APPLICATION OF TRANSYT-7F TO TRAFFIC SIGNAL COORDINATION ALONG SIXTH AVENUE, STILLWATER, OKLAHOMA

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CHAPTER I

INTRODUCTION

To provide progressive traffic movements on a street, it is not sufficient to ensure that each intersection is efficiently controlled. Equally important is the coordination of the signals in the network so that continous smooth flow in the system is possible [5].

By definition, coordination is the interaction between two or more intersection controllers in a system that allows moving platoons of vehicles to traverse the roadway with minimum stops and delay [1]. In order for vehicles to move efficiently through a set of signalized intersections, it is necessary to coordinate the initiation of their "green" times. The time difference in seconds between the start of the green initiation at one intersection as related to the start of the green interval at another intersection or from a system time base is called "offset" [13].

A simple pictorial example illustrating the relationship of offset and the passage of platoons of vehicles is shown on a time-space diagram in Figure 1. For the indicated signal pattern, it is seen that the offset between signals B and A in the Northbound direction is t

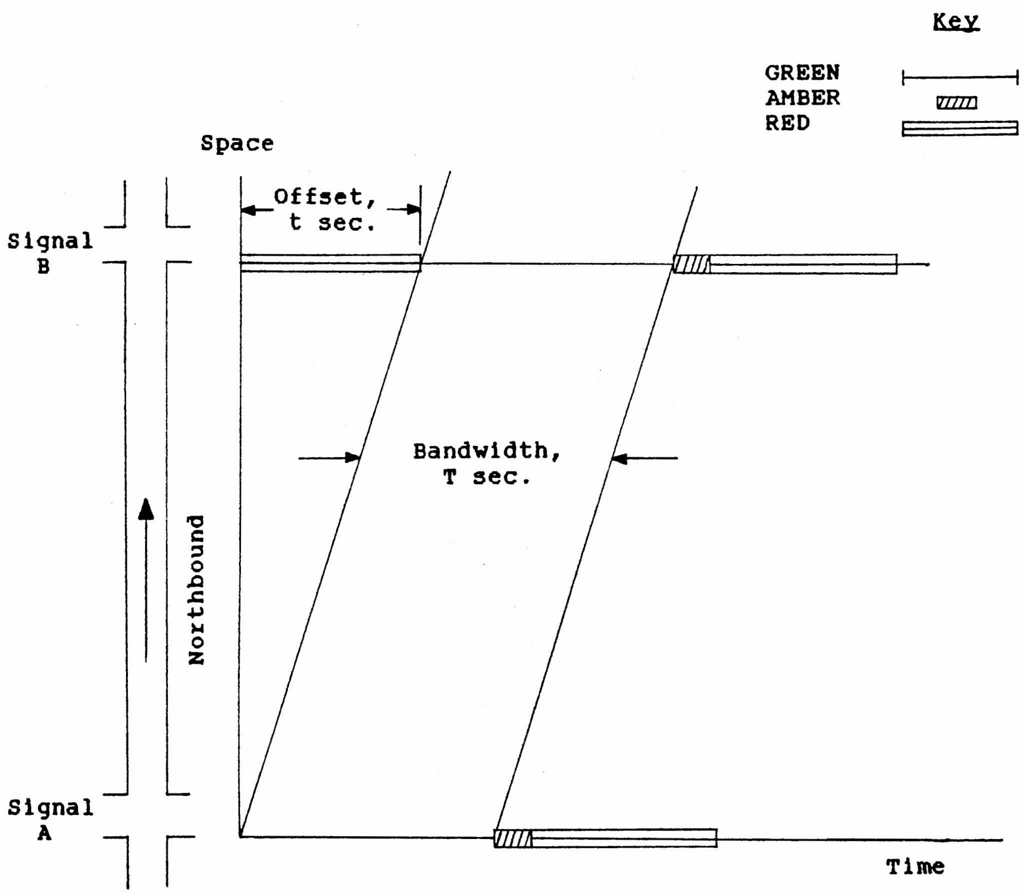


Figure 1. Time-space Diagram showing Signal Coordination

seconds and the bandwidth is T seconds. The bandwidth is the width (duration) of the "window" of green measured in seconds in a given direction [13]. In signal coordination, it is thus desirable to have a wide band of green, since the number of vehicles that can pass through the system is dependent on the duration of the band. From this figure it can be said that coordination involves the determination of offset values at each intersection that would allow as many vehicles as possible to pass through without undue delay.

Signal coordination can be improved through signal timing optimization and it is regarded as a low-capital action for expediting traffic flow, reducing highway user cost and energy consumption [11]. Optimization in traffic signals is the process of identifying the "best" signal timing plan that results in the least amount of delay at an intersection or in a system of signalized intersections [1].

Available Microcomputer Programs For Signal Coordination

Table 1 gives a summary of available computer programs that can be utilized for signal timing optimization on a coordinated arterial or network [6]. Among these programs, the TRAffic Network StudY Tool (TRANSYT-7F) is the most widely used. It is a traffic simulation and signal optimization program that can be used as a tool to develop optimal signal timing plans on arterials or networks of

TABLE I

MICROCOMPUTER PROGRAMS FOR TIMING SIGNALIZED NETWORK AND ARTERIALS [6]

Program	Description	Programming language	System requirements: M-Computer	System requirements: Operating system	System requirements: Memory	Developer
SIGRID	Optimizes offsets in a network of signals for minimum delay for a range of cycle lengths.	BASIC	Various	CP/M	64K	Bather Belrose Boje, Inc.
SPAN	Displays time location diagram for arterials. Simple offset optimization.	APPLESOFT BASIC	APPLE II	DOS 3.3	48K	Ken Courage University of Florida
PASSER-II (84)	Determine optimum progression along arterials while considering phasing sequences.	BASIC	Various	CP/M	64K	Texas DOT
SIGART	Arterial offsets analysis program. Balanced bandwidth.	BASIC	Various	CP/M	64K	Bather Belrose Boje, Inc.
FORCAST	Optimization of signal timings in a network of signalized intersections.	BASIC	TRS-80 Mod.I, III	CP/M	64K	Computran Systems, Co.
TRANSYT-7F	Simulation and Optimization of a signalized network.	FORTRAN	IBM-PC	MS-DOS	256K	FHWA
NOSTOP	Bandwidth progression on linear arterials.	FORTRAN	COMPUPRO	CP/M	64K	Barton-Aschman Associates.

coordinated, fixed-time signals [1]. In the words of the Federal Highway Administration (FHWA), " TRANSYT-7F .... is the best computer program available at this time" [12]. The program has come to be regarded worldwide as the most useful method of signal optimization with users in over 45 countries [9].

Originally, the TRAffic Network StudY Tool (TRANSYT) program was developed in the United Kingdom in 1967 by Dennis I. Robertson who was employed by the Transportation and Road Research Laboratory (TRRL). Robertson's work was an extension of the Combination Method developed by Peter Whiting [7]. The North-American version of TRANSYT is called TRANSYT-7F which is a modification of the United Kingdom TRANSYT-7 version. The "F" indicates that this is the Federal Highway Administration's Version of TRANSYT-7. TRANSYT-7 was the most current version that was available at the time that the Federal Highway Administration was launching the National Timing Optimization Project in 1980.

Experiences with TRANSYT-7F

The National Signal Timing Optimization Project

The TRANSYT-7F program has been used succesfully in eleven project cities as part of the National Signal Optimization Project which was initiated by the Federal Highway Administration in 1980 [8]. The purpose of this project was to encourage municipalities to undertake traffic signal optimization.

A summary report on these projects shows that for the average intersection in the project, the predicted annual improvements were savings of 15,470 vehicle-hours of delay, elimination of 455,921 vehicle stops and savings of 10,524 gallons of fuel [12]. Assuming unit costs of $0.50 per vehicle-hour of delay saved, $0.014 per vehicle-stop eliminated and $1.35 per gallon of gasoline saved, the equivalent total annual benefit per intersection averages $28,695.

There was a wide range in the improvements reported by the eleven project cities. Five cities reported improvements which appear to be quite optimistic. The reason for this relates to the elimination of saturated conditions on an approach from "before" to "after". In TRANSYT, when saturation condition exists on an approach, very high estimates of delay and fuel consumption is predicted. When the saturation condition is eliminated by the TRANSYT optimization process, the estimated improvements will also be very high. However, even when the results reported by the five cities that appeared to have this problem are eliminated, an average annual improvement of approximately 4,500 gallons of fuel per intersection is predicted [12]. Using an average figure of $1.35 per gallon for unleaded gas, a saving of $6075 per intersection annually is expected [2]. On a network-wide basis, 5 percent of fuel consumption is saved. Additionally, an 8.5

percent reduction in the measured travel time is achieved [12].

The Fuel-Efficient Taffic Signal Management (FETSIM) Program

One of the cities that participated in this program was the City of Berkeley, California [2]. After field implementation of the timing plans developed by TRANSYT-7F, field studies were conducted on a network consisting of 28 signals. The purpose of these studies was to establish a more precise indication of the benefits derived from signal coordination. The studies involved a test car which was equipped with electronic instruments to measure traffic performance and fuel consumption. From the Berkeley experiment, it was established that the optimization of the signal timings resulted in significant fuel savings, reduction in delays and improvement in the quality of traffic flow.

Measured benefits from the Berkeley network showed that stops decreased by 11.1 percent. Consequently, travel time was reduced by an average of 10.6 percent. Subsequently, fuel consumption dropped by approximately 6.6 percent. The fuel saved amounted to 6200 gallons per signal per year [2].

Other Studies

Several studies were performed to evaluate the effectiveness of TRANSYT-7F optimal timing plans. One study was conducted by the Department of Transportation in the City of Los Angeles. It was carried out to determine the nature and extent of traffic signal hardware malfunctions and signal timing inefficiencies and to quantify, where possible, their impacts on energy consumption [12]. The study concluded that using TRANSYT to optimize traffic signal timing city-wide would save more than 47,000 gallons of fuel per day. Thus, for the 3,600 total number of signals city-wide, this is a savings of 3,920 gallons per intersection.

A second study was conducted by Wagner-McGee Associates in Garden Grove, California, for the California Energy Commission [12]. This study utilized fuel flow meters in floating vehicles to actually measure fuel consumption on the street. The study concluded that a savings of 7,600 gallons per intersection per year could be realized by using TRANSYT to develop signal timing plans that minimize fuel consumption. A savings of about 5 percent in total travel time was achieved [12].

The title of this thesis is the application of TRANSYT-7F to Traffic Signal coordination along Sixth Avenue, Stillwater, Oklahoma. To have proper coordination, it is necessary to develop an optimal signal timing plan It is thus the objective of this thesis to apply TRANSYT-7F to the development of an optimal signal timing plan that will reduce delays, stops and consequently fuel consumption. The various aspects that are involved in the application are discussed in the respective chapters.

Chapter 2 outlines the required input data and the various TRANSYT-7F outputs. The basic elements of traffic signal timing and the concept of traffic flow simulation and signal optimization used in TRANSYT-7F are also discussed in this chapter.

Chapter 3 discusses the application of TRANSYT-7F to the Sixth Avenue in Stillwater. It also includes discussion of the required data for the TRANSYT-7F optimization process.

Chapter 4 discusses the output and the results of the TRANSYT-7F optimization process.

Chapter 5 includes the conclusions of the project and the recommendations of this study.

CHAPTER II

TRANSYT-7F PROGRAM

Elements of Traffic Signal Timing

There are basically four elements that constitute a signal timing. These are discussed as follows:

Cycle Length

Cycle length is the amount of time required for one complete sequence of signal indications. In a coordinated signal system, the cycle length is the same for all signals during any given control period. This is true whether the intersection controllers are pretimed or actuated [1].

There are four constraints on the system-wide cycle length [1]:

1. The cycle length must be long enough to provide sufficient minimum times for all phases. The sum of these minimum phase lengths is the absolute lower limit of the cycle length.

2. The cycle length should be sufficiently long to ensure that no movement is saturated, i.e., the degree of saturation should be less than 100 percent for all approaches at all intersection.

3. The cycle length should not be so long as to cause unacceptably high delays.

4. The cycle length should be chosen to facilitate traffic progression.

Interval.

An interval is a discrete portion of the signal cycle during which the signal indications remain unchanged [5]. In TRANSYT-7F, intervals are classified as being Variable or Fixed.

Fixed intervals such as the yellow and the all-red intervals are intervals whose durations are fixed and are not changed during TRANSYT-7F optimization run. Variable intervals are those whose durations may be changed during the TRANSYT-7F optimization process. There can only be one variable interval in each phase.

Figure 2 shows the relationship between fixed and variable intervals. Where only vehicular displays are present, the variable interval will be the green interval. If pedestrian signal indications exist, the "WALK" and the flashing "DONT WALK" intervals are regarded as the variable intervals. However, since only one interval can be input as the variable interval, the "WALK" intervals are usually regarded as the variable intervals.

Phase Lengths

A phase is that part of a signal cycle allocated to

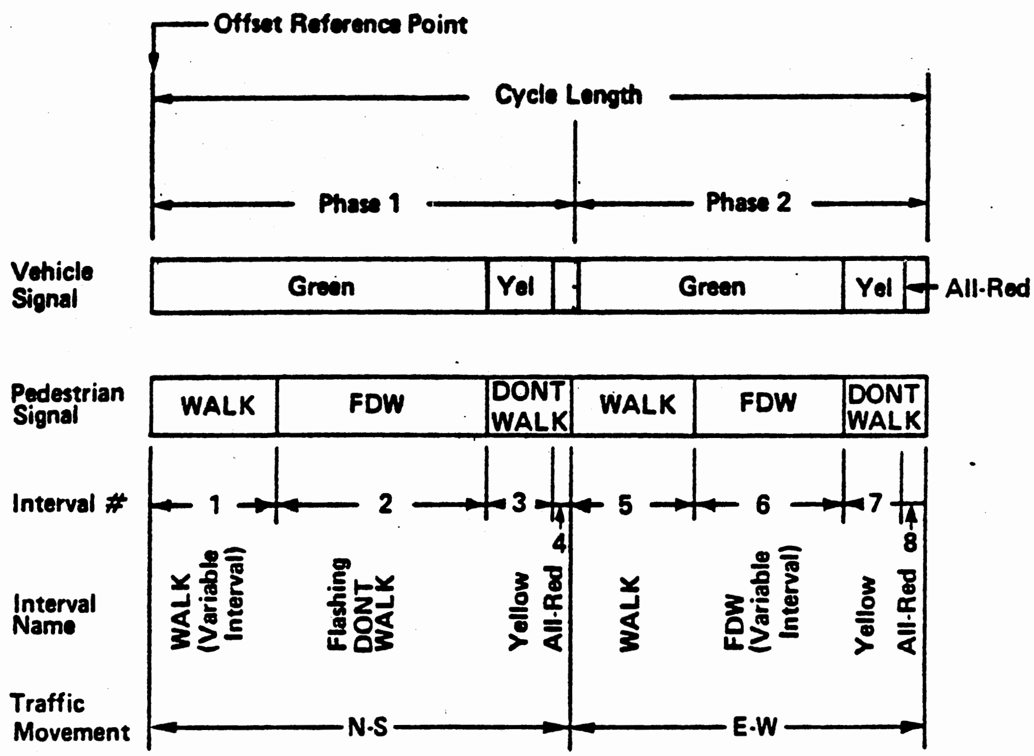


Figure 2. TRANSYT-7F representation of Signal Timing Elements [1]

any combination of one or more traffic movements simultaneously receiving the right of way during one or more intervals [5]. The amount of time given to each phase is called the phase length. In TRANSYT-7F, a phase must have a minimum of two intervals, i.e., green and yellow. The all-red interval is optional and is used as an additional safety consideration. In the TRANSYT-7F optimization process, the phase length is optimized rather than the individual intervals [1].

An important input timing parameter is the minimum phase length. During the optimization process, TRANSYT-7F will not reduce the length of a phase below a specified minimum phase value. Two cases are considered, namely:

1. When pedestrians are not a factor, the absolute minimum phase length is generally 5-10 seconds green plus vehicle clearance [1]. Theoretically, it should be long enough to permit a vehicle to travel, at normal intersection speed, a distance equal to the cross-street width between curbs plus a safe stopping distance [13].

The following formula is used to calculate the vehicle clearance interval [5].

$$CP = t + \frac{V}{2a} + \frac{W + L}{V} \qquad (1)$$

where

CP = clearance interval

t = perception-reaction time (usually 1 second)

V = approach speed, ft/s

a = deceleration rate, ft/s² (usually = 10)

W = width of the cross-street, feet

L = length of vehicle, feet (usually 20 feet)

In this study 10 seconds of green time is added to the vehicle clearance interval calculated from Equation 1 to give the minimum phase duration.

2. When pedestrians are a factor, the minimum phase length should be equal to the pedestrian reaction time (4 to 7 seconds) plus the pedestrian clearance interval [1,5]. The pedestrian reaction time is the time required for the pedestrian to enter the intersection while the signal indication is "WALK". The pedestrian clearance interval is the time necessary for pedestrians to safely cross the street [5]. Generally the pedestrian clearance is calculated by dividing the cross-street width by the pedestrian walking speed of 3.5 feet/second.

In this study, a pedestrian reaction time of 7 seconds is added to the pedestrian clearance time to give the minimum phase duration.

Phase sequence. The simplest form of phasing is the two phase sequence in which the first phase allocates the right-of-way to the main street and in the second phase the right-of-way is transferred to the cross street [5]. In this two-phase system, the primary through movements are separated. However, for left-turning traffic, the turning movement is possible only when there is sufficient gap in the opposing through traffic. As traffic volumes for both the left-turning and through movements increase, a situation will be reached where left-turning traffic will not have sufficient gap to make a left-turning movement. Due to this phenomena, provision of a separate phase for left-turning movement is warranted [5]. Thus, phasing primarily concerns the provision of a separate phase for left-turning traffic.

The number of phases varies from two to eight phases depending on the traffic movements that require protection during the respective green periods. Phase sequences may consist of numerous combinations of protected and unprotected movements [2]. TRANSYT-7F does not select phase sequences, rather they are required input [1].

TRANSYT-7F can handle a maximum of six vehicular traffic phases. For actuated controllers, the phase sequences and durations vary from cycle to cycle based on the fluctuations in traffic demand. Because TRANSYT-7F deals explicitly with pretimed control and also because it can handle a maximum of six phases, timing for actuated controllers must be converted to an "equivalent pretimed plan". This is done by recording the phase sequences and the durations of the fixed and variable intervals over a number of cycles to determine the "average" timing for the control period. To evaluate alternative phase sequences at an intersection, various user-input phase sequences are input and TRANSYT-7F will perform an evaluation run.

<u>Offsets or Yield Points</u>

These parameters are used to establish the time relationship between signals in coordinated signal systems so as to permit major platoons of traffic to flow through a number of signals without stopping [1]. Offsets and yield points are explicitly optimized by TRANSYT-7F.

The definitions of these two terms as used in the TRANSYT-7F are as follows [1]:

Offset is the time difference measured from a system reference point to the beginning of interval 1 (green interval as defined in TRANSYT-7F) of the cycle at each of the signal controllers in the system. Offsets are generally asociated with pretimed controllers and are always referenced to the beginning of interval 1 in TRANSYT-7F.

Yield point is used in lieu of an offset and is referenced to the beginning of any interval other than the first interval in the cycle. Yield points are used to facilitate representation of actuated signal controllers and are usually referenced to the beginning of the main street (primary movement) yellow clearance interval.

A network may contain both offset and yield point time references, depending on the type of signal controllers in the network. These two parameters can be referenced to a master controller located at any node in the network. If there is no on-street master controller, they can be referenced to a system reference point determined by the TRANSYT-7F program [1]. This system reference point is applicable if a street network is controlled by a central computer.

Input Data Requirements

The input data required by TRANSYT-7F fall into four general categories: arterial and geometric design data, signal timing parameters, traffic data and program control parameters. A detailed description of the input data is discussed in the TRANSYT-7F User's Manual [1].

1. Arterial and Geometric Design Data.

In TRANSYT-7F, the street network has to be represented in terms of nodes and links. A node is an intersection of two or more intersecting streets. Each node is assigned an identifying number from 1 to 9999 [1].

A link is a unidirectional section of roadway connecting two nodes. It is a representation of one or more lanes of traffic. As an example, a roadway that has two lanes carrrying through traffic is assigned a through link. A link may carry through traffic, turning traffic, bus traffic and/or special classification of traffic, e.g., trucks. Each link is assigned an identifying number from 1 to 9999. Figure 3 shows a typical link assignment. Link number 1 represents left-turning traffic that are protected, i.e., a separate signal phase is provided. A separate link number 2 is assigned to through traffic.

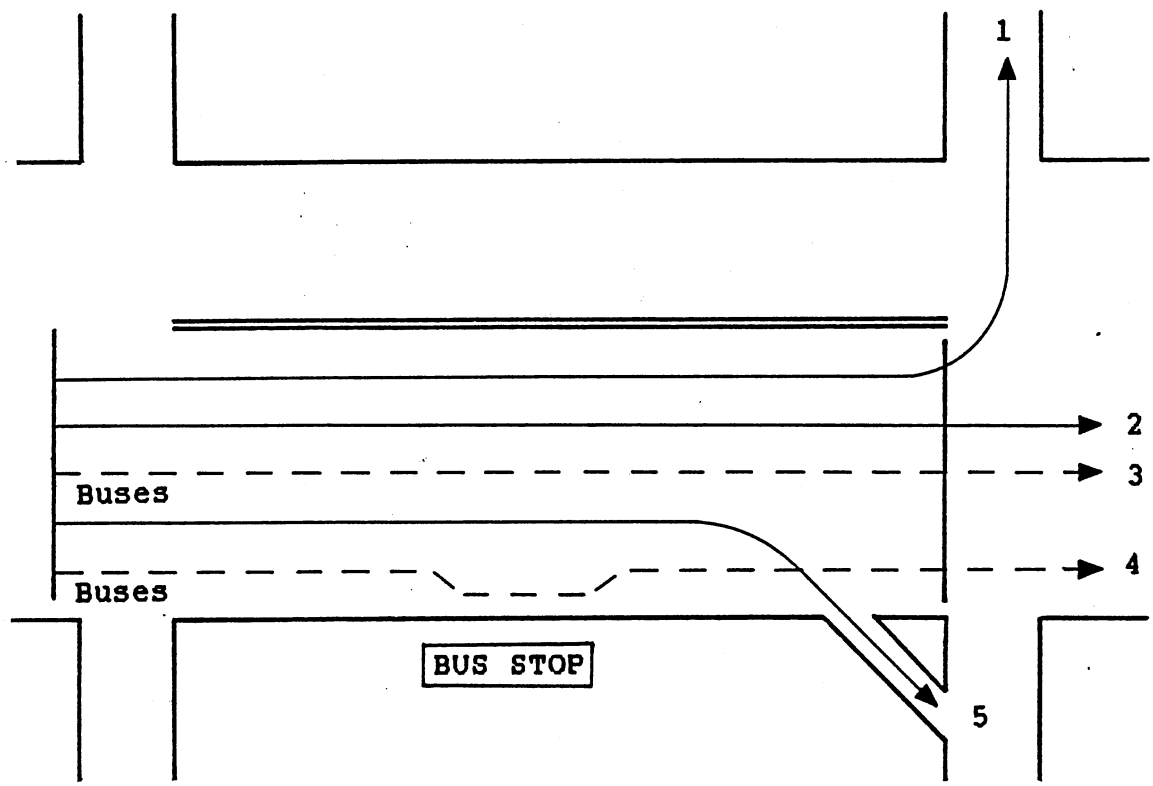


Figure 3. Typical Link Assignments [1]

Link number 3 is assigned to model the progression of through buses while link number 4 is assigned to account for buses that stop along the link. Link number 5 represents traffic that are free to make right turns at the downstream node.

The criteria for link assignments are as follows:

1. The through link is the main link and includes through traffic.

2. If there is a separate left-turn bay, a separate left- turn link is assigned, especially if the left-turn has a separate signal phase.

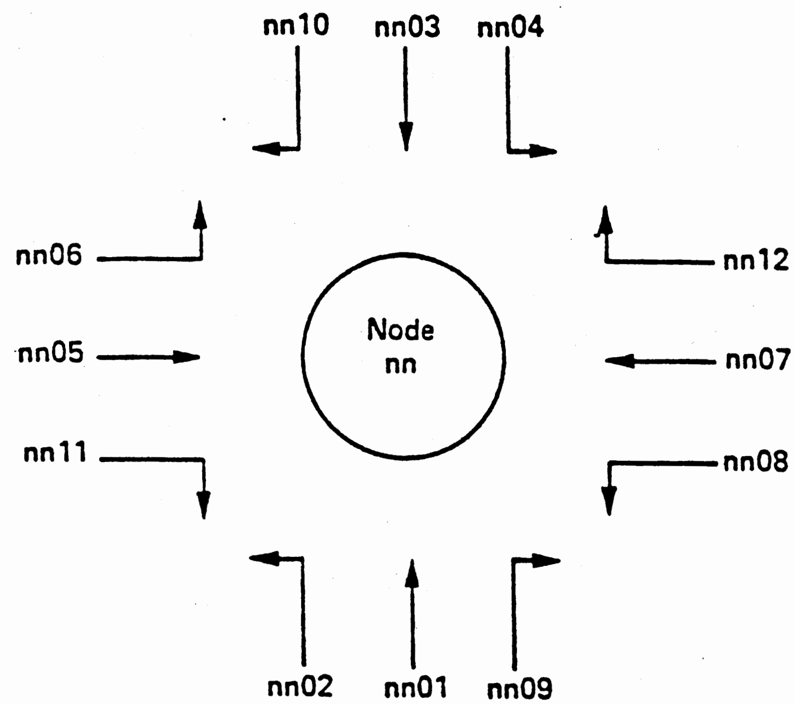
3. When a separate right-turning lane is available, a separate right-turning link is assigned.

4. A shared lane of through and unprotected left-turn traffic is modeled as a single through link, with the saturation flow rate reduced.

5. Lanes with total flow of less than 10 vehicles per hour are not assigned a link.

To model links that share a stopline and signal timings, the TRANSYT-7F stopline feature is used. This feature can be used to model, for example, buses that do not have a separate lane, but move in mixed mode with cars. The TRANSYT-7F format of identifying nodes and links is shown in Figure 4 where "nn" coresponds to the node number and "xx" corresponds to the links associated with that node [1].

The geometric design data include the link lengths,



Notes: 1. 'nn' is the node number.

2. Other special links will be numbered nnxx, where xx >12, and must be user-assigned. This applies to bus links, shared stopline links or diagonal links.

Figure 4. Node/Link Numbering Scheme [1]

number of lanes, and the street widths and turning-bays.

2. Signal Timing Parameters.

Signal Timing Parameters include cycle length, phase lengths, phase sequences, minimum phase durations, "WALK" and flashing "DONT WALK" intervals.

3. Traffic Data.

Traffic data include the traffic volumes, saturation flow rates and the average cruising speeds. The required traffic volume data include the total volume, through and turning movement volumes, mid-block source flows, link-to-link counts and classification studies, e.g., classifying trucks and buses. Total flows on a link are determined from the through and turning movement counts at the downstream node, while input flow volumes are determined from through and turning movement counts at the upstream nodes.

4. Program Control Parameters.

These data are needed to indicate those actions that are required of the program, e.g., a simulation, evaluation or optimization run, units to be in metric or in english, etc. A complete description on the control data and parameters is available in the TRANSYT-7F User's Manual [1].

Related Programs

In the course of this study, a number of microcomputer programs have been used in addition to TRANSYT-7F. The

Data Input Manager (T7F-DIM) has been used to create the TRANSYT-7F input data file. The Lotus LINKFLO has been used to determine the total flow on a link and also to determine the link input volumes. These volumes are then used as input data in T7F-DIM. The PPD program is used to plot the Platoon Progression Diagrams of requested links in the network.

The following sections briefly describe the application of these programs. The TRANSYT-7F Student Workbook provides further discussion on the application of the T7F-DIM and the PPD programs [2]. The instruction on using LINKFLO is contained in the LINKFLO program.

TRANSYT-7F Data Input Manager

Before executing the TRANSYT-7F program, an input data file has to be created. To create the data file, a TRANSYT-7F Data Input Manager (T7F-DIM) is used. In T7F-DIM, each screen-display is referred to as a card. Data are entered interactively on the screen-displays. In TRANSYT-7F, the input data are organized into four functional groups as shown in Figure 5. Data cards must be arranged in the sequence shown in Figure 5. The procedure of using T7F-DIM is described in the TRANSYT-7F Student Workbook [2]. Detailed description of the input requirements for each card-type shown in Figure 5 are documented in the TRANSYT-7F User's Manual [1]. The four functional groups of the various card-types are briefly discussed as follows:

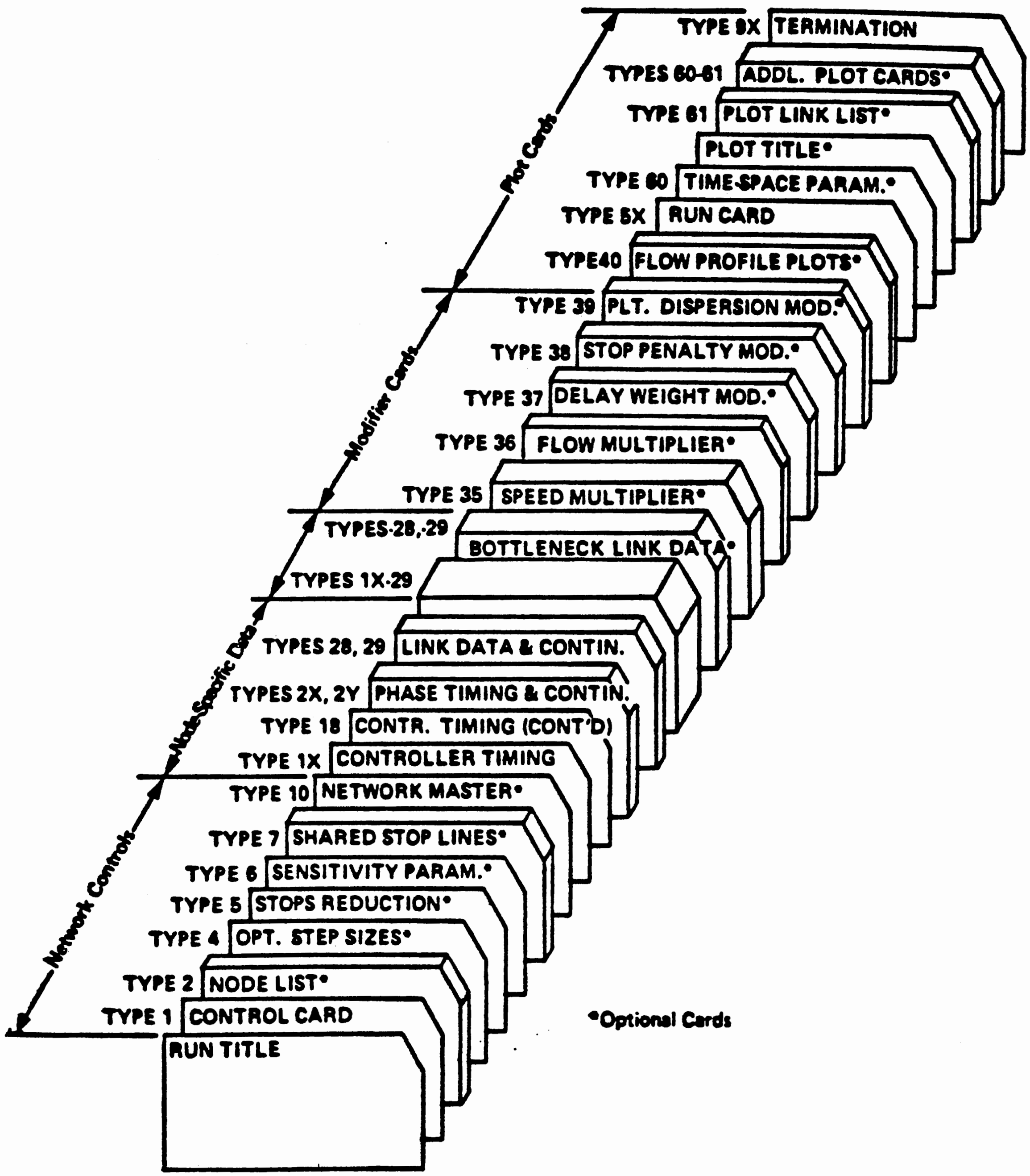


Figure 5. TRANSYT-7F Data Deck Stack [1]

1. Network Parameters and Program Control Options.

Cards that are grouped in this category contain data that are applied to the network as a whole and also data that control the optimization process.

2. Node Specific Data.

Cards in this category are used to input data associated with each node in the networks. They are also used to input data associated with each link. Examples of the node input data include the node numbers, signal timings and the link numbers. Link input data include the link lengths, saturation flow, total flow and the average cruising speed.

3. Modification Parameters.

The modifier cards are useful for answering "what if?" type of questions. These cards can be used for example to examine the sensitivity of a signal timing plan to changes in the cruise speed and the total flow. Modifier cards can also be used to "fine-tune" a timing plan by adding weighting factors to the stops and/or delays on specified links when calculating the Performance Index.

4. Plot and Run Control Cards.

Cards in this group include those cards that are used to request plotting of flow profile diagrams, the time-space diagrams and to request the creation of a Platoon Progression Diagram data file. Card-type 5X is used to request the type of a TRANSYT-7F run. The termination card is used to mark the end of TRANSYT-7F run. The termination card must be the last card in the input data deck for each individual run.

LINKFLO

LINKFLO is a set of LOTUS-123 templates that are used in preparing input data for the TRANSYT-7F program. Specifically, LINKFLO determines the link-to-link relationships between upstream and downstream traffic flows that are required as input data for TRANSYT-7F. The required input data in this program are the through and turning traffic volumes at the upstream intersection and at the downstream intersection of the subject link.

Platoon Progression Diagram (PPD)

The PPD program produces Platoon Progression Diagrams which show the density of traffic at all points in time and distance.

The data file that is to be read with the PPD program is created during a TRANSYT-7F run. Like a time-space diagram, the PPD plot illustrates the relationship between signal settings at adjacent intersections. However, it has the additional advantage of showing the flow of traffic, the formation of queues or the presence of secondary platoons, i.e., platoons of traffic that are formed by traffic originating from an upstream left or right turn movement. Traffic flow is depicted by shading on a time-space diagram, where darker shading is an indication that vehicles are closely-spaced, i.e., vehicles are moving in tight platoon. Lighter shading indicates that the platoon is dispersed.

The TRANSYT-7F Student Workbook provides further discussions on the application of this program [2].

TRANSYT-7F Outputs

There are seven types of output that are produced by TRANSYT-7F and they are briefly discussed as follows [1]:

1. Input Data Report - This report prints the input data with the appropriate headings. Any detected errors are identified by TRANSYT-7F's extensive diagnostics. Errors or potential error conditions are indicated through worded messages. A complete discussion on the diagnostics can be found in the TRANSYT-7F User's Manual [1].

2. Traffic Performance Table - This is a table of all measures of effectiveness (MOE's) for all links, subtotaled by intersection and aggregated for the entire network. The MOE's are indices of the quality of traffic flow used in the analysis or evaluation of traffic control systems.

3. Controller Timing Settings - The settings for each controller are shown in a format that is compatible with signal timing design.

4. Stopline Flow Profile Plots - For requested links, arrival and discharge flow rate profiles are printed. These plots are useful in evaluating the effectiveness of the signal timings in providing traffic progression.

5. Time-Space Diagram - The requested time-space diagrams for specified route are printed. They permit evaluation of the potential for through progression.

6. Platoon Progression Diagram - This is not a direct output from a TRANSYT-7F run. However, using A PPD program with a file created during a TRANSYT run, platoon progression diagrams are plotted.

7. Cycle Length Evaluation Summary - If more than one cycle length is input, a summary table is printed with pertinent MOE's for each cycle length printed.

The Structure of TRANSYT-7F*

The TRANSYT-7F program has two main elements, a traffic simulation model and an optimization model. The traffic simulation model is deterministic. For a given set of signal settings, the simulation model calculates several variables, e.g., stops, delays, queues that describe the performance of vehicles as they move through a network, on a link-by-link basis. It then calculates a "Performance Index" for the network using a particular set of signal timings. The optimization model then calculates an optimal set of offsets and phase lengths for a given cycle length by minimizing the performance index.

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*The theories and equations in this section and in subsequent sections in this chapter are cited from references 1 and 2.

The Simulation Model

The simulation model is macroscopic because it represents the flow of a platoon of vehicles. This model divides the common cycle length of all signals into a number of equal time intervals, typically one to three seconds, called steps. This results in a more detailed representation of traffic performance.

The simulation model makes the following assumptions [1]:

1. All major intersections in the network are signalized.

2. All signals have a common background cycle length. If desired, a cycle length equal to one half the background cycle length may be used. This is referred to as double cycling.

3. The percentage of turning movements, at each signal, remain constant throughout the cycle and from one cycle to another.

4. For a given intersection in the network, traffic enters at some constant specified rate on each approach, from one cycle to another.

The TRANSYT-7F traffic simulation model is among the most realistic of those available in the family of macroscopic traffic simulation models [1]. Unlike the other models that assume uniform distribution of traffic within the traffic platoon, TRANSYT-7F simulates traffic flow based on the concept of platoon dispersion.

To illustrate how TRANSYT-7F treats traffic flow, consider a single lane of traffic with a standing queue at an intersection [1]. Following the signal change to green, there is a slight delay before the first vehicle reacts and crosses the stopline. This is called the start-up lost time (L). After several vehicles have crossed the stopline, usually after three vehicles, the queue begins to discharge at a constant rate called the saturation flow rate. This process is shown in Figure 6. The vehicle trajectories depict the vehicle locations in time and space. All vehicles are stationary until time t_1, when the green is displayed. The start-up lost time is L, after which the first vehicle crosses the stopline.

Once the signal changes from green to yellow, some vehicles continue to pass through the intersection. This utilization of the clearance interval "extends" the amount of time vehicles can pass through the intersection by "E" seconds as shown in Figure 6. Thus the effective green (G_e) is the actual green time minus the start-up lost time, plus the utilization of the clearance interval.

The lower portion of Figure 6 shows the flow rate in vehicles per step and is plotted as a histogram. The saturation flow rate in this example is 2 vehicles per step or 1800 vehicles per hour of green. Thus, saturation flow rate is defined as the maximum rate of flow that can pass through a given intersection approach under prevailing traffic and roadway conditions, assuming that the movement

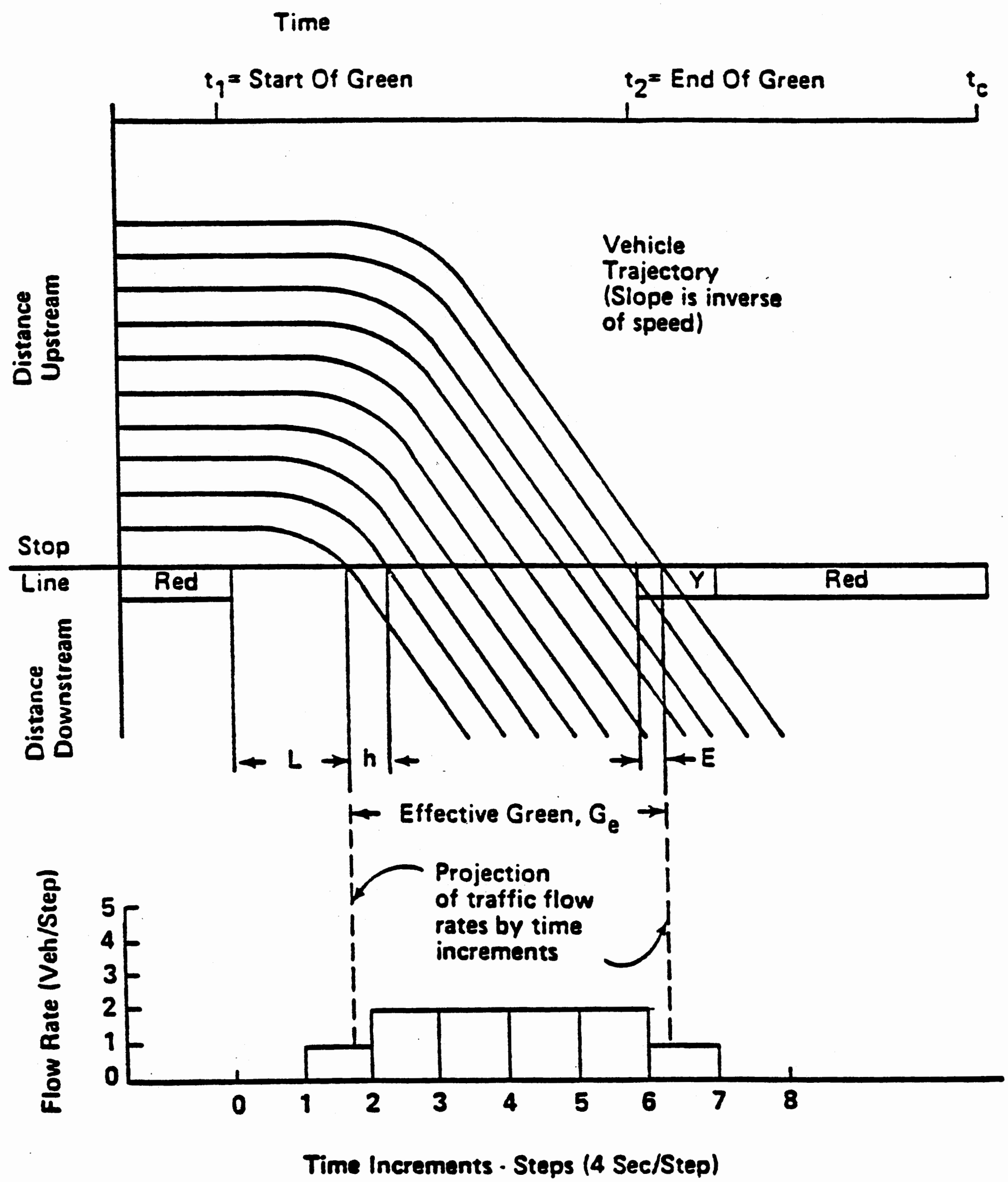


Figure 6. Simplified Representation of Traffic Flow from a Stopped Queue [2]

has green for a full hour.

Platoon Dispersion. A Traffic platoon is created when a queue is discharged from an upstream traffic signal at the start of green. The queue discharge rate is assumed to occur at a constant saturation flow rate [1]. As the platoon of vehicles progresses along the link, the flow rate changes due to the normal tendency of drivers to maintain safe headways or spacing between vehicles and also due to differences in travel speeds. This effect is shown in Figure 7. It is seen that, in addition to the changes in the slope of the platoon flow profile plot, its position in time changes which corresponds to the travel time of the vehicles along the street. Note that the flow rate is decreasing with time as the platoon becomes more dispersed at each observation point, i.e., at 0, 500 and 1000 feet from the upstream intersection.

The TRANSYT-7F program contains a platoon dispersion model which allows it to realistically simulate the dispersion of traffic and calculate downstream flow profiles. Figure 8 illustrates how all upstream inputs are explicitly considered in determining downstream arrival patterns. In Figure 8, two movements occur at the top intersection (node 1) and their departure profiles are shown. After some start-up lost time, platoon "A" departs and begins to disperse as it moves downstream. In the second signal phase, a smaller platoon "B" turns onto the link from a cross street and also begins to travel

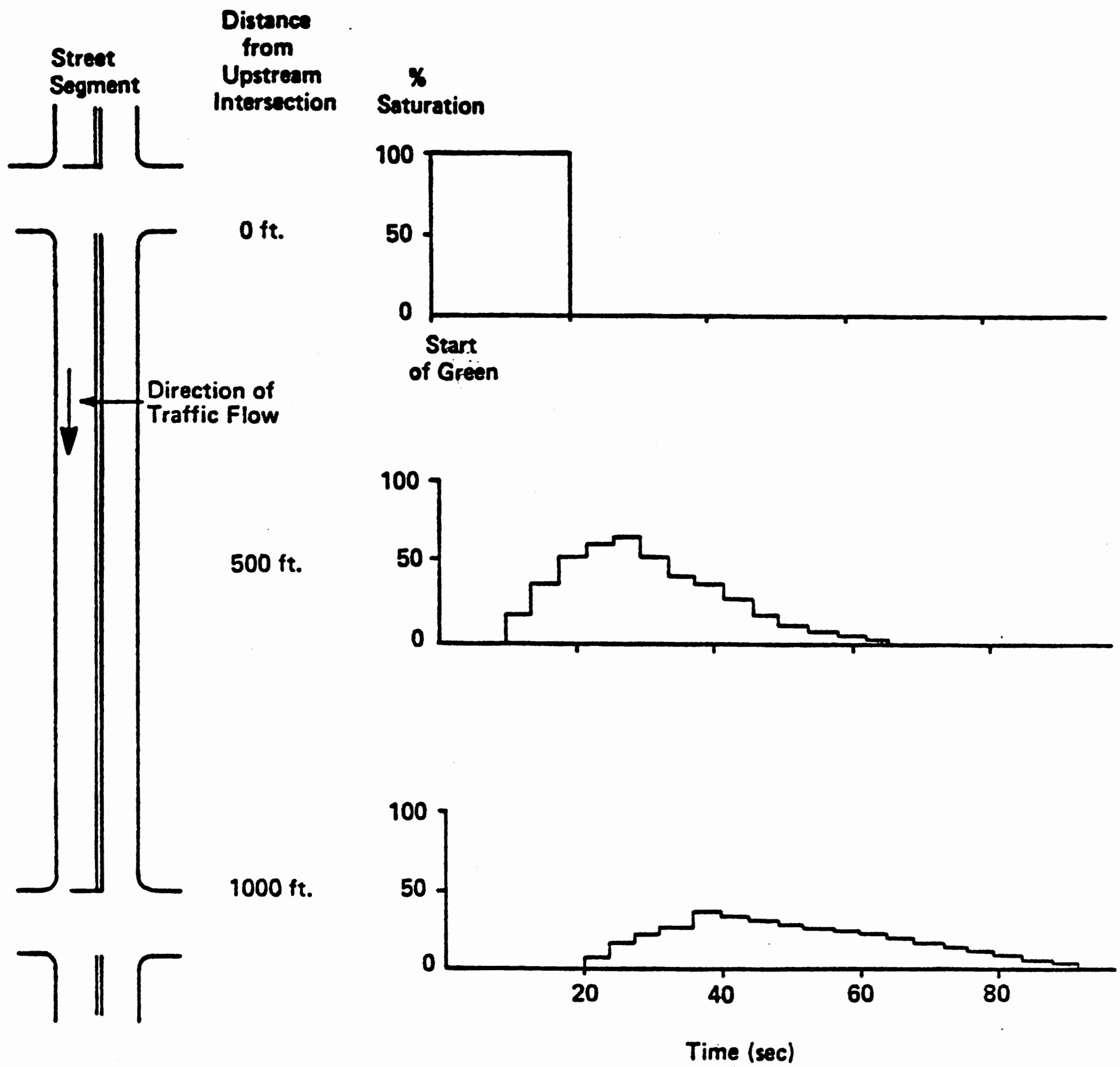


Figure 7. Simplified Platoon Dispersion [1]

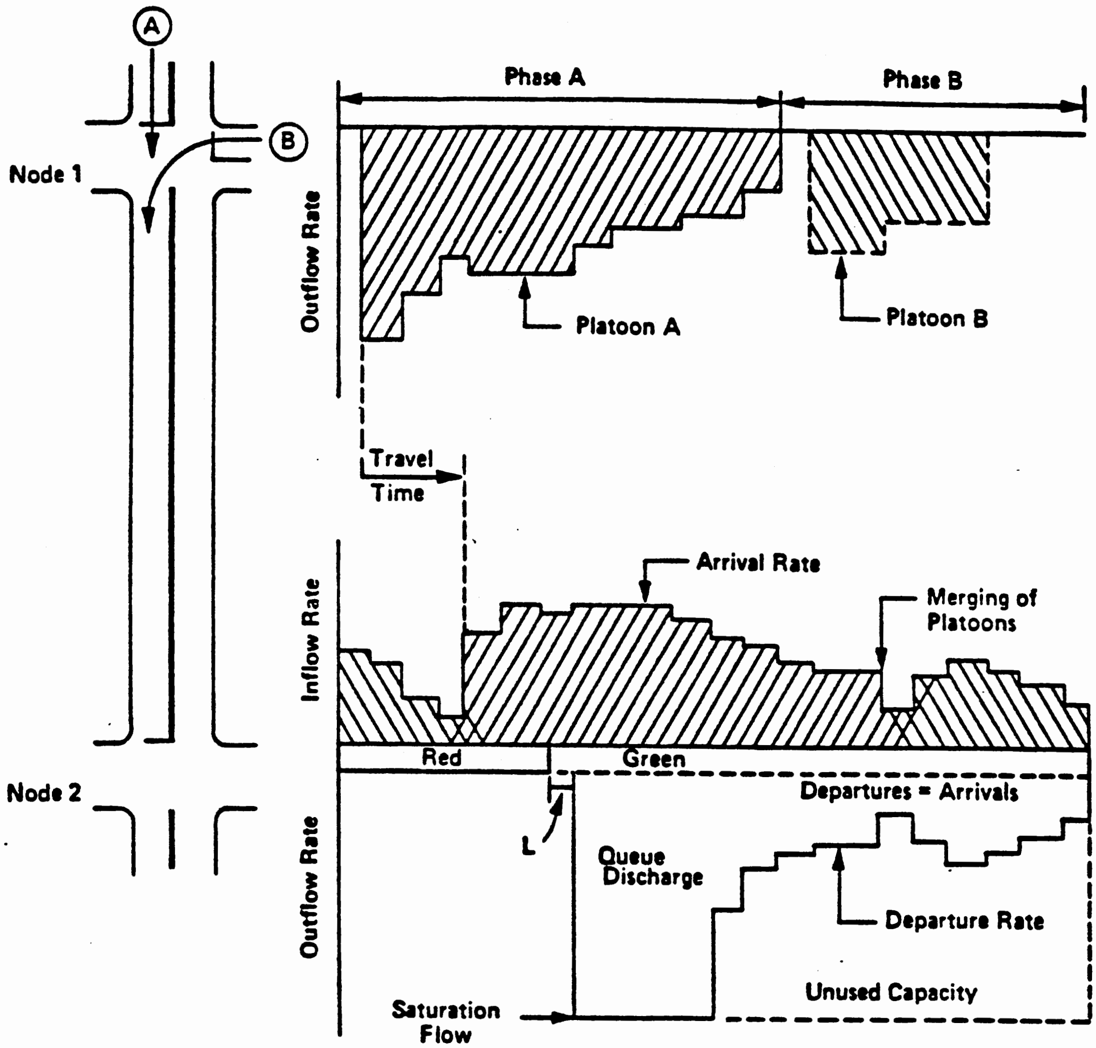


Figure 8. Dispersion of Multiple Platoon [1]

downstream. The two shaded areas show the flow profiles of platoon A and platoon B.

At node 2, the arrival rate of traffic is shown in the upper profile. It is seen that platoon B has merged into the back of platoon A. The front of platoon A has arrived on the red at node 2 and begins to queue.

The lower profile at the bottom of the figure shows the departure rate at node 2. After some start-up lost time, L, the signal becomes effectively green and the queue begins to discharge at the saturation flow rate until it is completely dissipated. For the remaining duration of the effective green, the departure pattern equals the arrival pattern and vehicles pass through the intersection without delay.

In modelling traffic flow, all upstream input volumes to all downstream links are explicitly considered in the arrival patterns downstream. In modelling the dispersion of a platoon, each link is considered individually. Queues that are formed on each link are expressly considered. The platoon dispersion concept is documented by Robertson and is based on works in the United Kingdom by Hillier and Rothery [1]. TRANSYT-7F uses the above formulation in estimating delays and stops.

Computational Algorithms for Traffic Flow Patterns

Each signal phase is identified by its start and end times. Since it is known which links have the right-of-way during each phase, it is a simple matter for the simulation model to construct the traffic flow patterns. Three different flow patterns are considered, namely: "IN", "GO" and "OUT" patterns.

The Arrival Flow (IN) Pattern. The "IN" pattern is expressed mathematically as follows:

$$IN_{it} = \sum_{j=1}^{n} F_{ij} \, [P_{ij} \times OUT_{jt}] \qquad (2)$$

where

IN_{it} = the in pattern on link i for step t

F_{ij} = a factor that controls the rate at which the platoon disperses on link j as it moves to link i. [$F = 1/(1 + \alpha T)$]. F is a function of the travel time of platoon, T, where T = 0.8 times the average travel time on link j. α is the platoon dispersion factor and a default value of 0.35 is used. It is dependent on the roadway characteristics.

OUT_{jt} = the out pattern of link j for step t

P_{ij} = the proportion of OUT_{jt} that feeds link i

n = the number of links (j) that feed link i

The "IN" pattern is estimated for each step, t, in the cycle, thus forming a pattern or profile similar to that shown in Figure 9.

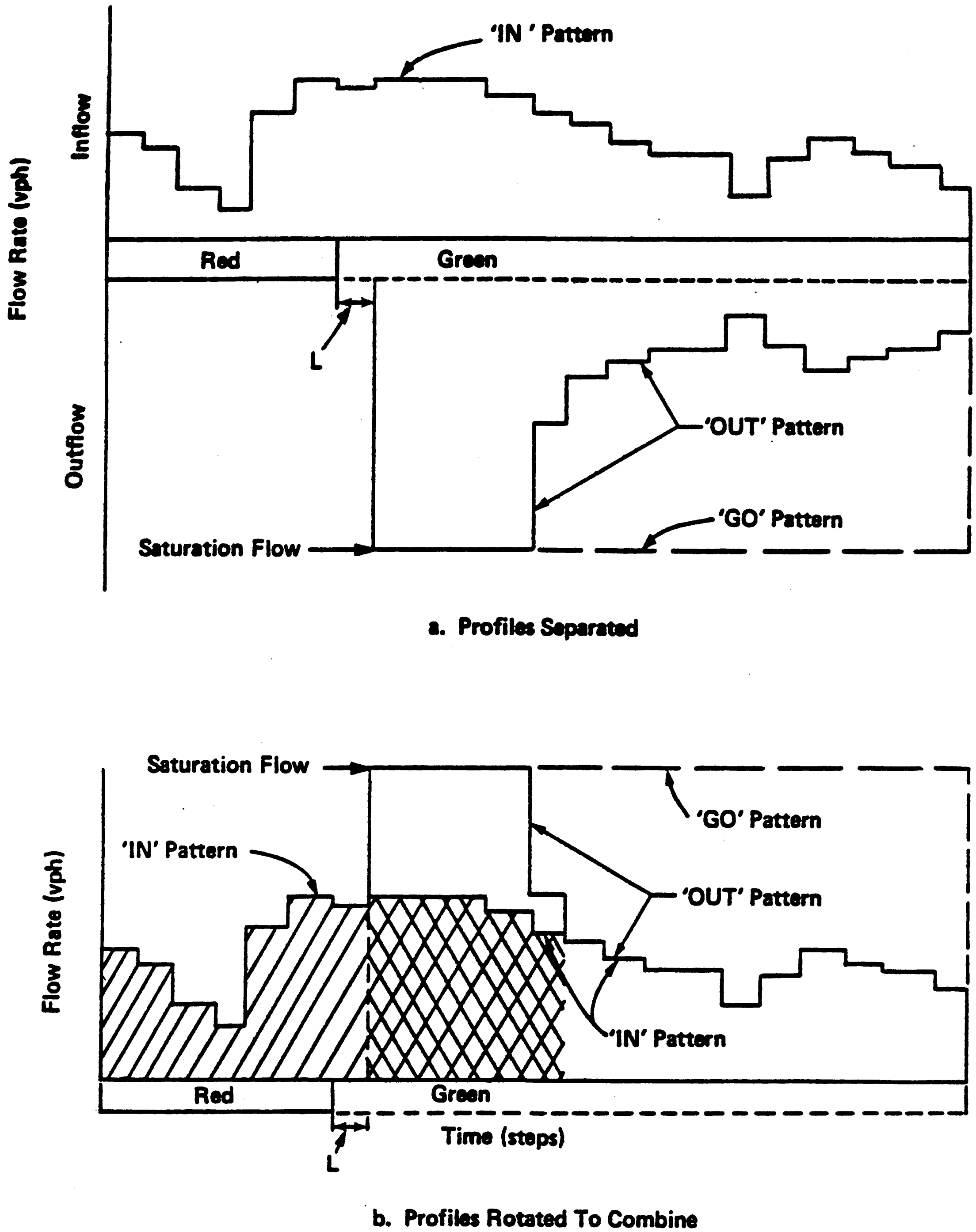


Figure 9. Traffic Flow Profiles [1]

The Saturation Output Flow (GO) Pattern. The "GO" pattern is the flow rate at each step that would leave the stopline if there were enough traffic to fully utilize the green as shown in Figure 9. The saturation flow rate is a user input. For the purpose of plotting the flow profile diagrams, the queue is assumed to be "stacked" vertically at the stopline. However the model does add new arrivals on green to the queue, while it is discharging.

The Output Flow (OUT) Pattern. The "OUT" pattern is the profile of traffic leaving the stopline. It is equal to the "GO" pattern as long as there is a queue. After the queue dissipates, it is equal to the "IN" pattern for the duration of the effective green.

To determine the "OUT" pattern, the number of vehicles held at the stopline during any time interval, t, must first be determined by:

$$m_{it} = \max [(m_{i,t-1} + q_{it} - s_{it}), 0] \tag{3}$$

Where

m_{it} = number of vehicles in the queue in time interval t on a given link i

$m_{i,t-1}$ = number of vehicles in the queue in time interval t-1 on a given link i

q_{it} = number of vehicles arriving in interval t on link i, given by the "IN" pattern

s_{it} = number of vehicles allowed to leave link i in interval t, given by the "GO" pattern

The "OUT" pattern for each link i during time interval t is given by the following expression:

$$OUT_{it} = m_{i,t-1} + q_{it} - m_{it} \qquad (4)$$

where

OUT_{it} = OUT pattern of link i for step t

m_{it} = number of vehicles in the queue in time interval t on link i.

$m_{i,t-1}$ = number of vehicles in the queue in time interval t-1 on link i

q_{it} = number of vehicles arriving in interval t on link i, given by the "IN" pattern t.

If there is a queue, the "OUT" pattern profile is equal to the "GO" pattern profile. Otherwise it is equal to the "IN" pattern profile. The combined traffic flow pattern is shown in the lower part of Figure 9. It is seen that the first "step-down" after the "GO" pattern contradicts the above statements. It must be noted that TRANSYT-7F simulates traffic flow in a step-size function. If the simulation is done with a continous function, then the ideal case of the "OUT" pattern equals the "IN" pattern, when there is no queue, would be achieved.

Derivation of Delay. The most important aspect of traffic signal study is the delay to vehicles in the system. Delay represents indirect cost to the motorists in terms of lost time and a direct cost in terms of fuel consumption. Excessive delay at signalized intersections reflects the inefficiency of the signal timing. The most widely used model for delay computation is the Webster's model [1]:

$$D = \frac{C(1-\lambda)^2}{2(1-\lambda X)} + \frac{X^2}{2q(1-X)} - 0.65 \left[\frac{C}{q^2} \right]^{1/3} X^{(2 + 5\lambda)} \quad (5)$$

where

D = average delay per vehicle on a particular approach in seconds

C = cycle length in seconds

λ = proportion of the cycle that is effectively green for the phase under consideration, i.e., g/C, where g = effective green in seconds

q = traffic volume in veh/sec

X = the degree of saturation. (i.e., $X = q/\lambda S$, where S = Saturation flow in veh/sec).

The first term in Webster's Model is the delay due to recurring cyclic demands and stops, called the uniform delay, d_u, component. The second component is the random delay, d_r, component which adjusts for the random arrivals of traffic. The last component is purely an empirical adjustment, d_e, which adjusts the sum of the uniform and random elements to conform more closely to measured delay. This model is only considered valid for degrees of saturation up to about 95 percent [1].

In TRANSYT-7F, macroscopic estimates of delay are computed from the flow profiles. This process is illustrated by rotating the departure profile 180 degrees in the lower part of Figure 8 so that it is superimposed over the arrival profile, as shown in Figure 10. Beginning at time zero, the inflow rate minus the outflow rate is equal to the inflow rate up until time (t_i + L), where t_1 is the start of green and L is the start-up lost time, and all arriving vehicles are being stopped and delayed. These stopped vehicles form a traffic queue. By accumulating all stopped vehicles arriving during time (t_1 + L), the curve depicted conceptually by the dashed line is produced. Once traffic begins to move at time (t_i + L), vehicles continue to join the back of the queue, but the front of the queue is discharging at a higher rate. Thus, the queue length begins to shorten. At time t_2, the queue has dissipated entirely and no further delay occurs in this cycle until the signal turns red, at time t_c (or t_o). Uniform delay is then calculated by integrating the area under the dashed line.

Random delay and delay due to saturation must also be calculated. The delay due to saturation occurs when the degree of saturation on a link approaches or exceeds 100 percent. TRANSYT-7F uses a formulation that is similar to Webster's model. However, to produce meaningful delay values when the degree of saturation approaches or exceeds 100 percent, it must be corrected [2].

The overall delay is illustrated in Figure 11. It is seen that the random delay and delay due to saturation increase rapidly when a link is oversaturated to account

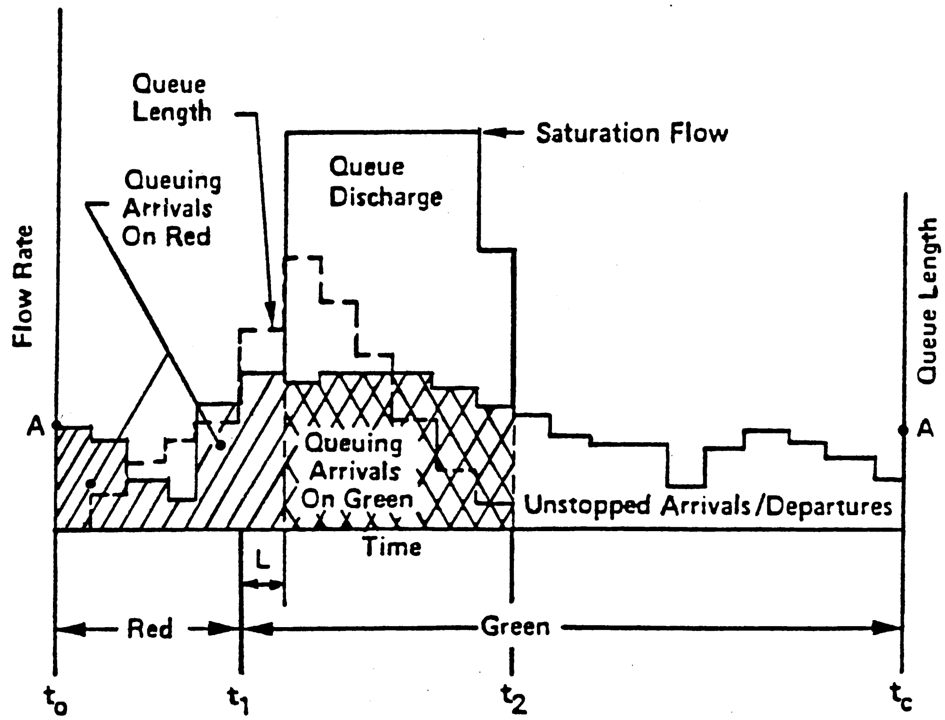


Figure 10. Derivation of Uniform Delay [1]

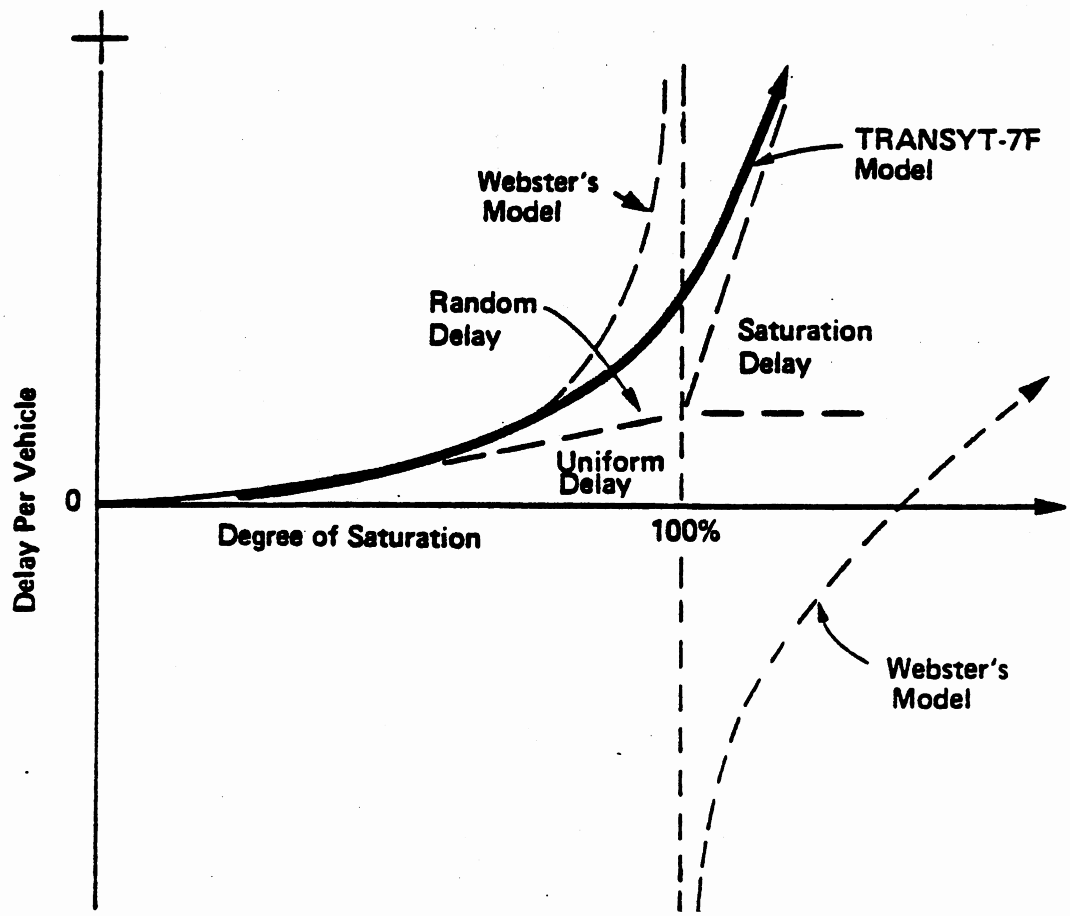


Figure 11. TRANSYT-7F Estimate of Delay [1]

for failure of the queue to clear within one cycle. Consequently, the total delay increases rapidly when a link is oversaturated. As seen from the figure, Webster's Model is not applicable when the degree of saturation approaches or exceeds 100 percent. However, the TRANSYT-7F model continues to produce meaningful results at degrees of saturation exceeding 100 percent. Although more realistic than Webster's model, high delays due to this random plus saturation delay component should be viewed as gross estimates, especially if oversaturated conditions only last for a short period of time [2].

Stops and Queue Length. This section describes how the TRANSYT-7F traffic simulation model estimates stops and queue length. TRANSYT-7F assumes that vehicles which are delayed are also stopped. In reality, this is not the case but the question is how to properly model "slowdowns" when the vehicles do not actually stop. Figure 12 shows a typical time-space profile on a link at a node. It depicts the arrival, queuing and the departure pattern of traffic. Since the TRANSYT-7F uniform delay model does not consider accelerations and decelerations, the uniform delay model assumes that vehicles approaching the stopline or the back of the queue stop instantaneously, then after some delay (d_u), restart instantaneously. The inset in Figure 12 illustrates the arrival, queuing and departure profile of a vehicle. If the loci of points A and B for all stopping vehicles are plotted, they will form the sloping sides of

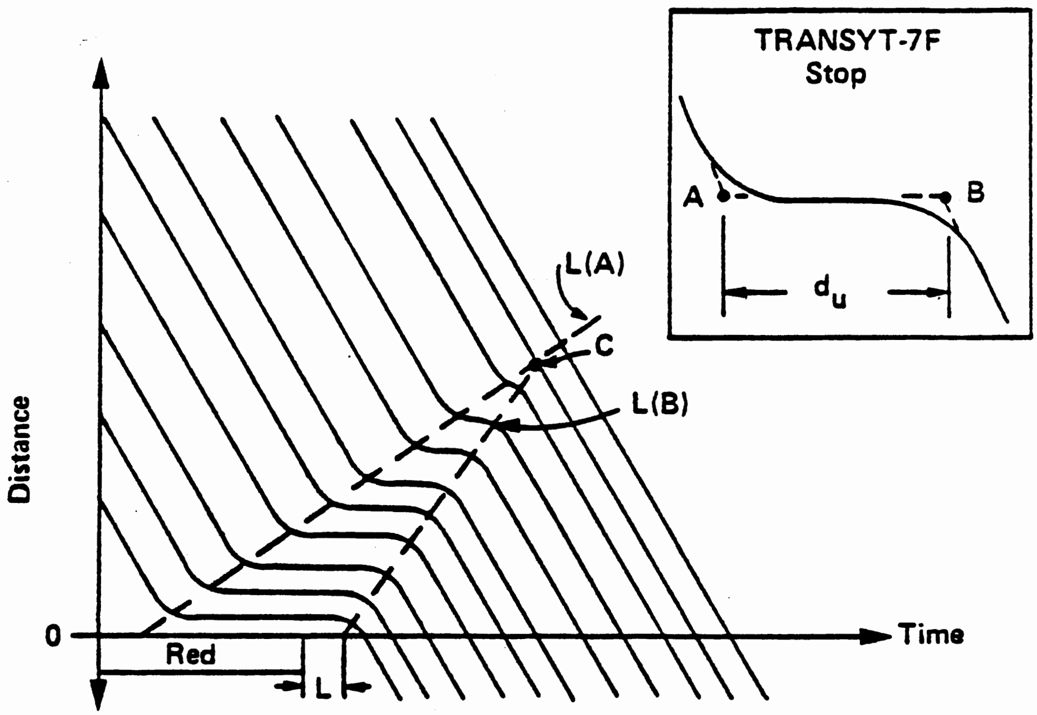


Figure 12. Derivation of Stops [1]

the triangle shown in Figure 12. The triangle represents the back, L(A), and front, L(B), edges of the queue, respectively. Approaching the convex of these loci, the queue is now moving and further arrivals are not stopped.

The above discussion can be used to describe how queue length is estimated. Conceptually, the queue is the vertical "distance" between L(A) and L(B). In TRANSYT-7F, point C is reported in the performance tables as the maximum back of the queue, in terms of the number of vehicles. The maximum back of queue is the number of vehicles that queue at the beginning of green. It also includes the number of vehicles that arrive during the green and join the back of the queue while the front of the queue is discharging [1]. The performance table produced by TRANSYT-7F includes a queue capacity value for each link in the network. Queue capacity is the desired extension of the back of the queue [1]. Simply, it is a measure of the number of vehicles per unit length of roadway [5]. The queue capacity value may be input or the program will calculate a value for each link. It is determined by multiplying the link length by the nominal number of lanes (estimated from the saturation flow rate), and dividing by a nominal spacing between vehicles of 25 feet [1]. By comparing the maximum back of queue with the queue capacity, the potential of a spillover on a link can be determined.

Optimization Model

The optimization model of TRANSYT-7F uses a hill-climbing (iterative search) technique that varies the offset and phase lengths at each signal to locate the particular set of signal timings that minimizes the Performance Index (PI) for the entire street network. When the minimum network PI is obtained at a particular intersection, the process is repeated at the next downstream signal. During the optimization process at the downstream intersections, the optimal signal settings that have been determined at the upstream intersections are retained. The process is repeated until all signals are optimized. The Performance Index (PI) is a linear combination of delays and stops. It can be expressed as:

$$PI = \sum delay + ("K" \times stops) \qquad (6)$$

where "K" is the "network-wide stop penalty" and it is used to express the importance of stops relative to delay. Equation 6 is a simplification of how the Performance Index is computed by TRANSYT-7F. The complete form of PI is :

$$PI = \sum_{i=1}^{n} [(delay_i \times WD_i) + ("K" \times stops_i \times WS_i)] \qquad (7)$$

Where

$delay_i$ = delay on link i in veh-hr

$stops_i$ = stops on link i in stops/sec.

WD_i = delay weight for link i

WS_i = stop weight for link i

"K" = coefficient to express the importance of stops relative to delay (network-wide stop penalty).

n = number of links in the network

The delay here implies time lost while traffic is impeded by some elements over which the driver has no control, such as a traffic signal. The stops refer to the number of times vehicles stop in the system and it is used as a measure of effectiveness to assess the effectiveness of the timing plan. Therefore, in a coordinated traffic signal system, the goal is to minimize delays and stops.

In running TRANSYT-7F it is recommended that "-1" is coded in field 8 of card-type-1 since the program will automatically determine and set the stop penalty on each link that will minimize the fuel consumption due to stops and delays on the link.

Offset Optimization. It was found that for a system of only six signals and a 60 seconds cycle length, over 46 billion trials would be required if a constant step size of 1 second was used [1]. For the purpose of reducing computer time during the offset optimization, the TRANSYT-7F hill-climbing process uses varying step sizes. The unit of time in TRANSYT-7F is called step. In the optimization process, a step size is the amount of time by which the offsets will be varied. Further discussions on step size are available in the User's Manual [1].

The step-sizes in this example as shown in Figure 13 are S_1, S_2, S_3 and S_4. For the first step of the process, S_1, the change in offset is a medium-sized step of about 15% of the cycle. This changes the initial offset of zero to O_1. The PI is lower, so O_1 is "better" than O_0. Add S_1 again, which has the same result, so O_2 is the new offset. Adding S_1 again results in an offset of O_3, but with increasing PI. So the "best" offset thus far is O_2.

Let the next step size, S_2, be small, say one second. When S_2 is added to O_2, the PI increases, so the direction is reversed. The offset will continue to "improve" until the valley of the curve at O_4 is eventually found. This is the best solution thus far, but it is clearly not the optimal solution.

Next, use a large offset step size, S_3, about 40% of the cycle. The PI at the resulting offset, O_5, is lower than before, so the search has "escaped" from the local minimum. Adding S_3 would get the search back into the first peak at O_6, so O_5 is retained.

Finally, the series of small step size, S_4, are repeated and the best solution will eventually be found at O_7. Although the "best" solution was found in this example, there is no guarantee that the global optimum will always be found. However, TRANSYT-7F should always produce a good signal timing plan [1]. In TRANSYT-7F, depending on the type of TRANSYT-7F run requested in card-type 5X, one of two default step size lists is produced [1]. It is

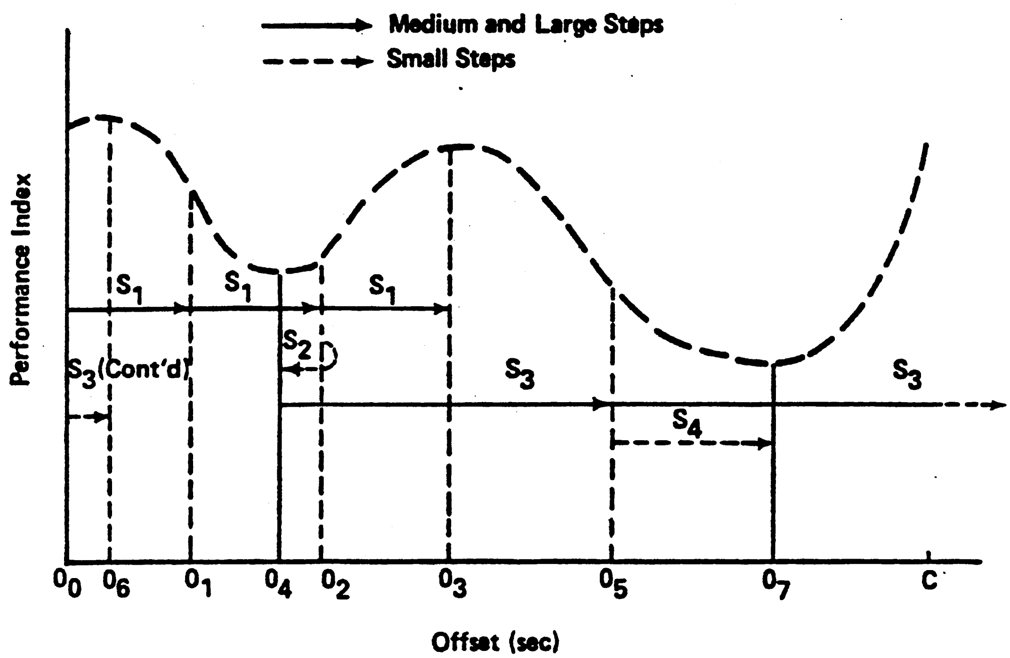


Figure 13. Illustration of the Hill-climbing Process [1]

recommended that these step size default lists be used. The default step size lists have been found to produce an acceptable signal timing plan [1].

Optimization of Phase Lengths. The phase length optimization process is similar to the offset optimization process, except that changes in the phase lengths at each signal are examined. After each change of the phase length, the new timing plan is then simulated to determine if traffic performance has changed. In the phase length optimization, the sum of the phase lengths must equal the cycle length.

System Measures of Effectiveness

TRANSYT-7F produces seven measures of effectiveness (MOE's) which are used for evaluating signal timing plans [1]. These MOE's are:

Total Vehicle-miles/hour of Travel

The total vehicle-miles of travel is simply the flow rate times the link length and can be expressed as [1]:

$$TT_i = q_1 \times L_i \quad (8)$$

Where

TT_i = total travel on link i in vehicle-miles per hour

q_i = traffic volume on link i in vehicles per hour

L_i = length of link in miles

The travel time is constant as long as the flow rate and link length are not changed.

Total Travel Time

The total travel time is estimated as follows [1]:

$$TTT_i = q_1 \left[\frac{L_i}{u_i} + D_i \right] \tag{9}$$

Where

TTT_i = total travel time in vehicle-hour per hour on link i

q_i = traffic volume on link i in vehicles per hour

L_i = length of link i in mile

u_i = average cruise speed on link i in miles per hour

D_i = Total delay on link i in vehicle-hour per hour.

Delay

The delay in TRANSYT-7F consists of three elements: uniform delay (d_u), random delay (d_r) and the delay due to saturation flow (d_s). The uniform delay is the delay due to recurring cyclic demands and stops. It is calculated by averaging the queue length over the cycle. Equation (3) provides the estimate of the queue length on link i, m_{it}, for any step ,t. If m_{it} is averaged over the cycle, the uniform delay is calculated as follows [1]:

$$d_u = \frac{C}{3600N^2} \sum_{t=1}^{N} m_{it} \tag{10}$$

Where

d_u = uniform delay in vehicle-hour/hour

C = cycle length in seconds

m_{it} = queue length on link i during step t

N = number of steps in the cycle

The random delay component of the delay equation accounts for the cycle-by-cycle variations in vehicle arrivals and for the effects of saturation. Random delay and delay due to saturation increase rapidly when a movement is oversaturated to account for failure of the queue to clear within one cycle and possible spillover into the upstream intersection.

The combined effect of random delay and saturation delay, drs, is computed as follows [1]:

$$d_{rs} = [(\frac{B_n}{B_d})^2 + \frac{X^2}{B_d}]^{1/2} - \frac{B_n}{B_d} \quad (11)$$

where

d_{rs} = random and saturation delay in vehicle-hour/hour

B_n = 2(1-X) + XZ

B_d = $4Z - Z^2$

Z = (2X/V) x 60/T

X = degree of saturation

V = volume on the link, vehicles per hour

T = simulation time, normally 60 minutes

Hence the total delay, D, is computed as follows:

$$D = d_u + d_{rs} \quad (12)$$

Stops

As discussed earlier, TRANSYT-7F assumes that vehicles that are delayed are also stopped. Studies by the TRRL suggest that short periods of delay can be expressed as fractions of stops for the vehicles affected. Empirical studies by TRRL produced the relationship between percentage of stops and length of delay as shown in Figure 14 [1]. TRANSYT-7F has a built-in stops reduction function which equates small values of delay to percentage of vehicles stopped. As an example, a delay of 4 seconds is equal to 76 percent stops. Thus at any link, if the uniform delay is less than or equal to ten seconds, the factors from the curve are used to effectively reduce the estimate of stops. This is more realistic than assuming that all vehicles that are delayed are also stopped [1].

Performance Index

As discussed above, the objective function of TRANSYT-7F optimization is to minimize the Performance Index (PI). An optimal timing plan is developed when a minimum network PI is achieved. The PI is a linear combination of delay and stops and can be computed using equations 6 and 7 [1].

Fuel Consumption

The estimate of the fuel consumption is based on a linear combination of total travel, delay and stops. The expression used is as follows [1]:

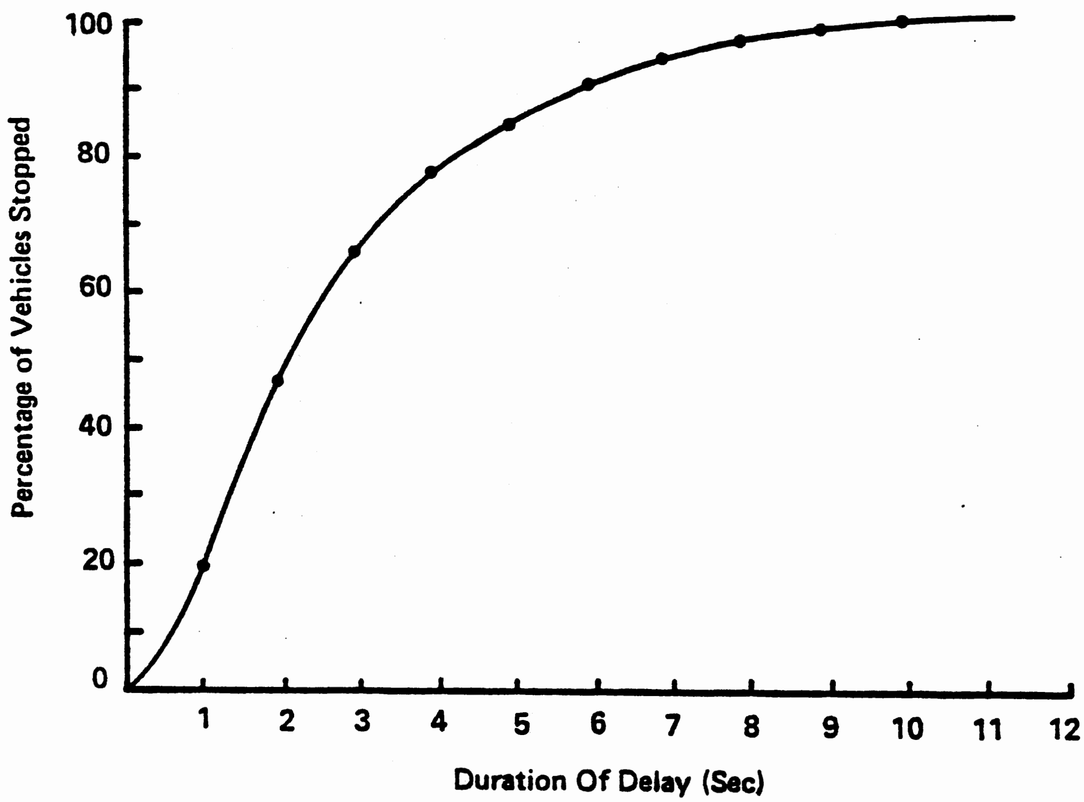


Figure 14. Reduction of Stops as a Function of Delay [1]

$$F = k_1TT + k_2D + k_3S \tag{13}$$

where

F = fuel consumed in gallons (liters) per hour

TT = total travel in vehicle-miles per hour

D = total delay in vehicle-hours per hour

S = total stops in stops per hour

k_i's = coefficients of regression, which are functions of cruise speed.

Average Speed

The average speed is derived by dividing the total travel (TT) by the total travel time (TTT) and is expressed in mph. It is an indication of the overall quality of flow in the network [1]. When a different optimization run is performed, it can be used as a measure of improvement.

CHAPTER III

THE SIXTH STREET PROJECT

Project Description

This project involves the coordination of nine traffic signals on a 2.1 mile section of Highway 51 (known as 6th Avenue) in Stillwater, Oklahoma. It represents a major thoroughfare that provides access to Oklahoma State University, the Stillwater Medical Center, the downtown area and other major land-use developments. The project begins about 17 miles east of I-35 at the intersection with Western Avenue and extends through most of the urban section of Highway 51 in Stillwater to the intersection with Perkins Road.

There are ten signalized intersections between these two intersections. However, the intersection between King's Road and Sixth Avenue (which is controlled by an actuated signal controller) is not considered in the project because there is very little traffic movement on King's Road. Therefore, traffic on Sixth Avenue has the right-of-way for most of the time. Thus, nine intersections are considered in the optimization project. Figure 15 shows the overall layout of the project network.

Of these nine intersections, five are controlled by

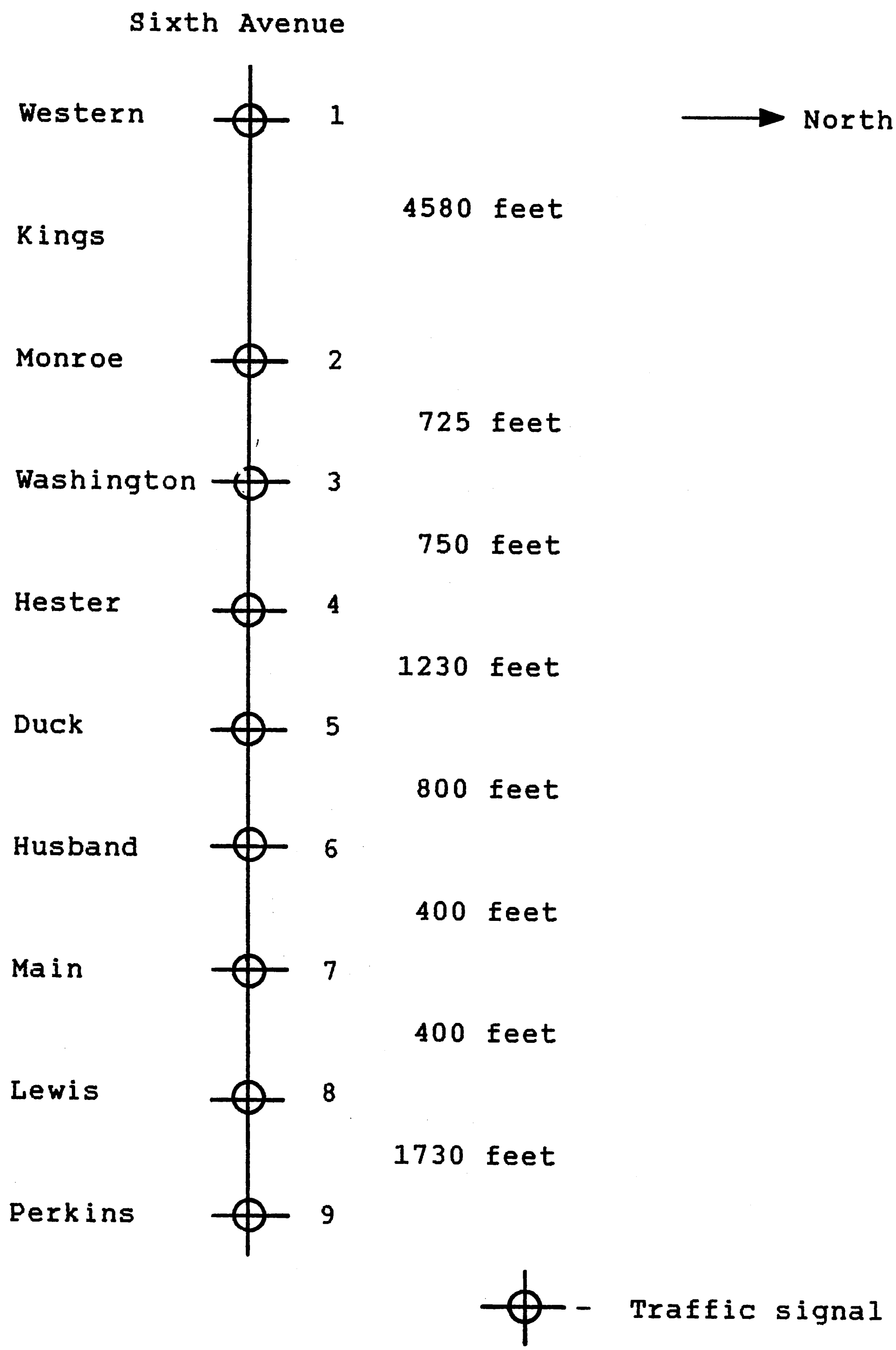


Figure 15. Layout of Project Network

pre-timed signal controllers and four are controlled by actuated signal controllers. The design period in this signal optimization project is the morning peak period.

Data Requirements

A summary of the data requirements is listed in Chapter 3. In this chapter, the required data will be discussed in the following order:

1. Traffic Volume Data
2. Speed Data
3. Saturation Flow
4. Link Lengths
5. Signal Timing Data

In TRANSYT-7F, the network has to be coded in terms of nodes and links. To be considered as a link, the total traffic volume on that link must meet a requirement of at least 10 vehicles per hour. To ensure that this absolute minimum requirement is met, it is necessary to reduce the raw traffic volume data prior to representing the street network in terms of nodes and links.

Traffic Volume Data

The through and turning movement volumes for the nine intersections were obtained from the Stillwater City Engineer's Office. The input volume data required for each link include the total flow approaching the downstream node and the input flow from each link leaving the upstream node.

<u>Data Reduction.</u> Appendix A shows the total through and turning movement volumes for the morning period that were collected in 15-minute intervals. These volumes must be converted to design hourly volumes. The steps that are involved in the reduction of the raw data to a form that is readily input into TRANSYT-7F are discussed below:

Step 1 - The peak one-half hour volume for each approach is selected from the through and turning movement volumes as given in appendix A. The peak one-half hour volume is obtained by adding the two consecutively highest 15-minute volumes from the 15-minute interval volume counts. Appendix B shows the peak one-half hour through and turning movement volumes.

Step 2 - To obtain the design hourly volume rates, the one-half hour through and turning movement volumes (Appendix B) are multiplied by two This adjustment allows for peaking within the hour and is a reasonable compromise between overdesign, i.e., multiplying the peak 15-minutes count by four, which yields poor estimates of the delay, and underdesign, i.e., using the peak hour count [1]. In normal practice, the design hourly volumes are calculated by multiplying the peak 15-minute volumes by a factor of four. The resulting design hourly volume rates for each node are recorded as in Figures 16 through 24.

Trucks are not considered in this project because the percentage of trucks are not available. To be considered,

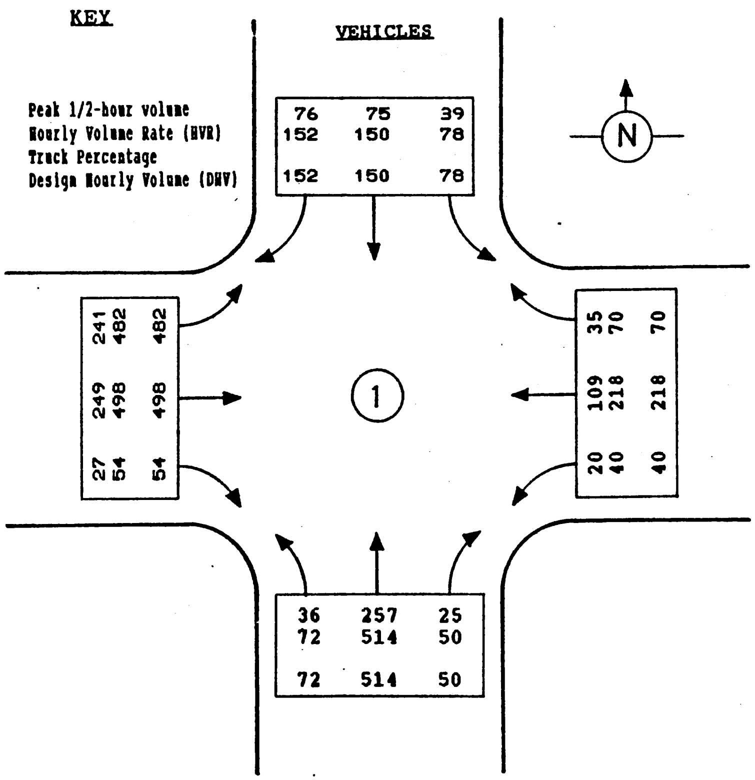


Figure 16. Design Hour Volume for Node 1

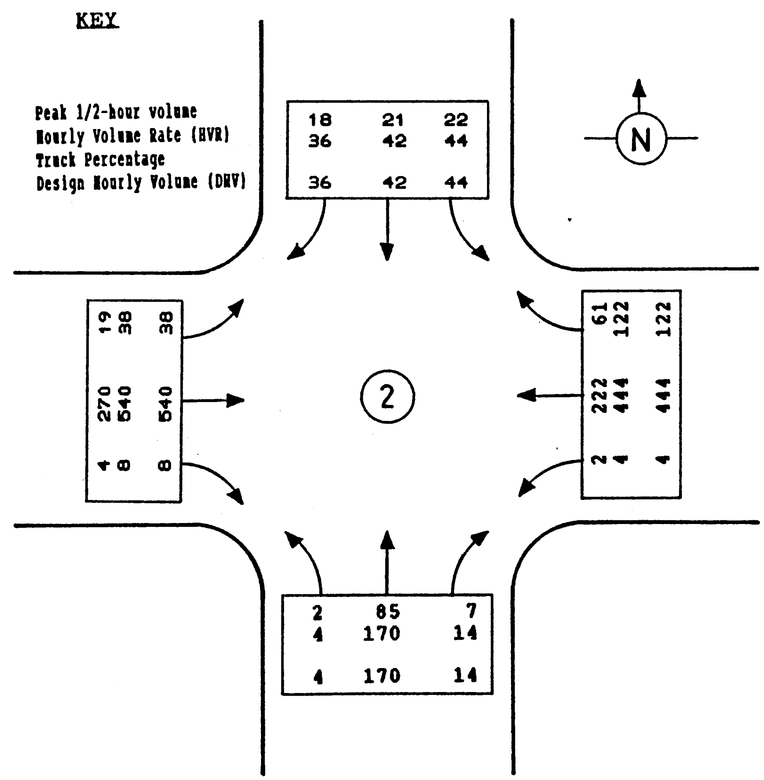


Figure 17. Design Hour Volume for Node 2

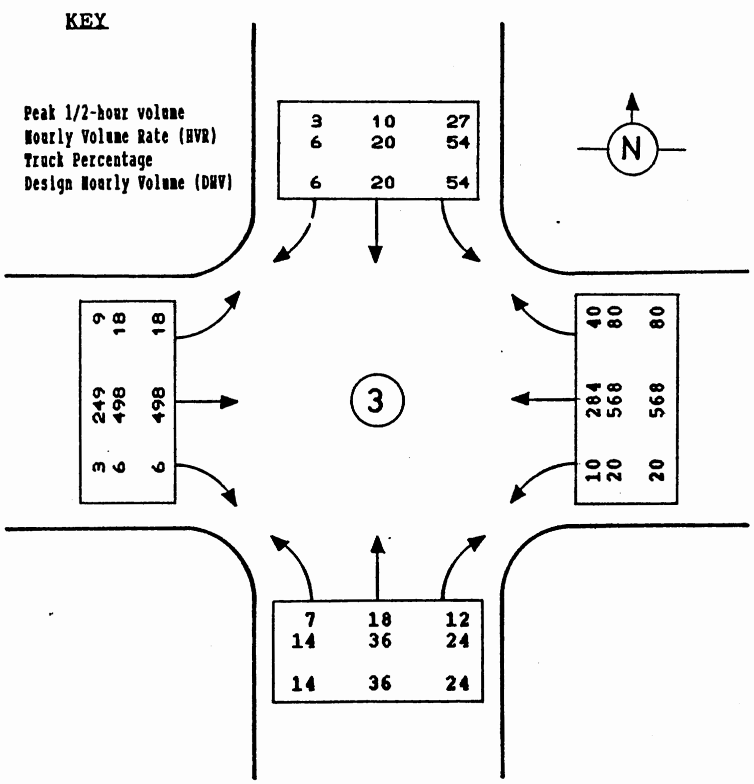


Figure 18. Design Hour Volume for Node 3

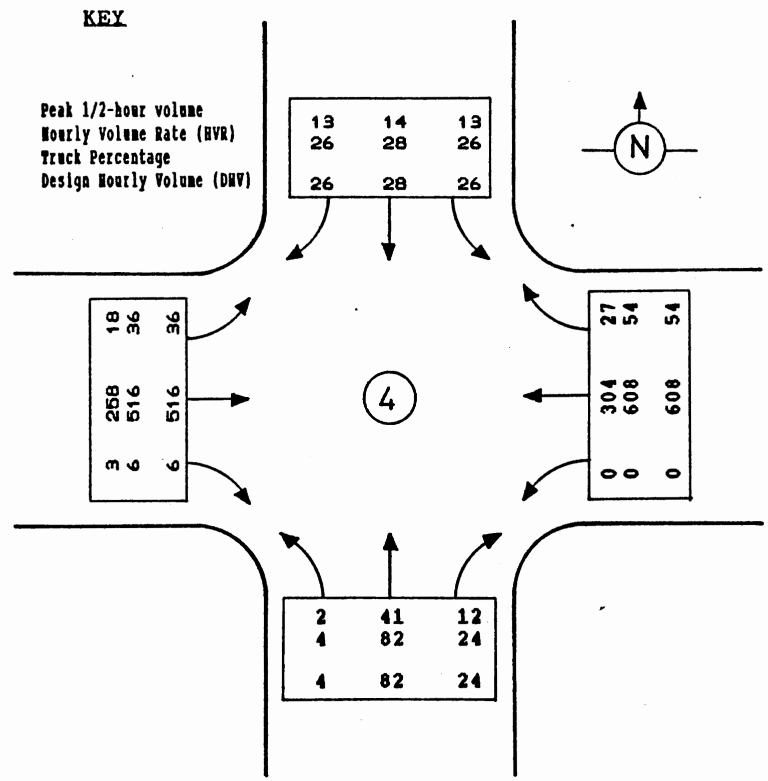


Figure 19. Design Hour Volume for Node 4

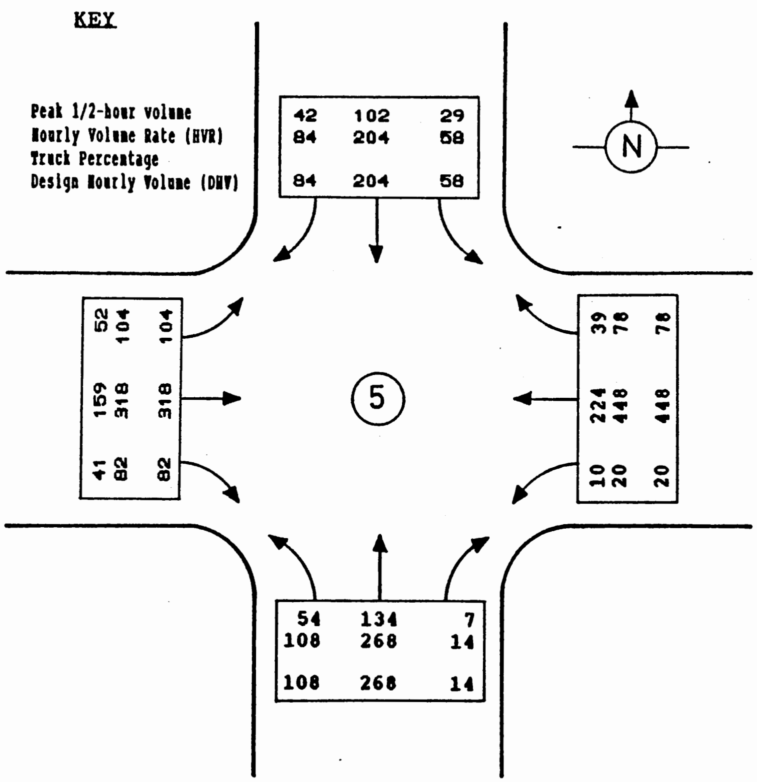


Figure 20. Design Hour Volume for Node 5

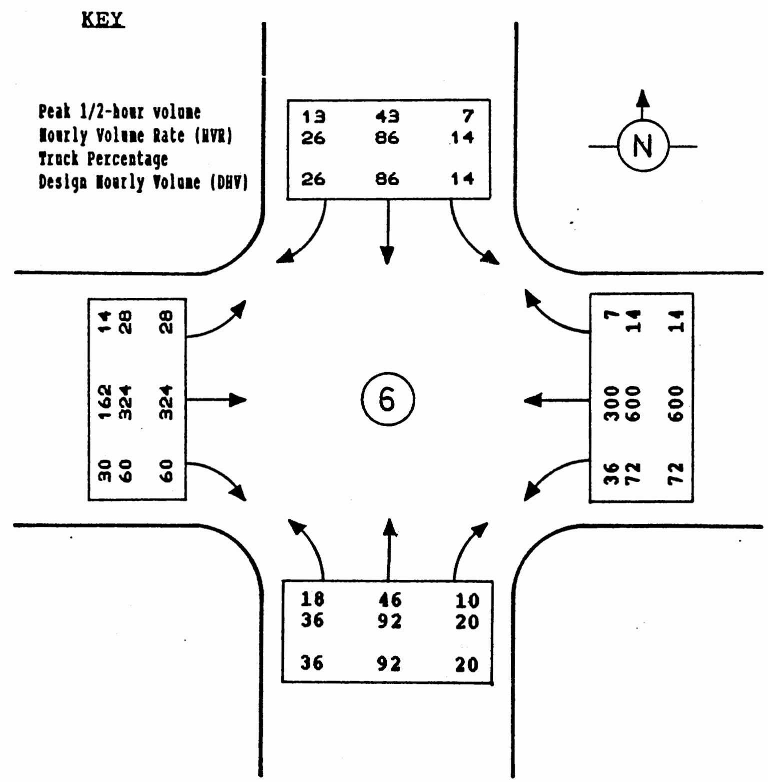


Figure 21. Design Hour Volume for Node 6

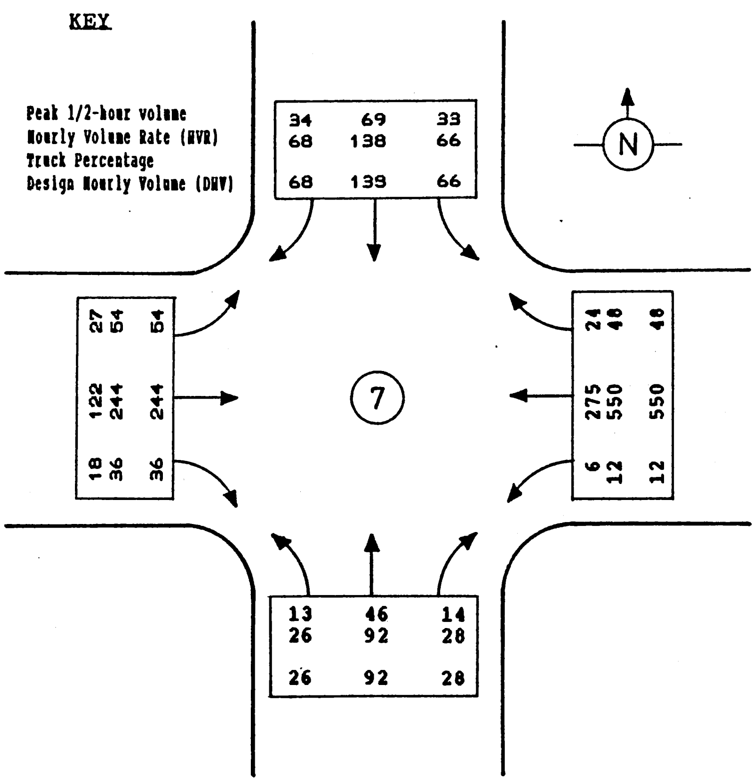


Figure 22. Design Hour Volume for Node 7

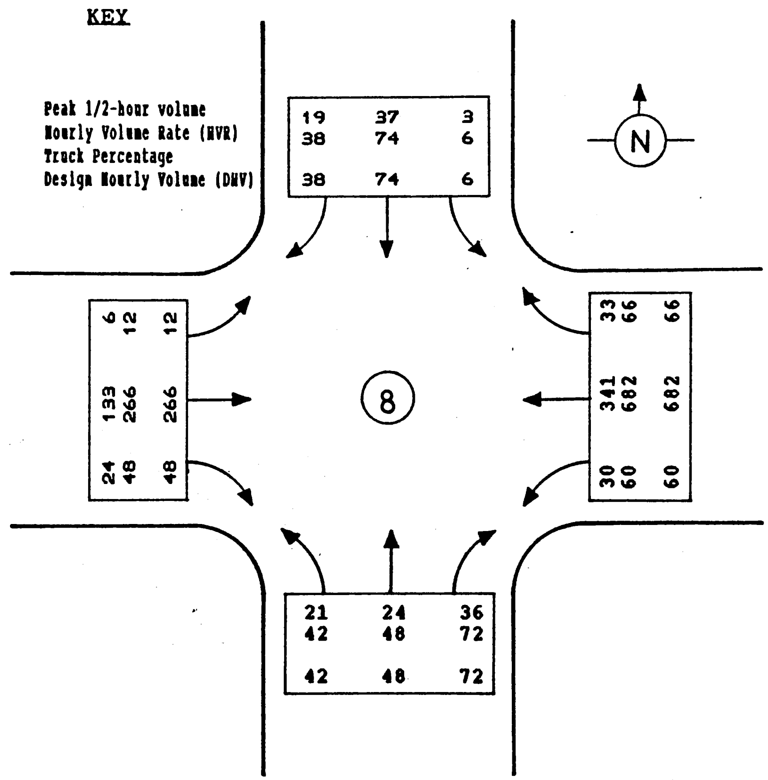


Figure 23. Design Hour Volume for Node 8

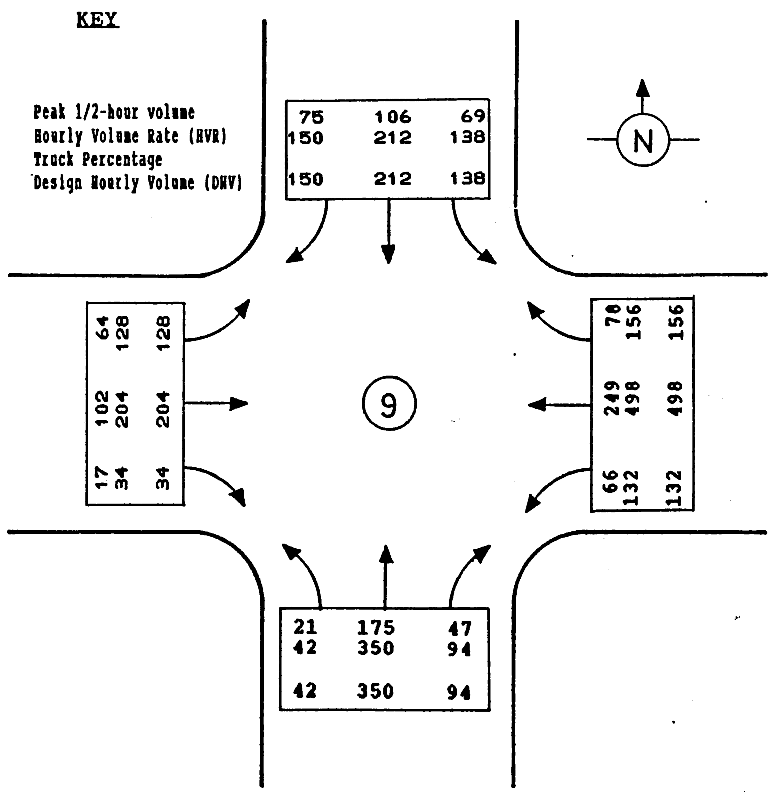


Figure 24. Design Hour Volume for Node 9

there must be at least 5 percent of trucks in the traffic volume. If trucks are present, an adjustment factor is applied to the traffic volume [1].

Determination of Total Flow and Link Assignments. The guidelines explained in Chapter 2 have been used in the link assignment. Initially, links are assigned based on the first four conditions mentioned in the guidelines. However, if the fifth condition, i.e., there must be a minimum of 10 vehicles per hour, is not met, they will not be considered as links. Since the total flow on a link is determined from the through and turning movement volumes at the downstream node, final link assignments can be decided based on the design hour volumes computed in Figures 16 through 24. Figure 25 shows the street network represented as nodes and links. This representation is based on the "nnxx" format as shown in Figure 4.

Figure 25 shows the node number for each intersection and the links associated with each node. For the Western Road and Sixth Avenue intersection, the identifying number will be "1", for Monroe and 6th it will be "2" and so on. Hereafter, each intersection will be identified by the node number.

Link Input Volumes. The total flow on a link is determined from the through and turning movement volumes at the downstream end of a link while input flow volumes on a link are determined from the through and turning movement

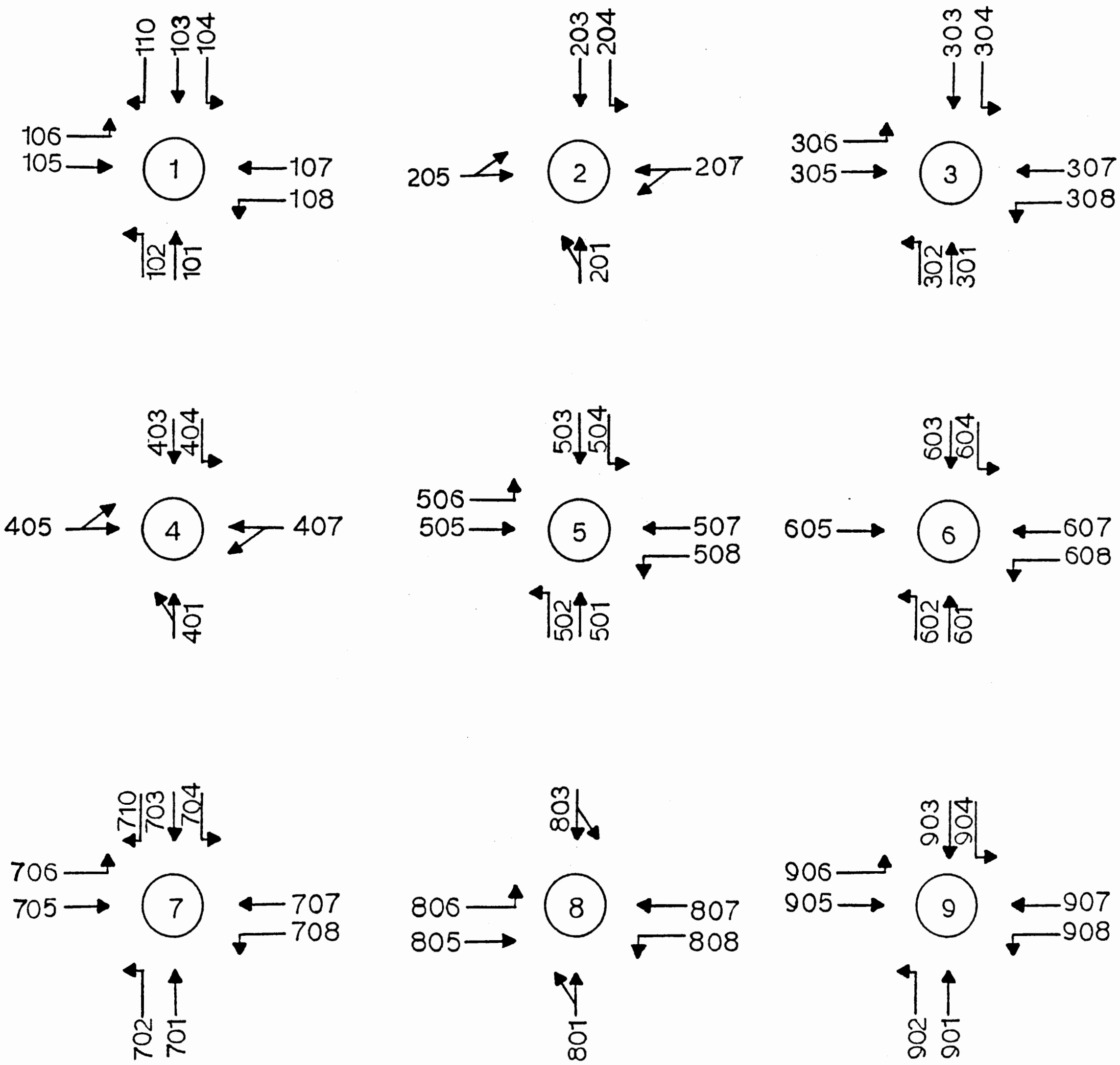


Figure 25. Network Represented as Nodes and Links

counts at the upstream node. To compute the link input volumes, the design hour volumes are entered in the appropriate templates in the LINKFLO program.

To illustrate the determination of the link input volumes, the eastbound movement between nodes 7 and 8 is considered. At the downstream node, i.e., node 8, a left turning bay is available. Therefore, a left turning link (link 806) is assigned to this left-turning movement. A through link (link 805) is assigned to the through moving traffic. From Figure 22, the design hour volumes at node 7 (upstream node) of the through, right and left movements are 244, 28, and 66 vehicles per hour, respectively. From Figure 23, the design hour volume approaching node 8 for the through, right and left movements are 266, 48, and 12 vehicles per hour, respectively.

A template corresponding to the above link assignments is selected from the LINKFLO program. Using the design hour volumes as input volumes, a LINKFLO output as shown in Figure 26 is produced. Figure 26 shows the total flow and the input volumes on links 805 and 806. From this figure, it can be seen that the total flow on links 805 and 806 are 314 and 12 vehicles per hour, respectively. The upstream link input volumes to link 805 are 235 (from link 705), 28 (from link 701), and 66 (from link 704) vehicles per hour. The upstream link input volumes to link 806 are 9 vehicles per hour (from link 705).

Since the volume data were obtained by field studies whose times varied, the sum of the input flows need not

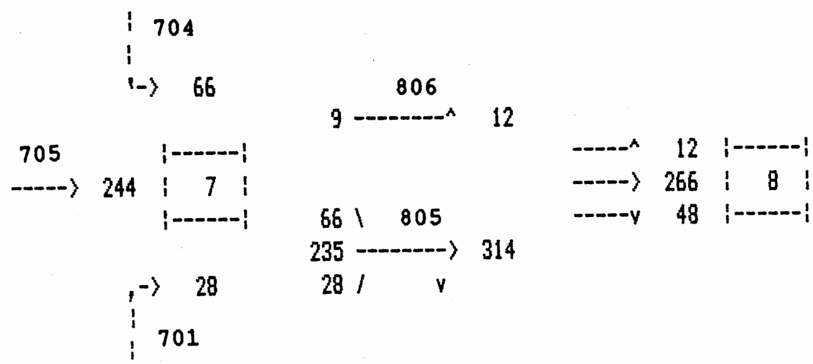


Figure 26. Determination of Link Input Volumes

equal the total flow. TRANSYT-7F automatically balances the input flow rates to equal the total flow rate, under the assumption that the total flow is correct. Warning messages are printed when large adjustments must be made in case these are caused by coding or data errors [1].

Table II shows the total flow and the link input volumes for the links in the network. From this table, links that do not have input volumes are the external links. Recall that external links are links that "feed" the network, therefore, they do not have upstream input volumes.

TABLE II

TABLE OF LINK INPUT VOLUME

Node	Link	Total Flow (veh./hr)	Input Link	Input Volume (veh./hr)
1	101	564		
	102	72		
	103	150		
	104	78		
	105	552		
	106	482		
	107	288	203	36
			207	390
	108	40	207	54
	110	152		
2	201	184		
	203	78		
	204	88		
	205	578	101	50
			104	78
			105	498
	207	566	302	14
			307	568
3	301	60		
	302	14		
	303	26		
	304	54		
	305	498	201	14
			204	44
			205	521
	306	18	205	19
	307	648	403	26
			407	590
	308	20	407	18

TABLE II (Continued)

Node	Link	Total Flow (veh./hr)	Input Link	Input Volume (veh./hr)
4	401	106		
	403	54		
	404	26		
	405	552	301	24
			304	54
			305	498
	407	662	502	108
			503	84
			507	448
5	501	282		
	502	108		
	503	288		
	504	58		
	505	400	401	24
			404	26
			405	410
	506	104	405	106
	507	526	602	36
			603	26
			607	578
	508	20	607	22
6	601	112		
	602	36		
	603	112		
	604	14		
	605	412	501	14
			504	58
			505	318
	607	614	702	26
			707	492
			710	68
	608	72	707	58

TABLE II (Continued)

Node	Link	Total Flow (veh./hr)	Input Link	Input Volume (veh./hr)
7	701	120		
	702	26		
	703	138		
	704	66		
	705	280	601	20
			604	14
			605	272
	706	54	605	52
	707	598	801	42
			803	38
			807	669
	708	12	807	13
8	801	204		
	803	118		
	805	314	701	28
			704	66
			705	234
	806	12	705	10
	807	748	902	42
			903	139
			907	461
	808	60	903	11
			907	37
9	901	444		
	902	42		
	903	362		
	904	138		
	905	238	801	47
			805	173
	906	128	801	25
			805	93
	907	654		
	908	132		

Speed Data

In measuring the average cruising speed, a test car is driven among other vehicles on the primary through links running in both the eastbound and the westbound directions. The cruising speed is indicative of the sustained speed under prevailing traffic conditions. This value is obtained by speedometer readings at points on the link where the test vehicle is not influenced by downstream stops or delay. This is typically at the middle section of the links. These speeds are as shown in in Tables III and IV. For the external links, i.e., side-streets, the imposed speed limits are used as the average cruising speed. The required speed data for all links in the network are tabulated in Table V.

Saturation Flow

In this study, it is assumed that the average driver behaviour pattern prevails. In TRANSYT-7F, this is called the "normal" driving condition [1]. Under this condition, the recommended saturation flow rates for the through and the protected turn movements of 1700 and 1600 vehicles per hour of green per lane, respectively are used [10, 1]. However, these values apply to a single lane. Thus for a two lane through link, the saturation flow will be 3400 vphg.

The saturation flow rates for unprotected left turns are determined by using the procedures as given in the 1985

TABLE III

AVERAGE CRUISING SPEED FOR
EASTBOUND LINKS

BLOCK	OBSERVED SPEED (Si)					n	$\sum$Si	S
1 - 2	40	38	40	40	38	10	390	39
	36	40	38	40	40			
2 - 3	30	30	30	30	30	10	300	30
	30	30	30	30	30			
3 - 4	30	30	30	30	30	10	300	30
	30	30	30	30	30			
4 - 5	30	30	30	30	30	10	300	30
	30	30	30	30	30			
5 - 6	30	30	30	28	30	10	300	29.6
	30	30	30	28	30			
6 - 7	30	28	25	25	25	10	279	27.9
	30	30	26	30	30			
7 - 8	30	30	20	25	25	10	268	26.8
	28	30	26	27	27			
8 - 9	30	30	30	30	30	10	300	30
	30	30	30	30	30			

$$S = \frac{1}{n} \sum_{i=1}^{n} Si$$

S = average cruising speed
n = total sample size
Si = observed speed i

TABLE IV

AVERAGE CRUISING SPEED FOR WESTBOUND LINKS

BLOCK	OBSERVED SPEED (Si)					n	$\sum$ Si	S
9 - 8	30	28	30	30	30	10	289	28.9
	25	28	28	30	30			
8 - 7	26	25	30	27	22	10	262	26.2
	25	27	26	26	28			
7 - 6	30	25	26	28	25	10	268	26.8
	25	28	28	25	28			
6 - 5	30	30	30	30	30	10	300	30
	30	30	30	30	30			
5 - 4	30	30	30	30	30	10	300	30
	30	30	30	30	30			
4 - 3	30	30	30	30	30	10	300	30
	30	30	30	30	30			
3 - 2	28	28	30	30	30	10	286	28.6
	28	28	28	26	30			
2 - 1	40	40	40	40	40	10	400	40
	40	40	40	40	40			

$$S = \frac{1}{n} \sum_{i=1}^{n} Si$$

S = average cruising speed
n = total sample size
Si = observed speed i

TABLE V

LINK INPUT DATA ASSOCIATED
WITH EACH NODE

Node	Link	Length (Ft.)	Total Flow (veh./hr)	Saturation Flow (vphg)	Speed (mph)
1	101	100	564	3400	35
	102	100	72	1600	35
	103	100	150	1700	40
	104	100	78	1600	40
	105	100	552	3400	40
	106	100	482	1600	40
	107	4580	288	3400	40
	108	4580	40	1600	40
	110	100	152	1600	40
2	201	100	184	1700	25
	203	100	78	1700	25
	204	100	88	1020	25
	205	4580	578	2930	39
	207	725	566	3400	29
3	301	100	60	1700	25
	302	100	14	1260	25
	303	100	26	1700	25
	304	100	54	1380	25
	305	725	498	3400	30
	306	725	18	920	30
	307	750	648	3400	30
	308	750	20	1280	30
4	401	100	106	1700	25
	403	100	54	1700	25
	404	100	26	1230	25
	405	750	552	2700	30
	407	1230	662	3400	30
5	501	100	282	3400	35
	502	100	108	1600	35
	503	100	288	3400	35
	504	100	58	1600	35
	505	1230	400	3400	30
	506	1230	104	1600	30
	507	800	526	3400	30
	508	800	20	1600	30

TABLE V (CONTINUED)

Node	Link	Length (ft.)	Total Flow (veh./hr)	Saturation Flow (vphg)	Speed (mph)
6	601	100	112	1700	25
	602	100	36	1150	25
	603	100	112	1700	25
	604	100	14	1100	25
	605	800	412	2170	30
	607	400	614	3400	27
	608	400	72	900	27
7	701	100	120	3400	25
	702	100	26	1600	25
	703	100	138	1700	30
	704	100	66	1600	30
	705	400	280	3400	28
	706	400	54	1600	28
	707	400	598	3400	26
	708	400	12	1600	26
	710	100	68	1600	30
8	801	100	204	1460	25
	803	100	118	1700	25
	805	400	314	3400	27
	806	400	12	500	27
	807	1730	748	3400	29
	808	1730	60	960	29
9	901	100	444	3400	35
	902	100	42	1600	35
	903	100	362	3400	35
	904	100	138	1600	35
	905	1730	238	3400	30
	906	1730	128	1600	30
	907	100	654	3400	25
	908	100	132	1600	25

Highway Capacity Manual [3]. The equation for computing the saturation flow rates for unprotected left-turn links are as follows:

$$s = s_o \, N \, f_w \, f_{hv} \, f_g \, f_l \, f_p \, f_{bb} \, f_a \, f_{rt} \, f_{lt} \qquad (14)$$

Where

s = saturation flow rate for the subject lane group, expressed as a total for all lanes in the lane group under prevailing conditions, in vehicles per hour of green or vphg. A lane group is defined as one or more lanes on an intersection approach serving one or more traffic movements.

s_o = ideal saturation flow rate per lane, 1700 vphgpl

N = number of lanes in the lane group

f_w = adjustment factor for lane width

f_{hv} = adjustment factors for heavy vehicles in the traffic stream

f_g = adjustment factor for approach grade

f_p = adjustment factor for the existence of a parking lane adjacent to the lane group and the parking activity in that lane

f_{bb} = adjustment factor for the blocking effect of local buses stopping within the intersection area

f_a = adjustment factor for area type

f_{rt} = adjustment factor for right turns in the lane group

f_{lt} = adjustment factor for left turns in the lane group

In the determination of saturation flow rates for left-turning movements using the 1985 Highway Capacity Manual, the following assumptions have been made:

1. All links are assumed to have level terrain
2. All lanes have standard lane width of 12 feet
3. There is 0 percent of heavy vehicles in the traffic volumes
4. Adjacent parking lane do not cause any interference to the lane group
5. There is no blocking effect from local buses.

The saturation flow rates for all links are tabulated in Table V.

Link Lengths

Link lengths have been obtained from the City of Stillwater Engineer's Office. Since external links, ie. links feeding the network, have no physical starting point, their length is assumed to be zero. However if the cruising speed on these links are different from the TRANSYT-7F default speed value of 30 mph, a nominal length is required as input . In this project, a nominal length of 100 feet is assumed for all external links. In TRANSYT-7F, the link length should be in the range of 50 feet to a maximum of 6560 feet, otherwise an error message will appear.

The data gathered from the preceeding sections are tabulated in Table V. The table shows the node numbers, the associated links, link length, cruise speeds and the saturation flow rates.

Maximum Back of Queue and Queue Capacity. As discussed in Chapter 2, TRANSYT-7F reports the maximum back of queue in the performance table. The maximum back of queue is the maximum extension of a queue upstream on the link during a cycle. It includes vehicles which arrive during the green and join the back of the queue while the front of the queue is discharging during the initial seconds of the effective green [1]. To determine whether there is a chance of spillover into the upstream intersection, the maximum back of queue is compared with the queue capacity. Queue capacity is the desired extension of the back of the queue [1]. Simply, it is a measure of the number of vehicles per unit length of roadway [5]. For through links, the queue capacity may be input. If the value is not provided, TRANSYT-7F calculates it by multiplying the link length by the nominal number of lanes (estimated from the saturation flow rates) and dividing by an average car spacing of 25 feet [2]. For links representing turn-bays, the queue capacity should be input.

The maximum back of queue is useful for alerting the possibility of spillover from a turn bay or from a downstream intersection. If such condition occur, a flag (">") will appear in the performance table implying that that number of vehicles on the link has exceeded the link's queue capacity. For turn bays, this condition leads to the formation of a long queue and results in blocking of the through link.

Spillover is not explicitly considered in TRANSYT-7F optimization process, that is, it disregards the effect of spillover [1]. If a flag appears in the performance table, it is relatively easy to identify where spillover may occur. The queue capacity or the average number of vehicles that can be stored on left-turning link is shown in Table VI.

Timing Data

Start-Up Lost Time. The recommended start-up lost time for a "normal" driving condition is 3 seconds [1]. This value has been used in this project. For unprotected left turning links, the present version of TRANSYT-7F can only approximate the movements on these links. This approximation is done by reducing the saturation flow rates on the left-turning links to account for vehicles turning through gaps. Since vehicles on unprotected left-turning links have to wait for a certain amount of time before they can make the turn, an additional start-up lost time can be added to these links. This additional start-up lost time will delay the start of effective green until the opposing queue has cleared [2].

The additional start-up lost times assumed in this project are 5 seconds for link 204. For link 204, an average of 8 seconds was required before the first vehicle

TABLE VI

QUEUE CAPACITY FOR LEFT-TURN LINKS WITH TURNING-BAY

Link No.	Queue Capacity (Veh./Link)
102	5
104	5
106	15
108	12
306	5
308	5
404	7
502	5
504	5
506	5
508	5
602	4
604	5
608	5
702	7
704	5
706	5
708	5
806	5
808	5
902	10
904	12
906	12
908	8

on the link could clear the intersection. Since the network start-up lost time is 3 seconds, the additional start-up lost time for link 204 is 5 seconds, i.e., eight minus three seconds). For the remaining unprotected left-turning links, the additional start-up lost time of 6 seconds for links 304 and 602 has been assumed to be representative of the additional start-up lost time. This was based on an average time of 9 seconds that was required by traffic on links 304 and 602 to clear the intersection.

A new version of TRANSYT-7F called "TRANSYT-7F Release 5" will include among other enhancements the capability to better model unprotected left-turns [2].

Extension of the Effective Green. The extension of the effective green is defined as that part of the clearance interval during which vehicles continue to pass through the intersection [1]. Generally, the extension of the effective green is less than the clearance interval by one or two seconds. In this study, a value of 3 seconds is used as the extension of the effective green [1].

Minimum Phase Length. Minimum phase durations are required to ensure safety of vehicles and pedestrians. It is required for every phase at each node. TRANSYT-7F uses this value as a constraint, that is, it will not assign less green (plus clearance and all-red) time to a phase than this value during an optimization run. The guidelines explained in chapter 2 have been used in determining these durations [1]. The minimum phase lengths should also be checked so that they are not less than the sum of the fixed interval lengths. Otherwise, an error message will be printed and the program will be terminated. The minimum phase length at each nodes are shown in Table VII.

Signal Timing

The existing signal timings for the design period were obtained through field observations. For nodes 2, 3, 4, 5, 6, 7, and 8, the signal timings and the respective phase sequences are shown in Figures 27 to 33. From these figures, the yellow clearance of 4 seconds and an all red time of 1 second are the fixed intervals. Where pedestrian indications are present, four intervals are shown. The first interval which is the "WALK" interval in each phase is considered as the variable interval. The second interval is the flashing "DONT WALK" interval. Where pedestrian signals are present but the durations of the "WALK" and the flashing "DONT WALK" are not available (this occur when the pedestrian signals function only when they are manually actuated, the corresponding vehicle signal intervals are recorded. An interpretation of the signal intervals is shown in Figure 2.

To illustrate, consider the signal timings for node 2 as shown in Figure 27. In the first phase, links 205 and 207 receive the right-of-way. The timing intervals for this phase are as follows:

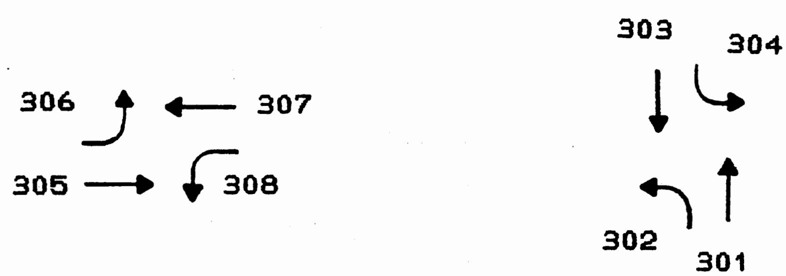
TABLE VII

MINIMUM PHASE LENGTHS

Node	Phase Number	Minimum Phase lengths (seconds)
1	1	16
	2	16
	3	16
	4	16
	5	16
	6	16
2	1	18
	2	20
3	1	18
	2	25
4	1	15
	2	15
5	1	20
	2	20
	3	20
	4	20
6	1	18
	2	20
7	1	21
	2	21
	3	22
	4	22
8	1	18
	2	20
9	1	16
	2	16
	3	16
	4	16
	5	16
	6	16

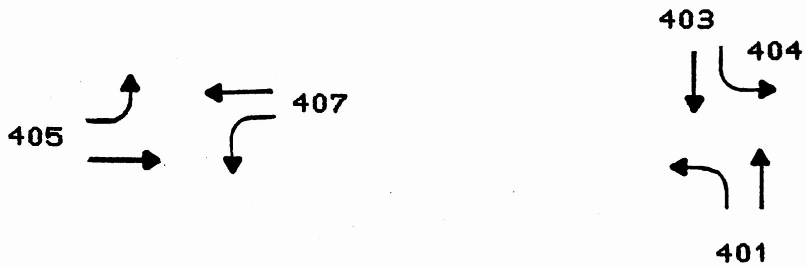
Interval number / Interval Length	
1 / 30	5 / 16
2 / 8	6 / 4
3 / 4	7 / 1
4 / 1	

Figure 27. Existing Signal Timing for Node 2



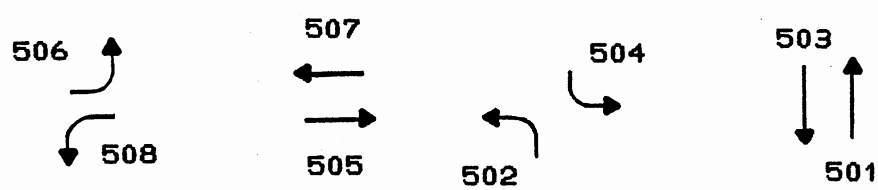
Interval number / Interval Length	
1 / 12	5 / 35
2 / 7	6 / 17
3 / 4	7 / 4
4 / 1	8 / 1

Figure 28. Existing Signal Timing for Node 3



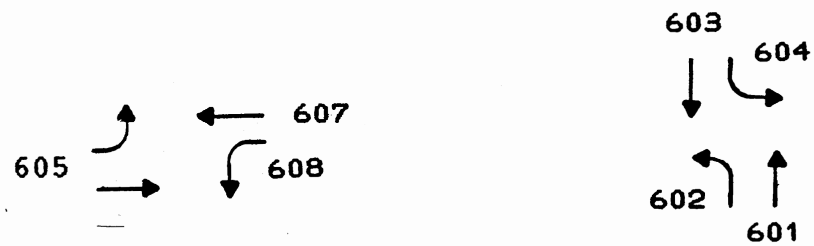
Interval number / Interval Length	
1 / 61	4 / 10
2 / 4	5 / 4
3 / 1	6 / 1

Figure 29. Existing Signal Timing for Node 4



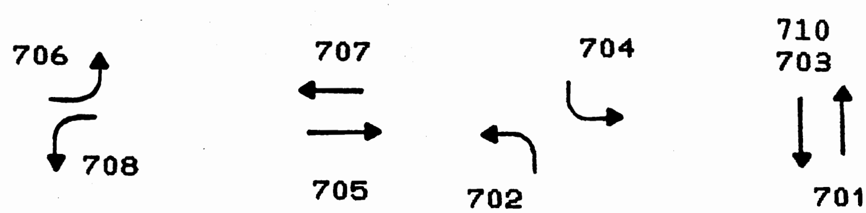
Interval number / Interval Length			
1 / 8	4 / 16	8 / 8	11 / 16
2 / 4	5 / 8	9 / 4	12 / 8
3 / 1	6 / 4	10 / 1	13 / 4
	7 / 1		14 / 1

Figure 30. Existing Signal Timing for Node 5



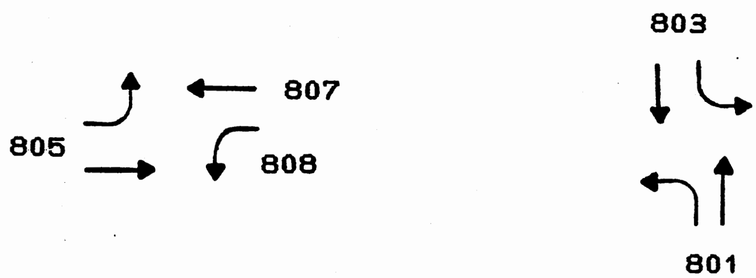
Interval number / Interval Length	
1 / 37	5 / 15
2 / 9	6 / 9
3 / 4	7 / 4
4 / 1	8 / 1

Figure 31. Existing Signal Timing for Node 6



Interval number / Interval Length			
1 / 8	4 / 12	8 / 10	11 / 10
2 / 4	5 / 8	9 / 4	12 / 7
3 / 1	6 / 4	10 / 1	13 / 4
	7 / 1		14 / 1

Figure 32. Existing Signal Timing for Node 7



Interval number / Interval Length	
1 / 34	5 / 15
2 / 9	6 / 9
3 / 4	7 / 4
4 / 1	8 / 1

Figure 33. Existing Signal Timing for Node 8

Interval 1 - "WALK" - Variable Interval

Interval 2 - Flashing "DONT WALK" - Fixed Interval

Interval 3 - Yellow clearance - Fixed Interval

Interval 4 - All-red - Fixed interval

In the second phase, links 201, 203 and 204 receive the right-of-way. Since the durations of the pedestrian "WALK" and flashing "DONT WALK" are not available, the timing intervals for this phase are expressed in terms of the vehicle signal intervals. The pedestrian signals for the second phase operate only when the push-buttons are actuated by pedestrians. Without actuation, the pedestrian signals will always be displaying red. For the second phase, the vehicular green is considered as the variable interval.

Interval 5 - Green - Variable Interval

Interval 6 - Yellow - Fixed Interval

Interval 7 - Red - Fixed Interval

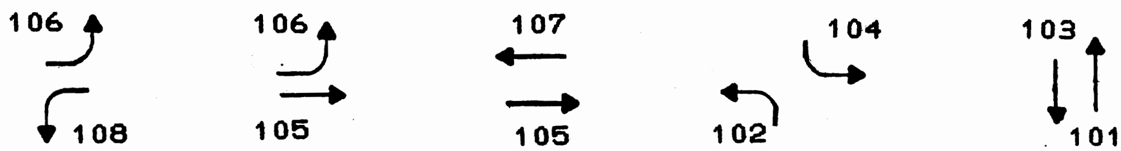
As mentioned earlier, TRANSYT-7F is programmed to handle timing plans associated with pretimed controllers, where the durations of each interval are fixed. Thus, for actuated controllers the timing plans have to be converted to an "equivalent" pretimed timing plan that can be used with TRANSYT-7F. This implies that the durations of the variable intervals in each phase at nodes 1, 2, 4 and 9 are the averaged green durations. These durations are obtained by averaging the durations of the green intervals for each movement in each phase over a number of observations.

For nodes 1 and 9, since the controllers operate with a maximum of eight phases per cycle during the design hour, equivalent phase sequences have to be established.

Phase Selection for Nodes 1 and 9. TRANSYT-7F cannot develop an optimal signal phasing scheme. However, it can evaluate a number of phase sequences provided by the user. During the design period, nodes 1 and 9 operate with a maximum of eight phases per cycle. Since TRANSYT-7F is limited to handle a maximum of six vehicular phases per cycle, the phase sequences for nodes 1 and 9 have been converted into equivalent sequences that can be used with TRANSYT-7F. For nodes 2 and 4, the existing number of phases are four per cycle and there is no necessity to perform phase selection for these two nodes.

Two sets of alternative phase sequences namely, a 5-phase and a 6-phase have been considered at nodes 1 and 9. The concept of "overlap phasing " has been used in the phasing sequence which allows traffic in heavy lanes to move in two consecutive phases [2]. The proposed 5-phase and 6-phase sequences and the length of each intervals at nodes 1 and 9 are shown in Figures 34 through 37.

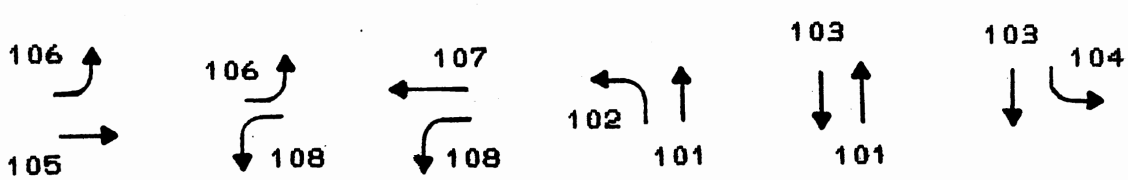
Evaluation of Phase Sequences at Nodes 1 and 9. To evaluate the proposed phase sequences for nodes 1 and 9, four TRANSYT-7F evaluation runs were performed. For evaluation purposes, input data files consisting of data related to nodes 1 and 9 were run with TRANSYT-7F. For



Interval number / Interval Length

1 / 7	4 / 20	7 / 17	10 / 11	13 / 21
2 / 4	5 / 4	8 / 4	11 / 4	15 / 4
3 / 1	6 / 1	9 / 1	12 / 1	16 / 1

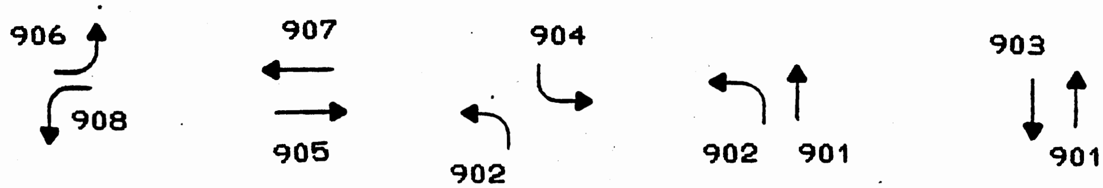
Figure 34. Proposed 5-Phase Sequence for Node 1



Interval number / Interval Length

1 / 26	4 / 11	7 / 17	10 / 12	13 / 5	16 / 10
2 / 4	5 / 4	8 / 4	11 / 4	14 / 4	17 / 4
3 / 1	6 / 1	9 / 1	12 / 1	15 / 1	18 / 1

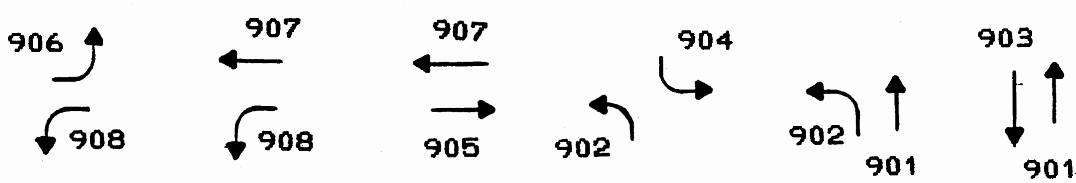
Figure 35. Proposed 6-Phase Sequence for Node 1



Interval number / Interval Length

1 / 10	4 / 47	7 / 10	10 / 29	13 / 13
2 / 4	5 / 4	8 / 4	11 / 4	14 / 4
3 / 1	6 / 1	9 / 1	12 / 1	15 / 1

Figure 36. Proposed 5-Phase Sequence for Node 9



Interval number / Interval Length

1 / 7	4 / 7	7 / 37	10 / 10	13 / 29	16 / 13
2 / 4	5 / 4	8 / 4	11 / 4	14 / 4	17 / 4
3 / 1	6 / 1	9 / 1	12 / 1	15 / 1	18 / 1

Figure 37. Proposed 6-Phase Sequence for Node 9

each proposed phase-sequence, TRANSYT-7F will evaluate the traffic performance on links associated with each node. A summary performance table consisting of several MOE's will be produced for each evaluation run.

To perform the evaluation run, a range of cycle lengths has been input. For nodes 1 and 9, the proposed 5-phase sequence has been evaluated with cycle lengths ranging from a minimum of 80 seconds to a maximum of 120 seconds. The minimum cycle length of 80 seconds for nodes 1 and 9 is obtained by adding the minimum phase durations, i.e., 16 seconds per phase, of the five phases at each node. For the proposed 6-phase sequence, the total minimum phase duration, i.e., 16 seconds per phase, of the six phases at each of nodes 1 and 9 is 96 seconds. However, a 100 seconds minimum cycle length has been used in the evaluation.

The results of TRANSYT-7F phase sequences evaluation for nodes 1 and 9 are shown in Tables VIll and 1X, respectively.

For node 1, the 5-phase sequence is desirable since it yields a lower Performance Index value at this intersection. While one link is saturated for the 80 seconds cycle length, there is no saturated link for cycle lengths 90 through 120 seconds. For the 6-Phase sequence, two links are saturated for every cycle length that is being considered. Since the 5-phase sequence is selected for node 1, the timing data and the phase sequences from

TABLE VIII

EVALUATION OF PHASE SEQUENCE FOR NODE 1

RUN TITLE: EVALUATION OF A 5 PHASE SEQUENCE AT WESTERN/6TH

CYCLE EVALUATION SUMMARY PERFORMANCE

CYCLE LENGTH (SEC)	STEP SIZE (STEPS)	AVERAGE DELAY (SEC/VEH)	PERCENT STOPS (%)	FUEL CONSUMPTION (GAL/HR)	PERFORMANCE INDEX	NUMBER SATURATED LINKS
80	27	104.91	77	74.4	60.8	1
90	30	33.86	80	40.4	26.8	0
100	33	35.53	81	41.3	27.7	0
110	37	38.52	80	42.7	29.0	0
120	40	43.29	80	45.0	31.4	0

BEST CYCLE LENGTH = 90 SEC. CYCLE SENSITIVITY = 41.1 %

RUN TITLE: EVALUATION OF A 6 PHASE SEQUENCE AT WESTERN/6TH

CYCLE EVALUATION SUMMARY PERFORMANCE

CYCLE LENGTH (SEC)	STEP SIZE (STEPS)	AVERAGE DELAY (SEC/VEH)	PERCENT STOPS (%)	FUEL CONSUMPTION (GAL/HR)	PERFORMANCE INDEX	NUMBER SATURATED LINKS
100	33	214.92	75	127.3	113.7	2
110	37	274.68	70	155.6	142.0	2
120	40	327.76	67	180.9	167.3	2

BEST CYCLE LENGTH = 100 SEC. CYCLE SENSITIVITY = 19.0 %

TABLE IX

EVALUATION OF PHASE SEQUENCE FOR NODE 9

RUN TITLE: EVALUATION OF A 5 PHASE SEQUENCE AT PERKINS/6TH

CYCLE EVALUATION SUMMARY PERFORMANCE

CYCLE LENGTH (SEC)	STEP SIZE (STEPS)	AVERAGE DELAY (SEC/VEH)	PERCENT STOPS (%)	FUEL CONSUMPTION (GAL/HR)	PERFORMANCE INDEX	NUMBER SATURATED LINKS
80	27	192.53	78	99.4	92.9	1
90	30	240.18	74	119.7	113.2	1
100	33	279.67	71	136.5	130.0	1
110	37	314.25	68	151.1	144.6	1
120	40	345.49	66	164.5	158.0	1

BEST CYCLE LENGTH = 80 SEC. CYCLE SENSITIVITY = 20.1 %

RUN TITLE: EVALUATION OF A 6 PHASE SEQUENCE AT PERKINS/6TH

CYCLE EVALUATION SUMMARY PERFORMANCE

CYCLE LENGTH (SEC)	STEP SIZE (STEPS)	AVERAGE DELAY (SEC/VEH)	PERCENT STOPS (%)	FUEL CONSUMPTION (GAL/HR)	PERFORMANCE INDEX	NUMBER SATURATED LINKS
100	33	37.39	84	32.6	26.0	0
110	37	41.00	82	34.0	27.4	0
120	40	47.88	84	37.2	30.7	0

BEST CYCLE LENGTH = 100 SEC. CYCLE SENSITIVITY = 8.4 %

Figure 34 are used as the input data for the network optimization.

For node 9, the 6-Phase sequence is better than the 5-phase sequence, since it results in a lower Performance Index value. Additionally, there are no saturated links. For the proposed 5-phase sequence, it is seen that one link is saturated for every cycle length that is being considered. Timing data and the phase sequences from Figure 37 are used as input data for the network optimization run.

From Tables VIII and IX, it is seen that the "best" cycle lengths for nodes 1 and 9 are 90 and 100 seconds, respectively. Traffic volumes at nodes 1 and 9 are heavier than at the other seven nodes. Since a 100 second cycle length will satisfy traffic performance at nodes 1 and 9, it will also satisfy traffic performance at the other nodes. Thus a 100 second cycle length is considered to be the minimum network cycle length.

Network Cycle Length Evaluation. To perform a TRANSYT-7F optimization run, a network-wide cycle length must first be determined. To arrive at a network-wide cycle length, all nine nodes have to be considered. In determining the network-wide cycle length, a TRANSYT-7F cycle evaluation run was performed using a range of cycle lengths. A minimum network-wide cycle length of 100 seconds (from the evaluation of the phase sequences run) and a maximum network-wide cycle length of 120 seconds was evaluated with a 5 second cycle increment. The results of the TRANSYT- 7F cycle evaluation are given in Table X.

This table shows that the "best" network cycle length is 105 seconds. This value was used as the network-wide cycle length in the TRANSYT-7F optimization process.

The data that have been determined are presented in a format as shown in Figures 38 through 46. These figures will facilitate entering the data in the TRANSYT-7F Data Input Manager. The schematic diagram in the top half of each figure shows the node number for each intersection and the associated links. For each link, the upstream input volumes, the total flow, and the saturation flow are shown. The bottom half of each figure shows the number of phases, the links that receive the right-of-way in each phase, the interval durations and the minimum phase length at each node.

Optimization Run

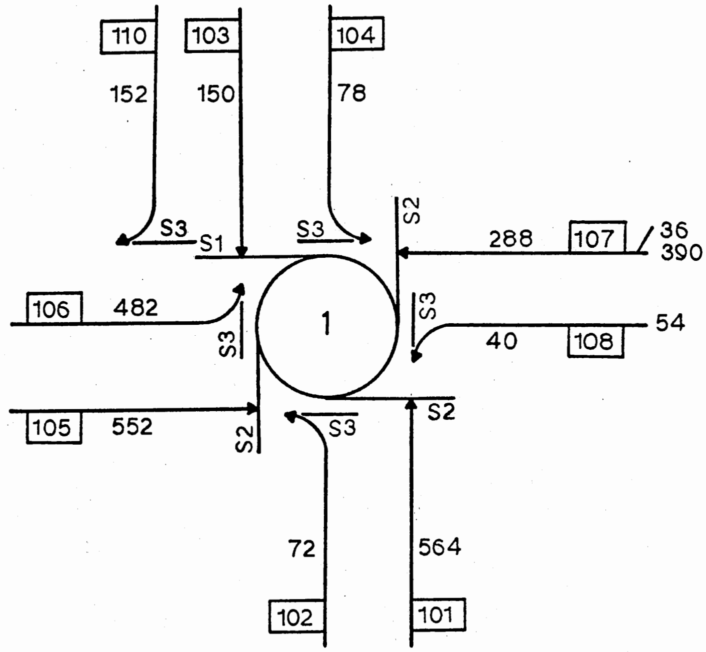
The network-wide cycle length to be used in the optimization run will be the "best" cycle length of 105 seconds that was developed during the cycle length evaluation. The data from Figures 38 through 46, the speed data from Table V and the left-turn link's queue capacity from Table VI are coded in the respective screen-display of the TRANSYT-7F Data Input Manager (T7F-DIM). A data file is completed when the required control parameters are input in the T7F-DIM.

TABLE X

CYCLE LENGTH EVALUATION SUMMARY PERFORMANCE

CYCLE LENGTH (SEC)	STEP SIZE (STEPS)	AVERAGE DELAY (SEC/VEH)	PERCENT STOPS (%)	FUEL CONSUMPTION (GAL/HR)	PERFORMANCE INDEX	NUMBER SATURATED LINKS
100	33	20.77	54	194.1	106.0	0
105	35	21.10	52	193.9	105.8	0
110	37	21.69	53	196.1	107.9	0
115	38	22.46	51	197.5	109.4	0
120	40	23.31	52	200.0	111.8	0

BEST CYCLE LENGTH = 105 SEC. CYCLE SENSITIVITY = 2.3 %

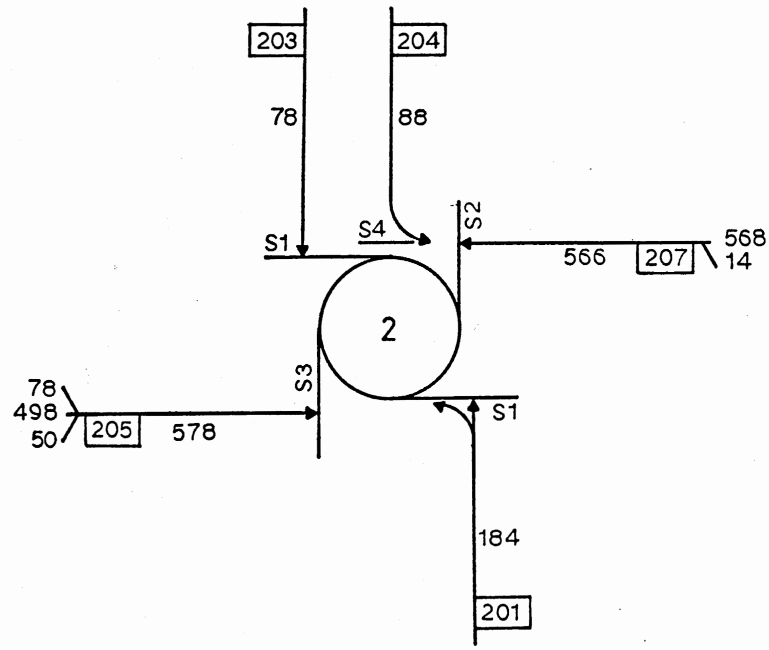


Phases	Links	Intervals / Time (sec.)	Min. Phase (sec.)
1	106, 108	1 / 7 2 / 4 3 / 1	16
2	105, 106	4 / 20 5 / 4 6 / 1	16
3	105, 107	7 / 17 8 / 4 9 / 1	16
4	102, 104	10 / 11 11 / 4 12 / 1	16
5	101, 103	13 / 21 14 / 4 15 / 1	16

Reference interval: 8
<u>Saturation flow</u>

S1 = 1700 S2 = 3400 S3 = 1600

Figure 38. Representation of Input Data for Node 1



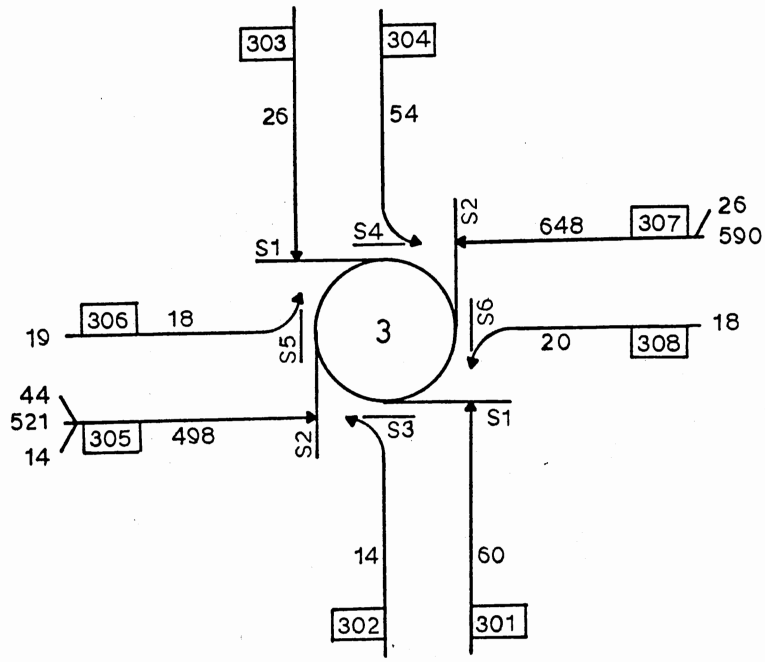
Phase	Links	Interval / Time (sec.)	Min. Phase (sec.)
1	205, 207	1 / 30	18
		2 / 8	
		3 / 4	
		4 / 1	
2	203, 204	5 / 16	
	201	6 / 4	20
		7 / 1	

Reference interval: 3

<u>Saturation Flow</u>

S1 = 1700   S2 = 3400   S3 = 2930   S4 = 1020

Figure 39. Representation of Input Data for Node 2



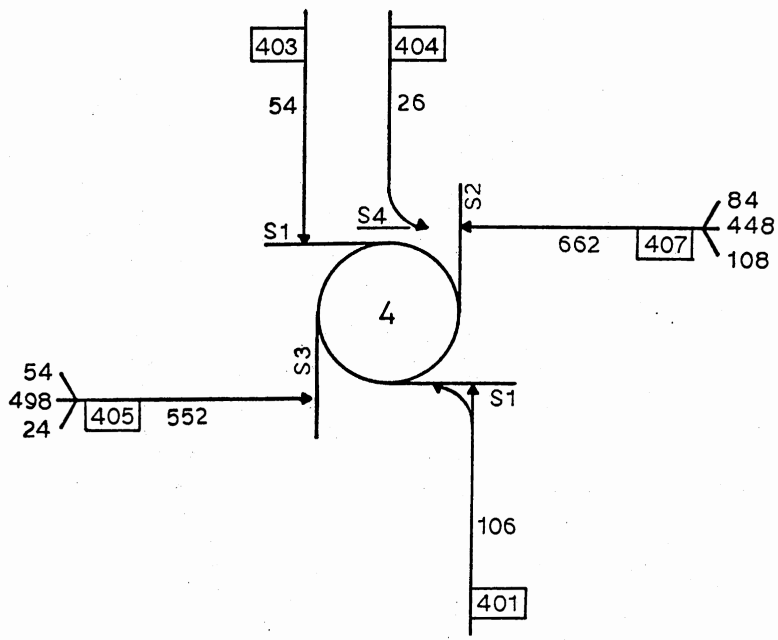
Phase	Links	Interval / Time (sec.)	Min. Phase (sec.)
1	305, 306 307, 308	1 / 12 2 / 7 3 / 4 4 / 1	18
2	301, 302 303, 304	5 / 35 6 / 17 7 / 4 8 / 1	25

Reference interval: 1

Saturation flow

S1 = 1700 S2 = 3400 S3 = 1260
S4 = 1380 S5 = 920 S6 = 1280

Figure 40. Representation of Input Data for Node 3



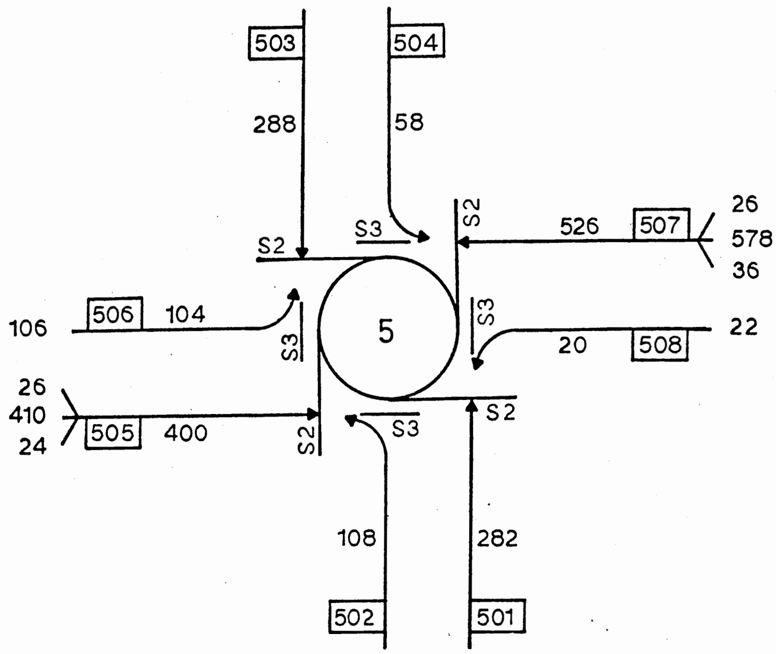
Phase	Link	Interval / Time (sec.)	Min. Phase (sec.)
1	405, 407	1 / 72 2 / 4 3 / 1	15
2	403, 404	4 / 10 5 / 4 6 / 1	15

Reference interval: 2

<u>Saturation flow</u>

S1 = 1700   S2 = 3400   S3 = 2700   S4 = 1230

Figure 41. Representation of Input Data for Node 4



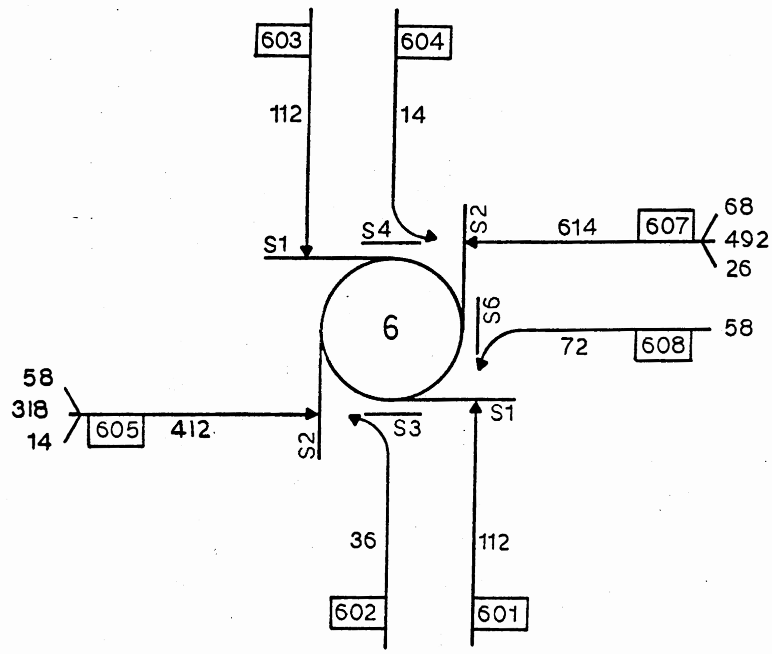
Phase	Link	Interval / Time (sec.)	Min. phase (sec.)
1	506, 508	1 / 8	20
		2 / 4	
		3 / 1	
2	505, 507	4 / 16	20
		5 / 8	
		6 / 4	
		7 / 1	
3	502, 504	8 / 8	20
		9 / 4	
		10 / 1	
4	501, 503	11 / 16	20
		12 / 8	
		13 / 4	
		14 / 1	

Reference Interval: 1

Saturation flow

S2 = 3400   S3 = 1600

Figure 42. Representation of Input Data for Node 5



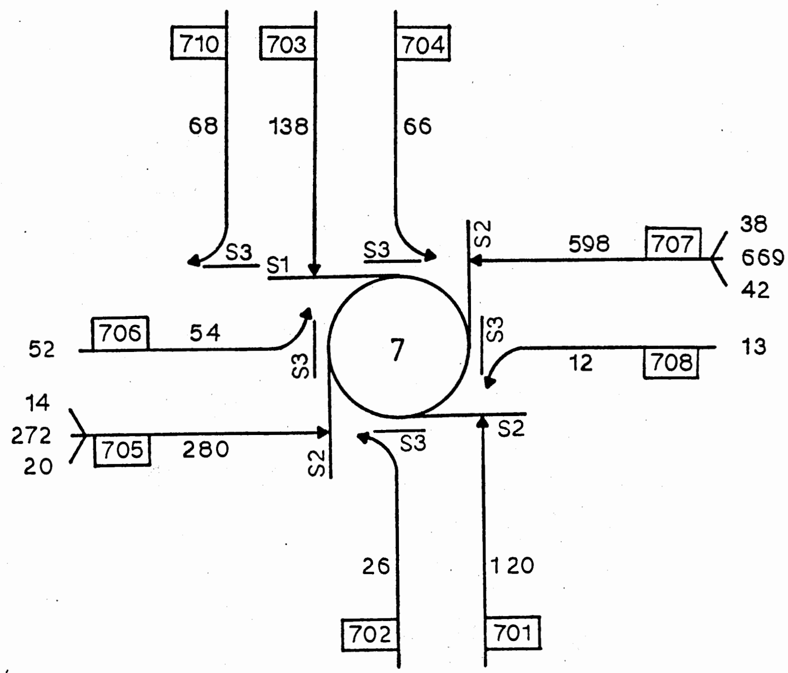
Phase	Link	Interval / time (sec.)	Min. phase (sec.)
1	605	1 / 37	18
	607, 608	2 / 9	
		3 / 4	
		4 / 1	
2	603, 604	5 / 15	20
	602, 601	6 / 9	
		7 / 4	
		8 / 1	

Reference Interval: 1

Saturation Flow

S1 = 1700 S2 = 3400 S3 = 1150
S4 = 1100 S5 = 600 S6 = 900

Figure 43. Representation of Input Data for Node 6



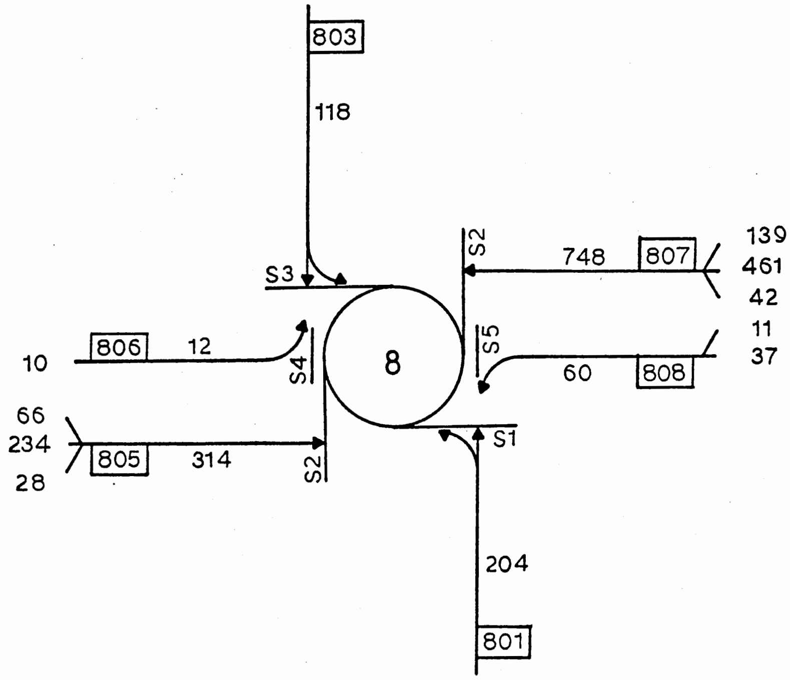
Phase	Link	Interval / Time (sec.)	Min. phase (sec.)
1	706, 708	1 / 8 2 / 4 3 / 1	21
2	705, 707	4 / 12 5 / 8 6 / 4 7 / 1	21
3	704, 702	8 / 10 9 / 4 10 / 1	22
4	701, 703 710	11 / 10 12 / 7 13 / 4 14 / 1	22

Reference Interval: 1

<u>Saturation Flow</u>

S1 = 1700 S2 = 3400 S3 = 1600

Figure 44. Representation of Input Data for Node 7



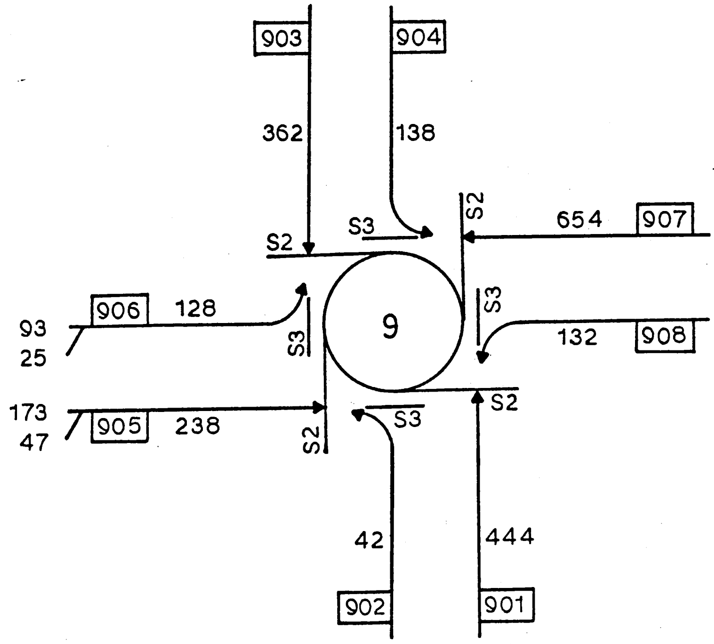
Phase	Link	Interval / Time (sec.)	Min. phase (sec.)
1	805, 806 807, 808	1 / 34 2 / 9 3 / 4 4 / 1	18
2	801, 803	5 / 15 6 / 9 7 / 4 8 / 1	20

Reference Interval: 1

<u>Saturation Flow</u>

S1 = 1460 S2 = 3400 S3 = 1700
S4 = 500 S5 = 900

Figure 45. Representation of Input Data for Node 8



Phase	Link	Interval / Time (sec.)	Min. Phase (sec.)
1	906, 908	1 / 7	16
		2 / 4	
		3 / 1	
2	907, 908	4 / 7	16
		5 / 4	
		6 / 1	
3	905, 907	7 / 37	16
		8 / 4	
		9 / 1	
4	902, 904	10 / 10	16
		11 / 4	
		12 / 1	
5	901, 902	13 / 29	16
		14 / 4	
		15 / 1	
6	901, 903	16 / 13	16
		17 / 4	
		18 / 1	

Reference Interval: 8
<u>Saturation Flow</u>

S2 = 3400 S3 = 1600

Figure 46. Representation of Input Data for Node 9

Before TRANSYT-7F can develop an optimal timing plan, an initial network timing plan will have to be developed. This is done by coding a "0" in field 10 of T7F-DIM. By coding a "0", only the yield point reference intervals, the durations of the fixed green, yellow clearance and all-red intervals need be input in card-type 1X. This means that the durations of the variable intervals need not be entered in card-type 1X. However, to avoid possible errors in the data input process, these variable intervals are nevertheless input in the relevant T7F-DIM fields.

In developing the initial network timing plan, TRANSYT-7F calculates the initial phase lengths based on the ratios of volume to saturation flow on each link at each node. The development of the final timing plan is then based on the initial timing plan. A TRANSYT-7F optimization run is requested by coding card-type "5X" with "X" = 2. After the input data file is created, it is then run with the TRANSYT-7F program to perform the optimization run.

In a TRANSYT-7F run, several outputs are produced automatically. These include the performance table and the optimal signal setting. However, to further analyze the optimal signal timing, other types of output are requested. These include the flow profile diagrams, the time-space diagrams and the platoon progression diagrams. Since it is desired to evaluate the progression of the primary through links (for both the eastbound and westbound directions) in the network, the flow profile diagrams and the platoon progression diagrams for these links are requested.

The results of TRANSYT-7F optimization run are discussed in the next chapter.

CHAPTER IV

DISCUSSIONS OF RESULTS

The outputs and the results of TRANSYT-7F optimization run are included in Appendix C. The contents of the Appendix include the following:

1. Input Data Report - this report prints the input data. Errors are identified by TRANSYT-7F's extensive diagnostics and these errors are indicated through worded messages.

2. Traffic Performance Table - this is a table of the Measures of Effectiveness (MOE's) for all links, subtotaled by intersection and aggregated for the entire network. The MOE's are indices of the quality of traffic flow used in the evaluation of traffic control systems [1].

In this project, performance tables for the initial settings and the optimal settings are printed.

3. Controller Timing Settings - the settings for each controller are shown in a format that is compatible with signal timing design. The length of each signal interval and the offset/yieldpoint are shown.

4. Stopline Flow Profile Plots - these plots show the arrival and discharge flow rate profiles for specified links. They are useful in evaluating the effectiveness of

the signal timings in providing traffic progression.

5. Time-Space Diagram - these are the Time-Space Diagrams for specified routes and are used to evaluate the potential for through progression.

6. Platoon Progression Diagram - this is not a direct output from a TRANSYT-7F run. However, using A PPD program with an data file created during a TRANSYT-7F run, platoon progression diagrams are plotted.

Performance Table

The performance table shows various MOE's and they include the following [1]:

1. Degree of saturation - this is the percent of saturation of each link and is used as a measure of congestion

2. Total travel - this is the total vehicle-miles/hour of travel

3. Total travel time - this is the total vehicle hours/hour of travel

4. Delay - this consists of uniform, random plus saturation and total delay in terms of vehicle hours per hour and average delay in seconds per vehicle.

5. Uniform stops - this is expressed in terms of vehicles stopped per hour and also in percent of vehicles stopped.

6. Maximum back of queue and queue capacity - this relates the number of vehicles on the link and are used to

indicate the possibility of spillover of traffic.

7. Fuel consumption - this is the total gallons of fuel consumed per hour.

8. Performance Index - this is the objective function of TRANSYT-7F optimization process.

To determine whether the timing plan developed by TRANSYT-7F is acceptable, it is essential that the MOE'S in the performance table be examined. The MOE's on certain links may indicate that traffic performance on that link may not be acceptable. The degree of saturation and the maximum back of queue are examined to ascertain unacceptable performance. The degree of saturation is the most important MOE since it defines the condition of each link with respect to its capacity. Thus, it can be used as a measure of congestion on a link. A link with a degree of saturation exceeding 95 percent is said to be oversaturated and this condition will lead to unacceptable traffic performance.

Traffic performance on a link is said to be unacceptable when its queue capacity is exceeded by the maximum back of queue. This condition is shown by the ">" flag in the performance table.

As discussed in Chapter 3, TRANSYT-7F does not consider the effects of spillover during its optimization process, thus, the maximum back of queue is used to indicate any potential spillover of traffic into an upstream intersection. Similarly, a long queue from a turn bay could block a through lane.

Since TRANSYT-7F was requested to develop initial settings, a performance table with the initial settings is also produced. However, in the discussion of the MOE's, reference is made to the MOE's in the performance table with the optimal settings.

Performance Table With Optimal Settings

On examination of the performance table, it is seen that all links in the network have degrees of saturation less than 95 percent indicating that all links are undersaturated. Based on the maximum back of queue, there is no indication of potential spillover, except for links 101, 105, 901, 903 and 907. It is seen that the queue capacity values for these links have been exceeded by the maximum back of queue, as indicated by the ">" flag. However, it should be noted that these are external links and the input link length for external links is 100 feet. Thus, in TRANSYT-7F's computation of the queue capacity values, the 100 feet length was used. The actual length of these links is longer than 100 feet. If the actual lengths were used, the computed queue capacity values will not be exceeded by the maximum back of queue. Therefore, it can be said that spillover of traffic is not expected to occur on any link in the network.

Table XI shows the MOE's for each node and the network-wide performance summary is shown at the bottom of

TABLE XI

PERFORMANCE TABLE WITH OPTIMAL SETTINGS

NODE NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	DELAY UNIFORM (VEH-H/H)	DELAY RANDOM (VEH-H/H)	DELAY TOTAL (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)		
1 :	2378	MAX =	88	322.73	34.53	20.68	2.72	23.40	35.4	1881.8(79%)	41.13 PI =	27.3
2 :	1494	MAX =	57	585.63	20.02	4.28	.40	4.68	11.3	423.5(28%)	27.58 PI =	6.0
3 :	1338	MAX =	29	168.78	7.24	1.96	.08	2.04	5.5	211.2(16%)	9.74 PI =	2.8
4 :	1400	MAX =	50	236.27	10.42	2.58	.23	2.81	7.2	282.0(20%)	13.30 PI =	3.6
5 :	1786	MAX =	49	213.94	22.03	14.05	.54	14.60	29.4	1228.8(69%)	26.31 PI =	17.2
6 :	1372	MAX =	30	119.58	7.28	3.01	.13	3.14	8.2	305.1(22%)	9.13 PI =	3.9
7 :	1362	MAX =	56	79.35	12.97	9.82	.40	10.22	27.0	832.3(61%)	15.51 PI =	11.9
8 :	1456	MAX =	41	295.31	12.70	4.00	.16	4.15	10.3	489.5(34%)	17.64 PI =	6.2
9 :	2138	MAX =	72	152.88	28.34	20.77	2.01	22.78	38.4	1819.9(85%)	33.07 PI =	26.3

<SYSTEM WIDE TOTALS INCLUDING ALL LINKS>

TOTAL DISTANCE TRAVELED (VEH-MI/H)	TOTAL TRAVEL TIME (VEH-H/H)	TOTAL UNIFORM DELAY (VEH-H/H)	TOTAL RANDOM DELAY (VEH-H/H)	TOTAL DELAY (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	TOTAL UNIFORM STOPS (VEH/H-%)	TOTAL FUEL CONSUM (GA/H)	PERFORMANCE INDEX	SPEED (MI/H)
2174.47	155.52	81.14	6.68	87.82	21.47	7474.0(51%)	193.42	105.25	13.98 <TOTALS>

the table. The MOE's in the table are those that have been averaged for each node. The flow is the total number of vehicles on links associated with each node. The degrees of saturation shown are the maximum values at each node. The maximum degree of saturation ranges from 29 to 88 percent with the highest occuring at node 1 and the lowest occuring at node 3. The average delay is highest at node 9 with a value of 38.4 seconds per vehicle and the lowest is at node 3 with a value of 5.5 seconds per vehicle. Also shown for each node is the average number of vehicles stopped and the percentage of vehicles stopped. The highest percentage of stops occurs at node 9 and the lowest is at node 3.

At the bottom of Table XI is the network-wide performance summary. The discussion of the network-wide MOE's are as follows:

The total distance traveled is 2174.47 vehicle-mile per hour and it is the total distance travelled by all traffic in the network during a one hour period. TRANSYT-7F used this value to determine one of the components of fuel consumption and also to derive the network average speed. With a given set of volumes, the total distance traveled remains constant for the network.

The total travel time of 155.52 vehicle-hour per hour is the total travel time for all traffic within the network and includes the time spent moving and time spent delayed at signals. It is used in the computation of the network average speed.

The total uniform delay in the network is 81.14 vehicle-hours per hour. It is the delay due to the average queue length estimated by TRANSYT-7F and is based on the assumption that the queue length is the same for each cycle during the design period.

The total random delay in the network is 6.68 vehicle-hours per hour. It accounts for the cyclic variation in the arrivals of vehicles.

The total delay is 87.82 vehicle-hours per hour and is the summation of the total uniform delay and the total random delay of traffic in the network. It is used to determine one of the components of fuel consumption.

The average delay in the network is 21.47 seconds per vehicle and it is obtained by dividing the total delay by the total volume in the network.

Stops are reported in units of vehicles/hour and also as percentage of vehicles stopped. In this network, the total stops are 7474.0 vehicles per hour or 51 percent stops. The total stops are used in determining the total fuel consumptions.

The total fuel consumption is 193.42 gallons per hour. Based on the optimal timing plan, the network Performance Index is 105.25 and the average network speed is 13.98 miles/hour. When several optimal timing plans are being evaluated, the average speed can be treated as a measure of improvement or indication of the overall quality of traffic performance in the network. Its value is calculated by dividing the total distance traveled by the total travel time. In calculating its value, the total travel time includes all time spent by vehicles stopped and delayed throughout the network and explains the low speed value obtained [1].

Based on the measures of effectiveness, it can be inferred that traffic performance will be acceptable for the given traffic volumes.

Controller Timing Settings

TRANSYT-7F is explicitly designed to develop signal timing plans for pre-timed signal controllers [1]. Thus the controller settings tables contain appropriate signal timing information for pretimed controllers.

Table XII is used to illustrate the timing information for node 6. This table contains information on all the intervals that have been input to the program. The durations of the fixed intervals, e.g., yellow clearance interval, all-red interval and flashing "DONT WALK" interval, are values that were input for these intervals. Each interval, i.e., variable, fixed, yellow or all-red, is identified by a "V", "F", "Y", or "R" below the interval number. The duration of the intervals that were designated as variable and the offsets/yieldpoints were developed during the optimization process.

Interval durations are given in seconds and percent of cycle length, along with a pin setting expressed in

TABLE XII

SIGNAL CONTROLLER SETTINGS
FOR NODE 6

INTERVAL NUMBER :	1	2	3	4	5	6	7	8
INTVL LENGTH(SEC):	63	9	4	1	14	9	4	1
INTVL LENGTH (%):	59	9	4	1	13	9	4	1
PIN SETTINGS (%):	100/0	59	68	72	73	86	95	99
PHASE START (PH#):	1				2			
INTERVAL TYPE :	V	F	Y	R	V	F	Y	R
LINKS MOVING :	605 607 608				601 602 603 604			

OFFSET = 49 SEC. 47 %.

cumulative percentages. The links receiving the right-of-way in each phase are also printed. The offset at node 6 is 49 seconds and it is shown at the bottom of the table. Since a network reference point was not input, the offsets and yieldpoints are referenced to an arbitrary system reference point [1]. In the proposed project, one of the signalized intersections will be established as the system master controller. Thus, all offsets and yieldpoints in the network will be referenced to the master controller. The master controller establishes the base line condition. The individual controller then operates its intersection in the predetermined relationship with the master controller [5].

At node 3, a warning, "THE OFFSET FALLS WITHIN 1% OF AN INTERVAL CHANGE POINT AT THE START OF INTERVAL NO. 8," is displayed at the bottom of the signal controller setting table. To avoid this conflict, the offset will have to be manually adjusted [1]. The offset at node 3 is 1 second. Thus by adjusting the offset to the beginning of interval number 1, the new offset at node 3 will be 0 seconds. This change should not have great effect on the system performance. The offsets/yieldpoints for each node that were developed by the program are shown in Table XIII.

With actuated controllers, not all of the information can be used. However the cycle length and the yieldpoints produced by TRANSYT-7F can be used. To establish the optimal timing at each actuated signal, other parameters such as the minimum initial green time and vehicle

TABLE XIII

Offset and Yieldpoint values

Node number	Offset (O)/Yieldpoints (Y) (Seconds)
1	78 (Y)
2	77 (Y)
3	0 (O)
4	69 (Y)
5	43 (O)
6	49 (O)
7	17 (O)
8	33 (O)
9	34 (O)

extension which are expressed in seconds, are required. These parameters are a function of the type and placement of detectors. It is not within the scope of this thesis to include the design of the optimal timing plan for actuated controllers.

Guidelines on using the TRANSYT-7F outputs to develop timing plan parameters for actuated controllers have been developed by the Institute of Transportation Studies [2]. Briefly, two cases are considered in setting the maximum green time for actuated controllers. First, when the degree of saturation for a critical movement is less than 85 percent and second, when the degree of saturation for a critical movement exceeds 85 percent. If the degree of saturation is less than 85 percent, then the optimal green produced by TRANSYT-7F can be set as the maximum green time. When the degree of saturation exceeds 85 percent, an additional amount of green time is required and this has to be added to TRANSYT-7F optimal green time to avoid overflow. The minimum green time is then calculated by subtracting the maximum green time from the cycle length [2].

Flow Profile Plots

For the purpose of illustration, the flow profile plots for links 907, 807 and 707 are shown in Figure 47. The plots show the periodic arrival and departure patterns of traffic at the stopline. They are expressed as a

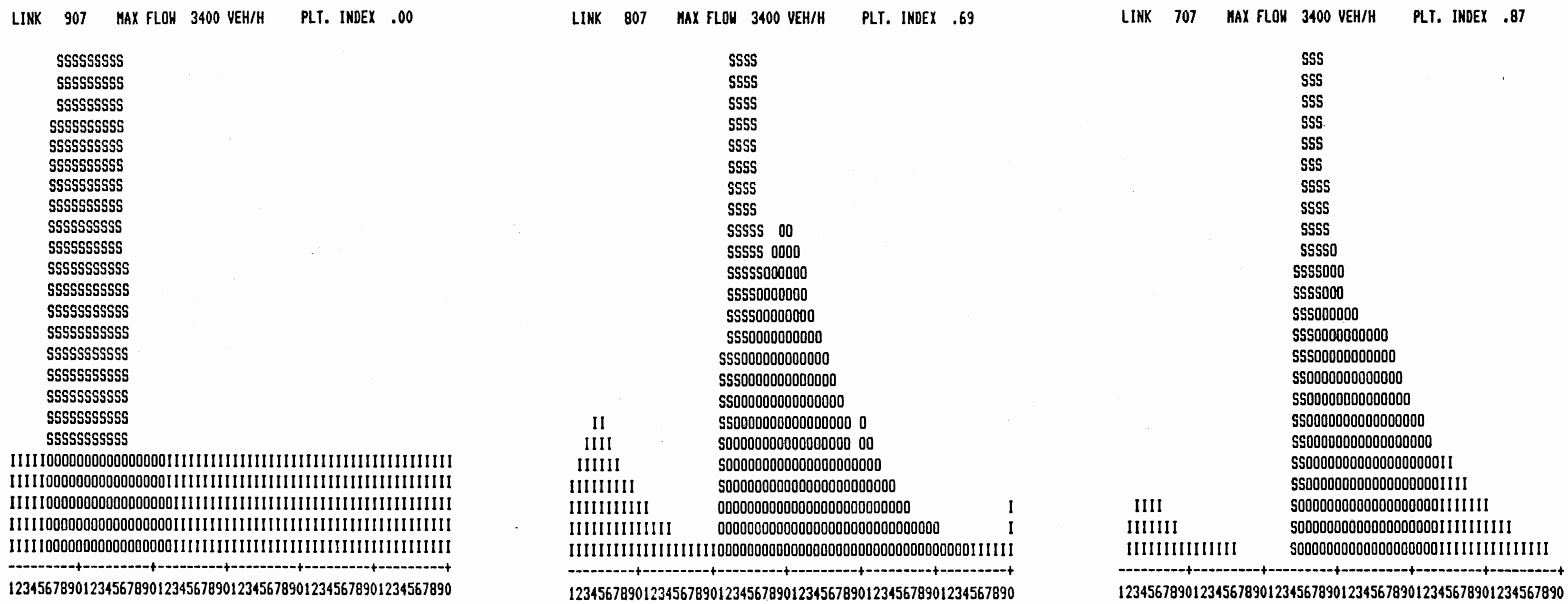


Figure 47. Flow Profile Plots for Links 907, 807, and 707

function of time in the cycle. The horizontal axis represents the cycle length, divided into steps. For a 105 seconds cycle with 60 steps, one step is equivalent to 1.75 seconds. The vertical axis is the flow rate for the link. The saturation flow rate, S, is always 24 symbols high. The "I" pattern includes only arrivals on red. Vehicles that arrive on green ("O") also join the back of the queue as long as the "S" symbol exists above the "O" symbol, i.e., as long as a queue exists. Once the queue dissipates, the "O" symbol depicts both arrivals and departures during green [1] .

For link 907, it can be seen that the queue departs at the saturation flow rate at step 6. The "O's"under the "S's" are arrivals on green that join the back of the queue and are thus delayed. At step 17, the queue has dissipated. From step 17 until the signal becomes effectively red at step 22, vehicles arrive and depart without delay.

Link 907 feeds link 807. Thus, vehicles from link 907 move as a platoon on link 807. At node 8, the platoon from link 907 arrives at step 27, just as the queue on link 807 has cleared, and departs without delay (platoons of "O's"). At step 40, a smaller secondary platoon from an upstream turning movement (platoons of I's) arrives. At step 55, the signal becomes effectively red. A smaller platoon of vehicles arrives on red from an upstream turning movement (platoons of I's).

Link 807 feeds link 707. Thus vehicles from link 807 move as a platoon on link 707. At step 24, the signal becomes effectively green and the queue on link 707 begins to discharge at the saturation flow rate (S's). At step 25, the front of the platoon from link 807 arrives and vehicles are delayed (O'S under the S's). However, from step 29 until step 32, the remainder of the platoon arrives on green and departs without delay. At step 33 a smaller secondary platoon from an upstream turning movement arrives and departs without delay until step 44 when the signal becomes effectively red. Another secondary platoon arrives on red at step 2 and are stopped.

The platooning index is shown at the top-right corner of each plot. It is used as a measure of the deviation of the periodic flow rate from the average flow rate over the entire cycle [1]. The index can have a value between 0 and 2. An index of zero indicates a uniform flow. External links have a uniform flow, thus, link 907 has a platooning index of zero. A high platooning index indicates bunching of traffic, i.e., vehicles are closely-spaced, and links with high platooning index will benefit from efficient signal system coordination [1].

Platoon Progression Diagram Plots

Generally, the performance table is used to analyze the Measures of Effectiveness (MOE's). However, the MOE's do not give a sense of the quality of traffic progression. To visualize the progression of traffic on the primary links, i.e., through movements, the Platoon Progression Diagram plots are examined.

Figure 48 shows the PPD plot which depicts the density of traffic at all points in time and distance. In addition to illustrating the relationship between signal settings at adjacent intersections, it also illustrates the progression of traffic by shaded areas on the time-space diagram. Darker shaded areas indicate that vehicles are moving in tight platoon, i.e., traffic are closely-spaced, and lighter shaded areas indicate that vehicles in the platoon are dispersed as they move downstream.

The right-half of the plot represents traffic flow in the westbound direction, i.e., from node 9 to 1, and the left-half of the plot shows the flow of traffic in the eastbound direction, i.e., from node 1 to 9.

To help explain the PPD plot, consider traffic progression from node 9 to node 7 in Figure 49. At the onset of green at node 9, traffic on through link 907 will depart and move as a platoon on link 807. It is seen that traffic from links 902 (left-turn) and 903 are departing on "red". Traffic from link 902 will be stopped at node 8, as indicated by the dark shading which represents a queue.

At node 8 the arrivals from link 907 gets through without stopping, as deduced from the flow profile plots. From the performance table in Appendix C, the percentage of stops on link 807 is 28. This percentage of stops is contributed by traffic from links 902 and 903. In any case

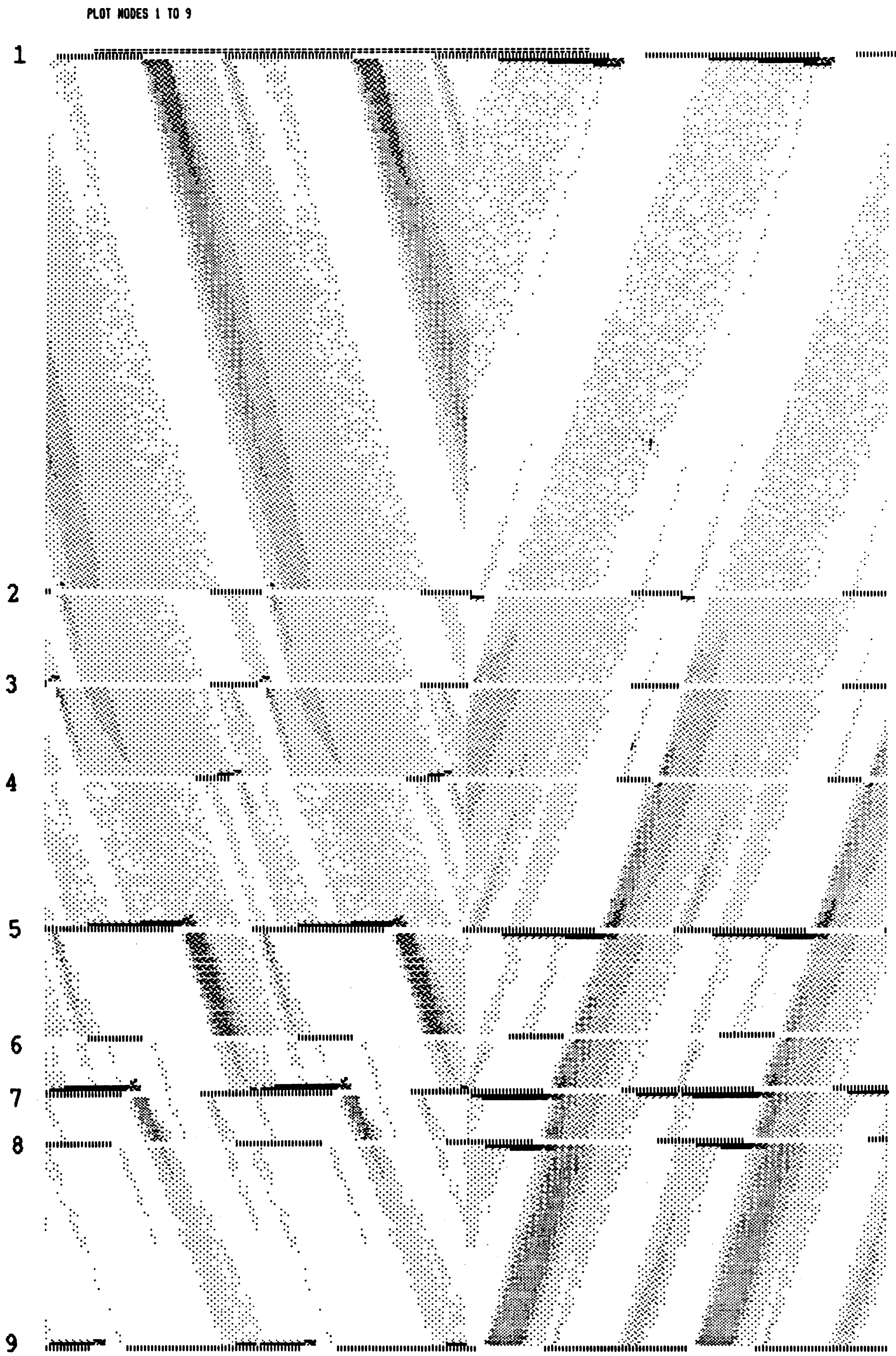


Figure 48. Platoon Progression Diagram

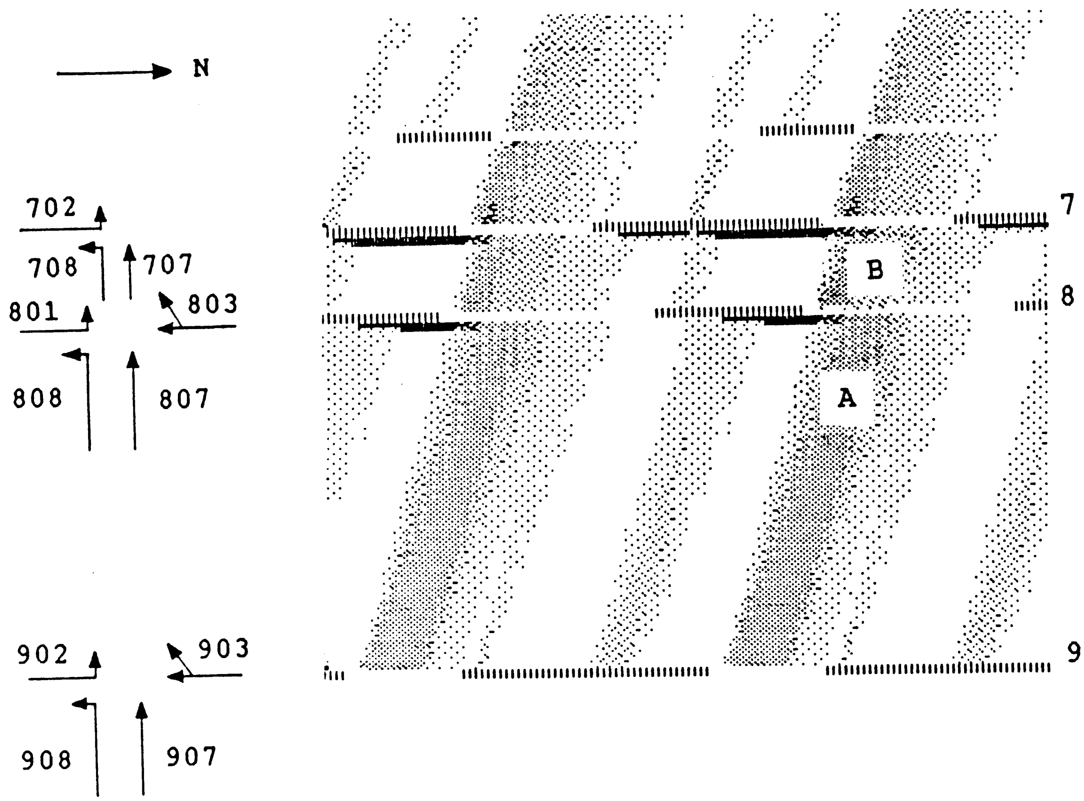


Figure 49. Platoon Progression From Node 9 to Node 7

"A" - Link 807

"B" - Link 707

all traffic from links 902 and 903 get through at node 8 but not without some delays and stops.

At node 8, traffic on link 807 will depart on green and move as a platoon on link 707. However, at node 7 some of the traffic from link 807 join the back of the queue and are stopped on green. Link 801 traffic will depart on "red" but some of the traffic will be stopped at node 7. This is illustrated by the dark horizontal shadings which represent a queue. It is noticed that a "break" occurs in the queue. The "thinner" shadings represent queuing of traffic from link 707 while the "thicker" shadings represent queuing of traffic from link 801 . The percentage of stops on link 707 as shown in the performance table in Appendix C is 29. This percentage of stops is contributed by traffic from links 801, 803 and 807. Although traffic originating from link 807 are delayed at node 7, all the vehicles will get through node 7 but not without some stops and delay.

Therefore, from the PPD plot, one can see the "continuous" progression of traffic as well as the formation of queues and the presence of a secondary movement. Although the PPD plots give a sense of the quality of progression, it is still necessary to refer to both the performance table and the flow profile plots for a better understanding of the traffic progression.

Time-Space Diagram

The time-space diagram plotted by TRANSYT-7F do not explicitly show the progression bands and these bands must be drawn manually. Figure 50 shows the time-space diagram for through links. For the westbound direction, it is seen that the bandwidth for the through progression is 21 seconds. For the eastbound direction, there is no through progression. The progression is disrupted at node 9. In developing the "Best" timing plan, the TRANSYT-7F optimization model considers delays and stops of all traffic in the network, including traffic on the cross-streets. Therefore, through progression bands may not always result [2]. If the time-space diagram has through progression bands, they may not be as wide as those produced manually or by a maximal bandwidth optimization model [1].

Additional consideration can be given to providing more green to specified links. This is done by assigning link-specific weights for delay and stops on the TRANSYT-7F card-types 37 and 38. Since there are no guidelines for the use of these parameters, a trial-and-error approach may be used to fine-tune the signal timing. Another way to provide additional green is by increasing the minimum phase length for the affected links [1]. However, it should be noted that by assigning weights to and by increasing the minimum phase lengths of specific links, the performance on other links may deteriorate.

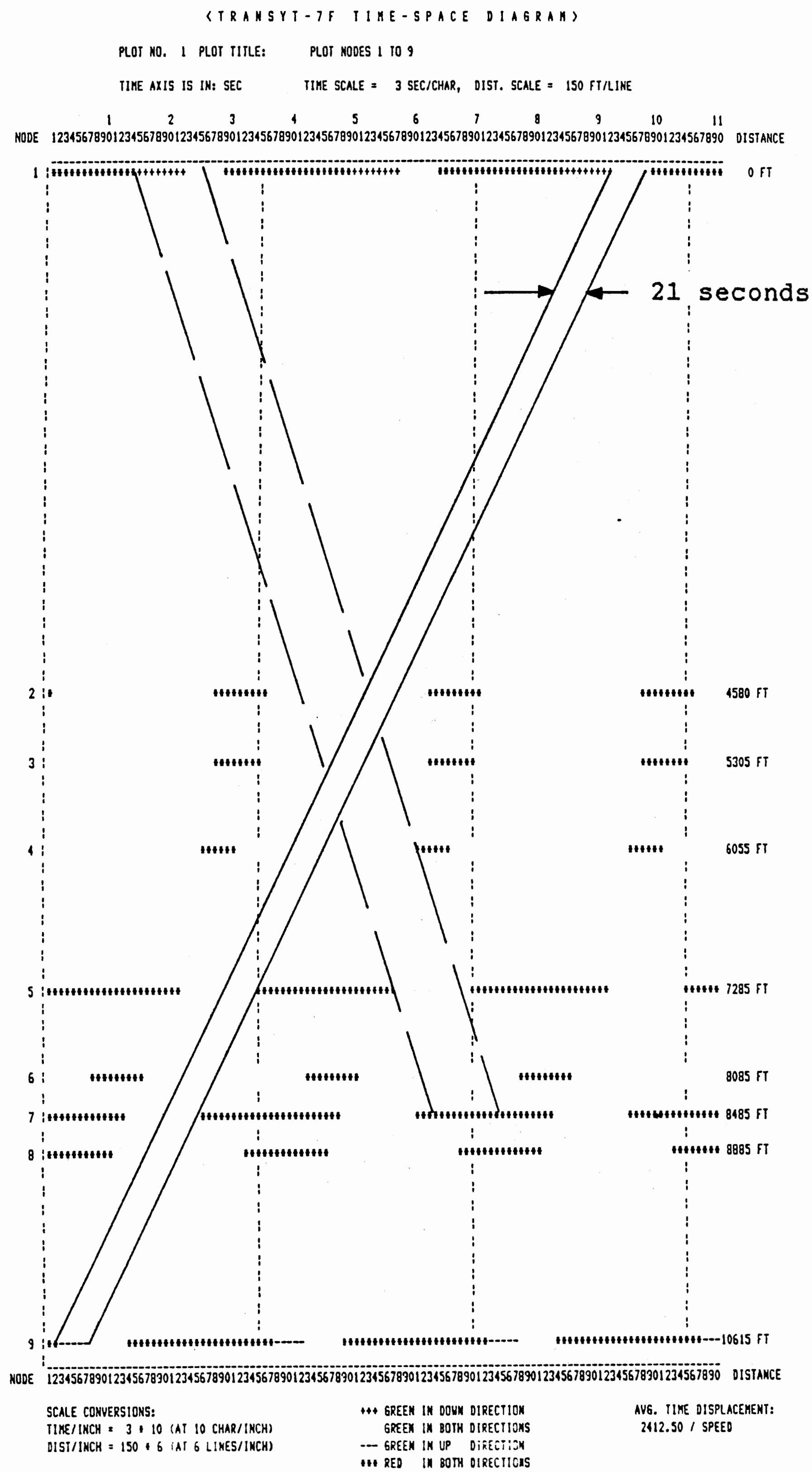


Figure 50. TRANSYT-7F Time-Space Diagram

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Since the signal timing plan developed by TRANSYT-7F has not been implemented yet, one cannot quantify the actual benefits that will be realized by motorists. However, if the positive results of previous studies on the effectiveness of TRANSYT-7F optimal timing plans are any indication, the timing plan developed in this project should also yield some benefits.

To evaluate the hourly benefits of optimal signal timing plans, the hourly savings in fuel consumption, stops and delays during the peak periods, i.e., morning, afternoon and evening period, are calculated. For the peak hour period, the hourly savings are the differences in the optimal and existing MOE's. The equivalent dollar total hourly benefits for the savings in fuel consumption, stops and delays are computed by multiplying these savings with unit costs of fuel saved, vehicle-hour of stops eliminated and vehicle-hour of delays saved, respectively. Unit costs of $0.50 per vehicle-hour of delay saved $0.14 per vehicle-stop eliminated and $1.35 per gallon of fuel saved have been used in a study to compute the equivalent dollar total hourly benefits [12]. The equivalent dollar total annual benefits is then computed by multiplying the equivalent dollar total hourly benefits by the number of peak hours for the year.

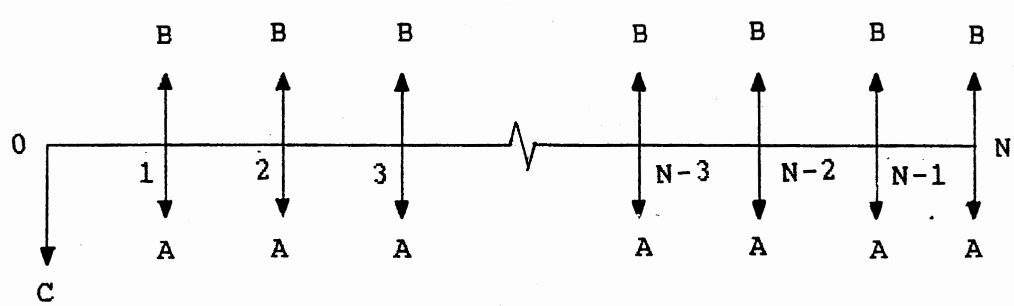
To determine the viability of the proposed project, the net present worth (NPW) method is used. In the present worth calculations, all benefits and costs are evaluated in the same period, that is at time period zero or at the present time [14]. The annual interest rate is assumed to be known in the net present worth method. To express the relationship between the benefits and costs of the proposed project, the following nomenclature is used:

C = capital cost of the proposed project

A = annual operating and maintenance costs of the signal controllers in the network

B = annual benefits to the users in terms of fuel consumption saved, stops eliminated and delays saved.

Assuming an annual interest rate of i percent and considering a period of N years, the relationship between costs and benefits can be represented as a cash flow diagram as follows:



For the project to be viable, the Net Present Worth at time zero must be greater than or equal to zero, i.e., NPW ≥ 0. This is equivalent to stating that the total benefits minus the total costs must be greater than or equal to zero, i.e., $B_0 - A_0 - C_0 \geq 0$.

As discussed in Chapter 5, there is no indication of saturation on any links in the network and also there is no potential occurrence of spillover. This implies that the timing plan developed by TRANSYT-7F is acceptable and satisfies the design traffic volumes.

The values of the pertinent Measures of Effectiveness are listed below:

1. Total delay - 87.82 vehicle-hour/hour
2. Average delay - 21.47 seconds/vehicle
3. Total uniform stops - 7474.0 vehicles/hour or 54 percent
4. Total fuel consumption - 193.42 gallons/hour
5. Performance Index - 105.25
6. Average speed - 13.98 miles/hour.

The objective function of TRANSYT-7F optimization process is to minimize the performance index (PI). Since the PI is a function of stops and delay, it follows that when a minimum PI is reached, stops and delays in the network will also be minimum. Therefore, if another optimization run is performed with the intention of developing a better timing plan, then that run should result in a smaller PI value. Subsequently, the new run should also lead to a reduction in fuel consumption and also an improvement in the network average speed. If the new timing plan does not produce a smaller PI value, then the previous timing plan should be retained.

There are two ways of evaluating the benefits that can be derived from TRANSYT-7F. Firstly, the performance of traffic in the network can be evaluated by analyzing the Measures of Effectiveness. Secondly, a field evaluation involving a before-and-after study is carried out. However, to perform this study, it must be ensured that normal traffic patterns and identical field conditions exist. Thus, the selection of the actual dates for the study is important.

It should be iterated that TRANSYT-7F is only a tool to assist in developing an optimal timing plan. Although the developed timing plan is optimal, it is still subjected to fine-tuning after it is implemented in order to complete the timing improvement. Timing plans should be developed for different times of the day, e.g. peak periods. Frequent TRANSYT-7F optimization runs should also be performed due to changing traffic patterns caused by land-use development or any changes in the existing street network. TRANSYT-7F is capable of performing various sensitivity analyses. For example, it can be used to evaluate the sensitivity of the signal timing to changes in the speeds and also to changes in the traffic flow. This option is possible through the use of the appropriate modifier cards.

In conclusion, TRANSYT-7F is a useful tool that can be used to determine the optimal settings of signal controllers that will result in reduced delay, stops and fuel consumption. Although it requires massive data collection and reduction, it is simple to use and is certainly much better than the manual procedures which are very time consuming.

Recommendations

1. TRANSYT-7F should be modified to include new improvements that would ease some of the shortcomings. The latest version of TRANSYT called TRANSYT-9 has been developed in the United Kingdom. It contains some new improvements. If these enhancements are incorporated into TRANSYT-7F, data can be entered interactively and this will make it more user friendly, and more flexible. The various advantages incoporated in TRANSYT-9 include the following [10]:

    1. TRANSYT-9 has an interactive editing program.
    2. The user is able to examine the likely effect of different phase sequences on the network performance index
    3. The GRAPH program in TRANSYT-9 is a new interactive program for showing queues and performance index graphs for individual links.
    4. It provides "help screens and help messages" which can be displayed by request [10].

2. It is important that if real life situations are to be modeled properly, comprehensive field measurements and observations of the actual field conditions must be carried out. Additionally current traffic counts should be used. If the existing counts are more than six months old, they should be carefully factored to current conditions [2].

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APPENDIX A

THROUGH AND TURNING MOVEMENT VOLUME

	WESTERN AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
TIME PERIOD	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM												-	
6.15 - 6.30 AM												-	
6.30 - 6.45 AM	4	8	7	10	19	4	0	1	10	1	12	5	81
6.45 - 7.00 AM	11	16	4	17	22	3	4	14	17	2	13	3	126
TOTAL	15	24	11	27	41	7	4	15	27	3	25	8	207
7.00 - 7.15 AM	9	27	13	46	43	6	2	6	15	2	18	2	189
7.15 - 7.30 AM	12	48	13	48	69	7	8	14	16	3	27	9	274
7.30 - 7.45 AM	16	98	11	80	88	13	10	17	31	3	31	15	413
7.45 - 8.00 AM	16	149	11	124	155	16	21	37	44	10	52	22	657
TOTAL	53	322	48	298	355	42	41	74	106	18	128	48	1533
8.00 - 8.15 AM	20	108	14	117	94	11	18	38	32	8	53	18	531
8.15 - 8.30 AM	3	58	17	107	101	13	15	33	48	12	56	17	480
8.30 - 8.45 AM	12	32	11	36	70	8	14	27	35	12	30	15	302
8.45 - 9.00 AM	12	26	13	56	55	10	10	11	24	9	40	9	275
TOTAL	47	224	55	316	320	42	57	109	139	41	179	59	1588
9.00 - 9.15 AM	3	36	20	64	75	12	10	10	18	9	36	8	301
9.15 - 9.30 AM	2	23	20	47	77	16	8	19	28	10	59	9	321
9.30 - 9.45 AM	10	14	6	35	58	6	5	21	32	12	45	7	251
9.45 - 10.00 AM	13	13	9	30	66	5	12	17	24	15	46	8	258
TOTAL	46	76	69	161	255	46	42	69	146	51	188	50	1199
10.00 - 10.15 AM	12	22	13	48	62	6	12	12	44	14	41	5	291
10.15 - 10.30 AM	13	14	17	55	60	13	8	25	26	14	45	18	308
10.30 - 10.45 AM	14	15	23	23	61	19	14	20	42	9	54	16	310
10.45 - 11.00 AM	7	25	16	35	72	8	8	12	34	14	48	11	290
TOTAL	58	102	90	157	275	36	60	100	233	58	306	44	1519
11.00 - 11.15 AM	14	22	27	31	47	10	14	28	35	16	76	7	327
11.15 - 11.30 AM	13	28	25	80	97	10	7	24	63	12	63	12	434
11.30 - 11.45 AM	8	18	20	30	67	7	18	24	70	14	81	12	369
11.45 - 12 00 AM	23	34	18	16	64	9	21	24	65	16	86	13	389
TOTAL	56	134	86	184	295	56	98	142	288	86	404	83	1912

TIME PERIOD	MONROE AND 6TH												TOTAL
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
	L	SA	R	L	SA	R	L	SA	R	L	SA	R	
6.00 - 6.15 AM	-												
6.15 - 6.30 AM													
6.30 - 6.45 AM													
6.45 - 7.00 AM												-	
TOTAL													
7.00 - 7.15 AM	-												
7.15 - 7.30 AM	-												
7.30 - 7.45 AM	1	21	1	15	74	0	5	2	1	1	96	31	249
7.45 - 8.00 AM	2	51	5	14	116	2	12	9	7	2	113	35	368
TOTAL	3	72	6	29	190	2	17	11	8	3	209	66	616
8.00 - 8.15 AM	0	34	2	11	129	0	10	12	11	0	109	26	344
8.15 - 8.30 AM	5	13	2	8	141	4	16	5	4	2	115	18	334
8.30 - 8.45 AM	3	3	0	7	104	3	9	3	6	1	86	8	233
8.45 - 9.00 AM	2	8	5	5	125	0	10	7	3	2	96	8	271
TOTAL	10	58	9	31	499	7	45	27	24	5	406	60	1181
9.00 - 9.15 AM	2	1	5	6	110	0	15	6	3	3	68	17	236
9.15 - 9.30 AM	0	4	1	4	98	0	15	3	7	2	96	9	239
9.30 - 9.45 AM													
9.45 - 10.00 AM													
TOTAL	2	5	6	10	208	0	30	9	10	5	164	26	475
10.00 - 10.15 AM													
10.15 - 10.30 AM													
10.30 - 10.45 AM													
10.45 - 11.00 AM													
TOTAL													
11.00 - 11.15 AM													
11.15 - 11.30 AM													
11.30 - 11.45 AM													
11.45 - 12 00 AM													
TOTAL													

	WASHINGTON AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
TIME PERIOD	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM													
6.15 - 6.30 AM													
6.30 - 6.45 AM													
6.45 - 7.00 AM													
TOTAL													
7.00 - 7.15 AM													
7.15 - 7.30 AM													
7.30 - 7.45 AM	2	5	4	3	84	1	6	1	1	2	109	14	232
7.45 - 8.00 AM	2	9	2	3	124	0	6	1	1	6	150	16	320
TOTAL	44	14	6	6	208	1	12	2	2	8	259	30	552
8.00 - 8.15 AM	5	9	10	6	125	3	12	5	1	4	134	24	338
8.15 - 8.30 AM	1	5	7	6	117	0	15	5	2	1	114	14	287
8.30 - 8.45 AM	1	1	3	7	109	3	4	3	1	4	91	11	238
8.45 - 9.00 AM	4	10	5	4	118	4	8	2	2	4	80	15	256
TOTAL	11	25	25	23	469	10	39	15	6	13	419	64	1118
9.00 - 9.15 AM	2	3	3	0	112	0	7	0	2	11	82	13	225
9.15 - 9.30 AM	1	7	3	1	90	1	13	4	3	4	85	14	226
9.30 - 9.45 AM	-												
9.45 - 10.00 AM	-												-
TOTAL	3	10	6	1	202	1	20	4	5	15	167	27	451
10.00 - 10.15 AM													
10.15 - 10.30 AM													
10.30 - 10.45 AM													
10.45 - 11.00 AM													
TOTAL													
11.00 - 11.15 AM													
11.15 - 11.30 AM													
11.30 - 11.45 AM													
11.45 - 12 00 AM													
TOTAL													

	HESTER AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
TIME PERIOD	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM													
6.15 - 6.30 AM													
6.30 - 6.45 AM													
6.45 - 7.00 AM													
TOTAL													
7.00 - 7.15 AM													
7.15 - 7.30 AM													
7.30 - 7.45 AM	1	7	1	3	86	1	3	1	13	0	119	11	246
7.45 - 8.00 AM	1	24	5	13	127	2	7	5	7	0	170	14	375
TOTAL	2	31	6	16	213	3	10	65	20	0	289	25	621
8.00 - 8.15 AM	1	17	7	5	131	1	6	9	6	0	134	13	330
8.15 - 8.30 AM	3	16	3	7	123	1	4	1	7	3	106	10	284
8.30 - 8.45 AM	2	12	2	2	122	2	4	2	5	3	102	7	265
8.45 - 9.00 AM	1	11	7	6	122	1	4	5	4	0	106	13	280
TOTAL	7	56	19	20	498	5	18	17	22	6	448	43	1159
9.00 - 9.15 AM	0	7	4	1	137	2	3	2	2	2	100	7	267
9.15 - 9.30 2	2	16	4	4	113	2	6	2	1	1	103	8	262
9.30 - 9.45 AM	2	23	8	5	250	4	9	4	3	3	203	15	529
9.45 - 10.00 AM													
TOTAL	4	46	16	10	400	8	18	8	6	6	406	30	1058
10.00 - 10.15 AM													
10.15 - 10.30 AM													
10.30 - 10.45 AM													
10.45 - 11.00 AM													
TOTAL													
11.00 - 11.15 AM													
11.15 - 11.30 AM													
11.30 - 11.45 AM													
11.45 - 12 00 AM													
TOTAL													

	DUCK AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
TIME PERIOD	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM													
6.15 - 6.30 AM													
6.30 - 6.45 AM	3	6	0	3	18	1	2	2	2	0	22	3	62
6.45 - 7.00 AM	3	5	0	10	22	2	5	11	14	1	27	5	105
TOTAL	6	11	0	13	14	3	7	13	16	1	49	8	167
7.00 - 7.15 AM	9	15	1	14	33	5	3	3	4	2	33	6	128
7.15 - 7.30 AM	7	36	1	12	55	9	3	8	15	0	64	8	218
7.30 - 7.45 AM	13	45	0	12	57	13	7	23	20	4	103	7	304
7.45 - 8.00 AM	28	70	2	28	75	20	12	49	21	5	118	20	448
TOTAL	57	166	4	66	220	47	25	83	60	11	318	41	1098
8.00 - 8.15 AM	26	64	5	24	84	21	17	53	21	5	106	19	445
8.15 - 8.30 AM	15	38	5	18	71	17	8	35	24	4	91	23	349
8.30 - 8.45 AM	9	52	4	19	65	6	6	23	15	3	66	24	292
8.45 - 9.00 AM	11	39	2	19	93	9	12	24	21	6	77	17	330
TOTAL	61	193	16	80	313	53	43	135	81	18	340	83	1416
9.00 - 9.15 AM	12	47	7	19	83	16	10	17	25	3	77	22	338
9.15 - 9.30 AM	10	24	3	25	80	9	10	24	12	4	76	14	291
9.30 - 9.45 AM	10	25	4	21	110	19	15	45	31	12	80	10	382
9.45 - 10.00 AM	10	26	2	14	53	5	8	9	10	3	93	6	239
TOTAL	42	122	16	79	326	49	43	95	78	322	326	52	1250
10.00 - 10.15 AM	8	27	2	18	92	8	19	33	16	3	97	17	340
10.15 - 10.30 AM	10	31	4	20	93	12	22	42	18	2	83	11	348
10.30 - 10.45 AM	10	29	3	21	100	14	20	45	20	3	106	9	380
10.45 - 11.00 AM	13	22	3	25	80	13	19	42	23	0	89	13	342
TOTAL	41	109	12	84	365	47	80	162	77	8	375	50	1410
11.00 - 11.15 AM	15	18	0	26	113	6	16	32	23	8	114	7	378
11.15 - 11.30 AM	17	37	6	390	105	16	18	33	34	4	93	15	408
11.30 - 11.45 AM	17	33	3	38	108	16	24	34	29	6	122	15	445
11.45 - 12 00 AM	15	33	3	32	140	17	24	53	36	9	129	16	507
TOTAL	64	121	12	126	466	55	82	152	122	27	458	53	1738

	HUSBAND AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
TIME PERIOD	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM													
6.15 - 6.30 AM													
6.30 - 6.45 AM													
6.45 - 7.00 AM													
TOTAL													
7.00 - 7.15 AM													
7.15 - 7.30 AM													
7.30 - 7.45 AM	5	14	5	5	45	3	2	8	4	15	109	2	217
7.45 - 8.00 AM	3	11	3	7	64	16	3	19	5	18	167	2	318
TOTAL	8	25	8	12	189	16	5	27	9	33	276	4	532
8.00 - 8.15 AM	10	24	5	4	85	18	4	24	8	18	133	5	338
8.15 - 8.30 AM	8	22	5	10	77	12	4	15	5	17	119	5	299
8.30 - 8.45 AM	7	16	6	6	79	9	2	8	5	11	86	9	244
8.45 - 9.00 AM	6	15	8	9	73	13	2	18	5	9	102	5	265
TOTAL	31	77	24	29	314	52	12	65	23	55	440	24	1146
9.00 - 9.15 AM	3	15	9	4	64	14	2	20	7	11	123	15	287
9.15 - 9.30 AM	7	23	5	3	88	15	5	28	2	12	91	8	287
9.30 - 9.45 AM													
9.45 - 10.00 AM													
TOTAL	10	38	14	7	152	29	7	48	9	23	214	23	574
10.00 - 10.15 AM													
10.15 - 10.30 AM													
10.30 - 10.45 AM													
10.45 - 11.00 AM													
TOTAL													
11.00 - 11.15 AM													
11.15 - 11.30 AM													
11.30 - 11.45 AM													
11.45 - 12 00 AM													
TOTAL													

	MAIN AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
TIME PERIOD	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM													
6.15 - 6.30 AM													
6.30 - 6.45 AM	1	4	1	3	11	4	4	2	2	1	29	9	71
6.45 - 7.00 AM	0	6	0	4	20	5	4	13	1	0	32	4	89
TOTAL	1	10	1	7	31	9	8	15	3	1	61	13	160
7.00 - 7.15 AM	4	8	0	1	17	4	2	7	4	2	46	12	107
7.15 - 7.30 AM	3	15	0	2	37	5	10	12	7	1	67	6	165
7.30 - 7.45 AM	3	10	4	7	32	3	8	21	5	6	72	17	188
7.45 - 8.00 AM	7	16	4	5	48	5	17	35	19	3	140	12	311
TOTAL	17	49	8	15	134	17	37	75	35	12	325	47	771
8.00 - 8.15 AM	6	30	10	15	52	10	16	34	15	3	135	12	338
8.15 - 8.30 AM	5	12	4	14	55	5	14	20	17	3	99	12	260
8.30 - 8.45 AM	3	25	5	13	67	13	11	11	16	3	65	11	243
8.45 - 9.00 AM	9	22	3	6	43	11	10	37	17	3	96	9	266
TOTAL	23	89	22	48	217	39	51	102	65	12	39	44	1107
9.00 - 9.15 AM	10	26	9	11	62	15	11	24	21	9	110	10	318
9.15 - 9.30 AM	10	15	8	16	48	10	11	50	22	3	80	11	284
9.30 - 9.45 AM	5	33	5	24	49	11	19	41	21	9	53	14	284
9.45 - 10.00 AM	5	32	10	18	68	22	11	34	17	7	88	18	330
TOTAL	30	106	32	69	227	58	52	149	81	28	331	53	1216
10.00 - 10.15 AM	10	43	3	21	42	15	15	38	16	12	70	15	300
10.15 - 10.30 AM	9	40	11	19	64	17	22	40	23	7	65	20	337
10.30 - 10.45 AM	12	42	7	15	64	20	29	47	29	5	86	21	377
10.45 - 11.00 AM	14	39	11	10	70	17	13	41	29	12	96	12	364
TOTAL	45	164	32	65	240	69	79	166	97	36	317	68	1378
11.00 - 11.15 AM	9	37	12	29	71	16	17	49	17	9	82	21	369
11.15 - 11.30 AM	12	45	14	19	84	12	25	50	27	12	80	25	405
11.30 - 11.45 AM	16	46	10	25	79	28	27	65	29	10	83	28	446
11.45 - 12 00 AM	20	43	11	36	85	11	32	48	20	9	90	20	425
TOTAL	57	171	47	109	319	67	101	212	93	40	335	94	1645

TIME PERIOD	LEWIS AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM													
6.15 - 6.30 AM													
6.30 - 6.45 AM													
6.45 - 7.00 AM													
TOTAL													
7.00 - 7.15 AM													
7.15 - 7.30 AM													
7.30 - 7.45 AM	1	10	3	4	43	10	0	5	1	9	145	5	236
7.45 - 8.00 AM	4	15	9	2	66	9	1	16	11	18	195	12	358
TOTAL	5	25	12	6	109	19	1	21	12	27	340	17	594
8.00 - 8.15 AM	10	17	13	2	69	13	2	21	8	12	146	21	334
8.15 - 8.30 AM	4	13	9	4	64	11	2	13	4	8	117	4	253
8.30 - 8.45 AM	4	11	7	1	63	16	0	13	3	14	95	3	230
8.45 - 9.00 AM	13	14	14	0	48	17	1	12	2	11	100	9	241
TOTAL	31	55	43	7	244	57	5	59	17	45	458	37	1058
9.00 - 9.15 AM	11	7	12	2	61	13	6	13	2	14	138	2	281
9.15 - 9.30 AM	10	17	24	1	70	17	1	9	3	13	97	5	267
9.30 - 9.45 AM													
9.45 - 10.00 AM													
TOTAL	21	24	36	3	131	30	7	22	5	27	235	7	548
10.00 - 10.15 AM													
10.15 - 10.30 AM													
10.30 - 10.45 AM													
10.45 - 11.00 AM													
TOTAL													
11.00 - 11.15 AM													
11.15 - 11.30 AM													
11.30 - 11.45 AM													
11.45 - 12 00 AM													
TOTAL													

	PERKINS AND 6TH												
	NORTHBOUND			EASTBOUND			SOUTHBOUND			WESTBOUND			
TIME PERIOD	L	SA	R	L	SA	R	L	SA	R	L	SA	R	TOTAL
6.00 - 6.15 AM													
6.15 - 6.30 AM													
6.30 - 6.45 AM	2	50	7	6	12	3	2	9	3	7	30	19	150
6.45 - 7.00 AM	8	47	7	10	6	4	10	26	17	6	38	11	190
TOTAL	10	97	14	16	18	7	12	35	20	13	68	30	340
7.00 - 7.15 AM	6	73	6	3	17	5	11	21	10	10	44	20	226
7.15 - 7.30 AM	16	58	10	16	24	7	17	32	12	10	66	32	300
7.30 - 7.45 AM	13	61	7	7	21	13	37	41	28	21	136	34	419
7.45 - 8.00 AM	13	105	18	28	29	6	44	43	39	34	135	34	528
TOTAL	48	297	41	54	91	31	109	137	89	75	381	120	1473
8.00 - 8.15 AM	8	70	29	40	45	9	25	63	36	32	114	44	515
8.15 - 8.30 AM	11	50	15	24	57	8	24	59	35	27	92	22	424
8.30 - 8.45 AM	7	37	12	12	48	10	23	42	26	34	108	25	384
8.45 - 9.00 AM	10	40	23	18	55	12	16	75	22	12	61	19	363
TOTAL	36	197	79	94	205	39	88	239	119	105	375	110	1686
9.00 - 9.15 AM	10	47	8	15	50	9	9	26	6	16	90	24	310
9.15 - 9.30 AM	9	34	13	20	45	8	19	31	16	21	81	28	325
9.30 - 9.45 AM	5	40	25	33	57	8	19	21	23	19	76	35	361
9.45 - 10.00 AM	7	31	26	33	65	5	27	39	26	15	71	26	371
TOTAL	31	152	72	101	217	30	74	117	71	71	318	113	1367
10.00 - 10.15 AM	4	28	20	34	63	6	25	41	20	20	90	40	391
10.15 - 10.30 AM	8	36	7	27	57	9	23	35	25	15	79	20	341
10.30 - 10.45 AM	9	42	14	32	72	12	33	42	16	19	66	30	387
10.45 - 11.00 AM	10	48	13	35	81	14	30	40	17	17	57	19	381
TOTAL	31	154	54	128	273	41	111	158	78	71	292	109	1500
11.00 - 11.15 AM	16	45	17	28	79	19	34	31	11	22	74	40	416
11.15 - 11.30 AM	7	24	10	27	73	9	30	33	21	21	79	22	356
11.30 - 11.45 AM	10	40	27	45	80	8	35	47	18	21	75	29	435
11.45 - 12 00 AM	10	63	13	49	101	13	35	41	32	14	89	19	479
TOTAL	43	172	67	149	333	49	134	152	82	78	317	110	1686

APPENDIX B

PEAK ONE-HALF HOUR VOLUME

	WESTERN								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	TOTAL
7.00 - 7.15	9	27	13	49	2	6	15	23	46	43	6	95	2	18	2	22	189
7.15 - 7.30	12	48	13	73	8	14	16	38	48	69	7	124	3	27	9	39	274
7.30 - 7.45	16	98	11	125	10	17	31	58	80	88	13	181	3	31	15	49	413
7.45 - 8.00	16	149	11	176	21	37	44	102	124	155	16	295	10	52	22	84	657
8.00 - 8.15	20	108	14	142	18	38	32	88	117	94	11	222	8	53	18	79	531
8.15 - 8.30	3	58	17	78	15	33	48	96	107	101	13	221	12	56	17	85	480
8.30 - 8.45	12	32	11	55	14	27	35	76	36	70	8	114	12	30	15	57	302
8.45 - 9.00	12	26	13	51	10	11	24	45	56	55	10	121	9	40	9	58	275
PEAK 30 MIN	36	257	25	318	39	75	76	190	241	249	27	517	20	109	35	164	

	MONROE								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	TOTAL
7.30 - 7.45	1	21	1	23	5	2	1	8	15	74	0	89	1	96	31	128	249
7.45 - 8.00	2	51	5	58	12	9	7	28	14	116	2	132	2	113	35	150	368
8.00 - 8.15	0	34	2	36	10	12	11	33	11	129	0	140	0	109	26	135	344
8.15 - 8.30	5	13	2	20	16	5	4	25	8	141	4	153	2	115	18	135	334
8.30 - 8.45	3	3	0	6	9	3	6	18	7	104	3	114	1	86	8	95	233
8.45 - 9.00	2	8	5	15	10	7	3	20	5	125	0	130	2	96	8	106	271
9.00 - 9.15	2	1	5	8	15	6	3	24	6	110	0	116	3	68	17	88	236
9.15 - 9.30	0	4	1	5	15	3	7	25	4	98	0	102	2	96	9	107	239
PEAK 30 MIN	2	85	7	94	22	21	18	61	19	270	4	293	2	222	61	285	

	WASHINGTON								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	TOTAL
7.30 - 7.45	2	5	4	11	6	1	1	8	3	84	1	88	2	109	14	125	232
7.45 - 8.00	2	9	2	13	6	1	1	8	3	124	0	127	6	150	16	172	320
8.00 - 8.15	5	9	10	24	12	5	1	18	6	125	3	134	4	134	24	162	338
8.15 - 8.30	1	5	7	13	15	5	2	22	6	117	0	123	1	114	14	129	287
8.30 - 8.45	1	1	3	5	4	3	1	8	7	109	3	119	4	91	11	106	238
8.45 - 9.00	4	10	5	19	8	2	7	17	4	118	4	126	4	80	15	99	256
9.00 - 9.15	2	3	3	8	7	0	2	9	0	112	0	112	1	82	13	96	225
9.15 - 9.30	1	7	3	11	3	4	3	10	1	90	1	92	4	85	14	103	226
PEAK 30 MIN	7	18	12	37	27	15	3	40	9	249	3	261	10	284	40	234	

	HESTER								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	TOTAL
7.30 - 7.45	1	7	1	9	3	1	13	17	3	86	1	90	0	119	11	130	246
7.45 - 8.00	1	24	5	30	7	5	7	19	13	127	2	142	0	170	14	184	375
8.00 - 8.15	1	17	7	25	6	9	6	21	5	131	1	137	0	134	13	147	330
8.15 - 8.30	3	16	3	22	4	1	7	12	7	123	1	131	3	106	10	119	284
8.30 - 8.45	2	12	2	16	4	2	5	11	2	122	2	126	3	102	7	112	265
8.45 - 9.00	1	11	7	19	4	5	4	13	6	122	1	129	0	106	13	119	280
9.00 - 9.15	0	7	4	11	3	2	2	7	1	137	2	140	2	100	7	109	267
9.15 - 9.30	2	16	4	22	6	2	1	9	4	113	2	119	1	103	8	112	262
PEAK 30 MIN	2	41	12	55	13	14	13	40	18	258	3	279	0	304	27	331	

	DUCK								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	TOTAL
7.00 - 7.15	9	15	1	25	3	3	4	10	14	33	5	52	2	33	6	41	128
7.15 - 7.30	7	36	1	44	3	8	15	26	12	55	9	76	0	64	8	72	218
7.30 - 7.45	13	45	0	58	7	23	20	50	12	57	13	82	4	103	7	114	304
7.45 - 8.00	28	70	2	100	12	49	21	82	28	75	20	123	5	118	20	143	448
8.00 - 8.15	26	64	5	95	17	53	21	91	24	84	21	129	5	106	19	130	445
8.15 - 8.30	15	38	5	58	8	35	24	67	18	71	17	106	4	91	23	118	349
8.30 - 8.45	9	52	4	65	6	23	15	44	19	65	6	90	3	66	24	93	292
8.45 - 9.00	11	39	2	52	12	24	21	57	19	93	9	121	6	77	17	100	330
PEAK 30 MIN	54	134	7	195	29	102	42	173	52	159	41	252	10	224	39	273	

	HUSBAND								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	TOTAL
7.30 - 7.45	5	14	5	24	2	8	4	14	5	45	3	53	15	109	2	126	217
7.45 - 8.00	3	11	3	17	3	19	5	27	7	64	16	87	18	167	2	187	318
8.00 - 8.15	10	24	5	39	4	24	8	36	4	85	18	107	18	133	5	156	338
8.15 - 8.30	8	22	5	35	4	15	5	24	10	77	12	99	17	119	5	141	299
8.30 - 8.45	7	16	6	29	2	8	5	15	6	79	9	94	11	86	9	106	244
8.45 - 9.00	6	15	8	29	2	18	5	25	9	73	13	95	9	102	5	116	265
9.00 - 9.15	3	15	9	27	2	20	7	29	4	64	14	82	11	123	15	149	287
9.15 - 9.30	7	23	5	35	5	28	2	35	3	88	15	106	12	91	8	111	287
PEAK 30 MIN	18	46	10	74	7	43	13	63	14	162	30	206	36	300	7	343	

	MAIN								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND TOTAL
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	
7.00 - 7.15	4	8	0	12	2	7	4	13	1	17	4	22	2	46	12	60	107
7.15 - 7.30	3	15	0	18	10	12	7	29	2	37	5	44	1	67	6	74	165
7.30 - 7.45	3	10	4	17	8	21	5	34	7	32	3	42	6	72	17	95	188
7.45 - 8.00	7	16	4	27	17	35	19	71	5	48	5	58	3	140	12	155	311
8.00 - 8.15	6	30	10	46	16	34	15	65	15	52	10	77	3	135	12	150	338
8.15 - 8.30	5	12	4	21	14	20	17	51	14	55	5	74	3	99	12	114	260
8.30 - 8.45	3	25	5	33	11	11	16	38	13	67	13	93	3	65	11	79	243
8.45 - 9.00	9	22	3	34	10	37	17	64	6	43	11	60	3	96	9	108	266
PEAK 30 MIN	13	46	14	73	33	69	34	136	27	122	18	167	6	275	24	305	

	LEWIS								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND TOTAL
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	
7.30 - 7.45	1	10	3	14	0	5	1	6	4	43	10	57	9	145	5	159	236
7.45 - 8.00	4	15	9	28	1	16	11	28	2	66	9	77	18	195	12	225	358
8.00 - 8.15	10	17	13	40	2	21	8	31	2	69	13	84	12	146	21	179	334
8.15 - 8.30	4	13	9	26	2	13	4	19	4	64	11	79	8	117	4	129	253
8.30 - 8.45	4	11	7	22	0	13	3	16	1	63	16	80	14	95	3	112	230
8.45 - 9.00	13	14	14	41	1	12	2	15	0	48	17	65	11	100	9	120	241
9.00 - 9.15	11	7	12	30	6	13	2	21	2	61	13	76	14	138	2	154	281
9.15 - 9.30	10	17	24	51	1	9	3	13	1	70	7	78	13	97	5	115	267
PEAK 30 MIN	21	24	36	81	3	37	19	59	6	133	24	163	30	341	33	404	

	PERKINS								6 TH								
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				GRAND
TIME PERIOD	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	L	SA	R	TOT.	TOTAL
7.00 - 7.15	6	73	6	85	11	21	10	42	3	17	5	25	10	44	20	74	226
7.15 - 7.30	16	58	10	84	17	32	12	61	16	24	7	47	10	66	32	108	300
7.30 - 7.45	13	61	7	81	37	41	28	106	7	21	13	41	21	13	34	68	419
7.45 - 8.00	13	105	18	136	44	43	39	126	28	29	6	63	34	135	34	203	528
8.00 - 8.15	8	70	29	107	25	63	36	124	40	45	9	94	32	114	44	190	515
8.15 - 8.30	11	50	15	76	24	59	35	118	24	57	8	89	27	92	22	141	424
8.30 - 8.45	7	37	12	56	23	42	26	91	12	48	10	70	34	108	25	167	384
8.45 - 9.00	10	40	23	73	16	75	22	113	18	55	12	85	12	61	19	92	363
PEAK 30 MIN	21	175	47	243	69	106	75	250	64	102	17	183	66	249	78	393	

APPENDIX C

TRANSYT-7F OUTPUT

T R A N S Y T - 7 F -- T R A F F I C S I G N A L S Y S T E M O P T I M I Z A T I O N P R O G R A M

RELEASE 4 JUNE, 1984 VERSION 5.0

SPONSORED BY:
FEDERAL HIGHWAY ADMINISTRATION
OFFICE OF TRAFFIC OPERATIONS

DEVELOPED BY:
TRANSPORT AND ROAD RESEARCH LABORATORY
UNITED KINGDOM AND
TRANSPORTATION RESEARCH CENTER
UNIVERSITY OF FLORIDA

I N P U T D A T A R E P O R T F O R R U N 1

FIELDS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

RUN TITLE CARD

LINE NO.	TITLE
1)	APPLICATION OF TRANSYT - 7F ON 6TH. STREET

NETWORK CONTROL CARD

LINE NO.	CARD TYPE	MIN CYCLE	MAX CYCLE	CYCLE INCR.	SEC/ STEP CYCLE	SEC/ STEP NORMAL	LOST TIME	GREEN EXTEN.	STOP PENALTY	OUTPUT LEVEL	INITIAL TIMINGS	PERIOD LENGTH	SEC(0) PERC(1)	SPD(0) TIME(1)	ENGL(0) METR(1)	PUNCH DECK(1)
2)	1	105	105	0	3	1	3	3	-1	2	1	60	0	0	0	0

+++ 104 +++ WARNING + THE SEC/STEP FACTOR IN FIELD 5 IS IGNORED IN A SINGLE CYCLE RUN.

+++ 106 +++ WARNING + THE SEC/STEPS FACTOR IN FIELD 6 IS TOO SMALL FOR CYCLE LENGTHS ABOVE 60 SECONDS.
IT WILL BE INCREASED TO ALLOW A MAXIMUM OF 60 STEPS/CYCLE.

+++ 107 +++ WARNING + A STOP PENALTY OF (-1) WILL RESULT IN AUTOMATIC CALCULATION OF THE PI TO MINIMIZE FUEL CONSUMPTION.
LINK SPECIFIC DELAY OR STOP WEIGHTS ON CARDS TYPE 37 & 38 WILL STILL BE APPLIED, HOWEVER.

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET

FIELDS: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

+++ 110 +++ WARNING + INITIAL TIMINGS HAVE BEEN REQUESTED IN FIELD 11.
TRANSYT-7F WILL IGNORE ANY OFFSET AND VARIABLE INTERVAL VALUES
CODED ON CARD TYPES 1X AND 18
AN OPTIMIZATION RUN IS EXPECTED.

LIST OF NODES TO BE OPTIMIZED

LINE NO.	CARD TYPE															
3)	2	1	2	3	4	5	6	7	8	9	0	0	0	0	0	0

SYSTEM MASTER DATA

LINE NO.	CARD TYPE	MASTER NODE	DEF. CLEARANCES YELLOW	ALL-RED	SYSTEM SATFLOW	EXTERNAL SPEED	SYSTEM PDF	FUEL FACTOR	VEHICLE LENGTH							
4)	10	0	4	1	1700	30	35	100	25	0	0	0	0	0	0	0

INTERSECTION 1

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
5)	15	1	0	8	7	4	1	20	4	1	17	4	1	11	4	0

CONTROLLER TIMING DATA (CONTINUED)

LINE NO.	CARD TYPE	NODE NO.	INTERVAL DURATIONS (SECS. OR PERCENT) INT12	INT13	INT14	INT15	INT16	INT17	INT18	INT19	INT20	INT21	INT22	INT23	INT24	INT25
6)	18	1	1	21	4	1	0	0	0	0	0	0	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE								CONT. FLAG
7)	21	1	1	1	2	3	16	106	108	110	0	0	0	0	0	0
8)	22	1	4	4	5	6	16	105	106	110	0	0	0	0	0	0
9)	23	1	7	7	8	9	16	105	107	110	0	0	0	0	0	0
10)	24	1	10	10	11	12	16	102	104	110	0	0	0	0	0	0
11)	25	1	13	13	14	15	16	101	103	110	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
12)	28	101	100	3400	564	0	0	0	0	0	0	0	0	0	0	0
13)	28	102	100	1600	72	0	0	0	0	0	0	0	0	0	0	5
14)	28	103	100	1700	150	0	0	0	0	0	0	0	0	0	0	0
15)	28	104	100	1600	78	0	0	0	0	0	0	0	0	0	0	5
16)	28	105	100	3400	552	0	0	0	0	0	0	0	0	0	0	0
17)	28	106	100	1600	482	0	0	0	0	0	0	0	0	0	0	15
18)	28	107	4580	3400	288	0	207	390	29	203	36	25	0	0	0	0
19)	28	108	4580	1600	40	0	207	54	29	0	0	0	0	0	0	12

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET PAGE 3

FIELDS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
20)	28	110	100	1600	152	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION 2

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) ... INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
21)	12	2	0	3	30	8	4	1	16	4	1	0	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE ...								CONT. FLAG
22)	21	2	1	1	3	4	18	205	207	0	0	0	0	0	0	0
23)	22	2	5	5	6	7	20	203	204	201	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
24)	28	201	100	1700	184	0	0	0	0	0	0	0	0	0	0	0
25)	28	203	100	1700	78	0	0	0	0	0	0	0	0	0	0	0
26)	28	204	100	1020	88	0	0	0	0	0	0	0	0	0	0	0

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
27)	29	204	5	0	0	0	0	0	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
28)	28	205	4580	2930	578	0	101	50	35	104	78	40	105	498	40	0
29)	28	207	725	3400	566	0	302	14	25	307	568	30	0	0	0	0

INTERSECTION 3

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) ... INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
30)	12	3	0	1	12	7	4	1	35	17	4	1	0	0	0	0

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET

FIELDS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE								CONT. FLAG
31)	21	3	1	1	3	4	18	305	306	307	308	0	0	0	0	0
32)	22	3	5	5	7	8	25	301	302	303	304	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
33)	28	301	100	1700	60	0	0	0	0	0	0	0	0	0	0	0
34)	28	302	100	1260	14	0	0	0	0	0	0	0	0	0	0	3

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
35)	29	302	6	0	0	0	0	0	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
36)	28	303	100	1700	26	0	0	0	0	0	0	0	0	0	0	0
37)	28	304	100	1380	54	0	0	0	0	0	0	0	0	0	0	0

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
38)	29	304	6	0	0	0	0	0	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
39)	28	305	725	3400	498	0	201	14	25	204	44	25	205	314	39	0
40)	28	306	725	920	18	0	205	19	39	0	0	0	0	0	0	5

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
41)	29	306	6	0	0	0	0	0	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
42)	28	307	750	3400	648	0	403	26	25	407	590	30	0	0	0	0
43)	28	308	750	1280	20	0	407	18	30	0	0	0	0	0	0	5

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET

FIELDS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
44)	29	308	6	0	0	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION 4

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
					INTERVAL DURATIONS (SECS. OR PERCENT) ...											
45)	12	4	0	2	61	4	1	10	4	1	0	0	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE ...								CONT. FLAG
46)	21	4	1	1	2	3	15	405	407	0	0	0	0	0	0	0
47)	22	4	4	4	5	6	15	401	403	404	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
48)	28	401	100	1700	106	0	0	0	0	0	0	0	0	0	0	0
49)	28	403	100	1700	54	0	0	0	0	0	0	0	0	0	0	0
50)	28	404	100	1230	26	0	0	0	0	0	0	0	0	0	0	7

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
51)	29	404	6	0	0	0	0	0	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
52)	28	405	750	2700	552	0	301	24	25	304	54	25	305	498	30	0
53)	28	407	1230	3400	662	0	502	108	35	503	84	35	507	448	30	0

INTERSECTION 5

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
					INTERVAL DURATIONS (SECS. OR PERCENT) ...											
54)	14	5	0	1	8	4	1	16	8	4	1	8	4	1	16	0

FIELDS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

CONTROLLER TIMING DATA (CONTINUED)

LINE NO.	CARD TYPE	NODE NO.	INTERVAL DURATIONS (SECS. OR PERCENT) INT12	INT13	INT14	INT15	INT16	INT17	INT18	INT19	INT20	INT21	INT22	INT23	INT24	INT25
55)	18	5	8	4	1	0	0	0	0	0	0	0	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE								CONT. FLAG
56)	21	5	1	1	2	3	20	506	508	0	0	0	0	0	0	0
57)	22	5	4	4	6	7	20	505	507	0	0	0	0	0	0	0
58)	23	5	8	8	9	10	20	504	502	0	0	0	0	0	0	0
59)	24	5	11	11	13	14	20	501	503	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
60)	28	501	100	3400	282	0	0	0	0	0	0	0	0	0	0	0
61)	28	502	100	1600	108	0	0	0	0	0	0	0	0	0	0	5
62)	28	503	100	3400	288	0	0	0	0	0	0	0	0	0	0	0
63)	28	504	100	1600	58	0	0	0	0	0	0	0	0	0	0	5
64)	28	505	1230	3400	400	0	401	24	25	404	26	25	405	410	30	0
65)	28	506	1230	1600	104	0	405	106	30	0	0	0	0	0	0	5
66)	28	507	800	3400	526	0	602	36	25	603	26	25	607	578	27	0
67)	28	508	800	1600	20	0	607	22	27	0	0	0	0	0	0	5

INTERSECTION 6

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
68)	12	6	0	1	37	9	4	1	15	9	4	1	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE								CONT. FLAG
69)	21	6	1	1	3	4	18	605	607	608	0	0	0	0	0	0
70)	22	6	5	5	7	8	20	601	602	603	604	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
71)	28	601	100	1700	112	0	0	0	0	0	0	0	0	0	0	0
72)	28	602	100	1150	36	0	0	0	0	0	0	0	0	0	0	4

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET PAGE 7

FIELDS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
73)	29	602	6	0	0	0	0	0	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
74)	28	603	100	1700	112	0	0	0	0	0	0	0	0	0	0	0
75)	28	604	100	1100	14	0	0	0	0	0	0	0	0	0	0	5

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
76)	29	604	6	0	0	0	0	0	0	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
77)	28	605	800	2170	412	0	501	14	35	504	58	35	505	318	30	0
78)	28	607	400	3400	614	0	702	26	25	707	492	26	710	68	30	0
79)	28	608	400	900	72	0	707	58	26	0	0	0	0	0	0	5

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
80)	29	608	6	0	0	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION 7

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) ... INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
81)	14	7	0	1	8	4	1	12	8	4	1	10	4	1	10	0

CONTROLLER TIMING DATA (CONTINUED)

LINE NO.	CARD TYPE	NODE NO.	INTERVAL DURATIONS (SECS. OR PERCENT) INT12	INT13	INT14	INT15	INT16	INT17	INT18	INT19	INT20	INT21	INT22	INT23	INT24	INT25
82)	18	7	7	4	1	0	0	0	0	0	0	0	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE ...								CONT. FLAG
83)	21	7	1	1	2	3	21	706	708	0	0	0	0	0	0	0
84)	22	7	4	4	6	7	21	705	707	0	0	0	0	0	0	0

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET PAGE 8

FIELDS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
85)	23	7	8	8	9	10	22	704	702	0	0	0	0	0	0	0
86)	24	7	11	11	13	14	22	701	703	710	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
87)	28	701	100	3400	120	0	0	0	0	0	0	0	0	0	0	0
88)	28	702	100	1600	26	0	0	0	0	0	0	0	0	0	0	7
89)	28	703	100	1700	138	0	0	0	0	0	0	0	0	0	0	0
90)	28	704	100	1600	66	0	0	0	0	0	0	0	0	0	0	5
91)	28	705	400	3400	280	0	605	272	29	604	14	25	601	20	25	0
92)	28	706	400	1600	54	0	605	52	29	0	0	0	0	0	0	5
93)	28	707	400	3400	598	0	801	42	25	803	38	25	807	669	29	0
94)	28	708	400	1600	12	0	807	13	29	0	0	0	0	0	0	5
95)	28	710	100	1600	68	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION 8

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INTERVAL DURATIONS (SECS. OR PERCENT) ... INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
96)	12	8	0	1	34	9	4	1	15	9	4	1	0	0	0	0

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE ...								CONT. FLAG
97)	21	8	1	1	3	4	18	805	807	808	806	0	0	0	0	0
98)	22	8	5	5	7	8	20	801	803	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
99)	28	801	100	1460	204	0	0	0	0	0	0	0	0	0	0	0
100)	28	803	100	1700	118	0	0	0	0	0	0	0	0	0	0	0
101)	28	805	400	3400	314	0	701	28	25	704	66	30	705	234	28	0
102)	28	806	400	500	12	0	705	10	28	0	0	0	0	0	0	5

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD START LOST-TIME	ADD CLEAR UTILIZAT.			FOURTH INPUT LINK NO.	VOL.	SPD/TT							
103)	29	806	6	0	0	0	0	0	0	0	0	0	0	0	0	0

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET PAGE 9

FIELDS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
104)	28	807	1730	3400	748	0	902	42	35	903	139	35	907	461	35	0
105)	28	808	1730	960	60	0	903	11	35	907	37	35	0	0	0	5

LINK DATA (CONTINUED)

LINE NO.	CARD TYPE	LINK NO.	ADD LOST-TIME	START UTILIZAT.	ADD CLEAR		FOURTH INPUT LINK NO.	VOL.	SPD/TT							
106)	29	808	6	0	0	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION 9

CONTROLLER TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	OFFSET/ YLD.PT.	REF INT	INT1	INT2	INT3	INT4	INT5	INT6	INT7	INT8	INT9	INT10	INT11	DOUBLE CYCLE
107)	16	9	0	8	7	4	1	7	4	1	37	4	1	10	4	0

INTERVAL DURATIONS (SECS. OR PERCENT)

CONTROLLER TIMING DATA (CONTINUED)

LINE NO.	CARD TYPE	NODE NO.	INT12	INT13	INT14	INT15	INT16	INT17	INT18	INT19	INT20	INT21	INT22	INT23	INT24	INT25
108)	18	9	1	29	4	1	13	4	1	0	0	0	0	0	0	0

INTERVAL DURATIONS (SECS. OR PERCENT)

PHASE TIMING DATA

LINE NO.	CARD TYPE	NODE NO.	START INTVL	VARIAB. INTVL	YELLOW INTVL	ALL-RED INTVL	MINIM. SECS.	LINKS MOVING IN THIS PHASE								CONT. FLAG
109)	21	9	1	1	2	3	16	906	908	0	0	0	0	0	0	0
110)	22	9	4	4	5	6	16	907	908	0	0	0	0	0	0	0
111)	23	9	7	7	8	9	16	905	907	0	0	0	0	0	0	0
112)	24	9	10	10	11	12	16	902	904	0	0	0	0	0	0	0
113)	25	9	13	13	14	15	16	901	902	0	0	0	0	0	0	0
114)	26	9	16	16	17	18	16	901	903	0	0	0	0	0	0	0

LINK DATA

LINE NO.	CARD TYPE	LINK NO.	LINK LENGTH	SAT. FLOW	TOTAL VOL.	MID-BLK. VOL.	FIRST INPUT LINK.... NO.	VOL.	SPD/TT	SECOND INPUT LINK.... NO.	VOL.	SPD/TT	THIRD INPUT LINK.... NO.	VOL.	SPD/TT	QUEUE CAP.
115)	28	901	100	3400	444	0	0	0	0	0	0	0	0	0	0	0
116)	28	902	100	1600	42	0	0	0	0	0	0	0	0	0	0	10
117)	28	903	100	3400	362	0	0	0	0	0	0	0	0	0	0	0
118)	28	904	100	1600	138	0	0	0	0	0	0	0	0	0	0	12
119)	28	905	1730	3400	238	0	801	47	25	805	173	27	0	0	0	0
120)	28	906	1730	1600	128	0	801	25	25	805	93	27	0	0	0	12
121)	28	907	100	3400	654	0	0	0	0	0	0	0	0	0	0	0
122)	28	908	100	1600	132	0	0	0	0	0	0	0	0	0	0	8

RUN TITLE: APPLICATION OF TRANSYT - 7F ON 6TH. STREET

FIELDS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							GRAPH	PLOT	CARDS							
LINE NO.	CARD TYPE	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	LINK NO.	
123)	40	105	107	205	207	305	307	405	407	505	507	605	607	705	707	0
124)	40	805	807	905	907	0	0	0	0	0	0	0	0	0	0	0

LINE NO.	CARD TYPE					RUN	CARD									
125)	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

--- PROGRAM NOTE --- A CARD TYPE 52 CAUSES RUN TO BE OPTIMIZED USING THE DEFAULT NORMAL OPTIMIZATION STEP SIZES.
IF CARD TYPE 4 WAS INPUT, IT IS IGNORED.

--- PROGRAM NOTE --- NO ERRORS DETECTED. TRANSYT-7F NOW BEGINS FINAL PROCESSING.
IF ERRORS ARE DETECTED, FURTHER PROCESSING IS SUSPENDED.

--- PROGRAM NOTE --- THERE ARE A TOTAL OF 9 NODES AND 65 LINKS (INCLUDING BOTTLENECKS, IF ANY) IN THIS RUN.

--- PROGRAM NOTE --- THERE WERE A TOTAL OF 4 WARNING MESSAGES ISSUED IN THE ABOVE REPORT.

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET 105 SECOND CYCLE 60 STEPS PAGE 11

<PERFORMANCE WITH INITIAL SETTINGS>

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	-------- DELAY -------- UNIFORM (VEH-H/H)	RANDOM	TOTAL	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)	QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
1	101	564	3400	79	10.51	7.18	6.09	.74	6.83	43.6	513.8(91%)	15	> 8C	8.24	27	101
1	102	72	1600	43	1.34	.98	.86	.08	.94	47.0	64.6(90%)	2	5	1.15	16	102
1	103	150	1700	42	2.80	1.65	1.48	.08	1.56	37.4	124.7(83%)	4	4	2.04	27	103
1	104	78	1600	47	1.45	1.08	.93	.10	1.03	47.8	70.0(90%)	2	5	1.25	16	104
1	105	552	3400	42	10.29	3.85	3.43	.07	3.50	22.8	376.0(68%)	12	> 8C	5.04	46	105
1	106	482	1600	79	8.99	4.77	3.74	.73	4.47	33.4	401.9(83%)	12	15	5.84	45	106
1	107	288	3400	74	249.82	12.02	2.83	.52	3.36	41.9	264.2(92%)	8	366	14.29	17	107
1	108	40	1600	24	34.70	1.78	.57	.02	.59	53.4	35.9(90%)	1	12	2.07	16	108
1	110	152	1600	9	2.83	.10	.00	.00	.00	.0	.0(0%)	0	4	.21	105	110
1 :		2378	MAX =	79	322.73	33.41	19.94	2.35	22.28	33.7	1851.1(78%)			40.15	PI =	26.3
2	201	184	1700	26	3.43	1.17	1.03	.02	1.06	20.7	115.7(63%)	3	4	1.55	48	201
2	203	78	1700	11	1.45	.46	.41	.00	.41	19.0	45.3(58%)	1	4	.66	48	203
2	204	88	1020	24	1.64	.64	.56	.02	.58	23.8	58.5(66%)	2	4	.87	48	204
2	205	578	2930	40	501.38	14.71	2.09	.07	2.16	13.4	376.8(65%)	11	366	23.24	57	205
2	207	566	3400	34	77.72	3.60	.99	.04	1.04	6.6	82.3(15%)	3	58	4.41	57	207
2 :		1494	MAX =	40	585.63	20.58	5.09	.15	5.24	12.6	678.6(45%)			30.73	PI =	9.2
3	301	60	1700	8	1.12	.32	.28	.00	.28	17.0	32.9(55%)	1	4	.47	51	301
3	302	14	1260	3	.26	.09	.08	.00	.08	20.2	8.4(60%)	0	3	.12	51	302
3	303	26	1700	3	.48	.13	.12	.00	.12	16.4	13.8(53%)	0	4	.20	51	303
3	304	54	1380	10	1.01	.35	.31	.00	.31	20.8	33.2(61%)	1	4	.49	51	304
3	305	498	3400	31	68.39	2.84	.91	.04	.95	6.8	106.6(21%)	3	58	4.11	54	305
3	306	18	920	5	2.47	.09	.03	.00	.03	5.5	1.8(10%)	0	5	.22	54	306
3	307	648	3400	41	92.21	4.27	1.15	.07	1.22	6.8	108.9(17%)	3	60	5.29	54	307
3	308	20	1280	4	2.85	.13	.04	.00	.04	6.5	2.7(14%)	0	5	.26	54	308
3 :		1338	MAX =	41	168.78	8.22	2.91	.11	3.02	8.1	308.3(23%)			11.16	PI =	4.2
4	401	106	1700	15	1.98	.60	.53	.01	.54	18.2	61.5(58%)	2	4	.88	50	401
4	403	54	1700	7	1.01	.30	.26	.00	.26	17.6	30.4(56%)	1	4	.44	50	403
4	404	26	1230	6	.48	.17	.15	.00	.15	20.9	16.0(61%)	0	7	.24	50	404
4	405	552	2700	43	78.55	4.39	1.67	.08	1.75	11.4	156.6(28%)	5	60	5.38	55	405
4	407	662	3400	41	154.26	10.99	6.07	.07	6.14	33.4	563.2(85%)	17	98	14.16	55	407
4 :		1400	MAX =	43	236.27	16.45	8.68	.16	8.84	22.7	827.7(59%)			21.09	PI =	11.4

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	-------- DELAY UNIFORM	RANDOM (VEH-H/H)	-------- TOTAL	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)	QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
5	501	282	3400	44	5.26	3.16	2.90	.08	2.99	38.1	239.1(85%)	7	8	3.71	25	501
5	502	108	1600	47	2.01	1.39	1.21	.11	1.32	44.0	95.2(88%)	3	5	1.64	20	502
5	503	288	3400	44	5.37	3.24	2.97	.09	3.06	38.3	244.2(85%)	7	8	3.80	25	503
5	504	58	1600	25	1.08	.69	.63	.02	.65	40.5	49.2(85%)	1	5	.83	20	504
5	505	400	3400	35	93.21	6.66	3.49	.05	3.53	31.8	244.1(61%)	7	98	7.77	40	505
5	506	104	1600	46	24.23	2.43	1.54	.09	1.63	56.5	103.5(100%)	3	5	2.77	20	506
5	507	526	3400	46	79.75	8.92	5.88	.10	5.98	40.9	432.3(82%)	13	64	9.78	40	507
5	508	20	1600	9	3.03	.40	.29	.00	.29	52.5	19.5(97%)	1	5	.43	20	508
5 :		1786	MAX =	47	213.94	26.89	18.91	.54	19.46	39.2	1427.0(80%)			30.75	PI =	21.6
6	601	112	1700	15	2.09	.64	.56	.01	.57	18.3	65.1(58%)	2	4	.93	50	601
6	602	36	1150	8	.67	.24	.21	.00	.21	21.3	22.1(61%)	1	4	.33	50	602
6	603	112	1700	15	2.09	.64	.56	.01	.57	18.3	65.1(58%)	2	4	.93	50	603
6	604	14	1100	3	.26	.09	.08	.00	.08	20.6	8.4(60%)	0	5	.12	50	604
6	605	412	2170	40	62.47	4.18	2.11	.07	2.18	19.0	191.4(46%)	6	32	5.26	55	605
6	607	614	3400	38	46.55	3.15	1.33	.06	1.39	8.1	158.8(26%)	5	32	3.74	55	607
6	608	72	900	19	5.46	.33	.11	.01	.12	6.2	7.8(11%)	0	5	.36	55	608
6 :		1372	MAX =	40	119.58	9.26	4.97	.15	5.12	13.4	518.5(38%)			11.69	PI =	6.5
7	701	120	3400	22	2.24	1.35	1.26	.02	1.28	38.3	99.7(83%)	3	8	1.65	22	701
7	702	26	1600	10	.48	.28	.26	.00	.26	36.5	21.2(81%)	1	7	.35	22	702
7	703	138	1700	50	2.57	1.73	1.52	.13	1.65	43.0	121.5(88%)	4	4	2.07	22	703
7	704	66	1600	25	1.23	.74	.68	.02	.70	38.3	54.9(83%)	2	5	.91	22	704
7	705	280	3400	25	21.23	1.89	1.13	.02	1.15	14.8	162.4(58%)	5	32	2.56	40	705
7	706	54	1600	22	4.09	.74	.59	.02	.60	40.2	35.1(65%)	1	5	.80	21	706
7	707	598	3400	53	45.33	5.50	3.78	.15	3.93	23.6	546.2(91%)	16	32	7.56	40	707
7	708	12	1600	5	.91	.19	.16	.00	.16	48.7	8.3(69%)	0	5	.23	21	708
7	710	68	1600	26	1.27	.79	.72	.02	.74	39.4	57.6(85%)	2	4	.96	22	710
7 :		1362	MAX =	53	79.35	13.22	10.10	.37	10.47	27.7	1106.9(81%)			17.08	PI =	13.4
8	801	204	1460	37	3.80	1.49	1.30	.05	1.36	24.0	138.9(68%)	4	4	1.91	45	801
8	803	118	1700	18	2.20	.78	.70	.01	.71	21.6	74.5(63%)	2	4	1.10	45	803
8	805	314	3400	18	23.80	2.54	1.69	.01	1.70	19.5	169.0(54%)	5	32	3.08	60	805
8	806	12	500	5	.91	.09	.06	.00	.06	17.7	4.2(35%)	0	5	.14	60	806
8	807	748	3400	42	244.94	12.20	5.21	.08	5.29	25.4	477.2(64%)	15	138	16.83	60	807
8	808	60	960	13	19.65	.98	.42	.01	.43	25.8	34.3(57%)	1	5	1.32	60	808
8 :		1456	MAX =	42	295.31	18.09	9.39	.15	9.54	23.6	898.0(62%)			24.37	PI =	12.9

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET 105 SECOND CYCLE 60 STEPS PAGE 13

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	-------- DELAY -------- UNIFORM (VEH-H/H)	RANDOM (VEH-H/H)	TOTAL (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)		QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
9	901	444	3400	43	8.28	3.91	3.55	.08	3.63	29.4	339.0(76%)	10	>	8C	4.85	37	901
9	902	42	1600	10	.78	.35	.33	.00	.33	28.1	30.0(71%)	1		10	.47	34	902
9	903	362	3400	70	6.75	4.82	4.20	.40	4.60	45.7	330.8(91%)	10	>	8C	5.45	21	903
9	904	138	1600	70	2.57	2.14	1.66	.39	2.05	53.6	126.9(92%)	4		12	2.40	18	904
9	905	238	3400	61	77.94	6.00	2.87	.24	3.11	47.0	185.5(78%)	6		138	6.49	17	905
9	906	128	1600	70	41.92	3.52	1.56	.40	1.96	55.1	121.8(95%)	4		12	3.80	17	906
9	907	654	3400	72	12.19	7.02	6.15	.46	6.61	36.4	562.9(86%)	17	>	8C	8.42	33	907
9	908	132	1600	31	2.46	1.22	1.11	.03	1.14	31.1	100.9(76%)	3		8	1.58	33	908
9 :		2138	MAX =	72	152.88	28.99	21.42	2.01	23.43	39.5	1797.7(84%)				33.45	PI =	26.7

<SYSTEM WIDE TOTALS INCLUDING ALL LINKS>

TOTAL DISTANCE TRAVELED (VEH-MI/H)	TOTAL TRAVEL TIME (VEH-H/H)	TOTAL UNIFORM DELAY (VEH-H/H)	TOTAL RANDOM DELAY (VEH-H/H)	TOTAL DELAY (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	TOTAL UNIFORM STOPS (VEH/H-%)	TOTAL FUEL CONSUM (GA/H)	PERFORMANCE INDEX	SPEED (MI/H)	
2174.47	175.12	101.41	6.01	107.41	26.26	9413.8(64%)	220.47	132.31	12.42	<TOTALS>

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET 105 SECOND CYCLE 60 STEPS PAGE 14

<PERFORMANCE WITH OPTIMAL SETTINGS>

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	-------- DELAY UNIFORM	RANDOM (VEH-H/H)	TOTAL --------	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)	QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
1	101	564	3400	67	10.51	6.10	5.40	.34	5.74	36.7	481.8(85%)	15	> 8C	7.27	31	101
1	102	72	1600	43	1.34	.99	.86	.08	.94	47.2	64.6(90%)	2	5	1.15	16	102
1	103	150	1700	36	2.80	1.45	1.31	.05	1.36	32.6	117.2(78%)	3	4	1.85	31	103
1	104	78	1600	47	1.45	1.09	.94	.10	1.04	47.9	70.0(90%)	2	5	1.26	16	104
1	105	552	3400	49	10.29	4.58	4.12	.12	4.23	27.6	412.3(75%)	12	> 8C	5.78	40	105
1	106	482	1600	88	8.99	6.05	4.25	1.50	5.75	43.0	429.6(89%)	13	15	6.93	41	106
1	107	288	3400	74	249.82	12.55	3.36	.52	3.89	48.6	274.0(95%)	8	366	14.73	17	107
1	108	40	1600	20	34.70	1.63	.43	.01	.44	39.8	32.3(81%)	1	12	1.94	18	108
1	110	152	1600	9	2.83	.10	.00	.00	.00	.0	.0(0%)	0	4	.21	105	110
1 :		2378	MAX =	88	322.73	34.53	20.68	2.72	23.40	35.4	1881.8(79%)			41.13	PI =	27.3
2	201	184	1700	54	3.43	2.16	1.89	.16	2.05	40.1	158.5(86%)	5	> 4C	2.51	26	201
2	203	78	1700	23	1.45	.81	.75	.02	.77	35.3	62.2(80%)	2	4	1.01	26	203
2	204	88	1020	57	1.64	1.23	.99	.18	1.17	48.0	78.6(89%)	2	4	1.42	26	204
2	205	578	2930	28	501.38	12.89	.31	.03	.34	2.1	67.6(12%)	3	366	18.88	79	205
2	207	566	3400	24	77.72	2.92	.34	.02	.36	2.3	56.6(10%)	2	58	3.76	79	207
2 :		1494	MAX =	57	585.63	20.02	4.28	.40	4.68	11.3	423.5(28%)			27.58	PI =	6.0
3	301	60	1700	19	1.12	.63	.58	.01	.59	35.5	47.9(80%)	1	4	.78	25	301
3	302	14	1260	8	.26	.16	.15	.00	.15	39.2	11.7(84%)	0	3	.20	25	302
3	303	26	1700	8	.48	.27	.25	.00	.25	34.5	20.3(78%)	1	4	.33	25	303
3	304	54	1380	29	1.01	.67	.60	.03	.63	42.2	46.7(86%)	1	4	.80	25	304
3	305	498	3400	21	68.39	2.11	.21	.01	.22	1.6	44.0(9%)	2	58	3.08	80	305
3	306	18	920	3	2.47	.07	.01	.00	.01	2.1	1.4(8%)	0	5	.20	80	306
3	307	648	3400	27	92.21	3.23	.15	.02	.18	1.0	37.9(6%)	1	60	4.13	80	307
3	308	20	1280	2	2.85	.10	.00	.00	.00	.8	1.4(7%)	0	5	.23	80	308
3 :		1338	MAX =	29	168.78	7.24	1.96	.08	2.04	5.5	211.2(16%)			9.74	PI =	2.8
4	401	106	1700	50	1.98	1.43	1.24	.13	1.37	46.4	95.2(90%)	3	4	1.68	18	401
4	403	54	1700	26	1.01	.67	.61	.02	.63	42.3	46.7(86%)	1	4	.80	18	403
4	404	26	1230	32	.48	.38	.33	.04	.37	50.8	23.8(91%)	1	7	.44	18	404
4	405	552	2700	26	78.55	3.03	.36	.02	.38	2.5	92.2(17%)	3	60	4.03	87	405
4	407	662	3400	25	154.26	4.91	.04	.02	.06	.3	24.2(4%)	2	98	6.36	87	407
4 :		1400	MAX =	50	236.27	10.42	2.58	.23	2.81	7.2	282.0(20%)			13.30	PI =	3.6

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET 105 SECOND CYCLE 60 STEPS PAGE 15

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	-------- DELAY UNIFORM (VEH-H/H)	RANDOM	-------- TOTAL	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)	QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
5	501	282	3400	44	5.26	3.13	2.87	.08	2.96	37.7	238.7(85%)	7	8	3.69	25	501
5	502	108	1600	47	2.01	1.37	1.20	.11	1.30	43.5	94.9(88%)	3	5	1.63	20	502
5	503	288	3400	44	5.37	3.21	2.94	.09	3.03	37.9	244.0(85%)	7	8	3.77	25	503
5	504	58	1600	25	1.08	.68	.62	.02	.64	40.0	49.2(85%)	1	5	.83	20	504
5	505	400	3400	37	93.21	5.96	2.78	.06	2.84	25.5	288.9(72%)	9	98	7.50	38	505
5	506	104	1600	40	24.23	2.10	1.24	.07	1.30	45.1	88.4(85%)	3	5	2.45	22	506
5	507	526	3400	49	79.75	5.14	2.08	.12	2.20	15.1	205.4(39%)	7	64	5.99	38	507
5	508	20	1600	8	3.03	.43	.32	.00	.32	57.6	19.6(98%)	1	5	.45	22	508
5 :		1786	MAX =	49	213.94	22.03	14.05	.54	14.60	29.4	1228.8(69%)			26.31	PI =	17.2
6	601	112	1700	30	2.09	1.16	1.06	.03	1.09	35.1	89.5(80%)	3	4	1.45	28	601
6	602	36	1150	19	.67	.41	.38	.01	.39	39.0	29.9(83%)	1	4	.50	28	602
6	603	112	1700	30	2.09	1.16	1.06	.03	1.09	35.1	89.5(80%)	3	4	1.45	28	603
6	604	14	1100	8	.26	.16	.14	.00	.15	37.6	11.4(81%)	0	5	.19	28	604
6	605	412	2170	28	62.47	2.30	.27	.03	.30	2.6	43.0(10%)	1	32	3.00	77	605
6	607	614	3400	26	46.55	1.84	.06	.02	.08	.5	21.7(4%)	2	32	2.19	77	607
6	608	72	900	13	5.46	.25	.03	.00	.04	1.9	20.1(28%)	1	5	.35	77	608
6 :		1372	MAX =	30	119.58	7.28	3.01	.13	3.14	8.2	305.1(22%)			9.13	PI =	3.9
7	701	120	3400	22	2.24	1.34	1.25	.02	1.27	38.1	99.7(83%)	3	8	1.65	22	701
7	702	26	1600	9	.48	.28	.26	.00	.26	36.0	20.7(80%)	1	7	.34	24	702
7	703	138	1700	50	2.57	1.72	1.51	.13	1.64	42.7	121.2(88%)	4	4	2.06	22	703
7	704	66	1600	23	1.23	.73	.67	.02	.69	37.7	54.9(83%)	2	5	.90	24	704
7	705	280	3400	26	21.23	3.44	2.68	.02	2.70	34.7	245.7(88%)	7	32	4.12	38	705
7	706	54	1600	22	4.09	.53	.38	.02	.39	26.2	48.8(90%)	1	5	.71	21	706
7	707	598	3400	56	45.33	3.90	2.14	.18	2.32	14.0	172.1(29%)	6	32	4.48	38	707
7	708	12	1600	5	.91	.24	.21	.00	.21	63.3	12.0(100%)	0	5	.29	21	708
7	710	68	1600	26	1.27	.78	.71	.02	.74	39.1	57.2(84%)	2	4	.95	22	710
7 :		1362	MAX =	56	79.35	12.97	9.82	.40	10.22	27.0	832.3(61%)			15.51	PI =	11.9
8	801	204	1460	39	3.80	1.58	1.39	.06	1.45	25.6	143.9(71%)	4	4	2.00	43	801
8	803	118	1700	19	2.20	.83	.74	.01	.75	23.0	76.4(65%)	2	4	1.14	43	803
8	805	314	3400	17	23.80	1.19	.34	.01	.34	3.9	40.3(13%)	1	32	1.46	62	805
8	806	12	500	5	.91	.03	.00	.00	.00	.2	.0(0%)	0	5	.07	62	806
8	807	748	3400	41	244.94	8.38	1.40	.07	1.47	7.1	210.0(28%)	8	138	11.98	62	807
8	808	60	960	13	19.65	.69	.13	.00	.14	8.1	18.8(31%)	1	5	.99	62	808
8 :		1456	MAX =	41	295.31	12.70	4.00	.16	4.15	10.3	489.5(34%)			17.64	PI =	6.2

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET 105 SECOND CYCLE 60 STEPS PAGE 16

NODE NO	LINK NO	FLOW (VEH/H)	SAT FLOW (VEH/H)	DEGREE OF SAT (%)	TOTAL TRAVEL (VEH-MI/H)	TOTAL TIME (VEH-H/H)	DELAY UNIFORM (VEH-H/H)	DELAY RANDOM (VEH-H/H)	DELAY TOTAL (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	UNIFORM STOPS (VEH/H;%)	MAX BACK OF QUEUE (VEH/LK)	QUEUE CAPACITY (VEH/LK)	FUEL CONSUM (GA/H)	PHASE LENGTH (SEC)	LINK NO
9	901	444	3400	43	8.28	3.88	3.53	.08	3.61	29.2	338.4(76%)	10 >	8C	4.83	37	901
9	902	42	1600	10	.78	.35	.32	.00	.33	28.0	30.0(71%)	1	10	.46	34	902
9	903	362	3400	70	6.75	4.80	4.17	.40	4.57	45.5	330.4(91%)	10 >	8C	5.43	21	903
9	904	138	1600	70	2.57	2.13	1.65	.39	2.05	53.4	126.2(91%)	4	12	2.39	18	904
9	905	238	3400	61	77.94	5.66	2.53	.24	2.77	41.9	218.8(92%)	6	138	6.39	17	905
9	906	128	1600	70	41.92	3.24	1.28	.40	1.68	47.3	110.4(86%)	3	12	3.54	17	906
9	907	654	3400	72	12.19	7.05	6.18	.46	6.64	36.6	565.0(86%)	17 >	8C	8.46	33	907
9	908	132	1600	31	2.46	1.22	1.10	.03	1.13	30.9	100.7(76%)	3	8	1.57	33	908
9 :		2138	MAX =	72	152.88	28.34	20.77	2.01	22.78	38.4	1819.9(85%)			33.07	PI =	26.3

<SYSTEM WIDE TOTALS INCLUDING ALL LINKS>

TOTAL DISTANCE TRAVELED (VEH-MI/H)	TOTAL TRAVEL TIME (VEH-H/H)	TOTAL UNIFORM DELAY (VEH-H/H)	TOTAL RANDOM DELAY (VEH-H/H)	TOTAL DELAY (VEH-H/H)	AVERAGE DELAY (SEC/VEH)	TOTAL UNIFORM STOPS (VEH/H-%)	TOTAL FUEL CONSUM (GA/H)	PERFORMANCE INDEX	SPEED (MI/H)	
2174.47	155.52	81.14	6.68	87.82	21.47	7474.0(51%)	193.42	105.25	13.98	<TOTALS>

TRANSYT-7F SIGNAL CONTROLLER SETTINGS

NETWORK-WIDE SIGNAL TIMING DATA

SYSTEM CYCLE LENGTH = 105 SECONDS

NO MASTER OFFSET REFERENCE CONTROLLER SPECIFIED

ALL OFFSETS ARE REFERENCED TO AN ARBITRARY TIME BASE.

INTERSECTION CONTROLLER SETTINGS

INTERSECTION 1

INTERVAL NUMBER :	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
INTVL LENGTH(SEC):	13	4	1	18	4	1	12	4	1	11	4	1	26	4	1
INTVL LENGTH (%):	12	4	1	17	4	1	11	4	1	10	4	1	25	4	1
PIN SETTINGS (%):	100/0	12	16	17	34	38	39	50	54	55	65	69	70	95	99
PHASE START (PH#):	1			2			3			4			5		
INTERVAL TYPE :	V	Y	R	V	Y	R	V	Y	R	V	Y	R	V	Y	R
LINKS MOVING :	106 108 110			105 106 110			105 107 110			102 104 110			101 103 110		

YIELD POINT = 78 SEC. 74 %; REFERENCED TO START OF INTERVAL NO. 8

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INTERSECTION    2
------------------

INTERVAL  NUMBER :     1   2   3   4   5   6   7

INTVL LENGTH(SEC):    66   8   4   1  21   4   1

INTVL LENGTH  (%):    62   8   4   1  20   4   1

PIN SETTINGS  (%): 100/0  62  70  74  75  95  99

PHASE START (PH#):     1               2

INTERVAL   TYPE  :     V   F   Y   R   V   Y   R

LINKS  MOVING  :     205             203
                     207             204
                                     201

YIELD POINT =  77 SEC.  73 %; REFERENCED TO START OF INTERVAL NO.   3


------------------
INTERSECTION    3
------------------

INTERVAL  NUMBER :     1   2   3   4   5   6   7   8

INTVL LENGTH(SEC):    68   7   4   1   3  17   4   1

INTVL LENGTH  (%):    64   7   4   1   3  16   4   1

PIN SETTINGS  (%): 100/0  64  71  75  76  79  95  99

PHASE START (PH#):     1               2

INTERVAL   TYPE  :     V   F   Y   R   V   F   Y   R

LINKS  MOVING  :     305             301
                     306             302
                     307             303
                     308             304

OFFSET =   1 SEC.   1 %.

+++ 193 +++ WARNING + THE OFFSET FALLS WITHIN 1% OF AN INTERVAL CHANGE POINT AT THE START OF INTERVAL NO  8.
```

INTERSECTION 4

INTERVAL NUMBER :	1	2	3	4	5	6
INTVL LENGTH(SEC):	82	4	1	13	4	1
INTVL LENGTH (%):	78	4	1	12	4	1
PIN SETTINGS (%):	100/0	78	82	83	95	99
PHASE START (PH#):	1			2		
INTERVAL TYPE :	V	Y	R	V	Y	R
LINKS MOVING :	405 407			401 403 404		

YIELD POINT = 69 SEC. 66 %; REFERENCED TO START OF INTERVAL NO. 2

INTERSECTION 5

INTERVAL NUMBER :	1	2	3	4	5	6	7	8	9	10	11	12	13	14
INTVL LENGTH(SEC):	17	4	1	25	8	4	1	15	4	1	12	8	4	1
INTVL LENGTH (%):	16	4	1	23	8	4	1	14	4	1	11	8	4	1
PIN SETTINGS (%):	100/0	16	20	21	44	52	56	57	71	75	76	87	95	99
PHASE START (PH#):	1			2				3			4			
INTERVAL TYPE :	V	Y	R	V	F	Y	R	V	Y	R	V	F	Y	R
LINKS MOVING :	506 508			505 507				504 502			501 503			

OFFSET = 43 SEC. 41 %.

INTERSECTION 6

INTERVAL NUMBER :	1	2	3	4	5	6	7	8
INTVL LENGTH(SEC):	63	9	4	1	14	9	4	1
INTVL LENGTH (%):	59	9	4	1	13	9	4	1
PIN SETTINGS (%):	100/0	59	68	72	73	86	95	99
PHASE START (PH#):	1				2			
INTERVAL TYPE :	V	F	Y	R	V	F	Y	R
LINKS MOVING :	605 607 608				601 602 603 604			

OFFSET = 49 SEC. 47 %.

INTERSECTION 7

INTERVAL NUMBER :	1	2	3	4	5	6	7	8	9	10	11	12	13	14
INTVL LENGTH(SEC):	16	4	1	25	8	4	1	19	4	1	10	7	4	1
INTVL LENGTH (%):	15	4	1	22	8	4	1	18	4	1	10	7	4	1
PIN SETTINGS (%):	100/0	15	19	20	42	50	54	55	73	77	78	88	95	99
PHASE START (PH#):	1			2				3			4			
INTERVAL TYPE :	V	Y	R	V	F	Y	R	V	Y	R	V	F	Y	R
LINKS MOVING :	706 708			705 707				704 702			701 703 710			

OFFSET = 17 SEC. 16 %.

INTERSECTION 8

INTERVAL NUMBER :	1	2	3	4	5	6	7	8
INTVL LENGTH(SEC):	48	9	4	1	29	9	4	1
INTVL LENGTH (%):	44	9	4	1	28	9	4	1
PIN SETTINGS (%):	100/0	44	53	57	58	86	95	99
PHASE START (PH#):	1				2			
INTERVAL TYPE :	V	F	Y	R	V	F	Y	R
LINKS MOVING :	805				801			
	807				803			
	808							
	806							

OFFSET = 33 SEC. 31 %.

INTERSECTION 9

INTERVAL NUMBER :	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
INTVL LENGTH(SEC):	12	4	1	11	4	1	12	4	1	13	4	1	11	4	1	16	4	1
INTVL LENGTH (%):	11	4	1	10	4	1	11	4	1	12	4	1	10	4	1	16	4	1
PIN SETTINGS (%):	100/0	11	15	16	26	30	31	42	46	47	59	63	64	74	78	79	95	99
PHASE START (PH#):	1			2			3			4			5			6		
INTERVAL TYPE :	V	Y	R	V	Y	R	V	Y	R	V	Y	R	V	Y	R	V	Y	R
LINKS MOVING :	906			907			905			902			901			901		
	908			908			907			904			902			903		

YIELD POINT = 34 SEC. 32 %; REFERENCED TO START OF INTERVAL NO. 8

<T R A N S Y T - 7 F F L O W P R O F I L E D I A G R A M S>

-KEY- I : ARRIVALS THAT QUEUE (NORMALLY ON RED).
S : DEPARTURES FROM QUEUE (NORMALLY AT THE SATURATION FLOW RATE).
O : ARRIVALS AND DEPARTURES ON GREEN.
-,+ : DELINEATORS ("+" MARKS EVERY TENTH STEP).
N : THE NUMBERS ACROSS THE BOTTOM ARE A TIME SCALE IN UNITS OF STEPS.

NOTE: THE FLOW PROFILE DIAGRAM SHOWS EFFECTIVE GREEN AND RED, NOT ACTUAL.
FUTHERMORE, THE "OFFSET" TO THE LINK EFFECTIVE GREEN HAS NOT BEEN
ADJUSTED TO THE MASTER CONTROLLER, IF THERE IS ONE.

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TRANSYT-7F:      APPLICATION OF TRANSYT - 7F ON 6TH. STREET                    105 SECOND CYCLE    60 STEPS    PAGE 23
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```
LINK   105    MAX FLOW  3400 VEH/H      PLT. INDEX  .00

                           SSSSSS
                           SSSSSS
                           SSSSSSS
                           SSSSSSS
                           SSSSSSS
                           SSSSSSS
                           SSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
                          SSSSSSSS
IIIIIIIIIIIIIIIIIIIIIIIII0000000000000000000000IIIIIIIIIIIII
IIIIIIIIIIIIIIIIIIIIIIIII0000000000000000000000IIIIIIIIIIIII
IIIIIIIIIIIIIIIIIIIIIIIII0000000000000000000000IIIIIIIIIIIII
IIIIIIIIIIIIIIIIIIIIIIIII0000000000000000000000IIIIIIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
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```
LINK   107    MAX FLOW  3400 VEH/H      PLT. INDEX  .22

                                        SSSS
                                        SSSS
                                        SSSS
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                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSSS
                                       SSSSSS
                                       SSSSSS
                                       SSSSSS
                                       SSSSSS
                                       SSSSSS
            IIIIIIIIIIIIIIII           SSSSSS
IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII000SSS 0      IIII  I
IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII00000000IIIIIIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
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```
LINK   205    MAX FLOW  2930 VEH/H      PLT. INDEX  .52

    S
    S
    S
    S
    S
    S
    S
    S
    S
    S
   SS
   SS
   SSS
   SSS  0
   SSS 0000
   SSS00000000
   SS000000000000
   S00000000000000000     0
   S0000000000000000000 00000
   00000000000000000000000000000
  I00000000000000000000000000000000
  I000000000000000000000000000000000000000000
 II0000000000000000000000000000000000000000000IIIIIIII
III0000000000000000000000000000000000000000000IIIIIIIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
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```
LINK   207    MAX FLOW  1943 VEH/H      PLT. INDEX  .58

   S
   S
   S
   S
   SS
   SS
   SS
   SS
   SS
   SS
   SS           000
   SS         000000000
   SS       0000000000000
   SS      000000000000000000000
   SS     000000000000000000000000
   SS     00000000000000000000000000
   SS     000000000000000000000000000
   SS    000000000000000000000000000000
   SS    0000000000000000000000000000000000000
   SS    0000000000000000000000000000000000000III
   SS    0000000000000000000000000000000000000IIIII
   SS    0000000000000000000000000000000000000IIIIIII
II SS    0000000000000000000000000000000000000IIIIIIIII
III0000  0000000000000000000000000000000000000IIIIIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET   105 SECOND CYCLE   60 STEPS   PAGE 24

```
LINK   305    MAX FLOW  2429 VEH/H     PLT. INDEX  .47

  S
  S
  S
  S
  S
  S
  S
  S
  S
  S
  S
  SS
  SS
  SS      OO
  SS      OOOOOO
  SS      OOOOOOOOO
  SS      OOOOOOOOOOOO
  SS      OOOOOOOOOOOOOOO
  SSO    OOOOOOOOOOOOOOOOOOOO   O
  OOOO   OOOOOOOOOOOOOOOOOOOOOOOOOOOOO
 IOOOOO  OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
 IOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOI
IIOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOIIIIIII
IIOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOIIIIIIIII   II
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

```
LINK   307    MAX FLOW  2429 VEH/H     PLT. INDEX  .60

  S
  S
  S
  S
  S
  S
  S
  S
  S
  SS
  SS   O
  SS OOOOOOO
  SSOOOOOOOOOO
  SOOOOOOOOOOOOOO
  SOOOOOOOOOOOOOOOO  OOOO
  SOOOOOOOOOOOOOOOOOOOOOOO
  SOOOOOOOOOOOOOOOOOOOOOOOO
  OOOOOOOOOOOOOOOOOOOOOOOOOOO
  OOOOOOOOOOOOOOOOOOOOOOOOOOOO    OOO
  OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
  OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
  OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO          I
  OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOI      IIIII
IIOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOIIIII  IIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

```
LINK   405    MAX FLOW  2700 VEH/H     PLT. INDEX  .34

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                                                       S
                                                       S
                                                       S
                                                       S
                                                       S
                                                       S
                                                      SS
                                                      SS
                                                      SS
                                                      SS
                                                      SS
                                                      SSS
                                                      SSS
                                                      SSS
                                                      SSS
           O         OOOOOOO                          SSS
           OO      OOOOOOOOOOOOOO                     SSS
  O       OOOO    OOOOOOOOOOOOOOOOOOOO                SSS
 OO       OOOOOO  OOOOOOOOOOOOOOOOOOOOOOOIIII         SSS
 OOOO     OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOIIIIIIIII    SSS
OOOOOO    OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOIIIIIIIIIIIIISSS O
OOOOOOOOO OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOIIIIIIIIIIIIIOOSOOO
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOIIIIIIIIIIIIIOOOOOO
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

```
LINK   407    MAX FLOW  2548 VEH/H     PLT. INDEX  .70

                                                       S
                                                      SS
                                                      SS
                                                      SS
                                                      SS
                                                      SS
                                                      SS
                                                      SS
                                                      SOO
                                                      SOOOO
                                                      SOOOOO
OO                                                    OOOOOO
OOOO          O                                       OOOOOO
OOOOOO       OOO                                      OOOOOO
OOOOOOOO    OOOO                                     IOOOOOO
OOOOOOOOOO  OOOOO                                    IOOOOOO
OOOOOOOOOOOOOOOOO                                    IOOOOOO
OOOOOOOOOOOOOOOOOO        O                          IOOOOOO
OOOOOOOOOOOOOOOOOOO      OOO                        IIOOOOOO
OOOOOOOOOOOOOOOOOOOO    OOOOO                       IIOOOOOO
OOOOOOOOOOOOOOOOOOOOO  OOOOOOOO                     IIOOOOOO
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO                   IIOOOOOO
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO                IIOOOOOO
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO           IIIOOOOOO
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET 105 SECOND CYCLE 60 STEPS PAGE 25

LINK 505 MAX FLOW 3400 VEH/H PLT. INDEX .23

```
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSSS
                                       SSSSSS
                                       SSSSSS
                                       SSSSSS
        II                             SSSSSS
        IIII                         II00000000
   I    IIIIIIIIII       IIIII IIIIIII000000000000000000
 IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII00000000000000000000
IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII000000000000000000000II
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

LINK 507 MAX FLOW 3400 VEH/H PLT. INDEX .73

```
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSSSS
                                       SSS0000
                                       SS000000000
                                       S000000000000
                                       S000000000000000
                                       000000000000000000
                                       0000000000000000000
I                                      0000000000000000000II
III          IIII          III        S0000000000000000000II
IIIII        IIIIIII      IIIIII      00000000000000000000II
IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII00000000000000000000II
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

LINK 605 MAX FLOW 2236 VEH/H PLT. INDEX 1.01

```
                                                   I
                                                   0
                                                  00
                              S                   000
                              S                   000
                              S                  0000
                              S                  0000
                              S                  00000
                              S                  00000
                              S                  00000
                              S                 000000
                              S                 0000000
                              S                 0000000
                              S                 00000000
                              S                 00000000
         0                    S                0000000000
        00                    S                00000000000
        00                   SS                000000000000
0       000                  SS                0000000000000
000     000I                 SS                0000000000000
00000  00001                 SS                0000000000000
000000 0000III               SS                0000000000000
00000000000IIIII      I      SS                0000000000000
00000000000IIIIIIIIIIIIIII   SS               00000000000000
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

LINK 607 MAX FLOW 3400 VEH/H PLT. INDEX .99

```
                              S
                              S
                              S
                              S
                              S
                              S
                              SS
                              S0
                              S00
                              0000
                              00000
                              000000
                              0000000
                             I000000000
                             I00000000000
                             I0000000000000
    0                        I00000000000000
    0                        00000000000000000
    0                        000000000000000000
   000                      I0000000000000000000  0
   000                      I0000000000000000000  0
   0000                     I00000000000000000000 00
   00000                    I0000000000000000000000
  000000000II               I00000000000000000000000000000
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

```
TRANSYT-7F:    APPLICATION OF TRANSYT - 7F ON 6TH. STREET                    105 SECOND CYCLE    60 STEPS   PAGE 26

LINK   705    MAX FLOW  3400 VEH/H     PLT. INDEX  .82

                         SSS
                         SSS
                         SSS
                         SSS
                        SSSS
                        SSSS
                        SSSS
                        SSSS
                        SSSS
                        SSSS
                       SSSSS
                       SSSSS
                       SSSSS
                       SSSSS
                       SSSSS
                       SSSSS
                       SSSSS                            II
                       SSSSS                           IIII
                       SSSSS                          IIIIII
I                      SSSSS                         IIIIIII
III                    SSSSS      0                  IIIIIII
IIIII        II       ISSSSS      00                IIIIIIII
IIIIIIIIII  IIII     II0SSSS      000              IIIIIIIII
IIIIIIIIIIIIIIIIIIIIIII0000S     000000            IIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890

LINK   707    MAX FLOW  3400 VEH/H     PLT. INDEX  .87

                        SSS
                        SSS
                        SSS
                        SSS
                        SSS
                        SSS
                        SSSS
                        SSSS
                        SSSS
                        SSSS0
                       SSSS000
                       SSSS000
                       SSS000000
                       SSS0000000000
                       SSS00000000000
                       SS0000000000000
                       SS00000000000000
                       SS0000000000000000
                       SS00000000000000000
                       SS000000000000000000II
                       SS000000000000000000IIII
  IIII                 S0000000000000000000IIIIIII
 IIIIIII               S0000000000000000000IIIIIIIIII
 IIIIIIIIIIIIII        S0000000000000000000IIIIIIIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890

LINK   805    MAX FLOW  2235 VEH/H     PLT. INDEX 1.09

                               00
                               00
                               00
                              000
                              000
                              000
                              000
                              000
                    S         000
                    S        00000
                    S        00000
                    S        00000
                    S        00000
                    S        00000
                    SS       00000                0
                    SS       000000               0
                    SS       000000               00
                    SS       000000               00
                    SS      00000000             000
                    SS      00000000             0000
     I              SS      000000000            0000
    III             SS      000000000  000       00000
    IIII            SS      0000000000000000    000000II
   IIIIIIIII        SS      0000000000000000000  00000IIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890

LINK   807    MAX FLOW  3400 VEH/H     PLT. INDEX  .69

                     SSSS
                     SSSS
                     SSSS
                     SSSS
                     SSSS
                     SSSS
                     SSSS
                     SSSS
                     SSSSS  00
                     SSSSS 0000
                     SSSSS000000
                     SSSS0000000
                     SSSS00000000
                     SSS0000000000
                    SSS000000000000
                    SSS0000000000000
                    SS000000000000000
                    SS0000000000000000 0
   II               SS0000000000000000 0
  IIII              S00000000000000000 00
 IIIIII             S000000000000000000000
IIIIIIIII           S00000000000000000000000
IIIIIIIIIII         00000000000000000000000000            I
IIIIIIIIIIIIII      000000000000000000000000000000        I
IIIIIIIIIIIIIIIIIII00000000000000000000000000000000000IIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET   105 SECOND CYCLE   60 STEPS   PAGE 27

```
LINK   905    MAX FLOW  3400 VEH/H     PLT. INDEX  .42

               SSS
               SSS
               SSS
               SSS
               SSS
               SSS
               SSS
              SSSS
              SSSS
              SSSS
              SSSS
              SSSS
              SSSS
              SSSS
              SSSS
              SSSS
              SSSS
              SSSSS
              SSSSS
              SSSSS
              SSSSS                                 IIIII
I             SSSSS                                IIIIIIIII
IIIIII    IIIIOSSSSOOOIII                I       IIIIIIIIIII
IIIIIIIIIIIIIIOOOOOOOOIIIIIIIIIIIIIIIII IIIIIIIIIIIIIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

```
LINK   907    MAX FLOW  3400 VEH/H     PLT. INDEX  .00

      SSSSSSSSS
      SSSSSSSSS
      SSSSSSSSS
     SSSSSSSSSS
     SSSSSSSSSS
     SSSSSSSSSS
     SSSSSSSSSS
     SSSSSSSSSS
     SSSSSSSSSS
     SSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
     SSSSSSSSSSS
IIIIOOOOOOOOOOOOOOOOIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
IIIIOOOOOOOOOOOOOOOOIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
IIIIOOOOOOOOOOOOOOOOOIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
IIIIOOOOOOOOOOOOOOOOOIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
IIIIOOOOOOOOOOOOOOOOOIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
---------+---------+---------+---------+---------+---------+
123456789012345678901234567890123456789012345678901234567890
```

```
-KEY-  I :  ARRIVALS THAT QUEUE (NORMALLY ON RED).
       S :  DEPARTURES FROM QUEUE (NORMALLY AT THE SATURATION FLOW RATE).
       O :  ARRIVALS AND DEPARTURES ON GREEN.
     -,+ :  DELINEATORS ("+" MARKS EVERY TENTH STEP).
       N :  THE NUMBERS ACROSS THE BOTTOM ARE A TIME SCALE IN UNITS OF STEPS.
```

NOTE: THE FLOW PROFILE DIAGRAM SHOWS EFFECTIVE GREEN AND RED, NOT ACTUAL.
FUTHERMORE, THE "OFFSET" TO THE LINK EFFECTIVE GREEN HAS NOT BEEN
ADJUSTED TO THE MASTER CONTROLLER, IF THERE IS ONE.

--- PROGRAM NOTE --- THIS IS THE INPUT DATA REPORT FOR TIME-SPACE DIAGRAM NO. 1

TIME-SPACE DIAGRAM DATA

LINE NO.	CARD TYPE	NO. NODES	TIME FLAG	TIME SCALE	DIST. SCALE											
126)	60	9	1	0	150	0	0	1	0	0	0	0	0	0	0	0

+++ 174 +++ WARNING + FIELD 8 IS USED FOR SPECIAL OUTPUTS THAT ARE WRITTEN TO UNIT NO 8.
THIS FILE MUST BE ALLOCATED IN THE JOB CONTROL INSTRUCTIONS.

PLOT TITLE CARD

LINE NO.	TITLE
127)	PLOT NODES 1 TO 9

PLOT LINK STREAM CARD

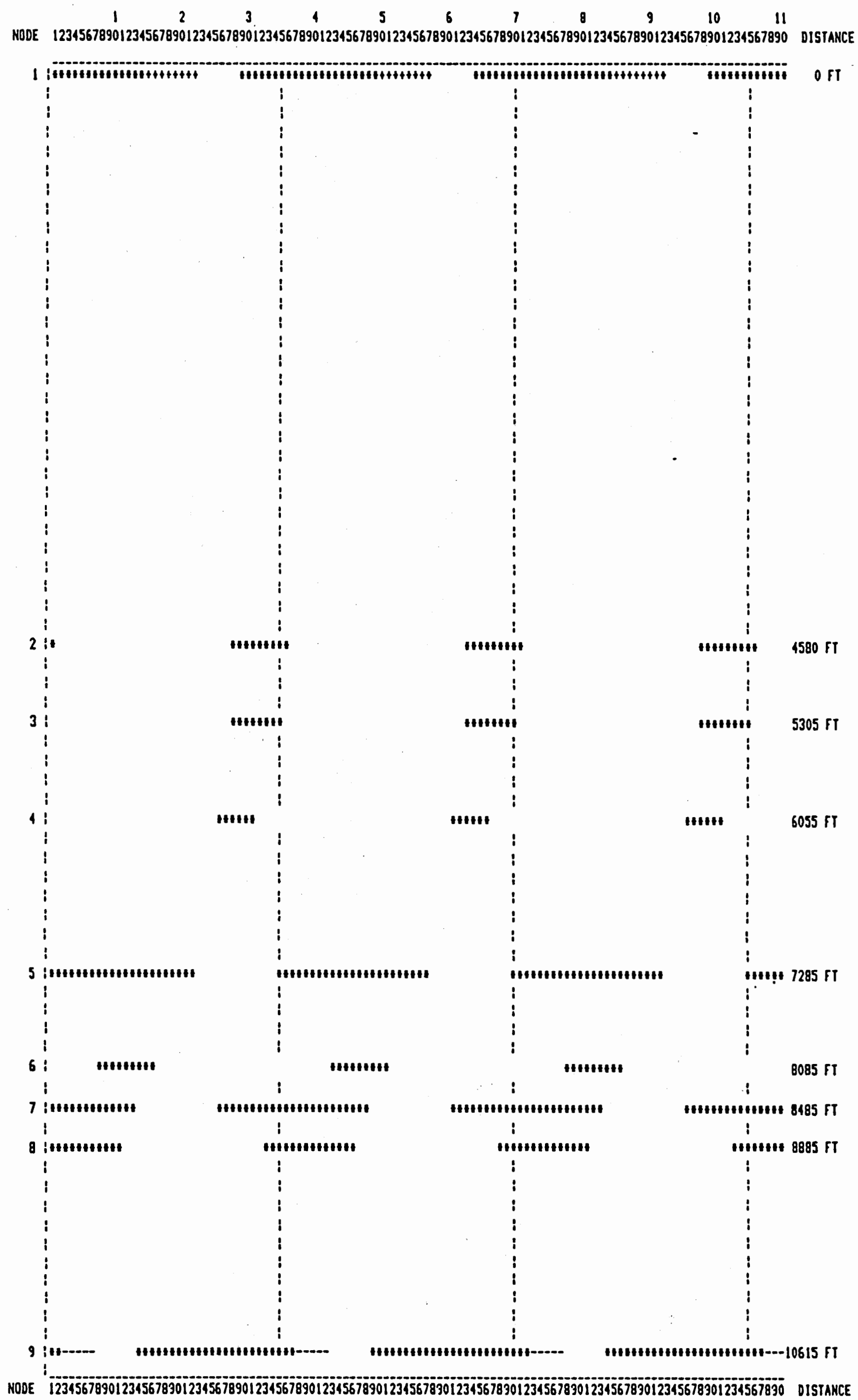
LINE NO.	CARD TYPE	LINK PAIRS ALTERNATING BY DIRECTION DOWN	AND UP	DOWN	AND UP	DOWN	AND UP	DOWN	AND UP	DOWN	AND UP	DOWN	AND UP	DOWN	AND UP	
128)	61	105	107	205	207	305	307	405	407	505	507	605	607	705	707	0
129)	61	805	807	905	907	0	0	0	0	0	0	0	0	0	0	0

TRANSYT-7F: APPLICATION OF TRANSYT - 7F ON 6TH. STREET 105 SECOND CYCLE 60 STEPS PAGE 30

<TRANSYT-7F TIME-SPACE DIAGRAM>

PLOT NO. 1 PLOT TITLE: PLOT NODES 1 TO 9

TIME AXIS IS IN: SEC TIME SCALE = 3 SEC/CHAR, DIST. SCALE = 150 FT/LINE



SCALE CONVERSIONS:
TIME/INCH = 3 * 10 (AT 10 CHAR/INCH)
DIST/INCH = 150 * 6 (AT 6 LINES/INCH)

+++ GREEN IN DOWN DIRECTION
GREEN IN BOTH DIRECTIONS
--- GREEN IN UP DIRECTION
RED IN BOTH DIRECTIONS

AVG. TIME DISPLACEMENT:
2412.50 / SPEED

LINE NO.	CARD TYPE							TERMINATION CARD								
130)	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

--- PROGRAM NOTE --- END OF JOB!

CIVIL ENG. OSU
PLATOON PROGRESSION DIAGRAM

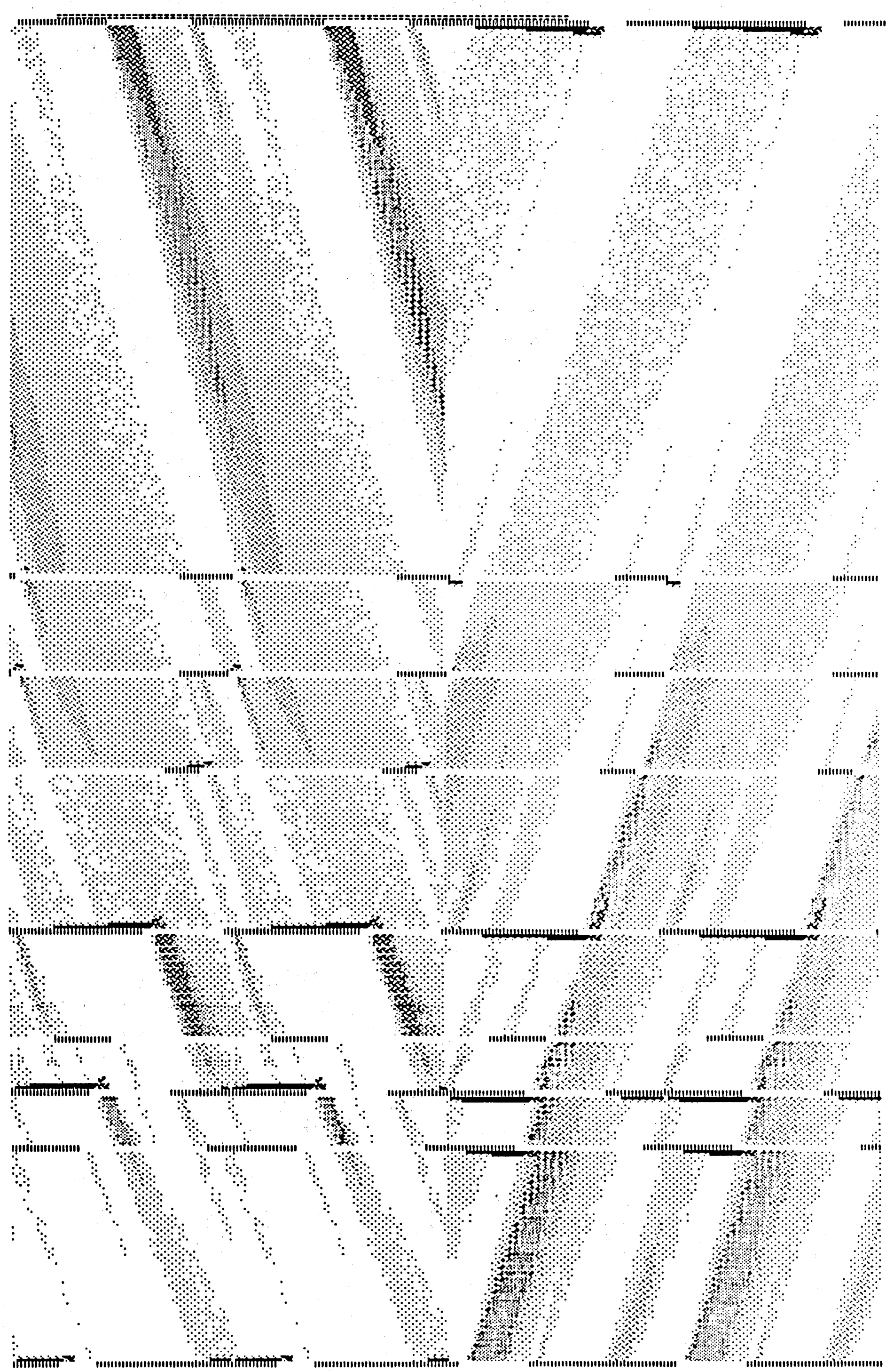
105 SECOND CYCLE... 60 STEPS PER CYCLE

RUN TITLE:

APPLICATION OF TRANSYT - 7F ON 6TH. STREET

PLOT TITLE:

PLOT NODES 1 TO 9



2

VITA

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Professional Experience: Civil Engineer, Public Works Department, Ministry of Works, Malaysia, 1980-1986.