



User's Guide For Travel Time Reliability Program Suite

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**Report 0-5453-2
User's Guide
Research Project 0-5453 – Appendix 1**

**Performed in cooperation with the
Texas Department of Transportation
and the
Federal Highway Administration**

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**USER'S GUIDE
FOR
TRAVEL TIME RELIABILITY PROGRAM SUITE**

by

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1 Introduction

This document is the User's Guide for the Travel Time Reliability program suite. This program suite contains a set of programs written under the TxDOT grant 0-5453 strategies for Improving Travel Time Reliability. This document contains information on how to use the programs in the Travel Time Reliability suite. For the rest of this document we shall refer to the Travel Time Reliability suite as *TTReliability*.

A software file "TTReliability.rsc" is supplied in the accompanying CD. Chapter 2 of this User's Guide contains the instructions to install this software file. During the installation process, the file will create an add-in which will appear as *TTReliability (0-5453)* menu on the menubar of TransCAD. Under the *TTReliability (0-5453)* menu are the following submenus:

- Adjust O-D Matrix
- Adjust Link Capacity
- Set Variance Of O-D Travel Time
- Traffic Assignment With Fixed O-D
- Traffic Assignment With Departure Time Choice
- Plot VHT & VMT
- Plot Hotspots
- Plot Capacity Reliability Curve

Each submenu consists of a program which performs a customized procedure or gives instructions for the user to perform a procedure using the default functions provided by TransCAD. These programs, when used in combinations, allow users to perform traffic assignment analyses with travel time reliability consideration. Chapter 3 explains the different sequences of execution of these programs for users to carry out various traffic assignment analyses. Chapters 4 to 11 contain the instructions on how to use each of these programs.

In the following chapters of this User's Guide, words that appear in italic, for example *TTReliability (0-5453)* indicate the items that appear in the TransCAD program (usually seen on the screen). These can be the names of menus, submenus, dialog boxes, buttons etc. Filenames, directories/paths are enclosed in double quotations. Single quotes are used to enclose the text and numbers that shall be entered by the user.

2 Installation

The supplied CD contains a file “TTReliability.rsc”. It has to be compiled and converted into a TransCAD desktop application. It is recommended for the user to be familiar with compilation and installation of the TransCAD add-in. Instructions for compilation and installation of add-ins can be found in the *Help* menu in TransCAD, under *GISDK Help* → *Quick Start* → *Lessons 5 and 6*. Nevertheless the step by step instructions for compiling and installing the “TTReliability.rsc” is given below.

Compilation of Resource file

1. Copy the file “TTReliability.rsc” from the CD to the desktop.
2. Start the TransCAD program.
3. Go to the *Tools* menu in TransCAD, select *Add-Ins*. A dialog box with the name *Add-ins* will appear. Select the *GIS Developer’s kit* from the list in the dialog box and click the *OK* button.
4. In the *GISDK Toolbox*, click the *Compile to UI* button (third button from the left) to display the *Compile* dialog box.
5. Choose the “TTReliability.rsc” file which is stored on your desktop and click the *Open* button.
6. TransCAD displays a *Save As* dialog box. Type the filename ‘ttreliability’ and click *Save* in the “TransCAD” folder. By the default installation settings of TransCAD, this folder is “C:\Program Files\TransCAD\”. This procedure creates a user database file “ttreliability.dbd” and six other files with the name “ttreliability” but with extensions “.1, .2, .3, .4, .5, .6” respectively.
7. Close the GISDK toolbox.

Creation of Add-In

The above steps compile the resource file “TTReliability.rsc” into the 7 different files in the TransCAD’s user interface database. The following steps are necessary to convert these 7 files into the TTReliability add-in.

1. Go to the *Tools* menu in TransCAD, select *Add-Ins*. A dialog box with the name *Add-ins* will appear.
2. Click the *Setup* button to display the *Setup Add-Ins* dialog box.
3. Click the *Add* button to create a new add-in. This procedure creates an *Untitled Add-in* in the *Add-ins* list box. The *Type: Macro* in the *Settings* frame is also selected by default.

4. Edit the *Description* text box in the *Settings* frame and enter ‘Travel Time Reliability’. This updates the *Untitled Add-in* in the *Add-ins* list box to the name *Travel Time Reliability*.
5. Next, edit the *Name* textbox in the *Settings* frame and enter ‘TTReliability’.
6. In the *Settings* frame, click the *Browse* button and choose the UI Database file “ttreliability.dbd” which you have created previously. If you follow the compilation instructions above, the file should be in the folder “C:\Program Files\TransCAD\”. Select this file and click the *Open* button.
7. In the *Setup Add-ins* dialog box, click the *OK* button to install the add-in and return to the *Add-Ins* dialog box.
8. Highlight the *Travel Time Reliability* in the scroll list and click the *OK* button. TransCAD now closes the *Add-Ins* dialog box and creates a menu *TTReliability (0-5453)* on the main menu bar as shown in Fig. 1.

Loading the Add-In

When the user starts the TransCAD program, *TTReliability (0-5453)* menu will not appear on the menu bar. The user has to execute the following steps in order to add the *TTReliability (0-5453)* menu to the main menu bar.

1. Go to the *Tools* menu in TransCAD, select *Add-Ins*. A dialog box with the name *Add-ins* will appear.
2. Highlight the *Travel Time Reliability* in the scroll list and click the *OK* button. TransCAD now closes the *Add-Ins* dialog box and creates a menu *TTReliability (0-5453)* on the main menu bar.

TTReliability as a Desktop Shortcut

It is possible to create a desktop shortcut such that each time when the TransCAD program is activated, it automatically loads the *TTReliability(0-5453)* menu onto the main menu bar. The following are the instructions to create a desktop shortcut of TransCAD with the *TTReliability(0-5453)* menu.

1. Make sure that the TransCAD is closed. If not select *File*→*Exit* to terminate the TransCAD program.
2. Create a shortcut of TransCAD and place it on your desktop.
3. Right-click on the shortcut icon and choose *Properties* tab to display the *Properties* dialog box.

4. Click the *General* tab and replace the text in the edit box with 'TransCAD with TTReliability'.
5. Click the *Shortcut* tab and append the following text in the Target edit box:
 -q -a TTReliability -ai TTReliability -n "TransCAD with TTReliability"
 The edit box now looks like this
 "C:\Program Files\TransCAD\tcw.exe" -q -a TTReliability -ai TTReliability -n "TransCAD with TTReliability"
6. Click the *OK* button to close the *Properties* dialog box.
7. The shortcut is now ready for use. Double-clicking this new shortcut icon will start TransCAD with the *TTReliability(0-5453)* menu in the main menu bar.

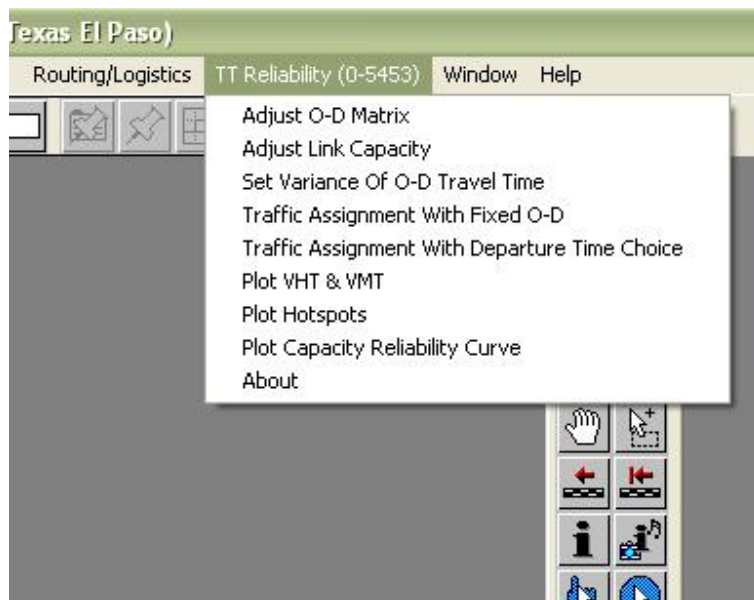


Figure 1: Travel Time Reliability Menu - After Installation.

3 Recommended Use of Travel Time Reliability Program Suite

The TTReliability program suite consists of eight programs:

- Adjust O-D Matrix
- Adjust Link Capacity
- Set Variance of O-D Travel Time
- Traffic Assignment with Fixed O-D
- Traffic Assignment with Departure Time Choice
- Plot VMT & VHT
- Plot Hotspots
- Plot Capacity Reliability Curve

These programs, in combinations, are used to perform various traffic assignment analyses for risk averse drivers in a stochastic network. Before presenting the recommended sequence on the use of these programs, the functions of each of these programs are briefly described below:

The ***Adjust O-D Matrix*** program displays instructions for users to use the default functions provided by TransCAD to multiply an original O-D matrix by a constant to form a new O-D matrix.

The ***Adjust Link Capacity*** program changes the capacities of all the links in the TransCAD Dataview table according to the link facility types and new capacities specified by the user.

The ***Set Variance of O-D Travel Time*** program computes the variance of route travel time between all the O-D pairs in a network caused by incidents. The variances between all the O-D pairs are stored in a matrix in the same format as the O-D matrix.

The ***Traffic Assignment with Fixed O-D*** displays instructions for users to use the default functions provided by TransCAD to perform traffic assignment for risk averse drivers in a stochastic network.

The ***Traffic Assignment with Departure Time Choice*** program automatically performs traffic assignment for risk averse drivers in a stochastic network over several time intervals, each with an O-D matrix. This program uses the travel times obtained from the traffic assignments to adjust the O-D matrices to account for changes in users' departure times. This program outputs a set of new O-D matrices (one for each interval) and the traffic assignment results of the intervals.

The ***Plot VMT & VHT*** program plots two charts from the output files of the Traffic Assignment with Departure Time Choice program: the total vehicle-miles traveled (VMT) in a network over the time intervals and the total vehicle-hours traveled (VHT) in a network over the time intervals.

The ***Plot Hotspots*** program plots the curves of Volume-Capacity (V-C) ratio versus time interval for selected links in a network based on the output of the Traffic Assignment with Departure Time Choice program.

The *Plot Capacity Reliability Curve* computes and plots the capacity reliability curve of a network when the network's traffic demand (original O-D matrix) is increased or decreased by a series of multiplication factors.

Some of these eight programs, when used in the correct sequences, enable you to perform two types of traffic assignment analyses:

- traffic assignment with a fixed O-D matrix
- traffic assignment with departure time choice

in a stochastic network with risk averse drivers. The sequences of use of these programs to perform the two types of traffic assignment analyses are described in the following two sections.

Performing Traffic Assignment with A Fixed O-D Matrix

This refers to traffic assignment for risk averse drivers in a stochastic network. The analysis is to be performed for the peak hour in the morning commute, or at other hour in the day when drivers exhibit risk averse route choice behavior. This analysis uses only one O-D matrix to represent the traffic demand during the peak hour. It assumes that the O-D matrix remains the same after traffic assignment, i.e., drivers will not change the departure times.

1. Decide on the hour of the day in which traffic assignment is to be performed.
2. Construct the hourly O-D matrix. Very often, the O-D matrix that comes with the TransCAD network database is a 24-hour O-D matrix in which the trips are in vehicles/day. Since the analysis period is one hour, the O-D matrix must be in unit of vehicles/hour. Follow the instructions in the Adjust O-D Matrix program to construct the hourly O-D matrix from the original matrix.
3. Adjust the link capacity to hourly capacity. Very often, the link capacity in the Dataview table in the TransCAD database is given in vehicles/day. Since the analysis period is one hour, the capacity must be in vehicles/hour. Use the *Adjust Link Capacity* program to change the link capacity in the Dataview table for each facility type.
4. Perform traffic assignment, with the hourly O-D matrix and hourly capacity as inputs, according to the instructions given in the *Traffic Assignment with Fixed O-D* program. Use the data in the traffic assignment output file (ASN_LinkFlow.bin) to analyze the link and network performances. Stop here if you do not wish to plot the capacity reliability curve.
5. Use the *Plot Capacity Reliability Curve* program to analyze the change in the network's capacity reliability when the overall traffic demand (O-D matrix) changes. If the O-D matrix in the future years are available (through some lane use-transportation forecasting models), you may use these new O-D matrices and repeat Steps 2 to 4. Alternatively, if the capacities of certain links change in the future years (for example, due to the construction or expansion of new facilities), you may repeat Steps 2 to 4 with the new link capacities. In other words,

the change in capacity reliability may be analyzed with respect to the changes in O-D matrix and/or link capacity.

Performing Traffic Assignment with Departure Time Choice

The idea of traffic assignment with departure time choice is to model the changes in drivers' departure times due to traffic congestion along the routes. This requires more effort to organize the input data and more steps in the modeling process.

To model the changes in drivers' departure times, a time period (e.g., 6:00 a.m. to 9:00 a.m.) that covers the morning peak needs to be defined. This time period is divided into several constant time intervals. Drivers can change the departure time from one interval to the next. The time intervals must be sufficiently short to reflect the drivers' decision interval (e.g., to depart 5, 10 or 15 minutes earlier or later) but sufficiently large enough for most of the drivers to complete their trips before the route travel time changes. A 15-minute interval is recommended as a compromise.

1. Decide the time period and duration of time intervals.
2. Construct the input O-D matrices. One input O-D matrix must be prepared to each time interval. Each matrix consists of the trips made within the time interval, expressed in vehicles/hour. You may use the *Adjust O-D Matrix* program to construct the hourly O-D matrix from the original 24-hour matrix. One way of obtaining the input matrices is to multiply the 24-hour O-D matrix by the respective K-factors of the intervals and then convert the unit to vehicles/hour.
3. Adjust the link capacity to hourly capacity. Since the unit of the O-D matrices is vehicles/hour, the capacity must be converted to vehicles/hour. Use the *Adjust Link Capacity* program to change the link capacity in the Dataview table for each facility type.
4. Use the *Adjust Link Capacity* program to perform traffic assignment and adjust the O-D matrices for all the intervals. The output of the *Traffic Assignment with Departure Time Choice* program is a set of new O-D matrices (one for each time interval) and a set of traffic assignment files (one for each interval). The following two steps help to analyze the output of this program using the data in these two sets of output files.
5. Use the Plot VMT & VHT program to visualize the change in total vehicle-miles traveled (VMT) and total vehicle-hours traveled (VHT) in the network over the time intervals.
6. Use the Plot Hotspots to visualize the change in V-C ratio of selected links over the time intervals.

4 Adjust O-D Matrix

The *Adjust O-D Matrix* program activates a dialog box that shows the instructions to modify an input Origin-Destination (O-D) matrix. This procedure may be used to convert an original O-D matrix which has trips over a longer period (e.g., 24 hours) into a new O-D matrix which has trips over a shorter period (say, one hour). The original matrix is multiplied by a constant (e.g., the K-factor to obtain an output matrix). The constant should be determined off-line by the user prior to using this program. Clicking the *Adjust O-D matrix* submenu pops up a dialog box which shows the instructions as in Fig. 2. Click the *Exit* button to return to the TransCAD menu.

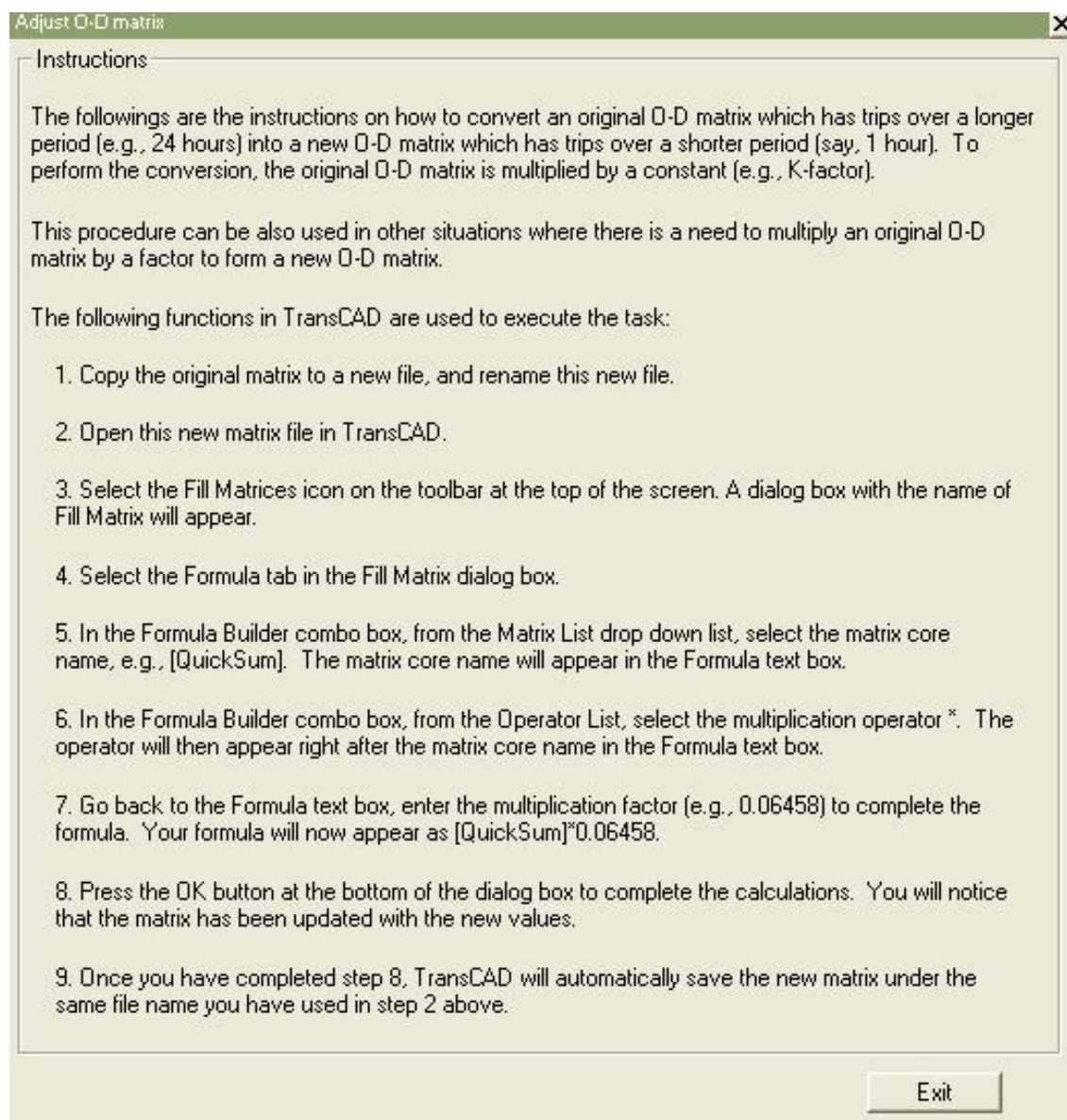


Figure 2: Adjust O-D Matrix – Instructions.

5 Adjust Link Capacity

This program is for users to change the capacities of all the links in a network. It changes the link capacities according to the link's facility type (or functional class). It requires the user to input the number of facility types and the capacity of each facility type in the network database in terms of vehicles per lane.

This program may be used to convert a TransCAD network database which has 24-hour capacity into hourly capacity. This program reads the network's geographic file (*.dbd) and its attribute table (*.bin). It replaces the link capacity values in columns (AB_CAP, BA_CAP, TOT_CAP) in the Dataview table with new values. The number of lanes in each direction of the links are taken into account. That is, the new capacity values in columns (AB_CAP, BA_CAP, TOT_CAP) are the capacities of all the lanes combined. The screenshot in Fig. 3 shows the first dialog box when the *Adjust Link Capacity* submenu is selected.

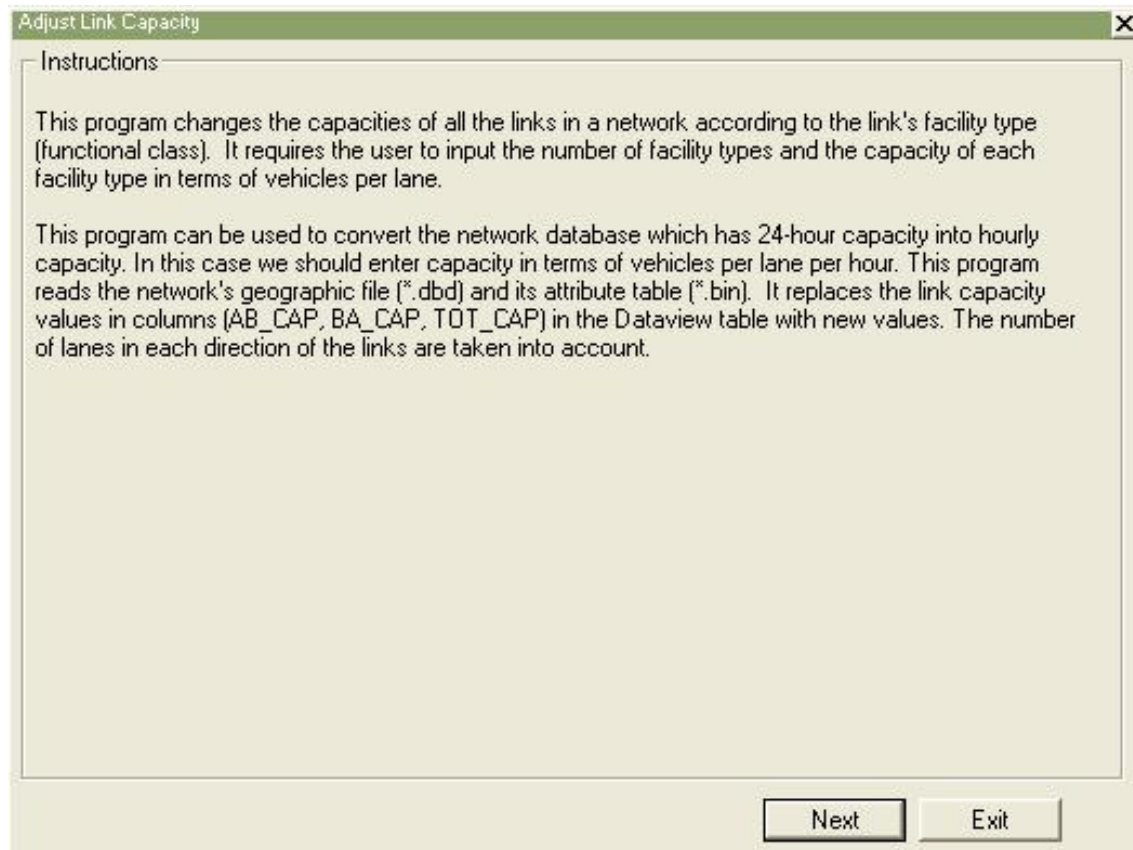


Figure 3: Adjust Link Capacity – Instructions.

Click the *Next* button to go to the next dialog box.

Browse for the geographic file (*.dbd) as shown in Fig. 4.

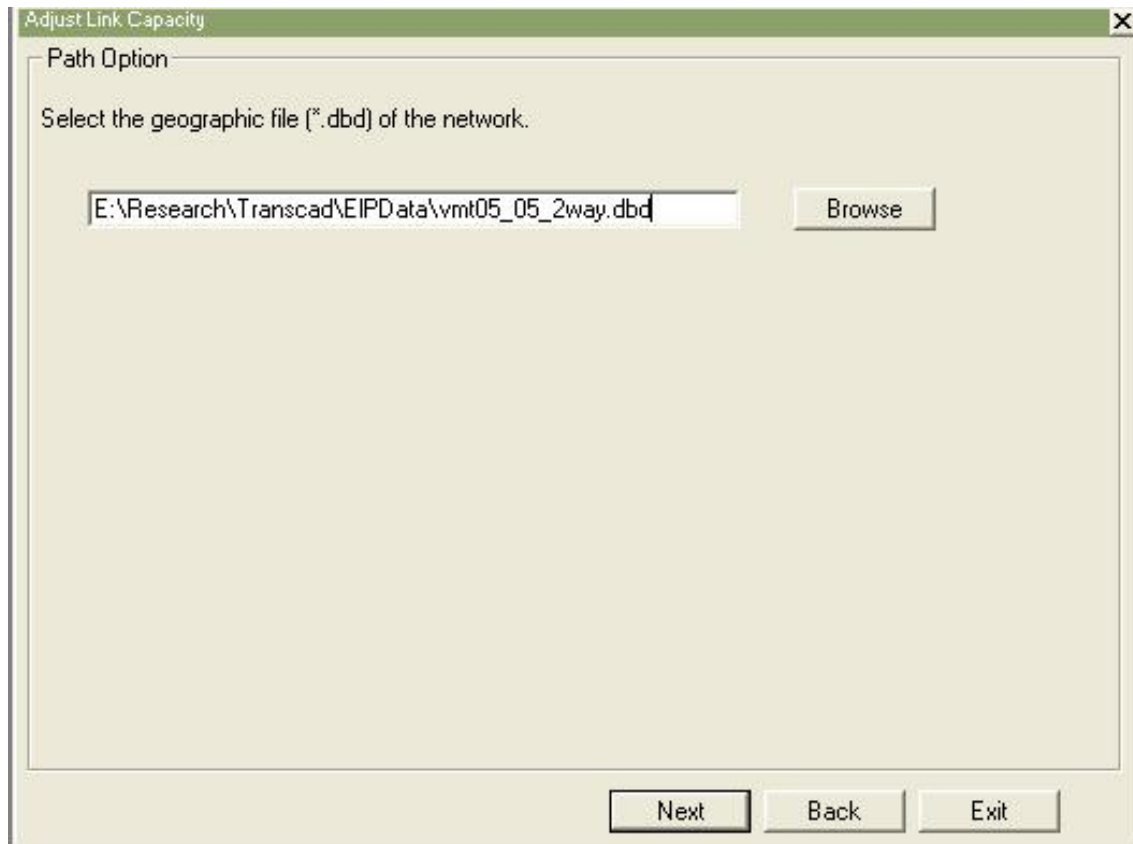


Figure 4: Adjust Link Capacity – Select Geographic File.

Click the *Next* button to open the geographic file.

Once the geographic file has been opened, the program will automatically detect and select the link layer as the current layer as shown in Fig. 5.

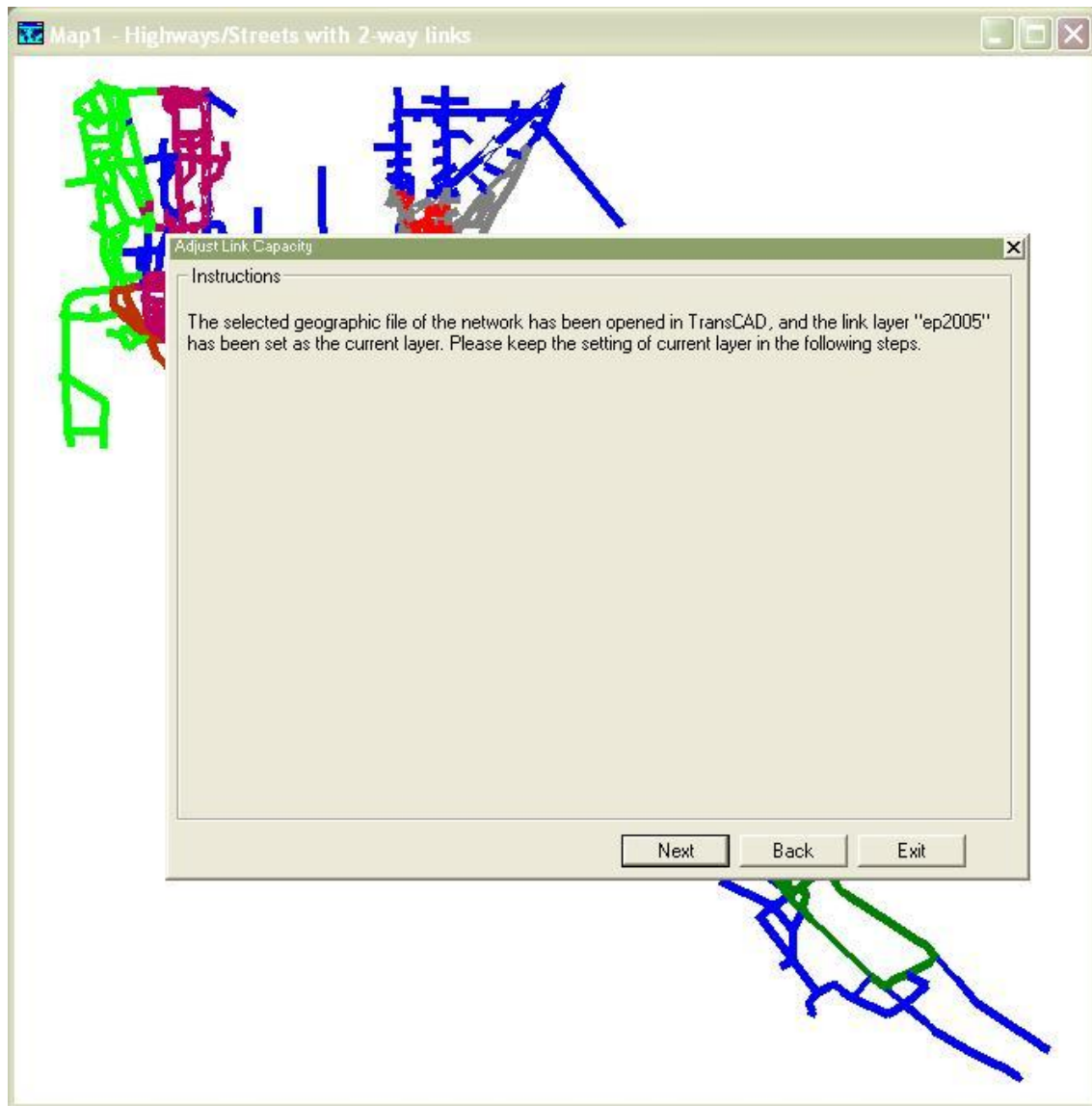
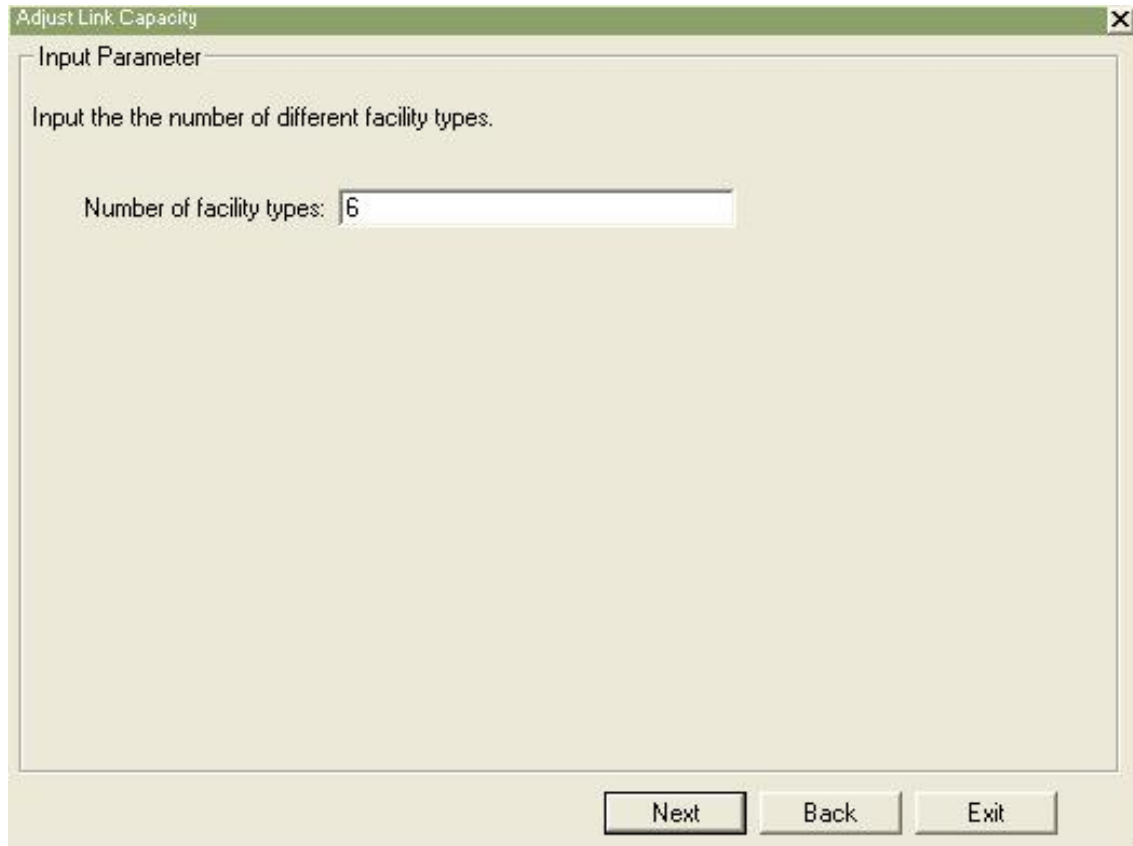


Figure 5: Adjust Link Capacity – Selected Geographic File.

Click the *Next* button to go to the next dialog box.

In the dialog box as shown in Fig. 6, enter the number of facility types (number of road classes) in the network. This value will lead the program to create the same number of rows of entry as shown in Fig. 7.



Adjust Link Capacity

Input Parameter

Input the the number of different facility types.

Number of facility types: 6

Next Back Exit

Figure 6: Adjust Link Capacity – Input Number of Facility Types.

It is important that you enter exactly the same number of facility types as in the database. For example, if the database has 6 facility types denoted by numbers 1, 2, 3, 4, 7, 8. Enter '6' in the provided text box. Click the *Next* button to continue to the next dialog box.

For each facility type as shown in Fig. 7, double click the item to activate an *Input Capacity* dialog box for the corresponding facility type. Enter the facility type number (road class) and the new capacity (in vehicles per hour per lane) in the *Input Capacity* dialog box, followed by clicking the *OK* button. Repeat this step for all the facility types.

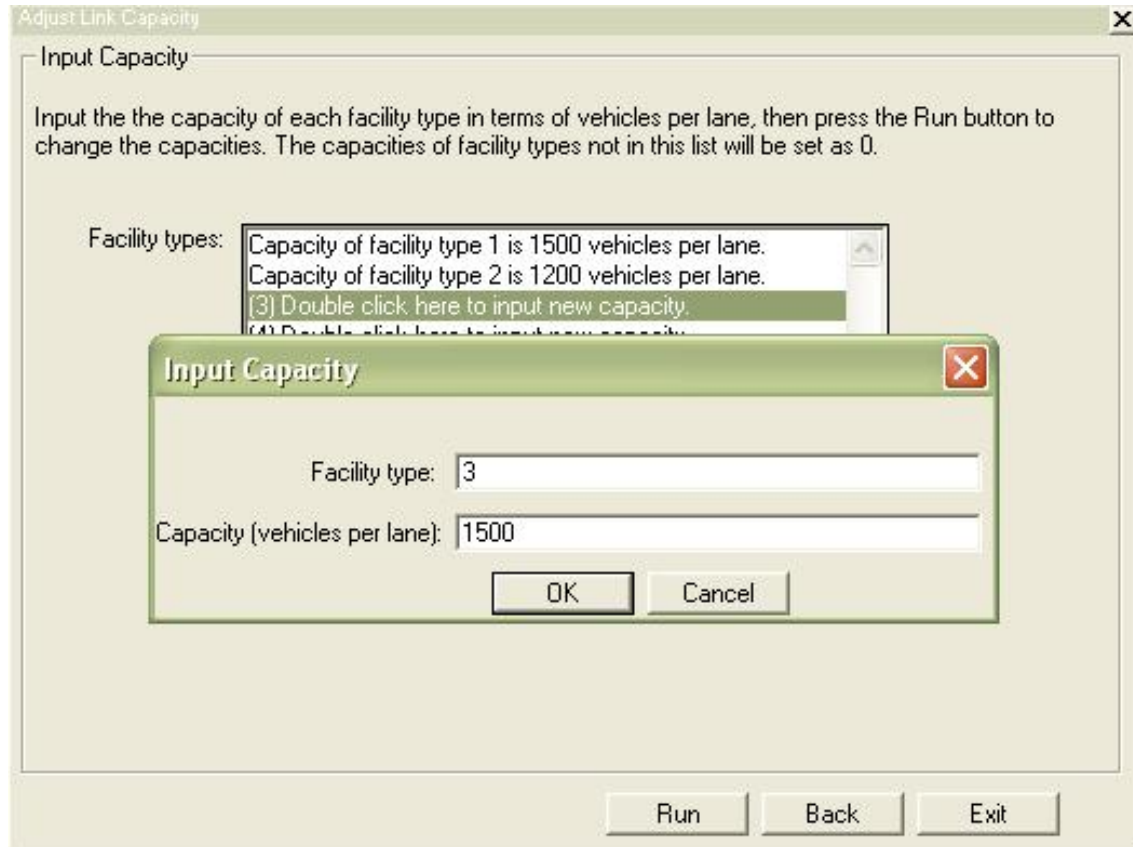


Figure 7: Adjust Link Capacity – Input Capacity.

Click the *Run* button to change the capacities in the Dataview table. If the program runs successfully, the final dialog box appears as shown in Fig. 8 will appear.

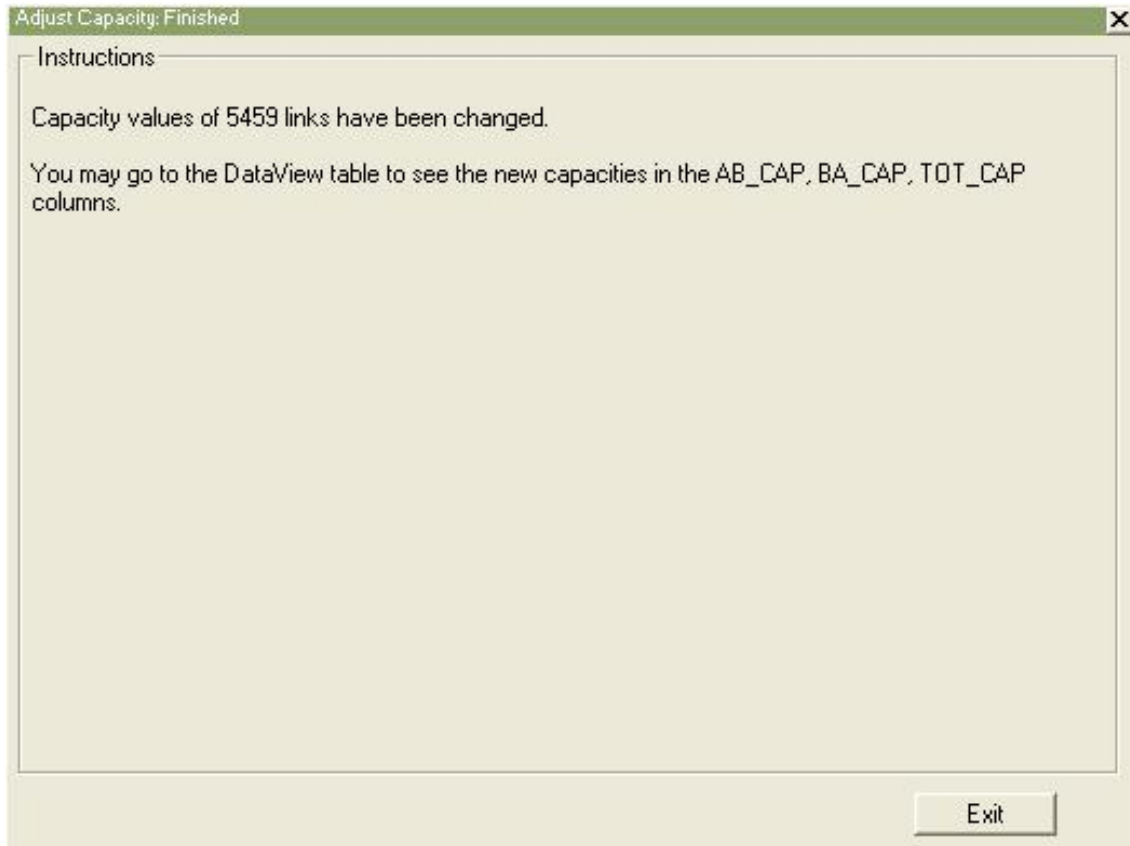


Figure 8: Adjust Link Capacity – End of Program.

Click the *Exit* button to end the program and return to the TransCAD menu. It is strongly recommended that you check the new capacity values in all the facility types in the DataView table in conjunction with the number of lanes in each link.

6 Set Variance Of O-D Travel Time

This program computes the variance of route travel time for all O-D pairs (denoted in short as variance OF O-D travel times) in a network. It assumes that the variance is caused by lane blocking incidents which can only occur one at a time in the network.

The program reads an incident database (*.bin) file that contains the link ID of the incident locations, number of lanes closed by the incidents and incident start times. For each of the incidents: (1) user equilibrium traffic assignment is performed with reduced link capacity at the incident location; followed by (2) calculation of O-D travel times. This program assumes that the incident data is collected over several months at the same time period of every day (e.g., morning peak of 6 a.m. - 9 a.m.). The time period in the database (e.g., 6 a.m. - 9 a.m.) is divided into several time intervals (e.g., 15 minutes). For each time interval, and for each O-D pair, the O-D travel times due to the presence and absence of incidents in this time interval are then used to compute the variance of O-D travel time in this time interval for this O-D pair.

To use this program, you must first run the programs Adjust O-D Matrix and Adjust Link Capacity. Use the Adjust O-D Matrix program to create O-D matrices corresponding to different time intervals.

This program requires one more input file: the incident database file in *.bin format. The number of rows in this data file is the number of incidents. This data file must have 4 columns:

- date
- time (in seconds from 0000 hrs)
- link ID of the incident locations
- number of lanes closed by the incidents

It assumes that all the links in the database are one-way links. The incident occurred during the entire time interval of interest (e.g., 15 minutes). An example of the incident database file is shown in Fig. 9.

Dataview1 - time69									
[Incident Pk]	[date]	[incident start time]	[incident type]	PrimaryNoInvolvedVeh	linkid	Highway	milepost	totalnoofflanes	[no of closed lanes]
20.00	5/30/06	360.0000	3	1	1763	1	22.00	2	0
21.00	5/30/06	360.0000	7	0	4203	1	25.00	4	1
22.00	5/30/06	360.0000	3	1	217	1	23.00	4	0
23.00	5/31/06	360.0000	1	2	4361	2	29.50	2	0
24.00	5/31/06	360.0000	1	2	1780	4	21.20	1	0
25.00	5/31/06	369.0000	1	2	4361	2	29.30	2	1
26.00	05/31/06	380.0000	8	1	1376	1	17.00	2	0
27.00	05/31/06	381.0000	3	1	3741	2	24.00	3	0
28.00	05/31/06	385.0000	8	1	2479	1	21.00	4	0
29.00	05/31/06	405.0000	3	2	950	3	23.50	2	0
30.00	05/31/06	410.0000	7	0	3741	2	24.00	3	1
31.00	05/31/06	410.0000	8	2	217	1	23.00	4	0
32.00	05/31/06	410.0000	1	3	2604	2	20.00	4	1
33.00	05/31/06	411.0000	8	1	1857	2	16.00	2	0
34.00	05/31/06	412.0000	1	2	2845	4	0.00	1	1
35.00	05/31/06	419.0000	3	1	1377	2	17.00	3	0
36.00	05/31/06	424.0000	7	1	4166	1	24.00	3	0
37.00	6/01/06	424.0000	2	1	4203	1	25.00	2	1
38.00	6/01/06	432.0000	2	1	1387	1	18.00	2	0
39.00	6/01/06	432.0000	3	1	2479	1	21.00	4	0
40.00	06/01/06	436.0000	7	0	4202	2	25.00	3	0
41.00	06/01/06	438.0000	8	1	3647	2	36.00	1	0
42.00	06/01/06	440.0000	7	0	1388	2	18.00	4	1
43.00	06/01/06	440.0000	4	0	4166	1	24.00	3	1
44.00	6/02/06	441.0000	1	2	2547	1	20.00	2	0
45.00	6/02/06	444.0000	7	1	1535	2	14.00	2	0
46.00	6/02/06	450.0000	1	2	4410	1	28.00	3	2
47.00	6/02/06	451.0000	5	9	1535	2	14.00	2	0
48.00	6/02/06	452.0000	2	200	4867	1	0.00	1	1
48.10	6/02/06	453.0000	3	--	-1	0	0.00	1	0
48.20	6/02/06	453.0000	3	--	-1	0	0.00	1	0
49.00	6/02/06	454.0000	8	1	798	3	29.20	1	0
50.00	6/02/06	456.0000	4	0	3741	2	24.00	4	0
51.00	6/02/06	459.0000	1	2	4415	2	28.00	2	1
52.00	6/02/06	462.0000	2	1	2011	2	26.00	2	1

Figure 9: Set Variance Of O-D Travel Time – Incident Database File.

This program produces several output files in the matrix format (*.mtx) corresponding to different time intervals within the time period. Each file contains the variances of travel times for all the O-D pairs in the network in a time interval. These matrices are the necessary input files for the Traffic Assignment with Departure Time Choice program.

The instructions as shown in Fig. 10 will be displayed when *Set Variance of Travel Time* submenu is selected.

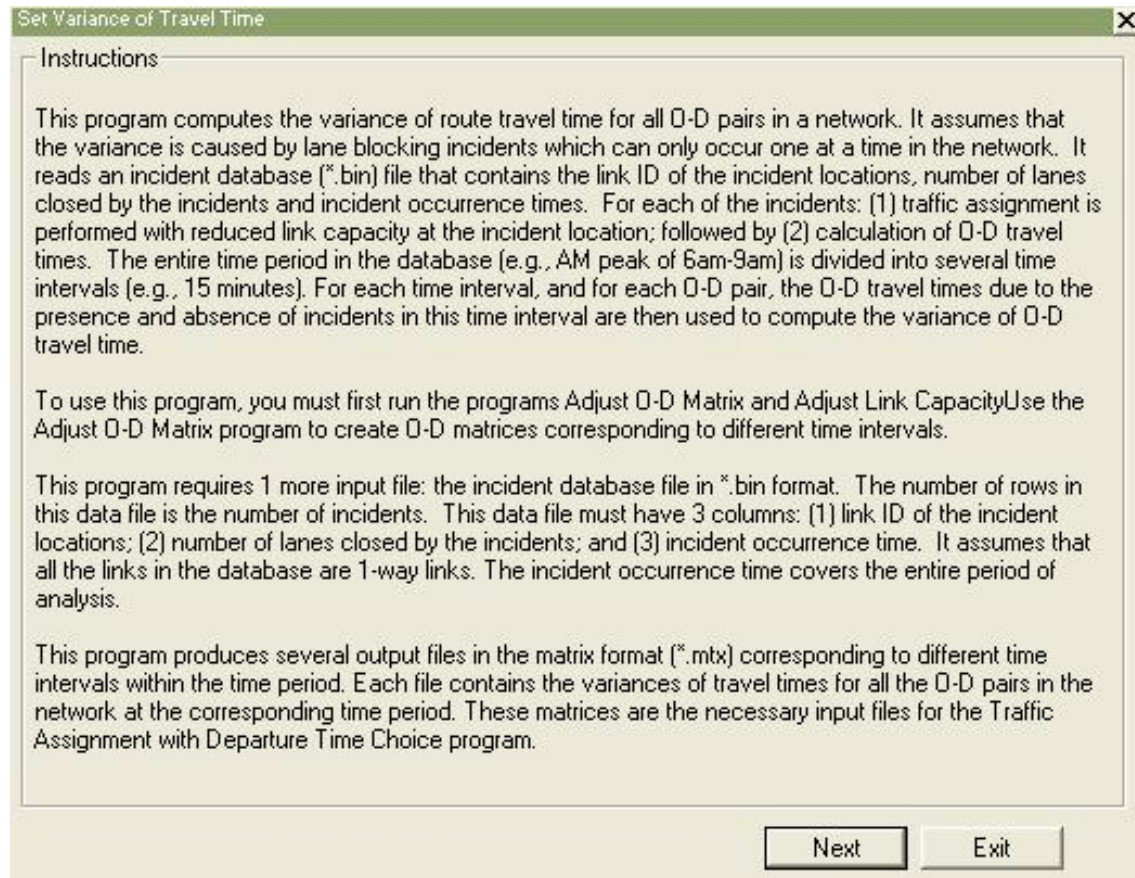


Figure 10: Set Variance Of O-D Travel Time – Instructions.

Click *Next* button to continue to the next dialog box.

The *Path Options* dialog box appears as shown in Fig. 11. Use the browse buttons to select the geographic file and incident database file.

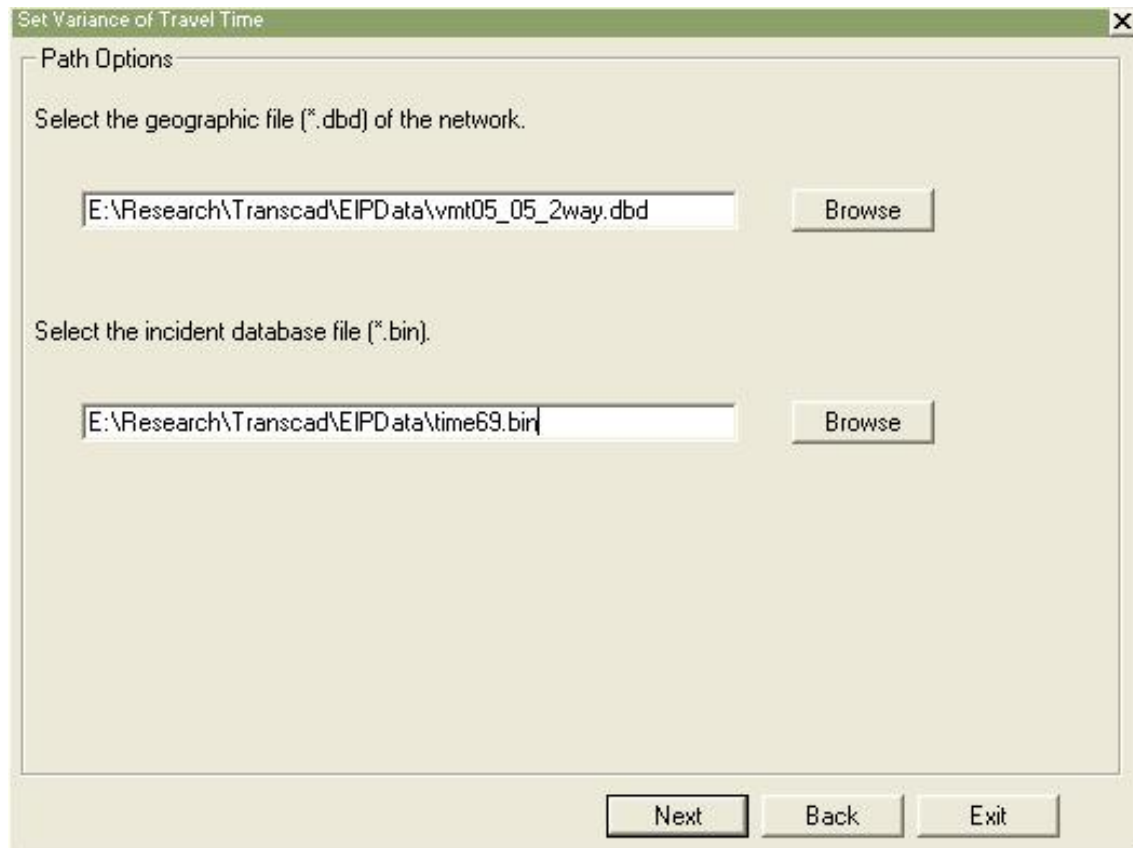


Figure 11: Set Variance Of O-D Travel Time – Path Options.

Click the *Next* button to open both files in TransCAD.

More instructions will be displayed as shown in Fig. 12. It shows that the line layer has been set as the current layer and warns the user not to change the current layer through out the entire program.

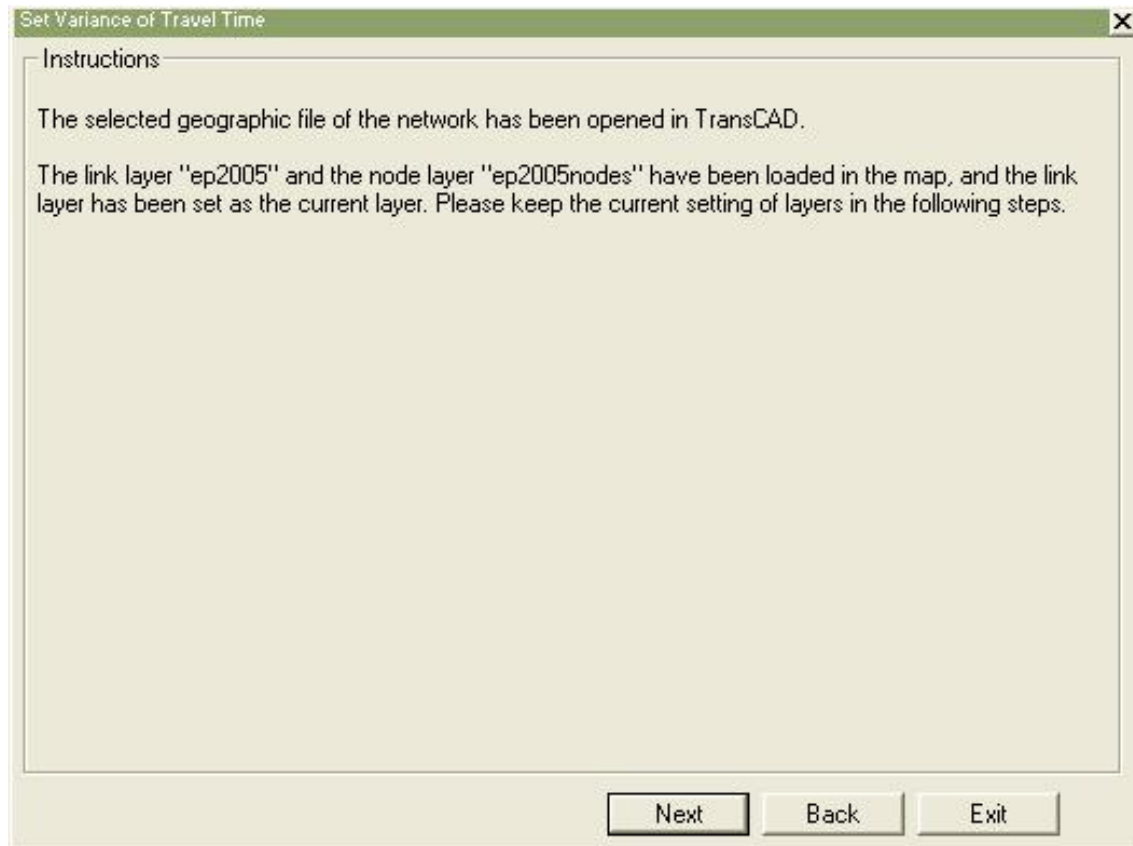


Figure 12: Set Variance Of O-D Travel Time – Selected Geographic File.

Click the *Next* button to proceed to the next dialog box.

Input the Dataview field names (column headings) of Capacity (E.g. AB_CAP/BA_CAP) and Time (E.g. TIME) as shown in Fig. 13. Do not include '[' and ']' in the column names, but keep the space in the column names, if any. If there are more than one columns associated with capacity (for two-way links), use '/' to separate them.

Set Variance of Travel Time

Input Parameters

Input the column names of free flow travel time and capacity as shown in the Dataview table. You may open the DataView to check the column names.

Please do not include '[' or ']' in the column names, but keep the space in the column names, if any. If there are more than one columns associated with capacity (for two-way links), use '/' to separate them.

Examples: Free_flow_travel time
 AB_CAP/BA_CAP

Column name of free flow travel time:

Column name(s) of capacity:

Figure 13: Set Variance Of O-D Travel Time – Input Capacity and Time Fields.

Click the *Next* button to continue to the next dialog box.

The *Path Options* dialog box appears as shown in Fig. 14. In this step, you need to specify the location of the folders to store the input and output files. Browse and select an existing folder, and then enter the name of a new subfolder with which the program will create later for the input and output files.

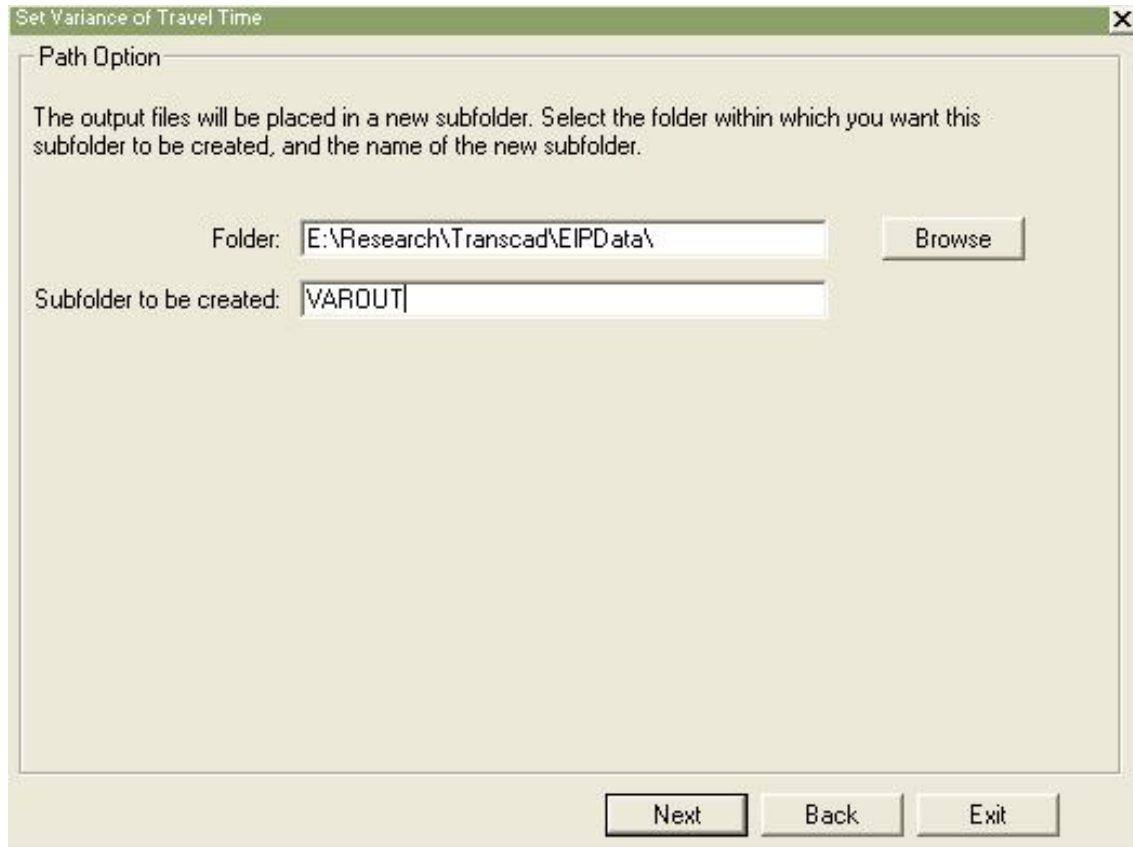
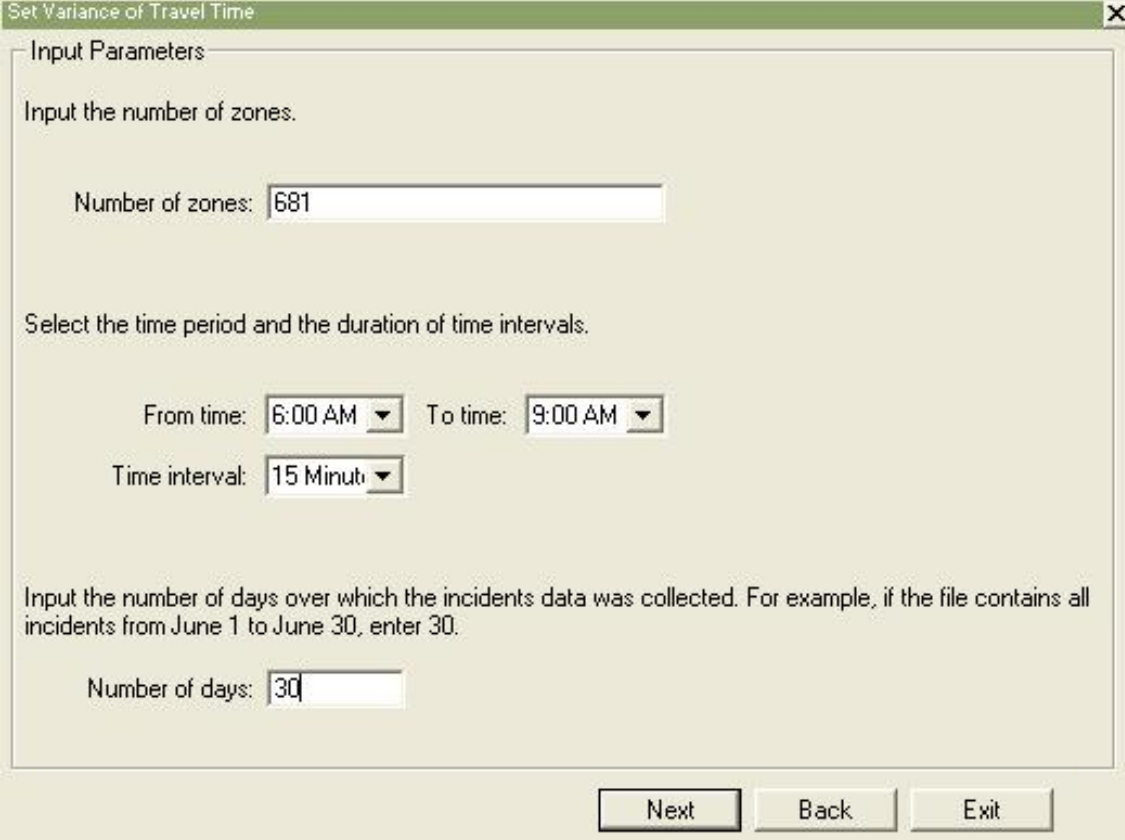


Figure 14: Set Variance Of O-D Travel Time – Matrix Paths.

Click the *Next* button to go to the next dialog box.

This dialog box requires you to provide the properties of the input O-D matrices like number of zones, time period, time intervals and the number of days over which the incident database was collected. The *Input Parameters* dialog box for entering these information is shown in Fig. 15.



The dialog box titled "Set Variance of Travel Time" contains an "Input Parameters" section. It prompts the user to "Input the number of zones," with a text box containing "681". Below this, it asks to "Select the time period and the duration of time intervals." This section includes "From time:" and "To time:" dropdown menus set to "6:00 AM" and "9:00 AM" respectively, and a "Time interval:" dropdown menu set to "15 Minute". Further down, it prompts to "Input the number of days over which the incidents data was collected. For example, if the file contains all incidents from June 1 to June 30, enter 30." with a text box containing "30". At the bottom right are three buttons: "Next", "Back", and "Exit".

Figure 15: Set Variance Of O-D Travel Time – Properties of Input O-D Matrix Files.

After you have entered all the necessary information, click the *Next* button to continue to the next dialog box.

The next dialog box as shown in Fig. 16 displays the instructions on how to copy and name the O-D matrix files. Follow the instructions as shown in the dialog box. You may copy and rename the matrix files in the window environment without exiting the Set Variance of Travel Time program. A folder view of copied input O-D matrices is shown in Fig. 17.

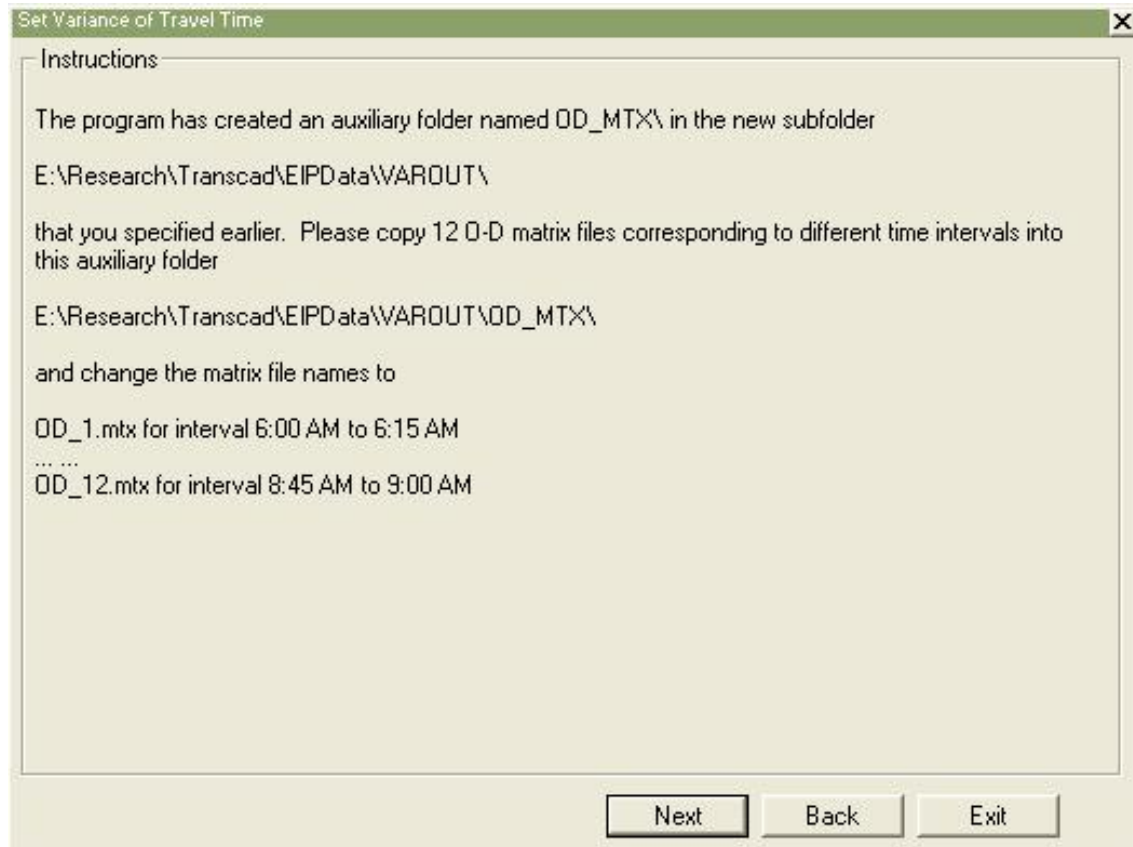


Figure 16: Set Variance Of O-D Travel Time – Copy O-D Matrix Files.

After you have finished copying and renaming the files, click the *Next* button in the dialog box to continue to the next dialog box.

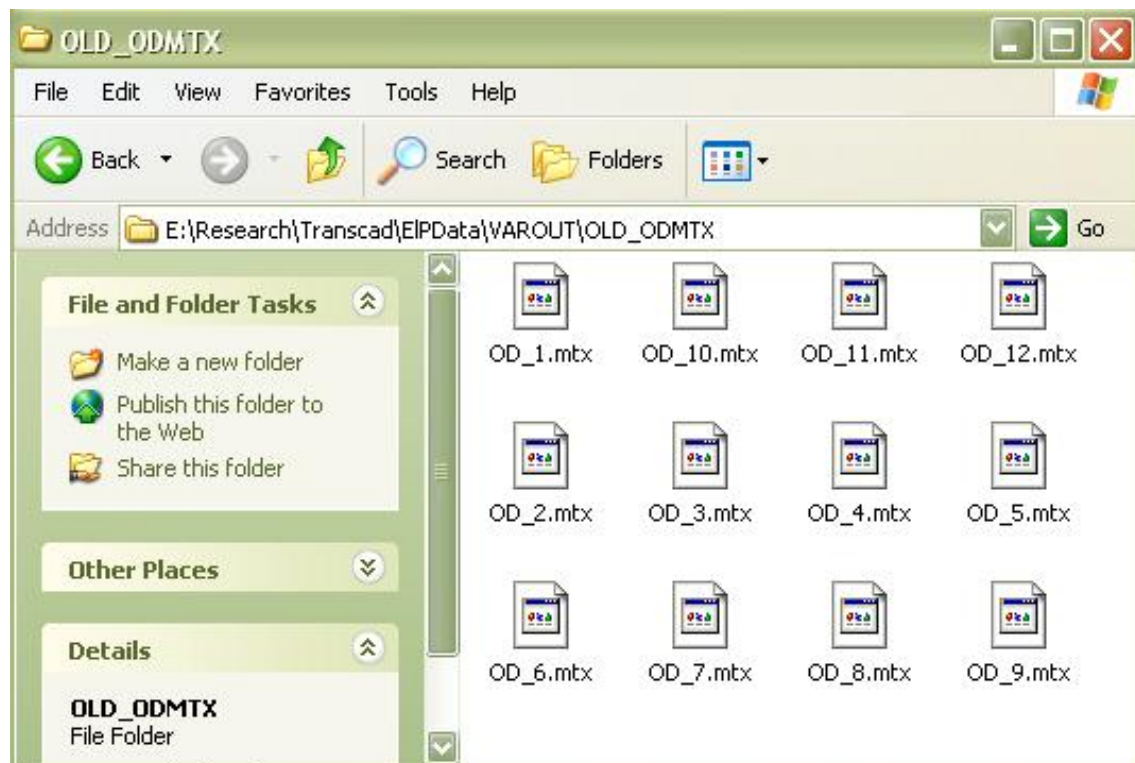


Figure 17: Set Variance Of O-D Travel Time – Folder View of Input O-D Matrices Folder.

The traffic assignment procedure within this program makes use of the ELD function to represent the risk averse route choice behavior of the drivers. Input the a_1 value for the ELD function. It is recommended that you keep the default value as shown in Fig. 18.

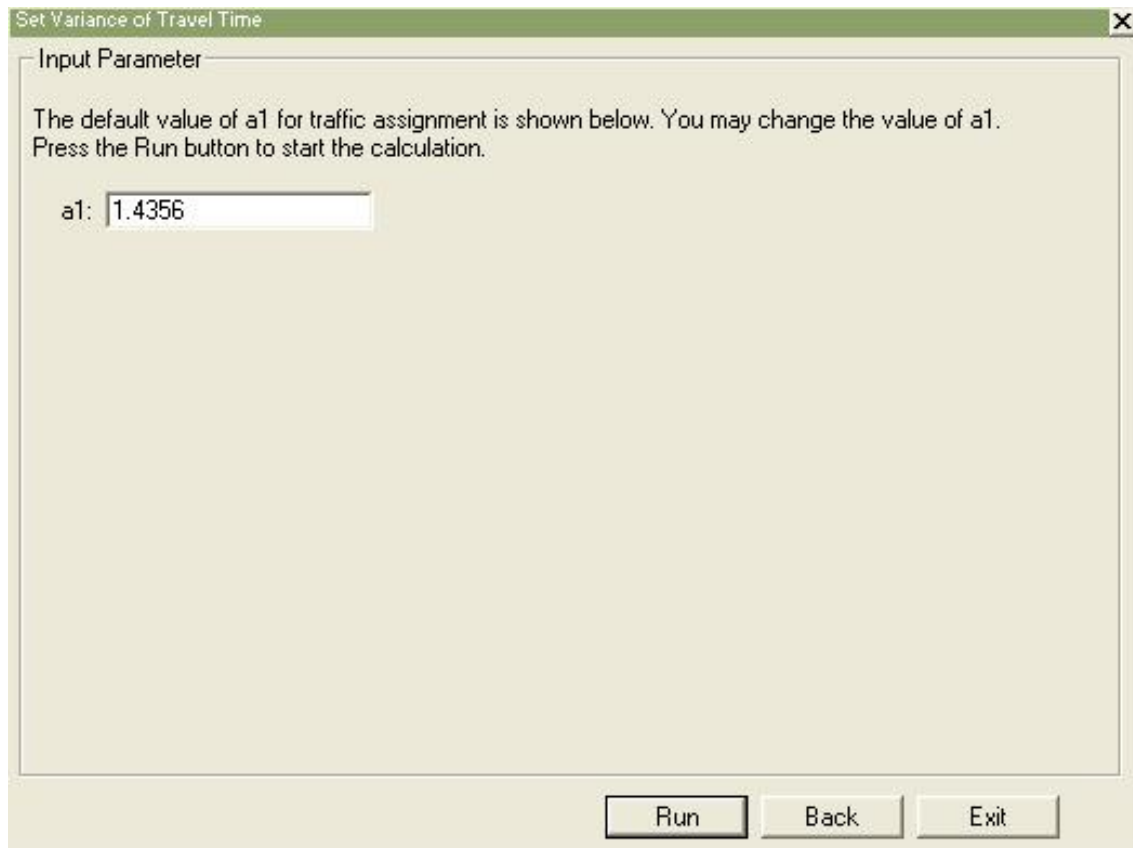


Figure 18: Set Variance Of O-D Travel Time – Default Value of a_1 .

Click the *Run* button to start running the program. Once the program has finished its calculations, a dialog box as shown in Fig. 19 will appear. The accompanying instructions indicate where the output matrices are saved. It is recommended that you check this new folder for the files such as the screen shot shown in Fig. 20. Take note of this folder as the output files will need to be copied to a specific folder when you run the *Traffic Assignment with Deaparture Time Choice* program later.

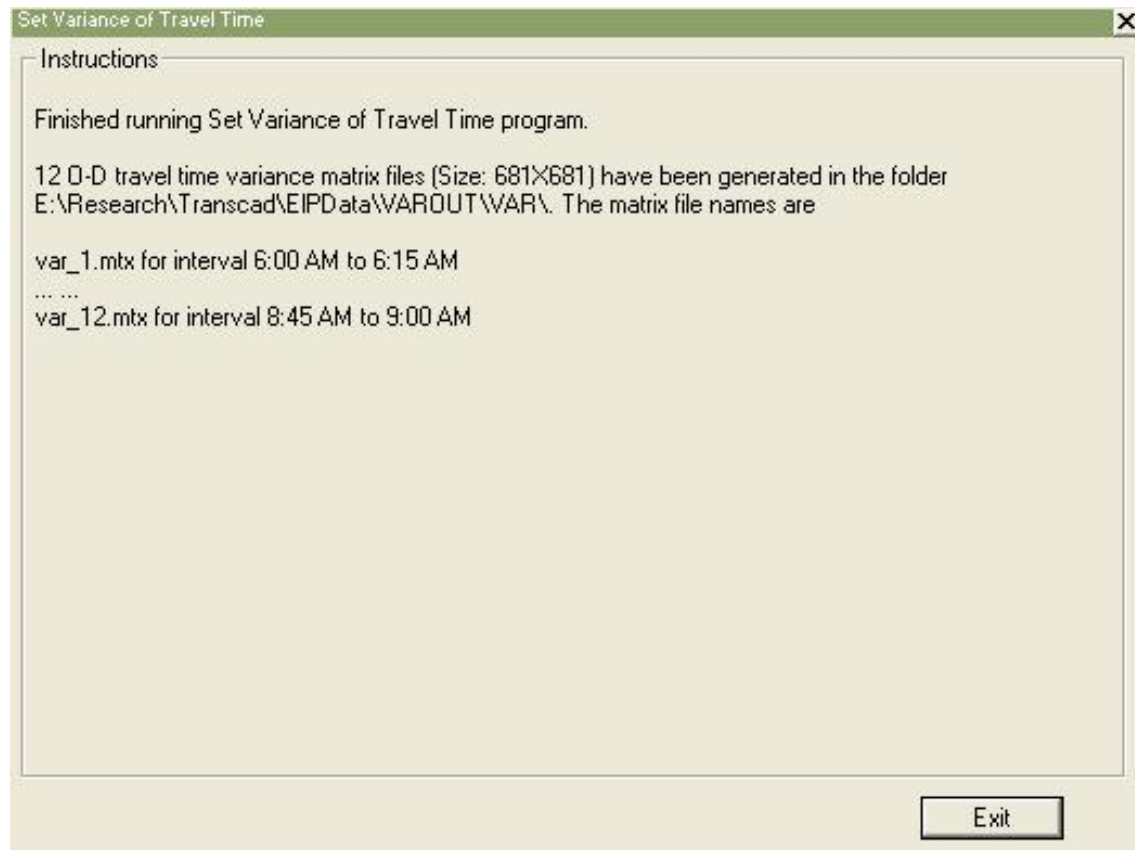


Figure 19: Set Variance Of O-D Travel Time – End of the Variance Program.

Click the *Exit* button to end this program and return to the TransCAD menu.

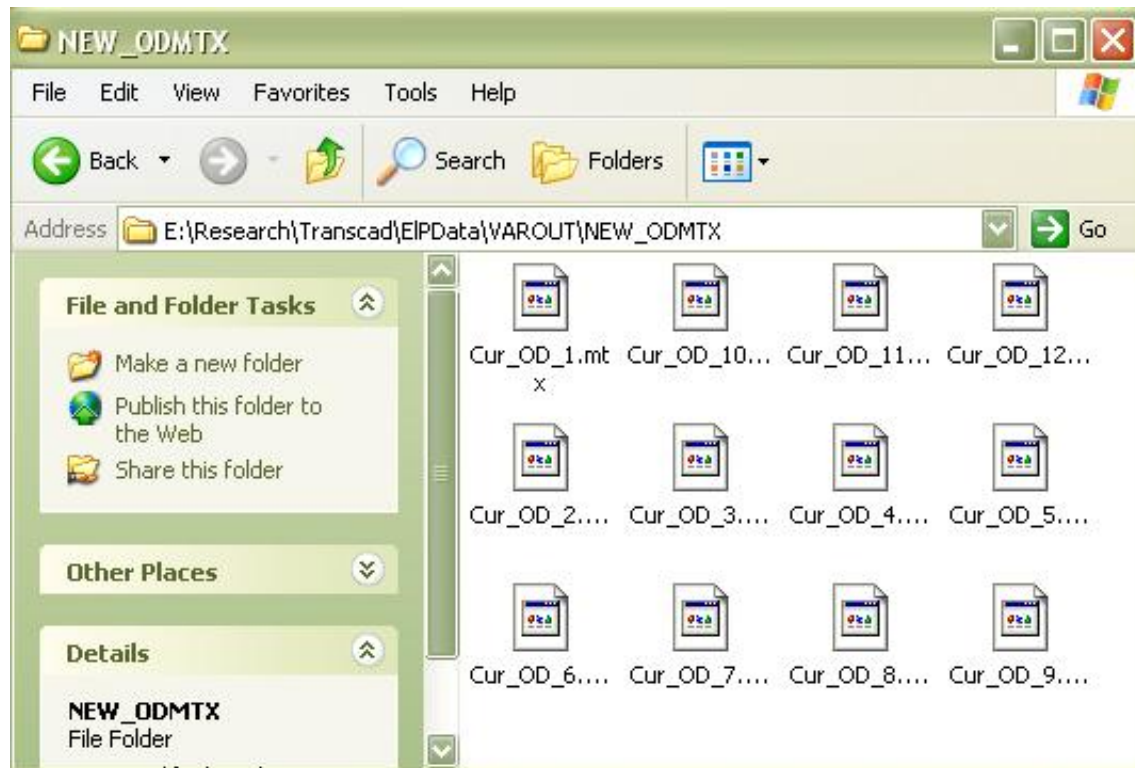


Figure 20: Set Variance Of O-D Travel Time – Folder View of New Output O-D Matrices.

7 Traffic Assignment With Fixed O-D

This program shows the instructions to perform user equilibrium traffic assignment for risk averse drivers using the equivalent link disutility (ELD) function, with a fixed O-D matrix as shown in Fig. 21. Traffic assignment using the BPR function can be performed with the standard TransCAD *Planning* → *Traffic Assignment* menu (see Chapter 9 of Travel Demand Modeling with TransCAD Version 4.8). User equilibrium traffic assignment with the ELD function (for example, with $a_1 = 1.4356$) can be performed by changing the default value of α to $a_1\alpha$. For example, if $\alpha = 0.15$, and $a_1 = 1.4356$; instead of typing $\alpha = 0.15$ in the *Alpha* text box as shown in Fig. 22, enter '0.2153' here.

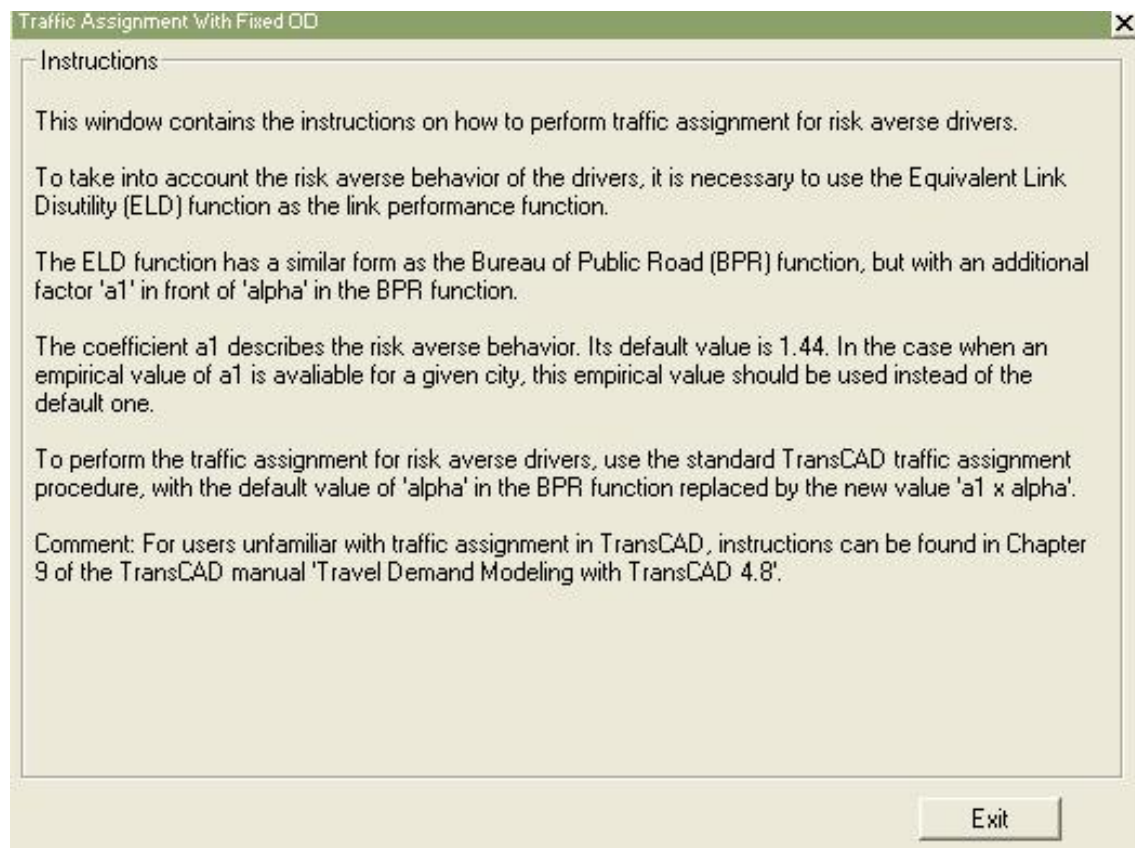


Figure 21: Traffic Assignment with Fixed O-D – Instructions.

Click the *Exit* button to return to the TransCAD menu.

Traffic Assignment ✖

Line Layer	ep2005	OK
Network File	E:\...NSCAD\ELPDATA\ELPNWFILE.NET	Cancel
Method	User Equilibrium	Network
Matrix File	Demand OD 8 9	Options
Matrix	Core One	Settings

Fields

Time	TIME	Alpha	None
Capacity	[AB_CAP/BA_CAP]	Beta	None
		Preload	None

Globals

Iterations	100	Alpha	0.2153
Convergence	0.0000	Beta	4.00
Function		Error	5.0000

Figure 22: Traffic Assignment with Fixed O-D – Traffic Assignment with Modified α Value.

8 Traffic Assignment With Departure Time Choice

This program performs traffic assignment for risk averse drivers using the equivalent link disutility (ELD) function and iteratively adjusts the O-D matrix to account for the change in user's choices of departure time intervals. Essentially this program divides a peak time period (e.g. 6 a.m. to 9 a.m.) into several consecutive time intervals (e.g. 15 minutes). For each time interval, traffic assignment is performed for risk averse route choice behavior. The travel times obtained from the traffic assignment is then used to adjust the drivers' departure times, and hence the O-D matrices. The new O-D matrices are then used to perform traffic assignment in the next iteration. The program will run iteratively until the changes in the O-D matrices are negligible.

This program requires two sets of input files:

1. O-D matrices. The number of O-D matrices must be the same as the number of time intervals in which you want to adjust the departure time choice. These matrices may be obtained from the Adjust O-D Matrix program. The unit in each element of the O-D matrices must be vehicles per hour.
2. Variance O-D travel time matrices. The number of travel time variance matrices must also be the same as the time intervals. These matrices may be obtained from the Set Variance of O-D Travel Time program.

This program produces two sets of output files:

1. New O-D matrices. One new O-D matrix will be generated for each time interval, after the users have adjusted their departure times.
2. ASN_LinkFlow.bin files. This is the output file of traffic assignment generated by TransCAD. One file will be generated for each time interval.

When you run this program, you will be asked to input the name of a new subfolder for the program to save all the input and output files. The above instructions will be displayed in a dialog box as shown in Fig. 23 when this program is activated.

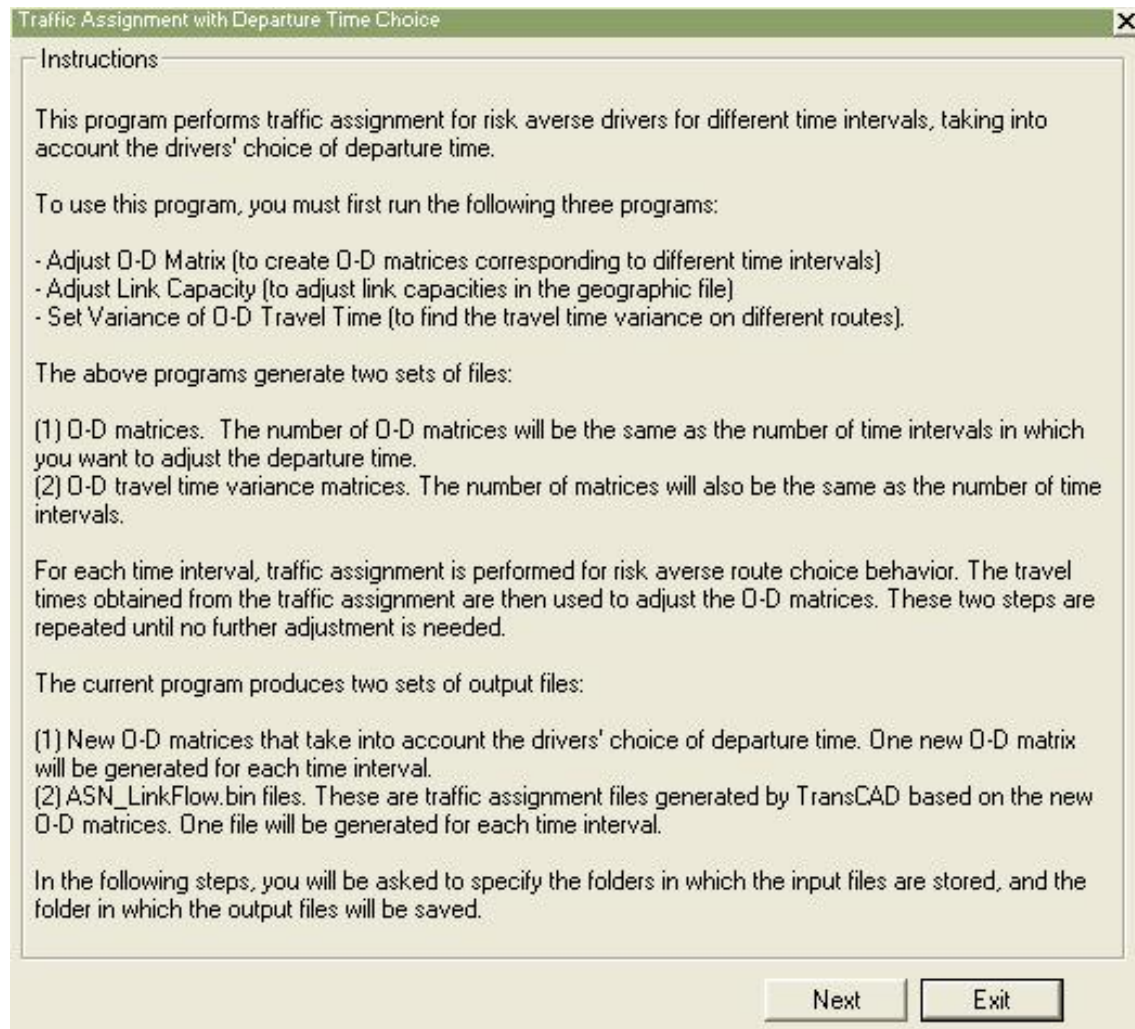


Figure 23: Traffic Assignment with Departure Time Choice – Instructions.

Click the *Next* button to input the data.

Use the *Browse* button to select a geographic file as shown in Fig. 24.

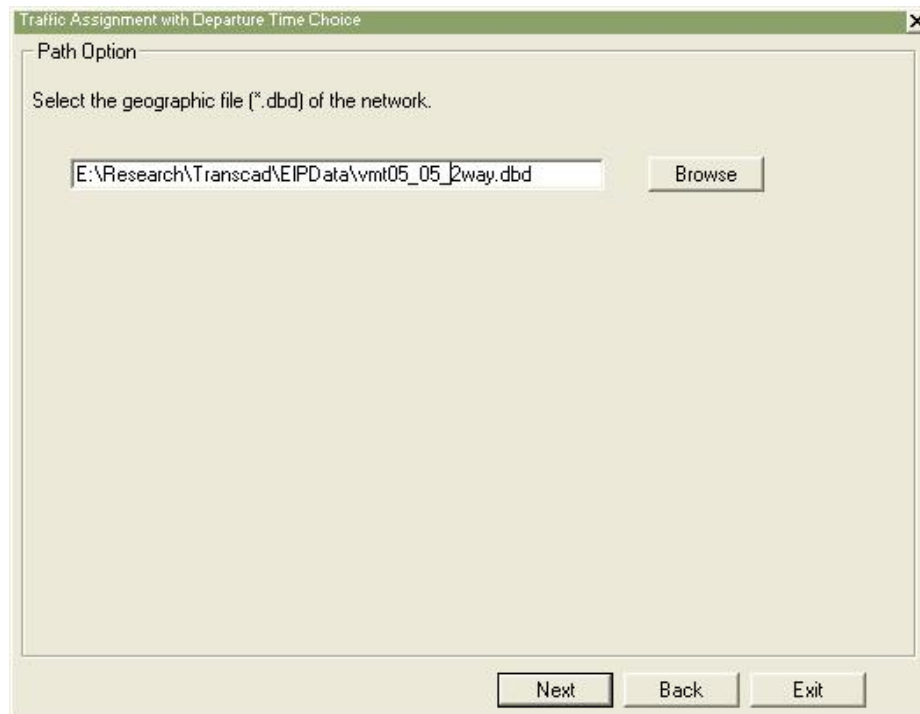


Figure 24: Traffic Assignment with Departure Time Choice – Select Geographic File.

Click the *Next* button to open the geographic file.

The program will automatically select the link layer as the current layer as shown in Fig. 25.

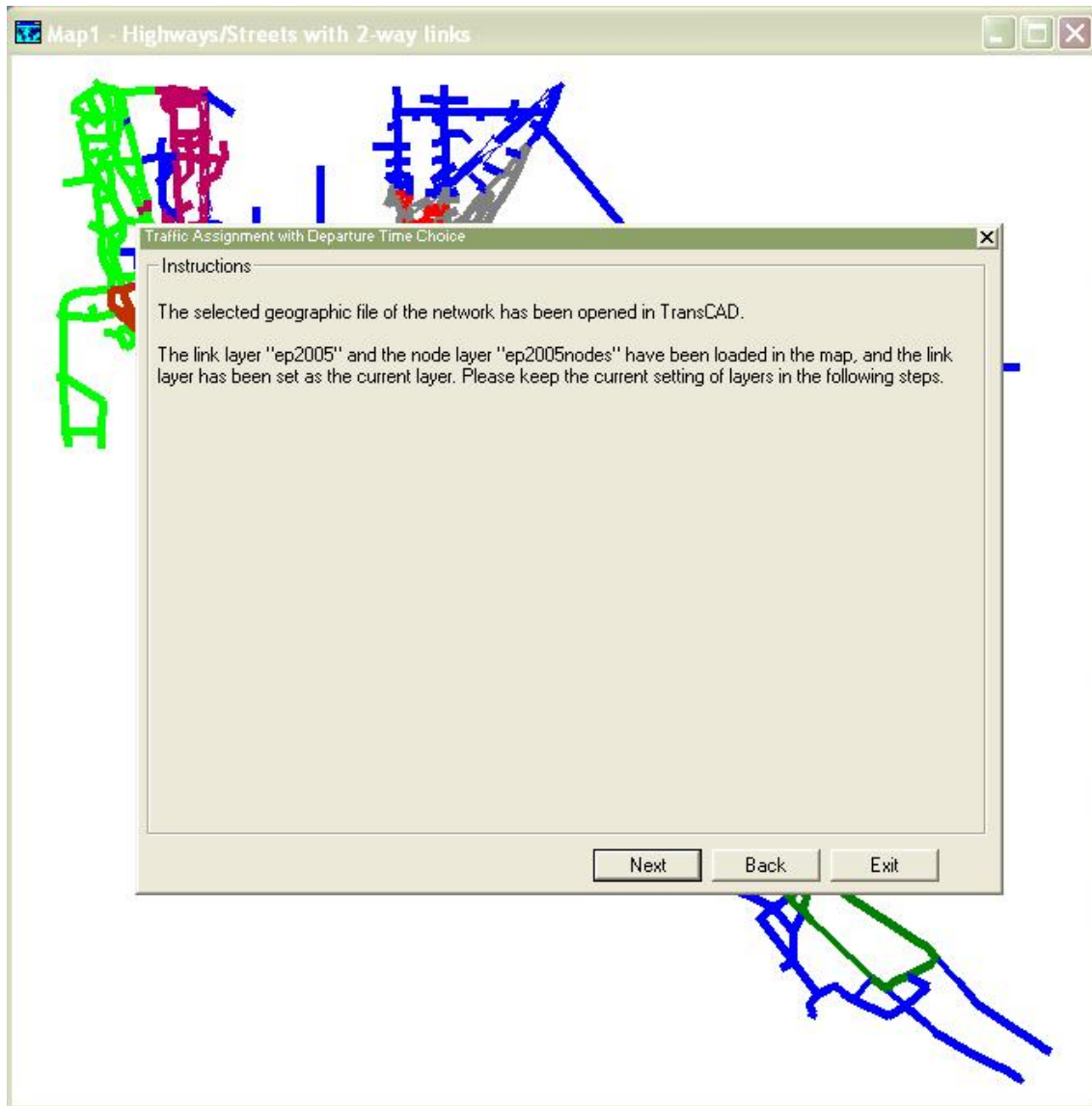


Figure 25: Traffic Assignment with Departure Time Choice – Selected Geographic File.

Click the *Next* button to specify the necessary link attributes in the Dataview table for traffic assignment.

Type the column names of free flow travel time and capacity in the Dataview table of the network as shown in Fig. 26. You may open the Dataview table in TransCAD to locate the correct columns and their names.

Traffic Assignment with Departure Time Choice

Input Parameters

Input the column names of free flow travel time and capacity as shown in the Dataview table. You may open the DataView to check the column names.

Please do not include "[" or "]" in the column names, but keep the space in the column names, if any. If there are more than one columns associated with capacity (for two-way links), use "/" to separate them.

Examples: Free_flow_travel time
 AB_CAP/BA_CAP

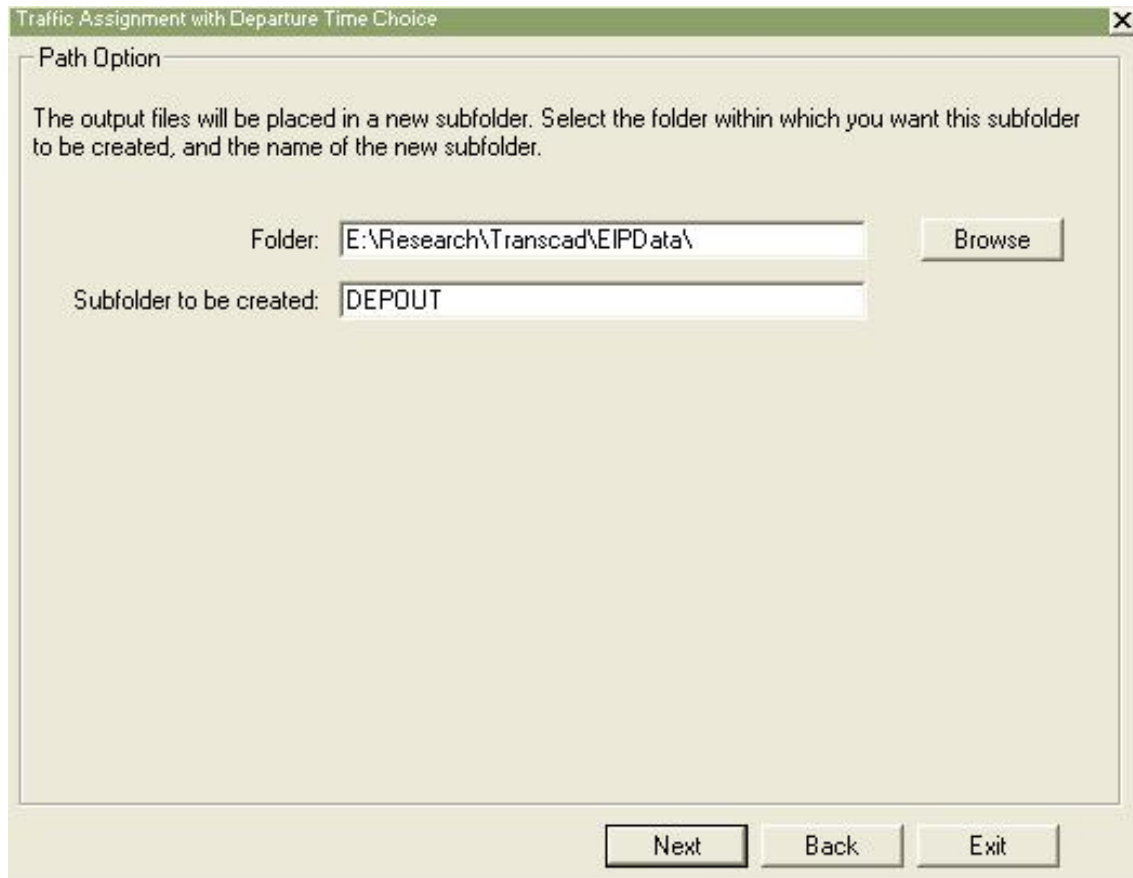
Column name of free flow travel time:

Column name(s) of capacity:

Figure 26: Traffic Assignment with Departure Time Choice – Input Column Names.

Click the *Next* button to create a new subfolder for the input matrices.

This program will create output files and save them in a new subfolder so that you can use them later for analysis. Therefore you must tell this program the location and name of this subfolder using the dialog box as shown in Fig. 27. Use the *Browse* button to select an existing folder. It is recommended that you select the same folder as the geographic file. Next, type the name of the new subfolder to be created.

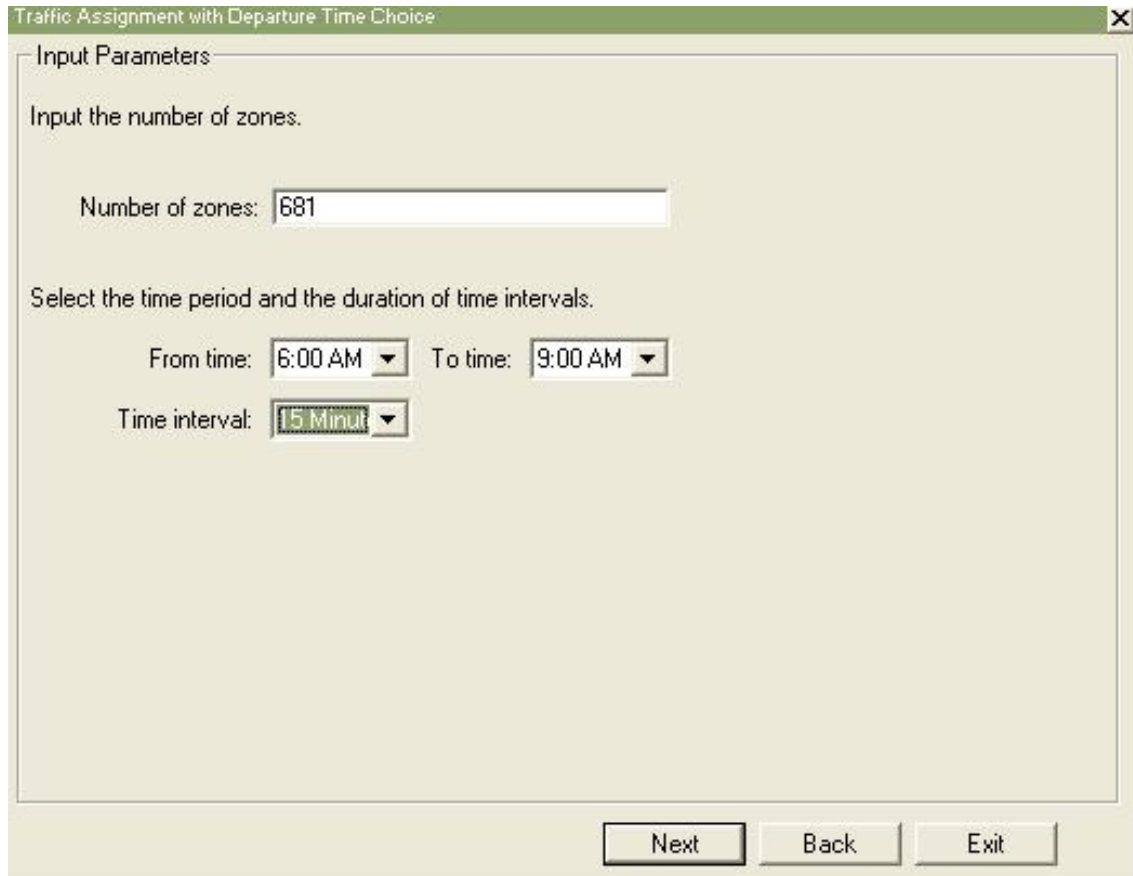


The screenshot shows a dialog box titled "Traffic Assignment with Departure Time Choice" with a close button (X) in the top right corner. The dialog has a tab labeled "Path Option". Inside the tab, there is a text box containing the instruction: "The output files will be placed in a new subfolder. Select the folder within which you want this subfolder to be created, and the name of the new subfolder." Below this text, there are two input fields. The first is labeled "Folder:" and contains the text "E:\Research\Transcad\EIPData\". To the right of this field is a "Browse" button. The second input field is labeled "Subfolder to be created:" and contains the text "DEPOUT". At the bottom of the dialog, there are three buttons: "Next", "Back", and "Exit". The "Next" button is highlighted with a black border.

Figure 27: Traffic Assignment with Departure Time Choice – Create Sub-Folder.

Click the *Next* button to create the new subfolder under this existing folder.

The succeeding dialog box (Fig. 28) is for you to provide the properties of the input O-D matrices. Fill the required fields as shown in Fig. 28. In the example shown, the user wants to input 15 minute O-D matrices to the program in the time period from 6:00 a.m. to 9:00 a.m. So a total of twelve 15-minute O-D matrices has to be provided to this program in the period '6:00 a.m. to 9:00 a.m.'.



Traffic Assignment with Departure Time Choice

Input Parameters

Input the number of zones.

Number of zones: 681

Select the time period and the duration of time intervals.

From time: 6:00 AM To time: 9:00 AM

Time interval: 15 Minut

Next Back Exit

Figure 28: Traffic Assignment with Departure Time Choice – Properties of O-D Matrices.

Click the *Next* button to see further instructions.

The program has now created the new subfolder you specified in Fig. 27. Under this subfolder, the program has further created two auxiliary folders named OLD_ODMTX and COST. Copy all the input O-D matrices into the OLD_ODMTX auxiliary folder and rename them to OD_1.mtx, OD_2.mtx ... etc. Copy the variance of O-D travel time matrices into the COST auxiliary folder and rename them to var_1.mtx, var_2.mtx ... etc. Remember that these folders were created within the new subfolder from the previous step.

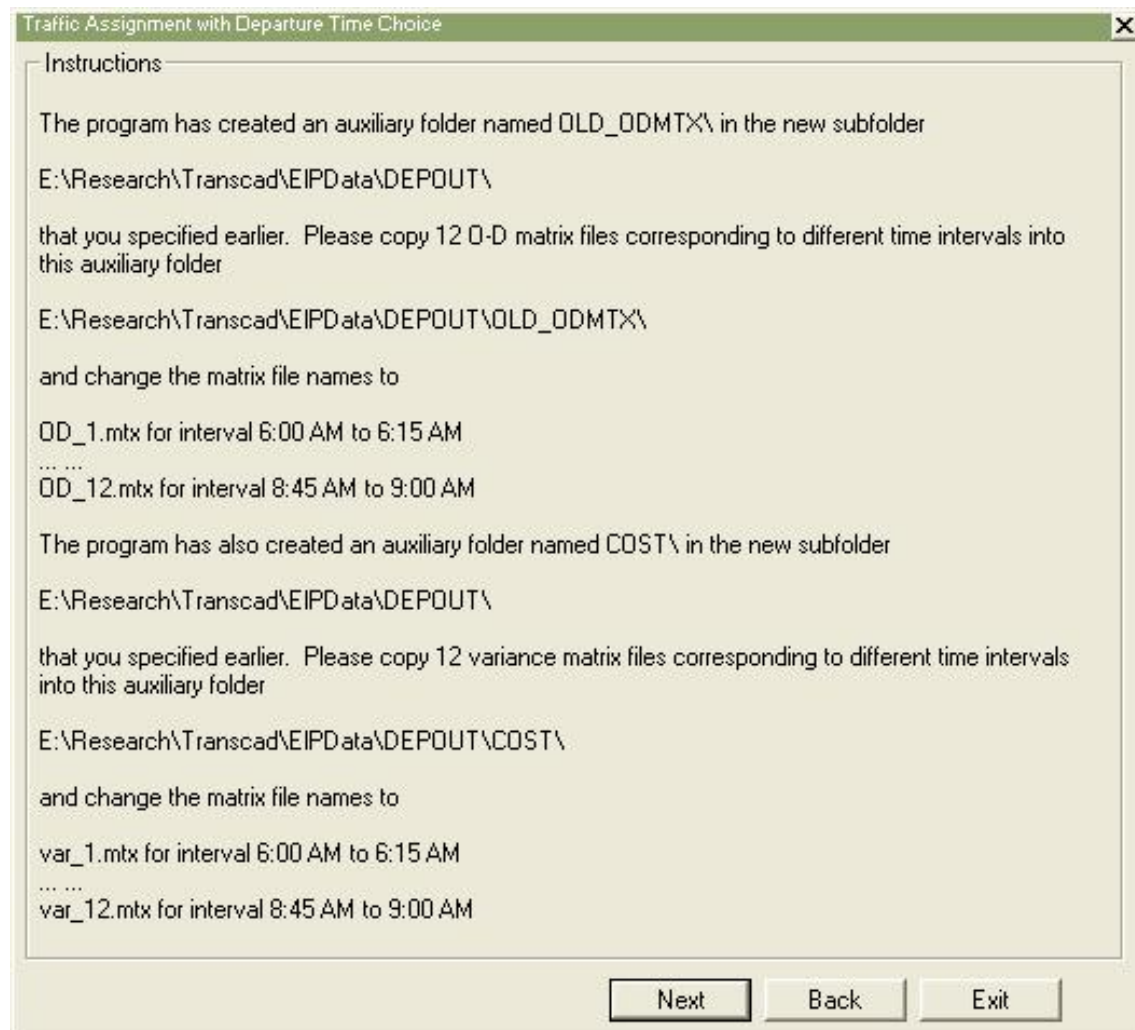


Figure 29: Traffic Assignment with Departure Time Choice – Copy Matrices.

After you have finished copying and renaming the files, click the *Next* button to continue to the next dialog box.

These folders may now look like the screenshots in Fig. 30 and Fig. 31. The O-D matrix files and the variance of O-D travel time files should be renamed as per the instructions in the dialog box.

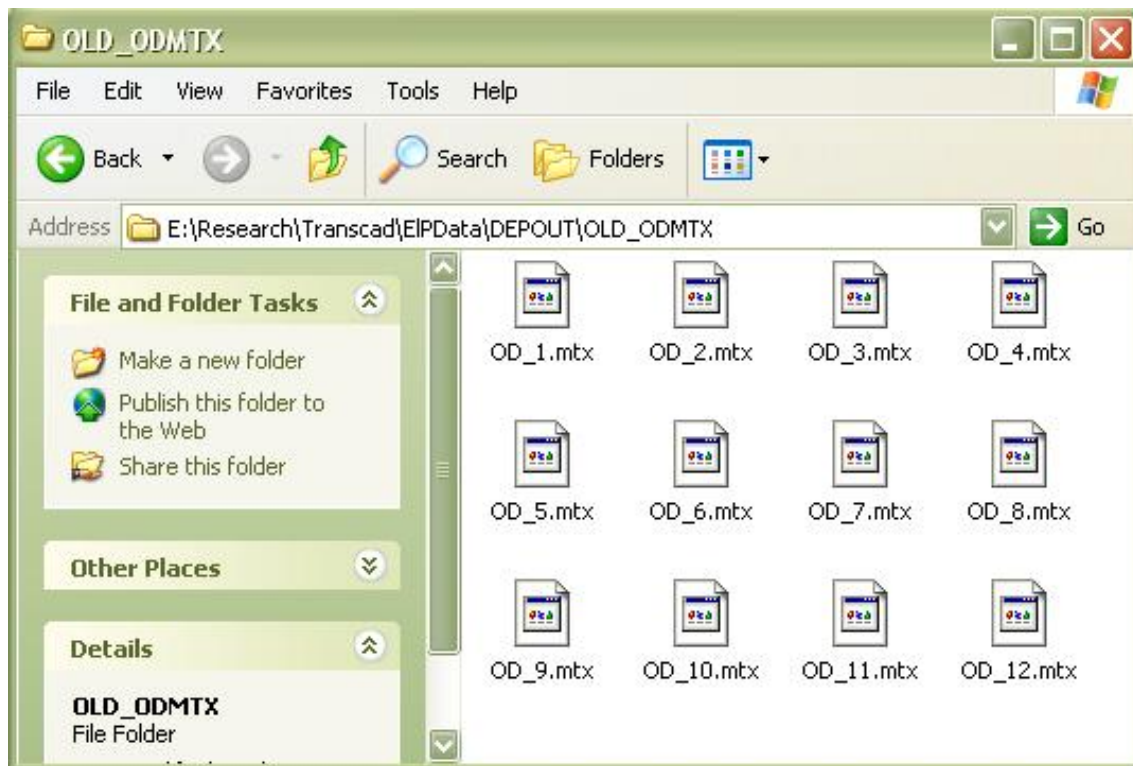


Figure 30: Traffic Assignment with Departure Time Choice – Old O-D Matrices Folder.

Click the *Next* button in the dialog box to proceed to input the work-start time of the zones.

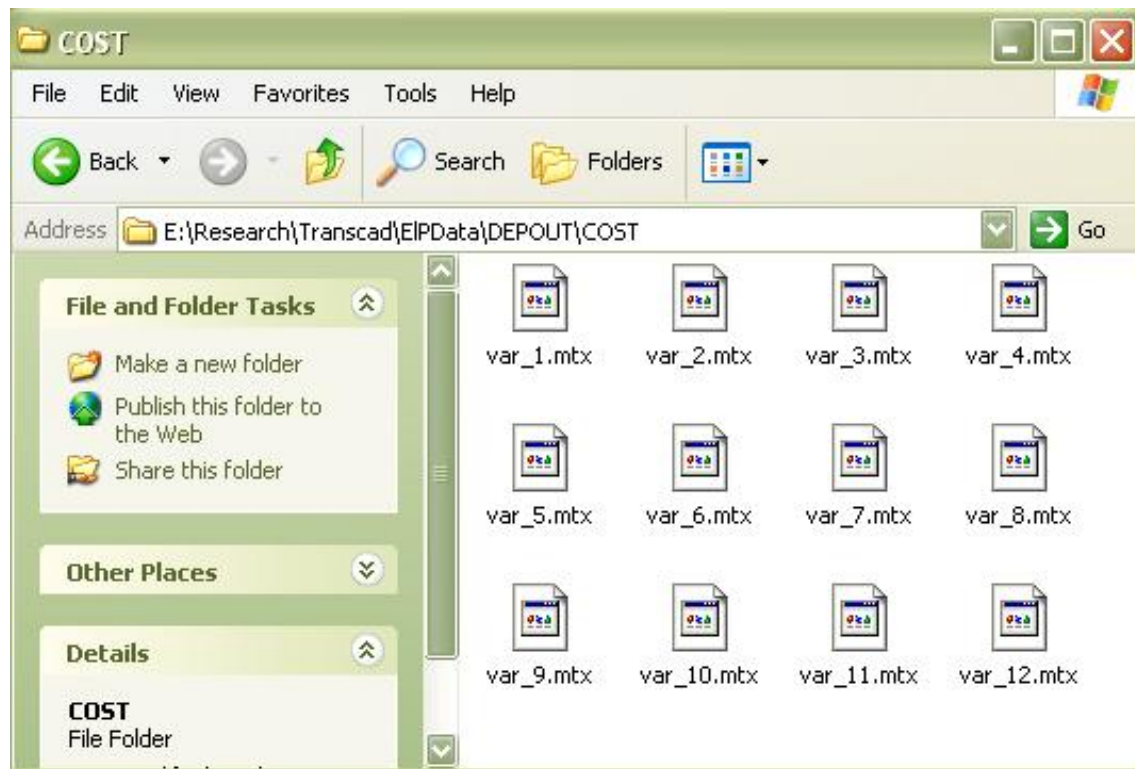


Figure 31: Traffic Assignment with Departure Time Choice – COST Folder.

The dialog box to input work-start time is as shown in Fig. 32. Input the default average work-start time for the zones. Also, enter the number of zones which have different average work-start times.

Traffic Assignment with Departure Time Choice

Input Parameters

Input the work-start time(s).

For different zones, we can have different work-start times. For example, 8:00 AM work-start time means that on average, drivers coming to this zone have to start work at 8:00 AM.

Default work-start time: Hour : Minute AM/PM

Some zone(s) may have different work-start time(s).

Number of zones using other work-start time(s):

Next Back Exit

Figure 32: Traffic Assignment with Departure Time Choice – Default Work-Start Time.

Click the *Next* button to input the work-start time of zones not following the default work-start time.

A list box will appear in the dialog box as shown in Fig. 33. The list box has the same number of entries as the number of zones you entered in the previous dialog box which have different work-start times. Double click each entry in the list box to bring out a dialog box named *Enter Work-Start Time for Special Zones*. Enter the ID of the zone and the special work-start time of the zone, then click the *OK* button. Repeat this step for all the zones in the list box.

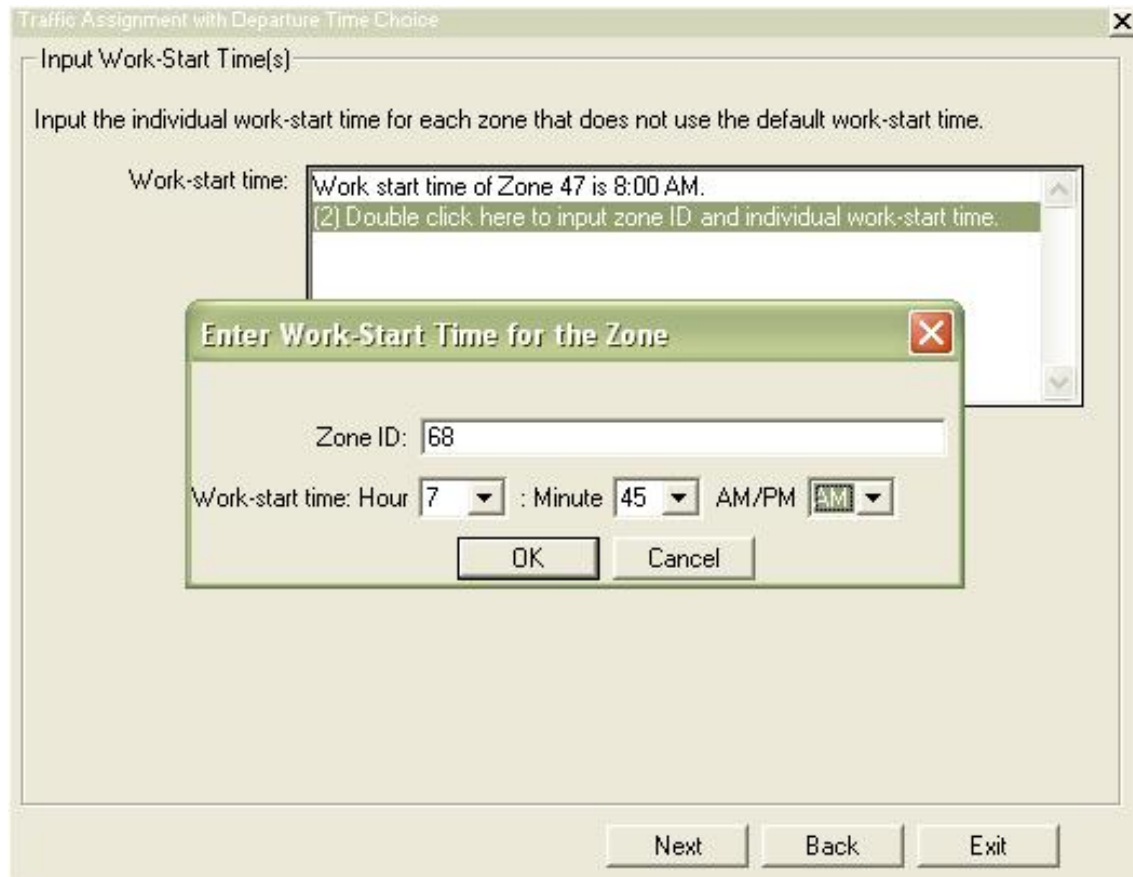


Figure 33: Traffic Assignment with Departure Time Choice – Special Work-Start Times.

The work-start times you have entered will overwrite the default work-start times. Click the *Next* button to specify the value of risk averse coefficient.

The default value of a_1 is 1.4356 is shown in Fig. 34. You may change the a_1 value if necessary. To use the BPR function, set $a_1 = 1.0$.

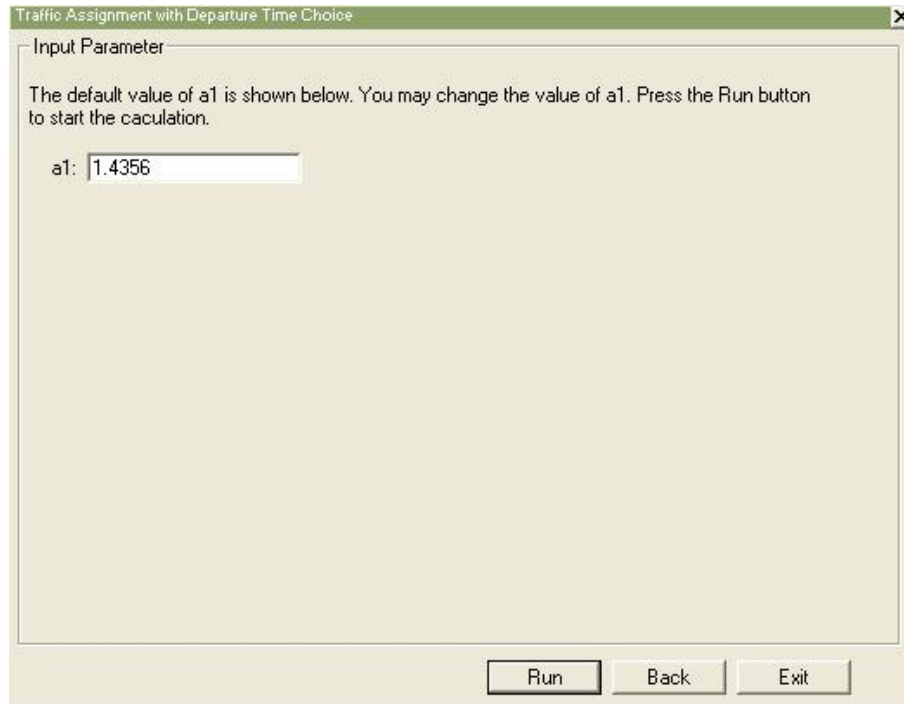


Figure 34: Traffic Assignment with Departure Time Choice – a_1 Value.

The program now has all the necessary input data. Click the *Run* button to start the iterative calculation. The program will run from a few minutes to a few hours, depending on the network size, convergence parameters in the Frank-Worfe algorithm, and the rate of convergence of the output O-D matrices. The program has internally set the default value of 100 iterations and convergence criteria of 0.00001 in the Frank-Worfe algorithm, according to TxDOT practice.

The dialog box in Fig. 35 will be displayed when the program has finished its calculations.

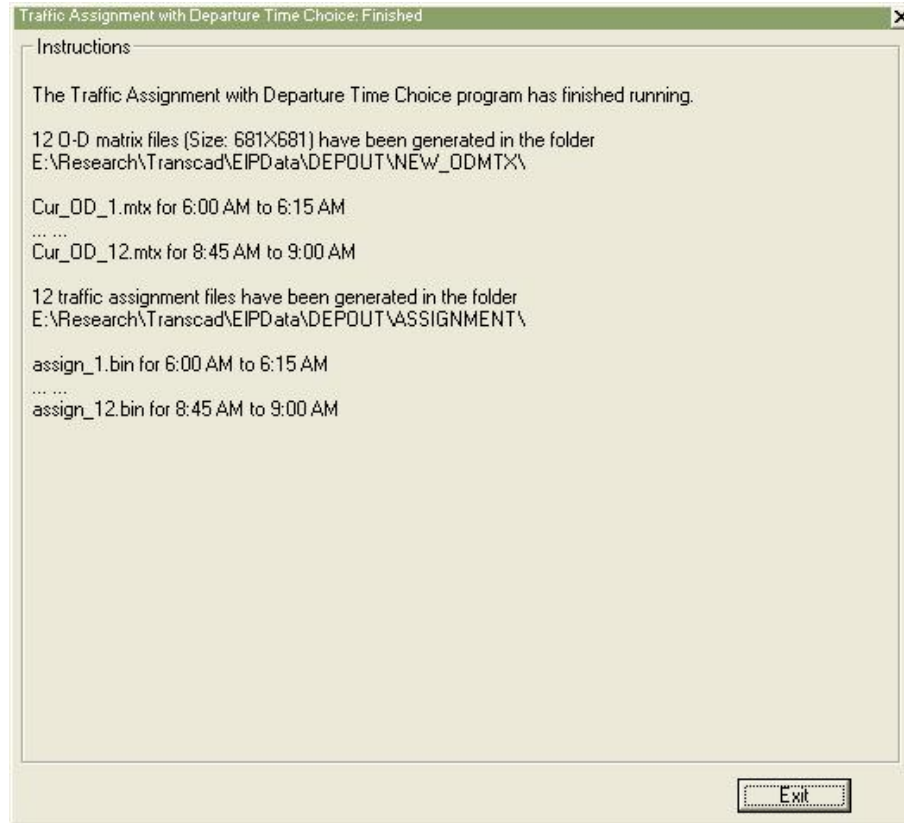


Figure 35: Traffic Assignment with Departure Time Choice – End of Program.

The program has created two more auxiliary folders: (1) NEW_ODMTX and (2) ASSIGNMENT. At the end of the calculations, the program has generated a set of new O-D matrices with names Cur_OD1.mtx, Cur_OD2.mtx ...etc . The number of new O-D matrices is equal to the number of time intervals. These new O-D matrices are saved in the new NEW_ODMTX auxiliary folder.

In addition, this program has created a set of traffic assignment files with name assign_1.bin, assign_2.bin ...etc. The number of these files is the same as the number of time intervals. These traffic assignment files are saved in the new ASSIGNMENT auxiliary folder.

Take note of the locations (full paths) of these two auxiliary folders as you will need them in the *Plot VMT & VHT* and *Plot Hotspots* programs.

Click the *Exit* button to end the program and return to the TransCAD menu.

9 Plot VHT & VMT

This program plots the total vehicle-miles traveled (VMT) and total vehicle-hours traveled (VHT) over the time intervals, from the output files of the *Traffic Assignment with Departure Time Choice* program.

This Plot VHT & Plot VMT program should only be used after you have ran the *Traffic Assignment with Departure Time Choice* program. This program requires all the output files of the *Traffic Assignment with Departure Time Choice* program. The time intervals in the plots are the same as the departure time intervals used in the *Traffic Assignment with Departure Time Choice* program.

This program plots the following curves:

1. Total VMT in the network over time intervals
2. Total VHT in the network over time intervals.

This program produces two curves in two different dialog boxes and a text file that has the values of the data points used to plot the curves.

The first dialog box of this program is as shown in Fig. 36.

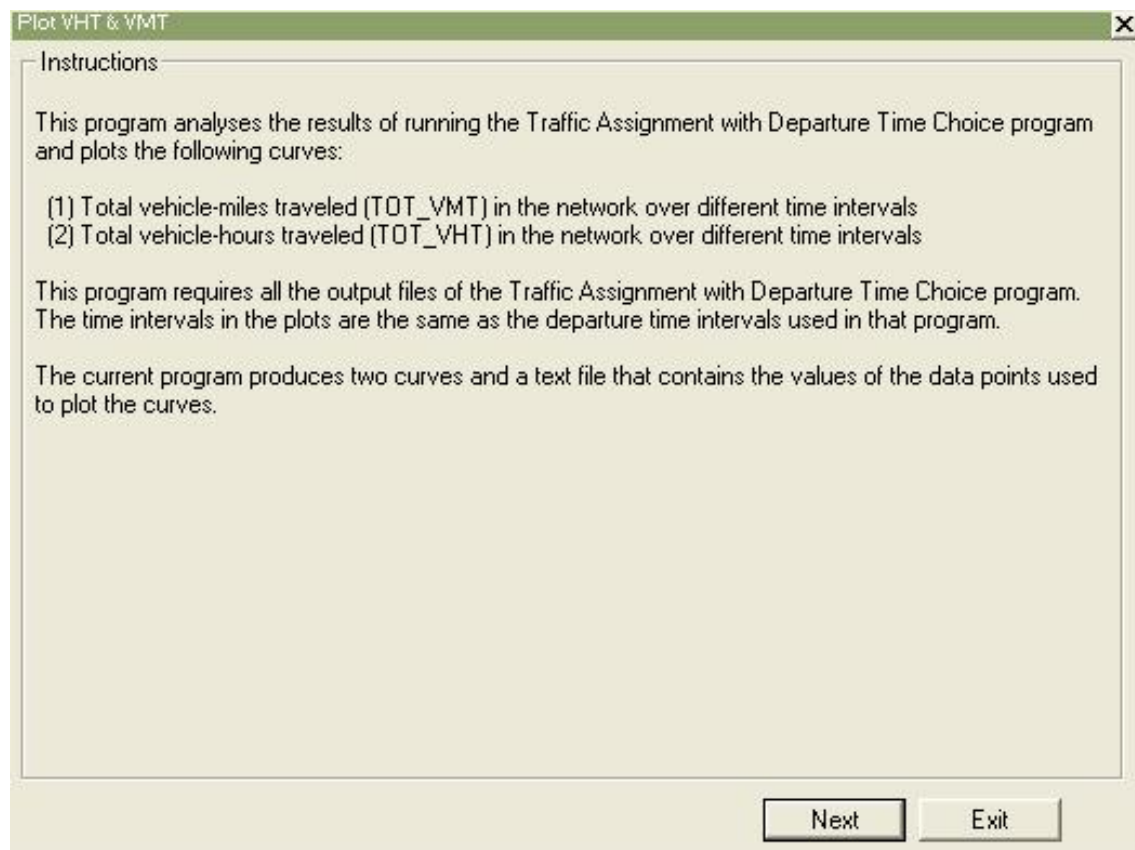


Figure 36: Plot VMT & VHT – Instructions.

Click the *Next* button to bring out the *Path Options* dialog box as shown in Fig. 37. Browse for the folder which has the output files that were created from *Traffic Assignment with Departure Time Choice* program.

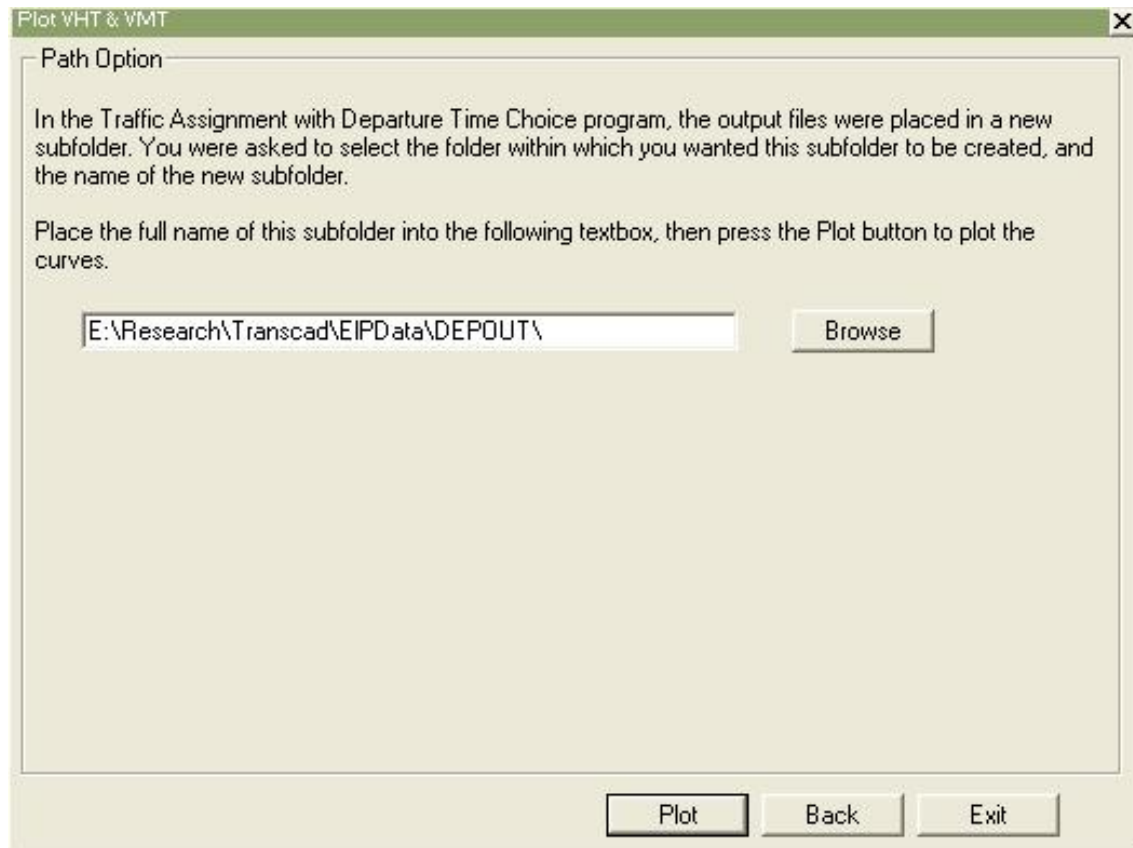


Figure 37: Plot VMT & VHT – Select Project Folder.

Click the *Plot* button to begin plotting the curves. The final plots may look like the one as shown in Fig. 38.

The two charts are behind the *Instructions* dialog box as shown in Fig. 38. Move the dialog box to see the charts. The two charts should look like Fig. 39 and Fig. 40. Chart 1 plots the total VMT in the network over the departure time choice intervals. The total VMT is in vehicle-mile per hour. This is because, in traffic assignment, the unit of O-D matrix and the unit of link capacity are in vehicles per hour. Chart 2 plots the total VHT in the network over the departure time choice intervals. The total VHT is in vehicle-hour per hour. This is also because, in traffic assignment, the unit of O-D matrix and the unit of link capacity are in vehicles per hour.

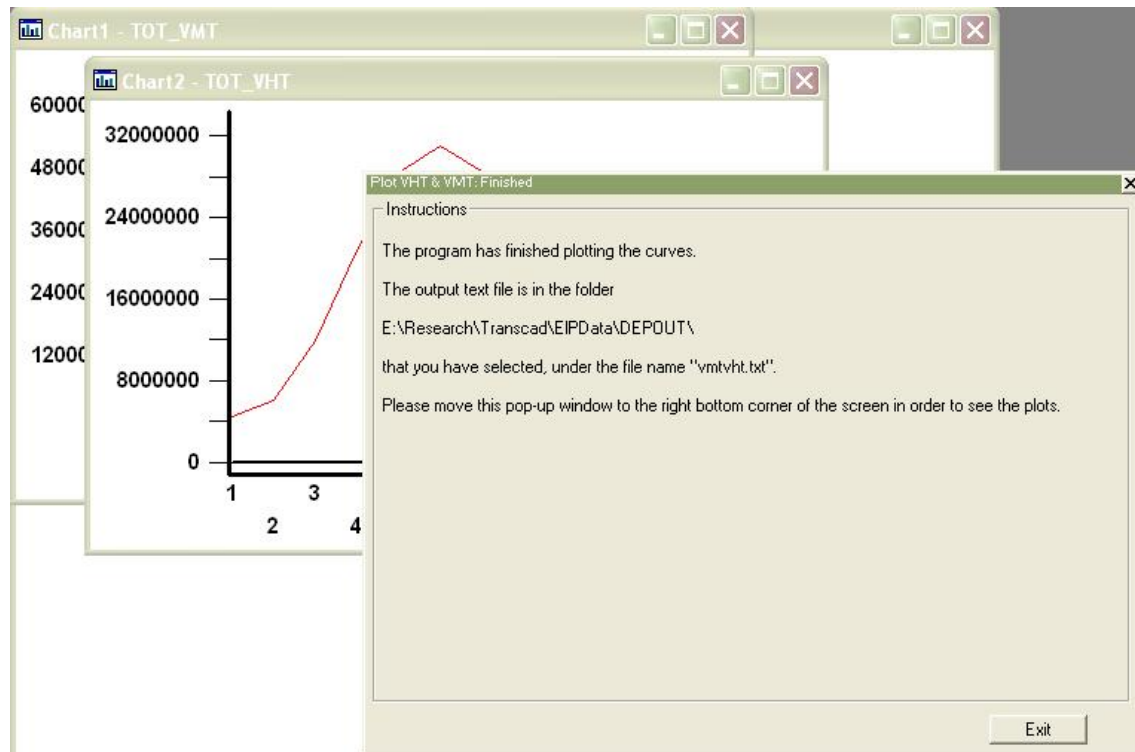


Figure 38: Plot VMT & VHT - End of Program.

Click the *Exit* button to end this program and return to the TransCAD menu.

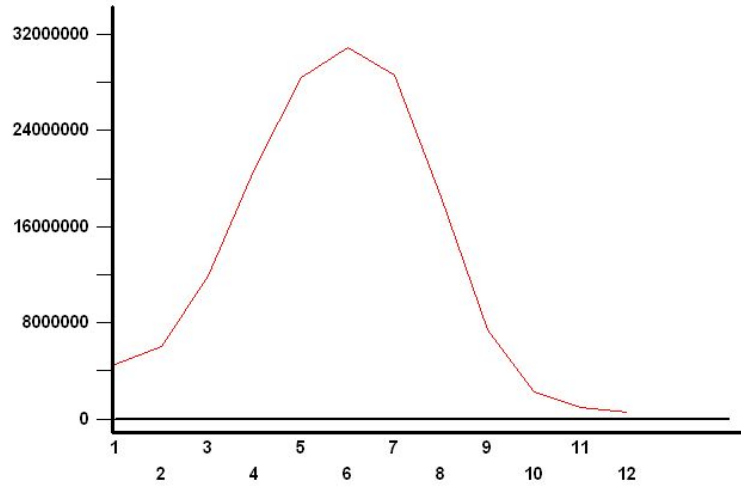


Figure 39: Plot VMT & VHT - VHT Chart.

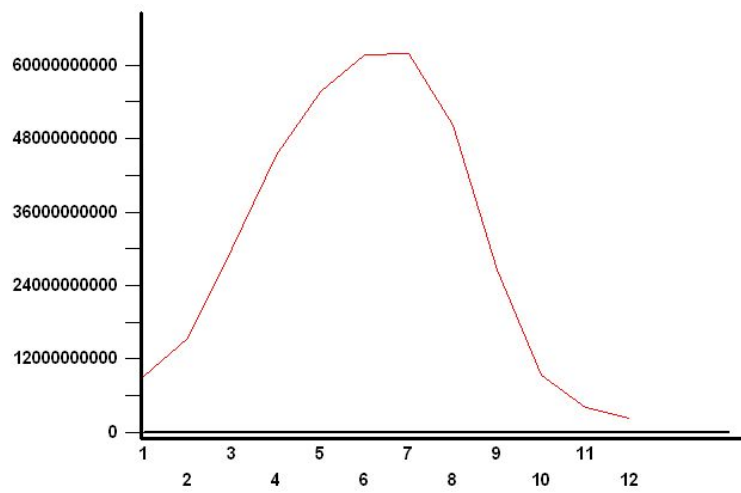
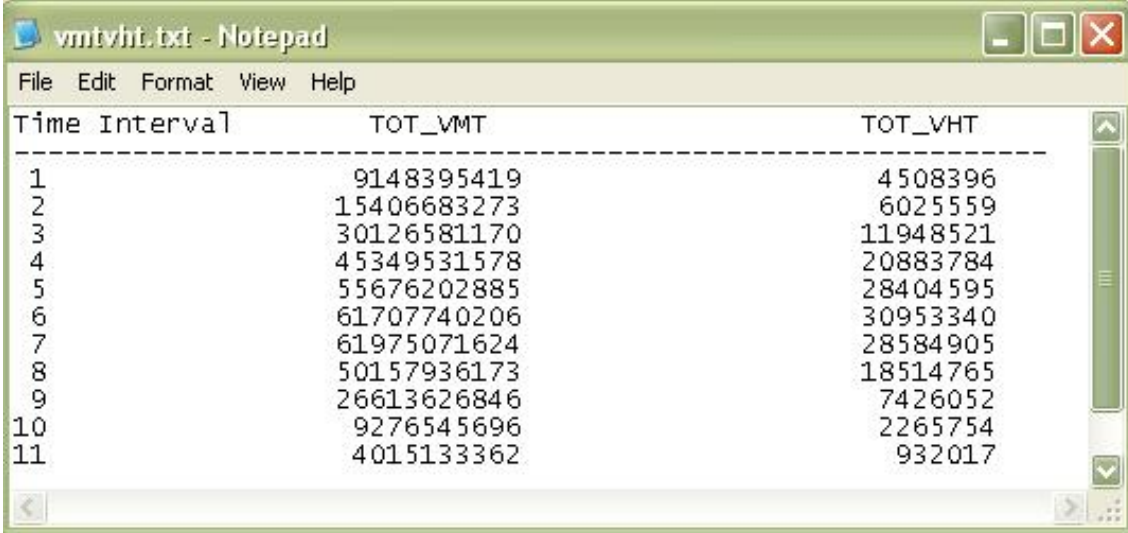


Figure 40: Plot VMT & VHT - VMT Chart.

In addition, a text file that stores the data points used to plot the charts has been created, and saved in the folder you selected in Fig. 37. The format of the text file is shown in Fig. 41. You may open the text file using a standard text editor.



Time Interval	TOT_VMT	TOT_VHT
1	9148395419	4508396
2	15406683273	6025559
3	30126581170	11948521
4	45349531578	20883784
5	55676202885	28404595
6	61707740206	30953340
7	61975071624	28584905
8	50157936173	18514765
9	26613626846	7426052
10	9276545696	2265754
11	4015133362	932017

Figure 41: Plot VMT & VHT - Output Text File.

10 Plot Hotspots

This program plots the Volume-Capacity (V-C) ratio versus time interval for a selected link in a network. Here, Hotspots refer to important links in a network where congestion is likely to occur. This program should only be used after you have run the *Traffic Assignment with Departure Time Choice* program. This program requires all the output files of the *Traffic Assignment with Departure Time Choice* program. The time intervals in the plot are the same as the departure time choice intervals. This program produces a plot for each link (with one or two curves depending on whether the link is a one-way or two-way link) and a text file that has the values of the data points used to plot the curves.

Click the *Hotspots* submenu to display the *Instructions* dialog box as shown in Fig. 42.

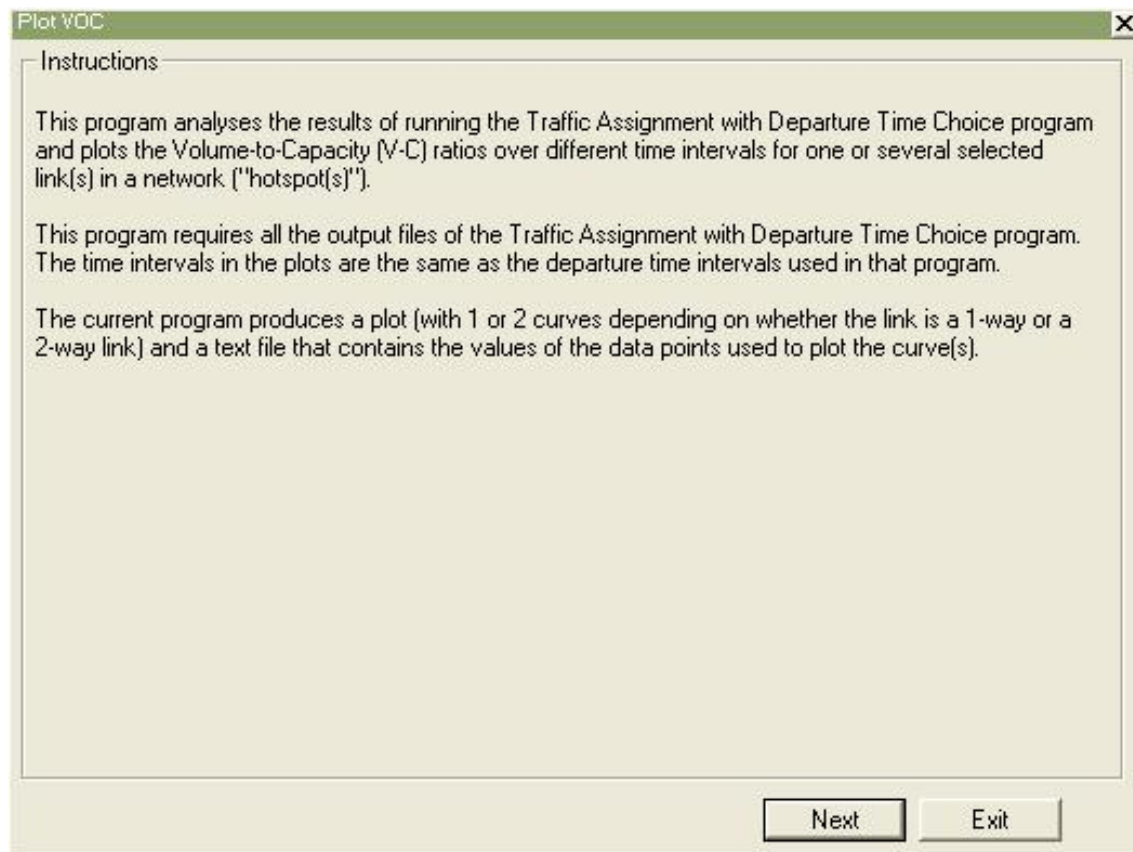


Figure 42: Plot Hotspots – Instructions.

Click the *Next* button to display the next dialog box as shown in Fig. 43.

Browse for the folder which stores the output files of the *Traffic Assignment with Departure Time Choice* program.

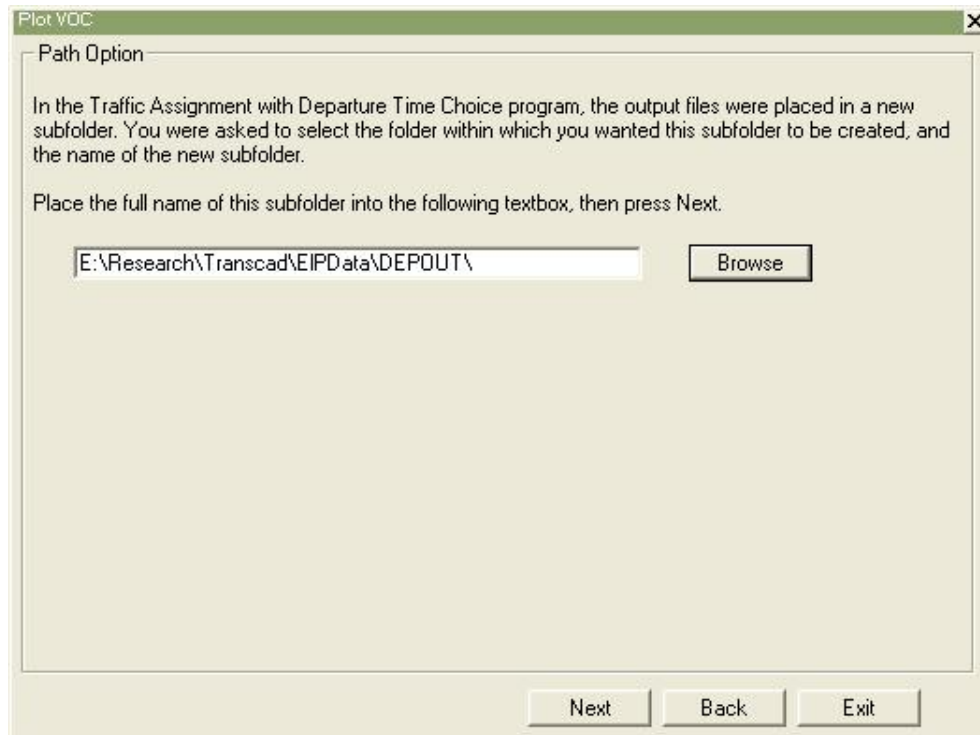


Figure 43: Plot Hotspots – Select Folder.

Click the *Next* button to display the *Path Options* dialog box as shown in Fig. 44.

Select the geographic file.

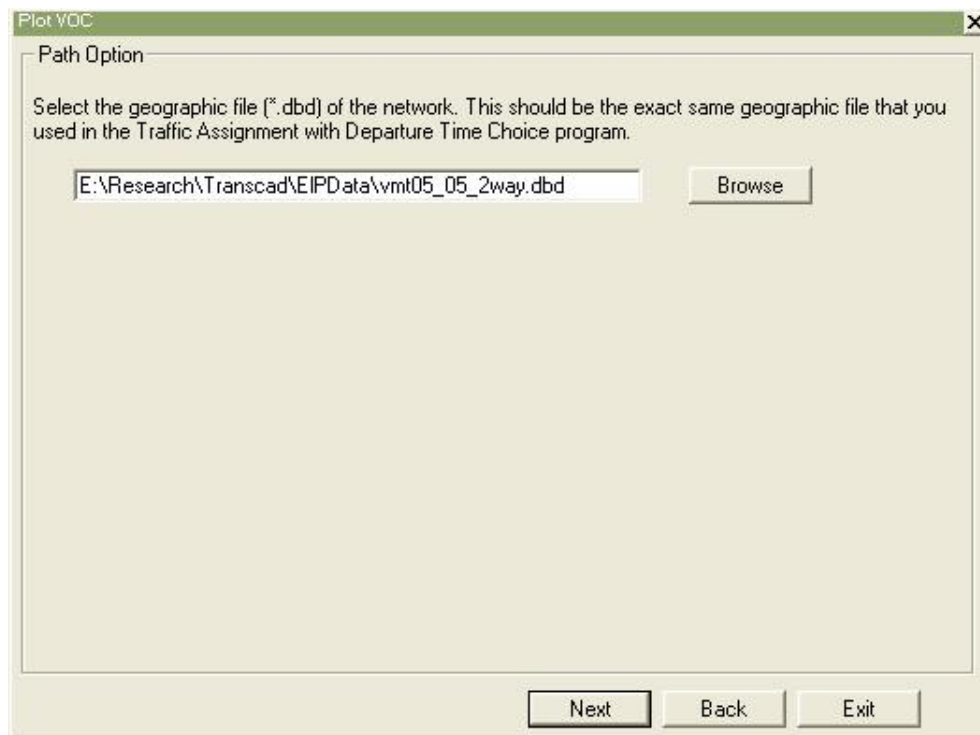


Figure 44: Plot Hotspots – Select Geographic File.

Click the *Next* button to go to the next dialog box.

After you have specified the geographic file and clicked the *Next* button, the next dialog box as shown in Fig. 45 appears. You may then use the geographic file to locate the hotspot and identify the link ID of the hotspot.

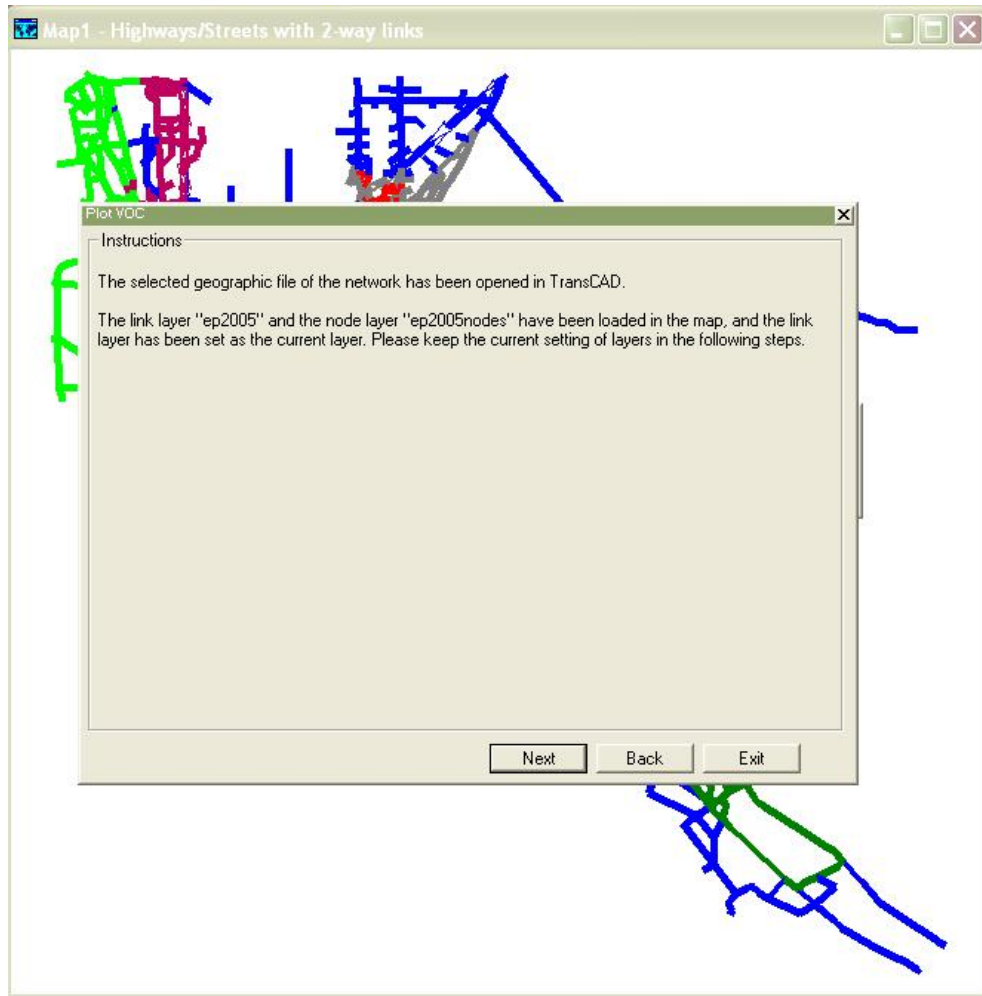
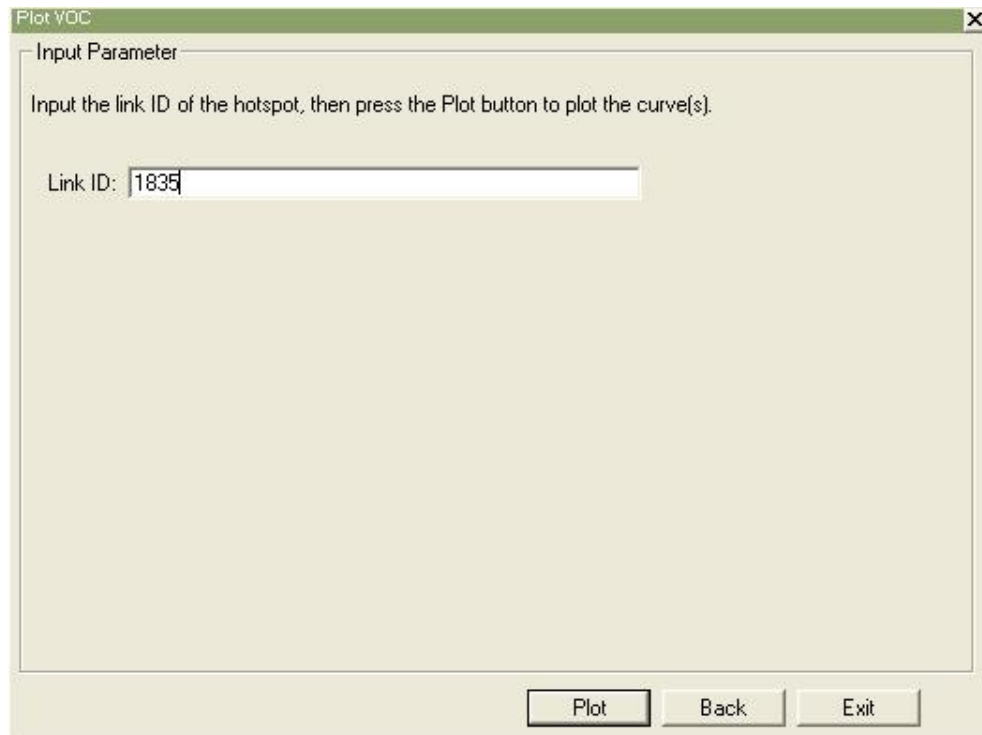


Figure 45: Plot Hotspots – Selected Geographic File.

Once you have identified the link ID, return to the dialog box and click the *Next* button. Enter the *Link ID* as shown in Fig. 46 followed by clicking the *Plot* button.



The image shows a software dialog box titled "Plot VOC" with a standard Windows-style title bar (green) and a close button (X). The main area of the dialog is light beige. At the top, it says "Input Parameter" followed by the instruction "Input the link ID of the hotspot, then press the Plot button to plot the curve(s).". Below this is a text input field labeled "Link ID:" containing the number "1835". At the bottom of the dialog, there are three buttons: "Plot", "Back", and "Exit". The "Plot" button is highlighted with a black border.

Figure 46: Plot Hotspots – Input Link ID.

The program then searches the folder specified in Fig. 43 and retrieves the data, then plots the V-C curve(s). The graphical output of this program is shown in Fig. 47. Move this pop-up window to the right bottom corner of the screen to see the chart(s) that looks like the Fig. 48 and Fig. 49. The X-axis of the charts refers to the volume over capacity ratios and the Y-axis of the charts refers to the number of time intervals. If the hotspot is a one-way link, only one V-C curve will be plotted in a chart. If the hotspot is a two-way link, there will be two V-C curves in two different charts, one for each direction of travel. The directions can be identified by AB_VOC and BA_VOC in the name of the charts.

The curves show the change in V-C ratios over several departure time choice intervals. This program will automatically detects the number of departure time choice intervals from the files in the data folder.

At any time you may click the *Exit* button to exit the program and return to the TransCAD menu.

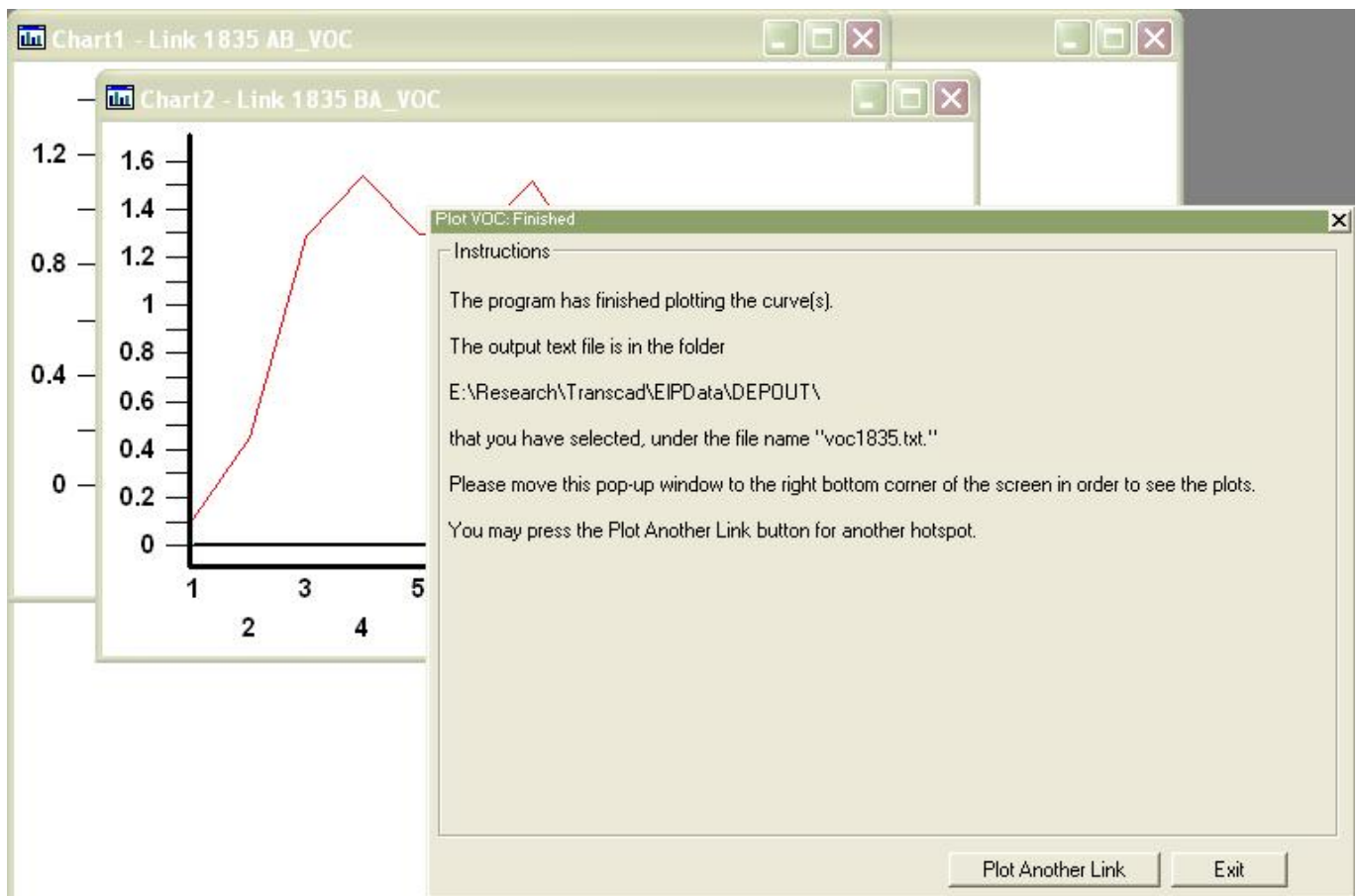


Figure 47: Plot Hotspots – End of Program.

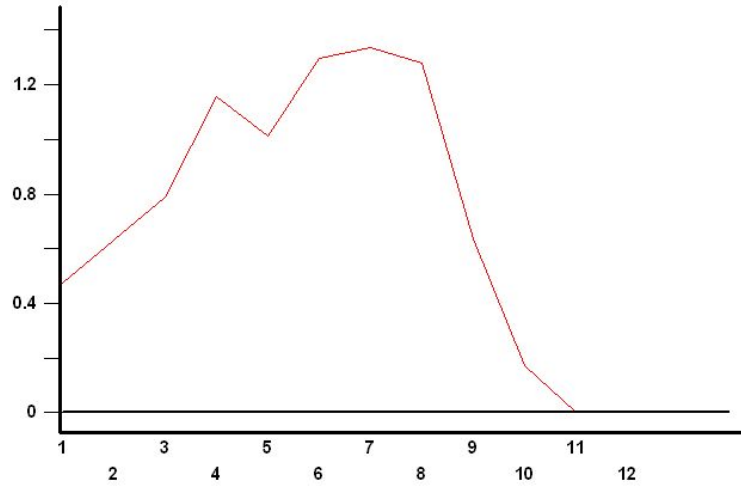


Figure 48: Plot Hotspots – AB_VOC vs Time Intervals.

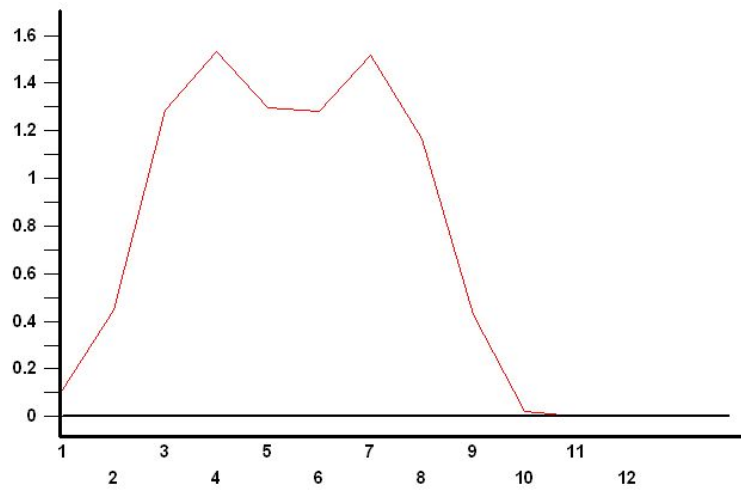
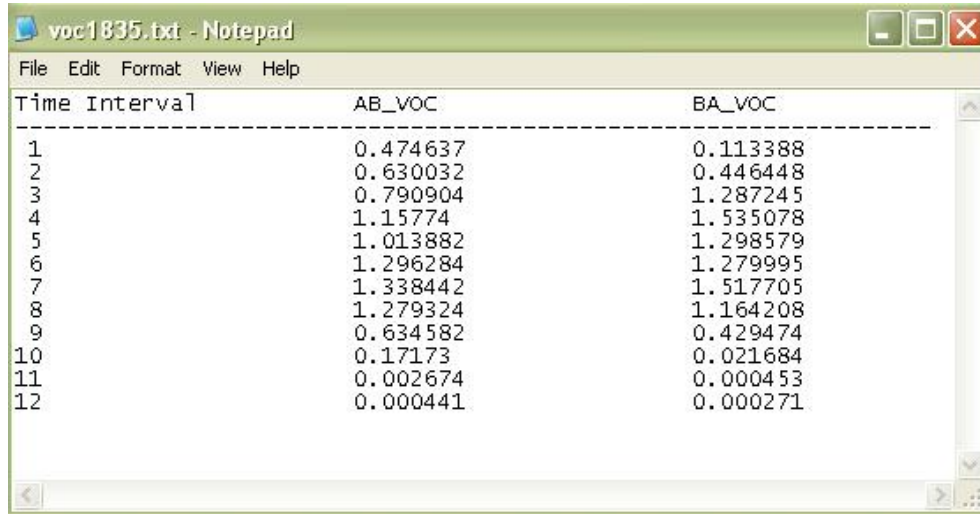


Figure 49: Plot Hotspots – BA_VOC vs Time Intervals.

This program will also produce a text file as shown in Fig. 50, which contains the data points in the V-C curve(s). You may continue to plot another hotspot by clicking the *Plot Another Link* button. Doing this will bring you back to the dialog box in Fig. 46. You may use the geographic file to identify the link number before continuing with the plot.



Time Interval	AB_VOC	BA_VOC
1	0.474637	0.113388
2	0.630032	0.446448
3	0.790904	1.287245
4	1.15774	1.535078
5	1.013882	1.298579
6	1.296284	1.279995
7	1.338442	1.517705
8	1.279324	1.164208
9	0.634582	0.429474
10	0.17173	0.021684
11	0.002674	0.000453
12	0.000441	0.000271

Figure 50: Plot Hotspots – Output Text File.

11 Plot Capacity Reliability Curve

This program plots the capacity reliability curves for a given transportation network. These curves describe how the networks' level of service changes when the overall traffic demand (O-D matrix) changes. To simulate the change in traffic demand, we multiply all the trips in the O-D matrix by the same factor μ .

The networks' level of service can be characterized by the percentage of congested links. For example, links for which the volume exceeds the capacity and therefore, the volume-to-capacity (V-C) ratio is higher than 1. Another reasonable measure of congestion is the percentage of supplied facilities (in lane-miles) in the network that are congested.

The current program plots the two curves that illustrate the dependence of the above two measures on the factor μ :

1. % of links with V-C ratio ≥ 1 versus μ
2. % of lane-miles with V-C ratio ≥ 1 versus μ

This program reads two input files:

1. Geographic file of the network (*.dbd)
2. O-D matrix file (*.mtx)

This program performs traffic assignment (with a fixed matrix, for risk averse drivers in a stochastic network) for each μ value specified by the user. After the traffic assignment, the two measures of level service computed. This procedure is repeated for all the μ values in order to generate all the data necessary to plot the capacity reliability curves.

The program produces two curves and a text file which contains the values of the data points used to plot the curves. Click the *Plot Capacity Reliability Curve* submenu to display the *Instructions* dialog box as shown in Fig. 51.

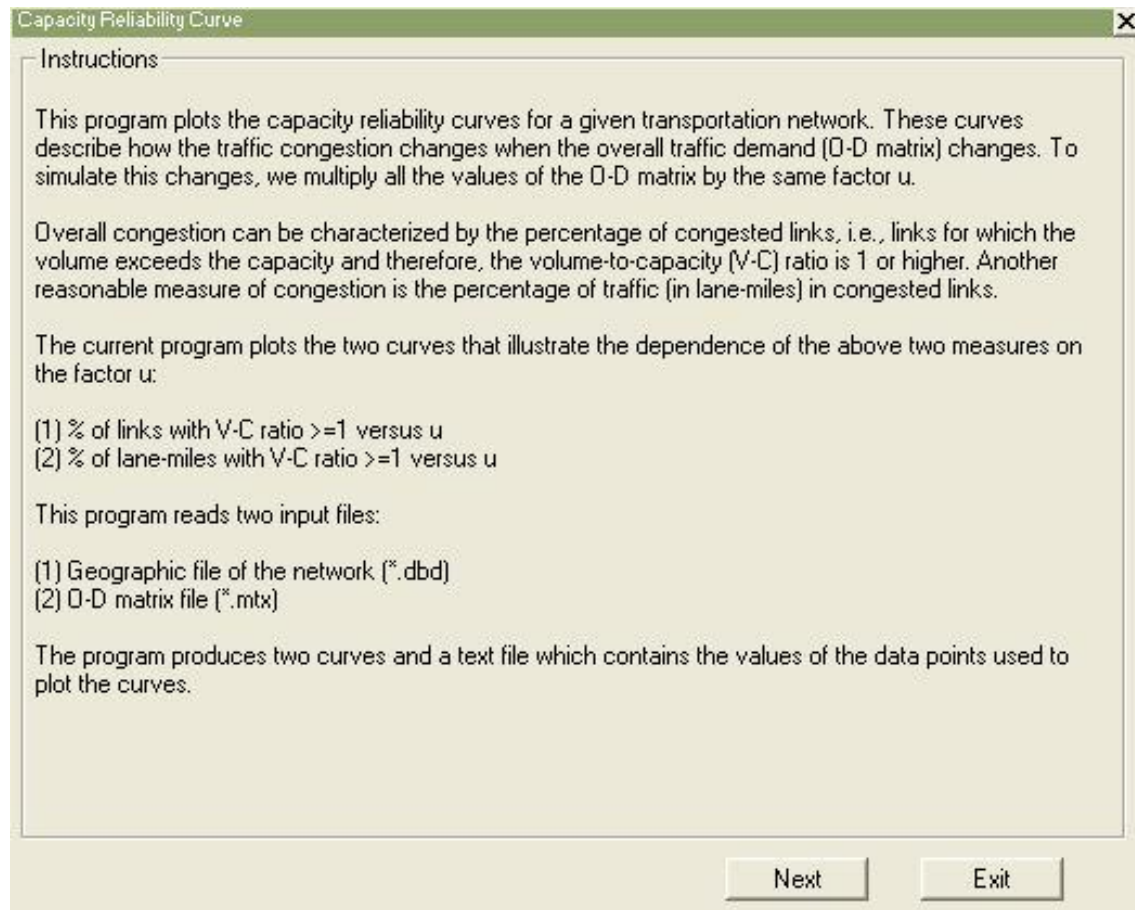


Figure 51: Plot Capacity Reliability Curve – Instructions.

Click the *Next* button to display the *Path Options* dialog box as shown in Fig. 52.

The *Path Options* dialog box appears as shown in Fig. 52. Use the *Browse* button to select the geographic file.

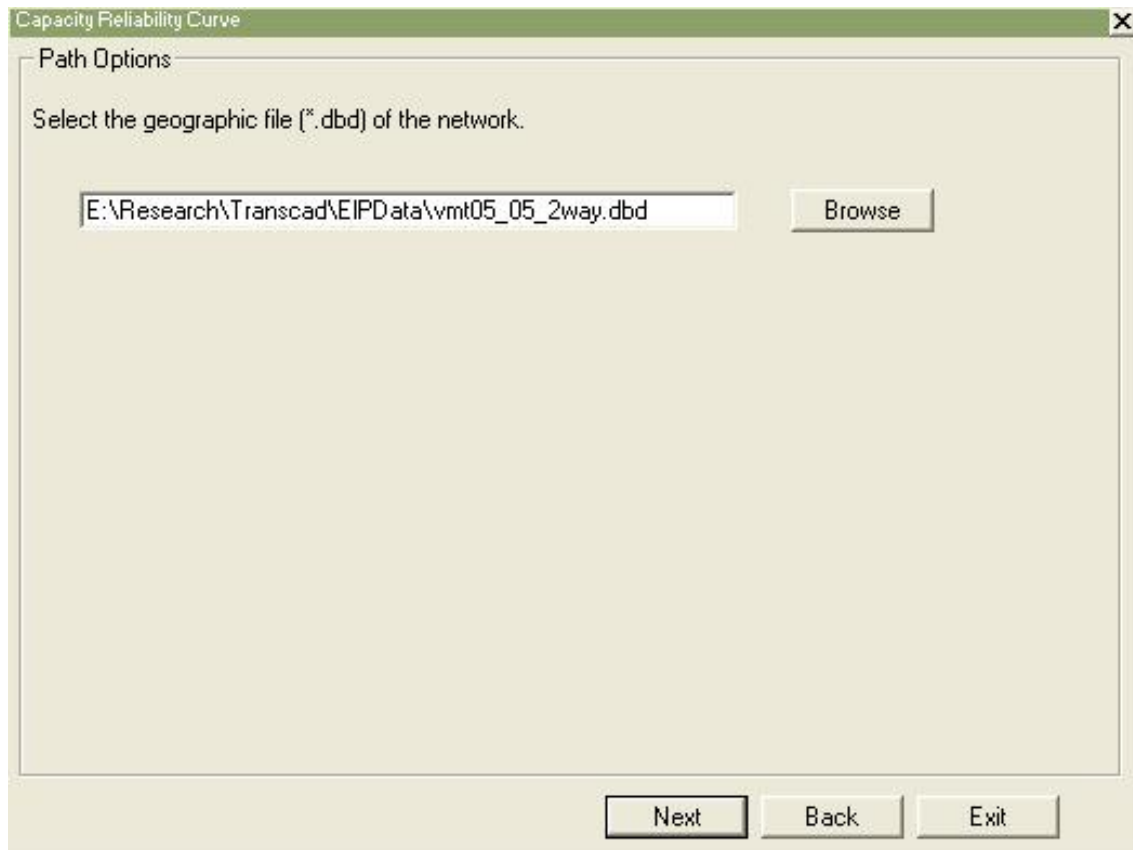


Figure 52: Plot Capacity Reliability Curve – Path Options.

After you have specified the geographic file and clicked the *Next* button, the next dialog box as shown in Fig. 53 appears. It shows that the line layer has been set as the current layer and warns you not to change the current layer throughout the entire program.

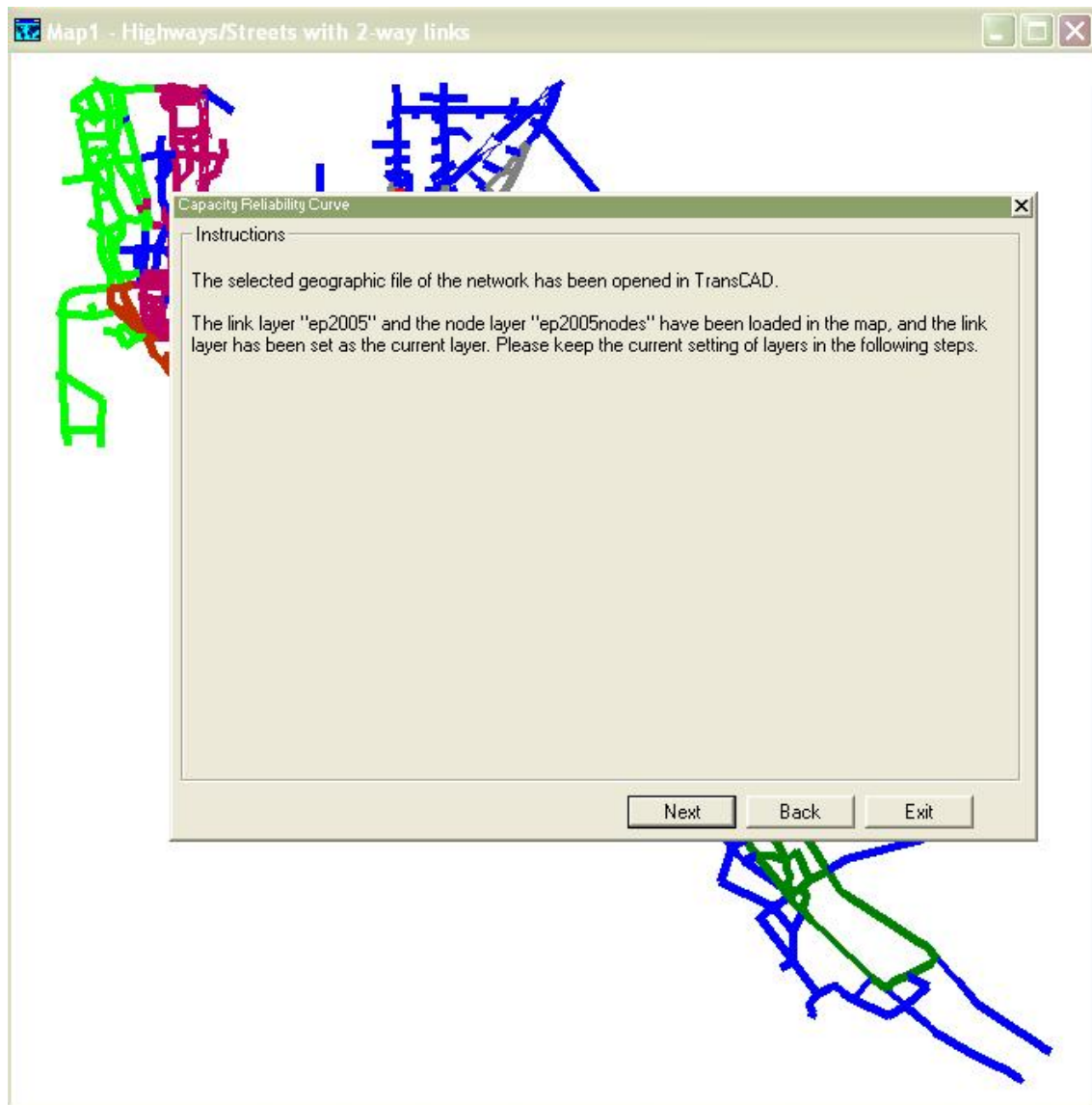


Figure 53: Plot Capacity Reliability Curve – Selected Geographic File.

Click the *Next* button to display the next dialog box as shown in Fig. 54.

In the *Curve Options* frame, input the minimum μ value, maximum μ value and number of intervals between the minimum μ and maximum μ values. For example, if you want to plot the curves for $\mu = 0.8, 0.9, 1.0, 1.1, 1.2$, enter '0.8' for *Min u*, '1.2' for *Max u* and '4' for *No. of intervals* in the respective text boxes.

In the *Path Options* frame, browse for the O-D matrix file. In the *Link Performance Function Options* frame, select the link performance function you want to use in traffic assignment. In the *Traffic Assignment Fields*, specify the names of the columns in the Dataview table which corresponds the link capacity and free flow travel time.

The screenshot shows a dialog box titled "Capacity Reliability Curve" with a close button (X) in the top right corner. The dialog is divided into four main sections:

- Curve Options:** Contains instructions: "Input the range of 'u' and the number of intervals within this range. You may change the default values shown." Below this are three input fields: "Min u" with value "0.8", "Max u" with value "1.2", and "No. of intervals" with value "4".
- Path Options:** Contains instructions: "Select the O-D matrix (.mtx) file. Make sure that this matrix corresponds to the same time period as the link capacities in the geographic file (e.g., 1 hour)." Below this is an "O-D File" input field with the value "\EIPData\OD 89 05.mtx" and a browse button (...).
- Link Performance Function Options:** Contains two radio buttons: "BPR" (selected) and "ELD with a1 = 1.4356". Below the radio buttons is a text box with the value "1.4356". A note below states: "The ELD function reflects the behavior of risk averse drivers. If you select the ELD function, you may change the 'a1' value."
- Traffic Assignment Fields:** Contains two input fields: "Capacity" with value "AB_CAP/BA_CAP" and "Time" with value "TIME". Below these fields is a note: "Input the column names of free flow travel time and capacity as shown in the Dataview table. E.g. Capacity: AB_CAP/BA_CAP Time: TIME".

At the bottom of the dialog, there is a paragraph of text: "Press the Plot button to start the calculations. This may take a few minutes depending on the number of intervals for u." Below this text are three buttons: "Back", "Plot", and "Exit".

Figure 54: Plot Capacity Reliability Curve – Input Parameters.

Click the *Plot* button to start running the program. When the program has finished calculating the curve points, an *Instructions* dialog box will be displayed as shown in Fig. 55. The two charts are behind the *Instruction* dialog box as shown in Fig. 55. Move the dialog box to see the charts. Chart 1 plots the percentage of lane-miles in the network that have V-C ratios $> one$ versus μ as shown in Fig. 56. Chart 2 plots the percentage of links that have V-C ratios $> one$ versus μ as shown in Fig. 57.

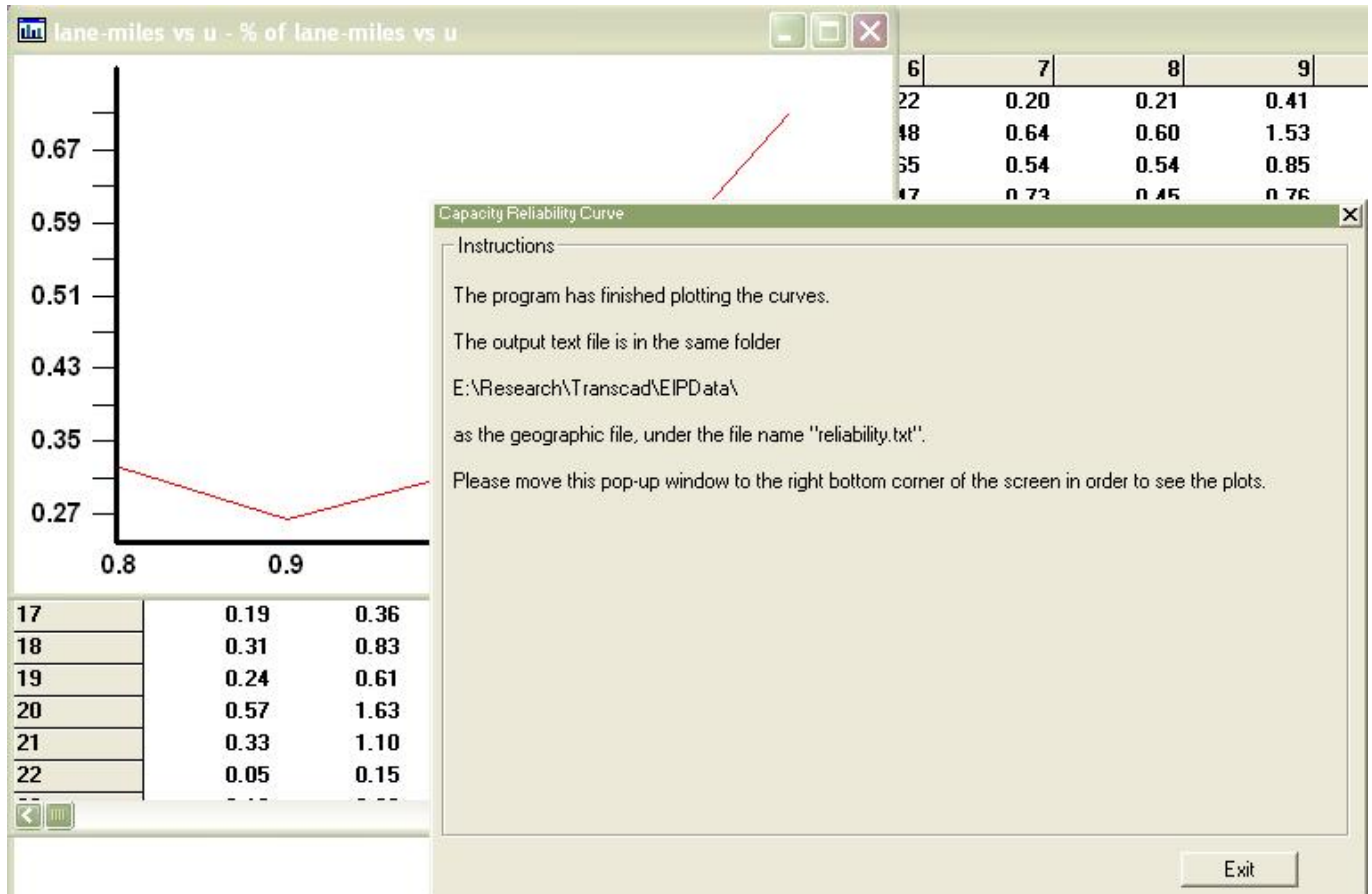


Figure 55: Plot Capacity Reliability Curve – End of the Program.

Click the *Exit* button to return to the TransCAD menu.

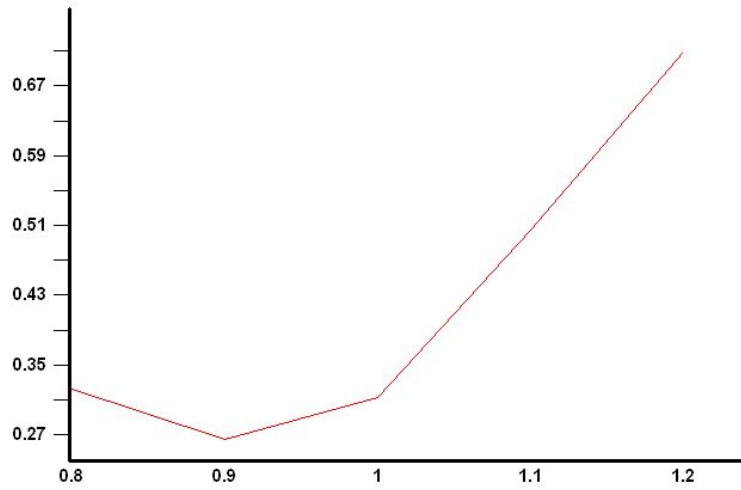


Figure 56: Plot Capacity Reliability Curve – Chart 1.

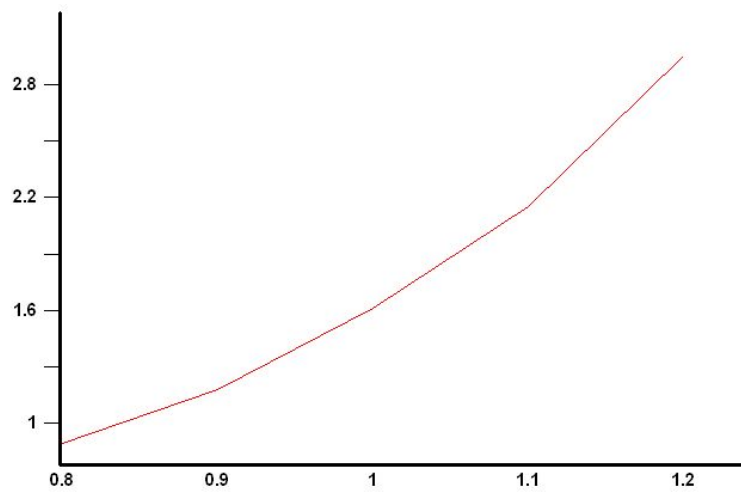
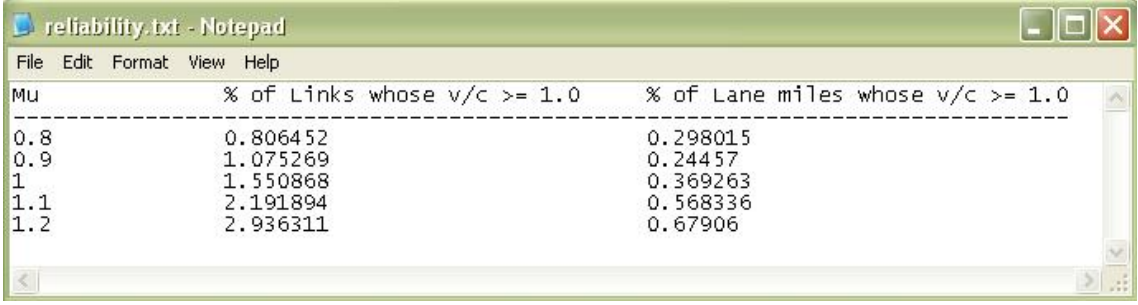


Figure 57: Plot Capacity Reliability Curve – Chart 2.

A text file with the name “reliability.txt” as shown in Fig. 58 has been generated and stored in the same folder as the geographic file which you have selected.



The screenshot shows a Notepad window with the title "reliability.txt - Notepad". The window contains a table with three columns: "Mu", "% of Links whose v/c >= 1.0", and "% of Lane miles whose v/c >= 1.0". The data is as follows:

Mu	% of Links whose v/c >= 1.0	% of Lane miles whose v/c >= 1.0
0.8	0.806452	0.298015
0.9	1.075269	0.24457
1	1.550868	0.369263
1.1	2.191894	0.568336
1.2	2.936311	0.67906

Figure 58: Plot Capacity Reliability Curve – Output Text File.