Chapter 4 : DESCRIPTION OF RAMP -WEAVE MODEL

4.1 Introduction:

The developed model in this research uses the CORSIM simulation model. A sequential process is used in the development of the simulation model as shown in Figure 4-1. The principal aim is to model and compare the results for particular weaving scenarios using the simulation model and the HCM.

The following section describes the various assumptions made in CORSIM. This is followed by the adopted modeling methodology adopted. Four different scenarios are described along with their geometric characteristics as given by the HCM. Finally the chapter ends with a table which describes about the various values used in CORSIM to model a similar scenario and their corresponding card type in CORSIM.

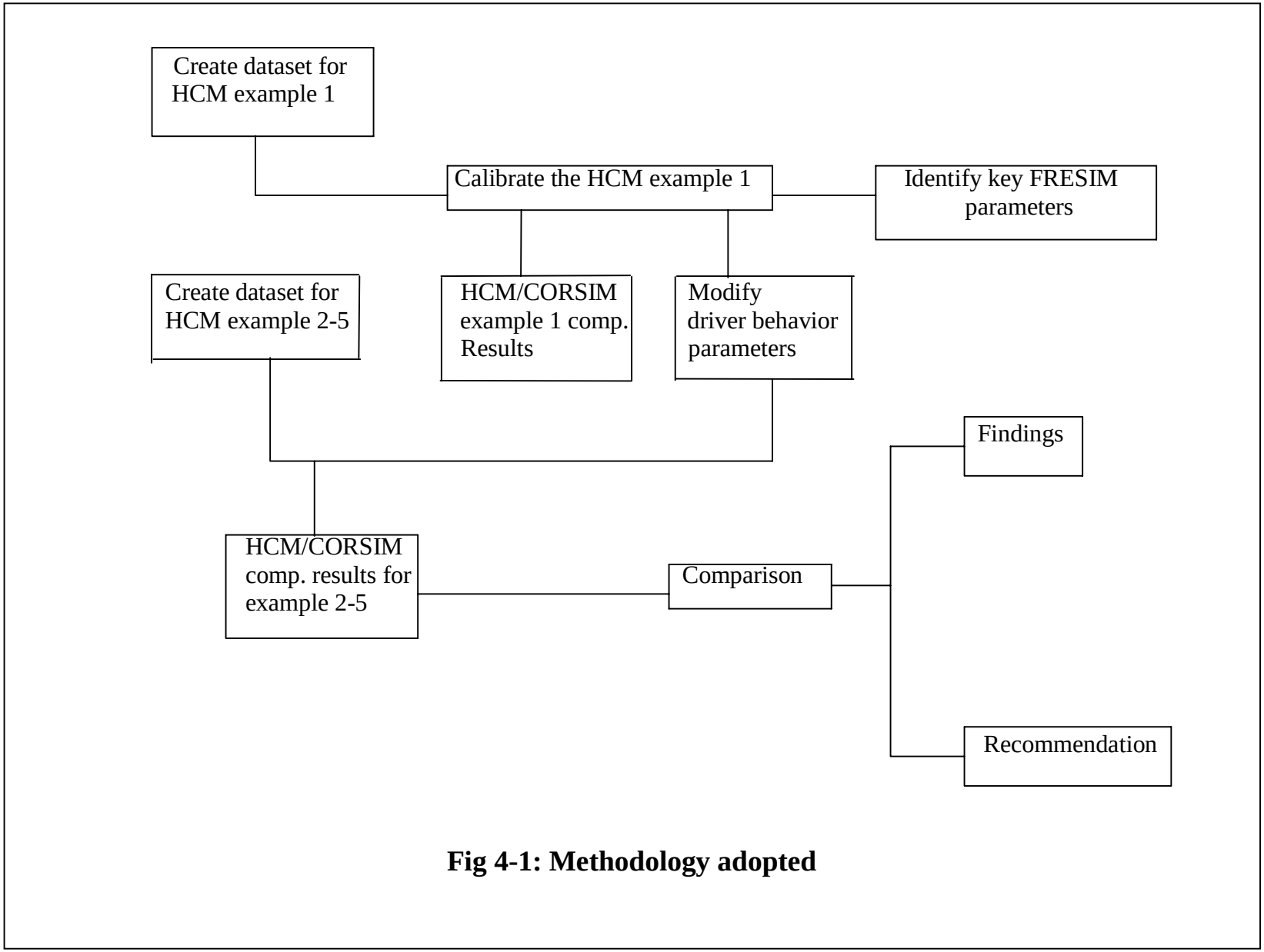


Fig 4-1: Methodology adopted

4.2 Assumptions:

To model a similar type of weaving scenario as the one conducted using the HCM, the following assumptions needs to be done for CORSIM

1. All vehicles adhere to standard specifications, shape and performance
2. Each vehicle follows a particular behavioral pattern which is quantifiable
3. The position of a vehicle is given by the location of its front bumper. The headway between two vehicles is measured from the front bumper of the leading vehicle to the front bumper of the following vehicle.
4. Whenever there occurs a variation in change of velocity of the two cars, then it can be observed that a merge is taking place and the merging vehicle is continuously adjusted in velocity to suit the modified time of the merging.
5. All standard assumptions such as freeway freeflow speed of 65 mph and a ramp flow speed of 45 mph are used. The lane widths are also assumed to be of 12 feet.
6. The whole model is simulated for a period of 15 minutes. A 15 minute simulation run only represents one point of the data sample while HCM method may represent an average value of samples. Although only one run has been made, more runs or longer time may be necessary for a statistically meaningful comparison in chapter 5.

4.3 The Modeling Concept:

The traditional models in HCM predict volumes immediately upstream of the ramp junction. This prediction is based upon full hour volumes and is done in mixed vehicles per hour (vph). These models, while simple and straightforward in prediction of volume become complex when applied to capacity analysis.

In the context of the proposed model construct, several changes have been made to incorporate a similar model existing in HCM

1. Traditional HCM models focus on volume as input and get speed as an output for the entire weaving section. In this study it is assumed that all weaving maneuvers take place in the two right most lanes on the freeway (i.e. lane 1 and the auxiliary lane). Thus the variable of interest is the number of vehicles in both auxiliary lane and the mainline lanes.
2. The 1985 HCM is based upon analysis of flow rates within 15-minute periods of time. To conform to other methodologies in HCM, 15-minute data periods were used in all the models studied.
3. All calibrations are made in passenger car equivalents (pce's). Early and subsequent trials indicated that conversion of heavy vehicles to pce's before calibration resulted in better fitting models. So all pce's are done initially with all following computations based upon converted flow rates.

4.4 Default Values Used in CORSIM Simulation

Table 4-1: Default values used in CORSIM

Description	Default Values	Record Type
Maneuver Time (Sec)	3	70
Sensitivity factor for Car Following (sec)	1	68
Driver Yielding Percentage	20%	70
Lag to Accelerate (sec)	0.3	69
Lag to Decelerate (sec)	0.3	69
Minimum Vehicle Separation (sec)	0.2	70
Desired Free Flow Speed (mph)	65	20
Off-ramp Warning Sign Distance (ft)	2500	20
Mean Startup delay (sec)	1	20
% of Vehicles in each lane	Uniform	50

4.4.1 Assumptions made in CORSIM:

1. Lane changes that are occurring upstream of the on-ramp are anticipatory lane change. Anticipatory lane changes , represent the behavior of motorists who vacate a lane in anticipation of potential slow down caused by low-speed merges
2. Vehicles traveling on the auxiliary lane initiate a mandatory lane change to merge with the main line traffic as soon as their rear bumper crosses the on-ramp gore. Lane changes are initiated upon crossing the advanced anticipatory warning sign located 1500 ft upstream of the ramp gore. This cannot be altered.
3. The 94HCM manual specifies the weaving speed and the non-weaving speed per vehicle. As simulation cannot be done over each vehicle an approximation is done per lane. The assumption is made that the auxiliary lane and the lane adjacent to it carry the most number of weaving vehicles while the other lanes carry the non-weaving vehicles. Hence an average speed over the auxiliary lane and adjacent lane are taken to be the weaving and over the remaining lanes to be the non weaving speed

4.4.2 General modeling strategy used in CORSIM:

To develop a similarly scenario as the highway capacity manual, the network editor ITRAF has been used. The above example has been graphically modeled as a combination of nodes and links. As we know in all the examples described above travel route of each vehicle is predesignated, in CORSIM the same can be done using the concept of origin and destination. The users input the specification for entry volumes at freeway origins and exiting fractions at freeway destinations using RT. 74. The lane, which connects both the on-ramp and the off-ramp gore, is modeled as a full-length auxiliary lane. There are detectors placed (near the on ramp, mid weaving section, near the off ramp) on each lane of the weaving link to observe the vehicle behavior (speed, density, and headway) on each lane within the link. The rates at which vehicles are generated at the entry link on the freeway follow a random normal distribution. The input data set is shown in Appendix A and the output data set for all the different scenarios is shown in Appendix B

4.5 Description of the Models:

A description of the models used in the comparative analysis of HCM and CORSIM is outlined below.

Scenario 1:

Model Description: Analysis of ramp weave section

Geometric Characteristics in HCM: Lane widths are 12 ft and the section is located in a level terrain. There are no lateral obstructions. For conveniences, all traffic flow conditions are given in terms of peak flow rates for ideal conditions, expressed in passenger cars per hour. This is a type A configuration, because both weaving movements are required to make one lane change.

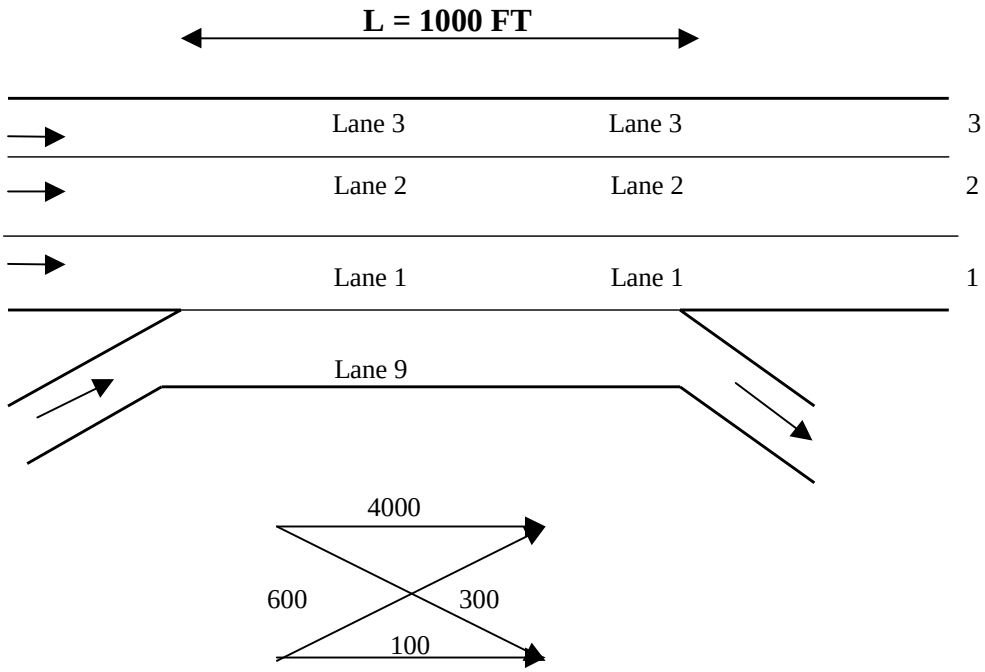


Fig 4.2 : Analysis of a ramp-weave section

Modeling Concept in CORSIM:

Scenario 1 can be modeled in CORSIM as a series of links and nodes. Since CORSIM can handle only a type A configuration, all models incorporate a type A configuration. Table 4-1 gives a brief description of some values used in the input data set (Appendix A) for modeling weaving areas similar to scenario 1. Table 4-1 also gives the default values used in addition to Table 4-2 . Appendix A gives the simulation results.

Table 4-2: CORSIM parameters for scenario 1

Parameters used	Values Used	Card type
Run Control:		
Simulation Time	15 minutes	02
Number of Time periods	1	02
Geometric Characteristics		
a) Weaving Link Length	1000 ft	19
b) On ramp Link length	1500 ft	19
c) Off -ramp link length	1500 ft	19
d) Number of mainline lanes	3	19
e) Number of off ramp lanes	1	19
f) Number of on ramp lanes	1	19
g) No of auxiliary lanes	1	19
h) Type of auxiliary lane	Full Length (3)	19
i) Lane Width	12 ft	
Traffic characteristics:		
a) Main line entry volume	4300 vph	50
b) On - ramp entry volume	700 vph	50

Scenario 2:
Model Description: A constrained operation of Ramp Weave Section
Geometric Characteristics in HCM : The Ramp weave section shown in figure serves demand volumes as indicated in the figure 4-3. All geometric conditions are ideal with 12 ft lanes and no lateral obstructions. The section is located in a generally rolling terrain. Also a ten- percent trucks is reported in this section which is composed of daily commuters.

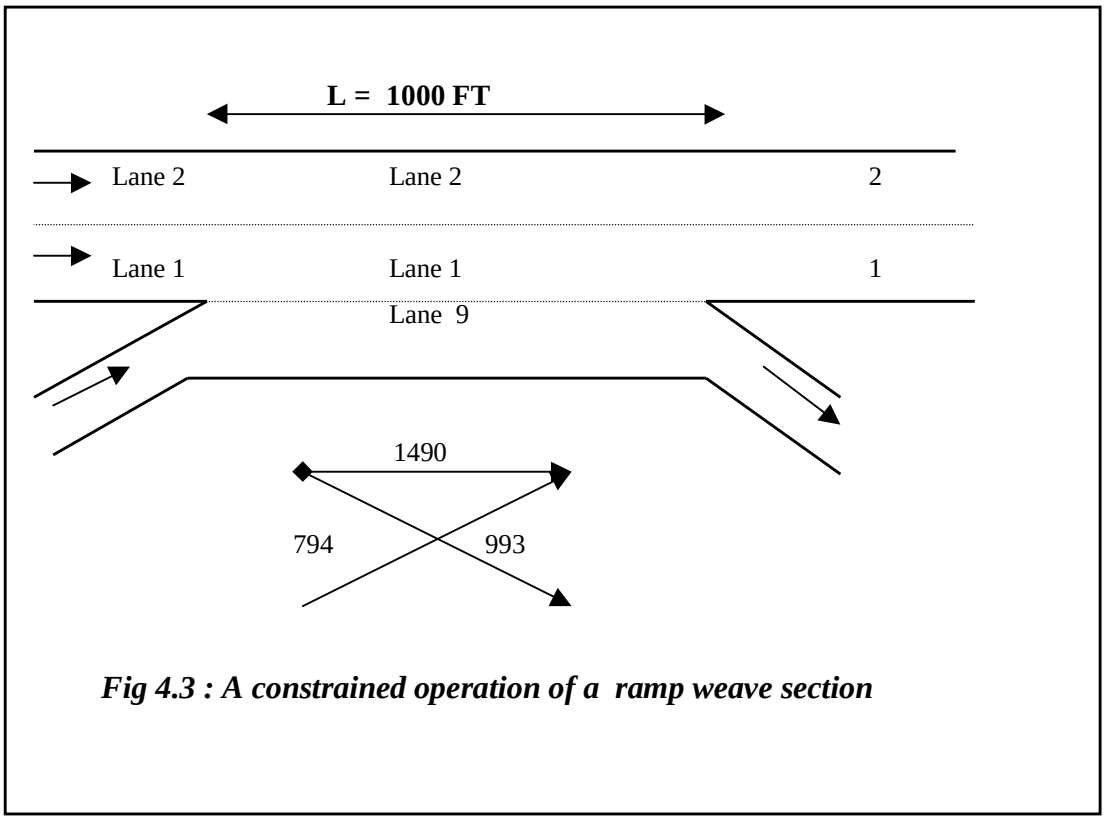


Fig 4.3 : A constrained operation of a ramp weave section

Modeling Concept in CORSIM:

Scenario 2 can be modeled in CORSIM as a series of links and nodes. Since CORSIM can handle only a type A configuration, all models have been modeled to have a type A configuration. Table 4-3 gives a brief description of the some values used in the input data set (Appendix A) for modeling weaving areas similar to scenario 1. Table 4-1 also gives the default values used in addition to Table 4-3 .

Table 4-3: CORSIM parameters for scenario 2

Parameters used	Values Used	Card type
Run Control:		
Simulation Time	15 minutes	02
Number of Time periods	1	02
Geometric Characteristics		
a) Weaving Link Length	1000 ft	19
b) On ramp Link length	1500 ft	19
c) Off -ramp link length	1500 ft	19
d) Number of mainline lanes	2	19
e) Number of off ramp lanes	1	19
f) Number of on ramp lanes	1	19
g) No of auxiliary lanes	1	19
h) Type of auxiliary lane	Full Length (3)	19
i) Lane Width	12 ft	19
j) Truck percentage	10 %	50
Traffic characteristics:		
a) Main line entry volume	2483 vph	50
b) On - ramp entry volume	794 vph	50
c) Freeway freeflow speed	65 mph	19
d) Ramp freeflow speed	45 mph	19
O-D Data:		
a) Mainline to mainline volume	1490 vph	74
b) Mainline to off-ramp volume	993 vph	74
c) On ramp to Mainline volume	794 vph	74

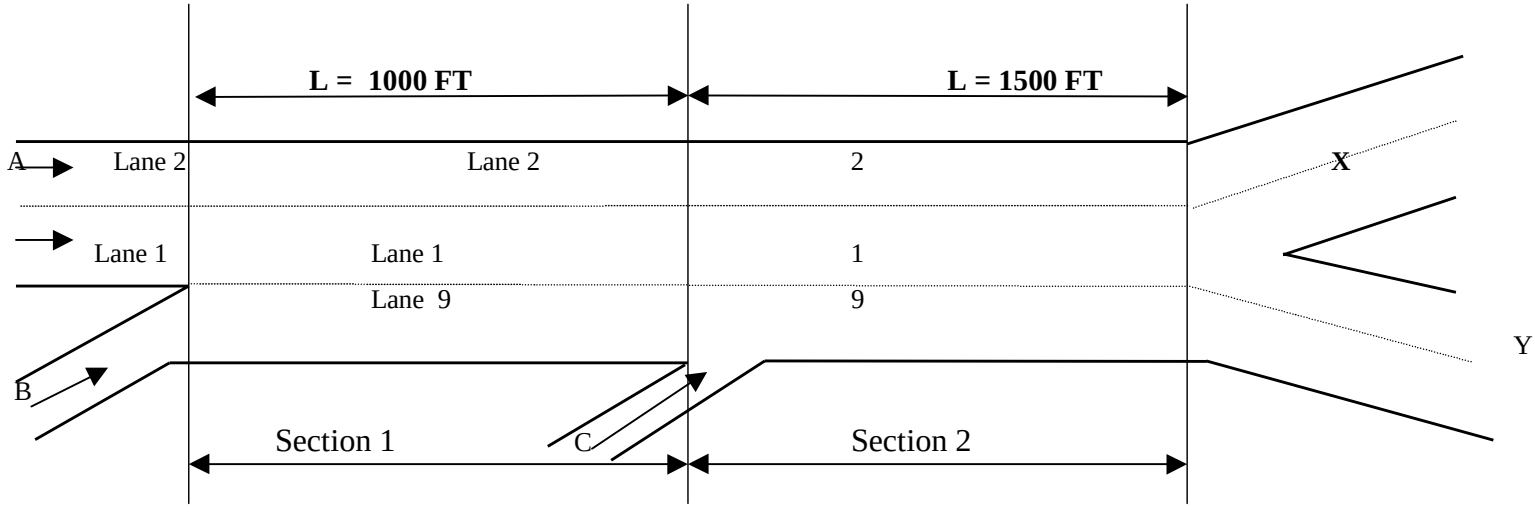
Scenario 3:

Model Description : A Multiple Weaving Area

Geometric Characteristics in HCM : Figure 4-4 shows a multiple weaving area with peak flow rates already given. All geometric conditions are ideal and the length of the weaving section are 1000 ft and 1500 ft. Also the lane widths are 12 ft apart and the terrain is a level terrain.

Modeling Concept in CORSIM:

Scenario 3 is modeled in CORSIM as a series of links and nodes. The model shown in Figure 4.4 is divided into two sections. The section 1 consist of an on -ramp in which the auxiliary lane is modeled as a full-length auxiliary lane and the weaving length is 1000 ft. According to HCM, the section 2 is aligned to the section 1 in such a way that the auxiliary lane of the section 1 is in line with the auxiliary lane of the section 2. The current version of CORSIM cannot model two auxiliary lanes to be aligned to each other. Hence to model a similar scenario in CORSIM a different methodology is adopted. Figure 4-4a shows a similar model used in CORSIM for comparative analysis with Figure 4-4 of HCM. Section 2 is split up into three different links for easier analysis. In this model, section 1 is aligned to lane number 1 in section 2. The on ramp "C " feeds vehicles onto a acceleration pocket which is having a distance of 500 ft. Link 2b shows the end of the acceleration pocket and vehicles merging onto the mainline lane. As CORSIM has a limitation that a mainline cannot feed only the ramp section link 2c is modeled as a deceleration lane having length 500 ft. In addition as CORSIM has a limitation that only a main line lane can be modeled as a lane going towards the on ramp and main line, lane number 1 as indicated in figure 4-4 is modeled as a main line lane. Table 4-4 gives a brief description of the some values used in the input data set (Appendix A) for modeling weaving areas similar to scenario 1. Table 4-1 also gives the default values used in addition to Table 4-4 .



Peak Flow Diagram in PCPH:

a. A-X = 900

b. B-X = 400

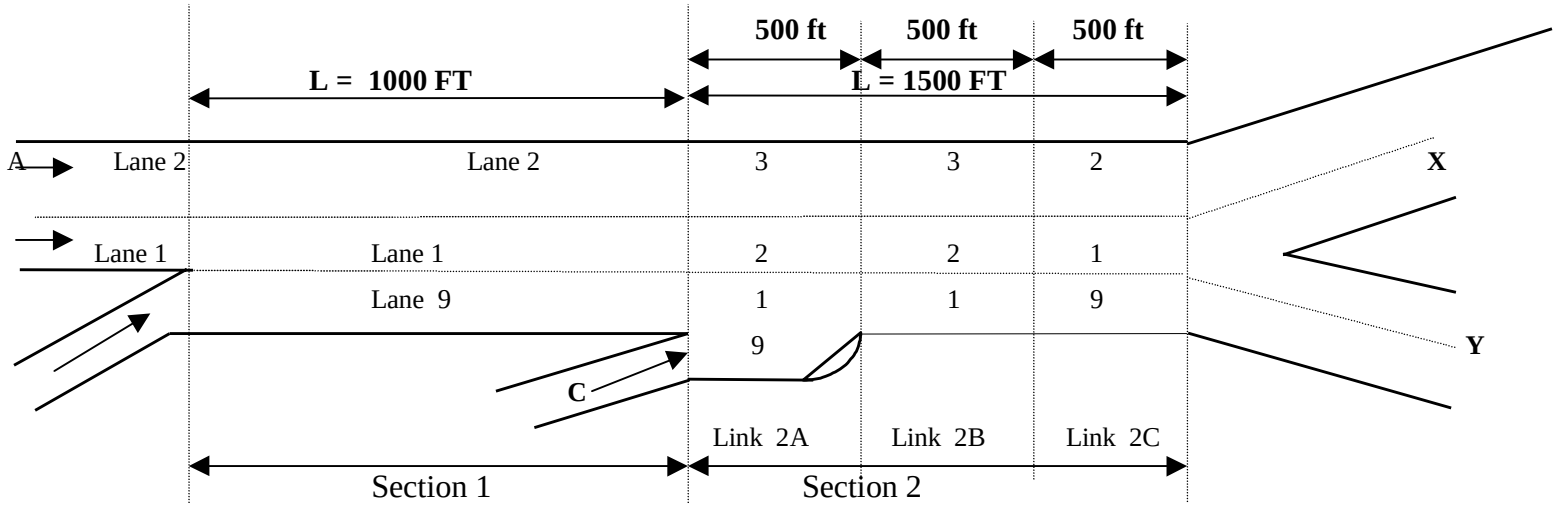
c. A-Y = 1000

d. B-Y = 200

e C-X = 300

f C-Y = 100

Figure 4-4 : A multiple weaving area with flow distribution



Peak Flow Diagram in PCPH:

a. A-X = 900

b. B-X = 400

c. A-Y = 1000

d. B-Y = 200

e C-X = 300

f C-Y = 100

Figure 4-4 A : A multiple weaving area with flow distribution using CORSIM

Table 4-4 : CORSIM parameters for scenario 3

Parameters used	Values Used	Card type
Run Control:		
Simulation Time	15 minutes	02
Number of Time periods	1	02
Geometric Characteristics		
a) Weaving Link Length		
Section 1	1000 ft	19
Section 2	1500 ft	19
b) On ramp Link length		
Section 1	1000 ft	19
Section 2	1500 ft	19
c) Off -ramp link length	1500 ft	19
d) Number of mainline lanes		
Section 1	1500 ft	19
Section 2	1500 ft	19
e) Number of off ramp lanes	2	19
f) Number of on ramp lanes		
Section 1	1	19
Section 2	1	19
g) No of auxiliary lanes		
Section 1	1	19
Section 2	1	19

Parameters used	Values Used	Card type
h) Type of auxiliary lane		
Section 1	Full Length	19
Section 2	Full Length	19
i) Lane Width	12 ft	19
O-D Data:		
a) Mainline to mainline volume	900 vph	74
b) Mainline to off-ramp volume	1000 vph	74
c) On ramp to Mainline volume		
section 1	400 vph	74
section 2	300 vph	74
d) On ramp to Off ramp volume		
section 1	200 vph	74
section 2	100 vph	74

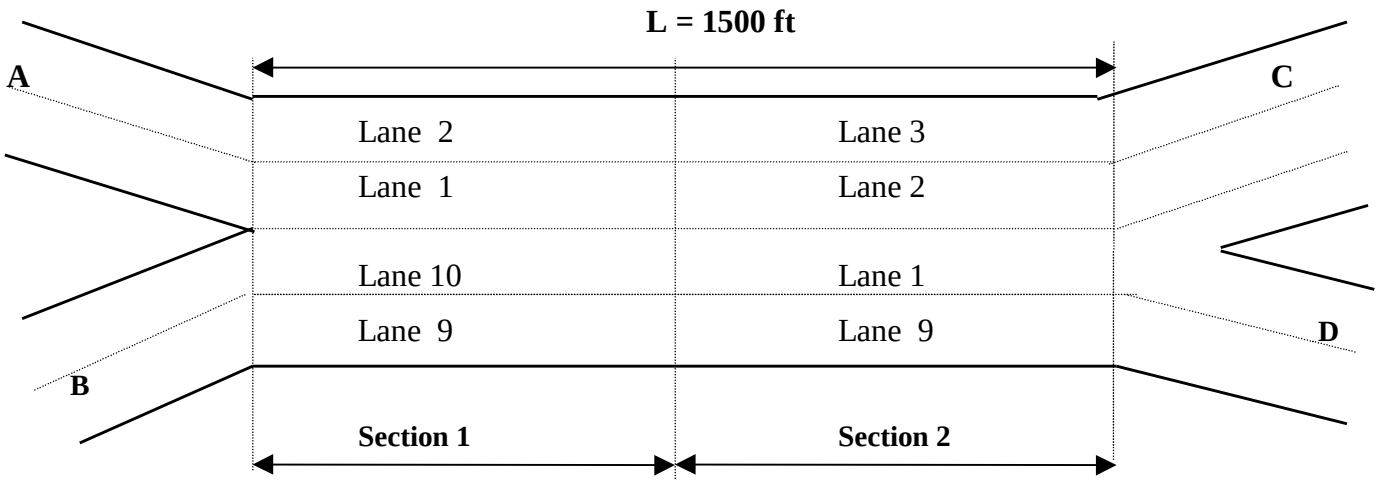
Scenario 4:
Model Description: Analysis of Major Weaving Area
Geometric Characteristics: Figure 4-5 shows a major weaving area. The section is generally located in a level terrain and the lane widths are 12 ft. There are no lateral obstructions. The driver populations are composed primarily of commuters.
Modeling Concept using CORSIM:

Scenario 4 is modeled in CORSIM as a series of links and nodes. Figure 4-5 shows a major weaving area to be modeled in CORSIM. The current version of CORSIM cannot handle the merging and diverging of two freeways. So in order to make an comparative analysis, the on ramp and off ramp are treated as another freeways with higher ramp speed (figure 4-5). Table 4-5 gives a brief description of the some values used in the input data set (Appendix B) for modeling weaving areas similar to scenario 4. Table 4-1 also gives the default values used in addition to Table 4-5 .

Table 4-5: CORSIM parameters for scenario 4

Parameters used	Values Used	Card type
Run Control:		
Simulation Time	15 minutes	02
Number of Time periods	1	02
Geometric Characteristics		
a) Weaving Link Length	1500 ft	19
b) On ramp Link length	1500 ft	19
c) off ramp link length	1500 ft	19
d) Number of mainline lanes		19
Section 1	2	19
Section 2	3	19
e) Number of on ramp lanes	2	19
f) Number of off ramp lanes	2	19
g) No of auxiliary lanes		
Section 1	2	19
Section 2	1	19
h) Type of auxiliary lane		
Section 1	Full length	19
Section 2	Full length	19
i) Lane Width	12 ft	19
Volume:		
a) Main line entry volume	3300 vph	50
b) On - ramp entry volume	2700 vph	50

Parameters used	Values Used	Card type
Freeway freeflow speed	65 mph	19
Ramp freeflow speed	65 mph	19
O-D Data:		
a) Mainline to mainline volume	2100 vph	74
b) Mainline to off-ramp volume	800 vph	74
c) On ramp to Mainline volume	1200 vph	74
d) On-ramp to off ramp volume	1500 vph	74



Peak Flow Rates:

a. A - C = 2100

b. A - D = 800

c. B - C = 1200

d. B - D = 1500

Figure 4-5 : Analysis of a major Weaving Area