Record Types

00

Run Title

Table 5-1. Record Type 00 – run title.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-72	Alphanumeric information (up to 72 characters)
2	79-80	00

Record Type 00 must be the **first record type** in the input stream of each case study. The alphanumeric information is selected by the user and will be printed on the first page of the output report. The user can specify as many Record Type 00s (in sequence) as he desires.

01
Run Identification

Table 5-2. Record Type 01 – run identification.

ENTI	COLUMN(S)	DESCRIPTION
1	l-36	User name (up to 36 characters)
2	39-40	Month (such as 08 for August)
3	43-44	Day of the month (such as 02 for August 2)
4	47-48	Year (such as 95 for 1995)
5	49-72	Agency name (up to 23 characters)
6	73-76	Run identification number. Must be **blank** or **positive.**
7	79-80	01

On Record Type 0 1, the user **must** input his name, the date of the run, and the name of the agency. The date of the run can be used to record either the date on which the execution is made or the date on which the data are simulated. The optional run identification number can be used to describe similar variations of data.

02

Run Control

Table 5-3. Record Type 02 - run control.

ENTRY	COLUMN(S)	DESCRIPTION
1	4	**Blank or 0** No other case study follows **1** Another case study follows
2	7–8	**1** Run one or more simulation models **-1** Run only diagnostics for a simulation model **2** Run only traffic assignment **-2** Run only diagnostics for traffic assignment **3** Run traffic assignment and a simulation model **-3** Run only diagnostics for traffic assignment and a simulation model
3	12	Code [0,1] if FRESIM off-line incident detection, point processing, or MOE estimation [is not, is] desired
4	17–20	Fill time in **minutes** prior to simulation. Simulation commences whether or not equilibrium is attained. If set negative, simulation will **not** commence if equilibrium is not achieved during fill time.
5	22–26	Eight-digit random number seed (ending in 1, 3, 7, or 9) used to generate vehicle emission headways for NETSIM
6	31–32	Fuel and emissions option for NETSIM. **Blank** if NETSIM is not used.
7	33–34	Code that identifies the selected option of the fuel consumption and emissions feature in FRESIM
8	37	Code [0,1] if NETSIM emission headways should be generated by a [normal, Erlang] distribution when Record Type 53 is specified
9	38	Value **a** describing the type of Erlang distribution to be used to generate NETSIM emission headways. Leave **blank** when Entry 8 is zero. Otherwise, this entry can range from 1 to 4. Note that the Erlang distribution with a = 1 is known as a shifted exponential distribution.
Entries 10–14 **only** apply if the user has a Real-Time Traffic Adaptive Control System (RT-TRACS) Interface.		
10	39–40	Number of seconds between successive outputs of NETSIM second-specific data to be sent to a real-time traffic control algorithm. Range = **1-30 seconds.**
11	41	Code [0,1] if the user [does not, does] want to generate NETSIM time-interval specific data for a real-time traffic control algorithm.
12	42	Code [0,1] if the user [does not, does] want to generate NETSIM time-period specific data for a real-time traffic control algorithm.

ENTRY	COLUMN(S)	DESCRIPTION
13	43	Code [0, l] if the user [does not, does] want to generate NETSIM second-specific data for debugging operations with a real-time traffic control algorithm.
14	44	Code [0, l] if the user [does not, does] want to generate NETSIM second-specific, time interval, time period, and/or debugging data (for a real-time traffic control algorithm) in separate "per second" files for debugging purposes only. The desired files are to be specified in Entries 10-13.
15	46	Units of measurement of input data: 0 English units (miles per hour, feet, etc.) 1 Metric units (kilometers per hour, meters, etc.)
16	48	Units of measurement of output reports: 0 Same as input units 1 English units 2 Metric units 3 Two sets of reports; one in each unit
17	52	Model whose data will appear after the run control records: 3 NETSIM 8 FRESIM
18	53-56	Clock time (in military time) at the beginning of the simulation
19	60	Pretimed signal transition algorithm **(blank** if not used): 1 Immediate transition 2 Two-cycle transition 3 Three-cycle transition
20	61-68	Eight-digit random number seed (ending in 1, 3, 7, or 9) used to generate vehicles for the NETSIM traffic stream. Keep constant during multiple runs to obtain identical traffic movements.
21	**69-76**	Eight-digit random number seed (ending in 1, 3, 7, or 9) used to generate responses to traffic choices (e.g., accepting gaps in traffic and lane blockages). Vary during multiple runs to obtain different traffic environments. This entry is for NETSIM and FRESIM.
22	**79-80**	02

Discussion of Selected Entries

2 If the user wants to execute a simulation analysis, traffic assignment, or both, the code should be set to 1, 2, or 3, respectively. If the user wants the program to read and check his input stream, but he does not want to execute traffic assignment, or any simulation model, the code is set negative. This option is provided for the following reasons:

> It provides the user with the opportunity to review his specified inputs as perceived by the program. Therefore, any errors or improper inputs not detectable by the diagnostic logic can be corrected prior to invest the resources required to execute the program. After all the inputs are verified, the user can resubmit this run with the code as a positive value.

> The program logic that performs the input testing is designed to minimize memory requirements and computing time. Therefore, this option should produce a rapid turnaround on the computer facility.

3 If the user wants to execute the FRESIM off-line incident detection option, a value of 1 is entered.

Note: The options available in Entries 2 and 3 (as described in table 5-4) define all the options available in the FRESIM model.

Table 5-4. FRESIM off-line incident detection options.

ENTRY 2	ENTRY 3	OPTIONS
1	0	Simulation run only
1	1	Simulation and off-line incident detection
-1	0	Diagnostic run only
-1	1	Off-line incident detection only

4 At the start of a simulation, the roadway network contains no vehicles. The period of time called the "fill time" is used to load vehicles on each subnetwork so that statistics can be gathered on a network with meaningful results. If equilibrium is attained over a shorter period of time, the program will automatically complete the initialization period, reset clocks and accumulators, and begin gathering statistics. If equilibrium is not attained within this estimated time, the program will either terminate (if Entry 4 is negative) or continue simulation and start accumulating statistics at the end of initialization (if Entry 4 is positive).

If the specified fill time is not an integer multiple of the time interval specified on Record Type 04, the program will round it down to the nearest integer multiple of the time interval. The algorithm to test for equilibrium requires fill time to be at least three time intervals (see Record Type 04). If the specified fill time is less than three time intervals, the program will automatically increase fill time to three time intervals. The program will abort if the fill time is not specified.

5 The NETSIM model can emit vehicles from Entry links and source links at a uniform (fixed) rate or a variable rate. The user can choose to vary the headway between each emission by completing this entry and using Record Type 53.

Entry 5 is a random number seed used to generate a random variation for each emission headway. The user can vary this seed between runs to vary the times that vehicles are scheduled to enter the simulated roadways. Note that the total number of vehicles due to be emitted will remain the same between runs even though the time between individual vehicle emissions will vary.

When Entry 5 is omitted, the software will employ a default base random number seed of 798 1 to generate random emission headways when data is supplied on Record Type 53.

Stochastic emission headways can be generated from a normal distribution shifted exponential distribution or Erlang distribution. See the description of Entries 8 and 9 to select the desired distribution.

6 The NETSIM model computes estimates of fuel consumption and vehicle emissions using tables of fuel consumption and emission rates. An option is provided whereby NETSIM writes vehicle "'trajectory points" on peripheral unit 32 in the course of executing a simulation. In a subsequent run, the user can request NETSIM to read this unit, use modified rate tables on peripheral unit 31, and calculate fuel consumption and vehicle emissions for a different vehicle fleet without executing another simulation. Entry 6 is a code that identifies the selected option pertaining to the "environmental data" feature of NETSIM. This code is in the form XY, where X is in column 31 and Y is in column 32. Table 5-6 specifies the values of those codes.

Each value of the code Y controls four elements of this optional feature:

1 Whether NETSIM will execute a simulation or read trajectory data from a peripheral unit

2 Whether environmental measures are to be calculated

3 Whether the embedded tables of fuel consumption rates and pollutant emission rates are to be modified exogenously (i.e., Record Type 60s are required)

4 Whether a file containing vehicle trajectory data is to be written so that a subsequent analysis with modified tables can be undertaken.

The eight codes for Y cover all realistic combinations. For example, consider the following codes for Entry 6: A 3 NETSIM will read Record Type 60s and their associated tabular rate data records to modify the embedded tables and perform a simulation analysis, calculate the environmental measures, and write the history of the vehicle trajectories on peripheral unit 32.

If the entry is 15, NETSIM will read a peripheral unit containing vehicle trajectory data and then read Record Type 60s to modify the embedded rate tables. The environmental measures will be calculated, reflecting those vehicle trajectories and the modified rate tables, which will be printed.

The Record Type 60s, as well as all the subsequent tabular data records, are required only for a value of 2, 3, or 5, which specifies that the rate tables are to be modified.

Table 5-5. Environmental MOE options for X.

VALUE OF X	MEANING OF X
0 (blank)	The tables containing fuel consumption rates and pollutant emission rates will not be printed. Default = **0.**
1	These tables will be printed

Table 5-6. Environmental MOE options for Y.

VALUE OF Y	MEANING OF Y			
	SIMULATION	ENVIRONMENTAL MEASURES	RATE TABLES USED	TRAJECTORY FILE PROCESSING
0 (default)	PERFORMED	CALCULATED	EMBEDDED	NOT WRITTEN
1	PERFORMED	CALCULATED	EMBEDDED	WRITTEN
2	PERFORMED	CALCULATED	MODIFIED	NOT WRITTEN
3	PERFORMED	CALCULATED	MODIFIED	WRITTEN
4	NOT PERFORMED; READ TRAJECTORY FILE	CALCULATED	EMBEDDED	NOT WRITTEN
5	NOT PERFORMED; READ TRAJECTORY FILE	CALCULATED	MODIFIED	NOT WRITTEN
6	PERFORMED	NOT CALCULATED	EMBEDDED	NOT WRITTEN
7	PERFORMED	NOT CALCULATED	EMBEDDED	WRITTEN

This option allows the user to determine fuel consumption and emission statistics for varying sets of consumption and emission rates without rerunning the basic simulation each time. For the initial run, all the data needed to perform a NETSIM simulation is prepared. The user requests a simulation to be performed in Entry 2 on Record Type 02. In addition, Entry 6 is set to 1, 3, 7, 11, 13, or 17 so that trajectory data resulting from the simulation will be recorded on peripheral unit 32.

For subsequent runs, the user resubmits the entire input stream. Even though a NETSIM simulation is not to be performed, the user must again request simulation in Entry 2 of Record Type 02. However, the user informs the model that the trajectory file on unit 32 will be substituted for a NETSIM simulation by setting Entry 6 on Record Type 02 to 4, 5, 14, or 15. Embedded or modified rate tables will be employed to generate the fuel and emission statistics depending on the value of this code. Modifications to the fuel and emission rates would be specified through the use of Record Type 60 and its associated table data records. The JCL for all subsequent runs must identify the trajectory file created from the initial run as peripheral unit 32. When this feature of TRAF is employed, the network for both initial and subsequent runs must use only the NETSIM component.

The default condition that will probably be executed most frequently is specified by a value of zero (or blank) for Entry 6. In this case, the embedded rate tables will be employed but not printed (i.e., there will be no Record Type 60s specified in the input stream), the simulation will be executed, and the environmental measures (fuel consumption and vehicle emissions) will be computed and output. Vehicle trajectory points will not be written on unit 32.

7 The fuel and emissions codes for FRESIM are identical to the ones used for NETSIM.

8–9 The NETSIM model can generate emission headways stochastically using either a normal, negative exponential, or Erlang distribution (see the discussion of Entry 5).

The form of the Erlang distribution is as follows:

$$f(t) = \frac{(qa)^a}{(a-1)!} t^{a-1} e^{-aqt} \qquad \mathbf{a = 1, 2, ...}$$

The variable, a, describes the level of randomness of the distribution ranging from a = 1 (most randomness) to a = ∞, (complete uniformity). The case where a = 1, is considered a special form of the Erlang distribution known as the negative exponential distribution.

Entry 8 is used to select either the normal or Erlang family of distributions to generate emission headways.

When the Erlang distribution is selected (i.e. Entry 8 = 1), then Entry 9 is used to define the value of a for the distribution. The negative exponential distribution can be selected by setting Entry 9 = 1. NETSIM can generate headways from Erlang distributions ranging from a = 1 to a = 4. Thus, acceptable values of Entry 9 range from 1 to 4. This entry must be blank or zero if Entry 8 is blank or zero.

10–14 Entries 10–14 **only** apply if the user has a Real-Time Traffic Adaptive Control System (RT-TRACS) Interface. These entries are used to transfer surveillance data to an external real-time traffic control algorithm and receive signal control decisions from the algorithm. Entry 10 defines the frequency with which information is sent between NETSIM and the control algorithm. Leave Entries 10–14 blank if this feature is not requested for a given run. Otherwise, Entry 10 can range from 1 to 30 seconds.

Entry 10 is nonzero it is possible to store NETSIM's time-interval specific measures of effectiveness for a real-time traffic control algorithm if necessary. It is also possible to store time-period-specific measures of effectiveness and second-by-second information from the NETSIM data base for debugging purposes. To provide any of this information, complete Entries 11–14 as follows:

Set Entry 11 = 1 to store time-interval specific measures of effectiveness for use by a real-time control algorithm.

Set Entry 12 = 1 to store time-period-specific measures of effectiveness for use by a real-time control algorithm.

Set Entry 13 = 1 to store second-by-second debugging data for use by a real-time control algorithm.

Set Entry 14 = 1 to store second-by-second, time interval, time period, and/or debugging data for use by a real-time control algorithm in a separate "per second" tile.

Note that if the flag in Entry 14 is set to zero (0), at the completion of the simulation there will be one output data file for each flag set in Entries 10-13. These files will contain data for the last second simulated and the file names will be in the form NETDAT.____. If the flag is set to 1, at the completion of the simulation there will still be a collection of files for each second of simulation (i.e., a 360-second simulation with Entry 10 set to 30 will produce 12 second-specific output data files with the file names 00030.sec, 00060.sec, . ..00360.sec and the signal output data files with the file names 00030.sig, 00060.sig, . ..00360.sig).

15-16 These entries allow the user to enter data in either English or metric units and to receive simulation output in either of those units, or in both units if desired. Metric datasets are internally converted to English units because all program computations and data diagnostics are performed in the English unit system. In addition, the data diagnostic messages are only presented in English units.

Input data is echoed to the user in tabular format in both English and metric units, regardless of the value of Entries 15-16. Intermediate simulation output for NETSIM contains no information specific to the English or metric unit system. Therefore, only one set of intermediate output tables is provided for the models, regardless of the code specified in Entry 16.

Output tables are presented in either English or metric units, according to the code specified in Entry 16. If the user requests output in both units (i.e., Entry 16 = 3), a complete set of output tables will be printed and labeled in English units, followed by a duplicate set of tables in metric units. Comparisons can be made by separating the two sets of tables. Because this option doubles the amount of output generated by the simulation, it should only be used when necessary.

17 Specifies the subnetwork type defined by the set of records immediately following Record Type 05.

18 Specifies the time that the simulation begins. For example, if the run is to simulate traffic behavior at 4:30 p.m., enter 1630. This entry is used for printout purposes only.

19 The user can alter original signal interval durations, reference offsets, and signal indications for a controller by respecifying Record Types 35 and 36 for subsequent time periods. The model provides logic to simulate the controller transition from one timing plan to the next. Several options are available to the user for defining how this transition is accomplished-based on the value of Entry 19-and these options are identified in table 5-7.

Table 5-7. Types of signal transitions.

VALUE OF ENTRY 19	TYPE OF SIGNAL TRANSITION
1	**Immediate** transition to new settings, with the controller dwelling in main street green until the new offset is attained
2	Controller transitions to new settings over the course of **two cycles** by adjusting main-street-green times each cycle to complete the transition period with minimum disruption
3	Same as code = 2, except that the transition is completed over **three cycles**

Transition to a new signal pattern does not automatically commence at the start of a new time period. Instead, the transition period begins as soon as the controller reaches phase 1 (main street green) for the first time after the start of the new time period. The user must ensure that phase 1 is coded as main street green on Record Types 35 and 36. Entry 19 should be left blank if the transition feature is not used. If Entry 19 is nonzero, it must be 1, 2, or 3, and Record Types 35 and 36 must appear within the subsequent time period specifications to define a new timing plan.

20 The TRAF system employs a multiplicative, congruent technique to generate random numbers that are used to simulate the random elements of traffic flow. For example, given a mean dwell time for buses at a station, the actual dwell time of any one bus varies relative to this mean, and this variation is determined by using a random number. Several other processes in the simulation also employ random numbers.

TRAF generates each random number on the basis of a seed value. As a random number is generated, a new seed value is generated as well to be used for the generation of the next random number and random number seed in the series.

Entry 20 is the traffic random number seed used to start the stochastic process affecting the traffic stream. Decisions such as the routing pattern of each vehicle and the characteristics of each driver/vehicle combination are generated from this base seed.

If Entry 20 is left blank, a default value of 7781 is used for this base seed. The user can specify a different value for Entry 20 to generate an entirely new pattern of traffic. A series of runs with different values for Entry 20 would illustrate the variance in the traffic performance measures of effectiveness that are due to variations in traffic patterns.

When different traffic control strategies are being compared, it is desirable to minimize this variance and examine changes in the measures of effectiveness that are due solely to differences in the effectiveness to the control policy. Under those circumstances, the same value of Entry 20 (and 21) should be employed in all such comparison runs. By keeping Entry 20 fixed during a series of runs, the same driver/vehicle mix and routings will be employed in each run as long as the same geometry, turn percentages, and volumes are used.

Leave Entry 20 blank if the NETSIM model is not used in this run or if the default value of 7781 is acceptable for this run.

21 See Entry 20.

This general random number seed is the common seed for the TRAF system, and it is used for all stochastic processes. The seed is used for all time-dependent stochastic decision-making processes (e.g., accepting available gaps for turns and determining location and duration of lane blockages). The user can change this random number seed and keep the traffic random number seed (Entry 20) constant to replicate a CORSIM simulation run; that is, the user can simulate with traffic streams exhibiting identical routing and driver/vehicle characteristics, but in a traffic environment derived by using a different sequence of random number seeds that are generated by the general random number seed. This entry can be used in NETSIM and FRESIM runs.

If this entry is left blank, a default value of 758 1 is asserted by the model.

03
Time Period Specification

Table 5-8. Record Type 03 – time period specification.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Duration of the 1 st time period (in seconds)
2	5-8	Duration of the 2nd time period (in seconds). **Blank** if the previous time period was the last time period.
3	9-12	Duration of the 3rd time period (in seconds). **Blank** if the previous time period was the last time period.
4	13-16	Duration of the 4th time period (in seconds). **Blank** if the previous time period was the last time period.
5	17-20	Duration of the 5th time period (in seconds). **Blank** if the previous time period was the last time period.
6	21-24	Duration of the 6th time period (in seconds). **Blank** if the previous time period was the last time period.
7	25-28	Duration of the 7th time period (in seconds). **Blank** if the previous time period was the last time period.
8	29-32	Duration of the 8th time period (in seconds). **Blank** if the previous time period was the last time period.
9	33-36	Duration of the 9th time period (in seconds). **Blank** if the previous time period was the last time period.
10	37-40	Duration of the 10th time period (in seconds). **Blank** if the previous time period was the last time period.
11	41-44	Duration of the 1 lth time period (in seconds). **Blank** if the previous time period was the last time period.
12	45-48	Duration of the 12th time period (in seconds). **Blank** if the previous time period was the last time period.
13	49-52	Duration of the 13th time period (in seconds). **Blank** if the previous time period was the last time period.
14	53-56	Duration of the 14th time period (in seconds). **Blank** if the previous time period was the last time period.
15	57-60	Duration of the 15th time period (in seconds). **Blank** if the previous time period was the last time period.
16	61-64	Duration of the 16th time period (in seconds). **Blank** if the previous time period was the last time period.

ENTRY	COLUMN(S)	DESCRIPTION
17	65-68	Duration of the 17th time period (in seconds). **Blank** if the previous time period was the last time period.
18	69-72	Duration of the 18th time period (in seconds). **Blank** if the previous time period was the last time period.
19	73-76	Duration of the 19th time period (in seconds). **Blank** if the previous time period was the last time period.
20	79-80	03

The TRAF system describes the changing conditions that prevail over a roadway network, and those conditions are either endogenous (internal to the system) or exogenous (specified as external stimuli in the form of inputs prepared by the user). Exogenous data, for instance, include changes in traffic volumes, turn movement percentages, and lane channelizations. If the user specifies how the time-dependent data items change in the course of a simulation run, he must indicate the time frame for those changing conditions. The TRAF system allows the user to partition the simulation time into a series of "time periods" of varying duration. Each set of exogenous input data applies for (and remains constant during) one time period, and the user can specify up to 19 time periods.

Record Type 03 is used to identify the number of time periods applicable to a specific run as well as the duration of each period. If all the data remains fixed throughout a run, only one time period should be specified. When the user wants to modify certain time-dependent inputs during the simulation, he should specify the sequence of time periods.

04

Time Intervals and Time Steps per lime Period

Table 5-9. Record Type 04 – time intervals and time steps per time period.

ENTRY	COLUMN(S)	DESCRIPTION
1	12-16	The FRESIM **time step** (in tenths of a second) (e.g., 20 = 2 seconds). Range: **1** to 90 tenths of a second. **Blank** for the default value of **1** second. Each time interval (Entry 2) is partitioned as a series of time steps. The time interval **must** be an integer multiple of the specified time step duration. Figure 5-l depicts the relationship among the time step, the time intervals, and the time periods.
2	17-20	**Time interval** is the period of time (in seconds) during which one model simulates before a second model begins to simulate the same time interval during multiple-model simulations. Range **= l-200** seconds. **Blank** for the default value of 60 seconds. Each time period (specified on Record Type 03) must be an **integer** multiple of the time interval, which should be the most common traffic signal cycle length.
	79-80	04

Each time period is subdivided into a sequence of time intervals. Each simulation model requested for a given run is brought in and out of central memory once during each time interval. The output of cumulative simulation statistics is only available on a time interval basis (see Record Type 05). The time interval duration is typically set to the most common signal cycle length in a study network. Each time period duration must be **at least** one time interval, as specified on Record Type 04. Furthermore, the duration of each time period **must** be an integer multiple of the time interval duration. The program will automatically guarantee this requirement by truncating each time period duration to the nearest integer multiple of the time interval duration. The relationship between the time interval and the time period is further discussed on pages 5-14 and 5-15. (Refer to figure 5-l for the relationship among the time period, the time interval, and the time step.)

05
Reports and Graphics

Table 5-10. Record Type 05 – reports and graphics.

ENTRY	COLUMN(S)	DESCRIPTION
1	l-4	Number of time intervals between cumulative simulation statistics reports. **Blank** for a single report at the end of each time period.
The following groups of three entries represent the following statement: Start producing intermediate simulation reports every T2 seconds (for a duration of T3 seconds) at time Tl from the beginning of the simulation		
2	9-12	**Tl** Time to begin the **first** set of reports (in number of seconds from the beginning of the simulation)
3	13-16	T3 Duration of the **first** reporting period (in seconds)
4	17-20	T2 Time between each intermediate set of reports in the **first** reporting period (in seconds)
5	21-24	**Tl** Time to begin the **second** set of reports (in number of seconds from the beginning of the simulation)
6	25-28	T3 Duration of the **second** reporting period (in seconds)
7	29-32	T2 Time between each intermediate set of reports in the **second** reporting period (in seconds)
8	33-36	**Tl** Time to begin the **third** set of reports (in number of seconds from the beginning of the simulation)
9	37-40	T3 Duration of the **third** reporting period (in seconds)
10	41-44	T2 Time between each intermediate set of reports in the **third** reporting period (in seconds)
11	48	; Turn-movement-specific output is **not** requested Turn-movement-specific output **is** requested
12	52	0 Do **not** generate graphical display files 1 Generate files for static and animated graphical displays for **GTRAF** 9 Generate files for static and animated graphical displays for **Traphix**
13	53-58	Name of the graphical output file (up to 6 characters)
14	79-80	05

Record Type 05 provides flexibility for controlling the frequency at which statistics are output by the various simulation models. Each model will always output its cumulative simulation statistics at the completion of each time period.

If the user requires a more detailed history of traffic operations, these data can be provided by intermediate output. If intermediate output is not required, Entries 2-l 0 should be left blank.

Entry 11 allows the user to request cumulative MOEs that are stratified by the turn movement for each link in the NETSIM subnetwork. When this option is selected, three additional tables will be included in each set of standard cumulative outputs. Those tables present MOEs on a link-specific basis that are stratified for left-turning, through, diagonal, and right-turning traffic.

Entry 12 allows the user to create files containing the data needed to produce graphical displays of the CORSIM subnetwork and MOE displays. Enter 1 to generate GTRAF-compatible files (for NETSIM networks only). Enter 9 to generate Traphix-compatible files (for NETSIM, FRESIM, or CORSIM networks). If graphical files are not required, leave Entry 12 blank.

Only one Record Type 05 can be specified for each case study.

Controlling Simulation Runs

The first step in controlling the simulation is deciding which model(s) will be used. The first model to be used must be defined in Entry 9 on Record Type 02. TRAF uses random number seeds to start random number generators. The generated random numbers are used to generate events from distributions for various activities. For example, there is a probability distribution for a driver to stop at a yellow light, depending on the speed and distance from the intersection when the light turns yellow. Based on the distribution, the random number seed is used to determine whether the driver will stop. A random number seed for controlling random events must be entered in Entry 13 on Record Type 02 (the default value is 758 1). This random number controls non-traffic-stream processes in CORSIM. A separate random number seed for generating vehicles in NETSIM should be entered in Entry 12 on Record Type 02 (the default value is 7781). Using the same random number in successive runs will generate vehicles at identical times with identical driver characteristics and identical paths through the network. This identical traffic stream sharply reduces the variance involved in comparing one alternative to another, and it reduces the number of simulation runs needed to “prove” that alternative B is better (or worse) than alternative A.

The second step is defining the types of information that are desired. First, the user defines (in Entries 7 and 8 on Record Type 02) whether he wants the input and output in metric units or in English units (default). The intermediate simulation results for NETSIM contain no data in English or metric units and are unaffected by the unit flags. Requesting **both** sets of units will produce two sets of reports and thus **double** the output volume. Second, the user defines (in Entries 5 and 6 on Record Type 02) whether he wants fuel consumption and vehicle emissions data.

The third step is planning the timing of the simulation. First, the user determines the common cycle lengths of the traffic signals in the network and the total duration of the period to be simulated. Each model produces a cumulative output at the end of each time period. The user can vary traffic volumes, turn percentages, lane channelizations, and pretimed signal timings (in NETSIM only) from time period to time period. Therefore, the time period durations should be chosen to match the traffic system variations. For example, the user may want to specify a short pre-rush-hour period with light traffic, a rush-hour period with heavy traffic and an HOV lane, and a short post-rush-hour period with medium traffic and no HOV lane. Up to 19 such time periods can be specified on Record Type 03.

Because TRAF is divided into a set of models, each model simulates traffic during each time period, and each turn is called a “time interval.” To minimize disruption to the simulation, it is suggested that the most common cycle length in the network be the duration of the time interval. The time period must be an **integer** multiple of the time interval. Should the user specify a time period duration that is **not** an integer multiple, TRAF will truncate it to the nearest integer multiple. Therefore, the user should choose the approximate duration that he wants for the time period and then find the nearest integer multiple of the time interval that is desired.

For example, if the user wants a **15-minute time period** for cumulative reports:

>Desired Time Period Length = 15 minutes = 900 seconds

> Common Cycle Length = 80 seconds = Suggested Time Interval Length

> 900 + 80 = 11.25, which is **not** an integer multiple

>Time Period Duration = 11 x 80 = 880 seconds

If the user wants a **5-minute time period** for more frequent cumulative reports:

- Desired Time Period Length = 5 minutes = 300 seconds
- Common Cycle Length = 80 seconds = Suggested Time Interval Length
- 300 ÷ 80 = 3.75, which is **not** an integer multiple
- Time Period Duration = 4 × 80 = 320 seconds

As shown in figure 5–1, each model executes in turn during each time interval. Vehicles moving from one subnetwork to another are stored in vehicle holding areas and are discharged into the next network during its execution time (at the same clock time they are discharged from the first network). Time intervals less than the most common cycle length can be used. However, there will be a significant performance penalty because the number of "swaps" between models will be dramatically increased. A swap occurs when one model is removed from the memory and another model is read into memory from a disk. In addition, there will a significant increase in the number of cumulative outputs printed because one is printed at the end of each time period. Normally, the time interval duration cannot be set to less than 50 seconds or greater than 200 seconds.

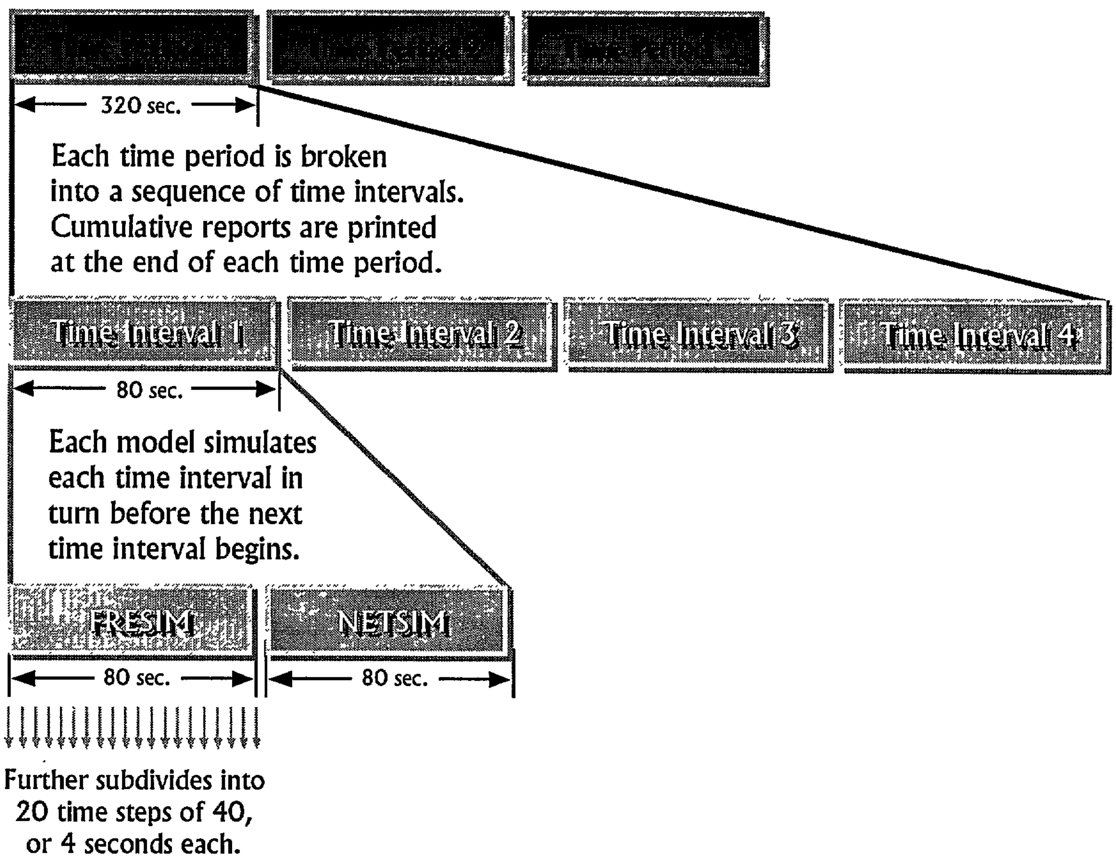


Figure 5–1. Time intervals per time period.

10
Link Names

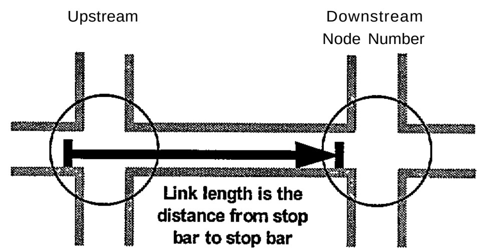
Table 5-11. Record Type 10 – link names.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	First link's upstream node number 
2	5-8	First link's downstream node number
3	9-20	Street name of the block represented by the first link
4	79-80	10

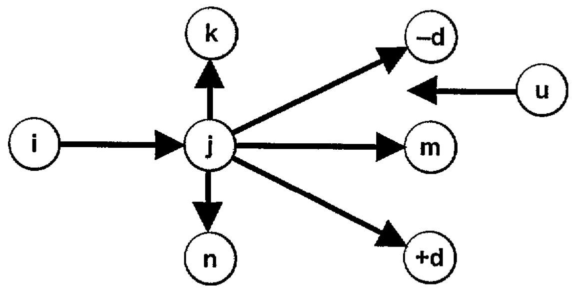
The link name record in NETSIM allows the user to document which links refer to which city blocks so that the traffic engineer can easily understand the system without having to refer back to the link-node diagram.

11
NETSIM Link Description

Table 5-12. Record Type 11 - NETSIM link description.

<table>
<tr><th>ENTRY</th><th>COLUMN(S)</th><th colspan="2">DESCRIPTION</th></tr>
<tr><td>1</td><td>1–4</td><td colspan="2">Link's upstream node number</td></tr>
<tr><td>2</td><td>5–8</td><td colspan="2">Link's downstream node number</td></tr>
<tr><td>3</td><td>9-12</td><td>Length of link</td><td>
</td></tr>
<tr><td>4</td><td>13-16</td><td colspan="2">Length of left-turn pocket</td></tr>
<tr><td>5</td><td>17-20</td><td colspan="2">Length of right-turn pocket</td></tr>
<tr><td>6</td><td>22</td><td>Number of lanes servicing traffic for the entire length of the link (excluding lanes with parking)</td><td rowspan="3">Sum of left- and right-pocket lanes plus through lanes ≤ 7 for NETSIM</td></tr>
<tr><td>7</td><td>24</td><td>Number of lanes in left-turn Docket (blank, 1, or 2)</td></tr>
<tr><td>8</td><td>26</td><td>Number of lanes in right-turn pocket (blank, 1, or 2)</td></tr>
<tr><td>9</td><td>27-28</td><td colspan="2">Grade (in a percentage from -9% to 9%)</td></tr>
<tr><td>10</td><td>29</td><td colspan="2">Queue discharge characteristics</td></tr>
<tr><td>11</td><td>30</td><td>Channelization code lane 1 (curb)</td><td rowspan="7">0 Blank (unrestricted)
1 Left turn only
2 Buses only
3 Closed
4 Right turn only
5 Carpool only
6 Carpools and buses only
7 Right turns + (right, diagonal, and/or through)
8 Left turns + (left, diagonal, and/or through)
9 All movements permitted by the geometry and adjacent lane channelization
D Diagonal traffic only
T Through traffic only</td></tr>
<tr><td>12</td><td>31</td><td>Channelization code lane 2</td></tr>
<tr><td>13</td><td>32</td><td>Channelization code lane 3</td></tr>
<tr><td>14</td><td>33</td><td>Channelization code lane 4</td></tr>
<tr><td>15</td><td>34</td><td>Channelization code lane 5</td></tr>
<tr><td>16</td><td>35</td><td>Channelization code lane 6</td></tr>
<tr><td>17</td><td>36</td><td>Channelization code lane 7</td></tr>
</table>

ENTRY	COLUMN(S)	DESCRIPTION
18	37–40	Downstream node k that receives left-turning traffic
19	41-44	Downstream node **m** that receives through traffic
20	45-48	Downstream node n that receives right-turning traffic
21	49-52	Downstream node -d (left) or +d (right) that receives diagonal traffic
22	53-56	Upstream node u for traffic opposing left-turning traffic. This node **must** be coded even if there is no left-turning traffic.
23	57-60	Mean value of start-up lost time for the first vehicle (in tenths of a second)
24	61-64	Mean queue discharge headway (in tenths of a second)
25	65-68	Desired free-flow speed (in miles per hour or kilometers per hour)
26	70	Right-turn-on-red (RTOR) code: 0 Right turn on red is allowed 1 Right turn on red is prohibited
27	71	Pedestrian code for pedestrians crossing link **(i,j)** at node j: 0 No pedestrian traffic 1 Light pedestrian traffic (100-250 pedestrians/hour) 2 Moderate (250-500 pedestrians/hour) 3 Heavy (> 500 pedestrians/hour)
28	72	Through lane number of link **(i,j)** that aligns with Entry 29 for link **(j,m)**
29	73	Through lane number of link **(j,m)** that aligns with Entry 28 for link **(i,j)**
30	79-80	11



Traffic flow on a link is from the first (upstream) node to the second (downstream) node. 8### (8000) nodes represent the boundary of the network. Traffic enters the network on (8###,####) links and departs the network on (####,8###) links. The nodes between the entry nodes and the intersection are called "dummy" nodes. The ### after the 8 represents any arbitrary combination of the digits from 0 to 9. The #### represents any valid node number for internal nodes.

This NETSIM link record describes the input-output geometry and the traffic characteristics of NETSIM links. The characteristics that vary from time period to time period include the queue discharge characteristics headway (Entry 24), lane channelization codes (Entries 11-17), the RTOR code (Entry

26), and the pedestrian intensity code (Entry 27). **Changes in other entries are ignored by the program.** For example, the channelization for the curb lane (Entry 11) might be 0 (unrestricted) for Time Period 1 (pre-rush hour) and 6 (HOV only) for Time Period 2 (rush hour). All other entries would be identical. As a result, the user would copy the record from Time Period 1 to Time Period 2 and then change Column 30 in Entry 11 from 0 to 6.

Discussion of Selected Entries

1 For internal links, upstream node numbers must range from 1 to 750. For entry links, the value must range from 8000 to 8999. For entry interface links, the value must range from 7000 to 7999.

2 For internal links, downstream node numbers must range from 1 to 750. Exit links must not be input (i.e., Entry 2 must be less than 8000). Exit interface links should have downstream node numbers between 7000 and 7999.

3 The length of link (ij) extends from the stop line of the upstream feeder link to the stop line of the subject link. The minimum length of an urban link is 50 feet (15 meters). A maximum length of 9,999 feet (3,049 meters) is an upper limit for NETSIM. If a NETSIM subnetwork link exceeds 4,000 feet (1,218 meters), the user must insert a dummy node to create two links in sequence. The link length must not be input for entry links.

4-5 The length of the right- and left-turn pockets extending upstream from the stop line. This value must not be input for entry links. The minimum length of a pocket is 20 feet (6 meters). The maximum length of a pocket is 1,000 feet (303 meters).

6 The number of full lanes servicing **moving** traffic on link (i,j); neither a parking lane (if any) nor a left- or right-turn pocket is included. The maximum number of full lanes is seven with no turn pockets, six with one turn pocket lane, five with two turn pocket lanes, and so forth. Provision is made for up to seven lanes on each NETSIM link, as an aggregate of full and pocket lanes.

7-8 Pockets with one or two lanes can be accommodated. These entries must be specified if the respective Entries 4 and 5 are specified.

9 Any grade outside the permissible range should be assigned a value of 9% [use the negative sign (-) for downgrade]. If the grade is not known, leave this entry blank. The grade must not be input for entry links.

10 This entry identifies the choice of statistical distribution used for the queue discharge characteristics of link (i,j) as well as the distribution used to define the start-up lost time. As each queued vehicle moves up to the stop line, it is assigned a delay (in tenths of a second) until discharged, reflecting queue discharge headways, which are obtained by multiplying the mean queue discharge headway (specified for the link in Entry 24) by a percentage, which is extracted from a decile distribution that applies to that "type" of link. The vehicle's driver characteristic is used as an index for referencing the proper element in the distribution, as described in the discussion of Record Type 149.

The value specified in Entry 10 for the link type is also used to assign a distribution that describes the characteristics of the start-up lost time, which is experienced by the first vehicle in the queue when the signal turns to green. The distribution contains percentage values that are applied to the specified mean lost time (Entry 23) in a manner identical to the computation of the queue discharge headway. The vehicle's driver characteristic is also used as an index for referencing the proper element in the distribution, as described in the discussion of Record Type 149.

Generally, this entry is left blank, and the link type defaults to 1. For the default distributions for link types 1 and 2, see Record Type 149. The user can alter those values or create additional discharge headway or lost time distributions for link types 3 and 4 by specifying Record Type 149. If additional link types are defined on Record Type 149, any link can be assigned those types. If no Record Type 149s are included, Entry 10 **must** be blank, 1, or 2.

11-17 The allowed values for lane channelizations are as follows:

0	Blank (unrestricted)
1	Left turn only
2	Buses only
3	Closed
4	Right turn only
5	Carpool only
6	Carpools and buses only
7”	Right turns + (right diagonal and/or through)
8”	Left turns + (left diagonal and/or through)
9	All movements permitted by the geometry and adjacent lane channelization
D	Diagonal traffic only
T	Through traffic only

*If a diagonal receiver exists, then this code implies “turn plus diagonal.” If there is no diagonal traffic and no other lane is available to service through traffic, through traffic would also be serviced in this lane. To channelize a lane for turn, diagonal, and through traffic, a code of 9 must be used.

To properly code these entries, the user should familiarize himself with the following model concepts and restrictions:

> Unless otherwise specified, all right turns take place from the single rightmost lane and all left turns take place from the single leftmost lane. If these lanes are unchannelized, then a mix of through and turning traffic exists in these lanes.

> Any turn movement in excess of 100 + LN% (with LN representing the number of moving full lanes on the link) should always be modeled by channelizing the appropriate lane. For example, if a two-lane street exhibits 60% right turns, then the outside lane (lane 1) is channelized exclusively for right-turners. If the turn movement, in a percentage, is moderately below 100 + LN (i.e., as low as 75 + LN), but the lane services turning traffic only, then that lane should be’so channelized. In the above example, if the turn movement were 40% and yet observation indicates that only turning traffic utilizes the outside lane, then it should be channelized accordingly.

- Only full lanes can be channelized using these entries. Because a turn pocket does not extend throughout the length of a link, it is not considered a full lane.
- The channelization code for a link with a single lane should be either 0 or 9.
- The NETSIM model imposes de facto channelization, whenever conditions dictate, to reflect real-world responses. Specifically, if an unchannelized lane services a high volume of turners, then the program will internally assert that the lane will service only turners for the appropriate time period. This internal channelization is imposed whenever the turn percentage exceeds 75 + LN.
- If it is necessary to represent a turn movement utilizing more than one lane, then the two rightmost or leftmost lanes should be channelized accordingly.
- A turn movement on NETSIM links cannot be assigned more than three channelized lanes.
- A lane cannot be channelized for left-turners unless all other lanes to the left are either channelized for left-turners or closed.
- A lane cannot be channelized for right-turners unless all other lanes to the right are either channelized for right-turners or closed.
- A closed lane is usually a transient condition that is due to, for example, a construction requirement.
- A parking lane is not reflected as a closed lane; a parking lane is simply not included in the number of moving lanes.
- If a receiving link is specified for through or diagonal traffic, then at least one lane must always remain unchannelized, even if there is no through or diagonal traffic specified.
- Only one lane on a link can be channelized for buses.
- Only one lane on a link can be channelized for Carpools.
- Only one lane on a link can be channelized for both buses and Carpools when there is no other bus or carpool lane.
- A link cannot be totally channelized for one turn movement; that is, the leftmost lane cannot be channelized for right-turners, and the rightmost lane cannot be channelized for left-turners. If necessary, the user must treat such turn movements as left- or right-diagonal movements.

Channelization codes can be changed by the user from one time period to another. If a channelization code is input for a lane in a time period other than the first, then channelization codes for all lanes must be entered (see figure 5-3 for the NETSIM lane-numbering procedure). Note that full lanes are numbered from right to left, starting with lane 1, regardless of the link configuration. In specifying channelization codes, the user should refer to the appropriate figure to identify the proper lane number.

When the user changes the channelization codes for a given link in a subsequent time period, the model will retain that new channelization until it is changed by the user. For example, if the user specifies that the outside lane of a link is unchannelized during Time Periods 1, 2, and 5 and is channelized exclusively for right-turners during Time Periods 3 and 4, then he must specify those entries as follows:

- Lane 1 is specified as unchannelized on Record Type 11 for Time Period 1.
- Lane 1 is specified as channelized for right-turners on Record Type 11 for Time Period 3.
- Lane 1 is specified as unchannelized on Record Type 11 for Time Period 5.

Refer to figure 5–2 for examples of channelization codes.

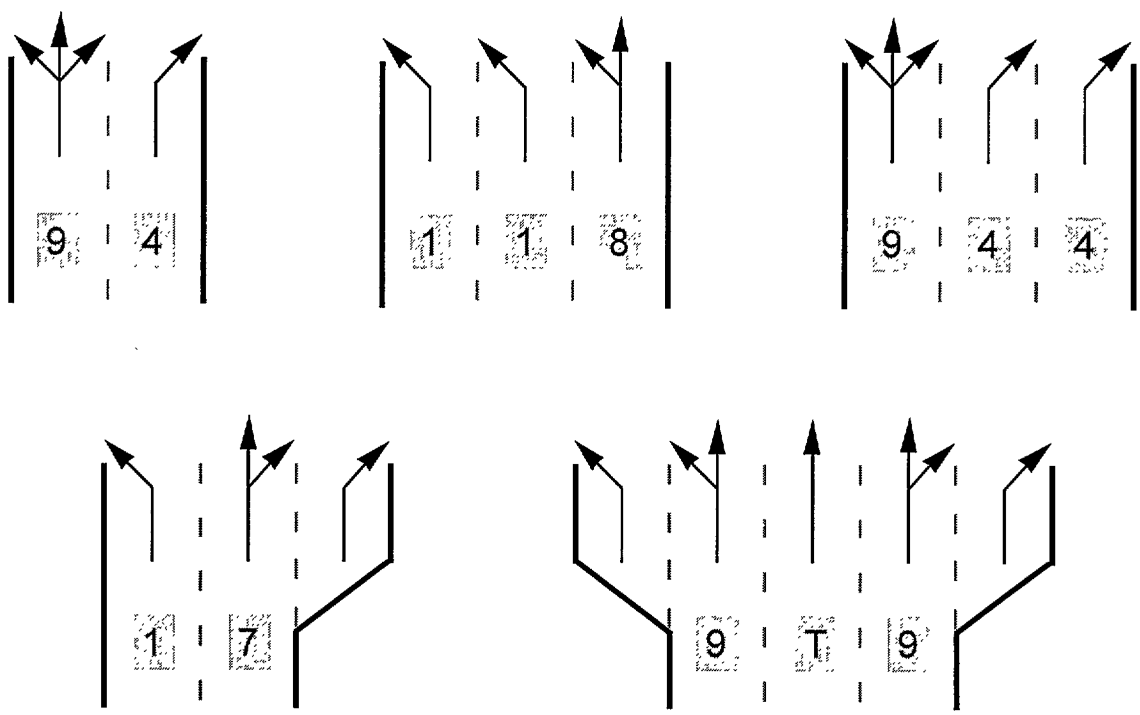


Figure 5–2. Examples of lane channelizations.

The following procedure should be used for the internal lane numbering to ensure that the lane channelization codes are input in the correct columns:

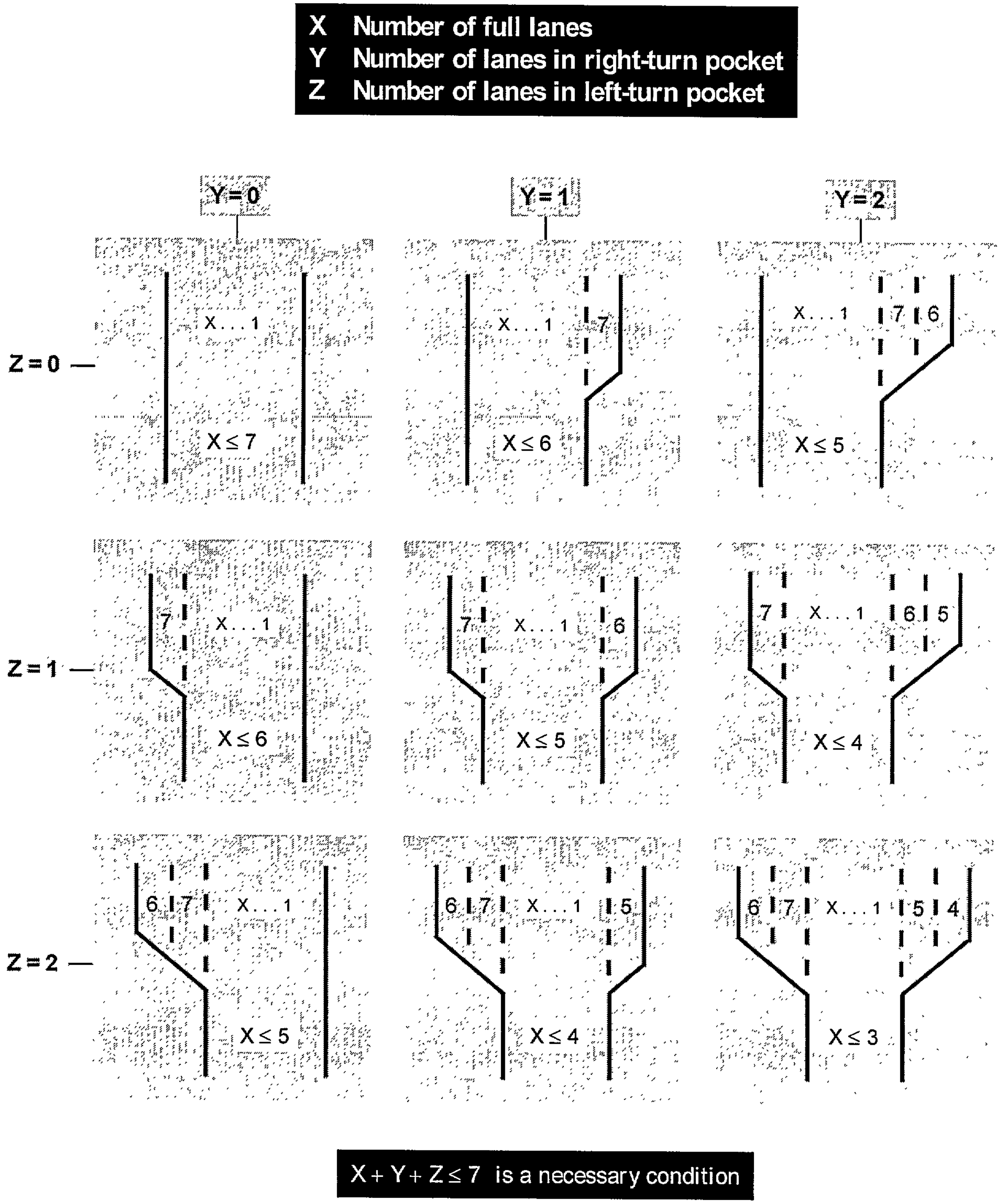


Figure 5-3. NETSIM lane-numbering procedure.

18-22 These entries identify the links that receive the vehicle leaving link (i,j) and the link opposing left-turners from link (i,j). If a left-diagonal movement exists, the value of "d" is entered as a **negative** value. If the left-diagonal movement carries traffic to an interface or exit node, then that link will have to be represented as two distinct links in a series (i.e., insert a dummy node) because only four columns are available for the node number and sign. These entries must be compatible with the specified turn movements; i.e., every movement with a nonzero turn percentage must be related to a receiving link.

If the subject link (i,j) is an interface link (i.e., the downstream node number of Entry 2 is from 7000 to 7999), then no receiving links should be specified, and these entries **must** be blank.

23 The start-up lost value, expressed in tenths of a second (an entry of 26 denotes 2.6 seconds), is the delay experienced by the first three vehicles in queue when responding to a phase change from red to green. If the value entered is less than 0.5 seconds, then a warning message will be written, but the data will not be considered an error. The maximum acceptable value is 9.9 seconds. If this entry is left blank, a mean of 2.0 seconds will be used.

24 The mean time gap (headway) between vehicles discharging from a standing queue is entered. This value, in tenths of a second, applies only to those vehicles that were fourth in queue or further upstream. An entry of 24 denotes a value of 2.4 seconds. If the value entered is less than 1.4 seconds, then a warning message will be written, and a value of 1.4 will be stored in the database. The maximum acceptable value is 9.9 seconds. If this entry is left blank, a value of 1.8 seconds will be used.

25 The desired, unimpeded mean free-flow speed is entered in miles per hour or kilometers per hour if the metric input option is used (see Record Type 02). This value must be attained by traffic in the absence of any impedance due to other vehicles, pedestrians, or control devices. A warning message will be written for a value above 65 mph (104 kmph), and a speed of 65 mph (104 kmph) will be asserted by the model. A fatal error occurs whenever Entry 25 is nonzero and less than 10 mph (16 kmph) or whenever a nonzero speed is specified for an entry link. If this entry is left blank, a value of 30 mph (48 kmph) will be used.

27 This entry specifies the intensity of pedestrians crossing at node j for link (i,j). Pedestrians will cross the intersection parallel to moving traffic on link (i,j). For example, for link (i,j) in the figure relating to Entries 18-22 in table 5-12, pedestrians will cross node j across links (n,j) and (kj). The pedestrian volume specified for this entry is applied to both sides of the node.

28-29 These entries describe the alignment of lanes on the subject link with those of its through receiving link. If these entries are left blank, it will be assumed that lane 1 of the subject link aligns with lane 1 of the link receiving through traffic.

19
Freeway Link Geometry

Table 5-13. Record Type 19 – freeway link geometry.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Upstream node number i of subject link **(i,j)**
2	5-8	Downstream node number **j** of subject link **(i,j)**
3	9-12	Downstream node number k of link **(j,k),** which receives through-movement traffic from subject link **(i,j)**
4	13-17	Length of the freeway link (in feet)
5	18	Freeway link type code: **Blank or** 0 Mainline link 1 Ramp link
6	20	Number of through lanes
7	2 l-22	Identification code for the first auxiliary lane: 6 First auxiliary left lane 7 Second auxiliary left lane 8 Third auxiliary left lane 9 First auxiliary right lane **10** Second auxiliary right lane **11** Third auxiliary right lane
8	23	Lane type code for the **first** auxiliary lane: 1 Acceleration auxiliary lane 2 Deceleration auxiliary lane 3 Full auxiliary lane
9	24-28	Length of the **first** auxiliary lane
10	29-30	Same as Entry 7 but for another auxiliary lane
11	31	Same as Entry 8 but for another auxiliary lane
12	32-36	Same as Entry 9 but for another auxiliary lane
13	37-38	Same as Entry 7 but for another auxiliary lane
14	39	Same as Entry 8 but for another auxiliary lane
15	40-44	Same as Entry 9 but for another auxiliary lane
16	45-46	Identification number of the lane on the immediate downstream link that receives through traffic from lane 1 of the link described on this record

ENTRY	COLUMN(S)	DESCRIPTION
17	47-48	Identification number of the lane on this link that feeds lane 1 of the downstream off-ramp (if any). **Blank** if there is no downstream off-ramp.
18	49-50	Identification number of the right lane of a pair of lanes that are separated by physical barriers (if any)
19	5 l-52	Identification number of the right lane of another pair of lanes that are separated by physical barriers (if any)
20	79-80	19

Record Type 19 is **required** for all of the links in the FRESIM subnetwork, and it is used to describe the physical properties (such as the number of lanes and their length) as well as the interconnections of each link that is to be modeled.

The TRAF model employs several link types. Traffic from outside the study area enters the simulation network through entry links, which are designated as such by specifying an upstream node number from 8000 to 8999 for Entry 1. For FRESIM, traffic is emitted from entry links, but it is not modeled on them. The length of the entry links should be left blank; consequently, statistics will not be provided. Only unidirectional links can be specified in FRESIM subnetworks.

Traffic discharges from a TRAF network through exit links, which are identified by downstream node numbers from 8000 to 8999. As in most of the other TRAF models, exit links in FRESIM are not explicitly modeled, and they are not specified on a link record. Exit links are inferred by the model when a node number from 8000 to 8999 is specified as a receiving node for traffic from another link.

When more than one simulation model is employed in a run, interface links receive traffic in **FRESIM** from an adjacent subnetwork. Interface links are specified by upstream node numbers from 7000 to 7999. Exit interface links, which receive traffic from FRESIM destined for another subnetwork, are specified by downstream node numbers from 7000 to 7999. Traffic is modeled explicitly on interface links, for which statistics are generated.

All of the other links are denoted as internal links.

Discussion of Selected Entries

1 For internal links, upstream node numbers must range from 1 to NMAX. The value of NMAX for this release of TRAF is provided under ‘Size Limitations” in the third chapter of this manual. For entry links, the value must range from 8000 to 8999. For entry interface links, the value must range from 7000 to 7999.

2 For internal links, downstream node numbers must range from 1 to NMAX (see Entry 1). Exit links must not be input. Exit interface links should have downstream node numbers that range from 7000 to 7999.

3 For each subject link **(i,j)**, the downstream node number k of the link (j,k), which receives through traffic, identifies this entry. For a freeway or on-ramp link, this entry refers to the freeway link immediately downstream.

4 The length of the freeway link extends from the upstream node to the downstream node. The maximum length of the link is 99,999 feet. Although there is no minimum length, values of less then 100 feet are not recommended.

5 There are two types of freeway links: mainline links and ramp links. A connector between two freeway segments consists of more than one ramp link.

6 The maximum number of through lanes for mainline links is five. A through lane is any lane that is not an auxiliary lane (as described under Entry 7). This number does not include auxiliary lanes for mainline links. The maximum number of through lanes for ramp links is three. (Note: The total number of through lanes for the entry link and its receiving link must be the same. The receiving link of the entry link cannot have **full** auxiliary lanes.)

7 Auxiliary lanes are any lanes that are directly fed by an on-ramp, that directly feed an off-ramp, or both. They can occur on the left or right side of the roadway. If the lane is on the right side of the roadway, the numbering convention is as follows:

9 The auxiliary lane closest to lane 1
10 The auxiliary lane second closest to lane 1
11 The auxiliary lane farthest from lane 1

If the lane is on the left side of the roadway, the numbering convention is as follows:

6 The auxiliary lane closest to the leftmost through lane
7 The auxiliary lane second closest to the leftmost through lane
8 The auxiliary lane farthest from the leftmost through lane

This lane-numbering system is shown in figure 5-4.

It is possible to have two different auxiliary lanes with the same identification number on the same link. For example, if there is both an acceleration lane and a deceleration lane (see Entry 8) on the right side, both lanes would be numbered as lane 9.

8 There are three types of auxiliary lanes: acceleration, deceleration, and full. An acceleration lane extends from the upstream end of a freeway link to a midlink position and must be fed by an on-ramp. A deceleration lane extends from a midlink position to the downstream end of a freeway link and must feed an off-ramp. A full auxiliary lane extends the full length of a freeway link, with at least one end connecting to an on-ramp or an off-ramp. Figure 5-5 depicts some of the typical auxiliary-lane configurations.

9 The length of the first auxiliary lane is entered here. This field should be specified for all auxiliary lane types, including full auxiliary lanes.

10-12 Same as Entries 7-9 but for another auxiliary lane.

13–15 Same as Entries 7–9 but for another auxiliary lane.

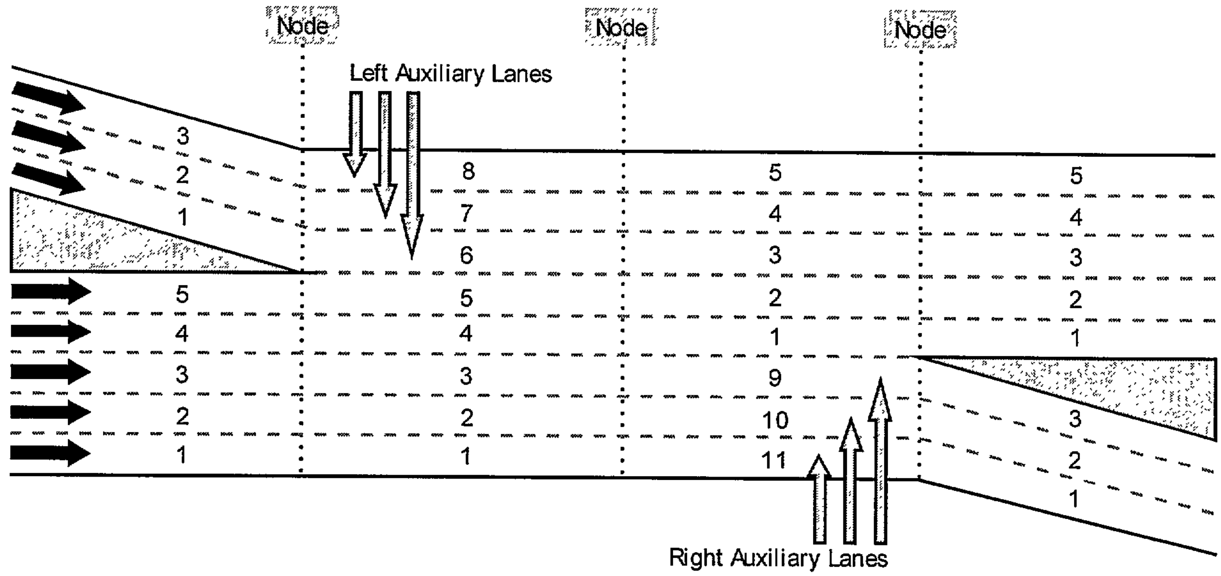


Figure 5–4. Freeway lane identification codes.

16 This entry establishes the lane alignment of adjacent through links. If the through movement is to an exit link, a "1" should be coded for this entry. This entry is extremely important because errors in this entry will cause the model to malfunction. The basic rule is that all lanes entering a node must feed one, and only one, lane leaving the node. The **only** exception is when an outside through lane feeds both a lane on a downstream through link and a lane on a downstream off-ramp link (see Entry 17). It is strongly recommended that a schematic drawing be made to show lane numbering. Some examples of lane alignment are shown in figure 5–6.

17 This entry establishes lane alignment between lanes on mainline links and off-ramps. This entry should be left blank if there is no downstream off-ramp. As on the mainline links, off-ramp lanes are numbered sequentially from right to left. Some examples are shown in figure 5–6. Like Entry 16, errors in Entry 17 will cause the model to malfunction.

18–19 The specification of lane barriers prevents lane changing between affected lanes in a pair. Each lane pair separated by a barrier is identified by the identification number of the right lane of the pair. Two barriers can be specified for each link. Barriers involving auxiliary lanes are allowed.

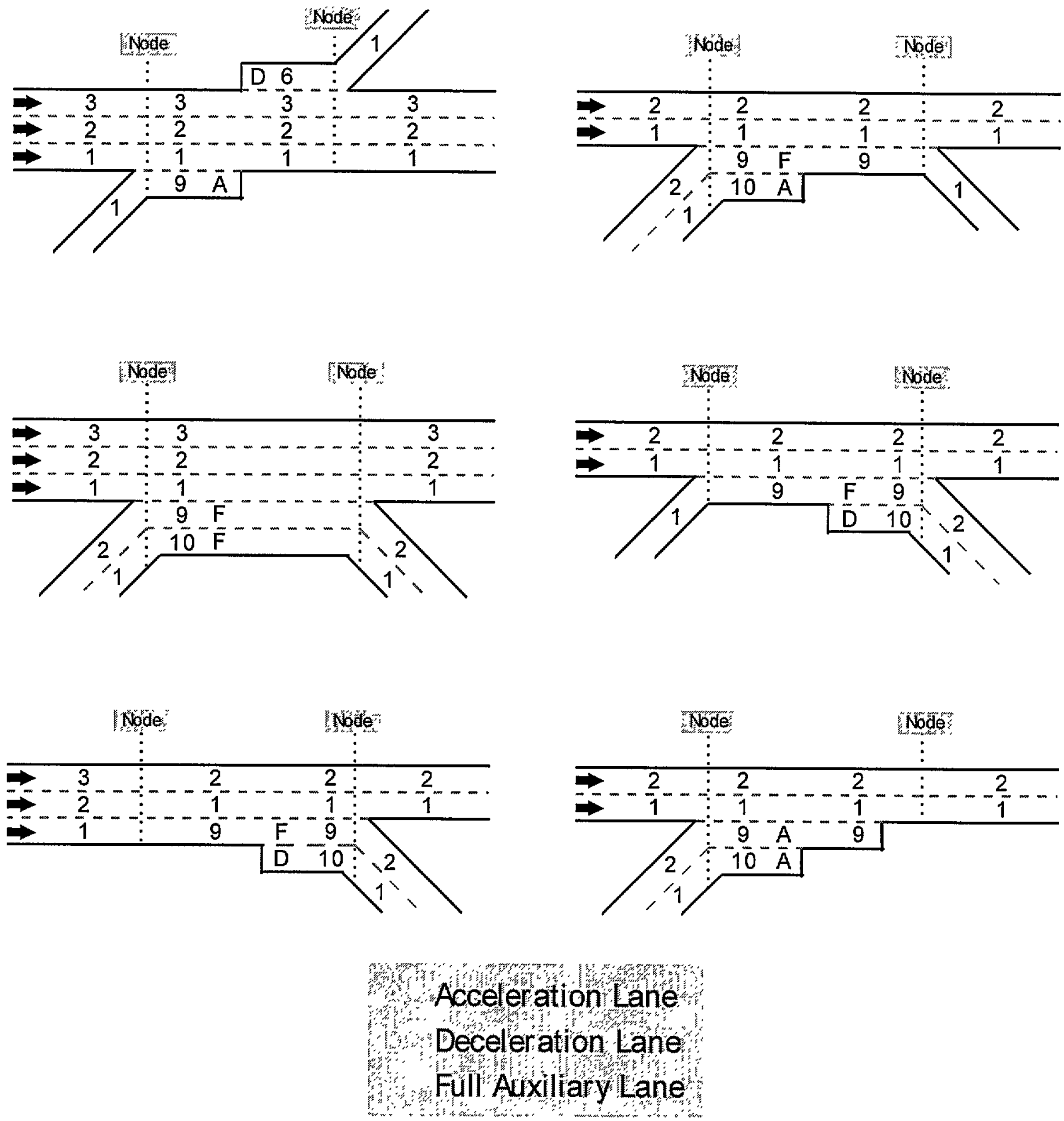


Figure 5-5. Typical freeway link configurations.

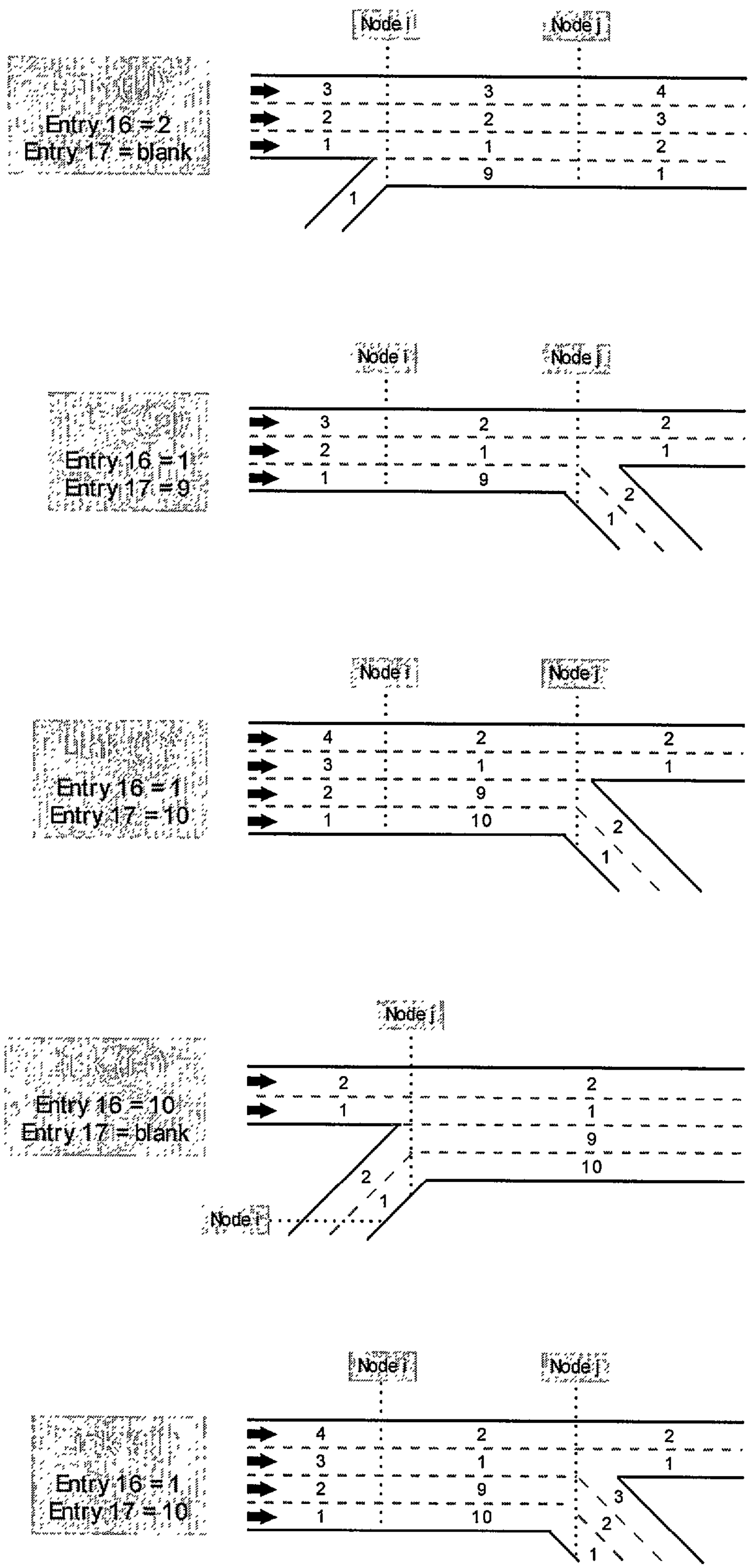


Figure 5-6. Examples of lane alignment.

20
Freeway Link Operation

Table 5-14. Record Type 20 – freeway link operation.

ENTRY	COLUMN	DESCRIPTION
1	1-4	Upstream node number i of subject link **(i,j)**
2	5-8	Downstream node number **j** of subject link **(i,j)**
3	9-10	Grade (in a percentage). Range = -9% **to +9%.**
4	1 l-12	Superelevation (in a percentage)
5	13-16	Radius of curvature (in feet). **Blank or** 0 denotes a tangent section.
6	18	Pavement code: **1** Dry pavement 2 Wet concrete 3 Dry asphalt 4 Wet asphalt
7	19-20	Mean start-up delay (in tenths of a second)
8	21-22	Desired free-flow speed (in miles per hour). If an entry link, this entry can be left **blank.**
9	24	Truck movement code: 0 Trucks are neither biased nor restricted (default) 1 Trucks are biased to a certain lane 2 Trucks are restricted to a certain lane
10	26	Identification number of the through lane to which trucks are biased or restricted. **Blank** if Entry 9 is blank or 0.
11	28	Truck directional code: 0 Trucks are restricted/biased to the right-hand lanes 1 Trucks are restricted/biased to the left-hand lanes
12	29-33	Distance (in feet) from the downstream end of this link to a warning sign at which drivers begin to react to the off-ramp exiting from this link. **Blank** if this link has no off-ramp destination.
13	34-38	Distance (in feet) from the freeway data station to the upstream node of the link. **Blank** if there is no station.
14	79-80	20

This record type is **required** for all of the links in the FRESIM subnetworks. The freeway link operation characteristics of this record complement the geometric characteristics of Record Type 19.

Discussion of Selected Entries

1-2 See Entries 1 and 2 on Record Type 19.

3 FRESIM is designed to accept link-specific grade as input. A continuous section of roadway that contains a significant change in gradient can be defined as two contiguous links, with a node at the point where the grade changes.

4 A change in superelevation is sufficient reason to divide a freeway section into two links. In FRESIM, one method for limiting speed on horizontal curves is to define superelevation, horizontal curvature, and pavement condition. The basic equation for vehicle operation on a curve, which is used to generate an upper bound for desired free-flow speed, is as follows:

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

where

V = Vehicle speed (in miles per hour)
R = Radius of curvature (in feet)
e = Rate of roadway superelevation (in feet/foot)
f = Friction coefficient for a given pavement condition

FRESIM applies the minimum of the input free-flow speed and the result of the above equation to traffic on the subject link.

5 The relationship between radius of curvature and vehicle speed is shown in the formula under Entry 4.

6 The pavement code determines the friction coefficient used in the formula under Entry 4. Values of the friction coefficient for each pavement type can be specified on Record Type 69.

7 The mean start-up delay is entered. Values are entered in tenths of a second; an entry of 24, for example, denotes 2.4 seconds. The maximum acceptable value is 9.9 seconds (i.e., an entry of 99). If left blank, a value of 1.0 second will be used. This input is used by the model to discharge stopped queues on the freeway, which occur under stop-and-go conditions.

8 The desired, unimpeded, mean free-flow speed that is attained by traffic, in the absence of any impedance due to other vehicles or control devices (see the "Level of Service A" in the chapter on freeways in *the Highway Capacity Manual).*

9 FRESIM can bias or restrict truck (and bus) movement on the mainline to specified lanes. The user is free to specify lanes that will be the target of trucks. The following kinds of truck behavior are allowed:

> Trucks can be biased to selected lanes. In this condition, trucks can pass other vehicles by leaving their bias lane and then returning to that lane after passing.

> Trucks can be restricted to a selected lane. In this condition, trucks are not allowed to leave their assigned lane to pass another vehicle.

10 This entry identifies the lane number to which trucks (and buses) are biased or restricted. Trucks will also be biased to all lanes to the left or right of this lane, as specified in Entry 11.

11 This entry identifies whether trucks are biased to the right or left lanes on the freeway. A blank or zero entry designates trucks as biased/restricted to the lane specified in Entry 10 and all lanes to the right of it. If the trucks are biased/restricted to the left lanes, a value of 1 must be coded.

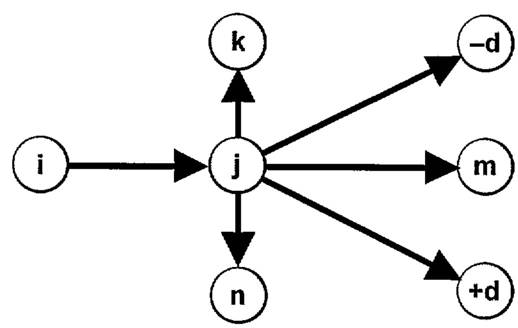
12 For a link with an off-ramp destination, this entry tells the model how far upstream of the downstream end of the link that vehicles destined to exit at the off-ramp begin to react to the exit's presence. At this distance, a vehicle will begin to enter the proper lane for exiting.

It is recommended that values of 2,500 feet or more be input. If the output indicates that a substantial number of vehicles are missing this exit (a message is printed every time this occurs), the distance should be increased.

13 The distance of the freeway data station from the upstream node of the link is specified. Leave blank if there is no data station on this link. A freeway data station is different from a detector station, which is defined on Record Types 28, 63, and/or 65. If a data station is specified with this entry, headway and speed statistics will be collected and printed across all freeway lanes at the specified position.

21
Surface Street Turn Movements

Table 5-15. Record Type 21 – surface street turn movements.

<table>
<tr><th>ENTRY</th><th>COLUMN(S)</th><th colspan="2">DESCRIPTION</th></tr>
<tr><td>1</td><td>1–4</td><td colspan="2">Link's upstream node number i for the first link (valid internal node numbers range from 1 ≤ number ≤ 750). Valid entry node numbers range from 8000 to 8999.</td></tr>
<tr><td>2</td><td>5–8</td><td colspan="2">Link's downstream node number j for the first link [cannot be an exit node (8###)]</td></tr>
<tr><td>3</td><td>9–12</td><td>Percentage of traffic (or vph) turning left to node k</td><td rowspan="4">
</td></tr>
<tr><td>4</td><td>13–16</td><td>Percentage of traffic (or vph) going through to node m</td></tr>
<tr><td>5</td><td>17–20</td><td>Percentage of traffic (or vph) turning right to node n</td></tr>
<tr><td>6</td><td>21–24</td><td>Percentage of traffic (or vph) turning diagonally to node –d (left) or node +d (right)</td></tr>
<tr><td>7</td><td>25</td><td colspan="2">0 Left-turn movement is allowed
1 Left-turn movement is prohibited</td></tr>
<tr><td>8</td><td>26</td><td colspan="2">0 Through movement is allowed
1 Through movement is prohibited</td></tr>
<tr><td>9</td><td>27</td><td colspan="2">0 Right-turn movement is allowed
1 Right-turn movement is prohibited</td></tr>
<tr><td>10</td><td>28</td><td colspan="2">0 Diagonal-turn movement is allowed
1 Diagonal-turn movement is prohibited</td></tr>
<tr><td>11</td><td>79–80</td><td colspan="2">21</td></tr>
</table>

Entries 3-6 are used when turn movement data are entered. Entries 7-l 1 are used when traffic assignment is being used to generate turn movement data.

Turn movement percentages only apply to cars, Carpools, and trucks. Bus turn movement data is based on the bus path data specified on Record Type 187. All traffic exiting on interface nodes must travel straight through to the next network. To allow for the collection of statistical data, if the upstream node is an entry node (8###), then the downstream node should be a dummy node, not an actual intersection. This condition will allow for the collection of statistics between the dummy node and the actual intersection. In this case, 100% of the traffic will travel through from the entry node through the dummy node to the actual intersection. New turn movement records can be entered for each time period to reflect the changes in turn percentages or traffic blockages. If a new record is not entered for a new time period, CORSIM will assume that the turn movement percentages and blockages for the previous time period apply to the new time period.

Record Type 2 1 is required for all intersections unless traffic assignment is used to generate turn movement data. If traffic assignment is used, then it is only used for links requiring explicit turn prohibitions such as "NO LEFT TURN." Those turn prohibitions should only be made when the network geometry allows for the turn movement. Inconsistent inputs (e.g., a nonzero turn volume specified for a prohibited movement) will be detected by the diagnostic software, and the run will be aborted with a message identifying the problem. Entries 7-10 are used by the traffic assignment model. They are ignored by the simulation models because any prohibition must be reflected by a zero value specified for the turn percentage in Entries 3-6.

22
Conditional Turn Movements

Table 5-16. Record Type 22 – conditional turn movements.

ENTRY	COLUMN(S)	DESCRIPTION
1	l-4	Upstream node number **i** of subject link **(i,j)** Conditional turn movements cannot be specified on entry links or entry interface links.
2	5-s	Downstream node number **j** of subject link **(i,j).** Conditional turn movements cannot be specified on exit interface links.
3	9-12	Percentage of vehicles or the total number of vehicles per hour turning left at node **j,** given that vehicles entered link **(i,j)** from a left-turn movement
4	13-16	Percentage of vehicles or the total number of vehicles per hour traveling through at node **j,** given that vehicles entered link **(i,j)** from a left-turn movement
5	17-20	Percentage of vehicles or the total number of vehicles per hour turning right at node **j,** given that vehicles entered link (i,j) from a left-turn movement
6	21-24	Percentage of vehicles or the total number of vehicles turning diagonally at node **j,** given that vehicles entered link (i,j) from a left-turn movement
7	25-28	Same as Entries 3-6 but for vehicles that have entered link (i,j) from a through movement
8	29-32	
9	33-36	
10	37-40	
11	41-44	Same as Entries 3-6 but for vehicles that have entered link (i,j) from a right-turn movement
12	45-48	
13	*49-52*	
14	53-56	
15	57-60	Same as Entries 3-6 but for vehicles that have entered link (i,j) from a diagonal movement
16	61-64	
17	65-68	
1s	69-72	
19	77-80	22

This record **type** is **optional,** and it **is** used to constrain vehicles from making a series of unrealistic turn movements. For example, the user may want to constrain vehicles from making a series of consecutive left turns (i.e., restrain vehicles from going around a block). The NETSIM model normally applies turn movement percentages specified on Record Type 2 1 to **all** vehicles entering a link, regardless of their previous path. Record Type 22 allows the user to define discharge turn percentages that are conditioned on the basis of entry movement. Therefore, the percentage of vehicles executing left turns after entering via a left turn can be made substantially less than the percentage of vehicles executing left turns after entering via a through movement.

If the user defines turn percentages on Record Type 22 for one entry movement-exit movement combination, he must define the discharge turn percentages for all other traffic entering from **that** direction.

When discharge turn percentages are defined for traffic entering from some directions and not from others, the traffic entering from the remaining directions is assigned discharge movements subject to the percentage of the **total** entering traffic executing each turn movement defined on Record Type 2 1. For example, if Record Type 22 indicates that 5% of the traffic that enters via right turns discharges via left turns and Record Type 21 indicates that 15% of the **total** traffic turns left, traffic entering via through and left movements would be assigned left turns because **15%** of **all** entering traffic would turn left.

When Record Type 22 is used to define discharge movements for **all** entering directions, it is not possible to satisfy the turn percentages specified on Record Type 2 1.

Record Type 22s can be input each time period to reflect changes in conditional turn movements over time. If the user wants to remove all conditional turn movements specified for a given link, then a Record Type 22 for that link, specifying only the upstream and downstream nodes, **must** be placed in a subsequent time period.

Discussion of Selected Entries

1 This entry is for internal links only; therefore, the upstream node number must range from 1 to 750.

2 Internal links must have downstream node numbers that range from 1 to 750.

3-6
7-10
11-14
15-18
The conditional turn movements specified on this record are presented as **percentages** of vehicles performing each movement at the downstream node of the subject link, or they are expressed consistently in terms of the **total number** of vehicles per hour that perform the perform the movements. These percentages or hourly volumes are applied over the duration of one time period. For subsequent time periods, this card needs to be used only to indicate changes in conditional turn movement specifications. Inputs on this record remain in effect until they are changed by another Record Type 22 for the same link.

When an upstream entering movement to the subject link has conditional turn movements assigned to the downstream node of the subject link, it is not required to assign conditional turn movements to all upstream entering movements. For each upstream entering movement affected, however, all vehicles entering from that direction must be accounted for. Therefore, if Entries 3-6 are specified, they must add to 100 (if percentages are used) or represent the total number of vehicles entering from the left.

23
Turn Movement Variations within a Time Period

Table 5-17. Record Type 23 – turn movement variations within a time period.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Upstream node number
2	5-8	Downstream node number
3	9-12	Time associated with turn movement data in the next four entries; elapsed time from the beginning of the time period (in minutes)
4	13-16	Count of left-turning vehicles or the percentage of left-turning traffic
5	17-20	Count of through vehicles or the percentage of through traffic
6	21-24	Count of right-turning vehicles or the percentage of right-turning traffic
7	25-28	Count of diagonal turning vehicles or the percentage of diagonal traffic
8	29-32	
9	33-36	
10	37-40	Same as Entries 3-7 but for another time period (at least 1 minute later)
11	41-44	
12	45-48	
13	49-52	
14	53-56	
15	57-60	Same as Entries 3-7 but for another time period (at least 1 minute later)
16	61-64	
17	65-68	
18	79-80	23

This record type is **optional.** It can be used to specify variations in turn movements within a time period. Up to five Record Type 23s can be specified for each entry link or internal link within a given time period, which allows the user to specify up to 15 variations in turn movements for each time period.

If a Record Type 23 and a Record Type 21 are entered for a particular link, then all turn movements entered on Record Type 23 will be used, and the turn movements on Record Type 21 will be ignored.

If a Record Type 23 is used for a particular link, then enter all the associated turn movements for the link, including starting turn movements and variations within the time period.

Discussion of Selected Entries

1 For internal links, upstream node numbers must range from 1 to 750. For entry links, the value must be between 8000 and 8999.

2 Internal links must have downstream node numbers that range from 1 to 750. Exit links and exit interface links must not be input.

3, 8, 13 The start time associated with the turn movements in the next four entries is entered here. This value is the elapsed time from the beginning of the simulation, and it is entered in minutes. Entry 8 must be at least 1 minute later than Entry 3, and Entry 13 must be at least 1 minute later than Entry 8. For example, if "0" is entered in Entry 3, then the value in Entry 8 must be at least "1," and the value in Entry 13 must be at least "2."

4, 9, 14 The count of left-turning vehicles or the percentage of left-turning traffic is entered here.

5, 10, 15 The count of through vehicles or the percentage of through traffic is entered here.

6, 11, 16 The count of right-turning vehicles or the percentage of right-turning traffic is entered here.

7,12,17 The count of diagonal-turning: vehicles or the percentage of diagonal traffic is entered here.

25
Freeway Turn Movements

Table 5-18. Record Type 25 - freeway turn movements.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Upstream node number **i** of subject link **(i,j)**
2	5–8	Downstream node number **j** of subject link **(i,j)**
3	9–12	Downstream node number **k** of link **(j,k)**, which receives through traffic from subject link **(i,j)**
4	13–16	Percentage of vehicles or the total number of vehicles that have a through movement to link **(j,k)**
5	17–20	Downstream node number **l** of an off-ramp that receives traffic exiting from subject link **(i,j)**
6	21–24	Percentage of vehicles or the total number of vehicles that exit at the off-ramp link **(j,l)**
7	79–80	25

When simulation is performed using FRESIM, this record type is required to specify turn percentages for every link that has an off-ramp emanating from its downstream end. If a link has only a through movement, this record can be omitted, and the model will assign a 100% turn percentage to the through link, as shown in Entry 3 of Record Type 19.

Discussion of Selected Entries

1–2 See Entries 1 and 2 on Record Type 19.

3 For each subject link **(i,j)**, the downstream node number **k** of the link **(j,k)**, which receives through-movement traffic, is entered here. For a freeway or an on-ramp link, this entry will usually be the next downstream freeway link.

4 The turn specifications on this record are presented as the percentage of the vehicles performing each movement at the downstream node of this link or the total number of vehicles per hour performing the movement. These percentages or hourly volumes are applied over the duration of one time period. For subsequent time periods, this record is optional and needs to be used only to indicate changes in turn specifications. Inputs on this record remain in effect until they are changed by another Record Type 25 for the same link in a subsequent time period.

If turn specifications are presented in the form of vehicles/hour, the model will internally convert these inputs to turn percentages. If any of the entries contains a percentage, then all of them must contain percentages. Similarly, if one entry contains a vehicle count, then all of the entries must contain a vehicle count.

5 For each mainline subject link **(i,j),** the downstream node number 1 of off-ramp link (j,l), which receives vehicles exiting from the mainline.

6 The turn fraction exiting at the off-ramp (a percentage or the total hourly flow of vehicles) (see Entry 4).

28
Freeway Surveillance Specification

Table 5-19. Record Type 28 – freeway surveillance specification.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Upstream node number **i** of subject link **(i,j)**
2	5–8	Downstream node number **j** of subject link **(i,j)**
3	9–12	Identification number of the lane in which the detector is located
4	13–16	Longitudinal location of the detector from the upstream end of the link (in feet)
5	17–20	Effective detector loop length (in feet)
6	21–24	Loop separation for a coupled pair of short loops (in feet)
7	28	Detector type code: **0** Doppler radar **1** Short loop **2** Coupled pair of short loops
8	31–32	Station number for this detector
9	79–80	28

This record type is optional, and it can appear in the input stream for the FRESIM model within the specifications for the first time period. The purpose of this input is to allow simulation of a surveillance system. Detectors are required if options such as incident detection or certain ramp-metering algorithms are used.

Discussion of Selected Entries

1–2 Node numbers that define the link at which a detector is located. Detectors are not permitted on entry, entry interface, exit, or exit interface links.

3 This entry specifies the lane in which the detector is located. Refer to the lane-numbering procedure in figure 5–3 for specification of the lane number.

4 This entry specifies the location of the detector, which is determined as follows:

- > **Single** loop-Distance from the upstream end of the loop to the upstream end of the link
- > **Double** loop-Distance from the downstream end of the downstream loop to the upstream end of the link
- > **Doppler radar-Distance** from the acquisition point of data to the upstream end of the link.

The detector upstream end or downstream end should **not be** at the same location as the internal node.

5 This entry specifies the effective detector loop length (in feet), which must be greater than zero and less than 50 feet. Each loop of a coupled pair must have the same effective loop length. Leave blank for Doppler radar detectors.

6 This entry specifies the distance (in feet) that separates the loops of a coupled pair. This value is defined as the distance between the downstream ends of the loops, and it must not exceed 20 feet. This field is ignored for other detector types.

7 This entry specifies the detector as one of three possible types.

8 This entry specifies the station number for this detector, which must be ≤ 50. If this entry is left blank, no station number will be assigned to this detector. This capability is provided because the usual practice in surveillance and control systems is to group a set of detectors across some or all of the lanes at the same longitudinal location as a station. If other detectors are specified for this same station (and this link), then additional Record Type 28s must be used to indicate the location of these detectors.

29

Freeway Incident Specification

Table 5-20. Record Type 29 – freeway incident specification.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Upstream node number i of subject link (i,j)
2	5–8	Downstream node number j of subject link (i,j)
3	10	Incident code and its effect for lane 1: 0 Normal speed 1 Traffic capacity reduced by the rubberneck factor at the point of the incident 2 Blockage at point of incident
4	12	Incident code for lane 2
5	14	Incident code for lane 3
6	16	Incident code for lane 4
7	18	Incident code for lane 5
8	20	Incident for third left auxiliary (lane S)
9	22	Incident for second left auxiliary (lane 7)
10	24	Incident for first left auxiliary (lane 6)
11	26	Incident for third right auxiliary (lane 11)
12	28	Incident for second right auxiliary (lane 10)
13	30	Incident for first right auxiliary (lane 9)
14	33-37	Longitudinal location of the upstream end of the incident from the upstream node (in feet)
15	40-44	Length of the roadway affected by the incident (in feet)
16	48-51	Time of onset of the incident (in seconds)
17	52-56	Duration of the incident (in seconds)
1s	61-64	Rubberneck factor (in a percentage)
19	65-69	Location of the upstream warning sign for blockage incidents
20	79-80	29

A comprehensive freeway incident simulation procedure is provided in FRESIM. The user can specify either blockages or “rubbernecking” to occur on a lane-specific basis. Each incident occurs at the specified longitudinal position on a freeway link, extends over the user-specified length of the roadway, and lasts for any desired length of time.

The character of an incident can change with time. For example, it is possible to specify a two-lane blockage that becomes a one-lane blockage after a specified duration. The lane from which the blockage is removed can then become unrestricted or subject to rubbernecking.

Rubbernecking can be applied, without a corresponding blockage, to simulate a shoulder incident. The user can enter a factor indicating the percentage reduction in capacity and the consequent reduction in speed for vehicles traversing the affected lane segment.

The following rules should be followed when coding a blockage incident:

- The length of the roadway that is blocked should be determined. A reasonable predictor of the affected roadway length is the number of vehicles involved plus 1. For example, a two-vehicle collision would be represented appropriately by a 60-foot blockage.
- Rubbernecking should be specified for the blocked lanes. The rubbernecking factor in FRESIM is simulated by increasing the distance at which vehicles follow each other by the amount of the factor entered. Therefore, a rubbernecking factor of 10% which has been shown to be appropriate in the simulation of Los Angeles incident data, results in a reduction in the capacity of the affected lane by 10%.
- A secondary incident that only consists of rubbernecking should extend downstream from the primary incident. The length of the affected roadway should be the same as for the primary incident.

Discussion of Selected Entries

1-2 Node numbers that define the link at which the upstream end of the incident is located. Incidents are not permitted on entry or entry interface links or on exit or exit interface links.

3-7 Incident code for lanes 1-5, respectively.

8-10 Incident codes for the third, second, and first left auxiliaries, respectively.

11-13 Incident codes for the third, second, and first right auxiliaries, respectively.

14 Longitudinal location of the upstream end of the incident (in feet) from the upstream node.

15 Length of the roadway affected by the incident (in feet). The affected length can exceed the length of the link.

16 Time of the onset of the incident (in seconds), which is measured from the start of the simulation. For a blockage incident that is being used to simulate a work zone, a value of 0 will place the blockage at the beginning of the initialization period.

17 Duration of the incident (in seconds).

18 The rubberneck factor (in a percentage) represents the reduction in capacity at the point of the incident for vehicles that are in lanes that have an incident code of 1.

19 The location of the upstream warning sign for a blockage incident that is being used to simulate a work zone. This entry represents a location (upstream of the incident) at which vehicles will respond to the blockage by attempting to lane-change away from the lane(s) affected by the blockage. This capability was designed to reflect the fact that signs are usually placed on the roadway to warn motorists that a work zone is ahead and to indicate which lanes are affected. The warning sign might be placed even further upstream from the blockage if the work zone is a long-term situation and if it is believed that motorists respond to it even before they reach the warning sign. This field should be set to a small value (a few feet) for nonrecurring incidents because motorists usually cannot respond to them until they see the blockages.

32
Freeway Lane Add and/or Drop

Table 5-21. Record Type 32 – freeway lane add and/or drop.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Upstream node number **i** of subject link **(i,j)**
2	5-8	Downstream node number **j** of subject link **(i,j)**
3	12	Lane add or drop code: **1** Lane add 2 Lane drop
4	14	Identification number of the lane being added or dropped
5	17-21	Distance from the upstream node to the end of the lane drop or to the beginning of the lane add (in feet)
6	22-26	Position of a warning sign, at which motorists respond to the lane drop (in feet)
7-10	32-50	Same as Entries 3-6 but for a second lane add or drop
11-14	52-72	Same as Entries 3-6 but for a third lane add or drop
15	79-80	32

A Record Type 32 must be specified whenever a **through lane** is added or dropped (see figure 5-7). This type of lane drop or add represents a case in which a lane drop has no destination or a lane add has no origin. This is in contrast to a lane drop or add at a node that is handled by auxiliary lanes (see Record Type 19).

Discussion of Selected Entries

1-2 Node numbers that define the link at which the lane is added or dropped. A lane add/drop is not permitted on entry or interface links or on exit or exit interface links.

3 The code that specifies a lane add or a lane drop.

4 The identification number of the lane being added or dropped can range from 1 to 5. Auxiliary lane adds and drops are handled on Record Type 19. Following each lane add or drop, the freeway lanes must be renumbered. Any subsequent designation of lanes must reflect the new

lane numbers. Figure 5–7, for example, shows a segment of a freeway with two successive lane drops. For the first lane drop, the identification number of the lane being dropped is 1. Following the renumbering of the lanes, the identification number of the second lane being dropped is also 1.

5 This entry denotes the distance from the upstream node to the end of the lane drop or to the beginning of the lane add (in feet). Two lanes cannot be added or dropped at the same position. There must be a minimum 1-foot separation between successive lane adds or drops in any combination.

6 This entry applies only to a lane drop and represents the distance upstream of the lane drop at which motorists begin to react. Motorist reaction consists of trying to change lanes away from the dropping lane. This distance does not necessarily refer to an actual sign, but to the point of reaction to the lane drop. The default value is 1,500 feet.

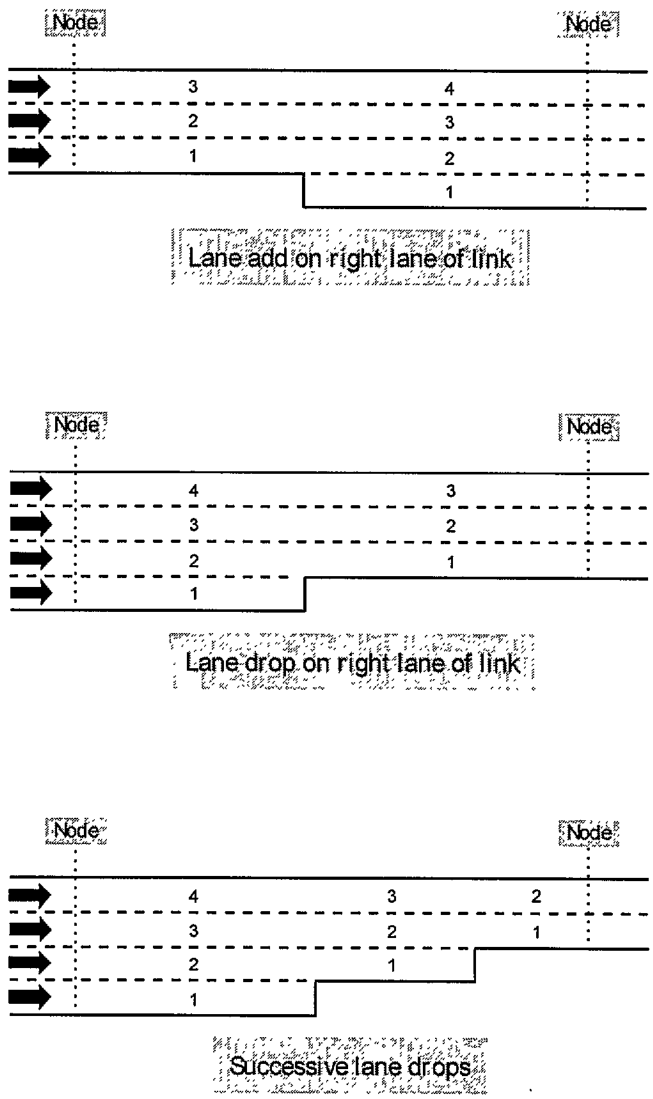


Figure 5–7. Examples of a lane add, a lane drop, and successive lane drops.

35
Sign or Pretimed Signal Control Timing

Table 5-22. Record Type 35 - sign or pretimed signal control timing.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Node number of the intersection
2	5–8	Reference offset to signal interval 1 (in seconds)
3	9–12	Upstream node number of **approach link 1**
4	13–16	Upstream node number of **approach link 2**
5	17–20	Upstream node number of **approach link 3**
6	21–24	Upstream node number of **approach link 4**
7	25–28	Upstream node number of **approach link 5**
8	30–32	Duration of **signal interval 1** (in seconds) **($1 \leq X \leq 120$)**
9	34–36	Duration of **signal interval 2** (in seconds) **($1 \leq X \leq 120$)**
10	38–40	Duration of **signal interval 3** (in seconds) **($1 \leq X \leq 120$)**
11	42–44	Duration of **signal interval 4** (in seconds) **($1 \leq X \leq 120$)**
12	46–48	Duration of **signal interval 5** (in seconds) **($1 \leq X \leq 120$)**
13	50–52	Duration of **signal interval 6** (in seconds) **($1 \leq X \leq 120$)**
14	54–56	Duration of **signal interval 7** (in seconds) **($1 \leq X \leq 120$)**
15	58–60	Duration of **signal interval 8** (in seconds) **($1 \leq X \leq 120$)**
16	62–64	Duration of **signal interval 9** (in seconds) **($1 \leq X \leq 120$)**
17	66–68	Duration of **signal interval 10** (in seconds) **($1 \leq X \leq 120$)**
18	70–72	Duration of **signal interval 11** (in seconds) **($1 \leq X \leq 120$)**
19	74–76	Duration of **signal interval 12** (in seconds) **($1 \leq X \leq 120$)**
20	77–78	Minimum main-street-green duration during transition. Minimum value = **10 seconds. Blank** for Time Period 1.
21	79–80	35

Record Type 35 identifies the approaches to an intersection as well as the signal intervals for that intersection. This record is used with Record Type 36 to define sign and pretimed signal control at an intersection (see the section on “Sign and Signal Control for Record Types 35 and 36”).

36
Sign or Pretimed Signal Control Codes

Table 5-23. Record Type 36 – sign or pretimed signal control codes.

ENTRY	COLUMN(S)	DESCRIPTION	
1	1–4	Node number of the intersection (≤750)	
2	6	Control code for approach link 1	Interval number 1
3	7	Control code for approach link 2	
4	8	Control code for approach link 3	
5	9	Control code for approach link 4	
6	10	Control code for approach link 5	
7	11	Control code for approach link 1	Interval number 2
8	12	Control code for approach link 2	
9	13	Control code for approach link 3	
10	14	Control code for approach link 4	
11	15	Control code for approach link 5	
12	16	Control code for approach link 1	Interval number 3
13	17	Control code for approach link 2	
14	18	Control code for approach link 3	
15	19	Control code for approach link 4	
16	20	Control code for approach link 5	
17	21	Control code for approach link 1	Interval number 4
18	22	Control code for approach link 2	
19	23	Control code for approach link 3	
20	24	Control code for approach link 4	
21	25	Control code for approach link 5	

ENTRY	COLUMN(S)	DESCRIPTION	
22	26	Control code for approach link 1	Interval number 5
23	27	Control code for approach link 2	
24	28	Control code for approach link 3	
25	29	Control code for approach link 4	
26	30	Control code for approach link 5	
27	31	Control code for approach link 1	Interval number 6
28	32	Control code for approach link 2	
29	33	Control code for approach link 3	
30	34	Control code for approach link 4	
31	35	Control code for approach link 5	
32	36	Control code for approach link 1	Interval number 7
33	37	Control code for approach link 2	
34	38	Control code for approach link 3	
35	39	Control code for approach link 4	
36	40	Control code for approach link 5	
37	41	Control code for approach link 1	Interval number 8
38	42	Control code for approach link 2	
39	43	Control code for approach link 3	
40	44	Control code for approach link 4	
41	45	Control code for approach link 5	
42	46	Control code for approach link 1	Interval number 9
43	47	Control code for approach link 2	
44	48	Control code for approach link 3	
45	49	Control code for approach link 4	
46	50	Control code for approach link 5	
47	51	Control code for approach link 1	Interval number 10
48	52	Control code for approach link 2	
49	53	Control code for approach link 3	
50	54	Control code for approach link 4	
51	55	Control code for approach link 5	

<table>
<tr><th>ENTRY</th><th>COLUMN(S)</th><th colspan="2">DESCRIPTION</th></tr>
<tr><td>52</td><td>56</td><td>Control code for approach link 1</td><td rowspan="5">Interval
number
11</td></tr>
<tr><td>53</td><td>57</td><td>Control code for approach link 2</td></tr>
<tr><td>54</td><td>58</td><td>Control code for approach link 3</td></tr>
<tr><td>55</td><td>59</td><td>Control code for approach link 4</td></tr>
<tr><td>56</td><td>60</td><td>Control code for approach link 5</td></tr>
<tr><td>57</td><td>61</td><td>Control code for approach link 1</td><td rowspan="5">Interval
number
12</td></tr>
<tr><td>58</td><td>62</td><td>Control code for approach link 2</td></tr>
<tr><td>59</td><td>63</td><td>Control code for approach link 3</td></tr>
<tr><td>60</td><td>64</td><td>Control code for approach link 4</td></tr>
<tr><td>61</td><td>65</td><td>Control code for approach link 5</td></tr>
<tr><td>62</td><td>77</td><td colspan="2">Code [0,1] if the intersection [is not, is] to be modeled as a micronode</td></tr>
<tr><td>63</td><td>79–80</td><td colspan="2">36</td></tr>
</table>

Intersections designated as micronodes in Entry 62 are modeled in detail and include the following:

- The behavior of left-turners who "hang" within the intersection
- The lane blockages caused by pedestrians in the crosswalk
- Driver responses to accidents or vehicle breakdowns that occur within the intersection.

Output statistics for each micronode include the number of traffic conflicts, fuel consumption, and pollutant emissions.

Sign and Signal Control for Record Types 35 and 36

Approaches must be coded in sequence with no gaps. For example, if there are three approaches to an intersection, they must be coded sequentially (approaches 1,2, and 3). Approaches 4 and 5 do not exist.

For uncontrolled nodes, a code of 1 is used to indicate no control, i.e., a perpetual green ball for that approach. For sign control, a code of 5 is used for stop signs, and a **code** of 0 is used for yield signs.

Record Types 35 and 36 can also be used to define the pretimed signal control for NETSIM intersections. The models can simulate a multiple-dial traffic control system in which pretimed timing plans can vary in offset, interval durations, and signal codes from one timing plan to another.

To simulate a multiple-dial system, the user must specify the type of transition between signal timing plans. This is **not** done on the pretimed signal records, but on Record Type 02 (pretimed signal transition algorithm). Three transitions are possible: immediate transition; two-cycle transition; and three-cycle transition. The transition to a new timing plan occurs the first time a controller reaches main street green after the beginning of a new time period. The user **must** specify that interval number 1 is coded as main street green on Record Types 35 and 36. Because no transition can occur for the first timing plan, no minimum value for main street green (Entry 20) can be specified for Time Period 1. Even if only some of the controllers change their timing from one timing plan to another, **all** intersections must have their timing specified for the new timing plan.

The codes that define the signs and signal indications for each approach for each signal interval are shown in figure 5-8. The signal codes are placed on Record Type 36 in groups of five to define each signal interval for the intersection. The groups of five represent the five possible approaches to each intersection, which can be controlled for each interval.

Amber intervals for single movements (e.g., left-turn arrows and right-turn arrows), with other movements retaining the green, are computed internally by the models. For these movements, the user specifies an amber code for the approach for the movement specific amber interval. The user then specifies the appropriate code for the green indications in the subsequent interval. TRAF internally computes to which movement(s) the amber is applied.

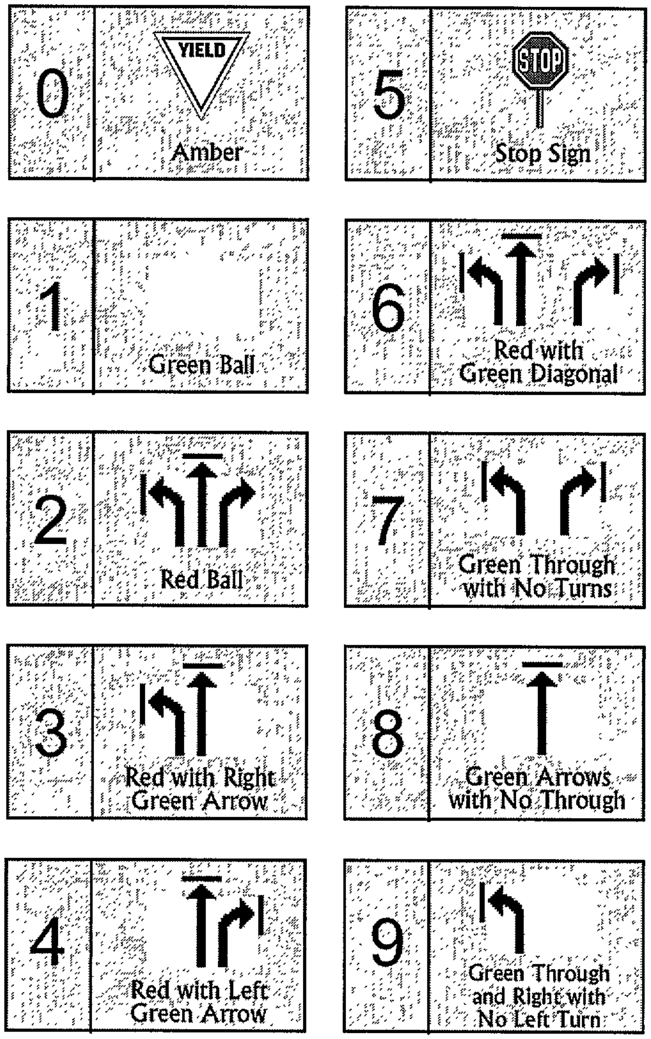


Figure 5-8. Sign and pretimed signal control codes.

37

Freeway Metering

Table 5-24. Record Type 37 - freeway metering.

ENTRY'	COLUMN(S)	DESCRIPTION
1	**1-4**	Node number at which the metering signal is located. A metering signal **cannot** be specified at interface and entry nodes.
2	8	Ramp-metering codes and their corresponding control strategy: **1** Clock-time metering 2 Demand/capacity metering 3 Speed control metering 4 Gap acceptance merge control metering
3	9-12	Time for the onset of metering (in seconds) from the beginning of the simulation
4	13-16	Metering headway (in seconds) for **clock-time metering.** This field is ignored for demand/capacity, speed control, and gap acceptance merge control metering strategies.
5	17-20	Capacity of freeway (in vehicles per hour) for **demand/capacity metering.** This field is ignored for clock-time, speed control, and gap acceptance merge control metering strategies.
6	21-24	**First** speed threshold (in miles per hour) for **speed control metering.** This field is ignored for clock-time, demand/capacity, and gap acceptance merge control metering strategies.
7	25-28	Metering headway corresponding to the **first** speed threshold specified in Entry 6
8	29-32	**Second** speed threshold (in miles per hour) for **speed control metering.** This value is required to be less than the value specified in Entry 6. This field is ignored for clock-time, demand/capacity, and gap acceptance merge control metering strategies.
9	33-36	Metering headway corresponding to the **second** speed threshold specified in Entry 8
10	37-40	**Third** speed threshold (in miles per hour) for **speed control metering.** This value is required to be less than the value specified in Entry 8. This field is ignored for clock-time, demand/capacity, and gap acceptance merge control metering strategies.
11	41-44	Metering headway corresponding to the **third** speed threshold specified in Entry 10

ENTRY	COLUMN(S)	DESCRIPTION
12	**45-48**	Minimum acceptable gap (in tenths of a second) for **gap acceptance merge control metering.** This field is ignored for clock-time, demand/capacity, and speed control metering strategies.
13	79-80	37

Four types of on-ramp control strategies can be implemented in the FRESIM model:

1 **Clock-time metering**

2 **Demand/capacity metering**

3 **Speed control metering**

4 **Gap acceptance merge control metering.**

A link-node representation for a typical metering application is shown in figure 5-9, which has a ramp signal located at node b. Links **(a,b)** and **(b,c)** constitute portions of the ramp feeding the freeway. Links **(d,c)** and (c,e) are freeway links. All of the links depicted in the figure must be **internal** freeway links.

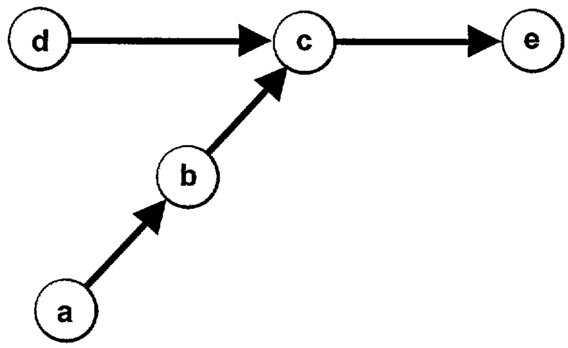


Figure 5-9. Typical ramp-metering configuration.

Discussion of Selected Entries

1 Node number designating the location on the on-ramp that is being metered by a signal. This node is usually just upstream of the node representing the merge point with the freeway.

2 This entry identifies the type of metering that is being applied.

3 The time of onset for metering is entered here, measured **from** the beginning of the simulation. If left blank or entered as a zero, the metering will start at the beginning of initialization.

4 The metering headway, in seconds, for clock-time metering is entered here. To simulate clock-time control of on-ramp, one fixed heading is specified at each node. A count-down clock is assigned to each associated on-ramp and the signal is set to green each time the clock returns to zero.

A noncompliance percentage, currently 5%, is applied arriving during the red signal. The indicated percentage of vehicles will be discharged during the red signal.

This entry is the inverse of the metering rate. This field is ignored for demand/capacity, speed control, and gap acceptance merge control strategies.

5 If demand/capacity metering is selected in Entry 2, then the capacity of the freeway should be entered here (in vehicles per hour per lane). An evaluation of current excess capacity, immediately downstream of the metered on-ramp, is performed at given intervals, based on counts from the surveillance detectors on the freeway mainline (see below). A maximum metering rate is calculated such that the capacity of this freeway section is not violated. This metering rate is applied like clock-time metering. A minimum metering rate of three vehicles/60 seconds is applied to ensure that waiting vehicles are not trapped between the meter and the ramp connection to the freeway. The metering rate is also limited to headways that are greater than 2 seconds.

In addition to the specification of the capacity, the user must specify the detectors on the link that will provide the input to the metering algorithm (see Record Types 28 and 38). This field is ignored for clock-time, speed control, and gap acceptance merge control strategies.

6 If speed control metering is selected in Entry 2, then the first speed threshold is entered here, in miles per hour. The procedure for this form of ramp metering is similar to the demand/capacity strategy procedure. 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 detector location will be upstream of the on-ramp, although the logic does 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 prevailing speed at the datum freeway station is compared to the tabulated speed minimums to determine the proper metering rate.

The metering signal is set to the metering rate specified in Entry 7 if speed (as measured by the detector identified in the corresponding Record Type 38 for this node number) is below the speed threshold specified in this entry. If the detected speed is greater than the highest threshold speed, the meter is set to the maximum rate. Additionally, speed thresholds must be arranged in descending order (i.e., Entry 6 > Entry 8 > Entry 10).

A Record Type 28 and 37 must be specified for each link controlled by this type of metering strategy. This field is ignored for clock-time, demand/capacity, and gap acceptance merge control strategies.

7 This entry specifies the headway (in seconds) that corresponds to the first speed threshold for speed control metering.

8-9 Same as Entries 6 and 7 but for a second speed threshold. For speed control metering only.

10-11 Same as Entries 6 and 7 but for the third speed threshold. For speed control metering only.

12 If gap acceptance merge control metering is selected in Entry 2, then the minimum acceptable gap, in tenths of a second, is specified in this entry. In this type of ramp control, ramp vehicles are released by the control signal so as to merge smoothly in gaps, expressed in units of time and detected in the outside freeway lane. The input required to implement this procedure is simplified such that no evaluation period or metering rate criterion is required. A coupled pair of detector loops has to be defined on Record Types 28 and 38 in the outside lane of the upstream freeway link.

Gaps detected in the traffic stream are projected downstream to the merge point. The merge point gap size is adjusted to reflect the relative speeds of the leading and following vehicles. The user must ensure that the following conditions do not exist:

- 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 that it greatly affects the accuracy of the projected gap size.

The field is ignored for clock-time, demand/capacity, and speed control strategies.

38

Freeway Metering Detector Specification

Table 5-25. Record Type 38 – freeway metering detector specification.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Node number for the metering signal
2	5–8	Upstream node of freeway link with detectors associated with this metering signal
3	9–12	Downstream node of freeway link with detectors associated with this metering signal
4	15–16	Lane number for the detector used for measuring the freeway link. Lane numbers are those specified on Record Type 19 for this link.
5	17–20	Longitudinal position of the detector in the lane specified in Entry 4 (in feet) from the upstream node
6–7	23–28	Same as Entries 4 and 5 but for another lane
8–9	31–36	
10–11	39–44	
12–13	47–52	
14–15	55–60	
16–17	63–68	
18	79–80	38

Record Type 38, which complements Record Type 37, defines the location of the detectors necessary for the application of three types of metering strategy:

1. **Demand/capacity**
2. **Speed control**
3. **Gap acceptance merge control.**

Surveillance records (Type 28) must also be specified for all of the detectors identified on Record Type 38.

Discussion of Selected Entries

1 Node number at which the metering signal is located.

2 Upstream node of the freeway link that contains detectors used in measuring freeway performance to control metering.

3 Downstream node of the freeway link that contains detectors to be used in measuring freeway performance to control metering.

4 Lane identification number in which the detector being used is located. The detector specified for this entry will measure the following:

> Freeway volume for demand/capacity metering

> Freeway speed for speed control metering

> Speed and size of gap (from coupled loop detectors) for gap acceptance merge control metering.

5 The distance (in feet) between the upstream node and the detector located in the lane specified in Entry 4 is entered in this field. This field should be identical to the location specified on the corresponding surveillance specification record (Type 28) for this detector.

The remaining entries apply only to the demand/capacity strategy, and they associate the detectors in other lanes with the ramp control located at this node; otherwise, their descriptions are the same as Entries 4 and 5.

42
Surveillance Detector Specification

Table 5-26. Record Type 42 – surveillance detector specification.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Upstream node number of the link containing the surveillance detector
2	5–8	Downstream node number of the link containing the surveillance detector
3	12	Number of the **first** lane in which the sensor is located (lane A)
4	13	Number of the **second** lane in which the sensor is located (lane B)
5	16–20	Distance of the trailing edge of the detector sensing zone from the stop line (in tenths of a foot or meter)
6	23–26	Detector station number (optional)
7	29–32	Sensor length (in tenths of a foot or meter)
8	35	Detector operation code: **1** Passage **0** Presence
9	79–80	42

This record is used to specify surveillance detectors in a NETSIM subnetwork. Although Record Type 42 can only appear in the first time period, the detectors that are specified will be active during Time Periods 2–19.

During simulation, a detector measures the "presence" or "passage" of a vehicle. NETSIM collects and processes such information when a vehicle activates a detector. These raw data form the basis on which such statistics as volume, occupancy, and speed are computed and cumulated. The user can specify the cumulative output or the frequency of the intermediate output of these statistics on Record Type 64.

A detector can be of any type as long as its detection is based on the principle of "sensing" passage or presence. In the CORSIM simulation environment, the user cannot distinguish whether a detector identifies passage or presence. Many detectors, such as loop detectors, operate on the basis of passage **or** presence detection. Algorithms are embedded in CORSIM to realistically mimic the detector data-processing logic.

Currently, a maximum of 300 detectors can be specified in a surface-street network, and no more than 40 detectors can be located on a single link. See Record Type 64 for more details on detector output.

Discussion of Selected Entries

3 A detector can be assigned to any moving lane. The lane number entered must conform to the NETSIM lane-numbering convention (see Record Type 11). If a 9 is coded as either lane A or B, then the detector is assumed to span all lanes, including pockets. If an 8 is coded as either lane A or B, then the detector is assumed to span all full lanes (this does not include turn pockets).

4 As above, the number of another lane covered by the sensor can be entered.

5 The sensing zone is defined as having a leading and trailing edge. The leading edge is defined to be the edge furthest upstream. The trailing edge is furthest downstream (i.e., closest to the stop line). The distance of the trailing edge to the stop line would be placed in this entry (in tenths of a foot or meter).

6 The station number of this detector can be defined in this entry. This optional entry must be numeric.

7 The length of the sensing zone (as described in Entry 5) must be coded (in tenths of a foot or meter).

8 The detector type is coded in this entry. An entry of 1 specifies a passage detector, while an entry of 0 specifies a presence detector. A passage detector will provide vehicle counts and average speeds. A presence detector will provide vehicle counts, average speeds, cumulative activation time (on time), and occupancy. All of these measures are cumulative from the beginning of the simulation.

43

Approach Configuration for NETSIM Actuated Controller

Table 5-27. Record Type 43 – approach configuration for NETSIM actuated controller.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Internal node **j** that identifies the actuated controlled intersection. Range = **1 ≤ node number ≤ 750. Cannot** be an entry, exit, centroid, or interface node.
2	5–8	Upstream node number of the **first or sixth** link that is designated as an approach to the actuated intersection. Range = **1 ≤ node number ≤ 750** for an internal link **or 7000 ≤ node number ≤ 7999** for an interface link.
3	9–12	Downstream node number of the **first or sixth** link that is designated as an approach to the actuated intersection. Range = **1 ≤ node number ≤ 750** for an internal link **or 7000 ≤ node number ≤ 7999** for an interface link.
4	13–16	Upstream node number of link number **2 or 7**
5	17–20	Downstream node number of link number **2 or 7**
6	21–24	Upstream node number of link number **3 or 8**
7	25–28	Downstream node number of link number **3 or 8**
8	29–32	Upstream node number of link number **4 or 9**
9	33–36	Downstream node number of link number **4 or 9**
10	37–40	Upstream node number of link number **5 or 10**
11	41–44	Downstream node number of link number **5 or 10**
12	45–48	Sequence number of this node: **0** **First** Record Type 43 **1** **Second** Record Type 43
13	77	Code **[0,1]** if the intersection [is not, is] to be modeled as a micronode. This entry is for **NETSIM** only.
14	79–80	43

This record is used to identify approaches to an intersection that is controlled by an actuated signal controller. At least one Record Type 43 should be specified for each intersection within the NETSIM subnetwork that has actuated signal control. These records can only appear within the input stream for the NETSIM submodel during the first time period. If no NETSIM intersections have actuated control, this record is omitted.

Actuated intersections are described to the model through the use of Record Types 43-48. These record types are coded **instead** of Record Types 35 and 36. These latter record types are used only for intersections with signs or fixed time signal control.

A separate Record Type 43 must be input for each actuated controller node specified. Up to 100 nodes can have actuated controllers. The data on this record define all links serviced and/or referenced by this controller. Up to 10 links can be specified, but only five links can be approaches to the node. If more than five links are serviced/referenced by this controller, a second Record Type 43 must be specified for this intersection. Generally, most (if not all) of the specified links are approach links to the node at which the actuated controller is located. On occasion, one or more of these links **cannot** be approaches to the node specified in Entry 1. However, such links can still have detectors present that will affect the operation of the node. The approaches to the actuated controlled node must be specified first. There should be a one-to-one mapping between the order of the first five approaches on this record and the specification of allowable movements on Record Type 45. Detector data are also entered on Record Type 46 through the specification of approach numbers.

Actuated controllers can only be placed at intersections that are represented by **internal** nodes (see the description of Entry 1). Entry, exit, centroid, or interface nodes must not be specified with actuated control.

Approaches to an intersection with actuated control must not be entry links. Because entry links in urban subnetworks have zero length, there is no way for TRAF to accurately represent detector actuations on entry links. When a peripheral node of a network (i.e., one that services entry link approaches) is controlled with an actuated signal, it is necessary for the user to introduce a dummy node between the entry node and the node controlled by the actuated signal. This is explained in the description of Entries 2-l 1 below.

Discussion of Selected Entries

1 A link controlled by an actuated signal must be either an internal link or an entry interface link. Entry 1 identifies the intersection at which the actuated signal is located. This intersection is the downstream node of each of the approach links to the intersection. This downstream node number must range from 1 to NMAX. The value of NMAX is 750.

2-11 These entries define the upstream node number and downstream node number of each link controlled by the actuated signal located at the node identified in Entry 1. These approach links must be either internal links or entry interface links. Therefore, these upstream node numbers must range from 1 to NMAX (see Entry 1) or be between 7000 and 7999. An entry link (upstream node number between 8000 and 8999) cannot be serviced by an actuated controller. When a peripheral node of a network (i.e., one that services entry link approaches) is controlled with an actuated signal, it is necessary for the user to introduce a dummy node.

12 This entry defines the number of Record Type 43s input for a given actuated controller node. The default value is 0, which represents the first Record Type 43 for the node. A value of 1 for this entry represents a second Record Type 43. Currently, only two Record Type 43s (which specify up to 10 approach links) can be specified for an actuated controller node.

13 Intersections designated as micronodes are modeled in detail and include the following:

> The behavior of left-turners who “hang” within the intersection
> The lane blockages caused by pedestrians in the crosswalk
> Driver responses to accidents or vehicle breakdowns that occur within the intersection.

Output statistics for each micronode include the number of traffic conflicts, fuel consumption, and pollutant emissions.

44

Coordination for NETSIM Actuated Controller

Table 5-28. Record Type 44 - coordination for NETSIM actuated controller.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Node number for the intersection operating under actuated signal control
2	5–7	Cycle length (in seconds)
3	8–10	Yield point (in seconds)
4	11–13	Time when permissive period 1 begins (in seconds)
5	14–16	Time when permissive period 1 ends (in seconds)
6	17–19	Time when permissive period 2 begins (in seconds)
7	20–22	Time when permissive period 2 ends (in seconds)
8	23–25	Time when permissive period 3 begins (in seconds)
9	26–28	Time when permissive period 3 ends (in seconds)
10	29–31	Force-off time for **phase 1**
11	32	Number of a leading side-street left-turn phase that can be extended beyond its normal force-off time **when no pedestrian demand exists. Blank** if none.
12	33–34	Number of seconds that the force-off can be extended for the phase identified in Column 32. This entry must be **0 or blank** if Column 32 is 0 or blank; otherwise, it must be non-zero.
13	35–37	Force-off time for **phase 3**
14	38–40	Force-off time for **phase 4**
15	41–43	Force-off time for **phase 5**
16	44	Number of another leading side-street left-turn phase that can be extended beyond its normal force-off time **when no pedestrian demand exists. Blank** if none.
17	45–46	Number of seconds that the force-off can be extended for the phase identified in Column 44. This entry must be **0 or blank** if Column 44 is 0 or blank; otherwise, it must be non-zero.
18	47–49	Force-off time for **phase 7**
19	50–52	Force-off time for **phase 8**

ENTRY	COLUMN(S)	DESCRIPTION
20	53-55	Permissive period codes for **phase 1**
	53	Code [0, 1] if sync phases [cannot, can] yield to phase 1 during the **first** permissive period
	54	Code [0, 1] if sync phases [cannot, can] yield to phase 1 during the **second** permissive period
	55	Code [0, 1] if sync phases [cannot, can] yield to phase 1 during the **third** permissive period
21	59-61	Permissive period codes (same as Entry 20) for **phase 3**
22	62-64	Permissive period codes (same as Entry **20)** for **phase 4**
23	65-67	Permissive period codes (same as Entry **20)** for **phase 5**
24	71-73	Permissive period codes (same as Entry 20) for **phase 7**
25	74-76	Permissive period codes (same as Entry **20)** for **phase 8**
26	79-80	44

A Record Type 44 must be introduced when actuated (nonpretimed) coordination is present. One of these records is required for each such node. In the coordination mode, phases 2 and 6 are the "coordinating phases" (sometimes referred to as "sync phases"); i.e., they are the phases that yield during the permissive periods to allow a conflicting phase to be served if there is a vehicle or pedestrian demand. Thus, in the absence of a call, the controller will rest in main-street-green, phases 2 and 6. For coordinated operation, the sync phases (2 and 6) should be placed on minimum vehicle recall, Entry 22 on Record Type 47.

Coordination is defined by the sync phases. When the yield point is reached, the sync phases can terminate if in a permissive period. After sync phase termination, the other phases are served in their normal sequence, provided there is demand (calls).

The nonsync phases can terminate by gapout, maxout, or force-off point, whichever occurs first. Any remaining phase time becomes available to **the next phase (in sequence) for which there is a call.** After termination of the last phase, the controller will return and remain in the sync phase until the yield point is again reached.

If a Record Type 44 is not included, the controller will operate in a noncoordinated, or free, fully actuated mode. Semiactuated operation is simulated by placing the appropriate nonactuated phases in maximum vehicle recall on Record Type 47. The nonactuated phases would not need detectors.

Note that force-off times and **permissive periods** are not defined for the sync phases. The sync phases are always permitted and yield only when a call exists on a phase during a permissive period.

Discussion of Selected Entries

1 Internal node number at which the actuated controller is located. This node **must** correspond to a node identified on a Record Type 43.

2 This entry identifies the cycle length specified for the coordinated signal system.

3 This entry specifies the yield point, which is defined to the end of the sync phase.

4 This entry specifies the **begin time** for the **first defined permissive period.**

Up to three permissive periods are allowed. During these periods, calls can be answered for phases other than the sync phases. Each permissive period has a begin time and an end time. The phases that can be yielded to in each permissive period are defined in Entries 20-25. Permissive periods can overlap; i.e., the **beginning** time for one can occur before a previous permissive period has ended. Once the controller yields, all subsequent permissive periods are disabled for that cycle and the controller will then sequence normally from that point depending on the demand. Once the controller returns to the sync phase during a cycle, it will stay in the sync phase until the next yield point.

5 This entry specifies the **end time** for the **first defined permissive period.**

6-7 Same as Entries 4 and 5 but for the second permissive period.

8-9 Same as Entries 4 and 5 but for the third permissive period. Leave blank if Entries 6 and 7 are blank.

10 A force-off causes an actuated controller to terminate the active phase, and to go to the next phase in the signal sequence requesting the right of way. Force-off times should be specified for every defined phase except for the sync phases (2 and 6). The force-off entry for phase 1 is made to this location.

11-12
16-17 Preset signal splits based on **pedestrian timing requirements** can be dynamically altered by the simulated controller when no side street pedestrian demand exists. This feature causes the controller to skip the side street pedestrian phase when no demand exists and extend the force-off time for the leading left turn side street phases. For the controller to operate in this manner, the number of the leading left turn side street phases must be input in Entries 11 and 16. These phase numbers are normally but not necessarily 3 and 7. The amount of time that the force-off can be extended for these phases in the absence of pedestrian demand is specified in Entries 12 and 17.

13-15
18-19 Same as Entry 10 but for phases 3 to 8 (but excluding 6).

20 This entry specifies the permissive period codes for phase 1.

Three columns are assigned for defining the permissive periods for each phase (i.e., one column per permissive period). The first column corresponds to the first period, the second column corresponds to the second period, and the third column corresponds to the third period. An entry of 1 in a given column means that the corresponding period is defined. Thus, an entry of 100 at this point means that phase 1 can be yielded to during the first permissive period. An entry of 001 means that phase 1 can be yielded to in the third permissive period, and so on. Each nonsync phase can be assigned to any combination of permissive periods.

Note that phases 2 and 6 are not assigned permissive periods. All other phases **must** be assigned to a permissive period.

21-25 Same as Entry 20 but for phases 3 to 8 (but excluding 6).

45

Traffic Movements for NETSIM Actuated Controller

Table 5-29. Record Type 45 – traffic movements for NETSIM actuated controller.

ENTRY	COLUMN(S)	DESCRIPTION	
1	1–4	Internal node **j** that identifies the actuated controlled intersection. Range = **1 ≤ node number ≤ 750. Cannot** be an entry, exit, centroid, or interface node.	
2	8	Number of the phase being described (**1 ≤ phase ≤ 8**)	
3	10 11 12 13 14	Left Through Right Left diagonal Right diagonal	Movement-specific codes that identify when a discharge movement on approach 1 is serviced during the subject phase: **1** Movement is allowed **2** Movement is prohibited
4	20 21 22 23 24	Left Through Right Left diagonal Right diagonal	Same as for Entry 3 but for approach 2
5	30 31 32 33 34	Left Through Right Left diagonal Right diagonal	Same as for Entry 3 but for approach 3
6	40 41 42 43 44	Left Through Right Left diagonal Right diagonal	Same as for Entry 3 but for approach 4
7	50 51 52 53 54	Left Through Right Left diagonal Right diagonal	Same as for Entry 3 but for approach 5
8	79–80	45	

This record type is used to define the traffic movements permitted during each phase, at each intersection serviced by a traffic actuated controller. A separate record is required for each phase. Codes are specified for each movement on each approach link. The discharge movements considered are left turn, through, right turn, left diagonal, and right diagonal. Five separate approach links can be specified for each node, and they **must** be correspondingly identified on Record Type 43.

Discussion of Selected Entries

1 Internal node number for the intersection being serviced by an actuated controller. This node **must** correspond to a node identified on Record Type 43.

2 The phase number can range from 1 to 8. The data on the Record Type 45 **with** this phase number must correspond to the data on Record Types 46-48 with the same phase numbers.

3 The five movement-specific codes are input in this entry in the five specified columns for approach link number 1. The respective order of the movements for the five consecutive columns (10, 11, 12, 13, and 14) is as follows:

> **Left**

> **Through**

> **Right**

> **Left diagonal**

> **Right diagonal**

If the given movements are allowed, a “1” is entered in the corresponding column. If the movements are not allowed, a “2” is entered into the column. The approaches specified in Entries **3-7 must** correspond to the approach links identified on Record Type 43 for this node.

46

Detectors for NETSIM Actuated Controller

Table 5-30. Record Type 46 – detectors for NETSIM actuated controller.

ENTRY	COLUMN(S)	DESCRIPTION	
1	1–4	Internal node j that identifies the actuated controlled intersection. Range = **1 ≤ node number ≤ 750. Cannot** be an entry, exit, centroid, or interface node.	
2	6	Number of the phase being described **(1 ≤ phase ≤ 8)**	
3	8	Type of detector group **(1 or 2)**	
4	10–11	Approach number of the link at which the detectors specified on this record are located	
5	12	Number of the lane in which the sensor is located (lane A)	Detector #1 (if the detector group is 1) or detector #4 (if the detector group is 2)
6	13	Number of the second lane in which the sensor is located (lane B)	
7	14–17	Distance of the trailing edge of the detector sensing zone from the stop line (in tenths of a foot or meter)	
8	18–20	Delay time (in tenths of a second)	
9	21–23	Carry-over time (in tenths of a second)	
10	24–26	Sensor length (in tenths of a foot or meter)	
11	27–28	Limit time for the detector group 2 (Type III) (in seconds)	
12	29	Detector operation code: **Blank** Presence **1** Passage	
13	32	Same as Entries 5–12 but for detector #2 (if the detector group is 1) **or** for detector #5 (if the detector group is 2)	
14	33		
15	34–37		
16	38–40		
17	41–43		
18	44–46		
19	47–48		
20	49		

ENTRY	COLUMN(S)	DESCRIPTION
21	52	Same as Entries 5-12 but for detector #3 (if the detector group is 1) or for detector #6 (if the detector group is 2)
22	53	
23	54-57	
24	58-60	
25	6 l-63	
26	64-66	
27	67-68	
28	69	
29	79-80	46

The detector input data are node, phase, and approach specific. At least one record must be prepared for each phase and for each approach where detectors are located that serve the phase. Nonactuated phases do not **need Record** Type 46. All detector characteristics are defined on this record type. Because each field designates a specific type of detector, the number of records is determined by 1 the type of detector specified and 2 the number of detectors of a given type.

Discussion of Selected Entries

1 Internal node number at which the controller is located that is served by these detectors. **This node must** correspond to a node identified on Record Type 43.

2 The phase number served by these detectors ranges from 1 to 8. This number must correspond to a phase identified on Record Type 45.

3 Two types of detector groups are defined. Each group has different detector characteristics (see figure 5-10). All three detectors specified on this record must be long to the same group as defined by this entry. Assignment of group type 1 allows the selection of detectors 1 through 3 on this record. Detector I is specified in the first field (Entries 5-12), detector 2 in the second field (Entries 13-20), and detector 3 in the third field (Entries 2 l-28). Assignment of group type 2 allows the selection of detectors 4 through 6 in the given three record fields. Thus, for group type 2, detector 4 is specified in the first field, detector 5 in the second field, and detector 6 in the third field.

Detectors l-3 are **extension** and **count** detectors. They also place **calls** to a referenced phase whenever the signal indication is red and there is an actuation. They thus place calls on a phase, whether it is active or inactive. Extension detectors provide for a vehicle extension of the service green for each actuation (up to the maximum extension or maximum green specified on Record Type 47) when the phase is green. Count detectors provide counts that are used in the variable initial computation, if that feature is desired. These counts are recorded during yellow and red intervals.

Detector 4 is an extension-only detector (it does not provide counts). It places calls when the phase is active. Detectors 5 and 6 are Type III detectors (see Entry 11).

More than one record can be specified for a type 1 detector group or a type 2 detector group. This would be done when two or more sensors are connected to one controller input. When this occurs, the outputs of detectors with the same number are logically 'OR'ed together. That is, the output of any one of the sensors would determine detector actuation. The only limitation on the number of sensors that can be connected to one controller input is that the total number of sensors must not exceed 300 and the number of detectors on any link cannot exceed 40. These limits include all detectors, including surveillance detectors.

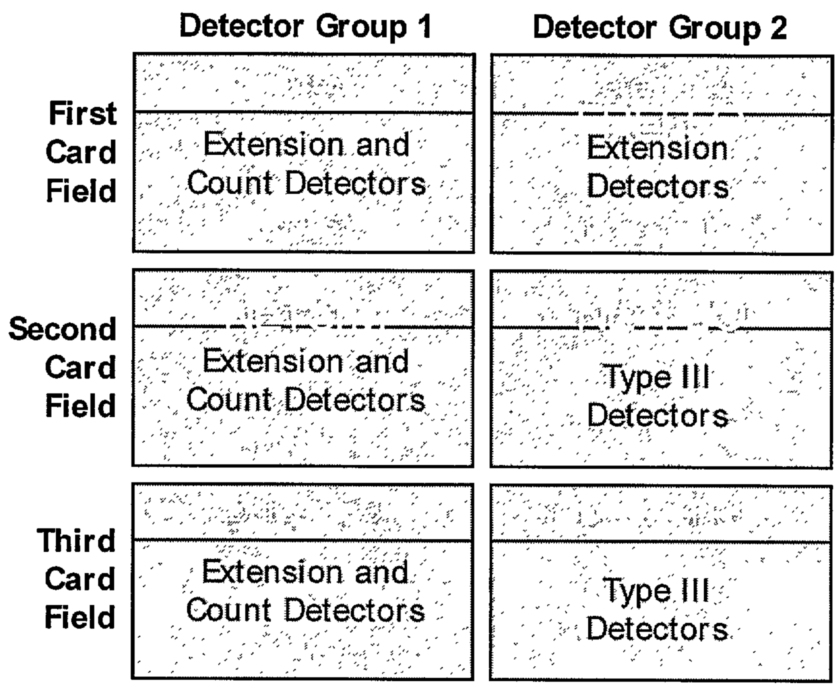


Figure 5-10. Record field configuration for the two detector groups.

4 The approach link numbers are defined on Record Type 43. The approach link number corresponding to the detectors specified in this record is entered at this location.

5 A detector can be assigned to any moving lane. The lane number entered must conform to the NETSIM lane-numbering convention (see Record Type 11). If 9 is coded in either lane A or B, then the detector is assumed to be across **all** lanes, including pockets. Additionally, the specification of a pocket lane assumes that the sensor is placed across all lanes in the pocket.

With the lane A and lane B definitions, two lanes can be assigned to the same sensor. As an example, a loop sensor covering two separate lanes can be so represented by entering the two lane numbers in Columns 12 and 13. This added feature reduces the work required to define two identical sensors on two separate lanes. (This would otherwise require the preparation of two input records.) The lane number for one of these lanes (A or B) would be entered in this location.

6 Same as Entry 5 but the number of another lane covered by the detector.

7 The sensing zone is defined to have a leading edge and a trailing edge. The leading edge is defined to be furthest upstream. The trailing edge is furthest downstream (i.e., closest to the stop bar). The distance of the stop bar from the detector trailing edge would be entered in this position, in tenths of a foot or in tenths of a meter if input is in metric units.

8 The extension and count detectors and calling detectors are capable of a "delay" of input to the phase while that phase is red. This entry provides input for this **delay time** in tenths of a second. This feature can sometimes be helpful for right-turn-on-red situations, to allow isolated right-turners resting on a detector to find a gap in the traffic, without having the phase yield to the through movement.

9 Both types of detectors are capable of "carryover." Carryover is the ability to continue placing a vehicle actuation to the phase after the vehicle has left the detection area while the phase is green. Carryover time is the additional time during which an actuation is placed, after the vehicle has left the detection area. An example of this application is when a series of "speed" sensors are located in an intersection approach. The carryover time will carry the actuations from one sensor to the other, until the vehicle clears the intersection. This value is entered in tenths of a second.

10 The sensing zone was described in Entry 7. Its length is specified here in tenths of a foot or meter.

11 A Type III detector is a special type of calling detector that maintains the phase call after the signal indication has changed to green, so long as the actuation is continuous. The Type III detector time begins when the signal indication turns green and continues until there is no actuation or when the limit time specified in this entry is exhausted. The Type III detector is then disconnected from the active phase until the signal indication changes back to red and it functions as a standard call detector. This type of detector can be applied where sluggish start-up of heavy trucks can impede the following traffic.

A non-zero entry in this location will define detectors 5 and 6 to be Type III detectors (thus, a Group Type 2 must be defined). If this entry is set to zero, detectors 5 and 6 will operate as standard calling detectors.

12 Generally, detectors have a passage or presence capability. In passage operation (code =l), a constant 0.3 second pulse is generated whenever a vehicle is detected, regardless of the length of time the vehicle spends over the sensor. In presence operation (code = l), the length of the pulse generated is proportional to the length of time the vehicle spends **over** the sensor. The selected detector operation code is set into this entry.

13-20 Same as Columns 4-12 but for detector 2 (or detector 5 if Group Type 2 is defined).

21-29 Same as Columns 4-12 but for detector 3 (or detector 6 if Group Type 2 is defined).

47

Phase Operations for NETSIM Actuated Controller

Table 5-31. Record Type 47 – phase operations for NETSIM actuated controller.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Internal node j that identifies the actuated controlled intersection. Range = **1 ≤ node number ≤ 750. Cannot** be an entry, exit, centroid or interface node.
2	6	Number of the phase being described **(1 ≤ phase ≤ 8)**
3	8–10	Maximum green time in seconds (**blank** if Entry 6 is specified)
4	11–13	Minimum green time (in seconds)
5	14–15	Vehicle extension (passage time) (in tenths of a second)
6	16–18	Maximum extension time (in seconds) (**blank** if Entry 3 is specified)
7	19	Initial interval code (IIC): **0 or blank** Extensible (default) **1** Added initial **2** Computed initial
8	20–22	Time added to the initial interval for each vehicle actuation (in tenths of a second)
9	23–24	Number of the actuations that can be serviced during the minimum interval (if IIC = 1) **or** the number of the actuations required to obtain the maximum initial interval (if IIC = 2). **Blank** if IIC = 0.
10	25–28	Maximum initial interval time (in seconds). **Blank** if IIC = 1.
11	29	Gap reduction code: **0 or blank** Reduce by/reduce every **1** Reduce by every second **2** Time to reduce to minimum gap
12	30–33	Reduce by time in hundredths of a second. **Blank** if Entry 11 = 2.
13	34–36	Reduce every time (in tenths of a second) (if Entry 11 = 0) **or** time to reduce to the minimum gap (in seconds) (if Entry 11 = 2).
14	37–40	Minimum gap (in hundredths of a second)
15	41–44	Maximum gap (in hundredths of a second)
16	45–47	Duration of yellow change interval (in tenths of a second)

ENTRY"	COLUMN(S)	DESCRIPTION
17	48-50	Duration of red clearance interval (in tenths of a second)
18	51	Red lock code: **1** Set 0 Not set
19	52	Yellow lock code: 1 Set 0 Not set **Blank** If Entry 18 = 1
20	53	Double entry code: **1** Is allowed 0 Is prohibited
21	54	Last vehicle passage feature: **1** Is active 0 Is inactive
22	55	Minimum (vehicle) recall code: 1 Minimum initial interval is recalled when there is no demand 0 Minimum initial interval is not recalled when there is no demand **Blank** If Entry 23 or 24 = 1
23	56	Maximum recall code: 1 Phase is serviced to maximum green when there is no demand 0 Phase is not serviced to maximum green when there is no demand **Blank** If Entry 22 or 24 = 1
24	57	Rest in red code: 1 Phase will rest in red 0 Phase will NOT rest in red **Blank** If Entry 22 or 23 = 1
25	58	Lag code: 1 Phase **lags** the other phase in its phase pair 0 Phase **leads** the other phase in its phase pair
26	59-62	Designation of phase as 1 of a phase pair detining overlap A, B, C, or D:
	59	1 Phase is one of a phase pair defining overlap A 0 Phase is **not** one of a phase pair defining overlap A
	60	1 Phase **is** one of a phase pair defining overlap B 0 Phase **is not** one of a phase pair defining overlap B
	61	1 Phase **is** one of a phase pair defining overlap C 0 Phase **is not** one of a phase pair defining overlap C
	62	1 Phase **is** one of a phase pair defining overlap D 0 Phase **is not** one of a phase pair defining overlap D
27	63-66	Red revert time (in tenths of a second)

ENTRY	COLUMN(S)	DESCRIPTION
28	68	Code [1,0] if this phase [cannot, can] terminate before its defined force-off point is reached. This lag phase hold feature applies **only** to coordinated controllers.
29	70	Code [1,0] if this phase [does, does not] require both phases in a barrier-crossing situation to simultaneously gapout or have both maximum timers expire to terminate the phase
30	72	Code [1,0] if this phase [can, cannot] be serviced twice during a cycle. This conditional (dual) service feature cannot be requested for lag phases and cannot be requested for coordinated controllers.
31	75–76	Minimum conditional service time (in seconds). This is the minimum amount of time that **must** be available to provide the **conditional service phase** when a call is issued for the phase.
32	79–80	47

This record type describes controller input data that are phase and node dependent. One record must be prepared for each phase (for each node with actuated control). Phase operations capabilities accommodate either a Type 170 controller or a NEMA controller. The input to some of the entries depends on the type of controller that is being modeled.

Discussion of Selected Entries

1 Node number of NETSIM intersection serviced by the actuated controller.

2 The phase number ranges from 1 to 8, and it **must** correspond to a phase identified on Record Type 45.

3 In a NEMA controller, two options are possible: ❶ a maximum green time or ❷ a maximum green time extension. If a maximum green time is specified, it is entered at this position. "Maximum green time" is the maximum duration of the sum of all green intervals: initial + added initial (if any) + service green. The initial interval is the maximum (minimum initial, variable initial). If this entry is non-zero, then Entry 6 must be left blank.

4 Minimum green is the duration of the minimum initial interval.

5 Vehicle extension (passage time) is the timing interval during the service green, which is usually the travel time for a vehicle to move from the detector through the intersection. It is the maximum allowable value of the intervehicular gap (unit extension). It controls when a phase ends due to a gapout. The minimum value accepted by the program is 1.1 seconds.

6 The maximum extension option is specified for either a Type 170 controller or a NEMA controller. The maximum extension is the maximum duration of "service green": duration of green beyond the end of the minimum green or variable initial interval, whichever is greater.

The maximum extension is entered at this location. When this entry is made, then Entry 3 must be left blank. If the phase is a pedestrian phase, then maximum extension plus minimum green must be equal to or greater than the "WALK" plus flashing "DON'T WALK" time.

7 The initial interval code (IIC) ranges from 0 to 2. There are three types of initial intervals:

1. **Extensible initial**
2. **Added initial**
3. **Computed initial**

The desired initial interval type is obtained by entering the appropriate code:

> IIC = 0 if the extensible initial is specified (default)

> IIC = 1 if the added initial is specified

> IIC = 2 if the computed initial is specified.

For the extensible initial option (IIC = 0), the controller adds a specified amount of time (Entry 8) to the minimum initial interval for every recorded actuation subject to a specified maximum (Entry 10). The extensible initial option can be specified for the 170 controller or NEMA-type controllers.

For the added initial option (IIC = l), the controller adds a specified amount of time (Entry 8) to the minimum green (also termed minimum initial interval) (Entry 4) for every recorded actuation above a specified value (Entry 9). If IIC = 1 for any phase, it must also be 1 for all other phases at this controller. The added initial option or computed initial option can be specified for NEMA-type controllers.

For the computed initial option (IIC = 2), the controller computes the initial interval (Entry 10) + (Entry 9) x (number of recorded actuations) subject to the specified minimum (Entry 4) and maximum (Entry 10) constraints. Entry 9 is defined differently when IIC = 2 than when IIC = 1.

8 The added time per vehicle actuation is the amount of time to be added to the minimum initial interval for every vehicle actuation recorded from the count detector (detectors 1,2, or 3 on Record Type 46).

9 The input to this entry depends on the initial interval type (IIC) specified:

> **If** IIC = 0 then 0 or no input is specified to this entry

> **If** IIC = **1** then this input is the number of actuations accumulated that can be serviced during the minimum initial interval. Only if this number is exceeded will the controller provide added initial interval time.

> **If IIC** = 2 then this input is the number of actuations required to attain the maximum value of initial interval that is specified in Entry 10.

10 The maximum initial time is the maximum value of the initial interval (if IIC = 0 or 2). When specified, this entry should at least equal to the minimum green specified in Entry 4.

11 The three gap-reduction (GR) timing options are as follows:

1 **GR = 0** **reduce by/reduce every**

2 **GR = 1** **reduce by every second**

3 **GR = 2** **time to reduce to minimum gap (see** figure 5-11).

> **If GR** = 0 then the user can specify that the gap can be reduced by a specified amount, Entry 12, for every specified interval Entry 13. Only the Type 170 controller has this option available.

> **If GR** = 1 then the user can specify that the gap will be reduced by Entry 12 (in hundredths of a second) every second.

> **If** GR = 2 then the user can specify that the controller will reduce the gap from its maximum value (Entry 15) to its minimum value (Entry 14) in the time specified in Entry 13 (see figure 5-l 1).

12 The user can specify that the gap (vehicle extension) can be **reduced by** a specified amount at this entry (in hundredths of a second) for every specified time (Entry 13). If Entry 11 = 2, then this entry should be left blank.

13 This entry depends on the gap-reduction option:

>**If GR** = 0 then the time over which the gap reduction is to be made is entered (in tenths of seconds)

> **If GR = 1** then no entry is made.

>**If GR** = 2 then the time to reduce to minimum gap is entered (in seconds).

14 Minimum gap is applicable only if the controller is of the volume-density type (Entry 11 = 2). If no reduction option is specified, then this entry should be set equal to vehicle extension (Entry 5), and must also equal the maximum gap. The minimum value accepted by the program is 1.1 seconds.

15 Maximum gap is applicable only if the controller is of the volume-density type. This is the value from which gap reduction is initiated when an opposing call occurs (see figure 5-l 1). This value will be equal to or greater than the vehicle extension time, it determines the time before gap reduction. The minimum value accepted by the program is 1.1 seconds. If the controller is not of the volume-density type, then the vehicle extension (Entry 5) should be entered here.

16 The yellow change interval follows the green right-of-way interval. This entry must be non-zero.

17 In the red clearance interval, both the termination phase and the next right-of-way phase display red. The duration in tenths of a second is entered here.

18 When red lock is set, vehicle actuations placed during the red interval are remembered and serviced during the ensuing green.

19 When yellow lock is set, vehicle actuations placed during the yellow change **and** red intervals are remembered and serviced during the ensuing green.

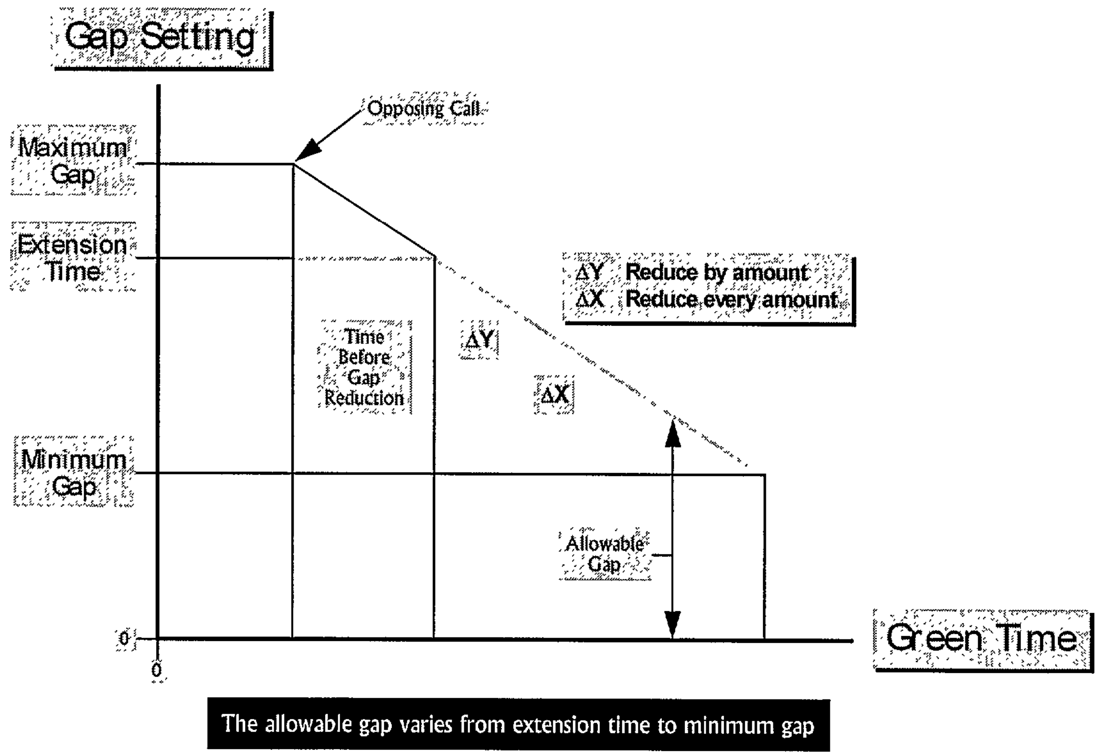


Figure 5-11. Gap setting versus time.

20 When the double-entry flag is set, this phase is then activated when a compatible phase is active in another ring and there is no other compatible demand in this ring. Double entry is useful when it is desirable to turn on two separate signal indications concurrently even though only one of them can have a demand.

21 The setting of the last vehicle passage entry will allow the phase to terminate due to reduced gapout, but actual service will extend one full extension interval to allow the last vehicle in a staggered platoon to pass through the intersection.

22 The minimum (vehicle) recall setting will force a phase to be serviced, even in the absence of vehicle demand, to its minimum initial period, but can extend in response to demand. This entry should be left blank if either Entry 23 or Entry 24 = 1.

23 The maximum recall setting will force a phase to be serviced to its maximum green time, even in the absence of vehicle demand. This entry should be left blank if either Entry 22 or Entry 24 = 1.

24 The red rest setting of this entry denotes that the phase will rest in red in the absence of calls if recall is not set. Entry 22 or 23 should be left blank if this setting is used.

25 The lag setting designates that this phase lags the other phase of the phase pair. Thus, the setting of this flag for all defined phase pairs determines the allowable phasing sequence. The phase pairs are 1 and 2, 3 and 4, 5 and 6, and 7 and 8. In the NEMA phase sequence, the lag phases are 2, 4, 6, and 8 (see figure 5-12).

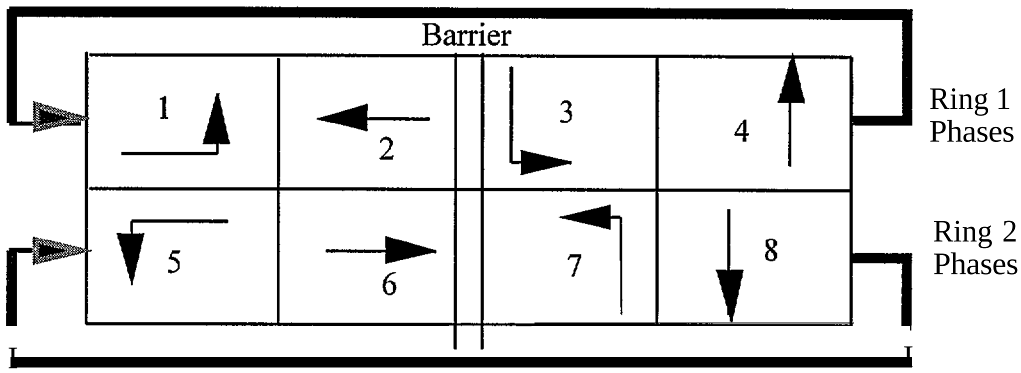


Figure 5-12. Phase pair on dual ring.

26 The overlap entry designates which phases are overlap phases. Up to four phases can be designated to be overlaps (in Columns 59-62). Thus, if a 1 is entered for overlap A (Column 59) in the two records for phases 1 and 6, then these two phases will have an overlap (defined to be Overlap A) that corresponds to this phase.

The overlaps are defined by specifying the allowable movement (through Record Type 45). Thus, in figure 5-13 if phase 1 is defined to be a left-turn and phase 6 is defined to be a through movement on link (3, 4), then an overlap for these two phases could be defined to be the right-turn movement in link (10, 4). That is, if either phase 1 or phase 6 is active, then the overlap is active. In such a case, the right-turn movements would be entered into the link (10, 4) column (refer to the allowable movement output table) for the two given phases.

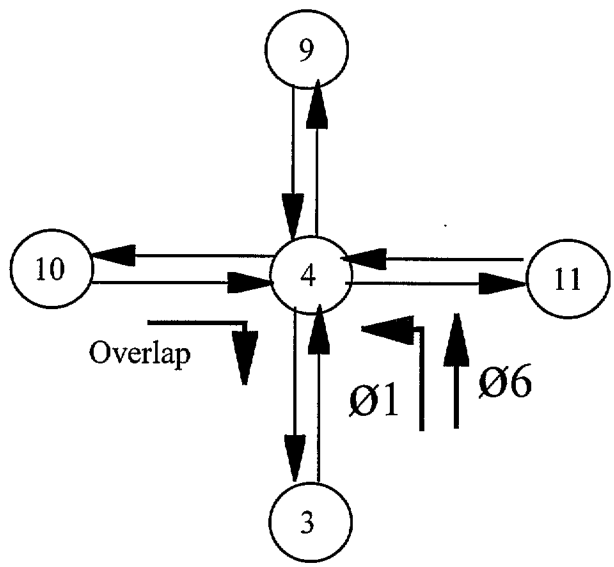


Figure 5-13. Phases with overlapping movements.

27 The red revert time assures that a minimum red signal indication will immediately follow the yellow clearance interval of the phase. The red revert time is input in this entry in tenths of a second.

28 During coordinated operation, a "hold" can be placed on user-selected phases to prevent these phases from terminating before their force-off point is reached. This is desirable when lead-lag left-turn phasing combinations are used to maximize two-way progression. Placing a "hold" on a lagging left-turn phase prevents that phase from premature "gapout" and ensures that the phase does not terminate until its force-off point is reached. This prevents the concurrent through phase from **terminating** prematurely and shortening the progression band in that direction. To "hold" this phase until force-off, specify a 1 for this entry. Otherwise, the entry should be blank or 0.

29 The controller terminates concurrent vehicle phases in a barrier crossing situation after one phase has reached its maximum time and the other phase experiences gapout. The simulated controller will operate in this manner if this entry is 0 or blank. If a value of 1 is specified, the controller will not terminate the phases unless both phases gapout simultaneously or **both** maximum timers expire. This feature, known as "simultaneous gapout," is in general use on both Type 170 and NEMA controllers.

30–31 When there are heavy left-turn movements and the controller is noncoordinated, it can be desirable to service the left-turn phase twice during a cycle as a leading and lagging movement. Specifying a value of 1 for Entry 30 will cause the simulated controller to service this phase a second time during the cycle when there is demand even if there are conflicting calls on other phases. The minimum amount of time that must be available to repeat this phase once a call is issued is specified in Entry 31. If this "conditional (dual) service" feature is not desired, or the controller is coordinated or the phase is a lag phase, Entries 30 and 31 must be 0 or blank. If Entry 30 is non-zero, Entry 31 must also be non-zero.

48

Pedestrian Operations for NETSIM Actuated Controller

Table 5-32. Record Type 48 - pedestrian operations for NETSIM actuated controller.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Internal node j that identifies the actuated controlled intersection. Range = **1 ≤ node number ≤ 750. Cannot** be an entry, exit, centroid, or interface node.
2	8	Number of the phase being defined **(1 ≤ phase ≤ 8)**
3	9–12	Duration of the **WALK** interval (in seconds)
4	13–16	Duration of the flashing **DON'T WALK** interval (in seconds)
5	17–20	Pedestrian intensity (in pedestrians per hour) for stochastic arrivals. **Blank** if Entry 6 > 0.
6	21–24	Pedestrian arrival headway (in seconds) for deterministic arrivals. **Blank** if Entry 5 > 0.
7	25–28	Elapsed time (in seconds) from start of simulation to beginning of deterministic arrivals. **Blank** if Entry 5 > 0.
8	32	Pedestrian recall code: **0** Phase is not recalled when there is no demand **1** Phase is recalled even when there is no demand **Blank** If Entry 9 = 1
9	36	Pedestrian rest code **0** Pedestrian WALK interval **will not rest** in this phase **1** Pedestrian WALK interval **will rest** in this phase **Blank** If Entry 8 = 1
10	37–40	Elapsed time (in seconds) from start of simulation to the beginning of the constant pedestrian demand period **1**
11	41–44	Elapsed time (in seconds) from the beginning of the simulation to the end of the constant pedestrian demand period **1**
12	45–48	Begin time of constant demand period **2**
13	49–52	End time of constant demand period **2**
14	53–56	Begin time of constant demand period **3**
15	57–60	End time of constant demand period **3**

ENTRY	COLUMN(S)	DESCRIPTION
16	61–64	Begin time of constant demand period 4
17	65–68	End time of constant demand period 4
18	69–72	Begin time of constant demand period 5
19	73–76	End time of constant demand period 5
20	79–80	48

Each pedestrian-actuated phase is defined on a separate Record Type 48. The three pedestrian actuation modes are as follows:

❶ Actuation based on the stochastic arrival of pedestrians

❷ Actuation based on the deterministic arrival (constant headways) of pedestrians

❸ Actuation based on the periods of constant pedestrian demand (pedestrian push button is continuously depressed).

Discussion of Selected Entries

1 Node number at which the controller is located. This node must correspond to a node number specified on Record Type 43.

2 The phase number ranges from 1 to 8, and it corresponds to the phase number on a Record Type 47 for the node specified in Entry 1. The Record Type 47 specifies the vehicular phase that will time concurrently with the pedestrian phase as a result of the Record Type 48 entries.

3 The length of time of the pedestrian "WALK" interval, in seconds. The duration of this entry and Entry 4 must not exceed the "sum of maximum extension and minimum green" or maximum green for this phase as specified on Record Type 47.

4 The length of time of the pedestrian clearance, flashing "DON'T WALK" interval (in seconds).

5 The expected pedestrian intensity for the crosswalk(s) actuating this phase, specified in pedestrians per hour. If this entry is non-zero, then the arrivals are stochastic. (In assigning these pedestrian intensities, a user should take into account the pedestrian densities defined on Record Type 11.)

6 The pedestrian arrival headway for the crosswalk(s) actuating this phase, in seconds. If this entry is non-zero, and Entry 5 is zero, then deterministic arrivals are defined by this entry.

7 The initial pedestrian arrival time, for deterministic arrivals, in seconds. This starts timing when the simulation is initialized.

8 When this flag is set, then the pedestrian phase defined in this record is activated in its proper turn, even with no pedestrian demand.

9 When this flag is set, then the pedestrian WALK interval will rest in the phase defined in this record.

10 Five periods of constant pedestrian demand are provided, where a continuous call is placed on the pedestrian phase (in Entries 1 O-19). This would occur, for example, when school lets outs at 3:00 p.m. For 15 minutes after that time, there would be a continuous call placed at that given intersection. These periods are defined in terms of begin times and end times for each period. The begin time for the first constant demand period is input in this entry.

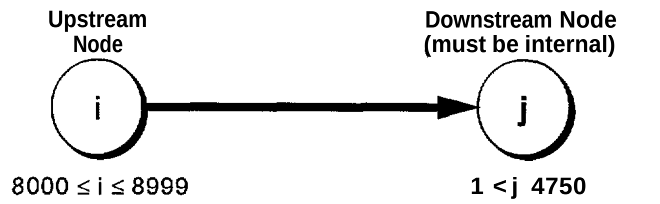
11 The end time for the first constant demand period is input to this entry.

12-13 Same as Entries 10 and 11 but for constant demand periods 2 through 5. Blank entries are not
14-15 permitted within the middle of the sequence. In addition, these periods of time cannot overlap.
16-17
18-19

50

Entry Link Volumes

Table 5-33. Record Type 50 – entry link volumes.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Upstream node number i 
2	5-8	Downstream node number **j**
3	9-12	Flow rate in vehicles per hour entering from entry node number **i** on entry link **(i,j)**
4	13-16	Percentage of vehicles entering link **(i,j)** that are trucks
5	17-20	Percentage of vehicles entering link **(i,j)** that are Carpools. **Blank** for FRESIM.
6	6 1-63	Percentage of vehicles entering **lane 1**
7	64-66	Percentage of vehicles entering **lane 2**
8	67-69	Percentage of vehicles entering **lane 3**
9	70-72	Percentage of vehicles entering **lane 4**
10	73-75	Percentage of vehicles entering **lane 5**
11	79-80	50

Record Type 50 describes the volume, in vehicles per hour, entering NETSIM and FRESIM networks on entry links. Entry nodes usually form the outer boundary of the network. Unless a subnetwork is entirely bound by other subnetworks, it will receive traffic from entry nodes on its periphery. If a network receives **all** of its traffic from other networks and from source/sink nodes, then entry link records could be omitted for that network. Entry volumes will normally be required for all networks except when the traffic assignment option is used to generate traffic volumes.

Entry links are unique in that they are not part of the network itself. As vehicles are generated by TRAF, they are accumulated on the entry links for later discharge onto the network from the entry link. Both the control and spillback conditions at the downstream node of the entry link regulate entry of vehicles onto the network. For example, if the downstream link is completely filled with vehicles, then new vehicles cannot enter it. Network statistics are not accumulated for the entering vehicles until they have left the entry link. Traffic volumes enter the network in a uniform distribution every fixed number of seconds. Traffic volumes can be made to fluctuate over time. This is done by changing entry volumes in each new time period. The entry of vehicles into the network can be made to vary by providing long links downstream to the entry links. The car-following logic in TRAF will cause variation in traffic headways that in turn will cause vehicles to arrive at the downstream intersection at varying rates.

Traffic volumes are defined as the number of vehicles per hour and the percentage of vehicles of each type. Carpool and truck percentages are defined explicitly on Record Type 50. Carpool percentages are only specified for NETSIM entry links. Car percentages are defined by subtractingcarpool and truck percentages from 100%. Bus volumes are not part on the entry volume and are defined separately on Record Type 189.

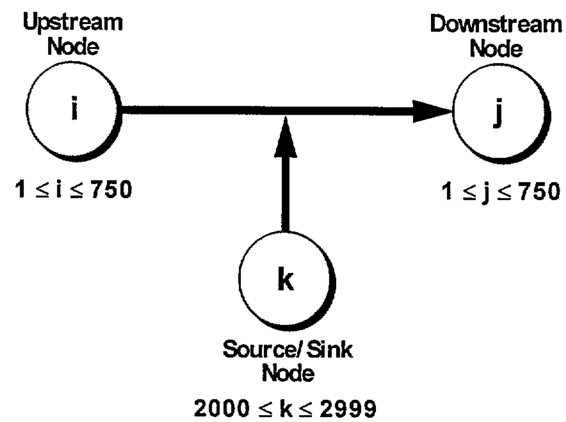
Discussion of Selected Entries

6-10 In CORSIM, users these entries to assign vehicles across lanes. The percentage of vehicles entering each lane is based on the total flow rate specified in Entry 3. The sum of the percentages in Entries 6-10 must equal 100%. Only one entry link per Record Type 50 can use this feature.

51

Traffic Volumes on Source/Sink Links

Table 5-34. Record Type 51 – traffic volumes on source/sink links.

ENTRY	COLUMN(S)	DESCRIPTION	
1	1–4	Source/sink centroid number **k**	Range = **2000–2999.** This entry can be left **blank** because it is optional.
2	5–8	Upstream node **i** of internal link on which source/sink node lies (**cannot** be an entry node)	
3	9–12	Downstream node **j**	
4	13–16	**Net** flow rate (in vehicles per hour) exiting or entering via source/sink node number **k** from link **(i,j).** Negative numbers reflect net flow off the arterial onto the source/sink node, while positive numbers reflect net flow onto the arterial from the source/sink node.	
5	79–80	51	

After defining entry volumes from entry nodes, internal volumes generated within the network can be defined. These are usually defined with the source/sink record. Entry links **can** be used within the network for locations that have to **both** generate traffic and have it exit the network such as very large parking garages. Buses must enter the network from entry nodes and leave the network on exit links and therefore do not use source/sink nodes.

Source/sink nodes have only net volumes. That is, they either discharge traffic into or receive traffic from the network. This is different from entry nodes that can both discharge entering traffic and receive exiting traffic. Therefore, source/sink nodes are best for representing places with predominant flow in one direction. An example would be commuter parking garages, which take in vehicles in the morning and discharge them in the afternoon. The flow rate applies for the time period entered and all subsequent time periods until a different flow rate is entered. Suppose the net flow rate is 90 for Time Period 1, 0 for Time Period 2, and 30 for Time Period 3. Records would have to be entered for all three time periods because the flow rate would be 90 for Time Period 2, unless a source/sink record for Time Period 2 was entered with a value of 0.

Source/sink nodes represent net flow for the entire block. They represent the **net** gains or losses for all parking garages on the links and the net curb parking turnover. If there are minor streets such as alleys, hotel driveways or stop sign controlled minor streets with only 2 or 3 vehicles per hour on the link, they would also be included in this number. Therefore, source/sink nodes are pseudo nodes representing the aggregate of many minor traffic activities **not** real nodes representing a single traffic activity. NETSIM treats the activity of the source/sink node as occurring midblock. If there are major parking garages with continuous in and out activity that disrupts traffic flow through the time period, then these should be modeled with 8### nodes and not with source sink nodes. Figure 5-14 shows how traffic generators and sinks on link **(i,j)** are coded as a source/sink node k.

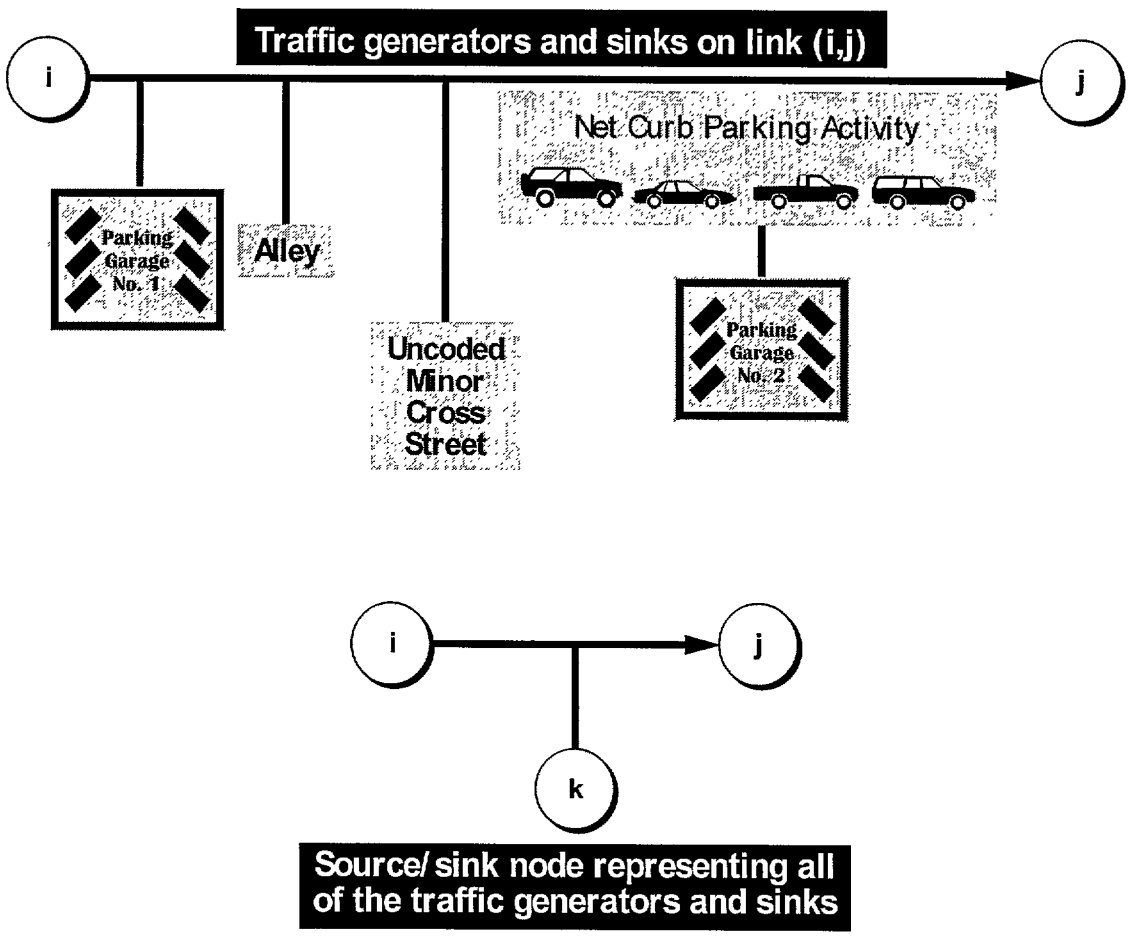


Figure 5-14. Traffic generators and sinks as a source/sink node.

52
Load Factors

Table 5-35. Record Type 52 – load factors.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Automobile occupancy (in hundredths). Default = **130** (1.3 persons per automobile). Range = **100 ≤ automobile occupancy ≤ 600** (1.0–6.0 persons per automobile).
2	5–8	Carpool occupancy (in hundredths). Default = **350** (3.5 persons per carpool). Range = **200 ≤ carpool occupancy ≤ 600** (2.0–6.0 persons per carpool).
3	9–12	Truck occupancy (in hundredths). Default = **120** (1.2 persons per truck). Range = **100 ≤ truck occupancy ≤ 400** (1.0–4.0 persons per truck).
4	13–16	Bus occupancy (in hundredths). Default = **2,500** (25 persons per bus). Negative values are prohibited.
5	79–80	52

To get an accurate feel for the meaning of system performance, it is often useful to obtain statistics on person delay as well as vehicle delay. To do this accurately, the average occupancy of the automobiles, carpools, trucks and buses must be specified. This is done through the use of Record Type 52. This record is optional, as there are default values for these occupancies. The default values are 1.3 persons per car, 3.5 persons per car pool, 1.2 persons per truck and 25 persons per bus. For NETSIM, these values can be overridden by Record Type 58, which allows more detailed stratification of vehicle types and specification of the vehicle occupancies for the more detailed fleet.

This record **must** be placed in the first time period data. Values in this record are entered as integers and scaled down by 100. For an occupancy of 1.3 persons/vehicle, for example, enter 130. Blank entries on this record are interpreted as a request for the default values, **not** as a request for a zero value.

The terms "load factors" and "vehicle occupancy" can be used interchangeably for describing the number of people in a vehicle. TRAF uses load factor to distinguish people occupancy of vehicles from the occupancy term used to describe the vehicle occupancy on the link.

53

Entry Link and Source/Sink Volume Variations within a lime Period

Table 5-36. Record Type 53 – entry link and source/sink volume variations within a time period.

ENTRY	COLUMN(S)	DESCRIPTION
1	**1-4**	Upstream node number
2	5-8	Downstream node number
3	9-12	Vehicle count or volume (vph)
4	13-16	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)
5	17-20	Vehicle count or volume (vph)
6	21-24	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)
7	25-28	Vehicle count or volume (vph)
8	29-32	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)
9	33-36	Vehicle count or volume (vph)
10	37-40	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)
11	41-44	Vehicle count or volume (vph)
12	45-48	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)
13	49-52	Vehicle count or volume (vph)
14	53-56	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)
15	57-60	Vehicle count or volume (vph)
16	61-64	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)
17	65-68	Vehicle count or volume (vph)
18	69-72	Time of count or volume in previous entry expressed as elapsed time from the beginning of the simulation (in minutes)

ENTRY	COLUMN(S)	DESCRIPTION
19	76	Code [0,1] if [vehicle counts, hourly volumes] were specified on this card
20	79–80	53

This record type is **optional,** and it can be used to specify variations in entry and source/sink volumes within a time period. Up to two Record Type 53s can be specified for each entry link or internal link with source/sink flows, within a given time period, which allows the user to specify up to 16 variations in volume for each time period. The actual emission volume V_n at any time t_n within the time period is computed by interpolation:

$$V_n = V_p + \frac{(V_N - V_p)}{(T_N - T_p)}(t_n - T_p)$$

where

V_n = Emission volume at time **n**

V_p = Specified volume at time $\mathbf{T_p}$

V_N = Specified volume at time $\mathbf{T_N}$

T_N = Next time after time **n** that volume data was defined on Record Type 53

T_p = Most recent time prior to time **n** that volume data was defined on Record Type 53

As with Record Type 23, if a Record Type 53 and a Record Type 50 and/or 51 are entered for a particular link, then all volumes entered on Record Type 53 will be used and the volumes on Record Type 50 or 51 will be ignored. If a Record Type 53 is used for a particular link, then enter all of the associated volumes for the link, including starting entry and source/sink volumes and the variations of these within the time period.

Discussion of Selected Entries

1 For entry links, the value must range from 8000 to 8999. Only internal links can be used for source/sink links. For internal links, upstream node numbers must range from 1 to 750.

2 Internal links must have downstream node numbers that range from 1 to 750. Exit links and exit interface links must not be input.

3, 5, 7, 9 13, 15, 17 The entry volume or source/sink volume is entered here. The value can be entered either as a vehicle count or as a volume (vph).

4, 6, 8, 10, 12 14, 16, 18	The start time associated with the volumes in the previous entries is entered here. This value is expressed as the elapsed time from the beginning of the simulation, and it is entered in minutes.
19	This entry specifies the code that corresponds to either the vehicle counts or hourly volumes specified on this record type.

54

Short-Term Events

Table 5-37. Record Type 54 - short-term events.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Upstream node **i** of link **(i,j)**. Short-term events cannot be specified on entry links or entry interface links.
2	5–8	Downstream node j of link **(i,j)**
3	9–12	Mean frequency of short-term events specified as events per hour (a minimum of eight events per hour)
4	13–16	Mean duration of short-term event (in seconds) **must not** exceed 60 seconds
5	79–80	54

This record type can be specified for the NETSIM model only. The record type is **optional** and needs to be specified only if one or more internal links on the analysis network experience short-term blockages due, say, to illegal parking, standing, or stopping on lane 1 only. This record type can be specified in the input stream only for the first time period; the program will create these short-term events throughout the simulation run at the specified frequency and duration. Events that are longer than 60 seconds must be specified as "long-term events" on Record Type 55.

The simulation logic permits only one short-term event at a time to appear on a link. If two events are scheduled concurrently, then they are combined on lane 1. The blockage will be positioned where the earlier event begins and will remain until the later scheduled termination time is reached.

See Record Type 55 for the treatment of concurrent short- and long-term events.

55

Long-Term Events

Table 5-38. Record Type 55 – long-term events.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Upstream node number **i** of link **(i,j)** Long-term events **cannot** be specified on entry links or entry interface links.
2	5-8	Downstream node number **j** of link **(i,j)** (To create a blockage within a microintersection, the downstream node j of link (i,j) must be a micronode.)
3	9-12	Elapsed time (in seconds) from beginning of first time period to the commencement of the event
4	13-16	Duration of event (in seconds)
5	18	Code [0, l] if blockage [is not, is] located within an intersection
6	19	**Lane** z on cross street locating blockage (for intersection blockages only) (see figure 5-15 for more detail)
7	20	Lane blocked by an event for nonintersection blockages. For intersection blockages **lane y** on approach link **(i,j)** (See Record Type 11 for lane-numbering conventions.)
8	79-80	55

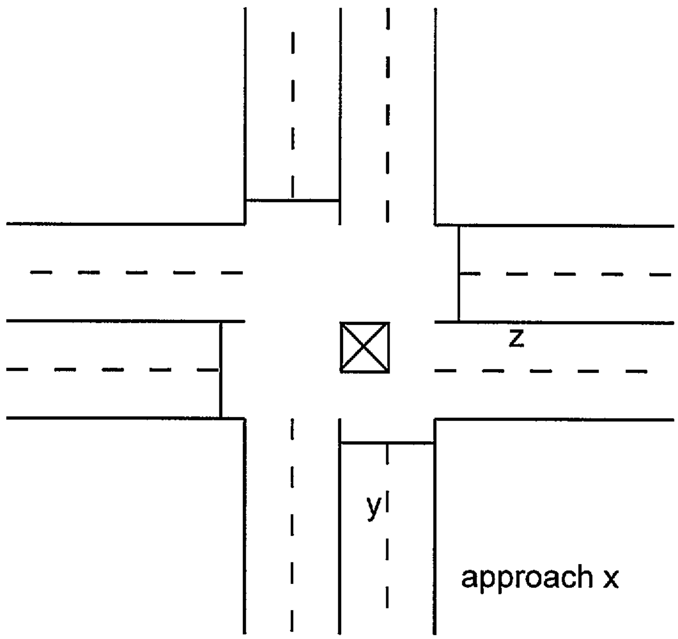
This record **type** is **optional,** and it can be specified for the NETSIM model only. It need be specified only if one or more internal links on the NETSIM analysis subnetwork experiences long-term blockages due, say, to illegal parking or vehicle breakdown. This record type can be specified only in the input stream for the first time period; the specified value of elapsed time (Entry 3) can place the commencement of the event in **any** time period.

The user can specify long-term events for **any** lane channelized **or** unchannelized, but not a pocket lane. To specify blockage for any lane the user must specify the blocked lane number according to the lane number procedure included in the description of Record Type 11.

The simulation logic permits only one event (short term or long term) on a link at any moment. If the specifications on Record Type 54 and/or 55 imply concurrent events, only one blockage is positioned on the link. The events are combined so that the single blockage remains in effect until the later scheduled termination time is reached.

Concurrent events are always located in the lane in which the event with the later termination time occurs. For example, if an existing long-term event on lane 2 has 10 seconds remaining until termination and a new short-term event is about to begin on lane 1 with a duration of 15 seconds, the blockage on lane 2 is cleared and a 15-second blockage is established on lane 1. If both events occur on lane 1, the position of the earlier blockage is maintained. See Record Type 56 for the treatment of concurrent events and parkers.

To locate a blockage within an intersection, the lane y on the approach link x [which is link (i,j)] and the lane z on the cross link must be specified. Figure 5–15 shows the location of (x,y,z).



y	1,2, ..., number of lanes on approach x, which is denoted by (i,j)
z	0,1,2, ..., number of lanes on cross street. When z = 0, the blockage is located between the stop line and the beginning of the intersection
NOTE	If the desired location is further downstream on approach x than can be attained by the maximum value of z, a different approach must be specified

Figure 5–15. Position of intersection blockage.

56
Parking Activity

Table 5-39. Record Type 56 - parking activity.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Upstream node number i of link **(i,j).** Parking activity **cannot** be specified on entry links or on entry interface links.
2	5-8	Downstream node number j of link **(i,j)**
3	9-12	Distance from the downstream stop line to front of the parking zone on the right curb of link **(i,j)** (in feet or meters). Default = 0. Maximum value **= 1,000 feet (304 meters).**
4	13-16	Length of the parking zone on the right curb of link **(i,j)** (in feet or meters). Default = 0. Maximum value **= 2,000 feet (609 meters).**
5	17-20	Distance from downstream stop line to front of parking zone on left curb of link **(i,j)** (in feet or meters). Default = 0. If this link is part of a two-way street [i.e., link (i,j) exists], then this entry must be left **blank.** Maximum value **= 1,000 feet (304 meters).**
6	21-24	Length of the parking zone on the left curb of link **(i,j)** (in feet or meters). Default = 0. If this link is part of a two-way street [i.e., link (i,j) exists], then this entry must be left **blank.** Maximum value **= 2,000 feet (609 meters).**
7	25-28	Mean duration of the parking maneuvers on this link (in tenths of a second). **Cannot** exceed 100 seconds (1,000 tenths of a second).
8	29-32	Expected (mean) number of the parking maneuvers on link (per hour). **Must** exceed 14 per hour.
9	79-80	56

This record type is **optional,** and it can appear in the input stream during any time period for the NETSIM model only.

If curb parking activity is of sufficient intensity on some NETSIM links to impede moving traffic, then the user can specify this input record type for these links. Note that parking activity can take place only in lane 1 (curb lane) if a link is part of a two-way street. If the link represents a one-way street, then parking activity can impede moving vehicles in both outside lanes.

The program diagnostics check that these specifications are “sensible” in the following ways:

- A parking zone cannot extend into a turn pocket.
- A parking zone cannot extend into the upstream intersection.
- A parking zone cannot extend into a bus station.

This record type can be specified in the input stream for any time period. For example, if parking on a link is permitted for the first time period, prohibited during the second, and permitted during the third time period, the user would have to specify this record type for all three time periods. For the second time period, the user must eliminate the parking zone (i.e., set Entries 3-8 to blank) on the link, then recode it for the third time period.

If the parking specifications are the same for the first two time periods and change for the third time period, then the user must specify a Record Type 56 for the first and third time period’s only; the program perpetuates the specified parking parameters from one time period to the next **unless** changed by new inputs.

58

Vehicle Type Specifications for NETSIM

Table 5-40. Record Type 58 - vehicle type specifications for NETSIM.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Vehicle type (a numeric index). Range = **1-16.**
2	5-8	Length of this vehicle type (in feet or meters)
3	9–12	Value of the maximum acceleration x 10 (in tenths of a mph/sec or tenths of a kph/sec at zero speed) on level grade and dry pavement
4	13-16	Value of the maximum speed (in mph or kph) at which acceleration is zero on level grade and dry pavement
5	17-20	Factor (in a percentage) applied to the specified link-specific values of mean queue discharge headway to reflect the differences between the queue discharge operation of this vehicle type relative to that of "typical" passenger cars. **Blank** if this vehicle type falls into the category of "typical" passenger cars (i.e., this factor = 100%).
6	41-44	Percentage of **private automobile fleet** that consists of this vehicle type
7	45-48	Percentage of **truck fleet** that consists of this vehicle type
8	49–52	Percentage of **mass transit fleet** that consists of this vehicle type
9	53-56	Percentage of **carpool fleet** that consists of this vehicle type
10	73-76	Average number of persons occupying this vehicle type (in hundredths)
11	79-80	58

This record type is **optional,** and it can appear in the input stream during the first time period for the NETSIM model only. This record type can be omitted when it is acceptable to describe each fleet component in the traffic stream (automobile, truck, Carpool, or bus) by a single type of vehicle exhibiting the default values for vehicle characteristics as shown in table 5-41.

Table 5-41. Default vehicle type specifications if Record Type 58 is not used.

FLEET COMPONENT	A_{MAX} (MPH/SEC)	V_{MAX} (MPH)	HEADWAY FACTOR	LENGTH (FEET)	OCCUPANTS
Private Automobile	6.8	75	100	16	1.3
Truck	3.2	75	120	35	1.2
Carpool	6.8	75	100	16	3.5
Bus	3.5	65	120	40	25.0

If the user does not want to accept these default values and/or wants to describe a fleet component in terms of several different types of vehicles with different performance characteristics, he can specify each vehicle type comprising the traffic stream on Record Type 58. This specification includes the following:

- A stratification of the traffic stream into "fleet components":
  1. Private automobiles
  2. Trucks
  3. Mass transit vehicles
  4. Carpool vehicles
- The distribution of vehicle types comprising each such fleet component.
- The operational characteristics of each vehicle type, as defined by a linear approximation in the acceleration-speed plane (see figure 5–16).

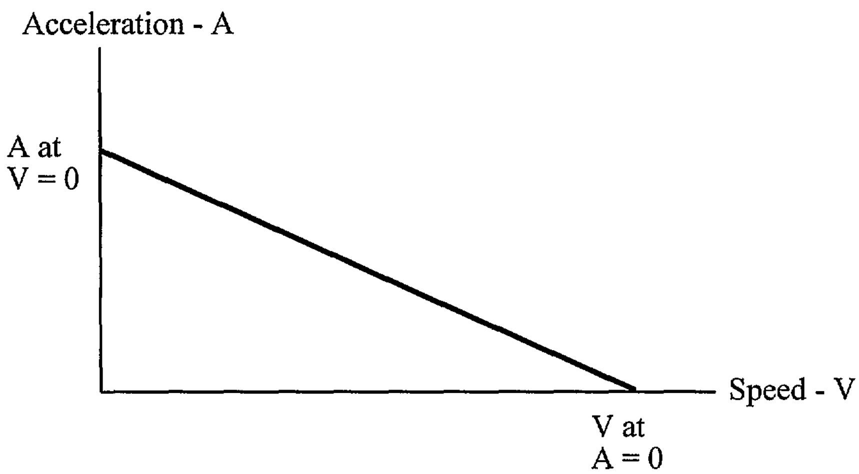


Figure 5–16. Approximate linear relation between speed and acceleration.

> The bumper-to-bumper length of each vehicle type. The program internally will add 3 feet (1 meter) to this value to obtain the "effective" length in a standing queue.

> The effect of vehicle type on queue discharge operations. This effect is expressed as a percentage applied to a "typical" passenger car discharge headway (h), which is specified as a mean value on Record Type 11 for each link. Therefore, the user can specify, for example, a value of 150 for a three-axle truck and a value of 90 for a subcompact.

In this example, a truck following a passenger car would discharge 1.5 x h seconds after its leader, while the subcompact would discharge 0.9 x h seconds after its leader. Here, h is the headway stochastically assigned to the subject vehicle by the software, based on the specified mean value of discharge headway for the link. (Whenever the lead vehicle is a non-passenger car, internal logic determines the discharge time of the subject vehicle, which is determined by the lead vehicle's length and speed across the stop line.)

The need to assign each vehicle type to one or more fleet components reflects the fact that several considerations are based upon the identification of fleet components. For example, the user can reserve lanes for buses and Carpools, specify data so that certain streets are reserved for buses, and specify the percentage of trucks and Carpool vehicles on each entry link. Bus vehicles are assigned routes and stations. However, a Carpool fleet can include several vehicle types (such as automobiles and minibuses), or a bus fleet can include several different types of buses with different performance characteristics because a vehicle type can be part of one or more fleet components. Hence, each vehicle processed by the model is identified by **type** and **fleet component.**

The model can accommodate up to 16 vehicle types that must represent all four fleet components. Each fleet component can be comprised of any mix of vehicle types specified by the user, reflecting current or projected vehicle populations. Of course, the aggregation of vehicle types assigned to any fleet component, as specified, must add to 100%.

Each fleet component is always represented by at least one vehicle type. If the user omits Record Type 58 from his dataset or specifies (several) vehicle types for some, but not all, of the four fleet components, then the model will internally assign one vehicle type with the appropriate default properties shown above for each fleet component not explicitly specified. Therefore, the total number of Record Type 58s, plus the number of fleet components for which defaults are asserted, must not exceed 16.

Record Type 52 can be used to override the vehicle occupancy default values for any fleet component that is not specified on Record Type 58. Record Type 52 is used optionally by several models, whereas the Record Type 58 is used only by the NETSIM model to provide greater detail in specifications. When vehicle occupancy values are input for a fleet component on both Record Type 52 and Record Type 58, the Record Type 52 value for that component is ignored.

Discussion of Selected Entries

1 A unique numeric index that ranges from 1 to 16 must be assigned to each vehicle type. This index is used by the program to access the internal arrays which contain the performance characteristics of this vehicle type. These performance characteristics are specified to the program on the remaining entries of this record type.

2 The length of a given vehicle type must range from 10 to 125 feet (3 to 38 meters).

3 This entry describes the maximum acceleration attainable by this vehicle type when the vehicle starts accelerating from a speed of zero on level grade and dry pavement. This maximum must reflect normal driving habits and not the upper bound of the physical capability of the vehicle. This is depicted as the maximum acceleration on the acceleration-speed graph shown in figure 5-16. This value is input in tenths of mph/sec or kph/sec (i.e., a value of 3.5 is entered as 35). This value must range from 20 to 86 tenths of a mile per hour per second (32 to 138 tenths of a kilometer per hour per second).

4 This entry describes the maximum speed attainable by this vehicle type when the acceleration is zero while traveling on level grade and dry pavement. This maximum should reflect the normal driving habits and not the upper bound of the physical capability of the vehicle. This is depicted as the maximum speed on the speed-acceleration graph shown in figure 5-l 6. This value must be between 25 and 125 mph (or between 40 and 201 kph).

5 This entry defines a multiplicative factor applied to the mean discharge headway that was assigned on a link-specific basis on Record Type 11. This factor reflects the difference in queue discharge headway between a "typical" passenger car and this vehicle type. It must range from 50% to 500% and will automatically be assigned to 100% if left blank.

6-9 The performance characteristics described on a Record Type 58 must be attributed to vehicles of at least one of the four fleet components (i.e., automobiles, trucks, Carpools, and buses). The percentage of the **total** number of vehicles in each fleet component that exhibit the performance characteristics of this vehicle type is specified in these entries. Once the performance characteristics are specified for a portion of a fleet component, other Record Type 58s must describe the remainder of that fleet component so that either 100% or 0% of each fleet component is described by Record Type 58s. (Default values are assigned for any fleet component not described by Record Type 58s.)

60
NETSIM Environmental Tables

Table 5-42. Record Type 60 – NETSIM environmental tables.

ENTRY	COLUMN(S)	DESCRIPTION
1	4	Code that identifies the type of data contained on this record: 0 Fuel consumption rate (10-5 gallons/sec) 1 HC emission rate (10-4 gallons/sec) 2 CO emission rate (10-3 gallons/sec) 3 NO, emission rate (10-4 gallons/sec)
2	8	Code that identifies the vehicle type to which this record applies: 1 Automobile 2 Truck 3 Bus
3	11-12	Vehicle speed (in feet per second) that applies to the data. Range = O-70 **ft/sec.**
4	16	Code [0, l] if the following data are for [acceleration, deceleration]
5	17-20	Value of the data item (specified in Entry 1) for the vehicle type (specified in Entry 2) traveling at the speed (specified in Entry 3) when the vehicle is accelerating or decelerating (specified in Entry 4) at 9 **ft/sec2**
6	21-24	Same as Entry 5 but for an acceleration/deceleration of 8 **ft/sec2**
7	25-28	Same as Entry 5 but for an acceleration/deceleration of 7 **ft/sec2**
8	29-32	Same as Entry 5 but for an acceleration/deceleration of 6 **ft/sec2**
9	33-36	Same as Entry 5 but for an acceleration/deceleration of 5 **ft/sec2**
10	37-40	Same as Entry 5 but for an acceleration/deceleration of 4 **ft/sec2**
11	41-44	Same as Entry 5 but for an acceleration/deceleration of 3 **ft/sec2**
12	45-4s	Same as Entry 5 but for an acceleration/deceleration of 2 **ft/sec2**
13	49-52	Same as Entry 5 but for an acceleration/deceleration of **1 ft/sec2**
14	53-56	If this record describes acceleration values (i.e., Entry 4 = 0), this entry is the same as Entry 5 but for a vehicle traveling at a constant speed. If the record is describing deceleration values (i.e., Entry 4 = 1), then this entry must be left **blank.**
15	79-80	60

This record type can be in the input stream for the NETSIM model only during the first time period.

The NETSIM model allows the user to modify any or all of the portions of the tabulated data that define fuel consumption rates and pollutant emission rates. For fuel consumption tables, the rate is expressed as a function of acceleration, speed, and vehicle type. There is only one table (for automobiles) for HC, CO, and NO, rates, and it defines the rates as a function of acceleration and speed.

Each Record Type 60 specifies the rates for acceleration or deceleration values, given a vehicle type and speed. Acceleration rates are input for values from 9 ft/sec2 to 0 ft/sec2, while deceleration rates are input for values of -9 ft/sec2 to - 1 ft/sec2

It is strongly recommended that the user group Record Type 60s of similar data and vehicle type together to combine all changes of a given table under a common heading and reduce the amount of output. In addition, grouping the tables in descending or ascending speed order will ease the readability of the output.

61
On-Line Incident Detection Specifications

Table 5-43. Record Type 61 – on-line incident detection specifications.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Polling frequency (in number/second). Default = 10.
2	5-8	Analog/digital code: 0 Digital mode 1 Analog mode
3	9-12	Evaluation frequency for incident detection (in number of freeway time steps between reevaluations)
4	22-24	Incident detection algorithm to be applied. Range = 1-3.
5	55-56	Assumed average vehicle length for incident detection (in feet)
6	79-80	61

FRESIM has the capability of performing on-line incident detection and off-line incident detection. Record Type 61 specifies the input for simulating on-line incident detection. In the on-line incident detection mode, incident detection is performed as FRESIM simulates the movement of vehicles through a specified network. (In the off-line mode of incident detection, vehicle movement is not simulated. Rather, incident detection is performed on a file of detector actuations obtained from a previous FRESIM run.)

The following three incident detection algorithms have been implemented:

1. **Algorithm 1** uses the California logic, which uses occupancies at sensor stations to determine the onset of the incident, its approximate location and the end of the incident.
2. **Algorithm** 2 is the Payne algorithm 8, which incorporates compression wave suppression logic to avoid incident false alarms due to the presence of transient compression waves in the traffic flow.
3. **Algorithm** 3 uses the method of double exponential smoothing in an attempt to reduce the number of incident false alarms.

Only one of these records is permitted per simulation, and it must be included with the first time period data.

Discussion of Selected Entries

1 Polling frequency is entered here. This is appropriate for digital detectors only (see Entry 2).

2 The analog/digital flag is entered in this field. If the digital mode is selected, the polling rate can be input in Entry 1.

3 The evaluation frequency is entered in this field, expressed as the number of freeway time steps between reevaluations.

If on-line incident detection is desired, a freeway time step of 10 tenths of a second must be specified in Columns 12-16 on Record Type 04.

4 The incident detection algorithm that is to be applied to the simulation is entered in this field. The entry must be equal to or less than 3 (but greater than zero). If two Record Type 62s are input for this algorithm, the second record does not need to specify an algorithm number in this column.

5 The assumed average vehicle length for incident detection is entered into this field, in feet. This number depends heavily on the truck percentage and truck type distribution in the simulated network.

62
On-Line Incident Detection Algorithm Parameters

Table 5-44. Record Type 62 – on-line incident detection algorithm parameters.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-s	First (or tenth) parameter for the on-line incident detection algorithm specified in Entry 4 on Record Type 6 1. Can be entered in floating point format.
2	9-16	Same as Entry 1 but for parameter 2 (or 11)
3	17-24	Same as Entry 1 but for parameter 3 (or 12)
4	25-32	Same as Entry 1 but for parameter 4 (or 13)
5	33-34	Same as Entry 1 but for parameter 5 (or 14)
6	41-4s	Same as Entry 1 but for parameter 6 (or 15)
7	49-56	Same as Entry 1 but for parameter 7 (or 16)
8	57-64	Same as Entry 1 but for parameter 8 (or 17)
9	65-72	Same as Entry 1 but for parameter 9 (or 18)
10	79-80	62

Up to two Record Type 62s can be input for the incident detection algorithm specified on Record Type 61. Parameters 1-9 are specified on the first record, and parameters 10-18, if needed, are specified on the second record, which must immediately follow the first. Parameters for each distinct incident detection algorithm must start on a new Record Type 62. Table 5-48 presents the parameters that are pertinent to the three different incident detection algorithms.

63

On-Line Incident Detection Detector Station Identification

Table 5-45. Record Type 63 - on-line incident detection detector station identification.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–2	**First** station number to be used for on-line incident detection
2	3–4	**Second** station number to be used for on-line incident detection
• • •	• • •	
39	77–78	**Thirty-ninth** station number to be used for on-line incident detection
40	79–80	63

Up to two Record Type 63s can be specified. **The station numbers relate to Entry 8 on Record Type 28.**

The sequence of entries **must** be input in order from upstream to downstream. If there are two or more freeway segments, the station number sequences representing these sections must be separated by an entry of 0.

64

Off-Line Incident Detection, Point Processing, or MOE Estimation Specification (FRESIM) or Evaluation Frequency for Surveillance Detectors (NETSIM)

Table 5-46. Record Type 64 - off-line incident detection, point processing, or MOE estimation specification (FRESIM) or evaluation frequency for surveillance detectors (NETSIM).

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Polling frequency (in number/second). Default = **10.**
2	7–8	Analog/digital code: **0** Digital mode **1** Analog mode
3	9–12	Evaluation frequency for MOE estimation and point processing (in seconds) or evaluation frequency for surveillance detectors (in seconds)
4	13–16	Time period for reevaluating off-line incident detection (in seconds)
5	21–24	Number of the **first** off-line incident algorithm
6	25–28	Number of the **second** off-line incident algorithm
7	29–32	Number of the **third** off-line incident algorithm
8	55–56	Assumed average vehicle length for off-line incident detection, point processing, and MOE estimation (in feet)
9	60	Code [0,1] if point processing [is not, is] desired. Default = **0.**
10	64	Code [0,1] if MOE estimation [is not, is] desired. Default = **0.**
11	79–80	64

If the off-line incident processing is desired, a Record Type 64 must occur in the data deck as the first off-line processing module data record. This record must be followed by a number of Record Type 65s if incident detection is specified. The specification of MOE estimation requires a Record Type 66. Finally, if off-line incident detection or MOE estimation is specified, the Record Type 67s would conclude the input for off-line processing. The basic premise behind this option is that a previous execution of the FRESIM model has created a detector data tape from the simulated surveillance system. Therefore, using this option is equivalent to performing the same functions on a detector data tape from a real surveillance and control system.

In a NETSIM dataset, this record is used to define the evaluation frequency of surveillance detectors using Entry 3. This record type **is optional,** and it can only appear once during the first time period. This record is used to set the frequency for surveillance detector intermediate output. Surveillance statistics (vehicle count, cumulative on-time, occupancy, and average speed) will be calculated for every surveillance detector during each evaluation period. For example, if the user specifies a 30-second evaluation frequency, surveillance information will be output for every 30 seconds of simulation. Each section of output will only contain statistics calculated during the previous **30** seconds.

Discussion of Selected Entries

1 This entry specifies the polling frequency, which only applies to digital detectors.

2 This entry specifies the analog/digital code. If the user wants to employ the digital mode, the polling frequency entered in Entry 1 will be used.

3 If FRESIM is used, the evaluation frequency for MOE estimation and point processing is entered. If off-line incident detection is run by itself, then this entry should be set according to Entry 4. If NETSIM is used, the evaluation frequency for surveillance detectors is entered.

4 This entry specifies the time period for reevaluating off-line incident detection. Note that the content of this entry should be an integer multiple (between 1 and 20) of Entry 3. If incident detection algorithm 2 will be applied, this entry is set at 60.

5-7 These entries specify the number of off-line incident detection algorithms that the user wants to analyze. A maximum of three such algorithms can be analyzed in each off-line run of the FRESIM model. The second and/or third entries are left blank if less than three algorithms are specified.

8 This entry specifies the assumed average vehicle length for off-line incident detection, point processing, and MOE estimation. This value will depend on the percentage and types of trucks in the vehicle stream.

9 This entry specifies the point-processing option. In FRESIM, each detector on a roadway collects raw data, such as detector activation and deactivation times. The point-processing method evaluates detector-specific data and then outputs such information as volume, time mean speed, mean time headway, and mean occupancy.

10 This entry specifies MOE estimation. A “1” indicates that a Record Type 66 must be present.

65
Off-Line Incident Detection Algorithm Parameters

Table 5-47. Record Type 65 – off-line incident detection algorithm parameters.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-8	Parameter (in floating point) applied for off-line incident detection algorithm
2	9-16	
. . .	. . .	
9	65-72	
10	75	Off-line incident detection algorithm to be applied. Range = l-3. If two Record Type 65s are input for this algorithm, the second does not need to specify an algorithm number in this column. The second record **must** immediately follow in the input stream.
11	79-80	65

Up to two Record Type 65s can be input for each off-line incident detection algorithm specified on Record Type 64. Parameters for each distinct off-line incident detection algorithm must start on a new Record Type 65. Table 5-48 describes the incident detection algorithm parameters.

Table 5-48. Incident detection algorithm parameters.

PARAMETER	ALGORITHM 1	ALGORITHM 2	ALGORITHM 3
1	Threshold of occupancy difference across successive sensor positions (8.0)*	Number of compression wave suppression periods (2.0)	**P1 = [1,2]** Occupancy feature to be used: 1 Change in occupancy between sensor positions 2 Percent change in occupancy over time
2	Threshold of percent occupancy difference across successive sensor positions	T1 Threshold of occupancy difference across successive sensor positions (13 .O)	**P2** Exponential smoothing coefficient (from 0 to 1) (0.5)
3	Threshold of percent occupancy difference at the downstream sensor over time (8.0)*	T2 Threshold of percent occupancy change at the downstream sensor over time (-30.0)	**P3** Incident threshold value (5.0)
4		T3 Threshold of percent occupancy difference across successive sensor positions (3 1 .0)	**P4** Absolute deviate smoothing coefficient (0.0, 1.0)
5		T4 Threshold of occupancy at the downstream sensor position (16.0)	
6		T5 Another threshold of occupancy at the downstream sensor position	

*Representative values of the parameters are shown in parentheses.
The user should input values that are appropriate to the given problem.

66
MOE Algorithm Parameters

Table 5-49. Record Type 66 – MOE algorithm parameters.

ENTRY	COLUMN(S)	DESCRIPTION
1	3	Number of the MOE estimation algorithm to be applied. Range = **1–3.**
2	4–9	Parameter number **1** for the MOE algorithm specified in Entry 1 (in hundredths of a unit) (e.g., input .08 as 8 in Columns 4–9)
3	10–15	Parameter number **2** for the MOE algorithm specified in Entry 1 (in hundredths of a unit)
4	16–21	Parameter number **3** for the MOE algorithm specified in Entry 1 (in hundredths of a unit)
5–8	24–42	Same as Entries 1–4 but for a **second** desired MOE estimation algorithm
9–12	45–64	Same as Entries 1–4 but for a **third** desired MOE estimation algorithm
13	79–80	66

Only one Record Type 66 can be present for each off-line module application. Table 5–50 presents the MOE parameters for the three MOE algorithms. **The same algorithm can be applied up to three times, with different parameters each time.**

Table 5-50. MOE parameters.

PARAMETER	ALGORITHM 1	ALGORITHM 2	ALGORITHM 3
1	Rough count error variance (30 veh^2)*	Variance of error term (0.08 veh^2)	Initial expected section density error variance (0.08 veh/lane-mile)
2	Variance of trap error term (0.08 veh^2)	Ratio of system/observation noise (between 0 and 1)	System noise variance (1.1)
3	Initial Kalman filter (between 0 and 1) (veh^2)	Initial count estimation error variance	Ratio of system/observation noise variance (478)
*Representative values of the parameters are shown in parentheses. The user should input values that are appropriate to the given problem.			

67
Off-Line Incident Detection, Point Processing, or MOE Estimation Detector Station

Table 5-51. Record Type 67 – off-line incident detection, point processing, or MOE estimation detector station.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–2	Station numbers to be used for incident detection, point processing, and MOE estimation. Must be input in upstream to downstream order. If there are two or more freeway segments, the station number sequences representing these sections must be separated by a zero.
2 • • •	3–4 • • •	
37	73–74	
38	79–80	67

Up to two Record Type 67s can be input. Record Type 67s must be present if point processing, incident detection, or MOE estimation is done. **The station numbers relate to Entry 8 on Record Type 28.**

68

Car-following Sensitivity Factor

Table 5–52. Record Type 68 – car-following sensitivity factor.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	New factor value for driver type **1** (in tenths of a second)
2	5–8	New factor value for driver type **2** (in tenths of a second)
3	9–12	New factor value for driver type **3** (in tenths of a second)
4	13–16	New factor value for driver type **4** (in tenths of a second)
5	17–20	New factor value for driver type **5** (in tenths of a second)
6	21–24	New factor value for driver type **6** (in tenths of a second)
7	25–28	New factor value for driver type **7** (in tenths of a second)
8	29–32	New factor value for driver type **8** (in tenths of a second)
9	33–36	New factor value for driver type **9** (in tenths of a second)
10	37–40	New factor value for driver type **10** (in tenths of a second)
11	79–80	68

The car-following model in FRESIM is based on the premise that drivers desire to follow the car in front of them at a given value of the time headway between them. This time headway, however, differs from driver to driver. The distribution of time headways is stored in the ZFOLK array, which designates the factors for driver type 1 that determine the desired car-following distance. The default values are shown in table 5–53.

Table 5–53. Car-following headway factors.

DRIVER TYPE	1	2	3	4	5	6	7	8	9	10
SENSITIVITY FACTOR	15	14	13	12	11	10	9	8	7	6

This record type is **optional,** and it can be input for the FRESIM model only within the input stream for the first time period. This record type is used to modify calibration parameters (override defaults) for the sensitivity factors of driver types 1–10. If this record type is present in the input stream, then all entries must be specified. A blank entry is interpreted as zero, not as a request for the default value.

69
Pavement Friction Coefficients—Lag to Accelerate and/or Decelerate

Table 5-54. Record Type 69 – pavement friction coefficients—lag to accelerate and/or decelerate.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Friction coefficient (× 100) for pavement code **1** (dry concrete)
2	5–8	Friction coefficient (× 100) for pavement code **2** (wet concrete)
3	9–12	Friction coefficient (× 100) for pavement code **3** (dry asphalt)
4	13–16	Friction coefficient (× 100) for pavement code **4** (wet asphalt)
5	17–20	Lag to accelerate (in tenths of a second)
6	21–24	Lag to decelerate (in tenths of a second)
7	79–80	69

This record type is **optional.** It can be used to override default values embedded in the model. Any blank or zero fields in this record type will be ignored, and the default values will be employed for those entries.

The pavement friction values are used in the computation of maximum speed on a curve. The values given here were taken from the INTRAS model and cannot represent real friction coefficients because of the lack of data available during program preparation. The embedded value is 16 hundredths for all pavement codes. The user should consider inputting other values if they are available. Acceptable entries range from 0 to 100.

The embedded values for lag to accelerate **and** lag to decelerate are 3 tenths of a second. The lags are time delays that motorists experience when making required maneuvers.

70

Time to Complete a Lane Change; Minimum Separation for Vehicle Generation; Lane-changing Probability; Percentage of Cooperative Drivers; and Nonemergency Acceleration

Table 5–55. Record Type 70 – time to complete a lane change; minimum separation for vehicle generation; lane-changing probability; percentage of cooperative drivers; and nonemergency acceleration.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Time to complete a lane-change maneuver (in tenths of a second)
2	5–8	Minimum separation for generation of vehicles (in tenths of a second)
3	9–12	Random lane-change probability (in a percentage). **This feature is currently disabled.**
4	13–16	Percentage of drivers desiring to yield the right-of-way to lane-changing vehicles attempting to merge ahead of them
5	17–20	Maximum nonemergency freeway deceleration (in tenths of a foot per second^2)
6	79–80	70

Any blank or zero fields in this record type will be ignored, and the default values will be employed for those entries.

The default value for time to complete a lane-change maneuver is 30 tenths of a second. The lane-changing logic in FRESIM is assumed to take place over a finite period of time. During this period, the lane-changing vehicle and its new follower are allowed to be in a temporarily unsafe following condition with respect to their leaders, thereby achieving a safe following condition at the end of the period. As a result, this period is analogous to a relaxation time in electrical circuits.

The default value of minimum separation for generation of vehicles is 20 tenths of a second. This governs the maximum rate at which vehicles can be emitted onto the network.

The default value for lane-change probability is 1%. This is the percentage of vehicles that will attempt to lane-change at any given time for no reason (i.e., random lane changes). **This feature is currently disabled within the model.**

The FRESIM model assumes that a certain fraction of putative followers in the target lane of a vehicle desiring to make a lane change will cooperate with the lane-changer to increase the probability of the lane change being successful. This is modeled by allowing a larger value of the lane-change risk factor to be accepted. Thus, a noncooperative driver will accept a risk of -8 ft/sec, while a cooperative driver will accept a risk of - 15 ft/sec The default value for the percentage of drivers that want to yield the right-of-way (this entry has also been termed the "courtesy factor") is 20%.

The default value for maximum nonemergency freeway deceleration is 80 tenths of a foot per $second^2$, which is the largest value of deceleration that is allowed for car following.

This record type can be used to override any or all of the default values.

71

Vehicle Type Specification

Table 5-56. Record Type 71 - vehicle type specification.

ENTRY	COLUMN(S)	DESCRIPTION
1	l-4	Vehicle type (a numeric index). Range = **1-16.**
2	5-8	Length of this vehicle type (in feet)
3	9-12	Jerk value (in tenths of a foot per second3) Default = 7 for all vehicle types.
4	13-16	Maximum deceleration for vehicle type (in tenths of a foot per second2) **on** level grade and dry pavement. Default = 150 (15 ft/sec2) for all vehicle types.
5	17-20	Percentage of **passenger car fleet** that consists of this vehicle type, if this vehicle is a passenger car
6	21-24	Percentage of **truck fleet** that consists of this vehicle type, if this vehicle is a truck
7	25-28	Percentage of **mass transit fleet** that consists of this vehicle type, if this vehicle **is** a bus
8	29-32	Vehicle performance index used to access tabulated data for maximum acceleration, fuel consumption, effect of grade, and environmental emissions. Range = l-7.
9	79-80	71

This record type is **optional,** and it can appear in the input stream for the FRESIM model only during the first time period. This record type can be omitted when it is acceptable to describe the fleet components in the traffic stream by the default values given below.

Table 5-57. Default values for the fleet components.

FLEET COMPONENT	VEHICLE TYPE	LENGTH	PERCENTAGE OF THE FLEET COMPONENT
PASSENGERCARS	1 Low-performance passenger car	17	25
	2 High-performance passenger car	19	75
TRUCKS	3 Single-unit truck	38	31
	4 Semitrailer truck with medium load	56	24
	5 Semitrailer truck with full load	56	36
	6 Double-bottom trailer truck	67	9
MASS TRANSIT VEHICLES	7 Intercity bus	43	100

If the user, on the other hand, does not want to accept these default values and/or wants to describe fleet components in terms of different distributions of several different types of vehicles with different performance characteristics, he can specify each vehicle type comprising the traffic stream on Record Type 71. This specification includes the following information:

> The bumper-to-bumper length of each vehicle type. The program will internally add 2 feet to this value to obtain the "effective" length in a standing queue.

> The operational characteristics of each vehicle type.

> A stratification of the traffic steam into the "fleet components" of passenger cars, trucks, and mass transit vehicles

> The distribution of vehicle types comprising each such fleet component.

The model can accommodate up to 16 vehicle types that **must** represent the three fleet components. Each fleet component can comprise any mix of vehicle types specified by the user, reflecting current or projected vehicle populations. The aggregation of vehicle types assigned to each fleet component, as specified, must equal 100%.

Each fleet component must be represented by at least one vehicle type. If the user omits Record Type 71 from his dataset or specifies several vehicle types for some, but not for all of the three fleet components, then the model will assign one vehicle type with the appropriate default properties shown above for each fleet component not explicitly specified.

Discussion of Selected Entries

1 A unique numeric index in the range from 1 to 16 must be assigned to each vehicle type. This index is used by the program to access the internal arrays that contain performance characteristics of this vehicle type. These performance characteristics are specified to the program on the remaining entries of this record type. The vehicle tables above denote the default relationships between this index and the various vehicle types.

2 The bumper-to-bumper length of a given vehicle type must range from 10 to 125 feet.

3 This entry describes the jerk (rate of change of acceleration) value, in tenths of a foot per second3. This is the maximum change allowed in the value of acceleration from one time step to the next.

4 This entry describes the maximum deceleration attained by this vehicle type on level grade and dry pavement. This maximum should reflect normal vehicle driving habits, not the upper bound of vehicle capability. This value is input in tenths of a foot per second2 (e.g., a value of 10.2 is entered as 102). This value must not exceed 16 feet per second2.

5-7 The performance characteristics described on a Record Type 71 must be attributed to vehicles of one of the three fleet components (passenger cars, trucks, or buses). Each fleet component must be comprised of at least one vehicle type. The percentage of the total number of vehicles in each fleet component that exhibit the performance characteristics of this vehicle type is specified in these entries. Once performance characteristics are specified for a portion of a fleet component, other Record Type 7 1 s must describe the remaining portions of the fleet component so that the total for the fleet component must add to 100%. Default values are kept for any vehicle type not described by Record Type 71 s. It should be noted that the percent of the total fleet for each component is given on Record Type 50.

8 FRESIM currently maintains tabulated data for maximum acceleration, fuel consumption, and environmental emissions as well as for the effect of grade on acceleration and fuel consumption. These tables are referenced by vehicle speed and (for environmental emissions and fuel consumption only) acceleration. FRESIM contains seven different tables for each data type, and these tables correspond to the seven default vehicle types. The user can specify which of the seven tables best describes the defined vehicle-type performance. The default values for Entry 8 are listed in table 5-58.

The user can also modify the tables on Record Types 72 and 73.

Table 5-58. FRESIM vehicle types.

VEHICLE PERFORMANCE INDEX	PERFORMANCE DESCRIPTION
1	Low-performance passenger car
2*	High-performance passenger car
3	Single-unit truck
4*	Semitrailer truck with medium load
5	Semitrailer truck with full load
6	Double-bottom trailer truck
7*	Intercity bus
*Default value.	

72
FRESIM Environmental Tables

Table 5-59. Record Type 72 – FRESIM environmental tables.

ENTRY	COLUMN(S)	DESCRIPTION
1	4	Code that identifies the table data to be modified: 0 Fuel consumption rate 1 HC emission rate 2 CO emission rate 3 NO, emission rate
2	8	Vehicle performance index to which the data apply. Range = l-7.
3	12	If the vehicle performance index (as specified in Entry 2) has the same fuel or emission rate data as another vehicle performance index, enter the type code here. If the rates will be entered explicitly, leave this entry **blank.** If a nonzero value is entered, the remaining entries on this record, excluding the record type, must be left **blank.**
4	15-16	Vehicle speed (feet/second) applicable to data on this record. Range = **0-110 ft/sec.**
5	20	Code [0, l] if the data entered in Entries 6-l 6 are for vehicle [acceleration, deceleration]
6	21-25	Value of the data item (as specified in Entry 1) for the vehicle performance type (as specified in Entry 2) when traveling at the speed entered in Entry 4 ant at an acceleration or deceleration (see Entry 5) of **10 ft/sec2**
7	26-30	Same as Entry 6 but for acceleration or deceleration of 9 **ft/sec2**
8	3 l-35	Same as Entry 6 but for acceleration or deceleration of 8 **ft/sec2**
9	36-40	Same as Entry 6 but for acceleration or deceleration of 7 **ft/sec2**
10	41-45	Same as Entry 6 but for acceleration or deceleration of 6 **ft/sec2**
11	46-50	Same as Entry 6 but for acceleration or deceleration of 5 **ft/sec2**
12	51-55	Same as Entry 6 but for acceleration or deceleration of 4 **ft/sec2**
13	56-60	Same as Entry 6 but for acceleration or deceleration of 3 **ft/sec2**
14	61-65	Same as Entry 6 but for acceleration or deceleration of 2 **ft/sec2**
15	66-70	Same as Entry 6 but for acceleration or deceleration of **1 ft/sec2**

ENTRY	COLUMN(S)	DESCRIPTION
16	71–75	Same as Entry 6 but for constant speed. **Blank** if Entry 5 = 1 (i.e., this record specifies deceleration data).
17	79–80	72

The FRESIM model allows the user to modify any or all of the parts of internal data tables defining fuel consumption and pollutant emission rates. The tables express these rates as a function of acceleration, given the vehicle performance index and vehicle speed. This record can be used to alter one half row of a table—all of the acceleration values or all of the deceleration values. By using combinations of these records, the user can modify a large portion of the internal data tables, or even the entire thing. (A complete table for one data type for one vehicle includes 222 records.)

It is possible for the user to apply the embedded data from a different vehicle performance index to a newly defined performance index. In this case, the user only needs to specify the performance index that corresponds to the existing embedded data as Entry 3.

The values for emission rates are scaled by 0.001 grams/sec. The values for fuel consumption rates are scaled by 0.0001 gallons/sec.

73
Maximum Acceleration Tables

Table 5-60. Record Type 73 – maximum acceleration tables.

ENTRY	COLUMN(S)	DESCRIPTION
1	4	Code that identifies which of the three acceleration-related data tables will be modified: **0** Maximum acceleration **1** Grade correction factor for maximum acceleration **2** Grade correction factor for fuel consumption
2	8	Vehicle performance index to which the data apply. Range = **1–7.**
3	12	If this vehicle performance index (as specified in Entry 2) has the same data as another index, enter the index code for that table here. If this entry is specified, the remaining entries must be left **blank.**
4	13–16	Value of data at **zero speed** × **100.** (For example, a maximum acceleration of 9.2 ft/sec^2 would be entered as 920, and a grade correction factor of 0.18 would be entered as 18.)
5	17–20	Value of data at **10 ft/sec** × 100
6	21–24	Value of data at **20 ft/sec** × 100
7	25–28	Value of data at **30 ft/sec** × 100
8	29–32	Value of data at **40 ft/sec** × 100
9	33–36	Value of data at **50 ft/sec** × 100
10	37–40	Value of data at **60 ft/sec** × 100
11	41–44	Value of data at **70 ft/sec** × 100
12	45–48	Value of data at **80 ft/sec** × 100
13	49–52	Value of data at **90 ft/sec** × 100
14	53–56	Value of data at **100 ft/sec** × 100
15	57–60	Value of data at **110 ft/sec** × 100
16	79–80	73

The FRESIM model allows the user to modify any or all of the portions of the tabulated data that define maximum acceleration, grade correction factor for maximum acceleration, and grade correction factor for fuel consumption.

Each Record Type 73 specifies the vehicle performance index to which the data record applies. This record must also have a data type code, which specifies whether the data are a substitute for the maximum acceleration, the grade correction factor for acceleration, or the grade correction factor for fuel consumption. Values are entered by the user as a function of speed every 10 ft/sec. Values in between those entered are computed internally by the FRESIM model via linear interpolation.

It is possible for the user to apply the embedded data for a different vehicle performance index to a newly defined index. In this case, the user need only specify the index (corresponding to the existing embedded data) as Entry 2 on Record Type 73.

74
Origin-Destination

Table 5-61. Record Type 74 – origin-destination.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Origin node number
2	5–8	Destination node number
3	11–12	Percentage of vehicles that are entering through the origin node specified in Entry 1 and that will travel to the destination node specified in Entry 2
4–6	13–24	Same as Entries 1–3 but for another O-D exchange
7–9	25–36	
10–12	37–48	
13–15	49–60	
16–18	61–72	
19	79–80	74

This record can be used to override the internally computed O-D exchanges.

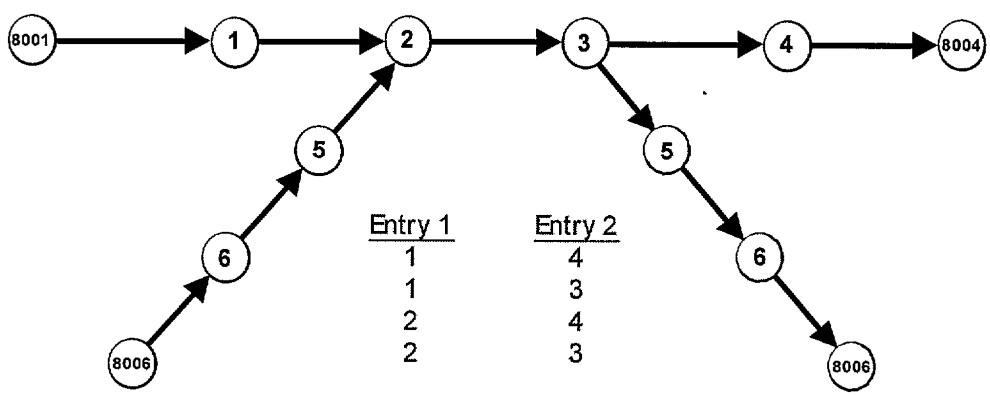


Figure 5-17. Example of origin-destination input.

Discussion of Selected Entries

1 For an on-ramp origin, this entry is the number of the node at which the on-ramp intersects with the freeway mainline. For a mainline origin, this entry is the number of the downstream node of the freeway entry link (see figure 5-17).

2 For an off-ramp destination, this entry is the number of the node at which the off-ramp departs from the freeway mainline. For a freeway mainline destination, this entry is the number of the upstream node of the freeway exit link (see figure 5-l 7).

3 The percentage will override the internally computed trip exchange from Entry 1 to Entry 2.

80

Optional Link Geometric Data

Table 5-62. Record Type 80 – optional link geometric data.

ENTRY	COLUMN(S)	DESCRIPTION
1	l-4	Upstream node number i of link **(i,j)**
2	5-s	Downstream node number j of link **(i,j)**
3	13-16	Width of lane **1** (in feet). Range = 8-15 **feet.** Default = 12 **feet.**
4	17-20	Width of lane 2 (in feet)
5	21-24	Width of lane 3 (in feet)
6	25-28	Width of lane 4 (in feet)
7	29-32	Width of lane 5 (in feet)
8	33-36	Width of lane 6 (in feet)
9	37-40	Width of lane 7 (in feet)
10	41-44	Longitudinal distance (in feet) from stop line to the near curb. Range = 3-35 **feet.** Default = 15 **feet.**
11	45-4s	Forward sight distance at stop line (feet). Range = 50-5,000 **feet.** Default = **1,000 feet.**
12	49-52	Angle of subject link relative to due north. Range = 0^{o}-360^{o}.
13	79-80	so

This record type is **optional,** and it pertains to the first time period only. This record type should be included when the user wants to simulate intersection traffic in micro detail by NETSIM. This detail includes a representation of the driver decision-making processes to recognize and resolve traffic conflicts within the intersection. The specifications in Entries 3-l 1 are not utilized by NETSIM unless the intersection identified in Entry 2 is specified as a micronode on Record Type 36 or 43.

If this record is omitted for an approach link to a microintersection, NETSIM will assume the following:

- All lanes are 12 feet (4 meters) wide.
- The stop line is located 15 feet (5 meters) upstream of the curb.
- Node coordinates are specified on Record Type 195 for all microintersection nodes, their approach nodes, their receiving nodes and all other approach nodes to the receiving nodes and receiving nodes from the receiving nodes.

The user should omit Entry 12 (the angle of the approach) if node coordinates are specified on Record Type 195 for the intersection node and all related nodes. (These coordinates must be specified as a matter of course if graphical displays are requested.) If node coordinates are omitted, Entry 12 must be completed for all links that include the following:

- Each approach link to an intersection to be represented in micro detail (that is, each approach link to a micronode).
- Each approach link to and receiving link from an intersection that receives traffic from a micronode. Thus, if one approach to an intersection receives traffic from a micronode, angles must be specified for all approaches to that intersection and all receiving links from that intersection even though the intersection itself is not a micronode.

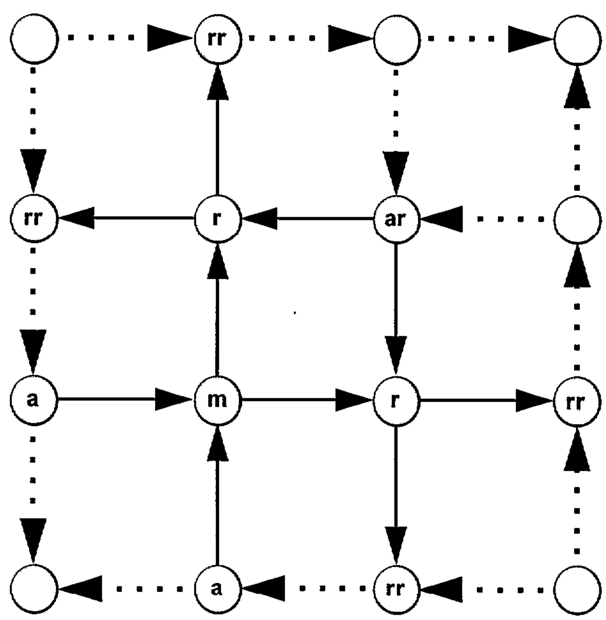


Figure 5-18. Node coordinate requirements for micronodes.

If node m is a micronode and node coordinates are specified for node m, then node coordinates must be specified for the following:

> All approach nodes a

> All receiving nodes r

> All approach nodes to the receiving nodes **ar**

> All receiving nodes of the receiving nodes rr.

If node coordinates are not specified, then Entry 13 on Record Type SO must be specified for all links that are drawn as solid lines in figure 5-l 8.

Discussion of Selected Entries

1 This entry is for internal links only, therefore the upstream node number must be between 1 and the maximum allowable internal node number, NMAX. Furthermore, the upstream and downstream node numbers specified in Entries 1 and 2 must correspond to a link that was previously defined on Record Type 11.

2 Internal links must have downstream node numbers in the range [1 ,NMAX] (see Entry 1).

3-9 These entries define the width of each lane of moving traffic as defined on Record Type 11. The lane numbers referenced by these entries must correspond to the lane numbers used on Record Type 11. Acceptable lane widths range from 8 to 15 feet (3-4 meters). A default value of 12 feet (4 meters) is assigned if the width of an existing lane is omitted.

10 This entry defines the distance between the stop line and the curb line. Acceptable values range from 3 to 35 feet (l-10 meters). If omitted, a default value of 15 feet (5 meters) is assigned.

11 This entry defines the forward visibility of a driver at the stop line to see approaching vehicles, and it is used to determine when drivers can see and respond to approaching vehicles that conflict with their movement within the intersection. Acceptable values for this entry range from 50 to 5,000 feet (16-1,524 meters). If omitted, a value of 1,000 feet (305 meters) is assigned.

12 This entry defines the angle of this intersection approach relative to due north. This entry is required when the subject link is an approach to a NETSIM microintersection and node coordinates were not specified on Record Type 195 for the micronode and all its related nodes. If graphical displays are requested on Record Type 05 (and thus all node coordinates must be defined on Record Type 195), this entry should be omitted.

Otherwise, this entry is needed to define the angles of all approaches to and receivers from a NETSIM microintersection. If angles are specified for at least one approach to a micronode, they must be specified for all related links.

Similarly, if node coordinates are specified on Record Type 195 for a micronode or any of its approaches, coordinates should be specified for the following:

> All approach nodes to the micronode

> All receiving nodes from the micronode

> All other approach nodes to the receiving nodes

> All receiving nodes from the receiving nodes.

Acceptable values for this entry are blank or l-360. **Due north is denoted by a value of 360, while a value of 0 implies that this entry is omitted.**

81
Lane-Change Parameters

Table 5-63. Record Type 81 - lane-change parameters.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Duration of a lane-change maneuver (in seconds). If omitted, the default value of **3 seconds** is assigned.
2	5–8	Mean time for a driver to react to a sudden deceleration of the lead vehicle (in tenths of a second); that is, a value of 3.5 seconds is entered as 35. If omitted, the default value of **10 tenths of a second** (i.e., 1 second) is assigned.
3	13–16	Deceleration at the beginning of a lane-change maneuver to be applied in the computation of acceptable risk (fpss or mpss). If omitted, the default value of **5 fpss** (2 mpss) is assigned.
Entries 4 and 5 pertain to mandatory and discretionary lane changes, respectively. Each of these entries is the difference in deceleration between the position at which a vehicle begins to respond to an object and the position of the object that causes the lane change (in fpss or mpss).		
4	17–20	**Mandatory** lane change (in fpss or mpss). If omitted, the default value of **10 fpss** (3 mpss) is assigned.
5	21–24	**Discretionary** lane change (in fpss or mpss). If omitted, the default value of **5 fpss** (2 mpss) is assigned.
6	25–28	Deceleration rate of **lead vehicle** (in fpss or mpss). If omitted, the default value of **12 fpss** (4 mpss) is assigned.
7	29–32	Deceleration rate of **follower vehicle** (in fpss or mpss). If omitted the default value of **12 fpss** (4 mpss) is assigned.
8	33–36	**Driver type factor** used to compute driver aggressiveness. If omitted, the default value of **25** is assigned.
9	37–40	**Urgency threshold** (in tenths of a second^2/foot or tenths of a second^2/per meter); that is, a value of 0.2 is entered as 2. If omitted, the default value of **0.2 seconds^2/foot** (0.1 seconds^2/meter) is assigned.
10	41–44	**Safety factor** × 10 in computing the lane-changer's estimation of the deceleration that would be acceptable to the follower target vehicle. If omitted, the default value of **8** is assigned, thus applying an actual safety factor of 0.8.
11	45–48	Percentage of drivers who cooperate with a lane-changer. If omitted, the default value of **50%** is assigned.

ENTRY	COLUMN(S)	DESCRIPTION
12	49-52	Headway below which all drivers will attempt to change lanes (in tenths of a second). If omitted, the default value of 2 **seconds** (i.e., 20 tenths of a second) is assigned.
13	53–56	Headway above which no drivers will attempt to change lanes (in tenths of a second). If omitted, the default value of 5 **seconds** (i.e., 50 tenths of a second) is assigned.
14	57–60	Longitudinal distance over which drivers decide to perform one lane change (in feet or meters). If omitted, the default value of 300 **feet** (92 meters) is assigned.
15	79-80	81

This record type is **optional,** and it can only be input during the first time period. It should only be input if the user wants to change some of the lane-change parameters set by the default values. The user can input as many of the entries as he desires. **Only one Record Type 81 can be entered.**

Discussion of Selected Entries

1 This entry must range from 1 to 8 seconds. Default = 3 seconds. NETSIM considers this entry the minimum amount of time after a lane change is initiated before another lane change can commence.

2 This is the amount of time required for a driver to begin to apply braking after his leader has begun a sudden deceleration. The range is from 1 to 30 tenths of a second. Default = 10 tenths of a second (i.e., 1 second).

3-5 In deciding whether a driver will initiate a lane change now, an assessment is performed of the level of risk the driver is willing to accept. This risk is expressed as the maximum deceleration rate (fpss) the driver is willing to accept in the event the leading and/or following vehicles in the target lane immediately initiated a “panic” deceleration.

This acceptable risk is a function of the driver’s position relative to the object causing the need for a lane change; that is, the closer the vehicle is to the object causing the lane change, the greater the deceleration the driver is willing to accept. NETSIM uses the following formula to escalate the acceptable risk as the vehicle approaches the cause of the lane change:

$$\text{Acceptable Risk} = -D_{x_c} - D(x_o - x_c)\,[(x - x_c) + (x_o - x_c)]^{0.5}$$

where

D_{x_c} = Deceleration at position xc (Entry 3). This parameter defaults to 5 fpss (2 mpss) and can be changed by specifying a value for Entry 3 that ranges from 1 to 10 fpss (l-3 mpss).

$D_{x_0} - x_c)$	=	Difference in deceleration between position x_c and x_o. This parameter is specified as Entry 4 for a mandatory lane-changer and as Entry 5 for a discretionary lane-changer. These entries must range from 5 to 15 fpss (2-4 mpss). The default for a mandatory lane-changer is 10 fpss (3 mpss). The default for a discretionary lane-changer is 5 fpss (2 mpss).
x	=	Current position of the vehicle.
x_c	=	Position at which the vehicle began to respond to the object.
x_o	=	Position of the object that causes the lane change.

As the values of Entries 3-5 increase, drivers will accept larger decelerations (i.e., riskier maneuvers), thus increasing the likelihood that a given lane-changing opportunity will be accepted.

6-7 In deciding whether a driver will accept a given lane-changing opportunity, NETSIM compares the driver's acceptable deceleration rate (i.e., acceptable risk as described in Entries 3-5) with the deceleration rate that would be required to stop safely if the new leader and/or follower vehicle immediately began a "panic" deceleration.

Entries 6 and 7 are the "panic" deceleration rates applied by the leader and follower vehicles respectively to determine the lane-changer's required deceleration for a safe stop. These entries can range from 10 to 15 fpss (36, mpss). If these entries are omitted, the program will default a value of 12 fpss (4 mpss) for these deceleration rates.

As the values of Entries 6-7 increase, the deceleration required for a lane-changer to stop safely also increases and the likelihood that a given lane-changing opportunity will be accepted decreases.

8 NETSIM simulates driver motivation to seek a lane-changing opportunity if the lead vehicle is traveling too slowly. A driver's "intolerable speed" **[Vi]** is computed as follows:

Vi = Vf(0.7 × DAF)

where

Vf	=	User-specified free-flow speed for this link
DAF	=	**1.0 + (Driver Type Code –** 5.5) + **FDA** (which is a driver aggressiveness factor)
Driver Type Code	=	1,2, ... 10 (depicting the aggressiveness of the driver)
FDA	=	Driver type factor (Entry S)

This factor is used to compute how motivated a driver will be to seek a lane change because of a slow-moving leader. The range for this value is 15-50. If omitted, a default of 25 is assigned by the model. With this default value, the value of the "intolerable speed" ranges from 0.57 Vf to 0.83 Vf. The value for a particular vehicle depends on its driver type code.

Decreasing Entry 8 will widen the difference in intolerable speeds between different driver types. By decreasing Entry 8, aggressive drivers would have lower intolerable speeds (and be more likely to attempt a lane change) and timid drivers would have higher intolerable speeds (and be less likely to attempt a lane change).

9 NETSIM estimates the "urgency" of a driver to initiate a lane change based on the driver's aggressiveness, the remaining distance to the object causing the lane change and the number of lane changes that are required to reach the driver's "goal" lane.

This "urgency" [U] is computed as follows:

$$U = DAF \times NLC \times V_f^2 \div (20\,x - x_0)$$

where

DAF = **1.0 + (Driver Type Code – 5.5) ÷ F_{DA}** (which is a driver aggressiveness factor) (see Entry 8)

NLC = Number of lane changes required to reach the "goal" lane

V_f = User-specified free-flow speed for this link

x = Current position of the vehicle

x_0 = Position of the object that causes the lane change

At urgency values of 0 up to some threshold [U_t] specified in this entry, the driver's acceptable deceleration to perform the lane change (i.e., acceptable risk) remains level at the value given in Entry 3. At urgencies above this threshold, the driver's acceptable deceleration will increase based upon the relationship described in the discussion of Entries 3–5.

The urgency threshold [Ut] must range from 0 to 5 tenths of a second^2/foot (0–1 tenths of a second^2/meter). If omitted, the default value of 2 tenths of a second^2/foot (1 tenth of second^2/meter) is assigned.

As values of the threshold increase, urgency values must also increase before drivers are willing to accept riskier lane-changing maneuvers. This will tend to discourage lane changing until the vehicle becomes closer to the object causing the lane change.

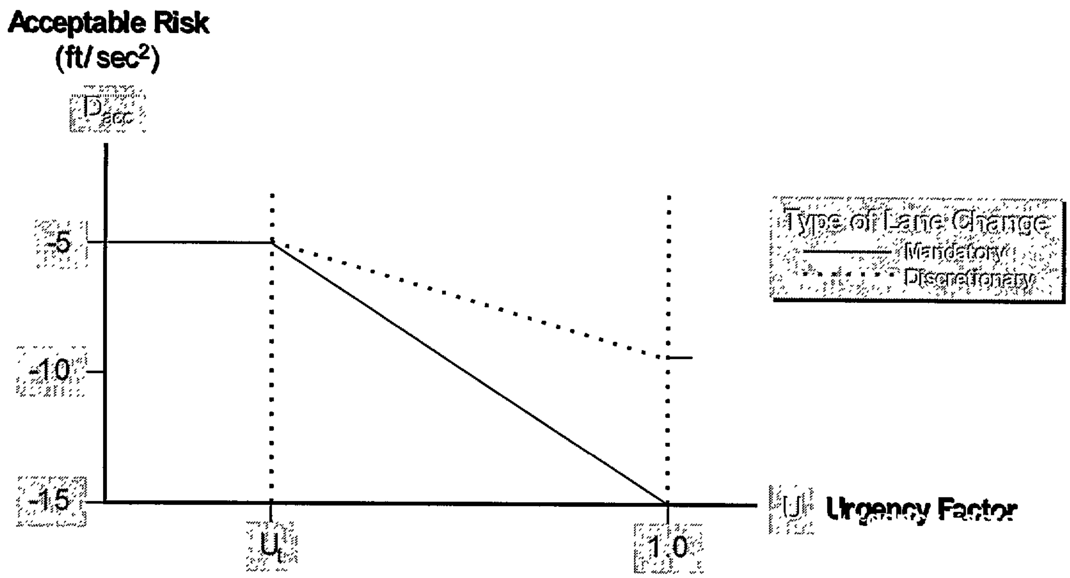


Figure 5-19. Lane-changing factors.

10 This entry represents a degree of caution on the part of the lane-changer; that is, to be on the safe side, the lane-changer perceives that the target follower is less aggressive and alert than he is.

The safety factor (× 10) specified in this entry is applied to lower the risk the lane-changer is willing to accept. For example, if a value of 7 is specified for this entry, the actual safety factor is 0.7. If the computed risk the driver is willing to accept is a deceleration of -10 fpss (based on his urgency as described in Entry 9) the actual risk that will be accepted is:

-10 fpss × 0.7 = -7 fpss

The range of this entry is 6–10, representing factors that range from 0.6 to 1.0. If omitted, the default value of 8 (i.e., a factor of 0.8) is assigned. As this value is decreased, the acceptable risk decreases and the margin of safety increases.

11 This entry represents the percentage of drivers who will slow to allow a lane-changer in front of them. Cooperative drivers in a standing queue will also stop to allow a lane-changer to come in front of them. The entry ranges from 10% to 100%. If omitted, the default value of 50% is assigned.

This parameter has a particularly significant impact on the lane-changing behavior. Increasing this value encourages lane changing to occur further upstream of the position where a lane change is required. This will decrease the number of instances where drivers must slow to a complete stop to complete their lane change.

12–13 NETSIM models the driver's "willingness" to attempt a discretionary lane change. If, indeed, the driver is willing to attempt a lane change, then the program will explore whether there is a material advantage to changing lanes and whether it is possible (or safe) for the lane-change maneuver to take place.

To assess the willingness of an individual driver to attempt a lane change, the model considers the range of headways over which drivers will explore lane changing. This range is defined by the following:

> The headway that is small enough that all drivers would want to attempt a lane change (Entry 12).

> The headway that is so large that no drivers would want to attempt a lane change (Entry 13).

With this range defined, the model will assess the willingness of an individual driver to attempt a lane change by computing the vehicle's current headway to its leader and then by comparing this headway to the range of headways over which lane changing occurs. For example, if the computed headway is in the 60th percentile of the headway range, 40% of the drivers would be willing to explore lane changing. Thus, the more aggressive drivers (types 7-10) would consider lane changing bases on this headway, while the more timid drivers (types 1-6) would not.

Entry 12 must range from 1 to 30 tenths of a second. If omitted, the default of 20 tenths (i.e., 2 seconds) is assigned.

Entry 13 must range from 30 to 100 tenths of a second. If omitted, the default of 50 tenths (i.e., 5 seconds) is applied by the model.

Increasing the minimum headway (Entry 12) would imply that timid drivers would consider longer headways than before as motivation to change lanes. Increasing the maximum headway (Entry 13) would imply that aggressive drivers would consider longer headways than before as motivation to change lanes. Both entries would tend to increase the number of attempted lane changes.

14 To ensure that a vehicle will be in the proper lane to perform its next turn movement, NETSIM will scan up to 12 links ahead to determine the best lane(s) for the vehicle to be positioned when it discharges each link. This is known as the vehicle's "goal" lane (or lanes) for a link.

Entry 14 is the distance required for a vehicle to contemplate and perform one lane change. Based on this distance, the logic can determine how far back the vehicle should begin to seek a lane change and what its goal lane should be on each upstream link.

This entry ranges from 50 to 2,500 feet (15-762 meters). If omitted, the default value of 300 feet (92 meters) is assigned.

As this value increases, drivers are more likely to seek lane-changing opportunities further upstream and less likely to have to slow to a stop to enter the lane required for their turn movement. In cases when travel patterns and roadway geometry require drivers to perform several lane changes over short distances, this parameter will have little effect.

90
Link Aggregations

Table 5-64. Record Type 90 – link aggregations.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	User-specified section number. If this record is a continuation of the previous record, it must match Entry 1 on the previous Record Type 90.
2	5–8	Upstream node of the **first** link in the section
3	9–12	Downstream node of the **first** link in the section
4	13–16	Upstream node of the **second** link in the section
5	17–20	Downstream node of the **second** link in the section
6	21–24	Upstream node of the **third** link in the section
7	25–28	Downstream node of the **third** link in the section
8	29–32	Upstream node of the **fourth** link in the section
9	33–36	Downstream node of the **fourth** link in the section
10	37–40	Upstream node of the **fifth** link in the section
11	41–44	Downstream node of the **fifth** link in the section
12	45–48	Upstream node of the **sixth** link in the section
13	49–52	Downstream node of the **sixth** link in the section
14	52–56	Upstream node of the **seventh** link in the section
15	57–60	Downstream node of the **seventh** link in the section
16	61–64	Upstream node of the **eighth** link in the section
17	65–68	Downstream node of the **eighth** link in the section
18	69–72	Upstream node of the **ninth** link in the section
19	73–76	Downstream node of the **ninth** link in the section
20	79–80	90

This record type is **optional,** and it can appear in the input stream for the NETSIM and FRESIM models during the first time period. This record needs to be specified only if the user wants the program to treat a particular set of links as a single entity for purposes of computing significant measures of effectiveness. Each such set is known as a section and is identified by a user-defined section number.

If a section will contain more than nine links, multiple Record Type 90s can be used until all of the links are entered. Any links within the network can be specified as part of a section, the links do not have to form a continuous path through the network.

When this option is selected, an additional output table is provided within each standard cumulative output. This table presents aggregated statistics for each section identified on Record Type 90. The full set of statistics are still provided for each link individually, in the link statistics table.

If errors occur in the specifications on Record Type 90, error messages will identify them. The user should check the input echo to verify that the sections were specified correctly. The user is reminded of the importance of a diagnostic-only run on any new dataset prior to a simulation run. It is possible to aggregate any links into sections.

Discussion of Selected Entries

2-19 The upstream and downstream nodes for each link contained in the section. Entry or exit nodes (8000-8999) or source/sink nodes (2000-2999) **cannot** be specified.

95
Interchange Definition Data

Table 5-65. Record Type 95 – interchange definition data.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Interchange number
2	5–8	Upstream node of the **first** link in the interchange
3	9–12	Downstream node of the **first** link in the interchange
4	13–16	Same as Entries 2 and 3 but for the **second** link in the interchange
5	17–20	
6	21–24	Same as Entries 2 and 3 but for the **second** link in the interchange
7	25–28	
8	29–32	Same as Entries 2 and 3 but for the **third** link in the interchange
9	33–36	
10	37–40	Same as Entries 2 and 3 but for the **third** link in the interchange
11	41–44	
12	45–48	Same as Entries 2 and 3 but for the **fourth** link in the interchange
13	49–52	
14	53–56	Same as Entries 2 and 3 but for the **fourth** link in the interchange
15	57–60	
16	61–64	Same as Entries 2 and 3 but for the **fifth link** in the interchange
17	65–68	
18	69-72	Same as Entries 2 and 3 but for the **fifth** link in the interchange
19	73-76	
20	79-80	95

This record type is **optional,** and it is used by the NETSIM model only. Record Type 95 is necessary when the user wants to specify origin-destination (O-D) travel patterns for an urban interchange. If so, the links comprising the interchange are specified on Record Type 95, and the O-D data are specified on Record Type 96. This information is used by NETSIM to accurately represent travel patterns within an interchange and is especially useful when weaving and merging operations are significant.

When O-D travel patterns are specified for an interchange through Record Types 95 and 96, NETSIM uses the information to determine the turn movement decisions (and therefore, lane-changing decision) of each vehicle within the interchange. Thus, link-specific turn movement data (i.e., Record Types 2 1 and 22) must be omitted for any link specified on Record Type 95. To properly depict the interchange on the animation display, it is necessary to specify link curvature and overpass data on Record Type 196.

If the appropriate information is specified on Record Type 196, it is possible to view interchange operations on the animation display even if Record Types 95 and 96 are omitted. In that case, turn movement data must be specified on Record Type 21 or 22 to identify travel patterns on each link.

Record Type 95 can only be specified for the first time period.

Each Record Type 95 allows the user to identify nine links that are part of the same interchange. If an interchange includes more than nine links, additional Record Type 95s can be input to specify the remaining links. All Record Type 95s pertaining to the same interchange must have the same interchange number specified in Entry 1. While NETSIM does not have a limit on the total number of links that can be included within a single interchange, it does require that the longest travel path through an interchange not exceed 11 links.

The set of links defining an interchange must be complete and without duplications. Each link included in the interchange must be connected to at least one other link that is a part of the same interchange.

Discussion of Selected Entries

1 A number uniquely identifying this interchange is specified in this entry. The interchange number must be between 1 and the maximum number of interchanges allowed by NETSIM. This maximum number is currently 15.

2-19 Upstream and downstream node numbers must be between 1 and the maximum allowable internal node number, NMAX; that is, the links that comprise an interchange must be internal links. No entry links, exit links, or interface links can be included within an interchange. Furthermore, the upstream and downstream node numbers specified in these entries must correspond to a link that was previously defined on Record Type 11,

While it is possible for a given pair of node numbers to be blank or zero, it is not possible for the upstream node number to be zero unless the downstream number is zero and vice versa.

96
Interchange Origin-Destination Data

Table 5-66. Record Type 96 – interchange origin-destination data.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Interchange number
2	5-8	Upstream node number i of link **(i,j),** which is an entry approach to the interchange
3	9-12	Downstream node of the entry approach to the interchange
4	13-16	Upstream node number k of final link (k,l) in the interchange encountered by some of the traffic entering from link **(i,j),**
5	17-20	Downstream node number l of final link (k,l). Represents the destination node accessible to the traffic entering the interchange on approach link **(i,j),**
6	21-24	Turn movement executed by traffic at the destination node in Entry 5: 1 Left 2 Through 3 Right 4 Diagonal
7	25-28	Percentage of traffic on approach link **(i,j),** that travels to the destination node in Entry 5 and executes the turn movement defined in Entry 6
8	**29-32**	Same as Entries 4-7 but for another destination node of turn movement
9	33-36	
10	37-40	
11	41-44	
12	45-48	Same as Entries 4-7 but for another destination node of turn movement
13	**49-52**	
14	53-56	
15	57-60	
16	61-64	Same as Entries 4-7 but for another destination node of turn movement
17	65-68	
18	**69-72**	
19	73-76	

ENTRY	COLUMN(S)	DESCRIPTION
20	79-80	96

This record **type** is **optional,** and it is used only by the NETSIM model. Record Type 95 is necessary when the user wants to specify origin-destination (O-D) travel patterns for an urban interchange. If so, the links comprising the interchange are specified on Record Type 95, and the O-D data are specified on Record Type 96. This information is used by NETSIM to accurately represent travel patterns within an interchange and is especially useful when weaving and merging operations are significant.

When O-D travel patterns are specified for an interchange through Record Types 95 and 96, NETSIM uses the information to determine the turn movement decisions (and, therefore, lane-changing decisions) of each vehicle within the interchange. Thus, link-specific turn movement data (i.e., Record Types 21 and 22) must be omitted for any link specified on Record Type 95. To properly depict the interchange on the animation display, it is necessary to specify link curvature and overpass data on Record Type 196.

If the appropriate information is specified on Record Type 196, it is possible to view interchange operations on the animation display even if Record Types 95 and 96 are omitted. In that case, turn movement data must be specified on Record Type 2 1 or 22 to identify travel patterns on each link.

Record Type 96 can only be specified for any time period. While the basic geometry of the interchange cannot change, the percentage of entering traffic that performs a specific exit movement can change from one time period to the next.

Each Record Type 96 allows the user to identify four destinations and turn percentages for a single entry approach to an intersection. Additional Record Type 96s can be input to specify remaining O-D data. All Record Type 96s pertaining to the same interchange must have the same interchange number specified in Entry 1.

Discussion of Selected Entries

1 A number uniquely identifying this interchange is specified in this entry. The interchange number must be between 1 and the maximum number of interchanges allowed by NETSIM. This maximum number is currently 15.

2-3 These node numbers define a link by which traffic enters the interchange; that is, its receiving links are part of the interchange but its feeder links are not. This link is considered a part of the interchange and must be identified on Record Type 95.

Upstream and downstream node numbers must be between 1 and the maximum allowable internal node number, NMAX; that is, the links specified by these entries must be an internal link. No entry links, exit links, or interface links can be included within an interchange. Furthermore, the upstream and downstream node numbers specified in these entries must correspond to a link that was previously defined on Record Type 11.

4-5, 8-9
12-13
16-17

These node numbers define a link by which traffic leaves the interchange; that is, its feeder links are part of the interchange, but its receiving links are not. These destination links are considered part of the interchange, and they must be identified on Record Type 95.

Upstream and downstream node numbers must be between 1 and the maximum allowable internal node number, NMAX. That is, the links specified by these entries must be an internal link. No entry links, exit links, or interface links can be included within an interchange. Furthermore, the upstream and downstream node numbers specified in these entries must correspond to a link that was previously defined on Record Type 11.

6,10
14, 18

This code identifies the turn movement that is performed at the downstream end of the destination link. This entry must range from 1 to 4 when a destination link is identified in the preceding two entries.

7, 11
15, 19

This is the percentage of traffic on the entry approach identified in Entries 2 and 3 that reaches the specified destination link and exits the destination link via the turn movement identified in the previous entry. This percentage must range from 1 to 100 whenever a nonzero turn movement code is specified in the preceding entry.

140

Left-Turn Jump, Left- and Right-turning Speeds, and Lane-switching Acceptable Lag

Table 5-67. Record Type 140 – left-turn jump, left- and right-turning speeds, and lane-switching acceptable lag.

ENTRY	COLUMN(S)	DESCRIPTION
1	4	Index I (lane number) of the LTJGAP array. Range = **1–7.**
2	5–8	New value for LTJGAP(I)
3	12	Index I (lane number of the **second** entry in the LTJGAP array to be changed)
4	13–16	New value for LTJGAP(I)
5	20	Index I (lane number of the **third** entry in the LTJGAP array to be changed)
6	21–24	New value for LTJGAP(I)
7	28	Index I (lane number of the **fourth** entry in the LTJGAP array to be changed)
8	29–32	New value for LTJGAP(I)
9	36	Index I (lane number of the **fifth** entry in the LTJGAP array to be changed)
10	37–40	New value for LTJGAP(I)
11	44	Index I (lane number of the **sixth** entry in the LTJGAP array to be changed)
12	45–48	New value for LTJGAP(I)
13	52	Index I (lane number of the **seventh** entry in the LTJGAP array to be changed)
14	53–56	New value for LTJGAP(I)
15	57–60	**Left-turn speed** (LEFTSP). If the default value is acceptable, leave **blank.**
16	61–64	**Right-turn speed** (ARTESP). If the default value is acceptable, leave **blank.**
17	65–68	**Lane-switching acceptable lag** (LSALAG). If the default value is acceptable, leave **blank.**
18	78–80	140

This record type is **optional.** It is input for the NETSIM model only within the input stream for the first time period. This record is used to alter the following calibration parameters:

> LTJGAP(I): Left-Turn Jumper Probabilities

A left-turn jumper is a vehicle that is first in queue when the signal changes to green, and executes the left-turn maneuver (immediately) before the oncoming queues can discharge. Each data item in the array, LTJGAP(I) is set to the probability of a lead left-turn vehicle jumping at the beginning of the green phase across I oncoming lanes, expressed as a percentage. The embedded default for LTJGAP(I) = 38; I = 1, 2, ...,7.

> LEFTSP and ARTESP: Maximum Allowable Turning Speeds

Moving vehicles unimpeded by others must slow as they approach an intersection if they are to negotiate a turning maneuver. The embedded default turning speed for right-turners is 13 fps (4 mph) and for left-turners is 22 fps (7 mph). A fatal error message is generated if the speeds are negative, if the left-turn speed exceeds 44 fps (14 mph), or if the right-turn speed exceeds 26 fps (8 mph).

> LSALAG: Lane-switching Acceptable Lag

A vehicle cannot switch lanes unless an acceptable lag is available in the target lane. The embedded default for this value, which is deterministically assigned, is 3 1 tenths of a second. A fatal error occurs if the specified lag exceeds 90 tenths of a second.

141

Spillback Probability, Probability of Left-Turn Lagger, and Vehicle Length

Table 5-68. Record Type 141 – spillback probability, probability of left-turn lagger, and vehicle length.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	New value of **SPLPCT(1)**
2	5–8	New value of SPLPCT(2)
3	9–12	New value of SPLPCT(3)
4	13–16	New value of SPLPCT(4)
5	17–20	New value of **LTLAGP(1)**
6	21–24	New value of LTLAGP(2)
7	25–28	New value of LTLAGP(3)
8	29–32	New value of **VEHLNG(1)**
9	33–36	New value of VEHLNG(2)
10	37–40	New value of VEHLNG(3)
11	41–44	New value of VEHLNG(4)
12	78–80	141

This record type is **optional.** It can be input for the NETSIM model only within the input stream for the first time period. If this record type is present in the input stream, then **all** of the entries must be specified. A blank entry is interpreted as **zero,** not as a request for the default value. The following calibration parameters are altered by Record Type 14 1:

>SPLPCT(I): Probability of a Vehicle Joining (or Causing) Spillback

A vehicle that faces a spillback condition on its receiving link at the time it is about to discharge must "decide" whether to discharge or wait until the spillback ahead dissipates. The probability (percentage) of a vehicle joining a spillback comprised of I vehicles is defined in the SPLPCT array with the following embedded values (which must range from 0% to 100%):

Table 5-69. Spillback probabilities.

I	1	2	3	4
SPLPCT	100	81	69	40

▶ **LTLAGP(I): Left-Turn Lagger Turn Probability**

A left-turn lagger is a queued vehicle that executes a left-turn across opposing traffic during a NO GO interval immediately following a left-turn GO (and AMBER) interval. If the left-turner is at the stop line within 2 seconds after the start of this NO GO interval, the probability (in a percentage) that he will execute the turn movement is stored in LTLAGP(1); if within 4 seconds, in LTLAGP(2); if within 5 seconds, in LTLAGP(3). The embedded default values (which must range from 0% to 100%) are as follows:

- **LTLAGP(1) = 50**
- **LTLAGP(2) = 15**
- **LTLAGP(3) = 0**

▶ **VEHLNG(I): Effective Length of Vehicle Type (in feet or meters)**

The effective length includes an intervehicle spacing of 3 feet. The embedded default values are shown in table 5–70. These values must range from 19 to 75 feet (6–23 meters). Metric units should only be specified when the metric input option is selected on Record Type 02.

Table 5-70. Default vehicle lengths.

I	FLEET COMPONENT	LENGTH
1	Automobile	19 feet (6 meters)
2	Truck	38 feet (11 meters)
3	Carpool	19 feet (6 meters)
4	Bus	43 feet (13 meters)

142

Acceptable Gap in Near-Side Cross Traffic for Vehicles at a Stop Sign

Table 5-71. Record Type 142 – acceptable gap in near-side cross traffic for vehicles at a stop sign.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	New value of NSGAP(1)
2	5–8	New value of NSGAP(2)
3	9–12	New value of NSGAP(3)
4	13–16	New value of NSGAP(4)
5	17–20	New value of NSGAP(5)
6	21–24	New value of NSGAP(6)
7	25–28	New value of NSGAP(7)
8	29–32	New value of NSGAP(8)
9	33–36	New value of NSGAP(9)
10	37-40	New value of NSGAP(lO)
11	78-80	142

This record type is **optional.** It can be input for the NETSIM model only within the input stream for the first time period. This record is used to alter the values of the following calibration array:

> NSGAP(I): Acceptable Gaps in Near-Side Cross-Street Traffic for Vehicles at a Stop Sign

The near-side cross street is always the approach to the left of the stop sign approach.

A vehicle at a stop line facing a stop sign cannot discharge until an acceptable gap is available in the cross-street traffic. The acceptable gap depends on the driver characteristic code and the total number of lanes **to** be crossed. The acceptable gap to cross a near-side cross street is based on driver characteristic code I and is chosen from a decile distribution, which is stored in the NSGAP array in tenths of a second. The embedded default values are shown in table 5-72. A fatal error occurs if any of these entries are outside the range of 15-75 tenths of a second.

Table 5-72. Distribution of acceptable gaps in cross-street traffic.

I = DRIVER TYPE	1	2	3	4	5	6	7	8	9	10
ACCEPTABLE GAP	56	50	46	42	39	37	34	30	26	20

When a far-side cross street exists at the intersection, additional time is added to this acceptable gap depending on the total number of lanes to be crossed. For a discussion of the distribution of this additional time, see Record Type 143. If this record type is specified in the input stream, **all** of the entries must be specified. A blank entry is interpreted as **zero,** not as a request for the default value.

143

Additional Time for Far-Side Cross Traffic in Acceptable Gap for Vehicles at a Stop Sign

Table 5-73. Record Type 143 - additional time for far-side cross traffic in acceptable gap for vehicles at a stop sign.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	New value of FSGAP(1)
2	5–8	New value of FSGAP(2)
3	9–12	New value of FSGAP(3)
4	13–16	New value of FSGAP(4)
5	17–20	New value of FSGAP(5)
6	21–24	New value of FSGAP(6)
7	25–28	New value of FSGAP(7)
8	29–32	New value of FSGAP(8)
9	33–36	New value of FSGAP(9)
10	37–40	New value of FSGAP(10)
11	78–80	143

This record type is **optional.** It can be input for the NETSIM model only within the input stream for the first time period. This record is used to alter the values of the following calibration array:

- **FSGAP(I): Time in Addition to Acceptable Gap Required for Vehicles to Cross the Far-Side Cross Street at a Stop Sign**

  The far-side cross street is always the approach to the right of the stop sign approach.

  A vehicle at a stop line facing a stop sign cannot discharge until an acceptable gap is available in the cross-street traffic. The acceptable gap depends on the driver characteristic code and the total number of lanes that must be crossed to clear the intersection. When a near-side cross street exists at an intersection, an acceptable gap is chosen based on the driver characteristic code. See Record Type 142 for a discussion on the distribution of acceptable gaps for near-side cross streets based on driver characteristic codes. For intersections with a far-side cross street, time based on the total number of lanes to be crossed is added to the acceptable gap based. This additional time is chosen from a decile distribution in the array, FSGAP. The array elements are in tenths of a second and are based on the total number of lanes and pockets on both the near and far-side cross streets I that a vehicle must cross to clear the intersection. The embedded default values are shown in table 5–74. A fatal error occurs if any of these entries are outside the range of 10–75 tenths of a second.

Table 5–74. Defaults for time in addition to acceptable gaps for far-side gaps.

I = TOTAL NUMBER OF LANES TO CLEAR INTERSECTION	1	2	3	4	5	6	7	8	9	10
ADDITIONAL TIME	12	21	26	31	35	39	42	46	49	51

If this record type is specified in the input stream, **all** of the entries must be specified. A blank is interpreted as **zero,** not as a request for the default value.

144
Amber Phase Response

Table 5–75. Record Type 144 – amber phase response.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	New value of AMBER(1)
2	5–8	New value of AMBER(2)
3	9–12	New value of AMBER(3)
4	13–16	New value of AMBER(4)
5	17–20	New value of AMBER(5)
6	21–24	New value of AMBER(6)
7	25–28	New value of AMBER(7)
8	29–32	New value of AMBER(8)
9	33–36	New value of AMBER(9)
10	37–40	New value of AMBER(10)
11	78–80	144

This record type is **optional,** and it can be input for the NETSIM model only within the input stream for the first time period. This record is used to alter the values of the following calibration array:

- **AMBER(I): Amber Phase Response**

  The response of drivers to the onset of the amber indication is expressed in terms of an acceptable deceleration. The attendant logic applies only to the lead moving vehicle in a lane that has no queue at the instant the signal turns amber. The deceleration that is required for the vehicle to stop is readily calculated, knowing the current position and speed of the vehicle. Using the driver characteristic code I, a decile statistical distribution, AMBER(I) is entered, to determine whether the acceptable deceleration extracted from this distribution exceeds the required value. If so, the vehicle will stop; otherwise, it will continue through the intersection. The embedded default values (in fpss) are shown in table 5–76. A fatal error occurs if any of these entries are outside the range of 2–30 fpss.

Table 5-76. Defaults for amber phase response.

I	1	2	3	4	5	6	7	8	9	10
ACCEPTABLE DECELERATION	21	18	15	12	9	7	6	5	4	4

If this record type is specified in the input stream, **all** of the entries must be specified. A blank is interpreted as **zero,** not as a request for the default value.

145

Left-Turn Gap

Table 5-77. Record Type 145 - left-turn gap.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Code [0,1] if this record modifies entries [1–10, 11–20] of the TRNGAP array
2	5–8	New value of TRNGAP(1) or TRNGAP(11)
3	9–12	New value of TRNGAP(2) or TRNGAP(12)
4	13–16	New value of TRNGAP(3) or TRNGAP(13)
5	17–20	New value of TRNGAP(4) or TRNGAP(14)
6	21–24	New value of TRNGAP(5) or TRNGAP(15)
7	25–28	New value of TRNGAP(6) or TRNGAP(16)
8	29–32	New value of TRNGAP(7) or TRNGAP(17)
9	33–36	New value of TRNGAP(8) or TRNGAP(18)
10	37–40	New value of TRNGAP(9) or TRNGAP(19)
11	41–44	New value of TRNGAP(10) or TRNGAP(20)
12	78–80	145

This record type is **optional,** and it can be input for the NETSIM model only within the input stream for the first time period. Up to two Record Type 145s can be input. They are used to alter the values of the following calibration array:

- **TRNGAP(I): Acceptable Gaps for Left-turning Vehicles**

  A decile distribution of acceptable gaps in the oncoming traffic facing left-turning vehicles is stored in the TRNGAP array. These embedded default values (in tenths of a second) are shown in table 5–78.

  The acceptable gap is chosen on the basis of driver characteristic code I from the decile distribution. A similar decile distribution (also stored in TRNGAP) provides acceptable gaps in the traffic stream on the outside lane of the near-side cross-street for right-turners to complete a RTOR maneuver. These default values (in tenths of a second) are shown in table 5–79.

  The appropriate distribution in TRNGAP is accessed through a random number from 1 to 10. A fatal error occurs if any of these entries are outside the range of 10–100 tenths of a second.

Table 5-78. Acceptable gap in oncoming traffic for left-turners.

I	1	2	3	4	5	6	7	8	9	10
ACCEPTABLE GAP	78	66	60	54	48	45	42	39	36	27

Table 5-79. Acceptable gap in oncoming traffic for right-turners.

10 + I	11	12	13	14	15	16	17	18	19	20
ACCEPTABLE GAP	100	88	80	72	64	60	56	52	48	36

If **any** of the TRNGAP elements describing acceptable gaps are entered, **all** of the 10 elements must be specified. This is also true for the 10 entries pertaining to acceptable gaps for right-turners. A blank is interpreted as **zero,** not as a request for the default value.

146

Pedestrian Delay

Table 5-80. Record Type 146 - pedestrian delay.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Code [0,1] if entries [1–10, 11–20] of the PDLY array are being modified
2	5–8	New value of PDLY(1) or PDLY(11)
3	9–12	New value of PDLY(2) or PDLY(12)
4	13–16	New value of PDLY(3) or PDLY(13)
5	17–20	New value of PDLY(4) or PDLY(14)
6	21–24	New value of PDLY(5) or PDLY(15)
7	25–28	New value of PDLY(6) or PDLY(16)
8	29–32	New value of PDLY(7) or PDLY(17)
9	33–36	New value of PDLY(8) or PDLY(18)
10	37–40	New value of PDLY(9) or PDLY(19)
11	41–44	New value of PDLY(10) or PDLY(20)
12	48	Index I that identifies the **first** element of the PPER array to be modified. Range = **1–3.**
13	49–52	New value of PPER(I)
14	56	Index I that identifies the **second** element of the PPER array to be modified. Range = **1–3.**
15	57–60	New value of PPER(I)
16	64	Index I that identifies the **third** element of the PPER array to be modified. Range = **1–3.**
17	65–68	New value of PPER(I)
18	78–80	146

This record type is **optional,** and it can be input for the NETSIM model only within the first time period.

If this record type is present in the input stream, then Entries 1–11 **must** be specified. A blank entry is interpreted as **zero,** not as a request for the default value. The PPER array will not be modified if Entries 12, 14, and 16 are zero.

Up to two Record Type 146s can be present in the input stream to input all of the changes to the PDLY array.

The following calibration arrays can be altered by Record Type 146:

- **PDLY(I): Delay Due to Pedestrian Conflict**

  The program defines two "kinds" of conflicts: strong interaction and weak interaction. The duration of vehicular delay (in seconds) for each kind of conflict is defined by a statistical decile distribution stored in the PDLY array. The embedded default values are shown in tables 5–81 and 5–82.

  I reflects a random number that ranges from 1 to 10. Strong interaction delay for heavy pedestrian flow is twice the table values. A fatal error occurs if any of these entries are outside the range of 0–50 seconds.

Table 5–81. Default distribution of weak interaction for pedestrian delay.

I	1	2	3	4	5	6	7	8	9	10
WEAK INTERACTION	0	0	0	0	0	0	0	1	2	6

Table 5–82. Default distribution of strong interaction for pedestrian delay.

10 + I	11	12	13	14	15	16	17	18	19	20
STRONG INTERACTION	0	0	0	1	2	3	4	5	8	15

- **PPER(I): Duration of Strong Pedestrian Interactions**

  The demarcation between light and strong interaction is expressed in terms of the elapsed time since beginning of the green phase that strong interaction prevails. For the remaining duration of the green phase, light interaction is in effect. The PPER array contains the duration (in seconds) of strong interaction for each of the three pedestrian intensities that are specified. The embedded default values are shown in table 5–83. A fatal error occurs if any of the entries are negative.

Table 5–83. Default durations of strong interaction periods for pedestrian flow levels.

LIGHT PEDESTRIAN FLOW	PPER(1) = 0
MODERATE PEDESTRIAN FLOW	PPER(2) = 10
HEAVY PEDESTRIAN FLOW	PPER(3) = 25

147

Free-Flow Speed Percentages

Table 5-84. Record Type 147 – free-flow speed percentages.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	New value of UFPCT(1)
2	5–8	New value of UFPCT(2)
3	9–12	New value of UFPCT(3)
4	13–16	New value of UFPCT(4)
5	17–20	New value of UFPCT(5)
6	21–24	New value of UFPCT(6)
7	25–28	New value of UFPCT(7)
8	29–32	New value of UFPCT(8)
9	33–36	New value of UFPCT(9)
10	37-40	New value of UFPCT(lO)
11	78-80	147

This record type is optional, and it can be input for the NETSIM model only during the first time period. If this record type is specified in the input stream, all of the entries must be specified. A blank is interpreted as zero, not as a request for the default value. The sum of all the entries must equal 1,000. Fatal errors occur if any of the entries are negative or if the sum of all of the entries does not equal 1,000. Values for the following calibration array can be altered by Record Type 147:

>UFPCT(I): Free-Flow Speed Percentages

As each vehicle enters a link, it is assigned a free-flow speed. This assignment is obtained by multiplying the specified mean free-flow speed for that link by a percentage. This percentage is obtained from a decile distribution, in which index I is the driver characteristic code. This distribution is stored in the UFPCT array with the following embedded default values that range from 75% to 127% of the mean free-flow speed:

Table 5-85. Default distribution of free-flow speed percentages.

I	1	2	3	4	5	6	7	8	9	10
PERCENTAGE MULTIPLIER OF FREE-FLOW SPEED	75	81	91	94	97	100	107	111	117	127

The maximum value of free-flow speed permitted by NETSIM is 127 ft/sec. If the calculated value obtained by multiplying an element of this distribution by the specified link-specific mean value of free-flow speed exceeds 127, then the program will set the value to 127.

148

Short-Term-Event Duration Percentages

Table 5–86. Record Type 148 – short-term-event duration percentages.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	New value of STEPCT(1)
2	5–8	New value of STEPCT(2)
3	9–12	New value of STEPCT(3)
4	13–16	New value of STEPCT(4)
5	17–20	New value of STEPCT(5)
6	21–24	New value of STEPCT(6)
7	25–28	New value of STEPCT(7)
8	29–32	New value of STEPCT(8)
9	33–36	New value of STEPCT(9)
10	37–40	New value of STEPCT(10)
11	78–80	148

This record type is **optional,** and it can be input for the NETSIM model only within the input stream for the first time period. Values for the following calibration array can be altered by Record Type 148:

- **STEPCT(K): Duration of Short-Term Events**

  The duration of a short-term event is assigned by multiplying the specified mean duration for that link by a percentage extracted from a decile distribution. A random number that ranges from 1 to 10 is used as an index to enter this distribution that is stored in the STEPCT array. The embedded default percentages are shown in table 5–87.

  If this record type is specified in the input stream, all of the entries must be specified. A blank is interpreted as zero, not as a request for the default value. Therefore, if one value is changed, all of the other values must be reentered. The sum of all of the entries must equal 1,000. Fatal errors occur if any entry is negative or if the sum of all of the entries does not equal 1,000.

Table 5-87. Default distribution of multiplier for short-term-event duration.

K	1	2	3	4	5	6	7	8	9	10
PERCENTAGE MULTIPLIER OF SHORT-TERM-EVENT DURATION	10	20	30	40	50	70	100	130	180	370

149

Link Type Distributions (Queue Discharge Headways and Start-Up Lost Time)

Table 5-88. Record Type 149 – link type distributions (queue discharge headways and start-up lost time).

ENTRY	COLUMN(S)	DESCRIPTION
1	4	Link type code I. Range = l-4.
2	8	Code [0, l] if this record contains modifications to the distributions in array [LSTME, HDWPCT]
3	9-12	New value of LSTME(J+l) or HDWPCT(J+l). J = 10 x (I – l), where I is the link type code specified in Entry 1.
4	13-16	New value of LSTME(J+2) or HDWPCT(J+2)
5	17-20	New value of LSTME(J+3) or HDWPCT(J+3)
6	2 l-24	New value of LSTME(J+4) or HDWPCT(J+4)
7	25-28	New value of LSTME(J+5) or HDWPCT(J+5)
8	29-32	New value of LSTME(J+6) or HDWPCT(J+6)
9	33-36	New value of LSTME(J+7) or HDWPCT(J+7)
10	37-40	New value of LSTME(J+8) or HDWPCT(J+8)
11	41-44	New value of LSTME(J+9) or HDWPCT(J+9)
12	45-48	New value of LSTME(J+10) or HDWPCT(J+10)
13	78-80	149

This record type is optional. It can be input for the NETSIM model only within the input stream for the first time period.

If this record type is present in the input stream, then all of the entries must be specified. A blank entry is interpreted as zero, not as a request for the default value. Fatal errors occur if entries for either distribution are negative or if the sum of all of the entries for a distribution does not equal 1,000.

Up to eight Record Type 149s can be input to specify changes to the following calibration arrays:

▶ LSTME(J): Start-Up Lost-Time Percentages

The first three vehicles in queue when the signal turns to green experience (start-up) lost time. Lost time (in tenths of a second) is computed by referencing a decile distribution defined by the "type," I, of the link as specified on Record Type 11. The vehicle's driver characteristic is used as an index for referencing the proper element in the distribution. The LSTME array contains four such distributions, one for each of four link "types." Elements of the LSTME array contain percentage values applied to the specified mean lost time. The following embedded default values exist for link "types" 1 and 2.

There are no internal default values specified for link types 3 and 4. These can be added and specified by the use of this record type. This record type can also be used to alter the default values for link types 1 and 2.

Table 5-89. Default distribution of multiplier for start-up lost-time percentages.

DRIVER CHARACTERISTIC K	1	2	3	4	5	6	7	8	9	10
LINK TYPE 1	218	140	125	118	102	86	78	63	47	23
LINK TYPE 2	258	190	143	114	95	76	57	38	29	0

▶ HDWPCT(J): Vehicle Queue Discharge Headways

The HDWPCT array contains factors needed to determine the proper headway for a vehicle on a link of a particular type. Up to four link types can be accommodated.

As each queued vehicle moves up to the stop line, it is assigned a delay until discharge (in tenths of a second), reflecting queue discharge headways. This headway is obtained by multiplying the mean queue headway specified for the link by a percentage. This percentage is extracted from a decile distribution that applies to that "type" of link. The vehicle's driver characteristic is used as an index for referencing the proper element in the distribution. The index J to HDWPCT is calculated as: $J = 10(I - 1) + K$, where I denotes the "type" of link specified on Record Type 11. K is the vehicle's driver characteristic (a number from 1 to 10). The following embedded default values exist for link "types" 1 and 2.

There are no internal default values specified for link types 3 and 4. These can be added and specified by the use of this record type. This record type can also be used to alter default values for link types 1 and 2.

Table 5-90. Default distribution of multiplier for discharge headway percentages.

DRIVER CHARACTERISTIC K	1	2	3	4	5	6	7	8	9	10
LINK TYPE 1	170	120	120	110	100	100	90	70	70	50
LINK TYPE 2	180	140	120	110	100	90	80	70	60	50

150
Dwell Time Distributions

Table 5-91. Record Type 150 – dwell time distributions.

ENTRY	COLUMN(S)	DESCRIPTION
1	4	Code for station type I. Range = l-6.
2	5-8	New value of DWLPCT(J+l). J = 10 x (I – 1), where I is the station type specified in Entry 1. Range = l-1,000.
3	9-12	New value of DWLPCT(J+2)
4	13-16	New value of DWLPCT(J+3)
5	17-20	New value of DWLPCT(J+4)
6	21-24	New value of DWLPCT(J+5)
7	25-28	New value of DWLPCT(J+6)
8	29-32	New value of DWLPCT(J+7)
9	33-36	New value of DWLPCT(J+8)
10	37-40	New value of DWLPCT(J+9)
11	41-44	New value of DWLPCT(J+10)
12	78-80	150

In most cases, the embedded dwell time distributions will accurately reflect bus operations. TRAF provides Record Type 150, however, to modify these distributions. This record type is optional, and it should not be used unless bus operations differ significantly from the six distributions embedded in TRAF.

These values are entered in array DWLPCT in TRAF, and their location is DWLPCT (J + 1), where J = 10 x (I – 1) and I is the station type. To change the array values, the user must specify the new values on Record Type 15 0.

Blank entries on this record are interpreted as zero. They are not interpreted as “do not change the value.” The sum of the values in Entries 2-l 1 must equal 1,000. Values must not be negative. The dwell time percentage is the factor by which the mean dwell time is multiplied to compute the actual dwell time that a bus spends servicing passengers at an individual stop.

152
Longitudinal Distance to Start to Attempt a Lane Change

Table 5-92. Record Type 152 – longitudinal distance to start to attempt a lane change.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Value of SLCDIS(1)
2	5–8	Value of SLCDIS(2)
3	9–12	Value of SLCDIS(3)
4	13–16	Value of SLCDIS(4)
5	17–20	Value of SLCDIS(5)
6	21–24	Value of SLCDIS(6)
7	25–28	Value of SLCDIS(7)
8	29–32	Value of SLCDIS(8)
9	33–36	Value of SLCDIS(9)
10	37–40	Value of SLCDIS(10)
11	78–80	152

This record type is optional, and it can be input for the NETISM model only during the first time period. If this record type is specified in the input stream, all of the entries must be specified. A blank is interpreted as zero, not as a request for the default value. The sum of all of the entries must equal 1,000. A fatal error occurs if any of the entries are negative or if the sum of all of the entries does not equal 1,000.

> SLCDIS(I): Distance at Which a Vehicle Starts to Attempt a Lane Change

To ensure that a vehicle will be in the proper lane to perform its next turn movement, NETSIM scans up to 12 links ahead to determine the best lane(s) for the vehicle to be positioned in when it discharges each link. Those lanes are known as the vehicle's "goal" lanes for each link.

Based on those goal lanes, a vehicle determines whether it must perform a lane change. At some distance upstream of the point at which the lane change is required, the vehicle will begin to attempt to make the lane change. The mean value of the distance is given in Entry 14 on Record Type 81. The default mean distance to start to attempt a lane change is 450 feet. That distance, however, will vary by the driver type of each vehicle.

This array gives the distribution of the distance to start to attempt a lane change. That distance is obtained by multiplying the default mean distance by a percentage, which is obtained from a decile distribution and is based on the driver type. The distribution is stored in the SLCDIS array. The default distribution is shown in table 5-93.

Table 5-93. Default distribution of distance to start to attempt a lane change.

I = DRIVER TYPE	1	2	3	4	5	6	7	8	9	10
PERCENTAGE MULTIPLIER OF DISTANCE	125	121	116	108	100	97	93	85	80	75

153
Driver's Familiarity with Paths

Table 5-94. Record Type 153 – driver's familiarity with paths.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Value of DRVFAM(l)
2	5-8	Value of DRVFAM(2)
3	78-80	153

This record type is optional, and it can be input for the NETSIM model only during the first time period. If this record type is specified in the input stream, all of the entries must be specified. A blank is interpreted as zero, not as a request for the default value. The sum of the entries must equal 100. A fatal error occurs if the sum of the entries does not equal 100.

>DRVFAM(I): Code for Driver's Familiarity with Paths

NETSIM assigns "goal" lanes for vehicles based on their upcoming turn movements. Vehicles can know and respond (by choosing the appropriate goal lanes) to their next non-through turn movements. Whether vehicles actually know their next turn movements and the appropriate lanes for those turn movements depends on the familiarity of the drivers with their paths. Therefore, each vehicle is randomly assigned a driver familiarity code, which is the number of next non-through turn movements that the vehicle is aware of in advance. The acceptable driver familiarity codes are 1 and 2 (i.e., the number of known upcoming turn movements). The percentage of all of the drivers with each driver familiarity code is included on Record Type 153.

The default codes for the percentage of each driver familiarity code are given in table 5-95.

Table 5-95. Defaults for percentages of driver's familiarity with paths.

I = NUMBER OF TURN MOVEMENTS	1	2
PERCENTAGE	10	90

170
Subnetwork Delimiter

Table 5-96. Record Type 170 – subnetwork delimiter.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Code that defines the section that follows in the input stream: 0 or blank All of the subnetwork data have been read. All of the subsequent record types in the input stream are numbered above 170. The following record could be Record Type 2 10. 3 Microscopic urban: NETSIM 8 Microscopic freeway: FRESIM
2	78-80	170

This record type is required to mark the end of the input stream for each subnetwork for every time period. Record Type 170 must be followed by one of the following:

> Data for another subnetwork for the current time period or

> A group of input record types that range from 171 to 209 for the "global" network for the current time period or

> A Record Type 2 10, which marks the end of the data for the current time period.

For the first condition, Entry 1 (code = 3 or 8) identifies the subnetwork that follows. For the latter two conditions, Entry 1 is set to zero or left blank.

175
Traffic Assignment Parameters

Table 5-97. Record Type 175 – traffic assignment parameters.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	**Epsilon** is the acceptable threshold of objective function (in units of 0.1%). Range = **1–250.** Default = **10** or Epsilon = **1.0%.**
2	5–8	**MAXITA** is the maximum number of traffic assignment iterations to be performed. Range = **5–20.** Default = **5.**
3	9–12	Value of the first parameter **a** for the impedance function multiplied by **100**
4	13–16	Value of the second parameter, for the impedance function **b,** multiplied by **10** for the FHWA impedance function or **100** for the modified Davidson impedance function
5	17–20	Capacity smoothing factor (in a percentage) to be applied (if more than one capacity adjustment iteration is requested). Range = **[0,1–100].**
6	24	Number of the capacity iterations to be applied (the traffic will be reassigned after each loop). Range = **1–5.** Default = **1.**
7	25–28	**Accur** = **[1%–250%] ÷ 10:** line-search accuracy threshold (in units of 0.1%). If **blank,** the default is **10 (1.0%).**
8	32	Code for the impedance function type: **0** FHWA impedance function (default) **1** Modified Davidson impedance function
9	36	Code for the type of optimality for the objective function: **0** User's optimal assignment (default) **1** System's optimal assignment
10	40	Print code for intermediate results: **0** Do not print (default) **1** Print intermediate path assignments **2** Print tree constructs for each iteration **3** Print detailed trees for each O-D pair **4** Print all of the intermediate outputs (1–3) **5** Print the final detailed trees for each O-D pair
11	44	Code [0,1] to [suppress, print] the final traffic assignment results. Default = **0.** This entry is **reset internally to 1** if more than one capacity iteration is to be performed (see Entry 6).

ENTRY	COLUMN(S)	DESCRIPTION
12	45–48	Ratio of the service discharge rate to the saturation rate **(0%-100%)** for the modified Davidson impedance function. Default = 62.
13	49–52	Percentage of the impedances produced by an all-or-nothing network loading that will be incorporated in the first assignment iteration. Range = O-99. Default = 0.
14	56	Code for generating the equivalent simulation dataset for the assignments obtained. Simulation records will be written to "CASINP"S. CASINP is the case name that is coded in Entry 14 on Record Type 05 (e.g., if CASINP = "DATA0 1," then the generated file is named DATA0 1 S): 0 Do not generate simulation records (default) 1 Generate simulation records 2 Generate simulation records (turn movements are expressed as percentages on Record Type 2 1)
15	78-80	175

This record type **is optional** in the input stream for the first time period if traffic assignment was requested on Record Type 02. This record can be omitted if all of the default values of the assignment parameters are satisfactory. This record **cannot** be used if traffic assignment was **not** requested. It appears in the input stream for the first time period only.

The network is first converted from its physical geometric structure into an equivalent path network. This path network has nodes representing the geometric network links, and links representing the geometric network turn movements. The traffic assignment is applied to the path network using the specified origin-destination traffic information on Record Type 176.

An intermediate solution for each iteration is obtained using link impedances produced by the previous iteration. For the first iteration, the link impedances are evaluated for free-flow conditions throughout the entire network. To obtain an optimal solution for each iteration, iterative line search is applied to the range between the current intermediate solution and the previous iteration solution. The search terminates when the contribution of current iteration is less than the accuracy threshold value (Accur).

The traffic assignment process terminates when the maximum number of iteration (MAXITA) is reached, or when the relative change of the objective function between two successive iterations is less or equal to the threshold value (Epsilon), whichever occurs first.

During the assignment process, the service discharge rates for turns are held constant, and are estimated initially for free-flow conditions. These estimates could be calibrated after the assignment of turn movements, then applied to the next assignment process, if requested. Entries 5 and 6 are used to select more than one capacity iteration and to specify the smoothing factor for capacity calibration as follows:

$$C_n = [rC_c + (100 - r)C_p] \div 100$$

where

C_n = New estimate of capacity (for the next assignment)
r = Capacity smoothing factor specified in Entry 5
C_c = Calculated capacity using previously assigned volumes
C_p = Previous estimate of capacity

If Entry 5 was left blank or coded as zero, then the estimated capacity will be evaluated by averaging all of the previous capacity estimates.

Two impedance functions are available to evaluate travel time on a path-link: ❶ the FHWA impedance function and ❷ the modified Davidson impedance function. The travel time on a path link includes the time required to traverse the geometric link and the time required, at its downstream intersection, to perform the desired turn movement.

The FHWA impedance function is as follows:

$$T = T_0 [1 + a(V \div C)^b]$$

The modified Davidson impedance function is as follows:

$$T = T_0 [1 + aV \div (S - V)] \qquad \text{if } V < bS$$

or

$$T = T_0 [1 + ab \div (1 - b)] + aT_0 (V - bS) \div [S(1 - b)^2] \qquad \text{if } V > bS$$

where

T = Mean travel time on the path-link
T_0 = Free-flow (zero volume) travel time on the path-link
V = Volume on the path-link
C = Capacity of the path-link
S = Path-link saturation rate = 100(C ÷ R)
R = Ratio of capacity to saturation rate (in a percentage)
a,b = Parameters to be specified, with the defaults as follows:

- **FHWA:** a = 0.60 b = 4 (coded as 60 and 40)
- **Modified Davidson:** a = 0.40 b = 0.80 (coded as 40 and 80)

In most highway network cases, the traffic assignment algorithm converges rapidly. For large networks with heavy traffic, however, the algorithm can converge slowly, especially for a system optimal solution. In such cases, the user could speed up the assignment process by specifying a percentage value on Entry 13 (X) from 0 to 99 (recommended value = 20). The link impedances for the first assignment iteration will be evaluated as follows:

$$T_1 = [T_0(100 - X) + T_f(X)] \div 100$$

where

T_1 = Link travel time for iteration 1 (= T_0 if X = 0)
T_0 = Free-flow travel time
X = Value of Entry 13
T_f = Link travel time induced by an all-or-nothing assignment

TRAF will always print traffic assignment results for each iteration if multiple-capacity iterations and intermediate results are requested. If intermediate results are **not** requested and multiple capacity iterations **are** requested, then it will print traffic assignment final results for the last capacity iteration only. See Entries 10 and 11 for the codes that relate to the printing of intermediate and final results.

176
Origin-Destination Trip Table

Table 5-98. Record Type 176 – origin-destination trip table.

ENTRY	COLUMN(S)	DESCRIPTION
1	1-4	Origin node number **i (8###** or 2###)
2	5-8	Percentage of **trucks** leaving the origin node. **Blank** if the node is a source/sink (2###).
3	9-12	Percentage of **Carpools** leaving the origin node. **Blank** if node is a source/sink (2###).
4	13-16	Destination node j (8###,2###) for the portion (specified in the next entry) of traffic entering at origin node **i**
5	17-20	Volume (vph) traveling from the origin node to the destination node specified in the previous entry
6	21-24	Destination node **k** (8###,2###) for the portion (specified in the next entry) of traffic entering at origin node **i**
7	25-28	Volume (vph) traveling from the origin node **i** to the destination node **k** specified in the previous entry
8	29-32	Destination node **1(8###,2###)** for the portion (specified in the next entry) of traffic entering at origin node **i**
9	33-36	Volume (vph) traveling from the origin node **i** to the destination node **1** specified in the previous entry
10	37-40	Destination node m (8###,2###) for the portion (specified in the next entry) of traffic entering at origin node **i**
11	41-44	Volume (vph) traveling from the origin node **i** to the destination node m specified in the previous entry
12	45-48	Destination node **n** (8###,2###) for the portion (specified in the next entry) of traffic entering at origin node **i**
13	49-52	Volume (vph) traveling from the origin node **i** to the destination node **n** specified in the previous entry
14	53-56	Destination node o (8###,2###) for the portion (specified in the next entry) of traffic entering at origin node **i**
15	57-60	Volume (vph) traveling from the origin node **i** to the destination node o specified in the previous entry
16	61-64	Destination node **p** (8###,2###) for the portion (specified in the next entry) of traffic entering at origin node **i**

ENTRY	COLUMN(S)	DESCRIPTION
17	65–68	Volume (vph) traveling from the origin node **i** to the destination node **p** specified in the previous entry
18	69–72	Destination node **q** (8###,2###) for the portion (specified in the next entry) of traffic entering at origin node **i**
19	73–76	Volume (vph) traveling from the origin node **i** to the destination node **q** specified in the previous entry
20	78–80	176

This record type is **required** in the input stream for the first time period if traffic assignment was requested on Record Type 02. This record **cannot** be used if traffic assignment was **not** requested on Record Type 02. The set of Record Type 176s defines the trip table for traffic assignment.

The traffic assignment model contained in TRAF is designed to treat the global analysis network as representing the aggregate of all specified subnetworks. The logic internally aggregates the individual subnetwork specifications into a single traffic assignment network. Currently, the traffic assignment model is only capable of treating NETSIM subnetworks. Traffic assignment cannot be performed on the networks represented by the FRESIM model.

Traffic assignment can be performed and followed by a simulation study in the course of a **single** analysis run (see Record Type 02). In that case, the trip table and other traffic assignment data specified on Record Types 176 and 177 replace the need to specify turning movement data (Record Type 21 or 26), entry link volume, and source/sink volume data (Record Types 50 and 51) normally required to perform simulation.

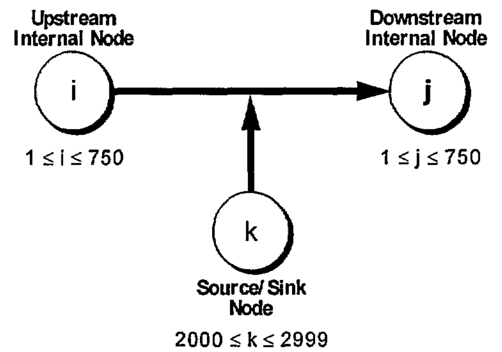
Origin-destination nodes can be specified in any order. However, if more than one record is needed for a certain origin to define all associated destinations, then such records must be grouped together and Entries 2 and 3 can only be coded for the first record (if applicable). For example, if 25 destination nodes are associated with a specified origin node, a total of three Record Type 176s must be input. These three records can then be followed by other Record Type 176s defining the O-D volumes from other origin nodes.

Two types of origin-destination nodes are recognized by the model. Node numbers of the form 8### represent entry and exit nodes connected to an internal node. Source/sink nodes in the form 2### serve traffic entering or discharging within the middle of an internal link. These nodes represent traffic generators or attractors, such as parking garages or shopping centers, within the network. Each source/sink node provides access to a single link, and each internal link can have only a single source/sink node. Every source/sink node specified on Record Type 176 must be identified on Record Type 177.

Traffic entering the network from an 8### origin node enters via entry links that must be defined by a link characteristics record (Record Type 11 or 15). Internal links associated with source/sink traffic must also be defined on Record Type 11. Source/ sink nodes **cannot** be specified within a freeway subnetwork. All of the origin-destination nodes for a freeway **must** be entry or exit nodes.

177
Source/Sink Nodes

Table 5-99. Record Type 177 - source/sink nodes.

ENTRY	COLUMN(S)	DESCRIPTION	
1	1–4	Source/sink centroid number **k**	Origin, destination, or both
2	5–8	Upstream node **i** of the internal link on which the source/sink node lies (**cannot** be an 8### entry node)	
3	9–12	Downstream node **j**	
4	78–80	177	

This record type is **optional,** and it pertains to the traffic assignment option only. This record **must** be specified for every origin/destination node (2###) specified on a Record Type 176.

Source/sink nodes represent midblock traffic generators, or destinations, such as shopping centers and office complexes. When traffic assignment is requested, Record Type 177 replaces Record Type 51 to identify such midblock flows.

The limitations for source/sink nodes are as follows:

- Source/sink nodes **cannot** appear anywhere within a freeway or rural-road subnetwork.
- Each source/sink node **must** access a single internal link. If a single facility (e.g., a parking garage) is accessible from more than one internal link, then it must be represented by as many source/sink nodes as the accessible internal links.
- An internal link can access a single source/sink node. If two or more distinct facilities are accessed from a single internal link, they have to be considered as a single source/sink node.

Because links are unidirectional, the user must consider receiving and discharging traffic from a midpoint location to more than one direction. In figure 5–20, for example, traffic in one direction is represented by origin-destination node 2000, while the reverse flow is represented by origin-destination node 200 1. If the O-D flows are known for each of these nodes, then this representation is adequate.

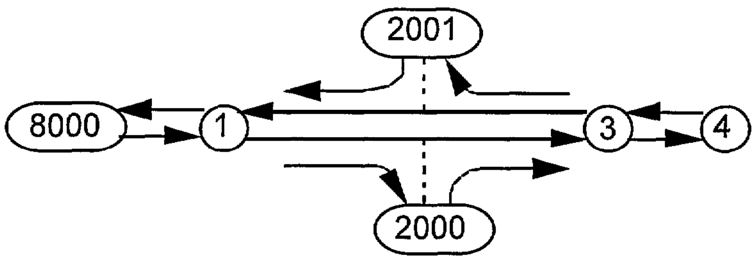


Figure 5-20. Unidirectional traffic of source/sink nodes.

This information is often unknown, which makes it one of the reasons for utilizing traffic assignment. In that case, all O-D flow is represented by a single origin that must allow traffic to both arrive and discharge from both directions. In figure 5-2 1, traffic can enter and discharge from node 2002 in both directions. All traffic leaving node 2002 will travel along link (2,3). Traffic can then discharge in either direction to link (3,l) or (3,4).

Figure 5-21. Source/sink node configuration for two directions.

An alternate representation is to use entry and exit links, as shown in figure 5-22. In this case, flow to and from node 8001 can arrive or depart in both directions, but requires more links than using a source/sink node.

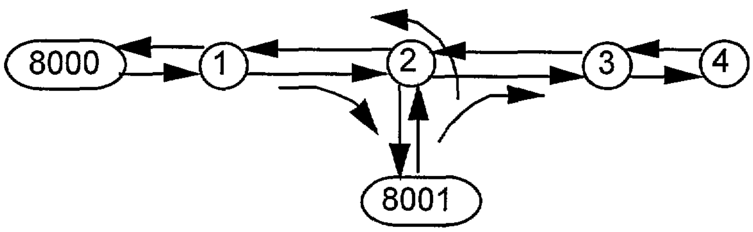


Figure 5-22. Use of entry and exit nodes to handle two-directional O-D traffic.

185
Bus Stations

Table 5-100. Record Type 185 – bus stations.

ENTRY	COLUMN(S)	DESCRIPTION
1	l-2	Bus station number. Range = l-99.
2	4	0 Protected (pull out/"NO PARKING BUS STOP") 1 Unprotected [blocks traffic while (un)loading]
3	5-8	Upstream node number of the link with the bus stop **(cannot** be an 8### node)
4	9-12	Downstream node number of the link with the bus stop **(cannot** be a 7### node)
5	13-16	Distance from the downstream end of the bus stop to the downstream stop bar
6	18	Maximum number of buses that the bus stop can hold at one time. Range = l– 6.
7	20	Station type code for the time the bus spends servicing passengers at the bus stop. Range = l-6. Default = 1.
8	78-80	185

Bus stations locations are defined on Record Type 185. The bus stations are identified by station number. Bus stop location is defined by whether it is protected or unprotected, by what link it is on, by how far its downstream end is from the downstream stop line, and by its capacity for holding buses. The bus stop dwell time distribution tells TRAF how to modify the average time a bus spends at a bus stop to get the actual time for individual stops at a bus stop (see the discussion of bus stop mean dwell time for of Record Type 186).

NETSIM has the logic to handle lane blockages by buses-protected versus unprotected and multiple bus capacity versus single bus capacity. FRESIM has bus routes but **not** bus stations. Therefore, bus station and bus route records are **not** permitted for the model.

Care must be exercised in specifying the (longitudinal) position of a bus station. In particular, if a bus station is located at the upstream end of a street, its location must be specified so that the rear of a bus in dwell will not extend into the intersection.

Within the NETSIM subnetwork, the curb space reserved for a bus station located at the downstream end of a link can be used as a right-turn pocket when a **protected** station is unoccupied, provided that Entry 5 is less than 20 feet. For example, parking is allowed on a link, but it is prohibited within 150 feet (46 meters) of the stop line, where the station is located. All such NETSIM stations **must** be assigned a number **less than 64.**

A station **cannot** be located within a pocket that is specified in Entry 4, 5, 7, or 8 on Record Type 11.

The capacity of a station is specified to the nearest integer. The "type" of station pertains to the statistical distribution of dwell times applicable to the station. This distribution is expressed as a percentage of the mean dwell time specified on the Record Type 186s for this station. To apply the default distribution (type 1), this entry should be blank.

The model accommodates six different station types (i.e., Entry 7 must range from 1 to 6). Table 5–101 shows the embedded values of distributions for the percentage of mean dwell time for each station type.

Table 5–101. NETSIM distributions for the percentage of mean dwell time.

STATION TYPE	K									
	1	2	3	4	5	6	7	8	9	10
1	40	60	70	80	90	100	120	130	140	170
2	24	48	59	75	85	94	111	126	155	223
3	30	47	65	77	90	103	116	137	157	178
4	0	29	59	75	92	108	125	148	170	194
5	0	18	36	70	104	125	144	156	167	180
6	0	0	0	48	96	120	144	171	198	223

K is a random number from 1 to 10. If the user wants to alter or replace any or all of these distributions, data can be entered on Record Type 150. Any changes to these distributions will apply to stations **in all** of the subnetworks.

For example, assume that the mean dwell specified for the station type 1 is 50 seconds. When the bus arrives at the bus stop, TRAF generates a random number from 1 to 10. Assume that it generates a 4. TRAF looks up Column 4 for station type 1 and finds that it is 80. TRAF then multiplies 80% times 50 seconds to get a stop time of 40 seconds for this stopping of the bus.

186

Mean Dwell Time for Buses

Table 5-102. Record Type 186 - mean dwell time for buses.

ENTRY	COLUMN(S)	DESCRIPTION
1	3-4	Station number. **Must** be a station number identified on a bus station record.
2	6-8	Mean dwell time (in seconds) for the time spent. stopped at this station to load and unload passengers. $0 \le$ **time** $\le$ **500.**
3	9-12	Percentage of buses servicing this station that do not stop because of a lack of demand. A warning message is generated if this value is > 90%.
4	78-80	186

After defining the locations of bus stations, the average (mean) time the bus spends stopped at each bus station should be defined. Each station must have a corresponding Record Type 186 entry and vice versa. Buses frequently bypass bus stops because of the lack of passengers to pick up or unload. This bypass percentage is defined on Record Type 186. TRAF will generate a warning message if the bypass percentage is between 90% and 100%, but it will still allow that value to be used.

Record Type 186 specifies the **mean** dwell time of buses at each bus station. One of up to six embedded statistical distributions (see Record Type 185) is referenced each time a bus enters a station to service passengers. The actual dwell time for the bus is extracted from this distribution. Therefore, individual dwell times can be regarded as a random variable.

Record Type 186s can be input each time period to reflect changes in mean dwell time or bus bypass percentages over time. If a Record Type 186 does not appear for a particular station during a subsequent time period, the previous time period values will be retained.

187
Bus Route Definition

Table 5-103. Record Type 187 – bus route definition.

ENTRY	COLUMN(S)	DESCRIPTION
1	2-4	Route number of the bus route. Range = **l-100.**
2	5-8	If this is the **first** link for this bus route, this entry is the upstream node number (8###) of the entry link for the bus route. If this is a subsequent record, it contains the **next** node number in the route through the network.
3	**9-12**	If this is the **first** link for this bus route, this entry is the downstream node number (which **cannot** be 8###) of the entry link for the bus route. If this is a subsequent record, it contains the next node number in the route through the network.
4	13-16	This is the next node number in the route through the network
5	17-20	
6	2 l-24	
7	25-28	
8	29-32	
9	33-36	
10	37-40	
11	41-44	
12	45-4s	
13	**49-52**	
14	53-56	
15	57-60	
16	61-64	
17	65-68	
18	69-72	
19	73-76	
20	78-80	187

If bus routes are present, they must be defined in the first time period on Record Type 187. Bus routes must enter the network from an entry node (type 8###), and they can traverse internal and interface nodes before exiting at an exit node (type 8###). Bus routes can travel between different TRAF subnetworks.

The current release of TRAF allows for a maximum of 100 bus routes. Lengthy bus routes can be defined on more than one Record Type 187. If a route is defined on multiple records, however, then each record must be completely filled prior to the coding of the subsequent record(s).

188

Bus-Route Station Stops

Table 5-104. Record Type 188 – bus-route station stops.

ENTRY	COLUMN(S)	DESCRIPTION
1	2–4	Route number of the bus route. Range = **1–100.**
2	5–8	Bus route offset for this route
3	9–10	If this is the **first** record for the route, then this is the number of the **first** bus station that is serviced by a bus on this route; otherwise, this is the next station number in sequence
4	11–12	If this is the **first** record for the route, then this is the number of the **second** bus station that is serviced by a bus on this route; otherwise, this is the next station number in sequence
5	13–14	**Third** (if any)
6	15–16	**Fourth** (if any)
7	17–18	**Fifth** (if any)
8	19–20	**Sixth** (if any)
9	21–22	**Seventh** (if any)
10	23–24	**Eighth** (if any)
11	25–26	**Ninth** (if any)
12	27–28	**Tenth** (if any)
13	29–30	**Eleventh** (if any)
14	31–32	**Twelfth** (if any)
15	33–34	**Thirteenth** (if any)
16	35–36	**Fourteenth** (if any)
17	37–38	**Fifteenth** (if any)
18	39–40	•
19	41–42	•
20	43–44	•
21	45–46	
22	47–48	
23	49–50	

ENTRY	COLUMN(S)	DESCRIPTION
24	51–52	
25	53–54	
26	55–56	
27	57–58	
28	59–60	
29	61–62	
30	63–64	
31	65–66	
32	67–68	
33	69–70	
34	71–72	
35	73–74	
36	75–76	
37	78–80	188

After defining the bus route with Record Type 187, the user should define the route with Record Type 188. The bus route is the unique series of bus stations that a bus stops at as it traverses its route. It is possible for two bus routes to have the same route but to stop at different stations. For example, bus route 1 might be an express while bus route 2 might be a local bus. Similarly, it is possible for multiple bus routes to stop at some of the same stations. Like other bus-related records, this record can only appear in Time Period 1. It must appear in conjunction with Record Type 185 (bus stations) because it uses bus station numbers to identify the route. Similarly, it must not appear if Record Type 185 is omitted. If there are no bus stops in a particular subnetwork then this record can be omitted.

Bus route offset (Entry 2) can be used to offset the time at which a bus route emits buses. The first bus on this route will be delayed by the time specified, then all other buses will be emitted based on the headway (Record Type 189) for the route. This feature is useful if two bus routes have the same route and headway through the network. One bus route can be given an offset so that a bus for each route will not enter the network at the same time.

189
Bus Headways (Flow Rates)

Table 5-l 05. Record Type 189 – bus headways (flow rates).

ENTRY	COLUMN(S)	DESCRIPTION	
1	2-4	Route number as identified on Record Type 187	**First** bus route
2	6-S	Mean headway (in seconds) between buses. **1 ≤ headway.** Headways **less than 30 seconds** will generate a warning message.	
3	78-80	189	

The final step in the specification of bus information is to define the flow rates, which must be specified for all routes. If Record Types 185-l 87 are missing, bus **flow** rates **cannot** be specified. Bus flow rates for a route are defined in terms of mean headway between buses on that route. They are not defined in terms of a schedule that emits buses at particular clock times. Headways can be any integer value greater than zero. Values that are less than 30 seconds, however, will cause TRAF to issue a warning that the value is low and should be checked by the user. Record Type 189 can appear in subsequent time periods to modify the flow rate. This can be used to generate higher flow rates in the rush-hour period and diminished flow rates in the post-rush-hour period. If Record Type 189 does not appear for a route in subsequent time periods, TRAF will assume that the flow rates will be unchanged for that route.

195
Node Coordinate Data

Table 5-106. Record Type 195 - node coordinate data.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Node number **n** that identifies the intersection
2	7–12	**X** coordinate of the node (in feet or meters) that defines the node position when the graphics option is used
3	15–20	**Y** coordinate of the node (in feet or meters) that defines the node position when the graphics option is used
4	78–80	195

This record type is required **only** if the graphics output option has been selected (see Entries 12 and 13 on Record Type 05). To view the simulation results graphically, the node coordinates **must** be input for every internal node in the network. The user can also enter node coordinates for interface nodes (7000–7999) and entry/exit nodes (8000–8999). Coordinates for those interface and entry/exit nodes not specified on Record Type 195 will be computed internally.

When coordinates are omitted for an entry/exit node, the node location will be calculated based on the location of the internal node at the other end of the entry/exit link and the average link length assigned to entry/exit links. Similarly, when coordinates are omitted for an interface node, the node location will be calculated based on the location of the adjacent internal nodes and the length of the links carrying traffic to/from the interface. If a more precise placement of these nodes is desired, then their coordinates should be input on this record type. In addition, if curvature is specified on Record Type 196 for a link whose upstream or downstream node is an interface node, then the coordinates of the interface node must be input.

It is not necessary to input the coordinates of all entry/exit or interface nodes if one or more are specified.

196
Optional Link Geometric Data

Table 5-107. Record Type 196 – optional link geometric data.

ENTRY	COLUMN(S)	DESCRIPTION
1	1–4	Upstream node number **i** of link **(i,j)**
2	5–8	Downstream node number **j** of link **(i,j)**
3	12	Code describing link curvature (in the direction of flow along that link): **0 or blank** If no curvature **1** If curvature of circular arc is clockwise **2** If curvature of circular arc is counterclockwise
Entries 4–19 are used to define other links that are crossed by overpass link **(i,j)**		
4	13–16	Upstream node number of the **first** link that is below and crossed over by link **(i,j)**
5	17–20	Downstream node number of the link identified in Entry 4
6	21–24	Upstream node number of the **second** link that is below and crossed over by link **(i,j)**
7	25–28	Downstream node number of the link identified in Entry 6
8	29–32	Upstream node number of the **third** link that is below and crossed over by link **(i,j)**
9	33–36	Downstream node number of the link identified in Entry 8
10	37–40	Upstream node number of the **fourth** link that is below and crossed over by link **(i,j)**
11	41–44	Downstream node number of the link identified in Entry 10
12	45–48	Upstream node number of the **fifth** link that is below and crossed over by link **(i,j)**
13	49–52	Downstream node number of the link identified in Entry 12
14	53–56	Upstream node number of the **sixth** link that is below and crossed over by link **(i,j)**
15	57–60	Downstream node number of the link identified in Entry 14
16	61–64	Upstream node number of the **seventh** link that is below and crossed over by link **(i,j)**
17	65–68	Downstream node number of the link identified in Entry 16

ENTRY	COLUMN(S)	DESCRIPTION
18	69–72	Upstream node number of the **eighth** link that is below and crossed over by link **(i,j)**
19	73–76	Downstream node number of the link identified in Entry 18
20	78–80	196

This record type is **optional,** and it can appear in the input specifications for CORSIM for the first time period only. This record is needed if the user wants to graphically depict curved links and overpasses. If the simulated network does not include these features, or if graphical displays are not required, this record type can be omitted.

When curvature is specified, a curved two-way street will be modeled as a clockwise link for one direction of travel and as a counterclockwise link for the other direction.

No more than eight underpasses can be specified for a link. Consequently, if a link has more than four underpasses, the link should be subdivided into two (or more) links. Conversely, a link can pass under up to four other links; that is, be listed on up to four different Record Type 196s as an underpass.

In networks that contain curved links and/or underpasses, inaccuracies in any of the following data items that cannot be detected by the simulation model can cause erratic network drawings to be produced by the animation software:

- **Link length**—The link length specified on Record Type 11 must be accurate to produce a realistic display. The length of a curved link must be greater than the length of the straight line connecting the upstream and downstream nodes of the link.
- **Node coordinates**—For curved links, the node coordinates define where the end points of a link are located on the arc of a circle. The length of the arc is the link length input on Record Type 11. This implies uniform curvature along the link. If a link is not uniformly curved it should be subdivided into two or more links (e.g., an S-shaped link).

Discussion of Selected Entries

1 The range of the upstream node number must be [1,NMAX], 7000–7999, or 8000–8999. The value of NMAX for this release of TRAF is provided under "Size Limitations" in the third chapter of this manual.

2 The range of the downstream node number must be [1,NMAX] or 7000–7999.

The nodes in Entries 1 and 2 must identify a link that is defined on Record Type 11.

3 This entry is specified if the link defined by Entries 1 and 2 is a curved section of roadway and if this curvature is to be reflected in graphical displays. A value of 1 is specified if travel along the link toward the stop line follows a circular arc that is clockwise in direction. Similarly, a value of 2 is specified if travel along the link follows a counterclockwise arc. Therefore, a curved two-way street would be defined as two separate links with clockwise flow for one link and counterclockwise flow for the other. Both static and animated graphical displays will depict the appearance and size of curved links by using this entry, the node coordinates specified on Record Type 195 and the link length specified on Record Type 11.

This entry should be omitted if the link defined by Entries 1 and 2 is essentially a straight section of roadway or graphical displays are not requested on Record Type 05.

Curvature **cannot** be specified for entry links.

4-19 These entries identify any links that lie underneath the subject link defined by Entries 1 and 2. This information is used to provide a graphical "aerial view" display of multilevel roadways. The entries should be completed if the subject link overpasses other links and graphical displays are requested on Record Type 05. An animation display of such overpasses will include vehicles that temporarily disappear from view as they pass below the subject link.

The upstream and downstream node numbers of up to four links that pass underneath the subject link can be specified on this record. These links can include entry, internal, and interface links.

The underpass links specified on a given Record Type 196 can exist on different levels below the subject link. An "aerial view" of a link at the lowest level of a multilevel interchange can be obscured by links from several higher levels. Therefore, a given underpass link can appear on more than one Record Type 196. Lower-level links should in fact be specified as underpass links on the Record Type 196 for each higher-level link that passes over it.

These entries should be omitted if the subject link does not pass over other links or if graphical displays are not requested on Record Type 05.

210
Time Period Delimiter

Table 5-108. Record Type 210 – time period delimiter.

ENTRY	COLUMN(S)	DESCRIPTION
1	4	Code [0,1] if this time period [is not, is] the **final** time period. If no other time period follows, this entry must be set to **1**, and this record is the final record in the input stream.
2	8	Code that defines the **first** section of the input stream for the next time period (if any). **Blank** indicates that no records follow (i.e., Entry 1 = 1). Codes **[3,8]** indicate that the next section of inputs consists of Record Types 11–170, which specify data for the following subnetwork **[NETSIM, FRESIM]**. **0 or blank** The following block of input record types are numbered above 170 and are terminated with a Record Type 210. **3** Microscopic urban: **NETSIM** **8** Microscopic freeway: **FRESIM**
3	12	Code that suppresses certain portions of the preprocessor output if this record is the **last** record for each individual case. This entry is ignored for intermediate Record Type 210s. **0 or blank** Print all preprocessor outputs **1** Suppress echo-print of input records **2** Suppress run specifications and network validation printouts **3** Both 1 and 2
4	26	Code **1** to **suppress** the conversion of graphical output files
5	78–80	210

This record is **required** to mark the end of the input specifications for a time period and to identify the first section of the input stream for the next time period (if any). Record Type 210 can also be used to suppress certain preprocessor outputs.

Appendix B

FEDIT

Appendix C

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