This User's Guide describes how to access and use TRAFED. The McTrans Center is maintaining TRAFED. Please refer to the TSIS User's Guide for information on obtaining TRAFED
TRAFED (TSIS Traffic Network Editor) is distributed as part of, and is designed to operate efficiently in conjunction with, FHWA's Traffic Software Integrated System (TSIS). TRAFED is used to create models of traffic networks using a point-and-click, graphical user interface. It is designed to support users of the FHWA's (Federal Highway Administration's) CORSIM microscopic traffic simulator. The primary goal of TRAFED is to enable traffic engineers to layout and build simulated traffic networks, quickly and easily, without having to know the internal workings of the traffic simulation that will be used to perform analysis. By displaying, editing, and storing the data in a manner that makes sense to a traffic engineer, TRAFED allows the engineer to spend time analyzing the data and making decisions rather than learning how to make the simulation work. There are over 1200 entries of data used to input and calibrate a traffic network. The CORSIM TRF file format stores this data on 84 record types. Many of the pieces of data were introduced by different people at different points over the thirty-year lineage of CORSIM. There is a very complicated relationship between the data and between the record types. TRAFED attempts to hide these relationships where possible.

This guide:

- Introduces users to the capabilities and features of TRAFED.
- Explains in detail how to use TRAFED and how to access all of its functionality.
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1 About TRAFED

1.1 Welcome to TRAFED

This User's Guide supports traffic engineers using TRAFED to create and modify a CORSIM traffic network. The guide describes neither the technical aspects of CORSIM, nor the types of analyses that can be performed using traffic simulations.

1.2 Introduction

This document describes the TSIS Traffic Network Editor known as TRAFED. TRAFED is used to create models of traffic networks using a point-and-click, graphical user interface. It is designed to support users of the Federal Highway Administration's (FHWA's) CORSIM microscopic traffic simulator. The primary goal of TRAFED is to allow traffic engineers to layout and build simulated traffic networks, quickly and easily, without having to know the internal workings of the traffic simulation that will be used to perform analysis. By displaying, editing, and storing the data in a manner that makes sense to a traffic engineer, TRAFED allows the engineer to spend time analyzing the data and making decision rather than learning how to use the traffic simulation tool. There are over 1200 data entries used to input and calibrate a traffic network. The CORSIM TRF file format stores this data on 84 record types. Many of the pieces of data were introduced by different people at different points over the thirty-year lineage of CORSIM. There is a very complicated relationship between the data and between the record types. TRAFED attempts to hide these relationships where possible.

TRAFED stores data in an object-oriented manner rather than using the record-oriented structure of CORSIM's TRF file format. All of the data used by CORSIM is contained in or derived from data in the object model used internally by TRAFED. The data is stored in its native format instead of the integer only format currently used by CORSIM. For example, much of the data are currently entered in the CORSIM record type format as tenths of feet or tenths of seconds (95 tenths of a second). TRAFED displays and stores this same data in floating point format as feet or seconds (9.5 seconds). TRAFED is capable of exporting data to the TRF file format required by CORSIM. Some entries are one-time input for the simulation; others can be changed for each object of a certain type.

TRAFED is laying the foundation for the future of traffic simulation. As the simulation inputs change, TRAFED can be easily modified to handle the changes. For example, the current record type format of CORSIM only allows 99 bus stations because the allotted space in the TRF file format for bus station identification number (ID) can only hold two digits. TRAFED has no internal restrictions as to the bus station ID. TRAFED's object model includes some data, such as geometric detail, that is not currently used by CORSIM. These details will assist TRAFED in drawing the network properly but may not be necessary for the simulation to model the traffic flow.
About TRAFED

In addition to hiding details about the simulation, TRAFED provides many nice features not found in other traffic network editors.

- Extend a network by dragging links out from existing links
- Split an existing link into two links by dropping a node on the link
- Set signal controller schemes by using saved default values
- Connect freeways and surface streets by dragging a link from a node of one type to a node of the other type
- Layout a network using a bitmap background as a guide to place nodes and links.

TRAFED is not a stand-alone program. It is an ActiveX control (trafed.ocx). It must run in another program called a container. In this case, TRAFED’s container is TShell. TRAFED is a component of TSIS. The TShell component of TSIS provides many services to TRAFED, such as toolbars, menu bars, text output handling, and access to CORSIM. If TRAFED were a stand-alone program this relationship would be very difficult to achieve.

Expert users that have taken many years to learn the format and usage of the record types used by CORSIM may find it useful to layout the initial network with TRAFED and thereafter edit the TRF file with a text editor. There are some network editing tasks that can be done faster with a text editor by expert users.

There are many features that we have identified that would be nice to include in TRAFED. As time and resources permit these features may be added to TRAFED as FHWA dictates. Some of the features include:

- More file formats for the bitmap background (JPEG, CAD, etc.)
- More graphical field entries
- Cut and paste groups of links and nodes
- Create certain types of interchanges from a script
- Edit many objects of the same type at the same time

The user can use the Network | Check menu command (refer to TRAFED Menu Bar) to validate the network with CORSIM in diagnostic mode. In addition, the following list contains the CORSIM record types that are not fully implemented in TRAFED at this time.

RT 52 Load Factors for Vehicle Occupancy. We translate this data into TRAFED and translate it out to a CORSIM file on RT 58 Vehicle Type Specifications.

RT 172 Environmental Tables. We have provided an interface that allows you to select a file containing a set of RT 172 records. It does not have to be a valid CORSIM file. It may just contain the RT 172 data and nothing else.

RT 173 Maximum Acceleration Tables. We have provided an interface that allows you to select a file containing a set of RT 173 records. It does not have to be a valid CORSIM file. It may just contain the RT 173 data and nothing else.
2 The Basics of TRAFED

2.1 Overview

TRAFED is a tool for creating and editing traffic networks. The following activities might occur during a typical session with TRAFED:

- Create a new file with TRAFED, or open an existing file. Each file represents a traffic network, which may include surface streets and freeways, and simulation parameters such as vehicle types and driver behavior.
- Create links and nodes based on a bitmap underlay.
- Create new links, nodes, and other objects "from scratch" using a pointing device (such as a mouse).
- Edit properties of objects like links and nodes.
- Specify network wide simulation parameters such as the length of time to simulate, random number seeds, etc.
- Save the traffic network.
- Export the traffic network as a TRF file.
- Submit the network to CORSIM for simulation.
- View the network and animation with TRAFVU.
- Make necessary changes to the network with TRAFED.
- Resubmit the network to CORSIM for simulation.
- Repeat this process until satisfied with the network.
- Close the network file.

2.2 The Physical Layout

Because TRAFED is a component of TSIS, and executes under the TShell component of TSIS, we need to briefly describe the TShell component. The TShell manual has a more in-depth discussion of these topics.

TShell has the following physical components:

- Title Bar
- Menu Bar
• Toolbars
• Status Bar
• Project View (displaying a file tree structure)
• Project Window (displaying a TRAFED TNO network)
• TSIS Output View (displaying the TSIS welcome message in the example)

These physical components are described in detail in the TShell User's Guide. The physical components that are unique to TRAFED will be described in the following sections.

### 2.3 The TRAFED Project Window

The Project Window displays the actual file opened from the Project View. When this file is a TRAFED TNO file the project window displays a TRAFED network, as illustrated below.
The following is a partial list of actions that can be performed within the window to create and manipulate a traffic network:

- Create traffic model objects.
- Zoom in or out of the Traffic Network window.
- Edit the properties of an object.
- Move objects within the Traffic Network window.
- Delete objects.

You can have more than one network open at a time. In general, menu commands, such as File | Save, and hot keys, such as Ctrl+S, only affect the active window.

Selecting the View | Full screen mode command from the TSIS menu bar, pressing F2, will expand the active window to occupy the entire display. Repeat the command to return to normal viewing mode.

2.4 TRAFED Menu Bar

The TRAFED menu bar is an enhanced TShell menu bar. Please refer to the TShell menu bar in the TShell User's Guide for a complete description of the TShell menu item functionality. Only the Edit | Find, View and Network menu items specific to TRAFED will be discussed in this section.
The Basics of TRAFED

2.4.1 Edit Submenu

The following is the TShell Edit submenu. These menu commands appear for all tools. The menu commands that are implemented in TRAFED are described below.

<table>
<thead>
<tr>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undo</td>
</tr>
<tr>
<td>Ctrl+Z</td>
</tr>
<tr>
<td>redo</td>
</tr>
<tr>
<td>Ctrl+Y</td>
</tr>
<tr>
<td>Cut</td>
</tr>
<tr>
<td>Ctrl+X</td>
</tr>
<tr>
<td>Copy</td>
</tr>
<tr>
<td>Ctrl+C</td>
</tr>
<tr>
<td>Paste</td>
</tr>
<tr>
<td>Ctrl+V</td>
</tr>
<tr>
<td>Delete</td>
</tr>
<tr>
<td>Del</td>
</tr>
<tr>
<td>Select All</td>
</tr>
<tr>
<td>Ctrl+A</td>
</tr>
<tr>
<td>Find</td>
</tr>
<tr>
<td>Ctrl+F</td>
</tr>
</tbody>
</table>

**Edit | Properties**

Selecting the Edit | Properties menu command invokes the selected objects property dialog. Refer to Working with Traffic Objects for descriptions of these dialogs.

**Edit | Undo Ctrl+Z**

Selecting the Edit | Undo menu command or pressing Ctrl+Z will undo the last editing action.

**Edit | Redo Ctrl+Y**

Selecting the Edit | Redo menu command or pressing Ctrl+Y will redo the last undone editing action.

**Edit | Delete Del**

Selecting the Edit | Delete menu command or pressing the Del button will delete the current selection.

**Edit | Find Ctrl+F**

Selecting the Edit | Find menu command or pressing Ctrl+F invokes the TRAFED Find Network Object Dialog.
**Object Type**
Select the object type for the search. Object types include controller, link and node.

**Object ID**
After the object type has been selected, the user can then select the object ID of the selected type from the list or type it in the edit field.

### 2.4.2 View Submenu
The following is the TRAFED View submenu. Refer to the View Toolbar for alternate ways to invoke these commands.

<table>
<thead>
<tr>
<th>Zoom In</th>
<th>Zoom Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoom In to Center</td>
<td>+</td>
</tr>
<tr>
<td>Zoom Out from Center</td>
<td>-</td>
</tr>
<tr>
<td>Pan</td>
<td>Show Entire Network</td>
</tr>
<tr>
<td>Grid</td>
<td></td>
</tr>
<tr>
<td>Node Numbers</td>
<td></td>
</tr>
<tr>
<td>Background Image</td>
<td>TIGER/Line Data</td>
</tr>
<tr>
<td>Outline</td>
<td>Distance Tool</td>
</tr>
<tr>
<td>Full Frame Mode</td>
<td>F2</td>
</tr>
<tr>
<td>Refresh Project View</td>
<td>F5</td>
</tr>
<tr>
<td>Main Toolbar</td>
<td>Traffic Tool Toolbar</td>
</tr>
<tr>
<td>Project View</td>
<td>Output View</td>
</tr>
<tr>
<td>Welcome Page</td>
<td>Status Bar</td>
</tr>
</tbody>
</table>

Since a network may be too big to fit in the available space at a sufficient level of detail, TRAFED provides various commands for changing the view, described below. These commands do not modify the network itself; they only affect the visible area.

**View | Zoom In**
The cursor has now changed. From this point, there are two different methods for implementing the Zoom In command; each providing different results. One method is to place the cursor on a specific point in the network and click the left mouse button. This will cause that point to become the center of an updated view, zoomed to a higher magnification level. The other method uses a "rubber band" to mark off the boundaries of a region, which will become the new view of the network. To perform this operation, place the cursor on a point you want to become the corner of a zoomed-in view. Press down on the left mouse button and drag the "rubber band" box to the point that forms the opposite corner of the new view. When you release the mouse button, the area within the "rubber band" will be expanded to fill the active window. Repeated zooms can be done without accessing the menu option. To free the cursor from this "Zoom In" state, press the
The Basics of TRAFED

Pointer button, press the Zoom In button, right-click on the open area of the network, or press the ESC key.

**View | Zoom Out**

The cursor has now changed. Place the cursor on a specific point in the network and click the left mouse button. This will cause that point to become the center of an updated view, zoomed to a lower magnification level. Repeat zooms can be done without accessing the menu option. To free the cursor from this "Zoom Out" state, press the Pointer button, press the Zoom Out button, right-click on the open area of the network or press the ESC key.

Note: The user can use the View | Zoom Out menu command to view outside the extent of the network.

**View | Zoom In to Center +**

This is a one-time version of the Zoom In mode. The network zooms in at a fixed level to the center point of the window. The + key is a short-cut key for this command.

**View | Zoom Out from Center -**

This is a one-time version of the Zoom Out mode. The network zooms out at a fixed level keeping the center point of the window. The - key is a short-cut key for this command.

Note: The user can use View | Zoom Out of Center menu command to view outside the extent of the network.

**View | Pan**

Panning repositions the network's display without affecting the current zoom level. Repeated "pans" can be done without accessing the menu option. To free the cursor from this "Pan" state, press the Pointer button, press the Pan button, or press the ESC key.

Note: The user can use the View | Pan menu command to view outside the extent of the network.

**View | Show Entire Network**

This command displays the entire network. The view will be re-centered and zoomed in or out as necessary so that the network fills the window.

**View | Grid**

This command hides or shows the grid on the network in the display.

**View | Node Numbers**

This command hides or shows the node numbers on the network in the display.

**View | Bitmap Background**

This command hides or shows the bitmap background on the network in the display. Refer to Changing the View of the Network for more information on bitmaps.
View | TIGER/Line Data
This command hides or shows the TIGER data on the network in the display.

View | Distance Tool
The Distance Tool allows the user to measure distances in the network. To begin measuring, click the Distance Tool menu. The cursor has now changed to the distance tool cursor. Click the distance tool cursor on the location where you want to begin measuring. As the cursor is moved away from that location the distance measured is displayed in the status bar. Click the cursor again to create a “way” point. Moving the cursor again will measure the cumulative distance from the starting point. This technique can be continued to measure the distance along a path in the network with many changes in direction. To start measuring again from a new starting point, double click the cursor. The cursor can then be moved to the new starting location where you will click the cursor to start again. To free the cursor from this "Distance Measuring" state, press the Pointer button, press the Distance Tool button, press the ESC key, or right click the cursor.

View | Full Screen mode  F2
Refer to the TShell manual for description. The F2 is a short-cut key for this command.

View | Main Toolbar
Refer to the TShell manual for description.

View | Traffic Tool Toolbar
Refer to the TShell manual for description.

View | Simulation Control Bar
Refer to the TShell manual for description.

View | TSIS Project View
Refer to the TShell manual for description.

View | TSIS Output
Refer to the TShell manual for description.

View | Status Bar
Refer to the TShell manual for description.

View | Welcome Page
Refer to the TShell manual for description.
2.4.3 Network Submenu

The following is the TRAFED Network submenu. Refer to the Palette Toolbar and the Control Toolbar for alternate ways to invoke these commands. These are the tools for building and editing a network.

<table>
<thead>
<tr>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export</td>
</tr>
<tr>
<td>Tool Palette</td>
</tr>
<tr>
<td>Default Link Type</td>
</tr>
<tr>
<td>Snap to Coordinate</td>
</tr>
<tr>
<td>Load Background Image...</td>
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<tr>
<td>Load TIGER Data...</td>
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<tr>
<td>Properties...</td>
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<td>NETSIM Setup...</td>
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<td>Bus Routes...</td>
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<td>Incident Detection, Point Processing, MOE Estim....</td>
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<tr>
<td>Traffic Assignment (NETSIM)...</td>
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<td>Origin-Destination (FRESIM)...</td>
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<td>Link Aggregation (NETSIM)...</td>
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<tr>
<td>Interchanges (NETSIM)...</td>
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<tr>
<td>Preferences...</td>
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</tbody>
</table>

Network | Check

This command checks for network validity, by internally converting the TRAFED data to a temporary TRF file and invisibly executing CORSIM in a "check inputs diagnostic only" mode. Any errors or warnings are displayed in the TSIS Output View. This functionality is not the same as using the XlateTool tool. For more information on this tool refer to the XlateTool User's Guide.

Network | Export

Export a network to a file that can be used by CORSIM. This brings up a SaveAs dialog box that will prompt for a location and filename to save the exported file. By default, the filename will have the same root name as the TRAFED TNO file with a TRF extension. After entering a filename, the network is checked for validity. If the network is not valid, messages will appear in the TSIS Output View, and a CORSIM TRF file will not be produced. The errors listed in the TSIS Output View must be corrected before an export can produce an output file. If the network is valid, then a CORSIM TRF file will be produced. Errors indicate attributes in the network that must be corrected before an output file can be produced. Warnings indicate that the network has been exported, but the resulting TRF file will not fully represent the information in the network. If there are no errors or warnings a message will appear in the TSIS Output View indicating that the export completed successfully.

The exported data will reflect the current state of the network displayed in the active TRAFED window. You can use this method to make many different CORSIM file scenarios from the same TRAFED file.
Network | Tool Palette

Pointing and clicking in the network window creates most types of traffic model objects. You select a menu command from the Network | Tool Palette submenu, or press the equivalent toolbar button, to put TRAFED in a mode for creating objects of the chosen type. Then point to the desired location for the object in the network window and click the left mouse button to create an object. You can continue creating more objects of the chosen type until a different tool is chosen from the palette.

Network | Tool Palette | Pointer

The default functionality is the pointer. To free the cursor from any other state, press the Pointer button, or press the ESC key.

Network | Tool Palette | Link, One-Way

This command sets the cursor to a single (one-way) link. To free the cursor from this state, press the Pointer button, press the Link, One-Way button, or press the ESC key.

Network | Tool Palette | Link, Two-Way

This command sets the cursor to a pair of links running in opposite directions. To free the cursor from this state, press the Pointer button, press the Link, Two-Way button, or press the ESC key.

Network | Tool Palette | Node, Surface

Point the cursor at the location where you want the node and click the left mouse button. You can continue creating nodes by clicking the left mouse button until you select a different functionality. You can accurately position a new node by holding down the left mouse button as you drag the mouse. An outline of the node will appear until you release the left mouse button. To free the cursor from this state, press the Pointer button, press the Node, Surface button, or press the ESC key.

Network | Tool Palette | Node, Freeway

Point the cursor at the location where you want the node and click the left mouse button. You can continue creating nodes by clicking the left mouse button until you select a different functionality. You can accurately position a new node by holding down the left mouse button as you drag the mouse. An outline of the node will appear until you release the left mouse button. To free the cursor from this state, press the Pointer button, press the Node, Freeway button, or press the ESC key.

Network | Tool Palette | Control

Actuated controllers, Pre-Timed controllers, or control signs can control traffic flow at intersections. The Control submenu can be used for creating each controller type.
The Basics of TRAFED

Network | Tool Palette | Control | Sign Control

A sign-controlled link is one where stop and/or yield signs are used for controlling traffic flow through the node. To insert a sign control after selecting the command, click on a valid link.

Network | Tool Palette | Control | Actuated

An actuated controlled node is one where an actuated controller controls traffic flow through the node. To insert an actuated control after selecting the command, click on a valid node.

Network | Tool Palette | Control | Pre-timed

A pre-timed controlled node is one where a pre-timed controller controls traffic flow through the node. To insert a pre-timed control after selecting the command, click on a valid node.

Network | Tool Palette | Control | Ramp Meter

A ramp-metered node is one where a ramp meter controls traffic flow through the node. To insert a ramp-meter control after selecting the command, click on a valid node.

Network | Tool Palette | Control | Delete Control

This command deletes a selected link's or node's control.

Network | Default Link Type

You will hardly ever need to specify whether to create a surface link or a freeway link, because TRAFED can automatically determine what type of link to create by observing the endpoints. When creating links without endpoints already defined, the default link type is created.

Network | Load Bitmap…

You can load an image, such as an aerial photograph or a street map, which can be used as a background for the traffic network being modeled. An image can serve as a visual reference for laying out the network, as a visual reference for observers, or just as an attractive background. Laying out a network from a bitmap is a very quick way to develop a traffic network of streets and intersections. Refer to Importing Images.

Network | Load TIGER Data…

You can load a TIGER file, which can be used as a background for the traffic network being modeled. The TIGER file can serve as a visual reference for laying out the network, as a visual reference for observers, or just as an attractive background. Laying out a network from a TIGER file is a very quick way to develop a traffic network of streets and intersections.
Network | Properties…
This command displays the Network Properties dialog. Refer to Network Properties.

Network | NETSIM Setup…
This command displays the NETSIM Setup dialog. Refer to NETSIM Setup.

Network | FRESIM Setup…
This command displays the FRESIM Setup dialog. Refer to FRESIM Setup.

Network | Bus Routes…
This command displays the Bus Routes dialog. Refer to Specifying Bus Routes.

Network | Incident Detection, Point Processing, MOE Estim…
This command displays the Incident Detection, Point Processing, MOE Estimation (FRESIM) dialog. Refer to Specifying Incident Detection, Point Processing, MOE Estimation (FRESIM).

Network | Traffic Assignment (NETSIM)…
This command displays the Traffic Assignment (NETSIM) dialog. Refer to Specifying Traffic Assignment (NETSIM).

Network | Origin-Destination (FRESIM)…
This command displays the Origin Destination (FRESIM) dialog. Refer to Specifying Origin-Destination (FRESIM).

Network | Link Aggregation (NETSIM)…
This command displays the Link Aggregation (NETSIM) dialog. Refer to Specifying Link Aggregation (NETSIM).

Network | Interchanges (NETSIM)…
This command displays the Interchanges (NETSIM) dialog. Refer to Specifying Interchanges (NETSIM).

Network | Preferences
This command displays the Preference Dialog. Refer to Preferences.

2.5 TRAFED Toolbar
There are 3 toolbars, the palette, the view and the control, associated with TRAFED. They appear in the TRAFED Project Window.
2.5.1 Palette Toolbar

Pointing and clicking in the network window creates most types of traffic model objects. You select a menu command from the Network | Tool Palette submenu, or press the equivalent toolbar button, to put TRAFED in a mode for creating objects of the chosen type. Then point to the desired location for the object in the network window and click the left mouse button to create an object. You can continue creating more objects of the chosen type until a different tool is chosen from the palette. Refer to Network | Tool Palette.

Surface Node

Point the cursor at the location where you want the node and click the left mouse button. You can continue creating nodes by clicking the left mouse button until you select a different functionality. You can accurately position a new node by holding down the left mouse button as you drag the mouse. An outline of the node will appear until you release the left mouse button. To free the cursor from this state, press the Pointer button, press the Node, Surface button again, or press the ESC key.

Freeway Node

Point the cursor at the location where you want the node and click the left mouse button. You can continue creating nodes by clicking the left mouse button until you select a different functionality. You can accurately position a new node by holding down the left mouse button as you drag the mouse. An outline of the node will appear until you release the left mouse button. To free the cursor from this state, press the Pointer button, press the Node, Freeway button again, or press the ESC key.

One-Way Link

This button sets the cursor to a single (one-way) link. To free the cursor from this state, press the Pointer button, press the Link, One-Way button again, or press the ESC key.

Two-Way Link

This command sets the cursor to a pair of links running in opposite directions. To free the cursor from this state, press the Pointer button, press the Link, Two-Way button again, or press the ESC key.

Pointer

The default functionality is the pointer. To free the cursor from any other state, press the Pointer button, or press the ESC key.

2.5.2 View Toolbar
Since a network may be too big to fit in the available screen space at a sufficient level of detail, the Input Editor provides various commands for changing the view, described below. These commands do not modify the network itself; they only affect the visible representation. Refer to View Submenu.

**Distance Tool**

The Distance Tool allows the user to measure distances in the network. To begin measuring, click the Distance Tool button. The cursor has now changed to the distance tool cursor. Click the distance tool cursor on the location where you want to begin measuring. As the cursor is moved away from that location the distance measured is displayed in the status bar. Click the cursor again to create a “way” point. Moving the cursor again will measure the cumulative distance from the starting point. This technique can be continued to measure the distance along a path in the network with many changes in direction. To start measuring again from a new starting point, double click the cursor. The cursor can then be moved to the new starting location where you will click the cursor to start again. To free the cursor from this "Distance Measuring" state, press the Pointer button, press the Distance Tool button again, press the ESC key, or right click the cursor.

**Pan**

Panning repositions the network's display without affecting the current zoom level. Repeated pans can be done without accessing the menu option. To free the cursor from this "Pan" state, press the Pointer button, press the Pan button again, or press the ESC key.

Note: The user can use the pan button to view outside the extent of the network.

**Zoom In**

The cursor has now changed. From this point, there are two different methods for implementing the Zoom In command; each providing different results. One method is to place the cursor on a specific point in the network and click the left mouse button. This will cause that point to become the center of an updated view, zoomed to a higher magnification level. The other method uses a "rubber band" to mark off the boundaries of a region, which will become the new view of the network. To perform this operation, place the cursor on a point you want to become the corner of a zoomed-in view. Press down on the left mouse button and drag the "rubber band" box to the point that forms the opposite corner of the new view. When you release the mouse button, the area within the "rubber band" will be expanded to fill the active window. Repeated zooms can be done without accessing the menu option. To free the cursor from this "Zoom In" state, press the Pointer button, press the Zoom In button again, right-click on the open area of the network or press the ESC key.

**Zoom Out**

The cursor has now changed. Place the cursor on a specific point in the network and click the left mouse button. This will cause that point to become the center of an updated view, zoomed to a lower magnification level. Repeated zooms can be done without accessing the menu option. To free the cursor from this "Zoom Out" state, press the Pointer button, press the Zoom Out button again, right-click on the open area of the network or press the ESC key.

Note: The user can use the zoom out button to view outside the extent of the network.
Show Entire Network

This button displays the entire network. The view will be re-centered and zoomed in or out as necessary so that the network fills the window.

Bitmap

This button hides or shows the bitmap behind the network in the display.

Grid

This button hides or shows the grid on the network in the display.

2.5.3 Control Toolbar

Actuated controllers, Pre-Timed controllers, or control signs can control intersections. The Control submenu can be used for creating each controller type. Refer to Network Submenu.

Sign Control

A sign-controlled link is one where stop and/or yield signs are used for controlling traffic flow through the node. To insert a sign control after selecting the command, click on a valid link.

Pre-Timed Control

A pre-timed controlled node is one where a pre-timed controller controls traffic flow through the node. To insert a pre-timed control after selecting the command, click on a valid node.

Actuated Control

An actuated controlled node is one where an actuated controller controls traffic flow through the node. To insert an actuated control after selecting the command, click on a valid node.

Ramp-Meter

A ramp-metered node is one where a ramp meter controls traffic flow through the node. To insert a ramp-meter control after selecting the command, click on a valid node.

Delete Sign or Control

This button deletes a selected link's or node's control.

2.6 Status Bar

The status bar forms the bottom edge of TShell. When the cursor rests on a toolbar button or menu choice, the status bar displays a brief description of the command performed by the button or menu. It shows the current
time and date if those options are selected. When editing networks, it also displays the x, y grid coordinates of the cursor. If the user is creating a link its length and angle from North are also displayed.

### 2.7 Traffic Model Objects

Traffic model objects are simply the elements that make up a traffic network. These include links, nodes, controllers, detectors, bus routes, etc. Links and nodes determine the geometry of the network. Controllers, detectors, and other objects affect the flow of traffic through the network. Note, the user can specify surveillance detectors through link properties and signal detector through node control properties.

Editing their properties in their respective property dialogs can alter traffic model objects, once created, or they can be manipulated graphically within the network window.

#### 2.7.1 Link Objects

A link represents a one-way, non-branching stretch of road where properties such as grade and pavement type are constant. Links are always connected to exactly one node at the upstream end and exactly one node at the downstream end. Links are drawn as arrows, with the arrowhead at the downstream end of the link. TRAFED uses color to distinguish between surface links (as for NETSIM) and freeway links (as for FRESIM). Surface links are drawn black, freeway mainline links are drawn gray, and freeway ramp links are drawn dark gray.

The length of the link is a very important property. During layout of the network, TRAFED determines the length of the link based on the upstream node to downstream node distance. This length can, and should, be changed to reflect the stop bar to stop bar distance or the distance along a curved link.

In this version of TRAFED links are shown as straight lines, even when they are specified as curved. To determine the effect of this curvature and length of link you must view the network with TRAFVU.

Also refer to Creating Links, Editing Surface Links and Editing Freeway Links.

#### 2.7.2 Node Objects

Broadly speaking, a node is a point where something of interest occurs along a roadway. There are several types of nodes used by the TRAFED.

- **Entry nodes** are points where traffic enters the simulated network. An entry node is displayed as a yellow plus sign at the upstream end of a link. The user does not explicitly place entry and exit nodes; they appear at the ends of entry and exit links.
- **Exit nodes** are points where traffic leaves the simulated network. An exit node is displayed as a yellow minus sign at the downstream end of a link. The user does not explicitly place entry and exit nodes; they appear at the ends of entry and exit links.
- **Surface nodes** occur within a surface-street sub-network (as for NETSIM). A surface node may represent a point where surface links intersect, or the grade of the road changes, etc. Surface nodes may also be inserted simply to shape the general path of the road. A surface node is displayed as a filled black circle.
- **Freeway nodes** occur within a freeway sub-network (as for FRESIM). Like surface nodes, freeway nodes are used where links merge or diverge, the properties of the road change, or to shape the general path of the road. A freeway node is displayed as a filled gray circle.
- **Interface nodes** provide a transition between a surface network and a freeway network. An interface node is displayed as an unfilled white circle.
When placing nodes, keep in mind that TRAFVU draws links so that the left curb of the link is over the node in most cases. See the TRAFVU manual for further discussion on this topic. Also note that TRAFED shows invalid nodes with a red border. This indicates that some property of the node needs further checking.

Refer to Node Objects, Editing Surface Nodes, Editing Freeway Nodes and Editing Entry Nodes.
3 Working with TRAFED Files and Networks

3.1 Opening an Existing File

An existing traffic network file can be opened through one of the two actions, select the File | Open menu command, or, if you have an open project, which contains traffic network files, you can double-click on the file name in the TSIS Project View.

Traffic network files created by TRAFED have a .tno filename extension (TNO file). TRAFED can also use translated data from a TRF file. To convert a TRF file to a TNO file the user must execute the XlateTool on the TRF file. For more information on this procedure, refer to the XlateTool User's Guide.

3.2 Opening a New File

To create a new traffic network file, select the File | New | TRAFED File menu command. A new file initially contains no traffic model objects.

3.3 Saving the Network

To save a traffic network to a file, press the Save button or choose the File | Save menu command. If the network has not been previously saved to a file, a standard "Save As..." dialog box will appear so that you can choose a filename. Otherwise, the network will be saved to the file named in the title bar.

If a previously saved file is to be saved to a different filename, choose the File | SaveAs menu command.

The user can set a flag in the Preferences dialog, which tells TRAFED to always produce a TRF file when saving a network. Refer to Exporting the Traffic Network to CORSIM for information on exporting.

3.4 Exporting the Traffic Network to CORSIM

To export the current network in the active TRAFED window to a file that can be used by CORSIM, choose the Network | Export menu command. The exported data will reflect the current state of the network displayed in the active TRAFED window. You can use this method to make many different CORSIM file scenarios from the same TRAFED file. Next, a Create TRAF File dialog will prompt for a location and filename to save the exported file. By default, the filename will have a TRF extension with the same root as the TRAFED TNO
file. After entering a filename, messages stating the status of the export, success, warnings and errors may appear in the TSIS Output View. The user should fix any problems before executing CORSIM with the TRF file. Different TRF files can be created without saving the TNO file. Many scenarios

The user can set a flag in the Preferences dialog, which tells TRAFED to always produce a TRF file when saving a network.

### 3.5 Closing the Project Window

To close a Project Window, choose either the File | Close menu command or click on the button located at the far right of the Project Window's title bar. Note that TShell, which contains the Project Window, has its own button, clicking that button exits TSIS rather than just closing the Project Window.

When closing a network with unsaved changes, a dialog appears asking if the work is to be saved. Pressing the Yes button will save the network to TNO file before closing the window. Pressing the No button will discard unsaved changes and close the window. Pressing the Cancel button will leave the Project Window open.

The user can set a flag in the Preferences dialog, which tells TRAFED to always produce a TRF file when saving a network. Refer to Exporting the Traffic Network to CORSIM for information on exporting.

### 3.6 Changing the View of the Network

Since a network may be too big to fit in the available screen space at a sufficient level of detail, TRAFED provides various commands for changing the view. These commands do not modify the network itself; they only affect the visible display. The user can use menu commands, toolbar buttons, scroll bars to change the view of the network in the Project Window. Refer to the View Submenu for details on how to change the view of the network with menu commands. Refer to the View Toolbar for details on how to change the view of the network with buttons. Refer to the Window's User Guide for details on how to use scroll bars. Note: the only way to view outside of the network is with the Zoom Out command or the Pan command. Using the full screen mode provides a larger area to work with.

### 3.7 Preferences

Selecting the Network | Preferences menu command will open a tabbed dialog from which TRAFED preference parameters can be specified. These values are saved in the registry for the current user and used as default for all new cases or new traffic objects.

#### 3.7.1 Preferences: User Information

To display the User Information tabbed page; open the Preferences dialog and then click on User Information page.
User Name
This field is used to specify the user's name.

Organization
This field is used to specify the user's organization or agency.

3.7.2 Preferences: Freeway Link
To display the Freeway Link tabbed page; open the Preferences dialog and then click on Freeway Link page.
Pavement Type
This field is used to specify the default pavement type for freeway links.

Freeflow Speed
This field is used to specify the default freeflow speed.

Mainline # of Lanes
This is the default value for the number of through lanes for a mainline link. The default value will be set in each link that is created. The number of lanes will not change at any time after creation without editing by the user.

Ramp # of Lanes
This is the default value for the number of through lanes for a ramp link. The default value will be set in each link that is created. The number of lanes will not change at any time after creation without editing by the user.

3.7.3 Preferences: Surface Link
To display the Surface Link tabbed page; open the Preferences dialog and then click on Surface Link page.

Freeflow Speed
This field is used to specify the default freeflow speed.

Lane Width
This field is used to specify the default lane width.
Internal Link # of Lanes
This is the default value for the number of through lanes for an internal link. The default value will be set in each link that is created. The number of lanes will not change at any time after creation without editing by the user.

Interface Link # of Lanes
This is the default value for the number of through lanes for an interface link. The default value will be set in each link that has an interface node at either end.

3.7.4 Preferences: Node Numbers
To display the Node Numbers tabbed page; open the Preferences dialog and then click on Node Numbers page. This page gives the user the ability to set the node numbers that will be automatically numbered when TRAFED creates new nodes. Existing nodes will not be renumbered. This may be useful for users that have a particular numbering scheme that they like to follow. For example, a user may want to create all surface nodes starting at xxx1 and then set the Preferences to x501 to create all freeway nodes starting at 501.

Minimum Entry Node Number
Newly created entry and exit nodes will start from the minimum entry node number value and increase as more entry or exit nodes are created. Existing entry and exit nodes will not be renumbered.

Minimum Internal Node Number
Newly created internal nodes will start from the minimum internal node number value and increase as more internal nodes are created. Existing internal nodes will not be renumbered.
Minimum Interface Node Number

Newly created interface nodes will start from the minimum interface node number value and increase as more interface nodes are created. Existing interface nodes will not be renumbered.

3.7.5 Preferences: Network

To display the Network tabbed page; open the Preferences dialog and then click on Network page.

Environment Table File

The default environment table file. In this version of TRAFED the individual values cannot be edited. However, the user can specify a TRF file containing Record 172 (refer to the CORSIM Reference Manual, Record 172) or a text file containing Record 172 records customized by the user.

Acceleration Table File

The default acceleration table file. In this version of TRAFED the individual values cannot be edited. However, the user can specify a TRF file containing Record 173 (refer to the CORSIM Reference Manual, Record 173) or a text file containing Record 173 records customized by the user.

Simulation Start Time

This entry specifies the default value for the simulation start time. It represents the clock time (in military time) at the beginning of the simulation. For example, if the run is to simulate traffic behavior at 4:30 p.m., enter 1630. This entry is used for user reference and printout purposes only.

Maximum Fill Time and Required Equilibrium

At the start of a simulation, the roadway network contains no vehicles. A period of time, called the initialization or "fill time," is needed to load vehicles onto each sub-network so that statistics can be gathered on a network with meaningful results. When traffic flow going in to the network is the same as traffic flow
going out of the network, then the network is at equilibrium. If equilibrium is attained over a shorter period of
time, CORSIM will automatically complete the initialization period, reset clocks and accumulators, and begin
gathering statistics. If equilibrium is not attained within this maximum time, the program will either terminate
(Required Equilibrium checkbox is checked) or continue simulation and start accumulating statistics at the end
of initialization (Required Equilibrium checkbox is unchecked).

### 3.7.6 Preferences: TRF File Generation

To display the TRF File Generation tabbed page; open the Preferences dialog and then click on TRF File
Generation page.

![Preferences dialog](image)

**Automatically Create TRF on Save**

When saving a TNO file a TRF file will automatically be generated.

**No overwrite warning on Export**

This option allows the export function to overwrite an existing file without prompting the user.

**Sort most TRF records on first two fields**

This option sorts the TRF file records when they are written so it is easier to find a particular record when
searching the TRF file. This sorting is done within a set of record types. For example, the record type 10s will
be sorted and then the record type 11s will be sorted separately. Most records can be uniquely identified and
sorted by the first two entries. Some records may be continued on the next record and therefore cannot be
sorted.

### 3.7.7 Preferences: Appearance

To display the Appearance tabbed page; open the Preferences dialog and then click on Appearance page.
Minimum Spacing Between Grid Lines (Pixels)

This field is used to set the minimum spacing between grid lines on the display. When zooming in and out the separation between grid lines will never be smaller than this value. Grid line locations will be changed instead.

3.8 Network Properties

The Network Properties dialog is used to specify data that apply to the network as a whole, rather than any particular traffic model object. This dialog is also used to specify simulation-input parameters that are shared by NETSIM and FRESIM. Simulation parameters specific to either NETSIM or FRESIM are specified on separate dialogs, described under NETSIM Setup and FRESIM Setup.

The Network Properties dialog contains a collection of tabbed pages for specifying various categories of data, as described in the following paragraphs. To open this dialog use the Network | Properties menu command.

3.8.1 Network Properties: Time Periods

To display the Time Period tabbed page; open the Network Properties dialog and then click on the Time Periods page. This page provides the ability to set the simulation start time, the number of time periods, the duration of each time period, and the reporting interval duration.
Simulation start time

This entry specifies the clock time (in military time) at the beginning of the simulation. For example, if the run is to simulate traffic behavior at 4:30 p.m., enter 1630. This entry is used for user reference and printout purposes only. The default time, when creating a new network is the default simulation time set in the Preferences.

Number of time periods

The number of time periods to be used during the simulation.

Time periods of varying duration define how the time-dependent data items change in the course of a simulation run. Each set of exogenous input data applies for (and remains constant during) one time period. If all the data remains fixed throughout a run, only one time period should be specified. When the user wants to modify certain time-dependent inputs during the simulation, he/she should specify the sequence of time periods. To address fluctuating traffic demand at a detailed level, time-varying entry volumes and turning fractions are allowed within each time period.

Time Period Durations

The duration of each time period must be at least one time interval. Furthermore, the duration of each time period must be an integer multiple of the time interval duration. The program will automatically guarantee this requirement by truncating each time period duration to the nearest integer multiple of the time interval duration. Select a time period from the drop down edit box and edit the desired duration.
**Time Interval Duration**

Each time period is subdivided into a sequence of time intervals. The output of cumulative simulation statistics is only available on a time interval basis. The time interval duration is typically set to the most common signal cycle length in a study network.

**Time Period, Time Interval and Time Step Relationship**

The relationship between the time period, the time interval, and the time step is shown below.

**New TRAFED File Set Time Period Properties**

Note when creating a new TRAFED file the following dialog appears, prompting the user to setup the Time periods first. The duration must be set for the simulation to run.

**3.8.2 Network Properties: Description**

To display the Description page, open the Network Properties dialog and then click on the Description page. On this page, you can specify the user's name, date, agency name, a description of the network, and a run ID number.
User Name

This optional entry specifies the user name. The default entry is set in Preferences.

Agency

This optional entry specifies the agency name. The default entry is set in Preferences.

Date

The date is input as three different integers, the month as a two-digit integer, the day of the month as a two digit integer, and the year as a four digit integer. For example, April 3, 1999 would be entered as shown below.

When a network file is first created, the current date is automatically inserted in the Date text boxes. You can change this date by typing in the text boxes.

Run ID

A default Run ID is automatically displayed, which can be modified as needed. The optional Run ID can be used as a reference for the user to describe similar variations of data. If a Run ID is used, it will be printed on the first page of the CORSIM output report.
Description
The Description edit box can be used as a free form area for a user to add comments to the traffic network file. It is not required to create a valid network.

3.8.3 Network Properties: Run Control
To display the Run Control tabbed page; open the Network Properties dialog and then click on the Run Control page. Within this page it is possible to specify simulation setup parameters such as the type of run and the maximum initialization time prior to simulation.

Type of Run
There are three possible categories; Run Simulation, Run Traffic Assignment, and Diagnostics Only. To execute a Run Simulation, Run Traffic Assignment, or both, check the corresponding check boxes. To read and check the input stream without executing traffic assignment or any simulation model, check the Diagnostics Only check box.

The Diagnostics Only option reviews the specified inputs and any errors or improper inputs will be detected by the diagnostic logic. After all the inputs are verified, the user can resubmit this run with the appropriate check box(es) checked.
If Traffic Assignment is selected each node will require additional information on turn prohibition. Refer to the Specifying Traffic Assignment (NETSIM). Note that traffic assignment applies to NETSIM only and requires an output file.

### Initialization period

At the start of a simulation, the roadway network contains no vehicles. A period of time, called the initialization or "fill time," is needed to load vehicles onto each sub-network so that meaningful statistics can be gathered on the network. For diagnostic purposes, the initialization period can be disabled so that the user can observe the network while it fills. To enable the initialization period, check the **Use initialization period** check box. The "Maximum initialization prior to simulation" text box provides the means of specifying the length of time allowed to reach equilibrium. If equilibrium is attained over a shorter period of time, CORSIM will automatically complete the initialization period, reset clocks and accumulators, and begin gathering statistics. If equilibrium is not attained within this maximum time, the program will either terminate (Stop if initialization does not reach equilibrium box is checked) or continue simulation and start accumulating statistics at the end of initialization (Stop if initialization does not reach equilibrium box is unchecked). When the traffic flow entering the network is the same as the traffic flow leaving the network, then the network is at equilibrium.

For very large networks or very short time intervals the algorithm that determines if equilibrium has been reached may falsely determine that equilibrium has been reached. If after animating the network it is obvious that the network has not reached equilibrium, **Force maximum initialization time** should be checked. This capability is also useful if it is necessary for each run of a multiple run test to start at the same time. Pre-timed traffic control signals will be consistent during each run if all runs start after the same amount of initialization. Furthermore, if the user specifies a sync reference time for actuated control, CORSIM will automatically force the initialization period to run to the specified maximum value.

If the specified maximum initialization time is not an integer multiple of the time interval specified on the Time Period tabbed page, CORSIM will round it down to the nearest integer multiple of the time interval. The algorithm to test for equilibrium requires initialization time to be at least three time intervals. If the specified initialization time is less than three time intervals, CORSIM will automatically increase initialization time to three time intervals.

### 3.8.4 Network Properties: Random Seeds

To display the Random Seeds tabbed page, open the Network Properties dialog and then click on the Random Seeds page. Within this page it is possible to specify random seeds for vehicle entry headways, response to traffic choices, and vehicle generation for the NETSIM traffic stream.
Vehicle entry headways

When stochastic vehicle entry headways are used, the "Vehicle entry headways" random number seed is used to generate a random variation for each entry headway. The user can vary this seed between runs to vary the times that vehicles are scheduled to enter the simulated roadways. Note that the total number of vehicles entering the network will remain the same between runs even though the time between individual vehicle entries will vary.

Response to traffic choices

The "Response to traffic choices" value is used as a general random number seed. It is the common seed for traffic simulations and it is used for most stochastic processes. The seed is used for all time-dependent stochastic decision-making processes (e.g., accepting available gaps for turns and determining location and duration of lane blockages).

Vehicles for NETSIM stream

The "Vehicles for NETSIM stream" value is used to seed the pseudo-random process by which NETSIM assigns driver and vehicle characteristics to each vehicle.

3.8.5 Network Properties: Environment Tables

To display the Environmental Tables tabbed page; open the Network Properties dialog and then click on the Environmental Tables page. This page can be used to override CORSIM's default environmental characteristics (fuel consumption and emission rates) for vehicles.
Use Default Environmental Tables

Determine if external environmental tables or the default values should be used.

Environment Table File

The environment table file is an optional input. In this version of TRAFED the individual values cannot be edited. However, the user can specify a TRF file containing Record 172 (refer to the CORSIM Reference Manual, Record 172) or a text file containing Record 172 records customized by the user. Use the Browse button to select the correct file.

Simulation

Perform simulation or read trajectory file. To determine fuel consumption and emission statistics for varying sets of consumption and emission rates without rerunning the basic simulation each time the user should select the option Read trajectory file. To produce new trajectory data (only output if the Write trajectory file is selected) for the session the user should select the Perform simulation option.

Network Type Specific Options: Select network type to edit

Each of the options listed below are available separately for surface streets and freeways. The fields listed below the options need to be changed for each option separately or the defaults for that option will be used.
Network Type Specific Options: Print fuel consumption and pollutant emission rates

Print out tables displaying the internal fuel consumption and pollutant emission rates in the CORSIM output file.

Network Type Specific Options: Calculate environmental measures

When checked, CORSIM calculates fuel consumption and emission rates from the trajectory file or internal tables.

Network Type Specific Options: Write trajectory file

When checked, CORSIM writes out a trajectory file. This file can be used to conduct other traffic operation analyses. This option allows the user to determine fuel consumption and emission statistics for varying sets of consumption and emission rates without rerunning the basic simulation each time.

3.8.6 Network Properties: Acceleration Tables

To display the Acceleration Tables tabbed dialog; open the Network Properties dialog and then click on the Acceleration Tables page. This page can be used to override CORSIM's default vehicle acceleration (maximum acceleration, grade correction factor for maximum acceleration, and grade correction factor for fuel consumption) characteristics.
Use Default Values

Determine if external acceleration tables or the default values should be used.

Acceleration Table File

The acceleration table file is an optional input. In this version of TRAFED the individual values cannot be edited. However, the user can specify a TRF file containing Record 173 (refer to the CORSIM Reference Manual, Record 173) or a text file containing only Record 173 records customized by the user. Use the Browse button to select the correct file.

3.8.7 Network Properties: Vehicle Types

To display the Vehicle Types tabbed page, open the Network Properties dialog and then click on the Vehicle Type page. The data on this page specifies the types of CORSIM vehicles to be used in the simulation. Vehicle types are used separately in NETSIM and FRESIM sub-networks, but defined together here so a vehicle will maintain its characteristics when it crosses from one sub-network to the other.

Vehicle Type

For each Vehicle Type the performance index, length, average occupancy, headway factor, jerk value, emergency maximum deceleration, non-emergency maximum deceleration, surface and freeway fleet percentage values must be entered or the default values will be used.
Each Vehicle Type is defined below.

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Type Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRESIM 1 – NETSIM 5</td>
<td>Low-performance passenger car</td>
</tr>
<tr>
<td>FRESIM 2 – NETSIM 1</td>
<td>High-performance passenger car</td>
</tr>
<tr>
<td>FRESIM 3 – NETSIM 2</td>
<td>Single-unit truck</td>
</tr>
<tr>
<td>FRESIM 4 – NETSIM 6</td>
<td>Semi-trailer truck with medium load</td>
</tr>
<tr>
<td>FRESIM 5 – NETSIM 7</td>
<td>Semi-trailer truck with full load</td>
</tr>
<tr>
<td>FRESIM 6 – NETSIM 8</td>
<td>Double-bottom trailer truck</td>
</tr>
<tr>
<td>FRESIM 7 – NETSIM 4</td>
<td>Conventional bus</td>
</tr>
<tr>
<td>FRESIM 8 – NETSIM 9</td>
<td>Low-performance passenger car</td>
</tr>
<tr>
<td>FRESIM 9 – NETSIM 3</td>
<td>High-performance passenger car</td>
</tr>
</tbody>
</table>

**Performance Index**

This entry specifies the vehicle performance index used to access tabulated data for maximum acceleration, fuel consumption, effect of grade, and environmental emissions.

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

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Type Description</th>
<th>Performance Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRESIM 1 – NETSIM 5</td>
<td>Low-performance passenger car</td>
<td>1</td>
</tr>
<tr>
<td>FRESIM 2 – NETSIM 1</td>
<td>High-performance passenger car</td>
<td>2</td>
</tr>
<tr>
<td>FRESIM 3 – NETSIM 2</td>
<td>Single-unit truck</td>
<td>3</td>
</tr>
<tr>
<td>FRESIM 4 – NETSIM 6</td>
<td>Semi-trailer truck with medium load</td>
<td>4</td>
</tr>
<tr>
<td>FRESIM 5 – NETSIM 7</td>
<td>Semi-trailer truck with full load</td>
<td>5</td>
</tr>
<tr>
<td>FRESIM 6 – NETSIM 8</td>
<td>Double-bottom trailer truck</td>
<td>6</td>
</tr>
<tr>
<td>FRESIM 7 – NETSIM 4</td>
<td>Conventional bus</td>
<td>7</td>
</tr>
<tr>
<td>FRESIM 8 – NETSIM 9</td>
<td>Low-performance passenger car</td>
<td>1</td>
</tr>
<tr>
<td>FRESIM 9 – NETSIM 3</td>
<td>High-performance passenger car</td>
<td>2</td>
</tr>
</tbody>
</table>

**Note:** Vehicle type FRESIM 8 - NETSIM 9 (low-performance carpool) and vehicle type FRESIM 9 - NETSIM 3 (high-performance carpool) share the same environmental tables of vehicle types FRESIM 1 – NETSIM 5 and FRESIM 2 - NETSIM 1, respectively, for low-performance passenger car and high-performance passenger car.

**Length**

This entry specifies the bumper-to-bumper length of this vehicle type. CORSIM will add 3 feet to this value to obtain the “effective” length in a standing queue. This length is used to determine the length of a bus station for transit fleet types.
Avg. Occupancy

This entry specifies the average number of occupants per vehicles of this type.

Headway Factor

This entry specifies the factor (in a percentage) applied to the specified link-specific values of mean queue discharge headway to reflect the differences between the queue discharge operation of this vehicle type relative to that of “typical” passenger cars. 100% if this vehicle type falls into the category of “typical” passenger cars (i.e., this factor = 100%). This factor reflects the difference in queue discharge headway between a “typical” passenger car and this vehicle type.

Jerk Value

This entry specifies the jerk value (rate of change of acceleration) value. This is the maximum change allowed in the value of acceleration from one time step to the next.

Max. Decel. (Emergency)

This entry specifies the maximum deceleration for vehicle type on level grade and dry pavement. This maximum should reflect normal vehicle driving habits, not the upper bound of vehicle capability.

Max. Decel. (non-Emergency)

This entry specifies the maximum deceleration for vehicle type on level grade and dry pavement. This maximum should reflect normal vehicle driving habits, not the upper bound of vehicle capability.

Fleet

Each vehicle type has a default fleet component as seen in the table below. A vehicle type may be in multiple fleet groups.

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Type Description</th>
<th>Fleet Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRESIM 1 – NETSIM 5</td>
<td>Low-performance passenger car</td>
<td>Auto</td>
</tr>
<tr>
<td>FRESIM 2 – NETSIM 1</td>
<td>High-performance passenger car</td>
<td>Auto</td>
</tr>
<tr>
<td>FRESIM 3 – NETSIM 2</td>
<td>Single-unit truck</td>
<td>Truck</td>
</tr>
<tr>
<td>FRESIM 4 – NETSIM 6</td>
<td>Semi-trailer truck with medium load</td>
<td>Truck</td>
</tr>
<tr>
<td>FRESIM 5 – NETSIM 7</td>
<td>Semi-trailer truck with full load</td>
<td>Truck</td>
</tr>
<tr>
<td>FRESIM 6 – NETSIM 8</td>
<td>Double-bottom trailer truck</td>
<td>Truck</td>
</tr>
<tr>
<td>FRESIM 7 – NETSIM 4</td>
<td>Conventional bus</td>
<td>Transit</td>
</tr>
<tr>
<td>FRESIM 8 – NETSIM 9</td>
<td>Low-performance passenger car</td>
<td>Carpool</td>
</tr>
<tr>
<td>FRESIM 9 – NETSIM 3</td>
<td>High-performance passenger car</td>
<td>Carpool</td>
</tr>
</tbody>
</table>

Surface %

This entry specifies the percentage of fleet that consists of this vehicle type on surface streets. As shown in the table below, the nine vehicle types are grouped according to fleet components (passenger cars, trucks, transit, or carpool vehicles). Each vehicle type is assigned a percentage of the fleet component to which it belongs. For example, FRESIM 1 – NETSIM 5, is assigned a percentage of 25%, and FRESIM 2 - NETSIM 1 is
assigned a percentage of 75%. This means that 25% of the auto fleet generated will be FRESIM 1 – NETSIM 5, and 75% will be FRESIM 2 - NETSIM 1. The percentages assigned to each of the vehicles in a fleet component must total 100 for surface streets.

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Type Description</th>
<th>Fleet Component</th>
<th>% of Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRESIM 1 – NETSIM 5</td>
<td>Low-performance passenger car</td>
<td>Auto</td>
<td>25</td>
</tr>
<tr>
<td>FRESIM 2 – NETSIM 1</td>
<td>High-performance passenger car</td>
<td>Auto</td>
<td>75</td>
</tr>
<tr>
<td>FRESIM 3 – NETSIM 2</td>
<td>Single-unit truck</td>
<td>Truck</td>
<td>31</td>
</tr>
<tr>
<td>FRESIM 4 – NETSIM 6</td>
<td>Semi-trailer truck with medium load</td>
<td>Truck</td>
<td>36</td>
</tr>
<tr>
<td>FRESIM 5 – NETSIM 7</td>
<td>Semi-trailer truck with full load</td>
<td>Truck</td>
<td>24</td>
</tr>
<tr>
<td>FRESIM 6 – NETSIM 8</td>
<td>Double-bottom trailer truck</td>
<td>Truck</td>
<td>9</td>
</tr>
<tr>
<td>FRESIM 7 – NETSIM 4</td>
<td>Conventional bus</td>
<td>Transit</td>
<td>100</td>
</tr>
<tr>
<td>FRESIM 8 – NETSIM 9</td>
<td>Low-performance passenger car</td>
<td>Carpool</td>
<td>25</td>
</tr>
<tr>
<td>FRESIM 9 – NETSIM 3</td>
<td>High-performance passenger car</td>
<td>Carpool</td>
<td>75</td>
</tr>
</tbody>
</table>

**Freeway %**

This entry specifies the percentage of fleet that consists of this vehicle type on freeways. As shown in the table below, the nine vehicle types are grouped according to fleet components (passenger cars, trucks, transit, or carpool vehicles). Each vehicle type is assigned a percentage of the fleet component to which it belongs. For example, FRESIM 1 – NETSIM 5, is assigned a percentage of 25%, and FRESIM 2 - NETSIM 1 is assigned a percentage of 75%. This means that 25% of the auto fleet generated will be FRESIM 1 – NETSIM 5, and 75% will be FRESIM 2 - NETSIM 1. The percentages assigned to each of the vehicles in a fleet component must total 100 for freeways.

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Type Description</th>
<th>Fleet Component</th>
<th>% of Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRESIM 1 – NETSIM 5</td>
<td>Low-performance passenger car</td>
<td>Auto</td>
<td>25</td>
</tr>
<tr>
<td>FRESIM 2 – NETSIM 1</td>
<td>High-performance passenger car</td>
<td>Auto</td>
<td>75</td>
</tr>
<tr>
<td>FRESIM 3 – NETSIM 2</td>
<td>Single-unit truck</td>
<td>Truck</td>
<td>31</td>
</tr>
<tr>
<td>FRESIM 4 – NETSIM 6</td>
<td>Semi-trailer truck with medium load</td>
<td>Truck</td>
<td>36</td>
</tr>
<tr>
<td>FRESIM 5 – NETSIM 7</td>
<td>Semi-trailer truck with full load</td>
<td>Truck</td>
<td>24</td>
</tr>
<tr>
<td>FRESIM 6 – NETSIM 8</td>
<td>Double-bottom trailer truck</td>
<td>Truck</td>
<td>9</td>
</tr>
<tr>
<td>FRESIM 7 – NETSIM 4</td>
<td>Conventional bus</td>
<td>Transit</td>
<td>100</td>
</tr>
<tr>
<td>FRESIM 8 – NETSIM 9</td>
<td>Low-performance passenger car</td>
<td>Carpool</td>
<td>25</td>
</tr>
<tr>
<td>FRESIM 9 – NETSIM 3</td>
<td>High-performance passenger car</td>
<td>Carpool</td>
<td>75</td>
</tr>
</tbody>
</table>

**3.8.8 Network Properties: Reports**

To display the Report tabbed page, open the Network Properties dialog and then click on the Report page. The data on this page specifies the types of CORSIM output and the frequency of report generation.
The data found on this page provide flexibility for controlling the frequency of output statistics. Cumulative simulation statistics are output at the completion of each time period. If the user requires a more detailed history of traffic operations, "snapshots" of network conditions can be provided by intermediate output.

**Number of time intervals between cumulative reports**

This entry specifies the number of time intervals between cumulative simulation statistics reports. Duration of time interval is input on time period page.

**Intermediate Output**

This entry allows the user to define three intermediate output reports.

- **Start time** - Time to begin the first set of reports (from the beginning of the simulation).
- **Duration** - Duration of the first reporting period.
- **Time between reports** - Time between each intermediate set of reports in the first reporting period.

**Include turn-movement specific output**

This entry allows the user to determine if turn-movement specific output is desired.

**Preprocessor output**

Suppress echo-print of the TRF file input records in the CORSIM Output file. Suppress run specifications and network validation output in the CORSIM Output file.
3.8.9 Network Properties: Controllers

To display the Controllers tabbed page, open the Network Properties dialog and then click on the Controllers page.

Pre-Timed Signal Transition Algorithm

This entry provides the ability to select which phase-transition algorithm to use when a pre-timed controller changes its timing plan from one time period to the next. The choices are immediate transition, two-cycle transition, and three-cycle transition. The model provides logic to simulate the controller transition from one pre-timed timing plan to the next.

Immediate transition - Immediate transition to new settings, with the controller dwelling in main street green until the new offset is attained.

Two-cycle transition - Controller transitions to new settings over the course of two cycles by adjusting main-street-green times each cycle to complete the transition period with minimum disruption.

Three-cycle transition - Same as Two-cycle transition, except that the transition is completed over three cycles.

Transition to a new signal pattern does not automatically commence at the start of a new time period. Instead, the transition period begins as soon as the controller reaches signal interval 1 (main street green) for the first time after the start of the new time period. The user must ensure that signal interval 1 is coded as main street green (i.e., the coordinated phase).
Actuated Control Sync Reference

The sync reference time is used for coordinating actuated controllers within the traffic network. When the Use Sync Reference checkbox is checked, the value entered into the “Sync Reference Time” text box specifies the time of day at which the actuated controllers are synchronized.

This value, along with the background cycle length, specified for each controller, defines the “system zero” times for the controllers. The offset time specified for each controller is relative to the system zero. For example, if the sync reference time is 2:00 am and the background cycle length is 100 seconds, system zeros occur at 02:00:00, 02:01:40, 02:02:20, and so on.

If not used, the sync reference time depends on the specified simulation start time and the length of the initialization period. This value must be specified to control the sync reference time. When the sync reference time is specified, CORSIM will automatically force the initialization period to run to the specified maximum value.

3.8.10 Network Properties: Vehicle Entry Headway

To display the Vehicle Entry Headway tabbed page; open the Network Properties dialog and then click on the Vehicle Entry Headway page.
Distribution Type

The Vehicle Entry Headway page enables the user to choose a vehicle entry headway distribution type. The available types are Constant Headway, Normal, and Erlang.

**Constant Headway** is the default. Vehicles enter at a constant headway based on the number of vehicles per hour per lane.

**Normal Distribution** generates entry headways stochastically using a normal distribution with a mean value based on the number of vehicles per hour per lane.

**Erlang Distribution** generates entry headways stochastically using an Erlang distribution. The following figure illustrates the Erlang distribution for several values of the shape parameter, $\alpha$, and for a mean value of 1.

The equation for the Erlang headway distribution is included in the figure, where $t$ represents the headway and $h$ is the average headway computed from the entry volume. The shape parameter, $\alpha$, describes the level of randomness of the distribution ranging from $\alpha = 1$ (most randomness) to $\alpha = \infty$ (constant value at the mean). When $\alpha = 1$, the Erlang distribution is equivalent to the negative exponential distribution.

\[ f(t) = \frac{(\alpha / h)^{\alpha}}{(\alpha - 1)!} t^{\alpha-1} e^{-\alpha t/h} \]

\[ \mu = h \]

\[ \sigma^2 = h^2 / \alpha \]

Erlang Distribution Shape Parameter

CORSIM will accept Erlang shape parameter ($\alpha$) values from 1 to 9. A parameter value of one produces a special form of the Erlang distribution known as the negative exponential distribution. Increasing the parameter value produces a sharper (less random) distribution centered about the mean.

3.9 NETSIM Setup

Selecting the Network | NETSIM Setup menu command will open a tabbed dialog from which NETSIM properties can be specified. NETSIM properties are the parameters, such as free-flow speed modifiers and spillback probabilities, which affect the operation of the NETSIM simulation. Many of these parameters take the form of an array of values indexed by driver type (e.g., amber interval response), or an array of values indexed randomly for stochastic processes (e.g., variation of link free-flow speed for each vehicle on the link).

NETSIM has built-in default values for all of these parameters. They need be changed only to calibrate the simulation to match the particular traffic environment being studied. Calibration of the simulation is an important step in the proper use of CORSIM, but is beyond the scope of this document. To override the defaults, type in the desired values on the appropriate page of the NETSIM Setup dialog.
3.9.1 NETSIM Setup: Amber Interval

To display the Amber Interval tabbed page; open the NETSIM Setup dialog and then click on the Amber Interval page.

Amber Interval Response

The response of drivers to the onset of the amber indication is expressed in terms of an acceptable deceleration. The attendant logic applies only to the lead-moving vehicle in a lane that has no queue at the second that the signal turns amber. The deceleration that is required for the vehicle to stop is readily calculated, knowing the current position and speed of the vehicle. Using the driver type, a decile statistical distribution is entered, to determine whether the acceptable deceleration extracted from this distribution exceeds the required value. If so, the vehicle will stop; otherwise, it will continue through the intersection. The embedded default values (in fps) are shown below.

<table>
<thead>
<tr>
<th>Driver Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable Deceleration (fps)</td>
<td>21</td>
<td>18</td>
<td>15</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

3.9.2 NETSIM Setup: Bus Station Dwell Time

To display the Bus Station Dwell Time tabbed page; open the NETSIM Setup dialog and then click on Bus Station Dwell Time page.
Distribution for the Percentage of Mean Dwell Time

In most cases, the embedded dwell time distributions will accurately reflect bus operations.

The sum of the values for each station must equal 1,000. Values must not be negative. The dwell time percentage is the factor by which the mean dwell time is multiplied to compute the actual dwell time that a bus spends servicing passengers at an individual stop.

The table below shows the embedded values of distributions for the percentage of mean dwell time for each station type. A random number from 1 to 10 is used to decide which value is used at an individual stop.

<table>
<thead>
<tr>
<th>Station Type</th>
<th>Random Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10</td>
</tr>
<tr>
<td>1</td>
<td>40  60  70  80  90 100 120 130 140 170</td>
</tr>
<tr>
<td>2</td>
<td>24  48  59  75  85  94 111 126 150 223</td>
</tr>
<tr>
<td>3</td>
<td>30  47  65  77  90 103 116 137 157 178</td>
</tr>
<tr>
<td>4</td>
<td>0   29  59  75  92 108 125 148 170 194</td>
</tr>
<tr>
<td>5</td>
<td>0   18  36  70 104 125 144 156 167 180</td>
</tr>
<tr>
<td>6</td>
<td>0   0   0   48  96 120 144 171 198 223</td>
</tr>
</tbody>
</table>

For example, assume that the mean dwell time specified for the station type 1 is 50 seconds. When the bus arrives at the bus stop, CORSIM generates a random number from 1 to 10. Assume that it generates a 4.
CORSIM looks up Column 4 for station type 1 and finds that it is 80. CORSIM then multiplies 80% times 50 seconds to get a stop time of 40 seconds for this stopping of the bus.

### 3.9.3 NETSIM Setup: Cross Traffic

To display the Cross Traffic tabbed page; open the NETSIM Setup dialog and then click on the Cross Traffic page.

#### Near-Side Cross-Street Acceptable Gap Distribution

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

A vehicle at a stop line facing a sign cannot discharge until an acceptable gap is available in the cross-street traffic. The acceptable gap depends on the type of sign, driver characteristic code and the total number of lanes to be crossed. The acceptable gap to cross a near side cross street is based on driver type and is chosen from a decile distribution. The embedded default values for a stop sign are shown below. The acceptable gap at a yield sign is 1.5 sec less than the gap required at a stop sign.

<table>
<thead>
<tr>
<th>Driver Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable Gap</td>
<td>5.6</td>
<td>5.0</td>
<td>4.6</td>
<td>4.2</td>
<td>3.9</td>
<td>3.7</td>
<td>3.4</td>
<td>3.0</td>
<td>2.6</td>
<td>2.0</td>
</tr>
</tbody>
</table>

#### Far-Side Cross-Street Additional Time Distribution

Time in Addition to Acceptable Gap Required for Vehicles to Cross the Far-Side Cross Street at a Sign:
The far-side cross street is always the approach to the right of the sign approach.

When a far side cross street exists at the intersection, additional time is added to this acceptable gap depending on the total number of lanes to be crossed.

A vehicle at a stop line facing a sign cannot discharge until an acceptable gap is available in the cross-street traffic. The acceptable gap depends on the driver characteristic code and the total number of lanes that must be crossed to clear the intersection. When a near-side cross street exists at an intersection, an acceptable gap is chosen based on the driver characteristic code and the type of sign (stop or yield). For intersections with a far side cross street, additional time based on the total number of lanes to be crossed is added to the acceptable gap. This additional time is chosen from a decile distribution. The array elements are based on the total number of lanes and pockets on both the near and far-side cross streets that a vehicle must cross to clear the intersection. The embedded default values are shown below.

<table>
<thead>
<tr>
<th>Total number of lanes to Clear Intersection</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Time</td>
<td>1.2</td>
<td>2.1</td>
<td>2.6</td>
<td>3.1</td>
<td>3.5</td>
<td>3.9</td>
<td>4.2</td>
<td>4.6</td>
<td>4.9</td>
<td>5.1</td>
</tr>
</tbody>
</table>

### 3.9.4 NETSIM Setup: Pedestrians

To display the Pedestrians tabbed page; open the NETSIM Setup dialog and then click on the Pedestrians page.

#### Distribution of Strong/Weak Interaction for Pedestrian Delay

The program defines two of pedestrian conflict periods: strong interaction period and weak interaction period.
Duration of Strong Interaction Periods for Pedestrian Flow Levels

The demarcation between weak and strong interaction periods is expressed in terms of the elapsed time since beginning of the green phase that strong interaction prevails. For the remaining duration of the green phase, weak interaction is in effect. The array contains the duration of strong interaction for each of the three pedestrian intensities that are specified. Each approach to an intersection may have a Pedestrian Flow Level assigned to it. The embedded default values are shown below.

<table>
<thead>
<tr>
<th>Pedestrian Flow Level</th>
<th>Default Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Pedestrian Flow</td>
<td>0</td>
</tr>
<tr>
<td>Moderate Pedestrian Flow</td>
<td>10</td>
</tr>
<tr>
<td>Heavy Pedestrian Flow</td>
<td>25</td>
</tr>
</tbody>
</table>

The duration of vehicular delay for each conflict period is defined by a statistical decile distribution of vehicle delays due to pedestrian conflict. The embedded default values are shown below. Strong interaction delay for heavy pedestrian flow is twice the table values.

<table>
<thead>
<tr>
<th>Random Number</th>
<th>Weak Interaction</th>
<th>Strong Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

Using the default conflict period durations and the default delay time tables for a vehicle, the model produces the approximate pedestrian flow rates shown in the following table.

<table>
<thead>
<tr>
<th>Pedestrian Flow Level</th>
<th>Default Pedestrian Range (pedestrians per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Pedestrian Flow</td>
<td>100 – 250</td>
</tr>
<tr>
<td>Moderate Pedestrian Flow</td>
<td>250 – 500</td>
</tr>
<tr>
<td>Heavy Pedestrian Flow</td>
<td>&gt; 500</td>
</tr>
</tbody>
</table>

Example: Every vehicle that approaches the stop bar for a right or left turn will make a random number draw. If Moderate Pedestrian Flow (pedestrian code = 2) is set for an approach to an intersection, during the first 10 seconds after start of green (default Moderate Pedestrian Flow strong interaction duration), the random number will be used to determine the delay from the Strong Interaction table. If a random number 7 was drawn, the
default delay due to pedestrian interaction assigned to that vehicle would be 4 seconds. The vehicle will pause for 4 seconds before discharging the link. Vehicles arriving after the initial 10 seconds of green will use the Weak Interaction table. If a random number of 8 were drawn, a 1 second delay would be used.

### 3.9.5 NETSIM Setup: Short Term Event

To display the Short Term Event tabbed page; open the NETSIM Setup dialog and then click on the Short Term Event page.

#### Distribution of Multiplier for Short-Term Event Duration

The duration of a short-term event is assigned by multiplying the specified mean duration for that link by a percentage extracted from a decile distribution. A random number that ranges from 1 to 10 is used as an index into the arrays. The embedded default percentages are shown below.

<table>
<thead>
<tr>
<th>Random Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>% multiplier</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>70</td>
<td>100</td>
<td>130</td>
<td>180</td>
<td>370</td>
</tr>
</tbody>
</table>

#### 3.9.6 NETSIM Setup: Spillback

To display the Spillback tabbed page; open the NETSIM Setup dialog and then click on the Spillback page.
Spillback Probabilities

A vehicle that faces a spillback condition on its receiving link at the time it is about to discharge must “decide” whether to discharge or wait until the spillback ahead dissipates. The probability (percentage) of a vehicle joining a spillback comprised of vehicles is defined in the probability of a vehicle joining spill-back array with the embedded values shown below:

<table>
<thead>
<tr>
<th># of Vehicles in the spillback</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of a vehicle joining a spillback</td>
<td>100</td>
<td>81</td>
<td>69</td>
<td>40</td>
</tr>
</tbody>
</table>

3.9.7 NETSIM Setup: Start-up Lost Time

To display the Start-up Lost Time tabbed page; open the NETSIM Setup dialog and then click on the Start-up Lost Time page.
Distribution of Multiplier for Start-up Lost-time Percentages

CORSIM will issue fatal errors if entries for either distribution are negative or if the sum of all of the entries for a distribution does not equal 1,000.

The first vehicle in queue when the signal turns to green experience (start-up) lost time. Lost time is computed by referencing a decile distribution defined by the code associated with the link. A NETSIM link can be assigned a distribution code on in its properties that will use these distributions. Also, discharge headways use these same distribution codes to define NETSIM link behavior. The vehicle’s driver characteristic is used as an index for referencing the proper element in the distribution. The start-up lost-time percentage array contains 4 such distributions, one for each of 4 distribution codes. Elements of the array contain percentage values applied to the specified mean lost time. The table below shows the embedded default values for distribution codes 1 and 2. There are no internal default values specified for codes 3 and 4, these are user definable.

![Distribution of Multiplier for Start-up Lost-time Percentages](image)

3.9.8 NETSIM Setup: Lane Changes (Driver Behavior)

To display the Lane Changes (Driver Behavior) tabbed page; open the NETSIM Setup dialog and then click on the Lane Changes (Driver Behavior) page.
Time to react to sudden deceleration of lead veh

This entry specifies the mean time for a driver to react to a sudden deceleration of the lead vehicle. This is the amount of time required for a driver to begin to apply braking after his leader has begun a sudden deceleration.

Driver type factor

This entry specifies the driver type factor used to compute driver aggressiveness. NETSIM simulates driver motivation to seek a lane-changing opportunity if the lead vehicle is traveling too slowly. Refer to the Details on Selected CORSIM Topics chapter for a more detailed explanation of Driver Intolerable Speed. This factor is used to compute how motivated a driver will be to seek a lane change because of a slow-moving leader. Decreasing this entry will widen the difference in intolerable speeds between different driver types. By decreasing this entry, aggressive drivers would have lower intolerable speeds (and be more likely to attempt a lane change) and timid drivers would have higher intolerable speeds (and be less likely to attempt a lane change).

Safety factor

This entry specifies the safety factor in computing the lane-changer’s estimation of the deceleration that would be acceptable to the follower target vehicle. This entry represents a degree of caution on the part of the lane-changer; that is, to be on the safe side, the lane-changer perceives that the target follower is less aggressive and alert than they are.

The safety factor specified in this entry is applied to lower the risk the lane-changer is willing to accept. If the computed risk the driver is willing to accept is a deceleration of -10 fpss (based on their urgency threshold) the...
actual risk that will be accepted is: \(-10 \text{ fps} \times 0.8 = -8 \text{ fps}\). As this value is decreased, the acceptable risk decreases and the margin of safety increases.

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

At urgency values of 0 up to some threshold specified in this entry, the driver’s acceptable deceleration to perform the lane change (i.e., acceptable risk) remains level at minimum deceleration for lane changing. At urgencies above this threshold, the driver’s acceptable deceleration will increase based upon the relationship described in the Urgency and Acceptable Risk section of the Details on Selected CORSIM Topics chapter.

% of drivers who cooperated with a lane changer
This entry specifies the percentage of drivers who cooperate with a lane-changer. This entry represents the percentage of drivers who will slow down to allow a lane-changer in front of them. Cooperative drivers in a standing queue will also stop to allow a lane-changer to come in front of them.

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

Headway at which all drivers will attempt a lane change
This entry specifies the headway below which all drivers will attempt to change lanes. See Note under Headway at which no drivers will attempt a lane change.

Headway at which no drivers will attempt a lane change
This entry specifies the headway above which no drivers will attempt to change lanes.

**NOTE:** NETSIM models the driver’s willingness to attempt a discretionary lane change. If, indeed, the driver is willing to attempt a lane change, then the program will explore whether there is a material advantage to changing lanes and whether it is possible (or safe) for the lane-change maneuver to take place. To assess the willingness of an individual driver to attempt a lane change, the model considers the range of headways over which drivers will explore lane changing. This range is defined by the following:

- The headway that is small enough that all drivers would want to attempt a lane change.
- The headway that is so large that no drivers would want to attempt a lane change.

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

Increasing the minimum headway would imply that timid drivers would consider longer headways than before as motivation to change lanes. Increasing the maximum headway would imply that aggressive drivers would consider longer headways than before as motivation to change lanes. Both entries would tend to increase the number of attempted lane changes.
Distance over which drivers will perform a lane change

This entry specifies the mean longitudinal distance over which drivers decide to perform one lane change. To ensure that a vehicle will be in the proper lane to perform its next turn movement, NETSIM will scan up to 12 links ahead to determine the best lane(s) for the vehicle to be positioned when it discharges each link. This is known as the vehicle’s “goal” lane (or lanes) for a link.

This entry is the mean distance required for a vehicle to contemplate and perform one lane change. For each individual driver, the distance to attempt a lane change is determined based on the mean and distribution around the mean. Based on the distance to attempt a lane change, the logic can determine how far back the vehicle should begin to seek a lane change and what its goal lane should be on each upstream link.

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

Distribution of Longitudinal Distance to Start to Attempt a Lane Change

The sum of all of the entries must equal 1,000. CORSIM will issue a fatal error if any of the entries are negative or if the sum of all of the entries does not equal 1,000.

To ensure that a vehicle will be in the proper lane to perform its next turn movement, NETSIM scans up to 12 links ahead to determine the best lane(s) for the vehicle to be positioned in when it discharges each link. Those lanes are known as the vehicle’s goal lanes for each link.

Based on those goal lanes, a vehicle determines whether it must perform a lane change. At some distance upstream of the point at which the lane change is required, the vehicle will begin to attempt to make the lane change. The default mean distance to start to attempt a lane change is 300 feet. That distance, however, will vary by the driver type of each vehicle.

This array gives the distribution of the distance to start to attempt a lane change. That distance is obtained by multiplying the default mean distance by a percentage, which is obtained from a decile distribution and is based on the driver type. The distribution is stored in the array containing the distribution of distance to start to attempt a lane change. The default distribution is shown in the table below.

<table>
<thead>
<tr>
<th>Driver Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage multiplier of distance</td>
<td>125</td>
<td>121</td>
<td>116</td>
<td>108</td>
<td>100</td>
<td>97</td>
<td>93</td>
<td>85</td>
<td>80</td>
<td>75</td>
</tr>
</tbody>
</table>

3.9.9 NETSIM Setup: Left/Right Turns

To display the Left Right/Turns tabbed page; open the NETSIM Setup dialog and then click on the Left/Right Turns page.
Maximum Allowable Turning Speeds

Moving vehicles unimpeded by others must slow as they approach an intersection if they are to negotiate a turning maneuver. The embedded default turning speed for right-turners is 13 fps (8 mph) and for left-turners is 22 fps (15 mph).

Acceptable Gap in Oncoming Traffic

This set of fields is used to specify a decile distribution of acceptable gaps in the oncoming traffic facing permissive left-turning vehicles.

The acceptable gap is chosen on the basis of driver type from the decile distribution. A similar decile distribution provides acceptable gaps in the traffic stream on the outside lane of the near side cross street for right-turners to complete a RTOR maneuver or a right turn at a sign.

<table>
<thead>
<tr>
<th>Driver Type</th>
<th>Acceptable Gap (Left Turn)</th>
<th>Acceptable Gap (Right Turn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>78</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>66</td>
<td>88</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>54</td>
<td>72</td>
</tr>
<tr>
<td>5</td>
<td>48</td>
<td>64</td>
</tr>
</tbody>
</table>
### 3.9.10 NETSIM Setup: Detector Eval. Freq.

To display the Detector Eval. Freq. tabbed page; open the NETSIM Setup dialog and then click on the Detector Eval. Freq. page.

#### Evaluation Frequency

This entry specifies the evaluation frequency for surveillance detectors.

### 3.9.11 NETSIM Setup: Jumped/Lagged Left Turns

To display the Jumped/Lagged Left Turns tabbed page; open the NETSIM Setup dialog and then click on the Jumped/Lagged Left Turns page.
Left-Turn Jumper Probabilities

A left-turn jumper is a vehicle that is first in queue when the signal changes to green, and executes the left-turn maneuver (immediately) before the oncoming opposing queues can discharge. Each data item is set to the probability of a lead left-turn vehicle jumping at the beginning of the green phase across oncoming lanes, expressed as a percentage. The defaults are shown below.

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-Turn Jumper Probability</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

Left-Turn Lagger Turn Probabilities

A left-turn lagger is a queued vehicle that executes a left-turn across opposing traffic during a NO GO interval immediately following a left-turn GO (green and amber) interval. If the left-turner is at the stop line within 2 seconds after the start of this NO GO interval, the default probability that he will execute the turn is 50%. The embedded default values are shown below:

<table>
<thead>
<tr>
<th># Seconds After Start of NO GO Interval</th>
<th>Default Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>
3.9.12 NETSIM Setup: Lane Changes

To display the Lane Changes tabbed page; open the NETSIM Setup dialog and then click on the Lane Changes page.

**Duration of lane Change maneuver**

This entry specifies the duration of a lane-change maneuver. NETSIM considers this entry the minimum amount of time after a lane change is initiated before another lane change can commence.

**Min. deceleration for a lane change**

This entry specifies the minimum deceleration for lane changing. This is the deceleration at the beginning of a lane-change maneuver to be applied in the computation of acceptable risk. Refer to the Details on Selected CORSIM Topics section on Urgency and Acceptable Risk for information on the theory behind acceptable risk.

**Deceleration rate of lead vehicle**

This entry specifies the deceleration rate of lead vehicle. Refer to the Details on Selected CORSIM Topics section on Urgency and Acceptable Risk for information on the theory behind acceptable risk.
Deceleration rate of follower vehicle

This entry specifies the deceleration rate of follower vehicle. This is also the acceptable risk of a mandatory lane change making a forced lane change. Refer to Urgency and Acceptable Risk for information on the theory behind acceptable risk.

Difference in min/max acceptable deceleration for: Mandatory lane change

This entry specifies the difference in maximum and minimum acceptable deceleration for a mandatory lane change. This entry pertains to mandatory lane changes. It is the difference in deceleration between the position at which a vehicle begins to respond to an object and the position of the object that causes the lane change. Refer to Urgency and Acceptable Risk for information on the theory behind acceptable risk.

Difference in min/max acceptable deceleration for: Discretionary lane change

This entry specifies the difference in maximum and minimum acceptable deceleration for a discretionary lane change. This entry pertains to discretionary lane changes. It is the difference in deceleration between the position at which a vehicle begins to respond to an object and the position of the object that causes the lane change. Refer to Urgency and Acceptable Risk for information on the theory behind acceptable risk.

3.9.13 NETSIM Setup: Discharge Headways

To display the Discharge Headways tabbed page; open the NETSIM Setup dialog and then click on the Discharge Headways page.
Distribution of Multiplier for Discharge Headway Percentage

The queue discharge headways determine the proper headway for a vehicle on a link associated with a distribution code. Up to four distribution codes can be accommodated. The distribution code for a NETSIM link is set in its properties. Start-up lost time is also associated with the same distribution code.

As each queued vehicle moves up to the stop line, it is assigned a delay until discharge, reflecting queue discharge headways. This headway is obtained by multiplying the mean queue headway specified for the link by a percentage. This percentage is extracted from a decile distribution that applies to that link's distribution code. The vehicle’s driver characteristic is used as an index for referencing the proper element in the distribution. The table below shows the embedded default values for link distribution codes 1 and 2. There are no internal default values specified for link distribution codes 3 and 4, these are user defined.

<table>
<thead>
<tr>
<th>Driver Characteristic</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Code 1</td>
<td>170</td>
<td>120</td>
<td>120</td>
<td>110</td>
<td>100</td>
<td>90</td>
<td>70</td>
<td>70</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Distribution Code 2</td>
<td>180</td>
<td>140</td>
<td>120</td>
<td>110</td>
<td>100</td>
<td>90</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

### 3.9.14 NETSIM Setup: Driver Familiarity

To display the Driver Familiarity tabbed page; open the NETSIM Setup dialog and then click on the Driver Familiarity page.
NETSIM assigns “goal” lanes for vehicles based on their upcoming turn movements. All vehicles know and respond (by choosing the appropriate goal lanes) to their next non-through turn movements. Whether vehicles actually know their successive turn movements and the appropriate lanes for those turn movements depends on the familiarity of the drivers with their paths. Therefore, each vehicle is randomly assigned a driver familiarity code, based on the distribution of the default percentages or the distribution of the percentages entered. The familiarity code determines the number of next non-through turn movements that the vehicle is aware of in advance. All vehicles entering a link know either 1 or 2 non-through turn movements. These entries allow the user to specify the percentage of all drivers that know only 1 turn movement and the percentage of drivers that know 2 turn movements. The default values mean that 90 percent of all drivers know 2 non-through turn movements and 10 percent know only 1 non-through turn movement.

The sum of the entries must equal 100. TRAFED determines the value of the second entry to ensure the sum of the entries equals 100 (the second entry is not editable).

### Distribution of Driver Familiarity with Paths

<table>
<thead>
<tr>
<th>Number of turn movements</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>10</td>
<td>90</td>
</tr>
</tbody>
</table>

### 3.9.15 NETSIM Setup: Free Flow Speed

To display the Free Flow Speed tabbed page; open the NETSIM Setup dialog and then click on the Free Flow Speed page.
Free-Flow Speed Percentages

As each vehicle enters a link, it is assigned a free-flow speed. This assignment is obtained by multiplying the specified mean free-flow speed for that link by a percentage. This percentage is obtained from a decile distribution, which is indexed by the driver characteristic code. The default values are shown below.

The sum of all the entries must equal 1,000. CORSIM will issue fatal errors if any of the entries are negative or if the sum of all of the entries does not equal 1,000.

<table>
<thead>
<tr>
<th>Driver Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERCENTAGE Multiplier of Free-Flow Speed</td>
<td>75</td>
<td>81</td>
<td>91</td>
<td>94</td>
<td>97</td>
<td>100</td>
<td>107</td>
<td>111</td>
<td>117</td>
<td>127</td>
</tr>
</tbody>
</table>

3.10 FRESIM Setup

Selecting the Network | FRESIM Setup menu command will open a tabbed dialog from which FRESIM parameters can be specified. Similarly to NETSIM, FRESIM has built-in default values for all of these parameters, but they can (and should) be edited to calibrate the simulation for a particular study area.

3.10.1 FRESIM Setup: Driver Behavior

To display the Driver Behavior tabbed page; open the FRESIM Setup dialog and then click on the Driver Behavior page.
Lag Acceleration
The acceleration lag is a time delay that motorists experience when starting to accelerate.

Lag Deceleration
The deceleration lag is a time delay that motorists experience when starting to decelerate.

Car Following Sensitivity
The car-following model in FRESIM is based on the premise that drivers desire to follow the car in front of them at a given value of the sensitivity factor. This sensitivity factor, however, differs from driver to driver. The default values are shown below.

<table>
<thead>
<tr>
<th>Driver Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity Factor</td>
<td>1.25</td>
<td>1.15</td>
<td>1.05</td>
<td>.95</td>
<td>.85</td>
<td>.75</td>
<td>.65</td>
<td>.55</td>
<td>.45</td>
<td>.35</td>
</tr>
</tbody>
</table>

Pitt car following constant
The Pitt car-following model is a separation constant. The smaller the constant the closer together two vehicles are allowed.

3.10.2 FRESIM Setup: Friction Coefficient
To display the Friction Coefficient tabbed page; open the FRESIM Setup dialog and then click on the Friction Coefficient page.
Dry Concrete

This entry specifies the friction coefficient for dry concrete pavement. The pavement friction values are used in the computation of maximum speed on a curve. The values given here were taken from the InTRAS model and cannot represent real friction coefficients because of the lack of data available during program preparation.

Wet Concrete

This entry specifies the friction coefficient for wet concrete pavement. The pavement friction values are used in the computation of maximum speed on a curve. The values given here were taken from the InTRAS model and cannot represent real friction coefficients because of the lack of data available during program preparation.

Dry Asphalt

This entry specifies the friction coefficient for dry asphalt pavement. The pavement friction values are used in the computation of maximum speed on a curve. The values given here were taken from the InTRAS model and cannot represent real friction coefficients because of the lack of data available during program preparation.

Wet Asphalt

This entry specifies the friction coefficient for wet asphalt pavement. The pavement friction values are used in the computation of maximum speed on a curve. The values given here were taken from the InTRAS model and cannot represent real friction coefficients because of the lack of data available during program preparation.

3.10.3 FRESIM Setup: Lane Change Parameters

To display the Lane Change Parameters tabbed page; open the FRESIM Setup dialog and then click on Lane Change Parameters page.
Time to complete a lane change maneuver

This entry specifies the time to complete a lane-change maneuver. The lane-changing logic in FRESIM is assumed to take place over a finite period of time. During this period, the lane-changing vehicle and its new follower are allowed to be in a temporarily unsafe following condition with respect to their leaders, thereby achieving a safe following condition at the end of the period.

Gap Acceptance Parameter

This entry specifies the parameter for determining the acceptable gap for mandatory lane changes. The lowest number represents the most aggressive lane-changing behavior and the highest represents the least aggressive lane-changing behavior for all drivers.

Percent of drivers yielding the right-of-way to lane-changing vehicles attempting to merge ahead

This entry specifies the percentage of drivers desiring to yield the right-of-way to lane-changing vehicles attempting to merge ahead of them. The FRESIM model assumes that a certain fraction of putative followers in the target lane of a vehicle desiring to make a lane change will cooperate with the lane-changer to increase the probability of the lane change being successful. This is modeled by allowing a larger value of the lane-change risk factor to be accepted. Thus, a non-cooperative driver will accept a risk of -8 ft/sec, while a cooperative driver will accept a risk of -10 ft/sec.

Multiplier for desire to make a discretionary lane change

This entry specifies the multiplier for desire to make a discretionary lane change. The higher the multiplier, the higher the desire for discretionary lane changes.
Advantage threshold for discretionary lane change

This entry specifies the advantage threshold for discretionary lane change. The desire to make a discretionary lane change must exceed the minimum required threshold (this field). Increasing this threshold decreases the number of lane changes.

### 3.10.4 FRESIM Setup: Miscellaneous

To display the Miscellaneous tabbed page; open the FRESIM Setup dialog and then click on Miscellaneous page.

#### Minimum separation for generation of vehicles

This entry specifies the minimum separation for generation of vehicles. This governs the maximum rate at which vehicles can be emitted onto the network.

#### HOVs that use HOV facilities

This entry specifies the percentage of HOVs that will enter HOV lanes throughout the FRESIM network. It is used to determine if an HOV will enter the HOV lane.

#### Gravity Model Error Tolerance $a \times 10^{-b}$

This entry specifies the error tolerance value to stop FRESIM gravity model iterations, in exponential notation. The gravity model iteration continues until this tolerance is met.

#### Leader’s Max. Deceleration as Perceived by its Follower

Leader’s maximum deceleration as perceived by its follower. Used in collision avoidance, helps determine if lane changing opportunities are acceptable.
3.10.5 FRESIM Setup: Free Flow Speed

To display the Free Flow Speed tabbed page; open the FRESIM Setup dialog and then click on Free Flow Speed page.

Free Flow Speed Percentages

As each vehicle enters a link, it is assigned a free-flow speed. This assignment is obtained by multiplying the specified mean free-flow speed for that link by a percentage. This percentage is obtained from a decile distribution, which is indexed by the driver characteristic code. CORSIM will issue fatal errors if any of the entries are negative or if the sum of all of the entries does not equal 1,000.

The default values are show below. The values range from 88% to 112% of the mean free-flow speed.

<table>
<thead>
<tr>
<th>Driver Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERCENTAGE Multiplier of Free-Flow Speed</td>
<td>88</td>
<td>91</td>
<td>94</td>
<td>97</td>
<td>99</td>
<td>101</td>
<td>103</td>
<td>106</td>
<td>109</td>
<td>112</td>
</tr>
</tbody>
</table>
4 Working with Traffic Objects

4.1 Overview

Pointing and clicking in the network window creates most types of traffic model objects. You select a menu command from the Network Submenu, or press the equivalent toolbar button from the Palette Toolbar, to put TRAFED in a mode for creating objects of the chosen type. Then point to the desired location for the object in The TRAFED Project Window and click the left mouse button to create an object. You can continue creating more objects of the chosen type until a different tool is chosen from the palette.

Each network traffic object has properties that can be edited. For instance, links have a pavement type, grade, free-flow speed etc. Each type of network object has a dialog for editing the object's properties.

Creating, selecting, deleting, finding, moving and editing traffic objects is discussed in more detail in the following sections.

4.2 Creating Links

There are many ways to create new links. To create links, first decide whether you want a single (one-way) link or a pair of links running in opposite directions. For a single link, press the Link, One-Way button or the Network | Tool Palette | Link, One-Way menu command from the menu. For a pair of opposing links, press the Link, Two-Way button or the Network | Tool Palette | Link, Two-Way menu command from the menu.

After choosing single or double links, specify the start and end positions of the link(s). The type of link created will be based on the default link type or the node type where the link begins or ends. This can be done in two ways:

- Click on the location you want the link to start. This can be on a surface node, a freeway node or on no node at all. Now click on the location you want the link to end. A link will be created between these two locations.
- Alternatively, you can press and hold the mouse button at the location you want the link to start. Keeping the button pressed, move the mouse to the location you want the link to end. Release the button and a link will be created between the two locations.
- If you continue to press and hold the mouse button at the location you last stopped at, a node will appear there, and an entry node will appear at the beginning of the previous link drawn, if it was not attached to a node already. Look at the diagrams below.

Create the first link. Note that at the ends of the link there is an entry node and an exit node.
Create a second link attaching it to the first link's exit node. Note that at the end of the first link there is still an entry node and at the end of the second link there is an exit node. Creation order defines traffic flow direction. The starting point of a single link is always its entry and its ending location is always its exit. Default link preferences can be modified by selecting the Network | Preferences menu command. All links will be created with these preferences, but can be changed on a link by link basis (refer to Editing Surface Links and Editing Freeway Links for information on how to change these properties). Note as you drag out a link, the end points location, distance from the start point, and the degrees from north will be displayed in the status bar.

You will hardly ever need to specify whether to create a surface link or a freeway link, because TRAFED can automatically determine what type of link to create by observing the endpoints. When creating links without endpoints already defined, the default link type is created. The default link type can be changed from the Network | Default Link Type menu command. A common way to create non-default links is to create a node of the non-default link type (if the default link type is surface create a freeway node) to start drawing links.
from. The link will take on the characteristics of the node (if the node is freeway the links attached will be freeway).

If the endpoint nodes are defined the link(s) will be created according to the following table. When you see the word Link(s) in the table, this means that one link gets created if you have Single Link selected, two links in opposite directions will get created if you have Double Link selected and are creating NETSIM links.

<table>
<thead>
<tr>
<th>Location 1</th>
<th>Location 2</th>
<th>What Gets Created?</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Node</td>
<td>Surface Node</td>
<td>Surface Link(s)</td>
<td></td>
</tr>
<tr>
<td>Freeway Node</td>
<td>Freeway Node</td>
<td>Freeway Link</td>
<td></td>
</tr>
<tr>
<td>Surface Node</td>
<td>Freeway Node</td>
<td>Surface Link, Interface Node, Freeway Link</td>
<td>The interface node gets created automatically.</td>
</tr>
<tr>
<td>Freeway Node</td>
<td>Surface Node</td>
<td>Freeway Link, Interface Node, Surface Link</td>
<td>The interface node gets created automatically.</td>
</tr>
<tr>
<td>Surface Node</td>
<td>Unoccupied</td>
<td>Surface Link(s), Exit Node, Entry Node</td>
<td>An entry is created only if you are creating a pair of links.</td>
</tr>
<tr>
<td>Freeway Node</td>
<td>Unoccupied</td>
<td>Freeway Link, Exit Node</td>
<td></td>
</tr>
<tr>
<td>Unoccupied</td>
<td>Freeway Node</td>
<td>Entry Node, Freeway Link</td>
<td></td>
</tr>
<tr>
<td>Unoccupied</td>
<td>Surface Node</td>
<td>Entry Node, Surface Link(s), Exit Node</td>
<td>An exit is created only if you are creating a pair of links.</td>
</tr>
<tr>
<td>Entry / Exit</td>
<td>Entry / Exit</td>
<td>Surface or Freeway Nodes, Interface Node (if needed), Surface or Freeway Links</td>
<td>Entry / Exit nodes are transformed into the appropriate Surface or Freeway Nodes. New links are created to connect them. Interface Nodes are created if necessary.</td>
</tr>
<tr>
<td>Unoccupied</td>
<td>Entry / Exit</td>
<td>Entry / Exit Node, Surface or Freeway Node</td>
<td>Entry / Exit nodes are transformed into the appropriate Surface or Freeway Nodes. New links are created to connect them.</td>
</tr>
<tr>
<td>Entry / Exit</td>
<td>Unoccupied</td>
<td>Entry / Exit Node, Surface or Freeway Node</td>
<td>Entry / Exit nodes are transformed into the appropriate Surface or Freeway Nodes. New links are created to connect them.</td>
</tr>
<tr>
<td>Unoccupied</td>
<td>Unoccupied</td>
<td>Entry Node, Default Link(s), Exit Node</td>
<td>This is the only case where you must specify the link type. Choose Surface or Freeway from the Network</td>
</tr>
</tbody>
</table>

The intent of this interface is to avoid any situations where the user is confused about what he/she must do to create links. It avoids any global mode that prevents the user from drawing certain types of links. Instead, the user can always draw any kind of link. Special nodes -- entry, exit, and interface nodes -- are created and managed automatically.

When drawing links, the drag line will highlight as the mouse pointer moves over a node. Interface nodes cannot be chosen as the target for a link.

### 4.3 Selecting a Link

Selecting a link makes it the focus of subsequent commands such as edit the properties of a link, move the link to another location, and/or delete the link.

Once a link is selected, its appearance is highlighted blue. The steps to select a link are:

1. Press the Pointer button or choose the Network | Tool Palette | Pointer menu command, if the cursor is not currently drawn as an arrow. Or, you can right-click the mouse in the green area on the grid and the arrow tool will then be the cursor.

2. Position the cursor over the link and click the left mouse button. The object will be drawn with a blue border to indicate that it is selected.
4.4 Editing Surface Links

To bring up a link's Properties dialog select the link and choose the Edit | Properties menu command, or double-click on the link in pointer mode, or right-click on the link and choose the Edit menu command from the pop-up menu.

The contents of the Properties dialog depend on the type of link, as described in the following sections.

In the properties dialog for a surface link, you can specify data such as the grade and pavement type; set the number of lanes and turn pockets; create bus stations, detectors, parking zones, and mid-link source/sinks; schedule long-term events; and specify the frequency and mean duration of stochastically generated short-term events. Relationships between a link and other links, such as turn movements and lane alignment, are specified in the Intersection Properties dialog for the node where they meet, rather than in the link's properties dialog.

The pages of the Surface Link Properties dialog are described in more detail in the following sections.

4.4.1 Surface Link: General

Name

The link name in CORSIM allows the user to associate each network link with a physical position of the roadway so that the traffic engineer can easily understand the system without having to refer back to the link-node diagram.
Length
This entry specifies the length of the link. The length of link extends from the stop line of the upstream feeder link to the stop line of the subject link. If a network link exceeds 4,000 feet, the user must insert a dummy node to create two links.

Note if the user has not changed the length, dragging a node on either end will reset the link length. If the length has been changed from the node to node length, dragging a node will not reset the link length.

Reset Length
This button resets the link length to the default length of the link. The default length of the link is the node to node distance and must be adjusted for intersection widths and link curvature.

Free Flow Speed
This entry specifies the desired free-flow speed. The desired, unimpeded mean free-flow speed is entered in miles per hour. This value must be attained by traffic in the absence of any impedance due to other vehicles, pedestrians, or control devices. CORSIM will issue a warning message for values above 65 mph, and CORSIM will assert a speed of 65 mph. CORSIM will issue a fatal error whenever this value is nonzero and less than 10 mph. The default value is set by selecting the Network | Preferences menu command, and selecting the Surface Link page.

Grade
This entry specifies the grade as a percentage. Any grade outside the permissible range should be assigned a value of 9% [use the negative sign (-) for downgrade].

Queue Discharge Characteristics: Mean Startup Delay
This entry specifies the mean value of start-up lost time. The start-up lost value is the delay experienced by the first vehicle in queue when responding to a phase change from red to green. If the value entered is less than 0.5 seconds, then CORSIM will issue a warning message, but the data will not be considered an error. The maximum acceptable value is 9.9 seconds.

Queue Discharge Characteristics: Mean Discharge Headway
This entry specifies the mean queue discharge headway. The mean time gap (headway) between vehicles discharging from a standing queue is entered. This value applies only to those vehicles that were fourth in queue or further upstream. If the value entered is less than 1.4 seconds, then CORSIM will issue a warning message, and a value of 1.4 will be stored.

Queue Discharge Characteristics: Distribution Code
This entry specifies the queue discharge and start-up lost time characteristics code (link type code). This entry identifies the choice of statistical distribution used for the queue discharge characteristics of link as well as the distribution used to define the start-up lost time. As each queued vehicle moves up to the stop line, it is assigned a delay until discharged, reflecting queue discharge headways, which are obtained by multiplying the mean queue discharge headway by a percentage, which is extracted from a decile distribution that applies to the code associated with the link. The vehicle’s driver characteristic is used as an index for referencing the proper element in the distribution.
This value is also used to assign a distribution that describes the characteristics of the start-up lost time, which is experienced by the first vehicle in the queue when the signal turns to green. The distribution contains percentage values that are applied to the specified mean lost time in a manner identical to the computation of the queue discharge headway. The vehicle’s driver characteristic is also used as an index for referencing the proper element in the distribution. Refer to NETSIM Setup on how these two distributions can be modified.

**Queue Discharge Characteristics: Time Period**

Select the desired time period for editing the Distribution Code.

### 4.4.2 Surface Link: Lanes

#### # of Full Lanes

This entry specifies the number of full lanes servicing traffic for the entire length of the link.

Note, for the number of full lanes plus number of left turn pocket lanes plus number of right turn pocket lanes must be less than or equal to 7 for NETSIM.

This entry specifies the number of full lanes servicing moving traffic on link; neither a parking lane (if any) nor a left- or right-turn pocket is included. The maximum number of full lanes is seven with no turn pockets, six with one turn pocket lane, five with two turn pocket lanes, and so forth. Up to seven total lanes are allowed on each NETSIM link (i.e., the sum of full and pocket lanes). The default for this entry can be set in Preferences.
Left Turn Pocket: # of Lanes
This entry specifies the number of lanes in the left-turn pocket. Pockets with one or two lanes can be modeled.

**NOTE:** For the number of full lanes plus number of left turn pocket lanes plus number of right turn pocket lanes must be less than or equal to 7 for NETSIM.

Left Turn Pocket: Length
This entry specifies the length of the left-turn pocket. The lengths of the right- and left-turn pockets extend upstream from the stop line.

Right Turn Pocket: # of Lanes
This entry specifies the number of lanes in the right-turn pocket. Pockets with one or two lanes can be modeled.

**NOTE:** For the number of full lanes plus number of left turn pocket lanes plus number of right turn pocket lanes must be less than or equal to 7 for NETSIM.

Right Turn Pocket: Length
This entry specifies the length of the right-turn pocket. The lengths of the right- and left-turn pockets extend upstream from the stop line.

Lane Alignment with Through Link: Lane of this link aligns with downstream
This entry describes the alignment of lanes on the subject link with those of its through receiving link.

Lane Widths: Lane
Select the desired lane for editing the width.

Lane Widths: Width
This entry specifies the width of the selected lane. These entries define the width of each lane of moving traffic.

Lane Widths: All lanes same width
If checked, all lanes with have the width currently displayed in the Width data field.
4.4.3 Surface Link: Lane Channelization

These entries specify the channelization for all defined lanes. Below is a table of the valid channelization entries, for more details on these entries refer to the Details on Selected CORSIM Topics section on Lane Channelization.

<table>
<thead>
<tr>
<th>Channelization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unchannelized</td>
</tr>
<tr>
<td>Left turn only</td>
</tr>
<tr>
<td>Buses only</td>
</tr>
<tr>
<td>Closed</td>
</tr>
<tr>
<td>Right turn only</td>
</tr>
<tr>
<td>Carpool only</td>
</tr>
<tr>
<td>Carpoools and buses only</td>
</tr>
<tr>
<td>Right turns + right diagonal; right turns + through; also right turns + right diagonal + through if no other lane allows the through movement</td>
</tr>
<tr>
<td>Left turns + left diagonal; left turns + through; also left turns + left diagonal + through if no other lane allows the through movement</td>
</tr>
<tr>
<td>All movements permitted by the geometry and adjacent lane channelization</td>
</tr>
<tr>
<td>Diagonal traffic only</td>
</tr>
<tr>
<td>Through traffic only</td>
</tr>
</tbody>
</table>
4.4.4 Surface Link: Graphics

**Direction of curvature**

This entry specifies a code describing link curvature (in the direction of flow along that link). The choices are Straight (default), Clockwise, or Counterclockwise.

This entry is specified if the link is a curved section of roadway and if this curvature is to be reflected in graphical displays. Clockwise is specified if travel along the link toward the stop line follows a circular arc that is clockwise in direction. Similarly, Counterclockwise is specified if travel along the link follows a counterclockwise arc. Therefore, a curved two-way street would be defined as two separate links with clockwise flow for one link and counterclockwise flow for the other. Graphical displays will depict the appearance and size of curved links by using this entry, the node coordinates and the link length.

**Minimum drawn radius of curvature**

This entry specifies the minimum radius of curvature used in drawing the link. Even if the link is specified as straight, the animation software may add curves to the link to ensure that links (primarily freeway links) connect smoothly at a node. This entry applies to all curves on the specified link. The user may wish to specify this parameter to prevent the animation software from depicting unrealistic curves. If the default value is used, the animation software will apply a minimum radius of curvature that is governed by the width of the link. This value is different than the FRESIM radius of curvature, which is used to calculate safe speeds.
**Link passing under this link**

This entry specifies the link that is below and crossed over by this surface link.

- These entries identify any links that lie underneath the selected link. This information is used to provide a graphical “aerial view” display of multilevel roadways. The entries should be completed if the subject link overpasses other links. An animation display of such overpasses will include vehicles that temporarily disappear from view as they pass below the subject link.
- Up to eight links that pass underneath the selected link can be specified.
- The underpass links specified can exist on different levels below the subject link. An aerial view of a link at the lowest level of a multilevel interchange can be obscured by links from several higher levels. Lower-level links should in fact be specified as underpass links for each higher-level link that passes over it.

### 4.4.5 Surface Link: Short-term Events

![Surface Link Interface](image)

Short-term events are generated stochastically to represent brief blockages of the rightmost lane due to illegal parking, standing, etc. The product of the frequency and the duration should not exceed 3600.

- **Generate short-term events on this link**
- **Mean frequency of events:** 1.0 events/hr
- **Mean duration of an event:** 2.0 sec

This data needs to be specified only if this link experiences short-term blockages, to illegal parking, to stopping on a lane. The program will create these short-term events stochastically throughout the simulation run at the specified frequency and duration. Events that are longer than 60 seconds on average must be specified as “long-term events”.

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

This entry specifies the mean frequency of short-term events specified as events per hour (a minimum of eight events per hour).

Mean Duration of an event

This entry specifies the mean duration of short-term events.

4.4.6 Surface Link: Long-term Events

Long-term events should be specified only if this link experiences long-term blockages, to illegal parking or to vehicle breakdown.

The user can specify long-term events for any lane channelized or unchannelized, but not a pocket lane. To specify blockage for any lane the user must specify the blocked lane number.

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

Concurrent events are always located in the lane in which the event with the later termination time occurs. For example, if an existing long-term event on lane 2 has 10 seconds remaining until termination, and a new short-term event is about to begin on lane 1 with a duration of 15 seconds, the blockage on lane 2 is cleared and a 15-second blockage is established on lane 1. If both events occur on lane 1, the position of the earlier blockage is maintained.
Start time
This entry specifies the elapsed time (in seconds) from beginning of first time period to the commencement of the event.

Duration
This entry specifies the duration of event (in seconds).

Lane Blocked
This entry specifies the lane blocked by an event for non-intersection blockages.

4.4.7 Surface Link: Detectors

During simulation, a detector measures the “presence” or “passage” of a vehicle. NETSIM collects and processes information when a vehicle activates a detector. From this raw data, statistics such as volume, occupancy, and speed are computed and accumulated. The user can specify the cumulative output or the frequency of the intermediate output of these statistics (refer to the NETSIM Setup: Detector Eval. Freq. dialog to set this frequency).

In CORSIM, surveillance detectors and actuated control detectors are separate detectors. In the real-world surveillance information may be collected from an actuated control detector. To collect surveillance information from an actuated control detector in CORSIM the detector must be specified both as a surveillance
A detector to be modeled can be of any type as long as its detection is based on the principle of “sensing” passage or presence. Many detectors, such as loop detectors, operate on the basis of passage or presence detection. Algorithms are embedded in CORSIM to realistically mimic the detector data-processing logic.

The simulated detectors give perfect information, which is much more accurate than data that can currently be obtained in the field with single loop surveillance detectors, especially at low or high lane occupancy values. The accuracy of the CORSIM surveillance detectors is closer to that of dual loop surveillance detector installations. It is therefore possible to simulate the data acquired from field dual loop surveillance detectors with single loop CORSIM surveillance detectors. It is the user’s responsibility to establish the accuracy and adjust the information from the surveillance detectors located in the field to that of the CORSIM surveillance detectors.

The user must select the **New** button and fill out the fields for each detector created on the link.

**New**

This button creates a new detector with default values. After this button is pushed for the first time the fields will become enabled.

**Detector ID**

This field is used to specify an identification number assigned the new detector. To edit an existing detector, select its ID from the drop down box.

**Operation Code**

This entry specifies the detector operation code Passage or Presence. A CORSIM passage detector will provide vehicle counts and average speeds. A presence detector will provide vehicle counts, average speeds, cumulative activation time (on time), and occupancy.

**Lanes Containing Sensors**

The user can select three options for defining the lanes containing the sensor, All lanes, All full lanes or Two selected lanes. A detector can be assigned to any lane. The lane numbers entered must conform to the NETSIM lane-numbering convention.

**Distance of the downstream edge from the stop line**

This entry specifies the distance of the downstream edge (trailing edge) of the detector-sensing zone from the stop line. The sensing zone is defined as having an upstream (leading edge) and downstream (trailing edge) edge.
Length of sensing zone

This entry specifies the length of the sensing zone. The limits of the sensing zone can extend beyond the physical limits of the sensor. For example, it is generally accepted that an inductive loop will detect a vehicle within three feet (on all sides) of the loop wire. This means that a 6' x 6' detector would have an actual sensing zone of 12 feet (3 ft. + 6 ft. + 3 ft.). It is the user’s responsibility to determine if the additional sensing zone length is critical to the CORSIM analysis.

Detector Station ID

This entry specifies the detector station number. This optional entry must be numeric.
4.4.8 Surface Link: Bus Stations

A bus will follow a route, specified as a series of links, and stop at stations on its path. Refer to Specifying Bus Routes for more information.

Station #

This entry specifies the bus station number. The station number must be less than 64. If the station number is 64 or greater, it will not be used as a right-turn pocket, regardless of its location.

Blocks traffic?

A bus station location is defined by whether it is protected or unprotected, by what link it is on, by how far its downstream end is from the downstream stop line, and by its capacity for holding buses. If the user leaves the checkbox unchecked, then the station is protected (pull-out/”No Parking Bus Stop”) or if the user checks the box, then the station is unprotected (blocks traffic while loading and unloading).

Loc.

This entry specifies the distance from the downstream end of the bus stop to the downstream stop bar. Care must be exercised in specifying the (longitudinal) position of a bus station. In particular, if a bus station is located at the upstream end of a street, its location must be specified so that the rear of a bus in dwell will not extend into the intersection. Within the NETSIM sub-network, the curb space reserved for a bus station located at the downstream end of a link can be used as a right-turn pocket when a protected station is unoccupied. The distance from the downstream stop bar must be less than or equal to 50 feet.
If parking is allowed on a link, it is prohibited within 150 feet of the stop line where a bus station is located. A station cannot be located within a pocket.

**Cap.**

This entry specifies the maximum number of buses that the bus stop can hold at one time. This value multiplied by the length of a bus (defined on the Network Properties: Vehicle Types dialog) determines the actual length of a station.

**Mean dwell time**

This entry specifies the mean dwell time for the time spent stopped at this station to load and unload passengers. The bus stop dwell time distribution determines how the average time a bus spends at a bus stop is factored to get the actual time for individual stops at a bus stop. Refer to NETSIM Setup: Bus Station Dwell Time for more information on dwell times.

**Station type**

This entry specifies the station type code for the time the bus spends servicing passengers at the bus stop. Refer to NETSIM Setup: Bus Station Dwell Time.

**Bypass %**

This entry specifies the percentage of buses servicing this station that do not stop because of a lack of demand. CORSIM will issue a warning message if this value is greater than 90%.
After defining entry volumes from entry nodes, internal volumes generated within the network can be defined.

Entry/Exit links can be used within the network for locations that have to both generate traffic and have it exit the network (such as very large parking garages). Buses must enter the network from entry nodes and leave the network on exit links and therefore they do not use source/sink locations.

Source/sink locations represent only net volumes for the entire block. Source/sink nodes are an aggregate of many minor traffic activities. CORSIM treats the activity of the source/sink centroid as occurring mid-block, so the entry point is always represented as being the middle of the link. There is no need to specify the location of a source/sink. They either discharge traffic onto or receive traffic from the network. This is different from entry/exit nodes that can both discharge entering traffic and receive exiting traffic. Therefore, source/sink locations are best for representing places with flow that occurs predominantly in one direction. An example would be a commuter-parking garage, which takes in vehicles in the morning and discharge them in the afternoon.

If there are major parking garages with continuous in and out activity that disrupts traffic flow through the time period, then these should be modeled with 8### nodes and not with source sink locations. The figure below shows how traffic generators and sinks on a link are coded as a source/sink centroid.
Source/Sink ID

This entry specifies the source/sink centroid number. This ID is required if the source/sink will be used as an origin-destination pair or for traffic assignment. This ID should be an internal node number. Refer to Specifying Traffic Assignment (NETSIM).

Time Period

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

Net Volume: Start time and Flow

This entry specifies the net flow rate (in vehicles per hour) entering/exiting via source/sink centroid number from link. Negative numbers reflect net flow off the arterial onto the sink location, while positive numbers reflect net flow onto the arterial from the source node.

If only one flow rate is entered, that flow rate applies for the time period entered and all subsequent time periods until a different flow rate is entered. Suppose the net flow rate is 90 for Time Period 1, 0 for Time Period 2, and 30 for Time Period 3. All three time periods must be entered because the flow rate would be 90 for Time Period 2, unless a source/sink for Time Period 2 was entered with a value of 0.

If more than one flow rate is entered for a specific time period, NETSIM performs an interpolation between the entered start times every minute to find the current flow rate, using the same methods as with time varying entry volumes. When using more than one flow rate, the flow can vary from positive to negative or from negative to positive within the same time period. A maximum of eight flow rates can be entered per time period per source/sink location.
4.4.10 **Surface Link: Parking**

Input information for this link if curb parking activity is of sufficient intensity to impede moving traffic. Note that parking activity can take place only in lane 1 (curb lane) if a link is part of a two-way street. If the link represents a one-way street, then parking activity can impede moving vehicles in both outside lanes.

Care should be taken so that the specifications are “sensible” in the following ways:

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

If parking on a link is permitted for the first time period, prohibited during the second, and permitted during the third time period, the user would have to specify data for all three time-periods. For the second time period, the user must eliminate the parking zone on the link; then re-code it for the third time period. If the parking specifications are the same for the first two time periods and change for the third time period, then the user must specify data for the first and third time period’s only; the program perpetuates the specified parking parameters from one time period to the next unless changed by new inputs.

**Time Period**

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

**Same as pervious time period**

The data associated with the selected time period will have all the same values as the previous time period.
**Left curb Parking**

Check the checkbox to allow left curb parking.

**Left-curb: Distance from DS node**

This entry specifies the distance from the downstream stop line to downstream end of the parking zone on the left curb of link. This field is enabled only if left curb parking is checked.

**Left-curb: Length**

This entry specifies the length of the parking zone on the left curb of link. This field is enabled only if left curb parking is checked.

**Right curb parking**

Check the checkbox to allow right curb parking.

**Right curb: Distance from DS node**

This entry specifies the distance from the downstream stop line to downstream end of the parking zone on the right curb of link. This field is enabled only if right curb parking is checked.

**Right curb: Length**

This entry specifies the length of the parking zone on the right curb of link. This field is enabled only if right curb parking is checked.

**Parking Maneuvers: Mean Duration**

This entry specifies the mean duration of the parking maneuvers on this link.

**Parking Maneuvers: Mean Frequency**

This entry specifies the expected (mean) number of the parking maneuvers on the link (per hour). It must exceed 14 per hour.

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**4.5 Editing Freeway Links**

To bring up a link's Properties dialog: select the link and choose Edit | Properties on the menu bar, double-click on the link, or right-click on the link and choose Edit from the pop-up menu.

In the Freeway Link dialog, you can specify data such as the grade and pavement type; set the number of lanes and auxiliary lanes; create incidents that block or slow traffic; and specify lane biases and prohibitions for trucks.

The pages of the Freeway Link Properties dialog are described in more detail in the following sections.
4.5.1 Freeway Link: General

**Name**

The link name in CORSIM allows the user to associate each network link with a physical position of the roadway so that the traffic engineer can easily understand the system without having to refer back to the link-node diagram.

**Type**

This entry specifies the freeway link type: Mainline link (default) or Ramp link. A connector between two freeway segments must include at least two links. There must be an off ramp from the first freeway segment and an on ramp onto the second freeway segment. During the creation process, a mainline link is created, unless the node to which the link is connected already has two mainline links. In this case the new link can only be a ramp link. TRAFED only allows changing this type if no other link is connected as a downstream or upstream link.

**Length**

This entry specifies the length of the link. If a network link exceeds 9,999 feet, the user must insert a dummy node to create two links.

Note if the user has not changed the length, dragging a node on either end will reset the link length. If the length has been changed from the node to node length, dragging a node will **not** reset the link length.
Reset Length
This button resets the link length to the default length of the link. The default length of the link is the node to node distance and must be adjusted for link curvature.

Free Flow Speed
This entry specifies the desired free-flow speed (in miles per hour). This value represents the desired, unimpeded, mean free-flow speed that is attained by traffic, in the absence of any impedance due to other vehicles or control devices (see the “Level of Service A” in the chapter on freeways in the Highway Capacity Manual). The default value is set by selecting the Network | Preferences menu command, and selecting the Freeway Link page.

Superelevation
This entry specifies the super-elevation as a percentage. A change in super-elevation is sufficient reason to divide a freeway section into two links. In FRESIM, one method for limiting speed on horizontal curves is to define super-elevation, horizontal curvature, and pavement condition. Refer to the Details on Selected CORSIM Topics section on Freeflow Speed on a Curve for more information.

Pavement
This entry specifies the pavement code: Dry concrete, Wet concrete, Dry asphalt, or Wet asphalt. The pavement code determines the friction coefficient used in the formula for superelevation and affects the freeflow speed used for this link. Refer to the Details on Selected CORSIM Topics section on Freeflow Speed on a Curve for more information.

Radius
This entry specifies the radius of curvature (in feet). 0 denotes a tangent section. The relationship between radius of curvature and vehicle speed is shown in the formula for superelevation and affects the freeflow speed used for this link. Refer to the Details on Selected CORSIM Topics section on Freeflow Speed on a Curve for more information.

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

Startup Delay
This entry specifies the mean start-up delay. The maximum acceptable value is 6.0 seconds. This input is used by the model to discharge vehicles from a ramp meter onto the freeway.

Car-following sensitivity multiplier
This entry specifies the car-following sensitivity multiplier. This permits the user to adjust the car-following sensitivity on a link-by-link basis in a FRESIM network. For example, this permits an adjustment in car-following sensitivity to simulate situations such as a vehicle entering a link and finding the sun in the driver's eyes. It permits the user to adjust the car-following sensitivity for all driver types while they are on this link.
This car-following sensitivity multiplier is only applied to vehicle following logic for nominal link processing. It is not applied to vehicles emitting onto the roadway, incident processing, or bus logic.

For example, if a driver type has a sensitivity value of 1.4 seconds and the user specifies a distance to reaction point for anticipatory lane changes of 80, then the sensitivity for that driver type will be adjusted to 1.12 seconds (.80 times 1.4) for this link. A 110 in this entry will dictate that all driver types use a 10% increase in car-following sensitivity.

**Collect speed and headway stats?**

This check box specifies whether data should be collected.

**Collect speed and headway stats?: Location**

This entry specifies the distance from the freeway data station to the upstream node of the link. A freeway data station is different from a detector station. If a data station is specified with this entry, headway and speed statistics will be collected and printed across all freeway lanes at the specified position.

### 4.5.2 Freeway Link: Lanes
How many through lanes

This entry specifies the number of through lanes. A through lane is any lane that is not an auxiliary lane. This number does not include auxiliary lanes for mainline links. The default number of through lanes for mainline and ramp links can be set using the Network | Preferences Freeway Link tabbed dialog.

Note the total number of through lanes for the entry link and its receiving link must be the same. The receiving link of the entry link cannot have full auxiliary lanes.

Auxiliary Lanes

This entry specifies the identification code for up to six auxiliary lanes, None, Right acceleration lane, Right deceleration lane, Right full auxiliary lane, Left acceleration lane, Left deceleration lane, or Left full auxiliary lane.

Auxiliary lanes can occur on the left or right side of the roadway. There are three types of auxiliary lanes: acceleration, deceleration, and full. An acceleration lane extends from the upstream end of a freeway link to a mid-link position and must be fed by an on-ramp. A deceleration lane extends from a mid-link position to the downstream end of a freeway link and must feed an off-ramp. A full auxiliary lane extends the full length of a freeway link, and can connect to an on-ramp at the upstream node and/or an off-ramp at the downstream node. It can also be used even where there is no ramp at either end of the link.

Auxiliary Lane: Length

This entry specifies the length of the auxiliary lane. This field should be specified for all auxiliary lane types, including full auxiliary lanes. TRAFED makes full auxiliary lanes length equal to the link length.

Anticipatory lane changes: Upstream traffic moves over if acceleration lane speed falls below

This entry specifies the minimum acceleration-lane-speed to trigger upstream anticipatory lane changes. Congestion caused by vehicles entering the freeway from an acceleration lane on this link can cause upstream vehicles to make lane changes away from the side of the freeway where the acceleration lane is located. These anticipatory lane changes will occur if the average speed on the acceleration lane falls below this value.

Anticipatory lane changes: Traffic begins to react

This entry specifies the distance to reaction point for upstream anticipatory lane changes. The distance upstream to the point at which vehicles will react to the congestion is measured in feet from the upstream end of the link.

Barrier on left side of lane: First barrier lane

This entry specifies the identification number of the right lane of a pair of lanes that are separated by physical barriers (if any). The specification of lane barriers prevents lane changing between affected lanes in a pair (a lane pair separated by a barrier is identified by the identification number of the right lane of the pair). Two barriers can be specified for each link. Barriers involving auxiliary lanes are allowed.

Barrier on left side of lane: Second barrier lane

This entry specifies the identification number of the right lane of another pair of lanes that are separated by physical barriers (if any). The specification of lane barriers prevents lane changing between affected lanes in a
pair (a lane pair separated by a barrier is identified by the identification number of the right lane of the pair). Two barriers can be specified for each link. Barriers involving auxiliary lanes are allowed.

### 4.5.3 Freeway Link: Lane Add/Drop

This type of lane add or drop represents a case in which a lane add has no origin or a lane drop has no destination. This is different from a lane drop or a lane add at a node, which is handled by auxiliary lanes. The user should not add or drop lanes so that the number of through lanes in the link is greater than 5 or less than 1.
First Add/Drop: Lane

This entry specifies the identification number of the lane being added or dropped. The identification number of the lane being added or dropped can range from 1 to 5. Following each lane add or drop, the freeway lanes are renumbered. Any subsequent designation of lanes must reflect the new lane numbers. The figure above, for example, shows a segment of a freeway with two successive lane drops. For the first lane drop, the identification number of the lane being dropped is 1. Following the renumbering of the lanes, the identification number of the second lane being dropped is also 1.

When the lane being dropped is an interior lane, i.e., there is a continuing lane on each side of the lane being dropped; the user may specify that the traffic in the dropped lane should merge with the traffic in the lane to the left or with the traffic in the lane to the right.
First Add/Drop: Add or Drop

This radio button specifies whether the lane is an add lane or drop lane. There is also an option to specify that the traffic in an interior drop lane should merge with the traffic in the lane to the left or with the traffic in the lane to the right.

First Add/Drop: Dist from USN

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

First Add/Drop: React Dist

This entry specifies the position of a warning sign, at which motorists respond to the lane drop (in feet). This entry applies only to a lane drop and represents the distance upstream of the lane drop at which motorists begin to react. Motorist reaction consists of trying to change lanes away from the dropping lane. This distance does not necessarily refer to an actual sign, but to the point of reaction to the lane drop. This entry applies only to a lane drop and represents the distance upstream of the lane drop at which motorists begin to react.

Second Add/Drop: Lane

This entry specifies the identification number of the lane being added or dropped. The identification number of the lane being added or dropped can range from 1 to 5. Following each lane add or drop, the freeway lanes must be renumbered. Any subsequent designation of lanes must reflect the new lane numbers. The figure above, for example, shows a segment of a freeway with two successive lane drops. For the first lane drop, the identification number of the lane being dropped is 1. Following the renumbering of the lanes, the identification number of the second lane being dropped is also 1.

When the lane being dropped is an interior lane, i.e., there is a continuing lane on each side of the lane being dropped; the user may specify that the traffic in the dropped lane should merge with the traffic in the lane to the left or with the traffic in the lane to the right.

Second Add/Drop: Add or Drop

This radio button specifies whether the lane is an add lane or drop lane. There is also an option to specify that the traffic in an interior drop lane should merge with the traffic in the lane to the left or with the traffic in the lane to the right.

Second Add/Drop: Dist from USN

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

Second Add/Drop: React Dist

This entry specifies the position of a warning sign, at which motorists respond to the lane drop (in feet). This entry applies only to a lane drop and represents the distance upstream of the lane drop at which motorists begin to react. Motorist reaction consists of trying to change lanes away from the dropping lane. This distance does not necessarily refer to an actual sign, but to the point of reaction to the lane drop. This entry applies only to a lane drop and represents the distance upstream of the lane drop at which motorists begin to react.
Third Add/Drop: Lane
This entry specifies the identification number of the lane being added or dropped. The identification number of the lane being added or dropped can range from 1 to 5. Following each lane add or drop, the freeway lanes must be renumbered. Any subsequent designation of lanes must reflect the new lane numbers. The figure above, for example, shows a segment of a freeway with two successive lane drops. For the first lane drop, the identification number of the lane being dropped is 1. Following the renumbering of the lanes, the identification number of the second lane being dropped is also 1.

When the lane being dropped is an interior lane, i.e., there is a continuing lane on each side of the lane being dropped; the user may specify that the traffic in the dropped lane should merge with the traffic in the lane to the left or with the traffic in the lane to the right.

Third Add/Drop: Add or Drop
This radio button specifies whether the lane is an add lane or drop lane. There is also an option to specify that the traffic in an interior drop lane should merge with the traffic in the lane to the left or with the traffic in the lane to the right.

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

Third Add/Drop: React Dist
This entry specifies the position of a warning sign, at which motorists respond to the lane drop (in feet). This entry applies only to a lane drop and represents the distance upstream of the lane drop at which motorists begin to react. Motorist reaction consists of trying to change lanes away from the dropping lane. This distance does not necessarily refer to an actual sign, but to the point of reaction to the lane drop. This entry applies only to a lane drop and represents the distance upstream of the lane drop at which motorists begin to react.
4.5.4 Freeway Link: Graphics

Direction of curvature
This entry specifies a code describing link curvature (in the direction of flow along that link). The choices are Straight (default), Clockwise, or Counterclockwise.
This entry is specified if the link is a curved section of roadway and if this curvature is to be reflected in graphical displays. Clockwise is specified if travel along the link toward the downstream end follows a circular arc that is clockwise in direction. Similarly, Counterclockwise is specified if travel along the link follows a counterclockwise arc. Therefore, a curved freeway segment would be defined as two separate links with clockwise flow for one link and counterclockwise flow for the other. Graphical displays will depict the appearance and size of curved links by using this entry, the node coordinates and the link length.

Minimum drawn radius of curvature
This entry specifies the minimum radius of curvature used in drawing the link. Even if the link is specified as straight, the animation software may add curves to the link to ensure that links (primarily freeway links) connect smoothly at a node. This entry applies to all curves on the specified link. The user may wish to specify this parameter to prevent the animation software from depicting unrealistic curves. If the default value is used, the animation software will apply a minimum radius of curvature that is governed by the width of the link. This radius is not the same as the radius of curvature found on Freeway Link: General tabbed dialog.
Links passing under this link

This entry specifies the links that are below and crossed over by this link.

- These entries identify any links that lie underneath the selected link. This information is used to provide a graphical “aerial view” display of multilevel roadways. The entries should be completed if the subject link overpasses other links. An animation display of such overpasses will include vehicles that temporarily disappear from view as they pass below the subject link.

- Up to eight links that pass underneath this link can be specified.

- The underpass links specified can exist on different levels below the subject link. An “aerial view” of a link at the lowest level of a multilevel interchange can be obscured by links from several higher levels. Lower-level links should in fact be specified as underpass links for each higher-level link that passes over it.

4.5.5 Freeway Link: Trucks

This entry specifies the truck movement code: Trucks are neither biased nor restricted (default); Trucks are biased to a certain lane (or lanes); Trucks are restricted to a certain lane (or lanes); or Trucks are restricted to a certain lane (or lanes) and other vehicle types are prohibited from using the (exclusive) truck lane. FRESIM can bias or restrict truck movement on the mainline to specified lanes. Only mainline through lanes and full auxiliary lanes can be designated as restricted; acceleration, deceleration, and ramp lanes cannot be designated as restricted. The following kinds of truck behavior are allowed:
• Trucks can be biased to selected lanes. In this condition, trucks can pass other vehicles by leaving their bias lane and then returning to that lane after passing.
• Trucks can be restricted to a selected lane. In this condition, trucks are not allowed to leave their assigned lane to pass another vehicle.

**Trucks are Biased/Restricted to**

This entry specifies the truck directional code: Rightmost (Trucks are restricted/biased to the right-hand lanes (default)) or Leftmost (Trucks are restricted/biased to the left-hand lanes). This entry identifies whether trucks are biased to the right or left lanes on the freeway.

**Trucks are Biased/Restricted to: through lane(s)**

This entry specifies the identification number of the through lane to which trucks are biased or restricted. Trucks will also be biased to all through and full-auxiliary lanes to the left or right of this lane.

**Truck lanes are exclusive**

Trucks can be biased or restricted to a selected lane, exclusively. When truck lanes are exclusive, other vehicles types are prohibited from using the truck lanes (except to cross the lane when entering or exiting the freeway).

**Drivers begin to react**

This entry represents the distance upstream of the start of exclusive truck lanes where drivers react to the presence of those lanes. It is not the physical location of the warning sign.

If this is the first link that contains exclusive truck lanes, the warning sign can be placed between the start of the truck lanes and the downstream node of the entry link. So if there are exclusive truck lanes on a link, say (i, j), which is immediately downstream of an entry link, the warning sign will be placed no farther upstream than node (i).

If there are exclusive truck lanes on link (k, i) which start at node (k), the warning sign for the lanes on link (i, j) will be placed no farther upstream than 1 foot downstream of node (k). However, it is left to the user to calibrate the location of the warning sign based on traffic volume and driver behavior.

1 ft
4.5.6 Freeway Link: HOV

All HOV lanes must be defined in the first time period, even if they are closed or open to all traffic. There can only be 1 HOV facility per link, i.e., all HOV lanes on a link will have the same operational characteristics. HOV lanes cannot be entered on entry links or exit links, but can be entered on ramp lanes.

**Number of HOV lanes**

This entry gives the total number of HOV lanes on the link. Only a maximum of 3 HOV lanes can be coded on a link. Full-length auxiliary lanes can also be coded as HOV lanes. The number of HOV lanes should be less than or equal to the sum of the number of full-length auxiliary lanes and mainline lanes.

**Location**

This entry specifies the location of the HOV facility: Left side (HOV lane(s) is on the left-hand side (default)), or Right side (HOV lane(s) is on the right-hand side). For example, if the two leftmost lanes are HOV lanes.

**Type of HOV lane**

This entry specifies the type of HOV facility: Non-exclusive/concurrent HOV (default) or Exclusive HOV. Exclusive HOV lanes can be separated from non-HOV vehicle lanes by using physical barriers or double solid line stripping.
**HOV lane begins**
This entry specifies the distance (in feet) from the upstream node to where the HOV facility begins. An entry of zero will be interpreted to mean the HOV facility starts at the upstream node. This entry should be less than the length of the link.

**Extends to end of link**
This check box specifies whether the HOV facility will end at the downstream node.

**HOV lane ends**
This entry specifies the distance (in feet) from the upstream node to the end of the HOV facility.

**Drivers begin to react**
This entry represents the distance upstream of the start of the HOV facility where drivers react to the presence of an HOV facility. It is not the physical location of the warning sign.

If this is the first HOV link, the warning sign can be placed between the start of the HOV facility and the downstream node of the entry link. So if there is an HOV facility on the link, say (i, j), which is immediately downstream of the entry link, the warning sign will be placed no farther upstream than node (i).

If there is an HOV facility on link (k, i) which starts at node (k), the warning sign for the HOV facility on link (i, j) will be placed no farther upstream than 1 ft downstream of node (k). However, it is left to the user to calibrate the location of the warning sign based on traffic volume and driver behavior.

1 ft

![Diagram showing HOV lane begins and ends with driver reaction point](image)

**Time-varying characteristics: Time Period**
Select the desired time period for editing. All time varying data displayed applies to the selected time period.

**Time-varying characteristics: Same as previous time period**
The data associated with the selected time period will have all the same values as the previous time period.

**Time-varying characteristics: Allowed users**
This entry specifies the lane-use code for the HOV facility: Carpoools and buses (default), Buses only, Carpoools only, Open to all traffic or Closed to all traffic. The usage of HOV lanes can be varied between time periods by using this entry and selecting different time periods. Once a lane has been defined as an HOV lane, the only way to make it stop being an HOV lane in a later time period is to make it open or closed to all traffic. For example, if an HOV lane allowing only carpoools is to be specified in the first time period, then it should be Carpoools only. If the user had wanted to open the HOV lane for all traffic in the second time period, then data should also be specified in the second time period, then it should be Open to all traffic.
**Time-varying characteristics: Pct usage by HOV's**

This entry can be used to override the entries on the FRESIM Setup dialog, on a link-by-link basis and by time period.

**Time-varying characteristics: Get percentage from FRESIM Setup dialog?**

Check this checkbox to get percentages from the FRESIM Setup (accessible through the Network | FRESIM Setup menu command) instead of defining the percentage for this link.

### 4.5.7 Freeway Link: Incidents

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

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

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

- The length of the roadway that is blocked should be determined. A reasonable predictor of the affected roadway length is the number of vehicles involved plus 1. For example, a two-vehicle collision, each vehicle is 20 feet, would be represented appropriately by a 60-foot blockage.

- Rubbernecking should be specified for the non-blocked lanes. The rubbernecking factor in FRESIM is simulated by increasing the distance at which vehicles follow each other by the amount of the factor entered.

- A secondary incident that consists only of rubbernecking should extend downstream from the primary incident. The length of the affected roadway should be the same as for the primary incident.

The user must select the **New** button and fill out the fields for each incident created.

**New**
Create a new incident with default values.

**Delete**
Delete the currently displayed incident.

**Incident #**
Number associated with the current incident. Select a different incident to edit its properties.

**Time of Onset**
This entry specifies the time of onset of the incident (in seconds). Time is measured from the start of the simulation. For a blockage incident, a value of zero will place the blockage at the beginning of the initialization period. This value must be less than the length of the simulation.

**Location**
This entry specifies the longitudinal location of the upstream end of the incident from the upstream node. It must be less than the link length.

**Duration**
This entry specifies the duration of the incident (in seconds). It must be greater than zero.

**Length**
This entry specifies the length of the roadway affected by the incident. This value must be greater than zero. The affected length can exceed the length of the link (i.e., extends to the next link).

**Lanes Affected by the Incident: Lane ID**
Select the lane ID for the incident code. Use the drop down edit box to select the ID.
Lanes Affected by the Incident

This entry specifies the incident code and its effect for the selected lane: not affected (normal speed), partially affected (reduced speed, traffic capacity reduced by the rubberneck factor at the point of the incident), or completely blocked-stopped (blockage at point of incident).

Rubberneck factor

This entry specifies the rubberneck factor (as a percentage). This value must be greater than zero if the incident code is rubberneck. The rubberneck factor (in a percentage) represents the reduction in capacity at the point of the incident for vehicles that are in lanes that have an incident code of rubbernecking.

Location of incident warning sign

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

4.5.8 Freeway Link: Detectors
The purpose of this input is to allow simulation of a surveillance system. Detectors are required if options such as incident detection or certain ramp-metering algorithms are used.

The user must select the **New** button and fill out the fields for each detector created on the link.

### New
Create a new detector with default values.

### Delete
Delete the currently displayed detector.

### Detector ID
A number associated with the displayed detector characteristics. Select a different detector to edit its properties.

### Type
This entry specifies the detector type code: Doppler radar, Short loop or Coupled pair of short loops.

### Position
This entry specifies the longitudinal location of the detector from the downstream end of the link.

The location is determined as follows:

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

The detector's leading or trailing edge should not be at the same location as an internal node.

### Lane ID
This entry specifies the identification number of the lane in which the detector is located. Select a different lane to change the lane associated with the current detector.
Station ID
This entry specifies the station number for this detector. This capability is provided because the usual practice in surveillance and control systems is to group a set of detectors across some or all of the lanes at the same longitudinal location as a station. This station ID is used for incident detection, MOE estimation, and point processing. Refer to Specifying Incident Detection, Point Processing, MOE Estimation (FRESIM) for more information.

Length
This entry specifies the effective detector loop length. Each loop of a coupled pair must have the same effective loop length. Length is only defined for short loop and coupled pair detectors.

Loop separation
This entry specifies the distance that separates the short loops of a coupled pair. This value is defined as the distance between the downstream ends (trailing edge) of the loops. Loop separation is only defined for coupled pair detectors.

4.6 Deleting a Link
To delete a link or a set of links select the link(s) to be deleted. Press the Delete key or select the Edit | Delete menu command.

4.7 Finding a Link
To locate a link whose ID you know, select the Edit | Find menu command or use the <Ctrl>+F keyboard shortcut. This brings up a dialog in which you can specify the type of object (link) and its ID.

As the user is typing, the edit field will auto complete the selection. When you press OK, the requested link will be highlighted with a blue border. If the link was not previously visible within the network window, the window will be panned and moved to bring the selected link into view.

4.8 Moving a Link
Moving a link can only be done by changing the location of its upstream node and downstream node, refer to Moving a Node.
4.9 Creating Nodes

To create surface nodes, press the Node, Surface button or select the Network | Tool Palette | Node, Surface menu command from the menu bar. Then point the cursor at the location where you want the node and click the left mouse button. You can continue creating nodes by clicking the left mouse button until you select a different toolbar button. You can accurately position a new node by holding down the left mouse button as you drag the mouse. An outline of the node will appear until you release the left mouse button. The outline of the selected node will be blue. The outline of an invalid node will be red. A red node indicates that some piece of information is missing or not correct. Otherwise nodes are outlined white.

Nodes can be inserted into existing links. If a newly created node intersects an existing link, the link is broken. New links are then automatically connected to the new node. (This only occurs, however, if the connections are allowed. For example, a freeway node cannot be inserted into a surface link and visa versa.) The new links lose most of their properties but both new links will maintain the type of link and the number of through lanes. The properties of both new links need to be reviewed by the user.

Creating freeway nodes is done in the same manner, except that you use the Node, Freeway button or the Network | Tool Palette | Node, Freeway menu command.

TRAFED automatically creates entry nodes, exit nodes, and interface nodes as needed. You cannot manually create these types of nodes. An entry node is automatically created for a link whose upstream end is not connected to any other node. Dragging a link from green space to an existing node will create an entry link and an entry node. An exit node is automatically created for a link whose downstream end is not connected to any other node. Dragging a link from a node to green space will create an exit link and an exit node. Deleting an entry or exit link will automatically delete the entry or exit node as well.

4.10 Selecting a Node

Selecting a node makes it the focus of subsequent commands such as editing the properties of a node, moving the node to another location or deleting the node.

Nodes are selectable objects. Once a node is selected, its appearance is highlighted by an outline of blue. The steps to select a node are press the Pointer button or choose the Network | Tool Palette | Pointer menu command, if the cursor is not currently drawn as an arrow. Or, you can right-click the mouse in the green area.
on the grid and the arrow tool will then be the cursor. Position the cursor over the node and click the left mouse button. The node will be drawn with a blue border to indicate that it is selected.

## 4.11 Editing Surface Nodes

To bring up a node's Properties dialog select the node and choose the Edit | Properties menu command, or double-click on the node in pointer mode, or right-click on the node and choose the Edit menu command from the pop-up menu.

You can use a surface node's Intersection Properties dialog to specify relationships (such as turn movements and lane alignment) between links that meet at the node. You can also use this dialog to specify traffic control (signs, Pre-Timed controllers, and actuated controllers), pedestrian traffic, and other properties of the node.

Whenever links are attached to or detached from a node, TRAFED will reset the node's properties according to the new geometry of the node.

The Intersection Properties dialog contains fields and pages. The fields common to all pages are defined below. The pages are defined in the following sections.

### Node ID

This field is used to specify the ID number of the selected node.

### Location: x, y

This is the position of the node, in feet, located relative to other points in the network. The x, y origin is in the bottom left corner of the grid. If the node coordinates are not consistent with the link lengths, the animation may appear distorted with either extra spacing between vehicles or possible vehicle stacking. CORSIM will issue a warning message if the mathematical distance between the node coordinates differs by plus or minus 20% from the values entered.

### Select an approach (upstream node ID) to edit

The ID numbers, of upstream nodes, of the links, attached to the selected node are displayed in the network window. Select the ID of the approach whose data you want to examine or modify. Each approach on a node needs to have its properties defined separately.
4.11.1 Intersection Properties: Turn Movements

Departures (downstream node IDs): Left, Thru, Right, Left Diag and Right Diag

Select the downstream node ID for the link that will receive turn movements from the selected approach.

NOTE: CORSIM's TRF file format allows only one diagonal movement for any given approach. If you use both the left diagonal and the right diagonal from the same approach, TRAFED will issue a warning if you export the network to TRF format, and one of the diagonals will be omitted from the resulting TRF file.

Traffic opposing left-turners comes from

This entry specifies the upstream node for traffic opposing left-turning traffic for the selected approach.

Time varying data: Time Period

Select the desired time period for editing. All time varying data displayed applies to the selected time period, otherwise the previous time periods data is used.
Time varying data: Relative Turn Volumes: Start time
The start time associated with the turn movements for the selected time period is entered here. This value is the elapsed time from the beginning of the simulation, and it is entered in minutes.

Time varying data: Relative Turn Volumes: Left, Thru, Right, and Diagonal
Turn movement percentages only apply to passenger cars, carpools, and trucks. All traffic exiting on interface nodes must travel straight through to the next network. To allow for the collection of statistical data, if the upstream node is an entry node (8####), then the downstream node should be a dummy node, not an actual intersection. This condition will allow for the collection of statistics between the dummy node and the actual intersection. In this case, 100% of the traffic will travel through from the entry node through the dummy node to the actual intersection. New turn movement data can be entered for each time period to reflect the changes in turn percentages or traffic blockages. If data is not entered for a new time period, CORSIM will assume that the turn movement percentages and blockages for the previous time period apply to the new time period.

If turn specifications are entered in the form of vehicles/hour, CORSIM will internally convert these inputs to turn percentages. If the entries total 100, CORSIM will use them as percentages. If the entries do not total 100, CORSIM will treat them as volumes and will convert them into percentages. Traffic volumes specified will not be used to determine traffic flow.

Turn Movements are required for all intersections unless traffic assignment is used to generate turn movement data. If traffic assignment is used, then the turn movement data is used only for links requiring explicit turn prohibitions such as “No Left Turn.” These turn prohibitions should be made only when the network geometry allows the turn movement but the movement is prohibited by signage. CORSIM will detect inconsistent inputs (e.g., a nonzero turn volume specified for a prohibited movement), and the run will be aborted with a message identifying the problem.

Time varying data: Right turn on red allowed
This check box specifies whether Right-Turn-On-Red (RTOR) is allowed for the selected time period.

4.11.2 Intersection Properties: Turn Prohibitions
This page will only appear if the Network Properties, Run Control, Type of Run: Traffic Assignment is selected. Refer to Network Properties.
Left Turn Prohibited
This entry specifies left-turn movement prohibitions for traffic assignment. The values associated with this entry are left-turn movement is allowed (unchecked) or prohibited (checked).

Through Movement Prohibited
This entry specifies through movement prohibitions for traffic assignment. The values associated with this entry are through movement is allowed (unchecked) or prohibited (checked).

Right Turn Prohibited
This entry specifies right-turn movement prohibitions for traffic assignment. The values associated with this entry are right-turn movement is allowed (unchecked) or prohibited (checked).

Diagonal Movement Prohibited
This entry specifies diagonal-turn movement prohibitions for traffic assignment. The values associated with this entry are diagonal-turn movement is allowed (unchecked) or prohibited (checked).
4.11.3 Intersection Properties: Turn Multipliers

Time Period
Select the desired time period for editing. All time varying data displayed applies to the selected time period for the selected approach.

Same as previous time period
The data associated with the selected time period will have all the same values as the previous time period.

Turning multipliers for specific vehicle types
The turning fractions defined on the Turn Movements page apply equally to all vehicle types. The turn multipliers page can be used to indicate that certain vehicle types have different turning fractions.

The vehicle types are defined as:

<table>
<thead>
<tr>
<th>NETSIM Vehicle Type</th>
<th>Vehicle Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High-performance passenger car</td>
</tr>
<tr>
<td>2</td>
<td>Single-unit truck</td>
</tr>
</tbody>
</table>
### NETSIM Vehicle Type

<table>
<thead>
<tr>
<th>NETSIM Vehicle Type</th>
<th>Vehicle Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>High-performance passenger car</td>
</tr>
<tr>
<td>4</td>
<td>Conventional bus</td>
</tr>
<tr>
<td>5</td>
<td>Low-performance passenger car</td>
</tr>
<tr>
<td>6</td>
<td>Semi-trailer truck with medium load</td>
</tr>
<tr>
<td>7</td>
<td>Semi-trailer truck with full load</td>
</tr>
<tr>
<td>8</td>
<td>Double-bottom trailer truck</td>
</tr>
<tr>
<td>9</td>
<td>Low-performance passenger car</td>
</tr>
</tbody>
</table>

#### 4.11.4 Intersection Properties: Lane Alignment

This page is used to create lane alignment other than turning into the nearest lane. In the example above 2 right turn lanes, 1 through lane and 1 left turn lane is shown.

**Lane Alignment**

Click a point on the connection box of the selected approach link (red highlighted lane) and drag to another lane connection point to set an alignment. To remove a connection click a point on the red highlighted lane.
and drag over an existing alignment to another lane point. The red highlighted lanes represent the current selected approach. Connect the points to the black lane points to define the turning alignments.

### 4.11.5 Intersection Properties: Conditional Turn Movements

**Intersection Properties**

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

- **Same as previous time period**
  The data associated with the selected time period will have all the same values as the previous time period.

- **Conditional Turn Movements**
  Use this data to prevent vehicles from making a series of unrealistic turn movements. For example, the user may want to prohibit vehicles from making a series of consecutive left turns (i.e., restrain vehicles from going around a block). The NETSIM model normally applies turn movement percentages to all vehicles entering a link, regardless of their previous path. The above data allows the user to define discharge turn percentages that are conditioned on the basis of entry movement. Therefore, the percentage of vehicles executing left turns...
after entering via a left turn can be made substantially less than the percentage of vehicles executing left turns after entering via a through movement.

If the user defines turn percentages for one entry movement–exit movement combination, he/she must define the discharge turn percentages for all other traffic entering from that direction.

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

When discharge movements are defined for all entering directions, it is not possible to satisfy the turn percentages.

The conditional turn movements specified are presented as percentages of vehicles performing each movement at the downstream node of the subject link, or they are expressed consistently in terms of the total number of vehicles per hour that perform the movements. These percentages or hourly volumes are applied over the duration of one time period.

When an upstream entering movement to the subject link has conditional turn movements assigned to the downstream node of the selected approach link, it is not required to assign conditional turn movements to all upstream entering movements. For each upstream entering movement affected, however, all vehicles entering from that direction must be accounted for. Therefore, if left, thru, right and diagonal entries are specified, they must add to 100 (if percentages are used) or represent the total number of vehicles entering from one direction.
**4.11.6 Intersection Properties: Stop Line**

**Distance from the stop line to the near curb**
This entry specifies the longitudinal distance from stop line to the near curb.

**Forward sight distance at the stop line**
This entry specifies the forward sight distance at the stop line. This entry defines the forward visibility of a driver at the stop line to see approaching vehicles, and it is used to determine when drivers can see and respond to approaching vehicles that conflict with their movement within the intersection.
4.11.7 Intersection Properties: Pedestrians

**Time Period**
Select the desired time period for editing. All time varying data displayed applies to the selected time period.

**Pedestrian Moving With (Not Across) This Approach**
This entry specifies the intensity of pedestrians moving with traffic on the selected approach and the selected time period. This entry affects the delay experienced by right and left turning vehicles. The choices range from no pedestrians to a high volume of pedestrians per hour. Refer to NETSIM Setup: Pedestrians for more information and default values.
4.11.8 Intersection Properties: Control

Control Type
This entry specifies what type of control is at the node, none, pre-timed or actuated. If the desired control is a signed control it is set up along the link (refer to Creating Sign Controls).

Properties
This button will bring up the properties of the pre-timed or actuated control. If there is no control at the node, then this button is disabled. Refer to Editing Pre-Timed Controllers and Editing Actuated Controllers.

4.12 Editing Freeway Nodes
To bring up a node's Properties dialog select the node and choose the Edit | Properties menu command, or double-click on the node in pointer mode, or right-click on the node and choose the Edit menu command from the pop-up menu.
In the Freeway Node Properties dialog, you can specify whether ramps are located on the left or right of the mainline, percentage of exiting traffic (if an off-ramp exists), and ramp metering control. Lane alignment is determined programmatically in TRAFED.

The Freeway Node Properties dialog contains fields and pages. The fields common to all pages are defined below. The pages are defined in the following sections.

**Node ID**

This field is used to specify the ID number of the selected node.

**Location: x, y**

This is the position of the node, in feet, located relative to other points in the network. The x, y origin is in the bottom left corner of the grid. If the node coordinates are not consistent with the link lengths, the animation may appear distorted with either extra spacing between vehicles or possible vehicle stacking. CORSIM will issue a warning message if the mathematical distance between the node coordinates differs by plus or minus 20% from the values entered.

### 4.12.1 Freeway Node Properties: Turn Movements

**Time Period**

Select the desired time period for editing. All time varying data displayed applies to the selected time period.
Off-ramp reaction point is
This entry specifies the distance from the downstream end of this link to a warning sign at which drivers begin to react to the off-ramp exiting from this link. This length may be upstream of the link itself, i.e., a longer distance than link length. For a link with an off-ramp destination, this entry tells the model how far upstream of the downstream end of the link that vehicles destined to exit at the off-ramp begin to react to the exit’s presence. At this distance, a vehicle will begin to enter the proper lane for exiting. If the output indicates that a substantial number of vehicles are missing this exit (a message is printed every time this occurs), the distance may need to be increased. If there is an exclusive HOV lane or a barrier on the link leading to an off-ramp, the warning sign should be positioned further upstream than the beginning of the HOV lane or the barrier. For example, you may need to position the warning sign on the previous link.

HOVs reaction point is
This entry defines the upstream location for an HOV exit warning sign. All HOVs that will be exiting the freeway from this link will avoid exclusive HOV lanes after passing this warning sign. If they are currently in an exclusive HOV lane they will attempt to exit from that HOV lane as soon as possible. This entry has no effect on other vehicles and only affects HOVs when exclusive HOV lanes have been entered. This value must be greater than or equal to off-ramp reaction point.

Relative Turn Volumes: Start time
The start time associated with each turn movement is entered here. It can vary within a time period.

Relative Turn Volumes: Thru traffic
This entry specifies the percentage of vehicles or the total number of vehicles that have a through movement to the downstream link. If the turn specifications are entered in the form of vehicles/hour, CORSIM will internally convert these inputs to turn percentages. If any of the entries contain a percentage, then all of them must contain percentages. Similarly, if one entry contains a vehicle count, then both of the entries must contain a vehicle count.

Relative Turn Volumes: Exiting traffic
This entry specifies the percentage of vehicles or the total number of vehicles that exit off the link. If the turn specifications are entered in the form of vehicles/hour, CORSIM will internally convert these inputs to turn percentages. If any of the entries contain a percentage, then all of them must contain percentages. Similarly, if one entry contains a vehicle count, then both of the entries must contain a vehicle count.

Exit percentage multipliers for specific vehicle types
This entry specifies the multipliers for the percentage of vehicles of this type that exit at the off-ramp link. This data can be used to indicate that certain vehicle types have different turning fractions for specific mainline links that have an associated off-ramp. For a vehicle type, the existing turning fraction at the mainline link will be multiplied by the defined factor.

The vehicle types are defined as:

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Type Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low-performance passenger car</td>
</tr>
<tr>
<td>2</td>
<td>High-performance passenger car</td>
</tr>
<tr>
<td>3</td>
<td>Single-unit truck</td>
</tr>
</tbody>
</table>
### Working with Traffic Objects

#### 4.12.2 Freeway Node Properties: Connections

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Type Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Semi-trailer truck with medium load</td>
</tr>
<tr>
<td>5</td>
<td>Semi-trailer truck with full load</td>
</tr>
<tr>
<td>6</td>
<td>Double-bottom trailer truck</td>
</tr>
<tr>
<td>7</td>
<td>Conventional bus</td>
</tr>
<tr>
<td>8</td>
<td>Low-performance passenger car</td>
</tr>
<tr>
<td>9</td>
<td>High-performance passenger car</td>
</tr>
</tbody>
</table>

**Ramp Position**

The ramp's freeway position is either Right of the mainline or Left of the mainline. This parameter allows TRAFED to determine lane alignment.
4.12.3 Freeway Node Properties: Ramp Meter

Meter Type

There are five types of on-ramp control strategies, which can be implemented in the FRESIM model: Clock-time metering, Demand/capacity metering, Speed control metering, Multiple-threshold occupancy control metering or ALINEA control metering. Refer to Editing Ramp Meters for details on the meter types.

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

When a user employs different metering strategies for different meters in one network, some meters (e.g., fixed-time strategy) may not need detectors while others may require detectors. In this case, the user should first input the meters that need detectors and then input the meters that do not require detectors. For instance, if a network has two meters that have different strategies (one has the fixed-time strategy and the other has the multiple-threshold control strategy), the user should input the meter with the multiple-threshold control strategy first and then input the meter with the fixed-time strategy.
Properties
This button will bring up the properties of the selected ramp meter. If there is no meter at the node, then this button is disabled. Refer to Editing Ramp Meters.

Detectors
This button will bring up the Meter to Detector Association dialog, shown below. If the selected meter type does not require detectors, then this button is disabled. The user must define these detectors on the Freeway Link: Detectors dialog, refer to Editing Freeway Links, prior to making the desired association. The user should select the desired detectors from the defined list.

<table>
<thead>
<tr>
<th>Link</th>
<th>Position</th>
<th>Lane</th>
<th>Station</th>
<th>Type</th>
<th>Use?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[2, 51]</td>
<td>955</td>
<td>1</td>
<td>1</td>
<td>Short Loop</td>
<td>☐</td>
</tr>
<tr>
<td>[57, 56]</td>
<td>965</td>
<td>2</td>
<td>2</td>
<td>Short Loop</td>
<td>☐</td>
</tr>
<tr>
<td>[520, 2]</td>
<td>1024</td>
<td>3</td>
<td>2</td>
<td>Short Loop</td>
<td>☐</td>
</tr>
<tr>
<td>[510, 52]</td>
<td>2244</td>
<td>3</td>
<td>2</td>
<td>Short Loop</td>
<td>☐</td>
</tr>
<tr>
<td>[520, 1]</td>
<td>320</td>
<td>1</td>
<td>2</td>
<td>Coupled Far</td>
<td>☐</td>
</tr>
</tbody>
</table>

Link
This column identifies the link on which the detector is located.

Position
This column identifies the longitudinal location of the detector from the upstream end of the link (in feet).

Lane
This column identifies the lane on which the detector is located.

Station
This column identifies the station number for this detector.
Type
This column identifies the detector type code: Doppler radar, Short loop or Coupled pair of short loops.

Use?
Select this check box if this detector is to be used for this ramp meter.

4.13 Editing Entry Nodes

To bring up an entry node's Properties dialog select the entry node and choose the Edit | Properties menu command, or double-click on the node in pointer mode, or right-click on the node and choose the Edit menu command from the pop-up menu.

Entry nodes usually form the outer boundary of the network. Unless a sub-network is entirely bound by other sub-networks, it will receive traffic from entry nodes on its periphery. If a network receives all of its traffic from other networks and from source/sink links (i.e., centroids), then there will not be any entry nodes. Entry volumes will normally be required for all networks except when the traffic assignment option is used to generate traffic volumes.

Entry links are unique in that they are not part of the network itself. As vehicles are generated by CORSIM, they are accumulated on the entry links for later discharge onto the network from the entry link. Both the control and spillback conditions at the downstream node of the entry link regulate entry of vehicles onto the network. For example, if the downstream link is completely filled with vehicles, then new vehicles cannot enter it. Network statistics are not accumulated for the entering vehicles until they have left the entry link. Traffic volumes enter the network in a uniform, random or Erlang distribution every fixed number of seconds for each new time period.

Traffic volumes are defined as the number of vehicles per hour and the percentage of vehicles of each type. Car percentages are defined by subtracting carpool and truck percentages from 100%. Bus volumes are not part of the entry volume and are defined separately.

If there is a subsequent time period that does not specify entry volumes, the entry volumes for that time period will be the same as the volume at the end of the previous time period.

Please refer to Specifying Origin-Destination (FRESIM) for more information on volumes and origin-destination.

Note: entry nodes are created by creating entry links.
4.13.1 Entry Properties

**ID**
This field is used to specify the ID number of the selected node.

**Location: x, y**
This is the position of the node, in feet, located relative to other points in the network. The x, y origin is in the bottom left corner of the grid. If the node coordinates are not consistent with the link lengths, the animation may appear distorted with either extra spacing between vehicles or possible vehicle stacking. CORSIM will issue a warning message if the mathematical distance between the node coordinates differs by plus or minus 20% from the values entered.

**Time Period**
Select the desired time period for editing. All time varying data displayed applies to the selected time period.

**Same as previous time period (if so, flow cannot be edited)**
Use time period information from the previous time period.

**Entry Volumes or Counts: Start Time and Flow**
This entry specifies the flow rate in vehicles per hour entering from the entry node for the selected time period. For a FRESIM entry node the maximum flow rate is limited by the minimum separation for vehicle generation.
The minimum separation is a FRESIM wide parameter changeable by selecting Network | FRESIM Setup menu command and going to the Miscellaneous page. The minimum separation might have to be decreased in order to get the desired flow rate. The minimum separation for vehicle generation will limit the flow rate in a given lane.

**Entry Flow is given as Vehicle counts or Volumes**

Determine if the entries found in the Entry Volumes or Counts table are number of vehicles or volumes in vehicles per hour. If the entries are specified in vehicles per hour CORSIM will interpolate between the data points to determine flow rates at times between the specified times. If the entries are specified in vehicle counts CORSIM will calculate the required flow rate to generate that number of vehicles over the specified time interval.

**Vehicle Types (other than passenger cars): Trucks and Carpools**

These entries specify the percentage of vehicles entering at this node that are trucks and carpools. A carpool vehicle is essentially the same as an auto except that it has a different occupancy and it can enter any HOV lane that allows carpools. It will be left up to the user to specify the percentage of carpools correctly to represent the actual number of qualifying carpools.

**Percentage of non-HOV vehicles that violate HOV lanes**

This entry specifies the percentage of vehicles entering at this node that are HOV lane violators. When a vehicle is flagged as a violator, it will try to enter the HOV lane. It is the user's responsibility to calibrate this entry so that the volume of violators generated in the output file is the desired value.

This entry is used for both NETSIM and FRESIM. HOVs that enter the network at a NETSIM node are also categorized as violators or non-violators because vehicles can enter the freeway from surface streets. However, violators specified at a NETSIM node will not enter an HOV lane in NETSIM. They behave as violators only when they enter the FRESIM sub-network.

**Lane distribution of entering vehicles (FRESIM): Leftmost lane through Rightmost lane**

These entries specify the percentage of vehicles entering the leftmost lane through the rightmost lane.

In FRESIM, use these entries to assign vehicles across lanes. The percentage of vehicles entering each lane is based on the total flow rate specified. The sum of the percentages must equal 100%. Note this is not enabled for NETSIM entry nodes.

### 4.14 Editing Exit Nodes

To bring up an exit node's Properties dialog select the exit node and choose the Edit | Properties menu command, or double-click on the node in pointer mode, or right-click on the node and choose the Edit menu command from the pop-up menu.

Note: exit nodes are created by creating exit links.
4.14.1 Node Location

Node ID
This field is used to specify the ID number of the selected node.

Location: x, y
This is the position of the node, in feet, located relative to other points in the network. The x, y origin is in the bottom left corner of the grid. If the node coordinates are not consistent with the link lengths, the animation may appear distorted with either extra spacing between vehicles or possible vehicle stacking. CORSIM will issue a warning message if the mathematical distance between the node coordinates differs by plus or minus 20% from the values entered.

4.15 Deleting a Node
To delete a node or a set of nodes select the node(s) to be deleted. Press the Delete key or select the Edit | Delete menu command. Deleting a node requires all connected links to be deleted first.

4.16 Finding a Node
To locate a node whose ID you know, select the Edit | Find menu command or use the <Ctrl>+F keyboard shortcut. This brings up a dialog in which you can specify the type of object (node) and its ID.

As the user is typing, the edit fields will auto complete the selection. When you press OK, the requested node will be highlighted with a blue border. If the node was not previously visible within the network window, the window will be panned and moved to bring the selected node into view.
4.17 Moving a Node

A node can be moved graphically, or by editing its location in its Properties dialog. To move a node graphically, select the node to be moved. With the cursor positioned over the node, press the left mouse button down and continue holding the button down while moving the cursor to a new location. The status bar displays the location of the cursor as it moves. Also, the TRAFED Project Window displays a coordinate grid, which aids in positioning nodes. Release the mouse button when the cursor is at the desired new location. The node is now displayed at this new location.

4.18 Creating Pre-Timed Controllers

There are two methods of creating Pre-Timed Controllers.

Click the Pre-Timed button, or choose the Network | Tool Palette | Control | Pre-Timed menu command. This will put the editor into Create Pre-Timed Controller mode. In Create Pre-Timed Controller mode the cursor will display as a "Not allowed" symbol over most of the network. As the cursor moves across the screen it will remain unchanged until it passes over a surface node. The cursor will then change to . If this is the node you wish to add a Pre-Timed controller to, click the left mouse button. If the node had no previous controller, a Pre-Timed controller will be added, and a square will appear within the surface node. A red node indicates that some piece of information is missing or not correct. Otherwise nodes are outlined white.

To change the controller’s properties refer to Editing Pre-Timed Controllers. If the node already had a controller, you will be asked if you wish to replace it. Doing so will delete the previous controller. You may continue adding Pre-Timed controllers to nodes until you switch to a different palette tool.

Alternatively, right click on the desired node and a pop-up menu will appear. Select Edit from the pop-up menu. Switch to the Control page on the Intersection Properties dialog. From the dropdown box, select Pre-Timed. A Pre-Timed Controller is created automatically. You may immediately edit the controller settings by clicking the Properties button on the Control page. This will take you to the Pre-Timed Controller Properties dialog.

4.19 Editing Pre-Timed Controllers

To edit a Pre-Timed Controller, right click on the node where the controller exists and select the Edit Controller menu command. Alternately, bring up the Properties dialog for the node with which the controller is associated, switch to the Control page, and click on the Properties button.

4.19.1 Pre-Timed Controller Properties

The properties for a pre-timed controller are specified using the Pre-Timed Controller dialog. In an effort to reduce the number of user inputs and to make the pre-timed controller dialog similar to the actuated controller dialog, TRAFED has implemented the CORSIM turning movement control codes and time intervals as “phases.” Each phase consists of a set of turn movements and the green, yellow, and all red times associated with those movements.

The dialog contains three major data entry and display sections. The intersection approach and turn movement diagram is displayed in the upper left of the dialog. The upper right contains controls for the time period,
phasing scheme, and offset, plus a display for the controller cycle length. The bottom of the dialog contains
the phase diagram and a set controls used for specifying the timing parameters for each phase of the controller.

Approaches and Phases

The approach diagram at the top left portion of the dialog identifies the approaches to the intersection under
control and all of the possible turn movements that can be assigned for each approach. The number in the
center of the diagram is the ID of the intersection node under control. The squares surrounding the node ID
represent the approaches to the intersection, where the numbers in the center of the squares are the IDs of the
nodes at the upstream end of each approach. Each square also contains turn movement buttons used to assign
movements for the approach to the phases identified in the phase diagram.

The phase diagram at the bottom of the dialog displays the movements assigned to each phase. To add or
remove a turn movement to or from a phase, first select the phase you wish to change by clicking in the
appropriate phase box in the phase diagram. The background of the phase box will turn white, indicating it is
now the active phase. Click on the movement buttons in the approach diagram for each movement you wish to
add to or remove from the phase. The movement buttons act as toggle switches, removing the movement from
the phase if it is present, or adding the movement if it is not.

Arrows representing the approaches and turn movements assigned to a phase will appear in the phase box for
the phase. Permitted left movement arrows appear as half-tone arrows. For the active phase, the movement
buttons in the approach diagram will appear depressed for the movements that are assigned to the phase. There
is no limit to the number of phases to which a given movement may be assigned.

To enter or change the timings associated with the green, yellow, and all red intervals associated with a phase,
simply enter the desired times in the appropriate edit boxes that appear below the phase box for the phase.
Although there are eighteen possible intervals on this dialog, CORSIM only allows twelve. Only the intervals with duration greater than zero will be translated to your simulation format.

**Time Period**

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

To simulate a multiple-dial system, the user must specify the method of transition between signal timing plans. Three transition methods are possible: immediate transition; two-cycle transition; and three-cycle transition. The transition to a new timing plan occurs the first time a controller reaches main-street green after the beginning of a new time period. Even if only some of the controllers change their timing from one timing plan to another, all intersections must have their timing specified for the new timing plan. The transition method is specified on the Network Properties Controller page, refer to Network Properties.

**Same as previous time period**

When checked, the data associated with the selected time period will have all the same values as the previous time period.

**Under External Control**

When checked, the signal will operate under external control (e.g., Run-Time Extension).

**Preset Phase Scheme, Save Scheme, Load Scheme**

Preset phase schemes are a simple way to set the movements for the entire controller at once. You can load a scheme for other similar intersections. To use an existing scheme, select it from the drop-down box and click the Load Scheme button. The dialog changes to reflect the chosen scheme. If the scheme does not have exactly the data you wish it to have, you may alter it and resave it with the same name. In the future, it will have your data instead of its original data. Or you may type a new name into the title box and save the altered version with the new scheme name. To create a new scheme, edit the controller so it contains the data you would like your scheme to have. Type a name for your scheme in the title box, and click the Save Scheme button in the dialog. Thereafter, your scheme will be shown in the drop-down box, and can be selected just like any pre-packaged scheme.

**Cycle Length**

This field indicates the total time for the defined phases. It is not an editable field and is supplied only to provide information to the user. It displays a running total for the defined phases.

**Offset Time**

This field is used to specify the reference offset to signal interval 1, which is the delay of the controller's cycle from the beginning of the simulation.

**Minimum Main Street Green**

This field is used to specify the minimum main-street-green duration during transition. It is valid only for time periods other than one.
Phase Movements
For each phase, the phase movement boxes display the movements assigned to the phase. Permitted left movements appear as half-tone arrows. To add or remove a turn movement to or from a phase, first select the phase you wish to change by clicking in the appropriate phase box in the phase diagram. The background of the phase box will turn white, indicating it is now the active phase. Click on the movement buttons in the approach diagram for each movement you wish to add to or remove from the phase. The movement buttons act as toggle switches, removing the movement from the phase if it is present, or adding the movement if it is not.

Green Time, Yellow Time and All Red Time for each Phase
The text edit fields below each phase box are used to specify the duration, in seconds, of the green, yellow, and all red intervals for the phase.

4.20 Creating Actuated Controllers
There are two methods of creating Actuated Controllers:

Click the Actuated button, or the Network \ Tool Palette | Control \ Actuated menu command. This will put the editor into Create Actuated Controller mode. In the Create Actuated Controller mode the cursor will display as a "Not allowed" symbol over most of the network. As the cursor moves across the screen it will remain unchanged until it passes over a surface node. The cursor will then change to . If this is the node you wish to add an actuated controller to, click the left mouse button. If the node had no previous controller, an actuated controller will be added, and a circle will appear within the surface node . A red node indicates that some piece of information is missing or not correct. Otherwise nodes are outlined white. To change the controller’s properties refer to Editing Actuated Controllers. If the node already had a controller, you will be asked if you wish to replace it. Doing so will delete the previous controller. You may continue adding actuated controllers to nodes until you switch to a different palette tool.

Alternatively, right click on the desired node a pop-up menu will appear. Select Edit from the pop-up menu. Switch to the Control page on the Intersection Properties dialog. From the dropdown box, select Actuated. An Actuated Controller is created automatically. You may immediately edit the controller settings by clicking the Properties button on the Control page. This will take you to the Actuated Controller Properties dialog.

4.21 Editing Actuated Controllers
To edit an Actuated Controller, right click on the node where the controller exists and select the Edit Controller menu command . Alternately, bring up the Properties dialog for the node with which the controller is associated, switch to the Control page, and click on the Properties button.

4.21.1 Actuated Controller Properties
The properties for an actuated controller are specified using the Actuated Controller Properties dialog. The dialog contains five major data entry and display sections. The intersection approach and turn movement
Approaches and Phases

The approach diagram at the top left portion of the dialog identifies the approaches to the intersection under control and all of the possible turn movements that can be assigned for each approach. The number in the center of the diagram is the ID of the intersection node under control. The squares surrounding the node ID represent the approaches to the intersection, where the numbers in the center of the squares are the IDs of the nodes at the upstream end of each approach. Each square contains turn movement buttons used to assign movements for the approach to the phases identified in the phase diagram. Each square also contains a detector button used to define detectors for the approach.

The phase diagram to the right of the approach diagram displays the movements assigned to each phase and indicates if the phase has been assigned pedestrian timings. The phase boxes in this diagram are arranged in two rows where the top row contains phases that belong to ring 1 in the standard NEMA 8-phase representation. The bottom row contains phases that belong to ring 2 in the standard NEMA 8-phase representation. Note that CORSIM supports only two rings where phases 1 through 4 are always in ring 1 and that phases 5 through 8 are always in ring 2.

To add or remove a turn movement to or from a phase, first select the phase you wish to change by clicking in the appropriate phase box in the phase diagram. The background of the phase box will turn white, indicating it is now the active phase. Click on the movement buttons in the approach diagram for each movement you wish
to add to or remove from the phase. The movement buttons act as toggle switches, removing the movement from the phase if it is present, or adding the movement if it is not.

Arrows representing the approaches and turn movements assigned to a phase will appear in the phase box for the phase. Permitted left movement arrows appear as half-tone arrows. Potential overlap movements appear as green arrows. For the active phase, the movement buttons in the approach diagram will appear depressed for the movements that are assigned to the phase. If pedestrian timings have been assigned to a phase, a blue “walker” icon appears in the phase box behind the phase number.

### Time Period

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

### Same as previous time period

When checked, the data associated with the selected time period will have all the same values as the previous time period.

### Under External Control

When checked, the signal will operate under external control (e.g., Run-Time Extension).

### Scheme, Save Scheme, Load Scheme

To help simplify phase coding, TRAFED provides some typical predefined settings. To load these settings use the Load Scheme button. The user can also save new settings using the Save Scheme button. Preset phase schemes are a simple way to set the movements for the entire controller at once. You can load a scheme for other similar intersections. To use an existing scheme, select it from the drop-down box and click the Load Scheme button. The dialog changes to reflect the chosen scheme. If the scheme does not have exactly the data you wish it to have, you may alter it and resave it with the same name. In the future, it will have your data instead of its original data. Or you may type a new name into the title box and save the altered version with the new scheme name. To create a new scheme, edit the controller so it contains the data you would like your scheme to have. Type a name for your scheme in the title box, and click the Save Scheme button in the dialog. Thereafter, your scheme will be shown in the drop-down box, and can be selected just like any pre-packaged scheme.

### 4.21.2 Actuated Controller Detectors

As its name implies, an actuated controller operates based on traffic demand, registered by detectors placed on the approaches to the intersection. When a detector is “actuated” by a vehicle, the detector places a call to the controller for the phase that is associated with the detector. Detectors are also used for implementation of several volume-density functions in the controller that are used to adjust the signal timings based on traffic demand. The user must specify detectors on an approach whenever any movements on that approach are associated with a phase that is actuated, i.e., a non-sync phase or a phase not having recall flags set.

Nearly all types of detector layouts and operational designs in common usage, including single-call detection, EC/DC or other types of dilemma zone detection, surveillance detection and detector switching can be simulated in CORSIM. Because all operational types of detectors (such as loop, magnetometer, infrared, sonic, and radar) are acquiring the same data from the field, the type of detector being used is irrelevant to CORSIM.

There are two groups of actuated control detectors that can be modeled in CORSIM. The two groups are identified in the following figure.
Group 1 detectors (detectors 1 through 3) are the standard extension and count detectors installed commonly in the field. They place a call to their associated phase whenever a vehicle actuates the detector. This call can be used to simply actuate the phase to service the vehicle, or be used to calculate the variable initial interval if the phase is in a red or yellow state (and the controller is operating under volume-density control), or to provide for vehicle extensions to the service green (up to the maximum green) if the phase is in a green state. The actual usage of the detector depends on the operational characteristics defined for the controller.

Group 2 detectors (detectors 4 through 6) are not presently in common usage, being marketed before modern actuated controllers (NEMA or Type 170) were developed. Most of the functionality provided by these detectors is now provided as an internal controller function using standard extension/count detectors (group 1 detectors). However, many of the newer detector functions presently available in actuated controllers are not currently available in CORSIM. Group 2 detectors are a primary example of this situation. Detector 4 in group 2 is an extension-only detector. It places calls to the controller only when the phase is green, resetting the extension (passage or gap) timer to zero with each actuation, thus providing a complete extension time for the current vehicle actuation. When the phase is red, the extension-only detector is disabled.

Detectors 5 and 6 in Group 2 are referred to as Type III detectors and are not presently manufactured. However, their function is now accomplished internal to the controller or by relays in the controller cabinet. Type III detectors are calling-only detectors. In common usage they are narrow detectors, often crossing several lanes. They are located at or near the stop line on the approach and only installed to place a call to the phase during the red portion of the signal display. These detectors are more commonly referred to as “single call” detectors and are installed on approaches to an intersection that has pulse detection installed several hundred feet from the stop line. Generally, a commercial drive or neighborhood street is also located between the stop line and the pulse detectors. In these instances a vehicle entering the approach from the neighborhood street or commercial drive will not pass the pulse detector and could be “trapped” between the loop and the stop line without actuating the controller. The “single call” detector takes care of this situation by placing one call to the controller during the red phase for this vehicle. The Type III detector not only places this single call to the controller but will hold the call into the green phase of the approach so long as the actuation is continuous or for a user-selectable amount of time. This feature can be applied to keep random occurrences of sluggish traffic and/or large trucks from “gapping-out” the signal phase while still maintaining a low value for minimum green time. In modern controllers this function is handled by gap reduction techniques. Because it is unlikely that the CORSIM user will encounter an actual Type III detector in the field, the detector
operational and timing parameters in the controller should be checked to determine if a “single call” or Type III detector operation is present and should be simulated.

Finally, in real-world applications surveillance information may be collected from an actuated control detector. However, CORSIM surveillance detectors and actuated control detectors are separate detectors. To collect surveillance information from an actuated control detector in CORSIM the detector must be specified both as a surveillance detector on the Surface Link property dialog Detector page and as an actuated control detector on the Actuated Controller Detector Properties dialog accessed from the Actuated Controller Properties dialog.

The only limitation on the number of sensors that can be connected to one controller is that the total number of sensors for the entire NETSIM sub-network cannot exceed 7000 and the number of detectors on any single link cannot exceed 40. These limitations include all detectors, including surveillance detectors.

**Specifying Detectors for Actuated Control**

To specify detectors for an approach to an intersection under actuated control, activate the Actuated Controller Detector Properties dialog by pressing the detector button, for the desired approach in the approach diagram. The link identifier for the approach will appear in the “Detector Location” group of the dialog along with the lane configuration diagram for the approach.

While the dialog is active, the detector button will appear depressed with a green background to aid the user in identifying the approach for which detectors are being specified.

**New**

To create a new detector on the approach:

1. Click the New button.
2. Select the phase that the detector actuates using the Phase drop-down list.
3. Select the detector Type and Operation mode using the radio buttons.
4. Select the lanes this detector occupies using the list box (more than one lane may be selected).
5. Enter the other parameters in the edit boxes provided.

The detector specification will be saved when the **OK** button is pressed, or discarded if the **Cancel** button is pressed.

### Delete

To delete an existing detector:

1. Select the detector you wish to delete using the **Detector** drop-down list.
2. Click the **Delete** button.
3. A confirmation dialog box will appear, asking if you are sure. If you are sure you want to delete the detector, click **Yes**. If you change your mind and do not want to delete the detector, click **No**.

### Detector

Use this drop-down list to specify a detector to delete or to edit. Note that this entry is not the detector ID used by CORSIM. It is a sequential number used to identify a detector in the set of detectors defined for an approach. To edit an existing detector:

1. Select the detector you wish to edit using the **Detector** drop-down list. Its current parameters will be displayed in the dialog.
2. Update the parameters as desired.

The updated detector specification will be saved when the **OK** button is pressed, or discarded if the **Cancel** button is pressed.

### Detector Location

The Detector Location group is used to specify the size and location of the detector longitudinally along the approach link and also the laterally across the link in terms of the lanes covered. The link identifier and lane configuration diagram for the approach link are displayed to aid the user in specifying the detector location.

#### Detector Location: Lanes

This entry specifies the lanes in which the sensor is located. A detector can be assigned to any lane or multiple lanes on the approach.

It is a common field practice to install a single lane sensor in each of two adjacent through lanes on the same approach. These two sensors would then be connected to the same detector amplifier in the controller cabinet. However, this combination of sensors provides the same operational characteristics as a single sensor covering two lanes and thus could be coded in CORSIM as such without affecting the operation of the sensors. This type of loop sensor can be represented by selecting two lanes in the list.

#### Detector Location: Distance from trailing edge to stop line

This field is used to specify the distance between the downstream edge of the detector sensing zone and the stop line as illustrated in the following figure. See the discussion regarding the physical size of the detector and its sensing zone in the description of the detector length below.
It is common practice to place stop bar detectors a few feet over the stop bar to ensure that vehicles that stop past the stop bar or "inch over" the stop bar while stopped will be detected. This is not necessary in CORSIM since vehicles come to a complete stop exactly at the stop bar. Consequently, the distance from the downstream edge of a detector to the stop bar must be greater than or equal to zero as illustrated in the figure.

**Detector Location: Detector length**

This field is used to specify the detector length. Note that this value specifies the length of the detector’s sensing zone and not the physical length of the detector.

It is important to remember that the limits of the zone of detection may not be the same as the size of the detector. For example, it is generally accepted that an inductive loop will detect a vehicle within three feet (on all sides) of the loop wire. This means that the downstream edge of the actual sensing zone would be 3 feet downstream to the loop wire and the limits of the sensing zone can extend beyond the physical limits of the end of the sensor. A 6' x 6' square loop detector would have an actual sensing zone of 12 feet (3 ft. + 6 ft. + 3 ft.), twice the size of the loop. It is the user’s responsibility to determine if the additional sensing zone length is critical to the CORSIM analysis. Also, there is no sensitivity loss with CORSIM detectors which makes it possible to simulate the operation of a long bank of multiple loop detectors (e.g., three 6' x 20' loops with 6' between loops in a single left-turn lane) with a single loop (6' x 72').

The upstream edge of a detector cannot be within the intersection at the upstream end of the link. Therefore, the distance to the downstream edge of the detector plus the sensor length must be less than the length of the link minus the width of the intersection at the upstream end of the length (see the following figure).

For detectors located within turn pockets, the upstream edge of the detector must lie within the pocket. Therefore, the distance to the downstream edge of the detector plus the sensor length must be less than the length of the turn pocket.
Operating Characteristics: Phase
This field is used to specify the phase that is called when this detector is actuated.

Operating Characteristics: Type
This field is used to specify the type of detector: Extension & count, Extension Only or Type III.

Operating Characteristics: Operation
This field is used to specify the detector operation code: Presence or Pulse. Generally, detectors have a pulse or presence capability. In pulse operation, a 0.3 second pulse is generated whenever a vehicle is detected, regardless of the length of time the vehicle spends over the sensor. In presence operation, the length of the pulse generated is equal to the length of time the vehicle spends over the sensor.

Operating Characteristics: Delay time
This field is used to specify the delay time. Extension and count detectors and calling detectors are capable of a “delay” of input to the phase while that phase is red. This feature can sometimes be helpful for right-turn-on-red situations to allow right-turners, resting on a detector, time to find a gap in traffic before the active phase has to yield control.

Operating Characteristics: Carry-over
This field is used to specify the carry-over (“extension”) time. Both types of detectors are capable of “carry-over”, which is the ability to continue placing a vehicle actuation to the phase after the vehicle has left the detection area while the phase is green. Carry-over time is the additional time during which an actuation is placed, after the vehicle has left the detection area. An example of this application is when a series of “speed” sensors are located in an intersection approach. The carry-over time will carry the actuations from one sensor to the other, until the vehicle clears the intersection.

Most controller manufacturers refer to this function as detector “stretch” or “extend” time. Remember, however, that while carry-over (detector stretch or extend) time is generally programmed as a controller parameter in the field, it is a detector timing function and should not be confused with the controller timing parameter called “vehicle extension” (passage time).

Operating Characteristics: Limit time
This field is used to specify the limit time for Type III detectors. This is the maximum time that a Type III detector can extend the first vehicle actuation.

4.21.3 Additional Links Associated with Controller
The Additional Links button at the bottom of the approach diagram in the Actuated Controller Properties dialog is used to specify internal links, additional to the approach links, on which detectors can be placed for use by the actuated controller. These additional, or indirect approaches, are used when emulating a field system where two intersections are controlled by one controller. They are also used when a direct approach is not long enough to support the location of an upstream detector, which must be placed on the upstream link that connects to the direct approach. In CORSIM, a maximum of 5 links can be direct approaches to an intersection node. However, up to 10 links can have detectors that support the operation of the controller at an intersection, including the direct approaches. Thus, for an intersection with 4 direct approaches, 6 additional links can be specified if required.
To specify additional links, select a link from the list of Available Surface Links and press the Add button (or double-click the link in the list). To remove a link from the list of additional links, select the link from the list of Additional Links and press the Remove button (or double-click the link in the list). The dialog will only allow additional links to be specified up the Maximum number of Additional Links indicated in the dialog.

To specify detectors on an additional link, select the link in the list of Additional Links and then press the Detectors button. Then follow the directions provided in the Actuated Controller Detectors section.

4.21.4 Operation Group Controls

The controls in this group on the dialog specify whether the controller will operate in a “free” (uncoordinated) or coordinated mode. When Free is selected, no other controls are enabled in this group. When Coordinated is selected, the other controls in the group become enabled and the user can specify the basic coordination parameters and use the Advanced Coordination button to specify additional coordination parameters.

**Cycle**

Use this edit field to specify the background cycle length in use for the coordinated set of controllers to which this controller belongs. When this field is changed, the values in the Split (sec) column on the Time Settings tab will update to reflect the change in the cycle length.
Offset

Use this edit field to specify the NEMA TS 2 offset, measured from the system reference point (T = 0) to the start of main street green, for this controller. TRAFED will convert this value into the yield point used by CORSIM. The yield point is defined as the time, in seconds, from the system reference point (T = 0) to the end of green for the coordinated (sync) phases. The yield point is designated “local zero” (t = 0) from which all other coordination parameters for an individual controller are referenced.

Inhibit Max Termination

Use this checkbox to enable the Inhibit Max Termination function for the controller. When enabled the controller will allow phases to terminate by “gap-out” or by “force-off” but will not allow phases to “max-out”. This is a unit (controller) function and cannot be set independently for a specific phase.

For a coordinated controller, the phase maximum green values are often set low to enable the controller to function in the isolated backup mode, e.g., in the case that one or more detectors fail. Assuming a long cycle length and split, it is possible that once the phase is active it will always terminate at the end of maximum green and never reach the phase force-off point. Controller manufacturers have taken care of this problem by implementing the Inhibit Max Termination function.

4.21.5 Actuated Controller Coordination

The Actuated Controller Properties dialog was designed to reduce the amount of input a user must supply for basic coordinated systems. For many coordinated systems, the user need only specify the data in the Operation Group (i.e., cycle length and offset) and the phase splits in the Time Settings tab. TRAFED provides reasonable default values for all other “advanced” coordination parameters. However, should the user need to review or change those parameters, they are accessible via the Actuated Controller Coordination dialog. Prior to describing that dialog, some background information regarding coordination is provided.

Any type of coordination control (i.e., hardware and master coordinator, telemetry communications and closed loop master, central office control, or any form of time-based local coordinator control) can be modeled by CORSIM as long as the local controller is either a NEMA or Type 170 or equivalent. Many “closed loop” signal systems using NEMA or Type 170 controllers are operating in the non-actuated mode with dial, offset, and split changes implemented by a time-of-day (TOD) command. These systems could easily be simulated as pre-timed systems. However, if the user requires the ability to evaluate a variety of complicated scenarios, it is recommended that these systems be coded as actuated controllers.

If the controller or group of controllers being simulated are operating without a common background cycle length in the fully or semi-actuated mode, the controller can be defined as operating in the “free” mode. Additionally, it is permissible in the same run to simulate a mixture of coordinated and non-coordinated controllers. It should be noted that an isolated actuated controller operating with maximum recalls active on all phases is not the same as operating with a background cycle length. This type of operation does not require coordination data to be specified to allow the mainline phases to begin operation at some random point in the cycle. Semi-actuated operation is simulated by placing the appropriate non-actuated phases in Maximum Vehicle Recall and those non-actuated phases would not need detectors.

The following is presented as a summary explanation of coordination in general and how it is handled by CORSIM. The following Typical timing dial diagram and Phase split diagram present a graphical representation of the coordination parameters. The diagram should be referenced throughout the remainder of the discussion.

All controllers operating within a coordinated system must have the same common background cycle length. (Multiples of the background cycle length are allowable if a controller is being “double cycled.”) Within the background cycle length, the coordinated (or sync) phases (phases 2 and 6) are guaranteed to display green at a certain time (start of coordinated phases) and for a minimum duration (split) within the background cycle length. If the controller is in the coordinated phases, it will remain there until the split has been timed out and
a call for service during the time that calls are allowed to be registered by the controller (permissive period) has been received on some non-coordinated phase. The point at which the controller is allowed to leave the coordinated phases to service other phases is the yield point, and in CORSIM it is always measured from the system reference (sync) point (system time T = 0) to the end of phase 2 and 6 green. The system reference (sync) points are defined by the actuated controller sync reference time and the background cycle length.

The yield point is the local reference point from which all other coordination parameters for a particular controller are measured and is referred to as “local zero or local t = 0.” This is a very important point which
many first time users of CORSIM overlook. The result is that they reference all permissive periods and force-off points to the system reference point (system T = 0) and then do not get the signal behavior they expect. Always remember that permissive periods and force-off times are measured from local zero, which is always the yield point and the end of phase 2 and 6 green.

Once a non-coordinated phase becomes active, i.e., displaying green, it will stay in that phase until it either gaps-out, reaches max-out, or reaches its force-off point (the end of its split duration or the maximum time the phase is allowed to remain green within the background cycle length). Additionally, any of the three permissive periods not used within the current cycle are removed and the controller is allowed to service vehicle/pedestrian actuations normally. However, force-off points remain active to ensure the controller returns to the coordinated phase at the proper time in cycle. The user is cautioned that the maximum green time for each phase is generally considered to be an isolated intersection function and may not be appropriate for all cycle lengths and split combinations to be simulated. Many system operators disable the maximum green function when the controller is in coordination. This is done by enabling the controller function “Inhibit Max Termination.” When this function is enabled, phases can then only be terminated by gapping-out or by a force-off as described in the previous section.

Because all controller phases may have to be serviced within any background cycle length, it is not possible to allow the controllers to service calls any time there is demand as is common in an isolated actuated operation. Permissive periods provide specific intervals when the controller can respond to these calls. CORSIM and many field controllers provide three permissive periods at user-specified times within the cycle. When modeling dual leading lefts on both streets using the standard NEMA phase numbering, permissive period 1 is generally programmed to allow the controller to service vehicle or pedestrian calls from phases 3 and 7, 4 and 8, and 1 and 5. Permissive period 2, occurring later in the cycle, allows service to phases 4 and 8, and 1 and 5. Permissive period 3 only allows service to controller phases 1 and 5.

While many permissive period configurations are in everyday usage in field operations, the following is fairly common and is used as a default by several controller manufacturers. CORSIM requires the beginning of permissive period 1 to be at the end of green for the coordinated phases (i.e., the yield point or local zero). This is the point at which the permissive window opens to respond to calls for service. The end of permissive period 1 will be at the point in the next phase where, if activated, there is still time remaining in the phase to service the clearance period for the current phase and the minimum green or pedestrian times before the force-off point for that phase is reached. Mathematically, it is the phase 3/7 split – phase 3/7 clearance – phase 3/7 minimum green, where “3/7” indicates potentially concurrent phases 3 and/or 7. The beginning of permissive periods 2 and 3 will be at the force-off points for phases 3/7 and 4/8, respectively. The end of permissive period 2 and 3 will be at the minimum service green point for phases 4/8 and 1/5, respectively.

Finally, while yield point, permissive period, and force-off times are not common coordination timing input values in newer NEMA or Type 170 controllers, these are the parameters used by the coordinators inside the controller. However, most modern controllers use the more common data input of cycle length, split and offset and then convert the data to yield point and force-off times for use by the coordinators. Because of this, TRAFED also uses cycle length, split, and offset data inputs. It converts those input values to yield point and force-off times for use by CORSIM.

**Specifying Advanced Coordination Parameters**

To edit or review the advanced coordination parameters, activate the Actuated controller Coordination dialog by pressing the Advanced Coordination button in the Operation group controls of the main actuated controller dialog.
Permissive Periods

TRAFED provides three options for defining the permissive periods used in coordination:

- Remaining Phases in Cycle
- Next Phase in Cycle
- Manual Specification

For the “Remaining Phases in Cycle” option, the start of permissive period 1 is at the yield point; the start of permissive period 2 is at the force-off of the next phase in sequence after the sync phase; and the start of permissive period 3 is at the force-off of the next phase in sequence after the phase used in permissive period 2. The end times for the permissive periods are set so that if a phase is activated during the permissive period, it will be able to service its minimum initial plus its yellow change plus its red clearance intervals before reaching its force off. For each permissive period all remaining phases that occur before the next sync phase can be serviced.

For the “Next Phase in Cycle” option, the permissive period start and end times are calculated in the same way as for the “Remaining Phases in Cycle” option. However, for each permissive period only the next phase in sequence can be serviced.

The “Manual Specification” option enables the user to code a set of permissive periods that do not conform to the other two default options.

Permissive Periods: Start Time

For each permissive period, these fields are used to specify the time when the permissive period begins, in seconds from local t = 0. Up to three permissive periods are allowed. During these periods, calls can be answered for phases other than the sync phases. Each permissive period has a begin time and an end time and can overlap; i.e., the beginning time for one can occur before a previous permissive period has ended.

Once the controller yields, all subsequent permissive periods are disabled for that cycle and the controller will sequence normally from that point depending on demand. Once the controller returns to the sync phase during a cycle, it will stay in the sync phase until the next yield point.
In CORSIM at least one permissive period should start at the yield point (t = 0), i.e., the starting time of at least one permissive period should be 0.

**Permissive Periods: End Time**

For each permissive period, these fields are used to specify the time when the permissive period ends, in seconds from local t = 0.

**Permissive Periods: Service Flags**

For each permissive period, these check boxes are used to specify if the phase can be serviced during the permissive period. That is, these fields are used to define the permissive periods (1, 2, or 3) during which the coordinated phases are allowed to yield control to the phase.

Each non-sync phase can be assigned to any or all of the three permissive periods. Note that phases 2 and 6 are not assigned permissive periods. All other active phases **must** be assigned to a permissive period or they will not be serviced.

**Extended Side-Street Leading Left-Turn Phases**

Preset signal splits based on pedestrian timing requirements can be dynamically altered by the simulated controller when no side street pedestrian demand exists. This feature causes the controller to skip the side street pedestrian phase when no demand exists and extend the force-off time for the leading left-turn side-street phases. In the absence of actuated pedestrian calls, modern controllers allow force-off points for leading left-turn phases to be extended into what would normally be the next through phase. For example, assume the phase 4 and 8 split is controlled by the time it takes to accommodate pedestrian timing and not vehicle demand. In the absence of pedestrian actuations, the phase 4 and 8 green time could be shortened and the extra green time given to a heavy demand left turn on phases 3 and 7. This function must be manually set to be active in the controller and phases and times defined. The status of this controller function should be determined prior to CORSIM analysis.

**Extended Side-Street Leading Left-Turn Phases: Phase**

These two drop-down lists enable the user to specify up to two leading side-street left-turn phases that can be extended beyond their normal force-off time when no pedestrian demand exists.

**Extended Side-Street Leading Left-Turn Phases: Duration**

These two edit boxes correspond to the two leading side-street left-turn phase drop down lists and are used to specify the number of seconds that the force-off times can be extended for the corresponding phases.

**Phase Termination Flags**

These check boxes are used to specify whether the non-sync phases can terminate before their defined force-off points are reached. This lag phase hold feature applies only to coordinated controllers.

During coordinated operation, a hold can be placed on user-selected phases to prevent those phases from terminating before their force-off point is reached. This is desirable when lead-lag left-turn phasing combinations are used to maximize two-way progression. Placing a hold on a lagging left-turn phase prevents that phase from premature “gap-out” and ensures that the phase does not terminate until its force-off point is reached. This prevents the concurrent through phase from terminating prematurely and shortening the progression band in that direction. To “hold” a phase until force-off, deselect its check box.
The lag phase hold input is commonly used in closed-loop systems that do not have local intersection vehicle detection. Once the phase is initialized, by either minimum recall or maximum recall it will continue to display green; not terminating until its force-off point is reached. When this entry is enabled, the maximum green, maximum extension, and passage time inputs will be ignored. The user is cautioned not to confuse this input with the controller function “Inhibit Max Termination”. That function allows the controller to “gap-out” or be “forced-out” but not “max-out”. The lag phase hold to force-off function will only allow the simulated controller to be “forced-out” and has no impact on controllers that are not operating within a coordinated system.

Plan Transition Settings

New timing plans can be implemented in actuated controllers by changing the parameters for an actuated controller in subsequent time periods, as scheduled by time of day or some other mechanism. The parameters entered here specify how the controller will transition between plans to maintain the progression of the coordinated system. Specification of a new plan does not necessarily require transition, but transition may be required if either the offset or cycle time are changed. Because timing plans can only change between time periods, the transition controls are disabled for time period 1. Furthermore, CORSIM will use the plan transition settings specified for time period n+1 when performing the plan transition from time period n to time period n+1.

Typically, if the offset (measured from the system sync reference point to the controller’s local zero) of a new plan is different from the old plan, then the controller will have to transition to the new plan. This is a 3-step process and may take several cycles. First, at the end of the coordinated phase, the splits and cycle time of the new plan are loaded. Next the cycle time of this new plan is adjusted over a period of several cycles until the actual specified offset of the new plan is obtained. When the current signal timings are in step with the desired timing plan, the cycle time is restored to the cycle time of the new plan.

The Plan transition concepts figure below illustrates how a controller might transition to a new plan. This figure was adapted from, Bullock, D., T. Urbanik, and A. Catarella, “Traffic Signal System Progression Recovery from Railroad Preemption,” Proceedings of the Fifth International Symposium on Railroad-Highway Grade Crossing Research and Safety, October 20-22, pp. 355-365, 1998. Sub-figure (a) depicts the desired (new) signal timings with an offset of $O$. Sub-figure (b) shows the signal timings after the split and cycle time parameters of the new plan have been loaded into the controller. If no adjustment is made to these signal timings, the timing plan in the controller will always start main-street green late (by the offset difference $O' - O$) and the intersection will not be well coordinated. Sub-figures (c) and (d) illustrate how the transition process can be accomplished by extending (Add method) or shortening (Subtract method) the cycle time of the new plan. After each cycle, the offset difference decreases and eventually the offsets shown in these figures are consistent with the offset shown in sub-figure (a).

In general, new timing plans can include changes to the majority of the actuated controller parameters. A free controller loads the new parameters (new plan) at its first phase 2 amber indication following the time period change. A coordinated controller loads the new parameters (new plan) at its first yield point (end of phase 2/6 green) following the time period change. When a controller is coordinated and the new plan includes changes to either its cycle length or offset, then the controller must transition from its old plan to the new plan according to one of the transition methods described in the following sections.
Plan Transition Settings: Method

This set of radio buttons is used to specify transition method to be used when the controller transitions from one plan to another. CORSIM supports four transitions methods:

- **Short Way**
- **Dwell**
- **Add**
- **Subtract**

To determine if a transition is required, the transition manager in the actuated control logic computes the difference between the next local zero (yield point) for the current plan and the next local zero for the new plan. The local zero for a plan is computed from the system sync reference time, the plan cycle length, and plan offset. If there is a difference, then a transition is required. The following paragraphs describe the operation of each transition method:

**Short Way:** The Short Way method is a composite of the Add and Subtract methods. At the controller’s yield point in each cycle during the transition, the transition manager computes the local zero difference as described above. The transition manager then determines if it is shorter (less time) to make up this difference by implementing an Add transition or a Subtract transition for the next cycle.

Note that some controller vendors refer to this method as “Smooth” or “Best Way”.

**Dwell:** For the Dwell method, the transition manager computes the local zero difference, as described above, just prior to the controller’s yield point. Then the Dwell method logic extends the current phase 2/6 green by the difference, up to the maximum percent of cycle length specified. If the difference exceeds the maximum allowed, the Dwell method logic continues to add green time to the phase 2/6 split for subsequent cycles until the difference is made up.

**Add:** At the controller’s yield point in each cycle during the transition, the transition manager computes the local zero difference as described above. Then the Add method logic adds time to each of the phase splits for the upcoming cycle, where the total amount of time added does not exceed the maximum percent of
cycle length specified. The amount of time added to each phase is based on its percentage of the cycle length in the new plan. If the local zero difference exceeds the maximum allowed, the Add method logic continues to add time to each phase over multiple cycles until the difference is made up.

**Subtract:** At the controller’s yield point in each cycle during the transition, the transition manager computes the local zero difference as described above. Then the Subtract method logic subtracts time from each of the phase splits for the upcoming cycle, where the total amount of time subtracted does not violate the maximum percent of cycle length specified. The amount of time subtracted from each phase is based on its percentage of the cycle length in the new plan, subject to the phase minimum split. The minimum split for a phase is calculated as the sum of its yellow change interval, red clearance interval and the maximum of its: minimum green, pedestrian timing, and maximum initial interval. In some cases where the amount subtracted from a phase is limited due to its minimum split, additional time can be subtracted from other phases that have not been limited, subject to no phase being reduced by more than the percentage specified in Entry 4. Finally, if the local zero difference cannot be made up in one cycle, the Subtract method logic continues to subtract time from each phase over multiple cycles until the difference is made up.

**Plan Transition Settings: % Add / Dwell**

This edit box is used to specify the maximum amount of adjustment per cycle for the Dwell or Add methods, expressed as a percent of the cycle length. This limit is also used by the Short Way method when it is operating in the add mode.

**Plan Transition Settings: % Subtract**

This edit box is used to specify the maximum amount of adjustment per cycle for the Subtract method, expressed as a percent of the cycle length. This limit is also used by the Short Way method when it is operating in the subtract mode.

### 4.21.6 Actuated Controller Data Tabs

The bottom third section of the Actuated Controller Properties dialog contains the following set of tabs used to specify timing data and operational characteristics for the actuated controller:

- Actuated Controller Time Settings Tab
- Actuated Controller Volume/Density Tab
- Actuated Controller Phase Controls Tab
- Actuated Controller Unit Controls Tab
- Actuated Controller Phase Sequence Tab
- Actuated Controller Ped Generator Tab

Several of these tabs contain grids used to supply phase-specific parameters. To access all of the columns on some of the grids, you will need to scroll the grid to the left. The following sections describe, in detail, each of the data items on each of the tabs.

Because of the complex interactions between the data, TRAFED performs many checks to warn you when data are not consistent. These checks are performed on a tab-by-tab basis whenever tabs are switched, when a subordinated dialog, e.g., Advanced Coordination, is accessed, or when the main dialog is dismissed with the **OK** button. When errors are encountered, TRAFED will issue a warning dialog, but will allow you to proceed. For example, if the split values for each ring, as specified on the Time Settings tab, do not add up to the cycle length, and you attempt to change tabs to the Phase Controls tab, TRAFED will issue a warning dialog identifying the problem (see following figure). However, when you dismiss the dialog, TRAFED will switch to the new tab. Only in the situation where you dismiss the main dialog with the **OK** button will TRAFED prevent the operation from taking place if there are input errors.
4.21.7 Actuated Controller Time Settings Tab

The **Time Settings** tab is used to specify the basic timing parameters for the actuated controller.

**Min Green**

The fields in this column of the grid are used to specify the minimum green time, in seconds, for each phase. Minimum green is the minimum duration of the phase or initial interval. The value of this entry must be greater than zero. Alternate front panel displays include **MIN GRN**, **MIN**, **MIN INI**, and **INITIAL**.

**Max Green**

The fields in this column of the grid are used to specify the maximum green time, in seconds, for each phase. Alternate front panel displays include **MAX 1**, **MAX 2**, and **MAX GRN**.

CORSIM offers two approaches to limiting the amount of time a phase can remain green under continuous flow conditions (i.e., continuous demand with no significant gaps between vehicles). To understand how the two approaches differ, the factors that affect the phase green duration must be examined. There are two basic components to the phase green time: the **initial interval** and the **extendable interval**. The initial interval is determined by the specified minimum green and the variable initial operation. When variable initial operation is enabled, the initial interval is computed at the beginning of phase green based on the vehicle detections that occurred during the immediately preceding yellow/red interval (see Section 4.21.8). Thus, the initial interval can vary from cycle to cycle, but it can never be less than the specified minimum green nor greater than the
specified maximum initial interval. Furthermore, the controller will hold the phase in green for the duration of
the initial interval regardless of demand or conflicting calls.

During the extendable interval, the phase will be allowed to terminate (e.g., gap out) if the vehicle headways
exceed the specified vehicle extension (passage) time. However, the phase must terminate at the end of the
extendable interval, even when there is demand. In CORSIM, the duration of the extendable interval is either
calculated from the specified maximum green (Max Green) or can be directly specified (Max Ext), but each
approach yields a slightly different behavior:

**Maximum Green** – Maximum green is the maximum amount of time a phase will be allowed to be active
(i.e., display green), and includes both the initial and extendable intervals. The duration of the extendable
interval is allowed to vary based on the actual initial interval, as follows:

\[
\text{extendable interval} = \text{max green} - \max (\text{min green, initial interval})
\]

Thus, the total green duration under continuous flow conditions will remain constant and equal to the
specified maximum green time.

**Maximum Extension** – Maximum extension is the amount of time a phase will be allowed service after
the minimum green and variable initial have timed out. The extendable interval is held constant and equal
to the specified maximum extension, and the max phase green duration is allowed to vary based on the
actual initial interval, as follows:

\[
\text{max phase green} = \text{extendable interval} + \max (\text{min green, initial interval})
\]

Thus, the total green duration under continuous flow conditions could vary from one cycle to the next,
depending on the duration of the initial interval. While some controller manufacturers still use maximum
extension, it is more commonly found in older isolated NEMA and Type 170 controllers.

When the maximum green time is specified, the maximum green extension (Max Ext) must be zero. When the
maximum green extension time is specified, the maximum green time (Max Green) must be zero.

**NOTES:**

1. If the controller is operating within a coordinated system, the maximum green time
   specified in the controller may not be appropriate for the cycle/split combination
   selected by the master controller. In this case the phase can max-out early without
   ever reaching the force-off point (the end of the assigned phase split) for the phase.
   To allow the controller to reach the force-off point or full split timing value, the user
   can either calculate a new maximum green time appropriate for the cycle/split
   combination in effect or can set the Inhibit Max Termination function as described in
   Section 4.21.4.

2. In certain manufacturers’ controllers, there is a timing function called “MAX EXT”.
   This is not the same as maximum extension green but the number of seconds used to
   extend the maximum green value when “MAX 3” is active. MAX 3 is not currently
   supported in CORSIM.

**Yellow**

The fields in this column of the grid are used to specify the duration of yellow change interval, in seconds, for
each phase. The yellow change (or yellow clearance) interval follows the green interval. If the user specifies
this value to be 0, CORSIM will insert a 1 second yellow change interval following the green interval. For
reference, the MUTCD requirements state that the yellow interval should not be less than 3 seconds for design
purposes. Alternate front panel displays include YELLOW. CORSIM internally rounds the specified value to
the nearest second.
Working with Traffic Objects

Red Clear
The fields in this column of the grid are used to specify the duration of red clearance interval, in seconds, for each phase. Red clearance is the optional safety clearance interval at the end of a phase, in which red is displayed for all traffic movements. Alternate front panel displays include RED, ALL RED and RED CLR. CORSIM internally rounds the specified value to the nearest second.

Walk
The fields in this column of the grid are used to specify the duration of the WALK interval, in seconds, for each phase. The sum of this value and the Ped Clear value must not exceed the Max Green or the sum of the Min Green and Max Ext values for the phase.

Ped Clear
The fields in this column of the grid are used to specify the duration of the flashing DON’T WALK (pedestrian clearance) interval, in seconds, for each phase.

Split (%)
The fields in this column of the grid are used to specify the duration of the phase split (including yellow and red times) for each phase as a percent of the cycle length. The column is disabled when the controller is operating in “free” mode. As changes are made to the cells in this column, the corresponding cells in the Split (sec) column are updated.

Split (sec)
The fields in this column of the grid are used to specify the duration of the phase split (including yellow and red times) for each phase, in seconds. The column is disabled when the controller is operating in “free” mode. As changes are made to the cells in this column, the corresponding cells in the Split (%) column are updated.

Passage Time
The fields in this column of the grid are used to specify passage time (vehicle extension time or gap time), in seconds, for each phase. Alternate front panel displays include VEH EXT, PASS, and GAP.

Passage time is the amount of time that the phase green will be extended for each vehicle actuation. It is typically set as the time it takes to travel from the vehicle detector to the stop line at the travel speed of the roadway for pulse loops or the average acceptable headway between vehicles for presence loops located close to the stop line. Therefore, the passage time is related to the minimum and maximum gap when gap reduction is used.

Max Ext
The fields in this column of the grid are used to specify the maximum extension time, in seconds, for each phase. See the discussion for Max Green for details regarding this parameter. In summary, the maximum green extension is the maximum time a phase will be allowed to display green after the minimum green and variable initial intervals have timed out. If the phase is a pedestrian phase, then maximum extension plus minimum green must be equal to or greater than the WALK plus flashing DON’T WALK time.
4.21.8 Actuated Controller Volume/Density Tab

The Volume/Density tab is used to specify the parameters for the volume-density functions in the actuated controller.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Variable Initial Type</th>
<th>Seconds / Actuation</th>
<th># of Actuations</th>
<th>Max Initial</th>
<th>Gap Reduction Type</th>
<th>Reduce By Time</th>
<th>Req</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Extensible Initial</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Extensible Initial</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Extensible Initial</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extensible Initial</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
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<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Extensible Initial</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>7</td>
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<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Extensible Initial</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>Reduce by/Redu</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

Variable Initial Type

The fields in this column of the grid are used to specify the type of variable initial timing for each phase. Variable initial timing is a volume/density function used to increase the initial green interval of a phase based on the demand for that phase during its previous inactive (yellow and red) state. This extra time provides an opportunity for a stopped platoon of vehicles to proceed through the intersection before the phase’s passage timer is allowed to become active. This function is ineffective with long presence detection located at the stop line. CORSIM supports three types of variable initial operation:

**Extensible initial** – A method of calculating the variable initial period commonly used in field practice. With this method, the variable initial interval is increased from zero by the specified Seconds/Actuation for each vehicle actuation received by a phase during the yellow and/or red signal up to the maximum initial (Max Initial) time. The initial timing will not exceed the maximum initial time and will not be less than the minimum green time. This method is common in both Type 170 and NEMA controllers (see following figure).

**Added initial** – This method is similar to extensible initial with the exception that the Seconds/Actuation calculation does not begin until a user specified number of vehicles actuations (# of Actuations) have occurred. Also, the variable initial interval is increased from the minimum green time rather than from zero. The added initial option is generally used when long minimum green times are specified. If this option is selected for any phase, it must be selected for all phases.

**Computed initial** – This method calculates the amount of time given to each vehicle actuation (computed seconds per actuation) during the yellow and red signal display of the phase based on the following formula:

Maximum initial interval time (Max Initial) divided by the number of actuations that can be serviced during the minimum initial interval (# of Actuations) times the number of recorded actuations.

The total time allowed for the computed initial interval is limited by both the minimum green time and maximum initial interval.
Seconds / Actuation
For each phase, the fields in this column of the grid are used to specify the time, in seconds, added to the initial interval for each vehicle actuation. For each vehicle actuation that is registered in the controller during the yellow and/or red signal of a phase, a specified amount of time is added to the initial interval. Alternate front panel displays include SEC PER ACT, SEC/ACT, and S/A. Setting this value to 0 disables variable initial operation.

# of Actuations
The meaning of this parameter depends on the type of variable initial operation in effect:

- If extensible initial is specified, this parameter should be set to 0.
- If added initial is specified, this field is used to specify the number of actuations that must be exceeded before the initial interval is extended. Alternate front panel displays include ACT B4 and CAR BEF.
- If computed initial is specified, this entry is the number of actuations required to attain the specified maximum value of the initial interval.

Max Initial
The fields in this column of the grid are used to specify the maximum initial interval time, in seconds, for each phase. The maximum initial interval is the maximum green time allowed for the variable initial interval timing. Regardless of which initial interval method is chosen, this maximum value is usually a function of the number of vehicles per lane that can be stored between the stop line and the detector during the red phase of the signal. After the variable initial period is complete the controller begins its vehicle extension green timing interval. Alternate front panel displays include MAX INI and MAX VI.

When variable initial operation is enabled, the value of this parameter must be at least equal to the specified minimum green time.

Gap Reduction Type
The fields in this column of the grid are used to specify the type of gap reduction for each phase. Gap reduction, as the name implies, reduces the gap or allowable headways between vehicles from a starting value (maximum gap) to a lesser value (minimum gap) over a specified amount of time. While gap reduction is used sporadically in the field, it can be a valuable tool. For example, assume there is an approach to a fully actuated intersection that experiences a very sluggish “start-up,” creating excessive headways until vehicles are moving at a more normal speed. If the gap is set where it should be for the normal speeds, the phase would constantly gap-out early. If, however, the gap were set to accommodate the start-up vehicles, the phase would run to
maximum green more times than necessary. This problem could be handled by providing a long minimum green time or extending the vehicle call, but those actions would also contribute to an inefficient signal operation. By providing a longer than normal vehicle extension (gap) time at the beginning of the signal phase and then reducing the gap to a more reasonable value during the vehicle start-up time the problem is relieved with little or no effect on efficiency. Similarly, gap reduction can take care of the problems experienced at intersections with large fluctuations in traffic volumes during the day. Generally these intersections have low vehicular volumes with long vehicle headways during off-peak travel times and shorter headways during peak travel periods. Gap reduction techniques could provide a longer gap at the beginning of the phase when volumes are low, headways are long, and an overall shorter cycle length is provided. The gap would then be reduced to a lesser value as volumes increase, headways decrease, and the cycle length increases.

CORSIM supports three types of gap reduction (please refer to the Gap setting versus time figure for the following discussion):

- **Reduce by/Reduce every** – The gap is reduced by a user-specified amount (Reduce By Time) for every user-specified interval (Reduction Time). Older Type 170 controllers only support this option.

- **Reduce by every second** – The gap is reduced by a user-specified amount (Reduce By Time) every second.

- **Time to reduce to minimum gap** – The gap is reduced from its maximum value (Max Gap) to a minimum value (Min Gap) over a user-specified amount of time (Reduce By Time). This method of gap reduction is commonly used in the field and is supported by all NEMA and newer model Type 170 controllers.

Regardless of the type of gap reduction selected, gap reduction is disabled by setting the minimum gap (Min Gap) equal to the maximum gap (Max Gap).

**NOTE:** The user is cautioned of two details of gap reduction in CORSIM:

1. For any method of gap reduction in CORSIM, the gap begins to be reduced at the receipt of a call on a conflicting phase. This is generally, but not always the beginning of phase green. Unlike the CORSIM model, NEMA and newer Type 170 controllers allow the field engineer to specify an amount of time from the beginning of phase green until gap reduction begins. This value is called “Time Before Reduction” and is commonly used in the field when gap reduction is active. To incorporate this value in CORSIM, the user should assume there is always a conflicting vehicle call (which is generally the case) and should specify the CORSIM Time-to-Reduce parameter as the sum of the Time-Before-Reduction and Time-to-Reduce values obtained from the controller. This will
tend to flatten the slope of the gap reduction line but will generally make little difference in the analysis. If the user would prefer to maintain the slope of the gap reduction line, the gap reduction line can be extended back to the beginning of phase green, and the gap value at that point should be specified for the maximum gap (Max Gap). Although neither approximation produces an exact simulation of the field operation, either method should produce acceptable analytical results when compared to actual field data.

2. CORSIM enforces a 1.1 second minimum for the minimum and maximum gap values, although lower values are common in field applications where a long detection zone presence detector is used. While the user can input lower values, CORSIM will reset these lesser values to 1.1 seconds. Depending on the detector configuration, traffic volumes and vehicle headways, this limitation may have little impact on the intersection analysis. However, it is the user’s responsibility to determine the degree of influence these CORSIM limitations have on any particular simulation analysis.

Reduce By Time

For each phase, the fields in this column of the grid are used to specify the amount of time, in seconds, by which the gap setting is reduced for every specified time interval (Reduction Time). This field should be left blank for the Time to reduce to minimum gap option. CORSIM internally rounds the specified value to the nearest tenth of a second.

Reduction Time

The meaning of this parameter depends on the type of gap reduction operation in effect:

- If “Reduce by/Reduce every” is specified, this entry is the “Reduce-every time” in seconds. This is the incremental time during which the gap setting is to be reduced (i.e., the denominator of the gap reduction slope calculation).
- If “Reduce by every second” is specified, this entry should be left blank.
- If “Time to reduce to minimum gap” is specified, this entry is the “Time to Reduce” in seconds. This is the time that it takes to reduce the gap from its maximum value (Max Gap) to its minimum value (Min Gap). This input can also include the Time-Before-Reduction parameter. Alternate front panel displays include TTR, TTREDUC, and TT RED.

Min Gap

For each phase, the fields in this column of the grid are used to specify the minimum acceptable vehicle gap in seconds. Minimum gap defines the gap at the end of the gap reduction period. When gap reduction is enabled, the minimum value for this entry, by program default, is 1.1 seconds. Alternate front panel displays include MIN GAP. CORSIM internally rounds the specified value to the nearest tenth of a second.

If the gap reduction function is not being used, both the minimum and maximum gap should be set equal to the passage time (Time Settings tab). However, the user can set both the min and max gap values to zero and CORSIM will set them appropriately.

Max Gap

For each phase, the fields in this column of the grid are used to specify the maximum gap in seconds. Maximum gap defines the gap at the beginning of the gap reduction period. This input can be used to establish the Time-Before-Reduction value. When gap reduction is enabled, the minimum value for this entry, by program default, is 1.1 seconds. Alternate front panel displays include MAX GAP. CORSIM internally rounds the specified value to the nearest tenth of a second.
If the gap reduction function is not being used, both the minimum and maximum gap should be set equal to the passage time (Time Settings tab). However, the user can set both the min and max gap values to zero and CORSIM will reset them appropriately.

**Last Passage**

The check boxes in this column of the grid are used to specify the last vehicle passage feature for each phase. Last vehicle passage should only be active if gap reduction is enabled. When this toggle is active, the last vehicle over a detector prior to a phase gap-out will receive the full passage time regardless of the reduced gap in effect at the time of gap-out. Alternate front panel displays include GUAR PASS, LAST CAR PASS, and LC PASS.

### 4.21.9 Actuated Controller Phase Controls Tab

The Phase Controls tab is used to specify the basic operational characteristics for the actuated controller.

<table>
<thead>
<tr>
<th>Time Settings</th>
<th>Volume/Density</th>
<th>Phase Controls</th>
<th>Unit Controls</th>
<th>Phase Sequence</th>
<th>Red Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
<td>Min Recall</td>
<td>Max Recall</td>
<td>Dual Entry</td>
<td>Red Rev</td>
<td>Simultaneous Gap</td>
</tr>
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</tbody>
</table>

**Min Recall**

The check boxes in this column of the grid are used to specify minimum recall for each phase. With the minimum vehicle recall active and in the absence of a vehicle call on the phase, a temporary call to service the minimum initial time will be placed on the phase. If a vehicle call is received prior to the phase being serviced, the temporary call will be removed. Once the phase is serviced it can be extended based on normal vehicle demand. This entry should be zero if maximum recall (Max Recall) is active. Alternate front panel displays include MIN RCL, MIN RECALL, or a choice of recall status switches MIN/MAX/PED/SOFT.

**NOTES:**

1. CORSIM does not currently support soft recall (SOFT) or call to non-actuated (CAN or NA). If the user encounters either of these functions from the field data of an existing controller, minimum recall should be used to approximate soft recall and maximum recall should be used for call to non-actuated.

2. If the controller is in a coordinated system and the coordinated phases (2 and 6) are not actuated, then either minimum recall or maximum recall require active status for the controller to service the coordinated phases.

**Max Recall**

The check boxes in this column of the grid are used to specify maximum recall for each phase. With the maximum vehicle recall active, a constant vehicle call will be placed on the phase. This constant call will force the controller to time the maximum green. Maximum recall is generally used to call a phase when local detection is not present or inoperative. This entry should be zero if minimum recall (Min Recall) is active. Alternate front panel displays include MAX RCL, MAX RECALL, RECALL TO MAX, or a choice of recall status switches MIN/MAX/PED/SOFT.
Dual Entry
The check boxes in this column of the grid are used to specify dual entry for each phase. When double (dual) entry is permitted, a vehicle call on one phase, in the absence of a call on a compatible phase, will automatically place a call on the primary corresponding compatible phase. For example, assume the intersection being simulated is under light traffic conditions and its controller is using the standard NEMA phase numbering scheme (refer to the following figure). A call for service is received on phase 2, but there are no other calls on phase 5 or 6. With dual entry active, the call on phase 2 automatically places a temporary call on phase 6. When phase 2 becomes active and no call has been received on phase 5, phase 6 will be displayed simultaneously with phase 2. If a call had been received on phase 5 before phase 2 became active, the temporary call on phase 6 would have been removed and phases 2 and 5 would have been displayed. In the standard NEMA phase numbering scheme, compatible dual-entry phases are 1 and 5, 2 and 6, 3 and 7, and 4 and 8. If dual entry is not active, a vehicle call on a phase will only allow the display of that phase in the absence of a call on a compatible phase. The usage of dual entry is generally a policy decision by the local DOT. However, common usage is to have dual entry active on the NEMA standard even-number phases (through movements) and inactive on NEMA standard odd-number phases (left-turn movements). Alternate front panel displays include DUAL ENTRY and DUAL ENTRY on/off.

Red Revert
The fields in this column of the grid are used to specify the red revert time, in seconds, for each phase. Under very light traffic conditions and fully actuated control it is possible, without red revert active, for a phase to go from green to yellow and then back to green without ever displaying a red indication. Red revert timing prevents this signal display sequence by forcing the red indication to be displayed after a yellow for at least the red revert time. Red revert is generally factory programmed at 2 seconds and seldom changed by the user. Alternate front panel displays include RED RVT and RED REVERT. CORSIM internally rounds the specified value to the nearest second.

Simultaneous Gap
The fields in this column of the grid are used to specify whether each phase requires both phases in a barrier-crossing situation to simultaneously “gap-out” or have both maximum timers expire (“max-out”) to terminate the phase. Alternate front panel displays include SIMULTANEOUS GAP.

The operational logic for both NEMA and Type 170 controllers specifies that both controller rings 1 and 2, (refer to the figure included in the discussion of Dual Entry) must cross the barrier at the same time. This can be accomplished by each of the phases 2 and 6 gapping-out, maxing-out, or forcing-off. With simultaneous gap-out inactive, one ring can gap-out and the other can max-out. Additionally, once a phase gaps-out it will stay in that condition, regardless of any future vehicle actuations until the phase in the opposite ring either gaps-out or reaches max-out and then both phases cross the barrier. With simultaneous gap-out active, neither
ring can cross the barrier until both phases have been terminated in the same manner, either by both gapping-out or both maxing-out. Additionally, if a phase initially gaps-out and then, due to increased vehicle demand, vehicle arrivals are less than the extension time, the gap-out flag for that phase is removed. With simultaneous gap-out active, the vehicle headways on both phases must currently be exceeding the gap in effect. The inactive status for this function generally produces a quicker reacting signal installation and shorter cycle lengths.

Conditional Service

The fields in this column of the grid are used to specify whether each phase can be serviced twice during a cycle. This conditional (dual) service feature cannot be requested for lag phases and cannot be requested for coordinated controllers. Alternate front panel displays include COND SERVICE.

When a heavy left-turn demand exists at an isolated (i.e., not coordinated) intersection, it may be desirable to service one of the left-turn phases twice in the same cycle. The conditional service entry, under a specific set of circumstances, allows the left to be serviced first as a leading phase and then as a lagging phase. Enabling conditional service will allow the simulated controller to operate in this manner under the following circumstances:

- There is a call for service on a leading left-turn phase.
- The controller is operating in the non-coordinated mode.
- There is a conflicting call on the opposite side of the barrier. Otherwise the left-turn phase will automatically be serviced next by standard controller logic unless the anti-backup controller feature is active.
- The through phase of the phase pair with the left-turn call for service has gapped-out.
- The time remaining on the active through phase’s maximum timer exceed the conditional service phase’s minimum conditional service time.

Conditional service should not be confused with conditional re-service, which is currently not supported by CORSIM.

Min Cond. Service Time

The fields in this column of the grid are used to specify the minimum conditional service time, in seconds, for each phase. This is the minimum amount of time that must be available to provide the conditional service phase when a call is issued for the phase. That is, this field specifies the minimum time that must be remaining on the active through phase’s maximum timer to service the left-turn phase again in this cycle. Conditional service time is generally equal to or greater than the minimum green of the left turn phase to be conditionally serviced. Alternate front panel displays include CS MAX and CS MGRN.

Red Lock

The fields in this column of the grid are used to specify whether each phase enables the red lock feature. Red lock is not supported by NEMA controllers and is not a common function in Type 170 controllers. When red lock is set to “on” (active), the controller “remembers” vehicle actuations that occur during the red display of the signal phase. When the controller determines if the phase should be called for service, it uses the remembered actuations to call the phase to service, even if the phase has no currently occupied detectors. When red lock is set to “off” (inactive), the controller does not remember actuations and the phase will be called to service only if it has a currently occupied detector. Red lock should not be set active unless the controller being analyzed specifically has a “red locking memory” that is active.
Yellow Lock

The fields in this column of the grid are used to specify whether each phase enables the yellow lock feature. Most NEMA and Type 170 controllers use yellow lock as a factory standard setting that cannot be changed by the user. However, some manufacturers provide this memory lock as a toggled option. When yellow lock is set to “on” (active), the controller “remembers” vehicle actuations that occur during the yellow and red display of the signal phase. When the controller determines if the phase should be called for service, it uses the remembered actuations to call the phase to service, even if the phase has no currently occupied detectors. When yellow lock is set to “off” (inactive), the controller does not remember actuations and the phase will be called to service only if it has a currently occupied detector. In no case should the locking memory set to “off” be considered as a Red Lock “on”. Both red lock and yellow lock can be set as inactive but both cannot be set active because yellow lock includes the actuations during the red interval. Alternate front panel displays include LOCK, MEMORY on/off, and LOCKING MEMORY on/off.

Pedestrian Recall

The fields in this column of the grid are used to specify whether each phase enables the pedestrian recall feature. When enabled, a pedestrian call for service will be input to the controller. When pedestrian recall is active, both the vehicular and pedestrian timing for the phase are active.

Pedestrian Rest

The fields in this column of the grid are used to specify whether each phase enables the pedestrian rest feature. When enabled, then the pedestrian WALK interval will rest in the phase.

4.21.10 Actuated Controller Unit Controls Tab

The Unit Controls tab is used to specify the unit-wide (non-phase-dependent) parameters for the actuated controller.

Red Rest

This check box is used to specify the rest-in-red feature for the controller. This function designates that all phases of the controller are allowed to rest in red in the absence of calls or recalls on any phase. Alternate front panel displays include RED REST and REST IN RED.

While this function is not uncommon, especially for an isolated intersection with relative even traffic flows on all approaches, it is the more general practice to allow the controller to rest in green on the mainline approaches in the absence of calls. In this case, rest in red would be set inactive.
4.21.11 Actuated Controller Phase Sequence Tab

The Phase Sequence tab is used to specify the order of activation of phases for the actuated controller as well as overlap phases.

### Lag Phases

This set of radio buttons is used to specify which phase of a phase pair displays green first, before the other phase. For the purposes of this entry, a phase pair is defined as adjacent phases in the same ring on the same side of the barrier on a standard NEMA phase diagram (refer to the figure included in the discussion of Dual Entry). Therefore, phase pairs are phases 1 and 2, 3 and 4, 5 and 6, and 7 and 8. Phase pairs are not NEMA compatible signal display phases such as 1 and 5, or 2 and 6.

In a standard NEMA 8 phase configuration operating in leading dual lefts on both streets, phases 2, 4, 6 and 8 are lag phases while phases 1, 3, 5, and 7 are leading phases. For a lead/lag sequence, phase 2 can lead, and phase 1 can lag. This will produce the signal display sequence of phases 2 and 5, then phases 2 and 6, then phases 1 and 6. It is also possible to have both left turns lagging by specifying phases 2 and 6 as leading and phases 1 and 5 as lagging.

### Overlaps

This set of drop-down lists is used to specify pairs of phases that define overlaps. An overlap is a vehicle movement, generally a right turn, which is allowed to run concurrently with two standard phases. For example, in the following figure the phase 4 right turn movement from link (10, 4) is defined as overlap “A”. Usually a 5-section signal head with a right arrow controls this type of overlap movement. In this case, overlap “A” is allowed to run concurrently with not only phase 4, under green ball control, but also whenever phase 1 is active in either the phases 1 and 5, or 1 and 6 combination. Therefore phases 1 and 4 are “parent” phases to overlap “A”. When overlap “A” is active with phase 1, the signal controlling the overlap movement is generally displaying a green right arrow indication.
When movements are added to the phase diagram, TRAFED automatically determines if the movement occurs in adjacent phases and can be considered a potential overlapping movement. If so, the movement is indicated as a green arrow in the phase diagram. However, potential overlap movements will not operate as overlapping movements in CORSIM unless the parent phases are specified in this tab. To make the task of specifying overlap movements easier, the Overlaps section in this tab provides an Auto Populate button. When this button is pressed, TRAFED examines all current overlap movements, determines the parent phases, and automatically sets the drop-down lists in the Overlaps section of this tab.

# 4.21.12 Actuated Controller Ped Generator Tab

The Ped Generator tab is used to specify the parameters that are used to generate pedestrian calls for the actuated controller.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Pedestrian Intensity</th>
<th>Acquisition Mode</th>
<th>Arrival Delay</th>
<th>Arrival Start</th>
<th>Start Period 1</th>
<th>Start Period 2</th>
<th>End Period 1</th>
<th>Start</th>
<th>End Period 2</th>
<th>Start</th>
</tr>
</thead>
<tbody>
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CORSIM supports three pedestrian actuation modes as follows:

1. Actuation based on the stochastic arrival of pedestrians.
2. Actuation based on the deterministic arrival (constant headways) of pedestrians.
3. Actuation based on the periods of constant pedestrian demand (pedestrian push button is continuously depressed).

It is not necessary to define the pedestrian generator unless the pedestrian demand conflicting with the turn movements from the phase being programmed is greater than 100 crossings per hour and is defined in the data for the link serviced by the phase. The absence of generator data for any phase with less than 100 crossings per hour will have no impact on the CORSIM analysis or the output MOE. However, it may be prudent for the CORSIM user to define the pedestrian generator data for approaches and phases with low pedestrian crossing.
values in order to show observers of the animation how a pedestrian signal would operate at an intersection even though the output MOE would not be affected.

It should be remembered that the pedestrian signal associated with a phase is for pedestrians crossing the approaches that receive the left and right turn movements from the phase being coded. For example, assume an isolated intersection is being coded where north is up, as shown in the following figure. In the figure, approach 1, 2, 3, and 4 are the westbound, northbound, eastbound, and southbound approaches to the intersection respectively. Also in the example, phase 2 displays green for all movements from the westbound approach. When specifying generator data for phase 2, the pedestrian volume and other data input are for pedestrians crossing approaches 2 and 4. Additionally, the pedestrian intensity code must be set for the link assigned as approach 1.

![Intersection Diagram]

Each pedestrian actuated phase is defined on a separate row in the grid. Three modes of pedestrian actuation are defined: (1) actuation based on random (stochastic) arrivals of pedestrians, (2) pedestrian arrivals and actuations at relatively regular (deterministic) intervals with constant pedestrian headways, and (3) continuous pedestrian actuations or demand (the pedestrian actuation button is always depressed) for one or more periods during the simulation. A mode 1 condition would be common for an intersection with relative light pedestrian volumes. Mode 2 conditions might occur at an intersection in a downtown business district during the lunch hour. An example of mode 3 conditions would be at an intersection adjacent to a commuter train station where continuous pedestrian demand would exist, followed by a period of no demand, followed by another period of continuous demand when the next train arrived.

CORSIM does not have the ability to simulate an exclusive pedestrian phase using the phase 9 method as provided by many controller manufacturers. However, in a limited number of situations where there are unused phases in the controller, the user may be able to employ one of those phases as an exclusive pedestrian phase. One such situation is the mid-link pedestrian signal. In this case the user can place node with actuated control at the location of the crossing signal. The vehicle through movements can be coded in phase 1, and phase 2 can be coded as the exclusive pedestrian phase. There are other possible configurations, but the user is cautioned to be careful when coding an unused phase as an exclusive pedestrian phase because the phase may be concurrent with a phase in the opposite ring.
Pedestrian Intensity

For each phase, the fields in this column of the grid are used to specify the pedestrian intensity, in pedestrians per hour, for stochastic arrivals. It should not be specified (i.e., zero) if the Arrival Headway is used to specify deterministic arrivals.

This value reflects the number of pedestrians (measured in pedestrians per hour) crossing the approach that would conflict with the right-turn vehicle movement from the controller phase for which it is specified. The value input for this field should correspond with the pedestrian intensity code for the link that receives the right turns from the approach defined for the phase.

Arrival Headway

For each phase, the fields in this column of the grid are used to specify the pedestrian arrival headway, in seconds, for deterministic arrivals. It should not be specified (i.e., zero) if the Pedestrian Intensity is used to specify stochastic arrivals. This value specifies the arrival headway of pedestrians actuating the push-button.

Arrival Start

For each phase, the fields in this column of the grid are used to specify the elapsed time, in seconds, from the start of the simulation to the beginning of deterministic arrivals. It should not be specified (i.e., zero) if the Pedestrian Intensity is used to specify stochastic arrivals.

Periods 1-5, Start and End

The grid provides 10 columns to define the start and end times for five periods of continuous pedestrian demand (mode 3). Each pair of adjacent columns is used to define the beginning time (clock time, in seconds, from the start of simulation) of the continuous demand period and the end clock time of the demand. No pedestrian actuations will be recorded by the controller between the end time of one period and the beginning time of the next period. As mentioned above, a good example of this type of pedestrian activity would be at an intersection adjacent to a commuter train station. Pedestrian signal demand would only occur shortly after arrival of a train and would be completed shortly after the train departs and this cycle of events could occur numerous and identifiable times during simulation analysis period.

For each phase, blank entries are not permitted out of sequence and each period of continuous demand must be unique without overlaps.

4.22 Creating Sign Controls

A sign-controlled node is one where stop and/or yield signs are used for controlling traffic flow through the node. This section will describe the mechanism for creating sign controls (stop and yield) at a surface node.

To create a sign control, press one of the Sign Control buttons or choose the Network | Tool Palette | Control | Sign Control menu command. Now, when the cursor is in the network window area, it will display as a "Not allowed" symbol. As the cursor moves across the screen it will remain unchanged until it passes over a surface link connected to a surface node where placement of the sign control is allowed. At this location, the cursor changes to an octagon or triangle depending on the sign control button pressed. To create a sign at the downstream end of the link, click the left mouse button.
4.23 Creating Ramp Meters

There are two methods of creating Ramp Meters.

Click the Ramp Meter button or the Network | Tool Palette | Control | Ramp Meter menu command. This will put the editor into Create Ramp Meter mode. In Create Ramp Meter mode the cursor will display as a "Not allowed" symbol over most of the network. As the cursor moves across the screen it will remain unchanged until it passes over a freeway node. The cursor will then change to . If this is the node you wish to add a Ramp Meter to, click the left mouse button. The following pop-up menu will appear:

- Externally-Defined
- Clock-Time
- Demand/Capacity
- Speed Control
- Multiple Threshold Occupancy
- ALINEA

Select one of the options, Externally-Defined, Clock-Time, Demand/Capacity, Speed Control, Multiple Threshold Occupancy or ALINEA. If the node had no previous meter, a Ramp Meter will be added, and a diamond will appear within the freeway node . A red node indicates that some piece of information is missing or not correct. Otherwise nodes are outlined white. To change the controller’s properties refer to Editing Ramp Meters. Otherwise, if a meter previously existed at the node the user will be prompt to replace the current meter. Doing so will delete the previous meter. You may continue adding Ramp Meters to nodes until you switch to a different palette tool.

Alternatively, right click on the desired node and a pop-up menu will appear. Select Edit from the pop-up menu. Switch to the Ramp Meter page on the Freeway Node Properties dialog. From the dropdown box, select Clock-Time, Demand/Capacity, Speed Control, Multiple Threshold Occupancy or ALINEA. A ramp meter is created automatically. You may immediately edit the meter settings by clicking the Properties button on the page.

4.24 Editing Ramp Meters

To edit a Ramp Meter, right click on the node where the controller exists and select the Edit Meter menu command. Alternately, bring up the Properties dialog for the freeway node with which the meter is associated, switch to the Ramp Meter page, and click on the Properties button.
There are five types of on-ramp control strategies, which can be implemented in the FRESIM model: Clock-Time metering, Demand/Capacity metering, Speed Control metering, Multiple-Threshold Occupancy control metering and ALINEA control metering.

Additionally, the user may specify an Externally-Defined ramp meter type that is not implemented inside the FRESIM model and that must be controlled using a run-time extension. There are no editable properties for an externally-defined ramp meter. However, the user may specify detectors for an externally-defined ramp meter.

A noncompliance percentage, currently fixed at 5%, is applied to vehicles arriving during the red signal. This percentage of vehicles will be discharged during the red signal.

### 4.24.1 Clock-Time Meter

To edit a clock-time ramp meter, right click on the node where the clock time meter exists and select the Edit Meter menu command. Alternately, bring up the Properties dialog for the freeway node with which the clock time meter is associated, switch to the Ramp Meter page, and click on the Properties button.
Under External Control

When checked, the ramp signal will operate under external control (e.g., Run-Time Extension).

Time Period

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

Metering Options

The user may select different options for different time periods. The options available are no metering this period, continue from previous period or change parameters. “No metering this period” turns off all metering for the selected time period. “Continue from previous period” keeps the same parameters from the previously defined time period. “Change parameters” allows the user to enter unique parameters for the selected time period.

Vehicles per Green

This entry specifies the number of vehicles (1 or 2) discharging onto the mainline per green indication per lane.

And headway of

This entry specifies the metering headway, in seconds, for clock-time metering.

To simulate clock-time control of the on-ramp, a single, fixed headway is specified. The meter’s countdown clock is initialized to this value at the beginning of the red indication and the signal is set to green each time the clock expires (returns to zero).

This entry represents the inverse of the metering rate, and its range depends on the number of vehicles discharged per green indication. For one vehicle per green per lane, this entry must be between 2.0 to 60.0 seconds, inclusive. For two vehicles per green per lane, this entry must be between 5.0 to 60.0 seconds, inclusive.
Furthermore, for two vehicles per green per lane, the difference between the metering headway (this entry) and the Mean Start-up Delay for the ramp link must be greater than or equal to 3.0 seconds. This requirement ensures that vehicles will properly discharge within one cycle of the meter.

Setting the headway to zero in a subsequent time period will turn the meter off.

**Take affect**

This entry specifies the time for the onset of metering, in seconds, from the beginning of the simulation. If entered as zero, the metering will start at the beginning of initialization.

For clock time metering only, subsequent time periods may be used. If this entry is specified for a subsequent time period, then it identifies the time when the specified metering rate is applied.

For example, in a case where the first time period has 360 seconds and the second time period has 360 seconds, a metering rate of 6 seconds starting at the 60th second in the first time period and a metering rate of 4 seconds starting at the 420th second in the second time period may be specified. In this case, the meter will use a metering rate of 6 seconds until the 419th second, and change to 4 second metering rate at the 420th second.

If the headway is set to zero in a subsequent time period the meter will be turned off at the specified time.

### 4.24.2 Demand/Capacity Meter

To edit a demand/capacity ramp meter, right click on the node where the demand/capacity meter exists and select the Edit Meter menu command. Alternately, bring up the Properties dialog for the freeway node with which the demand/capacity meter is associated, switch to the Ramp Meter page, and click on the Properties button.

#### Under External Control

When checked, the ramp signal will operate under external control (e.g., Run-Time Extension).

#### Capacity

This entry specifies the freeway capacity, in vehicles/hour/lane, used in the demand/capacity metering algorithm.

The demand/capacity metering algorithm performs an evaluation of current excess capacity, immediately downstream of the metered on-ramp, at regular intervals, based on counts from the surveillance detectors on the freeway mainline. A maximum metering rate is calculated such that the capacity of this freeway section is not violated. This calculated metering rate is then applied like clock-time metering. A minimum metering rate of three green signals/60 seconds is applied to ensure that waiting vehicles are not trapped between the meter.
and the ramp connection to the freeway. The metering rate is also limited to headways that are greater than two seconds.

In addition to the specification of the capacity, the user must specify the detectors on the link that will provide the input to the metering algorithm.

**Time of Onset**

This entry specifies the time for the onset of metering, in seconds, from the beginning of the simulation. If entered as zero, the metering will start at the beginning of initialization.

### 4.24.3 Speed Control Meter

To edit a speed control ramp meter, right click on the node where the speed control meter exists and select the `Edit Meter` menu command. Alternately, bring up the Properties dialog for the freeway node with which the speed control meter is associated, switch to the Ramp Meter page, and click on the `Properties` button.

![Speed Control Meter](image)

Under External Control

When checked, the ramp signal will operate under external control (e.g., Run-Time Extension).

**Speed threshold**

These entries specify the speed thresholds, in miles/hour, for speed control metering.

The algorithm for this form of ramp metering is similar to the demand/capacity strategy. A freeway link detector station must be established and identified at which speeds are evaluated and used to establish a metering rate. Generally, this detector location will be upstream of the on-ramp, although the logic does not preclude other placements. The user must specify a table of speeds and metering headways for the on-ramp. As each evaluation period concludes, the prevailing speed at the freeway detector station is compared to the tabulated minimum speeds to determine the proper metering rate.
Specifically, the meter is set to the specified headway, if the speed (as measured by the detector) is below the speed threshold specified in the corresponding entry. If the detected speed exceeds the highest threshold speed, the meter is set to a maximum metering rate of 30 vehicles/minute/lane. Speed thresholds must be arranged in descending order.

**Headway**
These entries specify the metering headways, in seconds, associated with the corresponding speed thresholds.

**Time of Onset**
This entry specifies the time for the onset of metering, in seconds, from the beginning of the simulation. If entered as zero, the metering will start at the beginning of initialization.

### 4.24.4 Multiple Threshold Occupancy Meter

To edit a multiple threshold occupancy ramp meter, right click on the node where the multiple threshold occupancy meter exists and select the Edit Meter menu command. Alternately, bring up the Properties dialog for the freeway node with which the multiple threshold occupancy meter is associated, switch to the Ramp Meter page, and click on the **Properties** button.
Under External Control
When checked, the ramp signal will operate under external control (e.g., Run-Time Extension).

Use default rate/threshold table
Selecting this check box uses the default values shown in the table below. In this default table, ten values of metering rate are used. However, users can only input 7 metering rates and 6 occupancy values if they choose to input their own table.

<table>
<thead>
<tr>
<th>Occupancy (%)</th>
<th>Metering Rate (vehicles/minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0, 10]</td>
<td>12.0</td>
</tr>
<tr>
<td>(10, 13]</td>
<td>11.0</td>
</tr>
<tr>
<td>(13, 16]</td>
<td>10.0</td>
</tr>
<tr>
<td>(16, 19]</td>
<td>9.0</td>
</tr>
<tr>
<td>(19, 22]</td>
<td>8.0</td>
</tr>
<tr>
<td>(22, 25]</td>
<td>7.0</td>
</tr>
<tr>
<td>(25, 28]</td>
<td>6.0</td>
</tr>
<tr>
<td>(28, 31]</td>
<td>5.0</td>
</tr>
<tr>
<td>(31, 34]</td>
<td>4.0</td>
</tr>
<tr>
<td>(34, 100]</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Metering Rate
These entries specify the metering rates, in vehicles/minute, that will be applied when the occupancy is less than or equal to the corresponding occupancy threshold but greater than the previous occupancy threshold. For one vehicle per green per lane, these entries must be greater than or equal to 1*NL and less than or equal to 15*NL (where NL is number of the lane on the on-ramp). For two vehicles per green per lane, these entries must be greater than or equal to 2*NL and less than or equal to 24*NL.

Occupancy Threshold
These entries specify the occupancy thresholds in percent. Occupancy thresholds must be entered in an increasing order.

Time of Onset
This entry specifies the time for the onset of metering, in seconds, from the beginning of the simulation. If entered as zero, the metering will start at the beginning of initialization.

Update Interval
This entry specifies the time interval, in seconds, at which the metering rate will be updated. It also represents the interval over which the algorithm measures the occupancy used in the algorithm.
Vehicles per Green
This entry specifies the number of vehicles (1 or 2) discharging onto the mainline per green indication per lane.

4.24.5 ALINEA Meter
To edit an ALINEA ramp meter, right click on the node where the ALINEA meter exists and select the Edit Meter menu command. Alternately, bring up the Properties dialog for the freeway node with which the ALINEA meter is associated, switch to the Ramp Meter page, and click on the Properties button.

The ALINEA ramp metering control uses a feedback strategy based on a linear regulator control system, as described in ALINEA Ramp Meter Logic.

Under External Control
When checked, the ramp signal will operate under external control (e.g., Run-Time Extension).

Update Interval
This entry specifies the time interval, in seconds, at which the metering rate will be updated. It also represents the interval over which the algorithm computes the average occupancy used in the ALINEA equation.

Initial Rate
This entry specifies the initial metering rate, in vehicles/minute, used by the algorithm when the ramp metering starts. This rate must be greater than or equal to 1*NL and less than or equal to 15*NL (where NL is number of the lanes on the on-ramp). It must also be greater than or equal to the specified Minimum Rate.
**Minimum Rate**

This entry specifies the minimum metering rate, in vehicles/minute, used by the algorithm when the metering rate computed from the ALINEA equation is less than the specified value. This rate must be greater than or equal to 1*NL and less than or equal to 15*NL (where NL is number of the lanes on the on-ramp).

**Regulator Parameter**

This entry specifies the ALINEA regulator parameter, $K_R$, in vehicles/minute.

**Desired Occupancy**

This entry specifies the desired downstream occupancy, $\hat{O}$, used in the ALINEA equation and expressed as an integer percent.

**Time of Onset**

This entry specifies the time for the onset of metering, in seconds, from the beginning of the simulation. If entered as zero, the metering will start at the beginning of initialization.

---

### 4.25 Deleting a Controller

To remove the control from a link or node, press the Delete Control button or the Network | Tool Palette | Control | Delete Control menu command. When the cursor enters the window area, it will display as the Not allowed symbol, until it passes over a link with a sign control or a node with a pre-timed controller, actuated controller or a ramp meter. As the cursor passes over the link with a sign control it changes to or depending on the sign control present. As the cursor passes over the node with a controller or meter it changes to an or respectively. Click the left mouse button to delete the control. Alternatively, select <None> from the drop down on the Intersection: Control page (refer to Editing Surface Nodes) or select <None> from the drop down on the Freeway Node: Ramp Meter page (refer to Editing Freeway Nodes).

---

### 4.26 Finding a Controller

To locate a controller whose ID you know, select the Edit | Find menu command or use the <Ctrl>+F keyboard shortcut. This brings up a dialog in which you can specify the type of object (controller) and its ID. Controller IDs are set internally by TRAFED, the user can not modify or set a controller’s ID. However, selecting an ID from the defined list will highlight the associated controller.
As the user is typing, the edit field will auto complete the selection. When you press OK, the requested controller will be highlighted with a blue border. If the controller was not previously visible within the network window, the window will be panned and moved to bring the selected controller into view.

4.27 Importing Images

You can load an image, such as an aerial photograph or a street map, which can be used as a background for the traffic network being modeled. An image can serve as a visual reference for laying out the network, as a visual reference for observers, or just as an attractive background. Laying out a network from a bitmap is a very quick way to develop a traffic network of streets and intersections. Currently, BMP, JPG, or JPEG files are the only types of image formats that can be used as a background for a network. Other image formats may be supported in the future.

4.27.1 Selecting a Bitmap

The accuracy of a traffic network developed with a background bitmap relies on the accuracy of the bitmap chosen. The bitmap must have the same resolution in the X (East West) direction as it does in the Y (North South) direction (some aerial photos may not adhere to this rule). The orientation of the map is not important to TRAFED. However, if the network is developed with a line drawn map, and then for presentation purposes, an aerial photo is associated with the network, the two bitmaps must have the same orientation. TRAFED does not have any functionality built in to edit the bitmap. If you wish to change the bitmaps orientation or drawing objects you must edit the bitmap outside of TRAFED with a graphics program. You may wish to edit out unwanted lines or objects or add objects, such as buildings or text, to the bitmap.

There are many types of bitmaps that may be used as a background for a traffic network. Aerial photographs may be used but may be hard to accurately select node locations if the world to bitmap ratio is very high. Many computer-mapping programs allow exporting a desired view to a bitmap format. These are very easy to use but may lack the accuracy you desire. Some CAD programs may allow you to export its data to a bitmap. Scanning a paper map, such as a street map and saving it as a bitmap, is also a viable option.

4.27.2 Loading a Background Image

To load a bitmap image (BMP, JPG, or JPEG file) select the Network | Load Bitmap menu command. The Load Bitmap dialog (below) will be presented. This dialog will assist you with the task of loading, positioning, and scaling the bitmap. This process associates a bitmap with a network and the association will remain until you remove the association.
Set the Bitmap Background file path

The first task is to input the file name and path to the bitmap file. You may type in the path and file name directly to the edit box or browse to it via a standard File Selection dialog that pops up when the **Browse** button is pushed. When the file is selected, the bitmap will be displayed in the left pane. The bitmap dimensions will be filled in and the scale will be initially set to one foot per pixel. For example, initially a 500 pixel wide bitmap represents 500 feet in the real world.

**Bitmap Width and Height**

In order for the bitmap to provide an accurate background, the World Width must be set by you to reflect the actual number of feet represented by the width of the bitmap. This step is critical to the accuracy of the traffic network. If the scale is not set accurately, the length of links created by referencing the bitmap may be off by hundreds of feet. This value can be determined by using known distances within the bitmap or using the scale of the map that generated the map. One method for determining the scale is as follows:

1. Print out the full bitmap.
2. Using a ruler, measure the distance between two points on the bitmap that you know the corresponding real world straight-line distance. For example, two intersections on a map that you know the distance between or a football field (300 feet or 360 if you include the end zones) on an aerial photograph make good points of reference.
3. Create a ratio of the real world distance in feet to inches or millimeters on the printout.
4. Measure the full width of the bitmap in inches or millimeters with the ruler.
5. Multiply the ratio and the bitmap width to get the number of feet represented by the width of the bitmap.
6. Enter this value in the World Width field on the Load Bitmap dialog.

You may need to adjust this value after you have created a few streets on the network. If the lengths of the links are not correct, enter a value that better represents the real world width of the bitmap. You may have to adjust the positions of nodes after the ratio has been reset.
Set the real world bottom left corner represented area: Left side alignment and Bottom side alignment

Setting the position of the bitmap is critical to aligning an existing network with a new bitmap. The default values for a new bitmap are set to the zero left value and a zero bottom value. This places the bottom left corner at the crossing point of the major axes. This is a good place to start a new network. For existing networks, you may have to move the bitmap behind the network by adjusting the left and bottom alignment points. These values are in network (real world) coordinates (feet).

4.27.3 Adjusting the Bitmap Background

A bitmap may need to be adjusted because the scale or the position was not input correctly. The bitmap background may be adjusted after it has been associated with a network by using the Load Bitmap dialog. The Network | Load Bitmap menu item will display the Load Bitmap dialog with the existing bitmap, file name and path, scale, and position information shown. You may select a different bitmap if desired. You may choose a different scale by adjusting the World Width value. You may also adjust the position of the bitmap by setting the Left and Bottom alignment values.

4.27.4 Hiding the Bitmap Background

The bitmap may be hidden using the View | Bitmap Background menu item. The association of the bitmap to the network will remain but the bitmap background will not draw behind the network until you click the menu item again or you reload the network. You may delete the association between the network and the bitmap by following the Deleting the Bitmap Background instructions.

4.27.5 Deleting the Bitmap Background

You may end the association between the bitmap and the network by removing the path and file name from the Load Bitmap dialog. The Network | Load Bitmap menu item will display the Load Bitmap dialog with the existing bitmap, file name and path, scale, and position information shown. Simply highlight the path and file name of the existing bitmap and delete it from the edit box. Select OK and the bitmap will no longer be associated with the network. The bitmap itself will not actually be deleted, just the association.

4.28 Specifying Bus Routes

A bus route is defined by a set of nodes making a path and a set of stations making a route. The surface street stations are defined on the Surface Link: Bus Stations dialog page.

After defining the links traversed by the bus route, the user should define the bus stations served by the route. Each bus route is defined by the unique series of bus stations at which a bus stops as it traverses its route. It is possible for two bus routes to have the same route but to stop at different stations. For example, bus route 1 might be an express while bus route 2 might be a local bus. Similarly, it is possible for multiple bus routes to stop at some of the same stations.

To invoke the following dialog select Network | Bus Routes menu command. New routes must be added before they can be edited or deleted.
After selecting the **Add new route** button, the following dialog appears.

### Bus Route Number

This entry specifies the route number of the bus route.

### Path Nodes

This list is used to specify the nodes on which the bus route passes. This list must begin at an entry node and end at an exit node. Buses must enter the network from an entry node and they can traverse internal and interface nodes before exiting at an exit node. Buses can travel between different CORSIM sub-networks. A bus route can be comprised of nodes that lie in the NETSIM and the FRESIM sub-networks.
**Route Stations**

Bus stations where buses stop on this route. Buses do not have to stop at every bus station they pass; only the ones with scheduled stops should be listed here. Bus stations need to be defined first before using in this dialog. Refer to Surface Link: Bus Stations dialog for creating bus stations.

The length of a bus station is computed by multiplying the length of the vehicle type (define on the Network Properties: Vehicle Types dialog) by the stations capacity (defined on the Surface Link: Bus Stations dialog).

**Insert Node, Insert Station**

The buttons found below the lists allow the user to insert rows above the cursor location, thus allowing the user to place nodes or stations anywhere in the list. Nodes and bus stations must already be defined on the network and the user must insert the correct IDs in the correct order into the lists.

**Time varying properties: Time Period**

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

**Time varying properties: Same as previous time period**

The data associated with the selected time period will have all the same values as the previous time period.

**Time varying properties: Mean Headway**

Bus flow rates for a route are defined in terms of mean headway between buses on that route. They are not defined in terms of a schedule that emits buses at particular clock times. Headways can be any integer value greater than zero. Values that are less than 30 seconds, however, will cause CORSIM to issue a warning that the value is low and should be checked by the user. This can be used to generate higher flow rates in the rush-hour period and diminished flow rates in the post-rush-hour period. If there is no new data for a route in subsequent time periods, CORSIM will assume that the flow rates will be unchanged for that route.

**Time varying properties: Offset**

Bus route offset can be used to offset the time at which a bus route emits buses. The first bus on this route will be delayed by the time specified; then all other buses will be emitted based on the headway for the route. This feature is useful if two bus routes have the same path and headway through the network. One bus route can be given an offset so that a bus for each route will not enter the network at the same time.

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**4.29 Specifying Incident Detection, Point Processing, MOE Estimation (FRESIM)**

FRESIM has the capability of performing on-line incident detection and off-line incident detection. To invoke the following dialog select Network | Incident Detection, Point Process, MOE Estim menu command.
The default option is to select no detection or processing. The other two options are On-Line Incident Detection and Off-Line Processing.

**Average Vehicle Length**

This entry specifies the assumed average vehicle length for incident detection. This number depends heavily on the truck percentage and truck type distribution in the simulated network.

**Detectors**

The user can select from two types of detectors: Analog Detectors or Digital Detectors.

**Polling Frequency**

This entry specifies the polling frequency. This is appropriate for digital detectors only.

**Station Identification**

These entries specify the detector station numbers to be used. The sequence of stations to be used must be input in order from upstream to downstream. If there are two or more freeway segments, the station number sequences representing these sections must be separated by an entry of 0 (Segment Separator). Stations are created on the Freeway Link: Detectors page, refer to Editing Freeway Links.
Available Station
The list of defined stations and the link they reside on.

Identified Stations
The sequence of identified stations to be used in Incident Detection, Point Processing, or MOE Estimation in order from upstream to downstream.

Insert
This button inserts the highlighted available station into the identified station list.

Remove
This button removes the highlighted station from the identified station list.

Segment Separator
If there are two or more freeway segments, the station number sequences representing these sections must be separated by an entry of 0 (Segment Separator).

Move
Tool for moving inserted stations up and down in the list.

4.29.1 On-Line Incident Detection
In the on-line incident detection mode, incident detection is performed as FRESIM simulates the movement of vehicles through a specified network.
On-Line Incident Detection Algorithm: California Logic

This algorithm uses occupancies at sensor stations to determine the onset of the incident, its approximate location and the end of the incident. The following dialog appears for inputting the parameters for this algorithm.

Threshold of Occupancy: Difference across successive sensors
Threshold of Percent Occupancy: Difference across successive sensor
Threshold of Percent Occupancy: Change at the downstream sensor over time
On-Line Incident Detection Algorithm: Payne #8

The Payne algorithm 8 incorporates compression wave suppression logic to avoid incident false alarms due to the presence of transient compression waves in the traffic flow. The following dialog appears for inputting the parameters for this algorithm.

Number of compression wave suppression periods

Threshold of Occupancy: Difference across successive sensor positions
Threshold of Occupancy: Downstream sensor position
Threshold of Occupancy: Another threshold at the sensor
Threshold of Percent Occupancy: Change at the downstream sensor over time
Threshold of Percent Occupancy: Difference across successive sensor positions

On-Line Incident Detection Algorithm: Expo Smooth

This algorithm uses the method of double exponential smoothing in an attempt to reduce the number of incident false alarms.

(Expo Smooth is currently disabled.)

On-line Evaluation Frequency

This entry specifies the evaluation frequency for incident detection.

4.29.2 Off-Line Processing

In the off-line incident detection mode, there are three independent options Incident Detection, Point Processing and MOE Estimation. Off-line means the processing is done after the simulation has finished.
Incident Detection

The following three off-line incident detection algorithms have been implemented:

**Off-Line Incident Detection Algorithm: California Logic**

This algorithm uses occupancies at sensor stations to determine the onset of the incident, its approximate location and the end of the incident. The following dialog appears for inputting the parameters for this algorithm.

**Threshold of Occupancy: Difference across successive sensors**

**Threshold of Percent Occupancy: Difference across successive sensor**

**Threshold of Percent Occupancy: Change at the downstream sensor over time**
Off-Line Incident Detection Algorithm: Payne #8

The Payne algorithm 8 incorporates compression wave suppression logic to avoid incident false alarms due to the presence of transient compression waves in the traffic flow. The following dialog appears for inputting the parameters for this algorithm.

Number of compression wave suppression periods
Threshold of Occupancy: Difference across successive sensor positions
Threshold of Occupancy: Downstream sensor position
Threshold of Occupancy: Another threshold at the sensor
Threshold of Percent Occupancy: Change at the downstream sensor over time
Threshold of Percent Occupancy: Difference across successive sensor positions

Off-Line Incident Detection Algorithm: Expo Smooth

This algorithm uses the method of double exponential smoothing in an attempt to reduce the number of incident false alarms.

(Expo Smooth is currently disabled.)

Off-Line Incident Detection Reevaluation Time Period

This entry specifies the time period for reevaluating off-line incident detection. Note that the content of this entry should be an integer multiple (between 1 and 20) of the Evaluation. If the Payne #8 incident detection algorithm will be applied, this entry should be set to 60.

Point Processing

In FRESIM, each detector on a roadway collects raw data, such as detector activation and deactivation times. The point-processing method evaluates detector-specific data and then outputs such information as time, link ID, lane ID, detector information, volume, mean speed, mean headway, and mean occupancy rate.

Evaluation Frequency

This entry specifies the evaluation frequency for MOE estimation and point processing. The evaluation frequency for MOE estimation and point processing is entered only if freeway links are defined and Point Processing is requested.
MOE Estimation

The same algorithm can be used with different values or different algorithms can be used with estimation of various measures of effectiveness.

MOE Estimation Algorithm: MOE Algorithm 1

Rough count error variance
Variance of trap error term
Initial Kalman filter

MOE Estimation Algorithm: MOE Algorithm 2

Variance of error term
Ratio of system/observation noise
Initial count estimation error variance

MOE Estimation Algorithm: MOE Algorithm 3

Expected section density error var
System noise variance
Ratio system/observation noise var
4.30 Specifying Traffic Assignment (NETSIM)

Traffic assignment is the generation of entry volumes and turn percentages by specifying OD data. Traffic assignment can be performed and followed by a simulation study in the course of a single analysis run. In that case, the trip table and other traffic assignment data specified replace the need to specify turning movement data, entry link volume, and source/sink volume data normally required to perform simulation.

To invoke the following dialog select Network | Traffic Assignment (NETSIM) menu command.

### Impedance Function

This entry specifies for the impedance function type: FHWA impedance function (default) or Modified Davidson impedance function.

### Parameters for Impedance

There are two parameters for impedance $a$ and $b$.

### Threshold of objective function

This entry specifies the acceptable threshold of objective function, Epsilon.

### Max number of traffic assignment iterations

This entry specifies the maximum number of traffic assignment iterations to be performed.
Capacity smoothing factor
This entry specifies the capacity smoothing factor (in a percentage) to be applied (if more than one capacity adjustment iteration is requested).

Number of capacity iterations
This entry specifies the number of the capacity iterations to be applied (the traffic will be reassigned after each loop).

Line-search accuracy threshold
This entry specifies the line-search accuracy threshold.

Type of Optimality
This entry is a code for the type of optimality for the objective function: User’s assignment (default), or System’s assignment.

Print intermediate results
This entry specifies the print code for intermediate results: Do not print (default), Print intermediate path assignments, Print tree constructs for each iteration, Print detailed trees for each OD pair, Print all of the intermediate outputs (1–3), or Print the final detailed trees for each OD pair.

Print final traffic assignment results
This entry determines whether to suppress, or print the final traffic assignment results. This box should be checked if more than one capacity iteration is to be performed.

Service discharge rate/saturation rate (Davidson Function)
This entry specifies the ratio of the service discharge rate to the saturation rate for the modified Davidson impedance function.

Impedance produced by all-or-nothing network loading
This entry specifies the percentage of the impedances produced by an all-or-nothing network loading that will be incorporated in the first assignment iteration.

Record Generation
This entry specifies the code for generating the equivalent simulation data set for the assignments obtained. Options include do not generate simulation records (default), generate simulation records, or generate simulation records with turn percentages.

O-D Trip Table
The traffic assignment model contained in CORSIM is designed to treat the global analysis network as representing the aggregate of all specified sub-networks. The logic internally aggregates the individual sub-network specifications into a single traffic assignment network. Currently, the traffic assignment model is only
Working with Traffic Objects

capable of treating NETSIM sub-networks. **Traffic assignment cannot be performed on the networks represented by the FRESIM model.**

Origin-destination nodes can be specified in any order. The model recognizes two types of origin-destination nodes. Node numbers of the form 8### represent entry and exit nodes connected to an internal node. Source/sink centroid numbers serve traffic entering or discharging within the middle of an internal link. These locations represent traffic generators or attractors, such as parking garages or shopping centers, within the network. Each source/sink location provides access to a single link, and each internal link can have only a single source/sink location.

Traffic entering the network from an 8### origin node enters via entry links that must be defined by a link characteristic. Internal links associated with source/sink traffic must also be defined.

To use this dialog, first the user selects an origin node. Second the user selects a destination node from the destination list. Third the user types in the number of vehicles per hour traveling from the selected origin to the selected destination. If the user wishes they can set the percentages of trucks and carpools. Finally the user can select the **Apply** button setting the defined information. This process can be repeated for as many nodes as desired. The user can remove all data currently set by selecting the **Reset** button.

**Origins**

For each origin node a destination list can be created containing node/volume pairs.

**Destination List**

This entry specifies the destination node for the portion (specified in the next entry) of traffic entering at the defined origin node.

**Number of vehicles per hour traveling from the selected origin to the selected destination**

This entry specifies the volume (vph) traveling from the origin node to the destination node specified in the previous entry.
**Trucks**

This entry specifies the percentage of trucks leaving the origin node. This value does not change between destination nodes, i.e., it is associated with the origin node.

**Carpools**

This entry specifies the percentage of carpools leaving the origin node. This value does not change between destination nodes, i.e., it is associated with the origin node.

### 4.31 Specifying Origin-Destination (FRESIM)

CORSIM uses volumes, vehicles per hour, of vehicles traveling from an origin node to a destination node. The user specifies an OD (origin-destination) pair in percentage. The percentage will be converted to an OD pair in vehicles per hour and CORSIM will maintain this volume during the OD calibration process. If there are no specified data for some OD pairs, an internal gravity model is applied to assign OD pairs. The volumes converted are also used as constraints to the internal OD gravity traffic assignment model.

The accuracy threshold value to stop the OD calibration, with or without any OD pairs specified can be input. In other words, even though the user doesn’t want to specify any individual OD pairs, the accuracy threshold can still be entered and will work with the data entered. The maximum number of iterations of the gravity model is fixed at 100.

The user should ensure that the summation of all the OD percentages from an entry node to all exit nodes equals one. It is the user’s responsibility to make sure all the percentages specified will not conflict with each other and not conflict with destination volumes.

The following table presents the maximum set of origin-destination node numbers which may be entered for the diagram presented above.

<table>
<thead>
<tr>
<th>Origin Node Number</th>
<th>Destination Node Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
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<tr>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>
It should be noted that for nodes with an off-ramp, specifying the node number as a destination node will indicate that traffic should exit at that node. Specifically, in the above diagram, specifying node 3 as a destination will cause traffic to exit via exit node 8004. Specifying node 4 as a destination will cause traffic to continue on the mainline and exit via exit node 8002. However, if the user specifies node 3 and node 4 at the same time, the summation of the percentages to node 3 and node 4 should equal 1.

To invoke the following dialog select Network | Origin-Destination (FRESIM) menu command.

To use this dialog, first the user selects a time period. Secondly the user selects an origin node. Thirdly the user selects a destination node from the destination list. Fourth the user types in the percentage of vehicles traveling from the selected origin to the selected destination. Finally the user can select the Apply button setting the defined information. This process can be repeated for as many time period / node combinations as desired. The user can remove all data currently set by selecting the Reset button.

**Time Period**

Select the desired time period for editing. All time varying data displayed applies to the selected time period.

**Origins**

This entry specifies the origin node number. For an on-ramp origin, this entry is the number of the node at which the on-ramp intersects with the freeway mainline. For a mainline origin, this entry is the number of the downstream node of the freeway entry link. Specifically, in the above figure, nodes 2, 5, and 6 all represent traffic entering via entry node 8003. For traffic entering via entry node 8001, node 1 is the only valid entry.

**Destination List**

This entry specifies a list of destination node number. For an off-ramp destination, this entry is the number of the node at which the off-ramp departs from the freeway mainline. For a freeway mainline destination, this entry is the number of the upstream node of the freeway exit link. Specifically, in the above figure, node 4
represents traffic exiting via exit node 8002. For traffic exiting via exit node 8004, node 3 is the only valid entry.

**Percentage of vehicles traveling from the selected origin to the selected destination**

This entry specifies the percentage of vehicles that are entering through the selected origin node and will travel to the selected destination node. The percentage will override the internally computed trip exchange from the selected origin node to the selected destination node.

---

### 4.32 Specifying Link Aggregation (NETSIM)

Specify link aggregation only if you want the program to treat a particular set of links as a single entity for purposes of computing significant measures of effectiveness. Each such set is known as an aggregation and is identified by a user-defined number.

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

Any link within the network can be specified as part of an aggregation. The links do not have to form a continuous path through the network. It is possible to aggregate any set of links.

To invoke the following dialog select Network | Link Aggregation (NETSIM) menu command.

#### Create New Aggregation

To create a new aggregation ID the user selects the Create New Aggregation button, which pops up the following dialog.
Enter a numeric ID for your aggregation

Enter a unique ID number. This number will be added to the Aggregation ID list.

**Aggregation ID**

This entry specifies a list of the user-specified aggregation IDs. Select the aggregation ID to edit properties.

**Available Surface Links**

This table lists the available links that can be added to the aggregation.

**Links in Aggregation**

This table lists the links selected for the selected aggregation.

**Add**

This button adds the selected surface link to the selected aggregation. This operation can be accomplished by double clicking on a surface link from the available list.

**Remove**

This button removes the selected link from the aggregation. This operation can be accomplished by double clicking on a surface link from the links in aggregation list.

### 4.33 Specifying Interchanges (NETSIM)

Specify interchanges when you want to specify origin-destination (OD) travel patterns for an urban interchange. The links comprising the interchange are specified, and the OD data are specified. This information is used by NETSIM to accurately represent travel patterns within an interchange.

When OD travel patterns are specified for an interchange, NETSIM uses the information to determine the turn movement decisions (and therefore, lane-changing decision) of each vehicle within the interchange. Thus, link-specific turn movement data must be omitted for any link specified here.

While NETSIM does not have a limit on the total number of links that can be included within a single interchange, it does require that the longest travel path through an interchange not exceed 10 links.

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

**Note** no entry links, exit links, or interface links can be included within an interchange.

To invoke the following dialog select Network | Interchanges (NETSIM) menu command.
Create New Interchange

To create a new interchange ID the user selects the Create New Interchange button, which pops up the following dialog.

Enter a numeric ID for your interchange

Enter a unique ID number. This number will be added to the Interchange ID list.

Interchange ID

This entry specifies a list of the user-specified interchange IDs. Select the interchange ID to edit properties.

Available Surface Links

This table lists the available links that can be added to the interchange.

Links in Interchange

This table lists the selected links for the selected interchange.
Add
This button adds the selected surface link to the selected interchange.

Remove
This button removes the selected link from the interchange.

Origin-Destination

To use this dialog, first the user selects an origin node. Thirdly the user selects a destination node and direction from the destination list. Fourth the user types in the percentage of vehicles traveling from the selected origin to the selected destination. Finally the user can select the Apply button setting the defined information. This process can be repeated for as many node combinations as desired. The user can remove all data currently set by selecting the Reset button.

Origins
This entry specifies the origin node number.

Destination List
This entry specifies a list of destination node number.

Percentage of vehicles traveling from the selected origin to the selected destination
This entry specifies the percentage of vehicles that are entering the interchange through the selected origin node and will travel to the selected destination node.
5 TRAFED Within TSIS

5.1 Tool Configuration

In the TSIS environment, TRAFED’s capability is enhanced to be TSIS aware. TRAFED is designed to take in files with a TNO extension (TRAFED files).

The TRAFED button is found on the Traffic Tool Toolbar within TShell. The button will be active whenever a valid input file is selected in the Project View or a valid input file is open in the workspace in its editor.

![Tools Toolbar](image)

You can also use the tool by selecting a file in the Project View then selecting the Tools | Editors | TRAFED menu command.

Or you can right click in the desired file and select Open With | TRAFED from the pop-up menu.

TRAFED is a basic tool delivered with the TSIS 6.0 toolkit. Within the TShell environment you can setup and change the tool’s configuration. By doing so, you can change the behavior of the tool. Refer to the TShell User’s Guide for more information on configuring tools.

TRAFED is delivered with the following settings. You can change these settings as desired. The tool (trafed.ocx) is found in the TRAFED directory below the install directory. The name is “TRAFed” and the Category is “Editor.” The Tool Tip String is TRAFED. TRAFED can take in TNO files so this extension is designated in the Associated Extensions field. The default bitmap that shows up on the tool button is the “TRAFed” bitmap.
The user can invoke help by pressing the help button found on all dialogs or by using Help | Help Topics | TRAFED menu command. The help settings are shown below.
6 Details on Selected CORSIM Topics

6.1 Driver Intolerable Speed
A driver’s “intolerable speed” \(V_i\) is computed as follows:
\[
V_i = V_f (0.7 \times DAF)
\]
where
- \(V_f\) = User-specified free-flow speed for this link
- \(DAF = 1.0 + \frac{\text{Driver Type Code} - 5.5}{\text{FDA}}\) (which is a driver aggressiveness factor)
- Driver Type Code = 1, 2, ..., 10 (depicting the aggressiveness of the driver)
- FDA = Driver type facto

6.2 Urgency and Acceptable Risk
This urgency \(U\) is computed as follows:
\[
U = DAF \times NLC \times V_f^2 \div (20 (x - x_o))
\]
where
- \(DAF = 1.0 + \frac{\text{Driver Type Code} - 5.5}{\text{FDA}}\) (which is a driver aggressiveness factor)
- \(NLC = \) For a mandatory lane change, the number of lane changes required to reach the goal lane. For a discretionary lane change, only one lane change will be made so \(NLC = 1\).
- \(V_f\) = User-specified free-flow speed for this link
- \(X = \) Current position of the vehicle
- \(X_o = \) Position of the object that causes the lane change

Note: In deciding whether a driver will initiate a lane change now, an assessment is performed of the level of risk the driver is willing to accept. This risk is expressed as the maximum deceleration rate (fpss) the driver is willing to accept in the event the leading and/or following vehicles in the target lane immediately initiated a panic deceleration.
This acceptable risk is a function of the driver’s position relative to the object causing the need for a lane change; that is, the closer the vehicle is to the object causing the lane change, the greater the deceleration the driver is willing to accept.

As the value increases, drivers will accept larger decelerations (i.e., riskier maneuvers), thus increasing the likelihood that a given lane-changing opportunity will be accepted.

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

NETSIM uses the following formula to escalate the acceptable risk as the vehicle approaches the cause of the lane change:

\[
\text{Acceptable Risk} = D_{\text{min}} + (D_{\text{max}} - D_{\text{min}}) \sqrt{\frac{U - Ut}{1 - Ut}}
\]

where

- \(D_{\text{min}}\) = Minimum acceptable deceleration at position \(x_o\), where \(x_o\) is the position of the object that causes the lane change.
- \(D_{\text{max}}\) = Maximum acceptable deceleration.
- \(U\) = Urgency Factor.
- \(Ut\) = Urgency Threshold
- \((D_{\text{max}} - D_{\text{min}})\) = Difference in deceleration between maximum and minimum deceleration. This parameter is specified as a mandatory lane-changer and as a discretionary lane-changer. The default for a mandatory lane-changer is 10 fps. The default for a discretionary lane-changer is 5 fps.

### 6.3 Lane Channelization

<table>
<thead>
<tr>
<th>CODE</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unchannneled</td>
</tr>
</tbody>
</table>
Details on Selected CORSIM Topics

<table>
<thead>
<tr>
<th>CODE</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left turn only</td>
</tr>
<tr>
<td>2</td>
<td>Buses only</td>
</tr>
<tr>
<td>3</td>
<td>Closed</td>
</tr>
<tr>
<td>4</td>
<td>Right turn only</td>
</tr>
<tr>
<td>5</td>
<td>Carpool only</td>
</tr>
<tr>
<td>6</td>
<td>Carpools and buses only</td>
</tr>
<tr>
<td>7</td>
<td>Right turns + right diagonal; right turns + through; also right turns + right diagonal + through if no other lane allows the through movement</td>
</tr>
<tr>
<td>8</td>
<td>Left turns + left diagonal; left turns + through; also left turns + left diagonal + through if no other lane allows the through movement</td>
</tr>
<tr>
<td>9</td>
<td>All movements permitted by the geometry and adjacent lane channelization</td>
</tr>
<tr>
<td>D</td>
<td>Diagonal traffic only</td>
</tr>
<tr>
<td>T</td>
<td>Through traffic only</td>
</tr>
</tbody>
</table>

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

- Only full lanes can be channelized using these entries. Since a turn pocket does not extend throughout the length of a link, it is not considered a full lane. Turn pockets are channelized as turn only.

- When a lane is unchannelized (0), right turns can take place from it only if that lane is the single rightmost lane and there is no right-turn pocket. Similarly left turns can take place from it only if that lane is the single leftmost lane and there is no left-turn pocket. If these lanes are unchannelized and there is no turning pockets, then a mix of through and turning traffic exists in these lanes.

- When a channelization code of 9 is used, right turns can take place from the single rightmost lane even there is a right-turn pocket. Similarly left turns can take place the single leftmost lane even there is a left-turn pocket.

- If a diagonal receiver exists then codes 7 or 8 imply “turn plus diagonal”. If there is no diagonal traffic, then codes 7 or 8 imply “turn plus through”. If there is diagonal traffic and no other lane is available to service through traffic, then codes 7 or 8 imply “turn plus diagonal plus through”. To channelize a lane for turn, diagonal, and through traffic and when there is at least one other lane available to service through traffic, a code of 9 must be used.
A channelization scheme may be coded using a different channelization code. For example, when there is no diagonal movement, 7 and 9 or 8 and 9 are interchangeable for a lane. However, only one lane on a link can be coded as 9.

The channelization code for a link with a single lane should be either 0 or 9 if there is no turning pocket on the link. The channelization codes for the single lane could be 0, 9, 7, or 8 if there exist(s) turning pocket(s).

The NETSIM model imposes de facto channelization, whenever conditions dictate, to reflect real-world responses. Specifically, if an unchannelized lane services a high volume of turners, then the program will internally assert that the lane will service only turners for the appropriate time period. This internal channelization is imposed whenever the turn percentage exceeds $75 \div LN$ (with $LN$ representing the number of moving full lanes on the link).

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

If it is necessary to represent a turn movement utilizing more than one lane, then the two rightmost or leftmost lanes should be channelized accordingly.

A turn movement on NETSIM links cannot be assigned to more than three channelized lanes. Only through movement can be assigned to more than three lanes.

A lane cannot be channelized for left-turners unless all other lanes to the left are either channelized for left-turners only or closed.

A lane cannot be channelized for right-turners unless all other lanes to the right are either channelized for right-turners only or closed.

A closed lane is usually a transient condition that is due to, for example, a construction zone.

A parking lane is not reflected as a closed lane; a parking lane is simply not included in the number of moving lanes.
• If a receiving link is specified for through or diagonal traffic, then at least one lane must always remain unchannelized, even if there is no through or diagonal traffic specified.
• Only one lane on a link can be channelized for buses.
• Only one lane on a link can be channelized for carpools.
• Only one lane on a link can be channelized for both buses and carpools when there is no other bus or carpool lane.
• Non-bus/non-carpool vehicles that enter the lane that is channelized as “bus/carpool only” due to upstream link channelization will leave the lane as soon as possible.
• If the right/left lane is channelized for buses or carpools, other vehicles can only use the lane to make right/left turns.
• A link cannot be totally channelized for one turn movement; that is, the leftmost lane cannot be channelized for right-turners, and the rightmost lane cannot be channelized for left-turners. If necessary, the user must treat such turn movements as left- or right-diagonal movements.

The user can change channelization codes from one time period to another. If a channelization code is input for a lane in a time period other than the first, then channelization codes for all lanes must be entered. Note that full lanes are numbered from right to left, starting with lane 1, regardless of the link configuration. In specifying channelization codes, the user should refer to the diagram below to identify the proper lane number.

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

- Lane 1 is specified as unchannelized for Time Period 1.
- Lane 1 is specified as channelized for right-turners, for Time Period 3.

Lane 1 is specified as unchannelized, for Time Period 5.

### 6.4 Freeflow Speed on a Curve

The basic equation for vehicle operation on a curve, which is used to generate an upper bound for desired free-flow speed, is as follows:

\[ V = \sqrt{15 R(e^1)} \]

Where

- \( V \) = Vehicle speed (in miles per hour)
- \( R \) = Radius of curvature (in feet)
- \( E \) = Rate of roadway super-elevation (in feet/foot)
- \( F \) = Friction coefficient for a given pavement condition

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

### 6.5 ALINEA Ramp Meter Logic

The ALINEA ramp metering control uses a feedback strategy based on a linear regulator control system, as described in the following journal articles:


ALINEA is an acronym for the French “Asservissement Linéaire d’Entrée Autoroutière”, which loosely translates to Linear Control of Entries to Motorways.

The ALINEA logic computes metering rates according to the following formula:

\[ R(k) = R(k - 1) + K_R [ \hat{O} - O_{out}(k - 1) ] \quad (1) \]

where:

- \( k = 1, 2, 3, \ldots \) = metering update interval (e.g., every 60 seconds)
- \( R(k) \) = metering rate at update interval \( k \)
- \( R(k - 1) \) = metering rate at update interval \( k - 1 \)
- \( K_R > 0 \) = regulator parameter
\( \hat{O} \) = a set (desired) value for the downstream occupancy, expressed as a percentage

\( O_{\text{out}}(k – 1) \) = occupancy, in percentage, computed from detector data at update interval \((k – 1)\)

**NOTE:** if \(O_{\text{out}}(k-1)\) is substantially greater than \( \hat{O} \), the computed \( R(k) \) may be less than zero. Therefore, users are required to input a minimum metering rate that will be used if the computed rate is less than zero. Finally, users are required to input an initial metering rate to employ Equation (1) properly.

### 6.6 Traffic Assignment

Traffic assignment is the generation of entry volumes and turn percentages by specifying OD data. This structure of data is a path network. This path network has nodes representing the geometric network links, and links representing the geometric network turn movements. The traffic assignment is applied to the path network using the specified origin-destination traffic information.

An intermediate solution for each iteration is obtained using link impedances produced by the previous iteration. For the first iteration, the link impedances are evaluated for free-flow conditions throughout the entire network. To obtain an optimal solution for each iteration, iterative line search is applied to the range between the current intermediate solution and the previous iteration solution. The search terminates when the contribution of current iteration is less than the accuracy threshold value.

The traffic assignment process terminates when the maximum number of iterations is reached, or when the relative change of the objective function between two successive iterations is less or equal to the threshold value, whichever occurs first.

During the assignment process, the service discharge rates for turns are held constant, and are estimated initially for free-flow conditions. These estimates could be calibrated after the assignment of turn movements, and then applied to the next assignment process, if requested.

\[
C_n = \left[ rC_c + (100 – r)C_p \right] / 100
\]

where

- \( C_n \) = New estimate of capacity (for the next assignment)
- \( r \) = Capacity smoothing factor
- \( C_c \) = Calculated capacity using previously assigned volumes
- \( C_p \) = Previous estimate of capacity

If the capacity smoothing factor is zero, then the estimated capacity will be evaluated by averaging all of the previous capacity estimates.

Two impedance functions are available to evaluate travel time on a path-link the FHWA impedance function and the modified Davidson impedance function. The travel time on a path link includes the time required to traverse the geometric link and the time required, at its downstream intersection, to perform the desired turn movement.

**The FHWA impedance function (formerly BPR) is as follows:**

\[
T = T_0 \left[ 1 + a(V / C)^b \right]
\]

**The modified Davidson impedance function is as follows:**

if \( V \leq bS \)

\[
T = T_0 \left[ 1 + aV / (S – V) \right]
\]

or if \( V > bS \)
Details on Selected CORSIM Topics

\[ T = T_0 \left[ 1 + ab \div (1 - b) \right] + aT_0 (V - bS) \div [S(1 - b)^2] \]

where

- \( T \) = Mean travel time on the path-link
- \( T_0 \) = Free-flow (zero volume) travel time on the path-link
- \( V \) = Volume on the path-link
- \( C \) = Capacity of the path-link
- \( S \) = Path-link saturation rate = 100(C \div R)
- \( R \) = Ratio of capacity to saturation rate (in a percentage)
- \( a, b \) = Parameters to be specified, with the defaults as described in the following table.

<table>
<thead>
<tr>
<th>Type of Impedance Function</th>
<th>Value of ( a ) and ( b )</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHWA:</td>
<td>( a = 0.60 ) and ( b = 4 ) (coded as 60 and 40)</td>
</tr>
<tr>
<td>Modified Davidson:</td>
<td>( a = 0.40 ) and ( b = 0.80 ) (coded as 40 and 80)</td>
</tr>
</tbody>
</table>

In most highway network cases, the traffic assignment algorithm converges rapidly. For large networks with heavy traffic, however, the algorithm can converge slowly, especially for a system optimal solution. In such cases, the user could speed up the assignment process by specifying a percentage value (smoothing factor) from 0 to 99 (recommended value 20). The link impedances for the first assignment iteration will be evaluated as follows:

\[ T_1 = \left[ T_0(100 - X) + T_f(X) \right] \div 100 \]

where

- \( T_1 \) = Link travel time for iteration 1 (= \( T_0 \) if \( X = 0 \))
- \( T_0 \) = Free-flow travel time
- \( X \) = Impedance produced by all-or-nothing network loading
- \( T_f \) = Link travel time induced by an all-or-nothing assignment

CORSIM will always print traffic assignment results for each iteration if multiple-capacity iterations and intermediate results are requested. If intermediate results are not requested and multiple capacity iterations are requested, then it will print traffic assignment final results for the last capacity iteration only.
7 Glossary of Terms

Active Window
When several windows are open, clicking the left mouse button anywhere in a window makes that the active window. The active window is indicated by a highlighted title bar. Also, the filename of the active window is displayed in the title bar of the main TSIS window.

ATMS
Advanced Traffic Management Systems

CORSIM
CORSIM (CORridor microscopic SIMulation program) is the corridor simulation and modeling component of the Traffic Software Integrated System (TSIS) tool suite.

DOT
Department of Transportation

FHWA
Federal Highway Administration. Sponsor for the development of the TSIS suite of traffic analysis tools.

FRESIM
The freeway network simulation portion of CORSIM.

Graphical User Interface
An interface between a user and a software tool, consisting of graphical elements and controls, e.g., windows, dialogs, buttons.

GUI
Graphical User Interface
HOV
High Occupancy Vehicle. There is more than 1 person in the vehicle.

HTML
Hypertext Markup Language is a system of marking up or tagging a document so that it can be published on the World Wide Web. It is used to display Script Tool on-line help.

Output View
The Output View is a dockable control window in the TShell interface that displays the output generated by the traffic tools as they operate on files.

NETSIM
The surface street network simulation portion of CORSIM.

OD
OD stands for Origin-Destination. CORSIM uses volumes, vehicles per hour, of vehicles traveling from an origin node to a destination node.

Project View
The Project View is a dockable control window in the TShell interface that displays a hierarchical tree structure of projects, cases, and case files. Using this tree structure, you can efficiently manage your traffic analysis projects and execute tools on project files.

Record
An 80 character line consisting of data fields that is part of the input (TRF) file specification for the CORSIM simulation.

Time Period
Partition the simulation time into a series of varying durations.

TNO
TNO file used by TRAFED.

Tool
A program or component that is installed into the TSIS environment for use in conducting traffic operations analysis. A tool can be an application (EXE), Dynamic Link Library (DLL), COM object or ActiveX Control (OCX), or a batch program (BAT).
Glossary of Terms

**ToolTip**
A small rectangular pop-up window that displays a brief description of a command bar (toolbar) button's purpose.

**Traffic Assignment**
Traffic assignment is the generation of entry volumes and turn percentages by specifying OD data.

**TRF**
A file that contains the input data, in record format, used to define a CORSIM network and to drive the CORSIM simulation for a single simulation case.

**TShell**
The graphical user interface for the TSIS integrated development environment. It provides a Project View that enables you to manage your TSIS projects. It is also the container for the pre-configured tools and any tools that you add to the suite.

**TSIS**
Traffic Software Integrated System. TSIS is the integrated development environment that hosts the CORSIM simulation and its support tools.
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