the peak hour turning volumes and other related factors calculated using the peak hour traffic volume data. The peak period is determined as the 60-minute (or 15-minute) time interval that has the highest 60-minute volume (or 15-minute flow rate) for the intersection. 60-minute volumes are as defined in the 60-Minute Volumes report.

The report is divided into two parts: movements peak values and approach/exit peak values. The first section tabulates the peaking characteristics for the twelve individual movements while the second section tabulates the approach and exit peaking information. The approach totals include the three movements which approach the intersection from the direction listed. The exit totals include the three movements which exit the intersection towards the direction listed. Both sections use the input approach and movement labels.

The following describes the entries which appear in each of the two output tables.

**Analysis Period.** The top line of the report lists the time period which was scanned to determine the peak period for the intersection and whether 60-minute volumes or 15-minute flow rates were used to determine the peak period. The period is defined with two times, a start time and an end time. Each time given represents the time of a 60-minute volume or 15-minute flow rate which is checked. For example, if the first time given is 1600 for a 60-minute volume analysis, this indicates that the first 60-minute volume scanned to find the intersection peak is the hour starting at 4:00 P.M. If the second time given is 1745, this indicates that the last 60-minute volume scanned to find the peak is the hour starting at 5:45 P.M.

If the second time is any of the last three time intervals of a 15-minute count period, note that the end of the peak scan will be for volumes that are not full 60-minute volumes. This will normally not affect the determination of the peak hour. If the identified peak is any of these three incomplete time intervals, this suggests that the actual intersection peak has not been completely counted and additional counts should be made. If the start and end times are the same, this indicates that a specific time interval is to be analyzed, and that the actual peak hour scan will be limited to that single interval.

**Design Hour Volume - DHV (vph).** The 60-minute volume or 15-minute flow rate, in vehicles per hour, which exists for the listed movement during the identified intersection peak. If the top line of the report indicates 60-minute volumes were used, this is a 60-minute volume. If 15-minute flow rates were used, this is a 15-minute flow rate.

**Distribution Percent - Distr (%).** For individual movements, this is the percent of the total approach volume that is contributed by the movement. The three movement percentages will always add up to 100 percent. For approaches and exits, this is the percent of total intersection volume that is contributed by the approach or exit. The four approach percentages will always add up to 100 percent, as will the four exit percentages. These values are useful in determining the percent of turning volume for a given approach or the directional distribution of arriving and departing traffic.

**Truck Percent - Truck (%).** When trucks volumes are specifically counted, this value represents the percent of trucks included in the total vehicle volume for the listed movement.

**Peak Hour Factor - PHF (-).** The total hourly volume of the movement divided by four times the highest 15-minute count during the peak hour. When a 60-minute count is made or when 15-minute flow rates are used to determine the peak period, the peak hour factor is always 1.00.

**Peak Time - Peak Time.** The beginning time of the peak time interval when the maximum number of vehicles was counted for each movement. This can be compared to the time when the entire intersection peaks to help determine if other time periods warrant further analysis.

**Peak Volume - Peak Volm.** The 60-minute volume or 15-minute flow rate counted during the peak time of the movement. This value should be compared to the volume that exists during the intersection peak, and is important for identifying peaks which do not coincide with the overall intersection peak. This is particularly important in turning lane design. It can also be used to determine when the exit from a development peaks (this is the intersection approach total) or when the entrance to a development peaks (this is the intersection exit total).

The following is an example of the Peak Hour Summary report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

## TEAPAC[Ver 8.00.00] - PM Peak-Hour Summary

Int# 16 Lincoln Avenue & Main Street

Analysis from 1600 to 1745 Hours using 60-Minute Volumes

| | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| DHV (vph) | 203 | 172 | 144 | 59 | 340 | 214 | 189 | 76 | 64 | 78 | 536 | 181 | 2256 |
| Distr (%) | 39 | 33 | 28 | 10 | 55 | 35 | 57 | 23 | 19 | 10 | 67 | 23 | 100 |
| Truck (%) | 9 | 18 | 19 | 22 | 3 | 10 | 12 | 9 | 17 | 22 | 4 | 12 | 10 |
| PHF (-) | 0.91 | 0.77 | 0.86 | 0.59 | 0.92 | 0.81 | 0.93 | 0.56 | 0.70 | 0.65 | 0.92 | 0.75 | 0.95 |
| Peak Time | 1615 | 1645 | 1700 | 1700 | 1630 | 1615 | 1600 | 1630 | 1700 | 1615 | 1615 | 1630 | 1615 |
| Peak Volm | 203 | 199 | 167 | 81 | 355 | 214 | 219 | 82 | 70 | 78 | 536 | 198 | 2256 |

Int# 16 Lincoln Avenue & Main Street

| | Approach Totals | | | | Exit Totals | | | | Int |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | N | E | S | W | N | E | S | W | Total |
| DHV (vph) | 519 | 613 | 329 | 795 | 316 | 869 | 464 | 607 | 2256 |
| Distr (%) | 23 | 27 | 15 | 35 | 14 | 39 | 21 | 27 | 100 |
| Truck (%) | 15 | 7 | 12 | 7 | 13 | 8 | 15 | 6 | 10 |
| PHF (-) | 0.89 | 0.94 | 0.79 | 0.95 | 0.68 | 0.98 | 0.96 | 0.97 | 0.95 |
| Peak Time | 1645 | 1700 | 1600 | 1615 | 1630 | 1615 | 1645 | 1615 | 1615 |
| Peak Volm | 560 | 633 | 351 | 795 | 348 | 869 | 465 | 607 | 2256 |

## TEAPAC[Ver 8.00.00] - 24-Hour Volume Estimates

Int# 16 Lincoln Avenue & Main Street

| | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Param. | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| Movement | 5712 | 5177 | 4769 | 2440 | 11016 | 6282 | 4565 | 2032 | 1369 | 1649 | 11492 | 4293 | 60792 |
| Approach | | 15657 | | | 19737 | | | 7965 | | | 17434 | | |
| Exit | | 8764 | | | 20825 | | | 13107 | | | 18097 | | |
| 2-way | | 24421 | | | 40562 | | | 21072 | | | 35531 | | |

## TEAPAC - 24-Hour Volume Estimates

The 24-Hour Volume Estimates report, generated using the PEAKANALYZE or COUNTREPORTS command, displays estimated 24-hour volumes for each movement, approach and exit of the intersection, as well as the intersection as a whole and the two-way flow on each leg of the intersection. 24-hour estimates are made by multiplying the entire traffic count by the input ADT factor.

**By Movement.** The first row of the table displays the 24-hour volume estimate for each of the twelve individual movements, labeled with the input labels, and listed clockwise from the north approach right turn.

**Approach/Exit Totals.** The second and third lines of the table list the total traffic approaching and exiting the intersection for each of the four legs of the intersection.

**2-way Totals.** The fourth line of the table displays the two-way traffic total for each leg of the intersection. This is the sum of the approach and exit totals for each leg.

**Intersection Total.** The last column of the table displays the total estimated 24-hour volume for the entire intersection.

The following is an example of the 24-Hour Volume Estimates report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - PM Peak-Hour Summary**

Int# 16 Lincoln Avenue & Main Street

Analysis from 1600 to 1745 Hours using 60-Minute Volumes

| | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| DHV (vph) | 203 | 172 | 144 | 59 | 340 | 214 | 189 | 76 | 64 | 78 | 536 | 181 | 2256 |
| Distr (%) | 39 | 33 | 28 | 10 | 55 | 35 | 57 | 23 | 19 | 10 | 67 | 23 | 100 |
| Truck (%) | 9 | 18 | 19 | 22 | 3 | 10 | 12 | 9 | 17 | 22 | 4 | 12 | 10 |
| PHF (-) | 0.91 | 0.77 | 0.86 | 0.59 | 0.92 | 0.81 | 0.93 | 0.56 | 0.70 | 0.65 | 0.92 | 0.75 | 0.95 |
| Peak Time | 1615 | 1645 | 1700 | 1700 | 1630 | 1615 | 1600 | 1630 | 1700 | 1615 | 1615 | 1630 | 1615 |
| Peak Volm | 203 | 199 | 167 | 81 | 355 | 214 | 219 | 82 | 70 | 78 | 536 | 198 | 2256 |

Int# 16 Lincoln Avenue & Main Street

| | Approach Totals | | | | Exit Totals | | | | Int |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | N | E | S | W | N | E | S | W | Total |
| DHV (vph) | 519 | 613 | 329 | 795 | 316 | 869 | 464 | 607 | 2256 |
| Distr (%) | 23 | 27 | 15 | 35 | 14 | 39 | 21 | 27 | 100 |
| Truck (%) | 15 | 7 | 12 | 7 | 13 | 8 | 15 | 6 | 10 |
| PHF (-) | 0.89 | 0.94 | 0.79 | 0.95 | 0.68 | 0.98 | 0.96 | 0.97 | 0.95 |
| Peak Time | 1645 | 1700 | 1600 | 1615 | 1630 | 1615 | 1645 | 1615 | 1615 |
| Peak Volm | 560 | 633 | 351 | 795 | 348 | 869 | 465 | 607 | 2256 |

**TEAPAC[Ver 8.00.00] - 24-Hour Volume Estimates**

Int# 16 Lincoln Avenue & Main Street

| | N-Approach | | | E-Approach | | | S-Approach | | | W-Approach | | | Int |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Param. | RT | TH | LT | RT | TH | LT | RT | TH | LT | RT | TH | LT | Total |
| Movement | 5712 | 5177 | 4769 | 2440 | 11016 | 6282 | 4565 | 2032 | 1369 | 1649 | 11492 | 4293 | 60792 |
| Approach | | 15657 | | | 19737 | | | 7965 | | | 17434 | | |
| Exit | | 8764 | | | 20825 | | | 13107 | | | 18097 | | |
| 2-way | | 24421 | | | 40562 | | | 21072 | | | 35531 | | |

## TEAPAC - Display of Intersection Volumes

The Display of Intersection Volumes report, generated by the PEAKSUMMARY or PEAKANALYZE command, displays a schematic diagram of the counted intersection with the counted traffic and calculated distribution percentages overlaid for each of the twelve movements. Approach and exit totals and distributions, and the intersection total are also displayed. Traffic volumes are either 60-minute volumes or 15-minute flow rates.

**Key.** The descriptive information which surrounds the schematic diagram identifies the type of information which is displayed. The lower right corner identifies whether 60-minute volumes or 15-minute flow rates are shown in the report. The display always includes all vehicles, including any truck counts which have been entered. The lower left corner identifies the beginning time of the period which is displayed. If 60-minute volumes are shown, this is the beginning time of the 60-minute period. If 15-minute flow rates are shown, this is the beginning of the 15-minute period. This section also lists the total intersection volume, as described below. The upper right corner of the display identifies the intersection with the intersection number and descriptive intersection, and the right side of the display shows that North is always oriented up in the display.

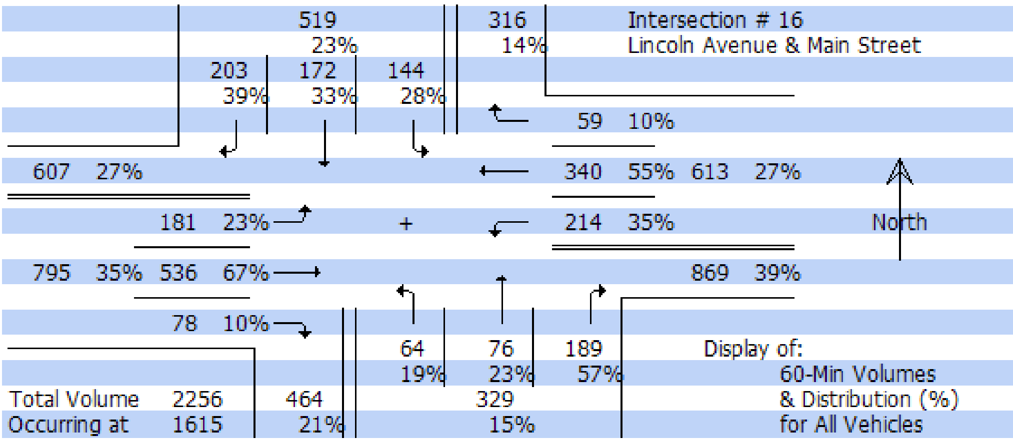
**Volumes.** Four types of intersection volumes are displayed in the report. Movement volumes are shown for each of the twelve movements at the intersection; approach volumes are shown as the sum of the three movements on each approach; exit volumes are the sum of the three movements which leave the intersection in a common direction; and the intersection total volume is displayed. The volumes are either 60-minute volumes or 15-minute flow rates, as described by the key in the lower right corner, and the volumes always include all vehicles.

**Distribution Percentages.** For individual movements, this is the percent of the total approach volume that is contributed by the movement. The three movement percentages will always add up to 100 percent. For approaches and exits, this is the percent of total intersection volume that is contributed by the approach or exit. The four approach percentages will always add up to 100 percent, as will the four exit percentages. These values are useful in determining the percent of turning volume for a given approach or the directional distribution of arriving and departing traffic.

The following is an example of the Display of Intersection Volumes report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - Display of Intersection Volumes**



## TEAPAC - Plot of Traffic Counts

The Plot of Traffic Counts report, generated using the COUNTGRAPH command, displays a graphical plot of the total intersection count for each 15-minute interval counted. The horizontal scale of the report is either entered manually or generated automatically to accommodate the largest 15-minute intersection count, and has the units of vehicles counted in each fifteen-minute period. If a count exceeds a manually entered scale maximum, that count is plotted off the scale to the right. All counts include any trucks which have been entered.

The vertical axis of the plot displays the beginning time of each 15-minute period plotted and the total number of vehicles counted during that period.

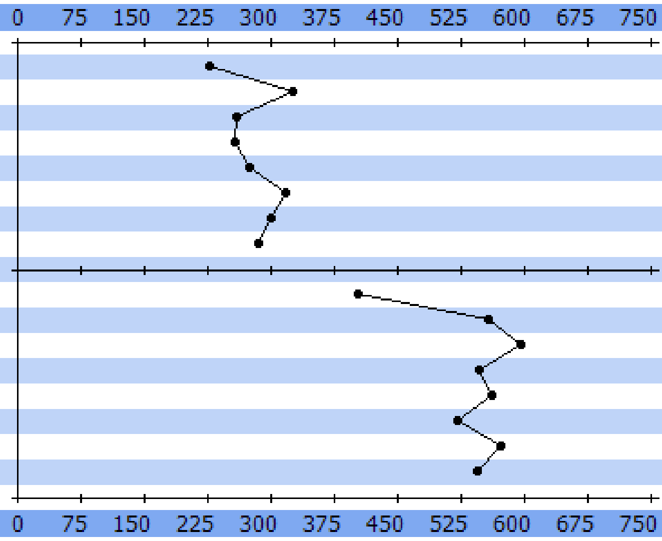
The following is an example of the Plot of Traffic Counts report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - Plot of Traffic Counts**

Intersection # 16 Lincoln Avenue & Main Street

| Begin Time | Int Count |
|---|---|
| 700 | 225 |
| 715 | 325 |
| 730 | 259 |
| 745 | 257 |
| 800 | 274 |
| 815 | 315 |
| 830 | 299 |
| 845 | 283 |
| 1600 | 402 |
| 1615 | 556 |
| 1630 | 595 |
| 1645 | 545 |
| 1700 | 560 |
| 1715 | 519 |
| 1730 | 572 |
| 1745 | 544 |



## TEAPAC - MUTCD Warrant Analysis

The MUTCD Warrant Analysis report, generated by the WARRANTS command, displays the basic intersection conditions for the warrant analysis, followed by a warrant analysis for each of the volume-oriented warrants of the *Manual on Uniform Traffic Control Devices* (MUTCD) for signal control and multi-way stop control. These include Warrants 1A, 1B, 1C, 2, 3A, 3B and 7 for a 2000 MUTCD signal analysis, Warrants 1, 2, 6, 8, 9, 10 & 11 for a 1988 MUTCD signal analysis, and Warrants A, B, C & D for a 2000 MUTCD multi-way stop analysis. The warrant analysis is divided into sections, as described below.

**Conditions Used for Warrant Analysis.** The first section of the warrant analysis lists the MUTCD version used for the analysis and the intersection conditions used to conduct the warrant analysis, apart from the actual traffic count data. These include the major street direction, number of lanes, high approach speed on major street, low population, effects on progression, trials of other remedies, number of accidents and minor street delay. Each of these are detailed clearly in the table, and follow the definitions provided in the MUTCD.

### Warrant Analysis for Traffic Signal

**Warrant 1A Analysis.** This is the 8-Hour Minimum Vehicular Volume warrant. For the given conditions, the warrant levels which are required for the minor and major volumes are listed in the last column along with the 8-hour requirement which is needed. In the first section, the minor and major volumes for the eight highest hours which are found are listed in rank order from left to right according to the minor street volume, with the last row stating whether these volumes meet the warrants. The last section of the table totals the number of hours meeting the warrant, identifies if a signal will not seriously disrupt progression, and states whether the warrant is met.

**Warrant 1B Analysis.** This is the 8-Hour Interruption of Continuous Traffic warrant. For the given conditions, the warrant levels which are required for the minor and major volumes are listed in the last column along with the 8-hour requirement which is needed. In the first section, the minor and major volumes for the eight highest hours which are found are listed in rank order from left to right according to the minor street volume, with the last row stating whether these volumes meet the warrants. The last section of the table totals the number of hours meeting the warrant, identifies if a signal will not seriously disrupt progression, and states whether the warrant is met.

**Warrant 1A Analysis (80%).** This is the 8-Hour Minimum Vehicular Volume warrant, evaluated at the 80% level for Warrants 1C and 7. For the given conditions, the warrant levels which are required for the minor and major volumes are listed in the last column along with the 8-hour requirement which is needed. In the first section, the minor and major volumes for the eight highest hours which are found are listed in rank order from left to right according to the minor street volume, with the last row stating whether these volumes meet the warrants. The last section of the table totals the number of hours meeting the warrant at the 80% level.

**Warrant 1B Analysis (80%).** This is the 8-Hour Interruption of Continuous Traffic warrant evaluated at the 80% level for Warrants 1C and 7. For the given conditions, the warrant levels which are required for the minor and major volumes are listed in the last column along with the 8-hour requirement which is needed. In the first section, the minor and major volumes for the eight highest hours which are found are listed in rank order from left to right according to the minor street volume, with the last row stating whether these volumes meet the warrants. The last section of the table totals the number of hours meeting the warrant at the 80% level.

**Warrant 1C Analysis.** This is the 8-Hour Combination of Warrants warrant. This table identifies whether 80% of Warrant 1A and 1B is met, if a signal will not seriously disrupt progression, and whether trials of other remedies have failed to improve the situation. The bottom line states whether the warrant is met.

**Warrant 2 Analysis.** This is the 4-Hour Vehicular Volume warrant. For the given conditions, each major street volume is used to determine the requirement for the minor street volume. In the first section, both the minor street volume and requirement are shown with the last row stating whether these volumes meet the warrants. The last column shows the 4-hour requirement which is needed. The last section of the table totals the number of hours meeting the warrant, identifies if a signal will not seriously disrupt progression, and states whether the warrant is met.

**Warrant 3A Analysis.** This is the Peak Hour Delay warrant. For the given conditions, the warrant levels which are required for the minor and major volumes are listed in the last column along with the 1-hour requirement which is needed. In the first section, the minor and major volumes for the eight highest hours which are found are listed in rank order from left to right according to the minor street volume, with the last row stating whether these volumes meet the warrants. The last section of the table totals the number of hours meeting the warrant, identifies if a signal will not seriously disrupt progression, identifies the total stop sign delay (and the requirement of 4 hours), and states whether the warrant is met.

**Warrant 3B Analysis.** This is the Peak Hour Volume warrant. For the given conditions, each major street volume is used to determine the requirement for the minor street volume. In the first section, both the minor street volume and requirement are shown with the last row stating whether these volumes meet the warrants. The last column shows the 1-hour requirement which is needed. The last section of the table totals the number of hours meeting the warrant, identifies if a signal will not seriously disrupt progression, and states whether the warrant is met.

**Warrant 7 Analysis.** This is the Crash Experience warrant. This table identifies whether 80% of Warrant 1A or 1B is met, if a signal will not seriously disrupt progression, whether trials of other remedies have failed to reduce accidents, and the number of accidents which are correctable by a signal. The required number of accidents (5) is shown, and the bottom line states whether the warrant is met.

**Signal Warrant Analysis Summary.** This is a summary of all the warrants checked for the signal warrant analysis. It shows the name and number of each warrant checked and the status of that warrant check, either MET or NOT MET. The last line of the table indicates that the signal warrant is MET if any of the listed warrants are MET; it indicates that the signal warrant is NOT MET if all of the listed warrants are NOT MET.

## Warrant Analysis for Multi-way Stop

**Warrant A Analysis.** This is the Interim Measure for Signal warrant. If a signal warrant was conducted as part of the Warrant Analysis report and that analysis indicated that a signal is warranted, this table indicates that a multi-way stop is warranted as a temporary measure until the signal can be installed. If the signal analysis indicated that a signal is not warranted, this table indicates that an interim multi-way stop is not warranted. If this Warrant Analysis report did not include a signal warrant analysis, this table is omitted from the multi-way stop results.

**Warrant B Analysis.** This is the Crash Experience warrant. This table identifies the number of accidents which are correctable by a multi-way stop. The required number of accidents (5) is shown, and the bottom line states whether the warrant is met.

**Warrant C Analysis.** This is the 8-Hour Minimum Vehicular Volume warrant. For the given conditions, the warrant levels which are required for the minor and major volumes are listed in the last column along with the 8-hour requirement which is needed. In the first section, the minor and major volumes for the eight highest hours which are found are listed in rank order from left to right according to the minor street volume, with the last row stating whether these volumes meet the warrants. The last section of the table totals the number of hours meeting the warrant, identifies the delay for all minor approaches and the required amount of delay (30 sec/veh), and states whether the warrant is met.

**Warrant D Analysis.** This is the 8-Hour Combination of Warrants warrant. This table identifies whether 80% of Warrant C is met, using the same table format as C above. It also identifies the Warrant B number of accidents which are correctable by a multi-way stop and the 80% required number of accidents (4), and the Warrant C delay for all minor approaches and the 80% required amount of delay (24 sec/veh). The bottom line states whether the warrant is met.

**Multi-way Stop Warrant Analysis Summary.** This is a summary of all the warrants checked for the multi-way stop warrant analysis. It shows the name and number of each warrant checked and the status of that warrant check, either MET or NOT MET. The last line of the table indicates that the multi-way stop warrant is MET if any of the listed warrants are MET; it indicates that the multi-way stop warrant is NOT MET if all of the listed warrants are NOT MET.

The following is an example of the MUTCD Warrant Analysis report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

## TEAPAC[Ver 8.00.00] - MUTCD Warrant Analysis

| Conditions Used for Warrant Analysis | 2003 MUTCD |
|---|---|
| Intersection # 16 Lincoln Avenue & Main Street | |
| Major Street Direction | NorthSouth |
| Number of Lanes in North-South direction | 1 |
| Number of Lanes in East-West direction | 1 |
| Approach speed on major street is greater than 40 mph | No |
| Isolated community has population less than 10,000 | No |
| Signal will not seriously disrupt progressive traffic flow | Yes |
| Trials of other remedies have failed to improve conditions | No |
| Number of accidents correctable by a signal | 2 |
| Peak hour stop sign delay for worst minor approach (veh-hours) | 7 |
| Number of accidents correctable by a multi-way stop | 8 |
| Peak hour average delay for all minor approaches (sec/veh) | 27 |

## TEAPAC[Ver 8.00.00] - Warrant Analysis for Traffic Signal

Warrant 1A Analysis - 8-Hour Minimum Vehicular Volume

| Start Time | 1645 | 1545 | 715 | 815 | 1745 | 615 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 726 | 511 | 493 | 365 | 168 | 104 | 0 | 0 | 150 |
| Major Volume | 851 | 606 | 355 | 332 | 232 | 83 | 0 | 0 | 500 |
| Warrant Met? | Yes | Yes | No | No | No | No | No | No | 8 |

| | |
|---|---|
| Number of 1-hour periods meeting the warrant | 2 |
| Signal will not seriously disrupt progressive traffic flow | Yes |

>> WARRANT 1A IS NOT MET <<

Warrant 1B Analysis - 8-Hour Interruption of Continuous Traffic

| Start Time | 1600 | 1700 | 715 | 815 | 615 | 0 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 711 | 694 | 493 | 365 | 104 | 0 | 0 | 0 | 75 |
| Major Volume | 821 | 868 | 355 | 332 | 83 | 0 | 0 | 0 | 750 |
| Warrant Met? | Yes | Yes | No | No | No | No | No | No | 8 |

| | |
|---|---|
| Number of 1-hour periods meeting the warrant | 2 |
| Signal will not seriously disrupt progressive traffic flow | Yes |

>> WARRANT 1B IS NOT MET <<

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - Warrant Analysis for Traffic Signal**

Warrant 1A Analysis (80%) - 8-Hour Minimum Vehicular Volume

| Start Time | 1645 | 1545 | 800 | 700 | 1745 | 0 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 726 | 511 | 480 | 482 | 168 | 0 | 0 | 0 | 120 |
| Major Volume | 851 | 606 | 427 | 343 | 232 | 0 | 0 | 0 | 400 |
| Warrant Met? | Yes | Yes | Yes | No | No | No | No | No | 8 |

Number of 1-hour periods meeting the warrant 3

Warrant 1B Analysis (80%) - 8-Hour Interruption of Continuous Traf

| Start Time | 1645 | 1545 | 715 | 815 | 1745 | 615 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 726 | 511 | 493 | 365 | 168 | 104 | 0 | 0 | 60 |
| Major Volume | 851 | 606 | 355 | 332 | 232 | 83 | 0 | 0 | 600 |
| Warrant Met? | Yes | Yes | No | No | No | No | No | No | 8 |

Number of 1-hour periods meeting the warrant 2

Warrant 1C Analysis - 8-Hour Combination of Warrants

| | |
|---|---|
| 80% of Warrants 1A and 1B are met | No |
| Signal will not seriously disrupt progressive traffic flow | Yes |
| Trials of other remedies have failed to reduce delays | No |

>> WARRANT 1C IS NOT MET <<

Warrant 2 Analysis - 4-Hour Vehicular Volume

| Start Time | 1645 | 1545 | 745 | 645 | 1745 | 845 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 726 | 511 | 458 | 380 | 168 | 124 | 0 | 0 | —— |
| Minor Reqrmt | 140 | 213 | 305 | 362 | 381 | 441 | 485 | 485 | <-- |
| Warrant Met? | Yes | Yes | Yes | Yes | No | No | No | No | 4 |

| | |
|---|---|
| Number of 1-hour periods meeting the warrant | 4 |
| Signal will not seriously disrupt progressive traffic flow | Yes |

>> WARRANT 2 IS MET <<

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - Warrant Analysis for Traffic Signal**

Warrant 3A Analysis - Peak Hour Delay

| Start Time | 1630 | 745 | 645 | 1730 | 1530 | 845 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 764 | 458 | 380 | 340 | 301 | 124 | 0 | 0 | 100 |
| Total Volume | 2219 | 1145 | 809 | 1116 | 958 | 283 | 0 | 0 | 800 |
| Warrant Met? | Yes | Yes | Yes | Yes | Yes | No | No | No | 1 |

| | |
|---|---|
| Number of 1-hour periods meeting the warrant | 5 |
| Signal will not seriously disrupt progressive traffic flow | Yes |
| Delay for worst minor approach (must be at least 4 veh-hours) | 7 |

>> WARRANT 3A IS MET <<

Warrant 3B Analysis - Peak Hour Volume

| Start Time | 1645 | 1545 | 715 | 815 | 1745 | 615 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 726 | 511 | 493 | 365 | 168 | 104 | 0 | 0 | —— |
| Minor Reqrmt | 257 | 367 | 480 | 491 | 536 | 603 | 640 | 640 | <-- |
| Warrant Met? | Yes | Yes | Yes | No | No | No | No | No | 1 |

| | |
|---|---|
| Number of 1-hour periods meeting the warrant | 3 |
| Signal will not seriously disrupt progressive traffic flow | Yes |

>> WARRANT 3B IS MET <<

Warrant 7 Analysis - Crash Experience

| | |
|---|---|
| 80% of Warrant 1A or 1B is met | No |
| Signal will not seriously disrupt progressive traffic flow | Yes |
| Trials of other remedies have failed to reduce accidents | No |
| Number of correctable accidents (must be 5 or more per year) | 2 |

>> WARRANT 7 IS NOT MET <<

Summary of MUTCD Traffic Signal Warrant Analysis

| | |
|---|---|
| Warrant 1A 8-Hour Minimum Vehicular Volume | NOT MET |
| Warrant 1B 8-Hour Interruption of Continuous Traffic | NOT MET |
| Warrant 1C 8-Hour Combination of Warrants | NOT MET |
| Warrant 2 4-Hour Vehicular Volume | MET |
| Warrant 3A Peak Hour Delay | MET |
| Warrant 3B Peak Hour Volume | MET |
| Warrant 7 Crash Experience | NOT MET |

>> Traffic Signal Warrant is MET <<

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - Warrant Analysis for Multi-way Stop**

Warrant A Analysis - Interim Measure for Signal

If signal warrants are met, a temporary multi-way stop is allowed

>> WARRANT A IS MET <<

Warrant B Analysis - Crash Experience

Number of correctable accidents (must be 5 or more per year) 8

>> WARRANT B IS MET <<

Warrant C Analysis - 8-Hour Minimum Vehicular Volume

| Start Time | 1630 | 800 | 700 | 1730 | 1530 | 0 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 1385 | 744 | 723 | 644 | 575 | 0 | 0 | 0 | 200 |
| Major Volume | 834 | 427 | 343 | 472 | 383 | 0 | 0 | 0 | 300 |
| Warrant Met? | Yes | Yes | Yes | Yes | Yes | No | No | No | 8 |

| | |
|---|---|
| Average minor volume for 8 highest minor hours | 509 |
| Average major volume for 8 highest minor hours | 307 |
| Delay for all minor approaches (must be at least 30 sec/veh) | 27 |

>> WARRANT C IS NOT MET <<

Warrant D Analysis - 8-Hour Combination of Warrants

| Start Time | 1630 | 745 | 1730 | 1530 | 645 | 845 | 0 | 0 | Req. |
|---|---|---|---|---|---|---|---|---|---|
| Minor Volume | 1385 | 746 | 644 | 575 | 535 | 186 | 0 | 0 | 160 |
| Major Volume | 834 | 399 | 472 | 383 | 274 | 97 | 0 | 0 | 240 |
| Warrant Met? | Yes | Yes | Yes | Yes | Yes | No | No | No | 8 |

| | |
|---|---|
| Average minor volume for 8 highest minor hours | 509 |
| Average major volume for 8 highest minor hours | 307 |
| Number of correctable accidents (must be 4 or more per year) | 8 |
| Delay for all minor approaches (must be at least 24 sec/veh) | 27 |

>> WARRANT D IS MET <<

Summary of MUTCD Multi-way Stop Warrant Analysis

| | |
|---|---|
| Warrant A Interim Measure for Signal | MET |
| Warrant B Crash Experience | MET |
| Warrant C 8-Hour Minimum Vehicular Volume | NOT MET |
| Warrant D 8-Hour Combination of Warrants | MET |

>> Multi-way Stop Warrant is MET <<

## TEAPAC - Imported IMC Count Data

The Imported IMC Count Data report, generated by the COUNTIMPORT command, displays the equivalent TEAPAC commands which are generated and entered into the TEAPAC program when the COUNTIMPORT process is executed. This includes the PROJECT, DESCRIPTION and NOTE commands to identify the count data, the COUNTTYPE and PERIODS commands to set up the type of count, and appropriate VEHICLECOUNTS (and TRUCKCOUNTS) commands to enter the actual count data.

The following is an example of the Imported IMC Count Data report using the Traffic-Count-Analysis.tpc sample data file.

Turning Movement Count Study
Lincoln Avenue & Main Street
Counts on January 1, 2004

**TEAPAC[Ver 8.00.00] - Imported Count Data**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROJECT | IMC Data | | | | | | | | | | | | |
| DESCRIPTION | Lincoln Avenue & Main Street | | | | | | | | | | | | |
| NOTE | 04-25-93 @ 0700 hrs | | | | | | | | | | | | |
| INTERSECTION | 16 Lincoln Avenue & Main Street | | | | | | | | | | | | |
| COUNTTYPE | REDUCED SEPARATE IMC Data: 04-25-93 @ 0700 hrs | | | | | | | | | | | | |
| PERIODS | 15 | 700 | 1745 | | | | | | | | | | |
| VCOUNT | 700 | 21 | 12 | 17 | 23 | 43 | 20 | 7 | 6 | 2 | 4 | 21 | 7 |
| VCOUNT | 715 | 30 | 21 | 17 | 10 | 94 | 26 | 4 | 6 | 3 | 6 | 41 | 10 |
| VCOUNT | 730 | 25 | 17 | 11 | 11 | 58 | 16 | 12 | 3 | 1 | 8 | 26 | 4 |
| VCOUNT | 745 | 13 | 13 | 14 | 9 | 60 | 15 | 9 | 5 | 0 | 7 | 39 | 15 |
| VCOUNT | 800 | 17 | 23 | 22 | 9 | 53 | 33 | 6 | 6 | 0 | 8 | 30 | 14 |
| VCOUNT | 815 | 27 | 16 | 23 | 14 | 81 | 23 | 8 | 10 | 3 | 9 | 32 | 7 |
| VCOUNT | 830 | 23 | 18 | 16 | 6 | 51 | 18 | 12 | 13 | 6 | 3 | 40 | 19 |
| VCOUNT | 845 | 31 | 14 | 13 | 15 | 52 | 27 | 12 | 6 | 4 | 7 | 40 | 7 |
| VCOUNT | 900 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 915 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 930 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 945 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1045 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1215 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1230 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1245 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1315 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1330 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1345 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1400 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1415 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1430 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1445 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1515 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1530 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1545 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VCOUNT | 1600 | 30 | 30 | 20 | 7 | 52 | 35 | 57 | 11 | 8 | 4 | 64 | 14 |
| VCOUNT | 1615 | 45 | 28 | 20 | 4 | 73 | 49 | 37 | 20 | 11 | 9 | 118 | 33 |
| VCOUNT | 1630 | 44 | 17 | 28 | 15 | 65 | 45 | 38 | 25 | 14 | 18 | 97 | 46 |
| VCOUNT | 1645 | 45 | 37 | 28 | 5 | 70 | 34 | 42 | 11 | 8 | 17 | 113 | 27 |
| VCOUNT | 1700 | 33 | 45 | 29 | 16 | 80 | 40 | 34 | 6 | 15 | 9 | 120 | 33 |
| VCOUNT | 1715 | 31 | 34 | 19 | 11 | 84 | 42 | 41 | 23 | 6 | 8 | 83 | 45 |
| VCOUNT | 1730 | 57 | 39 | 36 | 9 | 64 | 61 | 34 | 14 | 8 | 7 | 107 | 24 |
| VCOUNT | 1745 | 31 | 40 | 36 | 19 | 63 | 31 | 46 | 13 | 19 | 12 | 102 | 24 |
| RETURN | | | | | | | | | | | | | |

## Appendix D Topics (for Progression Analysis):

# TEAPAC - Summary of Parameter Values (PRG)

The Summary of Parameter Values (PRG) report, generated using the SUMMARIZEcommand, is a summary of all the data pertinent to the analysis of a signal system for linear arterial progression. The parameters are discussed below by the groups in which they appear.

## System Parameters

This section describes those variables which relate to the entire arterial system.

**Number of Intersections**. The total number of intersections in the arterial system being studied.

**Base Intersection and Offset.** This intersection has a fixed offset and what that fixed offset value is, in percent. Other intersections in the system have their offsets adjusted so that they relate properly to this offset value.

**Common Clearance Interval.** The clearance interval, in seconds, which is used at the end of every main-street through green phase.

**One-way or Two-way Operation.** Defines whether the system operates with a one-way or two-way progression. One-way progression is always from left-to-right.

**Units of Inputs.** Defines the units of the speed and distance inputs, either english or metric.

## Link/Node Parameters

This section describes the input variables which apply to each of the links and nodes of the system.

**Node Name and Number.** The name and number of the intersection whose data appears on that line of the summary report.

**Link Distance.** The distance, in feet or meters, from the intersection on this line to the next intersection.

**Progression Speeds.** The progression speeds, in mph or kmph, from this intersection to the next and from the next intersection to this one.

**Through Splits.** The phase time, in percent, for through traffic in both directions at this intersection.

**All-red Period.** The time, in seconds, at the end of the main street through phase, which is red for traffic in all directions.

**Use of Available Lead/Lag.** Defines which directions of flow on the arterial at this intersection should use any time which is available for lead or lag left turn phases.

**Lead/Lag Time.** The amount of time, in seconds, to be used for lead or lag left turn phases in each direction at the intersection.

**Offsets.** The system offset value, in percent, for the main street through phase at this intersection.

**Non-concurrent.** Defines whether non-concurrent (split phase) operation is used at the intersection.

## Design Parameters

This section describes those variables which control the optimization of offsets.

**Cycle Range.** The range and increment of cycle lengths, in seconds, to be used in the cycle optimization for the arterial. The first value is the lowest cycle to use, the second value is the highest value, and the third is the increment of cycle length used to step from the lowest to the highest value.

**Speed Tolerance.** The allowed speed variation, in percent, above and below the input link speeds, and the increment of speed, in mph or kmph, used to step away from the input link speeds up to that tolerance value.

**Band Ratio.** The desired ratio of the left-right band versus the right-left band to provide improved progression in one direction at the expense of the other direction.

**Speed Adjustment Factor.** The factor by which input link speeds will be adjusted before the offset optimization is performed.

**Fine Tune Option.** Defines whether the final solution should be refined to achieve more precise results.

The following is an example of the Summary of Parameter Values (PRG) report using the Progression-Analysis.tpc sample data file.

Sample Route Design Study
Lincoln Street - First to Third
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.00.00] - Summary of Parameter Values (PRG)

### System Parameters

| | | |
|---|---|---|
| Number of Intersections in System | 6 | |
| Base Intersection (#) & Offset (%) | 1 | 0.0 |
| Common Clearance Time (sec) | 3.0 | |
| One/Two-Way Progression | TWOWAY | |
| English/Metric Units | ENGLISH | |

### Link/Node Parameters

| | | | Speeds | | | | | LeadLag | | Offsets | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | # | Dist | LR | RL | Split | ARed | Avail | LR | RL | LR | RL | NCn |
| 1st | 1 | 2130 | 35.0 | 35.0 | 59.0 | 0.0 | NONE | 0.0 | 0.0 | 0.0 | 0.0 | NO |
| 2nd | 2 | 870 | 35.0 | 35.0 | 68.0 | 0.0 | NONE | 0.0 | 0.0 | 45.5 | 45.5 | NO |
| 3rd | 3 | 1180 | 35.0 | 35.0 | 64.0 | 0.0 | NONE | 0.0 | 0.0 | 47.5 | 47.5 | NO |
| 4th | 4 | 1930 | 35.0 | 35.0 | 68.0 | 0.0 | NONE | 0.0 | 0.0 | 95.5 | 95.5 | NO |
| 5th | 5 | 640 | 35.0 | 35.0 | 82.0 | 0.0 | NONE | 0.0 | 0.0 | 38.5 | 38.5 | NO |
| 6th | 6 | 0 | 0.0 | 0.0 | 74.0 | 0.0 | NONE | 0.0 | 0.0 | 42.5 | 42.5 | NO |

### Design Parameters

| | | | |
|---|---|---|---|
| Cycle Range and Increment (sec) | 60.0 | 120.0 | 10.0 |
| Speed Tolerance (%) & Increment (mph) | 0.0 | 0.0 | |
| Desired Band Ratio (LR/RL) | 1.00 | | |
| Speed Adjustment Factor | 1.000 | | |
| Finetune Optimization | NO | | |

## TEAPAC - Table of Efficiency versus Speed & Cycle

The Table of Efficiency versus Speed & Cycle report is generated during a PROGRESSION when a range of design speeds is provided using the PRG-TOLERANCE command. Each cycle length is tested for the design speed range specified. The resulting efficiency matrix shows the percent of the smallest split in the system that is available to the through band progression.

**Tolerance.** This indicates the maximum tolerance, in percent, that the design speed may vary. This percentage value is applied above and below the desired progression speed.

**Speed Adjustment Factors.** This row of numbers indicates the factors that are applied to the desired progression speeds. The factors are shown multiplied by 1000 (i.e., 1000 indicates a factor of 1.000 or no adjustment to the desired speeds).

**Link.** This indicates the link associated with the speed data shown to the right. The link is represented by the two intersection numbers at each end of the link, separated by a slash. In the example, "1/2" indicates the link between intersections 1 and 2. If the speed data for several adjacent links is identical, four dots will appear as "....".

**Mean Link Speeds.** These are the average two-way progression speeds that are assumed on each link, adjusted by the speed adjustment factors appearing at the top of the column the speed is found in.

**Charscale.** The character scale density plot appears to the left of the efficiency matrix. Each character in the Charscale corresponds to an efficiency value in the efficiency matrix. The charscale is designed such that the less dense the character (i.e., a period or a colon) the higher the efficiency. Each character shown is an increment of ten percent, with a blank corresponding to 100 percent, a period 90 to 99 percent, etc. The characters used for the charscale is listed in descending order above the density plot.

**Cycle Length.** The cycle length, in seconds, is listed for each cycle tested.

**Band Efficiencies.** This matrix of efficiencies (in percent of the smallest split) lists the two-way through band percentage for each of the cycle and speed combinations being optimized. An asterisk (*) next to an efficiency indicates that it is the highest efficiency for the cycle length in that row.

The following is an example of the Table of Efficiencies report using the Progression-Analysis.tpc sample data file.

Sample Route Design Study
Lincoln Street - First to Third
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.00.00] - Table of Efficiency versus Speed & Cycle

| | %Tol | Speed Adjustment Factors (x 1000) | | |
|---|---|---|---|---|
| | 5.0 | 971 | 1000 | 1029 |

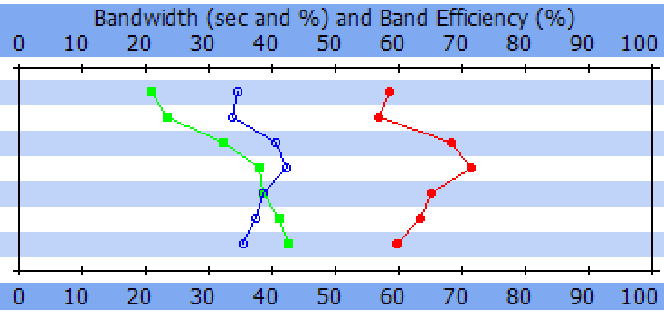
| | Link | Mean Link Speeds | | |
|---|---|---|---|---|
| | 1/ 2 | 34.0 | 35.0 | 36.0 |
| | .. .. | | | |

| Charscal: .:\|+ITXHMO | Cyc | Band Efficiencies (percent of smallest split) | | |
|---|---|---|---|---|
| III | 60* | 58.4 | 58.4 | 54.0 |
| III | 70 | 53.6 | 55.1* | 56.7 |
| +++ | 80 | 61.2 | 64.2* | 68.2 |
| \|++ | 90* | 71.3 | 67.5 | 64.5 |
| +++ | 100 | 60.9 | 62.6* | 65.0 |
| +II | 110* | 63.3 | 59.3 | 55.3 |
| III | 120 | 56.5 | 58.7* | 59.7 |

## TEAPAC[Ver 8.00.00] - Graph of Efficiency versus Cycle

| Cycle (sec) | Speed Factr (-) | Opt Effic (%) | Cycle (sec) |
|---|---|---|---|
| 60 | 0.971 | 58.4 | 60 |
| 70 | 1.029 | 56.7 | 70 |
| 80 | 1.029 | 68.2 | 80 |
| 90 | 0.971 | 71.3 | 90 |
| 100 | 1.029 | 65.0 | 100 |
| 110 | 0.971 | 63.3 | 110 |
| 120 | 1.029 | 59.7 | 120 |
| 90 | 0.971 | 71.3 | 90 |

Bandwidth (sec and %) and Band Efficiency (%)




Key: Bandwidth (sec) Bandwidth (%) Band Efficiency (%)

## TEAPAC[Ver 8.00.00] - Optimum Progression Data

| | |
|---|---|
| Cycle Length | = 90.0 sec |
| Speed Factor | = 0.971 = 971 / 1000 |
| Band Left-Right | = 37.8 sec = 42.1 % of cycle |
| Band Right-Left | = 37.8 sec = 42.1 % of cycle |
| Band Ratio | = 1.00 LR/RL (1.00 desired) |
| Efficiency | = 71.3 % of smallest split |

## TEAPAC - Graph of Efficiency versus Cycle

The Graph of Efficiency versus Cycle report is generated using the PROGRESSION command when a range of cycle lengths is provided by the PRG-CYCLES command. The efficiency plotted is the bandwidth as a percentage of the smallest split in the system. If a range of design speeds is used in the analysis, this table will be preceded by the Table of Efficiency versus Speed & Cycle report described previously.

### Graph of Efficiency versus Cycle

The graph plots the highest efficiency, in percent of the smallest bandwidth, achieved for each cycle length tested. When a range of design speeds is provided, the plot will indicate the speed factor used to achieve the best efficiency and the graph point is for this best speed. This graph is a useful tool in determining which cycle lengths maximize the progression, as well as how each cycle compares to the others in terms of the progression quality.

**Cycle Length.** The cycle length, in seconds, for which the graphed efficiency applies.

**Speed Factor.** The speed adjustment factor which, when multiplied by the input progression speed, produced the most efficient progression for the given cycle length.

**Optimum Efficiency.** This column displays the best efficiency which resulted for all the speeds tested at the given cycle length. This value is presented as the percentage of the smallest split in the system which is used by the equal-maximum, two-way progression bands. This is the primary value plotted in the body of the graph to the right.

**Bandwidth and Band Efficiency.** The body of the graph displays the optimum progression efficiency for each cycle length three different ways. The optimum efficiency described above (percent of smallest split) is plotted using the asterisk character "*". This is the primary evaluation parameter for the graph. This optimum bandwidth is also displayed in seconds using the period character "." and in percent of cycle using the plus character "+". These additional plots are useful in verifying that what appears to be a good efficiency is actually usable. For example, a band width of less than 10 seconds is probably not very practical, and the bandwidth percentage of cycle length is related to the probability of through vehicles actually getting into the progression band.

### Optimum Progression Data

The Optimum Progression Data displays the basic information about the optimum design created by TEAPAC. This includes the cycle length, design speed and bandwidth information. Additional reports document the details of how this progressive solution is achieved.

**Cycle Length.** This is the cycle length that was used for the design of the linear system. When this report immediately follows the Table or Graph of Efficiencies report, the cycle length is the optimum cycle length from the range of tested cycles.

**Speed Factor.** This is the factor that was used as a multiplier for the desired progression speeds to obtain the speeds used in the optimum progression for the cycle length analyzed. When this report immediately follows the Table or Graph of Efficiencies report, the speed factor is the one which produced the best progression for the cycle length from the range of tested speeds. The speed factor is shown both as the direct multiplier, as well as the multiplier x1000 which is used in the Table of Efficiencies report.

**Band Left-Right.** The width of the through band progressing from the left to the right, given in seconds and in percent of the cycle.

**Band Right-Left.** The width of the through band progressing from the right to the left, given in seconds and in percent of the cycle.

**Band Ratio.** The ratio of the actual optimized band width from left-to-right compared to the band width from right-to-left. The desired ratio is shown in parentheses.

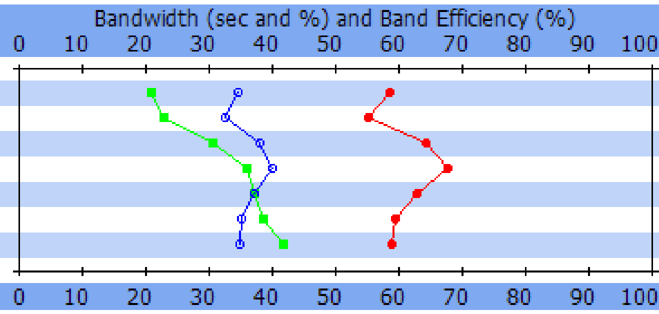
**Efficiency.** The two-way maximum bandwidth (before the band ratio is applied) expressed as a percentage of the smallest through split in the system. This means that an efficiency of 100% indicates that all of the smallest through split is being used for two-way through traffic progression (in which case this smallest through split must be increased in order to improve the progression).

The following is an example of the Graph of Efficiency versus Cycle report using the Progression-Analysis.tpc sample data file.

Sample Route Design Study
Lincoln Street - First to Third
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.00.00] - Graph of Efficiency versus Cycle

| Cycle (sec) | Speed Factr (-) | Opt Effic (%) | Cycle (sec) |
|---|---|---|---|
| 60 | 1.000 | 58.4 | 60 |
| 70 | 1.000 | 55.1 | 70 |
| 80 | 1.000 | 64.2 | 80 |
| 90 | 1.000 | 67.5 | 90 |
| 100 | 1.000 | 62.6 | 100 |
| 110 | 1.000 | 59.3 | 110 |
| 120 | 1.000 | 58.7 | 120 |
| 90 | 1.000 | 67.5 | 90 |




Key: Bandwidth (sec) Bandwidth (%) Band Efficiency (%)

## TEAPAC[Ver 8.00.00] - Optimum Progression Data

| | |
|---|---|
| Cycle Length | = 90.0 sec |
| Speed Factor | = 1.000 = 1000 / 1000 |
| Band Left-Right | = 35.9 sec = 39.8 % of cycle |
| Band Right-Left | = 35.9 sec = 39.8 % of cycle |
| Band Ratio | = 1.00 LR/RL (1.00 desired) |
| Efficiency | = 67.5 % of smallest split |

# TEAPAC - Optimum Progression Data

The Optimum Progression Data report, generated using the PROGRESSION command, provides all the information pertaining to the optimum operation of a linear signal system. This report is only produced when there is only one speed and cycle combination being analyzed. The following describes each of the sections of the report.

## Optimum Progression Data

The Optimum Progression Data displays the basic information about the optimum design created by TEAPAC. This includes the cycle length, design speed and bandwidth information. Additional reports document the details of how this progressive solution is achieved.

**Cycle Length.** This is the cycle length that was used for the design of the linear system. When this report immediately follows the Table or Graph of Efficiencies report, the cycle length is the optimum cycle length from the range of tested cycles.

**Speed Factor.** This is the factor that was used as a multiplier for the desired progression speeds to obtain the speeds used in the optimum progression for the cycle length analyzed. When this report immediately follows the Table or Graph of Efficiencies report, the speed factor is the one which produced the best progression for the cycle length from the range of tested speeds. The speed factor is shown both as the direct multiplier, as well as the multiplier x1000 which is used in the Table of Efficiencies report.

**Band Left-Right.** The width of the through band progressing from the left to the right, given in seconds and in percent of the cycle.

**Band Right-Left.** The width of the through band progressing from the right to the left, given in seconds and in percent of the cycle.

**Band Ratio.** The ratio of the actual optimized band width from left-to-right compared to the band width from right-to-left. The desired ratio is shown in parentheses.

**Efficiency.** The two-way maximum bandwidth (before the band ratio is applied) expressed as a percentage of the smallest through split in the system. This means that an efficiency of 100% indicates that all of the smallest through split is being used for two-way through traffic progression (in which case this smallest through split must be increased in order to improve the progression).

## Optimum Main Street Offsets

These are the optimum offsets for each intersection which progress traffic through the system most efficiently for the conditions given. These values include the offset to the beginning of main street green (green for both directions) as well as the offset to the green, yellow and red intervals for the through phase in each direction on the main street. All offsets are given in percent of cycle.

**Intersection No. & Name.** This is the sequence number and name of each intersection in the system.

**Through Phase - Begin Thru.** This is the latest offset of both the left-to-right and right-to-left through phases for a given intersection. This offset represents the point when the through green turns green for both directions of traffic on the main street.

**Through Phase Left-to-Right - Grn, Yel & Red.** The offsets to the beginning of the green, yellow and red intervals for the left-to-right through phase.

**Through Phase Right-to-Left - Grn, Yel & Red.** The offsets to the beginning of the green, yellow and red intervals for the right-to-left through phase.

## Optimum Through-Band Offsets

These are the offsets of the through band at each intersection which progress traffic through the system most efficiently for the conditions given. These values include the offset to the beginning and end of the band in both directions. All offsets are given in percent of cycle.

**Intersection No. & Name.** This is the sequence number and name of each intersection in the system.

**Through Band Left-to-Right - BEG & END.** Indicates the beginning and end, in percent, of the optimized through band moving left to right.

**Through Band Right-to-Left - BEG & END.** Indicates the beginning and end, in percent, of the optimized through band moving right to left.

## Split Timings

This section displays the green time for the progressive through phase, both in percent of cycle and in seconds. In addition, it summarizes the red time and all-red time (in seconds) experienced by through vehicles traveling in each direction on the arterial. The smallest green time of all intersections which is available to the progressive movement is indicated by an asterisk "*". This is the split which is used to define the system efficiency.

**Intersection No. & Name.** This is the sequence number and name of each intersection in the system.

**Through-Phase (w/yellow+AR).** This is the through split, in percent of cycle and in seconds, given at each intersection, including any lead or lag left turn phase time in either direction as well as the yellow and all-red clearance time. The input percentage split is converted to seconds for the cycle length which is used. An asterisk (*) indicates the intersection with the smallest percent used for calculating the progression efficiency.

**Through-Red (w/AR).** This is the time, in seconds, which through traffic in each direction experience as red time, including the all-red interval which is specified separately.

**All-Red.** This is the all-red time, in seconds, specified for each intersection, and included in the Through-Phase and Through-Red times described above.

## Available Lead/Lag Left-Turn Greens

This section displays the amount of time available for leading or lagging turn phases which would not interfere with progression. This report is useful in identifying opportunities to modify signal phasing with turn phases to improve intersection performance without hampering progression. It also identifies how much of the given green time is not used anywhere by the progression, and thus could be allocated to other phases without hampering the progression.

**Intersection No. & Name.** This is the sequence number and name of each intersection in the system.

**Left-Right - Lead/Lag.** This is the amount of time, in percent of cycle, available as either a leading or lagging left-turn phase for the left-to-right traffic flow. This amount of lead or lag time may be used without interference with the through progressions.

**Right-Left - Lead/Lag.** This is the amount of time, in percent of cycle, available as either a leading or lagging left-turn phase for the right-to-left traffic flow. This amount of lead or lag time may be used without interference with the through progressions.

**Unused Green - Beg/End.** This indicates the amount of time, in percent of cycle, at the beginning and end of the through phase which is not used for progression by either direction.

## Link Distances and Speeds

This section of the report summarizes the link characteristics of the system used in the design. Link distances are provided in two forms: cumulative distance from Intersection #1 and distance between intersections. Both the desired and actual design speeds are listed for each link.

**Intersection No. & Name.** This is the sequence number and name of each intersection in the system.

**Distances - Cumulative from 1.** The cumulative distance from Intersection number 1 to the specific intersection, in feet or meters.

**Distances - Link i/i+1.** The link-to-link distances, in feet or meters, between adjacent intersections. This is the distance to the next intersection for the intersection listed.

**Progression-Speeds - Desired.** The link-to-link progression speeds originally entered as input. These desired speeds may be modified by a speed adjustment factor in order to obtain better progression, producing the Optimum speeds described below.

**Progression-Speeds - Optimum.** The link-to-link progression speeds determined to be the optimum progressive speeds, as specified by an input speed adjustment factor or speed search range. If the program is not allowed to vary the design speeds, the optimum speeds will be the same as the desired speeds described above.

The following is an example of the Optimum Progression Data report sections using the Progression-Analysis.tpc sample data file.

Sample Route Design Study
Lincoln Street - First to Third
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.00.00] - Optimum Progression Data

| | |
|---|---|
| Cycle Length | = 90.0 sec |
| Speed Factor | = 1.000 = 1000 / 1000 |
| Band Left-Right | = 35.9 sec = 39.8 % of cycle |
| Band Right-Left | = 35.9 sec = 39.8 % of cycle |
| Band Ratio | = 1.00 LR/RL (1.00 desired) |
| Efficiency | = 67.5 % of smallest split |

## TEAPAC[Ver 8.00.00] - Optimum Main Street Offsets

| Intersection | | | Through-Phase | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Beg | Left-to-Right | | | Right-to-Left | | |
| No. | Name | Thru% | Grn% | Yel% | Red% | Grn% | Yel% | Red% |
| 1 | 1st | 0.0 * | 0.0 | 55.7 | 59.0 | 0.0 | 55.7 | 59.0 |
| 2 | 2nd | 45.5 | 45.5 | 110.2 | 113.5 | 45.5 | 110.2 | 113.5 |
| 3 | 3rd | 47.5 | 47.5 | 108.2 | 111.5 | 47.5 | 108.2 | 111.5 |
| 4 | 4th | 95.5 | 95.5 | 160.2 | 163.5 | 95.5 | 160.2 | 163.5 |
| 5 | 5th | 38.5 | 38.5 | 117.2 | 120.5 | 38.5 | 117.2 | 120.5 |
| 6 | 6th | 42.5 | 42.5 | 113.2 | 116.5 | 42.5 | 113.2 | 116.5 |

## TEAPAC[Ver 8.00.00] - Optimum Through-Band Offsets

| Intersection | | Through-Band | | | |
|---|---|---|---|---|---|
| | | Left-Right | | Right-Left | |
| No. | Name | Beg% | End% | Beg% | End% |
| 1 | 1st | 6.2 | 46.1 | 212.9 | 252.8 |
| 2 | 2nd | 52.4 | 92.2 | 166.8 | 206.6 |
| 3 | 3rd | 71.2 | 111.0 | 148.0 | 187.8 |
| 4 | 4th | 96.7 | 136.6 | 122.4 | 162.3 |
| 5 | 5th | 138.5 | 178.3 | 80.7 | 120.5 |
| 6 | 6th | 152.4 | 192.2 | 66.8 | 106.6 |

## TEAPAC[Ver 8.00.00] - Split Timings

| Intersection | | Through-Phase (w/yellow+AR) | | Through-Red (w/AR-sec) | | All-Red |
|---|---|---|---|---|---|---|
| No. | Name | % | sec | L-R | R-L | sec |
| 1 | 1st | 59.0 * | 53.1 | 36.9 | 36.9 | 0.0 |
| 2 | 2nd | 68.0 | 61.2 | 28.8 | 28.8 | 0.0 |
| 3 | 3rd | 64.0 | 57.6 | 32.4 | 32.4 | 0.0 |
| 4 | 4th | 68.0 | 61.2 | 28.8 | 28.8 | 0.0 |
| 5 | 5th | 82.0 | 73.8 | 16.2 | 16.2 | 0.0 |
| 6 | 6th | 74.0 | 66.6 | 23.4 | 23.4 | 0.0 |

Sample Route Design Study
Lincoln Street - First to Third
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.00.00] - Available Lead/Lag Left-Turn Greens

| Intersection No. | Name | Left-Right Lead% | Left-Right Lag% | Right-Left Lead% | Right-Left Lag% | Unused-Green Beg% | Unused-Green End% |
|---|---|---|---|---|---|---|---|
| 1 | 1st | 12.9 | 0.0 | 0.0 | 12.9 | 6.2 | 6.2 |
| 2 | 2nd | 21.3 | 0.0 | 0.0 | 21.3 | 6.9 | 6.9 |
| 3 | 3rd | 0.0 | 23.7 | 23.7 | 0.0 | 0.5 | 0.5 |
| 4 | 4th | 26.9 | 0.0 | 0.0 | 26.9 | 1.2 | 1.2 |
| 5 | 5th | 42.2 | 0.0 | 0.0 | 42.2 | 0.0 | 0.0 |
| 6 | 6th | 24.3 | 0.0 | 0.0 | 24.3 | 9.9 | 9.9 |

## TEAPAC[Ver 8.00.00] - Link Distances and Speeds

| Intersection No. | Name | Distances Cumul from 1 | Distances Link i/i+1 | Progression-Speeds Desired L-R | Desired R-L | Optimum L-R | Optimum R-L |
|---|---|---|---|---|---|---|---|
| 1 | 1st | 0. | 2130. | 35.0 | 35.0 | 35.0 | 35.0 |
| 2 | 2nd | 2130. | 870. | 35.0 | 35.0 | 35.0 | 35.0 |
| 3 | 3rd | 3000. | 1180. | 35.0 | 35.0 | 35.0 | 35.0 |
| 4 | 4th | 4180. | 1930. | 35.0 | 35.0 | 35.0 | 35.0 |
| 5 | 5th | 6110. | 640. | 35.0 | 35.0 | 35.0 | 35.0 |
| 6 | 6th | 6750. | 0. | 0.0 | 0.0 | 0.0 | 0.0 |

## TEAPAC - Time-Space Diagram

The Time-Space Diagram report is generated using the PLOTSIMPLE command. A time-space diagram can be plotted from the offset values obtained directly from the design optimization or from offsets input by the user. The Time-Space Diagram is useful in visualizing the progression in the system.

**Cycle Length.** The upper-left corner of the diagram shows the cycle length, in seconds, of the time-space diagram.

**Horizontal Axis.** The horizontal axis represents time, in percent of cycle. The axis shows three complete cycles (100%, 200% & 300%) with each character column equal to five percent of the cycle. The specified cycle length can be used to convert these axes to seconds for calculating the actual phase times or the travel time between intersections.

**Vertical Axis.** The vertical axis of the plot represents distance, in feet or meters, along the arterial. The intersection numbers are shown in the first column while the second column shows the cumulative distance to each intersection from the beginning of the system.

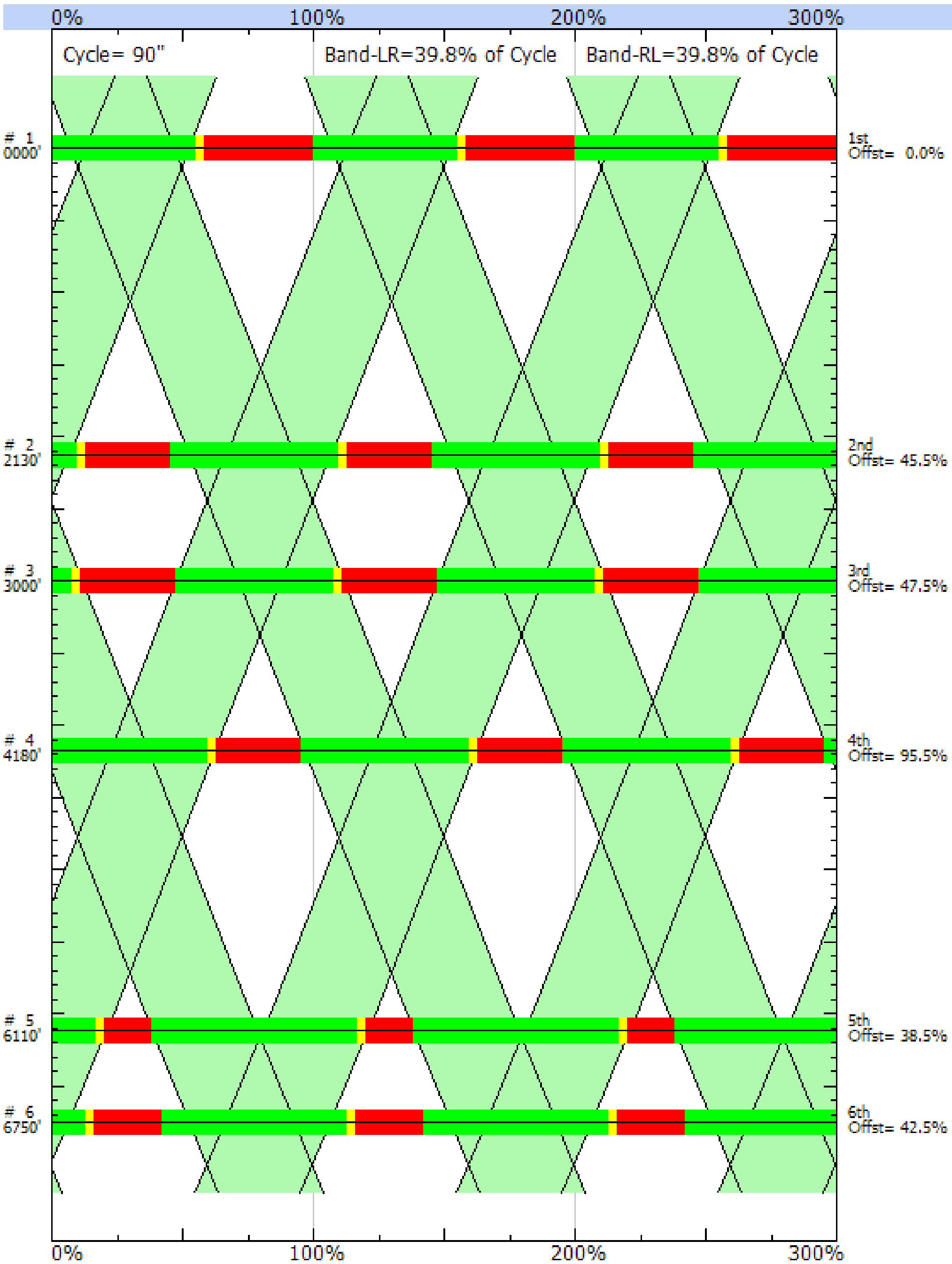
**Time-Space Diagram.** The body of the diagram shows each of the phases of the main street signal operation through the duration of the three cycles. These phases are displayed using equal signs (=) to represent the periods of the cycle when main-street flow is entirely blocked by cross-street phases (main-street red) and blank characters to represent periods when main-street flow is permitted in both directions (main-street green). Dashes (-) indicate lead and lag left turn phases on the main street. The offset to the first main-street phase is shown to the right of each intersection line.

In the text form of the report, slashes (/) and back slashes (\) are used to indicate where the optimized through bands pass through the system in either direction. The letter "X" is used to represent where bands are crossing a point simultaneously in both directions.

The following is an example of the Time-Space Diagram report using the Progression-Analysis.tpc sample data file.

Sample Route Design Study
Lincoln Street - First to Third
PM Peak Hour Design Conditions

## TEAPAC[Ver 8.00.00] - Time-Space Diagram



## Appendix D Topics (for Export and Import):

# TEAPAC - Summary of Parameter Values (EXP)

The Summary of Parameter Values (EXP) report, generated using the SUMMARIZE command, is a compilation of the data required to analyze network progression, recognizing all the pertinent information required by the host programs for export and import. It is divided into two report sections, the first for system parameters, and a section of intersection parameters for each intersection. The contents of these two sections are discussed below.

## System Parameters

The System Parameters are those parameters which define parameter values for the entire system or network. These values are entered only once for the system.

**Simulation Period.** The length of time, in minutes, of the simulation period.

**Steps per TRANSYT Cycle.** The number of incremental steps to be used by TRANSYT to simulate the performance during each cycle period.

**Actuated Model.** Describes whether TRANSYT's or PASSER's actuated model will be used for actuated movements.

**Default Link Assignment Method.** The link assignment method which will be used on any given link where a link-specific assignment method has not been selected.

**Optimization Type.** The parameters to be optimized such as cycle, splits and/or offsets, or a user-specified list. NONE indicates simulation only. If LIST is specified, the list of numbers represents the optimization step sizes to be used by TRANSYT. Otherwise, the first three numbers represent the PI, DI and PROS/DI parameters of the Card Type 5X.

**List of Intersection #'s in Network.** The list of valid node numbers that are to be included in the study network. The Master Node represents which of these is the master location or master offset for the system, if not 0.

**List of Intersection #'s in Defined Routes.** The list of node numbers that are included in each of the defined artery routes for the system. These are used by the PROS optimization and artery summary outputs.

**List of Intersection #'s in Subsystem.** The list of node numbers that are to be included in the simulation or optimization. If no list appears, all nodes of the network list will be included in the analysis. A negative number represents the negative value of the route number which will be used for the SUBSYSTEM definition.

**Specified List of Links to be Simulated.** The list of links, in simulation order, that are to be simulated for the network. If no list appears, all possible links will be included in the simulation.

## Intersection Parameters

The Intersection Parameters are those parameters which define an individual intersection within the network. These parameters are used to generate the actual host program network.

**Intersection #.** The intersection node number and description of the intersection. The node number is as appears in the system node list above.

**Demand Volumes.** The design hour volumes, in vehicles per hour, at the intersection for each of the twelve possible movements at the intersection.

**Peak Hour Factors.** The peak hour factors for each of the twelve possible movements at the intersection.

**Truck Percentages.** The percentage of heavy vehicles in the traffic stream for each of the twelve possible movements at the intersection.

**Right Turn on Red.** The volume of right turn on red maneuvers made per hour for each right turn at the intersection. For the hosts, a non-zero entry simply indicates the RTOR is permitted.

**Approach Widths.** The widths of pavement available for each of the twelve movements at the intersection. If no exclusive turn lane exists, a width of zero is shown for the turn movement.

**Number of Lanes.** The number of lanes included in the above width for each lane group at the intersection.

**Lane Group Type.** The type of lane group designated for each lane group above, including Normal, FreeFlow, DualOptional, Stop controlled or Yield controlled.

**Saturation Flow.** The maximum release flow rate, in vehicles per hour of green, for each lane group of the intersection. Each non-zero width requires a non-zero saturation flow rate.

**Minimum Green.** The minimum green time, in seconds, required for safe passage of each of the twelve movements.

**Actuated Movements.** A NO or YES flag which indicates whether each movement of the intersection is part of an actuated phase.

**Startup Lost Time.** The number of seconds of startup lost time at the beginning of green indications for each lane group at the intersection.

**End Gain Time.** The number of seconds of end gain time at the end of green indications for each lane group at the intersection.

**Storage.** The distance in feet for each lane group of the intersection in which stored vehicles can wait without impacting other lane groups of the intersection or system.

**Nema Phases.** The Nema phase number which has been assigned to each movement used to identify the controller phase module which will control the movement's display.

**Phasing/Order.** A two-digit code representing the basic phasing of the traffic signal is followed by the order codes. For multi-phase signal operation, the order indicates whether turning phases lead ahead of or lag behind the through phase. The first entry is for the north-south phases, the second is for the east-west phases.

**Permissives.** Denotes whether left turns are allowed to move on a permitted through phase following an exclusive left turn phase. If the phasing is single phase for the left turn, the movement is permitted regardless of the permissives setting.

**RT Overlaps.** Denotes whether right turns are allowed to overlap into adjacent left turn phases when an exclusive right turn lane exists.

**Greentimes (Maximums).** The maximum green time, in seconds, for each signal phase, in the order of the designated Sequence and Leadlag entries. If all numbers are less than 1.00, they represent proportions of the system cycle time, in seconds/second. If the timings are listed By-Phase, the phases are labeled with the keyword 'Phase' above the timings. Timings listed By-Movement are shown with the keyword 'Movement' above the timings and are listed in order for thrus and lefts clockwise around the intersection (default for HCM2016).

**Yellowtimes.** The yellow change time, in seconds, for each signal phase, in the order of the designated Sequence and Leadlag entries. If all numbers are less than 1.00, they represent proportions of the system cycle time, in seconds/second. By-Phase and By-Movement timings are represented according to the discussion above for Greentimes.

**Redcleartimes.** The red clearance time (all-red), in seconds, for each signal phase, in the order of the designated Sequence and Leadlag entries. By-Phase and By-Movement timings are represented according to the discussion above for Greentimes.

**Cycle Length.** The cycle length, in seconds, for the intersection. This is also the minimum cycle length if a cycle range is given.

**Max Cycle.** The maximum cycle length, in seconds, which will be searched in a cycle range evaluation.

**Cycle Increment.** The increment of cycle length, in seconds, which will be used in a cycle range evaluation to get from the minimum cycle to the maximum cycle.

**Offset.** The system progression offset for the phasing, and the phase number to which this offset applies. Numbers less than 1.00 represent proportions of the system cycle time, in seconds/second.

**Greentimes (Averages).** The average green time, in seconds, for each signal phase. Timings are listed By-Movement in order for thrus and lefts clockwise around the intersection.

**Network Data.** The description of the location of the intersection in the network being analyzed. For each approach to the intersection, this includes the distance in feet from the upstream node, the average travel speed from the upstream node, the node number of the upstream node, and the movements numbers at the upstream node which supply traffic to the downstream node, the link assignment method, the link curvature, and if the link distance has been manually entered. The X,Y coordinates of the node are also given.

The following is an example of the Summary of Parameter Values (EXP) report using the Export-Import.tpc sample data file.

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 8.56.01] - Summary of Parameter Values (EXP)**

SYSTEM PARAMETERS

Simulation Period of 15 minutes, 300 Steps per TRANSYT Cycle
Use actuated model? No, Default link assignment method: Full
Optimization Type: None w/ 0 0 0 2 0 0 0 0 0 0 0 0 0 0 0

List of Intersection #'s in Network: (Master Node is 13)
13 14 15

List of Intersection #'s in Defined Routes:
Route 1: 13 14 15

INTERSECTION # 13 MacArthur & Pershing

| MOVEMENT DATA | North | | | East | | | South | | | West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt |
| Demand Volumes | 122 | 216 | 80 | 79 | 722 | 187 | 212 | 310 | 198 | 139 | 660 | 134 |
| Peak Hr Factors | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 |
| Truck Percents | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Rt Turn on Red | 0 | | | 0 | | | 0 | | | 0 | | |
| Approach Widths | 0.0 | 24.0 | 0.0 | 0.0 | 24.0 | 12.0 | 0.0 | 24.0 | 12.0 | 0.0 | 24.0 | 12.0 |
| Number of Lanes | 0 | 2 | 0 | 0 | 2 | 1 | 0 | 2 | 1 | 0 | 2 | 1 |
| Lane Group Type | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm |
| Saturation Flow | 0 | 2380 | 0 | 0 | 3574 | 1774 | 0 | 3395 | 1003 | 0 | 3528 | 622 |
| Minimum Green | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Actuated Movmts | No | No | No | No | No | No | No | No | No | No | No | No |
| Startup Lost | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| End Gain | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Storage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nema Phases | 0 | 4 | 7 | 0 | 6 | 1 | 0 | 8 | 3 | 0 | 2 | 5 |

| SIGNAL CONTROL | | | | | | Movement | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Phasing/Ord | 12 | No | Ld | | GrnMax | 18.20 | 0.00 | 33.80 | 7.40 | 18.20 | 0.00 | 22.40 | 0.00 |
| Permissives | Ys | Ys | Ys | Ys | Yellow | 3.50 | 0.00 | 3.00 | 3.00 | 3.50 | 0.00 | 3.00 | 0.00 |
| RT Overlaps | Ys | Ys | Ys | Ys | RedClr | 0.50 | 0.00 | 1.00 | 1.00 | 0.50 | 0.00 | 1.00 | 0.00 |
| Cycle(s) | 60 | 60 | 30 | | Offset | 0.65 to start of Phase 2 | | | | | | | |
| | | | | | GrnAvg | 18.20 | 0.00 | 33.80 | 7.40 | 18.20 | 18.20 | 22.40 | 22.40 |

| NETWORK DATA | Dist | Spd | Node | Movements | | | | Asg | Crv | Man | X-Coord | Y-Coord |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | 0 | 0 |
| E Approach | 2130 | 35 | 14 | 5 | 9 | 1 | 0 | Def | No | No | | |
| S Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | | |
| W Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | | |

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 8.56.01] - Summary of Parameter Values (EXP)**

INTERSECTION # 14 Main & Pershing

| MOVEMENT DATA | North | | | East | | | South | | | West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt |
| Demand Volumes | 150 | 813 | 244 | 0 | 1296 | 589 | 0 | 0 | 0 | 386 | 620 | 0 |
| Peak Hr Factors | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 |
| Truck Percents | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Rt Turn on Red | 0 | | | 0 | | | 0 | | | 0 | | |
| Approach Widths | 0.0 | 48.0 | 0.0 | 0.0 | 24.0 | 24.0 | 0.0 | 0.0 | 0.0 | 12.0 | 24.0 | 0.0 |
| Number of Lanes | 0 | 4 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 0 |
| Lane Group Type | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm |
| Saturation Flow | 0 | 6889 | 0 | 0 | 3636 | 3445 | 0 | 0 | 0 | 1583 | 3636 | 0 |
| Minimum Green | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Actuated Movmts | No | No | No | No | No | No | No | No | No | No | No | No |
| Startup Lost | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| End Gain | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Storage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nema Phases | 0 | 4 | 7 | 0 | 6 | 1 | 0 | 8 | 3 | 0 | 2 | 5 |

| SIGNAL CONTROL | | | | | | Movement | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Phasing/Ord | 12 | No | Lg | | GrnMax | 12.80 | 12.80 | 39.20 | 20.60 | 0.00 | 0.00 | 14.60 | 0.00 |
| Permissives | Ys | No | Ys | Ys | Yellow | 3.50 | 3.50 | 3.00 | 3.00 | 0.00 | 0.00 | 3.00 | 0.00 |
| RT Overlaps | Ys | Ys | Ys | Ys | RedClr | 0.50 | 0.50 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| Cycle(s) | 60 | 60 | 30 | | Offset | 0.91 to start of Phase 2 | | | | | | | |
| | | | | | GrnAvg | 12.80 | 0.00 | 39.20 | 20.60 | 0.00 | 0.00 | 14.60 | 0.00 |

| NETWORK DATA | Dist | Spd | Node | Movements | | | | Asg | Crv | Man | X-Coord | Y-Coord |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | 2125 | 0 |
| E Approach | 530 | 35 | 15 | 5 | 9 | 1 | 0 | Def | No | No | | |
| S Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | | |
| W Approach | 2130 | 35 | 13 | 11 | 3 | 7 | 0 | Def | No | No | | |

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 8.56.01] - Summary of Parameter Values (EXP)**

INTERSECTION # 15 Water & Pershing

| MOVEMENT DATA | North | | | East | | | South | | | West | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt | Rt | Th | Lt |
| Demand Volumes | 0 | 0 | 0 | 466 | 780 | 0 | 386 | 135 | 453 | 0 | 573 | 291 |
| Peak Hr Factors | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 |
| Truck Percents | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Rt Turn on Red | 0 | | | 0 | | | 0 | | | 0 | | |
| Approach Widths | 0.0 | 0.0 | 0.0 | 12.0 | 36.0 | 0.0 | 12.0 | 48.0 | 0.0 | 0.0 | 24.0 | 12.0 |
| Number of Lanes | 0 | 0 | 0 | 1 | 3 | 0 | 1 | 4 | 0 | 0 | 2 | 1 |
| Lane Group Type | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm | Norm |
| Saturation Flow | 0 | 0 | 0 | 1583 | 5245 | 0 | 1583 | 6848 | 0 | 0 | 3636 | 1774 |
| Minimum Green | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Actuated Movmts | No | No | No | No | No | No | No | No | No | No | No | No |
| Startup Lost | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| End Gain | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Storage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nema Phases | 0 | 4 | 7 | 0 | 6 | 1 | 0 | 8 | 3 | 0 | 2 | 5 |

| SIGNAL CONTROL | | | | | | Movement | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Phasing/Ord | 13 | No | Lg | | GrnMax | 0.00 | 0.00 | 23.00 | 0.00 | 19.40 | 19.40 | 32.60 | 5.60 |
| Permissives | Ys | Ys | Ys | No | Yellow | 0.00 | 0.00 | 3.00 | 0.00 | 3.50 | 3.50 | 3.00 | 3.00 |
| RT Overlaps | Ys | Ys | Ys | Ys | RedClr | 0.00 | 0.00 | 1.00 | 0.00 | 0.50 | 0.50 | 1.00 | 1.00 |
| Cycle(s) | 60 | 60 | 30 | | Offset | 0.00 | to start of Phase 2 | | | | | | |
| | | | | | GrnAvg | 0.00 | 0.00 | 14.00 | 0.00 | 5.00 | 0.00 | 47.00 | 29.00 |

| NETWORK DATA | Dist | Spd | Node | Movements | | | | Asg | Crv | Man | X-Coord | Y-Coord |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | 2656 | 0 |
| E Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | | |
| S Approach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Def | No | No | | |
| W Approach | 530 | 35 | 14 | 11 | 3 | 7 | 0 | Def | No | No | | |

## TEAPAC - TRANSYTxxx Formatted Input

The TRANSYTxxx Formatted Input report is an example of an output report which is generated when the EXPORT command is used to "build" a third-party host input data file. The file created during an EXPORT is a text file ready for use with the host program. The Formatted Input report can be used to check the host program's data input prior to running the host.

**TRANSYTxxx Formatted Input.** The title line of the report displays the TRANSYT version number for which the input data has been generated.

**TRANSYT Data Input.** The "card images" which are listed include all the pertinent data required to run the TRANSYT model for the designated version. In addition, the data is in the correct fixed field format required by the TRANSYT model. The number in the first five columns of each line defines the card type. Since card types vary among the different versions of the TRANSYT model, refer to the correct version of the TRANSYT reference manual for details on the values included on each input line. The first "card" (first line) in the input data is the Run Title card which describes the input conditions prepared for the TRANSYT run. This is a combination of the PROJECT, DESCRIPTION and NOTE commands. TRANSYT comment cards are embedded in the data file to help identify the exported data.

The following is an example of the TRANSYTxxx Formatted Input report using the Export-Import.tpc sample data file.

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 8.10.00] - TRANSYT-7F11 Formatted Input**

```
0        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
Signal System Study       / Arterial System Retiming / PM Peak Hour
   -1   60                        1    0    0   -1    1    1   15    0    0    0
----- Node List -----
    2   13   14   15
----- Movement Numbering Scheme -----
    3    9    8    7    3    2    1   12   11   10    6    5    4
----- Network Master -----
   10   13    4    1 1700   30   35  100   25        85
===== Intersection   13 =====
----- Signal Timing & Phasing -----
   13   13   39    3   18    4    7    4   22    4                             0
   21   13    1         2        19 1302 1308-1309
   22   13    3         4         9 1305 1306
   23   13    5         6        19 1305 1311-1312-1306
----- Link Data -----
   28 1302    0 2410  465                                                      0
   29 1302   20   20
   28 1305 2130 2771  890      1405 1167   35 1402  135   35                   0
   29 1305   20   20
   28 1306 2130 1433  208      1405  273   35 1402   32   35                   0
   29 1306   20   20         2                1311  100
   28 1308    0 2337  580                                                      0
   29 1308   20   20
   28 1309    0       220                                                      0
   29 1309   20   20         2                1302  100
   28 1311    0 2525  887                                                      0
   29 1311   20   20
   28 1312    0       149                                                      0
   29 1312   20   20         2                1305  100
===== Intersection   14 =====
----- Signal Timing & Phasing -----
   13   14   55    3   13    4   15    4   21    4                             0
   21   14    1         2         9 1402
   22   14    3         4         9 1405 1410 1411
   23   14    5         6         9 1405 1406
----- Link Data -----
   28 1402    0 5296 1341                                                      0
   29 1402   20   20
   28 1405  530 3041 1440      1505  596   35 1508  346   35                   0
   29 1405   20   20
   28 1406  530 2606  654      1505  271   35 1508  157   35                   0
   29 1406   20   20
   28 1410 2130 1448  429      1311  281   35 1302   34   35 1308   91   35    0
   29 1410   20   20
   28 1411 2130 2634  689      1311  452   35 1302   55   35 1308  145   35    0
   29 1411   20   20
===== Intersection   15 =====
----- Signal Timing & Phasing -----
   13   15    0    3   19    4   23    4    6    4                             0
   21   15    1         2         9 1507 1508
```

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 8.10.00] - TRANSYT-7F11 Formatted Input**

```
0        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
   22   15    3         4         9 1504 1505 1511
   23   15    5         6         9 1511 1512
----- Link Data -----
   28 1504    0 1359  518                                                       0
   29 1504   20   20
   28 1505    0 3387  867                                                       0
   29 1505   20   20
   28 1507    0 1345  429                                                       0
   29 1507   20   20
   28 1508    0 4402  653                                                       0
   29 1508   20   20
   28 1511  530 2486  637      1411  457   35 1402  180   35                    0
   29 1511   20   20
   28 1512  530 1300  323      1411  232   35 1402   91   35                    0
   29 1512   20   20
----- Route Definitions and Weighting -----
   42    1 1311 1305 1411 1405 1511 1505
   43    1  100  151
----- Run Specs & Route Reports -----
   52    0    0    0                112
   60    1    2    5  200    1    1    1    1    3                              3
Route #1
   61    1
----- Node Coordinates -----
   70   13 1920 1440   1414209 1440   1517280 1440
   90
```

# TEAPAC - Time-Space Diagram for Cycle = XX sec

The Time-Space Diagram report is generated using the PLOTTSD command. A time-space diagram can be plotted for the offsets obtained from the host program or from any offsets input into TEAPAC. A time-space diagram is useful in visualizing the progression within a system. The terminology of Left, Right, Top and Bottom in the discussion below assumes that the time-space diagram is viewed with the distance axis running horizontally and such that the title headings are on the left-hand side of the page.

**Time-Space Diagram for Cycle = XX sec.** The title line of the report displays the cycle length, in seconds, for which the time-space diagram is plotted. This is the overall system cycle length.

**Vertical Axis.** The vertical axis of the diagram represents time, in percent of the system cycle length. The axis shows three complete cycles (100%, 200% & 300%). In the text version of the plot, each vertical increment equals five (5) percent of the cycle. The specified cycle length can be used to convert these axes to seconds for calculating the actual travel time between intersections.

**Horizontal Axis.** The horizontal axis of the diagram represents distance, in feet, measured cumulatively from the first intersection at the left of the diagram. The intersection numbers and the cumulative distance from the first intersection for each intersection is shown at the bottom of the diagram. Intersection names and offsets to the start of green in both directions (given in percent of cycle) are shown at the top of the diagram.

**Speed Slope Guide Lines.** The time-space diagram shows diagonal lines which approximately represent the slope of the speed profiles between intersections. These lines can be used as guides to estimate the travel profiles of vehicles traveling through the system. If paper or screen width is a problem for the text version of the plot, these speed slope lines may optionally be displayed within the body of the time-space diagram, but are not intended to represent the actual flow profiles when this is the case. The graphical version of the plot shows speed slope lines much more accurately.

**Time-Space Plot.** The body of the diagram shows each phase of each signal's operation, both main street and side street, through the duration of the three cycles. These phases are displayed using different characters to represent each phase, as described in the Legend of Phase Symbols. If average green times for phases are provided, the green periods shown in the time-space diagram will represent these average green times. This is the preferred and most appropriate result, using the average phase time estimates produced by the HCM 2016 analysis. In the event average phase times are not provided, the time-space diagram will be represented using the maximum greentime entries, but these may not be appropriate or accurate, particularly for actuated signals.

**Legend of Phase Symbols.** In the text version of the plot, darker characters (=, F, L, and E) are used to represent periods of the cycle when main-street flow is entirely blocked by cross-street phases. Lighter characters (blank, ', ., and :) are used to represent periods when main-street flow is permitted in varying degrees. The following describes the meaning of each of the symbols used in the plot.

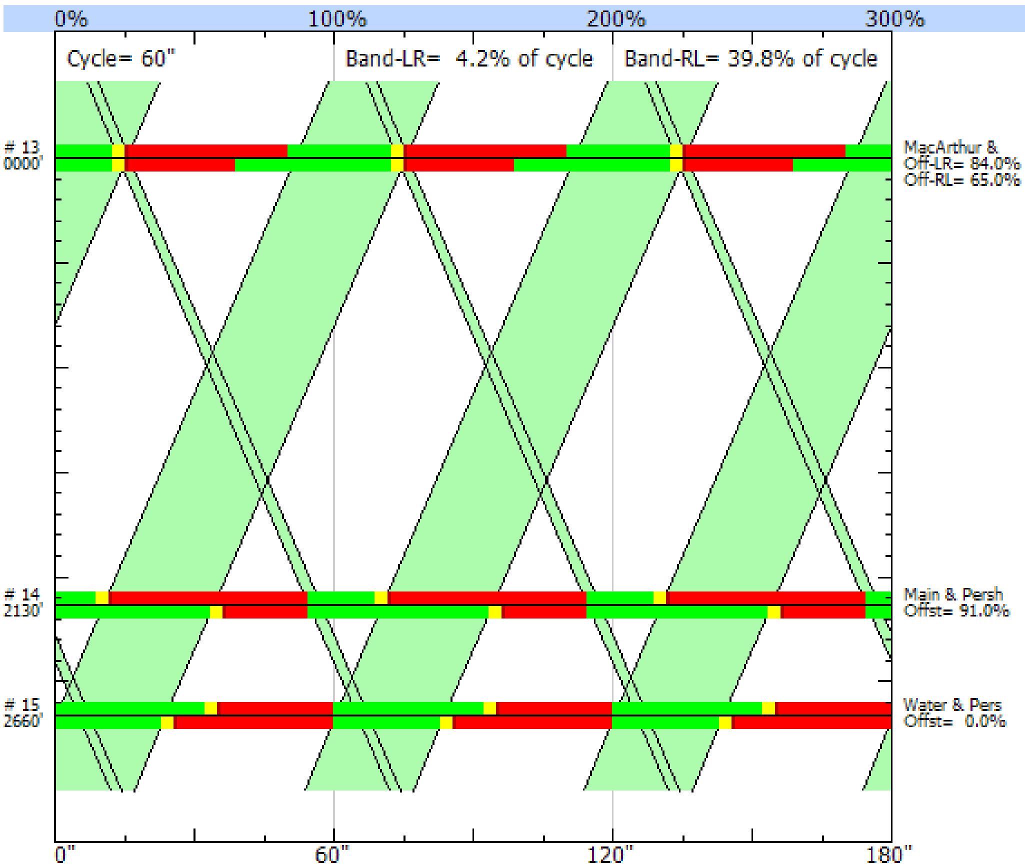
```
Symbol       Signal Phase Description
======       ================================================
blank        Main Street Through Phase
 '''         Main Street Lead or Lag from the Right (Overlap)
 ...         Main Street Lead or Lag from the Left  (Overlap)
 :::         Main Street Lead or Lag (Dual) Left-Turn Phase

 ===         Side Street Through Phase
 FFF         Side Street Lead or Lag from the Top
 LLL         Side Street Lead or Lag from the Bottom
 EEE         Side Street Lead or Lag (Dual) Left-Turn Phase
```

The following is an example of the Time-Space Diagram report using the Export-Import.tpc sample data file.

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 8.10.00] - Time-Space Diagram for Cycle = 60 sec**



## TEAPAC – Timing Plan for Intersection XX

The Timing Plan for Intersection XX report, generated using the TIMINGPLAN command, provides a summary of the current phasings and timings. This report can be used to summarize the original signal timings or final optimized timings. The report summarizes the timings for all phases and sub-phase intervals, in both seconds and percent. It also provides a phase diagram and cumulative splits and offsets calculated for the start of each interval displayed (green, yellow change and pedestrian FDW intervals).

**Sequence.** A two-digit code representing the phase sequencing of the traffic signal. The sequence code is actually two codes, the first digit indicates the phasing of the north-south movements while the second digit indicates the phasing of the east-west movements. For additional information, see the diagram of sequence codes used by all TEAPAC application functions in Chapter 1.

**Leadlags.** This indicates whether turning phases lead ahead of or lag behind the through phase in multi-phase signal operation. The north-south Leadlag condition is the first value and the east-west is the second value, both separated by a slash. LD (LEAD) indicates a leading multi-phase condition, LG (LAG) indicates a lagging multi-phase condition, and NO (NONE) indicates no leading or lagging condition. If NO (NONE) appears for a multi-phase sequence, this is equivalent to a LD (LEAD) condition.

**Phasing Diagram.** The body of the phasing diagram shows the movements which move during each phase. Each movement is represented by an arrow which indicates whether the movement is a through, right turn, or left turn. Permitted left turns which move on a green ball are displayed with dashed arrows. If pedestrian timing requirements have been entered, the pedestrian movements are shown with dashed blue lines in the appropriate phases (see the example output for Intersection #13 following). If the timings for the phasing have been defined 'By-Movement' rather than the default 'By-Phase', the phasing display shows a dual-ring and barrier representation of the phasing (Int #15 example). If provided as input, movements in the phasing diagram are labeled with the designated Nema phase numbers which will be used to control the movement in a protected phase.

**Cycle Length.** This is the cycle length, in seconds, for the individual signal. Typically there is only one cycle length for all signals in a system, the system cycle; however, a signal may be double-cycled, making its cycle length half of the overall system cycle length. In the event of a double-cycle condition, the half-cycle value is displayed.

**Phases (sec/%).** Phase times (the sum of the green and change+clearance intervals) for each phase are displayed in both seconds and percent, both with one decimal place of accuracy. These values are also displayed in parentheses ( ) rounded to the nearest second and percent, for implementation on systems which require such rounding. If rounding error causes these rounded values not to add up to the cycle length or 100 percent, the cumulated error is placed in the phase with the most allocated time. If the phasing is a dual-ring display for 'By-Movement' timings, these phases are the dual-ring controller phases, and rounding is also performed to assure that the times within each barrier add to the same totals.

**Interval (sec/%).** The individual interval times for the green, yellow change and red clearance intervals are displayed in seconds and percent of cycle. If the phasing is a dual-ring display for 'By-Movement' timings, these intervals are for the dual-ring controller phases (Int #15 example). If pedestrian timing requirements have been entered, the Walk and Flash Don't Walk (FDW) interval timings are shown separately in seconds for each potential pedestrian phase (Int #13 example).

**Cumulative Offsets (sec/%).** If the phasing display is for 'By-Phase' timings, the cumulative interval times starting from the beginning of phase 1 is displayed, for the beginning of each green, FDW and yellow change interval, both in seconds and percent of cycle (Int #13 example). This is intended for use with controllers which are typically used for this older style of phasing, such as electro-mechanical controllers. It is not provided when a more modern dual-ring display is selected for 'By-Movement' timings.

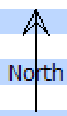
**System Offsets (sec/%).** The cumulative offsets from above are shifted by the system offset, for the beginning of each green, FDW and yellow change interval, both in seconds and percent of cycle. The specific interval which is defined as the offset reference point is displayed with a box around it, but any of the other system offsets displayed would be appropriate, as required by various controller hardware.

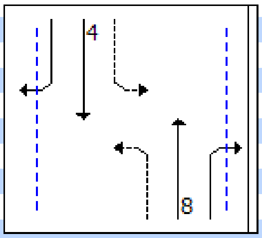
The following is an example of the Timing Plan for Intersection XX report using the Export-Import.tpc sample data file.

Signal System Study
Arterial System Retiming
PM Peak Hour

## TEAPAC[Ver 8.10.00] - Timing Plan for Intersection 13

Intersection #013 N-S: MacArthur
Seq 12 (**/LD)

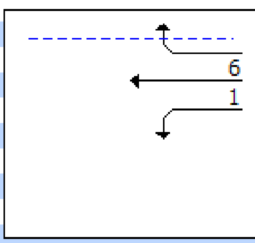


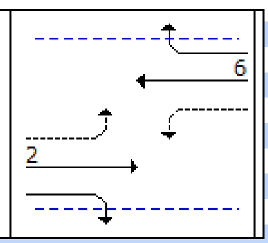




Cycle= 60 sec

| | | Green+Change+Clear | | | |
|---|---|---|---|---|---|
| Phases(Rounded) | sec | 22.2 ( 22 ) | | | |
| | % | 37.0 ( 37 ) | | | |
| | | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr |
| Veh Intervals | sec | 18.2 | | 3.5 | 0.5 |
| | % | 30.3 | | 5.8 | 0.8 |
| Ped Intervals | sec | 5.0 | 10.0 | 3.5 | 0.5 |
| | sec | 5.0 | 10.0 | 3.5 | 0.5 |
| Cumul Offsets | sec | 0.0 | 5.0 | 18.2 | |
| | % | 0.0 | 8.3 | 30.3 | |
| System Offsets | sec | 16.8 | 21.8 | 35.0 | |
| | % | 28.0 | 36.3 | 58.3 | |

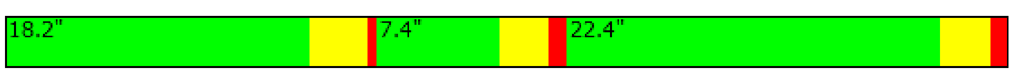
Intersection #013 E-W: Pershing
Seq 12 (**/LD)


Cycle= 60 sec

| | | Green+Change+Clear | | | | Green+Change+Clear | | | |
|---|---|---|---|---|---|---|---|---|---|
| Phases(Rounded) | sec | 11.4 ( 11 ) | | | | 26.4 ( 27 ) | | | |
| | % | 19.0 ( 19 ) | | | | 44.0 ( 44 ) | | | |
| | | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr |
| Veh Intervals | sec | 7.4 | | 3.0 | 1.0 | 22.4 | | 3.0 | 1.0 |
| | % | 12.3 | | 5.0 | 1.7 | 37.3 | | 5.0 | 1.7 |
| Ped Intervals | sec | 5.0 | 10.0 | | | | | 3.0 | 1.0 |
| | sec | | | | | 5.0 | 10.0 | 3.0 | 1.0 |
| Cumul Offsets | sec | 22.2 | 27.2 | 29.6 | | 33.6 | 38.6 | 56.0 | |
| | % | 37.0 | 45.3 | 49.3 | | 56.0 | 64.3 | 93.3 | |
| System Offsets | sec | 39.0 | 44.0 | 46.4 | | 50.4 | 55.4 | 12.8 | |
| | % | 65.0 | 73.3 | 77.3 | | 84.0 | 92.3 | 21.3 | |



Signal System Study
Arterial System Retiming
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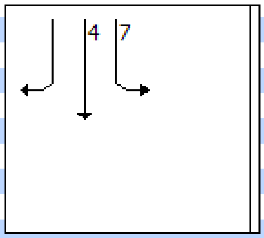
## TEAPAC[Ver 8.10.00] - Timing Plan for Intersection 14

Intersection #014 N-S: Main
Seq 12 (**/LG)

North

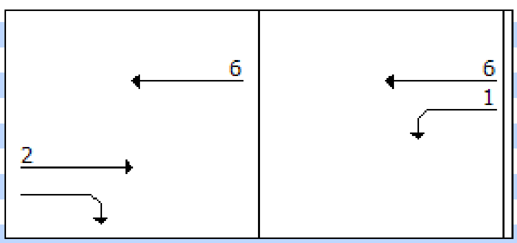



Cycle= 60 sec

| | | Green+Change+Clear | | | |
|---|---|---|---|---|---|
| Phases(Rounded) | sec | 16.8 ( 17 ) | | | |
| | % | 28.0 ( 28 ) | | | |
| | | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr |
| Veh Intervals | sec | 12.8 | | 3.5 | 0.5 |
| | % | 21.3 | | 5.8 | 0.8 |
| Cumul Offsets | sec | 0.0 | | 12.8 | |
| | % | 0.0 | | 21.3 | |
| System Offsets | sec | 37.8 | | 50.6 | |
| | % | 63.0 | | 84.3 | |

Intersection #014 E-W: Pershing
Seq 12 (**/LG)

North




Cycle= 60 sec

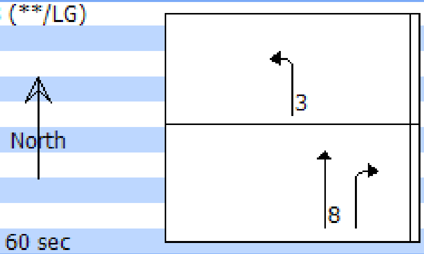
| | | Green+Change+Clear | | | | Green+Change+Clear | | | |
|---|---|---|---|---|---|---|---|---|---|
| Phases(Rounded) | sec | 18.6 ( 19 ) | | | | 24.6 ( 24 ) | | | |
| | % | 31.0 ( 31 ) | | | | 41.0 ( 41 ) | | | |
| | | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr |
| Veh Intervals | sec | 14.6 | | 3.0 | 1.0 | 20.6 | | 3.0 | 1.0 |
| | % | 24.3 | | 5.0 | 1.7 | 34.3 | | 5.0 | 1.7 |
| Cumul Offsets | sec | 16.8 | | 31.4 | | 35.4 | | 56.0 | |
| | % | 28.0 | | 52.3 | | 59.0 | | 93.3 | |
| System Offsets | sec | 54.6 | | 9.2 | | 13.2 | | 33.8 | |
| | % | 91.0 | | 15.3 | | 22.0 | | 56.3 | |

Signal System Study
Arterial System Retiming
PM Peak Hour

## TEAPAC[Ver 8.10.00] - Timing Plan for Intersection 15

Intersection #015 N-S: Water

Seq 13 (**/LG)

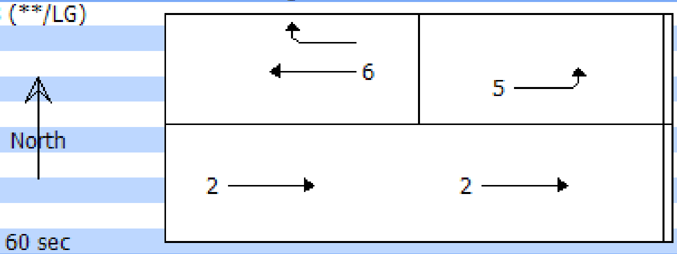



Cycle= 60 sec

| | | Green+Change+Clear | | | |
|---|---|---|---|---|---|
| Ring 1 Phases | sec | 0.0 ( 23 ) | | | |
| | % | 0.0 ( 39 ) | | | |
| Ring 2 Phases | sec | 23.4 ( 69 ) | | | |
| | % | 39.0 (117 ) | | | |
| | | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr |
| Ring 1 Veh Phs | sec | 0.0 | | 0.0 | 0.0 |
| | % | 0.0 | | 0.0 | 0.0 |
| Ring 2 Veh Phs | sec | 19.4 | | 3.5 | 0.5 |
| | % | 32.3 | | 5.8 | 0.8 |
| System Offsets | sec | 36.6 | | 56.0 | |
| | % | 61.0 | | 93.3 | |

Intersection #015 E-W: Pershing

Seq 13 (**/LG)




Cycle= 60 sec

| | | Green+Change+Clear | | | | Green+Change+Clear | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ring 1 Phases | sec | 27.0 ( 27 ) | | | | 9.6 ( 10 ) | | | |
| | % | 45.0 ( 45 ) | | | | 16.0 ( 16 ) | | | |
| Ring 2 Phases | sec | 36.6 ( 37 ) | | | | | | | |
| | % | 61.0 ( 61 ) | | | | | | | |
| | | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr | Grn/ Walk | Ped FDW | Ylo Chg | Red Clr |
| Ring 1 Veh Phs | sec | 23.0 | | 3.0 | 1.0 | 5.6 | | 3.0 | 1.0 |
| | % | 38.3 | | 5.0 | 1.7 | 9.3 | | 5.0 | 1.7 |
| Ring 2 Veh Phs | sec | 32.6 | | | | | | 3.0 | 1.0 |
| | % | 54.3 | | | | | | 5.0 | 1.7 |
| System Offsets | sec | 0.0 | | 23.0 | | 27.0 | | 32.6 | |
| | % | 0.0 | | 38.3 | | 45.0 | | 54.3 | |

## TEAPAC - TRANSYT-7F Imported Data

The TRANSYT-7F Imported Data report is an example of an output report which is generated when the IMPORT command is used to automatically input the optimized timings from a third-party host's output file. The Imported Data report can be used to verify the data values which were extracted from the host program's output.

**Controller Settings Found.** This message indicates that a valid output file was found with the necessary controller settings report included. If no such output is found, an error message to this effect is reported instead.

**Greens & Yellows Included.** This message indicates whether the green times and yellow times found in the controller settings report are included in or excluded from the IMPORT process. This is controlled by the type of OPTIMIZation selected.

**Imported Data.** The actual data values which are found in the output report are listed in the form of the TEAPAC command which is used to input these data values into TEAPAC. This includes INTERSECTION, OFFSET, CYCLES, GREENTIMES and YELLOWTIMES.

The following is an example of the TRANSYT-7F Imported Data report using the Export-Import.tpc sample data file.

Signal System Study
Arterial System Retiming
PM Peak Hour

**TEAPAC[Ver 8.10.00] - TRANSYT-7F Imported Data**

Controller Settings Found in IMPORT File
T7F Greens & Yellows are Included in IMPORT

```
NOTE T7F IMPORT
INTERSECTION      13
GREENTIMES        20.0   5.0  26.0   0.0   0.0   0.0
YELLOWTIMES        2.5   2.0   2.0   0.0   0.0   0.0
REDCLEARTIMES      0.5   1.0   1.0   0.0   0.0   0.0
OFFSET          39.0 2
INTERSECTION      14
GREENTIMES        17.0  18.0  16.0   0.0   0.0   0.0
YELLOWTIMES        2.5   2.0   2.0   0.0   0.0   0.0
REDCLEARTIMES      0.5   1.0   1.0   0.0   0.0   0.0
OFFSET          50.0 2
INTERSECTION      15
GREENTIMES        17.0  20.0  14.0   0.0   0.0   0.0
YELLOWTIMES        2.5   2.0   2.0   0.0   0.0   0.0
REDCLEARTIMES      0.5   1.0   1.0   0.0   0.0   0.0
OFFSET          58.0 2
RETURN
```

17 lines of data IMPORTed into TEAPAC

APPENDIX E

# Error Messages and Trouble Spots

Appendix E Topics

This appendix contains a description of each error message which the program is capable of issuing that is specific to individual applications of the TEAPAC program. Each application error message is discussed as to the potential cause, as well as actions which might be taken to correct the errors. Note also that additional error messages can be generated by the TEAPAC package itself, or by the operating system environment. These error messages are listed separately in Appendices F and G.

In addition to the error messages, discussion of typical problem areas and potential trouble spots is given to further assist in debugging problems, and to help avoid problems in the future.

## Appendix E Topics:



## Appendix E Topics (for Signal Analysis):



## Error Messages (for Signal Analysis)

The following messages are issued to indicate that the conditions of the program are not as expected. The SIGxx number that precedes the message in this document is the error number which is displayed at the top of the error message window. The notes that follow the message here indicate where to look for conditions that may have caused the message, and how to correct these conditions. Messages designated as **WARNINGS** may not cause computations to stop, while those designated as **ERRORS** will terminate all computations.

Errors and Warnings:

SIG01: WARNING
SIG02: WARNING
SIG03: WARNING
SIG04: WARNING
SIG06: WARNING
SIG07: ERROR
SIG08: ERROR
SIG09: ERROR
SIG10: ERROR
SIG11: ERROR
SIG13: ERROR
SIG14: ERROR
SIG15: ERROR
SIG16: ERROR
SIG17: ERROR
SIG18: ERROR
SIG19: ERROR
SIG20: WARNING
SIG21: WARNING
SIG22: ERROR
SIG23: WARNING
SIG24: ERROR
SIG25: ERROR
SIG26: WARNING
SIG27: WARNING
SIG28: ERROR

**SIG01: WARNING**
**xx-xx lane width exceeds upper limit of XX.X feet and will be extrapolated.**

This warning indicates that the calculated average lane width in the noted lane group is greater than or equal to the maximum limit displayed. This is the stated upper limit of lane widths allowed by the 2000 and 2016 *Highway Capacity Manuals*, thus the warning indicates that the calculations will continue by extrapolating the *Highway Capacity Manual* table and the user is aware of this occurrence. The user is also warned to make sure that the lane group width does not include any parking lane width, as was the case required in earlier versions of SIGNAL and SIGNAL85. See also error #SIG19. Action: Verify that the lane group width has been input according to the proper convention of the 2000 or 2016 *Highway Capacity Manual*, and that extrapolation is truly desired for inputs outside of the accepted *Highway Capacity Manual* range.

**SIG02: WARNING**
**Right turns in xx through lanes are xxx.x% which may indicate an input error.**

This warning indicates that the percentage of right turns in a through lane group has been calculated as exceeding 50%. The program warns the user because it may be more appropriate to analyze the shared lane as an exclusive turn lane group, but the computations continue as specified. Action: Verify that the lane usage has been input properly and that the high turn percentage is appropriate for continued analysis.

**SIG03: WARNING**
**Left turns in xx through lanes are xxx.x% which may indicate an input error.**

This warning indicates that the percentage of left turns in a through lane group has been calculated as exceeding 50%. The program warns the user because it may be more appropriate to analyze the shared lane as an exclusive turn lane group, but the computations continue as specified. Action: Verify that the lane usage has been input properly and that the high turn percentage is appropriate for continued analysis.

**SIG04: WARNING**
**The thru equivalent of the xx left turn suggests a Defacto LT Lane analysis.**

This warning indicates that the Defacto Left Turn Lane check calculations indicate that the shared through-turn lane probably behaves like an exclusive turn lane, and should be analyzed as such. The program does not make the defacto left turn adjustment automatically, however, allowing the computations to proceed so that the user can compare this analysis with one where the defacto lane adjustment is made manually by the user according to his professional judgment. Action: Verify that the lane usage used is appropriate, and alternatively conduct another analysis assigning the left-hand through lane to exclusive use by left turning vehicles.

**SIG06: WARNING**
**No sequence codes have been successfully DESIGNed, so none can be ANALYZEd.**

This warning indicates that an attempt was made via the DESIGN command to ANALYZE sequences following their design, where no successful sequences were DESIGNed. This is requested with the parameter of the DESIGN command. It usually suggests that the list of SEQUENCES allowed for the DESIGN did not include any phasing codes that were determined to be safe by DESIGN. This may be particularly prevalent if only one sequence code is given on SEQUENCES. Action: The typical response is to change the SEQUENCES list to ALL, then re-issue the DESIGN command.

**SIG07: ERROR**
**SEQUENCE xx has not been successfully DESIGNed, so no TIMINGS are available.**

This error indicates that the sequence code requested by the TIMINGS command was not found in the list of successful sequences created by a previous DESIGN command. Action: The successful sequences from the DESIGN can be re-listed with the SORT command, or the DESIGN can be re-generated. Make sure that in either case the desired sequence code is successfully DESIGNed, then re-issue the TIMINGS command. If the sequence code is not successful, optimum timings will have to be generated manually. The GOVERCS command may be useful in creating these optimum timings.

**SIG08: ERROR**
**No sequence codes have been DESIGNed, so none can be SORTed.**

This error indicates that a SORT command has been issued to list DESIGN results in sorted order, but a DESIGN has not been conducted for the current intersection. If a DESIGN was executed previously and this message appears, it is likely that the INTERSECTION number has changed since the DESIGN, preventing the SORT from being performed. Action: If the current intersection is the one desired, issue a DESIGN command first, then issue the SORT command. If a previous DESIGN was for an intersection different than the current intersection, use INTERSECTION to select the intersection of the previous DESIGN, then re-issue the SORT command.

**SIG09: ERROR**
**WIDTHS and LANES entries for xx-xx movement do not agree. Check and re-enter.**

This error indicates that for the specified lane group, either a non-zero WIDTH has been specified, but the number of LANES is zero, or a non-zero number of LANES has been specified, but the WIDTH is zero. Action: In either case, review the WIDTHS and LANES command values and make sure that every non-zero WIDTH has a corresponding non-zero number of LANES, and vice versa.

**SIG10: ERROR**
**No WIDTH entry exists for VOLUME on xx-xx movement. Check and re-enter.**

This error indicates that the specified movement VOLUME does not have a corresponding lane group WIDTH assigned to it. For a through movement VOLUME, this means no through movement WIDTH has been specified. For a turn lane movement VOLUME, this means neither an exclusive turn lane WIDTH nor an adjacent through movement WIDTH has been specified. Action: Review the VOLUMES and WIDTHS and correct the mis-match.

**SIG11: ERROR**
**No VOLUME entry exists for WIDTH on xx-xx movement. Check and re-enter.**

This error indicates that the specified lane group WIDTH does not have any corresponding VOLUMES assigned to it. For a through movement lane group WIDTH, this means there is no through VOLUME, nor is there any adjacent turning movement VOLUME that does not have an assigned exclusive turn lane WIDTH. For an exclusive turn lane group WIDTH, this means there is no turning movement VOLUME. Action: Review the WIDTHS and VOLUMES and correct the mis-match.

**SIG13: ERROR**
**GREENS & YELLOWS must add up to demo limit of 60 or 120 seconds. Re-enter.**

In a demonstration version of TEAPAC for signal analysis, the cycle length, as defined by the sum of the GREENTIMES, YELLOWTIMES and REDCLEARTIMES commands, must add up only to 60 or 120 seconds. Action: Correct the timings so this is the case, or purchase a full-use license of TEAPAC to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of TEAPAC.

**SIG14: ERROR**
**YELLOWTIMES are limited to values of only 3.0 seconds in demo. Re-enter.**

In a demonstration version of TEAPAC for signal analysis, the YELLOWTIMES can only take on values of 3.0 seconds. Action: Correct the YELLOWTIMES so this is the case, or purchase a full-use license of TEAPAC to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of TEAPAC.

**SIG15: ERROR**
**SEQUENCES list may not include code 0 or less when using DESIGN. Re-enter.**

This error indicates that the SEQUENCES list contained a sequence code of 0 (or less) when the DESIGN command was issued. The DESIGN command cannot optimize timings for an arbitrary phasing as defined by the PHASEMOVEMENTS when SEQUENCES is 0. The DESIGN is terminated. Action: The 0 must be removed from the SEQUENCES list. If this is the only phasing code in the SEQUENCES list, the phasing cannot be DESIGNed. In this case, either choose a phasing code that is as similar as possible to the actual phasing, then DESIGN and manually adjust the resultant timings for SEQUENCE 0, or use the GOVERCS command to generate the required greentimes for each of the movements, manually generate optimum timings and perform a capacity analysis for the resultant timings for SEQUENCE 0.

**SIG16: ERROR**
**GREENTIME for phase #X is too low. Enter proper value or use 0.01 seconds.**

This error indicates that a phase GREENTIME that has been input is too low. For most phases, this means a value of 0.0 seconds has been encountered, usually because a phase greentime has not been entered. Primary phases may not have zero phase times when performing analyses with ANALYZE, EVALUATE, QUEUECALCS, GOVERCS or SERVICEVOLUMES, otherwise division by zero will occur in the analysis. For the special case of overlap phases (the middle phase of a SEQUENCE 5, 6 or 8), phase green times may actually be negative numbers which are as negative as the clearance for the phase is positive. This is because the time of the overlap phase is not a real display time for any specific movement, but simply the amount of time two phases overlap. If the overlap is small, then the green time will appear to be negative. Action: If GREENTIMES have not been entered for one or more phases, enter the GREENTIMES and re-issue the analysis command. If a phase timing must be analyzed for a zero value, enter 0.01 seconds for the phase. This will appear as a zero in all output, but will not cause division by zero. If the phase in question is an overlap phase, make sure that the negative value of the green time entered is no larger than the positive value of the clearance time for that phase.

**SIG17: ERROR**
**Zero or negative FACTOR for xx-xx movement is not allowed. Check & re-enter.**

This error indicates that an adjustment factor has been entered either as a zero or negative value. All FACTORS entered for any movements must be positive numbers greater than zero, otherwise invalid calculations will result. Action: Review the FACTORS and correct the invalid entry.

**SIG18: ERROR**
**No phasing has been defined for SEQUENCE 0. Use PHASEMOVEMENTS to define it.**

This error indicates that the special SEQUENCES code 0 (or less) has been selected, but no special phasing has been defined with the PHASEMOVEMENTS command. Action: Select a standard SEQUENCES code greater than 0 or use the PHASEMOVEMENTS command to define the movements which move during each phase of the special phasing.

**SIG19: ERROR**
**xx-xx lane width exceeds lower limit of 8.0 feet and cannot be extrapolated.**

This error indicates that the calculated average lane width in the noted lane group is less than 8 feet. This is the stated lower limit of lane widths allowed by the 2000 and 2016 *Highway Capacity Manual*, thus the error indicates that the calculations cannot continue. Action: Verify that the lane group width has been input according to the proper convention of the 2000 and 2016 *Highway Capacity Manual*. It is unlikely that an analysis of a lane width of less than 8 feet would yield a valid result, but this can be simulated by using a larger lane group width and adjusting the satflow downwards with an appropriate FACTORS entry.

**SIG20: WARNING**
**Verify STARTUPLOST and ENDGAIN values. Cannot convert old LOSTTIME input.**

This warning indicates that a LOSTTIME entry has been encountered, normally when a SIGNAL85 or SIGNAL94 data file has been loaded. Due to the new technique used to calculate lost time values in the 1997 & 2000 HCMs using STARTUPLOST and ENDGAIN values, LOSTTIME entries from older versions of the program cannot be converted reliably. In this case, it is the user's responsibility to make sure that appropriate STARTUPLOST and ENDGAIN values are used. Action: If the default LOSTTIME value (3 seconds) was used in SIGNAL85 or SIGNAL94, the default STARTUPLOST and ENDGAIN values (2 seconds) in TEAPAC are probably appropriate and no action is required. Alternatively, STARTUP and ENDGAIN values can be entered (after the old data is loaded) which result in the desired lost time computation for each movement according to the techniques of the 2000 HCM.

**SIG21: WARNING**
**UTILIZATION entries > 1.0 from old data file have been inverted for new HCM.**

This warning indicates that a UTILIZATIONS entry has been encountered with a value greater than 1.0, normally when a SIGNAL85 or SIGNAL94 data file has been loaded. Due to the new technique used to define unbalanced lane utilization in the 1997 & newer HCMs, these values have been automatically inverted (1/x) to reflect the new definition. This message warns the user of this automatic conversion. Action: If the UTILIZATION values > 1.0 are, in fact, from an old SIGNAL85 or SIGNAL94 file, no action should be required. In any case, the user should simply make sure that this is the case and verify that the inverted results are appropriate.

**SIG22: ERROR**
**Phasing not appropriate for geometry according to HCM requirements.**

This error indicates that a SEQUENCES code has been selected which is not allowed by the methods of the 2000 HCM. This is typically when a type 4, 5 or 6 phasing has been selected, but an exclusive left turn lane does not exist for both left turns served by the protected phasing. If SEQUENCE code 0 has been selected, other requirements may also not be met. For example, movements may not start up more than once during the cycle length, negative movement numbers for permitted left turn operation may not be used unless a protected phase has also been defined, and negative movement numbers may only be used for left turns. Action: Check that an exclusive left turn lane exists for every approach served by a SEQUENCE type 4, 5 or 6. For SEQUENCE code 0, check that all of the detailed phasing requirements for defining phasings with code 0 have been met.

**SIG23: WARNING**
**Input for XXXXXXXX exceeds limits allowed by HCS. Check results carefully.**

This warning indicates that an input to TEAPAC which is being HCSEXPORTed to HCS exceeds a limit imposed by HCS. This is a limit that is more extreme than in TEAPAC, so the HCSEXPORT process must limit the HCS input in order to avoid an error condition in HCS. As a result, since the inputs to HCS differ from those made to TEAPAC, the results obtained from HCS may differ from the TEAPAC result for that reason. The input variable type is noted in the warning in the XXXXXXXX position of the message. Action: Check the input to HCS for the variable described in the message, and recognize any differences in the results that this changed input may cause.

**SIG24: ERROR**
**Lost time for movement XX results in negative or zero effective green.**

This error indicates that the combination of GREENTIMES, YELLOWTIMES, REDCLEARTIMES, STARTUPLOST and ENDGAIN for the listed movement has resulted in an effective green time less than or equal to zero and computations cannot continue. Action: Adjust any or all of the entries mentioned above for the movement listed such that the resulting effective green time, as defined in the HCM, is greater than zero.

**SIG25: ERROR**
**Host program defined by Options-Setup not found. Install or adjust setup.**

A check is made before the Auto option of HCSEXPORT is performed to make sure the required host program (HCS+) is present on the system. This error indicates that the designated host program cannot be located, and the Export is aborted. Action: The Options-Setup menu dialog defines the system path where the host HCS+ program is installed. Use this menu dialog to verify that the entry is correct. Optionally use the Browse button to either verify the path/folder named or to find and select the correct folder (select the required executable file). Press the Save button to save the new configuration. The Save button updates the contents of the TEAPAC.CFG file for the next time TEAPAC is run.

If the host program has not been installed, install it and verify the corresponding Options-Setup entry. If the program file to be executed is different than the name expected by TEAPAC, the executable file name to be used can be added at the end of the path entry.

**SIG26: WARNING**
**Intersection (or Dummy) with stop or yield control defined is being skipped.**

This warning indicates that one of the intersection's movements has been defined with GROUPTYPES as being controlled by a sign, either Stop or Yield, or that the intersection is defined as a 'Dummy node' in the INTERSECTION label. In either case, this condition cannot be analyzed by TEAPAC's capacity analysis techniques, and the analysis is skipped with this message. This is the desired response if the data is being included in TEAPAC only for later use by TRANSYT, CORSIM or SYNCHRO, any of which will handle the sign-control correctly upon export from TEAPAC. Action: Make sure that the sign-controlled or 'Dummy node' designation is correct. If this is the case, this and other messages can be closed automatically the next time they occur by selecting this option in the Warning box. If not, use GROUPTYPES to correct the lane group control to something other than sign controlled, or INTERSECTION to correct the 'Dummy node' designation.

**SIG27: WARNING**
**This function is not valid when all intersections have been selected.**

This warning indicates that all intersections have been selected (by selecting INTERSECTION 0) and an action which is not valid for all intersections has been requested. For example, SORT and TIMINGS are commands which follow DESIGN, but can only be issued when a single intersection is selected. HCSEXPORT is another such command for a single intersection because HCS can only handle a single intersection. DIAGRAMS is another such command. Action: Select the single intersection of concern with INTERSECTION and re-issue the desired action command. If DESIGN is desired for all intersections, use a non-zero parameter with the DESIGN command, since the manually selective functions of SORT and TIMINGS are not valid when all intersections are selected.

**SIG28: ERROR**
**The current HCM does not support coordination to a split phase operation.**

The current HCM (2010/2016) does not prescribe a way to analyze the effects of coordination when the coordinated phase is split phase operation (SEQUENCE 7). Proceeding with the analysis when this is the case would produce erroneous results, so this condition is currently disallowed by the program. Action: For a single intersection ANALYZE, the coordination can be removed in order to permit the analysis, but the coordinated phase will be evaluated without coordination effects, good or bad. To keep the signal coordinated to assess the coordination effects, change the phasing & timing to something similar to the actual split phase operation, such as lead-lag (SEQUENCE 8) with a short overlap time. For phasing optimization with DESIGN, any split phase options permitted for the coordinated phase will be marked as inappropriate.

## Trouble Spots (for Signal Analysis)

A number of common problems occur when people are first using TEAPAC for signal analysis, or as they begin to attempt more advanced applications. This section provides a limited discussion of these types of problems that have been identified. If other such problems occur, the user is referred to the User Forum at www.StrongConcepts.com/Forum to discuss the problem and possible solutions with other TEAPAC users.

Sub-topics for this section:

Lane Group WIDTH Designation (for Signal Analysis)
Phasing SEQUENCE Designations (for Signal Analysis)

## Lane Group WIDTH Designation (for Signal Analysis)

The WIDTHS command is a powerful command that designates both the width of a lane group as well as its lane usage. As such, it can be initially confusing, but ultimately provides a powerful and easy-to-use means of identifying this information in a simple and concise manner. The first thing to recognize is that if a non-zero WIDTH appears in a through lane group position, this WIDTH can be used by any vehicles on the approach. The only limitation is that turning vehicles that have designated exclusive turn lane WIDTH will not use the through lane width unless a dual-optional GROUPTYPES entry is made. Exclusive turn lane WIDTH is designated by putting a non-zero WIDTH in a turn lane group position.

Another way of looking at this is how VOLUMES are assigned to lane group WIDTHS. Through lane VOLUMES can only be assigned to through lane group WIDTHS. Turning VOLUMES will be assigned entirely to exclusive turn lane group WIDTHS, if they exist, otherwise they will be assigned only the adjacent through lane group WIDTH. If a dual-optional turn lane is defined, turning volumes are assigned to both the turn lane and the adjacent lane group.

A common occurrence of this dilemma is on the stem of a T-intersection, where no throughs exist, but all turns are made out of a single lane approach. In this case, the only option is to declare the single lane as a through lane from which all turns will be made. If more than one lane exists, each can be assigned to the appropriate turns as they are used.

## Phasing SEQUENCE Designations (for Signal Analysis)

Any time a "sequence code" is required by the program, as is the case for the SEQUENCES, ANALYZE, EVALUATE, QUEUECALCS, HCSEXPORT and DIAGRAMS commands, among others, a two-digit number must be entered. The first digit represents the phasing type for the north-south movements, as defined in Figure 1-2 of Chapter 1, while the second digit represents the phasing type for the east-west movements. This is a standard convention used by all TEAPAC application functions which require the specification of a signal phasing. It only requires remembering the eight distinct phasing types shown in Figure 1-2, all of which follow a logical progression of phasing treatment for left turns. By learning these eight types, a combination of 64 distinct phasings can be precisely represented with a single two-digit number. This phasing can also be communicated quickly and succinctly to other users.

Note also that the phasings specified by the sequence code can be altered slightly by the addition of permissive left turns as defined by the PERMISSIVES command, by a change in phase order as defined by the LEADLAGS command, and by the addition of overlapping right turns based on the existence of exclusive right turn lanes (OVERLAPS). Also, if SEQUENCE code -1 through -9 is specified, the phasing can be defined arbitrarily by proper use of the PHASEMOVEMENTS command. In the case of these special SEQUENCE codes, the defined phasing can only be analyzed with ANALYZE, EVALUATE or QUEUECALCS, but cannot be DESIGNed or HCSEXPORTed to HCS.

## Appendix E Topics (for Traffic Impact Analysis):



## Error Messages (for Traffic Impact Analysis)

The following messages are issued to indicate that the conditions of the program are not as expected. The TIAxx number that precedes the message in this document is the error number which is displayed at the top of the error message window. The notes that follow the message here indicate where to look for conditions that may have caused the message, and how to correct these conditions. Messages designated as **WARNINGS** may not cause computations to stop, while those designated as **ERRORS** will terminate all computations.

Errors and Warnings:



**TIA01: ERROR**
**This option is disabled for this demonstration version. Upgrade license.**

Certain options of the TEAPAC program are not available for demonstration versions of the program. This message indicates that such a situation has been encountered. Action: In order to release this constraint, a full-usage license to the program must be obtained.

**TIA02: ERROR**
**An INTERSECTION number must be given before this input can be made.**

Before any data can be entered for a given intersection, the INTERSECTION command must be issued for that intersection in order to set it up as the "current" intersection. Action: First issue the proper INTERSECTION command, then repeat the attempted data input for that intersection.

**TIA03: ERROR**
**An INTERSECTION number must be given before this DATA can be listed.**

Before any data can be displayed for a given intersection, the INTERSECTION command must be issued for that intersection in order to set it up as the "current" intersection. Action: First issue the proper INTERSECTION command, then repeat the attempted DATA command for that intersection.

**TIA04: ERROR**
**A PATHDISTRIBUTION type # must be given before this input can be made.**

Before any data can be entered for a given distribution type, the PATHDISTRIBUTION command must be issued for that distribution type in order to set it up as the "current" type. Action: First issue the proper PATHDISTRIBUTION command, then repeat the attempted data input for that distribution type.

**TIA05: ERROR**
**A PATHDISTRIBUTION type # must be given before this DATA can be listed.**

Before any data can be displayed for a given distribution type, the PATHDISTRIBUTION command must be issued for that distribution type in order to set it up as the "current" type. Action: First issue the proper PATHDISTRIBUTION command, then repeat the attempted DATA command for that distribution type.

**TIA06: ERROR**
**The inbound and outbound distribution factors must each sum to 100%. Check.**

In order for the traffic impact analysis computation to generate valid results, the sum of the distribution factors for each of the inbound distribution types and each of the outbound types must equal 100 percent. If this is not the case, all of the trips generated for either the inbound or outbound direction will not be assigned and the results will be incorrect. This error message indicates that this condition has not been met. Action: Check the sum of the distribution percentages for all of the inbound distribution types and for all of the outbound types and check that they sum to 100 percent. This is most easily done by producing the SUMMARIZE output to view the factors for each type.

**TIA07: ERROR**
**The percentages of the PATHS for TYPE xx must sum to 0 or 100%. Check & fix.**

In order for the traffic impact analysis computation to generate valid results, the sum of the percentages given for each of the PATHASSIGNMENTs of each distribution type must usually equal 100 percent. If this is not the case, all of the trips generated for the distribution type will not be assigned and the results will be incorrect. This error message indicates that this condition has not been met for the distribution type listed. Since some special applications of TEAPAC's traffic impact analysis computations accomplish negative assignments of traffic, the sum of the path percentages for these situations must equal 0 percent and this case is found to be acceptable as well. Action: Check the sum of the percentages for all of the paths defined for the listed distribution type and check that they sum to 0 or 100 percent.

**TIA09: ERROR**
**Path list must start/end with valid external/access node numbers. Re-enter.**

When entering a PATHASSIGNMENT command for the current PATHDISTRIBUTION type of traffic, the path list must either start or end with a valid external node number, and conversely must then end or start with a valid access node. Action: For inbound distribution types, the first node of the path list must be the same as the external node number appearing on the current PATHDISTRIBUTION command, and the last node must be one of the inbound access nodes on the inbound GENERATION command. Conversely, for outbound distribution types, the first node of the path list must be one of the outbound access nodes on the outbound GENERATION command, and the last node must be the same as the external node number appearing on the current PATHDISTRIBUTION command. Check what condition is not being met and adjust as appropriate.

**TIA10: ERROR**
**A COMPUTE list entry is not in the range of -1 to xx, or 999. Re-enter list.**

When the COMPUTEPATHS command is issued, the list of distribution types to compute traffic for must be composed of valid distribution type numbers. This includes any integer number from 1 up to the number of distribution types defined on the current SITESIZE command, or 999 to represent non-site traffic computations, or –1 (with no other entry) to indicate non-site traffic only, or 0 (with no other entry) to indicate no new traffic volumes are to be computed. Action: Determine which type number entered on the COMPUTEPATHS command does not meet the above criteria and re-enter the COMPUTEPATHS command.

## Trouble Spots (for Traffic Impact Analysis)

A number of common problems occur when people are first using TEAPAC for traffic impact analysis, or as they begin to attempt more advanced applications. This section will provide a limited discussion of these types of problems that have been identified. If other such problems occur, the user is referred to the User Forum at www.StrongConcepts.com/Forum to discuss the problem and possible solutions with other TEAPAC users.

The most common trouble in using TEAPAC for traffic impact analysis for the first time is recognizing the convention that traffic input data is entered by approach in a clockwise fashion. The first entry on any line of traffic data (e.g., VOLUMES and LANES) is the data value for traffic on the north approach, sometimes referred to as traffic coming "from the north". The next entry is for traffic on the east approach (from the east), then for the south, and lastly for the west. When movement numbers are required, the movements are numbered in an identical fashion, starting with the right turn on the north approach as movement number 1, and proceeding clockwise up to the left turn on the west approach as movement number 12. This is a convention held by all TEAPAC inputs and results, as described in Figure 1-1 of Chapter 1 in this manual.

## Appendix E Topics (for Count Analysis):

Appendix E Topics
Error Messages (for Count Analysis)

Trouble Spots (for Count Analysis)

## Error Messages (for Count Analysis)

The following messages are issued to indicate that the conditions of the program are not as expected. The COUxx number that precedes the message in this document is the error number which is displayed at the top of the error message window. The notes that follow the message here indicate where to look for conditions that may have caused the message, and how to correct these conditions. Messages designated as **WARNINGS** may not cause computations to stop, while those designated as **ERRORS** will terminate all computations.

Errors and Warnings:

COU01 - ERROR
COU02 - ERROR
COU03 - ERROR
COU04 - ERROR
COU05 - ERROR
COU06 - ERROR
COU07 - ERROR
COU08 - ERROR
COU10 - ERROR

**COU01: ERROR**
**Only x distinct time period range(s) is(are) allowed. More have been defined.**

The PERIODS command allows only five distinct time periods of counts to be defined. This requires five pairs of start and stop times to be entered. If more than five time periods are entered, this error will be generated. Action: If more than five periods were actually counted, they will need to be separated into two distinct runs or merged into fewer time periods with zeros entered for some of the count intervals which were not counted. If this is not the case, check for the proper entry of each of the start and stop times on the PERIODS command following the count interval.

**COU02: ERROR**
**The second time of the period cannot occur before the first time. Re-enter.**

The PERIODS command allows the entry of pairs of start and stop times to define the range of time each count period encompasses. The first number entered for each pair defines the start time, entered in 24-hour time notation. The second time of each pair defines the end time of the period, and must not be less than the first time of the period. If the second time is less than the first, this error is displayed. Action: In this case, correct the PERIODS entry so that each stop time is no earlier than its associated start time.

**COU03: ERROR**
**The time that was entered is not a valid time entry. Re-enter.**

If the time entry of the PERIODS command does not match the count interval entered, it is designated as an invalid time entry by this error message. For example, if 15-minute counts are to be entered, every time entry of the PERIODS command must end with 00, 15, 30 or 45. If 60-minute counts are to be entered, each time entry of PERIODS must end with 00. Action: Check the count interval used (first parameter of PERIODS) and make sure the times used on PERIODS match the constraints listed above or round entries to the nearest value that matches the above constraints.

**COU04: ERROR**
**The time periods entered have created more than the max of 97 entries.**

For an entire day of counts (24 hours), 96 distinct 15-minute time periods exist. If cumulative counts are performed, 97 count intervals will be needed for these counts. This is the maximum number of 15-minute intervals TEAPAC allows. This error is issued if it attempts to create more than 97 count intervals, based on the time period start and stop times entered. Action: Make sure that the start and stop times entered for the time periods do not overlap, cover more than a single 24-hour period, or in any other fashion attempt to generate more than 97 distinct count intervals. Non-overlapping count periods for a single day will always fit into this limit without error, if defined properly on the PERIODS command. Attempts to combine several days' counts for a single intersection should be avoided, with this error message being a common result of such an attempt.

**COU05: ERROR**
**The time periods entered cannot overlap. Re-enter without overlap.**

Each of the time periods defined on the PERIODS command are not allowed to overlap in any way. If the start time is the same as or precedes any other stop time, or if a stop time is the same as or follows any other start time, this error will be displayed. Action: Check that the time periods entered do not overlap in any way. If they do, they must be entered as two separate problems, and cannot be combined.

**COU06: ERROR**
**The extra inputs for this movement entry have been ignored. Check for error.**

This error is generated by either the VEHICLECOUNTS or TRUCKCOUNTS command when too many entries have been entered in the Manual Mode. If entries are being made for a given movement number, there cannot be more count entries following the movement number than there are number of count intervals defined by the PERIODS command. If entries are being made for a given time interval, no more than twelve count entries may follow the time being entered, one for each movement. Action: Check the entries made following the movement number of time, making sure the number of entries match the limits discussed above. This can be particularly tricky when entering counts for a given movement, especially when more than one time period is defined by the PERIODS command. Use the Tabular View of the Visual Mode or the ASK VEHICLECOUNTS command to see on the full-screen display what entries are expected when entering rows or columns of the count tables.

**COU07: ERROR**
**xxxxx is not a valid movement number or time value entry.  Re-enter properly.**

The first parameter of the VEHICLECOUNTS and TRUCKCOUNTS commands must define whether the following entries are for a given movement or a given time interval.  To do this, the first entry must be a valid movement number (1-12) or a valid time interval as defined by the PERIODS command.  Action: If entering data for a given time interval, use the DATA or ASK command to display the valid times which have been generated by the current PERIODS command.  Re-issue the VEHICLECOUNTS or TRUCKCOUNTS command with a proper movement number or time, or re-issue the PERIODS command so the proper times are defined for your count information.

**COU08: ERROR**
**The output file number, x, is not a valid file number for a defined file.**

In order for the FILE or BOTH option of the OUTPUT command to work properly with the PEAKANALYZE command, the file number given must point to a file in the FILES command that has been successfully located, and that file number must have a NEXTLINES value greater than 0.  If this is not the case, this error is issued.  Action: Check that the FILES command has a located file in the slot represented by the file number used on the OUTPUT command prior to using the PEAKANALYZE command.  Also check the NEXTLINES value for this file to make sure it is larger than 0.

**COU10: ERROR**
**Entry of this command is not allowed for the demonstration program.**

In a demonstration version of TEAPAC, the intersection conditions for a warrant analysis take on preset values which cannot be changed by use of the CONDITIONS command.  This error indicates an attempt has been made to use the CONDITIONS command.  Action: Purchase a full-use license of TEAPAC to eliminate this artificial constraint.  This message will not be issued in a full-use licensed version of TEAPAC.

## Trouble Spots (for Count Analysis)

A number of common problems occur when people are first using TEAPAC for count analysis, or as they begin to attempt more advanced applications.  This section provides a limited discussion of these types of problems that have been identified.  If other such problems occur, the user is referred to the User Forum at www.StrongConcepts.com/Forum to discuss the problem and possible solutions with other TEAPAC users.

Sub-topics for this section:

- Definition of Time Intervals (for Count Analysis)
- Cumulative Counts (for Count Analysis)
- Treatment of Truck Counts (for Count Analysis)

## Definition of Time Intervals (for Count Analysis)

The most common problem in using TEAPAC for count analysis is interpreting the meaning of a time value as it applies to actual time intervals on the clock. The primary thing to keep in mind is that every time value that is entered or displayed represents an interval of time, and that the time used always represents the beginning of that time interval. For example, in 15-minute counts, a time such as 645 will always indicate the time interval from 6:45 A.M. to 7:00 A.M. In 60-minute counts, a time such as 1600 will always indicate the time interval from 4:00 P.M. to 5:00 P.M. This applies to entries made on the PERIODS command, defining which counts are being entered on VEHICLECOUNTS and TRUCKCOUNTS commands, and any time a time is displayed in output reports.

The only exception to this is in the entry of cumulative counts, in which case the time used is the time the number to be entered was actually recorded. For example, in making a 1-hour count from 6:00 A.M. to 7:00 A.M., five counter numbers will be recorded, one each at times labeled as 600, 615, 630, 645 and 700. The 6:00 count will be the difference between the 600 and 615 entries, etc. Even in cumulative counts, however, all report outputs follow the rule mentioned above - a 600 time refers to a time period beginning at 6:00 A.M.

One other place where time notations can be confusing is with the PEAKANALYZE command parameters and output. The same rules apply, however, as mentioned above. If the PEAKANALYZE 600 700 command is issued, since 60-minute volumes will be scanned, this means to search for a peak hour starting with a count at 6:00 A.M. and ending with a count that stopped at 8:00 A.M. Since the 700 volume is the last complete volume with four 15-minute values added into it, it is likely that a 1-hour peak will be found that starts no later than 7:00 A.M., but this cannot be guaranteed. In the extreme, if only the hour from 6:00 to 7:00 A.M. is desired in the report, the PEAKANALYZE 600 600 command should be used.

## Cumulative Counts (for Count Analysis)

The above example also illustrates another trouble spot in using cumulative counts. Note that even though only four 15-minute count intervals are being made, five count entries are made since four differences are required to get the four final counts. In general, the number of entries for cumulative counts is always one more than the number of count intervals. Although this may seems to add unnecessary confusion to the whole count process, when doing manual counts this gives the best assurance that errors made in recording counts will not cumulate and that missed counts have not been arbitrarily manufactured after the fact.

## Treatment of Truck Counts (for Count Analysis)

Truck counts may be entered in two different ways in TEAPAC. In either case, the entry of trucks themselves are always made with the TRUCKCOUNTS command. The difference is whether the entries of VEHICLECOUNTS which are made have these TRUCKCOUNTS included, or if they are excluded from the VEHICLECOUNTS entries. If VEHICLECOUNTS include the values entered on the TRUCKCOUNTS commands, this is defined by the INCLUDED option of the COUNTTYPE command. This is the default condition. If trucks are not included in the VEHICLECOUNTS, the keyword SEPARATE is used on the COUNTTYPE command. In either case, all counts and volumes reported in the outputs are for all vehicles, including trucks, except for the optional truck table which is selected on the OUTPUT command with the keyword YES.

## Appendix E Topics (for Progression Analysis):



## Error Messages (for Progression Analysis)

The following messages are issued to indicate that the conditions of the program are not as expected. The NSTxx number that precedes the message in this document is the error number which is displayed at the top of the error message window. The notes that follow the message here indicate where to look for conditions that may have caused the message, and how to correct these conditions. Messages designated as **WARNINGS** may not cause computations to stop, while those designated as **ERRORS** will terminate all computations.

Errors and Warnings:



**PRG01 - ERROR**
**Intersection xx PRG-SPLIT time is too small. Re-enter PRG-SPLIT.**

This error indicates that a PRG-SPLITS value for the listed intersection is too small. This value has either not been entered, leaving the default value of 0.00, or has been entered as a value less than 5. In either case, a split less than 5 is not allowed at any of the intersections. Action: Re-enter the split with an appropriate value. If the actual split is not known, an approximation will frequently be adequate since the optimization is not overly sensitive to precise split entries.

**PRG02 - ERROR**
**Link xx PRG-DISTANCE is too small. Re-enter PRG-DISTANCE.**

This error indicates that a PRG-DISTANCES value for the listed link is too small. This is the PRG-DISTANCE input for the intersection with the same number as the link, that is, the link between intersection xx and xx+1. This value has either not been entered, leaving the default value of 0.00, or has been entered as a value less than 50. In either case, a link distance less than 50 is not allowed for any of the links. Action: Re-enter the distance with an appropriate value.

**PRG03 - ERROR**
**Link xx has a zero PRG-SPEED, which is not allowed. Check & re-enter speed.**

This error indicates that a PRG-SPEEDS value for the listed link has a zero value. This is the PRG-SPEED input for the intersection with the same number as the link, that is, the link between intersection xx and xx+1. This value has either not been entered, leaving the default value of 0.00, or has been entered as a zero. If the PRG-SPEED in only the LEFT-RIGHT direction has been entered, this will leave the default PRG-SPEED of zero in the RIGHT-LEFT direction. In either case, a zero link speed is not allowed for any of the links, since no progression can result with a zero speed. Action: Re-enter the zero speed with an appropriate non-zero value.

**PRG04 - ERROR**
**PRG-CYCLES values must be multiples of 10 from 60 to 120 for this demo.**

This error indicates that a PRG-CYCLES value which is not a multiple of 10 seconds, or is outside of the accepted range of 60 to 120 seconds, such as 40, 65, 92, 122, etc., has been entered in a demonstration version of TEAPAC. In the demonstration version, PRG-CYCLES values must be limited to multiples of 10 seconds between 60 and 120, such as 60, 70, 110, etc. The only acceptable cycle increment for a demo version of TEAPAC is 0 or 10 seconds. Action: Re-enter PRG-CYCLES values in multiples of 10 seconds within the accepted range, or license a full-use version of TEAPAC without this limitation.

**PRG05 - ERROR**
**NO SOLUTIONS FOUND**

This error indicates that the PROGRESSION optimization has been unable to find a solution which provides progression under the conditions which have been input. This may be caused by either a very long system and/or very small through splits on the arterial. Action: If it is feasible to increase the through splits at any of the intersections with smaller PRG-SPLITS values, this should be tried in an attempt to get a solution. If this fails, the system can be broken up into two or more shorter sub-systems which are analyzed independently. If the final optimized cycle length for each sub-system is the same, they can be inter-coordinated by using the PRG-BASE command to set the PRG-OFFSETS value of a common intersection. If the cycles are different, the sub-systems will operate independently. With this possibility in mind, the complete system should be broken up at points where such a discontinuity in the system would be appropriate. This is normally on longer links or congested links where coordination will not be very helpful anyway.

**PRG06 - ERROR**
**PRG-SIZE is not defined. Enter a non-zero system PRG-SIZE, then enter data.**

This error indicates that a non-zero value has not been entered for the PRG-SIZE command, defining the number of signals in the arterial system. This must be the first step in entering any intersection or link data for the system. After the PRG-SIZE has been set properly, appropriate intersection and link data can be entered. Action: Enter the proper PRG-SIZE of the arterial system, then enter the appropriate intersection and link data such as PRG-SPLITS, PRG-SPEEDS and PRG-DISTANCES. Then re-issue the PROGRESSION or PLOTSIMPLE command.

## Trouble Spots (for Progression Analysis)

A number of common problems occur when people are first using TEAPAC for progression analysis, or as they begin to attempt more advanced applications. This section provides a limited discussion of these types of problems that have been identified. If other such problems occur, the user is referred to the User Forum at www.StrongConcepts.com/Forum to discuss the problem and possible solutions with other TEAPAC users.

Sub-topics for this section:



## Left-Right versus Right-Left Orientation (for Progression Analysis)

The "Left-to-right" direction in a TEAPAC progression analysis is defined as moving along the arterial from lower intersection numbers to higher numbers. For example, moving from intersection 1 to intersection 2 is moving in the "Left-to-Right" direction. If a diagram of the arterial is placed with intersection 1 to the left and the last intersection to the right, then it is apparent why this direction is designated "Left-to-Right". The "Right-to-Left" direction is the opposite direction, moving from higher to lower intersection numbers. It is for this reason that it is best to define the intersection numbers increasing in a direction where such a layout will be sensible. This is usually increasing in a northbound or eastbound direction.

Information is always entered for intersections and links in order of increasing intersection number. That is, intersection 1 is always entered first, followed by intersection 2, 3, etc. up to the last intersection in the system. This means information is being entered in the "Left-to-Right" direction. This may be initially confusing when entering "Right-to-Left" parameters, such as PRG-SPEEDS and PRG-LEADLAGS, but the clarification is that data items are always entered in order from "Left-to-Right", regardless of the meaning of the data being entered.

## Appendix E Topics (for Export and Import):



## Error Messages (for Export and Import)

The following messages are issued to indicate that the conditions of the program are not as expected. The EXPxx number that precedes the message in this document is the error number which is displayed at the top of the error message window. The notes that follow the message here indicate where to look for conditions that may have caused the message, and how to correct these conditions. Messages designated as **WARNINGS** may not cause computations to stop, while those designated as **ERRORS** will terminate all computations.

Errors and Warnings:

EXP01 - ERROR
EXP02 - WARNING
EXP03 - WARNING
EXP04 - ERROR
EXP05 - ERROR
EXP06 - WARNING
EXP07 - ERROR
EXP08 - ERROR
EXP09 - ERROR
EXP10 - ERROR
EXP11 - ERROR
EXP12 - ERROR
EXP13 - ERROR
EXP15 - ERROR
EXP16 - WARNING
EXP17 - ERROR
EXP18 - ERROR
EXP19 - ERROR
EXP20 - ERROR
EXP21 – WARNING
EXP98 - WARNING
EXP99 - ERROR

**EXP01 - ERROR**
**The system cycle length has not been entered. Enter CYCLE before continuing.**

This error indicates that one of the [Results] commands has been executed prior to the entry of a valid system cycle length. Only IMPORT can be executed without a system cycle length entered. Action: Use the CYCLES command to enter a valid system cycle length.

**EXP02 - WARNING**
**An INTERSECTION number must be given before this input can be made.**

This warning indicates that an attempt has been made to enter data values for an [Intersection] command prior to defining which intersection this data belongs to. Action: Use the INTERSECTION command to first define the intersection number data will be entered for, then re-enter the data. In the Tabular View, make sure the Execute button is used to "execute" the INTERSECTION command.

**EXP03 - WARNING**
**An INTERSECTION number must be given before this DATA can be listed.**

This warning indicates that a request has been made to display the current DATA values for an [Intersection] command prior to defining which intersection this data is requested for. Action: Use the INTERSECTION command to first define the intersection number DATA is desired for, then re-enter the DATA request. In the Tabular View, make sure the Execute button is used to "execute" the INTERSECTION command.

**EXP04 - ERROR**
**The number of nodes in the LINKLIST exceeds the maximum of the program (XXX).**

This error indicates that when the LINKLIST command was processed to create the links to be simulated, the program limit of XXX simulation links was exceeded. XXX is 500 in current versions of TEAPAC. Action: Break up the system into two or more smaller sub-systems, or don't use the LINKLIST to specify the links you want simulated.

**EXP05 - ERROR**
**This INTERSECTION number is not in the NODELIST. Re-enter or add to NODELIST.**

This error indicates that the INTERSECTION command was executed using a node number that was not in the NODELIST. Action: If the node number desired is already in the NODELIST, re-execute the INTERSECTION command using the proper node number. If the node number is not in the NODELIST, but should be, append it to the end of the current NODELIST so as not to disturb any of the intersection entries already made, then re-execute the desired INTERSECTION command. The Manual Mode may be needed to append the new node number to the NODELIST if more than 12 entries will result. See the special Notes section of the NODELIST command for an explanation.

**EXP06 - WARNING**
**The SEQUENCE code for this INTERSECTION must be -1 thru -5 to use PHASEMOVS.**

This warning indicates that the PHASEMOVEMENTS command was executed for an intersection whose SEQUENCES code was not in the range of -1 through -5. Action: The SEQUENCE code for the intersection must first be set to a number in the range of -1 through -5 before the PHASEMOVEMENTS command can be executed.

**EXP07 - ERROR**
**Too many links are required for this network. Merge links or split network.**

This error indicates that the internal program limit for the number of links which can be modeled has been exceeded when the internal link diagram was being constructed. This limit is 1001 links in current versions of TEAPAC. Action: Break up the system into two or more smaller sub-systems, or specify fewer lane groups (non-zero WIDTHS) to describe your system. By merging lane groups, fewer links will be generated.

**EXP08 - ERROR**
**GREENS & YELLOWS must add up to demo limit of 60 seconds. Re-enter.**

In a demonstration version of TEAPAC, only 60 second cycle lengths can be modeled for export and import. This error indicates that this limitation has been exceeded. Action: Correct the GREENTIMES, YELLOWTIMES and REDCLEARTIMES so that they add up to the demo limit of 60 seconds, or purchase a full-use license of TEAPAC to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of TEAPAC.

**EXP09 - ERROR**
**YELLOWTIMES are limited to values of only 3.0 seconds in demo. Re-enter.**

In a demonstration version of TEAPAC, clearance intervals can only take on values of 3.0 seconds for export and import. This error indicates that this limitation has been exceeded. Action: Correct the YELLOWTIMES so that they equal the demo limit of 3.0 seconds, or purchase a full-use license of TEAPAC to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of TEAPAC.

**EXP10 - ERROR**
**Zero GREENTIME for phase X of node XXX not allowed. Re-enter or use 0.01 sec.**

This error indicates that a phase for the intersection whose node number is indicated has a GREENTIMES value of 0.0 seconds. Third-party host programs will typically not allow this to be modeled. Action: Re-enter the proper, non-zero GREENTIME for the phase. If the actual phase time is 0.0 seconds, enter a value of 0.01 seconds so that the input will not be rejected.

**EXP11 - ERROR**
**Movement XX of node XXX with non-zero WIDTH needs non-zero SATFLOW. Re-enter.**

This error indicates that a movement for the intersection whose node number is indicated which has a non-zero WIDTHS entry has a SATURATIONFLOWS entry of 0 vphg. This cannot be modeled by the third-party host programs. Action: Re-enter the proper, non-zero SATURATIONFLOWS for the lane group.

**EXP12 - ERROR**
**Movement XX of node XXX with non-zero WIDTH needs non-zero VOLUME. Re-enter.**

This error indicates that a movement for the intersection whose node number is indicated which has a non-zero WIDTHS entry has a VOLUMES entry of 0 vph. This suggests that a volume has been omitted, since every non-zero lane group should have a non-zero volume in it. Action: Enter a non-zero VOLUME for the referenced movement, or remove the movement's WIDTH entry if the lane group does not exist.

**EXP13 - ERROR**
**Movement XX of node XXX with non-zero VOLUME needs non-zero WIDTH. Re-enter.**

This error indicates that a movement for the intersection whose node number is indicated which has a non-zero VOLUMES entry has a WIDTHS entry of 0 feet. This suggests that a lane group has been omitted, since every non-zero volume should have a non-zero lane group in which it flows. Action: Enter a non-zero WIDTH for the referenced movement, or remove the movement's VOLUME entry if the movement does not exist.

**EXP15 - ERROR**
**Node XXX is not properly connected to other nodes in the NODELIST/SUBSYSTEM.**

A check is made before an EXPORT or PLOTTSD to make sure that each of the intersections in the NODELIST and/or SUBSYSTEM are reasonably connected. This does not guarantee that the system is fully or properly connected, but will catch intersections that are not connected to any other intersections in the network. Action: Review the NETWORK commands of the referenced intersection to make sure traffic flow from every signal in the NODELIST/SUBSYSTEM is properly defined, including both the source nodes and source movements. Also check intersections whose NETWORK commands include the referenced intersection.

In the case of 'diagonal' connections between intersections, special care must be taken when creating these connections, as follows. A diagonal connection is a link that connects two intersections without the typical rectangular relationship. For example, a rectangular connection might connect the east leg of one intersection to the west leg of another, while a diagonal connection might connect the east leg of one to, for example, the north leg of the other. The connection does not need to be a straight, diagonal line to be considered a diagonal connection, and often appears as a curved link -- the important consideration is that the link does not connect two intersections with the typical east-to-west or north-to-south relationship.

The best way to assure that the proper relationships are created for a diagonal link is to first create stubs for each of the intersections which approach the intersections from the typical rectangular directions, then connect these stubs with a new link, then move the dummy nodes at the ends of the original stubs (which have now become bend nodes) and/or add additional bend nodes to create the desired link appearance. If you have received this error message for a node which is connected with a diagonal (or curved) link, these requirements have probably not been met, and the easiest way to correct the situation is probably to delete any bend nodes on the link, and then re-create the connection with the instructions above.

**EXP16 - WARNING**
**Code X error detected during IMPORT (see App. E). Check results carefully.**

Several possible and typical errors which may be encountered when **IMPORTing data from TRANSYT-7F** output files are identified, as listed below. The most common is that TEAPAC detects a different version of TRANSYT in the output file than that indicated by the OUTPUT command. This will occur if the OUTPUT option in TEAPAC is not consistent with the version of TRANSYT which created the output file. Be especially careful of this problem if newer release of TRANSYT is being run with a data set which was SAVEd while using an earlier release of TRANSYT, as saved on the OUTPUT command.

0 File read error, usually due to a bad diskette or hard disk, no import is performed. Action: Determine and correct the cause of the bad disk.

1 TRANSYT-7F output for Release 6 or higher not found in output file, no import is performed.
Action: Verify that the Release of TRANSYT-7F being used is Release 6 or higher. If this is not the case, IMPORT cannot function. This error will also be issued if an empty file is selected or an incorrect file name with no valid TRANSYT output is used.

2 Controller settings not found in TRANSYT output file, no import is performed.

Action: Make sure that the run being made generates the Controller Settings output. Note that a multi-cycle evaluation does not produce this output, so not IMPORT is possible. This error may also occur if a TRANSYT error has occurred so no TRANSYT results exist; view the results to see if this is so.

3 Node number in import file is not in the node list, import is aborted.
Action: Make sure that the NODELIST contains all of the intersections which are found in the TRANSYT output, otherwise TEAPAC cannot IMPORT the results to the proper intersection's data.

4 TRANSYT-7F release in output file doesn't match OUTPUT command; import continues and OUTPUT command is modified to match import.
Action: No real action is necessary, except to verify that the correct version of TRANSYT is being used, as intended.

Several possible and typical errors which may be encountered when **IMPORTing data from PASSER-II and NOSTOP** output files are identified, as listed below.

0 File read error, usually due to a bad diskette or hard disk, no import is performed.
Action: Determine and correct the cause of the bad disk.

2 Pin settings not found in PASSER output file, no import is performed.
Action: Make sure that the run being made generates the Pin Settings output. This error may also occur if a PASSER error has occurred so no PASSER results exist; view the results to see if this is so.

3 Node number in import file is not in the node list, import is aborted.
Action: Make sure that the NODELIST contains all of the intersections which are found in the PASSER output, otherwise TEAPAC cannot IMPORT the results to the proper intersection's data.

Several possible and typical errors which may be encountered when **IMPORTing data from SYNCHRO, TRU-TRAFFIC and TS/PP-DRAFT** output files are identified, as listed below.

0 File read error, usually due to a bad diskette or hard disk, no import is performed.
Action: Determine and correct the cause of the bad disk.

1 MOVEMENTS.DAT header bad; import aborted. Action: Check for proper header line in data file.

2 MOVEMENTS.DAT data line bad; import aborted. Action: Check for proper data lines in data file.

3 LAYOUT.DAT header bad; import aborted. Action: Check for proper header line in UTDF data file.

4 LAYOUT.DAT data line bad; import aborted. Action: Check for proper data lines in UTDF data file.

5 Too many intersections in data files being Imported; import aborted. Action: Reduce the size of the system being Imported, so that it matches the maximum number of real nodes for your Usage Level (also, a maximum of 500 dummy nodes can be imported).

6 LANES.DAT header bad; import aborted. Action: Check for proper header line in UTDF data file.

7 LANES.DAT data line bad; import aborted. Action: Check for proper data lines in UTDF data file.

8 PHASING.DAT header bad; import aborted. Action: Check for proper header line in UTDF data file.

9 PHASING.DAT data line bad; import aborted. Action: Check for proper data lines in UTDF data file.

10 One or more intersection node numbers are too large. Action: Import may continue with no immediate problems, but recognize that the imported data will likely not be re-useable by TEAPAC due to the intersection node number(s) exceeding the TEAPAC limit of 9999.

11 Data in the SYNCHRO files has been determined to be Metric units, not U.S. Customary (USC) units; import aborted. Action: Data must be in USC units to be imported. Use the Options menu in SYNCHRO and select Convert-to-Feet, then re-save the SYNCHRO files and re-Import into TEAPAC.

12 An intersection in the network has been detected with more than four legs; import aborted. Action: Import into TEAPAC will only operate for intersections that have a maximum of four legs. Modify the SYNCHRO network to meet this constraint by removing insignificant intersection legs and re-Import.

**EXP17 - ERROR**
**A cycle length different than 60 sec. is not allowed in demo. IMPORT aborted.**

The demonstration version of TEAPAC only allows cycle lengths of 60 seconds for export and import and a different cycle length was found in the host program's output file. Action: Change the host run to a 60 second cycle length, or obtain a Full-Use licensed copy of TEAPAC.

**EXP18 - ERROR**
**Route definition error at node XXX in Route X; refer to Appendix E, code X.**

Several possible errors are detected in ROUTE definitions which are defined with the following codes. These errors detect the major problems which might be encountered when defining artery routes for TRANSYT, although not all possible errors will be trapped. The user carries the final responsibility for defining routes in a manner consistent with TRANSYT's needs.

1 Node number of route list is not in NODELIST.
Action: Correct the route definition by deleting the node which is not in the NODELIST, or add that node number to the NODELIST.

2 Part of the route is 1-way while another part is 2-way.
Action: Re-define the route so that it is entirely 1-way or entirely 2-way, or break up the route into sub-sections which are consistently 1-way and 2-way.

3 Left-to-right link not found in route list.
Action: Make sure that regardless of whether the route is 1-way or 2-way, it always has traffic moving in the left-to-right direction for the entire distance of the route.

**EXP19: ERROR**
**NODELOCATION coordinates are required by SYNCHRO for each node; please enter.**

In order to make a successful run of SYNCHRO, the X,Y coordinates of each intersection must be provided. This error is produced when TEAPAC detects that intersection coordinates have not been entered and all intersection coordinates still have their default values of 0,0. Action: Enter non-zero intersection coordinates for each intersection.

**EXP20 - ERROR**
**Host program defined by Options-Setup not found. Install or adjust setup.**

A check is made before the Auto option of EXPORT is performed to make sure the required host program is present on the system. This error indicates that the designated host program cannot be located, and the Export is aborted. Action: The Options-Setup menu dialog defines the system path where the host program is installed. Use this menu dialog to verify that the entry is correct. Optionally use the Browse button to either verify the path/folder named or to find and select the correct folder (select the required executable file). Press the Save button to save the new configuration. The Save button updates the contents of the TEAPAC.CFG file for the next time TEAPAC is run.

If the host program has not been installed, install it and verify the corresponding Options-Setup entry. If the program file to be executed is different than the name expected by TEAPAC (such as when the version of the host program differs from the most recent supported version) the executable file name to be used can be added at the end of the path entry.

**EXP21 - WARNING**
**Missing average greens will be replaced by maximums at 1 or more nodes (#XXX).**

This warning indicates that the EXPORT or PLOTTSD command was executed for an intersection whose GREENAVERAGES values are needed, but have not been entered, so its GREENTIMES values will be used instead. #XXX is the first intersection where this condition was encountered. Action: Normally, the average phase durations should be used to model average conditions, so the ANALYZE or DESIGN should be used to perform a 2016 HCM analysis to compute these values and place them in the GREENAVERAGES entries automatically.

**EXP98 - WARNING**
**Possible phasing spec error for node XXXX (timings do not sum to cycle).**

After an import for a given intersection, the imported phase timings are checked to see that they add up to the imported cycle length specified for that node. This message is issued if that sum is not equal to the cycle length. Action: This condition is likely caused by an attempt to import a phasing which is not defined in SYNCHRO in a manner that is comprehensible to TEAPAC, that is, normal techniques are used to define a phasing supported by TEAPAC. The flexibility allowed by SYNCHRO in this regard is significant, and when this message is issued the user must inspect the phasing and timings imported for node XXXX carefully. In most instances, the solution is to adjust the phasing or timings in TEAPAC to represent the conditions in SYNCHRO as closely as possible. In some cases, it will be apparent that some part of the SYNCHRO phasing definition is not 'normal' and a change in the SYNCHRO phasing definition to a more standard format may prevent this message from being issued.

**EXP99 - ERROR**
**Possible diagonal legs for node XXXX not specified in MOVEMENTS.DAT file.**

If SYNCHRO contains intersection legs that approach the intersection on defined diagonals, rather than in the normal perpendicular directions, this condition needs to be defined for TEAPAC via a MOVEMENTS.DAT file. When this warning is issued, TEAPAC has detected a condition where data in the UTDF LAYOUT.DAT or LANES.DAT file does not appear to follow the normal perpendicular directions (according to the column headings in the LAYOUT.DAT or LANES.DAT file), but corresponding definitions for these movements have not been found in a MOVEMENTS.DAT file. Action: Create or add to a MOVEMENTS.DAT file in the same folder as your other UTDF files a definition of the diagonal movements, as illustrated in the example below. The format of the file matches that of the other UTDF files, and includes a column for each of the 12 TEAPAC movements, in clockwise order starting with the right turn on the north approach. The first line labels the file and the second line indicates the TEAPAC movement column headings. Subsequent lines indicate first the intersection number, then the LANES.DAT column headings which match up with each of the expected TEAPAC movements. MOVEMENTS.DAT is a fixed-format file, so lining up the columns is important -- 6 spaces for the INTID and 5 spaces for each column label, all columns right-justified. Use '---' as placeholders for movements which do not exist at the intersection. The three lines of the following example can be pasted from this display to create an initial MOVEMENTS.DAT file with the correct format.

```
Movement Label Data
 INTID  NRT  NTH  NLT  ERT  ETH  ELT  SRT  STH  SLT  WRT  WTH  WLT
     3  SWR  SWT  SWL  WBR  WBT  WBL  NER  NET  NEL  EBR  EBT  EBL
```

## Trouble Spots (for Export and Import)

A number of common problems occur when people are first using TEAPAC for export and import, or as they begin to attempt more advanced applications. This section provides a limited discussion of these types of problems that have been identified. If other such problems occur, the user is referred to the User Forum at www.StrongConcepts.com/Forum to discuss the problem and possible solutions with other TEAPAC users.

Sub-topics for this section:

- Lane Group WIDTH Designation (for Export and Import)
- Phasing SEQUENCE Designations (for Export and Import)
- INTERSECTION Command (for Export and Import)

### Lane Group WIDTH Designation (for Export and Import)

The WIDTHS command is a powerful command that designates both the width of a lane group as well as its lane usage. As such, it can be initially confusing, but ultimately provides a powerful and easy-to-use means of identifying this information in a simple and concise manner. The first thing to recognize is that if a non-zero WIDTH appears in a through lane group slot, this WIDTH can be used by any vehicles on the approach. The only limitation is that turning vehicles that have designated exclusive turn lane WIDTH will not use the through lane width. Exclusive turn lane WIDTH is designated by putting a non-zero WIDTH in a turn lane group slot.

Another way of looking at this is how VOLUMES are assigned to lane group WIDTHS. Through lane VOLUMES can only be assigned to through lane group WIDTHS. Turning VOLUMES will be assigned entirely to exclusive turn lane group WIDTHS, if they exist, otherwise they will be assigned only the adjacent through lane group WIDTH.

A common occurrence of this dilemma is on the stem of a "T" intersection, where no throughs exist, but all turns are made out of a single lane approach. In this case, the only option is to declare the single lane as a through lane from which all turns will be made. If more than one lane exists, each can be assigned to the appropriate turns as they are used.

### Phasing SEQUENCE Designations (for Export and Import)

Any time a "sequence code" is required by the program, a two-digit number must be entered. The first digit represents the phasing type for the north-south movements, as defined in Figure 1-2 of Chapter 1, while the second digit represents the phasing type for the east-west movements. This is a standard convention used by all TEAPAC application functions which require the specification of a signal phasing. It only requires remembering the eight distinct phasing types shown in Figure 1-2, all of which follow a logical progression of phasing treatment for left turns.

By learning these eight types, a combination of 64 distinct phasings can be precisely represented with a single two-digit number. This phasing can also be communicated quickly and succinctly to other users.

Note also that the phasings specified by the sequence code can be altered slightly by the addition of permissive left turns as defined by the PERMISSIVES command, by a change in phase order as defined by the LEADLAGS command, and by the addition of overlapping right turns based on the existence of exclusive right turn lanes (OVERLAPS). Also, if a SEQUENCES code -1 through -5 is specified, the phasing can be defined arbitrarily by proper use of the PHASEMOVEMENTS command.

## INTERSECTION Command (for Export and Import)

In the Tabular View, the INTERSECTION command is an active command which requires use of the Execute button to "execute" it. When selecting a new intersection number from the NODELIST to use on the INTERSECTION command so that information can be entered or reviewed for that intersection, first enter the new node number, then use the Execute button to "execute" the INTERSECTION command. The dialog box will now show the current values for the new intersection. The first time the INTERSECTION command is issued for an intersection, the description can also be entered before the Execute button is used. When subsequent entries of the INTERSECTION command are made without the description, the previously entered description is retrieved.

APPENDIX F

# TEAPAC System Error Messages

Appendix F Topics

TEAPAC system messages are displayed by all TEAPAC applications whenever an identifiable fault condition is detected which is primarily not application-specific. The message may be due to the command itself, to one of its parameters, or as a result of the action taken by the command. When a condition is detected, an error number and message is displayed identifying the type of condition encountered. This appendix discusses the TEAPAC messages and their meanings, followed by a discussion of potential causes and actions which may correct the conditions. Table F-1 summarizes the error numbers which are discussed in this appendix. The remainder of the appendix lists and discusses each of these messages in numerical order.

The messages in this appendix are TEAPAC system messages which can be detected that are not necessarily related to any specific TEAPAC application function. These are identified by a prefix of "TPC" in the error code. Appendix E lists those errors which are unique to a specific TEAPAC application function. These are identified by a different prefix, "XXX", related to the application function being used. Appendix G lists those errors which are generated by the operating environment being used, and as such are unique to that operating environment. The form of these error messages is dependent upon the operating environment being used. Messages are either WARNINGS or ERRORS. A WARNING might be advisory only, while ERRORS are usually fatal and terminate the current action.

Once an error message has been displayed and acknowledged, the program will respond with either an opportunity to re-enter a parameter value, or, in the Manual Mode, the possible need to re-enter an entire new command line in order to fix the error. If a new parameter value is all that is needed to correct the problem, the program will prompt for this using the appropriate dialog.

**Table F-1**
**<u>Summary of TEAPAC System Error Messages</u>**

Command Entry Errors
- TPC01: ERROR - command is not recognizable
- TPC02: ERROR - abbreviation for more than one command

File Errors
- TPC11: ERROR - file name cannot be located as specified
- TPC12: ERROR - file number is not in the range of 0 to 5
- TPC13: ERROR - file number is not defined by FILES command
- TPC14: ERROR - requested file number is currently in use
- TPC15: ERROR - file access exceeds 6 levels of nesting
- TPC16: WARNING - file name does not exist, create?
- TPC17: ERROR - read/write error at line xxxxx in file x
- TPC18: WARNING - file name already exists, overwrite?
- TPC19: ERROR - failed attempt to read past end of file x
- TPC20: ERROR - path\file name exceeds size limits
- TPC21: WARNING - data written by XXXXX Vv.vv.bb may be lost, overwrite?
- TPC22: WARNING - possible inconsistent usage of advanced data file

Parameter Errors
- TPC31: WARNING - keyword is not recognizable
- TPC32: WARNING - more parameters found than were expected
- TPC33: WARNING - parameter is not a valid numeric entry
- TPC34: WARNING - integer number not in the accepted range
- TPC35: WARNING - decimal number not in the accepted range
- TPC36: WARNING - node number not in NODELIST

Command as Parameter Errors
- TPC41: WARNING - INVALID COMMAND IGNORED
- TPC42: WARNING - too many commands listed on this command
- TPC43: WARNING - AMBIGUOUS ENTRY IGNORED

Demonstration Errors
- TPC44: ERROR - AUTO Export not allowed for demo
- TPC45: ERROR - only one file can be opened at a time for demo
- TPC46: ERROR - use of printer not allowed for demo
- TPC47: ERROR - writing to disk not allowed for demo
- TPC48: ERROR - allowed input range limited for demo
- TPC49: ERROR - default values cannot be changed for demo

**Table F-1 (continued)**
**Summary of TEAPAC System Error Messages**

Command Specific Errors
TPC51: ERROR - GOTO variable does not match current REPEAT
TPC52: ERROR - ERROR IN PROGRAM SPECIFICATION
TPC53: ERROR - REPEAT specification is not valid
TPC54: ERROR - PERIODS allows only 5 distinct time period ranges
TPC55: ERROR - PERIODS time period 2nd entry occurs before 1st
TPC56: ERROR - PERIODS time value entered is not a valid time entry
TPC57: ERROR - PERIODS time periods entered define too many entries
TPC58: ERROR - PERIODS time periods entered cannot overlap
TPC59: ERROR - COUNTS (VEHICLE or TRUCK) too many entries
TPC60: ERROR - COUNTS (VEHICLE or TRUCK) invalid entry
TPC61: WARNING - INTERSECTION # required before input can be made
TPC62: WARNING - INTERSECTION # required before data can be listed
TPC63: ERROR - INTERSECTION # not in NODELIST
TPC64: WARNING - old UTILIZATION entries must be inverted
TPC65: WARNING - negative SEQUENCE code needed to use PHASEMOVS
TPC66: ERROR - CONDITIONS values cannot be entered for demo
TPC67: ERROR - PATHASSIGNMENT list must start/end with valid node
TPC68: WARNING - PATHDISTRIBUTION type # required before input can be made
TPC69: WARNING - PATHDISTRIBUTION type # required before data can be listed
Miscellaneous Errors
TPC71: ERROR - BUFFER SIZE EXCEEDED...SORT ABORTED
TPC72: ERROR - SCRATCH FILE LIMITS EXCEEDED...SORT ABORTED
TPC81: ERROR - higher Usage Level License is needed
TPC91: ERROR - HELP FILE MUST HAVE STRING COUNT IN LINE 1
TPC92: ERROR - TOO MANY CHARS REQUIRED FOR COMMAND STRINGS:

## Appendix F Topics



**TPC01 - ERROR**
**This command is not recognizable. Re-enter or type HELP [AllCmds] for list.**

This error message will be displayed if a command entry cannot be identified as a valid command. This error is generally generated by the misspelling of a command or an invalid command abbreviation in the Manual Mode. TEAPAC will accept a wide variety of abbreviations for any one command as long as the characters are unique to one and only one command (see TPC02 below) and the characters appear in the correct order as in the command. For example, VLMS is a valid abbreviation for the VOLUMES command while VMLS would generate a TPC01 error message. Since the command could not be identified, the program does not process any of the parameters entered and requests another entry. Action: Re-enter the command or a valid command abbreviation along with its appropriate parameters. Use the Help-Commands menu or HELP [AllCommands] to see all possible commands alphabetically.

**TPC02 - ERROR**
**This is an abbreviation for more than one command. Use more letters.**

This error is generated when the program has been unable to identify one and only one command from an abbreviated command in the Manual Mode. An abbreviation could be a single character if it uniquely defines a command; however, if the character or string of characters can be interpreted as more than one command, a TPC02 error message will be displayed. Since the command could not be identified, the program does not process any of the parameters entered and returns to the command level prompt. This error only applies to the Manual Mode. Action: Re-enter the correct command or a valid command abbreviation along with its appropriate parameters. Use the Help-Commands menu or HELP [AllCommands] to see all possible commands alphabetically.

**TPC11 - ERROR**
**This file name cannot be located as specified. Re-enter a different name.**

This error message has been superseded by TPC16 and TPC18.

**TPC12 - ERROR**
**File number xxxxx is not in the range of 0 to 5. All file access is aborted.**

TEAPAC can access from one to five data files at a given time. These five files are specified by the use of the FILES command. Each file is numbered from one to five in the order they are entered with the FILES command. Commands such as LOAD and SAVE direct the program to these files by giving the <File Number> of the file to be used. This error will occur if the <File Number> parameter value used is not between 1 and 5, inclusive. Other file access commands, such as OUTPUT, use the <File Number> parameter in a similar fashion. Action: Re-specify the command which is referencing an improper <File Number> with the correct <File Number>.

**TPC13 - ERROR**
**File number xxxxx is not defined by the FILES command. File access aborted.**

TEAPAC can access from one to five data files at a given time. These five files are specified by the use of the FILES command. Each file is numbered from one to five in the order they are entered with the FILES command. Commands such as LOAD and SAVE direct the program to these files by giving the <File Number> of the file to be used. This error will occur if the <File Number> parameter of a command references a position of the FILES command which is not currently defined. This error typically occurs when the FILES command is not used to define a <File Number> before referencing its use in a LOAD or SAVE command. It may also occur if an incorrect <File Number> was specified. Action: First define the <File Name> for the <File Number> being referenced with the FILES command, then re-issue the file access command; or re-issue the file access command with the correct <File Number>.

**TPC14 - ERROR**
**Requested file number xxxxx is currently in use.  All file access is aborted.**

Each of the five files named on the FILES command can be accessed by several commands; however, if a file is currently being access by one command (such as LOAD), that file can not be accessed by another command (such as another nested LOAD) until the current access is completed. This situation can occur when using a control file where one file's commands access another file's commands through use of nested LOADs. Action: Remove the multiple referencing to a single <File Number>; or restructure the file access so that one access is completed before the next is begun.

**TPC15 - ERROR**
**File access (LOAD/SAVE/etc) exceeds 6 levels of nesting.  All access aborted.**

File access commands such as LOAD and SAVE can only be nested to a depth of six levels. If more than six levels of file access are generated, this error message will result. This situation can inadvertently develop when a file process is aborted upon execution of the next file access command. Action: Re-issue the file access command which was aborted (this error will clear all file access); or eliminate the situation which requires more than six levels of file access.

**TPC16 - WARNING**
**This file name does not exist.  Create a file by this name? ........(No/Yes)**

This error message occurs when the requested <File Name> on the FILES command does not exist. Typically, this occurs when the File Switch for a new file was not used and the file cannot be located as specified (see Appendix G - File Specification). For example, if no Switch is designated and the file does not currently exist, then the warning message will be displayed to indicate that the file will need to be created if it has been specified properly. This condition normally occurs if the name of an existing file is misspelled on the FILES command or a request has been made to use a non-existent file. In either case, this message prevents a new file from inadvertently being created if this was not the intention. Action: The program is prompting the user whether the non-existent file should be created as if the /N switch had been used. By responding "Y" to this prompt, the file name used will be created and the error condition is erased. If any other character is pressed, then the file name will not be created and the user should re-specify the correctly spelled file name.

**TPC17 - ERROR**
**Read/write error at line xxxxx in file x.  ESCape to abort continued attempts.**

This error indicates that the <Record Number> in the file currently being accessed is not readable. This typically occurs when the record of the file has never been defined by a SAVE command or other file creation techniques. It will also occur if an attempt is made to access data past the physical end of the file, especially if the file does not have an end of file terminator. Action: Re-specify the location within the file to be accessed; or first create information in that part of the file before trying to use it. In the case where repeated TPC17 errors occur through an attempt to LOAD non-existent information from a file (normally past the end of the defined file's contents), the ESCape key will abort the LOAD process and return to enter another command. Frequently, this error can be avoided by adding an end of file terminator to the end of the file.

**TPC18 - WARNING**
**This file name already exists. Use it anyway? .....(No/Yes)**

This error message occurs when the requested <File Name> on the FILES command already exists, but the File Switch for a new file was used (see Appendix G - File Specification). For example, if the /N Switch is designated and the file currently exists, then the warning message will be displayed to indicate that the file's contents, if any, will be overwritten if the file has been specified properly. This condition normally occurs if the name of a new file is misspelled on the FILES command or the intended new file name has already been used. In either case, this message prevents the existing file from inadvertently being overwritten if this was not the intention. Action: The program is prompting the user whether the existent file should be used anyway, as if the /N switch had not been used. By responding "Y" to this prompt, the file will be used as specified and the error condition is erased. If any other character is pressed, then the file named will not be overwritten and the user should re-specify the correctly spelled or different file name.

**TPC19 - ERROR**
**Failed attempt to read past end of file x at line xxxxx. File access aborted.**

This message indicates that an end of file marker was read in a data file during a read operation (typically LOAD). The program will abruptly halt the file access with this message at that point and return to the command input mode. Normally, this situation will not occur, since the program should return from file access via the occurrence of a RETURN command in the data file. Action: Verify that the file access location is correct and that a RETURN command exists at the end of the file's information. Then re-issue the file access command, if appropriate.

**TPC20 - ERROR**
**Invalid path\file. Path exceeds 180 chars or name of file exceeds 70 chars.**

This message indicates that an attempt was made to name or open a file whose file path or file name specification exceeded the TEAPAC limits of 180 characters for the file path or 70 characters for the file name. The file path limit includes the drive letter, and the file name limit includes the file extension and any switches used. Action: If the file path is too long, re-locate the file or sub-folder being used to a location where this limit will not be exceeded. Then re-issue the file access command, if appropriate. As an alternate, network drives can frequently be mapped to a new drive name, thereby reducing the file path length considerably by using a drive letter instead. If the file name is too long, re-name the file so that it meets the file name limit. Since multi-scenario Condition files and certain file switch options can add as many as 6 characters to file names designated by users, it is recommended that user file names not exceed a limit of 64 characters to avoid potential problems when these tools are used.

**TPC21 - WARNING**
**Data written by XXXXX Vv.vv.bb may be lost. Overwrite?...(No/Yes)**

This message indicates that a save operation has been requested for a file which contains data which was written by a different TEAPAC program, and thus is subject to possible data loss if the save operation is permitted. The authoring program of a file is determined when a file is opened and used, only if it was created by any TEAPAC program with the Version 5 or later

TEAPAC interface. This message may also be issued if an earlier version of the same TEAPAC program being used created the file and that earlier version saved information in a different manner such that data loss may occur. The authoring program's name, version and build numbers are listed in the warning message. Action: The program is prompting the user whether the existing data in the file should be overwritten anyway. By responding "Y" to this prompt, the file will be used as specified, with the possible loss of prior data values. If any other character is pressed, then the file named will not be overwritten and the user should re-specify a different file name, as appropriate, and re-specify the save operation desired.

**TPC22 - WARNING**
**This Save appears inconsistent with prior Advanced file usage. Save anyway?**

This message indicates that a save operation has been requested for a file using a normal Windows menu such as File-Save where it appears that such a save might be inconsistent with prior advanced file usage techniques applied to this same file. Primarily this is detected when the most recent file activity was to a different location in the file, or to a different file. In such a case, a normal Windows save function such as File-Save which will go to line 1 of file 1 is anticipated to be an inadvertent save which might not be desired by the user. Action: This condition is merely a warning to prevent a possible overwrite of data in an advanced use file. The program is prompting the user whether the save should be performed, or not, at the user's discretion. If the save is desired, select Yes; if not or there is any uncertainty, select No to abort the save.

**TPC31 - WARNING**
**This keywordis not recognizable. Look at HELP for its allowed values.**

This error message indicates that an invalid parameter value was detected. Generally, this indicates that an invalid character string was entered as a parameter value. Action: Re-enter the appropriate parameter value or values to correct the invalid entry; or press the ENTER key to ignore the invalid entry and leave the previous parameter value.

**TPC32 - WARNING**
**More parameters were found than were expected. The extras have been ignored.**

This message is displayed when more parameter values are entered for a particular command than the program will accept. This usually indicates a miscount of input; often a parameter value was entered twice. Most commands will re-prompt for a correct parameter list after this error. After this error, any extra entries will be ignored. The parameter list can also be re-typed starting at the position where a duplicate or unwanted entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed as usual. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, where this error will most likely occur, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

**TPC33 - WARNING**
**This parameter is not a valid numeric entry. Re-enter with a proper number.**

This error message indicates that alphabetic or special characters were entered for a parameter which must be a numeric value. Most commands will re-prompt for parameter re-entry after this error. After this error is received, the invalid entries will be ignored. The parameter list can also be re-typed starting at the position where the invalid entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

**TPC34 - WARNING**
**This integer number is not in the accepted range xxxxx to xxxxx. Re-enter it.**
**This input is not in the accepted range xxxxxxxxxx to xxxxxxxxxx. Re-enter.**

When a parameter value is entered which lies outside the allowable range of values, this error message is displayed. If the input entry accepts decimal places, TPC35 is displayed. If input entries are rounded to the nearest integer value, TPC34 is displayed. The appropriate ranges of allowable values shown in the error message are usually constants; however, they may be controlled by other input parameters on other commands. Further information on input limits can be found in Chapter 4 or Appendix B of the program documentation. Most commands will re-prompt for parameter entry after this error. After the error is issued, the invalid entries will be ignored. The parameter list can also be re-typed starting at the position where invalid entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed as usual. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

**TPC35 - WARNING**
**This decimal number is not in the accepted range xxx.xx to xxx.xx. Re-enter.**

When a parameter value is entered which lies outside the allowable range of values, this error message is displayed. If the input entry accepts decimal places, TPC35 is displayed. If input entries are rounded to the nearest integer value, TPC34 is displayed. The appropriate ranges of allowable values shown in the error message are usually constants; however, they may be controlled by other input parameters on other commands. Further information on input limits can be found in Chapter 4 or Appendix B of the program documentation. Most commands will re-prompt for parameter entry after this error. After the error is issued, the invalid entries will be ignored. The parameter list can also be re-typed starting at the position where invalid entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed as usual. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

**TPC36 - WARNING**
**Node # xxx used in xxxxxxxxxxxxxxxx entry is not in NODELIST.**

When a node number is entered which is not included in the NODELIST, certain functions are not likely to perform properly. These include PATHDISTRIBUTION, PATHASSIGNMENT, GENERATION and ASSIGNMENT. Other entries such as NETWORK and MASTERNODE permit the entry of node numbers not included in the current NODELIST/SUBSYSTEM. Action: In the cases where the entered node number is expected to be included in the NODELIST, either add the intersection to the NODELIST, if appropriate, or change the entry so it uses an intersection number already in the NODELIST.

**TPC41 - WARNING**
**INVALID COMMAND IGNORED**

This error message indicates that an invalid command used as a parameter value was detected. This most often occurs when an unrecognizable command string is entered for either the HELP, ASK, DATA, SAVE, or RESET commands. These commands will ignore the entire command list when this occurs. Action: Re-issue the command with the correct or properly abbreviated command parameters.

**TPC42 - WARNING**
**There are too many commands listed as parameters for this command. Re-enter.**

This message is displayed when too many commands are entered as parameter values for a particular command. This only occurs when using the HELP, ASK, DATA, SAVE, or RESET commands (which use commands as parameters). Typically, this error occurs when using Group Names as parameter values. The total number of commands contained in the list cannot exceed the total number of commands in the program. When this error occurs, the program will prompt the user to re-enter the command with a shorter list. Action: Re-issue the command with the correct list of command parameters, or re-issue the command several times with partial lists to get the desired result.

**TPC43 - WARNING**
**AMBIGUOUS ENTRY IGNORED**

This error is identical to TPC41 above, where the command used as a parameter is ambiguous and the parameter is ignored. Action: Same as TPC41 above.

**TPC44 - ERROR**
**This demonstration version does not permit use of the AUTO option of EXPORT.**

For a demonstration program, the AUTO option of EXPORT and HCSEXPORT is disabled. Normally, this option allows the exported file to be launched directly into the host program without the need to name the file and manually run the host program and open the exported file. Action: Purchase a full-use license for this program to enable this feature.

**TPC45 - ERROR**
**This demonstration version permits use of only one file. Others are ignored.**

For a demonstration program, the use of multiple files simultaneously is disabled. Normally, this option allows up to five data files to be open simultaneously for easy access to data in all files using the advanced file handling techniques of TEAPAC. Action: Purchase a full-use license for this program to enable this feature.

**TPC46 - ERROR**
**This demonstration version does not permit use of printer. Request ignored.**

For a demonstration program, the ability to print results is disabled. Normally, this option allows the contents of any output window to be directed to any printer accessible from your computer. Action: Purchase a full-use license for this program to enable this feature.

**TPC47 - ERROR**
**This demonstration version does not permit use of the AUTO option of EXPORT.**

For a demonstration program, writing information to a disk file is disabled. Normally, input data and results can be saved to disk files at locations accessible from your computer. Action: Purchase a full-use license for this program to enable this feature.

**TPC48 - ERROR**
**This value is limited to the range allowed by this demonstration version.**

For a demonstration program, certain input ranges are limited so arbitrary input values cannot be entered. Normally, a full range of typical input values is allowed for every input accepted by the program. Action: Purchase a full-use license for this program to enable this feature.

**TPC49 - ERROR**
**This command's values cannot be modified in this demonstration version.**

For a demonstration program, certain command entry values cannot be changed from their default values. Normally, a full range of typical input values is allowed for every input accepted by the program. Action: Purchase a full-use license for this program to enable this feature.

**TPC51 - ERROR**
**The GOTO variable does not match the current REPEAT command. Access aborted.**

If the <Destination> parameter on a GOTO command is not a <Variable> parameter of the most active REPEAT command, this message will be displayed. Command execution is terminated and a new command instruction is issued. Action: Verify that all REPEAT and GOTO variable references are correct and re-issue the LOAD command to restart the REPEAT loop process.

**TPC52 - ERROR**
**ERROR IN PROGRAM SPECIFICATION**

This error occurs when an invalid <Program Name> parameter is used with the STOP command. The <Program Name> parameter must be specified following the rules for file specification outlined in Appendix G. Action: Re-issue the STOP command using the correct file specification; or execute the STOP command without a <Program Name> and do a system directory to determine the proper name for the desired program.

**TPC53 - ERROR**
**The REPEAT specification is not valid. Check manual. File access aborted.**

This error occurs when any of the parameter values for the REPEAT command are not acceptable. For example, it could be that the <Variable> used is already in use or not an alphabetic character, or that the range and increment variables are not valid numeric values. Action: Re-issue the REPEAT command using proper parameter values.

**TPC54 - ERROR**
**Only X distinct time period range(s) is(are) allowed. More have been defined.**

The PERIODS command allows only five distinct time periods of counts to be defined. This requires five pairs of start and stop times to be entered. If more than five time periods are entered, this error will be generated. Action: If more than five periods were actually counted, they will need to be separated into two distinct runs or merged into fewer time periods with zeros entered for some of the count intervals which were not counted. If this is not the case, check for the proper entry of each of the start and stop times on the PERIODS command following the count interval.

**TPC55 - ERROR**
**The second time of the period cannot occur before the first time. Re-enter.**

The PERIODS command allows the entry of pairs of start and stop times to define the range of time each count period encompasses. The first number entered for each pair defines the start time, entered in 24-hour time notation. The second time of each pair defines the end time of the period, and must not be less than the first time of the period. If the second time is less than the first, this error is displayed. Action: In this case, correct the PERIODS entry so that each stop time is no earlier than its associated start time.

**TPC56 - ERROR**
**The time that was entered is not a valid time entry. Re-enter.**

If the time entry of the PERIODS command does not match the count interval entered, it is designated as an invalid time entry by this error message. For example, if 15-minute counts are to be entered, every time entry of the PERIODS command must end with 00, 15, 30 or 45. If 60-minute counts are to be entered, each time entry of PERIODS must end with 00. Action: Check the count interval used (first parameter of PERIODS) and make sure the times used on PERIODS match the constraints listed above or round entries to the nearest value that matches the above constraints.

**TPC57 - ERROR**
**The time periods entered have created more than the max of 97 entries.**

For an entire day of counts (24 hours), 96 distinct 15-minute time periods exist. If cumulative counts are performed, 97 count intervals will be needed for these counts. This is the maximum number of 15-minute intervals TEAPAC allows. This error is issued if it attempts to create more than 97 count intervals, based on the time period start and stop times entered. Action: Make sure that the start and stop times entered for the time periods do not overlap, cover more than a single 24-hour period, or in any other fashion attempt to generate more than 97 distinct count intervals. Non-overlapping count periods for a single day will always fit into this limit without error, if defined properly on the PERIODS command. Attempts to combine several days' counts for a single intersection should be avoided, with this error message being a common result of such an attempt.

**TPC58 - ERROR**
**The time periods entered cannot overlap. Re-enter without overlap.**

Each of the time periods defined on the PERIODS command are not allowed to overlap in any way. If the start time is the same as or precedes any other stop time, or if a stop time is the same as or follows any other start time, this error will be displayed. Action: Check that the time periods entered do not overlap in any way. If they do, they must be entered as two separate problems, and cannot be combined.

**TPC59 - ERROR**
**The extra inputs for this movement entry have been ignored. Check for error.**

This error is generated by either the VEHICLECOUNTS or TRUCKCOUNTS command when too many entries have been entered in the Manual Mode. If entries are being made for a given movement number, there cannot be more count entries following the movement number than there are number of count intervals defined by the PERIODS command. If entries are being made for a given time interval, no more than twelve count entries may follow the time being entered, one for each movement. Action: Check the entries made following the movement number of time, making sure the number of entries match the limits discussed above. This can be particularly tricky when entering counts for a given movement, especially when more than one time period is defined by the PERIODS command. Use the Tabular View of the Visual Mode or the ASK VEHICLECOUNTS command to see on the full-screen display what entries are expected when entering rows or columns of the count tables.

**TPC60 - ERROR**
**xxxxx is not a valid movement number or time value entry. Re-enter properly.**

The first parameter of the VEHICLECOUNTS and TRUCKCOUNTS commands must define whether the following entries are for a given movement or a given time interval. To do this, the first entry must be a valid movement number (1-12) or a valid time interval as defined by the PERIODS command. Action: If entering data for a given time interval, use the DATA or ASK command to display the valid times which have been generated by the current PERIODS command. Re-issue the VEHICLECOUNTS or TRUCKCOUNTS command with a proper movement number or time, or re-issue the PERIODS command so the proper times are defined for your count information.

**TPC61 - WARNING**
**An INTERSECTION # must be given before this input can be made. Enter here?**

This message indicates that an INTERSECTION number has not been selected prior to the entry of a data value. When an input value is entered that is intended to pertain to a specific intersection, that intersection number must first be selected with the INTERSECTION entry before the input value is entered. If this has not occurred, the program doesn't know which intersection to assign the entry value to. Action: If you know the intersection number you intend to be using, enter it in the error dialog and select Yes. In this case, the INTERSECTION command will be issued for you for that intersection. If you do not know the intersection number you wish to use, or are uncertain, select No, then use the INTERSECTION command to select an intersection from the NODELIST and re-enter the input value for that selection. In the Tabular View, make sure the Execute button is used to "execute" the INTERSECTION command.

**TPC62 - WARNING**
**An INTERSECTION # must be given before this DATA can be listed. Enter here?**

This message indicates that an INTERSECTION number has not been selected prior to the request to list a DATA value. When a data value is to be listed with DATA for a specific intersection, that intersection number must first be selected with the INTERSECTION entry before the value can be listed. If this has not occurred, the program doesn't know which intersection's data to list. Action: If you know the intersection number you intend to be using, enter it in the error dialog and select Yes. In this case, the INTERSECTION command will be issued for you for that intersection. If you do not know the intersection number you wish to use, or are uncertain, select No, then use the INTERSECTION command to select an intersection from the NODELIST and re-enter the DATA request for that selection. In the Tabular View, make sure the Execute button is used to "execute" the INTERSECTION command.

**TPC63 - ERROR**
**This INTERSECTION number is not in the NODELIST. Add to NODELIST? ..(No/Yes)**

This message is issued if an intersection number is entered that is not currently in the NODELIST. Since the purpose of INTERSECTION is to select a node number from the list in NODELIST, most often this condition indicates an invalid selection that the user will want to correct. Action: The normal response will be to select No, indicating that the intersection number entered is incorrect and must be corrected. However, there a several cases where this message can be used as a shortcut method for adding intersections to the NODELIST. In the case where it is known that the entered number is not in the NODELIST and it is desired to add it to the end of the NODELIST, select Yes and the intersection will be added to the NODELIST and selected in a single click. This can be a very effective way of building a NODELIST on the fly as new intersections or scenarios are needed, or as multiple data files are loaded into a single multi-intersection database to be saved as a single file.

**TPC64 - WARNING**
**UTILIZATION entries > 1.0 from old data file have been inverted for HCM 2000.**

This warning indicates that a UTILIZATIONS entry has been encountered with a value greater than 1.0, normally when a SIGNAL85 or SIGNAL94 data file has been loaded. Due to the new technique used to define unbalanced lane utilization in the 1997 & 2000 HCMs, these values have been automatically inverted (1/x) to reflect the new definition. This message warns the user of this automatic conversion. Action: If the UTILIZATION values > 1.0 are, in fact, from an old SIGNAL85 or SIGNAL94 file, no action should be required. In any case, the user should simply make sure that this is the case and verify that the inverted results are appropriate.

**TPC65 - WARNING**
**The SEQUENCE code for this INTERSECTION must be -1 thru -9 to use PHASEMOVS.**

This warning indicates that the PHASEMOVEMENTS command was executed for an intersection whose SEQUENCES code was not in the range of -1 through -9. Action: The SEQUENCE code for the intersection must first be set to a number in the range of -1 through -9 before the PHASEMOVS command can be executed.

**TPC66 - ERROR**
**Entry of this command is not allowed for the demonstration program.**

In a demonstration version of TEAPAC, the intersection conditions for a warrant analysis take on preset values which cannot be changed by use of the CONDITIONS command. This error indicates an attempt has been made to use the CONDITIONS command. Action: Purchase a full-use license of TEAPAC to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of TEAPAC.

**TPC67 - ERROR**
**Path list must start/end with valid external/access node numbers. Re-enter.**

When entering a PATHASSIGNMENT command for the current PATHDISTRIBUTION type of traffic, the path list must either start or end with a valid external node number, and conversely must then end or start with a valid access node. Action: For inbound distribution types, the first node of the path list must be the same as the external node number appearing on the current PATHDISTRIBUTION command, and the last node must be one of the inbound access nodes on the inbound GENERATION command. Conversely, for outbound distribution types, the first node of the path list must be one of the outbound access nodes on the outbound GENERATION command, and the last node must be the same as the external node number appearing on the current PATHDISTRIBUTION command. Check what condition is not being met and adjust as appropriate.

**TPC68: WARNING**
**A PATHDISTRIBUTION type # must be given before this input can be made.**

This message indicates that a PATHDISTRIBUTION type number has not been selected prior to the entry of a data value. When an input value is entered that is intended to pertain to a specific distribution type, that type must first be selected with the PATHDISTRIBUTION entry before the input value is entered. If this has not occurred, the program doesn't know which type to assign the entry value to. Action: If you know the distribution type you intend to be using, enter it in the error dialog and select Yes. In this case, the PATHDISTRIBUTION command will be issued for you for that type. If you do not know the type you wish to use, or are uncertain, select No, then use the PATHDISTRIBUTION command to select a type and re-enter the input value for that selection. In the Tabular View, make sure the Execute button is used to "execute" the PATHDISTRIBUTION command.

**TPC69: WARNING**
**A PATHDISTRIBUTION type # must be given before this DATA can be listed.**

This message indicates that a PATHDISTRIBUTION type number has not been selected prior to the request to list a DATA value. When a data value is to be listed with DATA for a specific distribution type, that type must first be selected with the PATHDISTRIBUTION entry before the value can be listed. If this has not occurred, the program doesn't know which type's data to list. Action: If you know the distribution type you intend to be using, enter it in the error dialog and select Yes. In this case, the PATHDISTRIBUTION command will be issued for you for that type. If you do not know the type you wish to use, or are uncertain, select No, then use the PATHDISTRIBUTION command to select a type and re-enter the DATA request for that selection. In the Tabular View, make sure the Execute button is used to "execute" the PATHDISTRIBUTION command.

**TPC71 - ERROR**
**BUFFER SIZE EXCEEDED...SORT ABORTED**

TEAPAC actions which perform substantial built-in sorting functions may encounter files whose contents require too much buffer space to be sorted. Within TEAPAC, it is difficult to correct this situation. Action: Attempt to reduce the amount of information being sorted; or use a system program to sort the file external to the TEAPAC program.

**TPC72 - ERROR**
**SCRATCH FILE LIMITS EXCEEDED...SORT ABORTED**

TEAPAC actions which perform substantial built-in sorting functions may encounter files whose contents require too much scratch file space to be sorted. Within TEAPAC, it is difficult to correct this situation. Action: Attempt to reduce the amount of information you are trying to sort; or use a system program to sort the file external to the TEAPAC program.

**TPC81 - ERROR**
**A higher Usage Level License is needed to use this command. Upgrade license.**

A command or action request has been made for a function which is not supported by the Usage Level which has been licensed. For example, a Usage Level 2 function may have been requested while using a program licensed only for Usage Level 1. Also, the limits of program may have been exceeded for the Usage Level licensed, as in trying to use 25 intersections when the licensed usage level only allows 12. Action: Limit the function and/or size of the problem being analyzed to those licensed; or upgrade your licensed Usage Level to include the function and/or size needed.

**TPC91 - ERROR**
**HELP FILE MUST HAVE STRING COUNT IN LINE 1**

This error indicates there is a problem with the information in the XXXXX.CMD file which supports the running of the TEAPAC program, where XXXXX is the name of the program. This information is not user serviceable. Action: Re-install the program from the master program disk.

**TPC92 - ERROR**
**TOO MANY CHARS REQUIRED FOR COMMAND STRINGS**

This error indicates there is a problem with the information in the XXXXX.CMD file which supports the running of the TEAPAC program, where XXXXX is the name of the program. This information is not user serviceable. Action: Re-install the program from the master program disk.

APPENDIX G

# Operating System Messages and Installation Notes

<u>Appendix G Topics</u>

Certain aspects of program installation and execution will vary among different computer systems. This is dependent upon the operating system of the computer rather than the software installed. Run-time error codes and file specification are two of the more prominent of these aspects. In addition, control of printed output, interactive editing control and program installation are dependent on the operating system.

This appendix discusses these aspects of TEAPAC program implementation for any of the 32-bit Windows operating systems. The details discussed herein should be appropriate for any standard implementation of these operating systems. Table G-1 summarizes the organization of this appendix.

**Table G-1**
**<u>Summary of Operating System Messages and Installation Notes</u>**

Run-Time Error Codes
File Specification
File Access
- Line Numbers
- File Numbers

Output Control
- Printer Control
- Disk File Output

Installing TEAPAC

## Appendix G Topics

- Appendix G Introduction
- Run-Time Error Codes
- File Specification

File Access
Output Control
Installing TEAPAC

## Run-Time Error Codes

The list of standard run-time error codes for the software development system used for TEAPAC is too extensive to be produced here. The most common one is a divide-by-zero error, indicating unexpected conditions, usually where not enough information has been provided. If other such problems occur, the user is referred to the User Forum at www.StrongConcepts.com/Forum to discuss the problem and possible solutions with other TEAPAC users.

## File Specification

There are four descriptive elements used by TEAPAC to define and access a disk data file. The elements are 1) the name of the disk drive and path to be used; 2) the actual disk file name; 3) the file name extension; and 4) a switch option. When these elements are combined, they constitute a file name specification which usually appears in the form of <File Name> in the documentation and help files:

<File Name> = d:\path\nnnnn.eee/s

It is important to note that a colon ":" must separate the name of the disk drive and the rest of the file specification, back-slashes "\" must be used to define a specific path on the drive or the network (the file path), a dot "." must separate the actual file name and the file name extension, and a slash "/" must separate the switch option from the other elements. The name of the disk drive-path, actual file name and file extension elements are identical to the file specification conventions of Windows. The fourth element, the switch option, is a unique element of TEAPAC used to control an aspect of data file creation. Each of the four elements are discussed in detail below.

Sub-topics for this section:
Drive-Path Designation (d:\path\)
File Name (nnnnn)
File Extension (.eee)
Switch (/s)

### Drive-Path Designation (d:\path\)

The drive-path designation indicates which disk drive and/or system path should be used to find an existing <File Name> or to place a new <File Name>. Typically, drive-path designations are letters such as C: for the local hard drive, folder or sub-folder names enclosed in back-slashes, network paths starting with double back-slashes, or a combination of these designations. The length of the drive-path designation cannot exceed a maximum of 180 characters, and upper/lower case characters and spaces are allowed. If no drive-path designation is provided, the default drive-path comes from the third entry displayed in the dialog of the Options-Setup menu. This location comes from the program's CFG file on program startup, a file whose contents can be altered with the Save button of the Options-Setup dialog. The Options-Setup dialog changes dynamically as the user navigates through the File-Open and File-SaveAs dialogs.

A common feature of Windows can be used to direct TEAPAC data files to another drive path. This is the Map Network Drive function. This process substitutes a network drive location for a drive designation. For example, on a typical system with an A:, B: and C: drive, a MAPped D: drive can be created pointing to a network drive elsewhere on the network. Then files on the network drive can be referenced in a TEAPAC program by simply using the D: drive. The Command Prompt SUBST command can also be used to map any folder or sub-folder to a virtual drive, not just map a drive as above. This is a particularly convenient way to get around the 180-character limit imposed by TEAPAC on the drive-path designation., if necessary.

## File Name (nnnnn)

This element is the actual file name of the data file and should be descriptive of the information contained within the file. The file name, including any file extension or switch (see below), cannot exceed a maximum of 70 characters. Upper/lower case characters and spaces are allowed. Since multi-scenario Condition files and certain file switch options can add as many as 6 characters to file names designated by users, it is recommended that user file names not exceed a limit of 64 characters to avoid potential problems when these tools are used. There are some special symbols which may not be used such as colons ":", dots "." and slashes "/" which are used as separators between the <File Name> elements. In order to minimize potential problems in naming files, it is recommended that only letters and digits be used in the disk file name.

## File Extension (.eee)

As many as three characters may be used to describe the file extension. Typically, the file extension describes the format of a data file rather than the actual contents. In TEAPAC, if a file extension is not entered, the program will automatically generate ".tpc" as the default extension. The older TEAPAC file format extension of ".for" is also allowed. Use of the default extension is recommended.

## Switch (/s)

When using the FILES command, the operating systems provide the capability to automatically create data files on disk. This capability also allows the unintentional creation of a file or the accidental overwriting of an existing file without warning. In the case of overwriting an existing file, the loss of valuable data may result. In order to eliminate these potential file management problems, TEAPAC uses two switches ("/N" and "/O") to indicate the intention of creating a new disk data file. If a data file is expected to already exist, a switch is not required.

The "/N" switch is used to automatically create a "New" data file that doesn't already exist, without any error or user query. If the "/N" option is used and a data file already exists for <File

Name>, a warning message will be displayed stating that the <File Name> already exists. This protects the user from accidentally over-writing an existing file when a new file was expected. If no switch is used, the TEAPAC program will expect to find an existing data file on the designated disk drive. If there is no existing data file for <File Name>, a warning message will be displayed indicating the file can not be located. This protects the user from accidentally creating a new file when an existing file was expected to exist, probably identifying a spelling error in the file name.

If a requested file does not exist and the /N Switch is not used, the user will be prompted as to whether to allow the program to create the data file anyway. This effectively eliminates the need to use the /N Switch; the program will create a new file if prompted to do so even when /N is not used. Conversely, if a requested file exists and the /N Switch is used, the user will be prompted as to whether to allow the program to overwrite the contents of the data file anyway, even though it was thought to be a new file. In either case, a user response of "Y" eliminates the potential error condition and the program continues with the selected action. If "N" or any other response is made, the program processes the condition as an error, usually with an opportunity to re-enter the bad file specification.

The "/O" switch is used to designate an "Otherwise" or "dOn't care" condition. If a data file exists for <File Name>, the file will be used and possibly overwritten. If the data file does not exist, a new file will be created under this option. This option can also be interpreted as the "Output" option, since it is typically invoked only when the file is to be used for output, rather than input. This mode creates a file if it is needed or uses one that already exists.

## File Access

All file access commands in TEAPAC (such as LOAD and SAVE) use line numbers and file numbers to describe where the file access is to take place. For example, the syntax of the LOAD command is: **LOAD <Line Number> <File Number>**. In order to LOAD the proper information from the data file, the proper <Line Number> and <File Number> must be specified. The <File Number> describes which of the defined FILES are to be used, while the <Line Number> describes where in the file to start the access. Each of these parameters are discussed below.

The File-Open/Save/SaveAs dialogs always work with line number 1 of file number 1; the following discussion only applies to the Advanced Files LOAD and SAVE options.

Sub-topics for this section:
- Line Numbers
- File Numbers

### Line Numbers

The line number of the file describes where in the file the access should begin. If a new file has been opened to SAVE information, the line number should be line 1 to start at the beginning of the file. When this information is to be retrieved, line 1 should be used for the LOAD command. If only one set of information is to be stored in the file, line 1 should always be used for every SAVE and LOAD performed. This is equivalent to the standard Windows functions of File-Open/Save/SaveAs.

Information may be stacked in files sequentially. For example, if the data for an analysis is SAVEd starting at line 1 of a file and takes up 50 lines of the file, another scenario can be SAVEd starting at line 51 of the file. If it also takes 50 lines, as reported by the SAVE command, this information will be stored in lines 51-100. In order to retrieve this information, line 51 should be used as the starting line number of the LOAD command. If the first scenario is desired again, simply LOAD starting at line 1 again.

Any number of conditions may be SAVEd and LOADed to and from a file, simply by knowing at which line number the information starts. When SAVing information, it is important to either re-SAVE starting at the same line number as previously used, or to SAVE starting at the next available line number of the file. When re-SAVing information, make sure the same information is SAVEd as previously used so that it takes up the same number of lines used previously. If more lines are used, they will overwrite the beginning of the next information (if it exists), and if less lines are used they will not erase the end of the previously SAVEd information.

After any file access is completed, such as a LOAD or a SAVE, the default line number for that file remains at the "next line" of the file until another file access command is executed or another file is opened. For example, after the first SAVE above taking 50 lines of the file, the default line number for the next file access command will be line 51. If another scenario is to be SAVEd, the default line number may be used without remembering what it is. For File #1, this line number is displayed in the dialog box of the file access command. Another use of the default line number is for access of SAVEd scenarios in the same order they were SAVEd. For example, the first scenario from above can be LOADed starting at line 1 and analyzed, then the next scenario can be LOADed starting at the default line number of 51, again without remembering what it is.

Another line number that is remembered by the program is the "last line" that was used for the file by any file access command. This line number is designated by using line 0 of the file. For example, if information from the second scenario above was LOADed (starting at line 51) and the analysis determined that are error in the input existed, it could be corrected and re-SAVEd using line number 0. Since the previous file access command (LOAD) started at line 51, whether by default or actual input, the following SAVE 0 command will start at line 51 again, effectively re-SAVing the information over the previous information with the corrections. In this sense, a repeated series of **LOAD *** and **SAVE 0** commands will LOAD the next information from the file, then re-SAVE any changes made before LOADing the next information.

## File Numbers

The file numbers used in file access commands such as SAVE and LOAD refer to the position in which the file name desired exists on the current FILES command. The FILES command can carry up to five files simultaneously and the file number assigned to each is the position of the file name in the FILES list. For example, if existing conditions for an analysis are stacked sequentially in a file called EXIST and optimized conditions are to be stored in a file called OPTIM, each could be open at the same time by using the **FILES EXIST OPTIM** command. Since EXIST is the first file in the file list, it will then be referred to as file number 1 by subsequent file access commands. OPTIM is the second file name in the list, so subsequent file access commands will use file number 2 for optimized conditions.

For example, using this situation, each scenario of existing conditions would be retrieved by using the command **LOAD * 1** and each set of optimized conditions would be SAVEd by using the command **SAVE * 2**. If the optimized conditions are to be retrieved while the same FILES command is in effect, the first scenario would be retrieved by a **LOAD 1 2** command and subsequent scenarios would be retrieved by **LOAD * 2** commands.

The file number used only applies to the current FILES list in effect, and need not be the same every time the files are used. For example, if the above optimized scenarios are to be retrieved on another day and the existing conditions are of no concern, the **FILES OPTIM** command can be used to define OPTIM as file number 1, then the optimized scenarios can be retrieved with **LOAD * 1** commands. Furthermore, since file number 1 is the default file number when executed from the keyboard and the next line number is always the default line number, the entire default **LOAD * *** command can be used, making the LOADing as easy as possible.

## Output Control

Within a TEAPAC program it is possible to redirect output display on the screen to other output devices. The most common use of this function is to direct output to the printer; however, it is also possible to direct output to disk files. This section discusses the methods of redirecting output to these devices.

Sub-topics for this section:
- Printer Control
- Disk File Output

## Printer Control

Any of the results generated by TEAPAC will appear in a Results window from which they can be printed. The Results window has a File menu from which the Print command can be selected. This will direct the program output in the Results window to the default printer. The Ctrl-P key may also be used as a shortcut key to print the Results window. From the main menu, the File-Print (Ctrl-P) selection will print a copy of the last output seen in the Results window. This last output can be viewed with the View-LastOutput menu command.

The PrintSetup options of these File menus can be used to select specific printers, as well as printer options like number of copies, print to file, print both sides, etc. prior to issuing the File-Print command. The SetupAndPrint option performs both functions with a single menu selection. The default printer can be set outside of the TEAPAC program by selecting the Printers folder of My Computer, selecting the desired printer, and clicking the Set_As_Default option in the File menu.

### Disk File Output

TEAPAC has several options for directing program output to disk files.

In the Results window the File-SaveAsText menu option can be used to copy the text contents of the Results window to a file named and located by the subsequent dialog entry. This file is an ASCII text file which can be opened by any text editor. Its default extension is .txt. In the event that too much output has been generated to be displayed by the Results window, as in the possible case of output from a control file, the SaveAsText file will contain all of the output even though it cannot all be displayed.

The Edit-CopyWindowToClipboard menu option will copy the contents of the currently-displayed page of the Results graphics, formatted window to the Windows clipboard as a bitmap image. This can then be used by any other Windows program's paste function which will accept a bitmap image.

The Edit-Copy menu option will copy to the Windows clipboard only that part of the Results text window which has been selected by dragging the mouse cursor over a portion of visible text. The Edit-SelectAll menu option will select the entire text contents of the Results window for a subsequent Edit-Copy. This can then be used by any other Windows program's paste function which will accept text, such as a text editor or word processor.

Some printer drivers and/or Windows printing systems may also offer other alternative ways to direct printed output to a file, although this will normally not result in a strict bitmap image or ASCII text file like the options above.

## Installing TEAPAC

The installation of TEAPAC follows the normal Windows practice of running the distributed Setup program. Licensed copies, demos and updates are all downloaded from the internet and install the same way using the downloaded .exe file, usually named Setup.exe or TPCw32.exe. The installation process prompts the user for information about the installation folder, etc. and performs all the necessary configuration of the Windows environment, including file type registration, icon creation and un-install options in the Control Panel. The default .CFG file is also created.

The default .CFG file (whose contents can be reviewed and changed from the Options-Setup menu) contain the default installation path names for the most recent supported versions of any host programs which work in conjunction with the TEAPAC program (e.g., HCS+, PASSER-II, TRANSYT-7F, CORSIM, etc.). These paths should be modified, as necessary, to reflect the actual installed location of the host programs. If edited externally, TEAPAC.CFG must be edited with a text editor. The program will look for the host programs before an EXPORT or HCSEXPORT when the AUTO option is performed, and will issue a message if it cannot be located as specified. In the event that a host program uses a name for the required executable file which is different than that expected by the TEAPAC program, the desired executable name can be added at the end of the path in the Options-Setup dialog (or the .CFG file directly).

TEAPAC is designed to be installed on a local drive of the computer being used by the user. Network installations must take care that all files and directories used have correct read/write privileges for the users.

APPENDIX H

# Addenda

Appendix H Topics

Appendix H provides a location for recent release notes and addenda which may be published after the official release of this documentation. This appendix can also be used to store printed copies of new release notes for updated versions of the software, as produced by the Help-RecentChanges menu or the MESSAGES command, for off-line reference.

## Appendix H Topics:

## :TEAPAC  Ver 9.50 26JAN19

**Build 01 – 26JAN19**

>Release of TEAPAC Complete Ver 9.5 – Free Version.

The official release version of TEAPAC Complete Version 9.5 has been published. With this version TEAPAC enters a new era of free distribution. All features and functions of the largest distribution size (Usage Level 3, 500 intersections) are available to anyone who downloads this version, without the need for a user key to unlock any paid features. Annual maintenance contracts will continue to be available, as before, with the primary purpose being for technical support via email directly from Strong Concepts.

## :TEAPAC  Ver 9.01 08SEP16

**Build 01 – 12OCT16**

>Official Release Version of TEAPAC Complete 2016 (Ver 9).

The official release version of TEAPAC Complete 2016 has been published – Ver 9.01 Build 01. This version replaces the unofficial beta version of the program which has been available since May, 2016, awaiting formal publication of the Highway Capacity Manual 6th Edition upon which its capacity analysis methods are based. Please refer to the detailed documentation below for the beta version 9.00 for a complete description of all the changes made, including –

- New signalized intersection capacity methods for 2016 HCM.
- New option for Urban Street capacity method for coordinated signals from 2016 HCM.
- New feature keeps track of the reference phase for an offset.
- Patch available for WinHlp32 under Windows 8/10.

## :TEAPAC  Ver 9.00 16MAY16

**PreRelease 02 – 16MAY16**

>Signalized Capacity Analysis Method of 2016 HCM (6th Edition) Implemented.

The 2010 HCM capacity analysis method in TEAPAC for signalized intersections has been updated to reflect all the changes to the method that have been approved and published in chapter 19 of the 6th Edition of the Highway Capacity Manual (2016 HCM). The option in Edit-System-Output for selecting the 2010 method has been changed to select the 2016 method, and prior data files which include the 2010 selection will automatically select the 2016 method when they are opened.

## >Urban Streets Capacity Analysis Method of 2016 HCM (6th Edition) Implemented.

TEAPAC Complete 2016 now includes the Urban Street Facility capacity analysis from chapters 16 & 18 of the 6th Edition of the Highway Capacity Manual (2016 HCM). This method calculates performance measures for coordinated signals that include free-flow speed, travel speed, stop rate and level of service. The HCM urban streets method is sensitive to changes in the offset settings at each signal, making it another powerful tool to evaluate the performance of a linear signal system, and one which uses a succinct, well-documented national methodology that results in a nationally-accepted level of service grade between A and F.

The new UrbanStreet command in the Results menu is used to produce the capacity analysis in both directions for a defined arterial system of up to 9 signals. The Subsystem command can be used to select up to 9 signals for the analysis. If no Subsystem is defined, the analysis will include all signals defined in the program (or the first 9 signals if more than 9 are defined). Input requirements are basically the same as for a single intersection Signal Analysis combined with the coordination parameters (distance, speed, offset) which are required for the various Export functions.

## >Patch Available for WinHlp32 Under Windows 8/10.

Recent versions of Windows have dropped support for the WinHlp32 Help system which is has been used historically by all TEAPAC programs. Microsoft provided a download to replace this missing Help system for Windows 7, but since then such support has not been available.

In 2009 Komeil Bahmanpour prepared a workaround for this problem, and Strong Concepts has modified this workaround so that it works for any Windows system starting with Windows 7. This includes specifically Windows 7, Windows 8 and Windows 10.

On the left side navigation pane of www.StrongConcepts.com, click on the WinHlp32 Patch link in the DOWNLOADS section. On the page that appears, click on the link to download the WinHlp32Patch.zip file. After downloading and storing this .zip file on your hard disk, unzip the contents of the zip file into a folder and open the folder in Windows Explorer. Right-click the Install.cmd file in the unzipped folder, and select the Run-As-Administrator option. This will install the WinHlp32 Help system on your computer so it works fine with TEAPAC, as well as any other program you might have that continues to use this Help system on Windows.

## >New Feature Keeps Track of the Reference Phase for an Offset.

TEAPAC references the phase where a coordinated offset is applied according to the phasing which is present at the time of entering the offset reference phase (OFFSET Phase Number entry). If timings are changed, this can result in a change to the reference phase number which should be used. Further, if DESIGN is used for either timing optimization (as above), or more particularly phasing optimization, this operation has an even greater likelihood of changing the reference phase number that should be used.

In the past, it was the user's obligation to properly maintain the correct reference phase number when conditions such as these occurred. Now this function is performed automatically when the user changes a SEQUENCE code or a SEQUENCE code is changed by the program as a result of optimization of timings or phasings.

>Minor Bug Fixes.

A user analysis sequence of DESIGN, TIMINGS, DESIGN would sometimes encounter problems designing undefined sequences for the second DESIGN due to the fact that the first DESIGN might reduce the list of SEQUENCES to be DESIGNed to eliminate duplicate or redundant SEQUENCES. This difficulty has been eliminated.

The TIMINGS function would sometimes report incorrect green and yellow times after a DESIGN, depending on the status of specific inputs such as those related to actuated timings. The function would perform correctly in terms of delivering the correct timings to a subsequent function such as ANALYZE, but the display options of TIMINGS might not display the correct timings. This problem has been corrected.

Certain analysis functions such as ANALYZE, EVALUATE, QUEUECALCS, etc. could crash the program when certain very extreme v/c conditions existed. Practical limits on v/c for these calculations have been implemented to prevent these overflow conditions and subsequent crashes.

The 2010/2016 HCM does not prescribe a way to perform analysis of a coordinated split phase operation (SEQUENCE 7), so this condition is now detected and reported without results rather than reporting erroneous results.

## :TEAPAC Ver 8.62 12MAY14

**Build 01 – 12MAY14**

>Improved Detection of Changed Phasing Due to Optimization.

An HCM 2010 capacity analysis for an actuated signal can alter the phasing code used by TEAPAC to represent the phasing, due to the fact that the analysis estimates the average phase times which can result in an overlap phasing code that is different than what was originally specified. This fact comes hand-in-hand with the notion that in an HCM 2010 analysis, there is no difference between Sequence codes 4, 5 & 6 anymore. However, for compatibility with the HCM 2000 analysis which is still supported by TEAPAC Complete, Seq 4, 5 & 6 are still allowed to be specified uniquely. To accommodate this phenomenon, TEAPAC Complete assesses the phasing code specified and resulting, and will change the code, as appropriate, to reflect the optimized phasing and the average timings for that optimized phasing.

The above process is necessarily complex, and certain conditions have been discovered where the resulting displayed sequence code is different, but not consistent with, the original optimized sequence code. This can result in one phasing showing up at the top of the Sorted Design results, but another, inconsistent phasing showing up in the Capacity Analysis which follows. This can be particularly true when the program tries to discern the difference between a split phase (Seq 7) or Lead-Lag (Seq 8) optimized result when Seq 1, 2 or 3 is also permitted in the Sequences list to be optimized. This dilemma has been corrected, now delivering Analyze results for phasings which are consistent with the sequence code which shows up as the best phasing in a Design/Sort result.

## :TEAPAC Ver 8.61 21JAN14

**Build 01 – 22JAN14**

>Improved Modeling of Shared-Permitted Left Turn Operation.

Continuing improvements initiated at the end of 2012 have been made that affect the results obtained for single-lane and two-lane approaches with shared permitted left-turn operation. The changes were approved by vote of the Highway Capacity and Quality of Service Committee and incorporated by Errata in the 2010 HCM. The result of these changes is that the HCM now provides better corroboration of its results with observed behaviors of these special cases in the field.

Related changes affect the results for exclusive left-turn lanes with permitted or protected-permitted operation AND opposed by a single lane approach, as well as conditions when an approach has no shared lanes and no detection.

## :TEAPAC Ver 8.60 04JUL13

**Build 02 - 23AUG13**

>Analyze Dialog Text Expanded to Include Coverage by 2010 HCM.

The capacity analysis dialog (Analyze) has had its text updated to properly reflect the option of the analyst to be able to select either the 2000 or 2010 Highway Capacity Manual (HCM) as the method for the analysis, not just the 2000 method, as previously represented. The desired method can be selected with an Edit-System-Output menu entry.

>Traffic Impact Analysis Example Data File Updated.

The example data file for traffic impact analysis (TrafficImpactAnalysis.tpc) has been updated so that the abbreviations for entries which are used are compatible with the newest command entry data (GreenAverages, in particular) and thus the file works properly with the latest version of

TEAPAC Complete. In addition, the main intersection is selected when the file is opened and appropriate phasings and cycles have been provided for all intersections. Lastly, the north and south approaches have been adjusted so that the approach angles better fit the underlying bitmap aerial photo which is used by the example, especially for animation.

>Default Support for Newest TSIS/CORSIM 6.3.

The latest version of TSIS/CORSIM, version 6.3, has been set up as the default supported version by TEAPAC Complete, especially for the new installed folder which is used by the default TSIS installation.

>Network Management Dialog Updated for Clearer File-Save Actions.

Several entries which can be made in the Network Management dialog (accessed from the Setup... button in the main window) are only relevant to the current action of the user, and are not saved in or restored from any data file. This action has been made more clear by the text of the dialog, and the user is no longer prompted to do a File-Save when changes are made to these variables which are not actually saved anywhere.

**Build 01 – 08JUL13**

>Powerful New Feature Allows Better Export and PlotTSD Modeling for Actuated.

The 2010 HCM method in TEAPAC computes the average phase duration for actuated signals. The default behavior of TEAPAC is now to save those average duartions in the new GREENAVERAGES entry and use those average durations for all EXPORT and PLOTTSD actions. This means that the time-space diagram from PLOTTSD will now represent average phase times, not maximums, and modeling or optimization by third-party programs such as TRANSYT, PASSER-II and TruTraffic/TSPPDRAFT will now be able to perform their functions with these HCM averages as opposed to using maximums, which has been the normal use of these programs through the years.

In order to accomplish this, signal timings must be entered By-Movement, and normally the GREENAVERAGES dialog is populated automatically by the ANALYZE or DESIGN commands for a 2010 HCM analysis. For programs which are capable of modeling actuated operation in some fashion from data exported by TEAPAC (such as Synchro, TRANSYT or PASSER), the GREENAVERAGES are exported instead of GREENTIMES (maximum settings) and the actuated operation is disabled by setting recall-to-max, as necessary (ie, Synchro). If the normal actuated model of the third-party program is desired, this should be selected with the <Actuated> setting of the SIMULATION dialog, in which case GREENTIMES will be exported.

If the GREENAVERAGES values are intended to be used for EXPORT per the discussion above, but the GREENAVERAGES all have values of zero, the GREENTIMES values will be used instead, with a warning message to that effect. Normally this situation can be addressed by using the ANALYZE command for 2010 HCM to compute the average green times prior to EXPORT. However, if the EXPORT is specifically intended to represent maximum timings instead of average phase durations, then the GREENAVERAGES can be set to zero intentionally to achieve this effect.

## >Export to New HCS2010 File Format Now Supported.

The new data file format which is used by HCS2010 (Ver 6.41) is now supported for direct export of TEAPAC data to HCS2010, both for signalized and unsignalized locations. The default Options-Setup file path has been updated accordingly, as has the support for the new Streets.exe module when using the RunHost button in the HCSExport dialog.

## >New RTINFLUENCES Entry Allows Greater Control Over Permitted LT Modeling.

A new data entry dialog has been added to the [Approach] group of entries called RTINFLUENCES in support of a new HCM 2010 feature that has been approved. When an exclusive right-turn lane exists on an approach, the analyst can use this input to indicate whether traffic in the right-turn lane influences the permitted left-turn drivers' gap acceptance on the opposite approach. An entry of 'Yes' indicates this influence exists (this is the default). The determination that the exclusive right-turn lane does not influence gap acceptance should be based on knowledge of local driver behavior, traffic conditions and intersection geometry.

## >Other Minor Refinements to HCM2010 Methodology Implemented.

Minor refinements and clarifications to the HCM2010 methodology which have been published to-date (Version 7.11 of the TRB HCM computational engine) have been implemented in order to keep TEAPAC 2010 as precisely compliant as possible. Users may see minor changes to answers as a result of these changes, but significant differences should be limited to very specific cases documented for the engine changes.

## >Minor Bug Fixes.

HCM 2010 analyses require timing inputs be made using the By-Movement style, while HCM 2000 analyses permit either By-Movement or By-Phase timing entry. When using an old data file with prior timings entered By-Phase for a HCM 2010 analysis, the user is prompted whether or not the program should be allowed to convert the timings on-the-fly to the required By-Movement style, and circumstances have been discovered where this on-the-fly conversion is not performed correctly. This has been corrected. Also improved is the ability to abort an entire multi-intersection analysis when this conversion is not desired, as well as not checking or reporting intersections which are not included in the current subsystem for the need for such conversion.

When an HCM 2010 capacity analysis is being conducted for a situation which includes a free-flow right turn, the capacity analysis inadvertantly included the satflow for the free-flow lane as part of the reported satflow for the adjacent through lane group. This did not affect the validity of the results, as it was only an output representation error, and it has been corrected.

>Default Approach Speed Used for HCM2010 Calculations.

When an approach speed limit is not provided via the Network dialog, rather than using the default speed of 0 mph in HCM2010 calculations, a speed of 35 mph is now used to obtain more sensible results for those elements of the HCM2010 analysis that rely on a speed input. An example of this is how the speed limit is used to modify the calculation of Maximum Allowable Headway in the actuated model of the HCM2010. Using 35 mph produces more appropriate results than using 0 mph.

>Minimum Detector Length Enforced.

User inputs are checked to make sure that a non-zero detector length will be used in a HCM2010 capacity analysis, with a minimum value of 1 foot enforced. This prevents the HCM2010 methodology from delivering nonsensical results.

## :TEAPAC Ver 8.55 10APR13

**Build 01 – 10APR13**

> HCM2010 Logic Change Behaves Better for 1-Way Streets and T-Intersections.

An adjustment has been made to the HCM2010 logic prescribed by the Highway Capacity Manual so that conditions which do not include all movements at an intersection behave better in an HCM capacity analysis. This includes certain situation which can arise at T-intersections and intersections which include at least one 1-way street. Prior HCM2010 logic could produce conditions which cause 0^0 math errors which are likely to crash the program. The prescribed fix corrects this situation and prevents such math errors and/or crashes.

## :TEAPAC Ver 8.54 29DEC12

**Build 01 – 29DEC12**

>HCM2010 Signalized Methodology Updates per HCM Committee Changes.

Adjustments to TEAPAC's HCM2010 signalized intersection methodology have been made in accordance with approved changes to the methodology which have been made by the HCM Committee (Signalized Subcommittee) of the Transportation Research Board (TRB) in 2012. Many of these changes are incidental and will not cause noticeable changes to TEAPAC's results, but some may affect a small number of circumstances dramatically and with more appropriate results. Situations which contain permitted lefts opposed by multiple lanes with a shared left-through, permitted left turns in general, shared left-through lanes, movements that terminate a barrier with different clearance times, defacto left turn lanes, or exclusive right turn lanes with adjacent parking or local buses are most likely to reflect these changes with different results than before. The export to the TRB computational engine has also been updated to work with the latest version of the engine, Ver 4.3.

>Fix for Free-Flow Turns.

Situations with free-flow turn lanes have been found to generate inappropriate results under some circumstances. This problem has been corrected with this release of TEAPAC.

>Fix To Detect TruTraffic Ver 10.

Due to a change in the formatting of certain files in TruTraffic Ver 10, TEAPAC was incorrectly detecting that version of TruTraffic on a user's system and exporting the wrong format of data, and thus generating incorrect results. This problem has been corrected with this release of TEAPAC.

## :TEAPAC Ver 8.53 19NOV12

**Build 01 – 19NOV12**

>Direct Support for 'CORSIM-for-HCS'.

TEAPAC now links successfully to CORSIM when it is installed as part of HCS2010, making use of all of the functionality which CORSIM-for-HCS provides.

>Default Folders for Third-Party Programs Updated to Match Latest Versions.

The default installation of TEAPAC Complete 2010 now uses updated default folder locations for HCS2010, TRANSYT7F, CORSIM and Tru-Traffic which match those which the most recent versions of these programs use by default. Consistent with installation on the most modern 64-bit Windows installation, these are placed in the C:\Program Files (x86)\ folder, with the following subfolder names - \HCS2010\HCS\, \HCS2010\T7F11\, \FHWA\TSIS6.3\ and \Tru-Traffic 10\. Use of \Tru-Traffic 10\ is consistent with the special instruction in the Tru-Traffic 10 installation notes for installing it for all users on a given computer.

## :TEAPAC Ver 8.52 12JAN12

**Build 01 – 12JAN12**

>VISSIM Ver 5.3 and 5.4 Now Supported Directly.

The new default folder name which is used by the latest version of VISSIM (Ver 5.4) is now included as the default in TEAPAC for Export to VISSIM. Also, additional information (VehClasses) which is newly required by both VISSIM 5.3 and 5.4 is automatically included in the data file created by TEAPAC for any version of VISSIM.

>TruTraffic Ver 9 Now Supported Directly.

The new default folder and executable file names which are used by TruTraffic Ver 9 are now included as the defaults in TEAPAC for both Export and Import to/from TruTraffic. New information which is now included in the TruTraffic CSV files which are used for Importing are now also processed correctly.

>TRANSYT Rel 11 Support Improved for Genetic Optimization.

The new format of genetic optimization results which was adopted by TRANSYT in Release 11 has been accommodated in TEAPAC so that genetic optimization results can now be imported into TEAPAC, including optimized offsets as well as split times if they were optimized.

The Import of genetic results has also been enhanced so that results for node numbers which exceed the TRANSYT limit of 99 (and are therefore mapped by TEAPAC into temporary new node numbers for TRANSYT) can now also be imported back into TEAPAC, as above. In order to do this, the AUTOmatic Export and Import options in TEAPAC must be used to circumvent the problem of multiple file names which are employed by TRANSYT for a genetic optimization.

## :TEAPAC Ver 8.51 17JUN11

**Build 08 - 23SEP11**

>Data Files With Old Style Timing Input (ByPhase) Now Read Correctly.

Data files which have been saved previously by any prior TEAPAC version or program and which used the older style of timing input where timings are given for each HCM phase (ByPhase) rather than each Nema movement (ByMovement) were saved in such a way that backwards compatibility with older TEAPAC programs like PRETRANSYT, PRESYNCHRO, etc. was retained. With the change of the default entry mode from ByPhase to ByMovement in Ver 8.51, TEAPAC was not reading the ByPhase timings from these data files correctly, processing the un-designated timings as if they were the new default, ByMovement. This has been corrected so that un-designated (ByPhase) timings are both read and retained as ByPhase timings. Further, since more recent versions of these older TEAPAC programs were able to read the newer formatted data files, all timings which are saved are now fully-designated as either ByPhase or ByMovement, so no ambiguity exists in the future.

Any analyses made by prior Ver 8.51 releases (Builds 01-06) after opening files with ByPhase timings should be checked carefully, although it should be readily apparent that the timings are not correct in the analysis. Further, any files with ByPhase timings that have been opened and re-saved by prior Ver 8.51 releases should be checked to make sure that the proper timings have remained intact in the files.

Under certain circumstances, TEAPAC would adjust the first phasing in the SEQUENCES list (if more than one sequence code was listed for optimization) to better match the input timings, but this adjustment might occur prior to the actual entry of the timings and an inappropriate change would be made where the adjusted sequence code did not match the timings provided. This errant behavior has also been fixed.

>Prevent Rounding to Zero When Computing Analysis Volumes.

Every TEAPAC analysis computes the analysis volumes which can include multiplicative factors (VOLFACTORS) and additional volumes (VOLADDITIONALS) beyond the basic VOLUMES entry which is made. In a case where the computation results in a non-zero result, but one that rounds to zero (such as a VOLUME entry of 1 and a VOLFACTOR entry of 0.4), setting the analysis volume to zero can have unintended consequences, since TEAPAC will make certain decisions based on the existence or non-existence of a volume entry (non-zero vs. zero). With this in mind, a change has been made that prevents non-zero volume computation results from rounding to zero by setting the result to 1 vph in these cases. In a case where the actual computed result is exactly zero, such as with a VOLFACTOR equal to 0.0 or a VOLADDITIONAL equal to exactly the negative value of an entered VOLUME, the zero result will be allowed so that intentional zeroing of analysis volumes is still permitted.

>4-Digit Node Numbers Handled Properly for VISSIM Export.

A fix has been implemented so that use of 4-digit node numbers will be exported properly to VISSIM 5.10. Problems exporting to VISSIM 5.30 are still under investigation.

>Fix Split Phase Export to Synchro After HCM 2010 Change.

A change to the way split phase is handled in TEAPAC that was made for compatibility with the HCM 2010 method has caused problems exporting to Synchro - these problems have been fixed.

**Build 04 – 24AUG11**

> MinGap Added to Synchro Export.

The minimum gap setting (used for volume-density controllers by Synchro) is now exported for all controller types to avoid an error message in Synchro that suggests this setting must be at least as large as the vehicle extension, even if the controller is not a volume-density controller. The minimum gap is set to the same value as the vehicle extension.

>Chapter 2 Examples in Manual and Help Updated.

The initial example problems which appear in Chapter 2 of the TEAPAC manual and on-screen, context-sensitive help have been updated so they reflect the new default signal timing entry style which is now used. This is a 'by-movement' entry which matches the HCM 2010, rather than the previous 'by-phase' style for the HCM 2000. Both styles are still supported, and user data files of either style can be used with either HCM method in TEAPAC, but the example problems now match the HCM 2010 style. The example outputs in Appendix D have also been updated accordingly.

>Example Data File Modified.

The TEAPAC example data files which are provided with the software installation have been modified to reflect the correct phasing input style, now that the default input style has been changed from 'by-phase' to 'by-movement'. The example files previously used 'by-phase' for several intersections, but were not correctly notated to work properly with the new default.

**Build 02 – 21JUN11**

> HCM 2000 Method Retained When Older Data Files Opened.

Files saved with earlier versions of TEAPAC Complete (prior to Ver 8.50, or any other prior TEAPAC program) will not have any HCM method designated, since the 2000 method was the only method for these versions and/or programs. When these files are opened into TEAPAC Complete 2010, the HCM 2000 method will now be automatically selected so any subsequent analysis will be consistent with that performed when the files were saved. The method can be manually changed to 2010 with the Edit-System-Output dialog for Signal Analysis, and the method which is currently selected will be saved by any subsequent File-Save action. This change in behavior (in contrast to Build 01 below) will help make for a smoother, controlled transition to the use of the 2010 method on older data files which were started with the 2000 method. New problem data entry which follows File-New will default to the 2010 method, as before.

>Extra Debug Output Removed.

An unnecessary debug output window which was inadvertently left open has now been closed so it is not visible to the analyst.

**Build 01 – 17JUN11**

>Optimization Now Provided for TEAPAC Complete 2010.

TEAPAC's famous critical movement HCM delay optimization of green splits, cycle length and phasing has now been implemented in TEAPAC Complete 2010 for analyses based on the 2010

HCM methodology. Simply stated, the 2010 optimization method is utilized by the Results-Design function when 2010 method is selected, exactly the way Design has been used previously for the HCM 2000. The user now has the option of selecting either the 2000 or 2010 HCM methods for both capacity analysis and optimization.

A new format for the Results-Timings output in support of the new Design function is also provided so that the optimized 2-ring timings and critical movements are properly depicted, including a graphical timing bar which shows how the design cycle is sub-divided into splits (maximums or force-offs).

A special set of notes has been prepared describing some of the new considerations which have been brought to the table by the 2010 method in regards to both capacity analysis and optimization. These can be found in Appendix C of the Help-Contents menu or the printable pdf User Guide. The section title is Important Considerations for HCM 2010 Calculations, and it can be found as the second topic heading for the Signal Analysis section.

### >HCM Method Defaults to 2010.

Now that TEAPAC Complete 2010 can do both an HCM-compliant 2010 capacity analysis and optimization of that capacity analysis (per above), the default methodology for a new problem entry will be the 2010 method. For problems entered and/or saved with the prior 2010 versions (Ver 8.50), the selected method at the time of the file save will be retained. However, files saved with earlier versions of TEAPAC Complete will not have any HCM method designated, so the current default for HCM 2010 will be in force unless the method is manually changed back to 2000 with the Edit-System-Output dialog for Signals. If the prior HCM 2000 methodology is desired to be retained for either capacity analysis or optimization for these older files, they should be opened with Ver 8.51 and changed manually to 2000, then re-saved so this selection is the designated methodology for any subsequent analyses with TEAPAC Complete 2010.

### >Gapouts and DallasLefts Included in Phasings Menu.

The GapOuts and DallasLefts entries for TEAPAC Complete 2010 have been added to the Edit-Phasing submenu so that appropriate entries can be made in support of these options as part of the HCM 2010 methodology. These inputs are currently not relevant to any other analyses performed by TEAPAC Complete 2010.

### >Better Rounding for Cmin, Covers Fractional Clearance Requirements.

The minimum cycle length (Cmin) determination produced by the Results-Design function for either the 2000 or 2010 methods has been modified slightly so that the rounded cycle length which is displayed will always be large enough to cover any and all fractional green or clearance interval times. For example, if fractional interval timings previously produced an un-rounded Cmin result of 62.2 seconds, it would have had a rounded result reported as 62 seconds - this result will now be reported as 63 seconds.

>New Example Problem Demonstrates 2010 Method Better.

The Signal-Analysis.tpc example data file has been modified slightly so that it better illustrates some of the new features of the HCM 2010 method.

## :TEAPAC Ver 8.50 25APR11

**Build 04 - 07JUN11**

>Official Release of TEAPAC Complete 2010.

Build 04 of TEAPAC Complete 2010 is the first official release of the program, with several minor fixes and enhancements to the 2010 capacity analysis of the initial PreReleases in May.

>2010 Capacity Analysis Improvements.

The 2010 Capacity Analysis output was incorrectly reporting HCM 2000 V/C ratios instead of HCM 2010 V/C's. This has been corrected. Also, timings which are optimized by the HCM 2000 method and subsequently analyzed with the 2010 method now show the 2000 critical movements correctly in the 2010 output, and a vertical bar in the 2010 phasing display which was sometimes missing for T-intersections is now displayed properly.

>Improved Determination of Phase Clearance Times for Shared Phases.

When timings are entered by movement instead of by phase (which is required by the 2010 method, and is an option for the 2000 method) for phases that have shared movements which have different clearance requirements, the most demanding clearance requirements (Y+Rc) are now assigned as the clearance times for the shared phase module. This can be especially apparent at T-intersections and 1-way legs (such as ramp intersections). These differences can also come into play when converting timings between the ByPhase and ByMovement entry modes, as well as after producing the TimingPlan output.

**PreRelease 03 - 11MAY11**

>First Advertised PreRelease of TEAPAC Complete 2010.

PreRelease 03 marks the first public release of TEAPAC Complete 2010 which follows extensive beta testing by select TEAPAC users. This release has full HCM 2010 capacity analysis capabilities. Optimization of timings and phasing is still temporarily disabled while we put the finishing touches on the new optimization method which the 2010 capacity method requires.

This release allows users to explore the many new aspects of capacity analysis that the 2010 HCM method brings to the table. All that is needed to perform a 2010 capacity analysis is to select the 2010 HCM method from the Edit-System-Output menu for Signal Analysis. Checking default values and/or entering values for the many actuated inputs which are now used by the method is highly recommended.

Users are encouraged to read about suggested techniques and considerations regarding using the new 2010 method which can be found in Appendix C of the Help-Contents menu or the printable pdf User Guide. The section title is Important Considerations for HCM 2010 Calculations, and it can be found as the second topic heading for the Signal Analysis section.

>Several Adjustments to HCM 2010 Implementation Made.

Several adjustments have been made to the implementation of the 2010 HCM method as a result of user testing on a wide range of input conditions. These include better modeling of laggin operations when a coordinated phase is on a north-south leg, better modeling of conditions when an entered minimum exceeds an entered maximum for fixed-time operations, better treatment of default parking conditions, prevention of crashes when satflows can't be calculated, and better column headings for the draft worksheet output which is presently available.

**PreRelease 02 - 05MAY11**

>Several Temporary Constraints on the Use of the 2010 HCM Method Removed.

The 2010 Capacity Analysis method has been enhanced to handle signals which have coordinated North-South phases, so now any coordinated signal can be analyzed. Also, the ServiceVolumes function has been re-enabled so that a report for 2010 saturation flow rates can be produced. Similarly, when a 2010 capacity analysis is performed, the 2010 saturation flow rates are placed in the SaturationFlows entry for use by other programs such as TRANSYT, PASSER and Synchro in teh same fashion that this is done for a 2000 capacity analysis. Lastly, although no 2010 version of HCS exists at this time, the HCSExport function has been re-enabled when a 2010 analysis has been selected so an Export to the 2000 HCS is still possible.

>Several Enhancements for Export to Synchro Have Been Implemented.

When T-intersections or 1-Way-intersections exist and a nema phase number has not been given to the thru movement on the stem of the T or 1-way leg, then the nema phase number given for the turns on the stem will be used, as expected. This fixes a problem in both Synchro and TruTraffic where the phases for the stem were not being exported properly if the thru movement did not have a nema phase number entered.

FreeFlow right turns are now exported correctly, ignoring the method documented in the Synchro manuals and using an obviously more correct technique.

Exported timings are rounded and corrected for rounding inconsistencies in several additional places, especially for Synchro 7, so that the cycle length deteremined by Synchro is the intended whole-second cycle without any fractional seconds due to rounding.

The cycle length used and exported to Synchro is now determined on an intersection-by-intersection basis so that the Synchro export is independent of the need for a consistent system cycle length, thus allowing multiple sub-systems with differing cycle lengths to be exported all together in a single export rather than separate exports, one for each sub-system.

The controller type is now determined and exported for Synchro Ver 7. This is not an option for a Synchro 5 or 6 export.

When exporting to Synchro with the TEAPAC Optimize option set to None (meaning either for simulation or for no optimization), the actual vehicle MinSplit is sent to Synchro for a possible optimization, even though no optimization is expected.

**PreRelease 01 - 27APR11**

>Initial PreRelease Version of TEAPAC Complete 2010.

The first PreRelease version of TEAPAC Complete 2010 is now available, incorporating the vastly new capacity analysis methods of the 2010 Highway Capacity Manual. While optimization for this method is not yet included, this version allows users to explore the many new aspects of capacity analysis that the 2010 method brings to the table. All that is needed to perform a 2010 capacity analysis is to select the 2010 HCM method from the Edit-System-Output menu for Signal Analysis. Users are encouraged to discuss their initial use of TEAPAC Complete 2010 with Strong Concepts for insights into using the new method and what the initial PreRelease version is capable of. Feedback is very much desired and appreciated.

>Default PassageTime Changed to 0.

The default value for a PASSAGETIMES entry has been changed from 3 to 0 to indicate the desire to use a default value as defined by the selected HCM method. For HCM 2000, this default is 3.0 seconds, while for HCM 2010 the default is 2.0 seconds. For data files which have already been created, if a self-selecting default value of 0 is desired, it will need to be entered manually since the prior default of 3.0 will be what is found in the file. It is recommended that a non-zero value be entered when the option to include a portion of passage time in the minimums is selected.

>Default Offset Reference Phase Number changed to 0.

The default offset reference phase number has been changed from 1 to 0, since with the 2010 method this input takes on a new and important meaning. A non-zero phase number indicates a coordinated signal, and a zero entry indicates an un-coordinated signal - whether the signal is coordinated or not plays a big role in the way the 2010 HCM method estimates phase durations.

>Enhancements and Fixes Incorporated.

Several enhancements and fixes were implemented in this release to address issues that were observed during the development of this new version. These include the following -

The cycle length used in producing the TimingPlan output for any intersection is now based on the cycle length for that particular intersection, rather than the designated SubSystem cycle length. This makes the results more meaningful for double-cycle locations and relieves the user from making sure that the MasterNode location is properly set when producing the TimingPlan results.

Display of timings in TimingPlan output for T-intersections and diamond interchange ramp intersections are now represented more consistently, regardless of what lane group is used to represent the movements on the stem of the 3-leg intersection.

A very obscure problem with excess allocation of miniscule amounts of excess time in Design optimization has been repaired.

The progress display during Design optimization has been expanded to accommodate 4-digit intersection numbers.

A problem with calculations of very small results for poisson probablility distributions for 64-bit systems has been repaired.

## :TEAPAC Ver 8.23 20JUL10

**Build 03 – 20JUL10**

>Largest TEAPAC Node Number Allowed Has Been Increased from 999 to 9999.

The largest node number which is allowed in TEAPAC has been increased from 999 to 9999 to provide greater compatibility with other traffic software and increased flexibility to be compatible with node number schemes used by agencies in the field. All field widths where node numbers can be entered have been increased to allow 4-digit entries, with error checking limits increased to 9999, and output fields have also been expanded accordingly. Import and Export interfaces to third-party software have been adjusted, as well.

For CORSIM, only the last three digits of external dummy nodes are used when creating their associated entry nodes (which always must be numbered 8xxx). As long as there are less than 1000 dummy nodes in the exported network and none of the external dummy nodes share the same last three digits, this will not be a problem (this is typically the case).

>New Option for Controlling Node Numbering During Network Creation.

A new option has been added to the Network Display and Edit dialog which is used when the Setup button of the main window is pressed. Two entries at the bottom of the dialog provide a place for the starting node number which will be used when new nodes are created, one entry for real nodes and one entry for dummy nodes. Real nodes will use the next available node number counting upwards from the provided value, while dummy nodes will use the next available node number counting downwards from the provided value. The default values are 1 and 6999, respectively. Using 6999 for dummies avoids conflicts with the largest node number allowed by CORSIM, but a number as high as 9999 can be used if CORSIM use is not anticipated.

## >Export & Import for TRANSYT Adjusts Node Numbers So Always Less Than 100.

TRANSYT-7F has a limitation that node numbers must be in the range of 1-99 (hence, with a limitation of no more than 99 nodes in any given run of TRANSYT). Exporting to TRANSYT has been enhanced by adjusting the exported node numbers as necessary so that they are always in the range of 1-99. This is particularly useful in light of the enhancement above allowing node numbers in TEAPAC from 1-9999. This allows the full range of TEAPAC node numbers to now be useable, even when TRANSYT will be involved in the TEAPAC analysis (previously TEAPAC node numbers had to be in the range of 1-99 in order to be used with TRANSYT).

This is accomplished by first using any TEAPAC node numbers in an Export that are already in the range 1-99, then using only the last two digits of any other node numbers which do not conflict with the first group, then finally assigning arbitrary node numbers to the remaining nodes which are to be exported. This provides the best possible consistency between the TEAPAC node numbers and the node numbers which are seen in the TRANSYT results. The actual mappings used can be seen in the exported data file (.tin) which is created for TRANSYT.

When Importing optimized results from TRANSYT back into TEAPAC, the mapping of real vs. temporary node numbers used is first read from the .tin data file which corresponds to the the .tof results file which is being imported. This means that when TEAPAC node numbers greater than 99 are being used, the .tin data file created by the TEAPAC Export must be present when performing a subsequent TEAPAC Import.

## >Default Installation Support for New CORSIM 6.2.

The default Options-Setup path for CORSIM has been changed to the new default path which is used by a CORSIM 6.2 installation.

## >Miscellaneous Minor Issues Addressed.

Descriptive text in several dialog boxes that have migrated from earlier versions of TEAPAC programs have been updated so the dialog/command names referenced in the text agree with the new dialog/command names that were adopted for TEAPAC Complete.

The Synchro Import has been improved to accommodate longer Plan ID descriptions and avoid possible crash problems which involve these longer descriptions. Errors #PSY98 and #PSY99 have been renamed to #EXP98 and EXP99, as shown in the documentation.

The Summarize report for Traffic Impact Analysis data has been improved so that all of the data which appears in the text-only report is now included in the graphical results output. Error #TIA07 has also been expanded so it can accommodate 3-digit distribution types properly, and the Intersection command line which is optionally written to a data file for the ComputePaths function has been modified so it is not an ambiguous command entry (INTE -> INTR).

## :TEAPAC  Ver 8.22 10MAY10

**Build 00 – 10MAY10**

>Additional Actuated Inputs Provided to Interface with Synchro.

Five new data entry types are now allowed for each actuated intersection so that these values can be Exported to Synchro to perform actuated analysis. These entries are PassageTimes, Recalls, DualEntrys, FirstDetects and LastDetects. These entries will be stored in the TEAPAC data file so that they will be transfered to Synchro for each Export. The values can also be set when an entire network is Imported from Synchro. Two additional entries have also been added for future use, but not presently used by Synchro. With all of these data entries, it is now possible to create and store a complete actuated set of conditions in TEAPAC which can be Exported to (or Imported from) Synchro on demand, plus several sensitivity-oriented options described below which also exist in support of these new entries. When utilizing the actuated model in Synchro, GreenTimes entries will be interpreted as Maximum green times.

Vehicle extension times which have been previously entered via the Actuations entry in TEAPAC are now stored separately in PassageTimes, allowing the Actuations entry to be temporarily turned off (No) and back on (Yes) without the need to re-enter the actual passage time values. Extensions can still be entered on Actuations where PassageTimes will be entered automatically and Actuations will be set to Yes. The use of the Synchro actuated model can also be defeated for an Export with a single entry on the Simulation dialog (sending a recall-to-max to Synchro for each actuated movement), again without the need to re-enter all the actuated data to re-create the original actuated analysis. The default extension values are 3.0 seconds, consistent with the HCM2000 default, and the default Actuations and Simulation values are 'No' (unchanged from earlier) so that specific user input is required to implement the new actuated conditions.

A new option has been added that defines the need to add one or more extension times to the input Minimums entry when optimizing splits in TEAPAC, PASSER or TRANSYT. This provides the ability to assure that the optimum splits will time, for example, the entered Minimums value plus one extension time. A Factor entry on the new PassageTimes dialog allows the definition of anywhere from 0 to 300% of each extension time to be added to each of the specified Minimums entries. This option is only in force when a specific movement has its Actuations condition set to Yes. The default value is 0.0 so that extension times will not be added to Minimums unless specifically requested.

Recalls and DualEntrys parameters allow the entry of these typical actuated timing parameters, while FirstDetects and LastDetects enter the locations upstream of the stop bar where the first and last detections of moving vehicles are made for each movement. Defaults for Recalls and DualEntrys are both ‘No’, while the defaults for FirstDetects and LastDetects are 75’ and 5’ respectively for a typical and reasonable default detector size and location condition

## >Updated Import Functions for Synchro and TSPPD/TruTraffic.

The TEAPAC Import function has been updated so it will accept 170 and NEMA-TS2 offset reference styles (in addition to the normal NEMA-TS1 style) from the 1-file UTDF file format used by Synchro Ver 7 and TSPPD/TruTraffic Ver 8. This matches the Import capabilities still supported for the multi-CSV UTDF format used by Synchro Ver 6 and TSPPD Ver 7.

The Import function has also been updated so that it understands the implementation of the 1-file UTDF file format used by TSPPD/TruTraffic Ver 8, especially in the event that all of the movements do not exist at a particular intersection (which previously could cause a crash).

## >Abort Button Provided in Output Window.

A button has been added in the upper-right corner of the standard TEAPAC output window which can be used to abort any active analysis function(s) prior to its normal completion. This allows for convenient cancelling of actions which take more than a few seconds (such as certain kinds of optimizations) when it is apparent that the analysis will not produce the desired results. This can be used for routine capacity analyses (ANALYZE) or signal timing optimizations (DESIGN) for a large number of intersections to quickly change a selected option, for quick sensitivity testing that doesn’t require an analysis to fully complete, or in order to abort or re-start batch analyses for a mass of inter-related results which are being produced in sequence directed by a script control file (such as a complete traffic impact analysis consisting of traffic count analysis, warrant analysis, capacity analysis of existing conditions, projection of future volumes, and optimization and progression of. projected conditions).

## >Rounding Error Fixed in TimingPlan Results.

A complex algorithm exists in the TimingPlan output for rounding dual-ring phase times so that the rounded phase times (both seconds and percent) for each ring on each side of the barrier 1) add up to the same number on each individual side of the barrier, 2) add up to the correct cycle time across the barrier, and 3) add up to a total of 100 percent across the barrier. Because of these sometimes competing objectives, the final rounded values may not look like they are rounded by normal means, but this process creates rounded results that can be implemented directly on controllers without getting errors from the controllers that the entered numbers 'do not add up'.  A minor error which sometimes prevented achieving this balance has been identifed and fixed.

## :TEAPAC Ver 8.21 12FEB10

**Build 02 – 15MAR10**

>MUTCD 2009 Analysis of Warrants for Signals and Signs Now Supported.

A new option has been added to allow signal and sign warrant analyses following the methods of the new 2009 MUTCD which was recently published.  This is now the default warrant analysis of TEAPAC, with options still available for selecting 2003, 2000 and 1988 MUTCD methods.

>Launch VISSIM Animation Automatically with New EXPORT Option.

The recently added EXPORT support for VISSIM has been enhanced with an option to automatically start VISSIM with an active animation of the Exported conditions.  This option is the Animate option in the Export dialog.

If the new Animate option is selected, control will not return to TEAPAC until the animation in VISSIM is stopped.  To stop the animation, one of the Simulation play buttons in VISSIM may need to be pressed in order to enable the Simulation stop button.  If returning to TEAPAC during the animation is desired, select the View option in the Export dialog instead of Animate and start the animation manually with the Continuous Simulation play button in VISSIM.  Do not attempt to close the Export status message box during the animation or TEAPAC will be closed.

If VISSIM is started by an Export from TEAPAC and then subsequently closed, TEAPAC may need to be re-started so that it can create another instance of VISSIM with its next Export.  This condition can be avoided by making sure not to close VISSIM once it has been opened by TEAPAC until the instance of TEAPAC which started VISSIM has itself been closed.

>Problems Fixed Exporting to Synchro Using NemaPhases and Split Phase.

Certain difficulties exporting to Synchro when using NemaPhases different than the defaults have been fixed.  Also, certain phasing configurations for split phase that caused problems are now correctly exported.  Other special cases of the use of NemaPhases that caused problems have been fixed, including when left turn phase numbers the same as adjacent through movements are used.  Lastly, the way the phasing is exported has been modified so the Synchro displays are visually more consistent with the displays in TEAPAC.

>Install Package Modified to Always Install All Files.

The install package for TEAPAC has been adjusted so that all files are always installed, even if there is no change to a file or a currently installed file is a more recent version than that being installed. This will make for easier verification of which files are installed on a given system, and in the future will make installation of an older version over a newer version much easier than at present.

## :TEAPAC Ver 8.20 18NOV09

**Build 00 – 18NOV09**

>VISSIM Simulation and Animation Has Been Added to TEAPAC's Export Function.

The popular VISSIM simulation and animation program (Ver 5.10 distributed by PTV America) has been added as one of the many third-party programs which are supported by the Export function in TEAPAC. A complete signalized network can be exported to a .anm file which can be dragged to the VISSIM main window or imported with VISSIM's File-Import-ANM menu.

When using the AUTO option for VISSIM, VISSIM will be opened and the path to the TMPVIS.anm file which is created will be selected. Then the user should use the File-Import-ANM menu to perform the import. In the dialog that opens, the browse button for the Static Network Data file should be used to select the TMPVIS.anm file and the Import routing option should be unchecked. Specifying a target VISSIM input file is not necessary. As an alternative, the TMPVIS.anm file (or any .anm file created by the Export) can be dragged to the main VISSIM window.

>New Tru-Traffic Program Fully Supported by TEAPAC's Export and Import.

The newest version of TS/PP-Draft which is now called Tru-Traffic (Ver 8.00.40) is now fully supported by the Export and Import functions of TEAPAC. In addition to all of the prior support for TS/PP-Draft, the newest features for managing the background images in Tru-Traffic are also supported by TEAPAC's Export to Tru-Traffic.

>Conditional Turns Are Now Modeled in CORSIM.

CORSIM's feature that allows upstream-downstream assignments between adjacent intersections has been implemented so that the Limited assignment option of TEAPAC's Network entry can be modeled the same way it is optimized in TRANSYT when Limited assignment is selected. This provides an animation of the TRANSYT-optimized results which is more consistent with the traffic flows which were optimized in TRANSYT. Limited assignment can be quite useful for many situations such as closely-spaced intersections, and in particular, to model the upstream-downstream flows which are likely to exist at most diamond interchange situations.

>New Option to Include Warrants Which have Been Analyzed Externally.

A new option has been added to the warrant Conditions dialog to include warrants which have been analyzed externally to TEAPAC. Warrants for pedestrians, schools, coordination and networks are not analyzed directly by TEAPAC since they require data which is not included in TEAPAC. However, if the analyst would like to show that any of these warrants have either been Met or Not Met in the TEAPAC warrant analysis summary, inputs on the Conditions dialog can be made to include any or all of these warrants. The default remains the same as before - these four warrants are not shown in the warrant analysis at all.

>Windows 7 Is Fully Supported.

TEAPAC Complete has been tested and optimized for Windows 7 usage, and takes advantage of many of the nifty interface features offered by Windows 7. No changes will be apparent for usage under any of the other 32-bit Windows platforms such as Windows XP and Vista.

## :TEAPAC Ver 8.10 08APR09

**Build 14 - 27OCT09**

>Synchro Import Prevented from Setting IdealSatflows Equal to 0.

A Synchro Import is now prevented from setting IdealSatflows equal to zero for lane groups that do not exist. These zero values have been seen to be problematic when an analyst alters the geometry after the import and doesn't realize that the ideal satflows are zero. Rather than importing zeros, such values are now set to a more appropriate default of 1900.

>Fixed Synchronization for Edit-TrafficImpact and -CountAnalysis Menus.

Synchronization between the Edit-TrafficImpact menu selection and the dialog displayed has been corrected, where previously the selected menu did not always open the desired dialog. The same has been done for the Edit-CountAnalysis menu.

**Build 12 - 15SEP09**

>Improved Display of T-Intersections in Network Display.

T-Intersections which have only a shared 'through' lane for turns on the stem of the T will now display correctly as a T-intersection in the network display. Previously, the display could errantly show a fourth leg at the intersection in anticipation of a possible 1-way exiting leg - this display is now used only when through traffic in such a through lane validates the existence of the 1-way exiting leg.

>Scenario Template Function Fixed.

Access to the pre-programmed scenario templates provided with TEAPAC has been restored. The pre-programmed templates found in the Scenario dialog of the Edit menu provide a wide range of typical multi-scenario definitions that can be implemented quickly, and are a quick way to learn and experiment with the powerful scenario function built into TEAPAC.

>PDF User Guide Can Be Displayed from Help Menu.

A new option to open the PDF User Guide has been added to the Help menu. The PDF User Guide has the same content as the context-sensitive, interactive help system, but is formatted like a book for easy reading and is printable, either selectively or in its entirety. The PDF User Guide also provides a more context-friendly search function than the help system. The PDF User Guide is not included with the software download due to its size and redundancy with the Help content, but it can be downloaded at no charge from the Downloads section of StrongConcepts.com. After downloading, it should be saved in the folder where TEAPAC was installed (c:\Program Files\Strong Concepts\TEAPAC by default) so it can be accessed by the Help menu.

**Build 09 - 11JUL09**

>Synchro Import Enhancements Made.

The new REQYELLOWS input is now set when importing a complete network from SYNCHRO so that the yellow change and red clearance times which are imported will match those found in the Synchro data. The node which is selected in the TEAPAC display prior to a Synchro Import is also retained as the current node after the import is completed. A fix has been made to address difficulties importing certain problematic data situations from Synchro which caused unpredictable TEAPAC behavior after the Import.

>Data Input Checks for NOSTOP Export Modified.

Since volumes are not a real requirement for a TEAPAC Progression ANalysis (NOSTOP), the data check before an Export which requires volumes to be present for every defined lane group is now omitted for a NOSTOP Export. A band ratio which is normally based on directional arterial volumes is set to 1.0 when this is the case.

>Cycle Length Added to Output Display for TIMINGS and QUEUECALCS.

The cycle length which appears in the text-only outputs for the TIMINGS and QUEUECALCS results has been added to the graphical formatted output results for these actions.

>Approach Labels Added to Edit-Movement Menus.

The APPLABELS dialog has been added to the Edit menu for Movement data, primarily to been seen as column headings for entry of the movement data in the Tabular View.

>Approach and Movement Labels Added to TrafficImpact & CountAnalysis Menus.

The APPLABELS and MOVLABELS dialogs have been added to the Edit menus for TrafficImpact and CountAnalysis, primarily to been seen as column headings for entry of movement data (like VehicleCounts) in the Tabular View. This matches the presentation of the Tabular View that appeared in the prior WARRANTS and TURNS programs of TEAPAC.

**Build 06 - 20JUN09**

>Problem Caused by Deleting Dummy Nodes Resolved.

A problem which appeared in Build 03 has been resolved where deleting dummy nodes could potentially cause unexpected changes to other data values as the references to the deleted node were updated. This Build 06 update is strongly recommended for users of any version of TEAPAC Ver 8.10 starting with Build 03.

>New Lost Time Method Supported for Export/Import to/from Synchro Ver 7.

Synchro Ver 7 uses a new technique for describing lost time for movements, and ignores any attempts to use the prior method of describing lost time. TEAPAC has been adjusted to reflect this change in method so that lost time will be reflected consistently when data is exchanged between TEAPAC and Synchro Ver 7. This Build 06 update is strongly recommended for TEAPAC users exchanging data with Synchro Ver 7 either via Export or Import. Data exchange with earlier versions of Synchro is not affected.

>Default Import Folder Adjusted to Match Export AUTO Folder.

An earlier release of TEAPAC provided a new feature whereby the data folder used by Import functions was maintained separately from the user data folder so that import source files could be retained in a separate folder from other user data files. This feature can cause difficulties when executing Export AUTO functions followed by Import AUTO functions when the user data folder is being changed between each Export function. To resolve this, the default Import folder is now set to match the Export folder each time Export AUTO is used so that Import AUTO will use the same folder as Export AUTO in all cases.

**Build 04 - 21MAY09**

>Adjustment to License Key Processing So Qualified Licenses Self-Update.

A minor adjustment has been made to how license key information is processed to assure that all licenses with paid-up maintenance contracts self-update to allow full usage of all releases issued within the maintenance period, regardless of any change in version number.

**Build 03 – 18MAY09**

## >Red Clearance (All-Red) Time Now Supported Directly by TEAPAC.

A new entry for entering signal timings called REDCLEARTIMES can be used to define red clearance time which follows yellow change time at the end of a phase. For optimizing timings, the previous entry called REQCLEARANCES has been renamed to REQCHANGE+CLEARS because it encompasses all change and clearance time required (yellow + all-red), as before. A new entry called REQYELLOWS is now used to define how much of the REQC+C time is yellow, and the remainder will be red clearance (all-red). Setting REQYELLOWS to zero will prevent any red clearance from being used, making all of the REQC+C time YELLOWTIME, as before. For an HCM2000 capacity analysis, red clearance and yellow change have the same effect, so sub-dividing the change+clearance time into yellow and red clearance has no effect on capacity analysis results. Timings exported to HCS+ will now include red clearance, and timings imported from and exported to Synchro and TS/PP-Draft will now retain the red-clearance times which have been defined. REDCLEARTIMES are included in the Edit-Phasing menu and REQYELLOWS are in the Edit-Movement menu under the new REQCHANGE+CLEARS entry. They are both displayed in the Signalized Summary of Parameter Values report.

## >Pedestrian-Specific Signal Timing Parameters Can Now be Entered.

Pedestrian-specific signal timing parameters can now be entered and are maintained separately in the data base, and are used separately as constraints on optimization. Previously, if a ped signal timing requirement was larger than a vehicle minimum, that requirement was entered as the MINIMUM for the associated thru movement. Now new PEDWALKS and PEDFDWS entries can be made for each approach and these values are applied as optimization constraints in addition to the MINIMUMS constraint. Where previously TEAPAC would display an 'm' in the phasing for a phase which was constrained by a MINIMUMS entry, it now displays a 'p' for a phase which was constrained by a ped requirement. Since often it is desirable to test operation of a signal without ped constraints, a PEDWALKS factor can be entered to adjust the ped requirements. Setting it to 0.0 eliminates the peds requirements, while setting it to 1.0 uses the entered values, but other factors can also be used to test the sensitivity of the ped walk and flash don't walk (FDW) requirements. PEDWALKS and PEDFDWS are both found in the Edit-Approach menu under the PEDLEVELS entry. They are both displayed in the Signalized Summary of Parameter Values report and all phasing diagrams show the ped crossing as a dashed line in the appropriate phases.

## >TIMINGPLAN Output Report Has Been Significantly Enhanced.

The TIMINGPLAN output report has been significantly enhanced, primarily to accommodate the display of the new timing intervals for red clearance times and ped walk and flash-don't-walk times mentioned above, but other major enhancements have also been provided. These include the display of nema phase times when the phasing is defined 'by-movement' so the times displayed reflect the times which would be implemented on a typical dual-ring controller. Boxes around the various phases and/or nema movement results have been added to make it more clear to which displayed phases these numbers apply, and a proportional display of the actual phase/ring interval timings is provided at the bottom of the report. A related change now shows by-movement timings in the various Summary of Parameter Values reports when the user has selected this entry mode.

>New NEMAPHASES Entry Allows Labeling of Phases.

A new NEMAPHASES entry allows labeling of phases according to what is or will be implemented on a dual-ring controller. If these entries are zeros (the default), no change in the display is made, but entries which define which protected nema phase numbers have been assigned to each of the twelve entry movements will be displayed in any phase diagram, such as TIMINGPLAN above, a capacity analysis, or a SEQUENCES or GREENTIMES dialog. The NEMAPHASES entries are exported to Synchro so that the same phase numbering is used in Synchro, and when a complete network is imported from Synchro, the NEMAPHASES used in Synchro are imported into TEAPAC. NEMAPHASES is included at the bottom of the Edit-Movements menu.

>PLOTTSD Function Expanded for the Possibility of Two Green Bands per Cycle.

This eliminates a previous problem in displaying bands where a short red that disrupts an otherwise wide green band thru a system was not properly represented. Furthermore, if the offset units of the master node in a PLOTTSD result are provided in seconds, the PLOTTSD results will also be displayed in seconds instead of percent of cycle. If the PLOTTSD does not include a master node, the units of the first node in the system are used to define the PLOTTSD units. Other cleanup items have also been performed on this output report, one being the removal of an extra page at the end of the PLOTTSD that sometimes was displayed, and another being problems when all the nodes to be plotted are not properly connected.

>Importing Timings from 3rd-party Programs Expanded for By-Movement Timings.

Importing timings from third-party programs which use by-phase timings can now be performed when the TEAPAC timings are defined by-movement. This includes importing from PASSER, TRANSYT and NOSTOP optimizations. Further, when timings are imported from Synchro (which is always by-movement), the TEAPAC timing entry scheme in use is retained, either by-phase or by-movement; and if a whole network is being imported from Synchro, then the timing entry scheme assigned for all the intersections is now designated as by-movement to match the scheme used in Synchro, rather than by-phase which was used previously.

>ARRIVALTYPE Set to Reasonable Value for Network Import from Synchro.

Previously, this was the responsibility of the user, and still should be considered carefully by the user. Since this is not a direct input for Synchro or a result available in the UTDF file format, the best TEAPAC can do is as follows - if the signalized approach being imported has a real upstream node that is signalized and is no more than 1/3 of a mile away, then the arrival type is set to 4, otherwise the arrival type is set to 3.

>Example Data Files Renamed.

Example data files have been renamed so that the file names reflect the type of Results analysis in TEAPAC that the data has been set up for. On a related note, all prior user data files are upwards-compatible with all the changes described above.

>Internal Flags Reset After COMPUTEPATHS & COUNTANALYZE for New Volumes.

After new volumes are generated by either the COMPUTEPATHS or the COUNTANALYZE function, the volumes and geometrics for the intersection are re-scanned and internal flags are re-set to reflect the new conditions. In particular, when these functions add volumes to movements that otherwise had no volumes, certain flags that indicate the existence of the movements are now re-set for use by subsequent functions of the program, such as capacity analysis and optimization.

>Unconnected Dummy Nodes Ignored By Export.

Dummy nodes which may exist in a network after it has been edited, but are no longer connected to other nodes in the network, are now ignored when EXPORTing to third-party programs to avoid unpredicatable results and crashes due to these extraneous nodes.

>Improved Display of List of Phasing SEQUENCES to be Optimized.

Long lists of phasing SEQUENCES to be optimized are now displayed properly.

>Prevent Crash in PROGRESSION Optimization for 1-Node Arterial.

A PROGRESSION analysis normally cannot be performed unless two or more intersections are entered in the PROGRESSION inputs. However, a one-intersection analysis can be populated by an EXPORT function, resulting in a crash in the PROGRESSION optimization, so checks in the optimization function now prevent this crash and deliver a 'No Solutions found' message which also includes the number of intersections attempted by the optimization.

>EXPORT AUTO Now Checks Data and Host Paths for Invalid Characters.

Certain characters (such as '%') in a file path specification for both data files and host programs that are allowed by Windows can confound the linkage techniques used between TEAPAC and third-party host programs when the AUTO option of EXPORT is used. The data and host file paths are now scanned for such invalid characters with a clear message and clean termination of the EXPORT AUTO function.

>Remove Caution Message About HCS+ Export Using New XML File Format.

A cautionary message about usage of the new XML data file format for HCS+ exports has now been removed in light of the proven functionality of this method of exporting both signalized and unsignalized intersections to HCS+.

>Mouse Sensitivity Reduced for Intersection Selection Clicks.

Slight movement of the mouse during an intersection selection click could be misinterpreted as a drag-and-drop SUBSYSTEM selection, and one that might go un-noticed because of potential minor differences in the colors used to represent selected nodes and SUBSYSTEM nodes in the graphical display. To limit the possibility of this confusion, the size of a drag area which is needed to invoke SUBSYSTEM selection has been increased, making intersection selection less sensitive to slight mouse movement during selection clicks.

## :TEAPAC Ver 8.01 08DEC08

**Build 04 – 27JAN09**

>IMPORT Folder Can Be Independent From the Data Folder.

Previously, the folder from which import activities were performed was presumed (required) to be the same as the user data folder. However, by using the Browse button in the IMPORT and COUNTIMPORT dialogs, this joint-use folder could be changed, and likely without the user's specific knowledge of the specific ramifications. This could create a potential problem when saving the user's data file if it was assumed to be at an unchanged location from where it was opened or previously saved.

To remedy this, specifying a folder where an import file is located (either with the <Data File> specificaton or the Browse button in the dialog) no longer adjusts the folder location where future data file save activities will occur. The location of the last Import (IMPORT/COUNTIMPORT) file is remembered for use as the default folder for the next Import action, and the default folder for the first Import action is the data folder which is current for the first Import action.

>Direct Support for CORSIM Ver 6.1.

TEAPAC now directly supports the newest version of CORSIM (Ver 6.1) for the Export function of TEAPAC. Export support for prior versions of CORSIM remains in TEAPAC.

>CORSIM Export Option Corrected.

The CORSIM Export option was incorrectly displayed as Import instead of Animate in the EXPORT dialog box. This has been corrected. The Animate option allows a direct animate-only result after exporting to CORSIM without the need to view the simulation statistics.

>Node Number Delete & Renumber Prevented from Damaging Multi-Scenario Files.

The methods used to delete and renumber nodes are currently inconsistent with the data file structure used for multi-scenario data files, so these features have been disabled for multi-scenario situations to avoid potential damage to the integrity of the data files. A message to this effect is now displayed and the user is referred to Strong Concepts for a detailed discussion of the issues and potential methods around the problem.

>Help File Improvements.

Help for a number of Results dialogs has been restored for the Help buttons which appear in these dialogs. Also, a large number of pre-indexed search entries which had disappeared from the Help file have been restored.

>More Consistent Use of Enter Key for Dialog Entries.

An improvement has been made in the use of the Enter key in dialog displays for more consistent behavior for effecting a press of the default dialog button with the Enter key.

**PreRelease 03 - 02JAN09**

>IMPORT Problems from PROGRESSION (NOSTOP) Results Fixed.

Difficulties importing results from a PROGRESSION optimization (NOSTOP) for an arterial which has bend nodes or unsignalized intersections have been corrected.

>Problem Viewing NOSTOP Exported Data Fixed.

A problem scrolling through all of the output when including a view of the exported data for a PROGRESSION (NOSTOP) analysis has been corrected.

**PreRelease 02 - 24DEC08**

>COUNTIMPORT Dialog Repaired.

The COUNTIMPORT dialog produced from the Results menu to Import traffic count data from electronic counters was discovered to be inadvertantly damaged by a previous (incomplete) modification. This problem has been repaired.

**Build 01 – 08DEC08**

>Direct Support for TS/PP-Draft Ver 8 Export and Import.

TEAPAC now directly supports the newest version of TS/PP-Draft (Ver 8) for both the Export and Import functions of TEAPAC. TEAPAC automatically detects that Ver 8 is installed and adjusts the Export and Import functions accordingly. Export and Import support for prior versions of TS/PP-Draft remains in TEAPAC.

## >Synchro 7 Export Workaround Improved.

Trafficware has not yet fixed the problem with the 1-file UTDF 2006 .csv file format used by Synchro Ver 7, but a simpler workaround has been generated that involves only re-reading the .csv file with Synchro's File-Merge menu after the Exported .csv file is first opened. This simpler method has been added to the warning message that is issued when TEAPAC Exports to Synchro Ver 7.

## >More Complete Doc for OUTPUT Options in Dialog, Help and PDF.

All of the options for the OUTPUT dialog are now included in the on-screen help and printable pdf user guide. Previously, only those options relating to the Signal Analysis aspects of the program were included.

## >Added Capability to Double-Click Files with Blanks in File Name.

The capability has been added to be able to double-click TEAPAC data files that have spaces in their name as a way to launch TEAPAC and open the clicked file. This capability has existed previously for files without spaces in their name, but was recently noticed as an unintended exception for files with spaces in their names. A related improvement allows such files to be opened directly from attachments in an email program.

## >Help System Changes.

A hierarchical table of contents has been added to the on-screen help system for TEAPAC, and is accessible from the Contents button in the main Help window which is displayed when the F1 button is pressed or the Help-Contents menu is selected.

The original Windows Help-On-Help function (F2) has diminished in value over the years, and has been removed completely from Windows Vista, so it has now been removed from TEAPAC. Also, under Windows Vista, the standard Help system used by TEAPAC is available as a free download from Microsoft - go to www.support.microsoft.com and search for 'KB917607' to get the correct download for your system.

## >Fixed Synchronization for Edit-Intersection Menu and OUTPUT Dialog.

Synchronization between the Edit-Intersection menu selection and the dialog displayed has been corrected, where previously the selected menu did not always open the desired dialog. A similar adjustment has been made to the OUTPUT dialog which occasionally would display an un-selected program in its drop-down list.

## :TEAPAC Ver 8.00 27AUG08

**Build 02 – 27AUG08**

>First release of TEAPAC Complete, Ver 8.00.

This is the first release of TEAPAC Complete, Ver 8.00, which brings together all of the prior TEAPAC application programs into a single, fully-integrated program. TEAPAC Complete has all the functionality of the prior TEAPAC programs, and is distributed as a single-user, single-computer license. The application functions in the single TEAPAC Complete program now include:

HCM2000-compliant signalized capacity analysis and full HCM optimization of splits, cycle and phasing (previously known as SIGNAL2000).

Estimation of projected volumes for traffic impact studies, including user-adjustable, automated on-screen assignments of site traffic (previously known as SITE).

MUTCD-compliant signal warrant and multi-way stop warrant analyses (previously known as WARRANTS).

Complete traffic count analysis, including peak period determination and import of count data from a multitude of electronic traffic counters (previously known as TURNS).

Simplified bandwidth arterial progression optimization with full-color time-space diagrams (previously known as NOSTOP).

Full Export Capabilities for well-established third-party programs, such as HCS, TRANSYT-7F, PASSER-II, CORSIM, TS/PP-DRAFT and SYNCHRO/SIMTRAFFIC (previously known as SIGNAL2000, PRETRANSYT, PREPASSR, PRENETSIM, PRETSPPD and PRESYNCHRO).

Full Import Capabilities for a complete network created in SYNCHRO Ver 5, 6 or 7 (previously known as PRESYNCHRO).

Revolutionary TEAPAC multi-variable, multi-scenario data management for all applications above (previously known as SCENARIO).

Seamless exchange of inputs and results between all combined applications, such as peak period volumes, projected traffic volumes, optimized signal timings, computed saturation flow rates. etc.

One downloadable manual (and one on-screen help system) covers the entire breadth of TEAPAC applications, with full index and improved graphics and output examples.

Upgrade pricing from prior TEAPAC licenses is available.

## INDEX

This index provides an alphabetical list of keywords, commands and subjects covered in the *TEAPAC Tutorial/Reference Manual*. This includes references made in both the Tutorial and Reference sections of the manual. Tutorial Manual references are indicated by page numbers alone, while Reference Manual locations are indicated by the Appendix letter preceding the page number.

Entries in the index which are in all capital letters usually refer to specific command dialogs of the program. They may also refer to keyword options or a program name. Entries in all capital letters enclosed in square brackets [XXX] refer to group/menu names representing specific menus or groups of commands. Entries enclosed in angle brackets <XXX> refer to specific data inputs associated with commands of the program. Entries preceded by an equal sign =XXX indicate a discussion of an output of the program, either a result of the computations or an input tabulation.

## +



## <

## =

## *1*



## *2*



## *3*



## *5*



## *A*

## B



## C

## *D*

## E



## F

## G



## H



## I



## J



## K



## L

## *M*



## *N*



## *O*

## *P*

## Q



## R

## *S*

## *T*

## *U*



## *V*



## *W*



## *Y*



## *Z*