Vissim
(Version 11)

Module 4:
Diamond Interchange

Georgia Institute of Technology

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PTV-Vissim (V11) Module 4 Overview

This is the fourth in a series of Vissim modules. Module 1 guides the user through the creation of a corridor which consists of three signalized, pre-time, four-approach intersections. Module 2 adds coordinated-actuated control to the corridor from Module 1. Module 3 adds an unsignalized intersection. Module 4 will familiarize you with the basics of designing a freeway segment with a diamond interchange. Module 4 assumes the user is familiar with the concepts in the prior three modules. In this module, a diamond interchange will be created on the East end of the network developed in Modules 1, 2, and 3. Figure 1 shows the final Module 3 network and Figure 2 shows the network that will be developed by the end of Module 4.

In Module 4 all steps may not be given "click-by-click". Where a skill is already known from the earlier modules only the required action may be stated. For example, "draw the link" instead of step-by-step instructions on how to draw a link. New material and concepts will receive more detailed guidance.
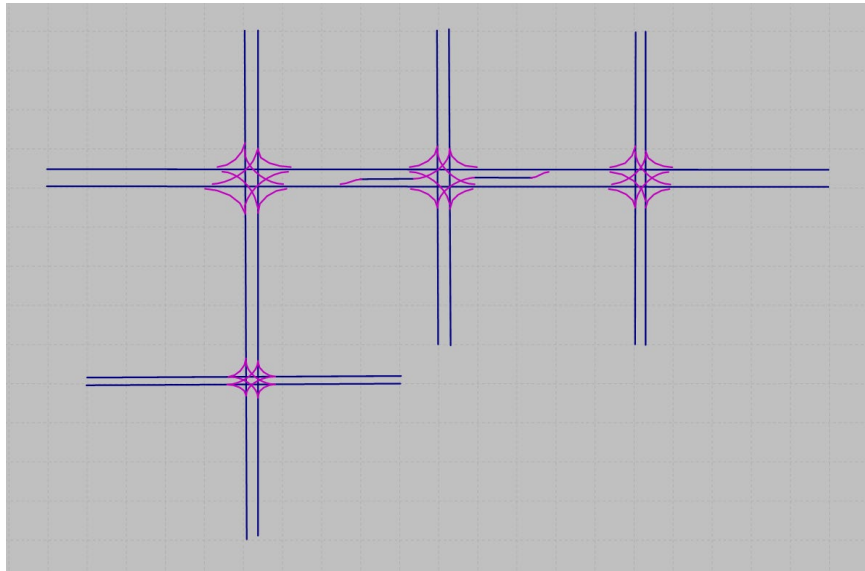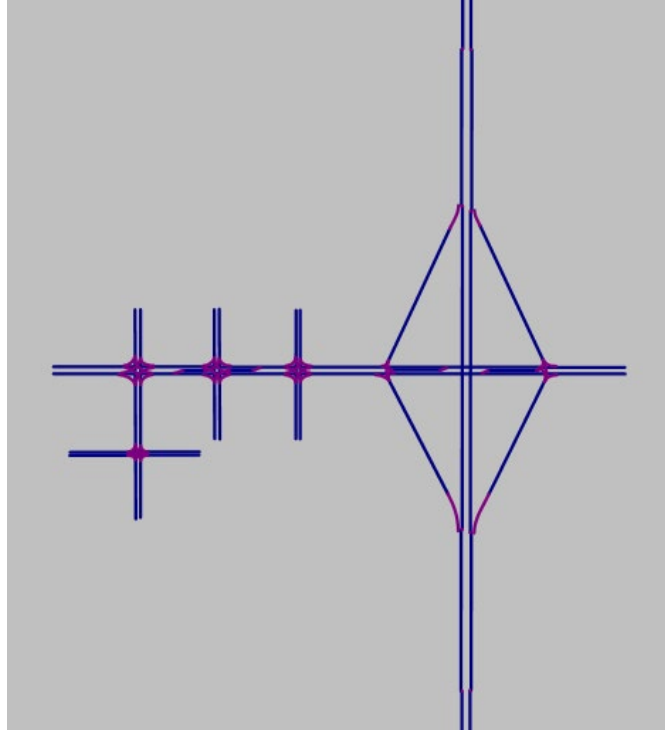

Figure 1: Module 3 Final Network Configuration

Figure 2: Module 4 Final Network Configuration

Module 4 will step through six primary tasks:

1. Saving a Vissim file under a new name and renaming the controller files.
2. Creating the diamond interchange network geometry.
3. Adding RBC control parameters at the interchange on-ramp and off-ramp intersections.
4. Developing the on-ramp and off-ramp freeway geometry.
5. Providing vehicle routes and vehicle inputs.
6. Running and checking the model.

Base Knowledge

For this module, it is assumed that you have a basic understanding of the concepts covered in Modules 1, 2, and 3, including:

- Starting Vissim and Navigating the GUI (Graphical User Interface)
- Links and Connectors
- Signal Controllers, Signal Groups, and Signal Heads
- Ring Barrier Control
- Conflict Areas

IMPORTANT: SAVE FREQUENTLY AS YOU WORK!

Open Module 3 Vissim File

As a first step, we will open the Module 3 Vissim .inpx, as Module 4 builds on the simulation constructed in Module 3.

Step i: Go to *Start → PTV_Vision 2018 → VISSIM 11.*
Step ii: Left-click the *File* pull down menu.
Step iii: Left-click *Open.*
Step iv: Find the Module 3 file and left-click on it. (The file will be wherever you saved it when you completed Module 3.)

(The above assumes a computer running Windows 10, start-up may be slightly different for other operating systems or installations. If you receive a start-up error you are likely having an installation or license issue, please contact your IT support.)

Save the file under a new name

As a first step let's save the model file under a new name. This will allow you to keep your original Module 3 input file.

Step i: Left-click the *File* pull down menu.
Step ii: Left-click *Save as…*
Step iii: In the *File name* box enter the new file name, i.e., *Module 4.*
Step iv: Left-click *Save.* Be sure to note where you are saving the file!

If a pop-up window asks if you want to save your previous results left-click *No.*

For Module 4 we will save the RBC files under new names. For the rationale for this or instruction on how to save the RBC files under new names see Module 2, Renaming Signal Controllers.

Use the following updated RBS file names:

- RBC_Mod4_Buzz_and_Burdell_v1.rbc
- RBC_Mod4_Buzz_and_Ramblin_v1.rbc
- RBC_Mod4_Buzz_and_Pi_v1.rbc

Creating Diamond Interchange Network Geometry

The next step is to add a freeway and diamond interchange to the East end of the current network.

Constructing the interchange will consist of a series of task:

1) extend the arterial,
2) add the freeway mainline,
3) add the ramp *links,*
4) add the *connectors* for the ramp intersections with Buzz Blvd,
5) create the merge area *links* and *connectors,*
6) create the diverge area *links* and *connectors,* and
7) Add the merge and diverge routes and input volumes.

Figure 3 shows the approximate dimensions of the additional network we will create in this subsection.
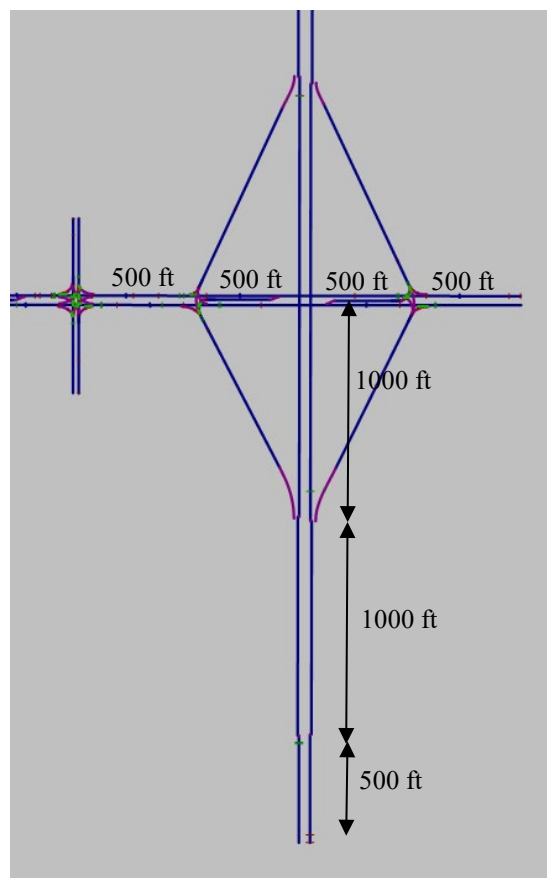
Figure 3: Diamond Interchange Dimensions

Extend Arterial Mainline

To create the link network:

step i.   Select *Links* in *Network Objects*.

step ii.   In the *Network Editor* window left-click the east-most end of the Buzz Blvd EB *link* and drag the endpoint until it is approximately 2000 ft past Pi Pkwy. (See Helpful Hints below for guidance on measuring distance.)

step iii. Repeat step 2 for the Buzz Blvd WB *link*.
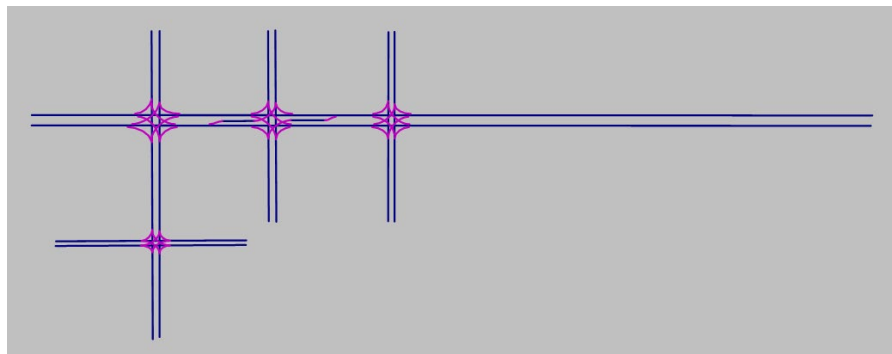
Your network should be similar to Figure 4.

Figure 4: Buzz Blvd EB and WB Arterial Links Extended

Helpful Hints

Typically, when drawing a network, you will be drawing over an aerial photograph of an existing network, allowing you to select locations based on the map. However, in our example there is no aerial so you need to rely on the Vissim scale. (This will also likely be necessary when simulating a new road.) One helpful tool is *measure distance* in the network editor icons. You can get the approximately location for 2,000 ft from Pi Pkwy using this tool (Figure below). Unfortunately, when you go to extend the link this distance measurement will disappear so you will need to remember the location.
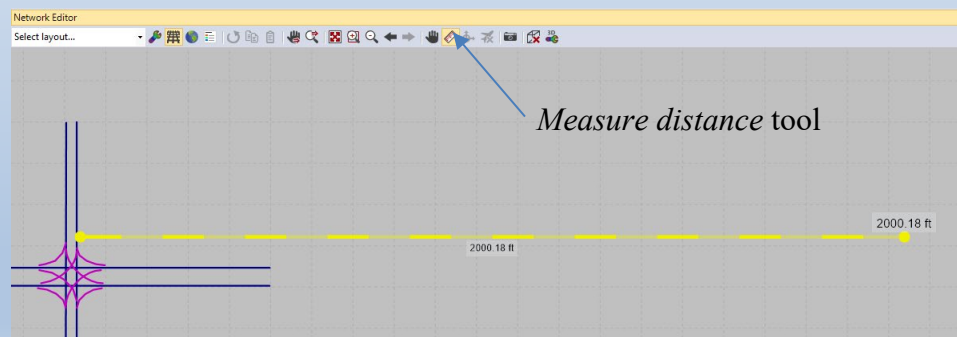
Add Freeway Mainline Links

step i. On Buzz Blvd, approximately 1000 ft. west of the east end of the *link* create a SB link (perpendicular to Buzz Blvd) that starts approximately 2500 ft north of Buzz Blvd and ends approximately 2500 ft south of Buzz Blvd. (You may find it easiest to add a short link in the correct location on Buzz Blvd and then drag the endpoints to the correct length.) Your network should look similar to Figure 5.
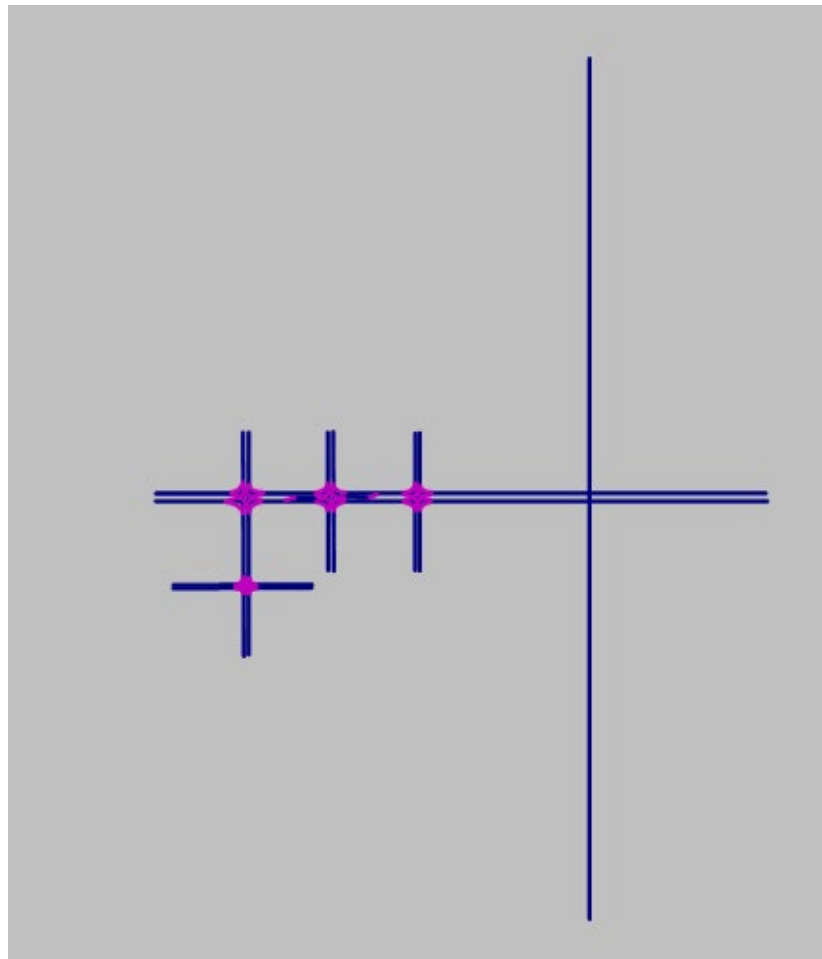

Figure 5: Network with SB Freeway Link

step ii. Double left-click on the *link* to open the *Link* dialogue box, Figure 6. Change the *Name* to Peach Freeway, *Link behavior type* to Freeway, and *Num. of Lanes* to 3. (For now, we will use the *Freeway Link behavior type*. Module 5 will provide additional information on *Link behavior types*.)

step iii. Left-click *OK*. We will leave the remaining items in the *Link* window at their default values.
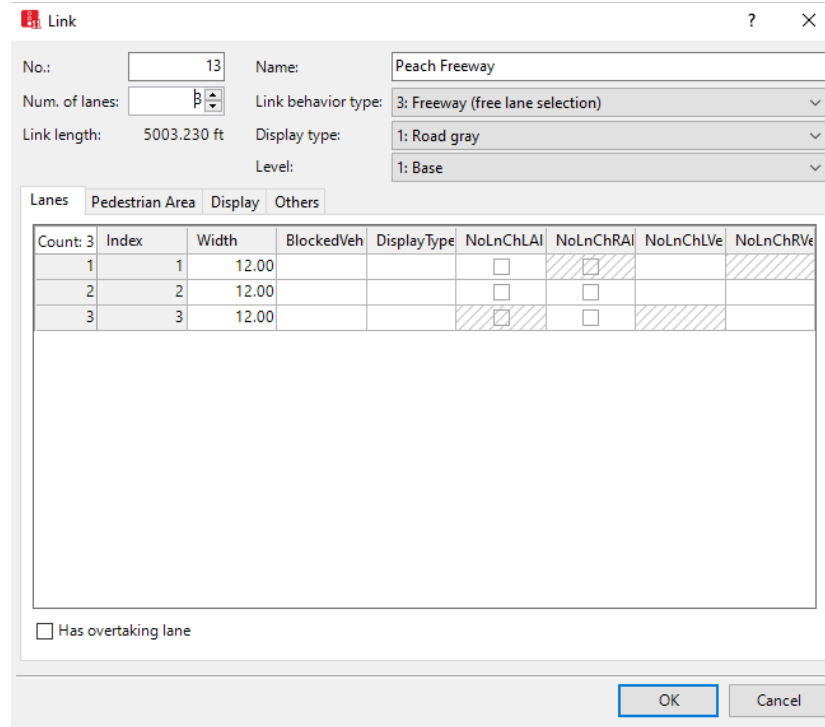
Figure 6: Peach Freeway SB Link Dialogue Box

step iv.   Ctrl-right-click the SB *link* and select *Generate Opposite Direction.*

step v.   Set the *Number of lanes* at 3.

step vi.   Use Ctrl+A to toggle between the lane view and wireframe and adjust the separation between the SB and NB *links* to avoid any overlapping in the graphics. You can add a small median distance as well. (This has no impact on the operation of the model, this is simply to improve the animation.)

Add Ramp Links

step i.   First, draw the *link* for SB off-ramp, Figure 7. Set the distance from where the ramp just meets Buzz Blvd and where the freeway crosses Buzz Blvd at approximately 500 ft. Set the distance from the tip of the ramp gore to the Buzz Blvd overpass at approximately 1000 ft. Be sure you create the *link* in the direction of travel, i.e., exit from the Freeway to Buzz Blvd.

step ii.   Double left-click to open the *Link* Dialogue box, Figure 7. Set the following:
   a.   *Num of lanes*: 1
   b.   *Name*: SB Off-Ramp @ Peach Freeway and Buzz Blvd
   c.   *Link Behavior Type: Freeway (free lane selection)*
   d.   Leave the other values at the default.
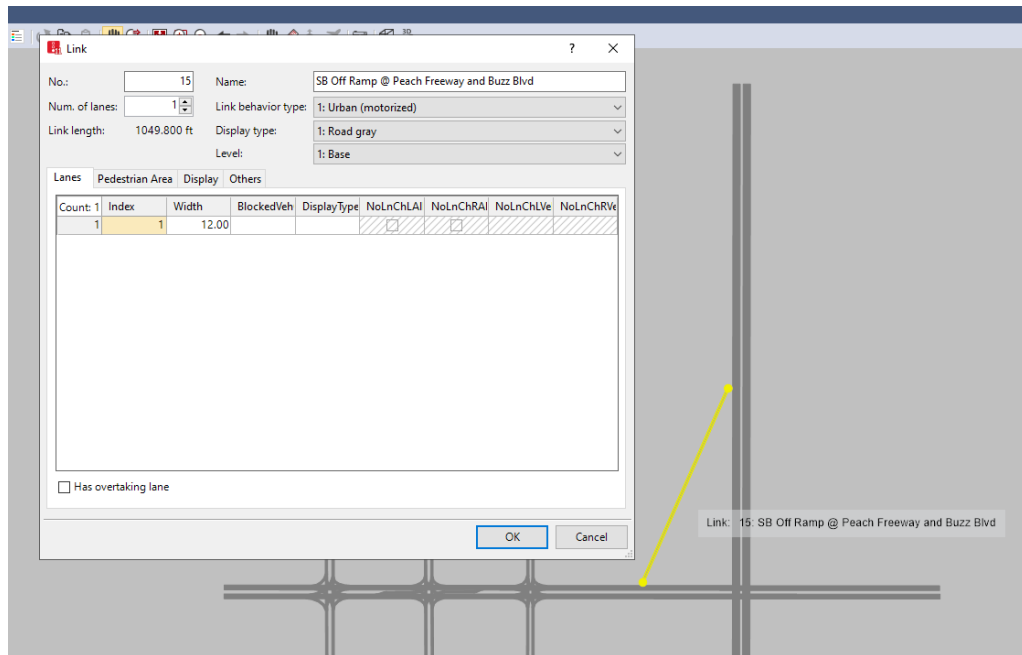
Figure 7: Placement of Southbound Off-Ramp and Link window

step iii. Repeat steps i and ii to draw the ramp *links* in the other three interchange quadrants. Remember, be sure you draw the *links* in the direction of travel. Your interchange should be similar to Figure 8.
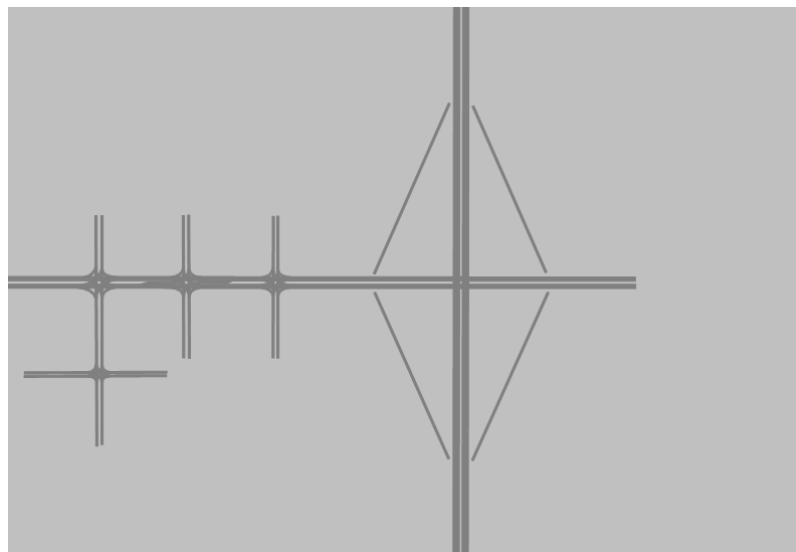

Figure 8: Peach Freeway and Buzz Blvd Ramp Links

Create Ramp Intersections with Buzz Street

The first step will be to create the ramp intersections with Buzz Blvd. Details for the procedures below may be found in Module 1 and Module 2, if necessary. Please refer to these modules to clarify the steps.

For these intersections:

1) Create a 300 ft *link* for a left turn bay from Buzz Blvd WB to the SB on-ramp.
2) Create a 300 ft *link* for a left turn bay from Buzz Blvd EB to the NB on-ramp.
3) Add the *connectors* for the west intersection. Select *Behavior type: Urban (motorized)* for all *connectors*:
   a. SB off-ramp to Buzz Blvd WB (right turn),
   b. SB off-ramp to Buzz Blvd EB (left turn),
   c. SB off-ramp to SB on-ramp (if the ramp-to-ramp movement was forbidden you could eliminate this *connector*, we will include it for completeness),
   d. Buzz Blvd EB to SB on-ramp (right turn), and
   e. Buzz Blvd WB to SB on-ramp (left turn).

   Be sure the right turn *connectors* are further upstream than the left and through *connectors* to allow for implementation of right-on-red behavior.

4) Add the *connectors* for the east intersection. *Select Behavior type: Urban (motorized)* for all *connectors*:
   a. NB off-ramp to Buzz Blvd WB (left turn),
   b. NB off-ramp to Buzz Blvd EB (right turn),
   c. NB off-ramp to NB on-ramp,
   d. Buzz Blvd EB to NB on-ramp (left turn), and
   e. Buzz Blvd WB to NB on-ramp (right turn).

   Be sure the right turn *connectors* are further upstream than the left and through *connectors* to allow for implementation of right-on-red behavior.

The *link* layout from 1) thought 4) should be similar to that in Figure 9.
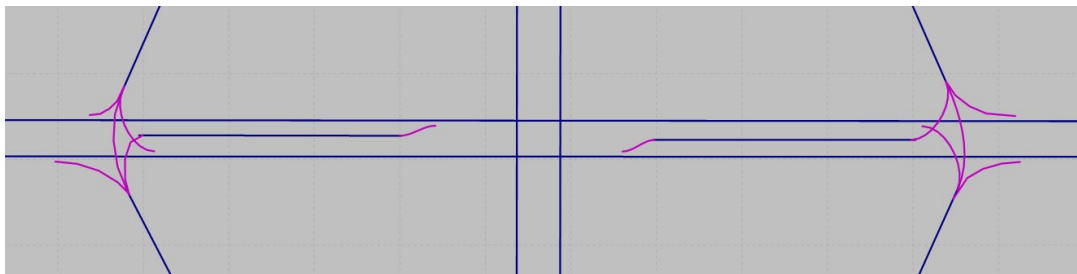

Figure 9: Buzz Blvd and Peach Freeway Arterial Intersections

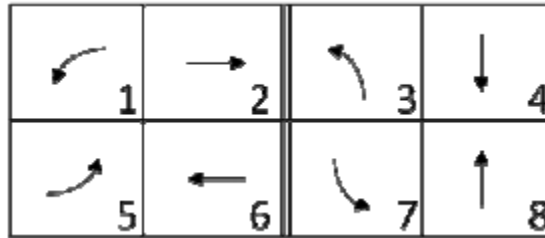5) We will use the same phase assignment as in the prior modules, Figure 10.

Figure 10: Dual Ring Diagram

6) Add a *Signal Controller* for the west-most intersection:
   a. number the intersection: 444,
   b. *name* the intersection: Buzz Blvd and Peach Freeway West Int,
   c. Set the *Type: Ring Barrier Control,* and
   d. Set the RBC *Basic* parameters as in Figure 11.

Basic																
SG Number	1	2	4	6												
SG Name	WB L	EB T	SB	WB T												
Min Green	5	20	8	20												
Veh Extension																
Max 1	40	60	50	60												
Yellow	3	3	3	3												
Red Clearance	2	2	2	2												
Ped SG Number																
Walk																
Ped Clear (FDW)																
Start Up	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Min Recall	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Max Recall	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ped Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Soft Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
NSE Max Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Dual Entry	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 11: Buzz Blvd and Peach Freeway West Most Intersection Signal Controller Basic settings

e. Set the RBC *Pattern 1* parameters as in Figure 12.

Pattern 1				
Signal Group:	**1**	**2**	**4**	**6**
▶ Splits	20	35	35	55
Splits Extension				
Floating Green				
Perm Min Green				
Min Green				
Alternate Max				
Veh Extension				
Transition Min				
Transition Max	24	42	42	66
Force Off				
Permissive Start				
Permissive End				
Max 2	☐	☐	☐	☐
Max 3	☐	☐	☐	☐
Floating Force Off	☐	☐	☐	☐
Coordinated	☐	☑	☐	☑
Walk Rest	☐	☐	☐	☐
Ped Recall	☐	☐	☐	☐
Min Recall	☐	☐	☐	☐
Max Recall	☐	☐	☐	☐
NSE Max Recall	☐	☐	☐	☐
Veh Omit	☐	☐	☐	☐
Ped Omit	☐	☐	☐	☐
Max Inhibit	☐	☑	☐	☑
Lead	☐	☐	☐	☐
CNA	☐	☐	☐	☐

Figure 12: Buzz Blvd and Peach Freeway West Most Intersection Signal Controller Pattern 1 settings

f. Set the RBC *Pattern Schedule* parameters as in Figure 13.

Schedule	
Pattern Number	**Pattern Start Time**
1	0

Figure 13: Buzz Blvd and Peach Freeway West Most Intersection Signal Controller Pattern Schedule settings

g. Set RBC *Sequence* parameters as in Figure 14.

Figure 14: Buzz Blvd and Peach Freeway West Most Intersection Signal Controller Sequence settings

h. Set the RBC *Detector, Vehicle* parameters as in Figure 15.

Figure 15: Buzz Blvd and Peach Freeway West Most Intersection Signal Controller Vehicle Detector settings

i. Set the *Pattern 1* and *Global Values* as in Figure 22.

Figure 16: Buzz Blvd and Peach Freeway West Most Intersection Signal Controller Pattern 1 and Global Variables

7) Add a Signal Controller for the east most intersecting:
   a. number the intersection: 445,
   b. *name* the intersection: Buzz Blvd and Peach Freeway East Int,
   c. Set the *Type: Ring Barrier Control,* and
   d. Set the RBC *Basic* parameters as in Figure 11.

Basic

SG Number	2	5	6	8													
SG Name	EB	EB L	WB	NB													
Min Green	20	5	20	8													
Veh Extension																	
Max 1	60	40	60	50													
Yellow	3	3	3	3													
▶ Red Clearance	2	2	2	2				■									
Ped SG Number																	
Walk																	
Ped Clear (FDW)																	
Start Up	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Min Recall	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Max Recall	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ped Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Soft Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
NSE Max Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 17: Buzz Blvd and Peach Freeway East Most Intersection Signal Controller Basic settings

   e. Set the RBC *Pattern 1* parameters as in Figure 12.

Pattern 1

Signal Group:	2	5	6	8												
Splits	55	20	35	35												
▶ Splits Extension			■													
Floating Green																
Perm Min Green																
Min Green																
Alternate Max																
Veh Extension																
Transition Min																
Transition Max	66	24	42	42												
Force Off																
Permissive Start																
Permissive End																
Max 2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Max 3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Floating Force Off	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Coordinated	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Walk Rest	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ped Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Min Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Max Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
NSE Max Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Veh Omit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ped Omit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Max Inhibit	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lead	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
CNA	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Veh=Ped Permissive	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 18: Buzz Blvd and Peach Freeway East Most Intersection Signal Controller Pattern 1 settings

f. Set the RBC *Pattern Schedule* parameters as in Figure 13.

Schedule	
Pattern Number	**Pattern Start Time**
1	0

Figure 19: Buzz Blvd and Peach Freeway East Most Intersection Signal Controller Pattern Schedule settings

g. Set the RBC *Sequence* parameters as in Figure 14.

Sequence											
Ring 1		2									
▶ Ring 2	5	6	8								
Ring 3											
Ring 4											

Figure 20: Buzz Blvd and Peach Freeway East Most Intersection Signal Controller Sequence settings

h. Set the RBC *Detector, Vehicle* parameters as in Figure 15.

Veh Detectors							
Detector Number	2	5	6	8			
Delay							
Extend							
Carry Over							
Queue Limit							
Detector Mode	No Disconnect	No Disconnect	No Disconnect	No Disconnect	No Disconnect	No Disconnect	No
Added Initial Mode	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	
▶ Call	2	5	6	8			
Yellow Lock							
Red Lock							
Extend SGs	2	5	6	8			
XSwitch SGs							

Figure 21: Buzz Blvd and Peach Freeway East Most Intersection Signal Controller Vehicle Detector settings

i. Set the RBC *Pattern 1* and *Global Values* as in Figure 22.

Figure 22: Buzz Blvd and Peach Freeway East Most Intersection Signal Controller Pattern 1 and Global Variables

8) Add the *Signal Heads* for all west intersection movements, Figure 23. Be sure to change the *Signal Groups* to the correct intersection-lane combinations. Remember to set the right turns (Buzz Blvd EB right turn and Ramp SB right turn) to allow RTOR (i.e., the *Signal Head* is placed downstream of the right turn *connector* and a *stop sign* is added to the *connector*). Set the WB left to allow permitted movements as well as protected, i.e., set the *Or signal group* to the WB through phase, Figure 24.
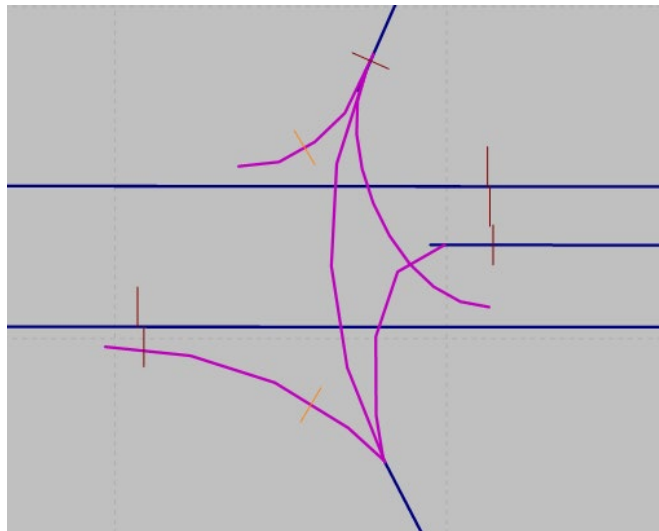
Figure 23: Buzz Blvd and Peach Freeway West Intersection Signal Head and Stop Sign Placement

Figure 24: Buzz Blvd and Peach Freeway, West Most Intersection, WB Left Signal Head Pop-up Window

9) Add Signal Heads for all movements in the west intersection, Figure 25. Again, account for the RTOR using stop signs.
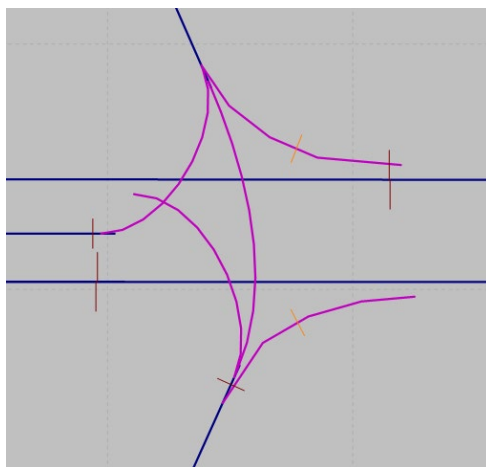
Figure 25: Buzz Blvd and Peach Freeway East Intersection Signal Head and Stop Sign Placement

10) Set the *routes* for the west intersection, use the following turn movement percentages:
   a. SB: right 50%, though 0%, and left 50%,
   b. EB: right 25% and though 75%, and
   c. WB: through 80% and left 20%.

11) Set the *routes* for the east intersection, use the following turn movement percentages:
   a. NB: right 50%, though 0%, and left 50%,
   b. EB: add though 80% and left 20%, and
   c. WB: add right 25% and through 75%.

12) Set the *Conflict Areas* for the west intersection:
   a. WB left receives priority over EB right,
   b. WB thru receives priority over SB right (this is a RTOR conflict),
   c. SB thru receives priority over EB right (this is a RTOR conflict), and
   d. EB thru receives priority over WB left; this is only necessary if you allow permissive lefts.

13) Set the Conflict Areas for the east intersection:
   a. EB left receives priority over WB right,
   b. EB thru receives priority over NB right (this is a RTOR conflict),
   c. NB thru receives priority over WB right (this is a RTOR conflict), and
   d. WB thru receives priority over EB left; this is only necessary if you allow permissive lefts.

14) Add 40 ft Stop Bar *Detectors* for the west intersection, Figure 26.
   a. WB LT and
   b. SB.

15) Add 40 ft Stop Bar *Detectors* for the east intersection, Figure 26.
   a. EB LT and
   b. NB.

16) Add 6ft *detectors* 150 ft upstream for the west intersection, Figure 26.
   a. EB Lanes 1 & 2 and
   b. WB Lanes 1 & 2.

17) Add 6 ft *detectors* 150 ft upstream for the east intersection, Figure 26.
   a. EB Lanes 1 & 2 and
   b. WB Lanes 1 & 2.
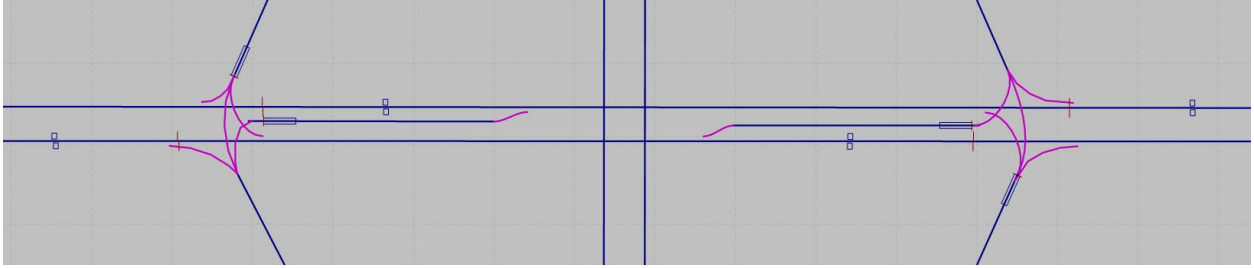
Figure 26: Buzz Blvd and Peach Freeway Detector Layout

Save Often!

While we still need to make the freeway ramp connections this would be a good time to run the model. Carefully watch the animation of the new sections and make sure they are working as expected. It is often a good idea to try trial runs along the way as you develop a model. This can be helpful in catching errors early.

Create On-Ramp to Freeway Merge

To create the on-ramp merge we will split the freeway *link* into several sections, upstream of the start of the ramp acceleration/auxiliary lane, the freeway segment that includes the acceleration/auxiliary lane, and downstream the acceleration/auxiliary lane. Let's start with the SB off-ramp.

step i.   Ctrl-right-click on the SB freeway near what would be the tip of the ramp gore, select *Split Link Here,* Figure 27.

step ii.   Select *OK* (notice the *connector* between the two new *links* is automatically generated.)
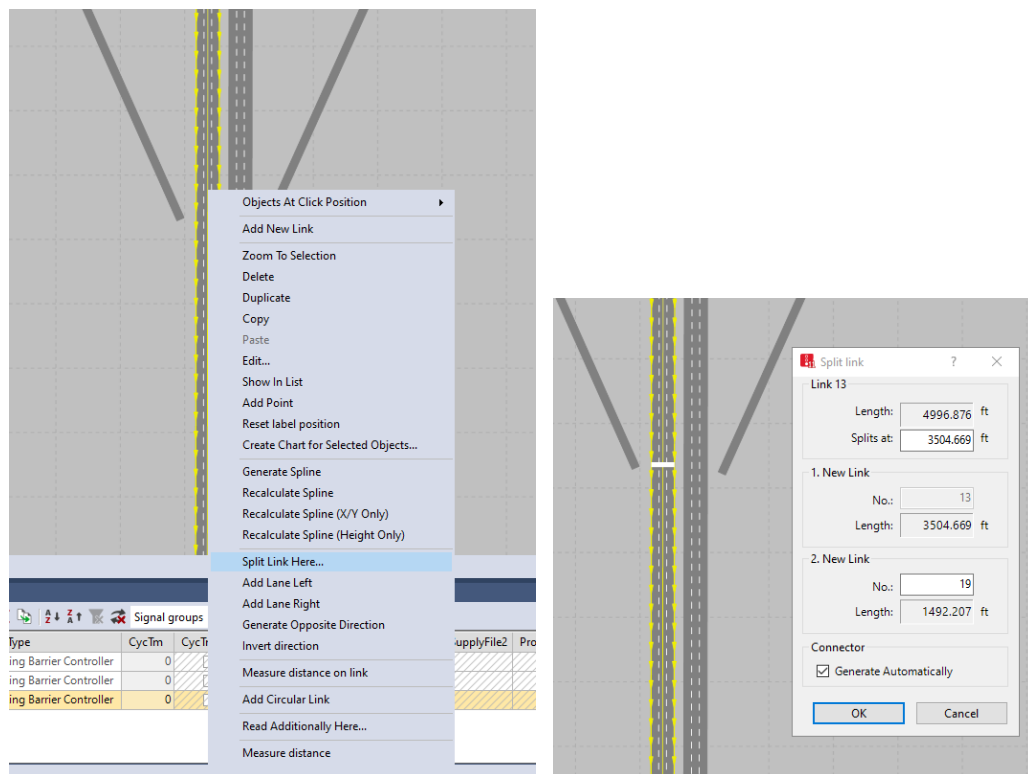
Figure 27: Split SB Link at tip of ramp gore

step iii.   Go approximately 1000' downstream of the *link* split just created and generated another *link* split; i.e., Ctrl-right-click on the *link*, select *Split Link Here,* select *OK*.

step iv.   Ctrl-right-click the SB *link* immediately downstream the ramp gore.

step v.   Select *Add Lane Right* (this new lane will be the acceleration/auxiliary lane).

step vi.   Next, create a *connector* from the end of the ramp to the auxiliary lane you just created. Right-click the end of the ramp, while holding down the right mouse button drag the *connector* to start of the auxiliary lane.

step vii.   Release the button when the *connector* connects to the freeway auxiliary lane.

step viii.   In the *Connector* Dialogue box (Figure 28) set:

    a. *Name*: SB On-Ramp at Peach Freeway and Buzz Blvd to Aux lane,

    b. *Behavior Type: Freeway (free lane selection),*

    c. *from link*: Lane 1,

    d. *to link*: Lane 1, and

    e. *Spline*:10.

step ix.   Select *OK.*

(You may want to grab the end of the ramp *link* and move it to a location that allows for a longer *connector* between the ramp *link* and auxiliary lane. You will then need to open the *Connector* window and set the *Spline* again (change to 11). Changing the *connector* length will not have a significant impact on model operation but the animation will look better. As mentioned previously, if we had an underlying aerial we would set the ramp and *connector* positions to follow the image.)
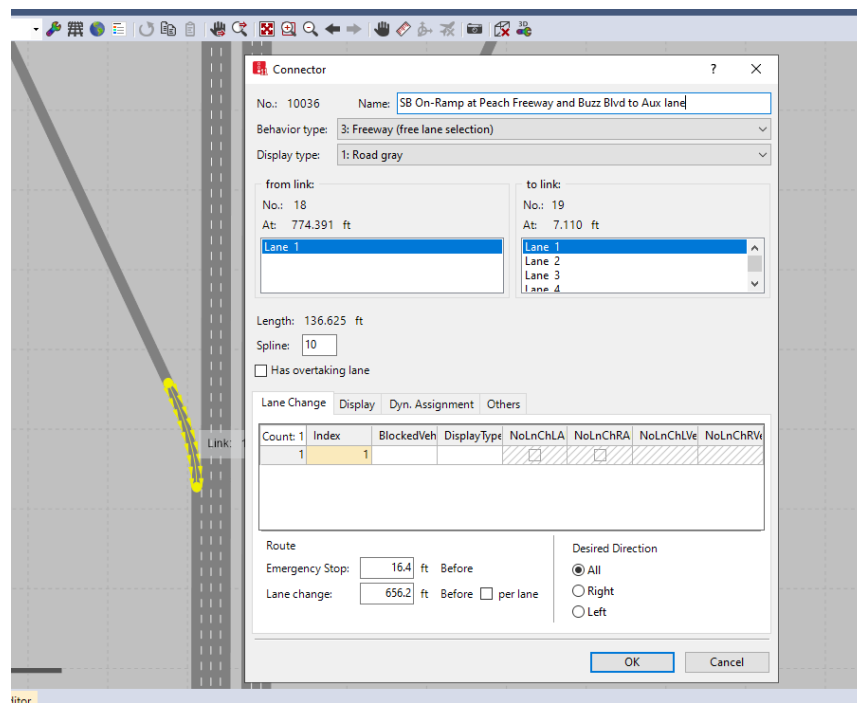
Figure 28: On-Ramp SB Connector and Connector Dialogue Window

Your ramp junction should now look similar to Figure 29.
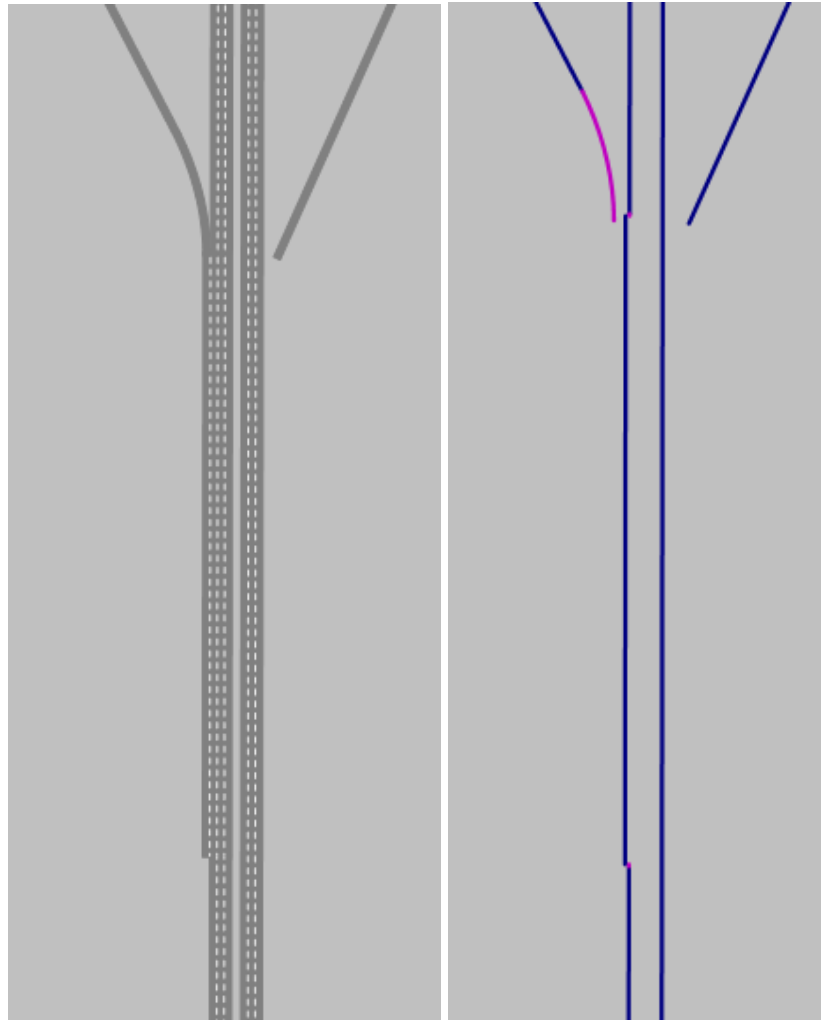
(a)   (b)

Figure 29: SB On-Ramp Junction, (a) lane view and (b) wireframe view

step x.	Select the *connector* at the downstream end of the freeway link with the auxiliary lane.
step xi.	In the *Connector* dialogue box set:

a. *Emergency Stop*: 250ft,
b. *Lane change*: 1050ft,
c. Make sure *from link* has lanes 2, 3, and 4 selected, and
d. Make sure *to link* has lanes 1, 2, and 3 selected.

step xii.	Select the *Vehicle Route* icon in *Network Objects*.
step xiii.	Place a *route* starting on the on-ramp, just south of the end of the intersection routes to **downstream** of the *connector* connecting the 5-lane freeway segment to the 4-lane freeway segment, Figure 30. Name the *route* Peach On-Ramp SB Ramp.

step xiv.   Place a *route* on the Peach Freeway starting just downstream of the off-ramp diverge to downstream of the *connector* connecting the 5-lane freeway segment to the 4-lane freeway segment, Figure 30. Name the *route* Peach On-Ramp SB Mainline.

Add new Static Vehicle Ro
On link: 20: Peach Freew
At: 8

(a)   (b)
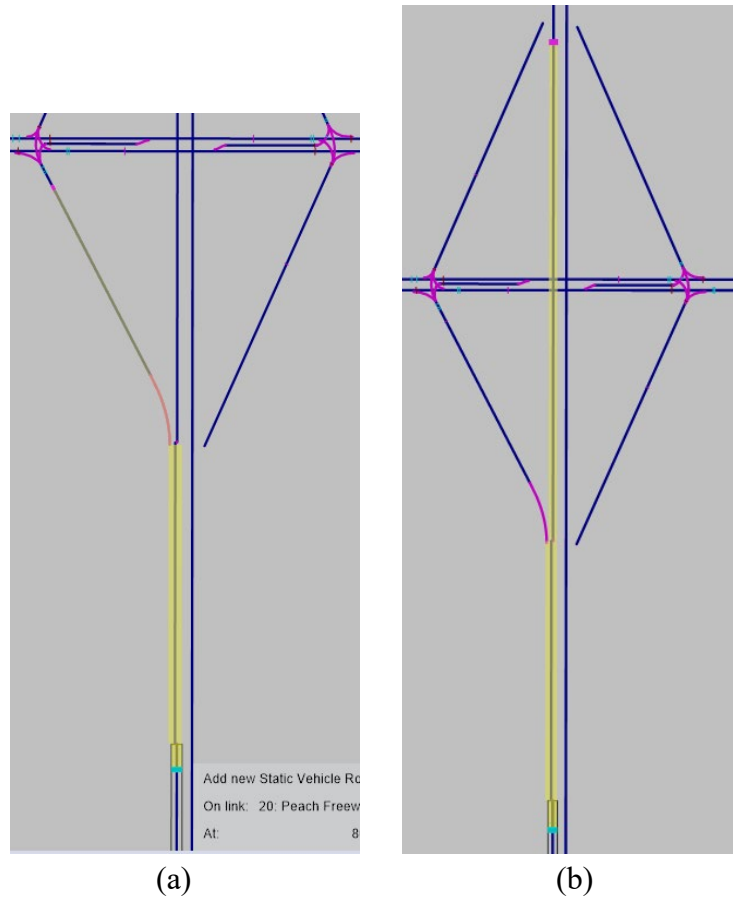
Figure 30: Peach Freeway SB On-Ramp Routes (a) from Buzz Blvd and (b) from Peach Freeway mainline

step xv.   Select the *Vehicle Inputs* Icon and place a 1500 veh/hr input on Peach Freeway SB.

If you run the model you should see vehicles come down the off-ramp and enter the freeway. Test the model, see how it works. See the critical concepts on the next page to better understand the operation of the on-ramp.

step xvi.   Repeat Steps i through xv for the NB on-ramp.

Critical Concepts

There are a number of critical interactions occurring on the ramp. The key is to understand the interaction between *routes* and *connectors*. If a vehicle is on a *route* that includes a *connector* the vehicle will adhere to the *connector emergency stop* and *lane change* distances. The *lane change* distance represents the point at which a vehicle will start attempting to change lanes to follow a route (you will notice vehicles turn on their turn signal indication at this point). Once within the *lane change* distance from the *connector,* the vehicle's objective is to change to a lane that will not require a lane change when the vehicle reaches the *connector*. The vehicle will make any necessary lane changes prior to reaching the *emergency stop* distance from the *connector*. (If there are multiple *connectors* on the route the vehicle follows the *emergency stop* and *lane change* distances for the next *connector* on its path.)

For example, on our model, we have placed a *route* from upstream on the ramp *link* to past the downstream ramp *connector* at the auxiliary lane drop (Figure 30a). To arrive at the *connector* a vehicle MUST change lanes from the auxiliary lane to the mainline lanes. The *emergency stop* represents the last possible point the vehicle will stay in the auxiliary lane. If the vehicle is unable to merge it will stop by this point and wait to merge into the mainline. For instance, if there was a taper this would represent the last point a vehicle could be in the auxiliary lane without physically encroaching into the path of vehicles in the adjacent main line. For existing conditions, the *emergency stop* should be set to the farthest downstream point where vehicles are observed to merge from the auxiliary lane to the mainline. For a new roadway, this point needs to be set based on engineering judgment and an understanding of typical driving behaviors for local conditions.

For our example, vehicles entering on the ramp will start considering a *route*-based necessary lane change 1050 ft upstream of the *connector*, meaning they may merge anywhere along the auxiliary lane, prior to the *emergency stop*. (A **necessary** lane change is a lane change **required** to stay on the assigned route, as opposed to a **free** lane change in which a vehicle makes a **discretionary** lane change attempting to enhance its position in traffic, i.e., change to a faster lane.)

The *lane change* distance also represents the last point on a route, prior to the connector, at which a vehicle will make a discretionary lane change to a lane that does not go to the *connector* without requiring a lane change. For instance, consider a *lane change* distance shorter than the auxiliary lane length on the mainline route (Figure 30b). A mainline vehicle following a slower vehicle in the lane adjacent to the auxiliary lane might change lanes into the auxiliary lane to try to pass the slower vehicle. The mainline vehicle is not aware that it will need to switch out of the auxiliary lane to stay on its *route* as it has not yet within a *lane change* distance. To avoid this behavior, it is important that the *lane change* distance extend upstream of the *link* with the auxiliary lane.

These two parameters are critical in the "smoothness" of the flow of the merge. When calibrating a model, the *emergency stop* and *lane change* distances should be adjusted to achieve the desired flow prior to any underlying driver behavior model parameter adjustments, e.g., Wiedemann parameters. Only when the expected behaviors cannot be achieved through these adjustments should you adjust underlying *driver behavior* model parameters.

A couple of quick "don'ts:"

1) Do not attach a *connector* from a ramp directly into the mainline lanes, always use an auxiliary lane. (You might do this for a Yield or Stop controlled merge, but this would be rare in a freeway situation. For a diverge it may be ok to connect a *connector* directly from the mainline to the ramp if there is not an auxiliary lane in the field.)
2) Do not use a separate *connector* for the auxiliary lane. Vehicles will not be able to merge or track the vehicles in the mainline to find a gap, until the *connector* ties into the mainline.

In Module 5 additional discussions will be provided on *lane change* and *emergency stop* distances, as well as an alternate way to construct an on-ramp merge.

Create Freeway to Ramp Diverge

The steps to create the off-ramp diverge are similar to that of the merge. We will split the freeway *link* into several sections: upstream of the start of the deceleration/auxiliary lane, the freeway segment that includes the deceleration/auxiliary lane, and downstream the deceleration/auxiliary lane. Let's start with the NB off-ramp.

step i.   Ctrl-right-click on the NB Freeway near what would be the tip of the ramp gore, select *Split Link Here.*

step ii.   Select *OK* (notice the *connector* between the two new *links* is automatically generated).

step iii. Go approximately 1000 ft upstream of the link split just created and generated another link split, i.e., Ctrl-right-click on the *link*, select *Split Link Here,* select *OK.*

step iv.   Ctrl-right-click the NB *link* immediately upstream the ramp gore.

step v.   Select *Add Lane Right*, this new lane will be the deceleration/auxiliary lane.

step vi.   Next, create *a connector* from the downstream end of the auxiliary lane; i.e., right-click the end of the auxiliary lane, while holding down the right mouse button drag the connector to the start of the ramp. (Before doing this you may

want to adjust the location of the ramp *link* to allow for a smoother flow between the auxiliary lane and the ramp.)

step vii.   Release the button when the *connector* connects to the freeway auxiliary lane.

step viii. In the *Connector* dialogue box (Figure 31) set:
  a. *Name*: NB Off-Ramp at Peach Freeway and Buzz Blvd,
  b. *Behavior Type: Freeway (free lane selection),*
  c. *from link*: Lane 1,
  d. to link: Lane 1,
  e. Spline:10,
  f. *Lane change*: 1200ft, and
  g. Check the *per lane* box.
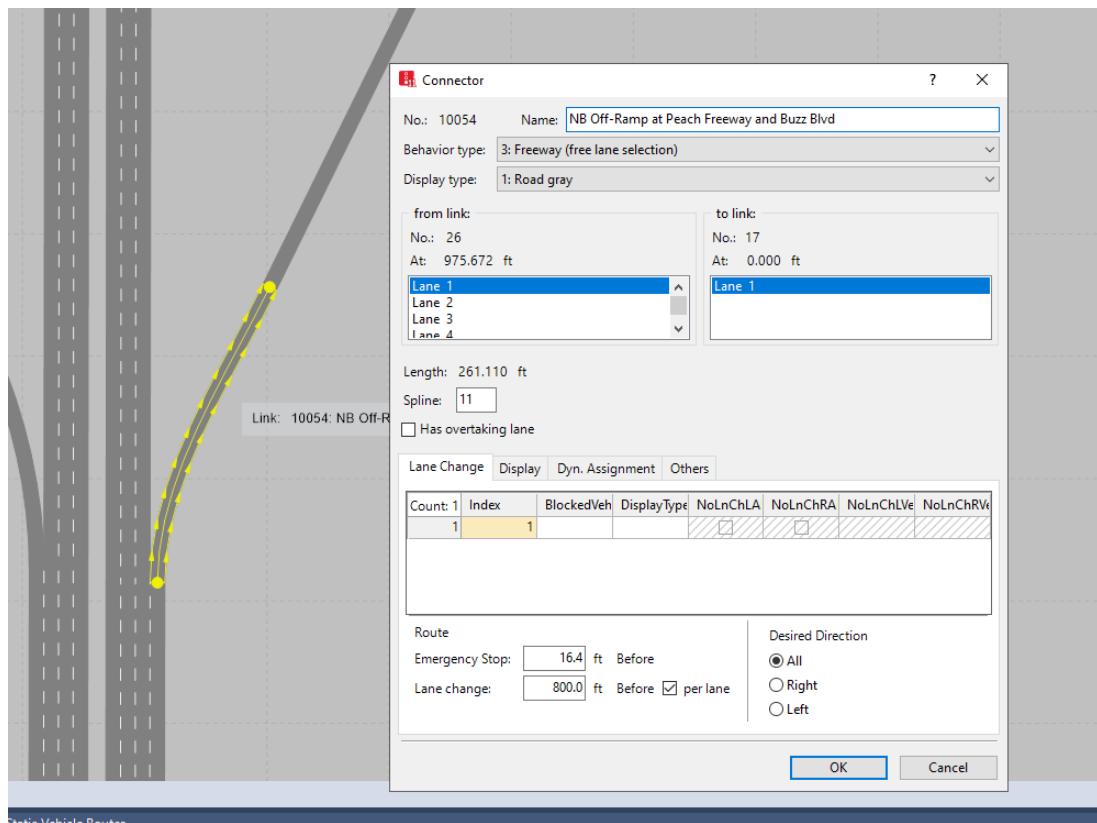
step ix.   Select *OK*

Figure 31: Off-Ramp NB Connector and Connector Dialogue Window

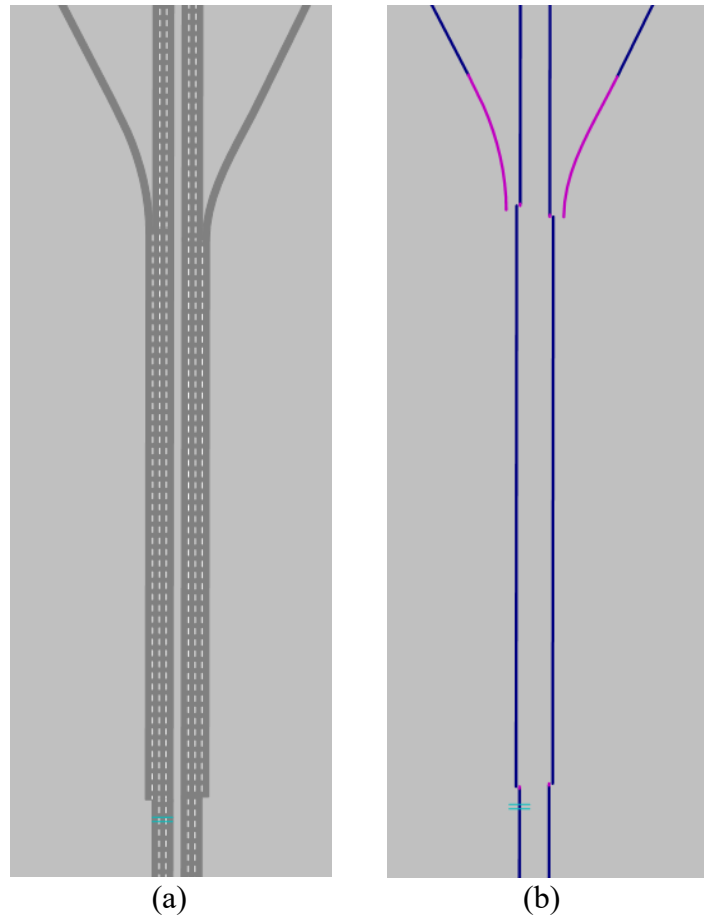Your ramp junction should now look similar to Figure 32

Figure 32: NB Off-Ramp Junction, (a) Lane View and (b) Wireframe View

step x.   Select the *connector* at the upstream end of the freeway *link* with the auxiliary lane.

step xi.   In the *Connector* dialogue box set:

    a. *Lane Change*: 1050ft,

    b. *Behavior Type: Freeway (Free Lane Selection),*

    c. Make sure *from link* has lanes 2, 3, and 4 selected, and

    d. Make sure *to link* has lanes 1, 2, and 3 selected.

step xii.   Select the *Vehicle Route* icon in *Network Objects.*

step xiii.   Place a *route* starting near the NB freeway entrance to:

    a. **downstream** of the *connector* connecting the 5-lane freeway segment to the 4-lane freeway segment, i.e., just after the ramp diverge.

    b. **downstream** of the *connector* connecting the auxiliary lane to the ramp.

step xiv.   Click in the network editor away from the roadway, *the Static Vehicle Routing Decision* list should now be active.

step xv.   Select the new *route*, name it: NB Peach Off-Ramp.

step xvi.   On the right side of the table *name* the two routes thru and ramp.

step xvii.   Set the relative flow as 20% for the ramp and 80% for the thru.

Your *routes* and *static table* should be similar to Figure 33 and Figure 34.

(a)   (b)
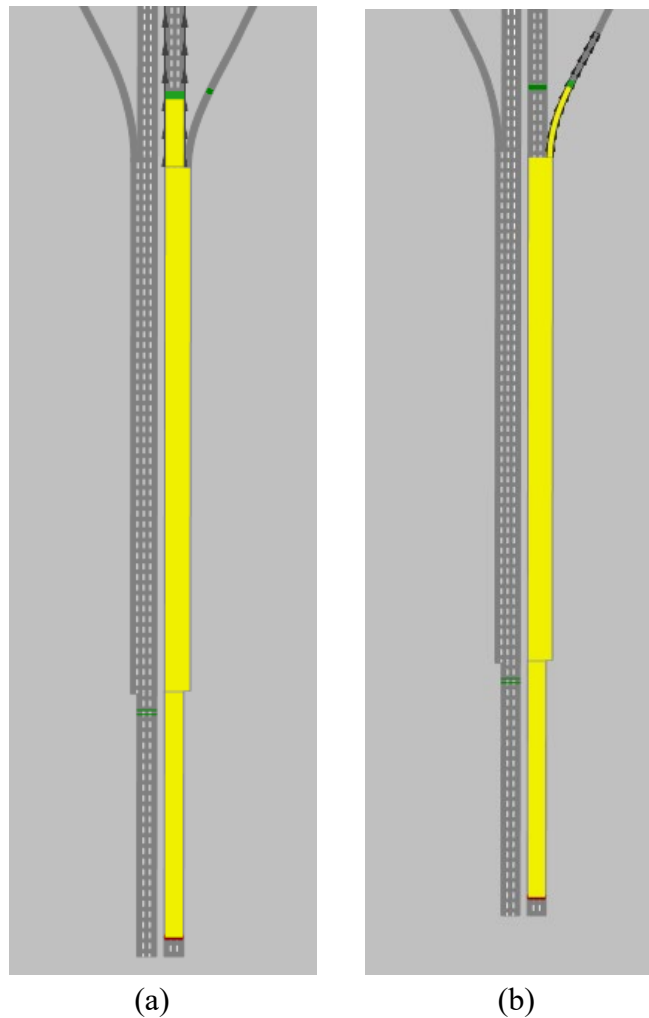
Figure 33: Peach Freeway NB Off Ramp Routes (a) mainline and (b) exit

Figure 34: NB Off-Ramp Static Vehicle Routing Table

step xviii.   Select the *Vehicle Inputs* icon and place a 1500 veh/hr input on Peach Freeway NB.

step xix.   Repeat Steps i through xvii for the NB on-ramp.

Critical Concepts

One significant difference you may have noticed with the diverge is the selection of the "*per lane*" check box on the *connector* from the auxiliary lane to the ramp. The *per lane* option may be used where vehicles may need to change multiple lanes as part of a *Vehicle Route*. In this case, the route is from the mainline to the ramp. Recall, lanes are numbered from the outside lane to the inside lane. For the freeway section immediately upstream of the ramp, the auxiliary lane would be lane 1, the next lane is lane 2, then lane 3, and finally the left-most lane is lane 4. Thus, if a vehicle is exiting, then its *route* contains the *connector* from the auxiliary lane to the ramp. If the exiting vehicle is in lane 2 it will begin seeking to merge into lane 1 (the auxiliary lane) 1200 ft upstream of the *connector*. If a vehicle is in lane 3, it will begin seeking to change to lane 2 at 2400 ft upstream of the *connector*, and finally, if the vehicle is in lane 4 it will begin seeking to change to lane 3 at 3600 ft upstream of the *connector*. Thus, using the *per lane* option increases the distance used by a vehicle to change lanes to the auxiliary lane by one-*lane change* distance for each additional lane change required. This allows the lane changes to be spread out along the freeway. Depending on the behavior of vehicles in your model area you can adjust this distance to better reflect observed behaviors.

Vehicle Speeds

If we recall from Module 1 the vehicle speeds for the default vehicle composition is set to 50 km/h (30 mph). Currently, that is the speed for vehicles on the freeway lanes as well. We would like to have a free flow speed of 120 km/h (72 mph). There are two ways to achieve this, we could create a new vehicle composition with a higher speed that we use for the freeway inputs or change the desired speed of the vehicle immediately after they

enter the freeway link. For now, we will do the later, however in Module 5 you will see additional details for both methods.

step i.   Select *Desired Speed Decisions* in the *Network Objects* list.
step ii.   Just downstream of the NB Peach freeway *vehicle input* place a *desired speed decision* (use a right-click) in the right-most lane. The *Desired Speed Decision* Window should have opened. Edit the *Name* to be Peach Freeway NB Ln 1. Figure 35.
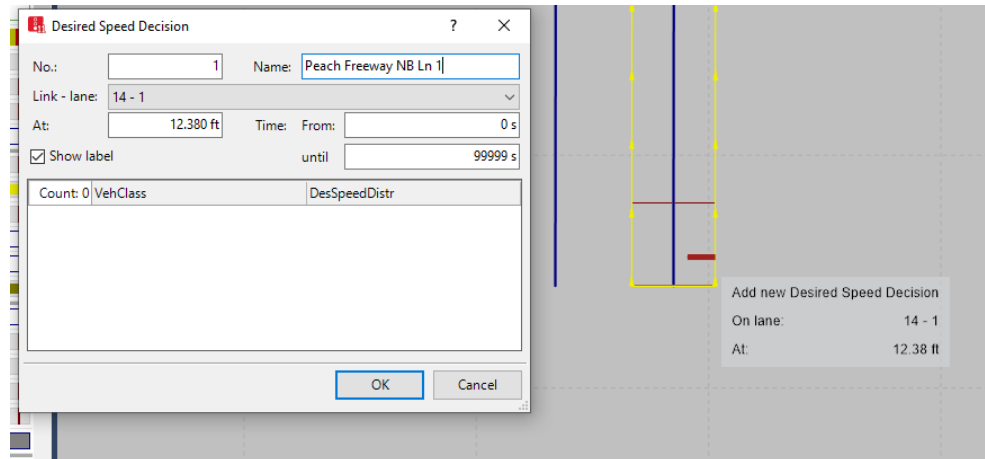

Figure 35 Desired Decision Speed Location and Window

step iii.   Right-click in the box in the bottom of the *Desired Speed Decision* window. Select *Add.*
step iv.   The *Car Vehicle Class* should have populated the first row. Use the pull-down menu for the *DesSpeedDistr* and select *120 km/h.*
step v.   Right-click in the box in the bottom of the *Desired Speed Decision* window again. Select *Add.*
step vi.   The *HGV Vehicle Class* should populate the second row. Use the pull-down menu for the *DesSpeedDistr* and select *120 km/h* (if it did not already correctly populate the speed).

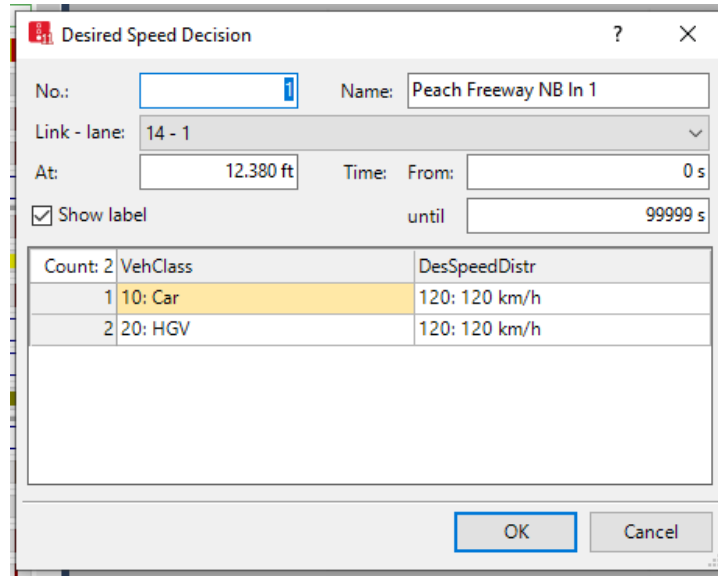The *Desired Speed Decision* window should be similar to Figure 36.

Figure 36 Updated Desired Speed Decision Window

step vii.   Select *OK* on the *Desired Speed Decision* Window.

step viii.   Ctrl-right-click on the *Desired Speed Decision* you just created.

step ix.   Select *Copy*.

step x.   Ctrl-right-click on the middle lane (lane 2) next to the original *desired speed decision*. Select *paste*. Open the *Desired Speed Decision* window and update *Name* to reflect ln 2.

step xi.   Copy and paste the *desired speed decision* into lane 3 and update the name.

step xii.   Repeat this process for the Peach Freeway SB lanes.

In the previous set of steps each vehicle that enters the freeway will have its desired speed set to 120 km/h. Recalling from Module 1 desired speed is a vehicle attribute and will remain the same for the vehicles trip throughout the network unless it is updated using a desired speed decision point as shown above. This means that, as currently constructed, a freeway vehicle that that uses an off-ramp will continue at 120 km/h on the arterial! Thus, it is necessary to place *Desired Speed Decision* points on the off-ramps as well, changing the *desired speed* of off-ramp vehicles to 50 km/h. Likewise, we need to add *Desired Speed Decision* points to the on-ramp, increasing the desired speed of vehicles from the arterial to the freeway speed.

step xiii.   Repeat Steps i through vii for each ramp. Update *Name* appropriately. Set the *desired speed* to *120 km/h* for the on-ramps and *50 km/h* for the off-ramps. In placing the desired speed decision points keep in mind that the vehicle will <u>start</u> changing its speed to its new *desired speed* when it crosses the point, Figure 37. Desired speed decisions will be discussed further in Module 5.
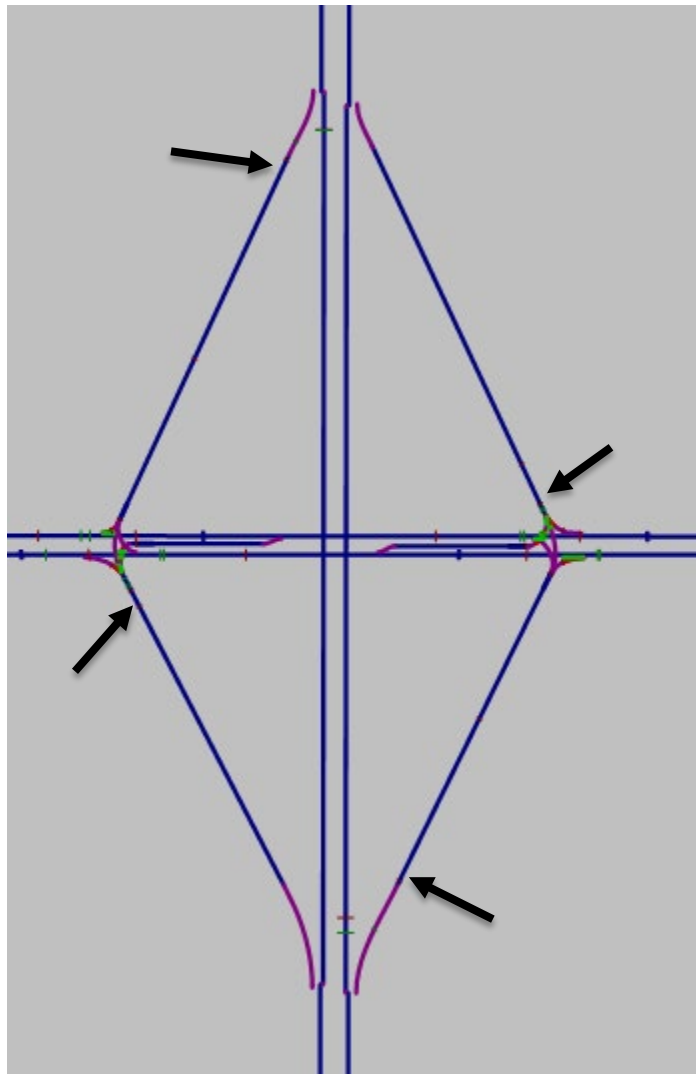
Figure 37 Location of Ramp Desired Speed Decision Points

Run the model

From the *Simulation* pull-down menu select *Continuous* (or press the blue arrow). Specifically, look at the weaving of vehicles in the merge area. Carefully watch the animation for any issues. Check your routes, signal timing, signal heads, etc. Check the warning messages generated by Vissim (if there are any).

There will be an error, probably several. There always is.

CONGRATULATIONS!!!

You have completed modeling a diamond interchange!

Way to go!!!