TWOPAS USER'S GUIDE

A User's Guide to TWOPAS — A Microscopic Computer Simulation Model of Traffic on Two-Lane, Two-Way Highways

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16. Abstract

This Guide presents information required to use TWOPAS, a microscopic computer simulation model of traffic on two-lane, two-way highways. The TWOPAS model simulates traffic operations on two-lane highways by reviewing the position, speed, and acceleration of each individual vehicle on a simulated roadway and advancing those vehicles along the roadway in a realistic manner. TWOPAS has the capability to simulate both conventional two-lane highways and two-lane highways with added passing lanes. This Guide documents the input formats for geometric, traffic, and vehicle data needed to run the TWOPAS model and the types of output obtained from the model. The TWOPAS model is written in FORTRAN and is intended to run on an IBM mainframe computer.

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I. INTRODUCTION

A. Organization of Guide

This volume is the User's Guide for the computer program TWOPAS, a microscopic simulation model of uninterrupted traffic flow on two-lane two-way highways with and without added passing lanes. This Introduction describes the need for the model, its history, the program approach, and features of interest to the user. Section II describes the input data for the TWOPAS model including the data items, formats, and program limitations. Section III describes the program output. A test case using the simulation model is presented in Section IV. The computer requirements for running the model on an IBM mainframe computer are described in Section V. A companion volume, the TWOPAS Programmer's Guide,[1] provides more detailed information on the program structure and operation that is not needed to run the program but is needed to update or revise the model.

B. Need for Model/Program

The traffic flows on two-lane two-way rural highways are known or thought to be impacted by numerous variables associates with the highway geometrics, traffic controls, the vehicle population, and the driver population. Data from the field are essential to the study of these variables and their correlates. However, field data collection is expensive, is nearly always incomplete relative to some variables, and offers no opportunity to examine the traffic operational effects of systematic variations in traffic controls, geometrics, flow rates, vehicle mixes, and vehicle characteristics.

An analytical microscopic simulation model that contains a realistic account of geometrics, traffic controls, driver behavior, and vehicle characteristics can be used to study the impact of these variables under controlled conditions and without hazard or capital investment. Microscopic models can be very accurate and realistic because they trace through time the movements of individual vehicles and the decisions of individual drivers. Providing this realism requires extensive logic and computations. Consequently, the model is computerized to be practical.

The TWOPAS model may be used to simulate existing and projected future traffic operations on a highway section and to examine the traffic operational effects of proposed improvements to the highway including realignment, cross-sectional improvements, and addition of passing lanes in level and rolling terrain. These aspects of the model have been validated against traffic operational field data. The model also has the capability to simulate added climbing lanes on long, steep grades, but this capability has not been field validated.

C. Program History and Application

The following discussion reviews the history of the TWOPAS computer program and its major applications since its original development in the 1970's. The initial version of the computer program was developed by Midwest Research Institute (MRI) between 1971 and 1974 as part of the NCHRP, Project 3-19; the results of this study are presented in NCHRP Report 185, "Grade Effects on Traffic Flow Stability and Capacity."[2] The program, then known as TWOWAF, was originally developed to run on a Control Data Corporation (CDC) computer and was later modified to be compatible with an IBM compiler and operating system by Mr. Harry B. Skinner and Mr. John Penzien of the FHWA.

The original TWOWAF program was extensively modified and supplemented to include the capability for climbing lanes (one lane added on the right). This work was performed at the Institute of Transportation Studies at the University of California-Berkeley, as part of the project, "A Decision-Making Framework for Evaluation of Climbing Lanes on Two-Lane Two-Way Rural Roads." The project was conducted by Professor Adolf D. May for the California Department of Transportation, and its results have been reported in the literature by Botha.[3]

The original TWOWAF program was also modified and applied by MRI in Contract No. DOT-FH-11-9434, "Implications of Light-Weight, Low-Powered Future Vehicles in the Traffic Stream."[4] Dr. Samuel C. Tignor was the FHWA technical monitor. The modified program was documented in 1981 under the contract in the volume, "Combined Users, Operations, and Program Maintenance Manual for TWOWAF, a Program for Microscopic Simulation of Two-Lane Two-Way Traffic."[5] Several major additions were made to the model at this time including an expansion in the number of individual vehicle types and the number of levels of desired speeds considered by the program. Another major addition made at this time was a capability for output of packed fuel determinate data for postprocessing in a fuel consumption model program also developed under the contract. The fuel model program was documented in 1983 in one volume as "Combined Users, Operations, and Program Maintenance Manual for a Computerized Model of Highway Vehicle Fuel Consumption."[6]

The revised TWOWAF model as modified above was employed by Texas Transportation Institute and KLD Associates in NCHRP Project 3-28A, "Two-Lane, Two-Way Rural Highway Capacity," with Mr. Robert E. Spicher as the NCHRP project engineer. TTI and KLD made further modifications. Several major additions were made to the model at this time including an expansion in the number of individual vehicle types and the number of levels of desired speeds considered by the program. However, no formal documentation is available. Pertinent information is contained in two working papers prepared during NCHRP Project 3-28A: "Analytical Framework for Evaluating Capacity and Level of Service for Two-Lane, Two-Way Rural Roads, Task 2 - Working Paper,"[7] and "Calibration and Validation of TWOWAF, Two-Lane, Two-Way Rural Road Computer Simulation Model, Task 3 - Working Paper."[8]

The TWOPAS model is an updated version of TWOWAF that incorporates the modifications and additions made in NCHRP Project 3-28A. There are four major additions: (a) capability to simulate passing and climbing lane sections; (b) entering traffic streams with user-specifiable percent of traffic platooned; (c) platoon leaders that are rationally selected to reflect the consequences of upstream geometrics; and (d) user-specifiable stations and subsections where spot data and overall data are collected. The ability of the model to simulate traffic operations in passing lane sections has been validated. This validation is presented in the FHWA report, "Operational Effectiveness of Passing Lanes."[9]

D. Program Approach and Features

The TWOPAS model simulates traffic operations on two-lane highways by reviewing the position, speed, and acceleration of each individual vehicle on a simulated roadway at 1-sec intervals and advancing those vehicles along the roadway in a realistic manner. The model takes into account the effects on traffic operations of road geometrics, traffic control, driver preferences, vehicle size and performance characteristics, and the oncoming and same direction vehicles that are in sight at any given time. The model incorporates realistic passing and pass abort decisions by drivers in two-lane highway passing zones. The model can also simulate traffic operations in added passing and climbing lanes on two-lane highways including the operation of the lane addition and lane drop transition areas and lane changing within the passing or climbing lane section. Spot data, space data, vehicle interaction data, and overall travel data are accumulated and processed, and various statistical summaries are printed.

In order to achieve realistic results, the program incorporates the major features listed below:

Geometrics

- Grades
- Horizontal curves
- Lane width, shoulder width, and pavement quality
- Passing sight distance
- Passing and climbing lanes

Traffic Control

- Passing and no-passing zones
- Speed limits

Vehicle Characteristics

- Vehicle acceleration and speed capabilities
- Vehicle lengths

Driver Characteristics and Preferences

- Desired speeds
- Preferred acceleration levels

- Limitations on sustained use of maximum power
- Passing and pass-abort decisions
- Realistic behavior in passing and climbing lanes

Entering Traffic

- Flow rates
- Vehicle mix
- Platooning
- Immediate upstream alignment

The characterization and application of each feature in the simulation model is described in Table 1. Further details about employing these features are given in the remainder of this volume.

TABLE 1

FEATURES OF THE TWOPAS SIMULATION MODEL

Features	Characterization in Simulation Model	Application in Simulation Model
GEOMETRICS		
Grades	Linear functions of position in user-specified sections.	Directly affect the maximum acceleration and speed maintenance capabilities of cars, RVs, and trucks. Indirectly (through other user input) provide crawl speeds for trucks on steep sustained downgrades. Indirectly (through other user input) influence the passing sight distances.
Horizontal curves	Radius, superelevation and degrees of alignment change.	Directly - may reduce speeds desired by vehicles in curve and its approach if radius and superelevation are sufficiently small. Directly - will reduce passing opportunity acceptances in approach to curvature to the right. Indirectly - may reduce passing sight distance (through other user input).
Lane width, shoulder width, and pavement quality	Indirectly through user-specified distribution of desired speeds	Directly - vehicles will attempt to travel at their desired speeds and, when free in most alignments, will exhibit the distribution associated with free speeds.
Passing sight distance	Separately in each direction as linear functions of position in user-specified sections.	Directly - oncoming vehicles are "seen" and affect the passing and pass abort decisions only if within the locally defined passing sight distance. Directly - the downstream end of a passing zone is "seen" and affects pass/abort decisions only if it is within sight.

TABLE 1 (Continued)

Features	Characterization in Simulation Model	Application in Simulation Model
GEOMETRICS (cont'd)		
Passing and climbing lanes	Specific locations of lane addition and lane drop. Specified geometrics of lane addition and lane drop.	Directly - initial lane choice of each entering vehicle based on: traffic ahead, vehicle category, state (free vehicle, platoon leader, platoon member), performance capability, desired speed, and effect of lane favored by local geometrics and markings. Subsequent lane choices described below under Driver Characteristics and Preferences.
TRAFFIC CONTROL		
Passing & no-passing zones on a conventional two-lane highway	Specific locations of zones by direction of travel.	Directly - drivers do not start passes in no-passing zones. They attempt to avoid initiating a pass that will extend into the no-passing zone if that boundary is in sight. Directly - When the driver is not committed to complete a pass, the pass will be aborted if the projected pass indicates that the end of the zone will be overrun. When driver is committed to complete a pass, the driver will attempt to avoid or minimize overrunning the end of the passing zone. Directly - impeded vehicles are motivated to examine pass opportunities when passing zone is first entered.
Passing and no-passing zones in the opposing direction to a passing or climbing lane	Specified by location and direction.	Directly - drivers observe the same constraints as above. They see opposing vehicles in either oncoming lane as potential conflicts.
Speed limit	Indirectly through the user-specified distribution of desired speeds.	See lane width, etc.

TABLE 1 (Continued)

Features	Characterization in Simulation Model	Application in Simulation Model
VEHICLE CHARACTERISTICS		
Acceleration and speed capabilities	Individual capabilities assignable to 13 vehicle types (four trucks, four RVs, and five cars/ light trucks).	Directly - maximum acceleration and speed capability depends on vehicle type and local grade.
		Directly - maximum acceleration and speed capability is always a potentially limiting constraint.
		Directly - drivers have an approximate concept of vehicle capability and use it as part of the projection of passing maneuvers and their outcomes.
		Directly - lack of a threshold acceleration or speed capability eliminates interest in passing.
Lengths	Assignable for each of 13 vehicle types.	Directly - vehicles "follow" the rear of an impeder.
		Directly - in passing an impeder, the passing vehicle must "clear," taking its own length into account.
DRIVER CHARACTERISTICS AND PREFERENCES		
Desired speeds	Assigned stochastically from a truncated normal distribution with user-specified mean and standard deviation.	Directly - each vehicle attempts to travel at its desired speed. It is also the basis for determining reduced speeds that may be preferred in horizontal curves and (for trucks) on downgrades.
		Directly - the desired speed is increased for vehicles during passing maneuvers.
		Directly - the difference between desired speed and impeder speed is one factor that helps determine how an impeded vehicle will "follow" and consider whether to pass.

TABLE 1 (Continued)

Features	Characterization in Simulation Model	Application in Simulation Model
DRIVER CHARACTERISTICS AND PREFERENCES (cont'd)		
Preferred acceleration levels	Incorporated in program logic.	Directly - unless otherwise restrained, vehicles use accelerations that are partly dependent on the difference between their current and desired speeds. Directly - If current speed exceeds desired speed, the deceleration used is dependent on the traffic situation.
Sustained use of maximum power performance	Behavior of cars and RVs is controlled by input and program logic.	Directly - vehicles will use maximum power performance if required in a pass or for acceleration toward a desired speed. However, for sustained periods, cars and RVs will use only a fraction (usually 70%) of maximum power, if user so designates.
Examination of passing possibilities (vehicle in direction of travel with only one lane)	Program logic plus user-specified probability.	Directly - Impeded vehicles examine passing possibilities and become motivated to pass only when they have first overtaken an impeder, entered a passing zone, cleared oncoming vehicles, and possess adequate vehicle performance capability to pass.
Acceptance/rejection of passing opportunities (vehicle in direction of travel with only one lane)	Built-in tables of acceptance probabilities are dependent on leader speed, type, and measure of constraint (i.e., sight distance or oncoming vehicle in sight), position in platoon, horizontal curvature, and location within passing zone.	Directly - passing opportunities are rejected if: projected time safety margin too small, truck already passing impeder, two other leaders already passing impeder leader aborting pass of same impeder, follower(s) in pass(es) that may produce conflict, pass maneuver time projected to be too long, or insufficient gap in front of impeder. Otherwise, acceptance based on stochastic decision and probabiliy tables.
Extend pass in progress to additional impeder (vehicle in direction of travel with only one lane)	Incorporated in program logic.	Directly - dependent on distance to next impeder, projected time to complete extended pass, gap in front of next impeder, and stochastic decision based on projected time safety margin.

TABLE 1 (Concluded)

Features	Characterization in Simulation Model	Application in Simulation Model
DRIVER CHARACTERISTICS AND PREFERENCES (cont'd)		
Behavior while being passed (vehicle in direction of travel with only one lane)	Incorporated in program logic.	Unless otherwise more constrained, a vehicle being passed will use only limited acceleration
Behavior in passing and climbing lane sections	Incorporated in program logic.	There are no arbitrary assignments of preferred lanes. Drivers use foresight and attempt to avoid being trapped behind an impeding vehicle in the right lane or being trapped in the closed lane at a lane drop. Drivers are increasingly motivated to move to the right lane of two unidirectional lanes when they will not be delayed in the near term by right lane vehicles, when their acceleration capability is small or negative and their speed is slow, and when they are impeding other vehicles. Trucks are slightly biased to move to the right lane. RVs have a lesser bias and cars have none.
ENTERING TRAFFIC		
Flow rates	Program logic creates entering traffic stream in response to user-specified flow rate.	Flow rate in entering traffic stream is near user-specified value.
Vehicle mix	Program logic responds to user-specified proportion of individual vehicle types by direction.	Vehicle mix in entering traffic stream is near user-specified distribution.
Platooning in entering traffic stream	Program logic responds to user-specified percentage of traffic platooned by direction, and the upstream alignment in which platoons formed.	Percentage of traffic platooned in entering traffic stream is near user-specified value, with platoon leaders chosen logically on the basis of vehicle performance, driver desired speed, and user-specified upstream alignment.
Immediate upstream alignment	User-specified maximum entrance speeds by direction for each vehicle type.	User-specified maximums are imposed at entrances when they are a limiting constraint.

II. INPUT

This section of the User's Guide describes the input data needed to run the TWOPAS model. The input data items are identified and briefly discussed and the input deck organization and format is documented. A sample input deck is presented with the test case presented in Section IV of the Guide.

A. The Position Coordinate System

The TWOPAS model simulates traffic in both directions of travel on a two-lane highway. These two directions of travel are referred to as the No. 1 and No. 2 Directions in the program documentation and the printed output.

The input data are entered into the model in the form that traffic engineers using the model are most likely to have available. In particular, it is anticipated that the program user will have a unidirectional coordinate system in mileposts or stations from highway plans or from a roadway inventory for the roadway section to be simulated. This unidirection coordinate system should be expressed in feet for use in the model. The No. 1 Direction in the simulation model should correspond to the direction of increasing values in the available coordinate system. All input data use the No. 1 Direction coordinate value to define positions. Note, however, that the coordinate system used in the input data must be zero at the end of the simulation road where No. 1 Direction traffic enters.

B. Overall Deck Configuration

The data deck consists of the following components:

1. Mandatory deck (in prescribed order).
    a. Comment cards, minimum of two.
    b. Remainder of mandatory deck, 10 cards in prescribed order.
2. Optional deck (no prescribed order except that Station Location (SL) cards must come last).
3. Blank card signals end of data for one simulation run.
4. First card of next deck.

The details of the individual cards used in the input deck are presented below. However, three aspects of these components require explanation. First, the optional deck includes the data for the size and performance characteristics of individual vehicle types. In the current program version, default values are <u>not provided</u> for these vehicle characteristics, so user specification is actually mandatory.

Second, at least two Station Location cards are required for each direction of travel to define the beginning and end ("start line" and "finish line") of the overall data collection section. The start line and finish line may have different locations in each direction of travel.

The third aspect that requires explanation is the significance of the first card of the next deck. If this is the first comment card of another data set, the data will be read and another simulation run performed. In this way, any number of separate simulation runs may be processed in succession without returning control to the operating system. Caution is suggested with regard to the way output line limits are counted and also the safeguarding of completed runs should any run after the first return control to the operating system in an abnormal exit.

A single card in place of the first card of the next deck may also be used to control program operation at the end of an input file. If a negative integer is placed in the first field (Columns 1 to 4) of this card, one of the following paths will be taken:

1. If the simulation run just completed included the specification of extra output (see Section II-D), the file on Unit 4 will be rewound and extra output data from all the preceding, sequentially performed simulations will be processed and printed. A normal exit follows.

2. If the simulation run just completed did not include the specification of extra output, a normal exit will be executed. (Recognize that, if extra output was specified in sequential simulations prior to the last, the data will be left on Unit 4 and may be lost in the absence of suitable job control.)

C. Mandatory Deck

The mandatory deck consists of comment cards and 10 data cards. They must be present and must be correctly sequenced in the order presented. Individual card formats and contents are described as follows:

Comment Cards (minimum of two required)

Columns	1-4	5-76
Format	I4	18A4
Content	RUN No.	Alphanumeric title for run identification

For all but the last comment card, the Columns 1-4 must contain a positive integer. On the final comment card, the Columns 1-4 must be blank.

The remainder of the mandatory deck consists of 10 cards described below:

Card No. 1

Columns	1	2	3-6	7-10	11-20	21-30	31-40	41-50	51-60
Format	I1		I4	I4	F10.0	F10.0	F10.0	F10.0	F10.0
Content	1	Blank	ISNAP	NSNAP	TWRM	TTES	DELT	TSP	FUEL

where: ISNAP = Number of seconds between sets of snapshot output.

NSNAP = Number of successive snapshots outputs in each set.

TWRM = Length of warmup period (time simulation is to run before data collection begins), min.

TTES = Length of test period (time simulation is to run while data are collected), min; total time = TWRM + TTES.

DELT = Length of review interval, sec; NOTE: the simulation has been run only with DELT = 1.

TSP = Measure of pass suppressing influence upstream of a curve to the right, sec; the distance equivalent is equal to 2.*TSP*VEAN, where VEAN is the mean desired speed; the value TSP = 5 has been used in testing the model.

IFUEL = Control code for fuel consumption data; IFUEL ≧ 0 causes fuel consumption data to be written on a file on Unit 10; the number of records written is printed on the output. IFUEL < 0 prevents output of fuel consumption data, and a corresponding message is printed.

Note that the card number appears in Column 1. This field is not read but is used to assist in keeping the deck sequenced correctly.

Card No. 2

Columns	1	2-10	11-20	21-30	31-40	41-50	51-60	61-70
Format	I1		F10.0	F10.0	F10.0	F10.0	F10.0	F10.0
Content	2	Blank	RL	XMS1	XMS2	SMIN	SNOM	PREC

where: RL = Total simulation road length, ft.

SMIN = Minimum passing sight distance, ft.

SNOM = Nominal passing sight distance, ft.

PREC = Probability that simulation driver will reconsider starting a pass during one review period; the value 0.2 has been used with 1-sec review periods, indicating the drivers will reconsider passing opportunities once every 5 sec. (Note: drivers are always motivated to consider a pass when they enter a passing zone or when they clear an opposing vehicle.)

XMS1 = The number of Station Location (SL) cards for the No. 1 Direction contained in the optional deck

NOTE: At least two SL cards must appear for each direction of travel. The first SL card defines the location at which traffic data collection by the program begins in that direction of travel ("start line"). The last SL card in that direction of travel defines the location at which data collection ends ("finish line"). The portions of the roadway before the location on the first SL card and after the location on the last SL card are buffer areas at either end of the simulated roadway where traffic operations are simulated but no data are collected.

XMS2 = The number of Station Location (SL) cards for the No. 2 Direction contained in the optional deck.

Card No. 3

Columns	1	2	3-8	9-14	15-20	21-26	27-32	33-38	39-44	45-50
Format	I1		F6.4	F6.4	F6.4	F6.4	F6.4	F6.4	F6.4	F6.4
Content	3	Blank	SFLO(1)	XPPL(1)	NUPG(1)	SFLO(2)	XPPL(2)	NUPG(3)	RE	RP

where: SFLO(1) = Specified flow rate in No. 1 Direction, veh/hr.

XPPL(1) = Specified percentage entering traffic following in platoons No. 1 Direction.

NOTE: If this field is left empty, TWOPAS will select a default value for percent platooned.

NUPG(1) = Type of upstream alignment specified for No. 1 Direction; the codes are:

1 = Level, tangent alignment
2 = Level with sharp curves
3 = Steep grade

NOTE: In each entering platoon, the vehicle with the slowest speed in the specified upstream alignment is placed as the platoon leader.

SFLO(2) = Specified flow rate in No. 2 Direction, veh/hr.

XPPL(2) = Specified percentage of entering traffic following in platoons in No. 2 Direction.

NUPG(2) = Type of upstream alignment specified for No. 2 Direction.

RE = Control for encounter workload; any negative number will cause logic to not apply the encounter workload; a blank field will cause logic to use encounter workload.

RP = Control for passing workload, defined similarly to RE.

Card No. 4

Columns	1	2	3-80
Format	I1	II	13F6.4
Content	4	1	FRC(1,KVT),KVT = 1,13

where: FRC(1,KVT) = Specified fraction of vehicle type KVT in No. 1 Direction flow.

Card No. 5

Columns	1	2	3-80
Format	I1	I1	13F6.4
Content	5	2	FRC(2,KVT),KVT = 1,13

where: FRC(2,KVT) = Specified fraction of vehocle type KVT in No. 2 Direction flow.

Card No. 6

Columns	1	2	3-8	9-14	15-20	21-26	27-32	33-38
Format	I1		F6.4	F6.4	F6.4	F6.4	F6.4	F6.4
Content	6	Blank	VEAN	VSIG	VBI(1)	VBI(2)	VBI(3)	SIGSM

Columns	39-44	45-50	51-56
Format	F6.4	F6.4	F6.4
Content	SIGBG	FPO	FP1

where: VEAN = Specified mean desired speed, ft/sec.

VSIG = Standard deviation of desired speeds, ft/sec.

VBI(1) = Bias to be added algebraically to desired speeds for trucks (KVT = 1-4), ft/sec.

VBI(2) = Bias to be added algebraically to desired speeds for recreational vehicles (KVT = 5-8), ft/sec.

VBI(3) = Bias for passenger vehicles (KVT = 9-13), ft/sec.

SIGSM = Lower limit of desired speed for sample used in operating speed calculation; value is in standard deviations, VSIG, from the unbiased mean, VMEAN.

SIGBG = Upper limit of desired speed for sample used to calculate operating speed; value is in standard deviations, VSIG, from the unbiased mean, VMEAN.

FP0 = Factor to be used on maximum acceleration to account for the horsepower restraint; the value used should be 0.73 for 70% power; a blank field will cause the default value 1.0 to be used.

FP1 = Factor to be used on maximum, zero-grade speed to account for horsepower restraint; the value used should be 0.90 for 70% power; a blank field will cause the default value 1.0 to be used; the fractional power restraint is applied to passenger cars and recreational vehicles. (Note: field data collected on sustained grades do indicate that restraint is used when high power is required for long time periods.)

Card No. 7

Columns		2	3-80
Format	I1	I1	13F6.4
Content	7	1	VENTR(1,KVT),KVT=1,13

where: VENTR(1,KVT) = An upper bound on the speed (ft/sec) with which any vehicle of type KVT can enter the simulated roadway traveling in the No. 1 Direction.

Card No. 8

Columns	1	2	3-80
Format	I1	I1	13F6.4
Content	8	2	VENTR(2,KVT),KVT=1,13

where: VENTR(2,KVT) = An upper bound on the speed (ft/sec) with which any vehicle of type KVT can enter the simulated roadway traveling in the No. 2 Direction.

Card No. 9

Columns	1	2	3-8	9-14	15-20	21-26	27-32	33-38
Format	I1		I6	I6	I6	I6	I6	I6
Content	9	Blank	IPOPYR	IPOPTP	IGEOM	IVMIX	ISFLO	ISPLIT

where: IPOPYR = The year which corresponds to the vehicle population for the run (i.e., 1978, 1981, 1985, 1995).

IPOPTP = The type of vehicle population for the run (i.e., there may be more than one set of vehicle characteristics used for a particular year).

IGEOM = Code representing the geometrics of the roadway studied.

IVMIX = Code representing the vehicle mix for run.

ISFLO = Code representing the level of traffic volume (No. 1 Direction plus No. 2 Direction) for the run.

ISPLIT = Code representing the directional split of traffic (the percentage of specified flow in No. 1 Direction).

Note that Card No. 9 is used only to supply data used as header information in the output file for fuel consumption written on on Unit 10; the values are not used in the simulation program. Card No. 9 is mandatory even if the fuel consumption output is suppressed with IFUEL < 0. In this case, however, a blank card could be used for Card No. 9.

Card No. 10

Columns	1-2	3-8	9-68
Format	I2	F6.3	10F6.3
Content	10	ZKCOR	BKPM(KDT),KDT=1,10

where: ZKCOR = Car-following sensitivity factor.

BKPM(KDT) = Stochastic driver type factor for driver type KDT.

Card No. 10 defines the risk-taking characteristics of each of 10 driver types. The values recommended for these parameters in NCHRP Project 3-28A are 0.8 for ZKCOR and 0.43, 0.51, 0.57, 0.65, 0.76, 0.91, 1.13, 1.34, 1.58, and 2.12 for BKPM(1) through BKPM(10).

D. Optional Data Cards

The following optional cards may be in any order, except that the Station Location (SL) cards must appear last. The card type is determined by the computer program using the letter entered in Column 2.

1. Random number seeds (RN)

Columns	1-2	3-20	21-70
Format	A2		4I10
Content	RN	Blank	NSRAND(N),N=1,5

where: NSRAND(1) = Seed for random number generation used to select entering headways and vehicle types in the No. 1 Direction.

NSRAND(2) = Seed for random number generation used to select entering headways and vehicle types in the No. 2 Direction.

NSRAND(3) = Seed for random number generation used to select desired speeds for entering vehicles in No. 1 Direction.

NSRAND(4) = Seed for random number generation used during priming to select desired speeds, and then used subsequently (without reset) to make stochastic decisions on pass initiation and pass extension during simulation.

NSRAND(5) = Seed for random number generation used to select desired speeds for entering vehicles in No. 2 Direction.

The random number seeds should generally be arbitrary 8-digit numbers. Note the same random number seeds are used in two runs with the same traffic inputs but different geometrics, then the identical traffic stream will be simulated for each geometric condition. On the other hand, if the random number seed is varied without changing the geometric or traffic inputs, then replicate runs can be made with random variations in traffic stream composition while maintaining approximately the same flow rate and vehicle mix.

2. Grades (GD): Each GD card presents the vertical alignment for a specified length of roadway, referred to as a grade region.

Columns	1-2	3-5	6-10	11-20	21-60
Format	A2	I3	I5		4F10.0
Content	GD	J	MJGD(1)	Empty	XGDN(J),G0(J),G1(J),X(J)

where: J = The sequence number of this grade region counting in the No. 1 Direction.

MJGD(1) = The total number of grade regions (dimensioned for a maximum of 30 grade regions in one direction).

XGDN(J) = The position coordinate of the beginning of this grade region (ft) measured in the No. 1 Direction.

G0(J) = The percent grade at XGDN(J) for traffic traveling in the No. 1 Direction.

G1(J) = The percent grade at X(J) for traffic traveling in the No. 1 Direction.

X(J) = The position coordinate of the end of this grade region (ft) measured in the No. 1 Direction.

The grade data are entered only for the No. 1 Direction. Program logic supplies the data for the No. 2 Direction. Positive grades represent upgrades in the No. 1 Direction; negative grades represent downgrades in the No. 1 Direction. Straight grades can be entered with grade discontinuities between adjacent regions; or, vertical curves can be specified through the difference in G0(J) and G1(J) values for a particular grade region. If grade data are entered, they must be supplied for the entire simulation road length of zero to RL. If no grade data are entered, a default value of zero is used and the entire road is considered to be level.

3. Passing zones, no-passing zones, and passing lanes (PS): Each PS card defines the beginning of a passing zone, a no-passing zone or an added passing or climbing lane on the simulated roadway. The zone defined by each PS card continues in effect to the beginning of next zone, defined on the next PS card, or to the end of the simulated roadway in the appropriate direction of travel.

Columns	1-2	3-5	6-10	11-15	16-20	21-30	31-40	41-50
Format	A2	I3	I5	I5	I5	F10.0	I10	I10
Content	PS	JD	MLP(1)	MLP(2)	KPZ	XPZO(KPZ)	JPS(KPZ)	LFAV(KPZ)

where: JD = Direction of travel for this zone, 1 or 2.

MLP(1) = Total number of zones in the No. 1 Direction.

MLP(2) = Total number of zones in the No. 2 Direction.

KPZ = Sequence number of this zone, counting in the appropriate direction of travel, from the appropriate end of the road.

XPZO(KPZ) = Position coordinate of beginning of this zone (ft), where the beginning is based on the appropriate direction of travel, but the position is expressed in No. 1 Direction coordinates.

JPS(KPZ) = Code identifying the type of zone; the codes used are:

- -1 No-passing zone (with either one or two lanes in the opposing direction)
- 0 Passing zone in opposing direction to a passing or climbing lane
- 1 Passing zone on conventional two-lane highway
- 2 Passing or climbing lane with right lane dropped at downstream end
- 3 Passing or climbing lane with left lane dropped at downstream end

LFAV(KPZ) = Lane favored by drivers at lane addition at upstream end of a passing lane; this code should be specified only for PS cards representing the beginning of a passing lane (i.e., PS cards with JPS(KPZ) equal to 2 or 3). The codes used are:

- 1 Left lane preference
- 2 No lane preference
- 3 Right lane preference

If passing and no-passing data are entered, they must be specified for the entire road in both directions. If data are not entered, the default is used as 100% passing zones in both directions.

4. Horizontal curves (CV): Each CV card describes one horizontal curve on the simulated roadway.

Columns	1-2	3-5	6-10	11-15	16-20	21-30	31-40
Format	A2		I5		I5	F10.0	F10.0
Content	CV	Blank	MJCV(1)	Empty	KCV	XCVN(KCV)	RCUR(KCV)

Columns	41-50	51-60
Format	F10.0	F10.0
Content	SCUR(KCV)	ACUR(KCV)

where: MJCV(1) = Total number of horizontal curves (counted in one direction of travel).

KCV = Sequence number of this curve counted in the No. 1 Direction.

XCVN(KCV) = Position coordinate where this curve begins (ft) for traffic in No. 1 Direction, expressed in No. 1 Direction coordinates.

RCUR(KCV) = Radius of this curve, ft.

SCUR(KCV) = Superelevation.

ACUR(KCV) = Angular change in alignment in curve, deg; the change in alignment is specified as a position number for a curve that turns to the right in the No. 1 Direction, and as a negative number for a curve turning to the left.

Horizontal curve data are entered only for the No. 1 Direction and only for the nontangent sections. The program logic assigns an approach section to each curve for each direction of travel if the curve will affect speeds. The program logic reduces (but does not eliminate) passing on horizontal curves and on the approach sections of curves that turn to the right. Very small changes in alignment should not be entered as curve data to avoid spurious reduction of passing in one direction of travel.

The computer program is dimensioned for a total of 60 regions associated with horizontal curves. Each curve has the potential of using up to three regions in each direction, for a total of six per curve. In one direction, the regions would be: (1) an uninfluenced region upstream, (2) an approach region, and (3) the curve itself. Therefore, the maximum number of horizontal curves normally admissable will be nine or ten. The program logic determines the locations of these regions based on the input data, which describes the location and geometrics curves in the No. 1 Direction.

5. Crawl regions (CW): Crawl regions are sections of the simulated roadway where trucks use crawl speeds on steep downgrades. Each CW card presents data for one crawl region.

Columns	1-2	3-5	6-10	11-15	16-20	21-30	31-40	41-50
Format	A2	I3	I5	I5	I5	F10.0	F10.0	F10.0
Content	CW	JD	MJCW(1)	MJCW(1)	KCW	XCWN(KCW)	CW2(KCW)	CSO(KCW)

Columns	51-60
Format	F10.0
Content	SCWL(KCW)

where: JD = Direction of travel in which this crawl region is located, 1 or 2

MJCW(1) = Total number of crawl regions in No. 1 Direction.

MJCW(2) = Total number of crawl regions in No. 2 Direction.

KCW = Sequence number of this crawl region in its particular direction of travel.

XCWN(KCW) = Beginning of the crawl region, the beginning of the crawl region is defined in its particular direction of travel, but the location is expressed in No. 1 Direction coordinates, ft.

CW2(KCW) = End of the crawl region; the end of the crawl region is defined in its particular direction of travel, but the location is expressed in No. 1 Direction coordinates, ft.

CWO(KCW) = Mean crawl speed in this region, ft/sec.

SCWL(KCW) = Standard deviation of crawl speeds in this region, ft/sec.

The input data supplied by the user specifies only the regions in which steady crawl speeds are used by trucks (and recreational vehicles if specified elsewhere). The program logic adds approach regions and uninfluenced regions, as required. A maximum of 12 crawl regions may be specified in input.

If no data are entered, the default roadway contains no crawl regions.

6. Passing sight distance (ST): Each ST card contains passing sight distance data for one sight distance region in a particular direction of travel.

Columns	1-2	3-5	6-10	11-15	16-20	21-30	31-40
Format	A2	I3	I5	I5	I5	F10.0	F10.0
Content	ST	JD	MLS(1)	MLS(2)	KSG	XSG(KSG)	SGTO(KSG)

Columns	41-50	51-60
Format	F10.0	F10.0
Content	SGTF(KSG)	XSGF(KSG)

where: JD = Direction of travel for this sight region, 1 or 2.

MLS(1) = Number of sight distance regions for No. 1 Direction.

MLS(2) = Number of sight distance regions for No. 2 Direction

KSG = Sequence number of this sight distance region, counting in its particular direction of travel.

XSGO(KSG) = Location where this sight distance region begins; the beginning of the sight distance region is identified in its particular direction of travel, but the location is expressed in the No. 1 Direction coordinate, ft.

SGTO(KSG) = Passing sight distance at beginning of sight distance region, XSFO(KSG), ft.

SGTF(KSG) = Passing sight distance at end of sight distance region, XSGF(KSG), ft.

XSGF(KSG) = Location where this sight region ends; the end of the sight distance region is identified in its particular direction of travel, but the location is based on the No. 1 Direction coordinates, ft.

Sight distance data need be entered only for regions where sight distances differ from the nominal value, SNOM, which is input on Card 2 in the mandatory deck. Program logic assigns regions of nominal value where input is lacking. Also, simulation logic selects the minimum sight distance, SMIN, on Card 2, whenever the specified sight distance on an ST card is less. A maximum of 60 sight distance regions are permitted for both directions of travel combined, considering both input sight distance regions and regions assigned by the program.

7. Vehicle characteristics for trucks and buses (VC): Vehicle characteristics for trucks and buses are defined on VC cards for vehicle types 1 through 4. It is recommended that vehicles be coded so that the lowest performance type is 1, next higher performance is 2, etc. All vehicle types for which a fraction of the flow is specified for either direction of travel (Cards 4 or 5) must be defined.

Columns	1-2	3-5	6-20	21-30	31-40	41-50	51-60
Format	A2	I3		F10.0	F10.0	F10.0	F10.0
Content	VC	KCT	Blank	WOHP(KVT)	WOA(KVT)	FLG(KVT)	CPE(KVT)

Columns	61-70
Format	F10.0
Content	CDE

where: KVT = Code number for vehicle type; KVT = 1, 2, 3, and 4 for trucks and buses.

WOHP(KVT) = Weight/net horsepower ratio for vehicle type KVT, lb/NHP.

WOA(KVT) = Weight/projected frontal area ratio for vehicle type KVT, lb/ft^2.

FLG(KVT) = Overall length for vehicle type KVT, ft.

CPE(KVT) = Factor correcting horsepower to local elevation for vehicle type KVT (normally 1.0).

CDE = Factor correcting aerodynamic drag to local elevation (normally 0.957).

8. Vehicle characteristics for recreational vehicles and passenger cars (VC): Vehicle characteristics for recreational vehicles are specified on VC cards for Vehicle Types 5 through 8 and for passenger cars on VC cards for Vehicle Types 9 through 13. It is recommended that vehicles be coded so that the lowest performance type is 5 for recreational vehicles and successively higher performance types are 6 through 8. The lowest performance passenger vehicle should be type 9. Successively higher performance types should be 10 through 13. All vehicle types for which a fraction of the flow is specified for either direction of travel (Cards 4 and 5) must be defined.

Columns	1-2	3-5	6-15	16-20	21-30	31-40	41-50
Format	A2	I3		I5	F10.0	F10.0	F10.0
Content	VC	KVT	Blank	KCWLF	PO(KVT)	SP1(KVT)	FLG(KVT)

where: KVT = Code number for vehicle type; Vehicle Types 5 through 8 are for recreational vehicles or Vehicle Types 9 through 13 are for passenger cars.

KCWLF = Control number; if set $\geqq 0$, the vehicle types up to and including KVT will use downgrade crawl regions and will deter multiple passing; if field is blank for all recreational vehicles and passenger cars, then only trucks and buses will respond to downgrade crawl zones and influence multiple passes.

PO(KVT) = Maximum acceleration using maximum available horsepower for vehicle type KVT, ft/sec^2.

SP1(KVT) = Pseudo-maximum speed on zero grade using maximum available horsepower for vehicle type KVT, ft/sec.

FLG(KVT) = Overall length for vehicle type KVT, ft.

9. Extra final output (EO): The EO card specifies that extra final output are to be generated at defined intervals throughout the simulation time. The extra final output are written to a file on Unit 4, which may be saved by appropriate Job Control Language and processed subsequently.

Columns	1-2	3-20	21-80
Format	A2		6F10.0
Content	EO	Blank	TO(N),N=1,6

where TO(N) = specification for simulated time (min) after test data collection begins when data are to be summarized. Specified values must increase for each incremental increase of N. Extra final output can be requested for a maximum of six specified times. If extra final output is requested, the simulation results are analyzed only for the entire simulation test time, and no data will be written to Unit 4. It should be noted that the extra final output feature of TWOPAS has not been updated from TWOWAF and, therefore, does not contain any output data for passing or climbing lanes. The use of this feature is not recommended for any run in which the simulated roadway contains an added passing or climbing lane.

10. Station locations (SL): A new capability has been incorporated in TWOPAS that allows the user to specify stations or spot locations on the simulated roadway at which spot speed and platooning data are collected during the simulation run. The data obtained are equivalent to what would be obtained from a field study of volume, speeds, and platooning at that spot location. The user can also specify subsections of the road length in either direction of travel, between adjacent pairs of stations or for a series of stations, where section travel time and platooning data are collected. The format of the SL cards is:

Columns	1-2	3-5	6-10	11-15	16-20	21-30	41-80
Format	A2		I5	I5	I5	F10.0	10A4
Content	SL	Empty	ISTA	JDD	JCDA(KTAB)	XSTA(KTAB)	PTDES(I,KTAB)

where: ISTA = The sequence number of the station in the specified direction of travel; station sequence numbers are consecutive integers that increase in the order they are encountered by vehicles in each direction of travel (i.e., in order of increasing coordinates for the No. 1 Direction and in order of descending coordinates for the No. 2 Direction); the maximum number of stations that can be specified in either direction of travel is 20.

JDD = The specified direction of travel for the station, 1 or 2.

JCDA(KTAB) = The sequence number of the specified subsection of which the road length downstream from the station location is part; a maximum of 20 subsections is permitted in either direction; use 0 if the road length downstream of the station location is not part of any subsection.

XSTA(KTAB) = The location of the station specified in feet in Direction 1 coordinates

PTDES(I,KTAB) = Text description of the station location; maximum of 40 characters

The printed output provided for user-specified stations and subsections is illustrated in Section III of this Guide.

III. OUTPUT

This section of the User's Guide describes the output available from the TWOPAS model including the data available on the output report and the interpretation of those data.

The output from the TWOPAS model includes both a printed report and, optionally, one or two output data files. Both the printed report and the output data files are discussed below.

A. Printed Output

Output is printed by the TWOPAS model at four times. First, the input data are printed as they are read. Second, data are printed while they are being prepared for application in the simulation. Third, the status of vehicles can be printed during simulation processing in snapshots at user-specified intervals as a method to monitor the simulation operation. Fourth, the simulation results are summarized after the simulation run is completed. Each aspect of the printed output is described in more detail in the following sections.

1. Reflection of input data: The input data supplied on cards are printed in expanded card format as shown in Figure 1. This is the first printed output provided by the program. The run number in Columns 1-4 on the first card is retained and printed, together with the alphanumeric data on all comment cards, at the top of the first page of output.

The mandatory cards follow on the printed output. Since input data are not required in each field, some zeros that appear in printed output correspond to blank fields in input and have no data connotation.

The optional cards are all read and printed in one format. Zeros with no data connotation may also appear in these lines to represent blank fields. Although sequencing of these cards is not mandatory, it is helpful to arrange the optional input deck in a logical order as shown in Figure 2.

The output illustrated in Figure 1 is the data set for the test case presented in Section IV of this manual.

2. Summary of specified times, flow rates, speeds, and vehicle characteristics: This second set of output, shown in Figure 2, is a summary of the user-specified times, flow rates, speeds, and vehicle characteristics. The heading on this page is the first comment card. The simulation times, warmup, test, and total are printed, followed by the value of PREC, the probability that a simulation driver will reconsider a pass opportunity during a given review period.

The specified flow rates are given for each direction and for each vehicle type by direction in vehicles per hour and as fractions of the directional flows.

```
RUN NO.  190      BASE CONDITION - SLIGHTLY ROLLING TERRAIN
                  RUN NO.19 USING 400 AS THE FLOW RATE AND NEW PS/SL CARDS -1.00MI.
   3600       2       5.000       30.000       1.000       5.000       0.000
      0       0   43000.000       17.000      12.000     800.000    2000.000
      0 400.0000  50.0000          1 400.0000  50.0000         1       0.0000    0.0000     0.200
      1   0.0060   0.0128   0.0170   0.0142   0.0005   0.0200   0.0200   0.0000
      2   0.0060   0.0128   0.0170   0.0142   0.0005   0.0200   0.0200   0.0005   0.0900   0.1350   0.1800   0.2250   0.2700
      0  88.0000  10.5800  -1.5000  -2.2000   0.0000   0.6293   1.6293   0.8100   0.9000   0.1350   0.1800   0.2250   0.2700
      1 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000
      2 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000
   1981       1       5       3       4      50       0   150.0000 150.0000 150.0000 150.0000 150.0000 150.0000 150.0000
CAR FOLLOWING SENSITIVITY FACTOR =   0.800
DRIVER TYPE STOCHASTIC DIST. =   0.430  0.510  0.570  0.650  0.760  0.910  1.130  1.340  1.580  2.120
VC    1     0     0     0        266.0000        620.0000        65.0000         1.0000         0.9570        0.0000
VC    2     0     0     0        196.0000        420.0000        65.0000         1.0000         0.9570        0.0000
VC    3     0     0     0        128.0000        284.0000        65.0000         1.0000         0.9570        0.0000
VC    4     0     0     0         72.0000        158.0000        30.0000         1.0000         0.9570        0.0000
VC    5     0     0     0          8.2200         78.7000        36.0000         0.0000         0.0000        0.0000
VC    6     0     0     0          8.6400         89.7000        28.0000         0.0000         0.0000        0.0000
VC    7     0     0     0          8.7500         96.0000        21.0000         0.0000         0.0000        0.0000
VC    8     0     0     0          8.7600         97.5000        32.0000         0.0000         0.0000        0.0000
VC    9     0     0     0          9.2770        109.1400        13.0000         0.0000         0.0000        0.0000
VC   10     0     0     0          9.7660        114.8900        14.0000         0.0000         0.0000        0.0000
VC   11     0     0     0         10.0890        118.6900        16.0000         0.0000         0.0000        0.0000
VC   12     0     0     0         10.4290        122.6900        17.0000         0.0000         0.0000        0.0000
VC   13     0     0     3         11.2010        131.7800        18.0000         0.0000         0.0000        0.0000
CV    0     9     0     1       2800.0000       1910.0000         0.0400        18.0000         0.0000        0.0000
CV    0     9     0     2       6800.0000       1910.0000         0.0400       -18.0000         0.0000        0.0000
CV    0     9     0     3      10800.0000       1910.0000         0.0400        18.0000         0.0000        0.0000
CV    0     9     0     4      14800.0000       1910.0000         0.0400       -18.0000         0.0000        0.0000
CV    0     9     0     5      18800.0000       1910.0000         0.0400        18.0000         0.0000        0.0000
CV    0     9     0     6      22800.0000       1910.0000         0.0400       -18.0000         0.0000        0.0000
CV    0     9     0     7      26800.0000       1910.0000         0.0400        18.0000         0.0000        0.0000
CV    0     9     0     8      30800.0000       1910.0000         0.0400       -18.0000         0.0000        0.0000
CV    0     9     0     9      34800.0000       1910.0000         0.0400        18.0000         0.0000        0.0000
ST    1    11    11     1       2400.0000        500.0000       500.0000      3400.0000         0.0000        0.0000
ST    1    11    11     2       6400.0000        500.0000       500.0000      7400.0000         0.0000        0.0000
ST    1    11    11     3      10400.0000        500.0000       500.0000     11400.0000         0.0000        0.0000
ST    1    11    11     4      14400.0000        500.0000       500.0000     15400.0000         0.0000        0.0000
ST    1    11    11     5      18400.0000        500.0000       500.0000     19400.0000         0.0000        0.0000
ST    1    11    11     6      22400.0000        500.0000       500.0000     23400.0000         0.0000        0.0000
ST    1    11    11     7      26400.0000        500.0000       500.0000     27400.0000         0.0000        0.0000
ST    1    11    11     8      30400.0000        500.0000       500.0000     31400.0000         0.0000        0.0000
ST    1    11    11     9      34400.0000        500.0000       500.0000     35400.0000         0.0000        0.0000
ST    1    11    11    10      38400.0000        500.0000       500.0000     39400.0000         0.0000        0.0000
ST    1    11    11    11      42400.0000        500.0000       500.0000     43000.0000         0.0000        0.0000
ST    2    11    11     1      43000.0000        500.0000       500.0000     42900.0000         0.0000        0.0000
ST    2    11    11     2      39600.0000        500.0000       500.0000     39000.0000         0.0000        0.0000
ST    2    11    11     3      35600.0000        500.0000       500.0000     35000.0000         0.0000        0.0000
ST    2    11    11     4      31600.0000        500.0000       500.0000     31000.0000         0.0000        0.0000
ST    2    11    11     5      27600.0000        500.0000       500.0000     27000.0000         0.0000        0.0000
ST    2    11    11     6      23600.0000        500.0000       500.0000     23000.0000         0.0000        0.0000
ST    2    11    11     7      19600.0000        500.0000       500.0000     19000.0000         0.0000        0.0000
ST    2    11    11     8      15600.0000        500.0000       500.0000     15000.0000         0.0000        0.0000
ST    2    11    11     9      11600.0000        500.0000       500.0000     11000.0000         0.0000        0.0000
ST    2    11    11    10       7600.0000        500.0000       500.0000      7000.0000         0.0000        0.0000
ST    2    11    11    11       3600.0000        500.0000       500.0000      3000.0000         0.0000        0.0000
RN    0     0     0     0   93742469.0000   99230755.0000   1120379.0000  41724931.0000  81500573.0000        0.0000
GD    1    30     0     0          0.0000          1.5000         1.5000      2800.0000         0.0000        0.0000
GD    2    30     0     0       2800.0000          1.5000        -1.5000      3200.0000         0.0000        0.0000
```

Figure 1 - Reflection of Input Data in Printed Output

GD	3	30	0	0	3200.0000	-1.5000	-1.5000	4800.0000	0.0000	0.0000
GD	4	30	0	0	4800.0000	-1.5000	1.5000	5200.0000	0.0000	0.0000
GD	5	30	0	0	5200.0000	1.5000	1.5000	6800.0000	0.0000	0.0000
GD	6	30	0	0	6800.0000	1.5000	-1.5000	7200.0000	0.0000	0.0000
GD	7	30	0	0	7200.0000	-1.5000	-1.5000	8800.0000	0.0000	0.0000
GD	8	30	0	0	8800.0000	-1.5000	1.5000	9200.0000	0.0000	0.0000
GD	9	30	0	0	9200.0000	1.5000	1.5000	10800.0000	0.0000	0.0000
GD	10	30	0	0	10800.0000	1.5000	-1.5000	11200.0000	0.0000	0.0000
GD	11	30	0	0	11200.0000	-1.5000	-1.5000	12800.0000	0.0000	0.0000
GD	12	30	0	0	12800.0000	-1.5000	1.5000	13200.0000	0.0000	0.0000
GD	13	30	0	0	13200.0000	1.5000	1.5000	14800.0000	0.0000	0.0000
GD	14	30	0	0	14800.0000	1.5000	-1.5000	15200.0000	0.0000	0.0000
GD	15	30	0	0	15200.0000	-1.5000	-1.5000	16800.0000	0.0000	0.0000
GD	16	30	0	0	16800.0000	-1.5000	1.5000	17200.0000	0.0000	0.0000
GD	17	30	0	0	17200.0000	1.5000	1.5000	18800.0000	0.0000	0.0000
GD	18	30	0	0	18800.0000	1.5000	-1.5000	19200.0000	0.0000	0.0000
GD	19	30	0	0	19200.0000	-1.5000	-1.5000	21000.0000	0.0000	0.0000
GD	20	30	0	0	21000.0000	1.5000	1.5000	23000.0000	0.0000	0.0000
GD	21	30	0	0	23000.0000	-1.5000	-1.5000	25000.0000	0.0000	0.0000
GD	22	30	0	0	25000.0000	1.5000	1.5000	27000.0000	0.0000	0.0000
GD	23	30	0	0	29000.0000	-1.5000	-1.5000	29000.0000	0.0000	0.0000
GD	24	30	0	0	29000.0000	1.5000	1.5000	31000.0000	0.0000	0.0000
GD	25	30	0	0	31000.0000	-1.5000	-1.5000	33000.0000	0.0000	0.0000
GD	26	30	0	0	33000.0000	1.5000	1.5000	35000.0000	0.0000	0.0000
GD	27	30	0	0	35000.0000	-1.5000	-1.5000	37000.0000	0.0000	0.0000
GD	28	30	0	0	37000.0000	1.5000	1.5000	39000.0000	0.0000	0.0000
GD	29	30	0	0	39000.0000	-1.5000	-1.5000	41000.0000	0.0000	0.0000
GD	30	30	0	0	41000.0000	1.5000	1.5000	43000.0000	0.0000	0.0000
PS	1	22	26	1	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	2	900.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	3	1000.0000	2.0000	2.0000	0.0000	0.0000	0.0000
PS	1	22	26	4	6280.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	5	7400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	6	10400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	7	11400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	8	14400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	9	15400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	10	18400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	11	19400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	12	22400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	13	23400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	14	26400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	15	27400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	16	30400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	17	31400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	18	34400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	19	35400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	20	38400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	21	39400.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	1	22	26	22	42400.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	1	43000.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	2	42900.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	3	39600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	4	39000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	5	5600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	6	35000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	7	31600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	8	31000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	9	27600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	10	27000.0000	1.0000	0.0000	0.0000	0.0000	0.0000

Figure 1 (Continued)

PS	2	22	26	11	23600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	12	23000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	13	19600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	14	19000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	15	15600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	16	15000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	17	11600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	18	11000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	19	7600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	20	7000.0000	1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	21	6280.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	22	6180.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	23	3600.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	24	3000.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	25	1100.0000	-1.0000	0.0000	0.0000	0.0000	0.0000
PS	2	22	26	26	1000.0000	1.0000	0.0000	0.0000	0.0000	0.0000

1	1	1	500.	500 - BEGINNING OF TEST ROAD
2	1	2	1000.	MP 0.00 - BEG OF PASSING LANE
3	1	2	2320.	MILEPOST .25
4	1	2	3640.	MILEPOST .50
5	1	2	4960.	MILEPOST .75
6	1	0	6230.	MILEPOST 1.00 - END OF PASSING LANE
7	1	0	6780.	500 FT DOWNSTREAM OF LANE DROP
8	1	3	7600.	MILEPOST 1.25
9	1	0	8920.	MILEPOST 1.50
10	1	4	10240.	MILEPOST 1.75
11	1	0	11560.	MILEPOST 2.00
12	1	0	16840.	MILEPOST 3.00
13	1	0	22120.	MILEPOST 4.00
14	1	0	27400.	MILEPOST 5.00
15	1	0	32680.	MILEPOST 6.00
16	1	0	37960.	MILEPOST 7.00
17	1	0	42990.	MILEPOST 7.95
1	2	0	42990.	OPPOSING DIRN - ENTRY POINT
2	2	1	16840.	OPPOSING DIRN - MILEPOST 3.00
3	2	0	11560.	OPPOSING DIRN - MILEPOST 2.00
4	2	0	10240.	OPPOSING DIRN - MILEPOST 1.75
5	2	0	8920.	OPPOSING DIRN - MILEPOST 1.50
6	2	0	7600.	OPPOSING DIRN - MILEPOST 1.25
7	2	2	6280.	OPP LANE DROP - MILEPOST 1.00
8	2	2	4960.	OPPOSING DIRN - MILEPOST 0.75
9	2	2	3640.	OPPOSING DIRN - MILEPOST 0.50
10	2	2	2320.	OPPOSING DIRN - MILEPOST 0.25
11	2	0	1000.	OPP LANE ADD - MILEPOST 0.00
12	2	0	500.	OPPOSING DIRN - END OF ROAD

Figure 1 (Concluded)

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

WARM TIME= 5.000 MINUTES   TEST TIME= 30.000 MINUTES   TOTAL TIME= 35.000 MINUTES   PREC=0.200

SPECIFIED FLOW RATES

VEH. TYPE	DIRECTION 1 FRACTION	DIRECTION 1 FLOW(VPH)	DIRECTION 2 FRACTION	DIRECTION 2 FLOW(VPH)
	400. VPH		400. VPH	
1	0.0060	2.400	0.0060	2.400
2	0.0128	5.120	0.0128	5.120
3	0.0170	6.800	0.0170	6.800
4	0.0142	5.680	0.0142	5.680
5	0.0005	0.200	0.0005	0.200
6	0.0200	8.000	0.0200	8.000
7	0.0200	8.000	0.0200	8.000
8	0.0005	0.200	0.0005	0.200
9	0.0900	36.000	0.0900	36.000
10	0.1350	54.000	0.1350	54.000
11	0.1800	72.000	0.1800	72.000
12	0.2250	90.000	0.2250	90.000
13	0.2700	108.000	0.2700	108.000

TOTAL= 800. VPH
RATIO(1)/(2)= 1.000

SPECIFIED SPEEDS

VEH. TYPE	MAX ENTRY	DESIRED MIN	DESIRED AVE	DESIRED MAX	MAX ENTRY
1	150.00	54.76	86.50	118.24	150.00
2	150.00	54.76	86.50	118.24	150.00
3	150.00	54.76	86.50	118.24	150.00
4	150.00	54.76	86.50	118.24	150.00
5	150.00	54.06	85.80	117.54	150.00
6	150.00	54.06	85.80	117.54	150.00
7	150.00	54.06	85.80	117.54	150.00
8	150.00	54.06	85.80	117.54	150.00
9	150.00	56.26	88.00	119.74	150.00
10	150.00	56.26	88.00	119.74	150.00
11	150.00	56.26	88.00	119.74	150.00
12	150.00	56.26	88.00	119.74	150.00
13	150.00	56.26	88.00	119.74	150.00

VEHICLE CHARACTERISTICS

VEH. TYPE	COEF. CN	COEF. C0 OR P0	COEF. C1 OR P1	COEF. C2	COEF. C3	LENGTH	MAX. SPEED (FT/SEC)	WT/NHP	WT/AREA
1	0.5694E+02	-0.2445E+00	-0.4000E-03	-0.3241E-04	0.5293E+02	0.6500E+02	96.8968	0.2660E+03	0.6200E+03
2	0.7727E+02	-0.2445E+00	-0.4000E-03	-0.4785E-04	0.7184E+02	0.6500E+02	100.5492	0.1960E+03	0.4200E+03
3	0.1183E+03	-0.2445E+00	-0.4000E-03	-0.7076E-04	0.1100E+03	0.6500E+02	107.3218	0.1280E+03	0.2840E+03
4	0.2103E+03	-0.2445E+00	-0.4000E-03	-0.1272E-03	0.1956E+03	0.3000E+02	111.8523	0.7200E+02	0.1580E+03
5		0.8220E+01	0.1044E+00			36.0000	78.7000		
6		0.8640E+01	0.9632E-01			28.0000	89.7000		
7		0.8750E+01	0.9115E-01			21.0000	96.0000		
8		0.8760E+01	0.8985E-01			32.0000	97.5000		
9		0.9277E+01	0.8500E-01			13.0000	109.1400		
10		0.9766E+01	0.8500E-01			14.0000	114.8900		
11		0.1009E+02	0.8500E-01			16.0000	118.6900		
12		0.1043E+02	0.8500E-01			17.0000	122.6900		
13		0.1120E+02	0.8500E-01			18.0000	131.7800		

KC= 3 , TYPE CODE KC AND LESS OBSERVE CRAWLZONES, AND DETER MULTIPLE PASSERS

Figure 2 - Summary of Specified Simulation Times, Flow Rates, Speeds, and Vehicle Characteristics

Specified mean and extremal desired speeds (ft/sec) are shown for each vehicle type. Maximum entry speeds are shown by vehicle type and direction. In the example, the terrain in both directions is relatively level, so the maximum entry speeds for all vehicle types are relatively high (150 veh/hr). On steeper grades, lower maximum entry speeds could be used to limit the initial speeds for vehicle categories such as trucks and RVs.

Vehicle characteristics listed for trucks (vehicle types 1-4) include the coefficients calculated by the program that will be used to represent the acceleration capabilities of vehicles (C0, C1, C2, and C3), as well as length, and the weight-to-power and weight-to-frontal-area ratios used by program logic to compute performance coefficients. The maximum speed shown on the printed output is for zero grade and zero wind.

For RVs (vehicle types 5-8) and passenger cars (vehicle types 9-13), P0 is the maximum acceleration capability (ft/sec^2) of the vehicle at zero speed on zero grade and P1 is the rate at which maximum acceleration decreases with speed (ft/sec^2)/(ft/sec) on zero grade. The maximum speeds shown on the printed output are for maximum power (without restraint) on zero grade.

The last line provides the value of KC, the maximum subscript for vehicle types that are influenced by downgrade crawl regions.

3. Road characteristics that influence traffic operations: The third set of printed data, illustrated by the example in Figure 3, summarizes the roadway characteristics that influence traffic operations in the simulation model. These data are equivalent to a roadway inventory listing arranged in descending order of the No. 1 Direction coordinate system. The grade and rate of change of grade, applicable to No. 1 Direction, appear in the center columns. The remainder of the data is arranged with mirror symmetry; data on the left are for the No. 2 Direction, and data on the right are for the No. 1 Direction. The headings (read down or up) indicate the succession of features as seen by simulation drivers.

At each region boundary of any characteristic, in either direction of travel, two lines are printed. One line shows the value from the terminating region and the second provides the value from the region just entered. A single line is printed where the minimum sight distance becomes applicable.

Regions with suppressed speeds due to downgrade crawl regions and horizontal curves are also identified on the printed output. These regions are identified by the applicable speed for the region. Crawl speeds outside of downgrade crawl regions are identified by the default speed value of 201 ft/sec. Tangent sections and horizontal curves where speeds are not suppressed are identified by the default speed value of 202 ft/sec. A negative sign attached to the speed on a horizontal curve or a curve approach indicates that the curve turns to the right and the acceptance of passing opportunities will be reduced.

DIRECTION 2 (READ DOWN)					ROAD CHARACTERISTICS		DIRECTION 1 (READ UP)				
CRAWL FT/SEC	CURVE FT/SEC	SIGHT FEET	PASS +-NO	LOCATION FEET	PERCENT GRADE	GRADE RATE PERCENT/FT	LOCATION FEET	PASS +-NO	SIGHT FEET	CURVE FT/SEC	CRAWL FT/SEC
201.	202.	500.	-1	0.	1.50	0.0000	43000.	-1	500.	202.	201.
201.	202.	500.	-1	100.	1.50	0.0000	42900.	-1	500.	202.	201.
201.	202.	2000.	1	100.	1.50	0.0000	42900.	-1	500.	202.	201.
201.	202.	2000.	1	600.	1.50	0.0000	42400.	-1	500.	202.	201.
201.	202.	2000.	1	600.	1.50	0.0000	42400.	1	2000.	202.	201.
201.	202.	2000.	1	2000.	1.50	0.0000	41000.	1	2000.	202.	201.
201.	202.	2000.	1	2000.	-1.50	0.0000	41000.	1	2000.	202.	201.
201.	202.	2000.	1	3400.	-1.50	0.0000	39600.	1	2000.	202.	201.
201.	202.	500.	-1	3400.	-1.50	0.0000	39600.	1	2000.	202.	201.
201.	202.	500.	-1	3600.	-1.50	0.0000	39400.	1	2000.	202.	201.
201.	202.	500.	-1	3600.	-1.50	0.0000	39400.	-1	500.	202.	201.
201.	202.	500.	-1	4000.	-1.50	0.0000	39000.	-1	500.	202.	201.
201.	202.	2000.	1	4000.	1.50	0.0000	39000.	-1	500.	202.	201.
201.	202.	2000.	1	4600.	1.50	0.0000	38400.	-1	500.	202.	201.
201.	202.	2000.	1	4600.	1.50	0.0000	38400.	1	2000.	202.	201.
201.	202.	2000.	1	6000.	1.50	0.0000	37000.	1	2000.	202.	201.
201.	202.	2000.	1	6000.	-1.50	0.0000	37000.	1	2000.	202.	201.
201.	202.	2000.	1	7400.	-1.50	0.0000	35600.	1	2000.	202.	201.
201.	202.	500.	-1	7400.	-1.50	0.0000	35600.	1	2000.	202.	201.
201.	202.	500.	-1	7583.	-1.50	0.0000	35417.	1	2000.	202.	201.
201.	88.	500.	-1	7583.	-1.50	0.0000	35417.	1	2000.	202.	201.
201.	87.	500.	-1	7600.	-1.50	0.0000	35400.	1	2000.	202.	201.
201.	87.	500.	-1	7600.	-1.50	0.0000	35400.	1	2000.	-87.	201.
201.	87.	500.	-1	7600.	-1.50	0.0000	35400.	1	2000.	-87.	201.
201.	87.	500.	-1	7600.	-1.50	0.0000	35400.	-1	500.	-87.	201.
201.	87.	500.	-1	8000.	-1.50	0.0000	35000.	-1	500.	-87.	201.
201.	87.	2000.	1	8000.	1.50	0.0000	35000.	-1	500.	-87.	201.
201.	87.	2000.	1	8200.	1.50	0.0000	34800.	-1	500.	-87.	201.
201.	202.	2000.	1	8200.	1.50	0.0000	34800.	-1	500.	-87.	201.
201.	202.	2000.	1	8217.	1.50	0.0000	34783.	-1	500.	-88.	201.
201.	202.	2000.	1	8217.	1.50	0.0000	34783.	-1	500.	202.	201.
201.	202.	2000.	1	8600.	1.50	0.0000	34400.	-1	500.	202.	201.
201.	202.	2000.	1	8600.	1.50	0.0000	34400.	1	2000.	202.	201.
201.	202.	2000.	1	10000.	-1.50	0.0000	33000.	1	2000.	202.	201.
201.	202.	2000.	1	10000.	-1.50	0.0000	33000.	1	2000.	202.	201.
201.	202.	2000.	1	11400.	-1.50	0.0000	31600.	1	2000.	[illegible]	201.
201.	202.	500.	-1	11400.	-1.50	0.0000	31600.	1	2000.	[illegible]	201.
201.	202.	500.	-1	11583.	-1.50	0.0000	31417.	1	2000.	202.	201.
201.	-88.	500.	-1	11583.	-1.50	0.0000	31417.	1	2000.	202.	201.
201.	-87.	500.	-1	11600.	-1.50	0.0000	31400.	1	2000.	202.	201.
201.	-87.	500.	-1	11600.	-1.50	0.0000	31400.	1	2000.	87.	201.
201.	-87.	500.	-1	11600.	-1.50	0.0000	31400.	1	2000.	87.	201.
201.	-87.	500.	-1	11600.	-1.50	0.0000	31400.	-1	500.	87.	201.
201.	-87.	500.	-1	12000.	1.50	0.0000	31000.	-1	500.	87.	201.
201.	-87.	2000.	1	12000.	1.50	0.0000	31000.	-1	500.	87.	201.
201.	-87.	2000.	1	12200.	1.50	0.0000	30800.	-1	500.	87.	201.
201.	202.	2000.	1	12200.	1.50	0.0000	30800.	-1	500.	87.	201.
201.	202.	2000.	1	12217.	1.50	0.0000	30783.	-1	500.	88.	201.
201.	202.	2000.	1	12217.	1.50	0.0000	30783.	-1	500.	202.	201.
201.	202.	2000.	1	12600.	1.50	0.0000	30400.	-1	500.	202.	201.
201.	202.	2000.	1	12600.	1.50	0.0000	30400.	1	2000.	202.	201.
201.	202.	2000.	1	14000.	-1.50	0.0000	29000.	1	2000.	202.	201.
201.	202.	2000.	1	14000.	-1.50	0.0000	29000.	1	2000.	202.	201.
201.	202.	2000.	1	14000.	1.50	0.0000	29000.	1	2000.	202.	201.
201.	202.	2000.	1	14000.	1.50	0.0000	29000.	1	2000.	202.	201.
201.	202.	2000.	1	15400.	1.50	0.0000	27600.	1	2000.	202.	201.
201.	202.	500.	-1	15400.	1.50	0.0000	27600.	1	2000.	202.	201.
201.	202.	500.	-1	15583.	1.50	0.0000	27417.	1	2000.	202.	201.
201.	88.	500.	-1	15583.	1.50	0.0000	27417.	1	2000.	202.	201.
201.	87.	500.	-1	15600.	1.50	0.0000	27400.	1	2000.	202.	201.
201.	87.	500.	-1	15600.	1.50	0.0000	27400.	1	2000.	-87.	201.
201.	87.	500.	-1	15600.	1.50	0.0000	27400.	1	2000.	-87.	201.
201.	87.	500.	-1	15600.	1.50	0.0000	27400.	-1	500.	-87.	201.
201.	87.	500.	-1	16000.	1.50	0.0000	27000.	-1	500.	-87.	201.
201.	87.	2000.	1	16000.	1.50	0.0000	27000.	-1	500.	-87.	201.
201.	87.	2000.	1	16200.	1.50	0.0000	26800.	-1	500.	-87.	201.
201.	202.	2000.	1	16200.	1.50	0.0000	26800.	-1	500.	-87.	201.
201.	202.	2000.	1	16217.	1.50	0.0000	26783.	-1	500.	-88.	201.
201.	202.	2000.	1	16217.	1.50	0.0000	26783.	-1	500.	202.	201.
201.	202.	2000.	1	16600.	1.50	0.0000	26400.	-1	500.	202.	201.
201.	202.	2000.	1	16600.	1.50	0.0000	26400.	1	2000.	202.	201.
201.	202.	2000.	1	18000.	-1.50	0.0000	25000.	1	2000.	202.	201.
201.	202.	2000.	1	18000.	-1.50	0.0000	25000.	1	2000.	202.	201.
201.	202.	2000.	1	19400.	-1.50	0.0000	23600.	1	2000.	202.	201.
201.	202.	500.	-1	19400.	-1.50	0.0000	23600.	1	2000.	202.	201.
201.	202.	500.	-1	19583.	-1.50	0.0000	23417.	1	2000.	202.	201.
201.	-88.	500.	-1	19583.	-1.50	0.0000	23417.	1	2000.	202.	201.
201.	-87.	500.	-1	19600.	-1.50	0.0000	23400.	1	2000.	202.	201.
201.	-87.	500.	-1	19600.	-1.50	0.0000	23400.	1	2000.	87.	201.
201.	-87.	500.	-1	19600.	-1.50	0.0000	23400.	1	2000.	87.	201.
201.	-87.	500.	-1	19600.	-1.50	0.0000	23400.	-1	500.	87.	201.
201.	-87.	500.	-1	20000.	1.50	0.0000	23000.	-1	500.	87.	201.
201.	-87.	2000.	1	20000.	1.50	0.0000	23000.	-1	500.	87.	201.
201.	-87.	2000.	1	20200.	1.50	0.0000	22800.	-1	500.	87.	201.
201.	202.	2000.	1	20200.	1.50	0.0000	22800.	-1	500.	87.	201.
201.	202.	2000.	1	20217.	1.50	0.0000	22783.	-1	500.	88.	201.
201.	202.	2000.	1	20217.	1.50	0.0000	22783.	-1	500.	202.	201.
201.	202.	2000.	1	20600.	1.50	0.0000	22400.	-1	500.	202.	201.
201.	202.	2000.	1	20600.	1.50	0.0000	22400.	1	2000.	202.	201.
201.	202.	2000.	1	22000.	1.50	0.0000	21000.	1	2000.	202.	201.
201.	202.	2000.	1	22000.	-1.50	0.0000	21000.	1	2000.	202.	201.
201.	202.	2000.	1	23400.	-1.50	0.0000	19600.	1	2000.	202.	201.
201.	202.	500.	-1	23400.	-1.50	0.0000	19600.	1	2000.	202.	201.
201.	202.	500.	-1	23583.	-1.50	0.0000	19417.	1	2000.	202.	201.
201.	88.	500.	-1	23583.	-1.50	0.0000	19417.	1	2000.	202.	201.
201.	87.	500.	-1	23600.	-1.50	0.0000	19400.	1	2000.	202.	201.
201.	87.	500.	-1	23600.	-1.50	0.0000	19400.	1	2000.	-87.	201.
201.	87.	500.	-1	23600.	-1.50	0.0000	19400.	1	2000.	-87.	201.
201.	87.	500.	-1	23600.	-1.50	0.0000	19400.	-1	500.	-87.	201.
201.	87.	500.	-1	23800.	-1.50	0.0000	19200.	-1	500.	-87.	201.
201.	87.	500.	-1	23800.	-1.50	-0.0075	19200.	-1	500.	-87.	201.
201.	87.	500.	-1	24000.	0.00	-0.0075	19000.	-1	500.	-87.	201.
201.	87.	2000.	1	24000.	0.00	-0.0075	19000.	-1	500.	-87.	201.
201.	87.	2000.	1	24200.	1.50	-0.0075	18800.	-1	500.	-87.	201.
201.	202.	2000.	1	24200.	1.50	0.0000	18800.	-1	500.	-87.	201.
201.	202.	2000.	1	24217.	1.50	0.0000	18783.	-1	500.	-88.	201.
201.	202.	2000.	1	24217.	1.50	0.0000	18783.	-1	500.	202.	201.
201.	202.	2000.	1	24600.	1.50	0.0000	18400.	-1	500.	202.	201.
201.	202.	2000.	1	24600.	1.50	0.0000	18400.	1	2000.	202.	201.
201.	202.	2000.	1	25800.	1.50	0.0000	17200.	1	2000.	202.	201.
201.	202.	2000.	1	25800.	1.50	0.0075	17200.	1	2000.	202.	201.
201.	202.	2000.	1	26200.	-1.50	0.0075	16800.	1	2000.	202.	201.
201.	202.	2000.	1	26200.	-1.50	0.0000	16800.	1	2000.	202.	201.
201.	202.	2000.	1	27400.	-1.50	0.0000	15600.	1	2000.	202.	201.
201.	202.	500.	-1	27400.	-1.50	0.0000	15600.	1	2000.	202.	201.

Figure 3 - Summary of Road Characteristics that Influence Traffic Operations in the Simulation Model

201.	202.	800.	-1	27583	-1.50	0.0000	15417.	1	2000.	202.	201.
201.	-88.	800.	-1	27583.	-1.50	0.0000	15417.	1	2000.	202.	201.
201.	-87.	800.	-1	27600.	-1.50	0.0000	15400.	1	2000.	202.	201.
201.	-87.	800.	-1	27600.	-1.50	0.0000	15400.	1	2000.	87.	201.
201.	-87.	800.	-1	27600.	-1.50	0.0000	15400.	1	2000.	87.	201.
201.	-87.	800.	-1	27600.	-1.50	0.0000	15400.	-1	800.	87.	201.
201.	-87.	800.	-1	27800.	-1.50	0.0000	15200.	-1	800.	87.	201.
201.	-87.	800.	-1	27800.	-1.50	-0.0075	15200.	-1	800.	87.	201.
201.	-87.	800.	-1	28000.	0.00	-0.0075	15000.	-1	800.	87.	201.
201.	-87.	2000.	1	28000.	0.00	-0.0075	15000.	-1	800.	87.	201.
201.	-87.	2000.	1	28200.	1.50	-0.0075	14800.	-1	800.	87.	201.
201.	202.	2000.	1	28200.	1.50	0.0000	14800.	-1	800.	87.	201.
201.	202.	2000.	1	28217.	1.50	0.0000	14783.	-1	800.	88.	201.
201.	202.	2000.	1	28217.	1.50	0.0000	14783.	-1	800.	202.	201.
201.	202.	2000.	1	28600.	1.50	0.0000	14400.	-1	800.	202.	201.
201.	202.	2000.	1	28600.	1.50	0.0000	14400.	1	2000.	202.	201.
201.	202.	2000.	1	29800.	1.50	0.0000	13200.	1	2000.	202.	201.
201.	202.	2000.	1	29800.	1.50	0.0075	13200.	1	2000.	202.	201.
201.	202.	2000.	1	30200.	-1.50	0.0075	12800.	1	2000.	202.	201.
201.	202.	2000.	1	30200.	-1.50	0.0000	12800.	1	2000.	202.	201.
201.	202.	2000.	1	31400.	-1.50	0.0000	11600.	1	2000.	202.	201.
201.	202.	800.	-1	31400.	-1.50	0.0000	11600.	1	2000.	202.	201.
201.	202.	800.	-1	31583.	-1.50	0.0000	11417.	1	2000.	202.	201.
201.	88.	800.	-1	31583.	-1.50	0.0000	11417.	1	2000.	202.	201.
201.	87.	800.	-1	31600.	-1.50	0.0000	11400.	1	2000.	202.	201.
201.	87.	800.	-1	31600.	-1.50	0.0000	11400.	1	2000.	-87.	201.
201.	87.	800.	-1	31600.	-1.50	0.0000	11400.	1	2000.	-87.	201.
201.	87.	800.	-1	31600.	-1.50	0.0000	11400.	-1	800.	-87.	201.
201.	87.	800.	-1	31800.	-1.50	0.0000	11200.	-1	800.	-87.	201.
201.	87.	800.	-1	31800.	-1.50	-0.0075	11200.	-1	800.	-87.	201.
201.	87.	800.	-1	32000.	0.00	-0.0075	11000.	-1	800.	-87.	201.
201.	87.	2000.	1	32000.	0.00	-0.0075	11000.	-1	800.	-87.	201.
201.	87.	2000.	1	32200.	1.50	-0.0075	10800.	-1	800.	-87.	201.
201.	202.	2000.	1	32200.	1.50	0.0000	10800.	-1	800.	-87.	201.
201.	202.	2000.	1	32217.	1.50	0.0000	10783.	-1	800.	-88.	201.
201.	202.	2000.	1	32217.	1.50	0.0000	10783.	-1	800.	202.	201.
201.	202.	2000.	1	32600.	1.50	0.0000	10400.	-1	800.	202.	201.
201.	202.	2000.	1	32600.	1.50	0.0000	10400.	1	2000.	202.	201.
201.	202.	2000.	1	33800.	1.50	0.0000	9200.	1	2000.	202.	201.
201.	202.	2000.	1	33800.	1.50	0.0075	9200.	1	2000.	202.	201.
201.	202.	2000.	1	34200.	-1.50	0.0075	8800.	1	2000.	202.	201.
201.	202.	2000.	1	34200.	-1.50	0.0000	8800.	1	2000.	202.	201.
201.	202.	2000.	1	35400.	-1.50	0.0000	7600.	1	2000.	202.	201.
201.	202.	800.	-1	35400.	-1.50	0.0000	7600.	1	2000.	202.	201.
201.	202.	800.	-1	35583.	-1.50	0.0000	7417.	1	2000.	202.	201.
201.	-88.	800.	-1	35583.	-1.50	0.0000	7417.	1	2000.	202.	201.
201.	-87.	800.	-1	35600.	-1.50	0.0000	7400.	1	2000.	202.	201.
201.	-87.	800.	-1	35600.	-1.50	0.0000	7400.	1	2000.	87.	201.
201.	-87.	800.	-1	35600.	-1.50	0.0000	7400.	1	2000.	87.	201.
201.	-87.	800.	-1	35600.	-1.50	0.0000	7400.	-1	800.	87.	201.
201.	-87.	800.	-1	35800.	-1.50	0.0000	7200.	-1	800.	87.	201.
201.	-87.	800.	-1	35800.	-1.50	-0.0075	7200.	-1	800.	87.	201.
201.	-87.	800.	-1	36000.	0.00	-0.0075	7000.	-1	800.	87.	201.
201.	-87.	2000.	1	36000.	0.00	-0.0075	7000.	-1	800.	87.	201.
201.	-87.	2000.	1	36200.	1.50	-0.0075	6800.	-1	800.	87.	201.
201.	202.	2000.	1	36200.	1.50	0.0000	6800.	-1	800.	87.	201.
201.	202.	2000.	1	36217.	1.50	0.0000	6783.	-1	800.	88.	201.
201.	202.	2000.	1	36217.	1.50	0.0000	6783.	-1	800.	202.	201.
201.	202.	2000.	1	36600.	1.50	0.0000	6400.	-1	800.	202.	201.
201.	202.	2000.	1	36600.	1.50	0.0000	6400.	-1	2000.	202.	201.
201.	202.	2000.	1	36720.	1.50	0.0000	6280.	-1	2000.	202.	201.
201.	202.	2000.	-1	36720.	1.50	0.0000	6280.	2	2000.	202.	201.
201.	202.	2000.	-1	36820.	1.50	0.0000	6180.	2	2000.	202.	201.
201.	202.	2000.	0	36820.	1.50	0.0000	6180.	2	2000.	202.	201.
201.	202.	2000.	0	37800.	1.50	0.0000	5200.	2	2000.	202.	201.
201.	202.	2000.	0	37800.	1.50	0.0075	5200.	2	2000.	202.	201.
201.	202.	2000.	0	38200.	-1.50	0.0075	4800.	2	2000.	202.	201.
201.	202.	2000.	0	38200.	-1.50	0.0000	4800.	2	2000.	202.	201.
201.	202.	2000.	0	39400.	-1.50	0.0000	3600.	2	2000.	202.	201.
201.	202.	800.	-1	39400.	-1.50	0.0000	3600.	2	2000.	202.	201.
201.	202.	800.	-1	39583.	-1.50	0.0000	3417.	2	2000.	202.	201.
201.	88.	800.	-1	39583.	-1.50	0.0000	3417.	2	2000.	202.	201.
201.	87.	800.	-1	39600.	-1.50	0.0000	3400.	2	2000.	202.	201.
201.	87.	800.	-1	39600.	-1.50	0.0000	3400.	2	2000.	-87.	201.
201.	87.	800.	-1	39600.	-1.50	0.0000	3400.	2	2000.	-87.	201.
201.	87.	800.	-1	39600.	-1.50	0.0000	3400.	2	800.	-87.	201.
201.	87.	800.	-1	39800.	-1.50	0.0000	3200.	2	800.	-87.	201.
201.	87.	800.	-1	39800.	-1.50	-0.0075	3200.	2	800.	-87.	201.
201.	87.	800.	-1	40000.	0.00	-0.0075	3000.	2	800.	-87.	201.
201.	87.	2000.	0	40000.	0.00	-0.0075	3000.	2	800.	-87.	201.
201.	87.	2000.	0	40200.	1.50	-0.0075	2800.	2	800.	-87.	201.
201.	202.	2000.	0	40200.	1.50	0.0000	2800.	2	800.	-87.	201.
201.	202.	2000.	0	40217.	1.50	0.0000	2783.	2	800.	-88.	201.
201.	202.	2000.	0	40217.	1.50	0.0000	2783.	2	800.	202.	201.
201.	202.	2000.	0	40600.	1.50	0.0000	2400.	2	800.	202.	201.
201.	202.	2000.	0	40600.	1.50	0.0000	2400.	2	2000.	202.	201.
201.	202.	2000.	0	41900.	1.50	0.0000	1100.	2	2000.	202.	201.
201.	202.	2000.	-1	41900.	1.50	0.0000	1100.	2	2000.	202.	201.
201.	202.	2000.	-1	42000.	1.50	0.0000	1000.	2	2000.	202.	201.
201.	202.	2000.	1	42000.	1.50	0.0000	1000.	-1	2000.	202.	201.
201.	202.	2000.	1	42100.	1.50	0.0000	900.	-1	2000.	202.	201.
201.	202.	2000.	1	42100.	1.50	0.0000	900.	1	2000.	202.	201.
201.	202.	2000.	1	43000.	1.50	0.0000	0.	1	2000.	202.	201.

Figure 3 (Concluded)

The passing sight distances indicate that the nominal value of 2,000 ft applies except where a lesser value (800 ft) was specified in the regions input data on ST cards.

The passing zone, no-passing zone, and passing lane regions in Figure 3 are derived entirely from input data and the location coordinates are provided for both the No. 1 and No. 2 Directions. The codes for these zones include:

-1 = No-passing zone (with either one or two lanes in the opposing direction).

0 = Passing zone in opposing direction to a passing lane.

1 = Passing zone on a conventional two-lane highway (only one opposing lane).

2 = Passing lane with right lane dropped at downstream end.

3 = Passing lane with left lane dropped at downstream end.

4. Representative desired speeds, and reference overall speeds and travel times: This fourth set of output summarizes the desired speeds for each vehicle type, as well as reference overall speeds and travel times, and is illustrated with the example shown in Figure 4. The heading on this page is the first comment card.

The next three lines list: seven unbiased desired speeds representing the distribution of desired speeds; the weight factor to be applied to each, and the user-specified biases for the desired speeds of trucks, RVs, and passenger cars.

The remainder of the output lists overall travel times (sec/mile) and overall average speeds for each vehicle type traveling alone on the specified alignment. The vehicle type code is not printed but is 1 for the far left-hand column and increases to 13 at the far right-hand column. The first line of the printed output lists the results for the first desired speed, the second line for second desired speed, etc., through seven desired speeds. The eighth line lists the weighted averages.

This set of printed output is the last before the program starts processing the simulation logic.

5. Traffic status (snapshots): During the simulation, the traffic status can be printed in the format shown by Figure 5. This format is known as a snapshot because it displays the status of all vehicles at a single point in time. The times at which snapshots are printed are specified by the user through ISNAP and NSNAP on the first of the 10 mandatory input cards following the comment cards. Although the snapshot feature was originally developed for program debugging purposes, it can also be used to track individual simulation vehicles for short periods of time.

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

ZERO TRAFFIC TRAVEL TIMES AND SPEEDS FOR VEHICLE TYPE AND DESIRED SPEED

DESIRED SPEED	67.37	76.57	81.65	88.00	94.35	99.43	108.63
WEIGHTING FACTOR	0.07	0.15	0.18	0.20	0.18	0.15	0.07
VEHICLE CATEGORY BIAS	-1.50	-2.20	0.00				

DIRECTION 1

	TRUCKS				REC. VEH.				PASSENGER CARS				
(SEC/MILE)	80.55	80.20	80.20	80.20	81.06	81.06	81.06	81.06	78.42	78.42	78.42	78.42	78.42
	72.27	70.40	70.38	70.38	75.11	71.05	71.05	71.05	69.01	69.01	69.01	69.01	69.01
	68.41	66.67	65.94	65.94	74.23	67.95	66.51	66.51	64.72	64.72	64.72	64.72	64.72
	64.17	62.62	61.10	61.10	74.16	65.23	63.07	62.67	60.06	60.06	60.06	60.06	60.06
	60.65	59.18	57.35	56.93	74.09	64.89	60.66	60.15	56.50	56.02	56.02	56.02	56.02
	58.29	56.83	55.00	53.98	74.04	64.82	60.52	59.58	54.65	53.56	53.17	53.17	53.17
	56.77	54.57	51.55	50.08	73.92	64.73	60.40	59.46	53.05	50.69	49.96	49.32	48.67
	65.28	63.72	62.46	62.13	74.76	67.57	65.17	64.79	61.60	61.19	61.07	61.03	60.98
(FT/SEC)	65.55	65.83	65.83	65.83	65.13	65.13	65.13	65.13	67.33	67.33	67.33	67.33	67.33
	73.06	75.00	75.02	75.02	70.30	74.32	74.32	74.32	76.51	76.51	76.51	76.51	76.51
	77.18	79.20	80.08	80.08	71.13	77.70	79.38	79.38	81.58	81.58	81.58	81.58	81.58
	82.28	84.31	86.41	86.42	71.20	80.95	83.71	84.25	87.91	87.91	87.91	87.91	87.91
	87.05	89.21	92.06	92.75	71.27	81.37	87.05	87.78	93.46	94.24	94.24	94.24	94.24
	90.58	92.91	96.00	97.81	71.31	81.46	87.24	88.62	96.61	98.58	99.31	99.31	99.31
	93.00	96.75	102.42	105.43	71.43	81.57	87.42	88.80	99.54	104.15	105.69	107.05	108.49
	81.65	83.73	85.69	86.30	70.66	78.43	81.59	82.13	86.72	87.49	87.71	87.81	87.91

DIRECTION 2

	TRUCKS				REC. VEH.				PASSENGER CARS				
(SEC/MILE)	80.38	80.20	80.20	80.20	81.06	81.06	81.06	81.06	78.42	78.42	78.42	78.42	78.42
	71.46	70.38	70.38	70.38	74.07	71.05	71.05	71.05	69.01	69.01	69.01	69.01	69.01
	67.34	66.34	65.94	65.94	73.04	67.53	66.51	66.51	64.72	64.72	64.72	64.72	64.72
	62.85	61.96	61.10	61.10	72.92	64.25	62.63	62.33	60.06	60.06	60.06	60.06	60.06
	58.98	58.25	57.15	56.93	72.82	63.87	59.76	59.37	56.32	56.02	56.02	56.02	56.02
	56.26	55.65	54.58	53.98	72.73	63.80	59.62	58.70	54.19	53.41	53.17	53.17	53.17
	54.03	52.49	50.72	49.81	72.61	63.67	59.47	58.54	52.30	50.08	49.54	49.08	48.67
	63.89	63.03	62.30	62.11	73.63	66.89	64.72	64.38	61.45	61.12	61.04	61.01	60.98
(FT/SEC)	65.68	65.83	65.83	65.83	65.13	65.13	65.13	65.13	67.33	67.33	67.33	67.33	67.33
	73.89	75.02	75.02	75.02	71.29	74.32	74.32	74.32	76.51	76.51	76.51	76.51	76.51
	78.41	79.59	80.08	80.08	72.28	78.19	79.38	79.38	81.58	81.58	81.58	81.58	81.58
	84.01	85.22	86.41	86.41	72.40	82.18	84.31	84.71	87.91	87.91	87.91	87.91	87.91
	89.52	90.65	92.38	92.75	72.51	82.67	88.35	88.93	93.75	94.24	94.24	94.24	94.24
	93.84	94.88	96.75	97.81	72.60	82.75	88.57	89.95	97.44	98.87	99.31	99.31	99.31
	97.72	100.58	104.10	106.01	72.72	82.92	88.78	90.20	110.96	105.42	106.58	107.57	108.49
	83.62	84.81	85.98	86.34	71.76	79.29	82.24	82.73	87.00	87.62	87.77	87.84	87.91

Figure 4 - Representative Desired Speeds and Reference Overall Speeds and Travel Times

SYSTEM SNAPSHOT AT TIME 1.00

DIRECTION 2 (MOVING DOWN)

POS	SPD LT SPD	D SPD	ACEL TMAR	VEH OC	INDX IMP	STATE STAGE
43050.	88.0	88.0000	0.00	13	6	1
43050.	88.0	88.0000	0.00	13	8	1
41415.	89.4	90.0000	1.42	13	907	1
41065.	87.0	87.0000	-1.00	12	919	1
40625.	86.8	67.0000	-1.20	11	929	1
39921.	86.8	84.0000	-1.20	10	936	1
38469.	86.1	88.0000	-1.93	13	906	3
38425.	86.8	80.0000	-1.20	9	941	1
37543.	89.5	91.0000	1.52	12	918	1
36225.	86.8	74.0000	-1.20	11	928	1
35519.	90.0	95.0000	1.96	13	905	1
34074.	85.9	87.0000	-2.10	12	917	3
34029.	86.8	86.0000	-1.20	10	935	1
32620.	90.1	96.0000	2.06	13	904	1
31829.	86.8	86.0000	-1.20	11	927	1
30514.	86.8	86.0000	-1.20	12	916	1
29679.	85.0	67.0000	-3.02	13	903	3
29634.	86.8	77.0000	-1.20	9	940	1
28226.	86.8	82.0000	-1.20	10	934	1
27433.	89.4	90.0000	1.42	11	926	1
26997.	86.1	77.0000	-1.20	12	915	1
26735.	86.1	74.0000	-1.20	13	902	1
24322.	79.6	76.0000	-1.20	6	943	1
23878.	81.2	74.0000	-1.20	7	942	1

DIRECTION 1 (MOVING UP)

POS	SPD LT SPD	D SPD	ACEL TMAR	VEH OC	INDX IMP	STATE STAGE
43400.	88.0	88.0000	0.00	13	1	6000
43400.	88.0	88.0000	0.00	13	3	6000
42638.	90.5	100.0000	2.50	13	947	1
41934.	89.8	94.0000	1.85	11	974	1
40612.	86.8	82.0000	-1.20	12	962	1
39734.	90.1	96.0000	2.06	9	991	1
39687.	85.6	85.0000	-2.40	13	948	3
38238.	89.7	93.0000	1.74	10	984	1
37533.	89.0	89.0000	1.00	11	975	1
37094.	90.2	97.0000	2.17	12	963	1
36742.	89.8	94.0000	1.85	13	949	1
33842.	89.0	89.0000	1.00	13	950	1
33578.	89.8	94.0000	1.85	12	964	1
33137.	86.8	78.0000	-1.20	11	976	1
32347.	90.5	100.0000	2.50	10	985	1
30942.	86.8	67.0000	-1.20	9	992	1
30897.	85.5	71.0000	-2.55	13	951	3
30064.	90.5	105.0000	2.47	12	965	1
29802.	78.5	82.0000	-0.07	2	1000	1
28743.	90.1	98.0000	2.13	11	977	1
27952.	90.5	100.0000	2.50	13	952	1
27474.	84.6	72.0000	-1.20	4	998	1
26547.	88.0	88.0000	0.00	10	986	1
26501.	83.0	92.0000	-5.03	12	966	3
25052.	90.7	102.0000	2.71	13	953	1

Figure 5 - Traffic Status Snapshot Available in Printed Output at User-Specified Times

23831.	84.8	86.0000	-1.20	13	981	1
23479.	86.8	67.0000	-1.20	12	914	1
23040.	89.5	92.0000	2.18	11	925	1
22338.	90.6	101.0000	2.60	10	933	1
20889.	84.5	92.0000	-3.54	13	900	3
20843.	89.5	92.0000	1.51	9	939	1
20010.	84.9	98.0000	-1.62	3	945	3
19962.	89.7	93.0000	1.74	12	915	1
18649.	87.0	87.0000	-0.31	11	924	1
17942.	91.1	106.0000	3.14	13	899	1
16494.	84.5	102.0000	-3.49	12	912	4
16447.	89.4	90.0000	1.42	10	932	1
15516.	87.1	90.0000	0.63	4	944	1
15041.	90.8	97.0000	3.47	13	898	1
14251.	91.1	114.0000	3.09	11	923	1
12940.	73.0	81.0000	-15.00	12	911	3
12924.	86.8	89.0000	0.27	2	946	1
12099.	84.5	81.0000	-3.50	13	897	3
12052.	89.3	91.0000	1.31	9	938	1
10658.	88.0	88.0000	0.69	10	931	1
9857.	89.4	90.0000	1.42	11	922	1
9418.	86.8	84.0000	-1.20	12	910	1
9154.	86.8	81.0000	-1.20	13	896	1
6255.	86.8	83.0000	-1.20	13	895	1
5902.	90.0	95.0000	1.96	12	909	1
5462.	89.6	92.0000	1.63	11	921	1
4758.	89.9	96.0000	1.92	10	930	1
3308.	84.8	84.0000	-5.21	13	894	3
3262.	89.3	91.0000	1.31	9	937	1
2388.	86.8	79.0000	-1.20	12	908	1
1067.	89.4	90.0000	1.42	11	920	1
364.	86.8	85.0000	-1.20	13	893	1
-400.	88.0	88.0000	0.00	13	2	6000
-400.	88.0	88.0000	0.00	13	4	6000

24347.	86.8	85.0000	-1.20	11	978	1
23832.	89.8	96.0000	2.52	12	967	1
22984.	84.6	65.0000	-1.20	3	999	1
22153.	89.3	103.0000	1.31	9	993	1
22106.	84.4	91.0000	-3.59	13	954	3
20655.	86.8	86.0000	-1.20	10	987	1
19951.	86.8	78.0000	-1.20	11	979	1
19513.	90.0	101.0000	2.68	12	968	1
19164.	91.2	92.0000	3.93	13	955	1
19062.	80.4	81.0000	-2.08	7	996	1
18519.	77.2	82.0000	-0.19	6	997	1
16261.	89.4	90.0000	1.42	13	956	1
15996.	86.8	71.0000	-1.20	12	969	1
15558.	89.8	99.0000	2.46	11	980	1
14770.	89.7	93.0000	1.74	10	988	1
13361.	86.8	71.0000	-1.20	9	994	1
13317.	86.3	92.0000	-1.66	13	957	3
12481.	87.0	87.0000	-1.00	12	970	1
11165.	90.2	92.0000	2.85	11	981	1
10375.	89.7	93.0000	1.74	13	958	1
8968.	90.4	99.0000	2.39	10	989	1
8921.	85.7	79.0000	-2.33	12	971	3
7469.	84.4	85.0000	-2.95	13	959	1
6771.	86.8	63.0000	-1.20	11	982	1
5452.	89.2	99.0000	1.23	12	972	1110
4572.	89.3	94.0000	1.26	9	995	1110
4525.	84.3	88.0000	-3.66	13	960	3110
3078.	86.3	87.0000	-0.98	10	990	1110
2375.	86.8	84.0000	-1.20	11	985	1110
1935.	86.8	79.0000	-1.20	12	973	1110
1584.	88.0	88.0000	0.00	13	961	[illegible]
-50.	88.0	88.0000	0.00	13	5	1
-50.	88.0	88.0000	0.00	13	7	1

TIME = 1.0

976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
964	1000	953	987	969	970	959	990	948	976	998	954	988	958	960	962	985	999	988	972	955	996	952	967	965
985	952	967	968	988	958	972	973	975	992	966	979	994	971	983	948	951	954	957	960	997	956	986	993	977
1	1	1	1	1	1	1	1110	1	1	1	1	1	1	1110	1	1	1	1	1110	1	1	1	1	1

Figure 5 (Concluded)

The example shown in Figure 5 depicts conditions at the end of 1 sec of simulation time. The time shown on the snapshot output is counted from the beginning of the warmup time.

The headings indicate the data items which are printed for each vehicle in the spatially sequenced format. A basic set of data about each vehicle is printed on one line. A second line of data is printed only when the vehicle is involved in a pass or is aborting a pass. In the first line for each vehicle are:

POS	Position, in No. 1 Direction coordinates, for vehicles in both directions of travel. (The same coordinate system is used to facilitate estimates of distances to oncomers.)
SPD	Speed (ft/sec). Speed is flagged with a minus sign if vehicle was passed (by a vehicle traveling in the same direction) during last review in a section with one unidirectional lane.
DSPD	Normal desired speed (ft/sec) unadjusted for local curve or crawl region.
ACEL	Average acceleration in last review period (ft/sec^2).
VEH	Vehicle type, 1 through 13.
INDX	Vehicle number.
STATE	State at end of review period.

STATE is printed in either single-digit and four-digit forms. The four-digit form is used to convey additional information in a packed form. The interpretation of the state variable is described below:

- Single-digit form with range 1 through 4 means that the vehicle is in a section with one lane available for its direction of travel. The single digit is a code representing the platooning status of the vehicle:

  1 = Vehicle traveling freely.
  2 = Vehicle overtaking leader, but speed still 8 ft/sec or more above leader's speed.
  3 = Vehicle following leader.
  4 = Vehicle following leader closely, with both the potential desire and the performance capability to pass.

- Four-digit form with range 5000 to 6999 means that the vehicle is in a section with one lane for its direction of travel, and:

First digit = 5, vehicle is engaged in a pass.
= 6, vehicle is aborting a pass.

The last three digits of the packed form are extra data for passes and aborts that are also printed in a more convenient form on next line of output.

<u>Four-digit form</u> with <u>range 1110 through 4223</u> means that the vehicle is in a section with two unidirectional lanes for its direction of travel (i.e., a passing or climbing lane). The first digit, in the approximately angle from 1 to 4 denotes the platooning status as defined in the single-digit form above.

The second digit is a code that identifies which lane the vehicle is in; Code 1 represents the left lane and 2 represents the right lane.

The third digit, 1 or 2, is a code that identifies target lane to which the vehicle is trying to change. (If the third digit is equal to the second digit, the vehicle is not motivated to change lanes; if third is not equal to the second digit, the vehicle is trying to change lanes.)

The fourth digit is a code in the range from 0 through 9, where:

Code 1 means that vehicle is motivated to change lanes to avoid the lane drop at the end of a passing lane, provided that the second and third digits are not equal. This lane change can be in either direction (left to right or right to left) depending on which lane is being dropped.

Codes 1 through 3 when the second and third digits are equal means that the vehicle has completed a lane change within last three review intervals; this vehicle will not examine lane change motivations except to avoid lane drop.

Codes 2 through 5 means that the vehicle is attempting to change lanes to left to avoid delay, providing the second and third digits are 21. This code is reduced by one during each review interval. (If the fourth digit is reduced to 2 without a lane change taking place, the motivation to change lanes will be reviewed again.)

Codes 6 through 9 means that the vehicle is attempting to change lanes to the right. This code is reduced by one during each review interval. (If the fourth digit is reduced to 6, the motivation to change lanes will be reviewed again.)

The second line for a vehicle is printed in the snapshot output only when the vehicle is engaged in a pass or pass abort involving use of the opposing direction lane(s). The data on the second line are:

LTSPD — During a pass, LTSPD is the maximum speed (ft/sec) that will be used by a driver, as limited by driver speed preferences. During a pass abort, LTSPD is the distance behind the leader-to-be that the aborting vehicle will begin its return to normal lane (ft).

TMAR — During a pass, TMAR is the most recently estimated time safety margin (sec). During a pass abort, TMAR is the time remaining before the aborting vehicle can begin the return to the normal lane (sec).

OC — The vehicle number of the next oncoming vehicle.

IMP — For a vehicle in pass, IMP is the vehicle number of the impeding vehicle being passed. For vehicle in a pass abort, IMP is the vehicle number of the leader-to-be after abort.

ISTG — State of the pass or abort maneuver, where:

Maneuver	ISTG	Meaning
Pass (state 5)	1	Not committed to complete pass.
	2	Committed to complete pass (i.e., would pull ahead of other vehicle even if large deceleration were used.)
	3	Ahead of impeder (measured nose to nose).
	4	Clear of impeder and making decision about passing another vehicle, if any.
	5	Clear of impeder, not extending pass, and has two review periods before vacating the opposing direction lane.
	6	Clear of impeder and has one review before vacating the opposing direction lane.
Aborting pass	1	Acquiring relative position to begin return to single, normal direction lane.
(state 6)	2,3,4	Not used.
	5	Clear of impeder and has two review periods before vacating the opposing direction lane.

6 Clear of impeder and has one period before vacating the opposing direction lane.

The furthest upstream and downstream vehicles in each direction of travel are the eight "dummy vehicles" used to facilitate computer program operation and control. The dummy vehicles are positioned off the ends of the simulated highway by 50 ft at the upstream end and by 400 ft at the downstream end. These dummy vehicles have vehicle numbers in the range from 1 to 8; they appear on every snapshot but are not processed by the simulation logic.

Snapshots are the only output normally printed by the program during simulation processing. The remaining output, described below, is printed after completion of the simulation run.

6. Space-averaged data and operating speeds: Space-averaged data and operating speeds are presented in printed output on a page labeled Page 1. An example of this page is shown in Figure 6. The header on this page includes the contents of the first comment card and the simulation "test time" during which the basic data were collected.

The flow rates measured at the finish line in each direction (i.e., the most downstream spot data station) are given prior to the space data results.

The space-averaged data for vehicle types and categories by direction include: vehicle miles traveled, space mean speeds, measured flow rates, specified flow rates and the difference between the specified and measured flow rate. The flow rates are also given in fractions for each direction of flow.

The flow rates here are based on space data which are collected for every vehicle during each review period it spends in the test length during test time. This measure provides the best estimate of flow rates and vehicle mixes for correlation with other traffic characteristics.

Page 1 concludes with the operating speed measures. These are a special type of overall speed measure which represents the speeds of vehicles traveling as fast as possible under prevailing geometric and traffic conditions. The operating speed is estimated from the average overall travel speed of a sample of the fastest passenger cars selected to meet the following criteria:

- Had a vehicle type of 12 or 13; i.e., one of the two highest performance passenger cars.
- Had a normal desired speed in the range indicated on the printout (94.66 to 105.24 ft/sec in the example).

The centroid (not the center) of the desired speed range is at the 85th percentile. Therefore, the operating speed is calculated here as the

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

30.00 MIN. PAGE 1

FLOW DATA ANALYZED FOR 30.00 MINUTES

FLOW RATES AT FINISH LINES DIRECTION 1 404. VPH DIRECTION 2 416. VPH

TOTAL FLOW RATE 820. VPH

DATA FROM SPACE MEASUREMENTS

DIRECTION ONE

TYPE OR CAT.	VEHICLE MILES	AVE. SPEED (FT/SEC)	FLOW RATE (VPH) MEAS.	SPECIFIED	DIFF.
1	4.54	68.05	1.13	2.40	-1.27
2	50.11	72.87	12.45	5.12	7.33
3	16.14	73.80	4.01	6.80	-2.79
4	16.07	73.47	3.99	5.68	-1.69
TRUCKS	86.86	72.88	21.59	20.00	1.59
5	0.00	0.00	0.00	0.20	-0.20
6	23.22	77.10	5.77	8.00	-2.23
7	44.34	71.97	11.02	8.00	3.02
8	0.00	0.00	0.00	0.20	-0.20
REC.V.	67.56	73.66	16.79	16.40	0.39
9	195.89	73.96	48.68	36.00	12.68
10	220.31	75.33	54.75	54.00	0.75
11	244.96	74.23	60.88	72.00	-11.12
12	355.46	75.49	88.34	90.00	-1.66
13	458.13	74.65	113.86	108.00	5.86
PASS.	1474.75	74.79	366.52	360.00	6.52
ALL	1629.18	74.64	404.90	396.40	8.50

	FRACTIONS MEAS.	SPECIFIED	DIFF.
1	0.0028	0.0061	-0.0033
2	0.0308	0.0129	0.0178
3	0.0099	0.0172	-0.0072
4	0.0099	0.0143	-0.0045
TRUCKS	0.0533	0.0505	0.0029
5	0.0000	0.0005	-0.0005
6	0.0143	0.0202	-0.0059
7	0.0272	0.0202	0.0070
8	0.0000	0.0005	-0.0005
REC.V.	0.0415	0.0414	0.0001
9	0.1202	0.0908	0.0294
10	0.1352	0.1362	-0.0010
11	0.1504	0.1816	-0.0313
12	0.2182	0.2270	-0.0089
13	0.2812	0.2725	0.0088
PASS.	0.9052	0.9082	-0.0030

DIRECTION TWO

TYPE OR CAT.	VEHICLE MILES	AVE. SPEED (FT/SEC)	FLOW RATE (VPH) MEAS.	SPECIFIED	DIFF.
1	0.00	0.00	0.00	2.40	-2.40
2	11.00	75.20	2.73	5.12	-2.39
3	8.02	74.30	1.99	6.80	-4.81
4	8.02	74.99	1.99	5.68	-3.69
TRUCKS	27.04	74.87	6.72	20.00	-13.28
5	0.00	0.00	0.00	0.20	-0.20
6	21.91	76.62	5.45	8.00	-2.55
7	14.26	75.69	3.54	8.00	-4.46
8	0.00	0.00	0.00	0.20	-0.20
REC.V.	36.18	76.25	8.99	16.40	-7.41
9	180.90	75.24	44.96	36.00	8.96
10	218.02	73.84	54.18	54.00	0.18
11	284.49	75.28	70.70	72.00	-1.30
12	479.44	73.90	119.15	90.00	29.15
13	415.16	74.44	103.18	108.00	-4.82
PASS.	1578.02	74.43	392.18	360.00	32.18
ALL	1641.24	74.48	407.90	396.40	11.50

	FRACTIONS MEAS.	SPECIFIED	DIFF.
1	0.0000	0.0061	-0.0061
2	0.0067	0.0129	-0.0062
3	0.0049	0.0172	-0.0123
4	0.0049	0.0143	-0.0094
TRUCKS	0.0165	0.0505	-0.0340
5	0.0000	0.0005	-0.0005
6	0.0134	0.0202	-0.0068
7	0.0087	0.0202	-0.0115
8	0.0000	0.0005	-0.0005
REC.V.	0.0220	0.0414	-0.0193
9	0.1102	0.0908	0.0194
10	0.1328	0.1362	-0.0034
11	0.1733	0.1816	-0.0083
12	0.2921	0.2270	0.0651
13	0.2530	0.2725	-0.0195
PASS.	0.9615	0.9082	0.0533

TOTAL MEASURED FLOW RATE = 812.79 FROM SPACE DATA

OPERATING SPEEDS BASED ON DESIRED SPEEDS FROM 94.66 TO 105.24 FT/SEC

	DIRECTION ONE	DIRECTION TWO	COMBINED
SAMPLE SIZE	19	18	37
OPERATING SPD (FT/SEC)	80.19	74.36	77.35
STD DEVIATION	6.18	5.15	6.35
MAX VALUE	89.85	81.74	89.85
MIN VALUE	64.78	67.11	64.78

Figure 6 - Space-Averaged Flow Rate and Operating Speed Data on Page 1 of Printed Output

arithmetic mean of overall speeds for high performance cars that attempted to travel with a mean desired space at the 85th percentile desired (free) speed.

7. <u>Overall and desired speeds</u>: Page 2 of the printed output presents the overall and desired speed measures. These data, illustrated in Figure 7, are broken down by vehicle type, by vehicle category, and for all vehicles combined for each direction separately.

The data include: sample sizes, specified and measured; average desired speeds, specified, measured, and differenced; two reference speeds; and overall speed statistics.

Both reference speeds are based on calculations with a set of representative desired speeds in conjunction with vehicle, driver, and alignment characteristics. The reference speeds headed "Ideal Geometry" are based on the speeds of isolated vehicles on straight and level alignment; the "Zero Traffic" measures are for isolated vehicles on the user-specified alignment of the simulated roadway. The reference speed averages for individual vehicle categories and for all vehicles combined are based on the specified rather than the measured proportions of each vehicle type.

The measured overall average speeds for individual vehicle types are arithmetic means, not the sum of distances traveled divided by the sum of travel times. The measured averages for vehicle categories and all vehicles are arithmetic means with equal weight for each measured overall vehicle speed.

8. <u>Travel times and delays</u>: The actual and reference speeds printed on Page 2 are used on Page 3 to determine overall travel time and delay measures. This page of printed output is illustrated in Figure 8. The average delay to motorists represents the difference between their actual speeds and their desired speeds. The reference speeds printed on Page 2 are used to apportion this delay to roadway geometrics that limit vehicle speeds and to traffic delay. All of the travel time and delay output are presented in units of sec/vehicle mile.

The data presented on Page 3 are in many respects similar to the data on overall speeds on Page 2. Sample sizes are printed, and reference times are provided together with measured times.

The reference times are based on the same factors described in the preceding section. The user-specified proportions of vehicle types in the traffic stream are used to combine the vehicle types into summary results for individual vehicle categories and for all vehicles combined. Note that the average of travel times (sec/veh-mi) can be inverted as 5,280/(sec/veh-mi) to provide a speed (ft/sec) which is the sum of distances traveled divided by the total of travel times. Normally, this space-mean speed will be slightly lower than the arithmetic average of speeds.

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SPEEDS, OVERALL AND DESIRED (FT/SEC)

DIRECTION ONE

VEH TYPE CAT.	SAMPLE SIZE SPECIFIED	SAMPLE SIZE MEAS.	AVE. DESIRED SPEC.	AVE. DESIRED MEAS.	AVE. DESIRED DIFF.	REFERENCE AVERAGES IDEAL GEOM.	REFERENCE AVERAGES ZERO TRAFFIC	MEASURED OVERALL AVERAGE	MEASURED OVERALL STD. DEVIATION	MEASURED OVERALL MAX.	MEASURED OVERALL MIN.
1	1.20	0.00	86.50	0.00	0.00	85.61	81.65	0.00	0.00	0.00	0.00
2	2.56	6.00	86.50	89.88	3.38	86.02	83.73	73.51	3.19	77.73	69.31
3	3.40	2.00	86.50	81.09	-5.41	86.50	85.69	73.85	0.95	74.52	73.18
4	2.84	2.00	86.50	87.59	1.09	86.50	86.30	73.64	5.04	77.20	70.08
TRUCKS	10.00	10.00	86.50	87.67	1.17	86.27	84.88	73.60	2.93	77.73	69.31
5	0.10	0.00	85.80	0.00	0.00	70.42	70.66	0.00	0.00	0.00	0.00
6	4.00	3.00	85.80	89.73	3.93	78.43	78.43	77.42	3.65	81.16	73.87
7	4.00	3.00	85.80	80.08	-5.72	81.71	81.59	70.34	5.92	76.65	64.90
8	0.10	0.00	85.80	0.00	0.00	82.25	82.13	0.00	0.00	0.00	0.00
REC.V.	8.20	6.00	85.80	84.91	-0.89	79.98	79.92	73.88	5.86	81.16	64.90
9	18.00	22.00	88.00	87.98	-0.02	87.07	86.72	74.52	5.87	83.66	63.71
10	27.00	25.00	88.00	88.40	0.40	87.62	87.49	76.13	4.99	86.27	66.97
11	36.00	25.00	88.00	88.52	0.52	87.87	87.71	75.24	5.54	90.02	67.75
12	45.00	38.00	88.00	90.82	2.82	88.00	87.81	76.53	6.67	89.85	63.00
13	54.00	47.00	88.00	85.66	-2.34	88.00	87.91	75.24	6.77	87.40	58.91
PASS.	180.00	157.00	88.00	88.12	0.12	87.82	87.66	75.59	6.14	90.02	58.91
ALL	198.20	173.00	87.83	87.98	0.15	87.42	87.20	75.42	6.00	90.02	58.91

DIRECTION TWO

VEH TYPE CAT.	SAMPLE SIZE SPECIFIED	SAMPLE SIZE MEAS.	AVE. DESIRED SPEC.	AVE. DESIRED MEAS.	AVE. DESIRED DIFF.	REFERENCE AVERAGES IDEAL GEOM.	REFERENCE AVERAGES ZERO TRAFFIC	MEASURED OVERALL AVERAGE	MEASURED OVERALL STD. DEVIATION	MEASURED OVERALL MAX.	MEASURED OVERALL MIN.
1	1.20	0.00	86.50	0.00	0.00	85.61	83.62	0.00	0.00	0.00	0.00
2	2.56	1.00	86.50	97.00	10.50	86.02	84.81	72.59	0.00	72.59	72.59
3	3.40	1.00	86.50	97.03	10.53	86.50	85.98	74.32	0.00	74.32	74.32
4	2.84	1.00	86.50	75.05	-11.45	86.50	86.34	74.99	0.00	74.99	74.99
TRUCKS	10.00	3.00	86.50	89.69	3.19	86.27	85.50	73.97	1.24	74.99	72.59
5	0.10	0.00	85.80	0.00	0.00	70.42	71.76	0.00	0.00	0.00	0.00
6	4.00	1.00	85.80	91.14	5.34	78.43	79.29	74.76	0.00	74.76	74.76
7	4.00	2.00	85.80	100.58	14.78	81.71	82.24	75.59	11.41	83.66	67.52
8	0.10	0.00	85.80	0.00	0.00	82.25	82.73	0.00	0.00	0.00	0.00
REC.V.	8.20	3.00	85.80	97.43	11.63	79.98	80.68	75.31	8.08	83.66	67.52
9	18.00	22.00	88.00	88.89	0.89	87.07	87.00	75.58	4.51	82.86	67.27
10	27.00	25.00	88.00	87.88	-0.12	87.62	87.62	74.12	4.74	84.22	65.03
11	36.00	31.00	88.00	87.83	-0.17	87.87	87.77	75.74	5.36	87.60	64.00
12	45.00	50.00	88.00	86.86	-1.14	88.00	87.84	73.75	5.62	84.16	57.07
13	54.00	50.00	88.00	87.64	-0.36	88.00	87.91	74.44	4.69	84.15	66.97
PASS.	180.00	178.00	88.00	87.64	-0.36	87.82	87.73	74.57	4.90	87.60	57.07
ALL	198.20	184.00	87.83	87.83	0.00	87.42	87.33	74.57	4.89	87.60	57.07

Figure 7 - Overall and Desired Speeds on Page 2 of Printed Output

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

TRAVEL TIMES AND DELAYS (SEC/MILE) 30.00 MIN. PAGE 3

DIRECTION ONE

VEH TYPE CAT.	SAMPLE SIZE SPECIFIED	MEAS.	IDEAL TIME	ZERO TRAFFIC TIME	GEOM. DELAY	MEASURED AVE.	TIME STD DEV.	AVE TRAFFIC DELAY	AVE TOTAL DELAY
1	1.20	0.00	62.47	65.28	2.80				
2	2.56	6.00	62.25	63.72	1.47	71.94	3.15	8.22	9.69
3	3.40	2.00	62.01	62.46	0.45	71.51	0.92	9.05	9.49
4	2.84	2.00	62.01	62.13	0.11	71.87	4.91	9.74	9.86
TRUCKS	10.00	10.00	62.13	63.02	0.90	71.84	2.88	8.81	9.71
5	0.10	0.00	75.01	74.76	-0.25				
6	4.00	3.00	67.55	67.57	0.02	68.30	3.21	0.73	0.75
7	4.00	3.00	65.06	65.17	0.10	75.42	6.25	10.25	10.35
8	0.10	0.00	64.69	64.79	0.10				
REC.V.	8.20	6.00	66.39	66.45	0.06	71.86	5.91	5.41	5.47
9	18.00	22.00	61.39	61.60	0.21	71.28	5.72	9.68	9.89
10	27.00	25.00	61.10	61.19	0.09	69.65	4.71	8.46	8.55
11	36.00	25.00	60.98	61.07	0.09	70.53	5.03	9.46	9.55
12	45.00	38.00	60.92	61.03	0.11	69.53	6.31	8.50	8.61
13	54.00	47.00	60.92	60.98	0.06	70.76	6.62	9.78	9.83
PASS.	180.00	157.00	61.01	61.10	0.10	70.32	5.87	9.22	9.31
ALL	198.20	173.00	61.29	61.42	0.14	70.46	5.74	9.04	9.17

DIRECTION TWO

VEH TYPE CAT.	SAMPLE SIZE SPECIFIED	MEAS.	IDEAL TIME	ZERO TRAFFIC TIME	GEOM. DELAY	MEASURED AVE.	TIME STD DEV.	AVE TRAFFIC DELAY	AVE TOTAL DELAY
1	1.20	0.00	62.47	63.89	1.42				
2	2.56	1.00	62.25	63.03	0.78	72.74	0.00	9.71	10.49
3	3.40	1.00	62.01	62.30	0.29	71.04	0.00	8.74	9.03
4	2.84	1.00	62.01	62.11	0.09	70.41	0.00	8.30	8.40
TRUCKS	10.00	3.00	62.13	62.62	0.49	71.40	1.20	8.77	9.27
5	0.10	0.00	75.01	73.63	-1.38				
6	4.00	1.00	67.55	66.89	-0.66	70.63	0.00	3.74	3.08
7	4.00	2.00	65.06	64.72	-0.35	70.66	10.67	5.94	5.59
8	0.10	0.00	64.69	64.38	-0.30				
REC.V.	8.20	3.00	66.39	65.88	-0.51	70.65	7.54	4.77	4.25
9	18.00	22.00	61.39	61.45	0.06	70.10	4.22	8.65	8.71
10	27.00	25.00	61.10	61.12	0.02	71.52	4.60	10.40	10.42
11	36.00	31.00	60.98	61.04	0.06	70.05	5.02	9.01	9.07
12	45.00	50.00	60.92	61.01	0.09	71.94	5.17	10.93	11.02
13	54.00	50.00	60.92	60.98	0.06	71.21	4.49	10.23	10.28
PASS.	180.00	178.00	61.01	61.07	0.06	71.12	4.77	10.05	10.11
ALL	198.20	184.00	61.29	61.35	0.06	71.12	4.76	9.77	9.83

Figure 8 - Travel Times and Delays on Page 3 of Printed Output

Three measures of delay are provided in the output on Page 3. The geometric delay is the difference between zero-traffic travel time and the ideal travel time. The purpose of this measure is to represent the delay to a vehicle when it travels along on the <u>specified</u> alignment rather than on ideal (straight and level) alignment.

The average traffic delay is the difference between the measured travel time (in the simulation results) and the zero-traffic time. In a large sample, this difference would normally be a positive number that represents delay and can be attributed to traffic interactions on the simulated roadway. In the small samples for trucks and RVs, the influences of a small number of atypical desired speeds can sometimes cause the traffic delay to be a negative number. Negative values for traffic delay can be taken as an indicator that the sample size is too small to be meaningful.

The total delay is the algebraic sum of geometric and traffic delays. It is also the difference between the measured travel time and the ideal travel time (sec/veh-mi).

It should be noted that the travel time in ideal alignment is the base for calculating all the delays provided in this output. Consequently, a vehicle can be performance limited on ideal alignment, experience longer than desired travel times on the ideal alignment as a result, and yet not have this penalty appear directly in the printed delays. The type of delay described is intrinsic and is performance induced; it can be seen in the example, Figure 8, where the lowest performance RV, vehicle type 5, requires 75.01 sec/mile "ideal time." The high performance cars can attain all desired speeds on level terrain and require only 60.92 sec/mile as do the highest performance trucks. Other low performance types also exhibit small intrinsic delays due to their performance limitations. The intrinsic, performance induced delay can be calculated as:

$$\text{Ideal time} = \sum_{i=1}^{7} \left[(\text{weight factor})_i \ (5{,}280/\text{representative speed}_i)\right]$$

where: Representative speed = i^{th} representative desired speed (see Figure 4).

Weight factor = Weight factor to be applied with i^{th} representative desired speed (see Figure 4).

In the example, the numerics are:

```
Ideal time - (0.07)(5,280/67.37)
           - (0.15)(5,280/76.57)
           - (0.18)(5,280/81.65)
           - (0.20)(5,280/88.00)
           - (0.18)(5,280/94.35)
           - (0.15)(5,280/99.43)
           - (0.07)(5,280/108.63)

= Ideal time -60.91
```

The highest performance vehicles are seen to have essentially no intrinsic, performance-induced delay. This is usually the case.

9. Overall speed histograms: Page 4 of the printed output presents overall speed histograms for each direction of travel. This page of the printed output is illustrated in Figure 9. The output which appears on two pages is well defined by headings. Figure 9 illustrates the separate speed histograms for the No. 1 and No. 2 directions. The speed histogram for both directions combined is presented on a second page not illustrated in the figure. The sample of vehicles used to compute the overall speed histograms consist of all vehicles which qualify as follows:

- Vehicles that were not primed onto road before simulation began;
- Vehicles that crossed the "start line" either before or during the test time; and
- Vehicles that crossed the "finish line" during the test time.

10. Time margins in passes and pass aborts: Page 5 presents a printed summary of the time margins to oncoming vehicles in passes and pass aborts. An example of this output is shown in Figure 10.

The time margins in passes are the projected times beyond pass completion (return to normal lane) when the pertinent critical event should occur. Potentially there are three kinds of critical events. They can be distinguished and described as follows:

- If the oncoming vehicle is in sight, the time margin is based on the projected time until the oncomer will be met.
- If the oncoming vehicle is not in sight, but the end of the passing zone is, the margin is based on projected time to reach the end of the passing zone.
- If neither the oncoming vehicle or end of passing zone is in sight, the margin is based on the projected time to reach the end of the then current passing sight distance.

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

30.00 MIN.

OVERALL SPEED HISTOGRAMS

DIRECTION ONE

SPEED	TRUCKS			REC VEH			PASSENGER			ALL		
RANGE (FPS)	NUM	%	% SUM	NUM	%	% SUM	NUM	%	% SUM	NUM	%	% SUM
0 LT 12	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
12 LT 18	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
18 LT 24	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
24 LT 30	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
30 LT 36	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
36 LT 42	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
42 LT 48	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
48 LT 54	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
54 LT 60	0.	0.0	0.0	0.	0.0	0.0	1.	0.6	0.6	1.	0.6	0.6
60 LT 66	0.	0.0	0.0	1.	16.7	16.7	9.	5.7	6.4	10.	5.8	6.4
66 LT 72	3.	30.0	30.0	1.	16.7	33.3	38.	24.2	30.6	42.	24.3	30.6
72 LT 78	7.	70.0	100.0	3.	50.0	83.3	47.	29.9	60.5	57.	32.9	63.6
78 LT 84	0.	0.0	100.0	1.	16.7	100.0	52.	33.1	93.6	53.	30.6	94.2
84 LT 90	0.	0.0	100.0	0.	0.0	100.0	9.	5.7	99.4	9.	5.2	99.4
90 LT 96	0.	0.0	100.0	0.	0.0	100.0	1.	0.6	100.0	1.	0.6	100.0
96 LT 102	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
102 LT 108	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
108 LT 114	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
114 LT 120	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
120 LT 999	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0

DIRECTION TWO

SPEED	TRUCKS			REC VEH			PASSENGER			ALL		
RANGE (FPS)	NUM	%	% SUM	NUM	%	% SUM	NUM	%	% SUM	NUM	%	% SUM
0 LT 12	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
12 LT 18	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
18 LT 24	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
24 LT 30	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
30 LT 36	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
36 LT 42	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
42 LT 48	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
48 LT 54	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0	0.	0.0	0.0
54 LT 60	0.	0.0	0.0	0.	0.0	0.0	1.	0.6	0.6	1.	0.5	0.5
60 LT 66	0.	0.0	0.0	0.	0.0	0.0	2.	1.1	1.7	2.	1.1	1.6
66 LT 72	0.	0.0	0.0	1.	33.3	33.3	46.	25.8	27.5	47.	25.5	27.2
72 LT 78	3.	100.0	100.0	1.	33.3	66.7	83.	46.6	74.2	87.	47.3	74.5
78 LT 84	0.	0.0	100.0	1.	33.3	100.0	38.	21.3	95.5	39.	21.2	95.7
84 LT 90	0.	0.0	100.0	0.	0.0	100.0	8.	4.5	100.0	8.	4.3	100.0
90 LT 96	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
96 LT 102	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
102 LT 108	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
108 LT 114	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
114 LT 120	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0
120 LT 999	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0	0.	0.0	100.0

Figure 9 - Overall Speed Histograms on Page 4 of Printed Output

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

TIME MARGINS (SEC.) IN PASSES AND ABORTS

30.00 MIN. PAGE 5

DIRECTION	MARGIN (SEC)	PASSES NUM	PASSES %	PASSES % SUM	ABORTS NUM	ABORTS %	ABORTS % SUM	BOTH NUM	BOTH %	BOTH % SUM
ONE	LT 0	0.	0.00	0.00	25.	0.00	0.00	25.	0.00	0.00
	0 LT 1	0.	0.00	0.00	6.	0.00	0.00	6.	0.00	0.00
	1 LT 2	0.	0.00	0.00	6.	0.00	0.00	6.	0.00	0.00
	2 LT 3	2.	0.00	0.00	0.	0.00	0.00	2.	0.00	0.00
	3 LT 4	3.	0.00	0.00	0.	0.00	0.00	3.	0.00	0.00
	4 LT 5	4.	0.00	0.00	0.	0.00	0.00	4.	0.00	0.00
	5 LT 6	3.	0.00	0.00	1.	0.00	0.00	4.	0.00	0.00
	6 LT 7	3.	0.00	0.00	0.	0.00	0.00	3.	0.00	0.00
	7 LT 8	3.	0.00	0.00	0.	0.00	0.00	3.	0.00	0.00
	8 LT *	10.	0.00	0.00	2.	0.00	0.00	12.	0.00	0.00
TWO	LT 0	0.	0.00	0.00	23.	0.00	0.00	23.	0.00	0.00
	0 LT 1	0.	0.00	0.00	5.	0.00	0.00	5.	0.00	0.00
	1 LT 2	1.	0.00	0.00	17.	0.00	0.00	18.	0.00	0.00
	2 LT 3	4.	0.00	0.00	0.	0.00	0.00	4.	0.00	0.00
	3 LT 4	4.	0.00	0.00	0.	0.00	0.00	4.	0.00	0.00
	4 LT 5	4.	0.00	0.00	0.	0.00	0.00	4.	0.00	0.00
	5 LT 6	4.	0.00	0.00	0.	0.00	0.00	4.	0.00	0.00
	6 LT 7	2.	0.00	0.00	0.	0.00	0.00	2.	0.00	0.00
	7 LT 8	2.	0.00	0.00	1.	0.00	0.00	3.	0.00	0.00
	8 LT *	27.	0.00	0.00	1.	0.00	0.00	28.	0.00	0.00
BOTH	LT 0	0.	0.00	0.00	48.	0.00	0.00	48.	0.00	0.00
	0 LT 1	0.	0.00	0.00	11.	0.00	0.00	11.	0.00	0.00
	1 LT 2	1.	0.00	0.00	23.	0.00	0.00	24.	0.00	0.00
	2 LT 3	6.	0.00	0.00	0.	0.00	0.00	6.	0.00	0.00
	3 LT 4	7.	0.00	0.00	0.	0.00	0.00	7.	0.00	0.00
	4 LT 5	8.	0.00	0.00	0.	0.00	0.00	8.	0.00	0.00
	5 LT 6	7.	0.00	0.00	1.	0.00	0.00	8.	0.00	0.00
	6 LT 7	5.	0.00	0.00	0.	0.00	0.00	5.	0.00	0.00
	7 LT 8	5.	0.00	0.00	1.	0.00	0.00	6.	0.00	0.00
	8 LT *	37.	0.00	0.00	3.	0.00	0.00	40.	0.00	0.00

Figure 10 - Time Margins in Passes and Pass Aborts on Page 5 of Printed Output

For pass aborts, the data printed is the pass margin at the time the abort maneuver is initiated.

11. Data on passing and pass abort rates, platoon leaders, and percent of time unimpeded: Summary statistics on passing and abort rates, platoon leaders, and the percent of time unimpeded are printed on Page 6 of the output. This page of output is illustrated in Figure 11.

The passing and pass abort rates are presented as events per veh-mi, which is the exposure measure seen by the driver; and as events per lane or road mi-hr, which is the exposure measure per unit highway length.

The meaning of the number of passes started and aborted is self explanatory. Extensions refer to the situations where a pass being completed around one impeder is extended to pass the next impeder without first returning to the normal line. Leap frog passes are those in which the passer returns to the normal lane between two vehicles in the same platoon. The data under Vehicle Passed are the number of vehicles passed by those in the indicated category; i.e., the vehicle category is associated with the passer.

Program users may find that some algebraic summations do not balance as anticipated. For example, (passes started)-(aborts) + (extensions) may or may not equal vehicles passed. It is necessary to recognize that some counts may be truncated in time or space.

The data on platoon leaders is provided to indicate the categories of vehicles that are impeding flows near the finish lines. These data do not include vehicles traveling alone.

The percent of time unimpeded is a measure of service provided to vehicle categories in the simulated traffic and alignment environment. The complement of percent of time unimpeded is known as the percent time delay; this measure, generated by an earlier version of TWOPAS is the level of service criterion for two-lane highway used in Chapter 8 of the 1985 Highway Capacity Manual.[10]

12. Headway and platoon data: Headway and platoon data are printed in summary form on Page 7 of the output. This page of output is illustrated by the example in Figure 12.

The histograms of headways measured at start and finish lines indicate some characteristics of the traffic flows and the changes in those characteristics in travel from start to finish lines.

The platoon sizes shown in the printed output include the leader; platoons of one vehicle are included to complete the table, although the vehicles traveling alone are not normally considered platoons.

13. Overtaking event data classified by speed differences: A summary of overtaking events classified by speed differences is presented on Page 8 of the printed output, and is illustrated in Figure 13.

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN 30.00 MIN. PAGE 6

PASSES AND ABORTS

VEH. CAT.	STARTED NUM	STARTED /VEH MILE	STARTED /LANE M.HR	ABORTED NUM	ABORTED /VEH MILE	ABORTED /LANE M.HR	EXTENSIONS NUM	EXTENSIONS /VEH MILE	EXTENSIONS /LANE M.HR	LEAP FROP NUM	LEAP FROP /VEH MILE	LEAP FROP /LANE M.HR	VEH PASSED NUM	VEH PASSED /VEH MILE	VEH PASSED /LANE M.HR
DIRECTION ONE															
TRUCKS	1.	0.01	0.25	1.	0.01	0.25	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00
REC.V.	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00
PASS.	66.	0.04	16.40	39.	0.03	9.69	0.	0.00	0.00	4.	0.00	0.99	28.	0.02	6.96
ALL	67.	0.04	16.65	40.	0.02	9.94	0.	0.00	0.00	4.	0.00	0.99	28.	0.02	6.96
DIRECTION TWO															
TRUCKS	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00
REC.V.	1.	0.03	0.25	1.	0.03	0.25	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00
PASS.	94.	0.06	23.36	46.	0.03	11.43	0.	0.00	0.00	14.	0.01	3.48	48.	0.03	11.93
ALL	95.	0.06	23.61	47.	0.03	11.68	0.	0.00	0.00	14.	0.01	3.48	48.	0.03	11.93
DIRECTIONS ONE PLUS TWO			ROAD/ M. HR.			ROAD/ M. HR.			ROAD/ M. HR.			ROAD/ M. HR.			ROAD/ M. HR
TRUCKS	1.	0.01	0.25	1.	0.01	0.25	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00
REC.V.	1.	0.01	0.25	1.	0.01	0.25	0.	0.00	0.00	0.	0.00	0.00	0.	0.00	0.00
PASS.	160.	0.05	39.76	85.	0.03	21.12	0.	0.00	0.00	18.	0.01	4.47	76.	0.02	18.89
ALL	162.	0.05	40.26	87.	0.03	21.62	0.	0.00	0.00	18.	0.01	4.47	76.	0.02	18.89

PLATOON LEADERS AT FINISH LINES

CAT.	DIRECTION ONE NUM	%	% SUM	DIRECTION TWO NUM	%	% SUM	COMBINED NUM	%	% SUM
TRUCKS	2.	9.09	9.09	1.	3.13	3.13	3.	5.56	5.56
REC.V.	1.	4.55	13.64	0.	0.00	3.13	1.	1.85	7.41
PASS.	19.	86.36	100.00	31.	96.88	100.00	50.	92.59	100.00
ALL	22.			32.			54.		

PERCENT OF TIME UNIMPEDED

CAT.	DIRECTION ONE	DIRECTION TWO	BOTH
TRUCKS	59.83	64.29	60.87
REC.V.	48.09	42.12	46.05
PASS.	36.43	32.78	34.54
ALL	38.20	33.50	35.84

Figure 11 - Data on Passing and Pass Abort Rates, Platoon Leaders, and Percent of Time Unimpeded on Page 6 of Printed Output

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

30.00 MIN. PAGE 7

HEADWAYS AND PLATOONS

HEADWAYS AT START LINES

HEADWAYS (SEC)	DIRECTION ONE NUM	%	% SUM	DIRECTION TWO NUM	%	% SUM	BOTH DIRECTIONS NUM	%	% SUM
0 LT 1	0.	0.00	0.00	3.	1.29	1.29	3.	0.65	0.65
1 LT 2	40.	17.24	17.24	50.	21.55	22.84	90.	19.40	20.04
2 LT 3	50.	21.55	38.79	54.	23.28	46.12	104.	22.41	42.46
3 LT 4	27.	11.64	50.43	19.	8.19	54.31	46.	9.91	52.37
4 LT 5	6.	2.59	53.02	5.	2.16	56.47	11.	2.37	54.74
5 LT 10	43.	18.53	71.55	25.	10.78	67.24	68.	14.66	69.40
10 LT 15	20.	8.62	80.17	28.	12.07	79.31	48.	10.34	79.74
15 LT 20	20.	8.62	88.79	12.	5.17	84.48	32.	6.90	86.64
20 LT 99	26.	11.21	100.00	36.	15.52	100.00	62.	13.36	100.00
ALL	232.			232.			464.		

HEADWAYS AT FINISH LINES

HEADWAYS (SEC)	DIRECTION ONE NUM	%	% SUM	DIRECTION TWO NUM	%	% SUM	BOTH DIRECTIONS NUM	%	% SUM
0 LT 1	10.	4.98	4.98	12.	5.80	5.80	22.	5.39	5.39
1 LT 2	90.	44.78	49.75	91.	43.96	49.76	181.	44.36	49.75
2 LT 3	47.	23.38	73.13	34.	16.43	66.18	81.	19.85	69.61
3 LT 4	18.	8.96	82.09	26.	12.56	78.74	44.	10.78	80.39
4 LT 5	2.	1.00	83.08	1.	0.48	79.23	3.	0.74	81.13
5 LT 10	3.	1.49	84.58	3.	1.45	80.68	6.	1.47	82.60
10 LT 15	5.	2.49	87.06	8.	3.86	84.54	13.	3.19	85.78
15 LT 20	1.	0.50	87.56	3.	1.45	85.99	4.	0.98	86.76
20 LT 99	25.	12.44	100.00	29.	14.01	100.00	54.	13.24	100.00
ALL	201.			207.			408.		

PLATOONS AT FINISH LINES

SIZE	DIRECTION ONE NUM	%	% SUM	DIRECTION TWO NUM	%	% SUM	BOTH DIRECTIONS NUM	%	% SUM
1	12.	35.29	35.29	13.	29.55	29.55	25.	32.05	32.05
2	4.	11.76	47.06	9.	20.45	50.00	13.	16.67	48.72
3	4.	11.76	58.82	4.	9.09	59.09	8.	10.26	58.97
4	0.	0.00	58.82	4.	9.09	68.18	4.	5.13	64.10
5-6	1.	2.94	61.76	7.	15.91	84.09	8.	10.26	74.36
7-8	3.	8.82	70.59	1.	2.27	86.36	4.	5.13	79.49
9-10	6.	17.65	88.24	1.	2.27	88.64	7.	8.97	88.46
11-15	1.	2.94	91.18	1.	2.27	90.91	2.	2.56	91.03
16-20	1.	2.94	94.12	4.	9.09	100.00	5.	6.41	97.44
21-30	2.	5.88	100.00	0.	0.00	100.00	2.	2.56	100.00
31-	0.	0.00	100.00	0.	0.00	100.00	0.	0.00	100.00
ALL	34.			44.			78.		

Figure 12 - Headway and Platooning Data on Page 7 of Printed Output

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

30.00 MIN. PAGE 8

OVERTAKING EVENTS CLASSIFIED ON SPEED DIFFERENCE

NUMBER OF EVENTS IN 30.00 MINUTES

DIRECTION ONE

SPEED DIFF (FT/SEC)	NUMBER IN PLATOON 1	2	3	4	5 - 9	10 -14	15 -19	GT 19	ALL
0 LT 10	559.	213.	122.	108.	204.	37.	14.	4.	1261.
10 LT 20	107.	17.	6.	1.	9.	0.	0.	0.	140.
20 LT 30	49.	3.	1.	0.	0.	0.	0.	0.	53.
30 LT 40	21.	2.	1.	1.	0.	0.	0.	0.	25.
40 LT 50	9.	0.	0.	0.	0.	0.	0.	0.	9.
50 LT 60	1.	0.	0.	0.	0.	0.	0.	0.	1.
60 LT 70	0.	0.	0.	0.	0.	0.	0.	0.	0.
70 LT999	1.	0.	0.	0.	0.	0.	0.	0.	1.
ALL	747.	235.	130.	110.	213.	37.	14.	4.	1490.

DIRECTION TWO

SPEED DIFF (FT/SEC)	NUMBER IN PLATOON 1	2	3	4	5 - 9	10 -14	15 -19	GT 19	ALL
0 LT 10	375.	227.	168.	137.	273.	58.	20.	0.	1258.
10 LT 20	51.	14.	11.	4.	6.	1.	0.	0.	87.
20 LT 30	17.	7.	3.	1.	0.	0.	0.	0.	28.
30 LT 40	7.	0.	0.	0.	0.	0.	0.	0.	7.
40 LT 50	2.	0.	0.	0.	0.	0.	0.	0.	2.
50 LT 60	1.	0.	0.	0.	0.	0.	0.	0.	1.
60 LT 70	0.	0.	0.	0.	0.	0.	0.	0.	0.
70 LT999	0.	0.	0.	0.	0.	0.	0.	0.	0.
ALL	453.	248.	182.	142.	279.	59.	20.	0.	1383.

BOTH DIRECTIONS

SPEED DIFF (FT/SEC)	NUMBER IN PLATOON 1	2	3	4	5 - 9	10 -14	15 -19	GT 19	ALL
0 LT 10	934.	440.	290.	245.	477.	95.	34.	4.	2519.
10 LT 20	158.	31.	17.	5.	15.	1.	0.	0.	227.
20 LT 30	66.	10.	4.	1.	0.	0.	0.	0.	81.
30 LT 40	28.	2.	1.	1.	0.	0.	0.	0.	32.
40 LT 50	11.	0.	0.	0.	0.	0.	0.	0.	11.
50 LT 60	2.	0.	0.	0.	0.	0.	0.	0.	2.
60 LT 70	0.	0.	0.	0.	0.	0.	0.	0.	0.
70 LT999	1.	0.	0.	0.	0.	0.	0.	0.	1.
ALL	1200.	483.	312.	252.	492.	96.	34.	4.	2873.

OVERTAKING EVENT RATES

DIRECTION	/VEH MILE	/LANE MILE HOUR
ONE	0.914573	370.3083
TWO	0.842655	343.7157

DIRECTION	/VEH MILE	/ROAD MILE HOUR
BOTH	0.878481	714.0240

Figure 13 - Overtaking Event Summary Classified by Speed Differences on Page 8 of Printed Output

An overtaking event occurs when a vehicle approaches another vehicle from the rear and first responds to its new leader. The first response occurs when the intervening distance, follower-to-leader, grows small enough for the leader to become a factor in the follower's choice of acceleration.

The overtaking event data are stratified by the initial speed difference between follower and leader. The potential hazard associated with an overtaking event is thought to increase with speed difference and with the number of vehicles in the overtaking platoon. The output supplies these factors.

The overtaking event rates are given in events per veh-mi and events per lane or road mi-hr.

Spurious counts may be included on rare occasions.

14. Overtaking events classified by initial acceleration and summary of acceleration noise: Page 9 of the printed output, illustrated in Figure 14, presents summary data on overtaking events classified by initial acceleration and a summary of acceleration noise statistics by direction. The overtaking events considered here are the same events quantified on Page 8. However, the severities of events are indicated here by the initial acceleration used by the overtaking vehicles. (Note that the negative signs for acceleration denote decelerations.)

The acceleration noise results are based on all vehicle review periods within the test time and test section.

15. Summary output for user-selected stations: Summary data collected during test time are printed for each station specified in input. These data represent traffic flow conditions in one direction of travel at the specified location. An example of the output printed for a station at a single-lane location is shown in Figure 15; an example of the output printed for a station in a passing lane section is shown in Figure 16.

The station number and direction number appear on the first two lines together with a description of the station supplied by the user in input. All data are provided by vehicle category and for all categories combined. Where there are two lanes in the specified direction of travel, data are provided by lane and for both lanes combined. For stations with only one lane in the specified direction of travel, the data are printed under the combined lane headings.

The flow rates, percent unimpeded, and percent at desired speed are analogous to the spot data that would be collected by a traffic data recorder placed at the specified location on the roadway during the test time. The average delay rates are formed from values calculated for each vehicle as: delay rate = (5,280/spot speed) - (5,280/desired speed). The average delay rate has units of sec/mi. The averages give equal weight to each vehicle.

RUN NO. 190 BASE CONDITION - SLIGHTLY ROLLING TERRAIN

30.00 MIN. PAGE 9

OVERTAKING EVENTS CLASSIFIED ON INITIAL ACCELERATION (FT/SEC SQR)

NUMBER OF EVENTS IN 30.00MINUTES

DIRECTION ONE

ACCEL.	1	2	3	4	5 - 9	10 -14	15 -19	GT 19	ALL
	NUMBER IN PLATOON								
GT 0	459.	138.	94.	72.	120.	24.	7.	3.	917.
0. -4.99	285.	97.	35.	38.	93.	13.	7.	1.	569.
-5. -9.99	2.	0.	0.	0.	0.	0.	0.	0.	2.
-10.-14.99	1.	0.	1.	0.	0.	0.	0.	0.	2.
-15.-19.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
-20.-24.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
ALL	747.	235.	130.	110.	213.	37.	14.	4.	1490.

DIRECTION TWO

ACCEL.	1	2	3	4	5 - 9	10 -14	15 -19	GT 19	ALL
	NUMBER IN PLATOON								
GT 0	219.	162.	126.	98.	178.	45.	16.	0.	844.
0. -4.99	232.	86.	56.	44.	99.	14.	4.	0.	535.
-5. -9.99	2.	0.	0.	0.	2.	0.	0.	0.	4.
-10.-14.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
-15.-19.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
-20.-24.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
ALL	453.	248.	182.	142.	279.	59.	20.	0.	1383.

BOTH DIRECTIONS

ACCEL.	1	2	3	4	5 - 9	10 -14	15 -19	GT 19	ALL
	NUMBER IN PLATOON								
GT 0	678.	300.	220.	170.	298.	69.	23.	3.	1761.
0. -4.99	517.	183.	91.	82.	192.	27.	11.	1.	1104.
-5. -9.99	4.	0.	0.	0.	2.	0.	0.	0.	6.
-10.-14.99	1.	0.	1.	0.	0.	0.	0.	0.	2
-15.-19.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
-20.-24.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
ALL	1200.	483.	312.	252.	492.	96.	34.	4.	2873.

ACCELERATION NOISE (FT/SEC SQR)

DIRECTION	AVE. ACCEL.	ACCEL. NOISE
ONE	-0.016	0.8300
TWO	-0.017	0.8006
BOTH	-0.017	0.8154

Figure 14 - Overtaking Event Summary Classified on Initial Acceleration and Acceleration Noise Summary on Page 9 of Printed Output

SUMMARY OUTPUT FOR USER-SELECTED STATION

STATION NUMBER 8 MILEPOST 1.25
DIRECTION 1 NUMBER OF LANES IN SPECIFIED DIRECTION 1

	FLOW RATE (VPH)			PERCENT UNIMPEDED			PERCENT AT DESIRED SPEED			AVE. DELAY RATE (SEC/VEH MILE)			
	LEFT	RIGHT	BOTH	LEFT	RIGHT	BOTH	LEFT	RIGHT	BOTH	LEFT	RIGHT	BOTH	
TRUCKS			20.			80.			50.			9.9	TRUCKS
RVS			18.			67.			67.			3.3	RVS
CARS			358.			61.			62.			6.5	CARS
COMB			396.			62.			62.			6.5	COMB

PLATOONING SUMMARY

	LEFT LANE					RIGHT LANE					COMBINED LANES				
	LEADERS		AVE.	MEMBERS		LEADERS		AVE.	MEMBERS		LEADERS		AVE.	MEMBERS	
	NO.	PERCENT	LENGTH	NO.	PERCENT	NO.	PERCENT	LENGTH	NO.	PERCENT	NO.	PERCENT	LENGTH	NO.	PERCENT
TRUCKS											1	2.5	2.00	1	1.1
RVS											3	7.5	4.33	10	10.8
CARS											36	90.0	3.28	82	88.2
COMB											40	100.0	3.32	93	100.0

SPOT SPEEDS (FT/SEC) AND DISTRIBUTION TO LANE

	LEFT LANE				RIGHT LANE				COMBINED LANES			
	MEAN	STD DEV	MIN	PERCENT LEFT	MEAN	STD DEV	MIN	PERCENT RIGHT	MEAN	STD DEV	MIN	
TRUCKS									75.8	13.02	59.2	TRUCKS
RVS									80.2	9.13	63.2	RVS
CARS									80.3	12.27	58.3	CARS
COMB									80.1	12.18	58.3	COMB

Figure 15 - Summary of Traffic Operations at a User-Specified Station with a Single Lane in the Specified Direction of Travel

SUMMARY OUTPUT FOR USER-SELECTED STATION

STATION NUMBER 3 MILEPOST .25
DIRECTION 1 NUMBER OF LANES IN SPECIFIED DIRECTION 2

	FLOW RATE (VPH)			PERCENT UNIMPEDED			PERCENT AT DESIRED SPEED			AVE. DELAY RATE (SEC/VEH MILE)			
	LEFT	RIGHT	BOTH	LEFT	RIGHT	BOTH	LEFT	RIGHT	BOTH	LEFT	RIGHT	BOTH	
TRUCKS	2.	18.	20.	100.	100.	100.	0.	44.	40.	10.4	2.9	3.7	TRUCKS
RVS	4.	12.	16.	100.	100.	100.	0.	50.	38.	4.7	4.9	4.9	RVS
CARS	112.	244.	356.	88.	89.	88.	59.	87.	78.	2.5	0.8	1.3	CARS
COMB	118.	274.	392.	88.	90.	89.	56.	82.	74.	2.7	1.1	1.6	COMB

PLATOONING SUMMARY

	LEFT LANE					RIGHT LANE					COMBINED LANES				
	LEADERS		AVE.	MEMBERS		LEADERS		AVE.	MEMBERS		LEADERS		AVE.	MEMBERS	
	NO.	PERCENT	LENGTH	NO.	PERCENT	NO.	PERCENT	LENGTH	NO.	PERCENT	NO.	PERCENT	LENGTH	NO.	PERCENT
TRUCKS	0	0.0	0.00	0	0.0	3	10.7	2.00	3	8.1	3	7.5	2.00	3	5.4
RVS	1	8.3	5.00	4	21.1	1	3.6	2.00	1	2.7	2	5.0	3.50	5	8.9
CARS	11	91.7	2.36	15	78.9	24	85.7	2.38	33	89.2	35	87.5	2.37	48	85.7
COMB	12	100.0	2.58	19	100.0	28	100.0	2.32	37	100.0	40	100.0	2.40	56	100.0

SPOT SPEEDS (FT/SEC) AND DISTRIBUTION TO LANE

	LEFT LANE				RIGHT LANE				COMBINED LANES			
	MEAN	STD DEV	MIN	PERCENT LEFT	MEAN	STD DEV	MIN	PERCENT RIGHT	MEAN	STD DEV	MIN	
TRUCKS	82.9	0.00	82.9	10.0	81.6	9.12	70.1	90.0	81.7	8.61	70.1	TRUCKS
RVS	80.9	0.32	80.6	25.0	75.9	6.70	63.2	75.0	77.2	6.11	63.2	RVS
CARS	89.7	7.52	67.1	31.5	84.4	10.03	59.1	68.5	86.1	9.62	59.1	CARS
COMB	89.3	7.54	67.1	30.1	83.9	9.98	59.1	69.9	85.5	9.63	59.1	COMB

Figure 16 - Summary of Traffic Operations at a User-Specified Station with a Passing Lane in the Specified Direction of Travel

The platooning summary does not include free vehicles. Platoon leaders are vehicles with one or more platoon members following. A platoon member is a vehicle with a time headway at the station of 4.0 sec or less. Platoon lengths include both the platoon leader and the platoon members.

Spot speed statistics and distributions to lane are presented in the final data set for each station.

16. Summary data for user-specified subsections: The final pages of the printed output for each run present space-averaged traffic data for user-specified subsections of the simulated roadway. Each subsection for which traffic data are printed represents a portion of the simulated roadway in one direction of roadway for the entire test time. Each subsection is bounded by a pair of user-specified stations, which are not necessarily adjacent stations.

Figures 17 and 18 illustrate the printed output for user-specified subsections with one and two lanes, respectively, in a particular direction of travel. The first three lines of output identify the upstream and downstream stations that bound the subsection, the subsection length, the direction of travel, and number of lanes available within the subsection. The number of lanes shown on the printed output is the maximum number of lanes available at any point within the subsection. The number of lanes will be printed as one only if there are no added lanes anywhere within the subsection.

The data for Overall Speeds are determined from data collected at each vehicle review when a vehicle within the subsection is advanced by the simulation program. Consequently, the mean speed printed is a space mean speed. The minimum speed printed is a minimum over space and time. The sample sizes shown on the printed output are the number of vehicle reviews analyzed.

The data for Overall Travel Times and Delays include values based on reference speeds of isolated vehicles shown on Page 2 of the output. The travel time and delay data printed here are analogus to the overall travel time and delay data printed on Page 3, but apply only to one particular user-specified section of the simulated roadway. The ideal travel time is the travel time in sec/mi by vehicle category if each vehicle traveled at the average desired speed for the category. The travel time for the ideal alignment is travel time on straight, level alignment with zero wind. The travel time for actual alignment is travel time of isolated vehicles on the specified alignment when the effects of grades, horizontal curves, downgrade crawl regions, vehicle performance limits, and driver acceleration speed preferences are included. The mean travel time is based on the actual travel times simulated by the model for vehicles which traveled the entire subsection during the test time. The geometric delay is the difference of two reference values: the travel time for actual alignment and for ideal alignment. Note that the geometric delay can be negative when a section is moderately downgraded so vehicles which are performance limited on level alignment can achieve their desired speeds on the actual alignment.

SUMMARY DATA FOR USER-SPECIFIED SECTION

FROM STATION 2 OPPOSING DIRN - MILEPOST 3.00
TO STATION 3 OPPOSING DIRN - MILEPOST 2.00
DISTANCE (FEET) = 5280. DIRECTION 2 NUMBER OF LANES AVAILABLE 1

	OVERALL SPEEDS (FT/SEC)				---------OVERALL TRAVEL TIMES AND DELAYS (SEC/MILE)---------						
CAT.	MEAN	STD DEV	MIN.	SAMPLE SIZES	IDEAL	IDEAL ALIGN	ACT. ALIGN	MEAN	GEO. DELAY	TRAFFIC DELAY	TOTAL DELAY
TRUCKS	70.91	5.21	60.79	298	61.04	62.13	62.70	74.43	0.57	11.73	12.30
RVS	73.16	4.66	64.84	288	61.54	66.39	66.13	72.16	-0.27	6.03	5.77
CARS	72.94	7.65	50.06	14185	60.00	61.01	61.21	72.35	0.20	11.14	11.34
COMB	72.90	7.57	50.06	14771	59.58	60.74	60.94	72.39	0.20	11.45	11.65

	PERCENT OF TIME UNIMPEDED			SAMPLE SIZES (VEH SECONDS)		PERCENT OF TIME NEAR DESIRED SPEED		
CAT	LEFT LANE	RIGHT LANE	COMB LANES	LEFT	RIGHT	LEFT LANE	RIGHT LANE	COMB LANES
TRUCKS			57.38		298.			25.84
RVS			23.61		288.			0.00
CARS			28.02		14185.			28.04
COMB			28.52		14771.			27.45

PASSING DATA (CATEGORY = VEH. PASSING)

	ONE UNIDIRECTIONAL LANE		TWO UNIDIRECTIONAL LANES	
CAT.	NUMBER	NUMBER/ VEH MILE	NUMBER	NUMBER/ VEH MILE
TRUCKS	0	0.000	0	0.000
RVS	0	0.000	0	0.000
CARS	4	0.020	0	0.000
COMB	4	0.020	0	0.000

Figure 17 - Summary of Traffic Operations on a User-Specified Subsection of the Simulated Roadway with a Single Lane in the Specified Direction of Travel

SUMMARY DATA FOR USER-SPECIFIED SECTION

FROM STATION 2 MP 0.00 - BEG OF PASSING LANE
TO STATION 6 MILEPOST 1.00 - END OF PASSING LANE
DISTANCE (FEET) = 5230. DIRECTION 1 NUMBER OF LANES AVAILABLE 2

CAT.	OVERALL SPEEDS (FT/SEC) MEAN	STD DEV	MIN.	SAMPLE SIZES	---------OVERALL TRAVEL TIMES AND DELAYS (SEC/MILE)--------- IDEAL	IDEAL ALIGN	ACT. ALIGN	MEAN	GEO. DELAY	TRAFFIC DELAY	TOTAL DELAY
TRUCKS	81.39	9.09	23.06	643	61.04	62.13	63.08	64.79	0.95	1.72	2.67
RVS	78.05	8.23	25.85	535	61.54	66.39	66.59	67.57	0.20	0.98	1.18
CARS	85.08	10.48	32.67	10922	60.00	61.01	60.78	61.89	-0.23	1.11	0.88
COMB	84.57	10.45	23.06	12100	59.58	60.74	60.59	62.28	-0.15	1.69	1.54

CAT	PERCENT OF TIME UNIMPEDED LEFT LANE	RIGHT LANE	COMB LANES	SAMPLE SIZES (VEH SECONDS) LEFT	RIGHT	PERCENT OF TIME NEAR DESIRED SPEED LEFT LANE	RIGHT LANE	COMB LANES
TRUCKS	83.81	94.80	93.00	105.	538.	43.81	64.13	60.81
RVS	88.50	99.29	97.01	113.	422.	19.47	54.50	47.10
CARS	79.58	93.24	88.10	4114.	6808.	69.13	91.79	83.25
COMB	79.92	93.68	88.75	4332.	7768.	67.22	87.85	80.46

PASSING DATA (CATEGORY = VEH. PASSING)

CAT.	ONE UNIDIRECTIONAL LANE NUMBER	NUMBER/ VEH MILE	TWO UNIDIRECTIONAL LANES NUMBER	NUMBER/ VEH MILE
TRUCKS	0	0.000	0	0.000
RVS	0	0.000	2	0.254
CARS	0	0.000	128	0.732
COMB	0	0.000	130	0.675

LANE CHANGES

LANE CHANGES BY MOTIVATION

% VEH	NUMBER SECONDS NUMBER	VEH MILES	DISTANCE EXIT
AVOID DROP	150	0.8	77.32
AVOID DELAY	35	0.2	
MOVE RIGHT	92	0.5	
COMBINED	277	1.4	

HISTOGRAMS FOR CHANGES TO AVOID LANE DROP

TO DROP	NUMBER
LT 0	0
0 LT 1	1
1 LT 2	2
2 LT 3	5
3 LT 4	14
4 LT 5	6
5 & MORE	122

TO DROP (FT)	NUMBER
LT 0	0
0 LT 200	4
200 LT 400	23
400 LT 600	22
600 & MORE	101

Figure 18 - Summary of Traffic Operations on a User Specified Subsection of the Simulated Roadway with a Passing Lane in the Specified Direction of Travel

The traffic delay is the difference between the mean travel time and the travel time on actual alignment. The total delay is the sum of the geometric delay and the traffic delay.

It should be noted that the reference travel time values for isolated vehicles are based on the specified traffic mix and on the expectation that a full distribution of desired speeds will be represented in the sample. It is frequently the case that the specified vehicle mix and desired speeds are not well represented in the truck and RV categories, because of small sample sizes. The same problem may occur for passenger cars if short test periods and low flows are simulated.

The Percent of Time Unimpeded printed on the output is the percent of vehicle reviews during which the vehicle being processed is not impeded by other vehicles. The sample sizes printed are numbers of vehicle reviews analyzed. Normally, the Percent of Time Near Desired Speed printed on the output will be lower than Percent of Time Unimpeded. Failure to be close to desired speed may be due to performance limitations, the need to recover speed following delay, and driver acceptance of small speed reductions without becoming motivated to pass.

The passing data are categorized by number of lanes available for each direction of travel. This provides a measure by which the passing rates in passing lane sections can be compared with the passing rates on normal two-lane highways. It should be noted that the passing rates for passing lane sections simulated by the TWOPAS model have been found to be extremely high in comparison to field data.[9] Therefore, passing rates simulated for two-lane sections should be used cautiously.

Finally, the printed output presents lane change rates classified by the reason for the lane change and summary data on lane changes made at the lane drop of passing or climbing lane sections.

B. Output Data Files

Two data files are potentially available from the TWOPAS model -- a file containing extra final output and a file containing data needed for fuel consumption calculations. These files are created on FORTRAN Units 4 and 10, respectively, and can be saved for subsequent processing if appropriate Job Control Language for these units is provided.

The extra final output file on Unit 4 was an original feature of the TWOWAF program to provide added output data at specified time intervals within the test period. This feature has not been updated in TWOPAS for use with passing or climbing lane sections, so its use is not recommended.

The fuel consumption data saved on Unit 10 consist of the vehicle type, direction of travel, vehicle speed, vehicle acceleration, and local grade for each vehicle within the test roadway at each review interval.

Existing programs are available for subsequent processing of these data to determine vehicle fuel consumption.[6] It should be noted that there is currently no capability to determine fuel consumption for subsections of the simulated roadway such as individual passing or climbing lanes.

C. Summary Output Utility

A utility program, TWOSUM, can be used to condense the extended output produced by the TWOPAS program (saved on disk or tape) into a one to two-page summary. An example of the summary output information from TWOSUM is shown in Figure 13.

TWOSUM input consists of the entire output of a TWOPAS job, minus the system-produced header of banner information (which should be deleted before running TWOSUM). TWOSUM scans each line of TWOPAS output, searching for specific phrases in the text. Occurrences of the specific strings are summarized as TWOSUM output. It should also be noted that TWOSUM cannot detect or flag errors in the original TWOPAS output; therefore the TWOPAS output should be scanned for problems before executing TWOSUM.

TWOSUM reads from and writes to disk files. Upon completion of a run, you must either print the disk area, or convert the JCL to have the listing go directly to the printer.

***** PROGRAM TWOPAS: RURAL TRAFFIC SIMULATION; OUTPUT SUMMARY *****

```
1RUN NO.     3       SIMULATION CASE STUDY   4 PASSING LANES   SPLIT 70/30 RUN 19
                     VOL = 800.  5 PCT TRUCKS, 15 PCT RVS
0     WARM TIME=   5.000 MINUTES          TEST TIME= 60.000 MINUTES          TOTAL TIME= 65.000 MINUTES
OVERALL TRAVEL TIME=   70.9 SEC, S.D.-   4.9 SEC
OVERALL % TIME DELAYED:  DIR1=  57.1 DIR2-  44.8 COMB-  53.4
```

*** SUMMARY SPOT CHARACTERISTICS ***

STN	LOCATION	DIRN	NL	FLOW	%UNIMP	%DESSP	PSIZE	NFOLL	SPTRK	SPRV	SPCAR	SPALL	%IMP	PFOLL
1	500 FT UPSTREAM OF MP 0.0 (E	1	1	557.0	72.0	70.0	3.7	282.0	56.0	57.1	57.5	57.4	28.0	50.6
2	MP 0.0 (EB)	1	1	558.0	63.0	57.0	3.7	294.0	55.6	54.8	56.1	55.9	37.0	52.7
3	MP 1.25 (EB)	1	1	562.0	31.0	30.0	4.5	400.0	49.8	49.8	51.1	50.8	69.0	71.2
4	MP 2.25 (EB)	1	1	563.0	26.0	21.0	5.8	447.0	48.2	48.5	49.4	49.2	74.0	79.4
5	MP 2.75 (EB) - UPSTREAM OF P	1	1	561.0	23.0	20.0	6.1	453.0	48.3	48.8	49.0	48.9	77.0	80.7
6	MP 3.25 (EB) - IN PASS LANE	1	2	564.0	77.0	61.0	3.0	296.0	53.2	53.2	56.6	55.9	23.0	52.5
7	MP 4.25 (EB) - DOWNSTREAM OF	1	1	553.0	50.0	39.0	4.5	368.0	51.1	49.9	51.7	51.4	50.0	66.5
8	MP 5.25 (EB)	1	1	552.0	40.0	38.0	4.7	374.0	51.1	52.0	52.4	52.3	60.0	67.8
9	MP 6.00 (EB)	1	1	555.0	34.0	28.0	5.5	398.0	49.4	48.9	50.2	49.9	66.0	71.7
10	MP 6.25 (EB)	1	1	558.0	30.0	27.0	5.6	414.0	49.0	49.1	49.6	49.5	70.0	74.2
11	MP 6.50 (EB) - UPSTREAM OF P	1	1	559.0	30.0	24.0	5.8	422.0	47.3	48.5	48.8	48.7	70.0	75.5
12	MP 7.25 (EB) - IN PASSING LA	1	2	563.0	78.0	62.0	3.1	291.0	52.5	53.2	57.3	55.9	22.0	51.7
13	MP 8.25 (EB) - DOWNSTREAM OF	1	1	559.0	49.0	44.0	5.0	373.0	47.7	50.9	52.0	51.5	51.0	66.7
14	MP 9.25 (EB)	1	1	549.0	41.0	37.0	4.6	352.0	50.1	50.7	51.2	51.1	59.0	64.1
15	MP 10.00 (EB)	1	1	544.0	32.0	29.0	5.4	397.0	49.0	49.8	50.0	49.8	68.0	73.0
21	500 FT UPSTREAM OF MP 10.00	2	1	236.0	64.0	58.0	4.2	132.0	54.0	54.0	56.3	55.9	36.0	55.9
22	MP 10.00 (WB)	2	1	236.0	60.0	54.0	4.1	131.0	52.9	52.6	54.8	54.4	40.0	55.5
23	MP 8.75 (WB)	2	1	252.0	40.0	37.0	4.8	165.0	49.2	52.3	51.8	51.8	60.0	65.5
24	MP 7.75 (WB) - UPSTREAM OF P	2	1	248.0	35.0	34.0	4.8	168.0	48.3	51.7	51.4	51.3	65.0	67.7
25	MP 6.75 (WB) - IN PASSING LA	2	2	249.0	81.0	78.0	2.8	113.0	56.6	55.2	58.0	57.3	19.0	45.4
26	MP 5.75 (WB) - DOWNSTREAM OF	2	1	249.0	62.0	60.0	3.8	127.0	54.3	54.0	54.8	54.7	38.0	51.0
27	MP 4.75 (WB)	2	1	253.0	54.0	50.0	3.6	131.0	55.0	53.8	53.5	53.5	46.0	51.8
28	MP 4.25 (WB)	2	1	254.0	51.0	48.0	4.1	144.0	54.2	53.9	52.8	52.9	49.0	56.7
29	MP 3.75 (WB) - UPSTREAM OF P	2	1	255.0	47.0	44.0	4.0	153.0	53.0	53.0	52.6	52.7	53.0	60.0
30	MP 2.75 (WB) - IN PASSING LA	2	2	257.0	87.0	70.0	2.9	102.0	55.2	52.5	57.3	56.6	13.0	39.7
31	MP 1.75 (WB) - DOWNSTREAM OF	2	1	262.0	69.0	63.0	3.8	124.0	54.3	52.9	55.6	55.2	31.0	47.3
32	MP 1.50 (WB)	2	1	261.0	69.0	68.0	3.4	114.0	55.1	55.3	56.1	56.0	31.0	43.7
33	MP 0.75 (WB)	2	1	258.0	62.0	59.0	3.3	116.0	52.5	54.4	54.9	54.8	38.0	45.0
34	MP 0.50 (WB)	2	1	259.0	60.0	58.0	3.3	115.0	53.1	53.8	54.8	54.6	40.0	44.4
35	MP 0.00 (WB)	2	1	255.0	56.0	56.0	3.6	125.0	53.4	54.6	54.1	54.1	44.0	49.0
36	500 FT DOWNSTREAM OF MP 0.00	2	1	257.0	62.0	55.0	3.6	124.0	53.6	53.8	54.1	54.1	38.0	48.2

*** SUMMARY INTERVAL INFORMATION ***

DIRN	FROM	TO	DIST	SPEED	TTIME	MTIME	DELAY	%UNIMP	%NDS	PR1	PR2	VTIME	NVEH
1	2	15	52800.	50.8	394855.	71.0	9.0	42.7	34.9	0.02	1.27	709.6	556.
2	2	15	52800	53.1	170935.	67.9	5.9	55.2	50.2	0.01	0.89	678.9	252.

Figure 19. Example of Summary Output from TWOSUM Utility Program

IV. SIMULATION TEST CASE

This section presents a test case that can be used to verify proper operation of the TWOPAS simulation model. This test case simulates the following conditions:

- An 8.1-mi (43,000 ft) two-lane highway
- Nearly level terrain (±1.5 percent grades)
- Nine horizontal curves
- Approximately 25 percent no-passing zones
- One 1-mi passing lane between coordinates 1000 and 6280 in the No. 1 Direction
- Flow rates of 400 veh/hr in each direction
- Fifty percent of the entering traffic stream traveling in platoons in each direction of travel

The input data set to simulate these conditions for 30 min of test time is illustrated in Figure 20. This input data set follows the input formats described in Section II of this Guide.

The printed output produced by this test case was used to illustrate the output formats in Section III of this Guide. The major portion of the output printed by the test case will consist of the printed data from Figures 1 through 14. Summary data will also be printed for 29 user-specified stations and six user-specified sections; Figures 15 through 18 serve as examples of this output.

```
   19 BASE CONDITION - SLIGHTLY ROLLING TERRAIN
      RUN NO. 19 USING 400 AS THE FLOW RATE AND NEW PS/SL CARDS -1.00MI.
1 3600    2        5.0        60.0       1.0       5.0
2                43000.       17.        12.       800.      2000.      .20
3   400.   50.    1   400.    50.     1
41.006  .0128 .017  .0142 .0005 .02   .02   .0005 .09   .135  .18   .225  .27
52.006  .0128 .017  .0142 .0005 .02   .02   .0005 .09   .135  .18   .225  .27
6  88.0  10.58 -1.5  -2.2   0.   .6293 1.6293 .81   .90
71 150.  150.  150.  150.  150.  150.  150.  150.  150.  150.  150.  150.  150.
82 150.  150.  150.  150.  150.  150.  150.  150.  150.  150.  150.  150.  150.
9    1981      1      5     3     4     50      0
10  .80    .43   .51   .57   .65   .76   .91  1.13  1.34  1.58  2.12
VC  1                          266.      620.       65.        1.0     .957
VC  2                          196.      420.       65.        1.0     .957
VC  3                          128.      284.       65.        1.0     .957
VC  4                           72.      158.       30.        1.0     .957
VC  5                          9.22      78.7       36.
VC  6                          8.64      89.7       28.
VC  7                          8.75      96.0       21.
VC  8                          8.76      97.5       32.
VC  9                         9.277    109.14       13.
VC 10                         9.766    114.89       14.
VC 11                        10.089    118.69       16.
VC 12                        10.429    122.69       17.
VC 13                  3     11.201    131.78       18.
CV         9           1      2800.     1910.       .04      18.00
CV         9           2      6800.     1910.       .04     -18.00
CV         9           3     10800.     1910.       .04      18.00
CV         9           4     14800.     1910.       .04     -18.00
CV         9           5     18800.     1910.       .04      18.00
CV         9           6     22800.     1910.       .04     -18.00
CV         9           7     26800.     1910.       .04      18.00
CV         9           8     30800.     1910.       .04     -18.00
CV         9           9     34800.     1910.       .04      18.00
ST  1     11     11    1      2400.      500.      500.      3400.
ST  1     11     11    2      6400.      500.      500.      7400.
ST  1     11     11    3     10400.      500.      500.     11400.
ST  1     11     11    4     14400.      500.      500.     15400.
ST  1     11     11    5     18400.      500.      500.     19400.
ST  1     11     11    6     22400.      500.      500.     23400.
ST  1     11     11    7     26400.      500.      500.     27400.
ST  1     11     11    8     30400.      500.      500.     31400.
ST  1     11     11    9     34400.      500.      500.     35400.
ST  1     11     11   10     38400.      500.      500.     39400.
ST  1     11     11   11     42400.      500.      500.     43000.
ST  2     11     11    1     43000.      500.      500.     42900.
ST  2     11     11    2     39600.      500.      500.     39000.
ST  2     11     11    3     35600.      500.      500.     35000.
ST  2     11     11    4     31600.      500.      500.     31000.
ST  2     11     11    5     27600.      500.      500.     27000.
ST  2     11     11    6     23600.      500.      500.     23000.
ST  2     11     11    7     19600.      500.      500.     19000.
ST  2     11     11    8     15600.      500.      500.     15000.
ST  2     11     11    9     11600.      500.      500.     11000.
ST  2     11     11   10      7600.      500.      500.      7000.
ST  2     11     11   11      3600.      500.      500.      3000.
RN                     93742469. 99230755. 1120379.  41724931. 81500573.
GD  1     30                    0.       1.5       1.5      2800.
GD  2     30                 2800.       1.5      -1.5      3200.
GD  3     30                 3200.      -1.5      -1.5      4800.
GD  4     30                 4800.      -1.5       1.5      5200.
GD  5     30                 5200.       1.5       1.5      6800.
GD  6     30                 6800.       1.5      -1.5      7200.
GD  7     30                 7200.      -1.5      -1.5      8800.
GD  8     30                 8800.      -1.5       1.5      9200.
GD  9     30                 9200.       1.5       1.5     10800.
GD 10     30                10800.       1.5      -1.5     11200.
GD 11     30                11200.      -1.5      -1.5     12800.
GD 12     30                12800.      -1.5       1.5     13200.
GD 13     30                13200.       1.5       1.5     14800.
GD 14     30                14800.       1.5      -1.5     15200.
GD 15     30                15200.      -1.5      -1.5     16800.
GD 16     30                16800.      -1.5       1.5     17200.
GD 17     30                17200.       1.5       1.5     18800.
GD 18     30                18800.       1.5      -1.5     19200.
GD 19     30                19200.      -1.5      -1.5     21000.
GD 20     30                21000.       1.5       1.5     23000.
GD 21     30                23000.      -1.5      -1.5     25000.
GD 22     30                25000.       1.5       1.5     27000.
GD 23     30                29000.      -1.5      -1.5     29000.
GD 24     30                29000.       1.5       1.5     31000.
GD 25     30                31000.      -1.5      -1.5     33000.
GD 26     30                33000.       1.5       1.5     35000.
```

Figure 20 - Input Data Set for TWOPAS Test Case

```
GD 27   30                   35000.    -1.5     -1.5    37000.
GD 28   30                   37000.     1.5      1.5    39000.
GD 29   30                   39000.    -1.5     -1.5    41000.
GD 30   30                   41000.     1.5      1.5    43000.
PS  1   22    22     1           0.     1.
PS  1   22    22     2         900.    -1.
PS  1   22    22     3        1000.     2.               2.
PS  1   22    22     4        6280.    -1.
PS  1   22    22     5        7400.     1.
PS  1   22    22     6       10400.    -1.
PS  1   22    22     7       11400.     1.
PS  1   22    22     8       14400.    -1.
PS  1   22    22     9       15400.     1.
PS  1   22    22    10       18400.    -1.
PS  1   22    22    11       19400.     1.
PS  1   22    22    12       22400.    -1.
PS  1   22    22    13       23400.     1.
PS  1   22    22    14       26400.    -1.
PS  1   22    22    15       27400.     1.
PS  1   22    22    16       30400.    -1.
PS  1   22    22    17       31400.     1.
PS  1   22    22    18       34400.    -1.
PS  1   22    22    19       35400.     1.
PS  1   22    22    20       38400.    -1.
PS  1   22    22    21       39400.     1.
PS  1   22    22    22       42400.    -1.
PS  2   26    26     1       43000.    -1.
PS  2   26    26     2       42900.     1.
PS  2   26    26     3       39600.    -1.
PS  2   26    26     4       39000.     1.
PS  2   26    26     5       35600.    -1.
PS  2   26    26     6       35000.     1.
PS  2   26    26     7       31600.    -1.
PS  2   26    26     8       31000.     1.
PS  2   26    26     9       27600.    -1.
PS  2   26    26    10       27000.     1.
PS  2   26    26    11       23600.    -1.
PS  2   26    26    12       23000.     1.
PS  2   26    26    13       19600.    -1.
PS  2   26    26    14       19000.     1.
PS  2   26    26    15       15600.    -1.
PS  2   26    26    16       15000.     1.
PS  2   26    26    17       11600.    -1.
PS  2   26    26    18       11000.     1.
PS  2   26    26    19        7600.    -1.
PS  2   26    26    20        7000.     1.
PS  2   26    26    21        6280.    -1.
PS  2   26    26    22        6180.     0.
PS  2   26    26    23        3600.    -1.
PS  2   26    26    24        3000.     0.
PS  2   26    26    25        1100.    -1.
PS  2   26    26    26        1000.     1.
SL       1     1     1    500.             500 - BEGINNING OF TEST ROAD
SL       2     1     2   1000.             MP 0.00 - BEG OF PASSING LANE
SL       3     1     2   2320.             MILEPOST .25
SL       4     1     2   3640.             MILEPOST .50
SL       5     1     2   4960.             MILEPOST .75
SL       6     1     0   6230.             MILEPOST 1.00 - END OF PASSING LANE
SL       7     1     0   6790.             500 FT DOWNSTREAM OF LANE DROP
SL       8     1     3   7600.             MILEPOST 1.25
SL       9     1     0   8920.             MILEPOST 1.50
SL      10     1     4  10240.             MILEPOST 1.75
SL      11     1     0  11560.             MILEPOST 2.00
SL      12     1     0  16840.             MILEPOST 3.00
SL      13     1     0  22120.             MILEPOST 4.00
SL      14     1     0  27400.             MILEPOST 5.00
SL      15     1     0  32680.             MILEPOST 6.00
SL      16     1     0  37960.             MILEPOST 7.00
SL      17     1     0  42990.             MILEPOST 7.95
SL       1     2     0  42990.             OPPOSING DIRN - ENTRY POINT
SL       2     2     1  16840.             OPPOSING DIRN - MILEPOST 3.00
SL       3     2     0  11560.             OPPOSING DIRN - MILEPOST 2.00
SL       4     2     0  10240.             OPPOSING DIRN - MILEPOST 1.75
SL       5     2     0   8920.             OPPOSING DIRN - MILEPOST 1.50
SL       6     2     0   7600.             OPPOSING DIRN - MILEPOST 1.25
SL       7     2     2   6280.             OPP LANE DROP - MILEPOST 1.00
SL       8     2     2   4960.             OPPOSING DIRN - MILEPOST 0.75
SL       9     2     2   3640.             OPPOSING DIRN - MILEPOST 0.50
SL      10     2     2   2320.             OPPOSING DIRN - MILEPOST 0.25
SL      11     2     0   1000.             OPP LANE ADD  - MILEPOST 0.00
SL      12     2     0    500.             OPPOSING DIRN - END OF ROAD
  -1
```

Figure 20 (Concluded)

V. COMPUTER REQUIREMENTS

The TWOPAS model is written in FORTRAN and has been compiled on a FORTRAN-77 compatible compiler. The model is intended to run on an IBM-compatible mainframe computer under an IBM OS/MVS operating system. An example of the Job Control Language required to execute the TWOPAS program using a FORTRAN catalogued procedure is illustrated in Figure 21. Execution of the test run presented in Section IV of this Guide required approximately 0.037 sec of CPU time for each 1-sec of real time simulated.

The FORTRAN source program for TWOPAS is available from the Federal Highway Administration.

```
1   //OIGTWOPA JOB (HBM1,408,C,300,20),CONLEY
    ***  JOB SUBMITTED BY OIG USING HYLBUR                                   JOB 3671
    ***KEYWORD=
    ***ROUTE  PRINT HOLD                                                     * JES2 *
    ***TITLE  SRA TECHNOLOGIES                                               * JES2 *
    ***DISCOUNT                                                              * JES2 *
2   //STEPONE EXEC FORVCALL,NAME='HBM1OIG.THOPAS.NOV.V1.LOAD',DISK=FILE61    * JES2 *
    ***
    ***      EXECUTE (VS FORTRAN) A LOAD MODULE FROM A PDS
    ***
    ***      PAL - 3/19/84
    ***
3   XX PROC  CORE=1500K,                      REGION FOR THE GO STEP
    XX       NAME=,                           DSNAME OF PDS
    XX       PROGRAM=MAIN,                    MEMBER NAME IN PDS
    XX       STORAGE=FILE,                    UNIT FOR PDS
    XX       DISK=                            VOLUME FOR PDS
    ***
4   XXGO      EXEC PGM=&PROGRAM,REGION=&CORE,COND=(8,LE)
    IEF653I SUBSTITUTION JCL - PGM=MAIN,REGION=1500K,COND=(8,LE)
    ***
5   XXFT05F001 DD  DDNAME=SYSIN
6   XXFT06F001 DD  SYSOUT=A,DCB=(RECFM=UA,BLKSIZE=133)
7   XXFT07F001 DD  SYSOUT=B
8   XXFT15F001 DD  SYSOUT=A,DCB=(RECFM=UA,BLKSIZE=133)
9   XXFT16F001 DD  SYSOUT=B,DCB=(RECFM=F,BLKSIZE=80)
10  XXSTEPLIB  DD  DSN=&NAME,UNIT=&STORAGE,VOL=(PRIVATE,RETAIN,SER=&DISK),
    IEF653I SUBSTITUTION JCL - DSN=HBM1OIG.THOPAS.NOV.V1.LOAD,UNIT=FILE,VOL=(PRIVATE,RETAIN,SER=FILE61),
    XX             DISP=SHR
11  //GO.FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(100,10)),
    //  DISP=(NEH,DELETE)
12  //GO.FT10F001 DD UNIT=FILE,SPACE=(TRK,(100,25)),
    //  VOL=SER=FILE61,DISP=(NEH,DELETE),
    //  DSN='HBM1TXM.THOPAS.UNIT10.SEPT.RUN1'
13  //GO.SYSIN DD DSN='HBM1OIG.THOPAS.DATA.RUN19',
    //  UNIT=FILE,VOL=SER=FILE25,DISP=(OLD,KEEP),
    //  DCB=(RECFM=FB,LRECL=80,BLKSIZE=6320)
```

Figure 21 - Example of Job Control Language for Execution of TWOPAS on IBM-Compatible Mainframe Computer