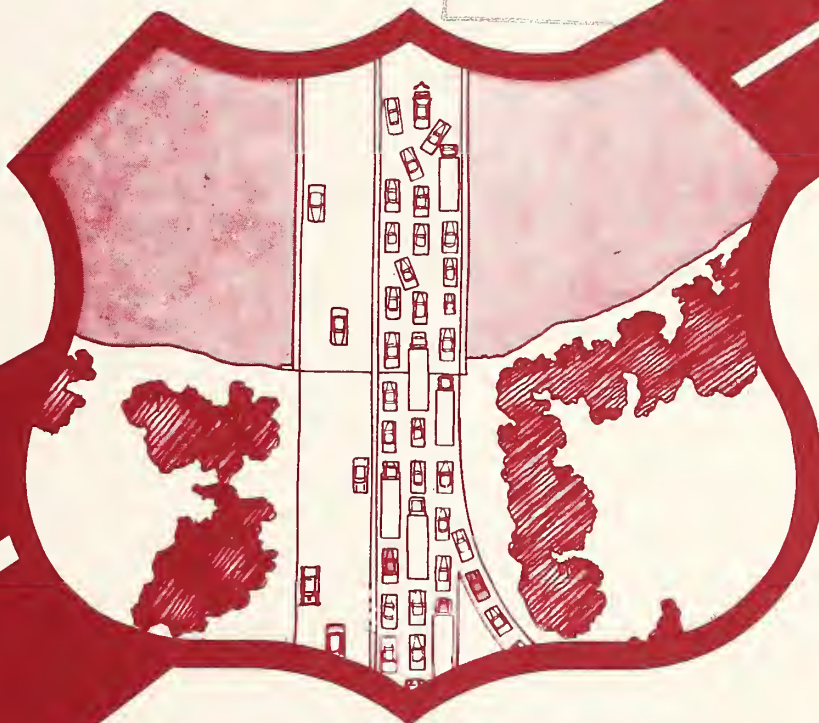
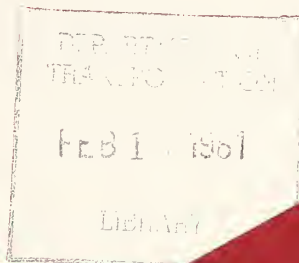


Report No. FHWA/RD-80/107

# DEVELOPMENT AND TESTING OF INTRAS, A MICROSCOPIC FREEWAY SIMULATION MODEL

Vol. 2. User's Manual  
October 1980  
Final Report



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Prepared for  
**FEDERAL HIGHWAY ADMINISTRATION**  
Offices of Research & Development  
Traffic Systems Division  
Washington, D.C. 20590

## FOREWORD

This report is the User's Manual for the INTRAS program which is a microscopic freeway simulation model which can be used to evaluate alternative designs of and control systems for urban freeways. It can also be used to study related subjects such as detector station spacing and the efficacy of incident detection algorithms. This volume also contains the description of the COMMON storage arrays.

This report is the second volume in a four volume Final Report on the study, "Adaptation of a Freeway Simulation Model for Studying Incident Detection and Control."

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Charles F. Schaffey

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## 1. INTRODUCTION

This report, Volume II of the Final Report for Contract No. DOT-FH-11-8502, is a User's Manual for the INTRAS (INTegrated TRAFFIC Simulation) microscopic freeway simulation program developed for the Federal Highway Administration. Volume I describes the development, calibration and freeway logical component validation of INTRAS. Volume III reports the results of system validation, incident detection algorithm validation and demonstrations performed with the simulation model. It is intended that this volume be a stand-alone document which will allow the use of INTRAS without referral to the other Final Report volumes. For that purpose, some text is repeated from Volume I.

Section 2 of this volume contains a full description of the purpose, structure, features and methods of INTRAS. Guidelines for traffic network representation are also provided. In Section 3, input data descriptions are presented. Output capabilities are defined in Section 4. Section 5 contains the operating procedures for executing INTRAS on the CDC 6600/7600 under the SCOPE operating system and on the IBM 360/370 under OS. A sample application is presented in Section 6. Appendices to this volume contain high level flow charts for the major logical program modules, error messages, COMMON block variable descriptions, and an index of subroutine cross references.

## 2. DEFINITION AND FEATURES OF THE INTRAS MODEL

This section of the INTRAS User's Manual is devoted to a description of the INTRAS simulation model and its major components. To provide the user with sufficient background to fully utilize INTRAS, detailed descriptions of the features included in the program are provided. Additionally, guidelines for representing a "real world" traffic network in the terminology of the program is presented. Section 2 should be understood before the user attempts to code the input card formats presented in Section 3.

### 2.1 Program Purpose and Capabilities

INTRAS has been developed for use in studying freeway incident detection and control strategies. It is based on knowledge of freeway operations and surveillance systems and incorporates detailed traffic simulation logic developed and validated for this project (Volume I).

To allow simulation of freeway control policies, including ramp metering and diversion, the capability of modelling the off-freeway environment is included in INTRAS. This "surface" traffic modelling is patterned after the logic of the UTCS-1 simulation model (Refs. 1 and 2)

To facilitate the simulation of closed loop incident detection and control, as well as off-line traffic analysis, the INTRAS model contains a realistic surveillance system simulation capability. The ability to visualize vehicle trajectories, and contours of Measures of Effectiveness (MOE's) in the time-space plane, is included in INTRAS via a digital plotting module. INTRAS also contains a statistical analyses module which permits comparison of MOE's from different simulation runs or field data, utilizing standard parametric and non-parametric tests.

Finally, a fuel consumption and vehicle emission evaluation module is built into INTRAS patterned after a similar module developed for the UTCS-1 simulation model.



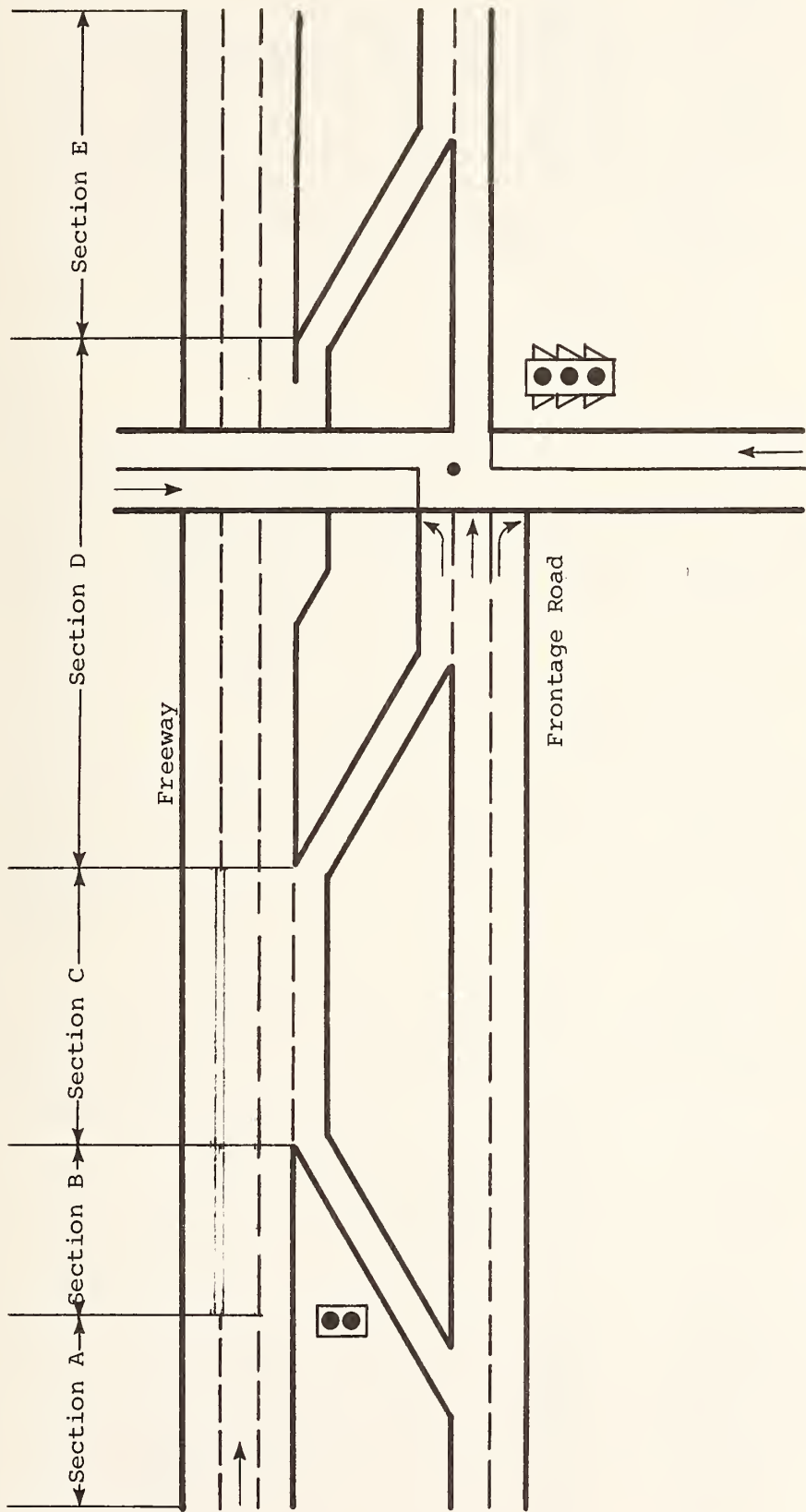


Figure 1: Sample Physical Freeway-Frontage Road Network

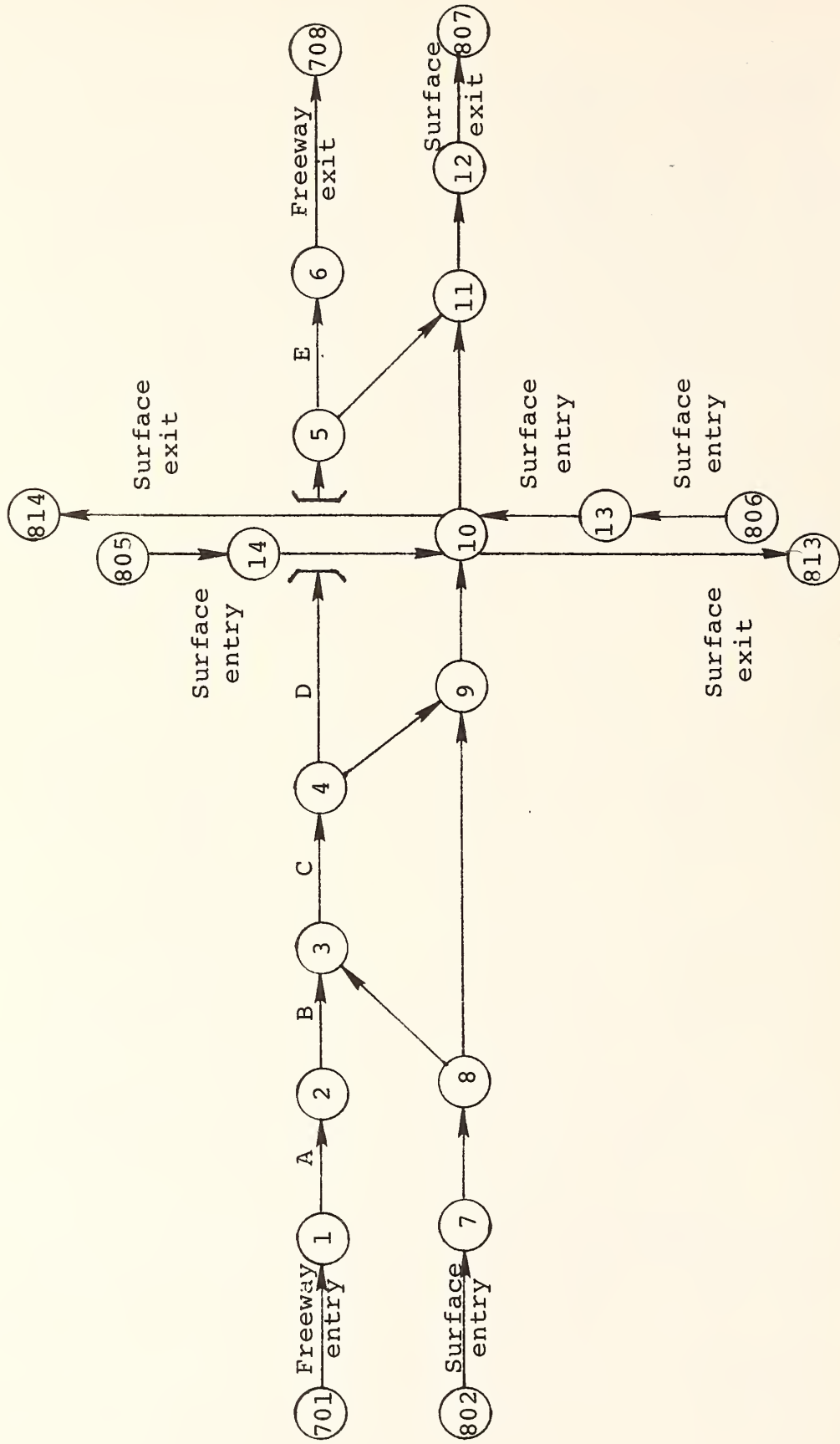


Figure 2: Representation of sample network

## 2.2 Network Idealization and Modelling Concepts

The representation of a "real world" traffic system in the terminology of INTRAS is the most important task a user faces. The simulation results cannot reflect the workings of the actual traffic system unless it is accurately represented to the model. The model's concept of the real network is built upon the data supplied; i.e., measurements of various network features and characteristics. A familiarity with definitions of these features is, therefore, required for the user to successfully utilize INTRAS.

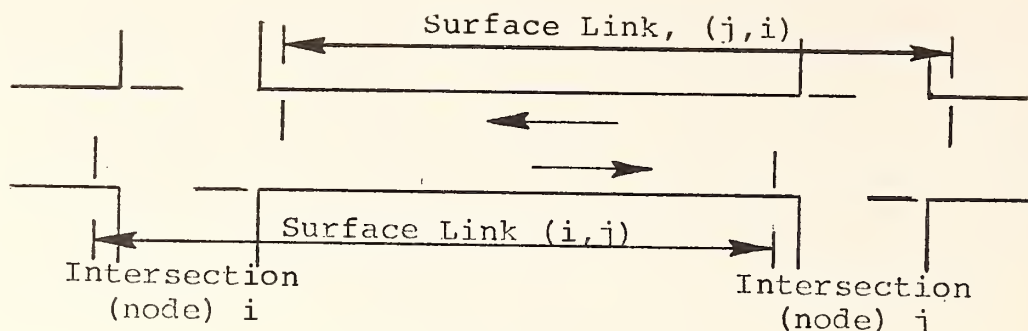
### 2.2.1 Network Representation

The geometric representation of a roadway system for the INTRAS model is comprised of links (one-directional roadway segments) and nodes (intersections or geometric discontinuities). The logical division of a road system into links may correspond to the natural segmentation caused by cross streets or ramp junctions. Figures 1 and 2 represent a typical roadway system and its network representation, respectively. If analysis of a natural segment indicates different characteristics on one portion than on another, it may be desirable to further subdivide the segment. For example, if it is observed that on the upstream portion of a segment, traffic always travels at a slower speed than on the downstream, the actual segment may be represented in the model inputs by two links with differing free-flow speeds. A change in grade is also sufficient reason for further segmentation.

Implementation of this type of characteristic would be accomplished by the insertion of an additional node. For example, link (8,9) in Figure 2 might be partitioned into two links, (8,15) and (15,9), by the insertion of an intervening node 15.

To permit appropriate logical treatment for roadway sections of diverse characteristics, and to realize some computer storage economy, three link types are defined for INTRAS.

A Surface link is defined as a roadway segment servicing one direction of traffic. The nodes at each end represent at-grade intersections. Each "surface" link extends from the upstream stopline to the downstream stopline as in the following sketch:



As indicated (in the sketch), a link is normally identified by the upstream and downstream node numbers. Each "surface" link may consist of up to five lanes in width. Two of these lanes may be turning pockets (one left and one right) which do not extend for the full link length.

Vehicles traversing an INTRAS "surface" link are moved at constant time intervals utilizing the logic established in the UTCS-1 urban traffic simulation model. The method properly replicates (Ref. 2) the dynamics of traffic on urban networks.

A Freeway link is defined as a one-way roadway segment, of a controlled-access highway, characterized by generally constant geometric characteristics (grade, curvature, number of through lanes). The extremities of a "freeway" link correspond to either ramp junctions or significant geometric changes. Each "freeway" link may contain up to five through lanes and two auxiliary lanes. Each auxiliary lane may be described as "acceleration", "deceleration" or "full", as defined below:

<u>Auxiliary Lane Type</u>	<u>Definition</u>
Acceleration	A lane which extends from the upstream extremity of a freeway link to some mid-link position



<u>Auxiliary Lane Type</u>	<u>Definition</u>
Deceleration	A lane which extends from a mid-link position to the downstream extremity of a freeway link
Full	A lane which extends for the full length of a freeway link with at least one end connecting to an on or off-ramp

Auxiliary lanes may occur on either the left or right-hand side of the roadway. Typical "freeway" links are illustrated in Figure 3.

Vehicles traversing "freeway" links move in accordance with the logic of car following, lane-changing and vehicle generation component models developed for INTRAS (see Volume I).

A Ramp link is defined as a one-way non-freeway roadway segment which connects directly to a freeway link. Ramps may be one or two lanes in width. "Ramp" links are further characterized as either on or off-ramps indicating that end of the link which connects to the freeway.

The same logic is applied to move vehicles on "ramp" links as for "surface" links.

Because the simulated network is just a portion of some real world traffic system, special links have been devised to handle conditions at the network extremities. These links serve to process vehicles into and out of the simulated study network.

Links handling incoming traffic are called entry links. The INTRAS model allows both freeway and surface entry links. They are coded on input cards and processed the same as interior freeway and surface links but are subject to a few additional requirements. For freeway entries, auxiliary lanes may not be specified, nor pockets on surface entries. It is not necessary that these links be exact replicas geometrically of their real world counterparts.



What is important is that the incoming volumes, distribution of vehicle types, and incoming lane distribution (for freeway entries) be accurately specified. The performance of vehicles on these special purpose links are not included in the network totals of the output reports.

Traffic leaving the network is said to move on to exit links. These links are never coded on input cards and therefore not included in link data arrays or processed explicitly. The notion of exit links only exists in connection with traffic movements. If an interior link specifies a node on the periphery as a destination for some traffic movement (i.e., left-turn, thru or right-turn), then an exit link is implied and traffic may leave the network by it.

Nodes on the periphery of the network (i.e., upstream nodes of entries and downstream nodes of exits) are identified to INTRAS by node numbers greater than 699. Values from 700 to 799 are reserved for freeway peripheral nodes, while those from 800 to 899 represent nodes associated with surface entries and exits.

### 2.2.2 Geometric Features

To model a roadway system in sufficient detail to replicate "real world" traffic statistics, it is necessary to accommodate those geometric features which significantly affect traffic performance. These features included in the INTRAS design are described below.

Intersections - The junction of surface links with either other surface links or ramp links are modeled as in the UTCS-1 program. Each intersection is identified by a unique node number. Links are identified by the ordered pair of node numbers which identify their upstream and downstream extremities. There may be up to four links approaching, and four links departing, a given intersection (node).

Vehicles on each approach link to an intersection may have up to three destinations (receiving links) upon passing through that intersection. Each of these receiving links is entered by performing the associated traffic maneuvers: left turn, through movement or right turn. Left turners seek gaps in opposing traffic; right turners slow before turning, etc.

Freeway-Freeway and Freeway-Ramp Interconnections - The lane alignment of freeway links and on-ramp links with the next downstream freeway link is defined by two input specifications. First, the number and type (through, auxiliary) of lanes which comprise each link is specified. Second, the lane in the downstream link which receives traffic from the right-most through lane of the upstream link must be identified.

Lanes are labeled for identification via the following convention. The through lanes of each freeway link (and all lanes of ramp links) are numbered sequentially from right to left (i.e., the right-most through lane is always labeled "1"). The left-hand auxiliary lanes are numbered 6 and 7, respectively, with lane 6 adjacent to the freeway lane. Right-hand auxiliary lanes are numbered 8 and 9, respectively, with lane 8 adjacent to the freeway lane.

Freeway links are logically connected to downstream off-ramps by specifying the number of ramp lanes, and whether it is a right-hand or left-hand off-ramp. The outside lanes on the designated side of the freeway are then internally assigned as connecting to the off-ramp.

As clarification of this convention, the following example is provided:

Figure 4a illustrates a roadway section containing four freeway links, one on-ramp, and two off-ramps. Figure 4b contains the network idealization for the same roadway section. In this example, the alignment of freeway links and on-ramps is given in the following table:

<u>Feeding link</u>	<u>Receiving link</u>	<u>Receiving lane for lane 1 traffic</u>
1,2	2,3	1
2,3	3,4	8
3,4	4,5	1
6,2 (on-ramp)	2,3	8

The off-ramp alignment is implicitly determined in INTRAS by the specification that left exiting vehicles from 2,3 enter 3,7 and right exiting vehicles from 3,4 enter 4,8. This specification, coupled with the number and definition of lanes in the four links, is sufficient to define alignment.



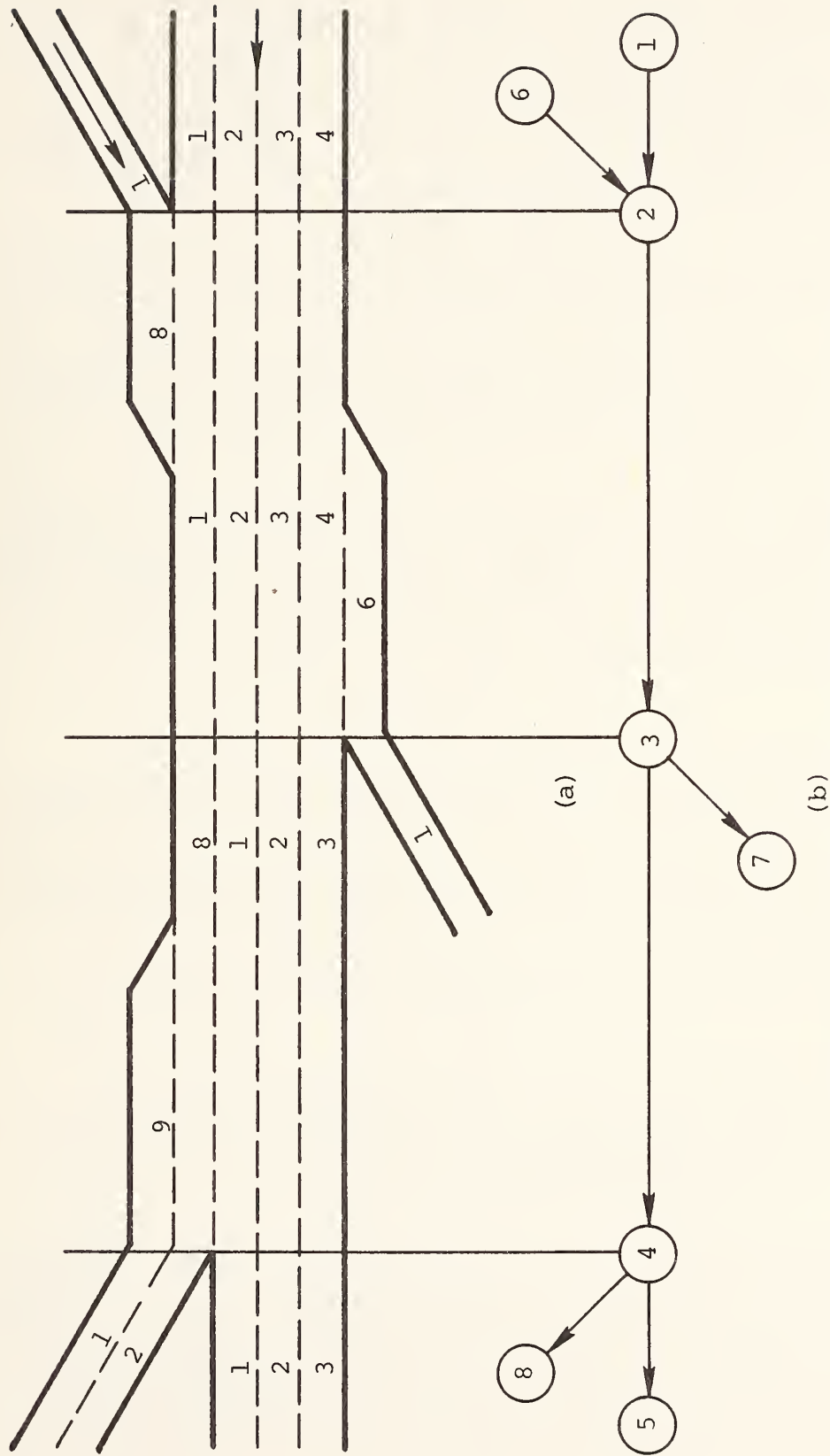


Figure 4: Ramp-Freeway Interconnection Example

Grade specification - INTRAS has been designed to accept link-specific grade as input. Thus, it is proper to define a continuous section of roadway (containing a significant change in gradient) as two contiguous links, with a node defined at the point where the grade changes. The INTRAS logic examines the link-specific grade specification to modify several operating parameters (see Volume I).

Curvature - As for grade, a change in horizontal curvature is sufficient reason to segment a roadway section into two links. Two methods of limiting vehicle performance on horizontal curves are available in the INTRAS design. First, a lowered value of desired free-flow speed may be defined for an affected link. Although easy to apply, this method presumes some pre-analysis on the part of the user.

Second, radius of curvature, super elevation and pavement condition may be defined. An internal table is referenced to determine friction coefficient from pavement condition. The basic equation for vehicle operation on a curve (Ref. 3 ), is then used to generate an upper bound for desired free-flow speed.

$$V = \sqrt{15R(e+f)}$$

where, e = rate of roadway superelevation,  
foot per foot

f = friction coefficient for given  
pavement condition

R = radius of curve in feet

V = vehicle speed, miles per hour

The simulation model applies the minimum of the input free-flow speed, and the curvature dictated upper bound, to traffic on the subject link.

Lane separation - The typical freeway often contains sections where lane changing is physically prohibited by virtue of barrier curbs or traffic islands. These restrictions are designed to segregate through traffic from weaving traffic, or, to guide vehicles around some obstruction (bridge abutments, etc.). INTRAS is designed to accept physical barriers of this nature on a link-specific basis.

### 2.2.3 Traffic Flow Patterns

Examination of the flow of traffic through a "real" traffic system is necessary to set up traffic flow patterns through a network. Turning movements (as percentages or counts) must be defined by the user in the model input. Lane channelization and early warning signs provide the model with information needed to guide vehicles into the proper lanes to negotiate these prescribed maneuvers.

Where surface lanes are restricted to a particular movement they must be coded as channelized. In some cases it may be appropriate to channelize lanes in the model inputs that are not channelized in the real system. This would apply where drivers avoid certain lanes because of heavy turning movements or turning movement restrictions. Consider a two-lane link with some percentage of traffic turning left. Drivers familiar with the road and not turning left may tend to avoid travelling in the left lane. The result is a natural channelization. In this instance, the left lane should be channelized in the model inputs as reserved for left-turning vehicles.

The early warning sign capability of INTRAS allows the user to define the point on the roadway at which drivers begin to react to an upcoming off-ramp. As simulated vehicles pass an early warning sign, they are assigned to either turn or remain on the freeway at the indicated off-ramp. Their desired lane thereafter reflects this downstream movement. If an early warning sign is not specified for a particular off-ramp, then vehicles do not exhibit lane preferences (due to the off-ramp) until they enter the freeway link which connects directly to the ramp.

One such sign may be coded in the model for each off-ramp. It must be positioned downstream of the previous off-ramp and upstream of the freeway link connecting directly to the specified off-ramp.

### 2.2.4 Signal and Sign Control

Each intersection in a simulated study network requires a control policy to establish the right-of-way for approaching vehicles. Similar to the UTCS-1 program, INTRAS has the ability to simulate both fixed-time signal control and sign control. Provision has been made for the modular inclusion and referencing of specially coded

subroutines to model traffic responsive signal control. Ramp metering and freeway traffic diversion procedures (described in later sections) utilize this provision.

Fixed-Time Signal Control - Intersections of an INTRAS simulated network may be controlled by fixed time signals of up to six control intervals each. During each interval, one of the following standard signal configurations is applied to control each of the approach links:

- Amber
- Green
- Red
- Red with Green Right Arrow
- Red with Green Left Arrow
- Red with Right Turn after Stop
- No Turns - Green Through Arrow
- Red with Left and Right Green Arrows
- No Left Turn - Green Through and Right

The duration of each control interval is user-specified.

Traffic Responsive Intersection Control - A control module containing procedures similar to those in the UTCS-1 simulation have been implemented conforming to the NEMA standard.

Sign Control - Each intersection not controlled by a fixed-time signal is controlled by either stop or yield signs. The user must specify which approaches face such signs. For the common situation, where no control of any kind is present, the INTRAS user will need to specify yield signs for one approach direction to indicate the minor street.

## 2.2.5 Traffic Descriptive Features

Each driver-vehicle pair in a traffic stream behaves as an individual entity having different motivations and standards of performance from those around it. This quality must be modelled in INTRAS to achieve the proper stochastic variation in individual vehicle performance. To accomplish this, the INTRAS design provides for five vehicle types, each possessing its own family of vehicle characteristics (length, speed acceleration profile, etc.) These characteristics may be revised as an option, so that the particular vehicle types chosen for the basic INTRAS model do not constitute a limitation on the user. The vehicle-types chosen for the basic INTRAS model are:



High Performance Passenger Car  
Low Performance Passenger Car  
Intercity Buses  
Single Unit Trucks  
Trailer Truck Combinations

Further discussion of vehicle-type specific characteristics appears in Volume I.

Variations within vehicle types are attributed to differences in driver performance. Decile distributions of these characteristics (variation about mean free-flow speed, queue discharge headway, etc.) are implemented in the INTRAS model as in the UTCS-1 program.

#### 2.2.6 Incident Simulation Capability

A comprehensive freeway incident simulation procedure has been designed for INTRAS. The user may specify either blockages or "rubbernecking" to occur on a lane-specific basis. Each incident may occur at any longitudinal position on a freeway link and extend for any desired length of time.

The character of an incident may be changed with time. It is possible to specify, for example, a two-lane blockage which, after some specified duration, becomes only a one-lane blockage. The lane from which the blockage is removed may then become unrestricted or subject to "rubbernecking".

"Rubbernecking" may be applied, without a corresponding blockage, to simulate a shoulder incident. The user will input a factor indicating the percentage reduction in speed for vehicles traversing the affected lane segment.

#### 2.2.7 Surveillance System Simulation

To render the INTRAS model an effective tool for evaluating a "real world" traffic performance evaluation and control techniques, it is necessary to simulate "real world" information gathering (surveillance) systems. Three types of traffic detectors are to be simulated by INTRAS.

Doppler radar detectors are characterized in the model by the lane and longitudinal location at which vehicles are



detected. Each simulated vehicle crossing this location will cause the surveillance logic to output speed and time of actuation.

Short inductance loops are characterized by lane and longitudinal position, and loop length. Either of two output methods may be chosen by the user. A digital output form may be selected to simulate the time interval scanning method prevalent in many control systems. The output for this method consists of an (occupied, not occupied) status indication. Normally the detector scanning interval will be of shorter duration than the simulation time step. The on, off status of each detector for each scanning interval is obtained by interpolating vehicle position across the simulation time step, assuming constant acceleration.

An analog output form may be chosen which outputs the time and duration of actuation for each vehicle.

Coupled short inductance loops are described to INTRAS as two single short loops of equal length. The downstream loop is located by lane and longitudinal position. The upstream loop is implicitly located by defining the separation distance between the pair. The output for coupled pairs may either be analog or digital as for single loops.

All surveillance system output is made available for subsequent treatment by point processing (detector specific) and system evaluation (measure of effectiveness (MOE)) estimation and incident detection modules. Internal arrays are maintained to service the dynamic control logic (see the following section).

#### 2.2.8 Freeway Traffic Responsive Control

Vehicles entering the freeway via on-ramps may be subjected (as a user option) to a variety of control techniques. In parallel to, or independent of on-ramp control, diversion of freeway vehicles to a parallel service facility may be simulated. Both metering of ramp vehicles and diversion of freeway traffic are accomplished on a node-specific basis via specially coded subroutines. This subroutine structure permits a modular replacement of control policies. Control parameters are entered through the normal input stream for each affected node, in a general format acceptable to all control policies.

### 2.2.8.1 On-Ramp Controls

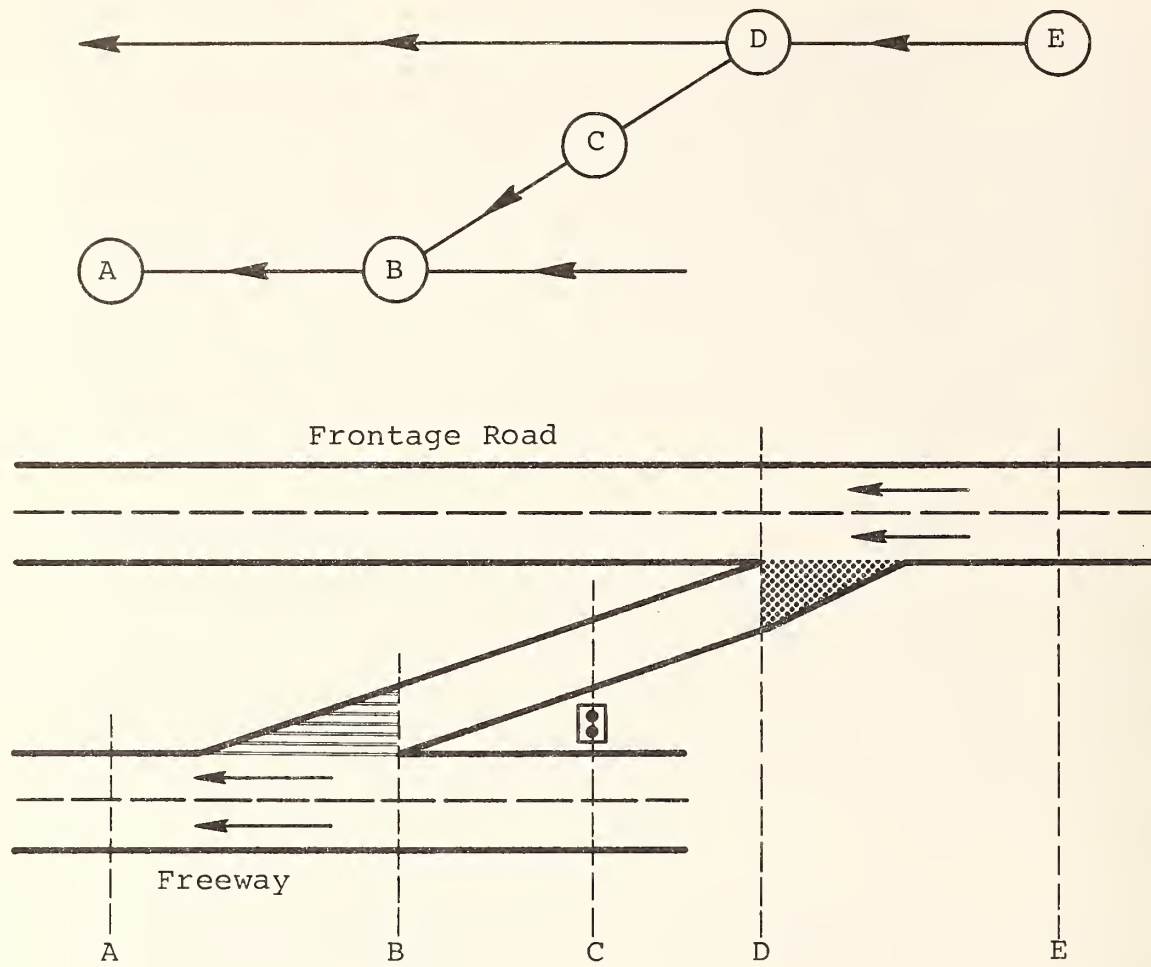
Four methods of on-ramp control are to be implemented in the INTRAS model. A typical geometric configuration of a metered on-ramp site is shown in Figure 5. The ramp signal (at C in the figure) is assumed to be upstream of the ramp-freeway interface at B. The downstream section of the physical ramp, link (C,B) is represented as a ramp link. The upstream portion (D,C) is represented as a surface link, subject to the normal queue discharge logic applied at all signalized intersections. Optionally, node C may be removed, and the ramp control may be applied at node D. In this event (D,B) is represented as a ramp link. The signal indication at D then specifies the ramp metering rate, as well as the control to through traffic.

Clock Time Metering - To simulate clock-time control of on-ramps, one fixed metering rate (vehicles per minute) is specified at each such node. A countdown clock is assigned to each associated on-ramp and the signal is set to "green" each time the clock returns to zero. The signal is maintained at "green" until a vehicle is discharged, and is then set to "red". A non-compliance percentage (user specified) is applied to vehicles arriving during the "red" signal. The indicated percentage of vehicles will be discharged through the "red" signal.

Demand/Capacity Metering - An evaluation of current excess capacity, immediately downstream of the metered on-ramp, is performed at user specified intervals. A maximum metering rate is calculated such that capacity of this freeway section is not violated. This metering rate is applied as for clock-time metering. A minimum metering rate of 1 vehicle/60 seconds is applied to ensure that waiting vehicles are not "trapped" (i.e., as in Section D,C of Figure 5).

In addition to the evaluation period, the user must specify the following parameters for each on-ramp operating under demand/capacity metering control:

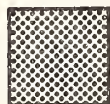
- Capacity at downstream freeway station
- Freeway link to which capacity applies
- Identify detectors on that link which provide input to the metering algorithms.



Key:



Auxiliary Lane of Freeway Link B,A



Left Turn Pocket of Surface Link E,D

Figure 5: Typical Metered Ramp Geometry

Speed Control Metering - The procedure for this form of ramp metering is rather similar to the demand/capacity description above. A freeway link detector station must be established and identified at which speed evaluations are to be made to establish a metering rate. Generally, this location will be upstream of the on-ramp, although the logic will not preclude other placements. The user must specify a table of speeds, and metering rates, for each speed controlled on-ramp. As each evaluation period concludes, the prevalent speed, at the datum freeway station, will be compared to the tabular speed minimums to determine the proper metering rate.

Gap Acceptance Merge Control - This method of ramp control employs the ramp signal control to release ramp vehicles so as to merge smoothly into gaps\* detected in the outside freeway lane traffic. The input required to implement this procedure is simplified in that no evaluation period nor metering rate criteria is required. A coupled pair of loop detectors must have been defined (via surveillance system specifications) in the outside lane of the upstream freeway link. The link identification and detector position must be identified to the gap acceptance algorithm, for each ramp, as well as the minimum acceptable gap size.

Gaps detected in the traffic stream are projected downstream to the merge point. The merge point gap size will be adjusted to reflect the relative speeds of the leading and following vehicles. As in the design of a physical system, the user will have to exercise care that one of the following two logical absurdities does not occur:

- The detector is so close to the merge point that vehicles at the ramp signal cannot be released in time to enter an acceptable gap
- The detector is so far upstream as to significantly affect the accuracy of the projected gap size.

All of the above ramp control methods are subjected to built-in distributions reflecting (by driver-type), maximum tolerable delay for queue leader, and willingness to join a queue. These distributions are imbedded in the modular ramp control subroutines.

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\*Gaps are expressed in units of time.



### 2.2.8.2 On-Freeway Diversion

Two procedures for diverting freeway vehicles to a parallel service facility will be programmed as subroutines of INTRAS. Both procedures will involve assignment of some portion of the through vehicles (at each freeway-off-ramp junction) to the off-ramp. Each diverted vehicle will be assigned to a user specified path, eventually leading either out of the network or back to the freeway.

Clock Time Diversion - This diversion method will apply a user specified percent of through vehicles to be diverted to each affected off-ramp. The time at which diversion begins must also be specified as well as the subsequent routing for each vehicle.

Least Time Path Diversion - For this procedure, travel time will be monitored for freeway paths and user-specified alternate paths which rejoin the freeway at some downstream node. When, and if, an all-freeway path is more time consuming than its alternate, vehicles will be diverted at the appropriate off-ramp.

### 2.2.9 Detector Output Processing

The simulated surveillance system produces output analagous to that generated by an on-line system. This output is stored on a peripheral device as a sequential file. At the conclusion of the simulation, this file may be saved for subsequent processing or analyzed immediately. The following procedures for analyzing detector data are included in the INTRAS design.

- Point processing procedures process each individual detector's output to generate local estimates of traffic flow parameters
- Measure of Effectiveness (MOE) estimation procedures, provided by FHWA, generate system-wide or sub-system (link)-specific parameters
- Incident detection procedures, provided by FHWA, analyze the detector data to identify the occurrence of capacity reducing incidents.



All evaluations aggregate data over time intervals of user specified duration.

The following subsections describe the functions of these procedures in more detail.

#### 2.2.9.1 Point Processing

Each detector on a roadway emits basic information as "raw" data. This "raw" data takes on different characteristics depending on the nature of the detector and the communications method. In "digital" mode each detector is polled at fixed intervals to determine current status (on-off, occupied-not occupied, etc.). In analog mode each detector sends a signal whose amplitude is proportional to the current measurement. INTRAS may operate in either digital or analog mode in simulating loop detectors. Simulated doppler radar detectors only operate as analog.

Table 1 describes the output of the detector types. Also shown are the parameters evaluated via point processing procedures. Each evaluation is detector specific. An assumed value of vehicle length is embedded in the point processing procedures to permit calculation of speed for single loops.

#### 2.2.9.2 MOE Estimation

Procedures specified by FHWA will be implemented in INTRAS to estimate traffic performance parameters for freeway sections between detector stations. These procedures will operate on the data generated by detectors at the upstream and downstream stations. Estimates of area-related parameters (travel time, density, delay, etc.) will be generated to characterize traffic performance in the study sections.

#### 2.2.9.3 Incident Detection

The primary goal of the subject project is to develop a simulation model to be used for the study of freeway incident detection and control. As described earlier, the INTRAS design includes comprehensive incident and surveillance system simulation capabilities. The INTRAS

Table 1: Output of INTRAS Simulated Detectors

Detector Type	Analog Output	Digital Output	Point Processing Output
Single Loop	Time and Duration of actuation	Occupied-not occupied Status	Volume Time Mean Speed Mean Time Headway Mean Occupancy
Coupled Loops	Time and Duration of actuation for each loop	Occupied-not occupied status for each loop	Volume Time Mean Speed Mean Time Headway Mean Occupancy
Doppler Radar	Speed and Time of Actuation	_____	Volume Time Mean Speed

model will contain algorithms (to be provided by FHWA) to analyze the detector data and determine whether or not an incident has occurred on the simulated freeway. Either "raw" detector data or the results of the point processing procedures may be used as input to the incident detection algorithms.

The output of these procedures will be the time of detection of both the onset and end of each incident. When all detector data for the full simulation run has been processed, a comparison of the performance of the detection algorithms with the actual simulated history will be generated. The MOE of interest will include time until detection (both onset and end of incident), percent of real incidents detected, and percent false alarms.

### 2.3 Simulation and Programming Method

The INTRAS simulation model employs a time stepping procedure for moving discrete vehicles through the simulated traffic network. Each time step all vehicles in the network are processed in accordance with their desired speeds and destinations inhibited by the immediate traffic and control environment. A description of the various traffic and network characteristics modelled by INTRAS was presented in Section 2.2.

To accomplish the traffic simulation and provide all of the capabilities noted in Section 2.1 effectively and economically, certain core storage saving procedures are imbedded in INTRAS. An overlay structure is employed which ensures that only the storage needed for each particular application is required to execute INTRAS.

The allocation of core to link and vehicle arrays is economized by packing multiple parameters within each storage element (word/halfword). The retrieval and storage of these individual parameters is simplified by adopting generalized parameter packing and unpacking procedures. These procedures work in conjunction with a storage reallocation method which allows maximum use of the available link and vehicle storage, during execution, by revising storage devoted to these functions as needed. A detailed description of these features is presented in the Final Report, Volume I.

Error conditions encountered during processing are reported via a generalized error procedure. This procedure is detailed as part of the INTRAS output descriptions of Section 4. The error messages are presented in Appendix B. Use of this procedure conserves program storage and allows more detail in the error messages.

## 2.4 Assumptions and Limitations

Certain restrictions on network geometry and parameter values were required before the programming of INTRAS could begin. Reasonable values for these restrictions were chosen by considering the mission of the program and then determining limitations which could not reasonably be considered to interfere with the expected applications. These design limitations are the subject of this section:

In Section 2.6 the procedures for expanding array storage (to accommodate more links, vehicles, nodes, etc.) are presented. The maximum possible expansion of these arrays is limited by both total computer storage available and some designed maximum allowable value of the individual element identifier (i.e., freeway link number). The limitations designed into INTRAS are presented in Table 2

The geometry of the simulated network is restricted as to link lengths, maximum allowable lanes on each link, and number of approaches to each node. These restrictions are identified in Table 3. Similar in nature to the geometric restrictions is the limitation on signal control intervals. A maximum of six such intervals are permitted for signal controlled intersections.

In the calibration of INTRAS (Volume I) assumptions were made as to the degree of detail required to accurately represent the dynamic characteristics of freeway traffic. A maximum of five vehicle types were defined. The first two types are allowed to exhibit different acceleration characteristics in the freeway and non-freeway environments.

Five grade categories are provided. The first of these categories is assumed to represent a negative gradient, and so, no limitation on desired speed (due to grade) is designed for this category.



Table 2: INTRAS Parameter Limits

<u>Definition</u>	<u>Limitation</u>
Freeway Vehicle Numbers	< 3200
Ramp Vehicle Numbers	< 3200
Surface Vehicle Numbers	< 3200
Freeway Link Numbers	< 299
Ramp Link Numbers	< 299
Surface Link Numbers	< 299
Node Numbers (excluding peripheral nodes for exit and entry definition)	< 699
Freeway Peripheral Nodes	> 699, < 799
Surface Peripheral Nodes	> 799, < 899
Detector Numbers	< 3200
Incident Numbers	< 99

Table 3: INTRAS Geometric Limits

<u>Definition</u>	<u>Limitation</u>
Number of Through Freeway Lanes per Link	< 5
Number of Auxiliary Freeway Lanes per Link	< 2
Number of Ramp Lanes per Link	< 2
Number of Surface Lanes per Link (including pockets)	< 5
Number of Right Turn Pockets per Surface Link	< 1
Number of Left Turn Pockets per Surface Link	< 1
Length of Freeway Links	< 9800 feet
Length of Surface and Ramp Links	< 3265 feet
Number of Approaches to Surface Intersection (Node) or	< 4 surface links < 3 surface links and 1 ramp link
Number of Approaches to Freeway Intersection (Node) or	< 1 freeway link < 1 ramp link



It is assumed that acceleration may be held constant for each vehicle type-grade combination over speed ranges of 20 feet per second extent.

It is important to note that the actual calibrated values of acceleration, limiting speed and grade categories (as well as numerous other calibration parameters) may be revised via data card input (See section 3). The restrictions noted in the preceding paragraphs affect only the number and character of the referenced attributes.

## 2.5 Functional Structure of INTRAS

The INTRAS model is a highly complex system containing procedures for multi-purpose input processing, diagnostic testing, microscopic traffic simulation, output reporting, statistical analysis, detector output processing and digital plotting. Reliable and efficient use of such a system depends on the system structure and organization. Early in the development of INTRAS, the time ordering of the above procedures was determined. The independent portions of each procedure were identified and isolated. This planning function provided a basis for the structural design of INTRAS.

One danger encountered in the implementation of large complex programming systems is that, when they are completed, storage restrictions may limit their usage to trivial applications. To achieve meaningful results it may then be necessary to segment the system. This unplanned segmentation often leads to loss of efficiency and debilitates certain features of the original plan. It is of utmost importance to design a system functionally, so that segmentation is planned, and the logical flow between segments occurs in the most efficient way, consistent with project goals.

INTRAS is designed with these factors in mind. The functional segments are overlaid so as to provide maximum computer storage for arrays and scalars. The maximization of data storage assures the greatest utility from the standpoint of treating large traffic networks. Major portions

of the data storage are optimized to increase network size capabilities to the maximum. This optimization is discussed in Volume I.

The overlay structure and information transfer of INTRAS is illustrated in Figure 6. The purpose of and methods employed by each functional segment (overlay module) are as follows:

#### The INTRAS Supervisor Module

**Purpose:** To call the functional modules in the order indicated by the Run Control specifications.

**Method:** For each case the first module to be transferred to is determined from examination of the Run Control card parameters. Subsequent transfers are determined by the individual modules and communicated by a control variable (NEXCAL).

#### The PORGIS Module

**Purpose:** To examine all simulation oriented input data for errors or inconsistencies and generate printed tables of input data. PORGIS may also store error-free simulation case data on tape.

**Method:** Information on each card of the input file is examined thoroughly for compatibility with the INTRAS model. Any items that do not conform with INTRAS specifications are reported by use of coded error messages. Input sequence checking and various logical checks on the network are also performed. When all input has been processed and is determined to be error free, the input tables are printed and, if desired, the data is written on the Case Data Tape.

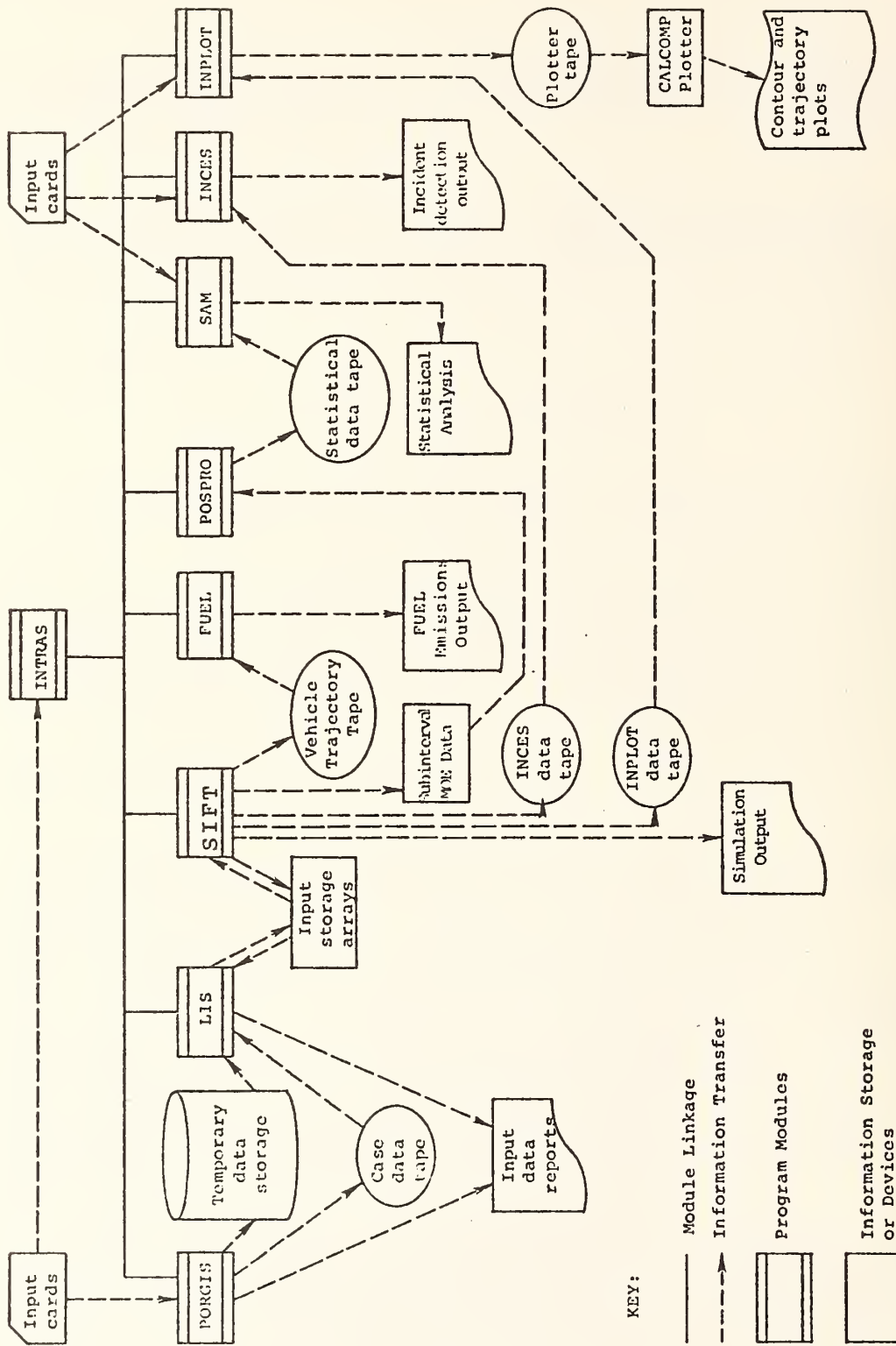


Figure 6: Functional Structure and Information Transfer of INTRAS

### The LIS Module

**Purpose:** To load simulation case data into data arrays and scalars in preparation for execution of a simulation subinterval. LIS may also retrieve and execute error free data sets stored on the Case Data Tape.

**Method:** Arrays and scalars for this subinterval are primed with data taken from card input or the Case Data Tape. Each new subinterval requires a pass through LIS to update appropriate arrays and scalars with subinterval specific data and output the revised data.

### The SIFT Module

**Purpose:** To perform all simulation activities.

**Method:** SIFT makes use of two lower level overlays to accomplish its tasks. Routines which perform frequent processing activities (at least once per time step) form one segment. The other segment contains those routines which perform relatively infrequent processing activities. At the beginning of each new time step the high frequency activity overlay is called. The low frequency activity overlay can be called from several locations depending upon the options requested.

### The FUEL Module

**Purpose:** To provide link-specific evaluations of fuel consumption and vehicle emissions throughout a simulation run.

**Method:** Calculations of fuel consumption and emissions (carbon monoxide, hydrocarbons, and nitrous oxides) are based upon the dynamics of individual vehicles at each time step. These data are stored by SIFT on the Vehicle Trajectory Tape for all vehicles. FUEL reports MOE values at the





### The INCES Module

**Purpose:** To perform all processing of detector data and to generate incident detection, point processing, and MOE reports.

**Method:** A total of three incident detection algorithms have been implemented:

Algorithm 1 is the California logic, as presented in Ref. 4. The logic uses occupancies at sensor stations to determine the onset of the incident, its approximate location and the end of the incident.

Algorithm 2 is the Payne Algorithm 8 (Ref. 9). This algorithm incorporates compression wave suppression logic to avoid incident false alarms due to the presence of transient compression waves in the traffic flow.

Algorithm 3 (Ref. 8) uses the method of double exponential smoothing in an attempt to reduce the number of incident false alarms.

Point processing statistics may be computed for each detector on the network. Three methods of MOE estimation have been implemented:

Method 1 is based upon the work of Gazis and Knapp (Ref. 7). Density is estimated based on initial conditions and inflows and outflows from the road section under consideration. Kalman filtering is used.

Method 2, developed by Gazis and Szeto (Ref. 5) uses a Kalman filtering technique to estimate density based on initial conditions.

Method 3 (Ref. 6) uses speeds and counts at sensor stations to estimate density. A recursive minimum mean square estimator with Kalman gains is used.

### The INPLOT Module

**Purpose:** To prepare vehicle trajectory and MOE contour plots based upon data on the INPLOT Data Tape.

**Method:** Plot types are generated in the time-space plane. The space axis may represent one or a group of contiguous freeway links. The user may request vehicle trajectory plots, in a single lane, or for

all lanes, in a specified freeway section. The available MOEs considered in the contour plots are: spot speed, volume, density, delay/vehicle-mile, headway and travel time/vehicle-mile as specified by the user. Contours are plotted for a standard set of values of each MOE embedded in INPLOT arrays. These standard values may be revised via the INPLOT parameter card. In addition to this option, an index may be created which details the current contents of the INPLOT Data Tape.

## 2.6 Size Modification Procedures

INTRAS is a tool for use in developing incident detection strategies and surveillance and control policies on freeway networks. Its standard capacities are as follows:

<u>Feature</u>	<u>Program Variable Name</u>	<u>Maximum Number Allowable</u>
Total Link and Vehicle Storage Elements	MNLV*	15000
Total Links of All Types	NTOTL	110
Nodes or Entry Links	NTOTN	50
Detectors	NDET	100
Incidents	NINCI	10
Actuated Nodes	IANOD	10
Freeway Statistical Data Stations	NSTATN	10

\*Note that each: freeway link uses 42 elements of MNLV  
 ramp link uses 18 elements of MNLV  
 surface link uses 22 elements of MNLV  
 freeway vehicle uses 22 elements of MNLV  
 ramp vehicle uses 8 elements of MNLV  
 surface vehicle uses 8 elements of MNLV.

Certain cases may require modifications of these capacities. Any increases will, of course, change the core storage requirement and computer running costs. The following procedures define the necessary steps for changing any or all of the above capacities.

### 2.6.1 Changing Size of Link and Vehicle Storage Space

The NLV array of COMMON /A1/ contains all link and vehicle arrays. Large networks, i.e., networks with many links or heavy volumes, may require more link and vehicle storage space in which case the NLV array must be expanded. To change NLV, do the following:

- 1) Change the value of MNLV in BLOCK DATA INTVAR to the new number of elements available for storage of link and vehicle arrays.
- 2) Change size of NLV array in all routines containing COMMON /A1/. Refer to Table 4.
- 3) Change associated dimension statement in all routines containing COMMON /A1/ so that the number of elements used for each freeway, ramp and surface link and vehicle array is less than or equal to MNLV.

#### Example:

Consider the problem of increasing link and vehicle storage from 10000 elements to 15000.

- 1) Change the data statement in BLOCK DATA INTVAR  
from DATA MNLV /10000/  
to DATA MNLV /15000/
- 2) In all routines containing COMMON /A1/ change the COMMON /A1/ statement from  
COMMON /A1/ MNLV,NLV(10000)  
to COMMON /A1/ MNLV,NLV(15000)
- 3) In all routines containing COMMON /A1/ change the DIMENSION statement from  
DIMENSION LNKF(42,238),LNKR(18,555),  
LNKS(22,454),VF(22,454),VR(8,1250),VS(8,1250)  
to  
DIMENSION LNKF(42,357),LNKR(18,833),  
LNKS(22,681),VF(22,681),VR(8,1875),VS(8,1875)

Table 4: Subroutine - COMMON Block  
Cross Reference Chart

INTRAS Module Routines																			
INTRAS	EROT	DEBUG	DRWS	INTVAR	ULNKR	ULNKS	UVR	UVS	UNPAK	PAK	PLNKR	PLNKS	PVR	PVS	FINDLN	FINDL	NEXTLN	LRANK	
X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	A1
X	X			X	X										X	X		X	A2
				X	X										X	X			A3
				X	X														A4
				X	X														A5
				X	X														A6
				X	X														A7
				X	X														A8
				X	X														A9
				X	X														A10
				X															A11
				X															A12
				X															ACT0
				X															ACT1
				X															ACT2
				X															ACT3
				X															ACT4
				X															ACT7
				X															ACT8
				X															ACT9
				X															ACT10
				X															ACT12
				X															ACT16
				X															ACT20
				X															CFUEL
				X												X			CONTRL
				X															CRASH
				X															DBLEXP
				X												X			ERTRAN
				X															FORINC
				X															FPAR
				X															FREDAT
				X															IHEAD
				X															IPLTN
				X															LASDCH
				X															NFILTS
				X															ONVEH
				X															P1
X				X															RANK
X				X															SIZE
				X															S1
				X															S2
				X															S3

COMMON Blocks



Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

PORGIS Module Routines		
PORGIS	X	A1
TABCON	X	A2
LPAK	X	A3
PRSIG	X	A4
PRACT	X	A5
CTPFF	X	A6
CTPSX	X	A7
CTPSV	X	A8
CIRALL	X	A9
PRMSND	X	A10
SURVIN	X	A11
INCIN	X	A12
SIGOUT	X	ACT0
INACT	X	ACT1
FLOOUT	X	ACT2
SUROUT	X	ACT3
INCOUT	X	ACT4
IMBED	X	ACT7
IMBEDO	X	ACT8
DETGEN	X	ACT9
MATCH	X	ACT10
LINKIN	X	ACT11
CHKNOB	X	ACT12
LINOUT	X	ACT16
TURNIN	X	ACT20
INT1	X	CFUEL
	X	CONTRL
	X	CRASH
	X	ERTRAN
	X	FORINC
	X	FPAR
	X	FREDAT
	X	IHEAD
	X	IMBDIN
	X	LASDCH
	X	NFILTS
	X	ONVEH
	X	P1
	X	RANK
	X	SIZE
	X	S1
	X	S2
	X	S3

COMMON Blocks



Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

LIS Module Routines			
LIS		X	A1
LIPAK	X	X	A2
LIPRSIG	X	X	A3
LIPRACT	X	X	A4
LICTPFE	X	X	A5
LICTPSX	X	X	A6
LICTPSV	X	X	A7
LICLRAL	X	X	A8
LIPRMSN	X	X	A9
LSURVI	X	X	A10
LINCIN	X	X	A11
LSIGOU	X	X	A12
LINACT	X	X	ACT0
LFLOOU	X	X	ACT1
LSUROU	X	X	ACT2
LINCOU	X	X	ACT3
LIMBED	X	X	ACT4
LIMBDO	X	X	ACT7
LIDETGE	X	X	ACT8
LILINKI	X	X	ACT9
LILINOU	X	X	ACT10
LITURNI	X	X	ACT11
LINTI	X	X	ACT12
			ACT16
			ACT20
			CFUEL
			CONTRL
			CRASH
			ERTRAN
			FORINC
			FPAR
			FREDAT
			IHEAD
			IMBDIN
			LASDCH
			NFILTS
			ONVEH
			P1
			RANK
			SIZE
			S1
			S2
			S3

COMMON Blocks

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

SIFT Module Routines																									
SIFT	VPAR	LASTLK	FRSTV	LASTV	FINDV	FINDRV	FINDSV	RANDOM	HICON	UPSIG	SIGACT	PDAFZ	PDNAFZ	UPACT	GRNSIG	REDSIG	TERMFZ	DECACCT	TERM	ACTFZ	ASIG	DETSW	FZCL		
	X	X	X	X	X	X	X																	A1	
									X													X			A2
									X	X												X			A3
									X	X															A6
																					X				A8
											X	X											X		ACT1
											X	X											X		ACT2
											X	X											X		ACT3
												X	X												ACT4
												X	X												ACT5
												X	X										X		ACT6
												X	X												ACT7
												X	X										X		ACT8
													X												ACT9
										X															ACT10
											X														ACT11
											X														ACT12
												X													ACT15
												X													ACT16
											X														ACT18
																									ACT20
																									CFUEL
																									CONTRL
																									CRASH
																									DBLEXP
																									ERTRAN
																									FORINC
																									INCDMP
																									IPLTN
																									NIDTSV
																									NRGY
																									SIZE
																									S2
																									S3
																									VBUF
																									VPOINT

COMMON BLOCKS

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

SIFT Module Routines (Cont.)			
CALL1		A1	
CALL2	X	A2	
CALL3	X	A3	X
CALL4	X	A4	X
CALL5	X	A5	X
CALL6	X	A6	X
MOOV		A7	
SVEH	X	A8	X
CLOSE	X	A10	X
BLOK		ACT0	
GOO		ACT1	
GFRRMP	X	ACT4	
HDMV		ACT7	
GETCD		ACT10	
LSMCH		ACT15	
LANES		CFUEL	
TSTSAT		CONTRL	X
DEFECT		CRASH	
TSTIG	X	ERTRAN	X
NORM		FORINC	X
CINDP	X	INCDMP	X
INCDAT	X	IPLTN	
TPROUT	X	LASDCH	X
MOEV	X	LENVI	X
OSTATE		NFILTS	
SELEN	X	NRGY	
FILL	X	ONVEH	
RELEN	X	RANK	
		SIZE	X
		SFFLAG	
		S1	X
		S2	X
		VBUF	
		VEER	
		VENVI	X

COMMON Blocks

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

SIFT Module Routines (Concluded)																															
SEVEN	GETUNV	REVEN	FMFIN	FMOVE	FGNRAT	ONRMP	PRESET	CONSOL	EMGNCY	CHANGE		CHECK	RISK	ICROSS	CANCEL	ADVANC	COLECT	LOCON	INIT	RESET	FILTST	FTSC	CPTOUT	CYCP	INTST	SINGES	SINCL	SINC2	SINC3	SPOINT	
																															A1
																															A2
																															A3
																															A4
																															A5
																															A7
																															A8
																															A10
																															A11
																															CFUEL
																															CONTRL
																															CRASH
																															DBLEXP
																															ERTRAN
																															FORINC
																															FPAR
																															FREDAT
																															IPLTN
																															LENVI
																															NFILTS
																															NIDTSV
																															NRGY
																															ONVEH
																															RANK
																															SIZE
																															SRFLAG
																															S2
																															S3
																															VBUF
																															VEER
																															VENVI

COMMON Blocks





It is important to note that the individual size of each of the revised arrays does not exceed 15000 elements. In this case, we have the following final sizes for the various arrays:

<u>Array</u>	<u>New Size</u>
LNKF	14994
LNKR	14994
LNKS	14982
VF	14982
VR	15000
VS	15000

### 2.6.2 Change Maximum Number of Links

To revise the maximum total number of links of all types, the following procedure must be followed:

- 1) Change value of NTOTL in BLOCK DATA INTVAR to new maximum number of links.
- 2) Change size of arrays IVFEET and ENDNDS in all routines containing COMMON /A2/. Change size of arrays VPROC, MNUVR, LTRNV, THRUV, RTRNV and VCONT in all routines containing COMMON /A10/. Change size of IFRANK array in all routines containing COMMON /RANK/. Change size of LADISH array in all routines containing COMMON /LASDCH/. Change size of LIN array in COMMON /SAMP2/ and the size of DMAT and DMBT in COMMON /SAMP3/. Refer to Table 4.
- 3) In addition to changing link specific arrays in COMMON blocks, the following local arrays must be changed also:

<u>Routines</u>	<u>Array</u>	<u>Size</u>
POSPRO, SAM, READCL	IB	(8 x NTOTL)
POSPRO, SAM, READCL	IZ	(8, NTOTL)
FUEL	LBUF	(NTOTL, 4, 5)
FUEL	KDIST	(NTOTL, 5)
FUEL	KFUELT	(NTOTL, 5)
LRANK	LENTY	(NTOTL)
LRANK	LTEMP	(NTOTL)

<u>Routines</u>	<u>Array</u>	<u>Size</u>
LRANK	LLEFT	(NTOTL)
INCDAT	LINKD	(NTOTL)
INCDAT	IBOUT	maximum of 21*NTOTL+1 or 3*NDET+10

### 2.6.3 Change Maximum Number of Nodes or Entry Links

To revise the maximum number of nodes or entry links, the following procedure must be followed:

- 1) Change value of NTOTN in BLOCK DATA INIVAR to new maximum number of nodes or entry links
- 2) Change size of SIGI array in all routines containing COMMON /A3/. Change size of SIG, NPHS and SIGT arrays in all routines containing COMMON /A6/. Change size of SNODE array in all routines containing COMMON /A7/. Refer to Table 4.

### 2.6.4 Change Maximum Number of Detectors

To revise the maximum number of detectors, the following procedure must be followed:

- 1) Change value of NDET in BLOCK DATA INIVAR to new number of detectors.
- 2) Change size of DTCTR array in all routines containing COMMON /A4/. Refer to Table 4.
- 3) Change size of IBOUT array in INCDAT to maximum of 3\*NDET+10 or 21\*NTOTL+1.

### 2.6.5 Change Maximum Number of Incidents

To revise the maximum number of incidents, the following procedure must be followed:

- 1) Change value of NINCI in BLOCK DATA INIVAR to new number of incidents
- 2) Change size of INCID array in all routines containing COMMON /A5/. Refer to Table 4.

### 2.6.6 Change Maximum Number of Actuated Nodes

To revise the maximum number of actuated nodes, the following procedure must be followed:

- 1) Change value of IANOD in BLOCK DATA INTVAR to new maximum number of actuated nodes.
- 2) Change size of IACPAR array in all routines containing COMMON /A6/. Refer to Table 4.

If the revision is to increase the number of intersection actuated traffic controlled nodes, the following procedure must be followed:

- 1) Change the value of MACR in BLOCK DATA INTVAR to new maximum number of intersection actuated traffic controlled nodes (MACR must be less than or equal to IANOD).
- 2) Change size of NAFZ, NAAFZ, NATMR, NADET, NADTM, NACNT, NALNK, NACDS, NACYC, NADEC, NASTAT, NEWDET and SIGA arrays in their respective COMMON blocks: /ACT1/, /ACT2/, /ACT3/, /ACT4/, /ACT5/, /ACT6/, /ACT7/, /ACT8/, /ACT9/, /ACT11/, /ACT12/, /ACT15/ and /ACT20/. Refer to Table 4.

#### 2.6.7 Change Maximum Number of Freeway Statistical Data Stations

To revise the maximum number of freeway statistical data stations, the following procedure must be followed:

- 1) Change value of NSTATN in BLOCK DATA INTVAR to new maximum number of entries.
- 2) Change size of LSTATN array in all routines containing COMMON/All/. Refer to Table 4.



## 2.7 Computer Requirements

The INTRAS model is written in standard FORTRAN as established by the American National Standards Institute (ANSI). INTRAS deviates from ANSI FORTRAN only in those areas where either the local computer operating system or compiler requires it or core storage or coding economies dictate it. INTRAS is developed for and implemented on the CDC 6600/7600 computer series under the SCOPE operating system and the IBM 360/370 computer series under OS/360. Since ANSI FORTRAN is used, the model may be implemented on virtually any large scale computer having an ANSI FORTRAN compiler. To accomplish this, those deviations from the standard mentioned above need be defined.

Since INTRAS is an overlaid program the means of achieving the overlay must be tailored to the individual operating system. CDC/SCOPE overlays are created by inserting delimiter "OVERLAY" cards in the deck. These cards exist in the CDC version of INTRAS preceding the routines; INTRAS, PORGIS, LIS, SIFT, HICON, LOCON, FUEL, INCES, POSPRO, INPLOT AND SAM. Each lower level overlay is entered via a "CALL OVERLAY" command in the immediate higher level overlay. Each overlay module under CDC/SCOPE has a main program which is begun with a "PROGRAM" card.

For IBM/OS the overlay structure is created by a linkage editor operation. This allows the IBM/OS FORTRAN to be standard ANSI. Under IBM/OS there is only one main program. The "PROGRAM" card is unnecessary as are "OVERLAY" delimiters and "CALL OVERLAY". Lower level overlays are referenced by standard FORTRAN subroutine CALLs.

The ANSI standard for FORTRAN "DATA" statements prohibits (or rather does not specifically endorse) implied "DO" loops and unsubscripted array names. To define large arrays of data without this convenience is both extremely voluminous (particularly in the case of the FUEL module)

and subject to transcription error. Large arrays in INTRAS requiring built-in data values rely on non-ANSI "DATA" statements. Such statements are located in the following routines: BLOCK DATA INTVAR, PRINT, STAT, TTEST, ANOVA, WILCOX, UTEST, BLOCK DATA BDFLCN, BLOCK DATA BDCOEM, BLOCK DATA BDNOEM, BLOCK DATA BEHCEM.

To achieve efficient storage of data in INTRAS, features of the specific CDC and IBM systems are used. The IBM 360/370 version of INTRAS makes use of the INTEGER\*2 (half word integer variable) capability of IBM 360/370 FORTRAN. INTEGER\*2 specifications are used for arrays in the COMMON blocks specified in Table 5. In addition, local variables in the subroutines specified in Table 6 are specified as INTEGER\*2.

In the CDC 6600/7600 version of INTRAS, the INTEGER\*2 specifications are carried as comment cards (column 1 contains the character "C"). To allow INTRAS to be run on a 64K word, small core memory (SCM) 6600 or 7600, the CDC large core memory (LCM) feature is employed. To invoke LCM, the variables in COMMON blocks SAMP3 and BFUEL are designated as "LEVEL 2" in the subroutines containing these blocks. This specification is unnecessary for 128K word CDC 6600/7600 systems.

Table 7 is a compilation of the data files used by INTRAS. The functional relationships of files which convey information between overlay modules are illustrated in Figure 6. Files 8 through 11 and 13 through 25 are sequential files which may be assigned to local peripheral devices (either tape or disk). File 12 is a transport for conveying CALCOMP digital plotting information to an off-line CALCOMP plotter. It is assumed that the CALCOMP software routines FIN, PLOT, SYMBOL, NUMBER and PLOTS are available in the local software library.

Table 5: INTEGER\*2 Arrays and Variables in COMMON  
for IBM Version of INTRAS

<u>COMMON</u> <u>Block</u>	<u>Arrays and Variables Declared INTEGER*2</u>
A1	NLV, LNKF, LNKR, LNKS, VF, VR, VS
A2	ENDNDS
A3	SIGI
A4	DTCTR
A5	INCID
A6	IACPAR, NPHS, SIGT
A8	CSTDCL, IPACK, ITPCT, LIMSPD, LNMNSP, MAXAC, TLNK
A10	LTRNV, MNUVR, RTRNV, THRUV, VCONT, VPROC
BFUEL	KCOEM, KFLCN, KHCEM, KNOEM
CRASH	IMMOE, INCALG, IPPT, KON, KPOINT, LENTHV, MAXCEL, MOEALG
LENVI	LACA, LACR, LCCR, LDHR, LDTR, LEXA, LFFR, LFTR, LLLA, LLNA, LLNR, LLOR, LLPA, LLTR, LMHR, LMTR, LPOA, LPOR, LPRA, LPRR, LRPA, LRTR, LSCA, LSHR, LSPA, LSPR, LSTR, LTCA, LTTR, LUVR, LVLR
ONVEH	IORG, IREN, IRV
RANK	IFRANK
SIZE	IS, IWDIND, IWDPK, NWDS
VBUF	NF, NFA, NFL, NRA, NRL

Table 6: Local INTEGER\*2 Arrays and Variables in Subroutines

<u>Subroutine</u>	<u>Arrays and Variables Declared INTEGER*2</u>
ULNKR,ULNKS	IWORD,JPARAM
UVR,UVS	IWORD,JPARAM
UNPAK,PAK	JPARAM
PLNKR,PLNKS	IWORD,JPARAM
PVR,PVS	IWORD,JPARAM
FINDLN	ICODE,LC,LPOS,LTEMP,LR27,L37,NLANE, NRLANE
NEXTLN	NEXL,LTEMP
LRANK	NEXTL,LTEMP,LENTY
PORGIS	IDPOS
PRSIG	ICODE,ITURN,LP
CTPSV	LN,JPARAM
PRMSND,LPRMSN	ILANE
SURVIN,LSURVI	IFE,IPARM
INCIN,LINCIN	ICOD,LDAT
INACT,LINACT	LN
FLOOUT,LFLOOU	ILANE
INCOUT,LINCOU	IPTR
DETGEN,LDETGE	IDET2
LINKIN,LLINKI	BUFFER,ITMP
LINOUT,LLINOU	BUFFER,IL,LEN,ONOFF,OUTBUF
TURNIN,LTURNI	BUFFER
INT1,LINT1	BUF,BUFFER,ITMP
LIS	IDPOS,LENA,LENG,NAUX1,NAUX2,NLANE
LPRSIG	ICODE
LCTPSV	JPARAM
SIFT,MOEV,CHECK	IHAF
LASTLK	LTEMP
FRSTV	IHAF,LK,LN,MA
LASTV	LTYP,L3,MLT
UPSIG	IL,IQ,ISG,ISGN,JCF,NLANE
ASIG	JY
CALL	IBASIC,METER
CAL2,CAL3	ISIG
CAL4	IBASIC,IHAF
CAL5	IHAF,JHAF
MOOV	IBASIC,IHAF,ISC,JHAF



Table 6: Local INTEGER\*2 Arrays and Variables in Subroutines (continued)

<u>Subroutine</u>	<u>Arrays and Variables Declared INTEGER*2</u>
SVEH	I2,NEWV2
CLOSE	JPACK
OFFRMP	IHAF,KROSBF,LRV,NNF
HDWY	IDT,IVT,ITC
TSTSAT	IVT
DETECT	ILSIG,ICODE,IDIST,IIV,ILAN,ILINK,ISP, IVL,LAN,LEN
CLNUP	IHAF,MXI
INCDAT	IPACK2
TPTOUT	ICOD,ILOC,IV,IVL,LENA,LENE,NAUX1, NAUX2,NLANE
SELEN	IDUM,L,LC,LK,LA
FILL	LKNUM,LL,LTEMP
SEVEN	ICODE2,LDIS2,ML2,MSP2
GETUNV	IP2
REVEN	LTEMP2
FMOVE	IHAF,JHAF
FGNRAT	IHAF,JV
ONRMP	IHAF,ILKF,IPRF,IPSF,ISF,ILKL,JHAF, LANFOL,LRLLEN,LRVPO,LRVSP
FRESET	LBUF,MQ
CHANGE	JHAF
LCROSS	IHAF,JDLANE,JHAF,KHAF,KROSBF,NNF
CANCEL	IHAF,JLF15,JLF18,JLL15,JLL18,JRF15, JRF18,JRL15,JRL18,NFX,NFY
ADVANC	IHAF,JHAF
COLECT	IAUXY,IS2,LINL,LOC1,LOC2,NUD
LOCON	KK
INIT,RESET	ITMP
FILTST	NE
FTSC	IHAF,ITSBUF
CPTOUT	KDET
CYCP	HDLAY2,HMOVE2,ICON2,ICYCF2, IHAF,IHSDL2,ILCHG2,IPCON2,IRPKT2, ISSDL2,IVOUT2,LANE2,LFPKT2,LANGTH2, SDLAY2,SMOVE2

Table 6: Local INTEGER\*2 Arrays and  
Variables in Subroutines (concluded)

<u>Subroutine</u>	<u>Arrays and Variables Declared INTEGER*2</u>
INTST	ICODE, ICON, ICYCFL, IDLAYH, IDLAYT, IMOVEH, IMOVET, ISDLYH, ISDLYT, ISIGCD, IVDIS, LCHAN, LCHNG, LK
BDFLCN, BDHCEM	JB
BDCOEM, BDNOEM	JB
INCES	IPACK2

Table 7 : INTRAS File Identification

<u>Fortran Logical File No.</u>	<u>Type</u>	<u>Function</u>
5	Formatted	Card input
6	Formatted	Printer output
7	Formatted	Punch output
8	Formatted	Case Data file
9	Unformatted	INCES Data file
11	Unformatted	SAM Data file
12	Unformatted	Plotter Output Tape
13	Formatted	Intermediate Case Data Storage
14	Unformatted	Extra SAM file for editing
15	Unformatted	POSPRO utility file (subinterval)
16	Unformatted	INCDAT utility file
17	Unformatted	POSPRO utility file (cumulative)
19	Unformatted	INPLOT Data file
20	Unformatted	INPLOT utility file (trajectories)
21	Unformatted	INPLOT utility file (contours)
23	Unformatted	FUEL Data file
22, 24, 25	Unformatted	FUEL utility files

### 3. INTRAS CARD INPUT FORMATS

The following subsections identify and define the content of input cards read by the various program modules. Numeric data fields on all INTRAS data cards are "fixed point". This specification requires that numeric values be coded into the extreme right-most digits of these fields. This requirement is necessitated by the presence of an assumed decimal point immediately to the right of the numeric field. For example, the number "24" would be coded into a three digit field as "b24", where "b" indicates a blank space.

One card type, the Run Control Card, is read by the INTRAS Supervisor module to define the type of run and indicate the lower level module to be called.

#### Run Control Card - Type 99

<u>Cols.</u>	<u>Description</u>
1	1 = Last 99 card request 0 (blank) - Another request follows
2	1 = Diagnostic run 2 = Simulation run 3 = Diagnostic + simulation 4 = Off-line incident detection run 6 = Simulation + off-line incident detection 7 = Diagnostic + simulation + off-line incident detection run 8 = Table of contents for case data tape 0 (blank) = <u>No</u> diagnostic, simulation or incident detection (this would imply that Col. 24 will be specified, indicating an INPLOT or SAM run, or a stand alone FUEL run will be indicated by a "1" in column 27).
4 - 6	If Col. 2 = 2 or 6, then a data deck must be taken from the Case Data Tape. This field contains the sequence number of that data deck on the Case Data Tape.
7 - 9	As for Col. 4 - 6, if a data deck must be taken from the Case Data Tape, then this field contains the Run Identification number of that deck. (Col. 61-63 of Type 00 card.)

Both fields 4-6 and 7-9 may be specified concurrently or individually. If two decks on the Case Data Tape possess the same Run Identification number, then 4-6 must be specified. If the sequence number is not known, then the Run identification may be specified alone. If neither field is specified, then the case data must follow the 99 card in the input stream.

- 11            If this SIFT simulation is to produce output information on the Incident Data Tape, then this field should be set = (1,2) if the Incident Data Tape (does not, does) contain previously stored detector data. Otherwise, this column should be left blank.
- 12            If this SIFT simulation is to produce output information on the INPLOT Data Tape, then this field should be set = 1 if the INPLOT Data Tape is currently empty (i.e., no previous plot data sets have been stored on it). Otherwise, this column should be left blank.
- 14            If this diagnostic run (Col. 2 = 1, 3 or 7) data deck is to be stored on the Case Data Tape, this field must be specified as (1,2) if the Case Data Tape (does not, does) contain previously stored data decks. If the data deck is not to be stored, then Col. 14 = 0 (blank).
- 15            If the statistical results of this simulation run (Col. 2 = 2,3,6 or 7) is to be stored on the Statistical Data Tape for analysis by SAM, this field must be specified as (1,2) if the Statistical Data Tape (does not, does) contain previously stored data. If the statistical output is not to be stored, then Col. 15 = 0 (blank).
- 16 - 18       Incident detection data specification. If Col. 2 was specified = 4, then a previously stored set of data must be retrieved from the Incident Data Tape. The Run Identification number for that data must be entered in this field. Otherwise, leave this field blank.



- 21 For any incident detection run (Col. 2 = 4,6 or 7) this field should be specified as [0 (blank), 1] if a list of the Run Identification numbers for those incident data sets on the Incident Data tape (is not, is) to be produced. If the purpose of this 99 card is only to produce this Run Identification list, then Col. 2 should be specified as 4, Col. 3-18 should be blank, and Col. 21 should be 1.
- 24 To specify that this 99 card is a request for an (INPLOT, SAM) program run, this field should be set (1,2). This field should only be specified if Col. 2 - 21 are blank.
- 27 Code indicating FUEL run type:
- = 0, if FUEL module is to be run along with simulation
- = 1, if FUEL module is to be run using data previously written on FUEL Data Tape, no simulation (implies that column 2 = 0)
- ≥ 2, if simulation only, no FUEL module
- 30 Code (0,1) if exogenous FUEL data cards (are not, are) to be read in. If so, cards appear after last type 60 card for this case.
- 33 Code (0,1) if FUEL Data Tape (is, is not) to be written during this simulation.
- 36 Code (0,1) if FUEL data tables (are not, are) to be printed out. Tables are always printed if column 30 = 1.
- 79, 80 ≡ 99 (card type identification)

### 3.1 Simulation Data Case Input Formats

The following cards are read by the PORGIS and LIS modules. Some cards may only be required and/or allowed for the first subinterval. Data cards for each simulation subinterval must occur in card type sequence in the data deck.

Simulation Title Card - Type 00 (One  
Permitted, First Subinterval Only)

<u>Cols.</u>	<u>Description</u>
1 - 60	Alphanumeric description of this run.
61 - 63	Three digit Run Identification Number. This number is used to identify output files for plotting, incident detection, and statistical analysis. Any runs which need be identified for future reference must be assigned a unique run identification.
65,66	Freeway Simulation Time step, in tenths of a second (i.e., 32=3.2 seconds). If left blank or zero, a default of 10 will be used. Must be specified as 10 for any off-line or on-line incident detection run.
67 - 69	Frequency at which lane change logic will be implemented in time steps. If left blank, a default of 2 will be used.
71 - 78	Seed for Random Number Generator. Must be odd and not a multiple of 5. If not specified, 7581 will be used.
79,80	= 00, card type.

Network Name Card - Type 01  
(One Permitted, First Subinterval Only)

<u>Cols.</u>	<u>Description</u>
1 - 60	Alphanumeric description of network, data, etc.
63 - 66	Maximum length of initialization (network priming) period, in seconds.
68	Flag (=0,≠0) if fill time (is not, is) to continue to maximum length even though equilibrium is reached.
69	Flag (=0,≠0) if simulation (is not, is) to proceed if equilibrium (input≈output) is not achieved during fill time.

<u>Cols.</u>	<u>Description</u>
72	Flag (=0,≠0) if statistics are to be (cumulative, subinterval specific).
73 - 74	Hrs. } Simulation Min. } starting time Sec. } on 24-hour clock
75 - 76	
77 - 78	
79,80	≡ 01, card type.

Link Geometry Cards - Type 02 (First Subinterval Only)

Data for exit links must not be specified on this card type, nor on any other link specific card type.

<u>Cols.</u>	<u>Description</u>
1 - 3	Node at upstream end of link. For entry LINKS this number must be (>700, >800) for freeway, non-freeway) entries. Corresponding numbers in the 700 and 800 series may <u>not</u> be used (i.e., if 703 is used as the upstream node of a freeway entry, then 803 may not be used elsewhere in the network).
4 - 6	Node at downstream end of link.
8 - 11	Link length (feet). For urban links this distance is measured from stop line to stop line. Maximum length of freeway links is 9800 ft. The limit for ramp and surface links is 3265 ft. Not an input for entry links; a default value of 9825 will be used for freeway entries, 3275 for surface entries.
12	Link type, as follows:  0 (blank) or 1 ≡ Urban links (all non-freeway links which <u>do not</u> connect directly to freeway links).  2 ≡ Ramps (all non-freeway links which <u>do</u> connect directly to freeway links).  3 ≡ Freeway links.

<u>Cols.</u>	<u>Description</u>
13 - 14	Mean desired free-flow speed (mph). The mean speed of traffic under low enough density conditions such that speeds are freely chosen.
15	Number of thru lanes (maximum 5). This figure does not include turn pockets for urban links, or auxiliary lanes for freeway links. Maximum number of lanes for ramps is 2. Maximum number of lanes for surface links=5-number of turn pockets. (Freeway entry links cannot have auxiliary lanes.)
16 - 18	Grade, in $\pm$ percent.
19 - 21	Node at downstream end of link receiving left turning traffic from this link. Leave blank if link being defined (in columns 1-6) is an on-ramp.
22 - 24	Node at downstream end of link receiving through traffic from this link.
25 - 27	Node at downstream end of link receiving right turning traffic from this link. Leave blank if link being defined (in columns 1-6) is an on-ramp.

For entry ramps, only a thru receiving (freeway) link may be specified. For exit ramps, two movements, at most, may be specified, one of which must be thru. More complex turn movements from an exit ramp require the placement of a dummy node such that the downstream portion of the ramp may be classified as a surface link. For freeway links, a receiving link for thru movements must be specified plus, at most, one other right or left turn movement to a ramp link.

Network exit links are implicitly specified by setting the node numbers at the downstream end of links receiving the exiting traffic (>700, >800) for (freeway, non-freeway) exits. As specified in the column 1-3 description, corresponding numbers in the 700 and 800 series may not be used. An off-ramp may not be an implied exit link.

<u>Cols.</u>	<u>Description</u>
29 - 30	Location on this freeway link at which drivers begin to react to an upcoming exit or location where early warning sign becomes visible to the motorist; expressed as percent of link length measured from upstream node. 100% is not an allowable value. Signs located at the downstream extremity of a freeway link should be coded as positioned 0% on the succeeding link.
31 - 33	Node locating off-ramp, freeway junction referred to by early warning sign of columns 29-30.
40 - 72	Same as Cols. 1-33 for another links geometry.
79,80	≡02, Card Type.

Link Name Cards - Type 03 (First Subinterval Only - Optional)

<u>Cols.</u>	<u>Description</u>
1 - 3	Node at upstream end of link
4 - 6	Node at downstream end of link
7 - 24	Alphanumeric Link Name
25 - 48 } 49 - 72 }	Same as Cols. 1 - 24 for another link
79,80	≡03, Card Type



Freeway Link Operation Cards - Type 04  
(First Subinterval Only)

<u>Cols.</u>	<u>Description</u>
1 - 3	Node at upstream end of freeway link ( <u>&gt;</u> 700 for freeway entry link).
4 - 6	Node at downstream end of freeway link.
9 - 12	Radius of curvature, feet (0 or blank denotes a straight link).
13	<u>Auxiliary Lane Code for First Auxiliary Lane</u> (Freeway entry links cannot have auxiliary lanes.) =0 or blank: No auxiliary lane =1: Right hand acceleration lane =2: Right hand deceleration lane =3: Right hand full auxiliary lane (Lane Length = Link Length) =4: Left hand acceleration lane =5: Left hand deceleration lane =6: Left hand full auxiliary lane (Lane Length = Link Length)
14 - 18	Lane length (feet) for first auxiliary lane. An acceleration lane extends for the specified distance from the upstream node. A deceleration lane extends for the specified distance from the downstream node. This field need not be specified for code = 3 or 6. To facilitate

Cols.                      Description

the internal logic of SIFT, it is important to correctly categorize the type of auxiliary lane. A deceleration lane is defined as a lane which is not fed directly by a lane in an upstream freeway or ramp link. Its length should be less than the link length. An acceleration lane is defined as a lane which does not feed directly a lane in a downstream freeway or ramp link. Its length should also be less than the link length. Only lanes which connect directly with lanes in both upstream and downstream links may be categorized as full auxiliaries.

19 - 24                      Same as Cols. 13-18 for second auxiliary lane.

27                              Identification of lane entered in through receiving link by vehicles in lane 1 of this link. If through movement is an exit link code a "1" in Col. 27. Lanes are identified as follows:

<u>Lane</u>	<u>ID</u>
Second Auxiliary Left Lane	7
First Auxiliary Left Lane	6
Lane 5	5
Lane 4	4
Lane 3	3
Lane 2	2
Lane 1 (Right-most thru lane)	1
First Auxiliary Right Lane	8
Second Auxiliary Right Lane	9

29 }  
30 }                              Specification of lanes separated by physical barriers which prevent weaving. Insert the lane ID of the right hand lane of each such pair. Thus, two such conditions may be specified for each link.

31 - 32                      Superelevation (percentage).

33                              Pavement code:  
                                     1 - dry concrete; 2 - wet concrete;  
                                     3 - dry asphalt; 4 - wet asphalt  
 Note: default is dry concrete.

<u>Cols.</u>	<u>Description</u>
36 - 39	Distance from upstream node of link for freeway data station (0 if no station), feet.
40 - 78	Same as Cols. 1-39 for another freeway link.
79,80	≡04, card type.

#### Ramp Link Operation Cards - Type 05

If any Card Type 5 is specified after the first subinterval, all variables which may change after the first subinterval should be specified to avoid confusion (e.g. Cols. 7,8-9).

<u>Cols.</u>	<u>Description</u>
1 - 3	Node at upstream end of ramp link.
4 - 6	Node at downstream end of ramp link.
7	"Type" of downstream intersection. Used as index of TLNK array to select appropriate distribution about mean queue discharge headway (default = 1).
8,9	Mean queue discharge headway in tenths of a second (i.e., 24=2.4 seconds). (This field is ignored for on ramps.)
12	Identification of lane entered in through receiving link by vehicles in lane 1 of this link. If through movement is an exit link, code a "1" in Col. 27. Lanes are identified as follows:

<u>Lane</u>	<u>ID</u>
Second Auxiliary Left Lane	7
First Auxiliary Left Lane	6
Lane 5	5
Lane 4	4
Lane 3	3
Lane 2	2
Lane 1 (Right-most thru lane)	1
First Auxiliary Right Lane	8
Second Auxiliary Right Lane	9

<u>Cols.</u>	<u>Description</u>
15 - 18	Radius of curvature (ft). 0 or blank for straight link. (May not be specified after first subinterval.)
19 - 20	Superelevation (%). (May not be specified after first subinterval.)
21	Pavement code: 1 - dry concrete; 2 - wet concrete; 3 - dry asphalt; 4 - wet asphalt. Note: Default is dry concrete. (May not be specified after first subinterval.)
40 - 60	Same as for Cols. 1-21 for another ramp link.
79,80	≡ 05, card type.

#### Surface Link Operation Cards - Type 06

If any card type 6 is specified after the first subinterval, all variables, which may change after the first subinterval, should be specified to avoid confusion (e.g., Cols. 7-12, 23-27).

<u>Cols.</u>	<u>Description</u>
1 - 3	Node at upstream end of urban link ( $\geq 800$ for entry link).
4 - 6	Node at downstream end of urban link.
7	"Type" of downstream intersection (TLNK array index). Default = 1.
8,9	Mean queue discharge headway, in tenths of a second (i.e., 24 = 2.4 seconds).
11,12	Lost time for first vehicle in queue when signal becomes green, in tenths of a second (i.e., 21 = 2.1 seconds). If zero or blank, a default distribution will be used.

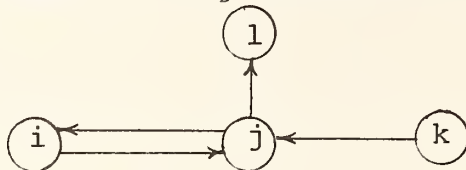


Cols.

Description

13 - 15

Upstream node of link whose thru traffic opposes left turning traffic from this link.



In the diagram link (k,j) opposes left turning traffic from (i,j). Therefore, k would be entered in Cols. 13-15 of the card type 06. Specification for link (i,j). If a link (j,k) exists which receives thru traffic from link (i,j) the model logic would automatically assume that the opposing link was (k,j) if it exists. Cols. 13-15 could be left blank for this case. (May not be specified after first subinterval.)

18

Size of right turn pocket, in number of passenger cars ( $\frac{\text{length}}{20 \text{ feet}} = \text{number of cars}$ ). May not be specified after first subinterval.

21

Size of left turn pocket in number of passenger cars ( $\text{length}/20 = \text{number of cars}$ ). May not be specified after first subinterval.

23

Code denoting channelization of lane 1 (curb lane) on this link.

Code            Channelization

- 0 (blank) Unrestricted
- 1            Reserved for left-turn vehicles
- 3            Closed for this subinterval
- 4            Reserved for right-turn vehicles

Note: Only one lane may be reserved for left turning vehicles and only one lane may be reserved for right turning vehicles.

24

Channelization code for lane 2 (if any).

25

Channelization code for lane 3 (if any).

26

Channelization code for lane 4 (if any).

27

Channelization code for lane 5 (if any).

40 - 66

Same as Cols. 1-27 for another link.

79,80

≡ 06, card type.

Link Turning Movement Cards - Type 08

<u>Cols.</u>	<u>Description</u>
1 - 3	Node at upstream end of link.
4 - 6	Node at downstream end of link.
7 - 9	Percentage of vehicles turning left at downstream node.
10 - 12	Percentage of vehicles traveling through at downstream node.
13 - 15	Percentage of vehicles turning right at downstream node.

For freeway links, turning percentage is applied only to vehicles entering subject link from an upstream freeway link. If an on-ramp enters the freeway at the upstream node of the subject link, all vehicles are assigned as through vehicles.

16 - 30	} Same as Cols. 1-15 for other links.
31 - 45	
46 - 60	
61 - 75	
79,80	≡08, Card Type.

Sign and Signal Control Cards - Type 10

One required for each node other than entry nodes  $\geq 700$ , first subinterval only.

<u>Cols.</u>	<u>Description</u>
1 - 3	Node number
6	Actuated signal index. If the intersection is controlled by signing or fixed time signals then this field should be set = 0 or blank. If a precoded traffic activated control subroutine is to be called, then the index of that routine should be entered here. Subroutine UPSIG calls these routines as required.

The format of the remainder of this card (with the exception of Cols. 79, 80) depends on the contents of Col. 6.

Sign and Fixed Time Control Format (Col. 6 = 0)

7 - 9	Reference offset to Interval 1, sec.(omit for sign control)
10 - 12	Upstream Node Number of approach link number 1
13 - 15	Upstream Node Number of approach link number 2
16 - 18	Upstream Node Number of approach link number 3
19 - 21	Upstream Node Number of approach link number 4

<u>Cols.</u>	<u>Description</u>																				
27	Control Code for signal facing approach link number 1 during Interval 1. <table border="1"> <thead> <tr> <th><u>Code</u></th> <th><u>Meaning</u></th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Yield sign or amber</td> </tr> <tr> <td>1</td> <td>Green</td> </tr> <tr> <td>2</td> <td>Red</td> </tr> <tr> <td>3</td> <td>Red with Green right arrow</td> </tr> <tr> <td>4</td> <td>Red with Green left arrow</td> </tr> <tr> <td>5</td> <td>Stop or Red with right turn permitted after stop</td> </tr> <tr> <td>7</td> <td>No turns - Green thru arrow</td> </tr> <tr> <td>8</td> <td>Red with left and right Green arrows</td> </tr> <tr> <td>9</td> <td>No left turn, Green thru and right</td> </tr> </tbody> </table>	<u>Code</u>	<u>Meaning</u>	0	Yield sign or amber	1	Green	2	Red	3	Red with Green right arrow	4	Red with Green left arrow	5	Stop or Red with right turn permitted after stop	7	No turns - Green thru arrow	8	Red with left and right Green arrows	9	No left turn, Green thru and right
<u>Code</u>	<u>Meaning</u>																				
0	Yield sign or amber																				
1	Green																				
2	Red																				
3	Red with Green right arrow																				
4	Red with Green left arrow																				
5	Stop or Red with right turn permitted after stop																				
7	No turns - Green thru arrow																				
8	Red with left and right Green arrows																				
9	No left turn, Green thru and right																				
28	Control Code for signal facing approach link number 2 during Interval 1.																				
29	Control Code for signal facing approach link number 3 during Interval 1.																				
30	Control Code for signal facing approach link number 4 during Interval 1.																				
31 - 33	Duration of control Interval 1, seconds. (Stop or Yield sign or uncontrolled freeway node: Leave blank.)																				
36 - 42	Same as Cols. 27-33 for control Interval 2. (Only one interval is input for sign control.)																				
45 - 51	Same as Cols. 27-33 for control Interval 3 (if any).																				
54 - 60	Same as Cols. 27-33 for control Interval 4 (if any).																				
63 - 69	Same as Cols. 27-33 for control Interval 5 (if any).																				
72 - 78	Same as Cols. 27-33 for control Interval 6 (if any).																				
79,80	≡ 10, card type.																				



Actuated Control Format (Col 6 > 0)

7 - 9 } Up to 24 parameter values may be specified  
10 - 12 } which will be made available to the particu-  
13 - 15 } lar actuated control subroutine specified  
  . } by the actuated signal index (Col. 6). A  
  : } definition of these parameters for six ramp  
76 - 78 } metering and freeway traffic diversion  
          } algorithms built in to INTRAS follows.

79,80       ≡ 10, Card Type

The first four Actuated Control methods are reserved for on-ramp metering algorithms developed for INTRAS. For all four metering procedures, it is assumed that only one link approaches the node at which metering is applied. This node must be the upstream node of a ramp link. Figure 5 in Section 2.2.8.1 illustrates a typical on-ramp configuration. Metering may be applied at either node C or D in this configuration. If the signal is placed at Node D the ramp link would extend from Node D to B (C would not be required). The general metering procedure alternates some basic signal code (see codes as described for the card type 10 "Sign and Fixed Time Control Format"), with some other more permissive code at a rate established by the particular metering algorithm. For example, at node C a "Basic Code" of 2 (red signal) might be alternated with a "Metered" code of 1 (green signal). "Basic" and "Metered" codes applied at node D might be 7 (green for through movement) and 1 (green signal) respectively.

At the frequency dictated by the prevailing metering rate, the "Metered" code would replace the "Basic" code. A vehicle discharge triggers a return to the "Basic" Code. The contents of Card Type 10 for the ramp metering algorithms are as follows:

Clock Time Ramp Metering (Col 6 = 1)

<u>Cols.</u>	<u>Description</u>
1 - 3	Node number
6	≡ 1, code indicating clock time metering
7	"Basic" signal code
8	"Metered" signal code
9	Movement for which discharging vehicle triggers return to "Basic" signal code, as follows:

	<u>Code</u>	<u>Movement</u>
	0	Left-turn
	1	Through
	2	Right-Turn
12 - 15		Time for onset of clock time metering, in seconds from start of simulation
17, 18		Metering headway, seconds. Signal will be set to "Metered" code at this frequency
79, 80		≡ 10, card type

Demand/Capacity Ramp Metering (Col 6 = 2)

<u>Cols.</u>	<u>Description</u>
1 - 9	Identical to Clock Time Metering Format except that Column 6 ≡ 2 to indicate Demand/Capacity metering
10 - 12	Upstream node of freeway link containing detectors to be used in measuring freeway performance.
13 - 15	Downstream node of freeway link containing detectors to be used in measuring freeway performance
17	Lane containing first detector to be used in measuring freeway volume
18 - 21	Longitudinal position of detector in lane specified in column 17, in feet from upstream node (Col. 10 - 12). This field should be identical to the "Location" specified on the Type 25 (surveillance specification) card for this detector.
23 - 27	These fields identify other detectors on the referenced freeway link to be used in measuring freeway volume. The data format is identical to that of columns 17 through 21.
29 - 33	
35 - 39	
41 - 45	
47 - 51	
53 - 57	

<u>Cols.</u>	<u>Description</u>
59 - 63	Capacity of freeway in vehicles per hour. The sum of volumes traversing the detectors specified in columns 17 through 57 will be compared to this "capacity" to determine a ramp metering headway based on excess capacity.
79, 80	≡ 10, card type

Speed Control Metering (Col 6 = 3)

<u>Cols.</u>	<u>Description</u>
1 - 15	Identical to Demand/Capacity Metering Format except that column 6 ≡ 3 to indicate Speed Control Metering
17	Lane containing detector to be used as indicator of freeway speed
18 - 21	Longitudinal position of detector in lane specified in column 17, in feet from upstream node (col. 10-12). This field should be identical to the "Location" specified on the Type 25 (Surveillance Specification) card for this detector.
23, 24	Speed threshold, miles per hour
26, 27	Metering headway, seconds. Signal will be set to "Metered" code at this frequency if speed (as measured by detector identified in cols. 17 - 21) is below speed threshold specified in cols. 23, 24.
29 - 33 } 35 - 39 }	As for cols. 23 - 27 for second and third speed criteria, if desired. Highest speed criteria must be specified first (i.e. in columns 23 - 27)
79, 80	≡ 10, card type

Gap Acceptance Merge Control (Col 6 = 4)

<u>Cols.</u>	<u>Description</u>
1 - 15	Identical to Demand/Capacity metering format except that column 6 = 4 to indicate Gap Acceptance Merge Control.
17	Lane containing coupled loop detector to be used to measure speed and size of gap in freeway traffic and speed.
18 - 21	Longitudinal position of coupled loop detector in lane specified in column 17, in feet from upstream node (cols. 10 - 12). This field should be identical to the "Location" specified on the Type 25 (Surveillance specification) card for this detector
23, 24	Minimum acceptable gap, tenths-of-a-second
79, 80	= 10, card type

Actuated control methods 5 and 6 are reserved for freeway traffic diversion algorithms developed for INTRAS. Both methods make use of user specified "alternate" paths to which freeway vehicles are diverted. The contents of Card Type 10 for the traffic diversion algorithms are as follows:

Clock Time Diversion (Col 6 = 5)

<u>Cols.</u>	<u>Description</u>
1 - 3	Node number at diversion point on freeway. One freeway link must be the only approach to the specified node. Two links (1 freeway and 1 off-ramp) must depart from the specified node.
6	= 5, code indicating clock time diversion
9 - 12	Time for onset of clock time diversion, in seconds from start of simulation
14 - 15	Percent of through traffic to be diverted to alternate path

<u>Cols.</u>	<u>Description</u>
16 - 18	Nodes defining alternate path of diverted traffic. All nodes along path must be specified starting with the next node after that given in columns 1 - 3. The final node of the alternate path must be either a surface exit $\geq 800$ or a freeway node at the downstream end of an on-ramp.
19 - 21	
22 - 24	
25 - 27	
28 - 30	
⋮	
76 - 78	
79,80	$\equiv 10$ , Card Type.

#### Least Time Path Diversion (Col 6 = 6)

For this method, use subinterval specific statistics (see Col. 72 on the type 01 card). The time evaluations are performed at the end of each subinterval and reflect the travel time for the latest subinterval. Diversion percentage will increase or decrease in increments of 5%, depending upon which route is the fastest.

<u>Cols.</u>	<u>Description</u>
1 - 3	Node number at diversion point on freeway. Defined as for clock time diversion.
6	$\equiv 6$ , code indicating least time path diversion
16 - 18	Nodes defining alternate path of diverted traffic. All nodes along path must be specified starting with next node after that given in columns 1 - 3. The final node of the alternate path must be either a surface exit $\geq 800$ or a freeway node at the downstream end of an on-ramp.
19 - 21	
22 - 24	
25 - 27	
28 - 30	
⋮	
76 - 78	
79,80	$\equiv 10$ , Card Type.

#### Intersection Actuated Traffic Control (Col 6 = 7)

Nodes under intersection actuated traffic control should be described on a type 10 card as follows (implies that type 15, 16 and possibly type 17 cards will be input):

<u>Cols.</u>	<u>Description</u>
1 - 3	Node number where actuated controller is located
6	$\equiv 7$ , code indicating intersection actuated traffic control
79,80	$\equiv 10$ , Card Type.



## Actuated Controller Card - Type 15

A separate input card type 15 must be punched for each actuated controller specified. The data on this card defines all links serviced and/or referenced by this controller. Up to six links may be specified. Generally, most (or all) of the specified links are approaches to the node at which the actuated controller is located. On occasion, one or more of these links may not be approaches to the node specified in Entry 1. These links which are approaches to the node specified in Entry 1 should be specified first, then followed by the other links, if any. Other characteristics of the controller are also specified on this card.

<u>Entry</u>	<u>Cols.</u>	<u>Description</u>
1	1-3	Node number of intersection controlled by an actuated signal controller
2	4-6	Upstream node number of approach number 1 which is serviced by this actuated controller
3	7-9	Downstream node number of approach number 1
4	10-12	Upstream node number of approach number 2 which is serviced by this actuated controller
5	13-15	Downstream node number of approach number 2 which is serviced by this controller
6	16-18	As for entry 2, but for approach number 3
7	19-21	Downstream node number of approach number 3
8	22-24	As for entry 2, but for approach number 4
9	24-27	Downstream node number of approach number 4.

<u>Entry</u>	<u>Cols.</u>	<u>Description</u>
10		Because card type 15 was adopted from the UTCS model version of card type 15, a change had to be made to omit references to approach 5 (INTRAS allows only four approaches to a node). Therefore, entries 10 and 11, which were nodes defining the fifth approach, should not be input.
11		
12	34-36	As for entry 2, but for approach number 6.
13	37-39	Downstream node number of approach number 6.
14	40-42	As for entry 2, but for approach number 7.
15	43-45	Downstream node number of approach number 7.
16	48	Controller Coordination Code, CCC CCC = 0 if controller <u>not</u> coordinated CCC = 1 if controller is coordinated.
17	51	Red rest code: 0 if rest-in-red option not applied; 1 if it is applied.
18	52-54	Value of background cycle length (if CCC = 1).
19	57	Entry Code = 0 if single ring = 1 if dual ring and single entry = 2 if dual ring and dual entry.
20	60	Detector Switching Code = 0 if detector switching feature inactive = 1 if detector switching feature active.
21	79,80	≡ 15 card type.

Entry

Discussion

- 1 Node at which actuated controller is located.
- 2 Upstream node of approach number 1 which is serviced by, and/or referenced by, this controller
- 3 Downstream node of approach number 1
- 4,6,8, Similar to entry 2 specifying the respective up-  
12,14 stream nodes of approach numbers 2,3,4,6, and 7.
- 5,7,9, Similar to entry 3 specifying the respective  
13,15 downstream nodes of approach numbers 2,3,4,6,  
and 7.
- 16 If CCC = 1, the following conditions must apply:  
a) This is a single-ring controller  
b) Phase 1 is non-actuated  
Hence, all coordinated controllers are single-  
ring controllers only.
- 17 The rest-in-red feature, if provided (code = 1),  
will terminate the active phase in the absence of  
traffic demand. If no calls are issued (i.e.,  
there are no detector actuations and all recall  
switches are "off"), all phases will be inactive  
and display a red indication. If this feature is  
not provided (code = 0), the current active phase  
will remain active in the absence of a call from  
a competing phase.
- 18 All coordinated controllers (CCC=1), entry 16  
are cycle-based. This entry is the value of the  
cycle length for this controller.
- 19 A dual-ring controller has to basic entry options:  
Single Entry (code = 1)  
Dual Entry (code = 2).

Consider the case of a dual-ring controller.  
When a barrier is crossed, and one or more calls  
have been issued by a phase on only one ring, the  
response of the controller depends on its entry  
option. If a single-entry controller, only the

Entry

Discussion

[first] called phase is activated; no phase on the other ring is activated. For the dual-entry option, the first phase beyond the barrier on the ring where no call was issued, will also be activated.

- 20 The detector switching feature is only available for dual ring controllers. This feature can become active under the following conditions:
- a) Two phases, one on each ring, must be active
  - b) Both phases must be just prior to a barrier
  - c) One phase (call it phase A) has "gapped out" or exceeded its maximum permitted duration, while the other (call it phase B) is still active. Note that since phases A and B are both at the barrier, both must terminate simultaneously. Since phase B is servicing a continuing demand, both A and B must be continued in an active status. When the detector switching feature is active, any subsequent actuations associated with phase A will be "switched" to phase B. That is, such actuations will be interpreted by the controller as having been generated by those detectors directly servicing phase B. If this feature is not available, the actuations associated with phase A will not contribute toward extending phase B and will serve no immediate control function at all.
- 21 This input, 15, must be punched (Card Type).

Phase Card - Type 16

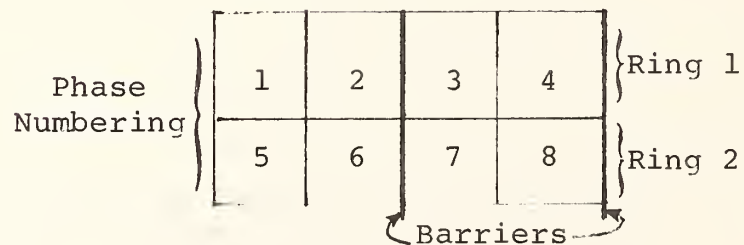
Each phase on each actuated controller is defined by a separate input card type 16. The data on this card defines the operating characteristics of this phase.

<u>Entry</u>	<u>Cols.</u>	<u>Description</u>	
1	1-3	Node Number	
2	6	Phase Number (1,2, ..., 8)	
3	9	Phase Actuation Code, PAC	
Phase Non-Actuated	4	10-12	Yield Point - Beginning of Yield Interval, seconds
	5	13-15	End of Yield Interval, seconds
	6	16-18	Offset, seconds
Phase Actuated	4	10-12	Force-off Point, seconds
	5	14-15	Minimum Initial Interval, seconds
	6	18	Initial Interval Code, IIC
7	20-21	Initial Interval Code, IID	
8	23-24	Initial Actuation Data, IAD	
9	26-27	Passage Time, tenths-of-a-second	
10	29-30	Minimum gap (unit extension), tenths-of-a-second	
11	32-33	Time to reduce to minimum gap, seconds	
12	35-36	The controller reduces the gap by the amount GG, every TT seconds. This entry is GG, tenths-of-a-second	
13	38-39	This is the time, TT, between reductions in gap, tenths-of-a-second	



<u>Entry</u>	<u>Cols.</u>	<u>Description</u>
14	41-42	The gap (unit extension) is reduced by this amount (tenths-of-a-second) every second
15	44-45	Maximum Extension, seconds
16	47-48	Maximum Green, seconds
17	51	Amber Duration, seconds
18	54	Red Clearance Duration, seconds
19	57	Red Revert Time, seconds
20	60	Recall Switch Code
22	66	Inhibit Maximum Termination Code
23	69	Overlap Code
24	79,80	≡ 16 Card Type

<u>Entry</u>	<u>Discussion</u>
1	Internal node number at which actuated controller is located.
2	Phase Number. If on Ring 1, it can be 1,2,3, or 4. If on Ring 2, it can be 5,6,7, or 8:



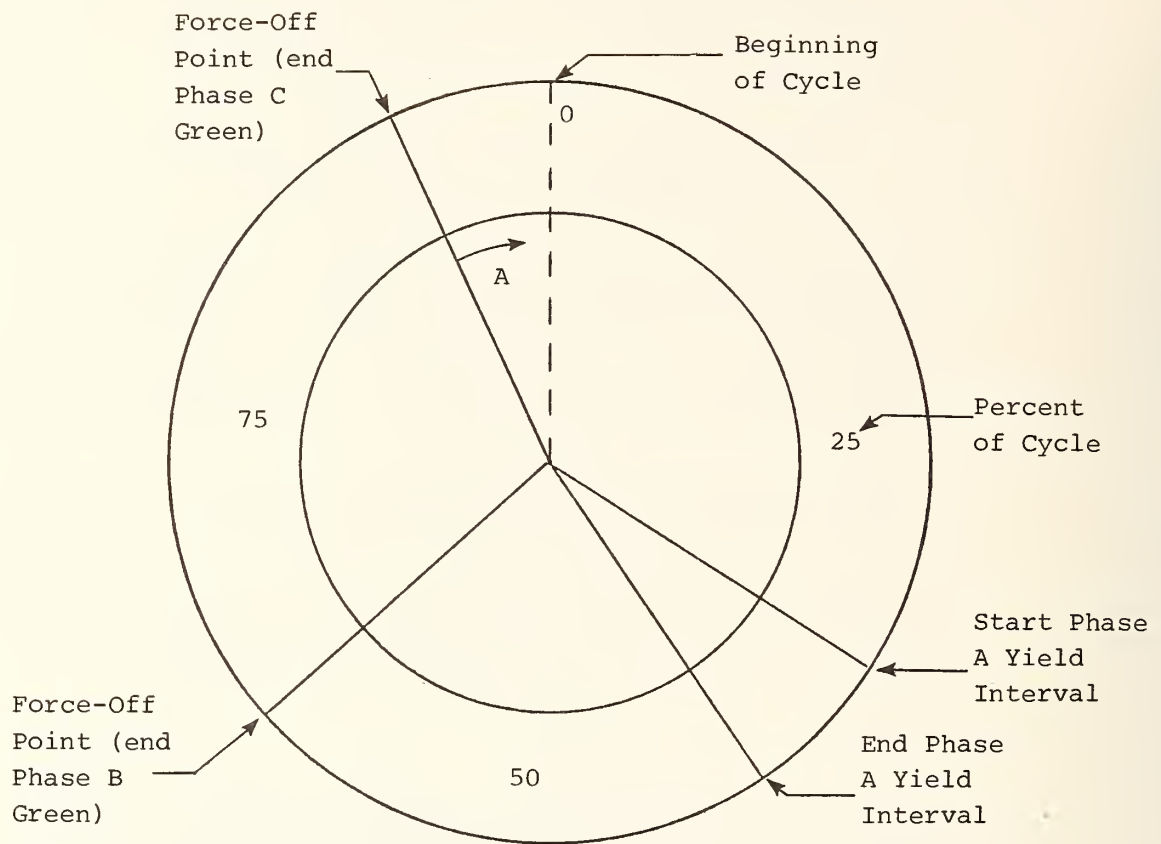
Entry

Discussion

- 3 The Phase Actuation Code, PAC, is set to 1 if this phase is not actuated; set to 0 if it is. An actuated phase must refer to at least one detector assigned to activate the Initial Interval.

Entries 4-6 If Phase Is Not Actuated  
and Controller is Coordinated

- 4 The Yield Point is the beginning of the Yield Interval and marks the end of the time period during which a non-actuated phase cannot be terminated. The time period is measured from:
- The beginning of the cycle if the controller is coordinated, i.e., CCC=1. If so, the non-actuated phase must be Phase 1.
  - The beginning of this phase if the controller is not coordinated, i.e., CCC=0.
- If a call has been issued by a competing actuated phase prior to the yield point, or if the recall switch of a competing phase is on, the non-actuated phase will be terminated at the yield point.
- 5 End of Yield Interval, measured as above. This input must be equal to or greater than that of Entry 4 (see Figure 7) for location of the yield interval). If, during the yield interval, a call is received from a detector servicing a competing phase, this phase will terminate. If, on the other hand, such a call is issued after the end of the yield interval, this non-actuated phase will remain active throughout the cycle.
- 6 Offset, if CCC=1 and this is Phase 1. Blank otherwise. If the controller is coordinated, only a single-ring controller is treated by this logic.



- Notes:
1. Phase A is non-actuated, Phases B and C are actuated.
  2. For each phase, specify its yield points or force-off point, in seconds.
  3. For two-phase operation, there will be only one force-off point (located approximately at the position shown above for forcing-off Phase C green).

Figure 7: Yield and Force-Off for Coordinated Three-Phase Semi-Actuated Controller Operation

Entries 4-6 If Phase Is Not Actuated  
and Controller Is Not Coordinated

<u>Entry</u>	<u>Discussion</u>
4	Same as above. The Yield Interval extends indefinitely until a call is received from a competing actuated phase. At this time, the non-actuated phase is terminated.
5,6	Not applicable; leave blank. Note: all controllers with a non-actuated phase must be single-ring controllers only. If the phase is non-actuated, all of the following entries on this card <u>must</u> be blank with the exceptions of Entries 17, 18 and 24.

Entries 4-6 If Phase Is Actuated

4	Force-off Point is the point in time when an actuated phase must terminate. It is measured from the beginning of the cycle if controller is coordinated, CCC=1. Not applicable if controller is not coordinated (see Figure 7).
5	Duration of Minimum Initial Interval (MII), sec.
6	Initial Interval Code, IIC = 0,1,2, or 3 IIC = 0 if the initial interval is constant; its duration is specified in Entry 5 IIC = 1 if the "Added Initial" option is selected IIC = 2 if the "Computed Initial" option is selected IIC = 3 if the "Extensible Initial" option is selected. For the "Added Initial" option (IIC=1), the controller adds a specified amount of time (Entry 8) to the minimum initial interval (Entry 5) for every recorded actuation above a specified value (Entry 7). For the "Computed Initial" option (IIC=2), the controller computes the Initial Interval

$$\left( \frac{\text{Entry 7}}{\text{Entry 8}} \times \text{no. of recorded actuations} \right)$$

Entry

Discussion

subject to the specified minimum (Entry 5) and maximum (Entry 7) constraints.

For the "Extensible Initial" option (IIC=3), the controller adds a specified amount of time (Entry 8) to the minimum initial interval (Entry 5) for every recorded actuation, subject to a specified maximum (Entry 7).

These variations probably reflect the different hardware designs available in the field. They are included since each is represented in the NEMA specifications.

- 7 Initial Interval Data (IID) depends on the value assigned to IIC in Entry 6.  
IIC = 0, leave blank  
IIC = 1, this input is the number of actuations (vehicles) accumulated that can be serviced during the Minimum Initial Interval. Only if this number is exceeded will the controller provide added initial interval time  
IIC = 2 or 3, this input is the maximum initial interval, sec.
- 8 Initial Actuations Data (IAD) depends on the value assigned to the IIC in Entry 6.  
IIC = 0, leave blank  
IIC = 1 or 3, this input is the duration of the "added" initial time (tenths-of-a-second) to be added to the minimum initial interval for every vehicle actuation  
IIC = 2, this input is the number of actuations required to attain the maximum value of initial interval that is specified in Entry 7.
- 9 The (initial) passage time is the travel time for a vehicle to move from the detector through the intersection. It is also the maximum value of lane-specific inter-vehicular gap (unit extension) when the detectors for this controller are of the passage type.



Entry

Discussion

- 10 Minimum gap (unit extension), tenths-of-a-second is only applicable if the controller is of volume-density type. If so, then either  
a) Entry 11 must be specified or  
b) Entries 12 and 13 must be specified or  
c) Entry 14 must be specified.  
If neither a), b) or c) is specified, Entry 10 should be left blank, since there is no gap reduction for this controller.
- 11 This is the time over which the controller will reduce the unit extension from its maximum value (Entry 9) to its minimum value (Entry 10).
- 12,13 The user may specify that the gap (unit extension) may be reduced by a specified amount, GG, for every specified time interval, TT.
- 14 The rate per second that the gap (unit extension) is reduced, in tenths-of-a-second per second.  
Note: The following combinations of the prior five entries may be specified:  
10 and 11; 10, 12 and 13; 10 and 14; none of these (10-14: blank).  
No other combinations are permitted; they would be redundant and possibly incompatible.
- 15 Maximum green extension is the maximum duration of "service green"; duration of green beyond the end of the initial interval.
- 16 Maximum green phase is the maximum duration of the sum of all green intervals: initial + added initial (if any) + service green.  
Note: Either Entry 15 or 16 may be specified-- not both. The timer does not start until a call is received for a competing phase.
- 17,18
- 19 These are fixed interval durations.

Entry

Discussion

- 20 This code is set to zero if the recall switch is off; set to 1 if it is on. If the switch is on, this phase will always be activated by the controller in its turn. In this case, the phase duration will be at least the duration of the minimum initial interval, regardless of any vehicle actuations. If the switch is off, the phase can only be activated if a call is received via a detector actuation.
- 22 This code is only set to 1 when no upper bound is desired on all phases of this ring.
- 23 Overlap code indicates whether this phase overlaps the next one, the previous one, neither, or both:  
Code = 0, this phase overlaps no other  
= 1, this phase overlaps prior phase  
= 2, this phase is overlapped by the next phase  
= 3, this phase overlaps prior phase and is overlapped by the next phase.  
This code applies only for a single ring controller.
- 24 Must always be punched: 16.

Phase Operations Card - Type 17

These cards define the signal indications associated with the specified phase as well as the location of all detectors which provide actuations affecting the phase.

<u>Entry</u>	<u>Cols.</u>	<u>Description</u>
1	1-3	Node number at which actuated controller is located.
2	6	Phase Number.

<u>Entry</u>	<u>Cols.</u>	<u>Description</u>
3	9	Signal code identifying the signal indication servicing approach number 1 on card type 15 during this phase.
4	12	As for Entry 3, for approach number 2.
5	15	As for Entry 3, for approach number 3.
6	18	As for Entry 3, for approach number 4.
7		Because card type 17 was adopted from the UTCS model version of card type 17, a change had to be made to omit references to approach 5 (INTRAS allows only four approaches to a node). Therefore, Entry 7, which was signal code for the fifth approach, should not be input.
8	23	Approach number as specified on card type 15 identifying the detector located in the next entry.
9	24	Lane of link specified in Entry 8 which contains this detector. Actuations of this detector issue calls for this phase when it is <u>inactive</u> . This detector is assumed to be 60 feet from the stop line.
10,11	26,27	As for Entries 8,9 for another detector.
12,13	29,30	As for Entries 8,9 for another detector.
14,15	32,33	As for Entries 8,9 for another detector.
16,17	35,36	As for Entries 8,9 for another detector.
18,19	38,39	As for Entries 8,9 for another detector.
20,21	41,42	As for Entries 8,9 for another detector.
22,23	44,45	As for Entries 8,9 for another detector.

<u>Entry</u>	<u>Cols.</u>	<u>Description</u>
24	47	Approach Number identifying detector located in the next entry.
25	48	Lane of link specified in Entry 24 which contains the detector which times the arrival of vehicles, <u>relative to the unit extension</u> . Actuations of this detector issue call for this phase when it is <u>active</u> . If there is more than one detector in lane, it is assumed to be the one farthest upstream.
26,27	50,51	As for Entries 24,25 for another detector.
28,29	53,54	As for Entries 24,25 for another detector.
30,31	56,57	As for Entries 24,25 for another detector.
32,33	59,60	As for Entries 24,25 for another detector.
34,35	62,63	As for Entries 24,25 for another detector.
36,37	65,66	As for Entries 24,25 for another detector.
38,39	68,69	As for Entries 24,25 for another detector.
40	79,80	≡ 17 card type.

<u>Entry</u>	<u>Discussion</u>
1	Self-explanatory.
2	This is the subject phase.
3	Signal code which defines the signal indication provided by this phase servicing Approach No. 1 (Entries 2 and 3 on card type 15).

<u>Entry</u>	<u>Discussion</u>
4,5,6	Similar to Entry 3. The relevant links are those identified as Link Nos. 2,3 and 4, respectively, on card type 15.
8	This entry defines the approach number (1,2, ..., 7) identified on card type 15 which locates the detector referenced in Entry 9.
9	This entry defines the lane in which a detector is located that services this phase when it is <u>inactive</u> . This detector is located on the <u>approach</u> identified in Entry 8. As such, the vehicle actuations sensed by this detector are aggregated by the logic for the purpose of: <ul style="list-style-type: none"> <li>1) Issuing a "call" for this phase</li> <li>2) Calculating the duration of the initial interval.</li> </ul> <p>The Link No. of Entry 8 corresponds to the link sequencing defined on card type 15.</p>
24,25	This pair of entries defines the location (link and lane) of a detector that services this phase when it is active. As such, the vehicle actuations sensed by this detector are processed to calculate inter-arrival gaps. The Link No. of Entry 24 corresponds to the link sequencing defined on card type 15.
40	The input 17 must be punched.



Volume Card - Type 20

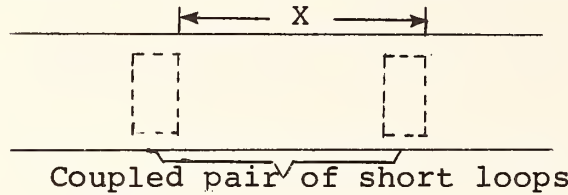
<u>Cols.</u>	<u>Description</u>
1 - 3	Node at upstream end of link. This Node number must be $\geq 700$ .
4 - 6	Node at downstream end of link.
8 - 12	Flow rate expressed in veh./hr.
13 - 15	% of vehicle Type 2
16 - 18	% of vehicle Type 3
19 - 21	% of vehicle Type 4
22 - 24	% of vehicle Type 5
	} high performance passenger car
	} intercity bus
	} heavy single unit truck
	} trailer truck
	The balance of vehicles not assigned to vehicle Type 2 through 5 will be considered as Type 1, low performance passenger cars.
26 - 27	% of vehicles assigned to Lane 2
28 - 29	% of vehicles assigned to lane 3
30 - 31	% of vehicles assigned to lane 4
32 - 33	% of vehicles assigned to lane 5
	The balance will be assigned to lane 1. If all the above fields are blank, then vehicles will be distributed evenly across all lanes (not including auxiliary lanes). Cols. 26-33 are not an input for surface entries.
40 - 72	Same as Cols. 1-33 for another link
79, 80	$\equiv$ 20 Card Type

Surveillance Specification Cards - Type 25

(Not for entry links. First subinterval only.)

<u>Cols.</u>	<u>Description</u>																				
1 - 3	Node at upstream end of link																				
4 - 6	Node at downstream end of link																				
7 - 11	Location of detector expressed as distance of downstream end of detector (downstream detector for coupled pair) from upstream node, in feet, or acquisition point for doppler radar																				
12	Detector Type Code <table><thead><tr><th><u>Code</u></th><th><u>Detector</u></th></tr></thead><tbody><tr><td>0</td><td>Doppler Radar</td></tr><tr><td>1</td><td>Short Loop</td></tr><tr><td>3</td><td>Coupled pair of short loops</td></tr></tbody></table>	<u>Code</u>	<u>Detector</u>	0	Doppler Radar	1	Short Loop	3	Coupled pair of short loops												
<u>Code</u>	<u>Detector</u>																				
0	Doppler Radar																				
1	Short Loop																				
3	Coupled pair of short loops																				
13, 14	Effective loop length (feet). Each loop of a coupled pair has the same effective loop length. This field is ignored for doppler radar detectors																				
15	Lane code of detector. <table><thead><tr><th><u>Code</u></th><th><u>Lane</u></th></tr></thead><tbody><tr><td>1</td><td>1</td></tr><tr><td>2</td><td>2</td></tr><tr><td>3</td><td>3</td></tr><tr><td>4</td><td>4</td></tr><tr><td>5</td><td>5</td></tr><tr><td>6</td><td>First auxiliary left lane of left turn pocket</td></tr><tr><td>7</td><td>Second auxiliary left lane</td></tr><tr><td>8</td><td>First auxiliary right lane or right turn pocket</td></tr><tr><td>9</td><td>Second auxiliary right lane</td></tr></tbody></table>	<u>Code</u>	<u>Lane</u>	1	1	2	2	3	3	4	4	5	5	6	First auxiliary left lane of left turn pocket	7	Second auxiliary left lane	8	First auxiliary right lane or right turn pocket	9	Second auxiliary right lane
<u>Code</u>	<u>Lane</u>																				
1	1																				
2	2																				
3	3																				
4	4																				
5	5																				
6	First auxiliary left lane of left turn pocket																				
7	Second auxiliary left lane																				
8	First auxiliary right lane or right turn pocket																				
9	Second auxiliary right lane																				

<u>Cols.</u>	<u>Description</u>
17,18	Distance, X, separating coupled pairs of short loops, in feet, measured as shown below. This field is ignored for other type detectors.



19 - 30 } 31 - 42 } 43 - 54 } 55 - 66 }	Same as Cols. 7-18 for other detectors on this link.
--	--

68,69	Station number for detectors input on this card ( $\leq 50$ ). If left blank, no station number will be assigned to this (group of) detector(s). If it is desired to assign different station numbers for other detectors on this link, they should be input on another type 25 card. If more than five detectors on this link are to be assigned the same station number, they should be input on another type 25 card with the same station number in Cols. 68-69.
-------	--

79,80	$\equiv 25$ , card type.
-------	--------------------------

Note: More than one of these cards may be specified for each link.

Incident Specification Cards - Type 30 (freeway links only)

All incidents for all subintervals should be input with the first subinterval data. See discussion which follows the card format description for recommended incident generation procedures.

<u>Cols.</u>	<u>Description</u>								
1 - 3	Node at upstream end of link								
4 - 6	Node at downstream end of link								
7	Incident Code for Lane 1								
	<table><thead><tr><th><u>Code</u></th><th><u>Effect</u></th></tr></thead><tbody><tr><td>0</td><td>Normal speed</td></tr><tr><td>1</td><td>Traffic capacity reduced at point of incident by amount specified by "rubber neck" factor</td></tr><tr><td>2</td><td>Blockage at point of incident</td></tr></tbody></table>	<u>Code</u>	<u>Effect</u>	0	Normal speed	1	Traffic capacity reduced at point of incident by amount specified by "rubber neck" factor	2	Blockage at point of incident
<u>Code</u>	<u>Effect</u>								
0	Normal speed								
1	Traffic capacity reduced at point of incident by amount specified by "rubber neck" factor								
2	Blockage at point of incident								
8	Incident Code for Lane 2								
9	Incident Code for Lane 3								
10	Incident Code for Lane 4								
11	Incident Code for Lane 5								
12	Incident Code for first left auxiliary lane								
13	Incident Code for second left auxiliary lane								
14	Incident Code for first right auxiliary lane								
15	Incident Code for second right auxiliary lane								
17 - 21	Longitudinal location of upstream end of incident in feet from upstream node.								
22 - 24	Length of roadway affected by incident, feet								

26 - 30	Time of onset in seconds measured from the start of simulation
33 - 36	Duration of incident, seconds
37 - 39	Rubberneck Factor. % reduction in capacity at point of incident for vehicles in lanes with Incident codes = 1
40 - 78	Same as Col. 1 - 39 for another incident
79, 80	≡ 30, Card Type

The user should follow certain basic rules in coding an idealized blockage type incident.

First, the length of roadway blocked should be determined. In general, the number of vehicles involved plus 1, multiplied by a nominal vehicle length (20 feet), is a reasonable predictor of affected roadway length. For example, a two vehicle collision would be well represented by a 60-foot blockage.

Second, rubbernecking should be specified for the non-blocked lanes. A rubberneck factor of 10% has been shown to be appropriate in simulation of Los Angeles incident data sets.

Third, a secondary incident, consisting of rubbernecking only, should extend downstream from the primary incident. The length of roadway affected should be the same as for the primary incident.



Embedded Data Change Card Formats:  
Card Types 35 through 49

To reduce to a minimum the total volume of input coding which must be prepared and coded by the user, certain values are incorporated directly into the model. Provision is made for convenient updating of these inputs by the user if he feels that it is necessary. The following fifteen types are for input of changes to the INTRAS embedded calibration data. The program variable names are used here as descriptors. See Appendix C for detailed description.

Card Type 35

<u>Cols.</u>	<u>Description</u>	
3	Index of JMPG array, $I \leq 5$ .	
4 - 6	JMPG(I).	
9 - 12 } 15 - 18 } 21 - 24 } 27 - 30 }	Same as Cols. 3-6 for other elements of JMPG array to be changed.	
31 - 33		ILT; leave blank for no change.
34 - 36		IRT; leave blank for no change.
37 - 39		IALAG; leave blank for no change.
42	Index of JERK array, $I \leq 5$ .	
43 - 45	JERK(I).	
48 - 51 } 54 - 57 } 60 - 63 } 66 - 69 }	Same as Cols. 42-45 for other elements of JERK array to be changed.	
79 - 80		$\equiv 35$ , Card Type.

Card Type 36

<u>Cols.</u>	<u>Description</u>	
3	Index of SPLPCT array, $I \leq 4$ .	
4 - 6	SPLPCT(I).	
9 - 12 15 - 18 21 - 24	Same as Cols. 3-6 for other elements of SPLPCT array to be changed.	
27		Index of CLEN array, $I \leq 5$ .
28 - 30		CLEN(I)
33 - 36 39 - 42 45 - 48 50 - 54	Same as Cols. 27-30 for other elements of CLEN array to be changed.	
79, 80		$\equiv 36$ , card type.

Card Type 37

1 - 3 4 - 6 7 - 9 . . . 28 - 30	Elements of LSLAG array; LSLAG(1) through LSLAG(10). If any are entered, all must be included.		
31 - 33 34 - 36 . . . 58 - 60		Elements of ITGAP array; ITGAP(1) through ITGAP(10). If any are entered, all must be included.	
79, 80			$\equiv 37$ , card type.

Card Type 38

<u>Cols.</u>	<u>Description</u>
1 - 3	Elements of IAMBR array; IAMBR(1) through IAMBR(10). If any are entered, all must be included in ascending order.
4 - 6	
7 - 9	
.	
.	
28 - 30	
31 - 33	Elements of IGAP array; IGAP(1) through IGAP(10). If any are entered, all must be included in descending order.
34 - 36	
37 - 39	
.	
.	
58 - 60	
79, 80	≡38, card type.

Card Type 39

3	Index of IGRVAL array, $I \leq 5$ .
4 - 6	IGRVAL(I)
9 - 12	Same as Cols. 4-6 for other elements of IGRVAL array to be changed.
15 - 18	
21 - 24	
27 - 30	
	Note: Elements of IGRVAL must be in ascending order.
33	Index of MINAC array, $I \leq 5$ .
34 - 36	MINAC(I)
39 - 42	Same as Cols. 33-36 for other elements of MINAC array to be changed.
45 - 48	
51 - 54	
57 - 60	
79, 80	≡39, card type.

Card Type 40

<u>Cols.</u>	<u>Description</u>
1 - 3 } 4 - 6 } . } . } . } 28 - 30 }	Elements of VFH array; VFH(1) through VFH(10). Must sum to 1000, ascending order. If any are entered, all must be included.
31 - 33 } 34 - 36 } . } . } . } 58 - 60 }	Elements of VFHF array; VFHF(1) through VFHF(10). Must sum to 1000, ascending order. If any are entered, all must be included.
79, 80	≡40, card type.

Card Type 41

3	Index of TLNK array, $I \leq 9$ .
4 - 6 } 7 - 9 } . } . } . } 31 - 33 }	Elements of TLNK array; TLNK (I,1) through TLNK(I,10). Must sum to 1000. If any are entered, all must be included
34 - 36	TLNK(I,21); leave blank for no change.
37 - 39	TLNK(I,22); leave blank for no change.
40 - 42	TLNK(I,23); leave blank for no change.
43 - 45	TLNK(I,24); leave blank for no change.
46 - 48	TLNK(I,25); leave blank for no change.
49 - 51	TLNK(I,26); leave blank for no change.
79, 80	≡41, card type.

Card Type 42

<u>Cols.</u>	<u>Description</u>	
3	Index of TLNK array; $I \leq 9$ .	
4 - 6 7 - 9 . . . 31 - 33	Elements of TLNK array; TLNK(I,11) through TLNK(I,20). If one is entered, all must be included.	
79, 80		≡42, card type.

Card Type 43

3	Index of FOLK array; $I \leq 10$	
4 - 6	FOLK(I)	
9 - 12 15 - 18 21 - 24 27 - 30 33 - 36 39 - 42 45 - 48 51 - 54 57 - 60	Same as Cols. 3-6 for other elements of FOLK array to be changed.	
79, 80		≡43, card type.

Card Type 44

3	Vehicle type index of LIMSPD array; $I \leq 5$ .
4 - 6	Grade code index of LIMSPD array; $J \leq 4$ .
7 - 9	LIMSPD(I,J)



Card Type 44 - continued

<u>Cols.</u>	<u>Description</u>
10 - 18	Same as for 1-9 for other elements of LIMSPD array to be changed
19 - 27	
28 - 36	
37 - 45	
46 - 54	
55 - 63	
64 - 72	
79 - 80	≡44, card type.

Card Type 45

1 - 3	Vehicle type index of MAXAC array, $I \leq 7$
	Note: for $I = 1$ or $2$ , input freeway accelerations for autos
	for $I = 6$ or $7$ , input non-freeway accelerations for autos (types 1 and 2)
4 - 6	Grade index of MAXAC array, $J \leq 5$ .
7 - 9	Speed index of MAXAC array, $K \leq 5$ .
10 - 12	MAXAC (I,J,K)
13 - 24	Same as Col. 1-12 for other elements of MAXAC array to be changed.
25 - 36	
37 - 48	
49 - 60	
61 - 72	
79 - 80	≡45, card type.

Card Type 46

<u>Cols.</u>	<u>Description</u>
1 - 3	Vehicle type index of CSTDCL array, $I \leq 5$
4 - 6	Speed index of CSTDCL array, $J \leq 3$
7 - 9	CSTDCL (I,J)
10 - 18	Same as 1-9 for other elements of CSTDCL array to be changed
19 - 27	
28 - 36	
37 - 45	
46 - 54	
55 - 63	
64 - 72	
79 - 80	$\equiv 46$ , card type.

Card Type 47

1 - 3	Total number of lanes (section width) $2 \leq I \leq 5$
4 - 6	LNMNSP (I-1,1) Value for Lane 1 of I
7 - 9	LNMNSP (I-1,2) Value for Lane 2 of I
10 - 12	LNMNSP (I-1,3) Value for Lane 3 of I
13 - 15	LNMNSP(I-1,4) Value for Lane 4 of I
16 - 18	LNMNSP (I-1,5) Value for Lane 5 of I
19 - 36	Same as columns 1-18 for another section width of LNMNSP to be changed
37 - 54	
55 - 72	

If one value is changed then all values for that section width must be changed (must sum to  $I*100$ )

Card Type 48

<u>Cols.</u>	<u>Description</u>
1 - 3	Total number of lanes (section width) $2 \leq I \leq 5$
4 - 6	ITPCT (I-1,1) % commercial vehs. in lane 1
7 - 9	ITPCT (I-1,2) % commercial vehs. in lane 2
10 - 12	ITPCT (I-1,3) % commercial vehs. in lane 3 (if $I \geq 3$ )
13 - 15	ITPCT (I-1,4) % commercial vehs. in lane 4 (if $I \geq 4$ )
16 - 18	ITPCT (I-1,5) % commercial vehs. in lane 5 (if $I \geq 5$ )

19 - 36 }  
37 - 54 } Same as columns 1-18 for another section  
55 - 72 } width of ITPCT array to be changed

If one value is changed, than all values for that section width must be changed. The values for each section width must sum to 100.

79 - 80       ≡ 48, card type.

Card Type 49

3	Index of IFCOEF, $I \leq 9$
4 - 6	IFCOEF(I)
9 - 12 } 15 - 18 } 21 - 24 } 27 - 30 } 33 - 36 } 39 - 42 } 45 - 48 } 51 - 54 }	Same as 3-6 for other elements of IFCOEF array to be changed
55 - 57	Amount of time to complete a lane-change maneuver in tenths-of-a-second.

<u>Cols.</u>	<u>Description</u>
58 - 60	Minimum separation in tenths-of-a-second for generation of freeway vehicles.
61 - 63	Lane change probability in percent.
64 - 66	Minimum non-emergency freeway acceleration in tenths of a foot per second per second.
67 - 69	Percent of drivers desiring to yield right of way.
70 - 72	Lag to accelerate in tenths of a second.
73 - 75	Lag to decelerate in tenths of a second.
	Note: For Cols. 55-75 any blank or zero fields will be ignored and default values will be preserved..
79,80	≡49, card type.

## Output of Simulation Vehicle Trajectory Card - Type 50

(Only one of these cards is allowed per SIFT simulation. It must be included with the first subinterval data.) The model will output the requested data on the INPLOT data tape for subsequent treatment by the INPLOT module.

<u>Cols.</u>	<u>Description</u>
1-3	Time step at which vehicle positions will be output, sec. This value must be greater or equal to the simulation time step specified on the Type 00 card.
7 - 9	These fields contain the sequence of nodes, describing the roadway section for which trajectory data is to be output. Each consecutive pair of nodes must represent a freeway link. If two (or more) non-contiguous roadway sections are to be stored, then a zero (or blank) field should be left between the sequences. Plots are not automatically generated by virtue of the data specified on these cards. They only serve to specify which data is to be retained.
10 - 12	
16 - 18	
.	
.	
.	
.	
76 - 78	
79, 80	≡ 50, Card Type



Output of Simulation Contour MOE Card-Type 51

(Only one of these cards is allowed per SIFT simulation. It must be included with the first subinterval data.) The model will output the requested data on the INPLOT data tape for subsequent treatment by INPLOT.

<u>Cols.</u>	<u>Description</u>
1 - 3	Time step at which MOE data will be output, minutes
4 - 6	Spacing for contour MOE evaluations, feet. (Minimum = 100). The model will generate detectors, throughout the roadway sections of study, at the specified spacing. The basic MOE values will be stored on the INPLOT data tape for each detector station at the frequency dictated by the time step (Col.1-3).
7 - 9	These fields contain the sequence of nodes describing the freeway section for which MOE contour data is to be output. If two (or more) non-contiguous roadway sections are to be stored, then a zero (blank) field should be left between the respective node sequences. Plots are not automatically generated by virtue of the data specified on these cards. They serve only to specify which data is to be retained.
10 - 12	
13 - 15	
16 - 18	
.	
76 - 78	
79,80	≡ 51, Card Type

On-line Incident Detection Specification Card - Type 55

(Only one of these cards is permitted per SIFT simulation. It must be included with the first subinterval data.)

<u>Cols.</u>	<u>Description</u>
1 - 3	Polling frequency (number/sec.) for digital detectors only. Default value = 10.
4 - 6	Analog/digital flag 0 digital mode 1 analog mode
7 - 12	Evaluation frequency for incident detection expressed as number of freeway time steps between re-evaluations. Note: If on-line incident detection is desired, a freeway time step of 10 tenths-of-a-second must be specified in Cols. 64-66 of card type 00.
22 - 24	Number of parameters to be input on type 56 card for incident detection algorithm specified in Col. 75 of the type 56 card. Must be $\leq 18$ .
56,57	Assumed average vehicle length for incident detection, feet.
79,80	$\approx 55$ , card type.

On-line Incident Detection Algorithm  
Parameter Card - Type 56

Up to two type 56 cards may be input for each incident detection algorithm indicated on card type 55; parameters 1-9 on the first and 10-18 on the second. Parameters for each incident detection algorithm must start on a new type 56 card. Table 8 presents samples of the incident detection parameters.

<u>Cols.</u>	<u>Description</u>
1 - 8 } 9 - 16 } : : 65 - 72 }	Parameters (in floating point) for algorithm specified in Col. 75.
75	Incident detection algorithm to be applied (<3). If two type 56 cards are input for this algorithm, the second need not specify an algorithm number in this column.
79,80	≅56, card type.

On-line Incident Detection Detector Station  
Identification Card

Up to two type 57 cards may be input.

<u>Cols.</u>	<u>Description</u>
1 - 3 } 4 - 6 } . : : 73 - 75 }	Station numbers to be used for incident detection. Must be input in upstream to downstream order. If there are two or more disconnected freeway sections, the station number sequences representing these sections must be separated by a zero.
79,80	≅57, card type.

Table 8: Incident Detection Parameter Definitions and Examples

Parameter Number	ALGORITHM		
	1	2	3
1	Threshold of occupancy difference across successive sensor positions (8.0*)	Number of compression wave suppression periods (2.0)	$P_1 = (1,2)$ The occupancy feature to be used: $P_1=1$ , Change in occupancy between sensor positions $P_1=2$ , Percent change in occupancy over time
2	Threshold of percent occupancy difference across successive sensor positions (50.0)	$T_1$ , Threshold of occupancy difference across successive sensor positions (13.0)	$P_2$ , Exponential smoothing coefficient (from zero to one)
3	Threshold of percent occupancy difference at the downstream sensor over time (8.0)	$T_2$ , Threshold of percent occupancy change at the downstream sensor over time (-30.0)	$P_3$ , The incident threshold value (5.0)
4		$T_3$ , Threshold of percent occupancy difference across successive sensor positions (31.0)	$P_4$ , Absolute deviate smoothing coefficient (0.0,1.0)
5		$T_4$ , Threshold of occupancy at the downstream sensor position (16.0)	
6		$T_5$ , Another threshold of occupancy at the downstream sensor position (30.0)	

\*Representative values of the parameters are given in parentheses. The user should input values appropriate to the given problem. See the indicated references for details.

Simulation Control Card - Type 60

One of these cards is required as the final card of each simulation sub-interval data.

<u>Cols.</u>	<u>Description</u>
3 - 6	Duration of subinterval, seconds (Minimum=10)
7 - 9	Time interval for print of cumulative (or subinterval specific) statistical output (seconds). Statistics (output tables) will be printed at the end of each subinterval and at the frequency specified by this field, during the subinterval.
10 - 15	Time interval (seconds) for print of intermediate output. If information on current queuing, channelization, assigned turn movements, and occupancy is desired, then this field should be specified. Otherwise, leave blank.
16 - 21	Time of first intermediate printout, in seconds, from start of subinterval.
22 - 27	Time span, seconds, during which intermediate printout will be produced at frequency specified in Col. 10 - 12.
30	Code = (0,1) if this (is, is not) the last subinterval for the simulation run data deck.
79, 80	≡ 60 Card Type



### 3.2 FUEL Module Data Input Formats

The following cards are read by FUEL to change embedded FUEL data. Submit card type 1 (and, optionally, card type 2) for each set of values to be changed for a given data type (i.e., fuel consumption, hydrocarbons, carbon monoxide and oxides of nitrogen emissions), vehicle type and speed. The sequence of the FUEL data cards should be card type 1 and, if necessary, its corresponding card type 2 followed by the next type 1 card and its type 2 card. If a FUEL type 2 card is submitted, a type 1 card must also be submitted. A blank delimiter card follows the last FUEL data card. All FUEL data cards follow the last type 60 card for a simulation case data deck or the 99 card for a stand alone FUEL run.

#### FUEL Exogenous Data Cards

Card 1:

Columns

Contents

1 - 4	Data value for -9 fpss.
5 - 8	Data value for -8 fpss.
..	
.	
72 - 76	Data value for +9 fpss.
77	Data type code: 1 Fuel consumption 2 HC 3 CO 4 NOX
78	Vehicle type: 1 Low performance auto 2 High performance auto 3 Intercity bus 4 Heavy single unit truck 5 Trailer truck
79,80	Speed, fps.

Card 2 (Optional):

Submit this card to specify non-zero values for accelerations of +10 to +12 fpss. for vehicle types 1 and 2.

Columns

1-4	Data value for +10 fpss
5 - 8	Data value for +11 fpss
9 - 12	Data value for +12 fpss
77 - 80	Must be identical to columns 77-80 of card type 1

FUEL Delimiter Card:

The delimiter card is one completely blank card.

### 3.3 INCES Module Data Input Formats

If the INCES module is called a type 65 card must occur in the data deck as the first INCES module data card. This card is followed by a number of type 66 cards if incident detection is specified. MOE estimation requires a type 67 card. Finally, if incident detection or MOE estimation is specified, the type 68 cards conclude the input.

#### Off-line Incident Detection, Point Processing and MOE Estimation Specification Card - Type 65

(Only one of these cards is permitted)

<u>Cols.</u>	<u>Description</u>
1 - 3	Polling frequency (number/sec.) for digital detectors only. Default value = 10.
4 - 6	Analog/digital flag 0 digital mode 1 analog mode
7 - 12	Evaluation frequency for MOE estimation and point processing in seconds. If incident detection is run alone, set this equal to contents of cols. 13 - 18.
13 - 18	Time period for re-evaluating incident detection, in seconds. Note: Contents of Cols. 13-18 should be an integer multiple (between 1 and 20) of Cols. 7 - 12.
22 - 24	Number of parameters to be input for first incident detection algorithm. Must be $\leq 18$ .
25 - 27	Number of parameters to be input for second incident detection algorithm. Must be $\leq 18$ .
28 - 30	Number of parameters to be input for third incident detection algorithm. Must be $\leq 18$ . Note: Leave Cols. 22-24, 25-27, 28-30 blank if no corresponding algorithm is to be applied.

<u>Cols.</u>	<u>Description</u>
56,57	Assumed average vehicle length for incident detection, point processing and MOE estimation, in feet.
60	(0 or blank, 1) if point processing (is not, is) desired.
63	(0 or blank, 1) if MOE estimation (is not, is) desired. A "1" indicates type 67 card must be present.
79,80	≡ 65, card type.

Incident Detection Algorithm  
Parameter Card - Type 66

Up to two type 66 cards may be input for each incident detection algorithm indicated on card type 65. Parameters for each incident detection algorithm must start on a new type 66 card. Table 8 presents examples of the incident detection parameters.

<u>Cols.</u>	<u>Description</u>
1 - 8 9 - 16 : : 65 - 72	} Parameters (in floating point) for algorithm specified in Col. 75.
75	Incident detection algorithm to be applied ( <u>≤</u> 3). If two type 66 cards are input for this algorithm, the second need not specify an algorithm number in this column. The second card must, however, follow immediately in the input stream.
79,80	≡ 66, card type



MOE Algorithm Parameter Card - Type 67

Definitions and examples of MOE algorithm parameters are given in Table 9. Only one card of this type may be present for each INCES module application.

Note: The same algorithm may be applied up to three times (with different parameters).

<u>Cols.</u>	<u>Description</u>
3	Number of MOE estimation algorithm to be applied, $\leq 3$ .
4 - 9	Parameter number 1 for algorithm specified in Col. 3, hundredths-of-a-unit. For example, input .08 as 000008 in Cols. 4-9.
10 - 15	Parameter number 2 for algorithm specified in Col. 3, hundredths-of-a-unit.
16 - 21	Parameter number 3 for algorithm specified in Col. 3, hundredths-of-a-unit.
24 - 42	Similar to Cols. 3-21 for another desired MOE estimation algorithm.
45 - 63	Similar to Cols. 3-21 for another desired MOE estimation algorithm.
79,80	$\equiv 67$ , card type.

Table 9: MOE Algorithm Parameter Definitions and Examples

Parameter Number	ALGORITHM		
	1	2	3
	(Ref. 7)	(Ref. 5)	(Ref. 6)
1	Rough count error variance (30 veh <sup>2</sup> )*	Variance of error term (.08 veh <sup>2</sup> )	Initial expected section density error variance (.08 (veh/lane-mi) <sup>2</sup> )
2	Variance of trap error term (.08 veh <sup>2</sup> )	Ratio of system/observation/noise (between zero and one)	System noise variance (1.1)
3	Initial Kalman filter (between zero and one)	Initial count estimation error variance (veh <sup>2</sup> )	Ratio of system/observation noise variance (478)

\*Representative values of the parameters are given in parenthesis. The user should input values appropriate to the given problem. See the indicated references for details.

Off-line Incident Detection and/or  
MOE Estimation Detector Station Card - Type 68

Up to two type 68 cards may be input.

<u>Cols.</u>	<u>Description</u>	
1 - 3 4 - 6 . . . 73 - 75	} Station numbers to be used for incident detection. Must be input in upstream to downstream order. If there are two or more disconnected freeway sections, the station number sequences representing these sections must be separated by a zero.	
77		Code (0,1) if next card (is not, is) a type 68 card.
79,80		≡68, card type.

### 3.4 Plot Request Input Formats

The following cards should be used if plot output is desired. These cards must occur immediately following a type 99 card with Col. 24 = 1.

#### Plot Request Cards - Type 70

<u>Cols.</u>	<u>Description</u>	<u>Meaning</u>
1	<u>Request Code</u>	
	1	Index of sequential file data request
	2	Contour plot request
	3	Trajectory plot request
	4	Revision of imbedded MOE contour values
<p>If request code 1 was specified (Col. 1), remainder of card should be blank. If request code 4 was specified, a different description prevails for the remainder of this card format. Remaining card formats for codes 2 and 3 follow.</p>		
2	Last request flag=(0,1) if more INPLOT data (does not, does) follow.	
3-5	Run identification number	
8-10	Upstream node of roadway section for which plots are to be performed.	
13-15	Downstream node of roadway section for which plots are to be performed.	
19,20	Lane number (trajectory plots only); = 10 if plots are to be performed for all lanes	
25	MOE code (contour only)	
	<u>Code</u>	<u>MOE</u>
	1	Spot speed (mph)
	2	Volume (veh/hr/lane)
	3	Density (veh/ln-mi)
	4	Delay (min/veh)
	5	Headway (sec/veh)
	6	Travel time (min/veh)
	7	All MOEs

Note: See COMMON /CNTR/. description for default values.

<u>Cols.</u>	<u>Description</u>
26-30	Beginning of time period to be plotted (minutes from start of simulation).
31-35	End of time period to be plotted (minutes from start of simulation). Note: For contour plots, the user should specify start and stop times according to what is on the data tape, remembering that contour data is written on the tape at intervals of $\Delta t$ . There is no data at time=0; the first point is at time= $\Delta t$ , representing the <u>time interval</u> from 0 to $\Delta t$ . So, for example, if $\Delta t=1$ minute and the user requests a plot from 2 to 4 minutes, the plot will appear with data from .5 to 3.5 minutes. For trajectory plots, the meaning of start and stop times is straightforward.
36-40	Time scale for plotting hundredths-of-a-minute/inch (x-axis for trajectory plots, y-axis for contour plots).
41-45	Distance scale for plotting, feet/inch (x-axis for contour plots, y-axis for trajectory plots). Note: The user should keep in mind the default axis lengths for typical 8 1/2 x 11-inch plots. For contour plots, the x-axis (dist.) is 9 inches; the y-axis (time) is 6 inches. For trajectory plots, the x-axis (time) is 8 inches; the y-axis (dist.) is 6 inches.
46-50	Plot length (must be between 110 and 140 tenths-of-an-inch).
51-55	Plot height (must be between 85 and 110 tenths-of-an-inch).  Note: If these fields are zero or blank, a default size of 110, 85 will be used (i.e., 11 x 8 1/2 inches).
79,80	$\equiv 70$ , card type.



If request code 4 (revision of imbedded MOE contour values) was specified in Col. 1, the following format prevails for the remainder of the card.

<u>Cols.</u>	<u>Description</u>
2	MOE identification
6-10	Each of these fourteen fields represents one value of the MOE specified in Col. 2. Contours will be plotted for these values only. Entries should be specified in ascending order. The imbedded values in the program will be replaced, in their entirety, by the values on this card for the remainder of the current application of the INPLOT module or until another Request Code 4 is encountered. Note: Must input desired values x 100 for MOE codes 4, 5 and 6. For MOE codes 1, 2 and 3, input the desired values.
11-15	
.	
.	
.	
71-75	
70	≡70, card type.

### 3.5 Statistical Module Input Formats

The following cards are to be used to activate the Statistical Module. Card Types 90 and 97 must always appear. The term "Statistical Data Tape A" refers to the tape unit referenced by the SIFT simulation as "Statistical Data Tape", FORTRAN logical file 11. "Statistical Data Tape B" is FORTRAN logical file 14.

#### Statistical Module Control Card - Type 90

This card defines the activity the Statistical Module is to perform. It must always occur immediately after a 99 card with Column 24 = 2.

<u>Cols.</u>	<u>Data Word</u>
1	A code named IC. This code identifies the type of function the Statistical Module is to perform. IC=1 specifies that a statistical analysis comparing two networks is to be performed. IC=2 specifies that a file management operation is to be performed.
3	A code named IM. This code identifies the particular file management function requested. IM=1 Copy contents of Statistical Data Tape A onto Statistical Data Tape B deleting certain files (which must be specified in card type 91). IM=2 Add contents of Statistical Data Tape A to contents of Statistical Data Tape B. IM=3 Produce a listing of the "basic" contents of Statistical Data Tape A. IM=5 Add contents of a file on PUNCH cards. (Card types 95 - 97) to Statistical Data Tape A. IM=6 Add contents of a file on PUNCH cards to empty Statistical Data Tape A.
6	IO= (0,1) if (only freeway links, all links) are to be included in statistical analysis (specify only if IC=1).
13 - 15	File-code number of Network (case) A (specify only if IC=1).

19 - 21            File-code number of Network (case) B (specify only if IC=1).

79, 80            = 90, Card Type

File Update Card - Type 91

This card must be used in conjunction with file management function IM=1 on the Type 90 card. It specifies the code numbers of files to be deleted from the tape in the updating activity. Only one of these cards should be submitted.

<u>Cols.</u>	<u>Data Word</u>
1 - 3	Code number of file to be deleted from tape.
4 - 6	Another file
7 - 9	Another file.
·	·
·	·
·	·
73 - 75	Another file
79, 80	= 91, Card Type.

File Creation Cards

The following cards are to be used to store the results of a field test on the data tape for future comparison against simulation results. They must appear in the card type order and must be positioned between the Type 90 and Type 97 cards.

Network Identification Card - Type 92

<u>Cols.</u>	<u>Data Word</u>
1 - 3	File identification number

<u>Cols.</u>	<u>Data Word</u>	
4 - 6	Number of sub-intervals	
7 - 9	Number of freeway links	
10 - 12	Number of ramp links	} Both ramp and surface must be zero if analysis is not desired on non-freeway links
13 - 15	Number of surface links	
79, 80	= 92, Card Type (must be punched).	

Sub-Interval Duration Card - Type 93

<u>Cols.</u>	<u>Data Word</u>
1 - 6	Length of first subinterval (minutes x 100)
7 - 12	Length of second subinterval (minutes x 100)
.	.
.	.
.	.
.	.
73 - 78	Length of thirteenth subinterval (minutes x 100) (if needed).
79, 80	= 93, Card Type (must be punched).

Second card type 93 will contain subinterval 14-26 subinterval length.

Link Identification Card - Type 94

<u>Cols.</u>	<u>Data Word</u>	
1 - 3	Upstream node of link number 1	} Order of definition should be freeway, then ramp and then surface links. Start each link type on a new card
4 - 6	Downstream node of link number 1	
7 - 9	Upstream node of link number 2	
10 - 12	Downstream node of link number 2	
.	.	
.	.	
.	.	
.	.	
73 - 75	Upstream node of link number 13	
76 - 78	Downstream node of link number 13	
79, 80	= 94, Card Type (must be punched).	

Include as many card types 94 as necessary. Second card type 94 will contain identity of links 14 through 26 and so on.

Link Data Cards - Type 95 - One of these cards is required for each link for each subinterval. Cards should follow link sequence created by Type 94 cards. All data must be subinterval specific.

<u>Cols.</u>	<u>Data Word</u>
1 - 3	Upstream node number
4 - 6	Downstream node number
8, 9	Sub-interval number (must be in order)
10 - 15	Number of vehicles discharged during the sub-interval
16 - 21	Total travel time in minutes x 100 (732 = 7.3 veh./min.)



<u>Cols.</u>	<u>Data Word</u>
22 - 27	Total delay time in minutes x 100
28 - 33	Total stopped delay in minutes x 100 for ramp and surface links or number of lane changes for freeway links
34 - 39	Total vehicle miles X 100
40 - 45	Average saturation % X 100 for ramp and surface links
46 - 51	Freeway link area (product of link length and number of lanes) in lane-feet. Auxiliary lanes must be included
79,80	= 95, Card Type

The data in columns 10 - 63 are subinterval specific.

#### Delimiter Card - Type 97

This card signifies the end of Statistical Module information and thus must always be the last card of the input stream. The next 99 card would follow this card.

<u>Cols.</u>	<u>Data Word</u>
1 - 78	Blank
79, 80	= 97, Card Type (must appear)

## 4.0 INTRAS Model Output

The INTRAS Model produces many standard and optional output formats. The following subsections identify, describe and illustrate each major variety.

### 4.1 PORGIS and LIS Output

Tables of input parameters are provided, by the PORGIS and LIS modules, for each simulation case run. These tables fully identify the geometric, control and traffic input descriptors which characterize the current study. The values of parameters which may change with time are output each subinterval.

Tables 10, 12, 14, 16, 18, 20 and 22 illustrate the Input Parameter Reports for the traffic network of Figures 1 and 2. Only nodes 9, 10, 11 and 12 have been included in Table 14 for brevity. The format of their sign control output would be similar to that of Node 12. Tables 11, 13, 15, 17, 19, 21 and 23 contain definitions of the column headings on the corresponding Input Parameter Reports.

### 4.2 Standard SIFT Output

The standard output report formats of the SIFT Module are illustrated in Tables 24, 26 and 28. These reports may be either cumulative or subinterval specific. The latter form is shown. The samples represent the statistical results from one five-minute simulation subinterval for the network of Figures 1 and 2. Table 30 is the intermediate report output showing statistics at two minutes 30 seconds into simulation. Definitions of the column headings for these four output reports are presented in Tables 25, 27, 29 and 31.

The "Freeway Link Station Data" of Table 28 is reported only for locations specified by the user. One such station may be defined for each freeway link.

Table 10: Sample Freeway Link Definition Report

L LINK		LANE SPAN		AUXILIARY LANES		MEAN FREE FLOW		PERCENT OF VOLUME/ DESTINATION NODES		CURVATURE		RT. LANE OF SEP. PAIR		REC IDENTIFICATION			
L	LINK	LANE	SPAN	FIRST	SECOND	FREE	FLOW	LEFT	THRU	RIGHT	RAD P	EL	FIRST	SECOND	LANE		
				LCH	ADFD	SPD	GRADE										
1	(701, 1)	3	0	0	0	0	0	0	0	100/	2	0	0	0	0	1	FREEWAY-T
2	( 1, 2)	3	600	0	0	0	0	0	0	100/	3	0	1000	1	10	1	FREEWAY-A
3	( 2, 3)	3	198	0	0	0	0	0	0	100/	4	0	0	0	0	1	FREEWAY-B
4	( 3, 4)	3	249	249	0	0	0	0	0	80/	5	20/	9	0	0	1	FREEWAY-C
5	( 4, 5)	3	600	249	0	0	0	0	0	90/	6	10/	11	0	0	1	FREEWAY-D
6	( 5, 6)	3	198	0	0	0	0	0	0	100/708	0/	0	0	0	0	1	FREEWAY-E

ADVANCED WARNING SIGNS

L LINK	DISTANCE FROM DOWNSTREAM NODE	NODE LOCATING OFF-RAMP	DISTANCE FROM OFF-RAMP
2 ( 1, 2)	450	4	897

Table 11: Definition of Column Headings in  
"Freeway Link Definition" Report

<u>Column Heading</u>	<u>Definition</u>
L	Freeway link index
LINK	Upstream and downstream nodes of link
LANE	Number of through lanes
SPAN	Link length (feet), no value printed for entry links
AUXILIARY LANES	
LGH	Auxiliary lane length (feet)
A,D,F	The auxiliary lane numeric code (see section 2.1) will appear in the appropriate column to indicate acceleration, deceleration, full auxiliary lane status
MEAN FREE FLOW SPEED	Input value of desired free-flow speed (miles per hour)
GRADE	Imbedded calibration value of grade (percent) which most closely represents the input value
PERCENT OF VOLUME/DESTINATION NODE	Percent of traffic performing the movements left-turn (LEFT), no-turn (THRU) and right-turn (RIGHT) at the downstream intersection; followed by the node number at the downstream end of the next link. Turn percent and destination node number are separated by a slash, "/".
CURVATURE	Indicates set of three parameters used to calculate limiting speed
RAD	Radius of curvature (feet). "0" indicates no value input, implying straight roadway
P	Pavement condition code
EL	Superelevation (percent)
RT. LANE OF SEP. PAIR	Right lane of pair separated by physical barrier. Two such separations are permitted per link, hence, the FIRST and SECOND subheadings
REC LANE	Lane in downstream "through" link receiving traffic from lane 1 of this link
IDENTIFICATION	Text describing link
DISTANCE FROM DOWNSTREAM NODE	Position within link locating advanced warning sign (feet)
NODE LOCATING OFF-RAMP	Node at which off-ramp referenced by advanced warning sign begins
DISTANCE FROM OFF-RAMP	Distance from advanced warning sign to off-ramp (feet)

Table 12: Sample Ramp and Surface Link Definition Report

RAMP LINKS																
L	LINK	LANE	SPAN	MEAN FREE FLOW SPEED		GRADE	PERCENT OF VOLUME/ DESTINATION NODES			TYPE OF	MEAN QUEUE		REC			
				L	R		LEFT	THRU	RIGHT		INTRSECT	HEADWAY		DISCHG	TIME	LANE
	1	( 8, 3)	1	300	24	-4	0/ 0	100/ 1	0/ 0	1	0	0	1000	2 5 ON	8	RAMP-G
	2	( 4, 9)	1	300	24	0	0/ 0	100/ 10	0/ 0	1	24	22	0 0 0	OFF	3	RAMP-I
	3	( 5, 11)	1	450	24	0	0/ 0	100/ 12	0/ 0	1	24	22	0 0 0	OFF	1	RAMP-L

SURFACE LINKS																	
L	LINK	LANE	SPAN	MEAN POCK FREE FLOW SPEED		GRADE	PERCENT OF VOLUME/ DESTINATION NODES			TYPE OF	MEAN QUEUE					IDENTIFICATION	
				L	R		LEFT	THRU	RIGHT		INTRSECT	TIME	HEAD	DISCH	OPP.		LANE
	1	(802, 7)	2	0	0	0	2	0/ 0	100/ 8	0/ 0	1	22	24	0	0 0 0 0 0	0	SURFACE-U
	2	( 7, 8)	2	350	0	0	0	60/ 3	40/ 9	0/ 0	1	22	24	0	0 0 0 0 0	0	SURFACE-F
	3	( 8, 9)	2	750	0	0	0	0/ 0	100/ 10	0/ 0	1	22	24	0	0 0 0 0 0	0	SURFACE-H
	4	( 9, 10)	3	300	0	0	0	33/814	34/ 11	33/813	2	15	20	0	4 0 1 0 0	0	SURFACE-J
	5	( 10, 11)	1	300	0	0	0	0/ 0	100/ 12	0/ 0	1	22	24	0	0 0 0 0 0	0	SURFACE-K
	6	( 11, 12)	1	400	0	0	0	0/ 0	100/807	0/ 0	1	22	24	0	0 0 0 0 0	0	SURFACE-M
	7	( 13, 10)	1	300	0	0	0	0/ 0	50/814	50/ 11	2	15	20	0	0 0 0 0 0	0	SURFACE-O
	8	( 14, 10)	1	400	0	0	0	20/ 11	80/813	0/ 0	2	15	20	7	0 0 0 0 0	0	SURFACE-P
	9	(806, 13)	1	0	0	0	0	0/ 0	100/ 10	0/ 0	1	22	24	0	0 0 0 0 0	0	SURFACE-R
	10	(805, 14)	1	0	0	0	0	0/ 0	100/ 10	0/ 0	1	22	24	0	0 0 0 0 0	0	SURFACE-S



Table 13: Definition of Column Headings in  
"Ramp and Surface Link Identification  
Report"

<u>Column Heading</u>	<u>Definition</u>
L	Ramp or Surface link index
LINK	Upstream and downstream nodes of link
LANE	Number of lanes (excluding pockets for surface links)
SPAN	Link length (feet), no value printed for entry links
POCK L R	Capacity of Left and Right turn pockets (passenger car vehicle lengths), for surface links only
MEAN FREE FLOW SPEED	Input value of desired free-flow speed (miles per hour)
GRADE	Imbedded calibration value of grade (percent) which most closely represents the input value
PERCENT OF VOLUME/DESTINATION NODE	Percent of traffic performing the movements left-turn (LEFT) no turn (THRU) and right-turn (RIGHT) at the downstream intersection; followed by the node number at the downstream end of the next link. Turn percent and destination node number are separated by a slash, "/".
TYPE OF DWNSTREAM INTRSECTN	Code indicating queue discharge characteristics at downstream intersection
LOST TIME	Time required for first queued vehicle to react to green signal (tenths of a second). A "0" indicates a distribution will be used, referenced by driver type. Not required for on-ramps.
MEAN QUEUE DISCHGE HEADWAY	Mean time between discharge of queued vehicles (tenths of a second)
CURVATURE	Indicates set of three parameters used to calculate limiting speed
RAD	Radius of curvature (feet). "0" indicates no value input, implying straight roadway.
P	Pavement condition code
EL	Superelevation (percent)
ON/OFF RAMP	Indicates, for ramp links, which end connects to freeway
REC LANE	Lane in downstream "through" link receiving traffic from lane 1 of this link
IDENTIFICATION	Text describing link
OPP. LINK	Link index identifying source of traffic opposing left-turners from this link
LANE CHAN	Channelization code indicating restrictive (left-turn only, right-turn only) status of each lane

Table 14: Sample Sign and Signal Control Definition Report

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES	
				( 4, 9)	( 8, 9)
9	1	56 ( 47P)	0 ( 0P)	2	1
9	2	4 ( 3P)	56 ( 47P)	2	0
9	3	56 ( 47P)	60 ( 50P)	1	2
9	4	4 ( 3P)	116 ( 97P)	0	2

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES	
				( 9, 10)	( 13, 10) ( 14, 10)
10	1	20 ( 17P)	5 ( 4P)	3	3
10	2	4 ( 3P)	25 ( 21P)	0	0
10	3	44 ( 37P)	29 ( 24P)	2	9
10	4	4 ( 3P)	73 ( 61P)	2	0
10	5	44 ( 37P)	77 ( 64P)	1	2
10	6	4 ( 3P)	1 ( 1P)	0	2

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES	
				( 5, 11)	( 10, 11)
11	1	56 ( 47P)	60 ( 50P)	2	7
11	2	4 ( 3P)	116 ( 97P)	2	0
11	3	56 ( 47P)	0 ( 0P)	1	2
11	4	4 ( 3P)	56 ( 47P)	0	2

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES	
				( 11, 12)	
12	1	0 (100P)	0 ( 0P)	1	

NODE 12 IS UNDER SIGN CONTROL

SIGNAL CODE GLOSSARY	
CODE	MEANING
0	YIELD SIGN OR AMBER
1	GREEN
2	RED
3	RED WITH GREEN RIGHT ARROW
4	RED WITH GREEN LEFT ARROW
5	STOP OR RED WITH RIGHT TURN PERMITTED
7	NO TURN - GREEN THRU ARROW
8	RED WITH LEFT AND RIGHT GREEN ARROWS
9	NO LEFT TURN, GREEN THRU AND RIGHT

Table 15

Definition of Column Headings in "Sign and  
Signal Control Definitions" Report

<u>Column Heading</u>	<u>Definition</u>
NODE	Node number identifying intersection
INTVL	Signal interval number
DURATION	Duration of signal interval (seconds); followed by (in parentheses) percent of signal cycle length represented by this interval. For sign control only one interval is presented of duration "0".
OFFSET	Offset of beginning of interval from reference time (seconds); followed by (in parentheses) percent of signal cycle length represented by this offset.
SIGNAL CODES FACING INDICATED APPROACHES	The upstream and downstream node numbers defining the approach links to the subject intersection are given as column headings. The signal codes defining the permitted movements for each approach during each signal interval are presented under the link identification headings. A glossary of the signal codes is given at the end of this report.

Table 16: Sample Entering Traffic Definition Report

SUB-INTERVAL 1

ENTRY LINK STATISTICS

LINK	TOTAL FLOW RATE (VEH/HR)	PERCENT BY VEHICLE TYPE					PERCENT VEHICLES BY LANE				
		1	2	3	4	5	1	2	3	4	5
(701, 1)	3000	60	20	6	6	8	40	30	30	0	0
(806, 13)	300	70	5	10	15	0	100	0	0	0	0
(802, 7)	600	50	20	10	10	10	50	50	0	0	0
(805, 14)	400	100	0	0	0	0	100	0	0	0	0

VEHICLE TYPE	DESCRIPTION
1	LOW PERFORMANCE PASSENGER CAR
2	HIGH PERFORMANCE PASSENGER CAR
3	INTERCITY BUS
4	HEAVY SINGLE UNIT TRUCK
5	TRAILER TRUCK

Table 17.

Definition of Column Headings in "Entering  
Traffic Definition" Report

<u>Column Heading</u>	<u>Definition</u>
LINK	Upstream and downstream node numbers which define each entry link
TOTAL FLOW RATE	Rate at which vehicles are generated on the entry link (vehicles/hour)
PERCENT BY VEHICLE TYPE	Percentage of TOTAL FLOW RATE allocated to each vehicle type
PERCENT VEHICLES BY LANE	Percentage of TOTAL FLOW RATE allocated to each lane of link. Applies to freeway entries only.



Table 18: Sample Surveillance System Definition Report

SPECIFICATION OF SURVEILLANCE DETECTORS

DETECTOR STATIONS  
LINK ( 2, 3)

STATION NUMBER	NUMBER	LANE	TYPE	LOCATION	LENGTH
1	1	1	3	150	6
1	2	1	4	140	6
1	3	2	1	150	6
1	4	3	1	150	6

LINK ( 3, 4)

STATION NUMBER	NUMBER	LANE	TYPE	LOCATION	LENGTH
2	1	1	3	150	6
2	2	1	4	140	6
2	3	2	1	150	6
2	4	3	1	150	6

STATION NUMBER	NUMBER	LANE	TYPE	LOCATION	LENGTH
3	1	1	1	150	6
3	2	2	1	150	6
3	3	3	1	150	6

GLOSSARY

CODE	DETECTOR TYPE
0	DOPPLER RADAR
1	SHORT LOOP
3	DOWNSTREAM LOOP OF COUPLED PAIR
4	UPSTREAM LOOP OF COUPLED PAIR

Table 19

Definition of Column Headings in "Surveillance System Definition" Report

<u>Column Heading</u>	<u>Definition</u>
NUMBER	Sequence number of surveillance detector within link
LANE	Lane containing detector
TYPE	Detector type as defined in "GLOSSARY" at end of report
LOCATION	Distance from upstream node of link to upstream end of detector, or acquisition point for doppler radar (feet)
LENGTH	Detector length (feet), does not apply for doppler radar

Table 20: Sample Incident Definition Report

LINK	INCIDENT DATA									DURATION (SEC)	RUBBERNECK FACTOR (PCT)			
	INCIDENT CODE BY LANE			UPSTREAM LOC. (FT)	LENGTH AFFECTED (FT)	TIME OF ONSET (SEC)								
( 3, 4)	1	2	3	4	5	6	7	8	9	10	20	30	40	50
	-	-	-	-	-	-	-	-	-					

- INCIDENT CODES
- 0 NOT AFFECTED
  - 1 SLOWED BY RUBBERNECKING
  - 2 BLOCKED

Table 21

Definition of Column Headings in  
 "Incident Definition" Report

<u>Column Heading</u>	<u>Definition</u>
LINK	Upstream and downstream node numbers which define link
INCIDENT CODE BY LANE	Incident code for each lane of link (as described in glossary at end of report)
UPSTREAM LOC.	Distance from upstream node of link to upstream end of incident (feet)
LENGTH AFFECTED	Length of roadway affected by incident extending downstream from "UPSTREAM LOC." (feet)
TIME OF ONSET	Time that incident begins measured from start of simulation (seconds)
DURATION	Length of time incident exists (seconds)
RUBBERNECK FACTOR	Percentage reduction in capacity due to rubbernecking

Table 22: Sample Run Identification and Control Options Report

CONTROL OPTIONS FOR SUBINTERVAL 1

VARIABLE	VALUE	MEANING
ICTYPE	7	CASE TYPE CODE
IINOT	1	INCIDENT DATA TAPE WILL BE PRODUCED
IPTOT	1	INPLOT DATA TAPE WILL BE PRODUCED
ISTOR	1	CASE DATA TAPE WILL BE PRODUCED
ISTAT	1	STATISTICAL DATA TAPE WILL BE PRODUCED
MINSTS	-0	SIMULATION TIME STEP = 10 TENTHS OF A SECOND FREEWAY TIME STEP MAY EQUAL 20 TENTHS OF A SECOND FOR LIGHT TRAFFIC
RNSEED	7581	RANDOM NUMBER SEED
IDRUN	105	RUN IDENTIFICATION NUMBER
MXINIT	300	MAXIMUM LENGTH OF INITIALIZATION (SEC)
IFILGO	0	FILL TIME ENDS WHEN EQUILIBRIUM IS REACHED
ISTFLG	0	CUMULATIVE STATISTICS
ITPOP	2	TRAJECTORY PLOT DATA OUTPUT INTERVAL (SEC)
NDT	600	LENGTH OF SUBINTERVAL (SEC)
IDMN	300	STATISTICS PRINTOUT INTERVAL (SEC)
NPRNT	300	INTERMEDIATE OUTPUT INTERVAL (SEC)
ISECI	300	TIME OF FIRST INTERMEDIATE OUTPUT FROM START OF SUBINTERVAL (SEC)
IDSEC	300	TIME SPAN FOR INTERMEDIATE OUTPUT (SEC)
HOURS	10 ***	
	*	
MINS	0 **	CLOCK TIME AT BEGINNING OF SUBINTERVAL
	*	
SECNS	0 ***	
JFUEL	0	FUEL MODULE WILL BE EXECUTED
MFUEL	0	EXOGENOUS FUEL DATA WILL NOT BE READ IN
NU23	0	FUEL DATA WILL BE WRITTEN TO UNIT 23



Table 23: Definition of Column Headings  
in "Run Identification and Control  
Option" Report

<u>Column Heading</u>	<u>Definition</u>
VARIABLE	Variable name from COMMON/CONTRL/ or COMMON/S2/ for control option being defined
VALUE	Value for this subinterval
MEANING	Definition of variable corresponding to the value printed

Table 24: Sample Freeway Statistical Report Design

SUBINTERVAL SPECIFIC OUTPUT AT TIME 10 05 00  
 FREEWAY LINK STATISTICS

LINK	VEHICLES		LANE CHNG	CURR CONT	AVG CONT	VEH-MILES	VEH-MIN	SECONDS/VEHICLE			VEH-TOTAL DELAY	VEH-MIN/VEH-MILE	VOLUME	DENSITY	SPEED	
	IN	OUT						TOTAL TIME	MOVE TIME	M/T						
2 ( 1, 2)	332	334	25	10	11.4	38.00	57.0	10.2	7.6	2.6	.74	1.50	.38	2000.	50.0	40.0
3 ( 2, 3)	498	495	16	7	5.9	18.78	29.5	3.5	2.5	1.0	.71	1.57	.70	1990.	52.1	38.2
4 ( 3, 4)	475	479	19	9	8.0	22.47	40.0	5.0	3.1	1.9	.63	1.78	.67	1907.	56.6	33.7
5 ( 4, 5)	489	492	20	17	18.7	55.78	93.5	11.4	7.6	3.8	.67	1.67	.56	1965.	54.9	35.8
6 ( 5, 6)	303	300	23	5	4.5	11.33	22.5	4.5	2.5	2.0	.44	1.99	.88	1809.	59.9	30.2
AVERAGES AND TOTALS			103	48	48.5	146.36	242.5				.66	1.66	.56	1918.	53.8	36.2

NETWORK STATISTICS INCLUDING RAMP AND SURFACE LINKS

VEHICLE-MILES = 200.33, VEHICLE-MINUTES = 428.5, MOVING/TOTAL TRIP TIME = .680,  
 AVERAGE CONTENT = 85.7, CURRENT CONTENT = 85, SPEED (MPH) = 28.05,  
 TOTAL DELAY (VEH-MIN) = 137.12, TRAVEL TIME (MIN)/VEH-MILE = 2.14, DELAY TIME (MIN)/VEH-MILE = .68

Table 25: Definition of Column Headings in  
"Sample Freeway Statistical Report"

<u>Column Headings</u>	<u>Definition</u>
L	Freeway link index
LINK	Upstream and downstream node numbers defining link
VEHICLES IN	Number of vehicles entering link during reporting period
VEHICLES OUT	Number of vehicles leaving link during reporting period
LANE CHNG	Number of lane changes in link during reporting period
CURR CONT	Current number of vehicles on link
AVG CONT	Average number of vehicles on link during reporting period
VEH-MILES	Total distance traveled on link by all vehicles during reporting period (minutes)
VEH-MIN	Total time spent on link by all vehicles during reporting period (minutes)
SECONDS/VEHICLE	
TOTAL TIME	Total time spent on link per vehicle (seconds)
MOVE TIME	Ideal time spent on link per vehicle assuming all vehicles travel at their desired speeds (seconds)
DELAY TIME	Excess time spent on link per vehicle (seconds) DELAY = TOTAL - MOVE
M/T	Ratio of MOVE TIME to TOTAL TIME
VEH-MIN/VEH-MILE	
TOTAL	Time to travel one mile at prevailing speed (minutes)
DELAY	Excess time to travel one mile above that required at desired speed (minutes)
VOLUME	Flow rate of vehicles through link (vehicles/lane/hour)
DENSITY	Concentration of vehicles per unit roadway area (vehicles/lane-mile)
SPEED	Prevailing space mean speed (miles/hour)

Table 26: Sample Ramp and Surface Statistical Report Design

SUBINTERVAL SPECIFIC OUTPUT AT TIME 10 05 00  
RAMP AND SURFACE STATISTICS

L	LINK	VEHICLES		AVG	VEH- MILES	VEH- MIN	SPEED MPH	SECONDS/VEHICLE		M/T	VEH-MIN/ VEH-MILE		PERCENT QUEUE DELAY	AVG SAT PCT	CYCLE FAILURE	LINK TYPE		
		IN	OUT					TOTAL TIME	MOVE TIME		VEH-MIN/ TOTAL	VEH-MILE DELAY						
1	( 8, 3)	43	44	2	1.5	2.48	7.5	19.8	10.3	8.6	1.7	.83	3.02	.50	73	10.2	0	Ramp
2	( 4, 9)	49	48	2	2.2	2.81	11.0	15.3	13.4	8.6	4.8	.64	3.90	1.40	85	14.9	0	Ramp
3	( 5, 11)	48	50	4	3.0	4.20	15.0	16.8	18.2	12.8	5.4	.70	3.57	1.06	79	13.5	0	Ramp
2	( 7, 8)	100	102	3	4.6	6.71	23.0	17.5	13.6	9.9	3.7	.73	3.43	.93	91	13.2	1	Surface
3	( 8, 9)	97	98	7	8.9	13.87	44.5	18.7	27.3	21.3	6.0	.78	3.21	.71	83	11.8	0	Surface
4	( 9, 10)	95	93	4	3.6	5.40	18.0	18.0	11.4	8.6	2.8	.75	3.33	.82	88	12.0	0	Surface
5	( 10, 11)	151	149	6	6.8	8.56	34.0	15.1	13.6	8.6	5.0	.63	3.97	1.46	72	15.0	1	Surface
6	( 11, 12)	48	47	3	2.2	3.59	11.0	19.6	14.0	11.4	2.6	.81	3.06	.57	79	10.9	0	Surface
7	( 13, 10)	47	48	2	2.1	2.71	10.5	15.5	13.2	6.8	6.4	.52	3.87	1.86	89	14.3	0	Surface
8	( 14, 10)	46	48	4	2.3	3.64	11.5	19.0	14.4	9.1	5.3	.63	3.16	1.16	90	11.4	0	Surface
AVERAGES AND TOTALS		37	37.2	53.97	186.0	17.4	.71	3.45	1.00	83	12.7	2						

Table 27: Definition of Column Headings in "Sample Ramp and Surface Statistical Report"

<u>Column Headings</u>	<u>Definition</u>
L	Ramp or surface link index
LINK	Upstream and downstream node numbers
VEHICLES IN	Number of vehicles entering link during reporting period
VEHICLES OUT	Number of vehicles leaving link during reporting period
CURR CONT	Current number of vehicles on link
AVG CONT	Average number of vehicles on link during reporting period
VEH-MILES	Total distance traveled on link by all vehicles during reporting period (miles)
VEH-MIN	Total time spent on link by all vehicles during reporting period (minutes)
SPEED	Mean speed of all vehicles on link during reporting period (miles/hour)
SECONDS/VEHICLE	
TOTAL TIME	Total time spent on link per vehicle (seconds)
MOVE TIME	Ideal time spent on link per vehicle assuming all vehicles travel at their desired speeds (seconds)
DELAY TIME	Excess time spent on link per vehicle (seconds)
	DELAY = TOTAL - MOVE
M/T	Ratio of MOVE TIME to TOTAL TIME
VEH-MIN/VEH-MILE	
TOTAL	Time to travel one mile at prevailing speed (minutes)
DELAY	Excess time to travel one mile above that required at desired speed (minutes)
PERCENT QUEUE DELAY	Percentage of delay time spent in queue
AVG SAT PCT	Average percentage of link area occupied by vehicles during reporting period
CYCLE FAILURE	Number of instances during reporting period when queue present at start of green was not discharged by end of green
LINK TYPE	Identifies link as Ramp or Surface type



Table 28: Sample Freeway Station Headway and Speed Report Design

SUBINTERVAL SPECIFIC FREEWAY LINK STATION DATA  
TIME 10 05 00

FREeway LINK 2 ( 1, 2) STATION PLACEMENT 300 FEET FROM NODE 1																															
LANE	MEAN SPEED MPH	MEAN HEADWAY SEC	PERCENT OF TRAFFIC AT OR BELOW INDICATED SPEED, MPH					PERCENT OF TRAFFIC AT OR BELOW INDICATED HEADWAY, SEC																							
			26	28	30	32	34	36	38	40	42	44	46	48	50	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2		
1	38.9	1.92	1	3	7	15	24	37	51	68	79	86	92	97	99	10	26	47	63	75	85	89	92	97	100	100	100	100	100	100	100
2	40.5	1.73	0	0	0	4	10	22	36	52	70	85	95	99	100	20	38	55	69	78	84	88	93	96	99	100	100	100	100	100	100
3	41.0	1.78	0	0	3	8	12	20	30	48	71	87	97	100	100	18	37	56	70	78	85	89	92	94	97	100	100	100	100	100	100

FREeway LINK 5 ( 4, 5) STATION PLACEMENT 250 FEET FROM NODE 4																															
LANE	MEAN SPEED MPH	MEAN HEADWAY SEC	PERCENT OF TRAFFIC AT OR BELOW INDICATED SPEED, MPH					PERCENT OF TRAFFIC AT OR BELOW INDICATED HEADWAY, SEC																							
			24	24	26	28	30	32	34	36	38	40	42	44	46	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2		
1	34.5	1.99	0	0	0	4	11	27	45	65	81	89	94	99	100	16	31	50	65	76	83	89	94	97	99	100	100	100	100	100	100
2	36.3	1.77	0	0	1	3	8	15	30	47	65	82	92	97	98	18	36	57	71	83	90	95	98	99	100	100	100	100	100	100	100
3	36.5	1.76	0	0	0	2	6	14	28	46	63	81	90	96	99	20	36	58	70	82	87	93	96	98	99	100	100	100	100	100	100

Table 29

Definition of Column Headings in "Sample Freeway Station  
Headway and Speed Report"

<u>Column Headings</u>	<u>Definition</u>
FREEWAY LINK	Freeway link index followed by upstream and downstream nodes in parentheses
STATION PLACEMENT	Distance from upstream node (feet)
LANE	Lane code number (i.e., 1-5 for through lanes, 6-9 for auxiliary lanes)
MEAN SPEED	Time mean speed for all vehicles crossing station in indicated lane during reporting period (miles/hour)
MEAN HEADWAY	Mean time between passage of individual vehicles for indicated lane during reporting period (seconds)
PERCENT OF TRAFFIC AT OR BELOW INDICATED SPEED	Subheadings beneath this general heading indicate the upper limit of each cell of a cumulative frequency distribution of speed (miles/hour). Under each speed value is displayed the number of vehicles which have passed the station, in the indicated lane, at or below the heading speed value, during the reporting period.
PERCENT OF TRAFFIC AT OR BELOW INDICATED HEADWAY	Subheadings beneath this general heading indicate the upper limit of each cell of a cumulative frequency distribution of headway (seconds). Under each headway value is displayed the number of vehicles which have passed the station, in the indicated lane, at or below the heading headway value, during the reporting period

Table 30: Sample Intermediate Report Output

LINK STATISTICS AT TIME 10 02 30

LINK TYPE	LINK	CON.	VEH DIS	TURN MOVEMENT									VEH DELAY/	VEH.	QUEUE/	CIC	SURFACE LINK		SIG	LANE				
				LEFT	THRU	RT.	1	2	3	4	5	6					7	8			9	FLR	CH	CHNG
FRWY	(701, 1)	10	151	0	155	0	5	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0		
FRWY	( 1, 2)	9	158	0	160	0	2	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	15	
FRWY	( 2, 3)	8	246	0	253	0	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
FRWY	( 3, 4)	9	230	0	192	47	2	3	1	0	0	0	3	0	2.0	0	0	0	0	0	0	0	0	9
FRWY	( 4, 5)	13	253	0	234	21	5	3	2	0	0	0	3	0	3.5	0	0	0	0	0	0	0	0	9
FRWY	( 5, 6)	7	157	0	166	0	4	2	0	0	0	0	1	0	2.2	0	0	0	0	0	0	0	0	11
RAMP	( 8, 3)	3	23	0	25	0	3	0	0	0	0	0	0	0	1.7	71	0	0	0	0	0	0	0	0
RAMP	( 4, 9)	2	21	0	23	0	2	0	0	0	0	0	0	0	4.6	86	0	0	0	0	0	0	0	0
RAMP	( 5, 11)	2	27	0	24	0	2	0	0	0	0	0	0	0	5.3	79	0	0	0	0	0	0	0	0
SURF	(802, 7)	5	58	0	60	0	2	3	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0
SURF	( 7, 8)	2	50	33	21	0	2	0	0	0	0	0	0	0	3.7	90	1	0	0	0	0	0	0	0
SURF	( 8, 9)	6	47	0	53	0	2	4	0	0	0	0	0	0	6.1	82	0	0	0	0	0	0	0	0
SURF	( 9, 10)	3	45	16	17	15	3	0	0	0	0	0	0	0	2.8	85	0	4	0	1	0	0	0	0
SURF	( 10, 11)	5	60	0	64	0	5	0	0	0	0	0	0	0	5.1	73	0	0	0	0	0	0	0	0
SURF	( 11, 12)	4	28	0	33	0	4	0	0	0	0	0	0	0	2.5	81	0	0	0	0	0	0	0	0
SURF	( 13, 10)	2	23	0	11	11	2	0	0	0	0	0	0	0	6.4	87	0	0	0	0	0	0	0	0
SURF	( 14, 10)	5	25	6	24	0	5	0	0	0	0	0	0	0	5.2	90	0	0	0	0	0	0	0	0
SURF	(806, 13)	3	18	0	20	0	3	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0
SURF	(805, 14)	4	29	0	35	0	4	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0

Table 31: Definition of Column Headings in  
"Intermediate Report Output"

<u>Column Headings</u>	<u>Definition</u>
LINK TYPE	Link type indicator
LINK	Upstream and downstream node numbers defining link
CON	Vehicle content on link at time output is called for
VEH DIS	Number of vehicles discharged during reporting period
TURN MOVEMENT LEFT THRU RT	Left-turning, through and right-turning traffic flows at the downstream end of link during reporting period
CURRENT NUMBER OF VEHICLES IN LANE	Vehicle content of lanes
DELAY/VEH	Average delay per vehicle (sec). Not calculated for entry links
QUEUE DLY (P)	Percent of delay time spent in queue. Not calculated for freeway and entry links
CYC FLR	Number of cycle failures on off-ramp and surface links during reporting period
SURFACE LINK CURRENT CHANNELIZATION	Current status of surface link channelization codes
AVG SPEED	Average speed on links during reporting period. Not calculated for entry links
SIG CODE	Signal code facing downstream end of link at time intermediate output is called for. Code is always green for freeway and on-ramp links
LANE CHNG	Number of lane changes occurring during reporting period. Applicable to freeway links only

### 4.3 FUEL Module Output

Table 32 illustrates the FUEL Module statistics report. Definition of the column headings are provided in Table 33. The sample report in Table 32 displays the fuel consumption and emission statistics for passenger cars and all vehicle types combined. A separate report is produced in a similar format containing commercial vehicle statistics.

### 4.4 INPLOT Module Output

The INPLOT Module creates CALCOMP digital plots of vehicle time-space trajectories, and contour maps of MOE values in the time-space plane, as requested. Figure 8 is an idealization of the vehicle trajectory plot design. The actual INPLOT output would contain the trajectories of all vehicles traversing the designated roadway section. To assist the user in correlating the plot with the roadway geometry, the position of nodes within the designated roadway section is displayed along the vertical (distance) axis of the plot.

Figure 9 illustrates the contour map output capability of INPLOT. This output form may be produced for several different Measures of Effectiveness including spot speed, volume, density, delay, headway and travel time. Contours are produced which represent constant values of these MOEs. The default family of speed contour values are displayed in Figure 9. A unique symbol is associated with each value and is used to label the plotted contours. The MOE contour values may be updated, as a user option, by card input. It would, for example, be possible for the user to specify a family of speed values of 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61 and 62 mph in order to obtain a much finer contour map than that shown in Figure 9.

As for the trajectory plots, node numbers are displayed along the distance axis for reference.



Table 32: Sample FUEL Consumption and Emissions Report

CUMULATIVE VALUES OF FUEL CONSUMPTION AND OF EMISSIONS

LINK	TYPE	FUEL CONSUMPTION						VEHICLE EMISSIONS (GRAMS/MILE)						NO X		
		GALLONS		M.P.G.		HC		CO		VEHICLE TYPE		VEHICLE TYPE		VEHICLE TYPE		
		1	2	6	1	2	6	1	2	6	1	2	6	1	2	6
( 1, 2)	FRWY	4.9	5.0	26.1	10.2	8.1	7.5	8.6	7.3	9.1	125.3	131.7	135.3	9.0	9.3	10.4
( 2, 3)	FRWY	2.2	2.4	14.7	9.9	7.6	7.0	5.2	5.3	5.9	94.6	104.3	105.7	8.7	8.9	9.8
( 3, 4)	FRWY	3.1	3.2	15.6	8.4	6.9	6.6	4.6	4.8	5.1	79.0	85.1	87.2	6.6	6.7	7.9
( 4, 5)	FRWY	5.0	5.3	26.0	11.6	8.0	7.8	12.7	13.0	13.3	248.1	252.2	263.9	9.8	10.1	11.3
( 5, 6)	FRWY	1.8	2.1	11.1	7.3	6.5	6.4	5.5	6.1	7.6	101.0	102.3	104.6	8.8	9.7	11.0
( 8, 3)	RAMP	2.9	3.1	15.8	6.6	5.0	4.8	3.6	3.9	4.2	56.5	59.7	61.5	8.0	8.8	9.9
( 4, 9)	RAMP	3.0	3.4	16.2	5.0	3.9	4.0	2.7	3.3	3.3	39.5	40.4	41.0	5.9	6.7	7.2
( 5, 11)	RAMP	3.8	4.1	21.0	5.8	4.0	3.9	3.0	3.5	3.7	44.9	52.8	55.1	6.0	7.1	8.1
( 7, 8)	SURF	2.7	2.9	15.0	4.2	3.9	3.9	4.2	4.9	5.0	63.9	64.3	65.4	6.6	6.9	7.9
( 8, 9)	SURF	5.4	5.4	26.0	6.0	4.2	4.1	5.6	6.0	6.2	100.8	102.0	103.3	7.3	7.3	7.9
( 9, 10)	SURF	2.6	2.7	14.9	4.3	3.6	3.4	3.3	3.4	4.9	45.2	57.3	60.8	5.1	5.2	6.3
( 10, 11)	SURF	2.5	2.6	14.8	5.8	4.1	4.0	2.9	3.4	4.0	38.7	38.9	39.2	5.9	6.4	7.0
( 11, 12)	SURF	2.9	3.1	15.8	5.3	4.0	3.9	3.8	4.1	5.0	55.5	58.6	60.5	8.3	8.9	9.2
( 13, 10)	SURF	2.7	2.7	14.2	5.8	3.9	4.0	3.0	3.5	4.7	58.1	59.4	59.7	7.2	7.6	8.8
( 14, 10)	SURF	3.0	3.3	16.0	4.9	3.6	3.4	2.7	2.9	3.8	41.3	43.2	47.0	6.1	6.2	7.4
NETWORK-WIDE STATISTICS																
		48.5	51.3	263.2	5.3	4.9	4.0	4.6	5.0	5.4	84.3	89.7	91.0	7.2	7.6	8.7
		VEHICLE TYPE 1 = LOW PERFORMANCE PASSENGER CAR														
		2 = HIGH PERFORMANCE PASSENGER CAR														
		6 = ALL VEHICLE TYPES														

Table 33: Definition of Column Headings in  
 "Fuel Consumption and Emissions Report"

<u>Column Heading</u>	<u>Definition</u>
LINK	Upstream and downstream nodes of link.
TYPE	Text indicating link type.
FUEL CONSUMPTION GALLONS	Number of gallons consumed by specified vehicle types on link.
M.P.G.	Mileage averaged by vehicles of specified type on link.
VEHICLE EMISSIONS (GRAMS/MILE)	
HC	Hydrocarbon emissions on link for specified vehicle types.
CO	Carbon monoxide emissions on link for specified vehicle types.
NOX	Oxides of nitrogen emissions on link for specified vehicle types.
NETWORK-WIDE STATISTICS	Totals for fuel consumption and emissions for specified vehicle types. Figures for GALLONS represent sums. All others are means.
VEHICLE TYPE	Definition of vehicle types described in table.

RUN 138 VEHICLE TRAJECTORIES  
 NCDE 8 THROUGH NODE 11, LANE 4

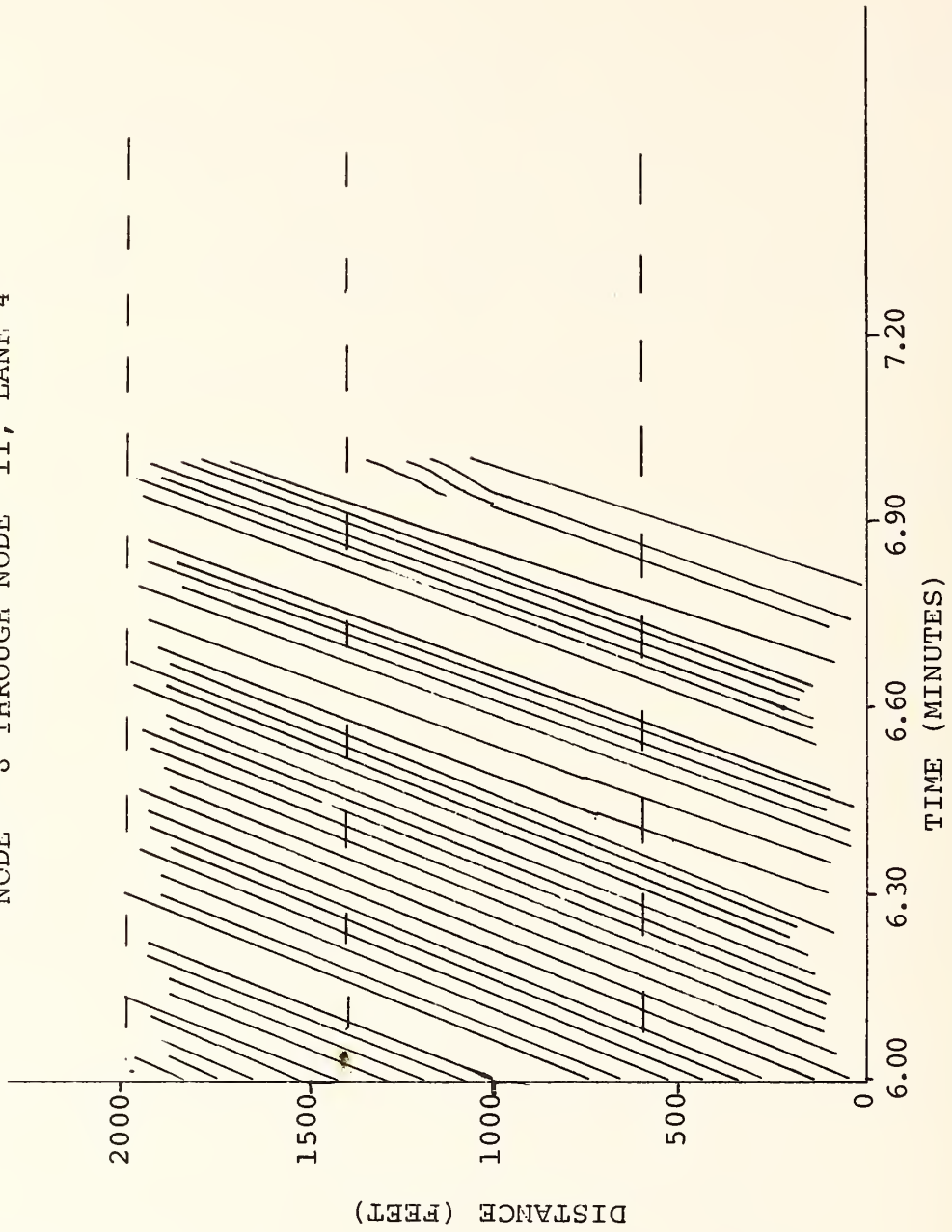


Figure 8: Sample of INPLOT Program Vehicle Trajectory Plot Design

RUN 138 MOE SPOT SPEED  
 NODE 5 THROUGH NODE 8

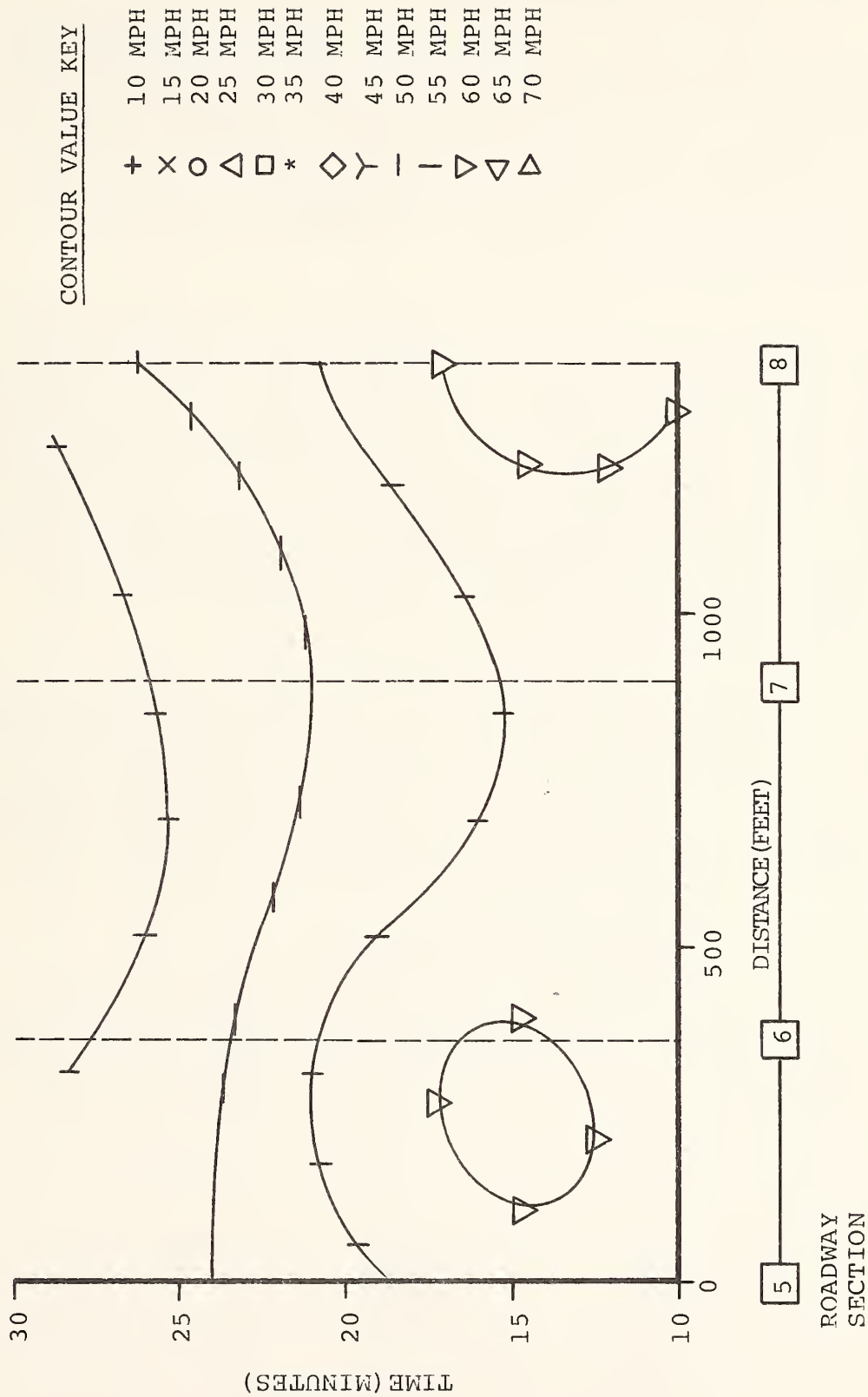


Figure 9: Sample of INPLOT Program Contour Plot Design

#### 4.5 INCES Module Output

The result of processing surveillance detector output is reported by the INCES module in three formats, illustrated in Tables 34, 35 and 36. Table 34 illustrates the output of the point processing procedures which calculate traffic parameter values on a detector specific basis. The Simulation Run number ("999" in the illustrative example) corresponds to the Run Identification number on the Type 00 card.

To illustrate the MOE estimation and incident detection output formats, it is assumed that a series of fully detectorized (one detector in each lane) stations have been defined by the user along the length of the freeway. Table 35 is an example of the MOE estimation report, produced by INCES, for a consecutive pair of such stations. The "VOLUME IN" and "VOLUME OUT" values are mean values across all lanes at the upstream and downstream stations, respectively. "SPACE MEAN SPEED" and "DENSITY" are estimates generated by the particular MOE estimation procedure employed.

Table 36 is a sample of the incident detection output report. As for the MOE report, one table is generated for each algorithm. In the sample, a compression wave was sensed during the sixth evaluation period and confirmed by the tenth period. Subsequently, the incident terminated and traffic was assumed to be freely moving by the fourteenth evaluation period.

#### 4.6 SAM Module Output Reports

Reports will be generated by the SAM module containing simple comparisons and statistical tests of MOE values from separate simulation runs. The MOEs to be studied are:



Table 34: Sample Point Processing Report Design

INCES POINT PROCESSING OUTPUT												
SIMULATION RUN 999												
FREWAY LINK	3	(	2,	3),	DOPPLER RADAR DETECTOR IN LANE 3 AT	50 FEET FROM NODE	2					
	120	240	360	480	600	720	840	960	1080	1200	1320	1440
	EVALUATION PERIOD											
VOLUME, VPH	1900	1862	1857	1883	1990	1942	1910	1894	1771	1792	1824	1836
TIME MEAN SPEED, MPH	39.5	39.8	40.0	39.9	38.5	38.3	39.4	39.6	40.4	40.1	39.7	39.7
MEAN HEADWAY, SEC	1.89	1.93	1.94	1.91	1.81	1.85	1.88	1.90	2.03	2.01	1.97	1.96
FREWAY LINK	3	(	2,	3),	COUPLED LOOP DETECTOR IN LANE 3 AT	90 FEET FROM NODE	2					
	120	240	360	480	600	720	840	960	1080	1200	1320	1440
	EVALUATION PERIOD											
VOLUME, VPH	1895	1865	1856	1885	1989	1946	1905	1895	1773	1791	1827	1837
TOTAL MEAN SPEED, MPH	39.5	39.9	40.2	39.8	38.5	38.6	39.2	39.3	40.5	40.1	40.0	39.6
MEAN HEADWAY, SEC	1.90	1.93	1.94	1.91	1.81	1.85	1.89	1.90	2.03	2.01	1.97	1.96
MEAN OCCUPANCY	.182	.177	.175	.179	.196	.191	.194	.183	.166	.169	.173	.176

Table 35: Sample MOE Estimation Report Design

INCES MOE ESTIMATION OUTPUT, SIMULATION RUN 999

ALGORITHM 2

FROM

STATION 1, LINK 2

TO

STATION 2, LINK 3

TIME (SEC)	VOLUME			SPACE DENSITY			VOLUME			SPACE DENSITY		
	IN	OUT	VPHPL	MEAN	VEHICLES	PER LANE	IN	OUT	VPHPL	MEAN	VEHICLES	PER LANE
	VPHPL	VPHPL	MPH	MPH	MILE	MILE	VPHPL	VPHPL	MPH	MPH	MILE	MILE
20	1880	1885	38.5	38.5	48.9	48.9						
40	1861	1858	39.0	39.0	47.7	47.7						
60	1865	1866	39.1	39.1	47.7	47.7						
80	1878	1873	38.8	38.8	48.3	48.3						
100	1892	1895	37.6	37.6	50.4	50.4						
120	1921	1850	33.5	33.5	56.2	56.2						
140	1893	1801	31.0	31.0	59.6	59.6						
160	1890	1787	28.6	28.6	64.2	64.2						
180	1898	1799	27.3	27.3	67.6	67.6						
200	1905	1800	26.4	26.4	70.1	70.1						
220	1840	1813	25.7	25.7	71.1	71.1						
240	1833	1852	26.1	26.1	70.6	70.6						
260	1851	1908	28.3	28.3	66.5	66.5						
280	1866	1890	29.3	29.3	64.2	64.2						
300	1869	1885	30.0	30.0	62.5	62.5						

Table 36: Sample Incident Detection Report Design

INCES INCIDENT DETECTION OUTPUT, SIMULATION RUN 999

ALGORITHM 3

PARAMETER 1 = 6.000000+E01, PARAMETER 2 = 2.000000+E01, PARAMETER 3 = 3.000000+E90, PARAMETER 4 = 1.000000+E01  
 PARAMETER 5=-4.400000-E01, PARAMETER 6 = 3.100000-E01, PARAMETER 7 = 2.900000+E01, PARAMETER 8 = 3.000000+E01

FROM  
 STATION 1, LINK 2  
 TO  
 STATION 2, LINK 3

TIME (SEC)	STATE	STATE	STATE	STATE	STATE
20	FREE				
40	FREE				
60	FREE				
80	FREE				
100	FREE				
120	CWAV				
140	CWAV				
160	CWAV				
180	TENT				
200	CONF				
220	INCD				
240	INCD				
260	TERM				
280	FREE				
300	FREE				

CODE DEFINITION

FREE NO INCIDENT IN SECTION  
 TERM INCIDENT TERMINATED  
 CWAV COMPRESSION WAVE  
 TENT TENTATIVE INCIDENT  
 CONF INCIDENT CONFIRMED  
 INCD INCIDENT IN PROGRESS

<u>MOE</u>	<u>Application</u>
Vehicles Discharged	All Links and Network
Delay Time (veh-min)	All Links and Network
Lane Changes	Freeway Links
Density	Freeway Links and Network
Avg. Saturation Percent	Non-Freeway Links
Vehicle-Miles	All Links and Network
Travel Time (veh-min)	All Links and Network
Volume	Freeway Links
Time in Queue (veh-min)	Non-Freeway Links
Average Speed	All Links and Network

Tables 37 through 41 illustrate the various SAM report formats comparing two statistical data sets for a simple three-link network simulated for three 5-minute time periods (subintervals). The simple data comparisons of Table 34 are repeated for all appropriate MOEs of the Freeway and Non-Freeway link categories. The same is true for the statistical test results of Tables 39 and 40. The term NETWORK may indicate all links, or, optionally, all freeway links.

The terms "CASE A" and "CASE B" identify the particular network statistical data sets as specified on the SAM input card type 90.

Table 37: Sample SAM Data Element Paired Comparisons

NUMBER OF VEHICLES DISCHARGED  
CASE A, CODE NO. 100  
CASE B, CODE NO. 714

FREEWAY LINKS

LINK	TOTAL	SUBINTERVAL												
		1	2	3	4	5	6	7	8	9	10	11	12	
( 1, 2 )	MOE(A)	299	272	280										
	MOE(B)	291	265	271										
	(A)-(B)	8	7	9										
	(A)/(B)	1.03	1.03	1.03										
( 2, 3 )	MOE(A)	295	253	261										
	MOE(B)	288	265	262										
	(A)-(B)	7	-12	-1										
	(A)/(B)	1.02	.95	1.00										
( 3, 4 )	MOE(A)	310	302	294										
	MOE(B)	307	315	304										
	(A)-(B)	3	-13	-10										
	(A)/(B)	1.01	.96	.97										



Table 38: Sample SAM Network Comparisons

NETWORK WIDE MOE - FREEWAY LINKS ONLY  
CASE A, CODE NO. 100  
CASE B, CODE NO. 714

	SUBINTERVAL											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>NUMBER VEHICLES</b>	<b>TOTAL</b>											
DISCHARGED	855	301	276	278								
MOE (A)		276	278									
MOE (B)	856	282	279									
(A)-(B)	-1	6	-6	-1								
(A)/(B)	1.00	1.02	.98	1.00								
<b>TOTAL DELAY</b>												
TIME-MIN.	13	5	4	5								
MOE (A)		4	4	4								
MOE (B)	12	1	0	2								
(A)-(B)	1	1.08	1.00	1.17								
(A)/(B)	1.08	1.00	1.00	1.17								
<b>VEHICLE MILES</b>												
MOE (A)	57	20	18	19								
MOE (B)	56	20	18	18								
(A)-(B)	1	0	0	1								
(A)/(B)	1.01	1.00	1.00	1.02								
<b>VEHICLE MINUTES</b>												
MOE (A)	75	26	24	25								
MOE (B)	74	26	24	24								
(A)-(B)	1	0	0	1								
(A)/(B)	1.01	1.00	1.00	1.04								
<b>DENSITY</b>												
VEH/IN-MILE	25.1	26.4	24.1	24.9								
MOE (A)		25.7	24.6	24.4								
MOE (B)	24.9	.7	-.5	.5								
(A)-(B)	.2	1.03	.98	1.02								
(A)/(B)	1.01	45.6	45.8	44.8								
MOE (A)		46.0	45.8	45.8								
MOE (B)	45.9	-.4	.0	-1.0								
(A)-(B)	-.5	.99	1.00	.98								
(A)/(B)	.99											

Table 39: Sample SAM Link Specific Statistical Test Report

NUMBER OF VEHICLES DISCHARGED  
ANALYSIS OF LINK STATISTICS

FREEWAY LINKS

	CASE A		CASE B		T-TEST	WILCOXON	U-TEST	ONE-WAY ANOVA		
	MEAN	VARIANCE	MEAN	VARIANCE	T	T/Z	U/Z	SSW	SSB	F
( 1, 2)	283.7	192.34	275.7	185.34	.71	-1.60	-.65	755.3	96.0	.51
( 2, 3)	269.7	497.34	271.7	202.34	.13	-.53	-.65	1399.3	6.0	.02
( 3, 4)	302.0	64.00	308.7	32.34	1.18	-1.07	-1.09	192.7	66.7	1.38

Table 40: Sample SAM Subinterval Specific Statistical Test Report

NUMBER OF VEHICLES DISCHARGED  
ANALYSIS OF SUBINTERVAL STATISTICS

FREEWAY LINKS

SUBINTERVAL	CASE A		CASE B		T-TEST T	WILCOXON T/Z	U-TEST U/Z	ONE-WAY ANOVA		
	MEAN	VARIANCE	MEAN	VARIANCE				SSW	SSB	F
1	303.3	66.14	295.3	107.33	1.06	-.53	-.65	340.9	96.0	1.13
2	275.7	610.33	281.7	833.33	.27	.00	-1.09	2887.3	54.0	.07
3	278.3	274.33	279.0	489.00	.04	-1.07	-1.09	1526.7	.7	.00

Table 4.1: Sample SAM Network Statistical Test Report

ANALYSIS OF NETWORK WIDE STATISTICS  
 FREEWAY LINKS ONLY

MOE	CASE A MEAN	CASE A VARIANCE	CASE B MEAN	CASE B VARIANCE	T-TEST T	WILCOXIN T/Z	U-TEST U/Z	ONE-WAY ANOVA SSW	ONE-WAY ANOVA SSB	F
NUMBER VEHICLES	285.1	385.61	285.3	414.25	.02	1.36	-.04	6398.9	.2	.00
TOTAL DELAY TIME-MIN.	4.4	4.28	4.1	5.11	.29	-1.02	-.62	75.1	.4	.09
VEHICLE MILES	19.1	103.76	18.8	92.95	.06	-.91	-.04	1573.7	.4	.00
VEHICLE MINUTES	25.1	173.11	24.6	164.78	.08	-1.59	-.18	2703.1	1.1	.01
DENSITY VEH/LN-MILE	25.13	3.02	24.9	2.36	.30	-.91	-1.41	43.0	.2	.09
AVERAGE SPEED MPH	45.70	1.86	45.86	1.71	.73	-.91	-1.41	28.6	.9	.53

#### 4.7 INTRAS Warning and Error Message Output

Experience with computer programs containing complex data verification procedures has shown that the reporting of error conditions often proves costly in terms of computer storage due to the storage consumed by FORMAT statements. A generalized error message procedure was designed for INTRAS to alleviate the storage demands of diagnostic processing.

Each recognizable error condition in INTRAS generates a standard message which identifies the message code number and reports the current value of up to 10 pertinent parameters. To determine the error condition, the user should refer to Appendix B. It will identify the condition and parameter meanings corresponding to the particular message code.

Because the INTRAS program contains nine major overlay modules, each with its own family of reportable error conditions, the message code numbers are stratified by originating module as follows:

<u>Module</u>	<u>Message Codes</u>
INTRAS	1- 99
PORGIS	100-399
LIS	400-499
POSPRO	500-549
FUEL	550-599
SIFT	600-699
INCES	700-799
INPLOT	800-899
SAM	900-999

The following is an example of the INTRAS generalized error message format:

```
**** ERROR 108, PARAMETERS =          63,          2,          50
```

The error message code, 108, indicates that the message originates from PORGIS. The explanation corresponding to message code 108 is as follows:

```
108 Node P1, specified on Type P2 card, is larger than  
maximum allowable node number P3.
```



When applying this to the example, we find that a node 63, specified on a type 2 card, is larger than the maximum allowable node number which is 50.

Table 42 lists all the error message codes and the routines they originate from.

Table 42: Origin of Message Codes

Module	Routine	Error Message Codes
INTRAS	INTRAS FINDL	1, 2, 4-9 107
PORGIS	PORGIS  LPAK PRSIG PRACT CTPFF CTPSX CTPSV PRMSND SURVIN INCIN IMBED DETGEN LINKIN  CHKNOD TURNIN INT1	100-105, 107, 108, 155, 388-392, 394-399 106 161-180, 191, 193 268, 269 270, 271, 273-279 280-293 294-299 181-188, 190, 192 101, 108, 200-208 250-256, 260, 262 250, 251, 257-259 261 100, 103, 105, 109-123, 125-132, 139, 149, 151, 153, 154 130, 131, 138 100, 103, 148, 156, 157 122, 124, 133-137, 140, 143-147, 150, 152
LIS	LIS	394, 399, 400, 401

Table 42: Origin of Message Codes (Concluded)

Module	Routine	Error Message Codes
SIFT	VPAK	617
	FINDFV	613
	FINDRV	614
	FINDSV	615
	CAL1	631-634
	CAL2	631-639
	CAL3	631-634, 636-642
	CAL4	631-634, 636-639, 643, 644
	CAL5	631, 645-647
	HICON	SELEN
SEVEN		612
SVEH		616
CLOSE		600
BLOK		606, 607
TSTSAT		604
HDWY		605
LANES		608
MOOV		602, 609
FGNRAT		660
OFFRMP		680, 681
CLNUP		651
INCDAT		700
DETECT		305
FMAIN	660	
FUEL	FUEL	550-552
SAM	SAM	900-906
INPLOT	INPLOT	800-803, 812
	CONTR	807
	PAGE	810, 811
	PATH	808, 809
	TRAJEC	806
INCES	INCES	701-716

## 5. DECK STRUCTURE AND OPERATING PROCEDURES

As with any unfamiliar computer program, the major tasks confronting the potential user are: how to communicate input parameters and options to the program, and, how to make the local computer system accept and execute the program. The preceding sections have described the input formats, program and file structures for the INTRAS model. At this point, a user who had a good deal of computer programming and/or applications experience could probably develop control cards (operating system control commands) which would allow him to execute INTRAS. This presumes, of course, that the user also has the INTRAS program deck at his disposal.

The user who is lacking in computer experience needs to follow an established procedure in order to effectively utilize a computer program. To aid the neophyte computer user and to expedite the application of INTRAS by those with computer exposure, the following subsections are provided illustrating the deck and control configuration for typical program run types.

### 5.1 Creation and Revision of a Program Object Module

The first task facing the user (hopefully with the assistance of someone knowledgeable in the workings of the local computer system) is to create an executable machine language version of INTRAS. This translation of the FORTRAN source code is highly machine and system dependent. Although it is not the purpose of this document to give a "short course" on the workings of the target IBM and CDC operating systems, examples of the procedure are given in this section as prototypes. The specific devices available at, and standards of the individual computer installation, will probably dictate changes in these prototypes.

Figures 10 and 11 illustrate the control card deck setup for a typical IBM installation operating under IBM/OS. Figure 10 illustrates a preparatory run performed to reserve (allocate) space on a magnetic disc device for storage of the object (load) module.

Figure 11 contains the prototype Job Control Language (JCL) necessary to translate the FORTRAN program and create

```
// EXEC PGM=IEFBRI4
//CREATE DD DSN=INTRAS.LOADMOD,VOL=SER=...,UNIT=.....,
// DCB=(RECFM=U,BLKSIZE=6400,SPACE=(TRK,(100,100,5)),
// DISP=(,KEEP)
//
```

Figure 10: Allocation of 360/370 Disc Space



```

//EXEC FORTGCL, PARM.LKED='OVLY'
//FORT, SYSIN DD *
*****PLACE ROUTINES TO BE RECOMPILED HERE
/*
//LKED.SYSLMOD DD DSN=INTRAS.LOADMOD, VOL=SER=....., UNIT=..., DISP=SHR
//LKED.SYSIN DD *
INCLUDE SYSLMOD (INTRAS)
INSERT MAIN,EROT,DBUG,DRWS,INTVAR,ULNKR,ULNKS,UVR,UVS,UNPAK,PAK,PLNKR
INSERT PLNKS,PVR,PVS,FINDLN,FINDL,NEXTLN,LRANK
INSERT SIZE,A1,A2,A3,A4,A5,A6,A7,A8,A9,A10,A11,A12,S1,S2,S3,CONTRL,ERTRAN
INSERT P1,FORINC,FPAR,ONVEH,RANK,FREDAT,NFILTS,CFUEL,CRASH,DBLEXP,IHEAD
INSERT IPLTN,LASDCH,ACT0,ACT1,ACT2,ACT3,ACT4,ACT7,ACT8,ACT9,ACT10,ACT12
INSERT ACT20
OVERLAY ALPHA
INSERT PORGIS,TABCON,LPAK,PRSIG,PRACT,CTPFF,CTPSX,CTPSV,CLRALL,PRMSND
INSERT SURVIN,INCIN,SIGOUT,INACT,FLOOUT,SUROUT,INCOUT,IMBED,IMBEDO,DETGEN
INSERT MATCH,LINKIN,CHKNOD,LINOUT,TURNIN,INT1
INSERT IMBDIN,ACT11,ACT16
OVERLAY ALPHA
INSERT LIS,LLPAK,LPRSIG,LCLRAL,LPRACT,LCTPFF,LCTPSX,LCTPSV,LPRMSN,LSURVI
INSERT LINCIN,LSIGOU,LFLOOU,LINACT,LSUROU,LINCOU,LIMBED,LIMBDO,LDETGE
INSERT LLINKI,LLINOUL,LTURNI,LINT1
INSERT IMBDIN,ACT11,ACT16
OVERLAY ALPHA
INSERT SIFT,VPAK,LASTLK,FRSTV,LASTV,FINDFV,FINDRV,FINDSV,RANDOM
INSERT NIDTSV,VPOINT,VBUF,NRGY,INCDMP
OVERLAY BETA
INSERT HICON,UPSIG,SIGACT,PDAFZ,PDNAFZ,UPACT,GRNSIG,REDSIG,TERMFZ,DECACT
INSERT TERM,ACTFZ,ASIG,DETSW,FZCL,CAL1,CAL2,CAL3,CAL4,CAL5,CAL6,CAL8,CAL9
INSERT MOOV,SVEH,CLOSE,BLOK,GOQ,OFFRMP,HDWY,GETCD,LSWCH,LANES,TSTSAT,DETECT
INSERT TSIG,NORM,CLNUP,INCDAT,TPTOUT,MOEV,QSTATE,SELEN,FILL,RELEN
INSERT SEVEN,GETUNV,REVEN,FMAIN,FMOVE,FGNRAT,ONRMP,CHOOZ,FRESET
INSERT CONSOL,EMGNCY,CHANGE,CHECK,RISK,LCROSS,ALANE,CANCEL
INSERT ADVANC,COLECT,TYPE
INSERT LENVI,SRFLAG,VENVI,VEER,ACT5,ACT6,ACT11,ACT15,ACT16,ACT18
OVERLAY BETA
INSERT LOCON,INIT,RESET,FILTST,FTSC,CPTOUT,CYCP,INTST
OVERLAY ALPHA
INSERT FUEL,BDFLCN,BDHCFM,BDCOEM,BDNOEM
INSERT BFUEL
OVERLAY ALPHA
INSERT INCES,READET,POINT,POUT,INC1,INC2,INC3,PINC,MOE1,MOE2,MOE3,MOUT
INSERT TTIME
INSERT INCDMP,PDATA,INCEST,AMD,MTOC,TRVTM,NUMP
OVERLAY ALPHA
INSERT POSPRO
OVERLAY ALPHA
INSERT INPLOT,AXPLOT,COMPCT,CONTR,CPLOT,FILEX,IOPROC,LEGEND,PAGE,PATH
INSERT SEARCH,SPTAL,TPLT,TRAJEC
INSERT IPERR,CRD,TMDAT,T1,PLT,CNTR,CHT,LANET
OVERLAY ALPHA
INSERT SAM,READCL,PRINT,STAT,TTEST,CALC,ANOVA,WILCOX,UTEST,RANK
INSERT SAMP2,SAMP3
ENTRY MAIN
NAME INTRAS(R)
/*
//
//

```

exclude this card for  
first compile

Figure 11: 360/370 Basic Compilation and Revision of INTRAS Simulation Model

an executable load module configured in the INTRAS overlay structure. Since disc space has been allocated by the preliminary run, the procedures to compile (translate) and link edit are the same, whether the entire program is compiled or only individual routines are revised and replaced. For the first compilation, the "INCLUDE SYSLMOD (INTRAS)" card should be omitted.

The preparation and revision of an object module for the CDC Version of INTRAS is illustrated by Figures 12 and 13. It is not necessary to run a preliminary disk space allocation run, however, the form of the creation and revision runs are somewhat different. Figure 12 illustrates the object creation deck setup. Note that generation of the proper overlay structure is contingent on the correct ordering of the input program deck (as indicated in the figure).

To revise the CDC version object module, it is necessary to execute the deck illustrated in Figure 13. This computer run will edit the newly compiled subroutines into the previous full object module. The edited object module will be stored as a permanent disc file as was its predecessor.

## 5.2 INTRAS Data Deck Structure

The order of card inputs in the INTRAS data deck must meet certain criteria for successful program execution. The data deck may be thought of as a series of blocks, each containing certain card types. Some of these blocks are optional depending on the particular application. Figure 14 illustrates the complete block structure and the card types (some of which may be optional) which may be present in each block.

Block 1 - This initial block contains the Run Control Card for each case. Essentially, it identifies which other data blocks follow. This block must be present in the input data deck for all applications of INTRAS. If applications are batched (i.e., two separate simulations are performed or the INPLOT or SAM module is to be exercised), then this Block must occur as the first block for each application.

```

INTRAS, T100.
ACCOUNT(.....)
REQUEST(OBJECT,*PF)
FTN(I=INPUT,A,B=OBJECT, EL=I,P,R=0)
CATALOG(OBJECT,INTRASOBJECT,ID=.....,RP=999)
****(Column 1 of this card should contain 7, 8 and 9
punches)
Place deck for INTRAS Main Program here. First card
must be "OVERLAY(INTRS1,0,0)"
Next come the source decks for SUBROUTINES EROT, DBUG,
DRWS, INTVAR, ULNKR, ULNKS, UVR, UVS, UNPAK, PAK,
PLNKR, PLNKS, PVR, PVS, FINDLN, FINDL, NEXTLN, LRANK.
Place decks for PORGIS Main Program here. First card
must be "OVERLAY(INTRS2,1,0)"
Next come the source decks for SUBROUTINES TABCON,
LPAK, PRSIG, PRACT, CTPFF, CTPSX, CTPSV, CLRALL,
PRMSND, SURVIN, INCIN, SIGOUT, INACT, FLOOUT, SUROUT,
INCOUT, IMBED, IMBEDO, DETGEN, MATCH, LINKIN, CHKNOD,
LINOUT, TURNIN, INT1.
Place decks for LIS Main Program here. First card
must be "OVERLAY(INTRS3,2,0)"
Next come the source decks for SUBROUTINES LLPAK,
LPRSIG, LPRACT, LCTPFF, LCTPSX, LCTPSV, LCLRAL,
LPRMSN, LSURVI, LINCIN, LSIGOU, LINACT, LFLOOU,
LSUROU, LINCOU, LIMBED, LIMBDO, LDETGE, LLINKI,
LLINOU, LTURNI, LINT1.
Place decks for SIFT Main Program here. First card
must be "OVERLAY(INTRS4,3,0)"
Next come the source decks for SUBROUTINES VPAK,
LASTLK, FRSTV, LASTV, FINDFV, FINDRV, FINDSV, RANDOM.
Place decks for HICON Main Program here. First card
must be "OVERLAY(HIACTY,3,2)"
Next come the source decks for SUBROUTINES UPSIG,
SIGACT, PDAFZ, PDNAFZ, UPACT, GRNSIG, REDSIG, TERMFZ,
DECACT, TERM, ACTFZ, ASIG, DETSW, FZCL, CAL1, CAL2,
CAL3, CAL4, CAL5, CAL6, CAL8, CAL9, MOOV, SVEH, CLOSE,
BLOK, GOQ, OFFRMP, HDWY, GETCD, LSWCH, LANES, TSTSAT,
DETECT, TSIG, NORM, CLNUP, INCDAT, TPTOUT, MOEV,
QSTATE, SELEN, FILL, RELEN, SEVEN, GETUNV, REVEN,
FMAIN, FMOVE, FGNRAT, ONRMP, CHOOZ, FRESET, CONSOL,
EMGNCY, CHANGE, CHECK, RISK, LCROSS, ALANE, CANCEL,
ADVANC, COLECT, TYPE.

```

Figure 12: Generation of Full CDC Version  
INTRAS Object Module

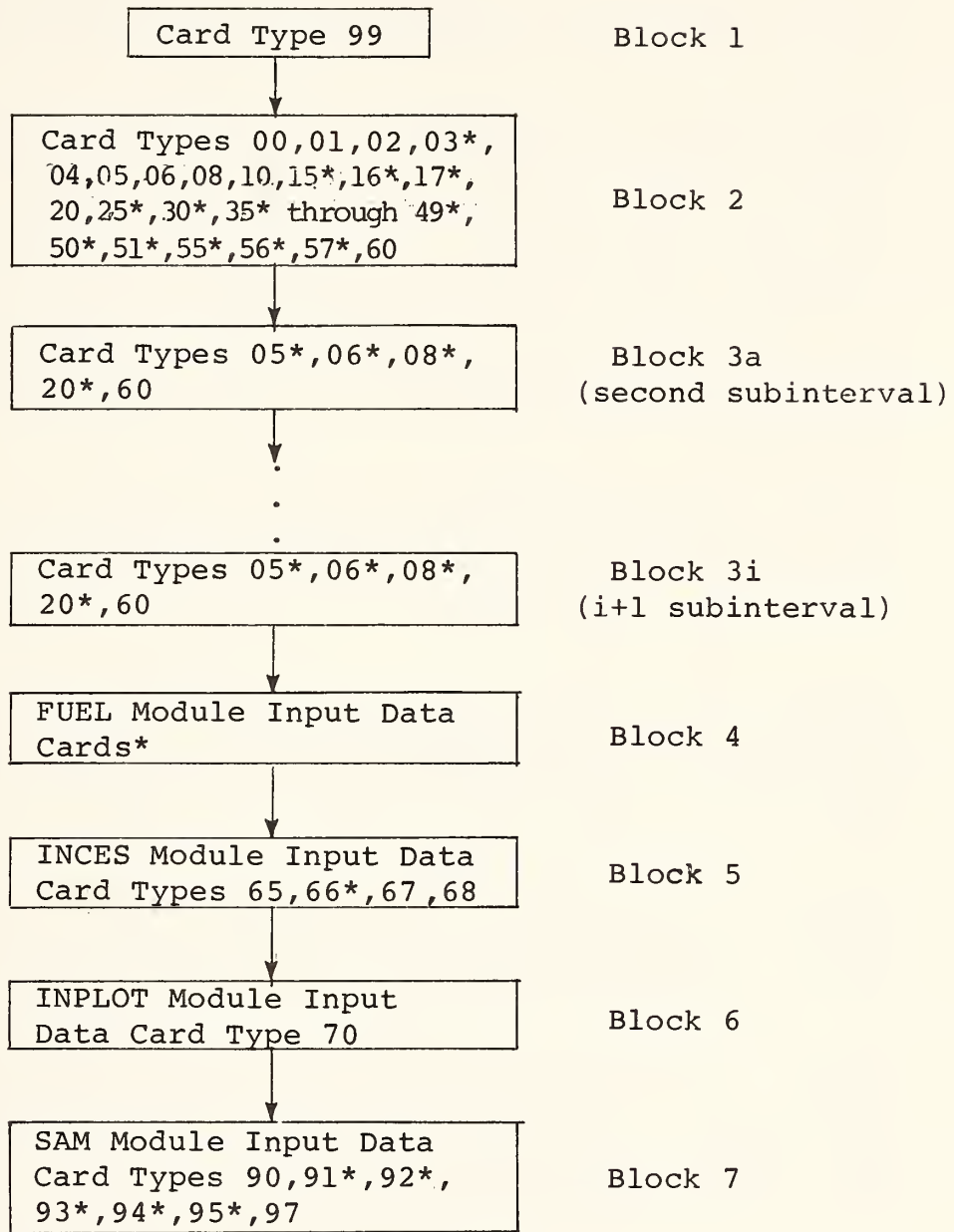
Place decks for LOCON Main Program here. First card must be "OVERLAY(LOACTY,3,1)"  
Next come the source decks for SUBROUTINES INIT, RESET, FILTST, FTSC, CPTOUT, CYCP, INTST.  
Place decks for FUEL Main Program here. First card must be "OVERLAY(INTRS5,4,0)"  
Next come the source decks for SUBROUTINES BDFLCN, BDHCEM, BDCOEM, BDNOEM.  
Place decks for INCES Main Program here. First card must be "OVERLAY(INTRS6,5,0)"  
Next come the source decks for SUBROUTINES READET, POINT, POUT, INCL, INC2, INC3, PINC, MOE1, MOE2, MOE3, TTIME, MOUT.  
Place deck for POSPRO Main Program here. First card must be "OVERLAY(INTRS7,6,0)"  
Place deck for INPLOT Main Program here. First card must be "OVERLAY(INTRS10,7,0)"  
Next come the source decks for SUBROUTINES AXPLLOT, COMPCT, CONTR, CPLOT, FILEX, IOPROC, LEGEND, PAGE, PATH, SEARCH, SPTAL, TPLOT, TRAJEC.  
Place deck for SAM Main Program here. First card must be "OVERLAY(INTRS11,10,0)"  
Next come the source decks for SUBROUTINES READCL, PRINT, STAT, TTEST, CALC, ANOVA, WILCOX, UTEST, RANK.  
\*\*\*\*(Column 1 of this card should contain 6, 7, 8 and 9 punches)

Figure 12: Generation of Full CDC Version  
INTRAS Object Module (concluded)



```
INTRAS,T100.
ACCOUNT (.....,.....)
REQUEST (NEWOB,*PF)
ATTACH (OLDOB,INTRASOBJECT,ID=.....)
FTN (I=INPUT,A,B=OBJECT,EL=I,P,R=0)
REWIND (OBJECT)
COPYL (OLDOB,OBJECT,NEWOB)
REWIND (NEWOB)
CATALOG (NEWOB,INTRASOBJECT,ID=.....,RP=999)
****(Column 1 of this card should contain 7, 8 and 9
punches
Place decks to be compiled here. If Main programs of
any overlay modules are compiled, then the "OVERLAY"
card must be included as the first card of each such
Main program.
****(Column 1 of this card should contain 6, 7, 8 and 9
punches)
```

Figure 13: Revision of CDC Version INTRAS  
Object Module



\*Denotes optional card type

Figure 14: INTRAS Data Deck Block Structure



Block 2 - This block contains all of the required and optional data needed to execute a one subinterval (or first subinterval of a multiple subinterval) simulation run.

Block 3a, 3b...3i - This block type is repeated for the second, and all subsequent, subintervals of a multiple subinterval simulation run. The data cards included in Block 3 allow link parameters to be varied from subinterval to subinterval. If a card is omitted from this block, the parameter values normally specified on that card will retain the values from the previous subinterval. Generally, if a card is included for a particular link, then all data fields on the card pertaining to that link should be specified.

Block 4 - This block type contains revisions to the built-in fuel consumption and vehicle emissions tables of the FUEL Module. FUEL may be exercised with or without Block 4. In the latter case, the built-in values are used.

Block 5 - This block contains input parameter data required to execute the point processing, MOE estimation and incident detection algorithms of the INCES module. If INCES is not required (on-line incident detection does not require the INCES module) then Block 5 may be omitted.

Block 6 - This block contains parameters which specify digital plotting activities to be performed by the INPLOT module. INPLOT is always executed alone so that the data deck for an INPLOT run consists of only Blocks 1 and 6.

Block 7 - This block contains parameters specifying the statistical activities to be performed by the SAM module. SAM is always executed alone so that the data deck for a SAM run consists of only Blocks 1 and 7.

Figure 15 illustrates the block structures for three different hypothetical data decks. The module which reads each block is indicated adjacent to the block in the figure. The following discussion describes the function and possible purpose of the runs represented by these data decks.

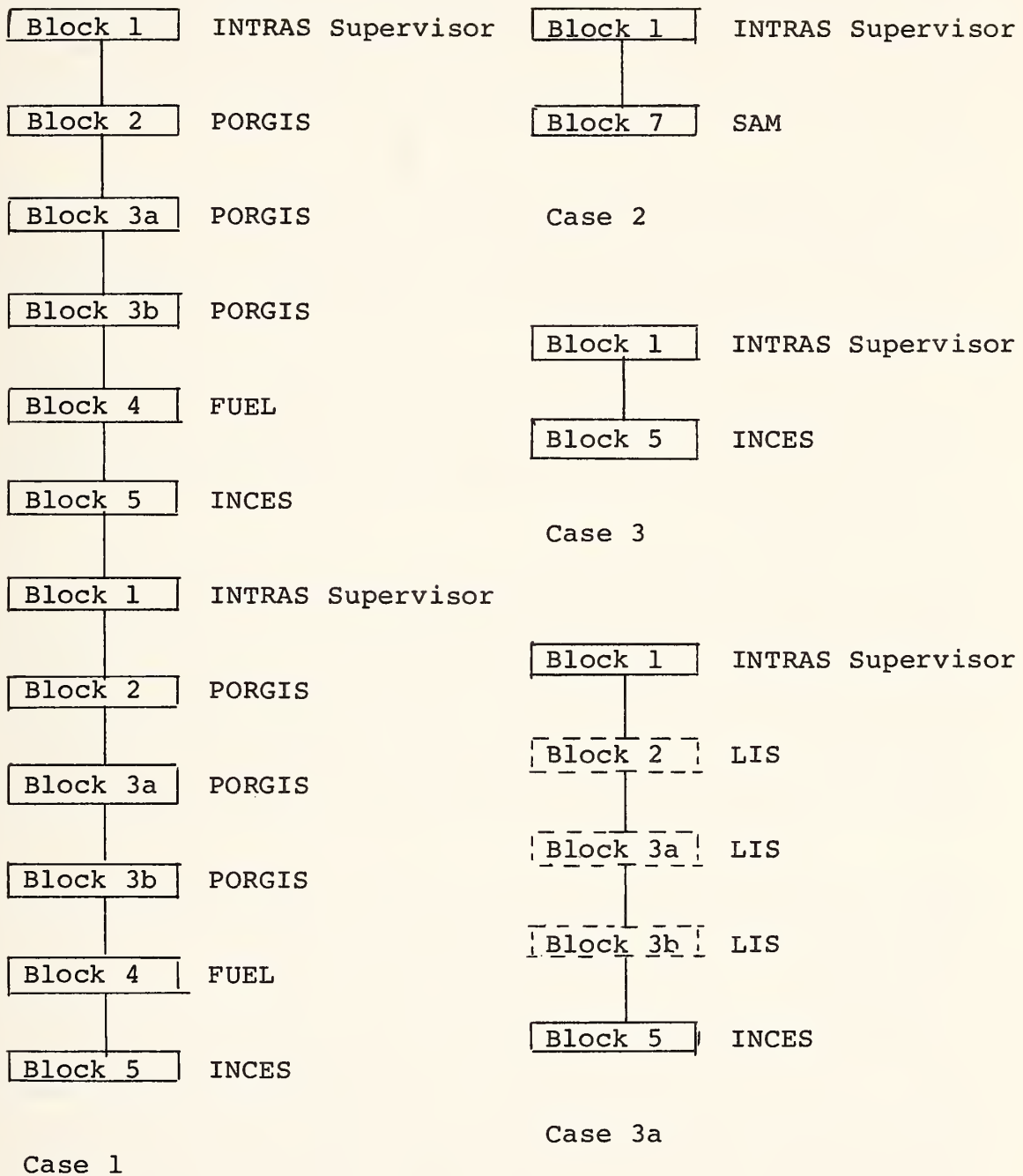


Figure 15: Hypothetical INTRAS Data Deck Structures

Case 1 - The deck structure of Case 1 would be used to execute two successive simulation cases. Each of the simulations would be followed by execution of the FUEL and INCES modules. As mentioned earlier, FUEL could be exercised without Block 4. The inclusion of Block 4 in the Case 1 data deck indicates that a revision is to be made in the built-in data tables.

The execution of INCES indicates that these simulations do not employ on-line incident detection control algorithms, but rather, that detector point processing, MOE estimation and/or incident detection evaluations are to be performed following each simulation.

During the execution of the simulations, the Case 1 user might well be creating and storing statistical and/or plotting data for future use. Whether or not this occurs is dependent upon specifications in the Type 99 Run Control Card of Block 1.

Case 2 - The deck structure of Case 2 illustrates the required sequence of blocks to perform a statistical analysis (via the SAM module) of data stored previously on the Statistical Data Tape. Case 2 might well be a follow-up to Case 1 if the Case 1 user had chosen to output statistics for the two simulations. Case 2 would then compare the two statistical output sets and determine if significant differences were present in these results.

Case 3 - The deck structure of Case 3 could represent two different applications. First, Case 3 might simply be the application of INCES to data stored, during the execution of a simulation study, on the INCES Data Tape.

Second, a current simulation may be performed during Case 3 followed by the application of INCES. This could occur if the simulation data had been submitted as an early run to PORGIS and then stored if it were free of errors on the Case Data Tape. This procedure would allow the user to "shake-down" simulation data cases at high priority during the day, and then run the more costly simulation at low priority overnight.

Case 3a illustrates the implied order of blocks read by INTRAS for this type of application. Blocks enclosed by dotted lines are not in the physical deck submitted by the

user. Rather, they are extracted from the Case Data Tape and read by the LIS module. All parameters required to specify this procedure are included in the Type 99 Run Control Card of Block 1.

### 5.3 Execution of the INTRAS Program

In Section 5.1 examples of the preparation of program load modules for IBM 360/370 and CDC 6600/7600 applications were presented. In this section, the execution of those modules under the IBM/OS and CDC/SCOPE operating systems will be described. As with the earlier examples, local (installation specific) characteristics may require slight modifications in the procedures presented here. The following examples are intended as prototypes from which analogs may be drawn to suit the hardware or software peculiarities of the individual computer system.

Figure 16 illustrates the IBM/OS JCL (Job Control Language) needed to execute the (IBM Version) object program load module created in the example of Section 5.1. Depending on the particular application, the data definitions for certain files (DD's) may be replaced by dummies. The FORTRAN logical file number consists of the third and fourth characters of the file name field FT12F001 ("12" in this case) of the DD statement. Table 43 identifies the files which may be replaced by dummies, the necessary conditions for replacement and the replacement DD statement.

Six of the files used by INTRAS may be retained by the user. These files (numbers 8, 9, 11, 12, 19 and 23) are assumed to reside on tape in the prototype of Figure 16. Since tape intensive computer runs are often impractical, it is recommended that the user consult with local systems personnel to determine the procedures needed to place the desired files in permanent disc storage.

Figure 17 illustrates the CDC/SCOPE control statements needed to execute the (CDC Version) object program load module created in the example of Section 5.1. As for the IBM version certain files may not be needed for particular applications. No action need be taken by the user to omit utility files 14, 15, 16, 17, 20, 21, 22, 24 and 25. Table 44 indicates those cards to be removed from the deck of Figure 17 if any permanent optional files are to be omitted.



```

// EXEC PGM=INTRAS
//STEPLIB DD DSN=INTRAS.LOADMOD,VOL=SER=.....,UNIT=.....,DISP=SHR
//FT06F001 DD SYSOUT=A,DCB=(RECFM=FA,LRECL=133,BLKSIZE=133)
//FT07F001 DD SYSOUT=B,DCB=(RECFM=F,LRECL=80,BLKSIZE=800),
// SPACE=(CYL,(1,1))
//FT08F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....)
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=F,LRECL=80,BLKSIZE=800,DEN=2)
//FT09F001 DD LABEL=(1,NL),VOL=PRIVATE,RETAIN,SER=.....),
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804,DEN=2)
//FT11F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804,DEN=2)
//FT12F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=F,LRECL=2044,BLKSIZE=2048,DEN=2)
//FT13F001 DD UNIT=SYSDA,DCB=(RECFM=F,LRECL=80,BLKSIZE=800),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT14F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT15F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT16F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT17F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT19F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804)
//FT20F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT21F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT22F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT23F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804)
//FT24F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT25F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT05F001 DD *
**** Place Data Cards Here ****
/*
//

```

Figure 16: IBM 360/370 Execution of INTRAS

Table 43: Allowable Dummy Data Definitions for  
IBM 360/370 Execution of INTRAS

<u>FORTAN</u>	<u>Logical</u>	<u>File No.</u>	<u>Necessary</u>	<u>Replacement</u>	<u>Dummy Data Definition (DD)</u>
8	No Case Data Tape required				//FT08F001 DD UNIT=SYSDA, SPACE=(CYL,(1,1)), // DCB=(RECFM=F,LRECL=80,BLKSIZE=800)
9	No simulation performed or no detectors in simulation				//FT09F001 DD DUMMY
11	No retention of simulation statistics for SAM and no SAM run performed				//FT11F001 DD DUMMY
12	No INPLOT run performed				//FT12F001 DD DUMMY
14	No SAM run performed				//FT14F001 DD DUMMY
15	Same as for File 11				//FT15F001 DD DUMMY
16	Same as for File 9				//FT16F001 DD DUMMY
17	Same as for File 11				//FT17F001 DD DUMMY
19	No retention of simulation data for INPLOT and no INPLOT RUN performed				//FT19F001 DD DUMMY
20	Same as for File 12				//FT20F001 DD DUMMY
21	Same as for File 12				//FT21F001 DD DUMMY
22	No FUEL run performed (with or without simulation)				//FT22F001 DD DUMMY
23	Same as for File 22				//FT23F001 DD DUMMY
24	Same as for File 22				//FT24F001 DD DUMMY
25	Same as for File 22				//FT25F001 DD DUMMY



```

INTRAS, T200.
ACCOUNT (.....)
ATTACH (OBJECT, INTRASOBJECT, ID=.....)
REQUEST (CASED, MT, HY, RING, VSN=.....)
REQUEST (INCESD, MT, HY, RING, VSN=.....)
REQUEST (SAMD, MT, HY, RING, VSN=.....)
REQUEST (PLOT, MT, LO, RING, VSN=.....)
REQUEST (INPLOTD, MT, HY, RING, VSN=.....)
REQUEST (FUELD, MT, HY, RING, VSN=.....)
OBJECT (, , , CASED, INCESD, SAMD, PLOT, INPLOTD, FUELD)
UNLOAD (CASED)
UNLOAD (INCESD)
UNLOAD (SAMD)
UNLOAD (PLOT)
UNLOAD (INPLOTD)
UNLOAD (FUELD)
**** (Column 1 of this card should contain 7, 8 and 9
      punches)
**** Place Data Cards Here ****
**** (Column 1 of this card should contain 6, 7, 8 and 9
      punches)

```

Figure 17: CDC 6600/7600 Execution of INTRAS

Table 44: CDC/SCOPE Control Cards To Be Omitted for Dummy Files

FORTRAN Logical File No.	Control Cards To Be Omitted If File Is Not Required
8	REQUEST (CASED, MT, HY, RING, VSN=.....) UNLOAD (CASED)
9	REQUEST (INCESD, MT, HY, RING, VSN=.....) UNLOAD (INCESD)
11	REQUEST (SAMD, MT, HY, RING, VSN=.....) UNLOAD (SAMD)
12	REQUEST (PLOT, MT, LO, RING, VSN=.....) UNLOAD (PLOT)
19	REQUEST (INPLOTD, MT, HY, RING, VSN=.....) UNLOAD (INPLOTD)
23	REQUEST (FUELD, MT, HY, RING, VSN=.....) UNLOAD (FUELD)

The conditions for omitting a file are those previously specified in Table 43 for the IBM version.

## 6. CASE STUDY

To ease the task of assimilating the foregoing text, an input preparation case study has been devised. This case study is based upon the traffic network illustrated earlier in Figures 1 and 2. The output report examples of Section 4 are, for the most part, products of this case study. Figure 18 illustrates a data deck coded for INTRAS. Most of the features of the INTRAS simulation model would be exercised by this data. Its primary purpose is to illustrate the preparation of input data. The following briefly describes the contents and purpose of the various data cards.

### Card 1: Run Control Card Type 99

The data on this card specifies that:

- ⊙ This case will involve diagnostic testing, simulation and incident detection
- ⊙ The Incident Data, INPLOT Data, Case Data, Statistical Data and FUEL Data Tapes will be produced
- ⊙ At least one more case follows
- ⊙ The FUEL Module will be exercised

### Card 2: Title Card

The data on this card specifies:

- ⊙ Title of run
- ⊙ The default time step will be used
- ⊙ This is Run "105"
- ⊙ The default Random Number Seed is to be used

															Card #		
07	11	11													99		
INTRAS DEMONSTRATION CASE															00		
DUMMY NETWORK															01		
701	1	3553	2			1	2	10003552		300	11	11	000	00	01		
2	3	5003553	00	4		3	4	10003553		3	10	4			02		
4	5	6003553		6	11	5	6	6003552		5	9	10	5		02		
802	7	1352		8		7	8	3501352		708					02		
8	3	3002351		4		8	9	12001352	00	3	9				02		
4	9	3002351		10		9	10	5001353		814	11813				02		
10	11	3001351	C	12		5	11	4502351			12				02		
11	12	4001352		807											02		
13	10	3001301		814	11										02		
						14	10	4001301	0	11813					02		
						806	13	1301		10					02		
805	14	1301		10											02		
701	1		FREEWAY-T	1	2			FREEWAY-A	2	3				FREEWAY-B	03		
3	4		FREEWAY-C	4	5			FREEWAY-D	5	6				FREEWAY-E	03		
802	7		SURFACE-U	7	8			SURFACE-F	8	3				RAMP-G	03		
8	9		SURFACE-H	4	9			RAMP-I	9	10				SURFACE-J	03		
10	11		SURFACE-K	5	11			RAMP-L	11	12				SURFACE-M	03		
				13	10			SURFACE-O	14	10				SURFACE-P	03		
				806	13			SURFACE-R805	14					SURFACE-S	03		
701	1			1		1	2			1					5004		
2	3			1	20	3	4	3		1	20			25004	23		
4	5	2	250	J		5	6			1					04		
8	31	8				4	9124	3							05		
5	11124	2													05		
802	7124	22				7	8124	22							06		
8	9124	22				9	10124	22		4	1				06		
10	11124	22				11	12124	22							06		
						13	10124	22							06		
14	10124	22	13												06		
806	13124	22				805	14124	22							06		
701	1	100	1	2	100	2	3	100	3	4	80	20	4	5	90	10	08
5	6	100	802	7	100	7	8	40	60	8	3	100	8	9	100		08
4	9	100	9	10	33	34	33	10	11	100	5	11	100	11	12	100	08
805	14	100	13	10	50	50	14	10	10	90	806	13	100				08
1		701			1												10
2		1			1												10
3		2	8		10												10
4		3			1												10
5		4			1												10
6		5			1												10
7		802			1												10
8		7			1												10
9		0	4	8	01												10
10		0	9	13	14	324	10	020	4	211	24	200	4	122	44	022	410
11		5	10		01												10
12		11			1												10
13		806			1												10
14		805			1												10
701	1	4000	20	6	6	8	3030		806	13	300	20	10	15	0		20
802	7	600	20	10	10	10			805	14	300	20	0	0	0		20
2	3	1503	61	10	1501	62		1501	63					1	1		25
3	4	1503	61	10	1501	62		1501	63					63	2		25
4	5	1501	61		1501	62		1501	63						3		25
3	4012000000		10	20	300		300	50									30
																	49
2	1	2	3	4	5	6								10			50
600300300300300																	50
701	1	5000	20	6	6	8	3030										60
600300300300300																	60
701	1	3400	20	6	6	8	3030										60
600300300300300																	60
16	0	60	60		3												60
8.0	50.0	8.0								17	1	0					65
1	2	3															66
10					1												66
30105	1	6				4	15	10	500	140	110						99
																	70

Figure 18: Case Study Input Data



### Card 3: Network Name

The data on this card specifies:

- Network descriptive name
- Initialization is to be a maximum of 300 seconds in duration
- Simulation will not begin unless equilibrium is attained
- Clock time at the start of simulation is 10:00:00

### Cards 4 through 14: Link Geometry

The data on these cards define the roadway sections (links) of the network and their interconnection with other links. For each link, the following characteristics, which will prevail throughout the simulation, are specified.

- Length
- Gradient
- Link Type (Surface, Ramp, Freeway)
- Mean Free-flow Speed
- Location of Early Warning Signs for Freeway Links

### Cards 15 through 21: Link Names

These optional cards contain 24 character alphanumeric descriptions for selected links.

### Cards 22 through 24: Freeway Link Operations

The data on these cards define physical characteristics of the freeway links which will prevail throughout the simulation. Specifically these characteristics are:

- Curvature
- Auxiliary Lane Geometries

- Lane Separation Barriers
- Superelevation
- Pavement Condition
- Lateral Alignment with Succeeding Link
- Station Location for Reporting Freeway Statistics

Cards 25 and 26: Ramp Link Operations

The data on these cards define physical characteristics of the ramp links, which will prevail throughout the simulation, as well as behavioral characteristics which may change for each new subinterval. Specifically, these characteristics are:

- Intersection "Type" (queue discharge distribution indicator)
- Mean Queue Discharge Headway
- Lateral Alignment with Succeeding Link
- Curvature, Superelevation and Pavement Condition

Cards 27 through 32: Surface Link Operation

The data on these cards define physical characteristics of the surface links, which will prevail throughout the simulation, as well as behavioral characteristics which may change for each new subinterval. Specifically, these characteristics are:

- Intersection "Type" (queue discharge distribution indicator)
- Mean Queue Discharge Headway
- Lost Time for First Vehicle in Queue
- Identification of Link Opposing Left Turners
- Geometrics of Left and Right Turning Pockets

- Lane Specific Channelization

#### Cards 33 through 36: Link Turning Movements

The data on these cards specify, for all links, the proportion of vehicles which turn left, go straight through, or turn right when discharging from the specified link.

#### Cards 37 through 50: Sign and Signal Control

The data on these cards specify the control exercised on vehicles approaching all nodes of the network. Specifically, the control characteristics are:

- Duration of each signal interval for signal controlled nodes
- Control Code facing each approach (by interval for signal control)
- Offset of Interval 1 for signal controlled nodes

#### Cards 51 and 52: Volume

The data on these cards specify the incoming volume characteristics for each entry link in the traffic network. Specifically, these volume characteristics are:

- Flow rate
- Percentage of each vehicle type
- For freeway entries, percentage of volume assigned to each lane

#### Cards 53 through 55: Surveillance System

The data on these cards define the geometrics of surveillance detectors in the traffic network. Specifically, these geometrics are:

- Type of detector
- Position of detector
- Size of detector (for induction loops)
- Detector station numbers

#### Card 56: Incident Specification

The data on this card defines an incident occurring in the traffic network. The incident characteristics are:

- Location of incident
- Roadway area affected (lanes and length)
- Nature of incident (blockage or rubbernecking)
- Onset and duration of incident

#### Card 57: Revision to Commercial Vehicle Freeway Lane Preference

The presence of this card indicates that a revision is to be made in the imbedded values of the percent of commercial vehicles assigned to each freeway lane. The contents of this card specify the revised commercial vehicle percentages.

#### Card 58: Output of Trajectories for Plotting

The presence of this card indicates that freeway vehicle trajectory data will be recorded on the INPLOT Data Tape. The contents of this card indicate the particular freeway links for which trajectories will be output.

#### Card 59, 61 and 63: Simulation Control

The data on these cards define subinterval specific parameters required for this three-subinterval simulation run. Specifically, these parameters are:

- Duration of subinterval
- Time and frequency of output reports
- Flag indicating whether there are more subintervals

### Cards 60 and 62: Revised Subinterval Volumes

The presence of these cards indicate that incoming volumes (or other volume related parameters) will be revised, during the second and third simulation subintervals, for the specified entry link. Note that numerous other card formats could have been included for subinterval specific parameter revisions (see Block 3a of Figure 14).

### Card 64: Off-line INCES Detector Processing

The presence of this card is mandated by the specification (in Card 1, the Type 99 card) that INCES will be exercised. The data on this card specify options and parameters needed for off-line detector processing. These options and parameters are:

- Flag indicating that detector specific (Point Processing) evaluations are to be performed
- Flag indicating that MOE estimation evaluations are not to be performed
- Flag indicating that loop detector data is to be treated as digital
- Polling frequency for digital mode
- Assumed vehicle length
- Specification of reevaluation time periods for incident detection
- Number of parameters required for the incident detection algorithm

### Card 65: Incident Detection Algorithm Parameters

The data on this card specifies the parameters to be used for the given incident detection algorithm. The algorithm number is also specified.



Card 66: Detector Station Specification

The data on this card indicate those detectorized freeway locations which are to be used for incident detection.

Card 67: Run Control for Second Case

The data on this card indicate:

- An INPLOT run is to be performed
- No more data cases follow

Card 68: Trajectory Plot Request

The data on this card indicates:

- Trajectory plots are to be performed for all lanes of traffic network using data stored on the INCES data tape
- The length of freeway for which trajectories are to be plotted is specified
- The time period for which trajectories are to be plotted is specified
- The time and space plotter scaling is specified

The foregoing data deck example is by no means exhaustive of the variations which a user may choose to submit to INTRAS. It is hoped that sufficient analogies exist to ease the task of submitting data for execution of the INTRAS program.



APPENDIX A

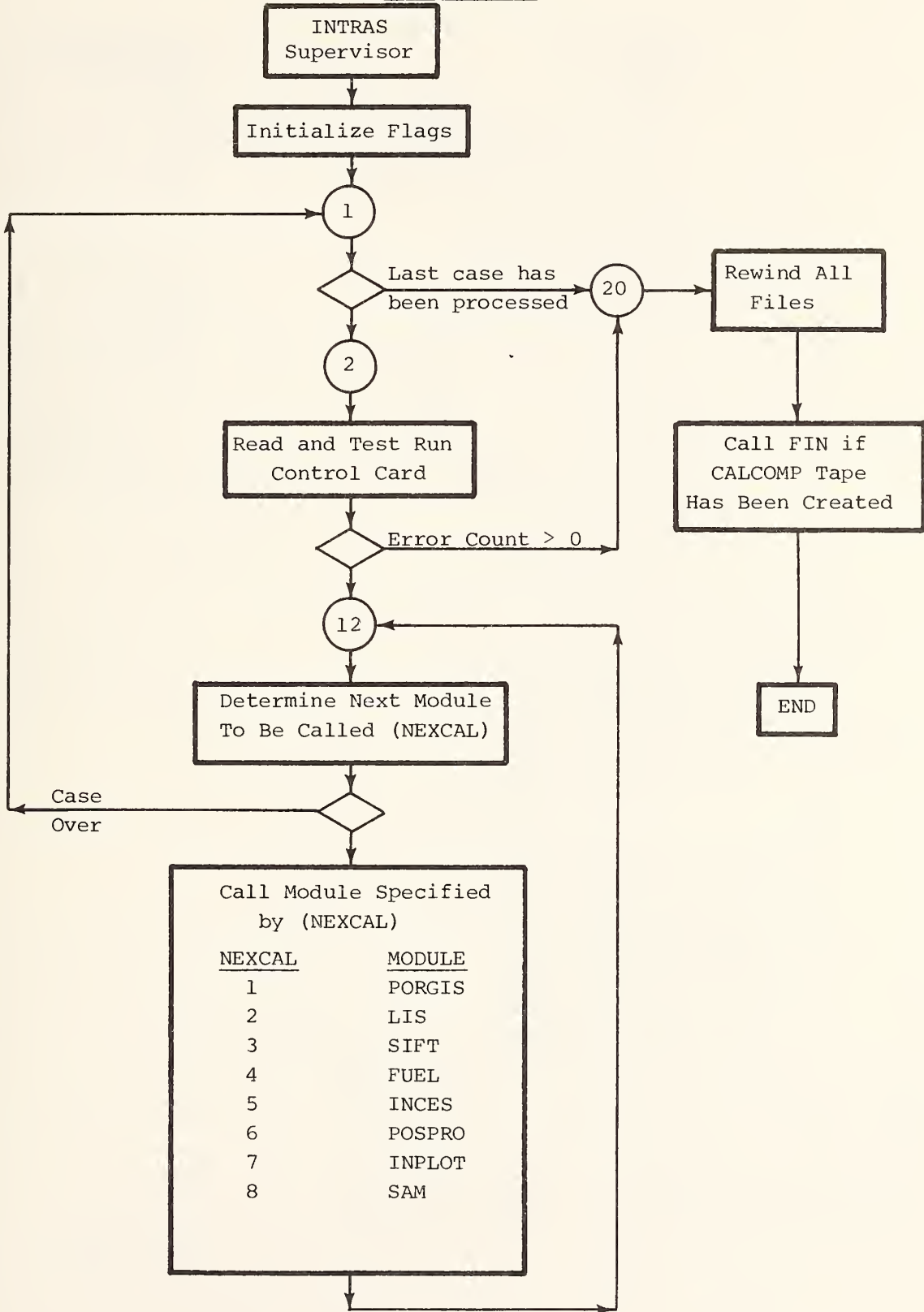


Figure 19: INTRAS Supervisor Logic  
189

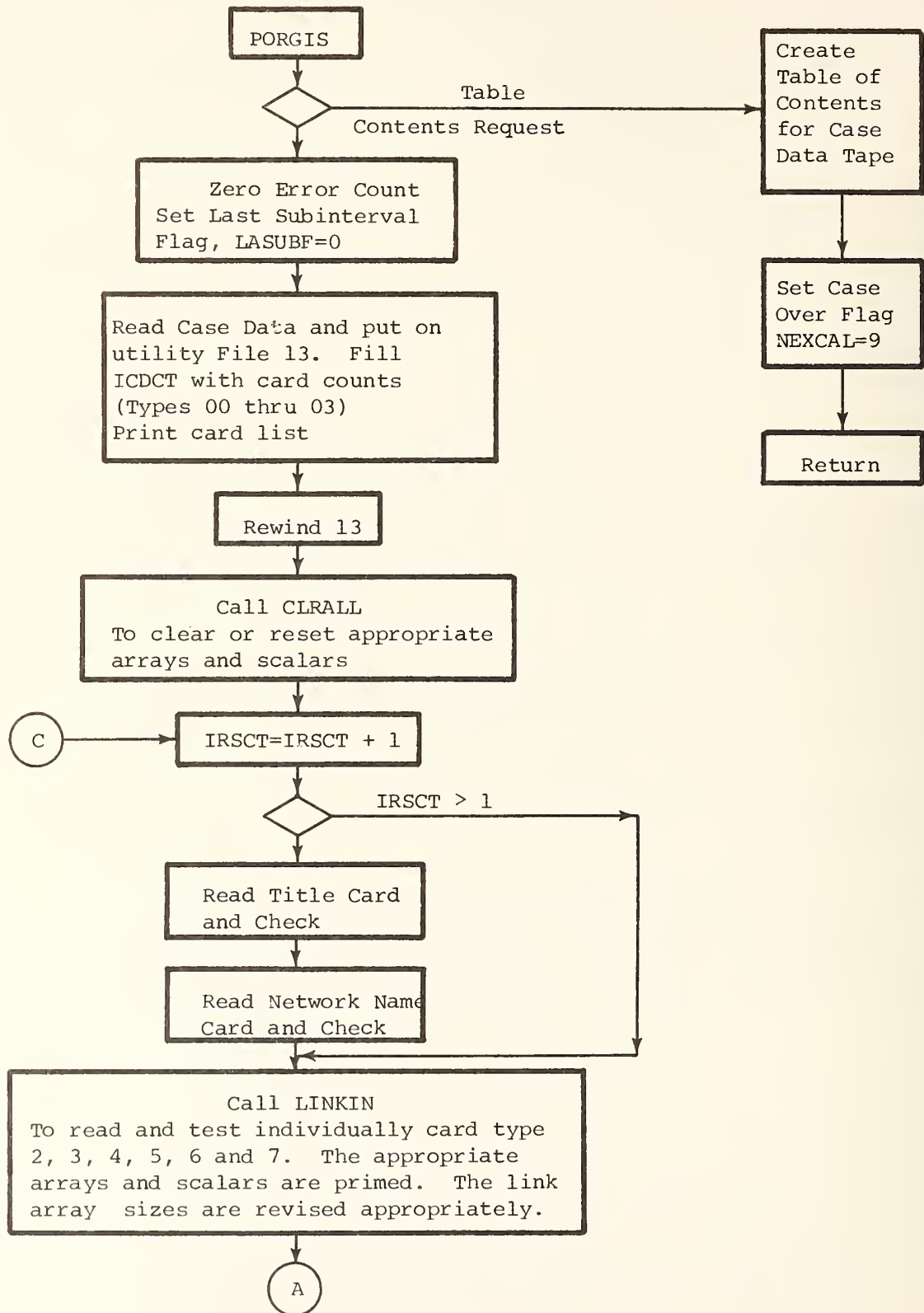


Figure 20: PORGIS Module Logic

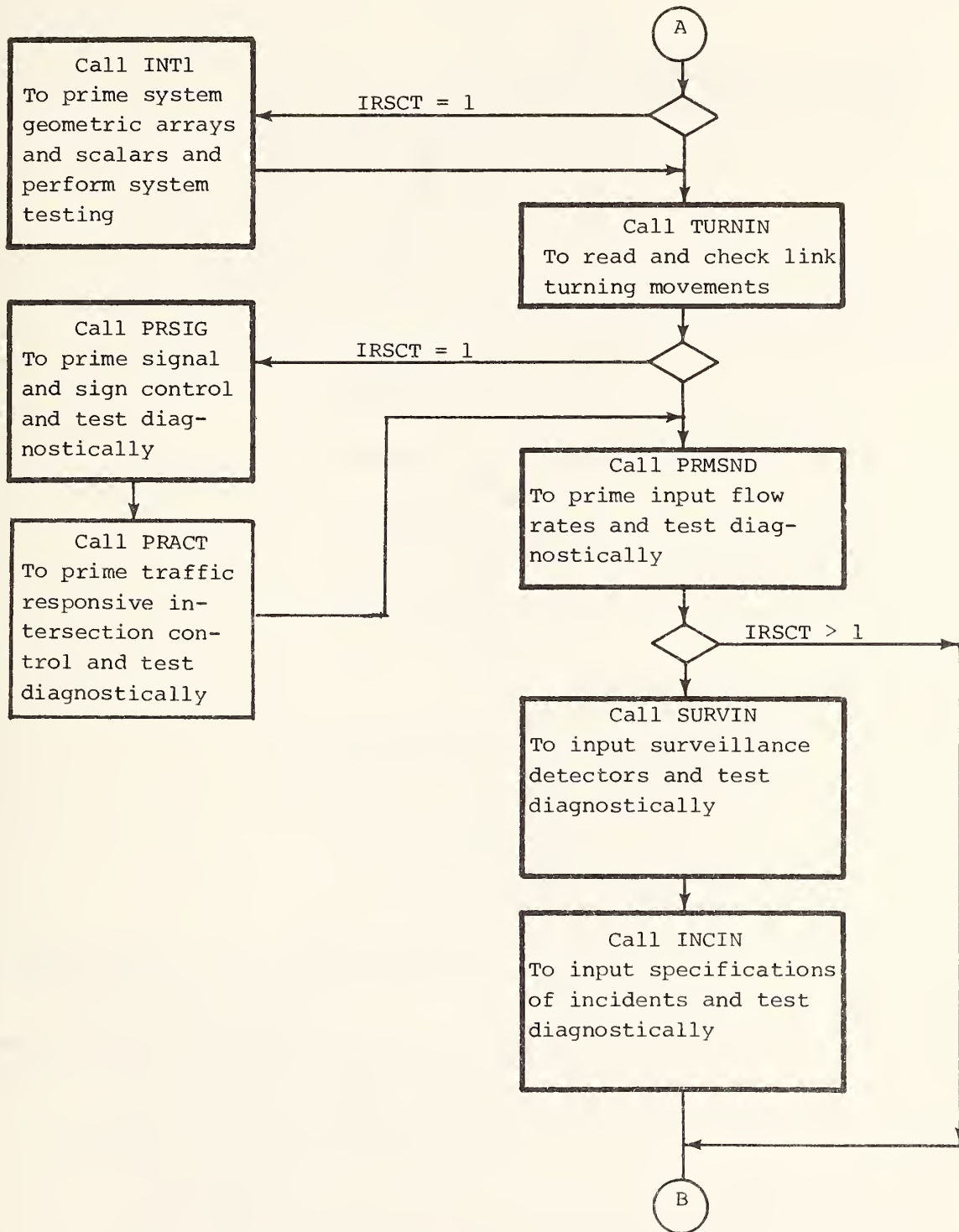


Figure 20: PORGIS Module Logic (continued)

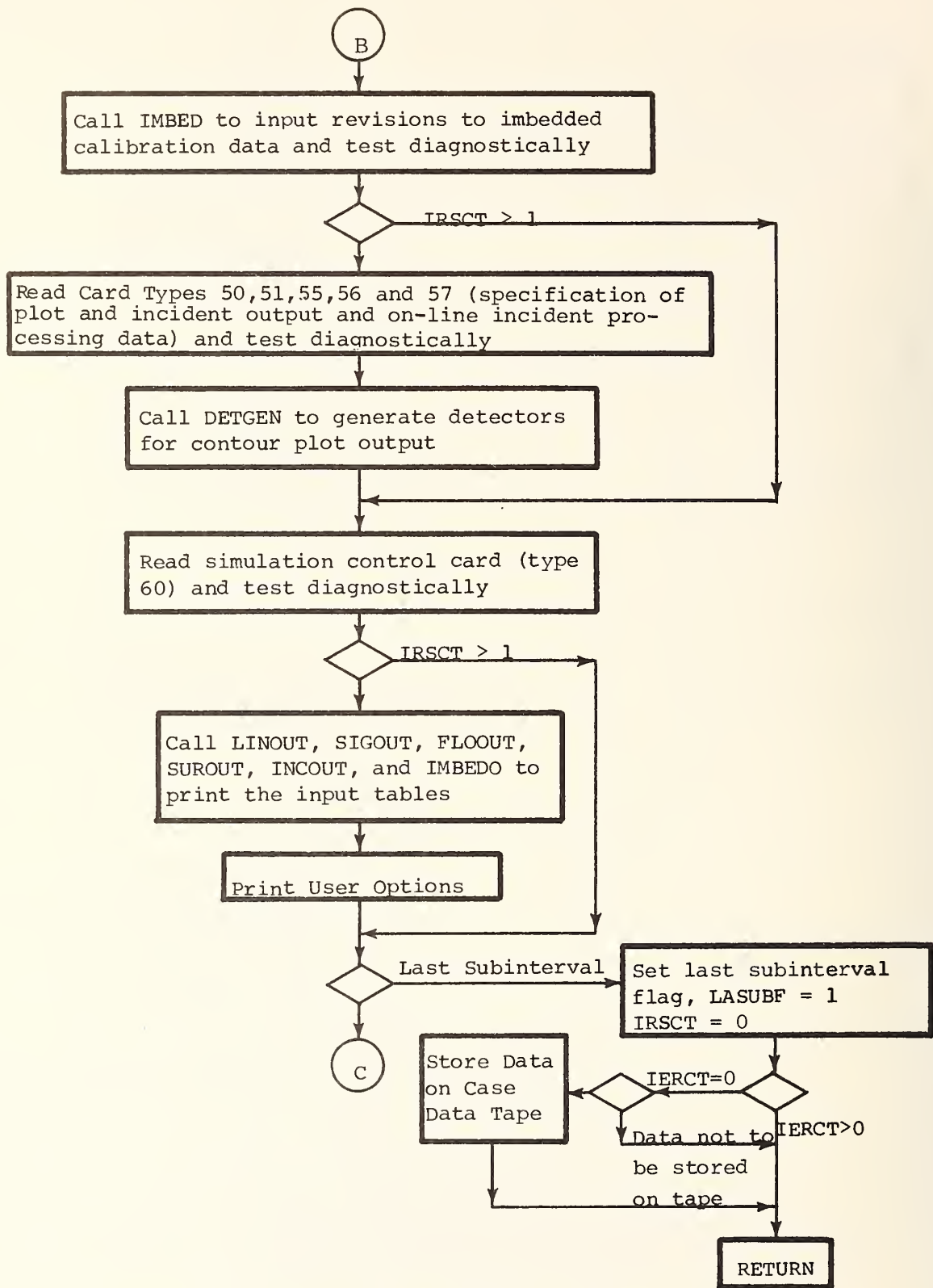


Figure 20: PORGIS Module Logic (concluded)

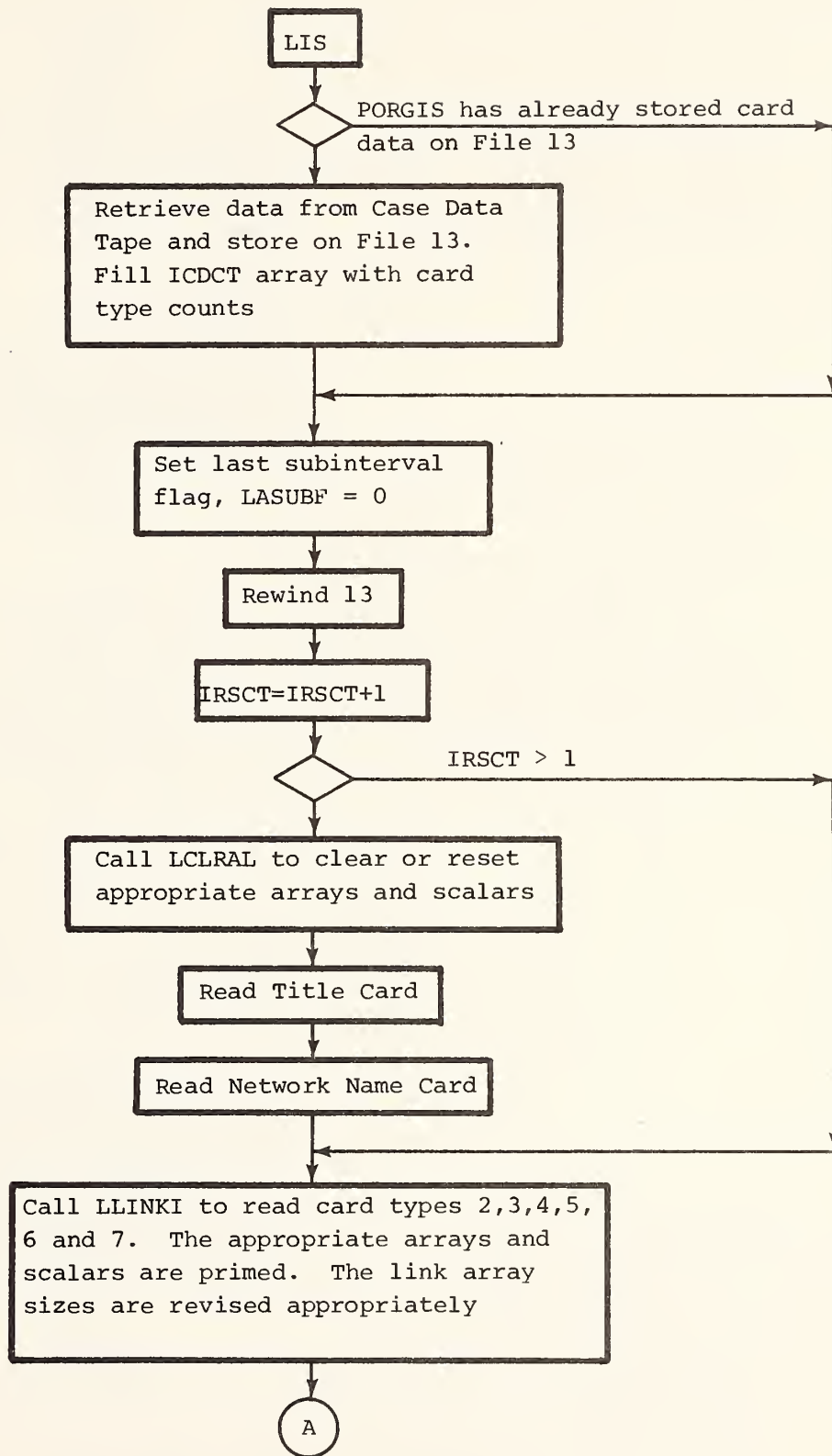


Figure 21: LIS Module Logic



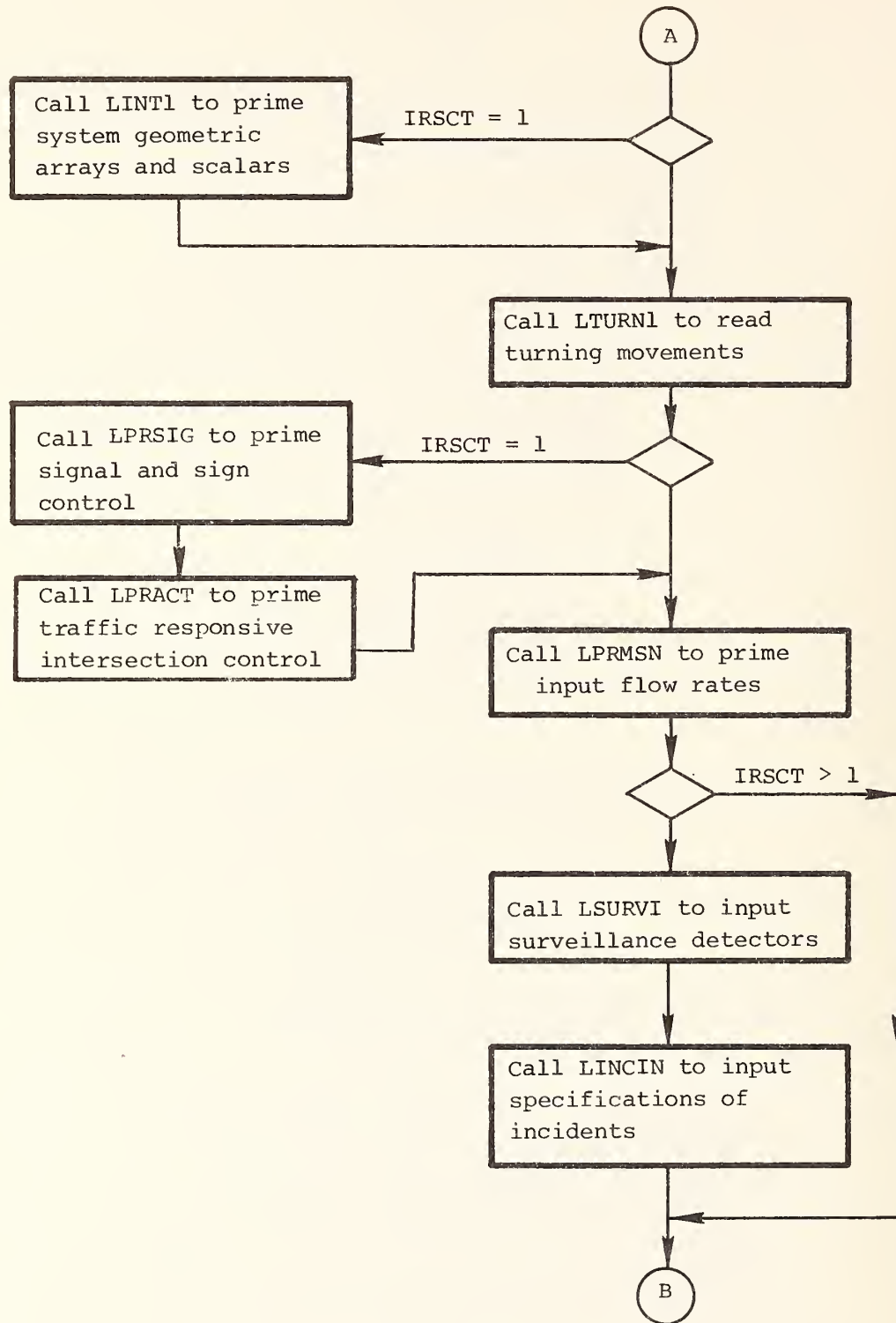


Figure 21: LIS Module Logic (continued)

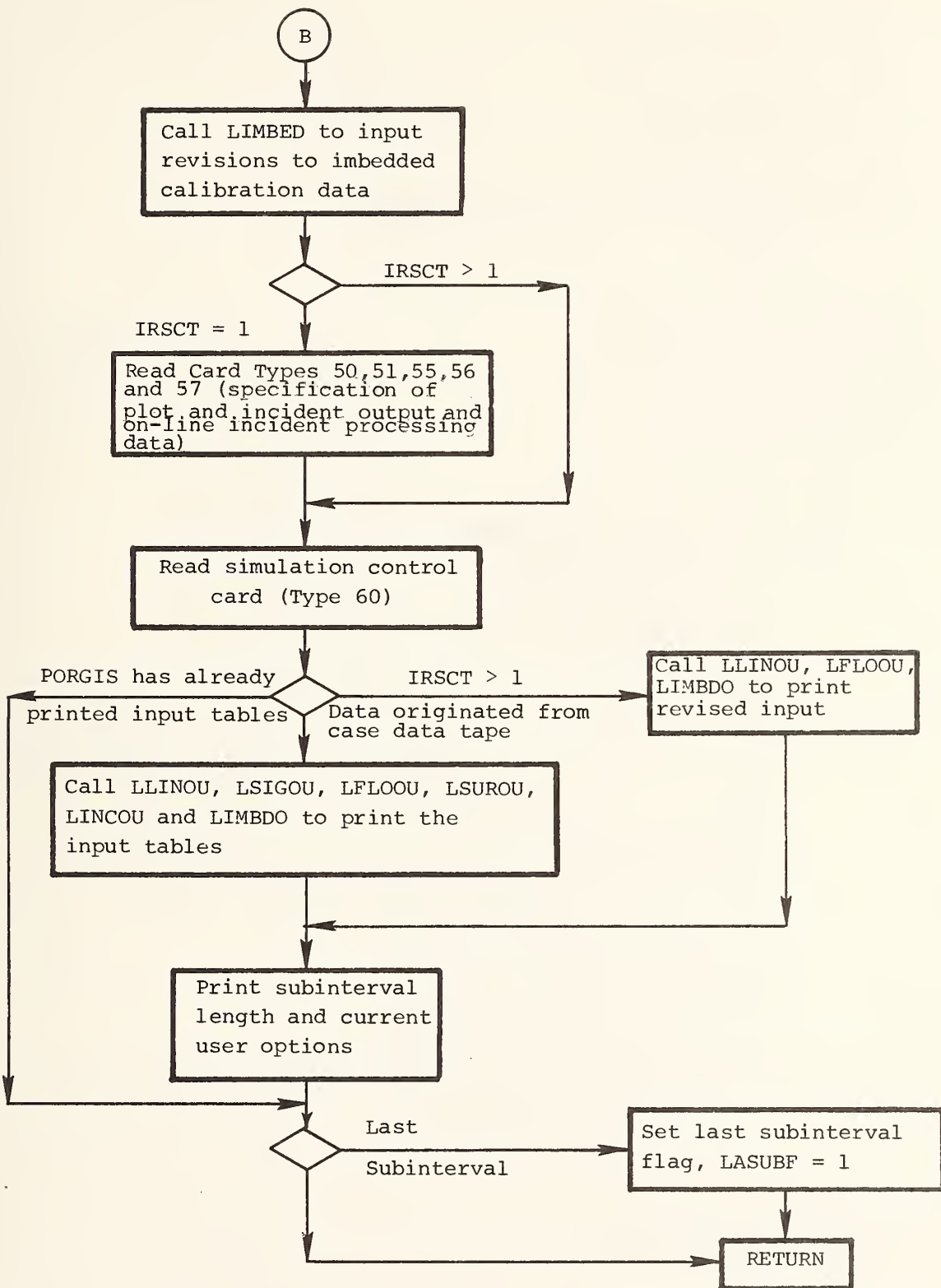


Figure 21: LIS Module Logic (concluded)

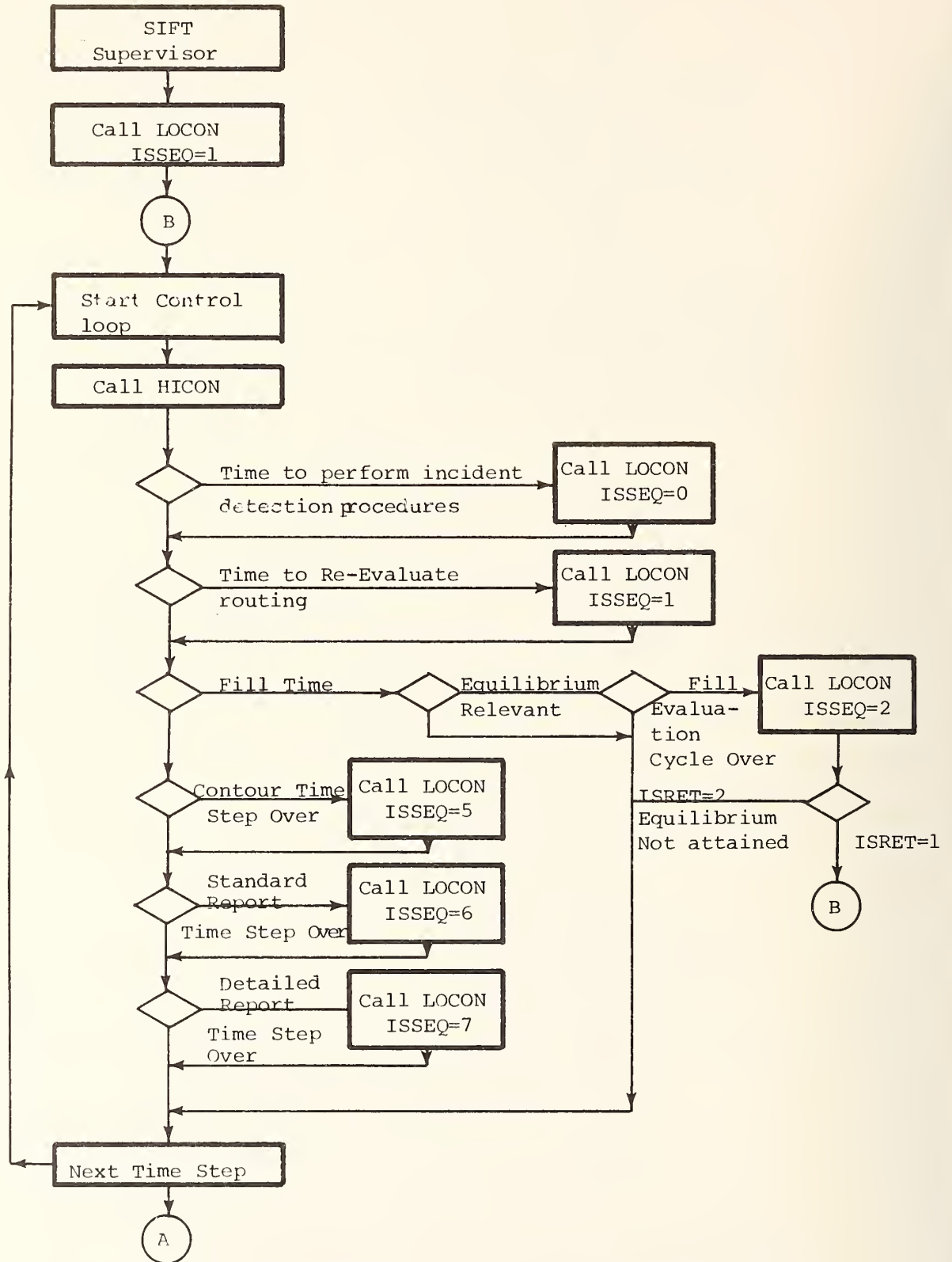


Figure 22: SIFT Supervisor Logic

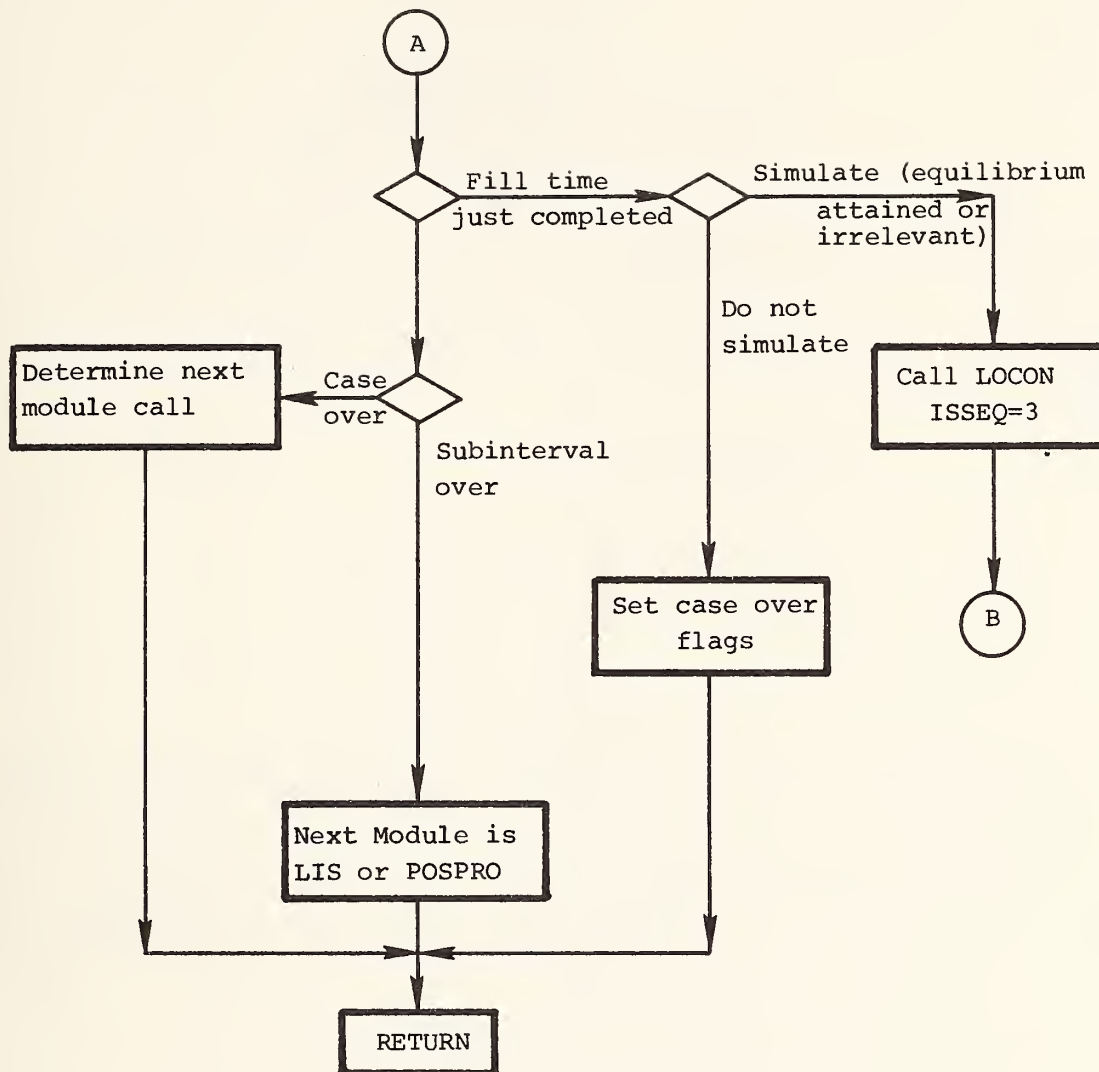


Figure 22: SIFT Supervisor Logic (continued)

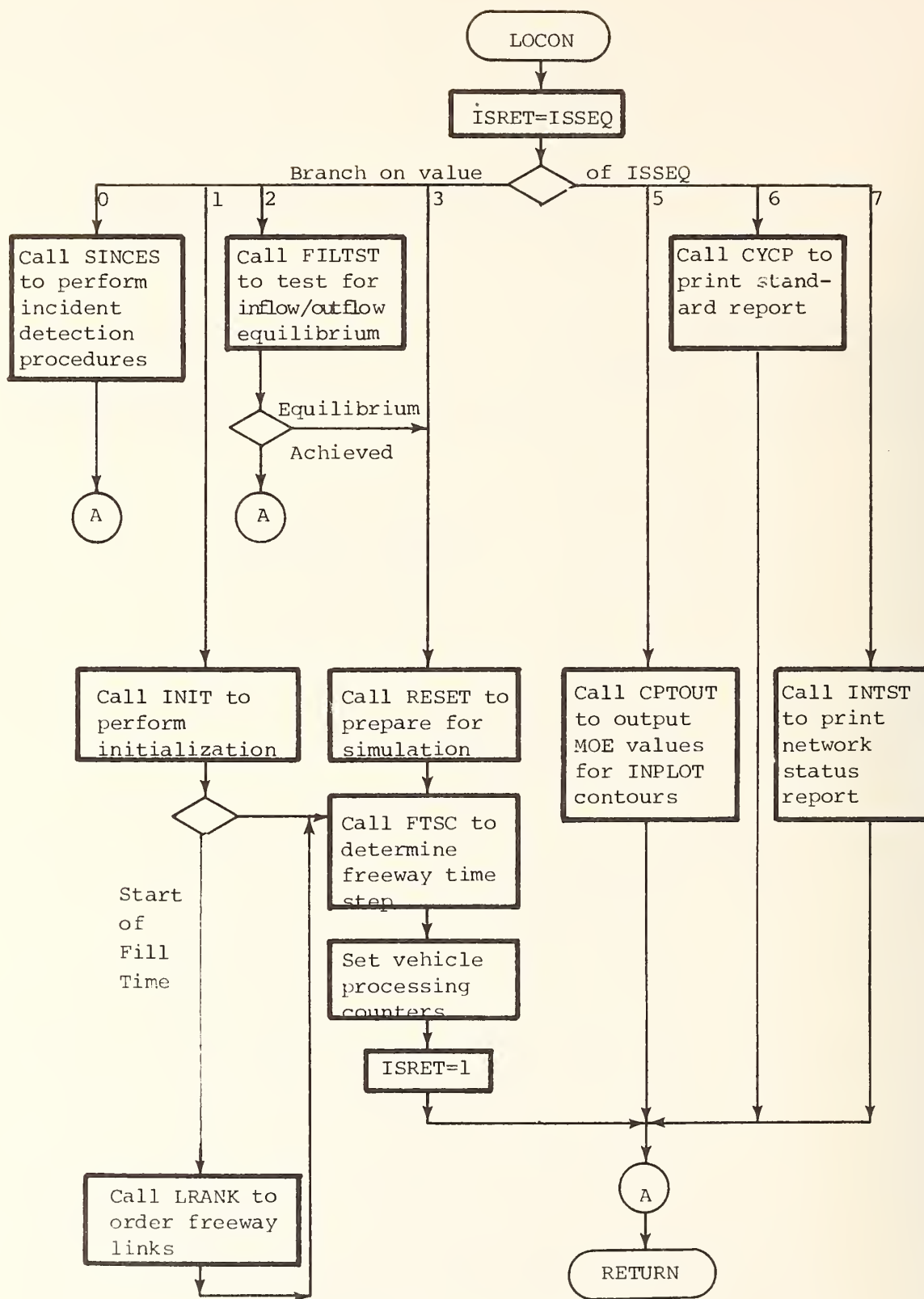


Figure 23: LOCON Suboverlay Logic

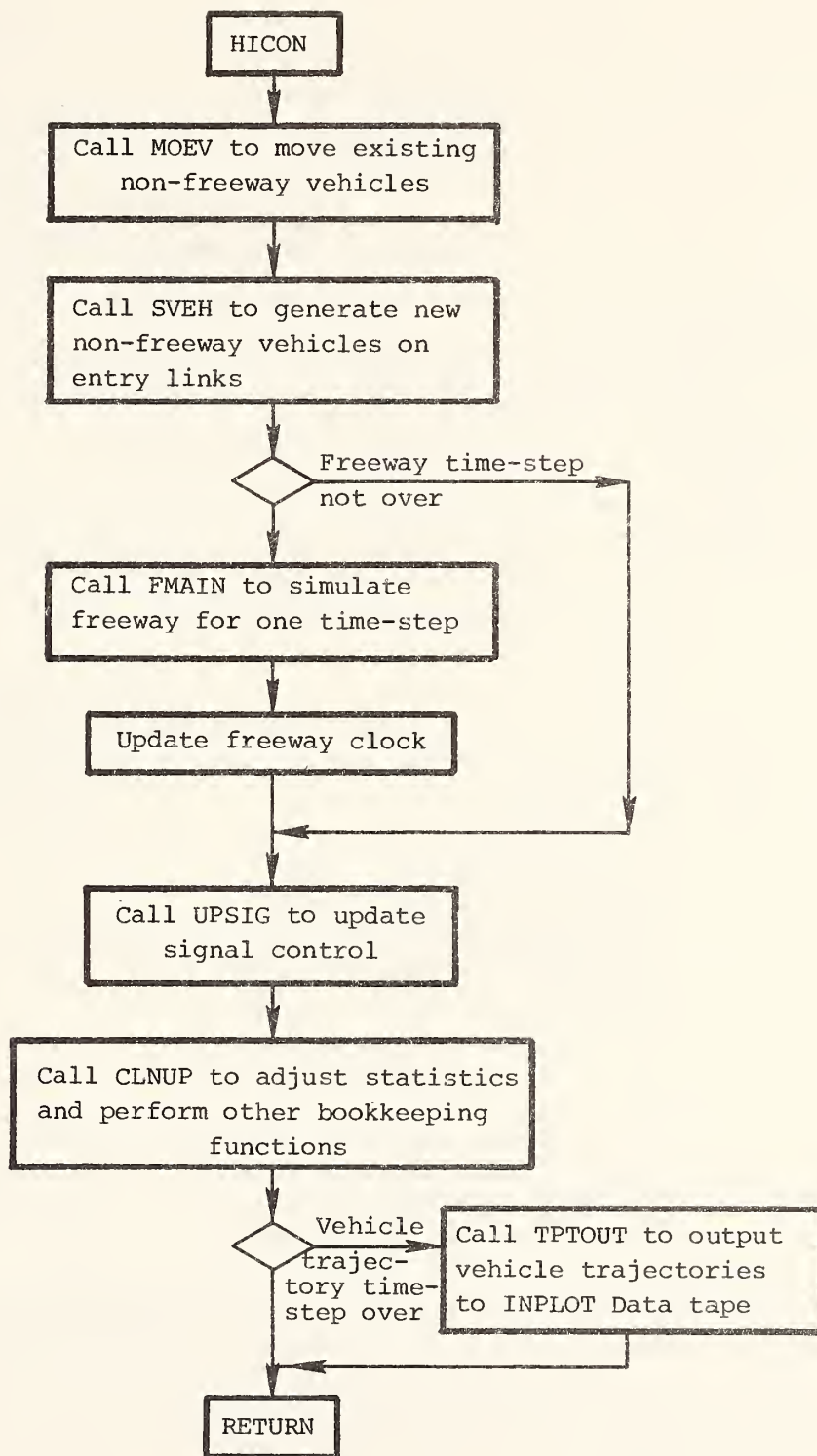


Figure 24: HICON Suboverlay Logic (concluded)



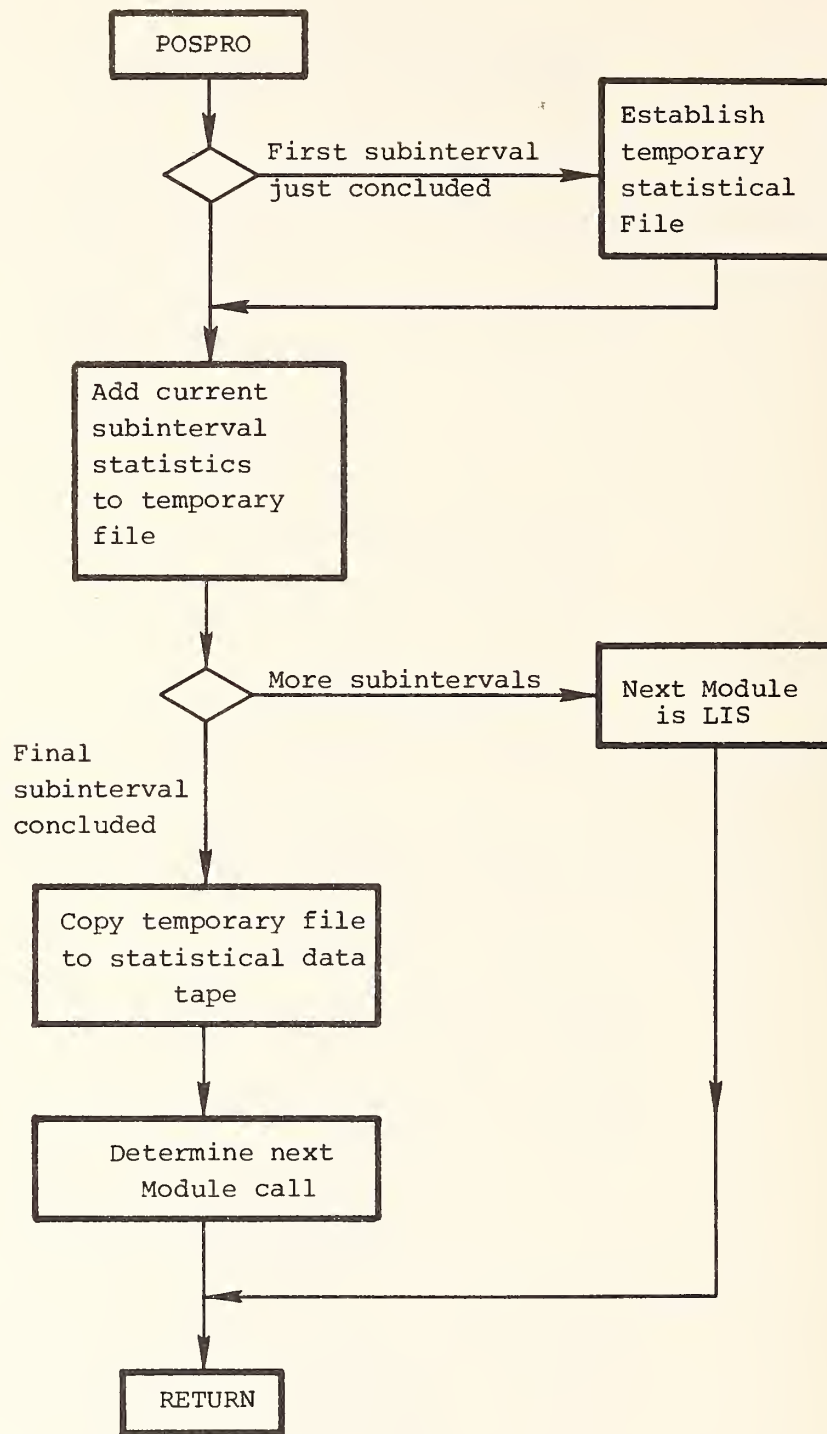


Figure 25: POSPRO Module Logic.

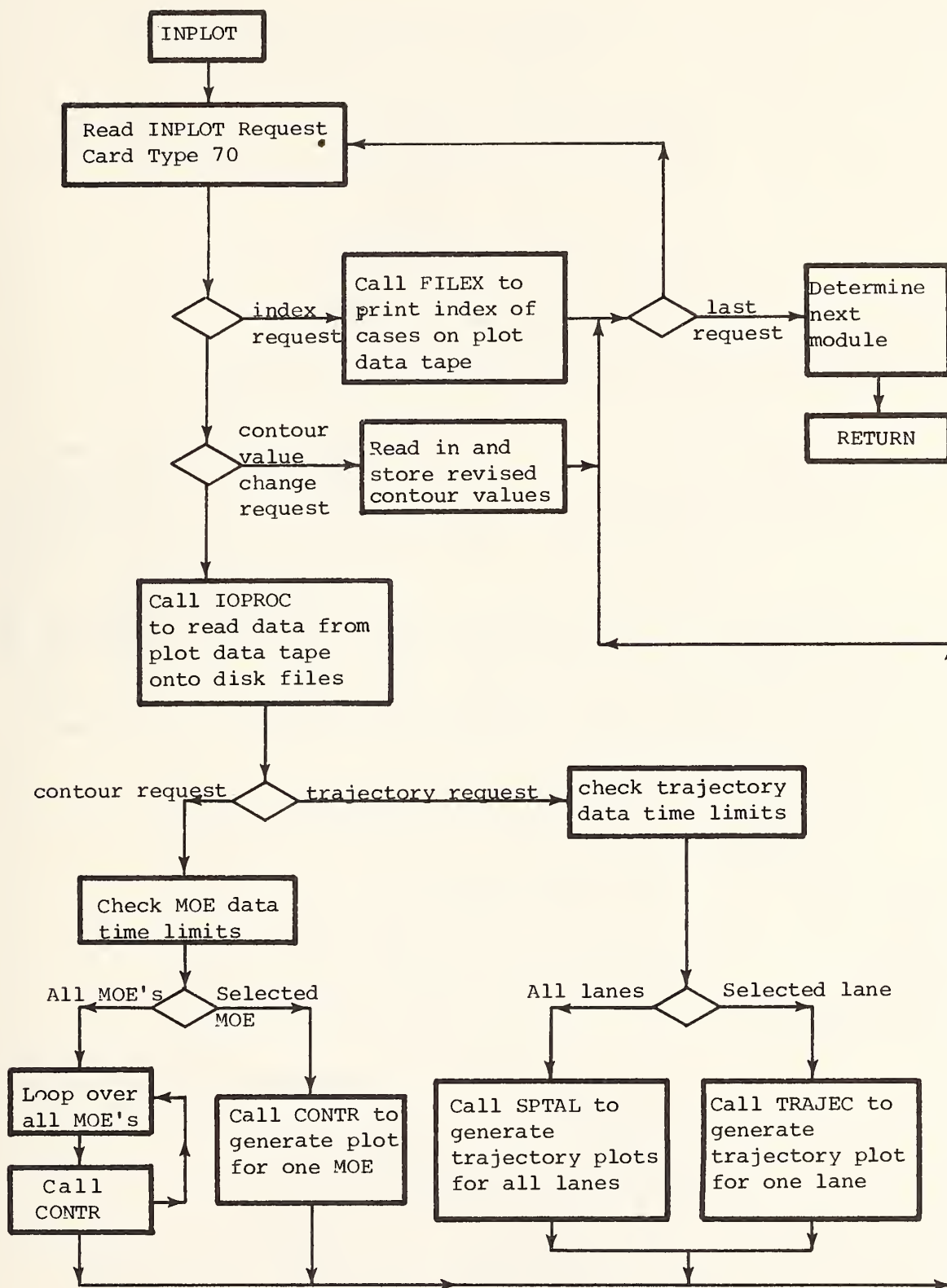


Figure 26: INPLOT Module Logic  
201

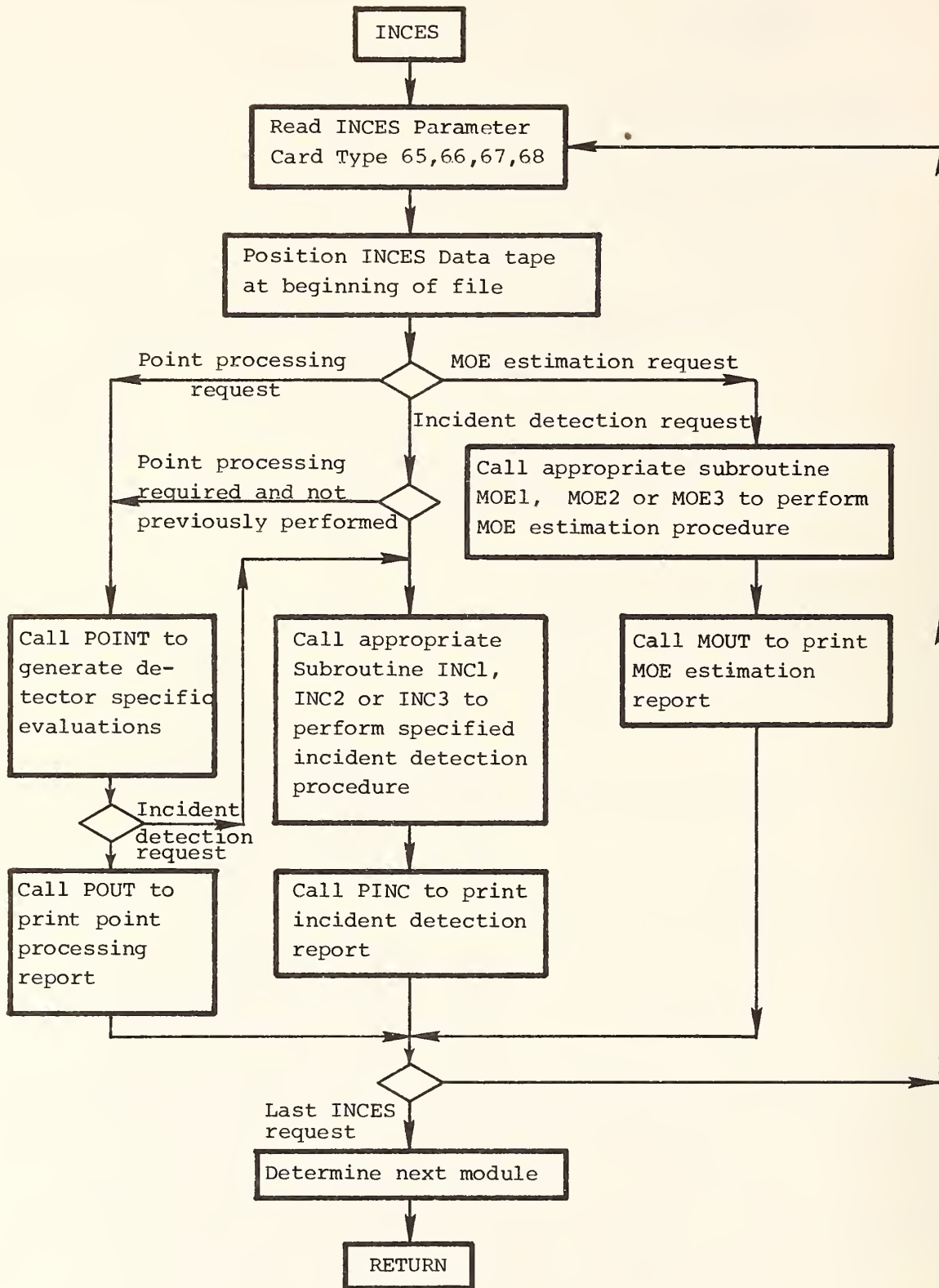


Figure 27: INCES Module Logic

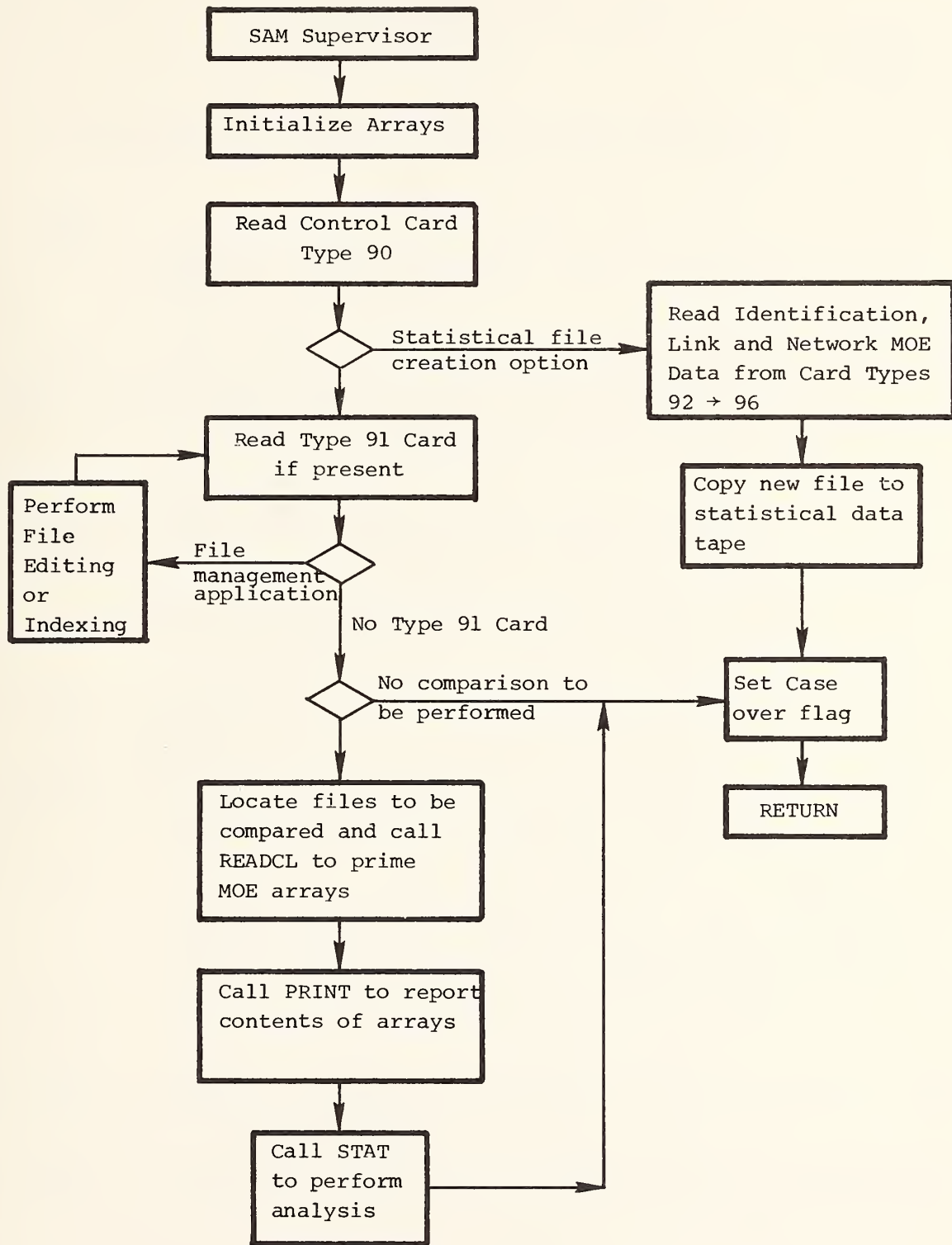


Figure 28: SAM Module Logical Flow

APPENDIX B

INTRAS Module Error Messages

<u>Code</u>	<u>Message</u>
1	Encountered Card Type P <sub>1</sub> while seeking Type 99. Will continue search for next Type 99 card.
2	Illegal Run Type - Column 2 of 99 card = 9 or 5.
4	Case Data Tape Sequence or Run ID negative - Columns 4 → 6 or 7 → 9 of 99 card negative.
5	Illegal value for Plot, Incident, Case Data or Statistical Tape Output Option Flag. Value of at least one of the flags in Columns 11, 12, 14 or 15 of 99 card is improper.
6	Incident Data Tape Old Run ID not specified. Column 2 of 99 card was input as 4 but no valid Run ID appears in Columns 10 → 18.
7	Incident Tape Table of Contents flag improperly specified. Column 21 on 99 card > 1.
8	SAM/INPLOT flag set for Valid Non-Zero Run Type. Column 24 of 99 card = 1 or 2 and Column 2 > 0.
9	Improper value for SAM/INPLOT flag. Column 24 of 99 card > 2, or = 0 with Column 2 = 0.

## PORGIS Module Error Messages

<u>Code</u>	<u>Message</u>
100	End File has been encountered while processing PORGIS Input Cards.
101	Card Type $P_1$ has been encountered while processing PORGIS Input cards. If this card type is $>60$ , then the run will terminate immediately. If card type = 99, then the last subinterval indicator (Column 24 =0 (blank)) was probably omitted from the last Type 60 card.
102	Incorrect number, $P_1$ , of Type $P_2$ cards.
103	Card Type $P_1$ encountered when attempting to read Type $P_2$ . Card type sequence error or missing required card type.
104	Invalid Time Step, Minimum= $P_1$ , Maximum= $P_2$ . One of the time steps specified on the Type 00 card is negative or $>320$ tenths of a second.
105	Card Type $P_1$ has been encountered for other than first subinterval. This card type is not allowed after first subinterval.
106	Total of all link types (Freeway $P_1$ , Ramp $P_2$ , Surface $P_3$ ) exceeds maximum $P_4$ . The specified maximum is defined as the upper bound of certain link specific arrays (i.e., ENDNDS and IVFEET).
107	Invalid link ( $P_1,P_2$ ) specified on card type $P_3$ .
108	Node $P_1$ , specified on Type $P_2$ card, is larger than maximum allowable node number $P_3$ .
109	Undefined link type $P_1$ specified for link ( $P_2,P_3$ ). Check Card Type 2. Processing of links continues.



PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
110	Invalid link length $P_1$ specified for link $(P_2, P_3)$ . Card Type 2. Length is invalid if: Link length $< 54$ ft. Freeway link length $> 9825$ ft. Ramp or surface link length $> 3275$ ft. Processing of links continues.
111	No through link specified to freeway link $(P_1, P_2)$ . Card Type 2. Processing of links continues.
112	No first movement specified for ramp link $(P_1, P_2)$ . Card Type 2. Processing of links continues.
113	No downstream link specified for ramp link $(P_1, P_2)$ . Card Type 2. Processing of links continues.
114	Invalid mean desired free flow speed, $P_1$ , for link $(P_2, P_3)$ . Card Type 2. Free flow speed is invalid if: Free Flow speed $\leq 0$ Ramp free flow speed $> 67$
115	Invalid number of lanes, $P_1$ , specified for link $(P_2, P_3)$ . Card Type 2. Invalid if: Number of freeway lanes $> 5$ Number of ramp lanes $> 2$ Number of surface lanes plus turn pockets $> 5$ .
116	Invalid grade, $P_1$ , specified for link $(P_2, P_3)$ . Card type 2. Invalid if grade $< P_4$ or grade $> P_5$ .
117	Invalid radius of curvature, $P_1$ , specified on link $(P_2, P_3)$ . Card Type 4. Invalid if $P_1 < 0$ .
118	Invalid auxiliary lane code, $P_1$ , for link $(P_2, P_3)$ . Card Type 5. Code must be $\leq 6$ .
119	No first auxiliary lane specified but second specified for link $(P_1, P_2)$ . Card Type 5.

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
120	Invalid auxiliary lane length specified for link (P <sub>1</sub> ,P <sub>2</sub> ). Auxiliary lane length, P <sub>3</sub> , must be $\leq$ link length, P <sub>4</sub> . Card Type 5.
121	Invalid downstream intersection type, P <sub>1</sub> , specified for link (P <sub>2</sub> ,P <sub>3</sub> ). Card Types 5 and 6. Intersection type must be a number from 1 through 9.
122	Invalid mean queue discharge, P <sub>1</sub> , specified for link (P <sub>2</sub> ,P <sub>3</sub> ). Mean queue discharge headway must be $> 0$ . Card Types 5 and 6.
123	Invalid lost time for first vehicle in queue, P <sub>1</sub> , specified for link (P <sub>2</sub> ,P <sub>3</sub> ). Lost time must be $> 0$ . Card Type 6.
124	Invalid turn pocket size, P <sub>1</sub> , specified for link (P <sub>3</sub> ,P <sub>4</sub> ). P <sub>2</sub> is (1,2) for (left,right) pocket. P <sub>5</sub> is maximum capacity of link. Invalid if: $\text{size} > \frac{\text{Link Length}}{20}$ Card Type 6.
125	Invalid channelization code, P <sub>1</sub> , specified for link (P <sub>2</sub> ,P <sub>3</sub> ). Code must be $\leq 4$ . Card Type 6.
126	More than 4 approaches have been specified to node P <sub>1</sub> . Card Type 2.
127	Receiving lane specified, during subinterval P <sub>3</sub> , for vehicles in lane 1 of link (P <sub>1</sub> ,P <sub>2</sub> ). May be specified in first subinterval only. Original specification remains unchanged. Card Type 5.
128	Upstream node, P <sub>1</sub> , of link whose through traffic opposes left turning traffic from link (P <sub>2</sub> ,P <sub>3</sub> ) specified in subinterval P <sub>4</sub> . May be specified during first subinterval only. Card Type 6.
129	Turn pocket size for link (P <sub>1</sub> ,P <sub>2</sub> ) specified during subinterval P <sub>3</sub> . May be specified during first subinterval only. Card Type 6.

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>										
130	One or both of the nodes of link (P <sub>1</sub> ,P <sub>2</sub> ) specified on Type P <sub>3</sub> card is larger than the maximum allowable node number P <sub>4</sub> .										
131	Invalid upstream node of link (P <sub>1</sub> ,P <sub>2</sub> ). Freeway entry node numbers range from 700 to 799. Surface entry node numbers range from 800 to 899. Card Type 2.										
132	Number of links specified, P <sub>1</sub> , exceeds maximum allowable, P <sub>2</sub> . Card Type 2.										
133	Exit ramp (P <sub>1</sub> ,P <sub>2</sub> ) not found. Card Type 2.										
134	Exit ramp (P <sub>1</sub> ,P <sub>2</sub> ) specified incorrectly as either a freeway or a surface link. Card Type 2.										
135	Non-freeway link (P <sub>1</sub> ,P <sub>2</sub> ) specified as downstream link for through movement from freeway link (P <sub>3</sub> ,P <sub>1</sub> ). Card Type 2.										
136	Freeway link (P <sub>1</sub> ,P <sub>2</sub> ) not found. Card Type 2.										
137	Ramp (P <sub>1</sub> ,P <sub>2</sub> ) is an on ramp and therefore must specify only a through downstream freeway link. <table style="margin-left: 40px;"><thead><tr><th style="text-align: left;"><u>P<sub>3</sub></u></th><th style="text-align: left;"><u>Error Condition</u></th></tr></thead><tbody><tr><td>1</td><td>First movement was not through</td></tr><tr><td>2</td><td>Receiving link was not a freeway link</td></tr><tr><td>3</td><td>Second movement was specified</td></tr><tr><td>4</td><td>Receiving link not found</td></tr></tbody></table> Card Type 2.	<u>P<sub>3</sub></u>	<u>Error Condition</u>	1	First movement was not through	2	Receiving link was not a freeway link	3	Second movement was specified	4	Receiving link not found
<u>P<sub>3</sub></u>	<u>Error Condition</u>										
1	First movement was not through										
2	Receiving link was not a freeway link										
3	Second movement was specified										
4	Receiving link not found										
138	Link (P <sub>1</sub> ,P <sub>2</sub> ) specified on Card Type P <sub>3</sub> has been defined in geometry cards as another link type.										
139	One or more of the downstream nodes of the receiving links for link (P <sub>1</sub> ,P <sub>2</sub> ) is/are out of range. Node numbers must be > 0 and ≤ NTOTN or ≥ 700 and < 900.										

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>														
140	Downstream exit node of link (P <sub>1</sub> ,P <sub>2</sub> ) invalid. Exit node numbers range from 700 to 799 for freeway exits and from 800 to 899 for surface exits. Card Type 2.														
143	Receiving link (P <sub>1</sub> ,P <sub>2</sub> ) for off-ramp (P <sub>3</sub> ,P <sub>1</sub> ) not found. Card Type 2.														
144	Freeway link (P <sub>1</sub> ,P <sub>2</sub> ) has been specified as a downstream link to off-ramp (P <sub>3</sub> ,P <sub>1</sub> ). Card Type 2.														
145	Surface link (P <sub>1</sub> ,P <sub>2</sub> ) specified link (P <sub>2</sub> ,P <sub>3</sub> ) as its downstream link. Card Type 2. <table><thead><tr><th style="text-align: left;"><u>P<sub>4</sub></u></th><th style="text-align: left;"><u>Error Condition</u></th></tr></thead><tbody><tr><td>2</td><td>Link (P<sub>2</sub>,P<sub>3</sub>) not found on geometry cards.</td></tr><tr><td>3</td><td>Link (P<sub>2</sub>,P<sub>3</sub>) is a freeway link. Not allowed.</td></tr><tr><td>5</td><td>Link (P<sub>2</sub>,P<sub>3</sub>) is an off-ramp. Should be an on-ramp.</td></tr></tbody></table>	<u>P<sub>4</sub></u>	<u>Error Condition</u>	2	Link (P <sub>2</sub> ,P <sub>3</sub> ) not found on geometry cards.	3	Link (P <sub>2</sub> ,P <sub>3</sub> ) is a freeway link. Not allowed.	5	Link (P <sub>2</sub> ,P <sub>3</sub> ) is an off-ramp. Should be an on-ramp.						
<u>P<sub>4</sub></u>	<u>Error Condition</u>														
2	Link (P <sub>2</sub> ,P <sub>3</sub> ) not found on geometry cards.														
3	Link (P <sub>2</sub> ,P <sub>3</sub> ) is a freeway link. Not allowed.														
5	Link (P <sub>2</sub> ,P <sub>3</sub> ) is an off-ramp. Should be an on-ramp.														
146	Surface link (P <sub>1</sub> ,P <sub>2</sub> ) designated (P <sub>2</sub> ,P <sub>3</sub> ) as its downstream link for through moving traffic. The model assumes (P <sub>3</sub> ,P <sub>2</sub> ) is the opposing link. Card Type 2. <table><thead><tr><th style="text-align: left;"><u>P<sub>4</sub></u></th><th style="text-align: left;"><u>Error Condition</u></th></tr></thead><tbody><tr><td>2</td><td>Link (P<sub>3</sub>,P<sub>2</sub>) is a freeway link. Freeway and surface links may not connect directly.</td></tr><tr><td>3</td><td>Link (P<sub>2</sub>,P<sub>3</sub>) is a ramp but link (P<sub>3</sub>,P<sub>2</sub>) is a surface link.</td></tr><tr><td>4</td><td>Link (P<sub>2</sub>,P<sub>3</sub>) is a surface link but link (P<sub>3</sub>,P<sub>2</sub>) is a ramp.</td></tr><tr><td>5</td><td>Link (P<sub>3</sub>,P<sub>2</sub>) is an on ramp. Since link (P<sub>1</sub>,P<sub>2</sub>) is a surface link, link (P<sub>2</sub>,P<sub>1</sub>) cannot be a freeway link.</td></tr></tbody></table>	<u>P<sub>4</sub></u>	<u>Error Condition</u>	2	Link (P <sub>3</sub> ,P <sub>2</sub> ) is a freeway link. Freeway and surface links may not connect directly.	3	Link (P <sub>2</sub> ,P <sub>3</sub> ) is a ramp but link (P <sub>3</sub> ,P <sub>2</sub> ) is a surface link.	4	Link (P <sub>2</sub> ,P <sub>3</sub> ) is a surface link but link (P <sub>3</sub> ,P <sub>2</sub> ) is a ramp.	5	Link (P <sub>3</sub> ,P <sub>2</sub> ) is an on ramp. Since link (P <sub>1</sub> ,P <sub>2</sub> ) is a surface link, link (P <sub>2</sub> ,P <sub>1</sub> ) cannot be a freeway link.				
<u>P<sub>4</sub></u>	<u>Error Condition</u>														
2	Link (P <sub>3</sub> ,P <sub>2</sub> ) is a freeway link. Freeway and surface links may not connect directly.														
3	Link (P <sub>2</sub> ,P <sub>3</sub> ) is a ramp but link (P <sub>3</sub> ,P <sub>2</sub> ) is a surface link.														
4	Link (P <sub>2</sub> ,P <sub>3</sub> ) is a surface link but link (P <sub>3</sub> ,P <sub>2</sub> ) is a ramp.														
5	Link (P <sub>3</sub> ,P <sub>2</sub> ) is an on ramp. Since link (P <sub>1</sub> ,P <sub>2</sub> ) is a surface link, link (P <sub>2</sub> ,P <sub>1</sub> ) cannot be a freeway link.														
147	Surface link (P <sub>1</sub> ,P <sub>2</sub> ) specified link (P <sub>3</sub> ,P <sub>2</sub> ) as its opposing link. Card Type 6. <table><thead><tr><th style="text-align: left;"><u>P<sub>4</sub></u></th><th style="text-align: left;"><u>Error Condition</u></th></tr></thead><tbody><tr><td>1</td><td>Link (P<sub>3</sub>,P<sub>2</sub>) not found.</td></tr><tr><td>2</td><td>Link (P<sub>3</sub>,P<sub>2</sub>) is a freeway link.</td></tr><tr><td>3</td><td>Link (P<sub>3</sub>,P<sub>2</sub>) is an on ramp.</td></tr><tr><td>4</td><td>Maximum allowable node number &lt; P<sub>3</sub> ≤ 699.</td></tr><tr><td>5</td><td>P<sub>3</sub> ≥ 900.</td></tr><tr><td>6</td><td>700 ≤ P<sub>3</sub> &lt; 800. Must be ≥ 800 for non-freeway entry node.</td></tr></tbody></table>	<u>P<sub>4</sub></u>	<u>Error Condition</u>	1	Link (P <sub>3</sub> ,P <sub>2</sub> ) not found.	2	Link (P <sub>3</sub> ,P <sub>2</sub> ) is a freeway link.	3	Link (P <sub>3</sub> ,P <sub>2</sub> ) is an on ramp.	4	Maximum allowable node number < P <sub>3</sub> ≤ 699.	5	P <sub>3</sub> ≥ 900.	6	700 ≤ P <sub>3</sub> < 800. Must be ≥ 800 for non-freeway entry node.
<u>P<sub>4</sub></u>	<u>Error Condition</u>														
1	Link (P <sub>3</sub> ,P <sub>2</sub> ) not found.														
2	Link (P <sub>3</sub> ,P <sub>2</sub> ) is a freeway link.														
3	Link (P <sub>3</sub> ,P <sub>2</sub> ) is an on ramp.														
4	Maximum allowable node number < P <sub>3</sub> ≤ 699.														
5	P <sub>3</sub> ≥ 900.														
6	700 ≤ P <sub>3</sub> < 800. Must be ≥ 800 for non-freeway entry node.														

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>																						
148	Link ( $P_1, P_2$ ) has been specified on a Type 8 card. <table><thead><tr><th style="text-align: left;"><u>P<sub>3</sub></u></th><th style="text-align: left;"><u>Error Condition</u></th></tr></thead><tbody><tr><td>0</td><td>Invalid downstream or upstream node.</td></tr><tr><td>1</td><td>One or more negative turning percentages.</td></tr><tr><td>2</td><td>All turning percentages are zero.</td></tr><tr><td>3</td><td>Link not found.</td></tr><tr><td>4</td><td>Link (<math>P_1, P_2</math>) is a freeway link. There is no exit ramp but a non-zero exiting percentage has been specified.</td></tr><tr><td>5</td><td>Freeway link (<math>P_1, P_2</math>) has a (left, right) exit ramp and a non-zero (right, left) turning percentage.</td></tr><tr><td>6</td><td>Freeway link (<math>P_1, P_2</math>) has an exit ramp with a zero exiting percentage specified. Warning message, non-fatal.</td></tr><tr><td>7</td><td>Ramp link (<math>P_1, P_2</math>) has two receiving links specified and only one turning percentage. Warning message, non-fatal.</td></tr><tr><td>8</td><td>Ramp link (<math>P_1, P_2</math>) has one receiving link specified but more than one turning percentage.</td></tr><tr><td>9</td><td>Surface link (<math>P_1, P_2</math>) has more turning percentages specified than receiving links.</td></tr></tbody></table>	<u>P<sub>3</sub></u>	<u>Error Condition</u>	0	Invalid downstream or upstream node.	1	One or more negative turning percentages.	2	All turning percentages are zero.	3	Link not found.	4	Link ( $P_1, P_2$ ) is a freeway link. There is no exit ramp but a non-zero exiting percentage has been specified.	5	Freeway link ( $P_1, P_2$ ) has a (left, right) exit ramp and a non-zero (right, left) turning percentage.	6	Freeway link ( $P_1, P_2$ ) has an exit ramp with a zero exiting percentage specified. Warning message, non-fatal.	7	Ramp link ( $P_1, P_2$ ) has two receiving links specified and only one turning percentage. Warning message, non-fatal.	8	Ramp link ( $P_1, P_2$ ) has one receiving link specified but more than one turning percentage.	9	Surface link ( $P_1, P_2$ ) has more turning percentages specified than receiving links.
<u>P<sub>3</sub></u>	<u>Error Condition</u>																						
0	Invalid downstream or upstream node.																						
1	One or more negative turning percentages.																						
2	All turning percentages are zero.																						
3	Link not found.																						
4	Link ( $P_1, P_2$ ) is a freeway link. There is no exit ramp but a non-zero exiting percentage has been specified.																						
5	Freeway link ( $P_1, P_2$ ) has a (left, right) exit ramp and a non-zero (right, left) turning percentage.																						
6	Freeway link ( $P_1, P_2$ ) has an exit ramp with a zero exiting percentage specified. Warning message, non-fatal.																						
7	Ramp link ( $P_1, P_2$ ) has two receiving links specified and only one turning percentage. Warning message, non-fatal.																						
8	Ramp link ( $P_1, P_2$ ) has one receiving link specified but more than one turning percentage.																						
9	Surface link ( $P_1, P_2$ ) has more turning percentages specified than receiving links.																						
149	No through movement for ramp ( $P_1, P_2$ ). On ramps must designate a through freeway movement. Off ramps must specify one or two movements, one of which must be through. Card Type 2.																						
150	Link ( $P_1, P_2$ ) has designated $P_3$ as the lane receiving its lane 1 traffic in link ( $P_2, P_4$ ). Link ( $P_2, P_4$ ) does not have a lane $P_3$ . Card Types 4 and 5.																						
151	$P_1 = XX$ (a 2-digit number). Exit or entry nodes of the form 8XX and 7XX have both been specified. Card Type 2.																						
152	Early warning sign messages for freeway link ( $P_1, P_2$ ). Card Type 2. <table><thead><tr><th style="text-align: left;"><u>P<sub>3</sub></u></th><th style="text-align: left;"><u>Error Condition</u></th></tr></thead><tbody><tr><td>1</td><td>Invalid node, <math>P_4</math>, specified as a freeway-ramp junction. <math>0 &lt; P_4 \leq NTOTN</math>.</td></tr><tr><td>2</td><td>Location of early warning sign, <math>P_4</math>, specified but no corresponding off-ramp was identified.</td></tr></tbody></table>	<u>P<sub>3</sub></u>	<u>Error Condition</u>	1	Invalid node, $P_4$ , specified as a freeway-ramp junction. $0 < P_4 \leq NTOTN$ .	2	Location of early warning sign, $P_4$ , specified but no corresponding off-ramp was identified.																
<u>P<sub>3</sub></u>	<u>Error Condition</u>																						
1	Invalid node, $P_4$ , specified as a freeway-ramp junction. $0 < P_4 \leq NTOTN$ .																						
2	Location of early warning sign, $P_4$ , specified but no corresponding off-ramp was identified.																						



PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
	3 Node $P_4$ identified by early warning sign is not upstream node of an exit ramp.
	4 Early warning sign refers to node $P_4$ which is not downstream of this freeway link.
	5 Negative percent, $P_4$ , specified as distance of early warning sign from upstream node.
	6 Node $P_4$ specified as freeway-ramp junction is not the downstream node of any freeway link.
153	On Card Type $P_1$ , link $(P_2, P_3)$ , maximum number of statistical data stations was exceeded.
154	On Card Type $P_1$ , link $(P_2, P_3)$ , invalid location $P_4$ of statistical data station was specified. Link length = $P_5$ .
155	On Card Type 55, invalid detector mode flag $P_1$ was specified (must be 0 or 1).
156	Turning percentages not specified for link $(P_1, P_2)$ . Check type 8 cards.
157	Turning percentages not specified for a ramp or freeway link. $P_1$ is (1,2) for (ramp, freeway) link. Check type 8 cards.
161	Card read with type < 10. $P_1, \dots, P_{10}$ are first 10 parameters from card in error. Program ignores card and looks for type 10 cards.
162	Negative control code or undefined control code (code = 6). $P_1$ = node number, $P_2$ = upstream node of approach link, $P_3$ = interval where error occurred. Card Type 10.



PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
163	At node $P_1$ , invalid reference offset $P_2$ specified to interval 1. Modulo cycle time reduced so that it is $\geq 0$ and $<$ cycle time. Card Type 10.
164	Invalid node number $P_1$ . Card ignored, processing continued with next card. Card Type 10.
165	For node $P_1$ , invalid upstream node, $P_2$ , specified. Remaining checks for this link ignored. Processing continues with next link. Card Type 10.
166	No link found by FINDL for approach link specified by node pair $(P_2, P_1)$ . Remaining checks for this link ignored. Processing continues with next link. Card Type 10.
167	Maximum number of actuated control signals exceeded. $P_1, \dots, P_{10}$ are first 10 parameters on card. Card ignored. Processing continues with next card.
168	Type 10 card input for node $P_1$ but no entry in SIGI array for this node. Card Type 10.
169	Entry in SIGI array for node $P_1$ but no Type 10 card was input for this node. Card Type 10.
170	No Type 10 cards were found.
171	No upstream nodes specified for node $P_1$ . Processing continues with next card. Card Type 10.
172	At node $P_1$ , only $P_2$ upstream nodes specified, but non-zero code $P_3$ specified for an upstream node $P_4$ for interval $P_5$ . Card Type 10.
173	At node $P_1$ , no interval duration was specified for interval $P_2$ . Card Type 10.
174	At node $P_1$ invalid control code $P_2$ was specified for signed intersection (must be 0, 1 or 5). Card Type 10.

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
175	At node $P_1$ with upstream node $P_2$ , a freeway link, an invalid control code was specified (must be 1 = green). Card Type 10.
176	At node $P_1$ with upstream node $P_2$ an invalid control code was specified (must be 0, 1 or 5 for ramp link or surface link with sign control). Card Type 10.
177	At node $P_1$ with upstream node $P_2$ no control code permitted left-turning traffic. Card Type 10.
178	Same as 177 for through traffic.
179	Same as 177 for right-turning traffic.
180	Approach ( $P_2, P_1$ ) was not signalized.
181	End of file encountered while trying to read Type 20 or 21 card. Control returns to calling program.
182	Card Type <20 encountered. $P_1, \dots, P_{10}$ are first 10 parameters on card in error. Program ignores card and continues to look for Type 20 or 21 cards.
183	Card type >21 encountered before any Type 20 or 21 cards found. $P_1, \dots, P_{10}$ are first 10 parameters on card in error.
184	Maximum dimension of SNODE array exceeded. $P_1$ and $P_2$ are upstream and downstream nodes of link which caused error. Ignores card. Processing continues with next card. Card Type 20.
185	Invalid upstream node $P_1$ or downstream node $P_2$ specified (must have $P_1 \geq 700$ , $P_2 \leq \text{NTOTN}$ ). Ignores this link and looks at next link. Card Type 20.
186	Entry link ( $P_1, P_2$ ) not found while processing Card Type 20. Check link geometry.
187	Percentages for vehicle types add up to > 100%. $P_1, \dots, P_8$ = upstream and downstream nodes, flow rate and percentages for this link. Card Type 20.

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
138	On subsequent interval input, no entry in SNODE array was found for link $(P_1, P_2)$ . Link is ignored. Card Type 20.
190	No SNODE array entry for link $(P_1, P_2)$ . Card Type 20.
191	End of file encountered by PRSIG. Control returns to calling program.
192	For link $(P_1, P_2)$ sum of percentages of vehicles on link lanes exceeded 100%. $P_3, \dots, P_6$ = percentages on Type 20 card.
193	Link $(P_1, P_2)$ is an on-ramp but was signalized. Must have sign control. Card Type 10.
200	Detectors specified for link $(P_1, P_2)$ . Not allowed for surface or entry links. Card Type 25.
201	Invalid detector type $P_1$ for link $(P_2, P_3)$ . Card Type 25.
202	Negative loop length for type $P_1$ detector on link $(P_2, P_3)$ . Card Type 25.
203	Invalid lane placement, $P_1$ , for detector on link $(P_2, P_3)$ . The indicated lane $P_1$ is not defined as either a through or auxiliary lane or as a turning pocket. Card Type 25.
204	Longitudinal placement ( $P_1$ feet) of detector in lane $P_2$ of link $(P_3, P_4)$ violates link boundaries. Loop length is $P_5$ . Either the upstream or downstream end of the detector violates the lane geometric definition. Card Type 25.
205	Too many detectors. Maximum allowed is $P_1$ . Card Type 25.

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
206	Invalid station number $P_1$ has been input for link $(P_2, P_3)$ Must be $\leq 50$ . Card Type 25.
207	Duplicated station number $P_1$ specified on links $P_2$ and $P_3$ . Card Type 25.
208	Improper coupled loop separation $P_1$ . Must be between 10 and 40 feet. Value reset to 10 if $P_1 < 10$ or reset to 40 if $P_1 > 40$ .

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
250	End of file encountered while looking for Type $P_1$ card. Control returns to calling program.
251	Type $P_1$ card encountered while looking for Type $P_2$ card. Action taken is to backspace and return if $P_1 > P_2$ and continue to look for $P_2$ if $P_1 < P_2$ .
252	Invalid node $P_1$ or $P_2$ specified on Card Type $P_3$ . Link ignored.
253	Invalid link ( $P_1, P_2$ ) specified on Card Type $P_4$ . If $P_3 = 0$ , no link could be found. If $P_3 > 1$ , link is not a freeway link. Link ignored.
254	Invalid incident code $P_4$ specified for lane $P_3$ of link ( $P_1, P_2$ ). Card Type 30.
255	Incident code specified for non-existent lane $P_3$ on link ( $P_1, P_2$ ). $P_4$ is actual number of lanes on link. $P_5$ and $P_6$ are actual first and second auxiliary lanes on link.
256	Dimension of INCID array exceeded. Link ( $P_1, P_2$ ) caused error. Program ignores remaining operations and goes on to next link. Card Type 30.
257	Invalid index $P_1$ , maximum index is $P_2$ . Imbedded data Card Type is $P_3$ . Data item ignored.
258	On Card Type $P_2$ a data list must be in (descending, ascending) order if $P_1 = (1,2)$ . This requirement was violated.
259	On Card Type $P_1$ data list did not sum to 1000 (100 for $P_1 = 48$ , 100 times number of lanes $P_1 = 47$ ).
260	Incident not within link ( $P_1, P_2$ ) bounds. Card Type 30. $P_3$ is length of link. $P_4$ is upstream end location. $P_5$ is downstream end location.
261	DTCTR array dimension exceeded. $P_1 = I$ , $P_2 = ICPLNK(I)$ . DETGEN stops processing and control returns to calling program.



PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
262	An invalid incident was specified for an entry link ( $P_1, P_2$ ). Card type $P_3$ .
268	EOF encountered while checking for a type 15 card.
269	Card type other than 15 or 16 found while reading types 15 and 16.
270	Invalid node $P_1$ , which indicates controller location, input on card type $P_2$ .
271	Actuated node $P_1$ previously specified on card type $P_2$ .
273	Actuated specification for node $P_1$ exceeds the maximum $P_2$ .
274	Invalid downstream node $P_1$ on card type $P_2$ . This node indicates an approach referenced by controller $P_3$ .
275	Invalid upstream node $P_1$ on card type $P_2$ . This node indicates an approach referenced by controller $P_3$ .
276	Cannot locate link ( $P_1, P_2$ ) referenced on card type $P_3$ for node $P_4$ .
277	Controller coordination code $P_1$ and red rest code $P_2$ disagree on card type 15 for node $P_3$ .
278	Invalid cycle length $P_1$ for node $P_2$ on card type 15.
279	Invalid entry code $P_1$ for node $P_2$ on card type 15. $P_1$ must be 0, 1 or 2.
280	Invalid node $P_1$ , which indicates node for which phases are input, specified on card type $P_2$ .
281	Node $P_1$ referenced on card type $P_2$ not actuated.



PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
282	Invalid phase $P_1$ for node $P_2$ on card type $P_3$ . $0 > P_1 \leq 9$ .
283	Phase $P_1$ for node $P_2$ referenced on card type $P_3$ has already been referenced.
284	Entry $P_1$ is negative on type $P_2$ card for node $P_3$ , phase $P_4$ .
285	Warning. Redundant entry $P_1 = P_2$ specified for phase actuation code $P_3$ on card type 16 for node $P_5$ , phase $P_4$ .
286	Beginning of yield $P_1$ occurs after end of yield $P_2$ , phase $P_4$ . Check type 16 card for node $P_3$ .
287	Force-off $P_1$ less than minimum initial interval $P_2$ , phase $P_4$ . Check type 16 card for node $P_3$ .
288	Illegal interval code $P_1$ for phase $P_3$ . $P_1$ must be less than 4. Check type 16 card for node $P_2$ .
289	Passage time $P_1$ less than minimum gap $P_2$ for phase $P_4$ . Check type 16 card for node $P_3$ .
290	Invalid force-off $P_1$ for phase $P_3$ . Check card type 16 for node $P_2$ .
291	Invalid yield point $P_1$ , end of yield $P_2$ , or offset $P_3$ , for phase $P_5$ . Check type 16 card for node $P_4$ .
292	Both maximum green extension, $P_1$ and maximum green phase $P_2$ specified on card type 16 for node $P_3$ , phase $P_4$ .
293	Illegal values or combination of values for entries 11 through 14 ( $P_1$ through $P_4$ ) for phase $P_6$ . Check card type 16 for node $P_5$ .
294	Invalid node $P_1$ , which indicates node for which phase operations are being defined, was input on card type $P_2$ .

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
295	Invalid phase $P_1$ for node $P_2$ on card type $P_3$ . $0 < P_1 \leq 9$ .
296	Phase $P_1$ for node $P_2$ referenced on card type $P_3$ has been previously specified.
297	Entry $P_1$ is negative on type $P_2$ card for node $P_3$ , phase $P_4$ .
298	Link index $P_1$ on card type 17 for node $P_2$ , phase $P_3$ refers to link not specified on card type 15.
299	Lane $P_1$ does not exist on link $P_2$ as referenced on type 17 card for node $P_3$ , phase $P_4$ .
388	Improper vehicle length $P_1$ for on-line incident detection. Must be $> 0$ . Card type 55.
389	Output incident or SAM tape to be produced. Therefore, a valid run identification number $P_1$ must exist. Card type 00.

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
390	Occupancy calculations for incident detection must be updated every $P_1$ tenths-of-a-second. Incident detection routines are called every $P_2$ tenths-of-a-second for incident check. $P_2$ must be $\geq P_1$ , $P_2/P_1$ must be $> 20$ and $P_2$ must be an integer multiple of $P_1$ . Note: The inputs to be changed are on the type 55 card; Contents of Cols. 13-18 should equal or exceed contents of Cols. 7-12.
391	Incident detection algorithm number $P_1$ must be between 1 and 3, is out of range. Card type 56.
392	Station to be used for incident detection input in incorrect order. Stations must be input in upstream to downstream order -- station $P_2$ was input before station $P_1$ on type 25 card -- or $P_2$ could not be located downstream of $P_1$ . Check station numbers on type 25 card and/or sequences on type 57 card.
394	On-line incident detection has been specified; therefore, the user <u>must</u> specify a non-zero freeway time step equal to 10 tenths-of-a-second. Card type 00.
395	Number of parameters $P_1$ input for use in desired incident detection algorithm is out of range (must be between 1 and 18). Card type 56.
396	No detectors have been found at station $P_1$ ; this station has been input for incident detection. Doppler radar detectors are not permitted for incident detection. Card type 25 and/or card type 56.
397	Station $P_1$ is to be used for incident detection and occupies a non-freeway link.

PORGIS (Cont.)

<u>Code</u>	<u>Message</u>
398	Station number $P_1$ occurs in more than one series of incident detection stations on type 57 card. This is not permitted.
399	Incident data tape to be produced. Therefore, freeway time step $P_1$ must be equal to 10 tenths-of-a-second. This value is reset internally and simulation is <u>not</u> aborted. Card Type 00.

## LIS Module Error Messages

<u>Code</u>	<u>Message</u>
400	Required data case not found on tape. P <sub>1</sub> is sequence number requested on Type 99 card. P <sub>2</sub> is run identification number requested on Type 99 card. Case is aborted.
401	Sequence number found but ID did not match run ID on Type 99 card. P <sub>1</sub> is sequence number of case. P <sub>2</sub> is run ID on Type 99 card. P <sub>3</sub> is run ID on tape. Case is aborted.

## FUEL Module Error Messages

<u>Code</u>	<u>Message</u>
550	Input code $P_1$ for vehicle type $P_2$ , speed $P_3$ , is incorrect. Case is aborted.
551	Vehicle type $P_2$ corresponding to input code $P_1$ , speed $P_3$ , is incorrect. Case is aborted.
552	Speed $P_3$ corresponding to input code $P_1$ , vehicle type $P_2$ , is incorrect. Case is aborted.



### SIFT Module Error Messages

<u>Code</u>	<u>Message</u>
600	LNEND array overflow. More than 3 incidents (including end of auxiliary lane) on lane $P_1$ , link $P_2$ , at time $P_3$ . Maximum of 3 incidents allowed. Simulation aborted.
602	Logical collision in lane $P_1$ of link $P_2$ at time $P_3$ . $P_4 = (1,2)$ for (Ramp, Surface) link. Vehicle is stopped and simulation will continue.
604	$P_3$ vehicles discharged from ramp link $P_1$ , lane $P_2$ in one time step. Informative message-- unusually high flow rate.
605	Vehicle $P_1$ on link $P_2$ , link type $P_3$ , lane $P_4$ , had invalid queue position $P_5$ . Queue position must be $\geq 1$ and $\leq 4$ , where 4 indicates any position beyond 3. Simulation aborted. Program malfunction. Rerun with revised initial random number seed.
606	Vehicle type $P_2$ came to stop at position $P_3$ in lane $P_1$ , trapped at incident. No action.
607	Logical collision in lane $P_1$ , vehicle type $P_2$ , location $P_3$ in link where incident is currently active. No action.
608	Vehicle about to discharge from link $P_1$ , link type $P_2$ , lane $P_3$ , turn code $P_4$ . No lane found in which vehicle could avoid collision with upstream vehicle. Subroutine TSTSAT indicates there is room in link but subroutine LANES cannot find room. Program malfunction. Rerun with revised initial random number seed. Simulation aborted.
609	Zero spacing between leader vehicle $P_1$ and follower $P_2$ after processing $P_1$ . Follower $P_2$ has positive velocity $P_3$ . Link is $P_4$ . Lane is $P_5$ . This error represents a self-correcting program malfunction if $P_3 < 5$ fps. Fatal otherwise. Rerun with revised initial random number seed.

SIFT (Cont.)

<u>Code</u>	<u>Message</u>
611	Link P <sub>1</sub> in COMMON/LENNVI/ with downstream node P <sub>2</sub> was not found as approach in SIGI array to node P <sub>2</sub> . Job aborted.
612	Current lane P <sub>1</sub> of subject vehicle does not match any LLOR array element. LLOR(1) through LLOR(5) equals P <sub>2</sub> through P <sub>6</sub> . Job aborted.
613	No space for new freeway vehicles in VF array. MNLV should be increased.
614	No space for new ramp vehicles in VR array. MNLV should be increased.
615	No space for new surface vehicles in VS array. MNLV should be increased.
616	No room for new vehicles on surface entry link (P <sub>1</sub> ,P <sub>2</sub> ). MNLV should be increased.
617	No more vehicle space at time P <sub>1</sub> . MNLV should be increased.
631	More than one approach to node P <sub>1</sub> . Actuated nodes may only have one approach. Simulation aborted.
632	Invalid metered signal code for node P <sub>1</sub> . Check type 10 card.
633	Invalid basic signal code for node P <sub>1</sub> . Check type 10 card.
634	Invalid movement code for node P <sub>1</sub> . Check type 10 card.
635	Invalid capacity. Capacity must be greater than zero. Check type 10 card for node P <sub>1</sub> .

SIFT (Cont.)

<u>Code</u>	<u>Message</u>
636	Upstream node $P_1$ and downstream node $P_2$ given on type 10 card to define detectorized link used in measuring freeway performance do not correspond to any defined freeway link in network. Check type 10 card for node $P_3$ .
637	Lane $P_1$ containing detector to be used in measuring freeway performance is invalid. Check type 10 card for node $P_2$ .
638	Link ( $P_1, P_2$ ) to be used in measuring freeway performance is not detectorized; it must be. Check type 10 card for node $P_3$ for errors or detector specifications on type 25 card.
639	Detector described on type 10 card for node $P_1$ by lane $P_2$ , and position $P_3$ does not match any detector established by a type 25 card. Check type 10 and 25 cards.
640	Invalid speed threshold for node $P_1$ . Check type 10 card.
641	Invalid metering headway for node $P_1$ . Check type 10 card.
642	Improper speed thresholds or metering headways specified for node $P_1$ . Speed thresholds must be in descending order and metering headways must be $> 0$ . Check type 10 card.
643	Unreasonable minimum acceptable gap specified for node $P_1$ . Check type 10 card.
644	Merge point for surface link $P_1$ with actuated signal (plus ramp link) and detectorized freeway link $P_2$ used to measure freeway performance not found. Check network geometry.

SIFT (Cont.)

<u>Code</u>	<u>Message</u>
645	Improper value $P_1$ specified for percentage of traffic to be diverted. Check type 10 card for node $P_2$ .
646	Improper diversion path specified for node $P_1$ . Check that first and second nodes in path are downstream nodes of off-ramp and surface links, respectively, and that last node is a surface exit on a freeway node at the downstream end of an on-ramp. The path must be consistent with the network geometry established by type 2 cards. Check Card Type 10.
647	Vehicle $P_1$ on link $P_2$ of type $P_3$ ( $P_3 = (1,2)$ for (ramp,surface) links) was diverted from node $P_4$ . At the current time, it is not on a link in the diversion sequence. This is a non-fatal message.
651	Vehicle $P_1$ of type $P_2$ was not processed this time step. Type $P_2 = (1,2,3)$ for (freeway,ramp,surface) links. This fatal error represents a program malfunction. Rerun with revised initial random number seed.
660	Freeway entry link $P_1$ cannot be found in SNODE array. This fatal error represents a program malfunction. Rerun with revised initial random number seed.
680	Vehicle assigned to non-existent lane $P_1$ on off-ramp link $P_2$ . This fatal error indicates a program malfunction. Rerun with revised initial random number seed.
681	Vehicle $P_1$ entering off-ramp $P_2$ too fast. Trajectory adjustment fails. Ramp either too short or leader vehicle too close. $P_3 =$ Target stopping point in feet from upstream end of off-ramp; $P_4 =$ Initial position; $P_5 =$ Initial speed, fps. This fatal error indicates program malfunction or very short ramp link. Rerun with revised initial random number seed.

## INCES Module Error Messages

<u>Code</u>	<u>Message</u>
700	Tape to be used for detector output is empty, user indicated that tape was not empty. <u>This is not a fatal error.</u> Card type 99.
701	Unexpected end of file on incident data tape. Processing aborts.
702	Unable to find run ID $P_1$ on incident data tape. Run aborted. Either wrong tape or wrong run ID number on type 99 card.
703	Unexpected end of file on reading INCES card data. Card type $P_1$ expected. Run aborts.
704	Card type $P_1$ expected in INCES input, but type $P_2$ encountered. Recheck all INCES data cards and card sequences. Run aborts.
705	On card type 65, invalid detector mode flag $P_1$ was specified (must be 0 for digital or 1 for analog detectors).
706	Occupancy calculations for incident detection must be updated every $P_1$ tenths-of-a-second. Incident detection routines are called every $P_2$ tenths-of-a-second for incident check. $P_2$ must be $\geq P_1$ , $P_2/P_1$ must be $> 20$ and $P_2$ must be an integer multiple of $P_1$ . Note: The inputs to be changed are found on the type 65 card. Contents of Cols. 13-18 should equal or exceed contents of Cols. 7-12.
707	Improper number $P_2$ of parameters for algorithm $P_1$ . Number input must be between 1 and 18. Card type 65.
708	Improper vehicle length $P_1$ for point processing or incident detection. Must be $> 0$ . Card type 65.



INCES (Cont.)

<u>Code</u>	<u>Message</u>
709	Improper point processing code $P_1$ . Must be 0 or 1. Card type 65.
710	Improper MOE code $P_1$ . Must be 0 or 1. Card type 65.
711	Improper incident detection algorithm number $P_1$ . Must be between 1 and 3. Card type 66.
712	Improper MOE algorithm number. Must be between 1 and 3. Card type 67.
713	Station number $P_1$ occurs in more than one series of incident detection stations on card type 68. This is not permitted.
714	Station $P_1$ is to be used for incident detection and occupies a non-freeway link. Run aborts. May have to change data station sequence. Card type 68.
715	No detectors have been found at station $P_1$ . This station has been input for incident detection. Check station number of card type 68.
716	Station to be used for incident detection input in incorrect order. Stations must be input in upstream to downstream order -- station $P_2$ was input before station $P_1$ on card type 68 -- or $P_2$ could not be located downstream of $P_1$ . Check sequence on card type 68.



## INPLOT Module Error Messages

<u>Code</u>	<u>Message</u>
800	End of file encountered while searching for Type 70 card. Run aborted
801	Card Type $P_1$ encountered while searching for Type 70 card. If $P_1 < 70$ , continue to look for Type 70 card. If $P_1 > 70$ , abort run.
802	End of file encountered on data tape while searching for data for plot request Type $P_1$ for case with run identification number $P_2$ . Program looks for next Type 70 card, if any.
803	Plot requested with maximum time $P_1$ sec., but data on tape only goes to $P_2$ sec. Run identification number is $P_3$ . Program looks for next Type 70 card, if any.
806	While processing trajectory plot for case $P_1$ , VPOS table overflowed; i.e., too many vehicles in system. Action - goes on to next case. Must enlarge VPOS array in COMMON /PLT/. Presently, VPOS(250,40) allows for 250 vehicles. Must also set MAXV = maximum number vehicles allowed (set in INPLOT). Common /PLT/ must be changed in routines INPLOT, AXPLOT, COMPCT, CNTR, CPLOT, FILEX, IOPROC, PAGE, PATH, SEARCH, SPTAL, TPLOT, TRAJEC. Must also enlarge IDVEH array to maximum number vehicles allowed. Also in CONTR and CPLOT, must enlarge MOE array which is equivalenced to VPOS array. Presently MOE is MOE(40,250), allowing for up to 250 MOE stations.
807	While processing contour plot for case $P_1$ , MOE table overflowed; i.e., too many stations in system. Simulation aborted. Must enlarge MOE, VPOS and IDVEH arrays, see error message 806.
808	No path could be found from upstream node $P_1$ to downstream node $P_2$ . Case is $P_3$ . Action - goes on to next case. Reexamine Type 70 card.

INPLOT (Cont.)

<u>Code</u>	<u>Message</u>
809	Dimension of NDLIST exceeded (path of more than 20 nodes requested). P <sub>1</sub> = upstream node; P <sub>2</sub> = downstream node; P <sub>3</sub> = case ID. Reexamine Type 70 card, input path of at most 20 nodes.
810	Points out of range of specified scale when drawing roadway section boxes. P <sub>1</sub> = upstream node; P <sub>2</sub> = downstream node. Reexamine Type 70 card, adjust x or y axis size. Plot aborted, program goes on to next case.
811	Bad time scale specified - exceeds axis - plot aborted, program goes on to next case. P <sub>1</sub> = axis length (y-axis for contour plot, x-axis for trajectory plot) P <sub>2</sub> = scale specified by user (tenths-of-a-min/inch) P <sub>3</sub> = start time (min) P <sub>4</sub> = stop time (min)
812	Invalid lane number (for trajectory plots) specified for case P <sub>1</sub> . Re-examine type 70 card. Plot aborted, program continues with next case.

SAM Module Error Messages

<u>Code</u>	<u>Message</u>
900	Card type P <sub>1</sub> was expected when end file was encountered. Data cards for statistical module are not complete.
901	Card type P <sub>1</sub> was expected when card type P <sub>2</sub> was encountered. Data cards out of order.
902	Number of files deleted (located on input tape) is P <sub>1</sub> . File P <sub>2</sub> could not be located. (File P <sub>2</sub> does not exist on this tape. Eliminate P <sub>2</sub> from desired file to be deleted or change to other file number.)
903	File P <sub>1</sub> was designated for statistical comparison but could not be located on input tape. Change file number or change input tape.
904	The number of freeway links in network P <sub>1</sub> is P <sub>2</sub> . The number of freeway links in network P <sub>3</sub> is P <sub>4</sub> . P <sub>2</sub> is not equal to P <sub>4</sub> . Unequal number of freeway links. WARNING - action is to not perform link specific analysis for freeway links.
905	For network P <sub>1</sub> number of ramp links is P <sub>2</sub> , number of surface links is P <sub>3</sub> . For network P <sub>4</sub> number of ramp links is P <sub>5</sub> , number of surface links is P <sub>6</sub> . Either P <sub>2</sub> ≠ P <sub>5</sub> or P <sub>3</sub> ≠ P <sub>6</sub> ; i.e., unequal number of corresponding ramp or surface links. WARNING - action is to not perform link specific analysis for non-freeway links.
906	Number of subintervals in network P <sub>1</sub> is P <sub>2</sub> . Number of subintervals in network P <sub>3</sub> is P <sub>4</sub> . P <sub>2</sub> ≠ P <sub>4</sub> . Unequal number of subintervals. Therefore cannot perform analysis.

APPENDIX C

COMMON /A1/

MNLV            Number of (words/halfwords) available for  
                 storage of link and vehicle arrays.

NLV(MNLV)      INTEGER\*2  
                 Array containing all link and vehicle data.

        Six two-dimensional arrays are equivalenced to NLV. The size of each of these arrays must be less than or equal to MNLV. Descriptions of the link arrays, LNKF, LNKR and LNKS for freeway, ramp and surface links and of the vehicle arrays VF, VR and VS for freeway, ramp and surface vehicles are provided on the following pages. Each vehicle array must be declared INTEGER. Also, each link and vehicle array must be declared INTEGER\*2 in IBM version of INTRAS.

LNKF (K,L) Array

INTEGER\*2

<u>K</u>	<u>Description</u>
1	Number of through lanes
2	1/3 the length of the freeway link (feet)
3	Code number of auxiliary lane 1 6 = Left lane 1 7 = Left lane 2 8 = Right lane 1 9 = Right lane 2
4	1/3 the length of auxiliary lane 1 (feet)
5	Code (0,1,2) if lane is (acceleration, deceleration, full)
6	Same as for K = 3 for second auxiliary lane
7	Same as for K = 4 for second auxiliary lane
8	Same as for K = 5 for second auxiliary lane
9	Mean free flow speed, fps
10	Grade code
11	Code (0,1) if grade (positive, negative)
12	Percentage of total volume on link L which leaves freeway at downstream node
13	Identifying number of ramp link servicing vehicles leaving freeway, if any
14	Number of vehicles now occupying link
15	Code (0,1) if ramp link in K = 13 is (right hand, left hand)
16	Radius of curvature, feet/100

<u>K</u>	<u>Description</u>
17	Unused
18	Number of vehicles discharged from link since beginning of simulation or beginning of subinterval, depending on reporting option, i.e., cumulative or subinterval specific
19	Total moving time (at desired free-flow speed) of all vehicles traversing link, tenths-of-a-second
20	Total delay time, tenths-of-a-second
21	Total delay time, halves-of-an-hour
22	Total moving time, halves-of-an-hour
23	Right hand lane of pair separated by barrier
24	Number of downstream link servicing through traffic (or downstream node of exit link $\geq$ 700)
25	Unused
26	Number of vehicles occupying link at end of last subinterval
27	Right hand lane of pair separated by barrier
28	Location within DTCTR array that the first detector data for this link is stored
29	Number of vehicle closest to upstream node in lane 1
30	Same as 29 for lane 2
31	Same as 29 for lane 3
32	Same as 29 for lane 4
33	Same as 29 for lane 5
34	Same as 29 for first auxiliary lane



<u>K</u>	<u>Description</u>
35	Same as 29 for second auxiliary lane
36	Location within INCID array containing the first incident data for this link
37	Lane identification for lane in downstream link (receiving through traffic) which receives traffic from lane 1 of this link
38	Location on this link at which an early warning sign becomes visible (in percent of link length from upstream node)
39	Node locating off-ramp referred to by early warning sign
40	Pavement code: 1 = dry concrete 2 = wet concrete 3 = dry asphalt 4 = wet asphalt
41	Superelevation (%)
42	Lane change counter

<u>K</u>	<u>Contents</u>	<u>Description</u>
1	XXXXY	XXXX = Length of ramp, feet Y = Number of lanes
2	WZYXX	XX = Mean free-flow speed, fps Y = Grade code Z = Code (0,1) if grade is (positive, negative) W = Code (0,1) if this link is an (on,off) ramp
3	XXXYY	XXX = Identifying number of link servicing first movement of vehicles leaving this link (surface link number for off-ramps and freeway link number for on-ramps) Y = Code (0,1) if first movement is (left, through)
4	XXXYY	XXX = Identifying number of surface link servicing second movement of veh- icles leaving this link (only applies for off-ramps) Y = Code (1,2) if second movement is (through, right)
5	XXXYY	XXX = Number of vehicles now occupying link YY = Percentage of total volume on ramp link, L, which makes the second movement (Y in LNKR (4,L))
6	XXXXXX	XXXXXX = Number of vehicles discharged from link since beginning of simulation or beginning of subinterval depending on reporting option; i.e., cumula- tive or subinterval specific
7	XXXXXX	XXXXXX = Total moving time (at desired free- flow speed) of all vehicles traversing link, tenths-of-a-second

<u>K</u>	<u>Contents</u>	<u>Description</u>
8	XXXXX	XXXXX = Total delay time, tenths-of-a-second
9	XXYY	XX = Total moving time, halves-of-an-hour YY = Total delay time, halves-of-an-hour
10	XXYYY	XX = Number of vehicles occupying link at end of previous subinterval YYY = Location within the DTCTR array that the first detector data for this link is stored
11	XXXXY	XXXX = Time in queue, halves-of-an-hour Y = "Type" of intersection at downstream node; used as index of TLNK array
12	XXXX	XXXX = Number of vehicle closest to upstream node in lane 1
13	XXXX	XXXX = Number of vehicle closest to upstream node in lane 2
14	XXYZZ	XX = Speed of previously discharged queued vehicles, fps Y = Signal code facing link ZZ = Mean queue discharge headway, tenths-of-a-second (applies only to off-ramps)
15	ZXXY	Y = Lane identification for lane in downstream link (receiving through traffic) which receives traffic from lane 1 of this link XX = Radius of curvature (ft/100) Z = Pavement code: 1 - dry concrete; 2 - wet concrete; 3 - dry asphalt; 4 - wet asphalt
16	YYXX	XX = Superelevation (%) YY = Start-up lost time for first queued vehicle (applies to off-ramps only), tenths-of-a-second

<u>K</u>	<u>Contents</u>	<u>Description</u>
17	XXXX	XXXX = Time in queue, tenths-of-a-second
18	XXXX	XXXX = Number of cycle failures

<u>K</u>	<u>Contents</u>	<u>Description</u>
1	XXXXY	XXXX = Link length, feet Y = Number of lanes, not including turn pockets
2	VWXYZ	Z = Channelization code for lane 1 Y = Channelization code for lane 2 X = Channelization code for lane 3 W = Channelization code for lane 4 V = Channelization code for lane 5
3	XXYYY	XX = Start-up lost time for first queued vehicle, tenths-of-a-second YYY = Location within DTCTR array in which the first detector data for this link is stored
4	XXYYY	XX = Capacity of left-turn pocket YYY = Number of vehicles occupying link
5	XXXX	XXXX = Number of vehicles discharged from this link since start of simulation or beginning of subinterval depending on reporting option; i.e., cumulative or subinterval specific
6	XXXX	XXXX = Total moving time (at desired free-flow speed) of all vehicles traversing link, tenths-of-a-second
7	XXXX	XXXX = Total delay time, tenths-of-a-second
8	XYYYZ	X = Code (0,1) if link receiving left-turn traffic (is not, is) a ramp YYY = Link number which receives left-turn traffic (or, downstream node of exit $\geq$ 800) Z = Current signal code facing link

<u>K</u>	<u>Contents</u>	<u>Description</u>
9	XYYYZ	X and YYY same as for K=8 but for through traffic Z = "Type" of intersection at downstream node
10	±XYYYZ	X and YYY same as for K=8 but for right-turn traffic Z = Grade code. This word is (+,-) if grade is (positive, negative)
11	XXXYY	XXX = Percent of traffic turning left YY = Mean queue discharge, tenths-of-a second
12	XXXYY	XXX = Percent of traffic proceeding through YY = Mean free-flow speed, fps
13	XXXYY	XXX = Percent of traffic turning right YY = Total moving time, halves-of-an hour
14	XXXX	XXXX = Time in queue, tenths-of-a-second
15	XXXXY	XXXX = Time in queue, halves-of-an hour Y = Capacity of right-turn pocket
16	XXXXY	XXXX = Identification of last vehicle in lane 1 (nearest the upstream node) Y = Original queue position occupied by vehicle in lane 1 now ready to discharge
17	XXXXY	Same as for K=16, but for lane 2
18	XXXXY	Same as for K=16, but for lane 3
19	XXXXY	Same as for K=16, but for lane 4
20	XXXXY	Same as for K=16, but for lane 5
21	YXXXX	XXX = Number of opposing link, if any, which carries on-coming traffic impeding left turners



K

Contents

Description

YY = Total delay time, halves-of-an-hour

22

XXXYY

XXX = Number of vehicles occupying link at conclusion of previous subinterval  
YY = Number of signal cycle failures

<u>K</u>	<u>Description</u>														
1	Origin node (last 2 digits)														
2	Destination node (last 2 digits)														
3	Process code (0,1) if vehicle (has not, has) been processed this time step														
4	Distance of vehicle from upstream node, feet														
5	Code (0,1) if vehicle is (accelerating, decelerating)														
6	Current speed, ft/sec														
7	Acceleration or deceleration of vehicle during this time step, ft/sec <sup>2</sup>														
8	Number of vehicle in front of this vehicle in current lane														
9	Code (0,1) if this vehicle (M) will (continue on, leave) the freeway at the downstream node														
10	Desired lane and lane switch code: <table><thead><tr><th><u>Code</u></th><th><u>Meaning</u></th></tr></thead><tbody><tr><td>0</td><td>Preferred lane is not mandatory</td></tr><tr><td>1</td><td>Preferred lane is mandatory, vehicle must achieve this lane before leaving link</td></tr><tr><td>2</td><td>Vehicle currently changing lanes to the left (occupies 2 lanes) and preferred lane is not mandatory</td></tr><tr><td>3</td><td>Vehicle currently changing lanes to the left and preferred lane is mandatory</td></tr><tr><td>4</td><td>Vehicle currently changing lanes to the right and preferred lane is not mandatory</td></tr><tr><td>5</td><td>Vehicle currently changing lanes to the right and preferred lane is mandatory</td></tr></tbody></table>	<u>Code</u>	<u>Meaning</u>	0	Preferred lane is not mandatory	1	Preferred lane is mandatory, vehicle must achieve this lane before leaving link	2	Vehicle currently changing lanes to the left (occupies 2 lanes) and preferred lane is not mandatory	3	Vehicle currently changing lanes to the left and preferred lane is mandatory	4	Vehicle currently changing lanes to the right and preferred lane is not mandatory	5	Vehicle currently changing lanes to the right and preferred lane is mandatory
<u>Code</u>	<u>Meaning</u>														
0	Preferred lane is not mandatory														
1	Preferred lane is mandatory, vehicle must achieve this lane before leaving link														
2	Vehicle currently changing lanes to the left (occupies 2 lanes) and preferred lane is not mandatory														
3	Vehicle currently changing lanes to the left and preferred lane is mandatory														
4	Vehicle currently changing lanes to the right and preferred lane is not mandatory														
5	Vehicle currently changing lanes to the right and preferred lane is mandatory														
11	Number of vehicle behind this vehicle in current lane														

<u>K</u>	<u>Description</u>
12	Vehicle type code: 1 = low performance passenger car 2 = high performance passenger car 3 = inter-city bus 4 = heavy single unit truck 5 = trailer truck
13	Driving characteristic of motorist
14	Desired free-flow speed, ft/sec
15	Current lane
16	Preferred lane on this link
17	Current freeway link
18	New lane change code: <u>Code</u> <u>Meaning</u> 0        Vehicle desires lane change to either left or right 1        Vehicle desires change to left 2        Vehicle desires change to right 3        No change desired 4-9      If value is greather than or equal to 4, vehicle is changing lanes. For this case, the value is the time step during lane change process plus 4
19	Code (0,>0) if vehicle formerly in front of this vehicle (is not, is) still in process of a lane change
20	Unused
21	Downstream node at which vehicle will leave freeway (flagged upon passing an early warning sign)
22	Node number at which vehicle will be diverted from freeway

<u>K</u>	<u>Contents</u>	<u>Description</u>
1	ZXXYY	XX = Destination node (last 2 digits) YY = Origin node (last 2 digits) Z = Process code: 0 - if vehicle has not been processed this time step; 1 - if vehicle has been processed this time step; 2 - if vehicle made lane change to left but has not been processed yet
2	XXXXW	XXXX = Distance of vehicle from upstream node, ft. If vehicle becomes first in queue then XXXX = time remaining till discharge, tenths-of-a-second W = Current lane
3	WXYZZ	W = Queue code: 0 - if vehicle is not in queue; 1 - if vehicle is in queue; 2 - if vehicle queued because of cycle failure X = Turn code: 0 - if vehicle will turn left; 1 - if vehicle is travelling thru; 2 - if vehicle will turn right Y = Acceleration or deceleration of vehicle during this time step, ft/sec <sup>2</sup> ZZ = Current speed, ft/sec
4	XXXX	XXXX = Number of vehicle in front of this vehicle
5	XXXX	XXXX = Number of vehicle in back of this vehicle
6	WYXZZ	W = Code (0,1) if vehicle is (accelerating, decelerating) Y = Vehicle type code: 1 - low performance passenger car; 2 - high performance passenger car; 3 - inter-city bus; 4 - heavy single unit truck; 5 - trailer truck

<u>K</u>	<u>Contents</u>	<u>Description</u>
		X = Driving characteristic of motorist ZZ = Desired free-flow speed, fps
7	XXX	XXX = Node number at which vehicle was diverted from freeway
8	XXX	XXX = Current ramp link number

<u>K</u>	<u>Content</u>	<u>Description</u>
1	ZXXYY	XX = Destination node (last 2 digits) YY = Origin node (last 2 digits) Z = Process code: 0 - if vehicle has not been processed this time step; 1 - if vehicle has been processed this time step; 2 - if vehicle made lane change to left but has not been processed
2	XXXXW	XXXX = Distance of vehicle from upstream node, feet. If vehicle becomes first in queue, then XXXX = time remaining till discharge, tenths-of-a-second W = Current lane
3	WXYZZ	W = Queue code: 0 - if vehicle is not in queue; 1 - if vehicle is in queue; 2 - if vehicle queued because of cycle failure X = Turn code: 0 - if vehicle will turn left; 1 - if vehicle is travelling thru; 2 - if vehicle will turn right Y = Acceleration or deceleration of vehicle during this time step, ft/sec <sup>2</sup> ZZ = Current speed, ft/sec
4	XXXX	XXXX = Number of vehicle in front of this vehicle
5	XXXX	XXXX = Number of vehicle in back of this vehicle
6	WYXZZ	W = Code (0,1) if vehicle is (accelerating, decelerating) Y = Vehicle type code: 1 - low performance passenger car; 2 - high performance passenger car; 3 - intercity bus; 4 - heavy single unit truck; 5 - trailer truck



<u>K</u>	<u>Contents</u>	<u>Description</u>
		X = Driving characteristic of motorist ZZ = Desired free-flow speed, fps
7	XXX	XXX = Node number at which vehicle was diverted from freeway
8	XXX	XXX = Current surface link number

COMMON /A2/

NTOTL                    Scalar defining maximum allowable combined  
                         number of all link types

IVFEET(L)                Number of feet travelled on link, L,  
                         where

L = Freeway link number, or ramp link  
     number + NLFR, or surface link number  
     + NLFR + NLRA

ENDNDS (L,K)            INTEGER\*2 and INTEGER Array

L = Link number, defined as for IVFEET

K = 1 for element specifying node at  
     upstream end of link, L

K = 2 for elements specifying node at  
     downstream end of link, L

COMMON /A3/

NTOTN            Scalar defining maximum allowable number  
                 of nodes (also largest node number)

SIGI (N,K) = YXXX    INTEGER\*2 and INTEGER

N = Node number

K = Approach to Node N (Max. 4)

Y = Code, as follows

<u>Code</u>	<u>Definition</u>
0	Freeway link approach
1	Ramp link approach
2	Surface link approach

XXX = Freeway, ramp or surface link number  
      of this approach

COMMON /A4/

NDET                    Scalar defining maximum allowable number of detectors

IDET                    Current number of detectors specified

DTCTR(N,K); INTEGER and INTEGER\*2 array describing detector, N, as follows:

<u>K</u>	<u>Contents</u>	<u>Description</u>										
1	XXXX	XXXX = Location of upstream end of detector in feet from upstream node, or acquisition point for doppler radar										
2	WXYZZ	<p>W = Code (0,1) if this detector (was not, was) generated to output plot parameters</p> <p>X = Code as follows:</p> <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 10px;"><u>X</u></td> <td><u>Detector Type</u></td> </tr> <tr> <td>0</td> <td>Doppler radar</td> </tr> <tr> <td>1</td> <td>Short loop</td> </tr> <tr> <td>3</td> <td>Downstream loop of coupled pair</td> </tr> <tr> <td>4</td> <td>Upstream loop of coupled pair</td> </tr> </table> <p>Y = Lane code</p> <p>ZZ = Effective loop length, feet</p>	<u>X</u>	<u>Detector Type</u>	0	Doppler radar	1	Short loop	3	Downstream loop of coupled pair	4	Upstream loop of coupled pair
<u>X</u>	<u>Detector Type</u>											
0	Doppler radar											
1	Short loop											
3	Downstream loop of coupled pair											
4	Upstream loop of coupled pair											
3	For plot output detectors only { Short loop {	<p>XXXXX = Sum of speeds of vehicles crossing detector in plot output time interval (for plot output detectors)</p> <p>X = Code (0,1) if detector (is not, is) currently occupied</p> <p>YYYY = Length of time that status <u>before</u> current status (X) prevailed, tenths-of-a-second</p>										
		<p>XXX = Speed of last acquired vehicle, ft/sec</p>										
4	For plot output detectors only {	XXXX = Number of vehicles crossing detector in plot output time interval (for plot output detectors)										

<u>K</u>	<u>Contents</u>	<u>Description</u>
For doppler or loop detectors	XXXX	XXXX = Vehicle number of vehicle which last entered loop or was acquired by radar
5	XXX	XXX = Pointer defining number of next detector for this link ( $\neq 0$ , if no more detectors)
6	XXXX	XXXX = Length of time that current status has prevailed, tenths-of-a-second
Short loop doppler radar	XXXX	XXXX = Time of actuation, tenths-of-a-second
7	XX	XX = Station number for this detector ( <u>&lt;50</u> )

COMMON /A5/

NINCI                    Scalar defining maximum allowable number  
of incidents

INCID(N,K)            INTEGER\*2 array describing incident, N,  
as follows:

<u>K</u>	<u>Contents</u>	<u>Description</u>								
1	VWXYZ	Z = Incident code for lane 1 Y = Incident code for lane 2 X = Incident code for lane 3 W = Incident code for lane 4 V = Incident code for lane 5 Incident Codes: <table><thead><tr><th><u>Code</u></th><th><u>Effect</u></th></tr></thead><tbody><tr><td>0</td><td>Normal speed</td></tr><tr><td>1</td><td>Traffic capacity reduced at point of incident by "rubber neck" factor</td></tr><tr><td>2</td><td>Blockage at point of incident</td></tr></tbody></table>	<u>Code</u>	<u>Effect</u>	0	Normal speed	1	Traffic capacity reduced at point of incident by "rubber neck" factor	2	Blockage at point of incident
<u>Code</u>	<u>Effect</u>									
0	Normal speed									
1	Traffic capacity reduced at point of incident by "rubber neck" factor									
2	Blockage at point of incident									
2	VWXYZ	Z = Incident code for first left auxiliary lane Y = Incident code for second left auxiliary lane X = Incident code for first right auxiliary lane W = Incident code for second right auxiliary lane V = (0,1) if this (is not, is) the final incident for this link								
3	XXXX	XXXX = Longitudinal location of upstream end of incident from upstream node, feet								
4	XXXX	XXXX = Length of roadway affected by incident, feet								
5	XXXX	XXXX = Time of onset, in seconds from the start of simulation								
6	XXXX	XXXX = Duration of incident, seconds								



<u>K</u>	<u>Contents</u>	<u>Description</u>
7	WWXY	WW = Pointer indicating location of next incident for this link X = Code (0,1) if incident (is not, is) over YY = Percent reduction in capacity at point of incident for "rubberneck" lanes

COMMON /A6/

MNODE                    Scalar denoting maximum node number active  
                          in current network

IANOD                    Scalar denoting maximum allowable number  
                          of actuated nodes

MANOD                    Scalar denoting maximum number of  
                          actuated nodes in current network

SIG(NTOTN,4) is a full word INTEGER array containing the signal codes facing each of the four possible approaches to a particular node ( $i \leq \text{NTOTN}$ ) for all signal intervals as follows:

SIG(N,I) = UVWXYZ (for fixed time or sign control)

where N = Node number  
      I = Approach number

and     Z = control code, interval 1, facing approach I  
      Y = control code, interval 2, facing approach I  
      X = control code, interval 3, facing approach I  
      W = control code, interval 4, facing approach I  
      V = control code, interval 5, facing approach I  
      U = control code, interval 6, facing approach I

For actuated control SIG(N,1) = -XY

where X = Actuated control algorithm I.D. code  
      YY = Actuated node number ( $\leq \text{IANOD}$ )

NPHS (NTOTN,6) is half word (INTEGER\*2 for IBM) INTEGER array containing the six possible interval durations for all nodes in the network. Each duration is expressed in seconds.

SIGT (NTOTN) is a half word (INTEGER\*2 for IBM) INTEGER array containing the current active interval for each node and the time remaining in that interval.

SIGT(N) =   XXX

where XXX = Remaining time in interval, tenths-of-a-second  
          Y = Current active interval at node N

IACPAR (24,IANOD) is a half word (INTEGER\*2 for IBM)  
array containing the 24 possible parameters associated with  
each actuated control node.

COMMON /A7/

NS      Scalar denoting current number of entry links

SNODE(J,K) - full word INTEGER array. This array identifies the status of freeway and surface entry links "feeding" the network. Maximum number of entry links accommodated by model is NTOFN. Each entry link, J, is described by a vector of elements. Note that the index, J, assigned internally to the entry links by the model, is not the identifying link number, L.

<u>K</u>	<u>Contents</u>	<u>Description</u>
1	YXXX	Y = (0,1) for (freeway, surface) entry J XXX = Link number (by type)
2	XXXX	XXXX = Emission headway on this entry, hundredths-of-a-second for surface entries, thousandths-of-a-second for freeway entries
3	WWXXYYZZ	WW = % of Vehicle Type 2 XX = % of Vehicle Type 3 YY = % of Vehicle Type 4 ZZ = % of Vehicle Type 5
4	XXXX	XXXX = Time remaining till next emission, hundredths-of-a-second for surface entries, thousandths-of-a-second for freeway entries
5	WWXXYYZZ	WW = % vehicles assigned to lane 2 XX = % vehicles assigned to lane 3 YY = % vehicles assigned to lane 4 ZZ = % vehicles assigned to lane 5

COMMON /A8/

The following arrays of COMMON/A8/ should be declared  
INTEGER: SPLPCT, CLEN, VFH, TLNK, FOLK, CSTDCL, VFHF.  
For IBM version of program, the following should be declared  
INTEGER\*2: IPACK, TLNK, LIMSPD, MAXAC, CSTDCL, LNMNSP,  
ITPCT.

JMPG(I) - probability of a lead left-turn vehicle jumping at the beginning of the green phase across I incoming lanes, expressed as percentage.  
JMPG(I)=38 for I equals 1 through 5. These values are as defined for the UTCS-1 simulation model.

ILT - Speed to which vehicle unimpeded by traffic must slow to negotiate a left turn, applied deterministically.  
ILT = 22 ft/sec.

IRT - Same as ILT for right turn  
IRT = 13 ft/sec

IALAG - Acceptable lag in target lane so that vehicle can switch lanes, applied deterministically.  
IALAG = 31 sec/10

JERK(I) - Maximum JERK for vehicle type I, ft/sec<sup>3</sup>.  
JERK(I) = 70, I = 1,5

SPLPCT(I) - A vehicle facing a spillback condition in its receiving link at the time it is about to discharge into it must "decide" whether to discharge or wait until spillback dissipates. This decision affects only through vehicles. Left-turners always join spillback (other conditions permitting) while right-turners are physically blocked by spillback. Probability of vehicle joining spillback comprised of I vehicles is:

$$\frac{I}{\text{SPLPCT}} \quad \frac{1}{100} \quad \frac{2}{81} \quad \frac{3}{69} \quad \frac{4}{40}$$

CLEN(I) - Car length of vehicle type I, ft., which includes a 3-foot spacing buffer

$$\frac{I}{\text{Car Length}} \quad \frac{1}{20} \quad \frac{2}{20} \quad \frac{3}{43} \quad \frac{4}{26} \quad \frac{5}{53}$$

LSLAG(I) - Vehicle at stop-line facing STOP sign cannot discharge until acceptable gap is available in cross street traffic. Decile distribution of acceptable gaps for near-side (or one-way cross street traffic) is stored in the LSLAG array (sec/10).

I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Acceptable gaps	56	50	46	42	39	37	34	30	26	20

ITGAP(I) - An additive factor must be applied for gaps in far-side cross street traffic to account for time required for discharging vehicle to reach far side. ITGAP contains this time, in sec/10, that elapses for vehicle to cross I lanes at acceleration of 8 ft/sec<sup>2</sup>.

I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Additional time	12	21	26	31	35	39	42	46	49	51

IAMBR(I) - Response of drivers to onset of amber signal is expressed in terms of acceptable deceleration. Applies only to lead moving vehicle in lane with no queue at instant the signal turns amber. The deceleration required for vehicle to stop is readily calculated knowing current position and speed. Using driver characteristic code a decile statistical distribution, IAMBR(I), is entered, to determine whether the acceptable deceleration extracted from distribution exceeds the required value. If so, vehicle will stop; otherwise it will continue through intersection. Values, in ft/sec, are:

I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Acceptable deceleration	4	4	5	6	7	9	12	15	18	21

IGAP(I) - A decile distribution of acceptable gaps in oncoming traffic facing left-turning vehicles is stored in IGAP. Values in sec/10 are:



I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Acceptable gaps	78	66	60	54	48	45	42	39	36	27

MINAC(I) - Maximum deceleration for vehicle type I, ft/sec<sup>2</sup>

I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Maximum deceleration	21	21	21	21	16

VFH(I) - As each vehicle enters a link, it is assigned a free-flow speed. This is obtained by multiplying a percentage by the free-flow speed specified for that link. This percentage is obtained from a decile distribution; the index, I, is the driver characteristic code

I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Percentage values:	75	81	91	94	97	100	107	111	117	127

VFHF(I) - Percentage of mean speed by driver type I on freeway links

I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
percentage	82	91	94	97	99	101	103	106	109	118

FOLK(I) - sensitivity factor for driver type I which determines desired car following distance

I	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
sensitivity factor	19	18	17	16	15	14	13	12	11	10

LSTTIM - Start-up lost time for first queued vehicle on off-ramps (tenths of a sec.)

LSTTIM = .22

LIMSPD(I,J) - limiting speeds by vehicle type (I) and grade index (J) (fps)

Vehicle type	Grade J	0° 1	2° 2	4° 3	6° 4
1		200	200	200	200
2		200	200	200	200
3		98	84	70	57
4		98	84	70	57
5		84	50	32	23

MAXAC(I,J,K) - Vehicle acceleration profiles by vehicle type (I), grade (J), and speed (K). Note: vehicle types 1 and 2 are freeway accelerations for autos; types 6 and 7 represent non-freeway accelerations for types 1 and 2 respectively (fpss)

For values, see Tables 45 - 48.

Table 45

Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in Ft/Sec<sup>2</sup>

J	Grade	Low Performance Passenger Car	Speed (ft/sec)				
			K=1	2	3	4	5
			0→20	20→40	40→60	60→80	80
1	-4%	Freeway, I=1	8	8	8	5	3
		Non-Freeway, I=6	5	4	3	3	3
2	0%	Freeway, I=1	6	6	6	3	2
		Non-Freeway, I=6	4	3	2	2	2
3	2%	Freeway, I=1	6	6	5	2	1
		Non-Freeway, I=6	4	3	2	1	1
4	4%	Freeway, I=1	5	5	3	1	1
		Non-Freeway, I=6	3	3	1	1	1
5	6%	Freeway, I=1	5	5	3	1	1
		Non-Freeway, I=6	3	3	1	1	1

Table 46

## Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in Ft./Sec.<sup>2</sup>

J	Grade	High Performance Passenger Car	Speed (ft/sec)				
			K=1	2	3	4	5
			0→20	20→40	40→60	60→80	Above 80
1	-4%	Freeway, I = 2	15	14	14	8	5
		Non-Freeway, I = 7	9	6	5	5	5
2	0%	Freeway, I = 2	11	11	10	5	3
		Non-Freeway, I = 7	7	5	3	3	3
3	2%	Freeway, I = 2	10	10	8	4	2
		Non-Freeway, I = 7	7	5	3	2	2
4	4%	Freeway, I = 2	9	9	5	2	1
		Non-Freeway, I = 7	6	5	2	1	1
5	6%	Freeway, I = 2	9	9	4	2	1
		Non-Freeway, I = 7	6	4	1	1	1

Table 47

Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in Ft/Sec<sup>2</sup>

For Buses and Heavy Single-Unit Trucks (I=3,4)

J	Grade	Speed (ft/sec)				
		K=1	2	3	4	5
		0→20	20→40	40→60	60→80	Above 80
1	-4%	3	2	2	2	1
2	0%	3	2	1	1	1
3	2%	2	1	1	1	1
4	4%	1	1	1	1	0
5	6%	1	1	1	0	0

Table 48

Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in Ft/Sec<sup>2</sup>

For Trailer Trucks (I=5)

J	Grade	Speed (ft/sec)				
		K=1	2	3	4	5
		0→20	20→40	40→60	60→80	Above 80
1	-4%	2	2	2	1	1
2	0%	1	1	1	1	1
3	2%	1	1	1	0	0
4	4%	1	1	0	0	0
5	6%	1	0	0	0	0



CSTDCL(I,J) - freeway coasting deceleration by vehicle type (I) and speed (J) in fps.

I	Speed Range (fps)		
	0-40	40-60	>60
	J=1	J=2	J=3
1	1	2	3
2	1	2	3
3	1	1	1
4	1	1	1
5	1	1	1

LNMNSP(I,J) - lane mean speed (percentage) by total number of lanes (I+1) and lane number (J).

Total # of Lanes	I	Lane Number, J				
		1	2	3	4	5
2	1	94	106	-	-	-
3	2	93	101	106	-	-
4	3	93	97	105	105	-
5	4	94	95	101	106	104

ITPCT(I,J) - percentage of commercial vehicles assigned to each lane, by total number of lanes (I+1) and lane number (J).

Total # of Lanes	I	Lane Number, J				
		1	2	3	4	5
2	1	75	25	-	-	-
3	2	50	50	0	-	-
4	3	38	37	25	0	-
5	4	30	30	30	10	0

TLNK(I,K) - As each queued vehicle moves up to stop-line, it is assigned a delay until discharge, in sec/10, reflecting queue discharge headways. This headway is obtained by multiplying mean queue discharge headway specified for link by percentage, obtained from decile distribution which applies to that "type" of link. Distribution is indexed by vehicle driver characteristic code. Data gathered on a test site indicates a single "type" of link for the purpose of defining a queue discharge headway distribution. This distribution is stored in the TLNK(I,K) array where I denotes intersection "type", and K, the decile index (I = 1,2 considered):

K	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Percentage Values	170	120	120	110	100	100	90	70	70	50

The headway so obtained must be modified if vehicle was 2nd or 3rd in queue when signal turned green. The following values must be added to headway:

2nd vehicle: TLNK(I,25) = 5 sec/10  
 3rd vehicle: TLNK(I,26) = 2 sec/10

If vehicle was not an auto, further modification is made: value must be multiplied by percentage to reflect different operating characteristics of other type vehicles.

Type 2      TLNK(I,21) = 100  
3      TLNK(I,22) = 160  
4      TLNK(I,23) = 160  
5      TLNK(I,24) = 160

First vehicle in queue when light turns green suffers a (start-up) lost time. If this lost time is specified on the link card, it is applied deterministically. Otherwise, lost time, in sec/10, is extracted from decile distribution using the vehicle driver characteristic; distribution referenced is defined by type, I, of link. Distribution is also stored in TLNK(I,K) array.

K	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>
type 1	56	36	32	30	26	22	20	16	12	6
type 2	68	40	30	24	20	16	12	8	6	0

IPACK(I) - Array to be used when unpacking or packing one vector of LNKF, LNKR, or LNKS array.

COMMON /A9/

CHEK78(12), INTEGER. This array contains flag digits indicating the presence and type (freeway and non-freeway) of external (entry, exit) nodes. Each digit represents one possible node number.

Digit i value

0	No node exists in either the 700 or 800 series
1	There exists an external node = $700 + (i-1)$
2	There exists an external node = $800 + (i-1)$
3	Error: Both the $800 + (i-1)$ and $700 + (i-1)$ exist

The digits are stored, 9 to each word, as follows:

CHEK78(1) = IHGFEDCBA

where

A is the value for  $i = 1$   
B is the value for  $i = 2$   
etc.

CHEK78(2) contains the values for digit  $i=10$  through  $i=18$ , etc.

For example: If CHEK78(1) = 1202, the subject network would contain the external nodes 703, 802 and 800.

COMMON /A10/

The following arrays of COMMON /A10/ should be declared INTEGER: VPROC, THRUUV, RTRNV, VCONT. For IBM version of program, all arrays in COMMON /A10/ should be declared INTEGER\*2.

- VPROC(L)            Number of vehicles discharged from link L through end of prior subinterval where:  
L = Freeway link number, or ramp link number + NLFR, or surface link number + NLFR + NLRA
- MNUVR(L,K)        Total number of vehicles for link L assigned to the various turning movements from beginning of simulation to present as follows:  
K = (1,2,3) for (left, through, right) movements
- LTRNV(L),  
THRUUV(L),  
RTRNV(L)        These arrays contain the number of vehicles assigned to the various turn movements through the end of the prior subinterval for link L.
- VCONT(L)        Number of vehicles occupying link L at end of prior subinterval

COMMON /All/

ISTATN            Current number of entries in LSTATN

NSTATN            Maximum number of entries in LSTATN

LSTATN(I) = ZZZXXXX  
              ZZZ = Link number (by type)  
              XXXX = Distance from upstream node of  
                      station for recording mean and  
                      frequency distribution output  
                      data (feet)



COMMON /A12/

IFCOEF(I) Friction coefficient for pavement code I,  
 $1 \leq I \leq 9$  (percentage). Embedded value is  
50 for all pavement codes. These values are  
synthetic and do not represent real friction  
coefficients due to the lack of data during  
the program development. The user should  
input appropriate values.

IGRVAL(I) Grade value for grade code I,  
 $1 \leq I \leq 5$  (percentage) (must be in ascending  
order). The embedded values are:

<u>I</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Grade Value	-4	0	2	4	6

COMMON /ACT0/

MACR	Maximum number of intersection actuated traffic control nodes
NNCR	Actual number of intersection actuated traffic control nodes in network
ISTDET	Distance of assumed detector from stop line. Embedded value is 60 feet.

COMMON/ACT1/

NAFZ(N,J,8) Contains eight data elements describing phase J at actuated controller, N. The eight elements are defined as follows:

<u>Data Element</u>	<u>Contents</u>	<u>Description</u>
1	YYYY	X = Phase actuation code YYY = Yield point if phase J is non-actuated or force-off point if phase J is actuated, seconds
2	XXX or YXX	XXX = End of yield interval, sec. } Non-actuated phase XX = Minimum initial interval, sec } Actuated phase Y = Initial interval code }
3	YYXX	YY = Initial interval data } Actuated phase XX = Initial actuations data }
4	YYXX	YY = Maximum passage time, tenths-of-a-second XX = Minimum gap, tenths-of-a-second
5	YYXX	YY = Amount of gap reduced every second, tenths-of-a-second } Actuated phases XX = Maximum extension, i.e., maximum green service interval, seconds }

<u>Data Element</u>	<u>Contents</u>	<u>Description</u>
	or XXX	XXX = Time elapsed since onset of phase to the onset of the amber interval
		} Non-actuated phases
6	ZYXX	XX = Maximum green, i.e., initial + added + green service intervals Y = Amber duration, seconds Z = Red clearance duration, seconds
7	ZYX	Z = Recall switch code (0,1) if (off, on) Y = Red revert time, seconds X = Memory switch code (0,1) if (passage, presence) detectors
8	YX	Y = Inhibit maximum termination code (0,1) if green service interval (is, is not) terminated when maximum time is attained X = Overlap code: 0 if no other phases overlap with phase J 1 if phase J overlaps with phase J-1 2 if phase J is overlapped by phase J+1 3 if phase J overlaps phase J-1 and is overlapped by phase J+1

COMMON/ACT2/

NAAFZ(N,I,J) Identifies the signal currently active on ring I of the actuated controller, N. For J=1 the (parent) phase is the only phase active. For J=2 a non-null entry identifies the phase that overlaps the indicated parent phase.

COMMON/ACT3/

NATMR(N,5,J) Contains five data elements that define the condition of the active phase on ring J at actuated controller, N. The five elements are defined as follows:

<u>Data Element</u>	<u>Contents</u>	<u>Description</u>
1	XXYYY	XX = Red revert time, seconds YYY = Time gap since last actuation for passage detectors, tenths-of-a-second. For presence detectors code (1,3) if a vehicle (is, is not) present.
2	XXXYY	XXX = Timer for current active interval (intervals with status codes 1 to 5), sec. YY = Timer for maximum service green, sec.

} Actuated phases

<u>Data Elements</u>	<u>Contents</u>	<u>Description</u>
		XXX = Time elapsed since onset of phase, sec., for non-coordinated phase only. Not used for coordinated phase. YY = 0 for non-actuated phases <div style="float: right; margin-left: 20px;">             } Non-actuated phases           </div>
3	XXXYY	XXX = Cycle time for coordinated controllers, sec. This timer cycles over the range [1,c] and is used to test YIELD intervals and force-off points YY = Current value of passage time for active phase if passage detector, tenths-of-a-second. If presence detector YY=2.
4	XX	Contains two timers that can never be concurrent; hence, they can occupy same storage XX = Calculated value of added initial time or XX = Timer for extension period, i.e., green service interval, sec.
5	XX	Timer for the "slave" phase that overlaps the prior phase, sec.



COMMON/ACT4/

NADET(N,I,J) Identifies the location and lane of detector, I, which services phase J of actuated controller, N, as follows:

<u>I</u>	<u>Contents</u>	<u>Description</u>
1	XXX Y	Location of the detector that furnishes actuations (and calls) for the initial interval of the inactive phase, J, where: XXX = link number Y = lane number
2	XXX Y	As for I=1, for another detector
.	.	.
.	.	.
.	.	.
8	XXX Y	As for I=1, for another detector
9	XXX Y	Location of the detector that furnishes actuations to test against the current value of passage time, for the service green interval of the active phase, J, where: XXX = link number Y = lane number
10	XXX Y	As for I=9, for another detector
.	.	.
.	.	.
.	.	.
16	XXX Y	As for I=9, for another detector

COMMON/ACT5/

NADTM(N,I,J) Contains the most recent actuation time of the passage detector (which services the actuated controller, N) identified in NADET (N,I+8,J) if phase J is active. If phase J is inactive the latest actuation time of the detector is stored.

COMMON/ACT6/

NACNT(N,I,J) Contains the current value of vehicle actuations recorded by detector, I (defined by NADET(N,I,J) of COMMON/ACT4/), servicing phase, J, of actuated controller, N, since the time that phase, J, became inactive. If I identifies a presence detector, this element is zero if no vehicles are present, 1 otherwise. When phase, J, becomes active, these elements are reset.

COMMON/ACT7/

NALNK(N,L) Contains the link number corresponding to approach L being serviced by actuated controller, N, where the number stored is link number+NLFR+NLRA.

COMMON/ACT8/

NACDS(N)            Contains identifying characteristics of actuated controller, N, as follows:  
= WXYZ where  
W = Code (0,1,2) if controller is (single ring, dual ring and single entry, dual ring and dual entry)  
X = Code (0,1) if controller (is not, is) coordinated  
Y = Code (0,1) if controller will (dwell in current active phase, terminate current active phase and rest-in-red) in response to an absence of demand  
Z = Code (0,1) if detector switching feature is (inactive, active)

COMMON/ACT9/

NACYC(N)            Contains the fixed cycle length of coordinated actuated controller, N. If controller is not coordinated, this element is zero.

COMMON/ACT10/

NACT(K)            Contains the actuated controller number corresponding to node K.

COMMON/ACT11/

NADEC(N,I,J) Contains a code that pertains to the phase identified in NAAFZ(N,I,J) of COMMON/ACT2/ as follows:

- 0 if phase will continue to be active
- 1 if phase will terminate under following conditions:
  - a) if a single-ring controller
  - b) if a dual ring and following phase
  - c) if a dual ring, this phase is at barrier and phase on other ring is also at barrier and also terminating
- 2 if phase will terminate at end of this time step

COMMON/ACT12/

NASTAT(N)            Contains in a packed word the status code  
of all phases at actuated controller, N.  
= STUVWXYZ where  
Z = Status code for Phase 1  
Y = Status code for Phase 2  
X = Status code for Phase 3  
W = Status code for Phase 4  
V = Status code for Phase 5  
U = Status code for Phase 6  
T = Status code for Phase 7  
S = Status code for Phase 8

<u>Status Code</u>	<u>Description</u>
0	Phase does not exist
1	Phase is active in initial interval
2	Phase is active in added initial interval
3	Phase is active in service green interval
4	Phase is active in amber interval
5	Phase is active in red clearance interval
6	Phase is active in red revert interval
7	Phase is inactive (red)

COMMON/ACT15/

NEWDET(N,I,J) Contains in a packed word information on the last actuation of detector I, servicing controller, N, during phase J as follows:  
= XXXXXYY where  
XXXXX = Time of last actuation, tenths-of-a-second  
YY = speed of vehicle at last actuation, fps.

COMMON/ACT16/

MTERM(J) Code (0,1) if phase J is to be (unchanged, terminated at) this time step.

COMMON/ACT18/

ND Node number at which actuated controller is located. NACT(ND) defines the controller number.



COMMON /ACT20/

SIGA(N,4) INTEGER array containing the signal codes facing each of the four approaches to actuated node N for all signal intervals as follows:

SIGA(N,I) = RSTUVWXYZ for approach I to actuated node N where,

Z = Control code, interval 1, facing approach I  
Y = Control code, interval 2, facing approach I  
X = Control code, interval 3, facing approach I  
W = Control code, interval 4, facing approach I  
V = Control code, interval 5, facing approach I  
U = Control code, interval 6, facing approach I  
T = Control code, interval 7, facing approach I  
S = Control code, interval 8, facing approach I  
R = Control code, interval 9, facing approach I

COMMON/CONTRL/

Variable RNSEED must be declared INTEGER

I99LAS Code = (0,1) if the current 99 card request  
(is not, is) the last request to be processed.

IRSCT Identification of the current simulation  
subinterval.

NEXCAL Code denoting which Module is currently being  
processed or, when returning from a Module to  
the INTRAS supervisor, it denotes the next  
Module to be called. NEXCAL is defined  
initially by the supervisor after reviewing  
the Type 99 Card codes. Subsequently, it is  
reset at the exit from each Module.

<u>Value</u>	<u>Module</u>
0	INTRAS
1	PORGIS
2	LIS
3	MIFSIM
4	FUEL
5	INCES
6	POSPRO
7	INPLOT
8	SAM
9	Case Over (Read new 99 card)

LASUBF Code = (0,1) if the current simulation  
subinterval (is not, is) the last one.

IFN Identifies the file being treated by the input/  
output subroutine DRWS.

IOP Identifies the operation to be performed by the  
DRWS subroutine, as follows:

<u>Value</u>	<u>Operation</u>
1	Read
2	Write
3	Rewind
4	Backspace
5	End file

IFORM Identifies the format to be applied in the current DRWS subroutine read/write operation.

ILEN Defines the length of the current DRWS subroutine read/write operation. ILEN is set = -1 in DRWS if an end-of-file is encountered when reading

ISCOT Time at end of last time step stored in UPSIG for use by CAL4, tenths-of-a-second.

INLOC Identifies the current positioning of the Case Data Tape. The value of INLOC is equal to the sequence number of the following case.

IPL Code = (0,1) if the CALCOMP plot tape (has not, has) been utilized during the current run.

ICTYPE Case Type as specified in column 2 of previous Type 99 card.

ICSIN Sequence number of required case Data Deck to be retrieved from Case Data Tape.

ICSRN Run Identification of required Case Data Deck to be retrieved from Case Data Tape.

IINOT Incident Data Disposition flag from column 11 of Type 99 card.

IPTOT INPLOT Data Disposition flag from column 12 of Type 99 card.

ISTOR Case Data Disposition flag from column 14 of Type 99 card.

ISTAT Statistical Data Disposition flag from column 15 of Type 99 card.

IININ Run identification of Incident Detection data set to be retrieved from Incident Data Tape.

IINCON Code = (0,1) if the Run Identifications for those cases on the Incident Data Tape (are not, are) to be printed.

IPT Code = (0,1,2) if the current case (is neither an INPLOT or SAM run, is an INPLOT run, is a SAM run).

ICARD        Type of last data card read.

ICDCT(4)    Array of counters containing the number of cards of types 00 → 03 in the current case data deck. This information is used to insure that cards containing alphabetic data are not read under numeric formats.

IBUF(30)    Buffer array used for initial storage of card data.

MINSTS      User specified freeway simulation time step, in tenths-of-a-second.

MAXSTS      Frequency at which lane change logic will be implemented, in time steps.

RNSEED      Random number seed.

IDRUN        Run identification number

MXINIT      Maximum Length of Initialization, seconds.

IFILGO      Flag (0,1) if fill time (is not, is) to continue to maximum length even if initialization is reached.

IGO          Flag (0,1) if simulation (is not, is) to proceed if equilibrium is not achieved during fill time.

ISTFLG      Flag (0,1) if statistics are to be (cumulative, subinterval specific).

NTRN        Flag (0,1) if (turn movement, traffic assignment) routing mode is in effect.

ITPOP        Interval for output of trajectory plot information, sec.

ITPLNK(24)  Link ID Table for output of trajectory plot data. YXXX: Y = (0,1,2) for (freeway, ramp, surface) link; XXX = link number.

ICPOP        Interval for output of contour plot information, min.

ICPLNK(24)  Link ID table for output of contour plot data, YXXX.

ICPSP        Spacing of detectors generated to output contour plot information, feet.

IIDOP	Polling frequency for digital detectors (number/sec). Default is 10.
IIDLNK(24)	Link ID Table for output of incident data, YXXX.
NDT	Length of subinterval, sec.
IDMN	Interval for printout of (cumulative, sub-interval specific) statistics, sec.
NPRNT	Interval for printout of intermediate output, sec.
ISECI	Time of first intermediate output from start of subinterval, sec.
IDSEC	Time span over which intermediate output is to be produced, sec.
IODFLG	Flag (0,1) if O-D volumes (are not, are) to be printed at end of subinterval.
ILSUB	Flag from type 60 card = (0,1) if this (is, is not) the last subinterval.
IIDMOD	Detector mode flag (0,1) for (digital, analog) detectors.

COMMON/CRASH/

The following arrays and variables of COMMON/CRASH/ must be declared INTEGER\*2 for the IBM version of the program: KON, MAXCEL, LENTHV, IPPT, IMMOE, INCALG, MOEALG, KPOINT.

KON(I)        XY  
              X = code (0,1) if detector I (is not, is)  
                      being used for incident detection  
              Y = detector state:  
                      0 if detector I has not been activated  
                              yet  
                      1 if last actuation was a deactivation  
                      2 if last actuation was an activation

LASTON(I)    Last activation time for detector I

LASTOF(I)    Last deactivation time for detector I

IOCC(I)       Occupancy for detector I (unscaled)

IOCC2(I)     Occupancy for detector I (scaled down to  
              point calculation)

INPOS(I)     YYYYYYXXX  
              YYYYYY = Location of sensor (a group of  
                              detectors used for incident de-  
                              tection) I in feet from upstream  
                              end of link  
              XXX = node downstream of sensor I

INCODE(K,J)  Contains incident codes corresponding to the  
              segment of roadway between sections K and  
              K+1 used by the J<sup>th</sup> algorithm to be applied.  
              See INCALG for the algorithm number corres-  
              ponding to the J<sup>th</sup> algorithm. Incident code  
              is 1 if no incident  
                      2 for onset of incident  
                      3 for end of incident  
                      4 for continuing incident



LOCATE (K)      YXXXXZZZ  
ZZZ = Station number corresponding to  
                  sensor position K  
XXX = First detector at sensor position K  
      Y = Code (0,1) if this (is not, is) the  
                  last sensor position  
LOCATE contains a sequence of sensors used  
for incident detection and MOE estimation.  
The end of a series is denoted with an  
entry where XXX=0.

OCCS(K,5)      Contains history of occupancies at sensor  
position K. OCCS(K,1) contains current  
occupancy. OCCS(K,2) through OCCS(K,5)  
contain occupancies for the previous four  
time periods.

OCCOLD(K,J)    For the J<sup>th</sup> incident detection algorithm  
applied at sensor position K, OCCOLD(K,J)  
contains the occupancy that existed  
immediately before an incident occurred.

MAXCEL          Number of occupancy updating intervals in an  
incident evaluation period.

INTVAL          The incident evaluation period in milli-  
seconds.

IUPDAT          The occupancy updating interval in milli-  
seconds.

KALL            A running count of the number of calls to  
incident detection routines.

IZERO           Time, in milliseconds, at the beginning of  
the current occupancy updating interval.

IFIN            Time, in milliseconds, at the end of the  
current occupancy updating interval.

LENTHV          Average vehicle length, in feet, used for  
incident detection.

IPPT            Code (0,1) if point processing (is not, is) desired.

IMMOE          Code (0,1) if MOE estimation (is not, is) desired.

INCALG(J)      The J<sup>th</sup> element contains the number of the incident detection algorithm to be applied.

MOEALG(J)      The J<sup>th</sup> element contains the number of the MOE estimation algorithm to be applied.

EPARAM(18,J)   For the J<sup>th</sup> incident detection algorithm applied up to 18 input parameters are stored in EPARAM (1,J) through EPARAM(18,J).

MPARAM(3,J)    For the J<sup>th</sup> MOE algorithm applied up to three input parameters are stored in MPARAM(1,J) through MPARAM(3,J).

NSECTL(K)      Distance, in feet, between section K and section K+1.

MAXSTA          Maximum number of stations.

LNKSTA(L)      YXXXXZZZ  
                  For detector station L:  
                  Y = link type  
                  XXX = link number where station is located  
                  ZZZ = sensor position corresponding to detector station L. (Used as an index in the LOCATE array.)

NUMSTN          Number of detector stations.

KPOINT(I)       Given detector I belonging to a detector station, KPOINT(I) defines the next detector at that station. If KPOINT(I) is zero, detector I is the last detector at that station.

COMMON/DBLEXP/

Contains the double exponential smoothing arrays required for incident detection algorithm 3.

SMTH1(K)	Single exponentially smoothed time series for station K.
SMTH2(K)	Double exponentially smoothed time series for station K.
YERR(K)	Series of estimation errors for station K.
ABSD(K)	Mean absolute deviation time series for station K.
SSQ(K,I)	Contains the sum of the error terms when I=1 and the sum of the error terms squared when I=2 for station K.

COMMON / ERTRAN/

IER            Index defining the specific error condition prevailing when the EROT subroutine is called.

NPAR           Index which transmits the number of parameters which must be printed out for the error condition specified by IER.

IEPAR(10)     Array in which error message parameters are stored prior to call to EROT subroutine.

IERCT         Error counter.

COMMON / IHEAD/

IHEAD(40)     Array containing title from card type 00 and network name from card type 01.

COMMON /FORINC/

ICALL            Code (0,1) if INCDAT (has not, has) been called for this case

NUMBER          A running count of the number of records in the output buffer to be transferred to INCDAT utility tape

IINC            Code (0,1) of this (is not, is) the last call to INCDAT. This last call is with no new data but simply to output whatever remains in the output buffer at the end of the last subinterval.

The following six variables are zero except after a call to DETECT when a non-doppler detector has been activated but not de-activated by a vehicle which has reached the end of the link.

LNUDE           Activated detector number

LLEND           Detector length

LLDET           Detector position on link

LLNLEN          Link length

VELOLD          Vehicle velocity at link boundary.

ACCOLD          Vehicle acceleration at link boundary.

ISTART          Time at start of freeway vehicle movement (when calling COLECT) in tenths-of-a-second. ISTART is approximately equal to ITIMEF but may exceed it.

ISTEP           Duration of freeway vehicle movement in tenths-of-a-second    ISTEP  $\leq$  IDTF

LENVH	Vehicle length, feet (includes 3 foot spacing buffer which must be subtracted when determining vehicle detector actuations)
IPOS1	Position of vehicle at start of movement. Distance from upstream end of link, in feet
ISPD1	Velocity of vehicle at start of movement in feet/sec.
LINK1	Freeway link on which vehicle resides at start of movement
LANE1	Freeway lane on LINK1 in which vehicle resides at start of movement
IPOS2	<p>These four parameters are analagous to IPOS1, ISPD1, LINK1 and LANE1. They define the vehicle state at the end of the movement. ISPOS2 is measured from the upstream end of LINK2 and so, if LINK1 <math>\neq</math> LINK2, <u>the length of LINK1 must be added to IPOS2 for distance comparisons.</u> In the event the vehicle has left <u>the freeway during the interval ISTEP, LINK2 will be set equal to -1.</u></p>
ISPD2	
LINK2	
LANE2	
NCHNG	Number of Freeway time steps (of length IDTF) required to change lanes
ICUR	Original lane of lane-changing vehicle. If vehicle not changing, ICUR = 0.
LINEON	Code (0,1) if online incident detection (is not, is) being performed
INCTIM	Time for next call to SINCES
IVNUM	Vehicle Identification number



COMMON / FPAR/

INCH Amount of time to complete a lane-change maneuver in tenths-of-a-second. Embedded value is 30.

NCH Index indicating the end of lane change to process (number of freeway time steps to complete a lane change +4)

INRAMP Code for on-ramps

IRF Index (2,3) for roadway type (ramp, freeway)

IORD Position of link being processed in IFRANK array of COMMON /RANK/

MINHDY Minimum separation in tenths-of-a-second for generation of freeway vehicles. Embedded value is 5.

IP Lane change probability in percent. Embedded value is 5.

MNAC Minimum non-emergency freeway acceleration, tenths-of-a-foot per second. Embedded value is -80.

ISENS Percent of drivers desiring to yield right of way. Embedded value is 40%

LAGA Lag to accelerate in tenths-of-a-second. Embedded value is 3.

LAGB Lag to decelerate in tenths-of-a-second. Embedded value is 2.

KET Time interval for current vehicle movement

LAG Effective lag for current vehicle reaction time

COMMON/FREDAT/

Used to store the lane specific speed and headway data gathered at freeway data stations during the course of simulation. All arrays of COMMON/FREDAT/ must be declared INTEGER.

FRHDWY(I,J,K) Contains the count of vehicles passing freeway data station I in lane J (J=6 refers to first auxiliary lane, J=7 refers to second auxiliary lane) as follows:

FRHDWY(I,J,1) = WWXXYYZZ

where ZZ = count of vehicles for which headway  $\leq$  .6 sec.

YY = count of vehicles for which .6 sec.  $<$  headway  $\leq$  1.0 sec.

XX = count of vehicles for which 1.0 sec.  $<$  headway  $\leq$  1.4 sec.

WW = count of vehicles for which 1.4 sec.  $<$  headway  $\leq$  1.8 sec.

FRHDWY(I,J,2) = Same as FRHDWY(I,J,1) for cells from 1.8 sec. to 3.4 sec.

FRHDWY(I,J,3) = Same as FRHDWY(I,J,1) for cells from 3.4 sec. to 5.0 sec.

FRHDWY(I,J,4) = Same as FRHDWY(I,J,1) for cells from 5.0 sec. to 6.6 sec.

FRHDWY(I,J,5) = same as FRHDWY(I,J,1) for cells from 6.6 sec. to 8.2 sec.

FRSPED(I,J,K) Contains the count of vehicles passing freeway data station I in lane J (where J is defined as for FRHDWY) as follows:

FRSPED(I,J,1) = WWXXYYZZ

where ZZ = count of vehicles for which speed  $\leq$  4 mph

YY = count of vehicles for which 4 mph  $<$  speed  $\leq$  8 mph

XX = count of vehicles for which 8 mph  $<$  speed  $\leq$  12 mph

WW = count of vehicles for which 12 mph  $<$  speed  $\leq$  16 mph

FRSPED(I,J,2) = same as FRSPED(I,J,1) for  
cells from 16 mph to 32 mph  
FRSPED(I,J,3) = same as FRSPED(I,J,1) for  
cells from 32 mph to 48 mph  
FRSPED(I,J,4) = same as FRSPED(I,J,1) for  
cells from 48 mph to 64 mph  
FRSPED(I,J,5) = same as FRSPED(I,J,1) for  
cells from 64 mph to 80 mph.

FRCONT(I,J)    XXXXYYYY for freeway data station I in  
lane J (where J is defined as for FRHDWY)  
where XXXX = count of all vehicles considered  
                  for speed distributions  
              YYYY = count of all vehicles considered  
                  for headway distributions  
Counts stop being incremented when some cell  
total reaches 99.

FRFLAG(I,J)    XYZZZZ for freeway data station I in lane J  
(where J is defined as for FRHDWY)  
where       X = code (0,1) if some headway  
                  cell (has not, has) reached 99  
              Y = same as X but for speed  
              ZZZZ = vehicle number which last  
                  passed freeway data station I  
                  in lane J at time specified by  
                  FRTIM(I,J)

FRTIM(I,J)    Contains the time that last vehicle passed  
freeway data station I in lane J (where J  
is defined as for FRHDWY).

COMMON /IMBDIN/

IMBDIN           Code (0,1) if changes to imbedded data  
                 (were not, were) input

COMMON /INCDMP/

NUMOUT           Number of actuations stored in ICIN

ICIN(I,N)        ICIN is the output accumulating buffer  
                 for the INCES Data Tape. It stores  
                 information on actuations at all  
                 detectors.

If I=1, then ICIN (1,N) = YYYXXX

where

XXX = detector number actuated  
YYY = the speed (hundredths-of-mpg)  
      for doppler detectors or  
      flag (1,0) if actuation  
      was (an activation, a  
      deactivation) for loop  
      detectors.

If I=2, then ICIN (2,n) contains the  
time of actuation (milliseconds)

COMMON /IPLTN/

IPLTN            Length of last record written to Plot  
Data Tape

COMMON /LASDCH/

LADISH            Each element LADISH (I,J) contains the  
(NTOTL,3)        vehicle identification number for a  
recently discharged vehicle from link I  
where:

I = freeway link number or ramp link  
      number + NLFR, or surface link  
      number + NLFR + NLRA

The three most recently discharged vehicles  
(J=1,2,3) are recorded for use in locating  
downstream interference for subsequent  
vehicles attempting to discharge from  
link I.

COMMON /LENI/

The following arrays must be declared  
INTEGER\*2 for the IBM version: LLNR, LCCR,  
LMTR, LDTR, LLTR, LFFR, LTTR, LMHR, LRTR,  
LSTR, LSHR, LUVR, LDHR, LFTR, LPRR, LPOR,  
LSPR, LACR, LVLR, LLOR, LLNA, LLLA, LLPA,  
LSTA, LRPA, LEXA, LPRA, LPOA, LSPA, LACA,  
LTCA

LINK           Number of link whose environment is stored  
                in arrays of this COMMON block

LANE           Number of lane in LINK

IOOF           Code (0,1) indicating whether LINK, if it  
                is a ramp, is (on,off)

IRALL          LANE identification of lane in downstream  
                link which receives traffic from lane 1 of  
                this link (1 for surface links)

IDITR          Number of feet travelled on link number LINK

JDNODE         ENDNDS(L,2) entry for link number LINK

LTSURF         Code (0,1,2) indicating lane type (thru,  
                right pocket, left pocket) of lane number  
                LANE

LADICH(K)      Vehicle numbers of last K vehicles discharged  
                from this link. The number of the last  
                vehicle discharged is placed in position K,  
                the next to last vehicle in position K-1 and  
                so on.

LLOR(I)        Order of lanes right to left of I possible  
                lanes. The maximum value of I is 5

LLNR(J)        Number of thru lanes for receiving link J.  
                J equals (1,2,3) indicates (left, thru,  
                right) direction



LCCR(J,I)	Lane channelization codes for lane I of link J where J is defined as above
LMTR(J)	Move time (tenths-of-a-second) for receiving link J
LDTR(J)	Delay time (tenths-of-a-second) for receiving link J
LLTR(J)	Percent of traffic on receiving link J turning left
LFFR(J)	Free flow speed for receiving link J
LTTR(J)	Percent of traffic on receiving link J going through
LMHR(J)	Move time (halves-of-an-hour) for receiving link J
LRTR(J)	Percent of traffic on receiving link J turning right
LSTR(J)	Time in queue (tenths-of-a-second) on receiving link J
LSHR(J)	Time in queue (halves-of-an-hour) on each receiving link J
LUVR(J,I)	Upstream vehicle in lane I on receiving link J
LDHR(J)	Delay time (halves-of-an-hour) on receiving link J
LFTR(J)	IVFEET(L) entry for receiving link J
LPRR(J,I)	Code (0,1) for lane I of receiving link J if it (has not, has) been processed yet
LPOR(J,I)	Position, speed, acceleration and length of
LSPR(J,I)	upstream vehicle in lane I of receiving
LACR(J,I)	link J
LVLR(J,I)	

LLNA(J)	Number of thru lanes for approach link J
LLLA(J)	Length of approach link J
LLPA(J)	Capacity of left turn pocket on approach link J
LSCA(J)	Signal code facing approach link J
LRPA(J)	Capacity of right turn pocket on approach link J
LEXA(J)	Code (0,1) if approach link J (does not, does) exist
LPRA(J)	Code (0,1) for approach link J if it (has not, has) been processed yet
LPOA(J,I)	Position, speed and acceleration of downstream vehicle in lane I of approach link J
LSPA(J,I)	
LACA(J,I)	
LTCA(J,I)	Turn code of farthest downstream vehicle in lane I of approach link J

COMMON/NFILTS/

NDSCHG            A count, maintained during fill time, of vehicles exiting the network. It is used to determine if equilibrium has been reached.

NDSCHO            The value of NCSCHG stored at end of previous equilibrium evaluation interval.

NENTRO            Number of vehicles which had entered the network at the end of previous equilibrium evaluation interval.

NLASEQ            Code (0,1) if equilibrium (was not, was) achieved during last equilibrium evaluation interval.

COMMON/NIDTSV/

NIDTSV            Used to store number of time steps in first subinterval during fill time.

COMMON /ONVEH/

NORG            Number of last item in tables IORG, IRV  
                 and IREN

IORG(50)        (INTEGER\*2)    XXXY  
                 XXX = link number  
                 Y = lane number of a freeway link that  
                                 vehicle on an onramp will enter

IRV(50)         (INTEGER\*2)  
                 Ramp vehicle number of vehicle entering  
                 freeway link

IREN(50)        (INTEGER\*2)  
                 Time of vehicle arrival in tenths-of-a-  
                 second since last freeway time step

COMMON /P1/

NAMES(L,6)     Name of absolute link number, L (see  
                 COMMON /A2/ description for definition of L).  
                 Names may be 24 characters in length and are  
                 stored in 6 words with 4 characters/word.

COMMON /RANK/

NFENT           Number of freeway entries

IFRANK           (INTEGER\*2)    Contains the sequence of  
  (NTOTL)        freeway links in downstream to upstream  
                 order ending with the entry link number if  
                 there is one. IFRANK may contain more  
                 than one sequence.

COMMON /S1/

MESSER          Flag set  $\neq$  0 upon entry to FINDL  
                 to disable error message

COMMON /S2/

IDTF	Current Freeway time step, tenths of a second
IDTS	Current surface time step, tenths of a second
ITIME	Current time since start of simulation, tenths of a second
ITIMEF	Current time (at end of last freeway time step) for freeway link, tenths of a second
IDT	Surface time step number in current subinterval (equal to index of control loop)
IFDT	Number of tenths of a second which have elapsed since the end of the last freeway time step
NIDT	Number of surface time steps in current subinterval (used as upper limit of control loop)
IPSL	Length of previous subinterval (or fill time), seconds
IEXCS	Time in this subinterval in excess of NIDT surface time steps, tenths of a second
MCYCL	Maximum cycle length in network or 30 sec. is no fixed time control, tenths of a second
IMCYCL	Counter to determine if one MCYCL period has elapsed, tenths of a second.
IREVP	Inactive

ICOINT	Counter to determine if one contour plot output interval has elapsed, tenths of a second
ICYCPO	Counter to determine if standard output period has elapsed since last report was generated
INTSTO	Counter to determine if intermediate detail output report period has elapsed
ITRINT	Counter to determine if one trajectory plot output interval has elapsed, tenths of a second
IHOURS } IMINS } ISECNS }	Real clock time at beginning of simulation



COMMON /S3/

ISSEQ	Indicator of purpose of call to either HICON or LOCON
ISRET	Indicator of reason for return to SIFT from HICON or LOCON

COMMON /SIZE/

NLFR                   Current maximum number of freeway links  
for which space has been allotted in NLV  
array

NLRA }  
NLSU }                   As for NLFR for ramp links, surface streets,  
NVFR } freeway vehicles, ramp vehicles, surface  
NVRA } link vehicles  
NVSU }

NLFO                   Offset of first freeway link from start  
of NLV array. That is, the scalar which  
must be added to each freeway link number  
to locate the link data in the NLV array

NLRO }  
NLSO }                   As for NLFO for the other link and vehicle  
NVFO } arrays  
NVRO }  
NVSU }

MXLFR                  Current number of freeway links  
MXLRA                  Current number of ramp links  
MXLSU                  Current number of surface links  
MXVFR                  Current number of freeway vehicles  
MXVRA                  Current number of ramp vehicles  
MXVSU                  Current number of surface link vehicles

IS(5)                  (INTEGER\*2) Array of constants,  
IS(I) =  $10^{I-1}$

IWDPAK(5)              (INTEGER\*2) Array of descriptors which  
identify the word and low order digit  
locations for all the parameters of the  
various link and vehicle arrays. Each  
element is formatted as XXY where, XX  
indicates the word/half-word containing the  
 $I^{\text{th}}$  parameter, and Y indicates the digit  
of that word/halfword which locates the low  
order digit of the  $I^{\text{th}}$  parameter

IWDIND(I) (INTEGER\*2) Each element of this array indicates the element of the IWDPK array which corresponds to the first parameter of one of the link or vehicle arrays as follows:

<u>I</u>	<u>Array</u>	<u>IWDIND(I)</u>
1	LNKF	1
2	LNKR	43
3	LNKS	76
4	VF	123
5	VR	145
6	VS	162
7	*	179

\*This is a dummy to facilitate locating the end of the VS parameters

NWDS(I) (INTEGER\*2) Each element of this array contains the number of words/halfwords in one of the link or vehicle arrays, as follows:

<u>I</u>	<u>Array</u>	<u>NWDS(I)</u>
1	LNKF	42
2	LNKR	18
3	LNKS	22
4	VF	22
5	VR	8
6	VS	8

COMMON /SRFLAG/

LTFLAG        1, if link being processed is a  
                 ramp link  
                 2, if link being processed is a  
                 surface link

COMMON /VBUF/

COMMON /VBUF/ is used mainly during the simulation process for storing vehicle parameters. However, it may be used at other times as a temporary storage area for various types of information.

NF(I)	(INTEGER*2) Contains unpacked freeway vehicle parameters
NRL(J)	(INTEGER*2) Contains unpacked ramp vehicle parameters
NRA(J)	(INTEGER*2) Contains unpacked ramp vehicle parameters
NFL(I)	(INTEGER*2) Contains unpacked freeway vehicle parameters
NFA(I)	(INTEGER*2) Contains unpacked freeway vehicle parameters

COMMON /VEER/

LNEND(3,9) = XXXXYYYY

XXXX = Location of upstream end of  
incident or lane end, relative  
to upstream end of subject link

YYYY = Location of downstream end of  
incident or lane end. Equals 9999  
if lane never opens up again (e.g.,  
end of accel. auxiliary lane)

Up to 3 incidents are allowed for each of 9 possible  
lanes.

LNRUB(9) = XXYYZZ

XX = Rubbernecking factor for incident  
1 of lane

YY = Rubbernecking factor for incident  
2 of lane

ZZ = Rubbernecking factor for incident  
3 of lane



COMMON /VENVI/

JVIDL	Lead vehicle of subject vehicle
JVIDLL	Lead vehicle in lane to left of subject vehicle
JVIDRL	Lead vehicle in lane to right of subject vehicle
JVDHL	Distance of JVIDL from upstream node or headway of JVIDL if JVIDL is first vehicle in queue
JVDHLL	Same as JVDHL for vehicle JVIDLL.
JVDHRL	Same as JVDHL for vehicle JVIDRL.
JVSPL	Speed of JVIDL (ft/sec)
JVSPLL	Speed of JVIDLL (ft/sec)
JVSPRL	Speed of JVIDRL (ft/sec)
JVQL	Queue code (0,1) if JVIDL (is not, is) in queue or 2 to indicate cycle failure
JVQLL	Same as JVQL for vehicle JVIDLL
JVQRL	Same as JVQL for vehicle JVIDRL
JVLEL	Number of vehicle in front of JVIDL
JVLELL	Number of vehicle in front of JVIDLL
JVLERL	Number of vehicle in front of JVIDRL
JVFOL	Number of vehicle in back of JVIDL
JVFOLL	Number of vehicle in back of JVIDLL
JVFORL	Number of vehicle in back of JVIDRL
JVVCL	Driver code of vehicle JVIDL
JVVCLL	Driver code of vehicle JVIDLL
JVVCLL	Driver code of vehicle JVIDLL
JVVCRL	Driver code of vehicle JVIDRL

JVACL	Code (-1, 0, +1) if JVIDL is (decelerating, travelling at constant speed, accelerating)
JVACLL	Same as JVACL for vehicle JVIDLL
JVACRL	Same as JVACL for vehicle JVIDRL
JVIDF	Number of vehicle behind subject vehicle
JVIDLF	Number of vehicle behind subject vehicle in left lane
JVIDRF	Number of vehicle behind subject vehicle in right lane
JVPRF	Process code (0,1) if JVIDF (has not, has) been processed this time step or 2 if a change was made to the left but the vehicle was not processed
JVPRLF	Same as JVPRF for vehicle JVIDLF
JVPRRF	Same as JVPRF for vehicle JVIDRF
JVDHF	Distance of JVIDF from upstream node or headway of JVIDF, if JVIDF is first vehicle in queue
JVDHLF	Same as JVDHF for vehicle JVIDLF
JVDHRF	Same as JVDHF for vehicle JVIDRF
JVSPF	Speed of JVIDF (ft/sec)
JVSPLF	Speed of JVIDLF (ft/sec)
JVSPRF	Speed of JVIDRF (ft/sec)
JVACF	Acceleration or deceleration of JVIDF
JVACLF	Acceleration or deceleration of JVIDLF
JVACRF	Acceleration or deceleration of JVIDRF
JVQF	Code (0,1) if JVIDF (is not, is) in queue or 2 to indicate cycle failure
JVQLF	Same as JVQF for vehicle JVIDLF
JVQRF	Same as JVQF for vehicle JVIDRF

JVLEF	Number of leader of JVIDF
JVLELF	Number of leader of JVIDLF
JVLERF	Number of leader of JVIDRF
JVLC	Link code (0,1) to indicate change (original link, new link)
JVFSP	Final speed of subject vehicle
JVFS	Final position of subject vehicle
JVFLN	Final lane of subject vehicle
JVFLK	Final link of subject vehicle
JVFLTY	Code (0,1) of final link type (surface, ramp) of subject vehicle
JVFLE	Final leader of subject vehicle
JVFFO	Final follower of subject vehicle
JVFAC	Final acceleration/deceleration (+/-) of subject vehicle
JVILT	Time on initial link
JVFLT	Time on final link
IDRL	Lane to right of subject vehicles lane
IDLL	Lane to left of subject vehicles lane
LCFV	Code (0,1) if a change (has not, has) been made this time step
LCDF	Lane change desire code (0,1,2,3) if (no desire, right, left, either)
LCPF	Lane change possibility code (0,1,2) if change is (not possible, right, left)
NEVE	Next vehicle to be processed (original follower)

LEDIS            Leader discharge flag set to 0 at  
                 start of lane processing.  If a vehicle  
                 discharges, LEDIS is set equal to time of  
                 discharge after start of time step (tenths-  
                 of-a-second).

JSIGP            Code = 0, if signal permissive  
                 1, if yield prohibitive  
                 2, if prohibitive

JSIGC            Code = 1, if signal just became permissive  
                 0, otherwise

JSIGS            Code = 1, if stop or yield or vehicle per-  
                 forming right turn on red  
                 0, otherwise

JVIDM            Vehicle identification number of subject  
                 vehicle

COMMON /VPOINT/

IFPT            Freeway vehicle array pointer

IRPT            Ramp vehicle array pointer

ISPT            Surface vehicle array pointer

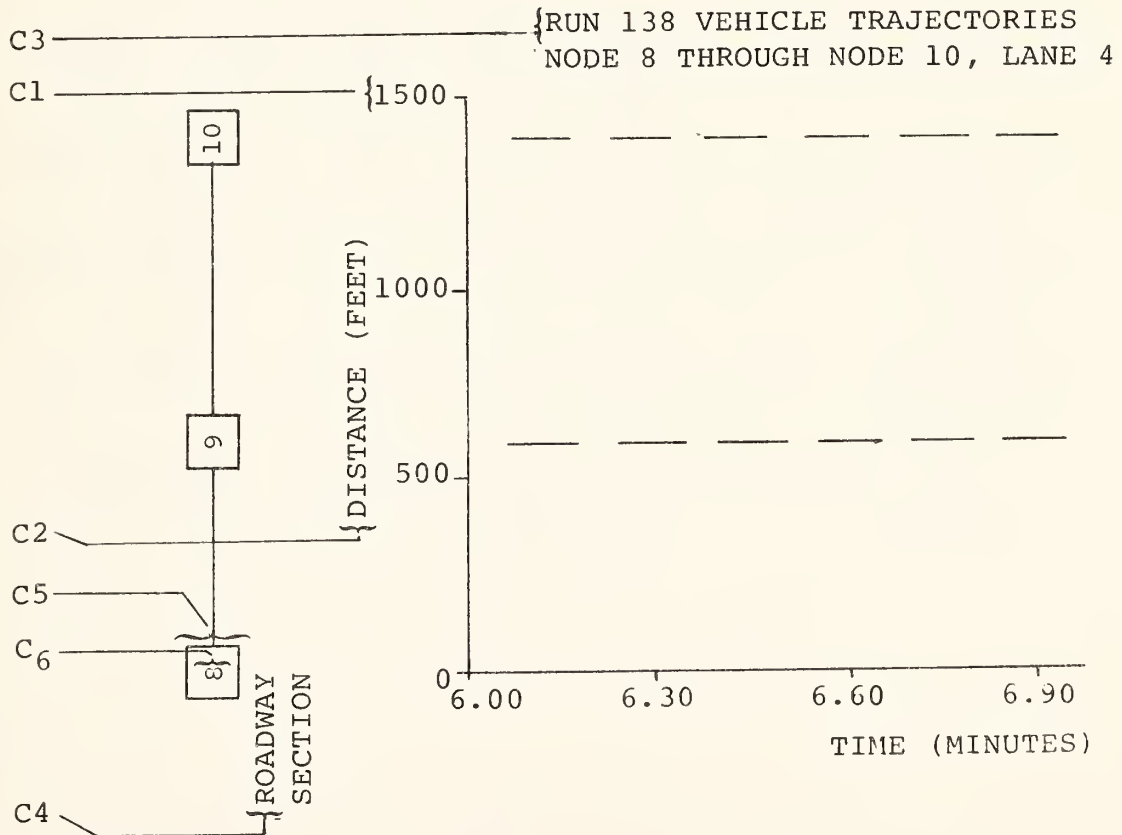
Pointer denotes position to begin searching for an empty vehicle slot.

INPLOT Module COMMON Block Definitions

COMMON /CHT/

- C1 Height of numbers labelling hashmarks (in.)
- C2 Height of time and distance labels (in.)
- C3 Height of top heading (in.)
- C4 Height of roadway section label (in.)
- C5 Height of roadway section box (in.)
- C6 Height of node number within box (in.)

The elements of COMMON /CHT/ are labelled in the following plot design:





COMMON /CNTR/

FS        INTEGER, Distance from upstream node of  
          link of station being processed (feet)

SGAP     INTEGER, Distance between stations on link  
          (feet)

SMAX     INTEGER, Number of stations on link

CTR(I,J) Contour default value J for MOE index I

<u>MOE</u>	<u>Name</u>	<u>Default Values</u>
1	Spot Speed (mph)	10., 14., 18., 22., 26., 30., 34., 38., 42., 46., 50., 54., 58., 62.
2	Volume veh/hr/lane	900., 1000., 1100., 1200., 1300., 1400., 1500., 1600., 1700., 1800., 1900., 2000., 2100., 2200., 2300.
3	Density veh/lane-mi.	35., 40., 45., 50., 55., 60., 65., 70., 75., 80., 85., 90., 95., 100.
4	Delay min/mi	0., .25, .50, .75, 1.0, 1.25, 1.50, 1.75, 2.0, 2.25, 2.5, 2.75, 3.0, 3.25
5	Headway sec/veh	.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0
6	Travel time min/veh	1.0, 1.25, 1.5, 1.75, 2.0, 2.25, 2.5, 2.75, 3.0, 3.25, 3.5, 3.75, 4.0, 4.25

COMMON /CRD/

IREQ Plot request code:  
1 - Index of plot data tape contents  
2 - Contour plot  
3 - Trajectory plot  
4 - MOE contour changes

RUNID INTEGER, Case id of case to be plotted

LANE Lane number (trajectory plots)

IMOE MOE index (contour plots)

DISPX Displacement of x-axis origin from page origin (inches)

DISPY Same as DISPX for y-axis (inches)

XLIM x-axis length (inches)

YLIM y-axis length (inches)

XPAGE Page width (parallel to x-axis) (inches)

YPAGE Page height (parallel to y-axis) (inches)

XORG x-coordinate of origin (lower left corner of page) (inches)

YORG y-coordinate of origin (inches)

COMMON /IPERR/

IPERR            Code (0,1) if there (was not, was) an error of any type at any point in producing a plot. If an error occurs, the plot is aborted and the next plot request is processed.

COMMON /LANET/

LANET            Lane number in furthest upstream link while generating trajectory plots for a group of consecutive links

COMMON /PLT/

IDVEH(I) Buffer containing i.d.'s of vehicle trajectory points in VPOS array for I vehicles

VPOS(I,J) INTEGER array containing position of vehicle I at time step J (for trajectory plots)

LNKID(100,2) LNKID(I,1) = XXXYYYYZW  
where XXX = upstream node  
YYY = downstream node  
Z = lane number  
W = receiving lane  
for link I  
LNKID(I,2) initially contains length of link-lane I, which is converted in AXPLOT routine to distance from beginning of path to link I

NDLIST(20) Contains indices of entries in LNKID array which form plot path requested by user

LKCNT Number of entries in NDLIST array

LEN Total length of path to be plotted (feet)

N Total number links of contour data on tape

M Total number link-lanes of trajectory data on tape

UNODE INTEGER, upstream node of path to be plotted

DNODE INTEGER, downstream node of path to be plotted

NDS(20)

Contains upstream and downstream node numbers which form path to be plotted (used only when trajectory plot for all lanes is requested)

COMMON /T1/

MAXV       Maximum number of vehicles allowed  
            in plot buffer or maximum number of  
            stations in MOE array

MAXT       Maximum number of time points allowed  
            in VPOS or MOE array



COMMON /TMDAT/

TSCALE	Time scale for plots (minutes/inch)
DSCALE	Distance scale (feet/inch)
DELT1	INTEGER, time step for contour data (minutes)
DELT2	INTEGER, time step for trajectory data (seconds)
TIME1	} INTEGER, start and stop times for plot data (min.) from beginning of simulation
TIME2	
NXT1	Time at which next contour data point will occur on tape (sec.)
NXT2	Same as NXT1, for trajectory data
ISTEP	Current time step number (index for VPOS and MOE arrays)
START	INTEGER, time from beginning of plot of first data point in VPOS or MOE array (sec.)
KPLOT	Total number of plots

FUEL Module COMMON Block Definitions

COMMON /BFUEL/

KHCEM(I,J,K) INTEGER\*2 array. Hydrocarbon emissions for acceleration of I-13 fpss and speed of J-1 fps for vehicle type K (milligrams/sec.)

KCOEM(I,J,K) INTEGER\*2 array. Same as KHCEM but for carbon monoxide emissions

KNOEM(I,J,K) INTEGER\*2 array. Same as KHCEM but for oxides of nitrogen emissions

KFLCN(I,J,K) INTEGER\*2 array. Fuel consumption, as above (hundred-thousandths of a gallon/sec.)

COMMON /CFUEL/

JFUEL	<u>Code</u>
	0 FUEL module is to be run with simulation
	1 FUEL module is to be run using data previously written on tape 23, no simulation
	2 Simulation only, no FUEL module
MFUEL	Code (0,1) if exogenous data cards (are not, are) to be read in
NU23	Code (0,1) if tape 23 (is, is not) to be written during this simulation
IPTAB	Code (0,1) if FUEL data tables (are not, are) to be printed out (tables are always printed out if MFUEL = 1)
NFLG	Code (0,1) if this (is, is not) the first call to FUEL

COMMON /NRGY/

JVACCP            Number of entries in JVACC buffer

JVACC(J,I)        FUEL vehicle trajectory buffer for  
                  vehicle I  
                  JVACC(1,I) = YXXX  
                  where Y = Link type  
                      XXX = Speed, fps  
                  JVACC(2,I) = ±WWVUUU  
                  where WW = Acceleration or deceleration  
                      V = Vehicle type  
                      UUU = Link number  
                      (+,-) for (acceleration, decelera-  
                      tion)

INCES Module COMMON Block Definitions

COMMON/AMD/

AMDAT(I,J,K) Used as an input-output buffer for MOE estimation. AMDAT(I,J,K) contains information for MOE estimation algorithm I on section K (section K is section between data station K and K+1) where J indicates the information type as follows:

<u>J</u>	<u>Description</u>
1	Volume into section K during current updating interval (veh/hr/lane)
2	Volume out of section K during current updating interval (veh/hr/lane)
3	Space mean speed (mph)
4	Density within section K (veh/lane-mile)

COMMON/INCEST/

INOUT(I,K) Contains incident code for section K (section between data station K and K+1) determined by incident detection algorithm I during the current updating interval.

COMMON/MTOC/

TOCC(K) Average occupancy at sensor position K over time period INTVAL.

COMMON/NUMP/

NPARS(J)            Number of input parameters required in  
                      J<sup>th</sup> incident detection algorithm.

COMMON/PDATA/

ISAMP(K,I)            Contains point processing statistics for  
                      station K where I indicates the informa-  
                      tion type as follows:

<u>I</u>	<u>Description</u>
1	Number of vehicle which crossed sta- tion K during the current updating interval
2	Number of vehicle on which there is speed data items for station K during the current updating interval
3	Same as I=2 for headway.

IRAW(K,I)            Contains point processing statistics for  
                      station K where I indicates the informa-  
                      tion type as follows:

<u>I</u>	<u>Description</u>
1	Sum of speeds of all vehicles crossing station K during current updating interval
2	Sum of headways of all vehicles crossing station K during current updating interval.

LASTVU(I)            Contains time that the last vehicle crossed  
                      upstream detector I of a coupled pair.

COMMON/TRVTM/

TT(K)                Estimated travel time between station K  
                      and K+1 in seconds. Used for MOE estima-  
                      tion.



Statistical Module COMMON Block Definitions

COMMON /SAMP2/

LIN(I,J,K)	Represents link correspondence between network A (K=1) and network B (K=2). J = (1,2) for (freeway, non-freeway) links. The I <sup>th</sup> link in network B, L = LIN(I,J,2), where L = 1 to number of links, corresponds to the L <sup>th</sup> link in network A; LINK(L,J,1) = XXXYYY where XXX = upstream node and YYY = downstream node.
NT(M)	If M = 1, NT is network identification number for network A. M = 2, NT is network identification number for network B.
LF	Number of freeway links
LR	Number of ramp links
LS	Number of surface links
N	Number of subintervals simulated
ISKIP	Code (0,1) if non-freeway links (should not be, should be ) skipped in analysis
NLSA	Code (0,1) if link by link analysis (should be, should not be) performed for freeway links
NLSA2	Code (0,1) if link by link analysis (should be, should not be) performed for non-freeway links
NFILEA	Number of statistical data input tape
NFILEB	Number of statistical data input tape

COMMON /SAMP3/

DMAT(I,J,K)      Contains the  $J^{\text{th}}$  MOE corresponding to the  $I^{\text{th}}$  link in network A in the  $K^{\text{th}}$  sub-interval

DNTA(M,K,N)      Contains the  $M^{\text{th}}$  MOE averaged over links in subinterval K in network A which consists of (only freeway, all) links for N equals (1,2)

DONETA(I,J)      The  $I^{\text{th}}$  MOE averaged over subintervals and links in network A which consists of (only freeway, all) links for J = (1,2)

DMBT(I,J,K)      Same as DMAT for network B

DNTB(M,K,N)      Same as DNTA for network B

DONETB(I,J)      Same as DONETA for network B

APPENDIX D

Table 49: Subroutine CALL Cross Reference Chart

INTRAS Module Calling Routine				
INTRAS	FINDLN	FINDL	NEXTLN	
		X		EROT
X	X	X	X	DEBUG
		X	X	ULNKR
		X		FINDLN
				PORGIS
				LIS
				SIFT
				FUEL
				INCES
				POSPRO
				INPLOT
				SAM

Called Routine

Table 49: Subroutine CALL Cross Reference Chart (Cont.)

PORGIS Module Calling Routine		
PORGIS	TABCON	
X	X	EROT
X	X	DRWS
		ULNKR
		ULNKS
		UNPAK
		PAK
		PLNKR
		PLNKS
	X	FINDL
		LRANK
	X	TABCON
		LPAK
	X	PRSIG
	X	PRACT
		CTPFF
		CTPSX
		CTPSV
	X	CLRALL
	X	PRMSND
	X	SURVIN
	X	INCIN
	X	SIGOUT
		INACT
	X	FLOOUT
	X	SUROUT
	X	INCOUT
	X	IMBED
	X	IMBEDO
	X	DETGEN
		MATCH
	X	LINKIN
		CHKNOD
	X	LINOUT
	X	TURNIN
	X	INT1

Called Routine

Table 49: Subroutine CALL Cross Reference Chart (Cont.)

LIS Module Calling Routine		
LIS		X
LPRSIG		X
LRACT		X
LCTPSV		X
LPRMSN		X
LSURVI		X
LINCIN		X
LSIGOU		X
LINACT		X
LFLOOU		X
LSUROU		X
LIMBED		X
LDETGE		X
LLINKI		X
LLINOU		X
LTURNI		X
LINT1		X
	EROT	
	DRWS	
	ULNKR	
	ULNKS	
	UNPAK	
	PAK	
	PLNKR	
	PLNKS	
	FINDL	
	NEXTLN	
	LRANK	
	LLPAK	
	LPRSIG	
	LRACT	
	LCTPFF	
	LCTPSX	
	LCTPSV	
	LCLRAL	
	LPRMSN	
	LSURVI	
	LINCIN	
	LSIGOU	
	LINACT	
	LFLOOU	
	LSUROU	
	LINCOU	
	LIMBED	
	LIMBDO	
	LDETGE	
	LLINKI	
	LLINOU	
	LTURNI	
	LINT1	

Called Routine



Table 49: Subroutine CALL Cross Reference Chart (cont.)

SIFT Module Calling Routine		Called Routine	
STRT			EROT
VPAK	X		DBUG
LASTK	X		DRWS
FRSTV	X		ULNKR
LASTV	X		ULNKS
FINDRV	X		UVR
FINDSV	X		UVS
RANDOM	X		UNPAK
HICON	X		PAK
UPSIG	X		PLNKR
SIGACT	X		PLNKS
PDAFZ	X		PVR
UPACT	X		PVS
RDSIG	X		FINDLN
TERMFZ	X		FINDL
DECACT	X		NEXTLN
ACTFZ	X		VPAK
ASIG	X		FRSTV
CAL1	X		LASTV
CAL2	X		FINDRV
CAL3	X		FINDSV
CAL4	X		RANDOM
CAL5	X		HICON
CAL6	X		UPSIG
MOOV	X		SIGACT
SVEH	X		PDAFZ
CLOSE	X		PDNAFZ
BLOK	X		UPACT
GOO	X		GRNSIG
OFFRMP	X		REDSIG
HDWY	X		TERMFZ
GETCD	X		DECACT
LSWCH	X		TERM
LANES	X		ACTFZ
TSTSAT	X		ASIG
DETECT	X		DETSW
TSIG	X		FZCL
			CAL1
			CAL2
			CAL3
			CAL4
			CAL5
			CAL6
			CAL8
			CAL9
			SVEH
			GOO
			HDWY
			GETCD
			LSWCH
			LANES
			TSTSAT
			DETECT
			TSIG
			NORM
			CLNUP
			INCDAT
			TPTOUT
			MOEV
			QSTATE
			SEVEN
			REVEN
			FMAIN
			CHOOZ
			LOCON

Called Routine



Table 49: Subroutine CALL Cross Reference Chart (cont.)

SIFT Module		Calling Routine (Continued)		Called Routine	
Module	Type	Module	Type	Module	Type
EROT	X				
DEBUG	X				
DRWS	X				
ULNKR	X				
ULNKS	X				
UVR	X				
UVS	X				
UNPAK	X				
PAK	X				
PLNKR	X				
PLNKS	X				
PVR	X				
PVS	X				
NEXTLN	X				
LRANK	X				
LASTLK	X				
FRSTV	X				
LASTV	X				
FINDFV	X				
FINDRV	X				
RANDOM	X				
MOOV	X				
CLOSE	X				
BLOK	X				
OFFRMP	X				
NORM	X				
INCDAT	X				
SELEN	X				
FILL	X				
RELEN	X				
GETUNV	X				
FMOVE	X				
FGNRAT	X				
ONRMP	X				
CHOOZ	X				
FRESET	X				
CONSOL	X				
EMGNCY	X				
CHANGE	X				
CHECK	X				
RISK	X				
LCROSS	X				
ALANE	X				
CANCEL	X				
ADVANC	X				
COLECT	X				
TYPE	X				
INIT	X				
RESET	X				
FILTST	X				
FTSC	X				
CPTOUT	X				
CYCP	X				
INTST	X				
SINCS	X				
SINC1	X				
SINC2	X				
SINC3	X				
SPOINT	X				



APPENDIX E

Table 50: INTRAS Link and Vehicle  
Array Parameter Identification

Parameter No.		IWDPAK(J)	Description
I	J	IWORD(I)	
Array Specific	Abso- lute		
			<u>LNKF</u>
1	1	11	Number of thru lanes
2	2	21	One-third the length of the freeway link, feet
3	3	31	Code number of auxiliary lane 1
4	4	41	One-third the length of auxiliary lane 1, feet
5	5	51	Code (0,1,2) if aux. lane 1 is (accel., decel.,both)
6	6	61	Code number of auxiliary lane 2
7	7	71	One-third the length of auxiliary lane 2, feet
8	8	81	Code (0,1,2) if aux. lane 2 is (accel., decel.,both)
9	9	91	Mean free-flow speed, fps.
10	10	101	Grade code
11	11	111	Code (0,1) if grade is (positive, negative)
12	12	121	Percent of volume leaving freeway
13	13	131	Ramp number for vehicles leaving freeway
14	14	141	Number of vehicles on link
15	15	151	Code (0,1) if ramp is (right hand, left hand)
16	16	161	Radius of curvature, feet/100
17	17	171	Unused
18	18	181	Number of vehicles discharged
19	19	191	Total moving time, tenths-of-a-second
20	20	201	Total delay time, tenths-of-a-second

Table 50

## INTRAS Link and Vehicle array parameter identification (cont.)

			<u>LNKF (cont.)</u>
21	21	211	Total delay time, halves-of-an-hour
22	22	221	Total moving time, halves-of-an-hour
23	23	231	Right hand lane of separated pair
24	24	241	Downstream link for thru movement
25	25	251	Unused
26	26	261	Occupancy at end of last subinterval
27	27	271	Right hand lane of separated pair
28	28	281	Location within DTCTR array for this links first detector
29	29	291	Number of furthest upstream vehicle in lane 1
30	30	301	Upstream vehicle, lane 2
31	31	311	Upstream vehicle, lane 3
32	32	321	Upstream vehicle, lane 4
33	33	331	Upstream vehicle, lane 5
34	34	341	Upstream vehicle, in first auxiliary lane
35	35	351	Upstream vehicle, in second auxiliary lane
36	36	361	Location within INCID array containing the first incident data for this link
37	37	371	Lane identification for lane in downstream link (receiving thru traffic) which receives traffic from lane 1 of this link.
38	38	381	Location on this link at which an early warning sign becomes visible (in percent of link length from upstream node)
39	39	391	Node locating off-ramp referred to by early warning sign



Table 50  
INTRAS Link and Vehicle array parameter identification (cont.)

		<u>LNKF (cont.)</u>	
40	40	401	Pavement code
41	41	411	Superelevation (%)
42	42	421	Lane change counter
 <u>LNKR</u>			
1	43	11	Y = Number of lanes
2	44	12	XXXX = Length of ramp, feet
3	45	21	XX = Mean free-flow speed, f.p.s.
4	46	23	Y = Grade code
5	47	24	Z = Code (0,1) if grade is (positive, negative)
6	48	25	W = Code (0,1) if this is an (on, off) ramp
7	49	31	Y = Code (0,1) if first move- ment is (left, through)
8	50	32	XXX = Link receiving first movement vehicles
9	51	41	Y = Code (1,2) if second movement is (through, right)
10	52	42	XXX = Link receiving second movement vehicles
11	53	51	YY = Percentage of volume making second movement
12	54	53	XXX = Number of vehicles occupying link
13	55	61	XXXX = Number of vehicles discharged
14	56	71	XXXX = Total moving time, tenths- of-a-second
15	57	81	XXXX = Total delay time, tenths- of-a-second
16	58	91	YY = Total delay time, halves- of-an-hour
17	59	93	XX = Total moving time, halves- of an hour
18	60	101	YYY = Location in DTCTR array of first detector for this link
19	61	104	XX = Content at end of previous subinterval

Table 50

## INTRAS Link and Vehicle array parameter identification (cont.)

20	62	111	Y = "Type" of downstream inter-section
21	63	112	XXXX = Stopped delay (halves-of-an-hour)
22	64	121	XXXX = Furthest upstream vehicle in lane 1
23	65	131	XXXX = Furthest upstream vehicle in lane 2
24	66	141	ZZ = Mean queue discharge headway, tenths-of-a-second (applies only to off-ramps)
25	67	143	Y = Signal code facing link
26	68	144	XX = Speed of previously discharged queued vehicle, fps.
27	69	151	Y = Lane identification for lane in downstream link (receiving through traffic) which receives traffic from lane 1 of this link
28	70	152	XX = Radius of curvature (ft/100)
29	71	154	Z = Pavement code
30	72	161	XX = Superelevation (%)
31	73	163	YY = Start-up lost time (off-ramps only) for first queued vehicle, tenths-of-a-second
32	74	171	XXXX = Stopped delay (tenths-of-a-second)
33	75	181	XXXX = Number of cycle failures
<u>LNKS</u>			
1	76	11	Y = Number of lanes, not including pockets
2	77	12	XXXX = Link length, feet
3	78	21	Z = Lane 1 channelization code
4	79	22	Y = Lane 2 channelization code
5	80	23	X = Lane 3 channelization code
6	81	24	W = Lane 4 channelization code
7	82	25	V = Lane 5 channelization code
8	83	31	YYY = Location in DTCTR array of first detector for this link
9	84	34	XX = First queued vehicle lost time, tenths-of-a-second
10	85	41	YYY = Number of vehicles occupying link



Table 50  
INTRAS Link and Vehicle array parameter identification (cont.)

11	86	44	XX = Capacity of left turn pocket
12	87	51	XXXX = Number of vehicles discharged
13	88	61	XXXX = Total moving time, tenths-of-a-second
14	89	71	XXXX = Total delay time, tenths-of-a-second
15	90	81	Z = Current signal code facing link
16	91	82	YYY = Link number receiving left-turn traffic
17	92	85	X = Code (0,1) if left-turn receiving link (is not, is) a ramp
18	93	91	Z = "Type" of downstream intersection
19	94	92	YYY } = as for 16 and 17, for thru traffic
20	95	95	
21	96	101	Z = Grade Code
22	97	102	YYY } = as for 16 and 17, for right-turn traffic
23	98	105	
24	99	106	± word is (+,-) if grade is (positive, negative)
25	100	111	YY = Mean queue discharge headway, tenths-of-a-second
26	101	113	XXX = Percent of traffic turning left
27	102	121	YY = Mean free-flow speed, fps
28	103	123	XXX = Percent of traffic proceeding through
29	104	131	YY = Total moving time, halves-of-an-hour
30	105	133	XXX = Percent of traffic turning right
31	106	141	XXXX = Total stopped delay, tenths-of-a-second
32	107	151	Y = Capacity of right-turn pocket
33	108	152	XXXX = Stopped delay (halves-of-an-hour)
34	109	161	Y = Original queue position of vehicle in lane 1 about to discharge
35	110	162	XXXX = Furthest upstream vehicle, lane 1
36	111	171	} as for 34 and 35, for lane 2
37	112	172	
38	113	181	} as for 34 and 35, for lane 3
39	114	182	
40	115	191	} as for 34 and 35, for lane 4
41	116	192	
42	117	201	} as for 34 and 35, for lane 5
43	118	202	

Table 50  
INTRAS Link and Vehicle array parameter identification (cont.)

44	119	211	XXX = Number of link opposing left turners
45	120	214	YY = Total delay time, halves-of-an-hour
46	121	221	YY = Number of signal cycle failures
47	122	223	XXX = Number of vehicles occupying link at conclusion of previous subinterval
<u>VF</u>			
1	123	11	Origin node (last 2 digits)
2	124	21	Destination node (last 2 digits)
3	125	31	Process code (0,1) if vehicle (has not, has) been processed this time step
4	126	41	Distance of vehicle from upstream node, feet
5	127	51	Code (0,1) if vehicle is (accelerating, decelerating)
6	128	61	Current speed, fps.
7	129	71	Acceleration or deceleration of vehicle during this time step, fpss
8	130	81	Number of vehicle in front of this vehicle in current lane
9	131	91	Code (0,1) if this vehicle will (continue on, leave) the freeway at the downstream node
10	132	101	"Desired lane and lane switch code"
11	133	111	Number of vehicle behind this vehicle in current lane
12	134	121	Vehicle type code
13	135	131	Driving characteristic of motorist
14	136	141	Desired free-flow speed, fps.
15	137	151	Current lane

Table 50  
INTRAS Link and Vehicle array parameter identification (cont.)

16	138	161	Preferred lane on this link
17	139	171	Current freeway link
18	140	181	New lane change code
19	141	191	Code (0,>0) if vehicle formerly in front of this vehicle (is not, is) still in process of lane change
20	142	201	Unused
21	143	211	Node number downstream at which vehicle will exit freeway
22	144	221	Node number at which vehicle was diverted from freeway
<u>VR</u>			
1	145	11	YY = Origin node (last 2 digits)
2	146	13	XX = Destination node (last 2 digits)
3	147	15	Z = Process code (0,1,2) if vehicle (has not, has, changed to left but has not) been processed this time step
4	148	21	W = Current lane
5	149	22	XXXX = Distance of vehicle from upstream node, feet, If vehicle becomes first in queue then XXX = time remaining till discharge, tenths-of-a-second
6	150	31	ZZ = Current speed, fps.
7	151	33	Y = Acceleration or deceleration of vehicle during this time step, fpss
8	152	34	X = Turn code of vehicle. Code (0,1,2) indicates (left, thru, right) movement.
9	153	35	W = Code (0,1,2) if vehicle [is not, is, is (because of cycle failure)] in queue
10	154	41	XXXX = Number of vehicle in front of this vehicle
11	155	51	XXXX = Number of vehicle in back of this vehicle
12	156	61	ZZ = Desired free-flow speed, fps.
13	157	63	X = Driving characteristic of motorist

Table 50  
 INTRAS Link and Vehicle array parameter identification (concl.)

14	158	64	Y = Vehicle type code
15	159	65	W = Code (0,1) if vehicle is accelerating, decelerating)
16	160	71	XXX = Node number at which vehicle was diverted from freeway
17	161	81	XXX = Current ramp link number
<u>VS</u>			
1	162	11	YY = Origin node (last 2 digits)
2	163	13	XX = Destination node (last 2 digits)
3	164	15	X = Process code (0,1,2) if vehicle (has not, has, changed to left but has not) been processed this time step
4	165	21	W = current lane
5	166	22	XXXX = Distance of vehicle from upstream node, feet. If vehicle becomes first in queue then XXXX = time remaining till discharge, tenths-of-a-second
6	167	31	ZZ = Current speed, fps
7	168	33	Y = Acceleration or deceleration of vehicle during this time step, fpss.
8	169	34	X = Turn code of vehicle. Code (0,1,2) indicates (left, thru, right) movement
9	170	35	W = Code (0,1,2) if vehicle [is not, is, is (because of cycle failure)] in queue
10	171	41	XXXX = Number of vehicle in front of this vehicle
11	172	51	XXXX = Number of vehicle in back of this vehicle
12	173	61	ZZ = Desired free-flow speed, fps
13	174	63	X = Driving characteristic of motorist
14	175	64	Y = Vehicle type code
15	176	65	W = Code (0,1) if vehicle is (accelerating, decelerating)
16	177	71	XXX = Node number at which vehicle was diverted from freeway
17	178	81	XXX = Current surface link number

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## ADDENDUM 1

### DEVELOPMENT AND TESTING OF INTRAS, A MICROSCOPIC FREEWAY SIMULATION MODEL

#### Volume II: User's Manual

#### 1. INTRAS RESTART CAPABILITY

In an attempt to conserve computing time and costs, the INTRAS model was adapted to accept a restart option. This feature allows the user to freeze an image of the program common storage structure and peripheral files at a given point in time. The program could then be restarted at some future time and simulation continued by restoring the COMMON data base from the restart tape. The restart option has the following capabilities:

- 1) It is possible for a user to specify the simulated time,  $t$ , at which the program can be preserved such that a subsequent run may start executing at time,  $t$ . Thus, all appropriate COMMON blocks, local variables and peripheral files are written on a restart tape at time,  $t$ . A subsequent simulation run then reads the restart tape and begins execution at time,  $t$ . It is also possible for time,  $t$ , to occur during initialization.
- 2) It is possible for a user to specify an interval of simulated time,  $\Delta t$ , such that the program may be preserved at intervals of  $\Delta t$ . Using this option, the program can be restarted at the end of the last interval,  $\Delta t$ , in a subsequent run. Thus, all appropriate COMMON blocks, local variables and peripheral files are written on a restart tape at the end of each interval,  $\Delta t$ . A subsequent simulation run then reads the restart tape and begins execution at the end of the last interval,  $\Delta t$ . The restart tape is also written at intervals,  $\Delta t$ , during initialization, with the last write occurring at the end of initialization.

It is possible to use both options 1) and 2) above in the same simulation run.



The restart option is controlled by four input data items on the type 99 card. Due to the fact that up to two restart files may be dumped, a corresponding number of output file numbers have been allocated. In addition, an input file is required to restart the simulation.

#### Restart Option Files

<u>File Number</u>	<u>Type</u>	<u>Contents</u>
26	OUTPUT	This file contains the restart file dumped at the user-specified simulated time, $t$ . It will not be written on again.
27	OUTPUT	This file contains the restart file dumped at the end of the last interval, $\Delta t$ . At the end of the current interval, $\Delta t$ , the file will be rewound and re-written.
8	INPUT	This file contains the restart file which was previously dumped either on file 26 or file 27. It is used on runs which attempt to restart simulation.

## 2. REVISED INPUT SPECIFICATION

The restart capability input requirements are handled in total by the Type 99 card. The revised card format is described below.

One card type, the Run Control Card, is read by the INTRAS Supervisor module to define the type of run and indicate the lower level module to be called.

### Run Control Card - Type 99

<u>Cols.</u>	<u>Description</u>
1	1 = Last 99 card request 0 (blank) = Another request follows
2	1 = Diagnostic run 2 = Simulation run 3 = Diagnostic + simulation 4 = Off-line incident detection run 6 = Simulation + off-line incident detection 7 = Diagnostic + simulation + off-line incident detection run 8 = Table of contents for case data tape 0 (blank) = <u>No</u> diagnostic, simulation or incident detection. (This would imply that Col. 24 will be specified, indicating an INPLOT or SAM run, or a stand-alone FUEL run will be indicated by a "1" in Col. 27.)
4-6	If Col. 2 = 2 or 6, then a data deck must be taken from the Case Data Tape. This field contains the sequence number of that data deck on the Case Data Tape.
7-9	As for Cols. 4-6, if a data deck must be taken from the Case Data Tape, then this field contains the Run Identification number of that deck (Cols. 61-63 of Type 00 card).

Both fields 4-6 and 7-9 may be specified concurrently or individually. If two decks on the Case Data Tape possess the same Run Identification number, then 4-6 must be speci-

fied. If the sequence number is not known, then the Run identification may be specified alone. If neither field is specified, then the case data must follow the 99 card in the input stream.

<u>Cols.</u>	<u>Description</u>
11	If this SIFT simulation is to produce output information on the Incident Data Tape, this field should be set = (1,2) if the Incident Data Tape (does not, does) contain previously stored detector data. Otherwise, this column should be left blank.
12	If this SIFT simulation is to produce output information on the INPLOT Data Tape, this field should be set = 1 if the INPLOT Data Tape is currently empty (i.e., no previous plot data sets have been stored on it). Otherwise, this column should be left blank.
14	If this diagnostic run (Col. 2 = 1, 3 or 7) data deck is to be stored on the Case Data Tape, this field must be specified as (1,2) if the Case Data Tape (does not, does) contain previously stored data decks. If the data deck is not to be stored, Col. 14 = 0 (blank).
15	If the statistical results of this simulation run (Col. 2 = 2, 3, 6 or 7) is to be stored on the Statistical Data Tape for analysis by SAM, this field must be specified as (1,2) if the Statistical Data Tape (does not, does) contain previously stored data. If the statistical output is not to be stored, Col. 15 = 0 (blank).
16-18	Incident detection data specification. If Col. 2 was specified = 4, a previously stored set of data must be retrieved from the Incident Data Tape. The Run Identification number for that data must be entered in this field. Otherwise, leave this field blank.

Cols.Description

- 21 For any incident detection run (Col. 2 = 4, 6 or 7), this field should be specified as [0 (blank), 1] if a list of the Run Identification numbers for those incident data sets on the Incident Data tape (is not, is) to be produced. If the purpose of this 99 card is only to produce this Run Identification list, Col. 2 should be specified as 4, Cols. 3-18 should be blank, and Col. 21 should be 1.
- 24 To specify that this 99 card is a request for an (INPLOT, SAM) program run, this field should be set (1,2). This field should only be specified if Cols. 2-21 are blank.
- 27 Code indication FUEL run type:  
= 0 if FUEL module is to be run along with simulation  
= 1 if FUEL module is to be run using data previously written on FUEL Data Tape, no simulation (implies that Col. 2 = 0)  
≥ 2 if simulation only, no FUEL module
- 30 Code (0,1) if exogenous FUEL data cards (are not, are) to be read in. If so, cards appear after last type 60 card for this case.
- 33 Code (0,1) if FUEL Data Tape (is, is not) to be written during this simulation.
- 36 Code (0,1) if FUEL data tables (are not, are) to be printed out. Tables are always printed if Col. 30 = 1.
- 39 A flag indicating the type of Restart dumps to be made:  
0 No dumps are to be made  
1 A single dump at a time specified in Cols. 40-45 is to be made  
2 Periodic dumps at time intervals specified in Cols. 48-50 are to be made  
3 Both periodic and one-time dumps are to be made.

<u>Cols.</u>	<u>Description</u>
40-45	Time, in seconds, from the start of simulation when a dump is to be made. If this time is negative, the time is in the initialization period. May be used on the restart run.
48-50	The interval of time, in seconds, at which dumps are to be made. The dumps begin after the start of fill time. The last dump during fill time is after the last second of fill. May be used on a restart run.
52	A flag (0,1) if restart (is not, is) to be attempted. If so, all other parameters except the last card in Col. 1 may be left blank. If a restart is to be attempted, the restart file must exist on file 8. Restart dumps may be made on a run which has been restarted from a previous file.
79,80	≡ 99 (Card Type)

### 3. ADDITIONAL INTRAS MODULE ERROR MESSAGES

<u>Code</u>	<u>Message</u>
10	Improper Restart Dump parameter, IRDMP. Pl should be between zero and three, inclusive. Col. 39 on the type 99 card.
11	Improper periodic dump time interval, Pl. Value is in seconds and should be greater than zero. Cols. 48-50 on the type 99 card.
12	Improper Restart parameter, Pl. Should be (0,1) for (no attempt, try) to restart. Col. 52 on the type 99 card.
13	A single Restart dump has been requested at time, Pl. This time should not equal zero. Cols. 40-45 on the type 99 card.



#### 4. NEW COMMON BLOCKS REQUIRED

COMMON/RSTRT/IFTSTR, IFDLT, IFSTRT, ITSTAR, ITDELT,  
IRSTRT, IRDMP, ITPD

- IFTSTR File number of the peripheral file where the dump at a specific time, ITSTAR, is to be made.
- IFDLT File number of the peripheral file where the dumps at interval, ITDELT seconds, are to be made.
- ITSTAR Time, in seconds, from the start of simulation when a dump is to be made. If ITSTAR is negative, the time is in the initialization period.
- ITDELT The interval of time, in seconds, at which dumps are to be made. The dumps begin after the start of fill time. The last dump during fill time is after the last second of fill.
- IRSTRT A flag (0,1) if restart (is not, is) to be attempted.
- IFSTRT File number of the peripheral file where the restart data file is located.
- IRDMP A flag (0,1,2,3):  
0 No dumps to be made  
1 One dump at time, ITSTAR, only  
2 Periodic dumps at interval, ITDELT, only  
3 Both periodic and one-time dumps.
- ITPD Flag indicating the type of dump to be made during the current time step = (0,1,2,3) for (none, one-time, periodic, both).

COMMON/SEQU/IFSEQ(10), JFSEQ

- IFSEQ An array which contains up to ten reasons to leave the high activity overlay to process periodic functions. This array is loaded in subroutine LOCTST.
- JFSEQ The number of entries in IFSEQ.

5. ADDITIONAL SUBROUTINE CALL CROSS REFERENCE CHART

		CALLING ROUTINES								
		<u>HICON*</u>	<u>CLNUP*</u>	<u>FXCHNF</u>	<u>FXCHNL</u>	<u>LOCON*</u>	<u>DMPOUT</u>	<u>DMPIN</u>	<u>DOIDFL</u>	<u>DIIDFL</u>
CALLED ROUTINES	LOCTST	X								
	FXCHNF		X							
	FXCHNL		X							
	LASTLK*			X						
	NEXTLN*				X					
	DMPOUT					X				
	DMPIN					X				
	DOODF						X			
	DOIDFL						X			
	POSIT								X	X
	DIIDFL								X	
	DIDDF								X	
	DOFDF						X			
	DIFDF								X	

\*Pre-existing routines

6. SUBROUTINE-COMMON BLOCK CROSS REFERENCE CHART

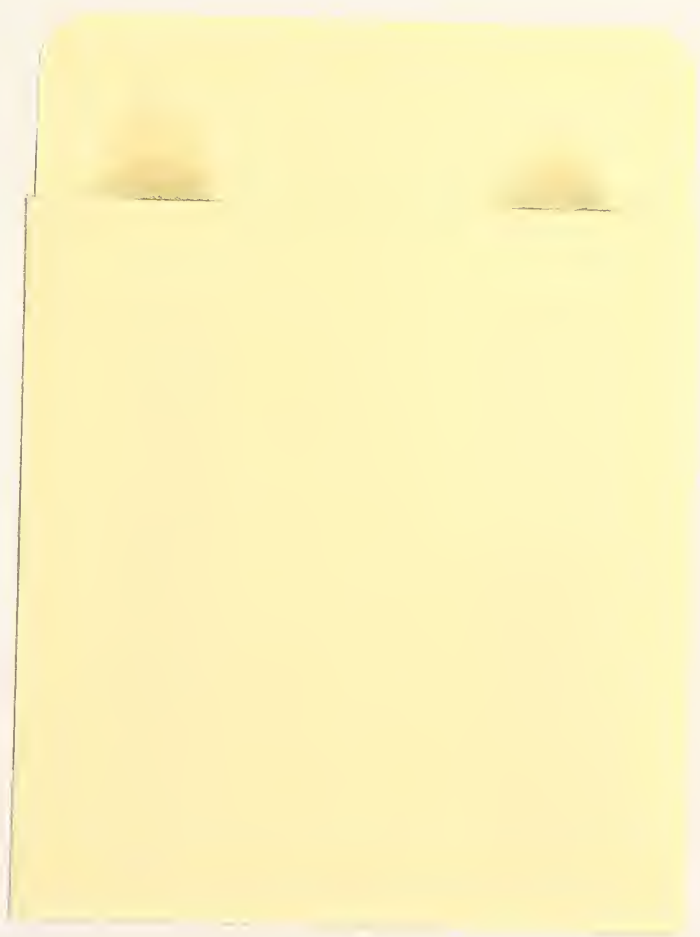
	<u>INTRAS</u>	<u>BLKDAT</u>	<u>SIFT</u>	<u>HICON</u>	<u>LOCTST</u>	<u>FXCHNF</u>	<u>FXCHNL</u>	<u>DMPIN</u>	<u>DMPOUT</u>
A1	X	X	X			X	X	X	X
A2	X	X		X		X		X	X
A3	X	X		X				X	X
A4	X	X						X	X
A5	X	X						X	X
A6	X	X		X				X	X
A7	X							X	X
A8	X							X	X
A9	X							X	X
A10	X							X	X
A11	X	X						X	X
A12	X							X	X
ACT0	X	X						X	X
ACT1	X							X	X
ACT2	X							X	X
ACT3	X							X	X
ACT4	X							X	X
ACT7	X							X	X
ACT8	X							X	X
ACT9	X							X	X
ACT10	X							X	X
ACT12	X							X	X
ACT20	X							X	X
CFUEL	X		X					X	X
CONTRL	X		X	X	X	X		X	X
CRASH		X	X		X			X	X
DBLEXP	X							X	X
ERTRAN	X		X					X	X
FORINC	X		X	X	X			X	X
FPAR	X							X	X
FREDAT	X							X	X
IHEAD	X							X	X
INCOMP			X	X				X	X
IPLTN	X		X					X	X
LASDCH	X							X	X
NFILTS	X							X	X
NIDTSV			X					X	X
NRGY			X					X	X
ONVEH	X							X	X
P1	X							X	X

INTRAS BLKDAT SIFT HICON LOCTST FXCHNF FXCHNL DMPIN DMPOUT

RANK	X							X	X
S1	X	X						X	X
S2	X		X	X	X	X		X	X
S3	X		X	X	X			X	X
SIZE	X	X	X	X		X	X	X	X
VBUF			X					X	X
VPOINT			X	X				X	X
RSTRT	X	X	X		X			X	X
SEQU			X		X				

DOIDFL POSIT DIIDFL DOODF DIDDF DOFDF DIFDF

CFUEL					X	X
CONTRL	X	X		X	X	X
RSTRT	X		X	X	X	X



ADDENDUM 2

DEVELOPMENT AND TESTING OF INTRAS,  
A MICROSCOPIC FREEWAY SIMULATION MODEL

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1. NEW COMMON BLOCK FOR BLOCKING THROUGH LANE NEXT TO AUXILLARY LANE LEADING TO EXIT RAMP

COMMON/BLKLN/NVSTP(110)

NVSTP(L) = XXXXYYYY

A packed word which contains information on an exiting vehicle on link L which is the leading such vehicle in a through lane next to an exiting lane and is trying to enter the exiting lane:

XXXX = Vehicle number

YYYY = Distance from upstream node of link L to the "virtual incident" which is set up to slow down vehicle XXXX to a crawl speed of 6fps.

This array is referenced in subroutines

STOPFL, FMOVE, CLRAL, LCLRAL, DMPIN, DMPOUT, CHANGE

2. NEW COMMON BLOCK INDICATING WHETHER A VEHICLE TRACING ERROR HAS BEEN DISCOVERED

COMMON/CHNERR/ICHNER

ICHNER Scalar switch denoting whether a vehicle tracing error has been found. (0,≠0) = (no error, error).

This array is referenced in subroutines

FMOVE, FRSTV



## FEDERALLY COORDINATED PROGRAM (FCP) OF HIGHWAY RESEARCH AND DEVELOPMENT

The Offices of Research and Development (R&D) of the Federal Highway Administration (FHWA) are responsible for a broad program of staff and contract research and development and a Federal-aid program, conducted by or through the State highway transportation agencies, that includes the Highway Planning and Research (HP&R) program and the National Cooperative Highway Research Program (NCHRP) managed by the Transportation Research Board. The FCP is a carefully selected group of projects that uses research and development resources to obtain timely solutions to urgent national highway engineering problems.\*

The diagonal double stripe on the cover of this report represents a highway and is color-coded to identify the FCP category that the report falls under. A red stripe is used for category 1, dark blue for category 2, light blue for category 3, brown for category 4, gray for category 5, green for categories 6 and 7, and an orange stripe identifies category 0.

### *FCP Category Descriptions*

#### **1. Improved Highway Design and Operation for Safety**

Safety R&D addresses problems associated with the responsibilities of the FHWA under the Highway Safety Act and includes investigation of appropriate design standards, roadside hardware, signing, and physical and scientific data for the formulation of improved safety regulations.

#### **2. Reduction of Traffic Congestion, and Improved Operational Efficiency**

Traffic R&D is concerned with increasing the operational efficiency of existing highways by advancing technology, by improving designs for existing as well as new facilities, and by balancing the demand-capacity relationship through traffic management techniques such as bus and carpool preferential treatment, motorist information, and rerouting of traffic.

#### **3. Environmental Considerations in Highway Design, Location, Construction, and Operation**

Environmental R&D is directed toward identifying and evaluating highway elements that affect

the quality of the human environment. The goals are reduction of adverse highway and traffic impacts, and protection and enhancement of the environment.

#### **4. Improved Materials Utilization and Durability**

Materials R&D is concerned with expanding the knowledge and technology of materials properties, using available natural materials, improving structural foundation materials, recycling highway materials, converting industrial wastes into useful highway products, developing extender or substitute materials for those in short supply, and developing more rapid and reliable testing procedures. The goals are lower highway construction costs and extended maintenance-free operation.

#### **5. Improved Design to Reduce Costs, Extend Life Expectancy, and Insure Structural Safety**

Structural R&D is concerned with furthering the latest technological advances in structural and hydraulic designs, fabrication processes, and construction techniques to provide safe, efficient highways at reasonable costs.

#### **6. Improved Technology for Highway Construction**

This category is concerned with the research, development, and implementation of highway construction technology to increase productivity, reduce energy consumption, conserve dwindling resources, and reduce costs while improving the quality and methods of construction.

#### **7. Improved Technology for Highway Maintenance**

This category addresses problems in preserving the Nation's highways and includes activities in physical maintenance, traffic services, management, and equipment. The goal is to maximize operational efficiency and safety to the traveling public while conserving resources.

#### **0. Other New Studies**

This category, not included in the seven-volume official statement of the FCP, is concerned with HP&R and NCHRP studies not specifically related to FCP projects. These studies involve R&D support of other FHWA program office research.

\* The complete seven-volume official statement of the FCP is available from the National Technical Information Service, Springfield, Va. 22161. Single copies of the introductory volume are available without charge from Program Analysis (HRD-3), Offices of Research and Development, Federal Highway Administration, Washington, D.C. 20590.



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