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16. Abstract

The Texas Department of Transportation (TxDOT) sponsored Project 0-4986, "An Assessment of Frontage Road Yield Treatments," to assess the effectiveness of a wide variety of frontage road–exit ramp and frontage road–U-turn yield treatments that exist in Texas. Toward this goal, simulation modeling procedures compensated for the impracticability of the data collection effort that would be required to compile every possible combination of volume, geometry and yield treatment types.

Researchers ran several simulations and generated significant numbers of measures of performance and comparative analysis. To better present the data in a more coherent manner, they developed a database tool to incorporate the results of the research and present these results in a format that would be useful to TxDOT staff. This report is the user guide for that database tool, the Frontage Road Yield Treatment Analysis Tool (FRYTAT).

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FRONTAGE ROAD YIELD TREATMENT ANALYSIS TOOL (FRYTAT) DATABASE: USER GUIDE

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ACKNOWLEDGMENTS

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LIST OF ACRONYMS, ABBREVIATIONS AND TERMS

CD   Compact Disc

FHWA   Federal Highway Administration

FRYTAT   Frontage Road Yield Treatment Analysis Tool

GUI   Graphic User Interface

MOE   Measures of Effectiveness

OD   Origin-Destination

PC   Personal Computer

PDF   Portable Document Format

SP2   Service Pack 2

TxDOT   Texas Department of Transportation

VPH   Vehicles Per Hour

1.0   ABOUT FRYTAT

1.1   Introduction

In the state of Texas, there are a variety of exit ramp and U-turn ramp configurations in use along the frontage roads of Texas Department of Transportation (TxDOT) highways. After surveying the 25 TxDOT districts, researchers identified seven categories of exit ramp and five categories of U-turn ramp design.

Researchers developed a total of 2,268 exit ramp–frontage road and 540 U-turn–frontage road simulation runs using various combinations of exit ramp, frontage road and U-turn volumes as well as a number of driveways and distances from the exit ramp gore to the downstream intersection.   Since each scenario was run three times, a total of 8,424 runs were made and over 25 measures of effectiveness (MOEs) were collected during each simulation.

Results from the simulation showed that certain designs (such as Category 1A for exit ramp–frontage road scenarios) performed well in most of the cases while certain other designs (such as Categories 3 and 6) only performed well if certain conditions were present. In those cases, however, those poorly performing categories performed better than the best category under other circumstances. A need developed to create a tool to transfer the knowledge gained by modeling and apply it to either a new design or existing roadway configuration.

The Frontage Road Yield Treatment Analysis Tool (FRYTAT) finds the best and safest yield treatment for the conditions inputted. It considers the effects of traffic volume, weaving and geometric layout scenarios including number of driveways and distance from the yield point/gore point to the downstream intersection.

It also allows the comparison of one kind of treatment to another and the effect that adding one more driveway or intersection has on the overall operation of the exit or U-turn ramp. FRYTAT displays warning statements for very high delays and high potential crash results. Figure 1 shows the workflow behind the development of the database.
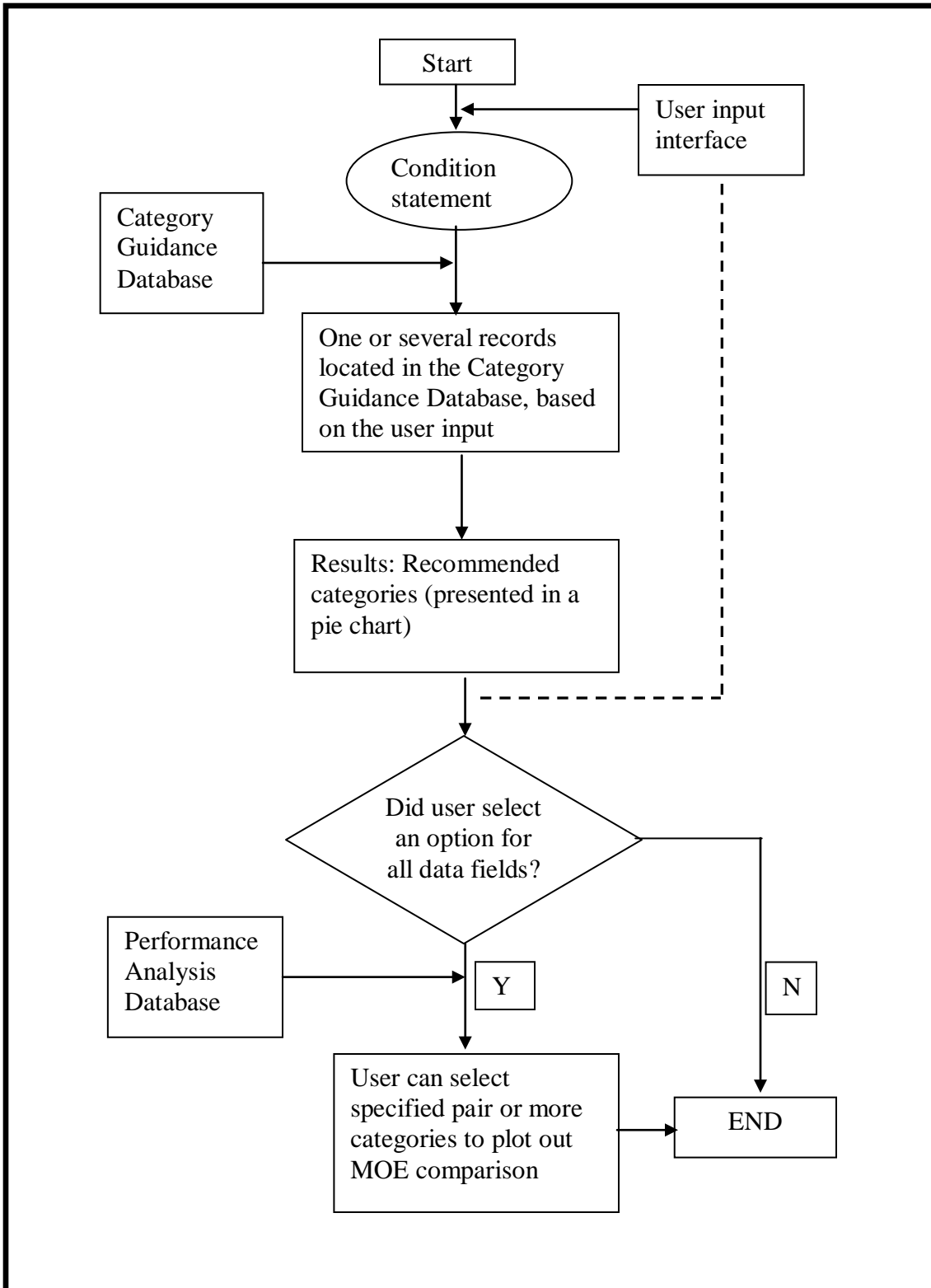
Figure 1. Flowchart for FRYTAT.

2.0   ACCESSING FRYTAT

2.1   Client System Requirements

To use FRYTAT, use a desktop or laptop computer with at least the following specifications:

- Microsoft® Windows® XP with Service Pack 2 (SP2),
- 256 MB of RAM,
- Microsoft® Internet Explorer® (IE) 6.0 with SP2,
- Portable document format (PDF) reader such as Adobe Acrobat Reader® 6.0, and
- Microsoft® Excel®.

There is no need to install any special client-side software to run FRYTAT.

2.2   Installing FRYTAT

Install FRYTAT from two main sources—a zipped folder sent via email or a storage disk.

2.2.1   Installation from Compressed/Zipped Folder via Email

To install FRYTAT from a zipped folder from an email, follow the following steps:

Step 1. Copy or download the attached zipped (compressed) file into any folder on the local drive.

Step 2. Right click on the zipped file. Select "Open with..." and "Compressed (Zipped) Folders." In some Windows versions, the user selects "Open with WinZip®."

Step 3. A new window pops up. Click the "Extract all files" link in the left panel of the window. Click "Next." The user can select the destination directory to install the program in. It is strongly recommended to install the program in the root directory of the C drive (C:\). Click "Next" and then "Finish."

Step 4. Go to the program folder; double click the executable program TreatmentData.exe (file with the yield sign icon) to run the program.

2.2.2   Installation from Storage Disk

To install FRYTAT from a storage disk, follow the following steps:

Step 1. Insert the compact disc (CD) or other storage device into the drive and copy the folder from the CD/storage disk to any location on a local drive. It is recommended for the user to save the program folder in the root directory of the C drive (C:\).

Step 2. Go to the program folder; double click the executable program "TreatmentData.exe" (yield sign icon) to run the program.

2.3   Recommended Installation and Operation Settings and Tips

Perform the following actions to help ensure the smooth installation and running of FRYTAT:

- Always install the FRYTAT program on the local drive of a personal computer (PC). Do not install on a shared drive location. It is recommended that the program be installed in the root directory of the C drive (C:\). FRYTAT is a single-user form program and does not support multiple users at the same time.
- User must have the right to install programs to the local drive or folder. Running FRYTAT will generate some temporary files, which will require this limited user privilege.
- Close Microsoft® Excel® and other worksheet and database-based programs before running FRYTAT.
- Change the macro security settings in Microsoft® Excel® to medium or lower. The user can do this in Microsoft® Excel® by going to Tools > Macro > Security; under "Security Level" select "Medium."

3.0   NAVIGATING FRYTAT

3.1   Screen Structure and Menu Options

After the user double clicks the TreatmentData.exe file, the FRYTAT graphic user interface (GUI) opens as shown in Figure 2. The FRYTAT opening screen has two general sections—the toolbar and the menu options as shown in Figure 2:

- Toolbar: This area, at the top of the user interface, includes the File and Help tabs.
    - File contains the Exit button to help the user close the program safely, and
    - Help contains the Glossary of Terms and the User Manual in PDF format.

- Menu: The menu section contains options for selecting a basic or detailed version of the FRYTAT program, followed by a choice of what kind of yield treatment analysis the user intends to perform—the Exit Ramp and Frontage Road or U-Turn and Frontage Road options.
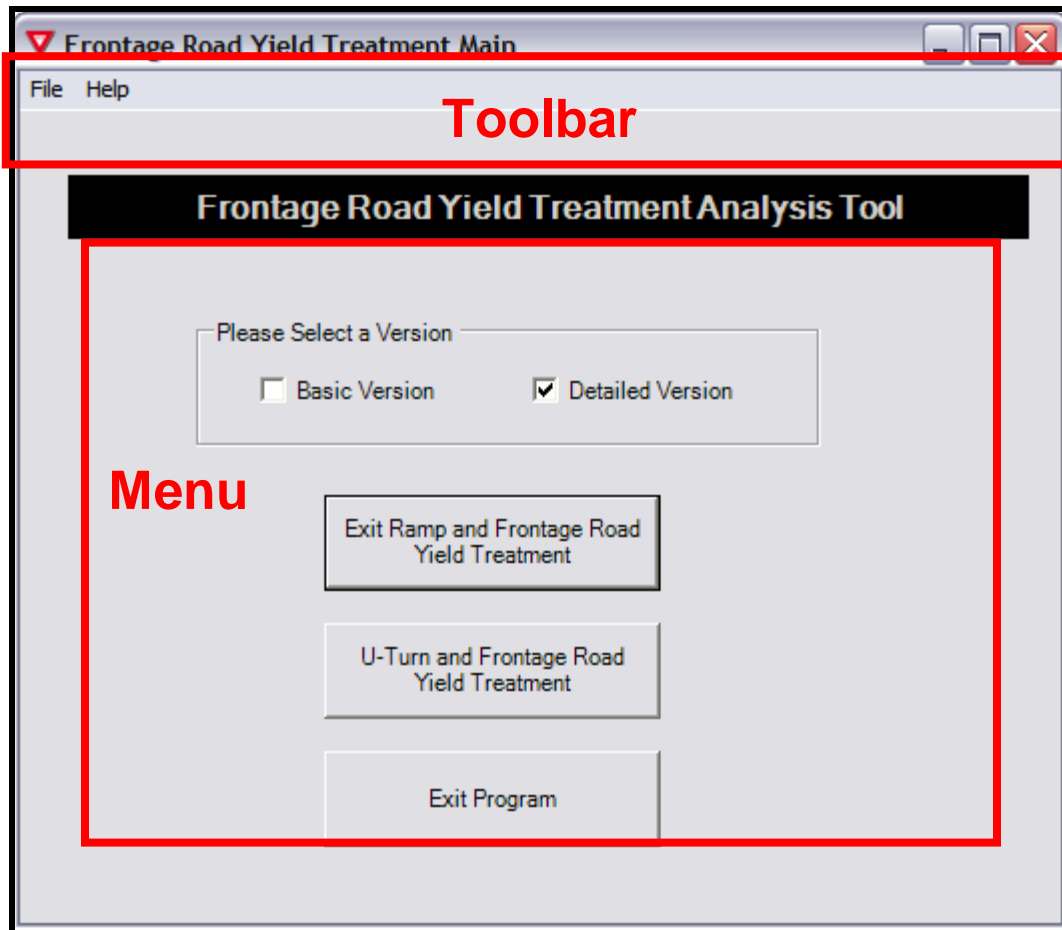

Figure 2. FRYTAT Opening GUI.

3.2 Toolbar Options

3.2.1 File

Click on "File" to display the Exit button that allows the user to close the FRYTAT program. The Exit Program button under the menu section of the GUI (as shown earlier in Figure 2) allows the user to exit the FRYTAT program.

3.2.2 Help

Click on "Help" in the toolbar to select either the Glossary (glossary of terms) or the User Manual (same document as this) in Acrobat$^®$ PDF formats.

Glossary

The Glossary contains definitions of various terms used in FRYTAT. It also contains details on:

- definitions of various vehicle maneuver terminologies,
- definitions of various levels of traffic volumes, and
- definitions of various distance measures.

User Manual

The User Manual document accessed through the Help tab on the toolbar contains the same information presented in this document. This allows the user to obtain quick references and tips for navigating FRYTAT without having to find a hard copy of the User Manual.

3.3 Menu Options

Under the menu, the user can select from the two modules of FRYTAT:

- Exit Ramp and Frontage Road Yield Treatment: analyzes input data for various exit ramp and frontage road yield treatment scenarios, and
- U-Turn and Frontage Road Yield Treatment: analyzes input data for various U-turn and frontage road yield treatment scenarios.

Under these two modules are two options for input of values into FRYTAT. The two options are the Basic Version and the Detailed Version. The next chapter, "Using FRYTAT," explains in detail what these two modules mean as well as when and how to use them.

4.0 USING FRYTAT

4.1 Exit Ramp and Frontage Road Yield Treatment

Under the Exit Ramp and Frontage Road Yield Treatment module, the user can select either the Basic Version or the Detailed Version.

4.1.1 Basic Version

Use this version when there is only a general knowledge of exit ramp and frontage road volumes as well as origin-destination (OD) patterns of exit ramp and frontage road vehicles.

Select the Basic Version option and click the Exit Ramp and Frontage Road Yield Treatment button to display the GUI for data input into the basic version of the database as shown in Figure 3. This allows the user to select options for Frontage Road Vehicle Maneuver, Exit Ramp Vehicle Maneuver, Number of Driveways, Distance, Exit Ramp Volume, and Frontage Road Volume.

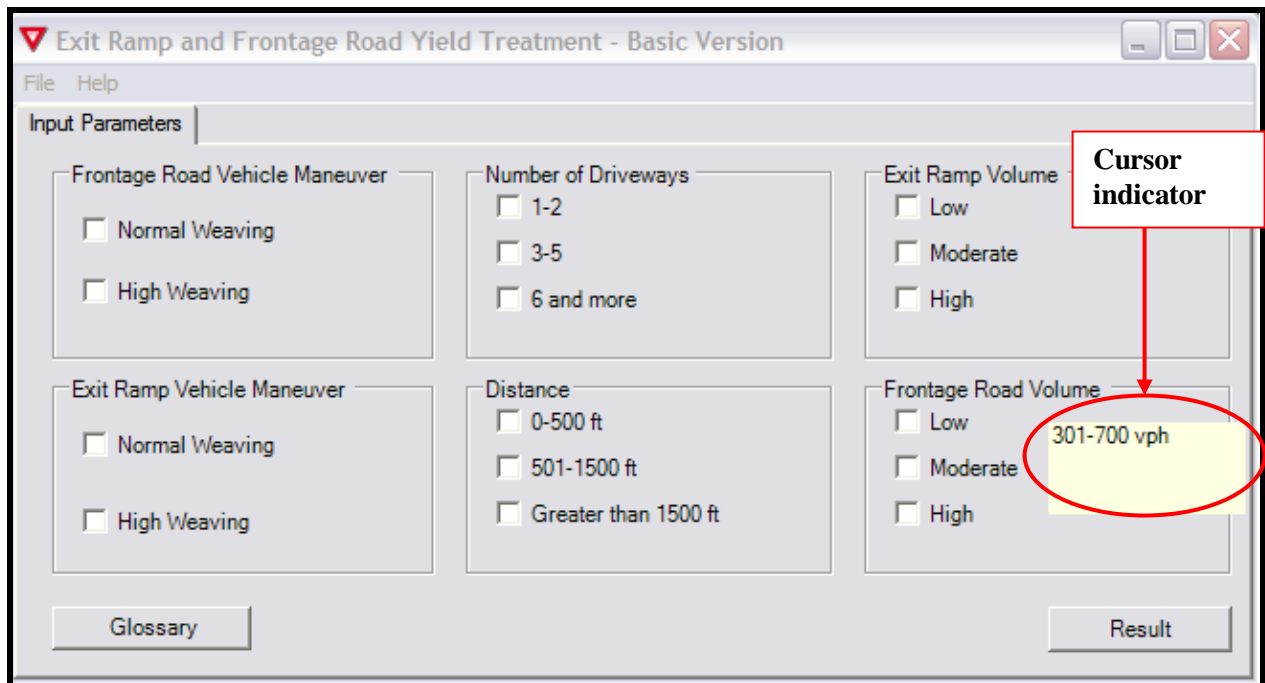**Figure 3. Exit Ramp and Frontage Road Yield Treatment GUI—Basic Version.**

The definitions for the various input parameters are given by clicking on the Glossary button on the menu shown in Figure 3. The Glossary of Terms under the Help option on the toolbar provides these definitions as well). FRYTAT also displays these definitions in a textbox that pops up whenever the cursor is on the input parameter (see Figure 3).

Frontage Road Vehicle Maneuver

This refers to the nature of vehicle movement from the frontage road approaching the downstream intersection. The user selects from two categories of frontage road vehicle maneuver:

- Normal Weaving: The user selects this option when there is minimal weaving of vehicles from the frontage road, with less than 50 percent of frontage road vehicles making a U-turn or turning left at the downstream intersection.
- High Weaving: The user selects this option when there is relatively higher weaving of vehicles from the frontage road, with more than 50 percent of frontage road vehicles making a U-turn or turning left at the downstream intersection.

Exit Ramp Vehicle Maneuver

This refers to the nature of vehicle movement for vehicles from the exit ramp approaching the downstream intersection. The user selects from two categories of exit ramp vehicle maneuver:

- Normal Weaving: The user selects this option when there is minimal weaving of vehicles from the exit ramp, with less than 30 percent of exit ramp vehicles turning into driveways or making a right turn at the downstream intersection.
- High Weaving: The user selects this option when there is relatively higher weaving of vehicles from the exit ramp, with more than 30 percent of exit ramp vehicles turning into driveways or making a right turn at the downstream intersection.

Number of Driveways

This refers to the number of active driveways between the gore of the exit ramp and frontage road merge area to the downstream intersection. The user selects from three main categories of number of driveways:

- 1-2,
- 3-5, and
- 6 and more.

Distance

This refers to the distance, measured in feet, from the gore of the exit ramp and frontage road merge area to the stop bar of the downstream intersection. The user selects from three main categories of distance:

- 0-500 ft,
- 501-1500 ft, and
- Greater than 1500 ft.

Exit Ramp Volume

This refers to exit ramp volume measured as vehicles per hour (vph) for a one-lane exit ramp during the peak period. The user can select from three categories of exit ramp volume:

- Low: 0-300 vph,
- Moderate: 301-800 vph, and
- High: more than 800 vph.

Frontage Road Volume

This refers to the volume of frontage road vehicles measured as vehicles per hour (vph) during the peak period. The user can select from three categories of frontage road volume:

- Low: 0-300 vph,
- Moderate: 301-700 vph, and
- High: greater than 700 vph.

After selecting various inputs for the various sections, the user can look up results of best performing yield treatments by clicking on the Result button shown in Figure 3.

4.1.2 Detailed Version

Use this version when there is detailed knowledge of exit ramp and frontage road volumes as well as OD patterns of exit ramp and frontage road vehicles. To use the detailed version, the user will need accurate data on the following:

- *peak hour volume (vph) and OD patterns of exit ramp vehicles,*
- *peak hour volume (vph) and OD patterns of frontage road vehicles, and*
- *distance from the exit ramp and frontage road gore to the downstream intersection (ft).*

Select the Detailed Version and click on the Exit Ramp and Frontage Road Yield Treatment button to open the GUI shown in Figure 4. Here the user can input specific values for frontage road volume, exit ramp volume, number of driveways and distance (from the exit ramp and frontage road gore to the stop bar of the downstream intersection).
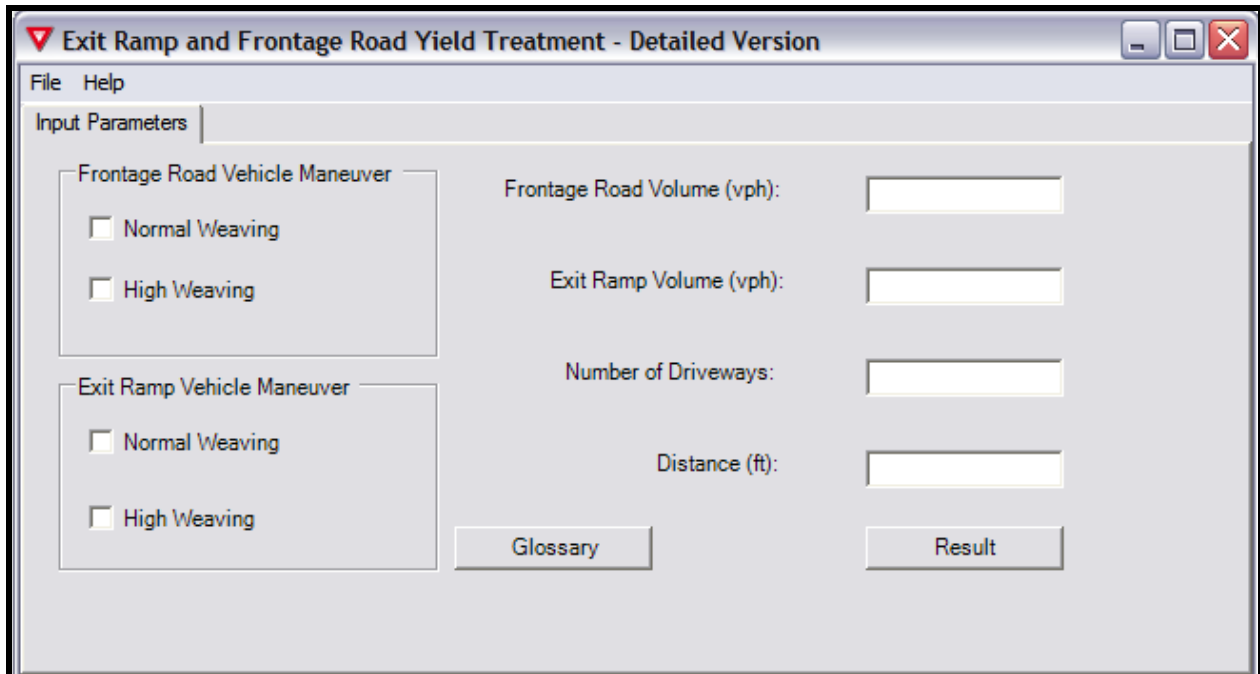
Figure 4. Exit Ramp and Frontage Road Yield Treatment GUI—Detailed Version.

4.2 U-Turn and Frontage Road Yield Treatment

Under the U-Turn and Frontage Road Yield Treatment module, the user can select either the Basic Version or the Detailed Version.

4.2.1 Basic Version

Use this version when there is only a general knowledge of exit ramp and frontage road volumes as well as OD patterns of U-turn and frontage road vehicles.

Select the Basic Version option and click the U-Turn and Frontage Road Yield Treatment button to display the GUI for input into the basic version of the database as shown in Figure 5. This allows the user to select options for Entrance Ramp, Distance Scenarios, Weaving Maneuvers, Driveway Volume, U-Turn Volume, and Frontage Road Volume.
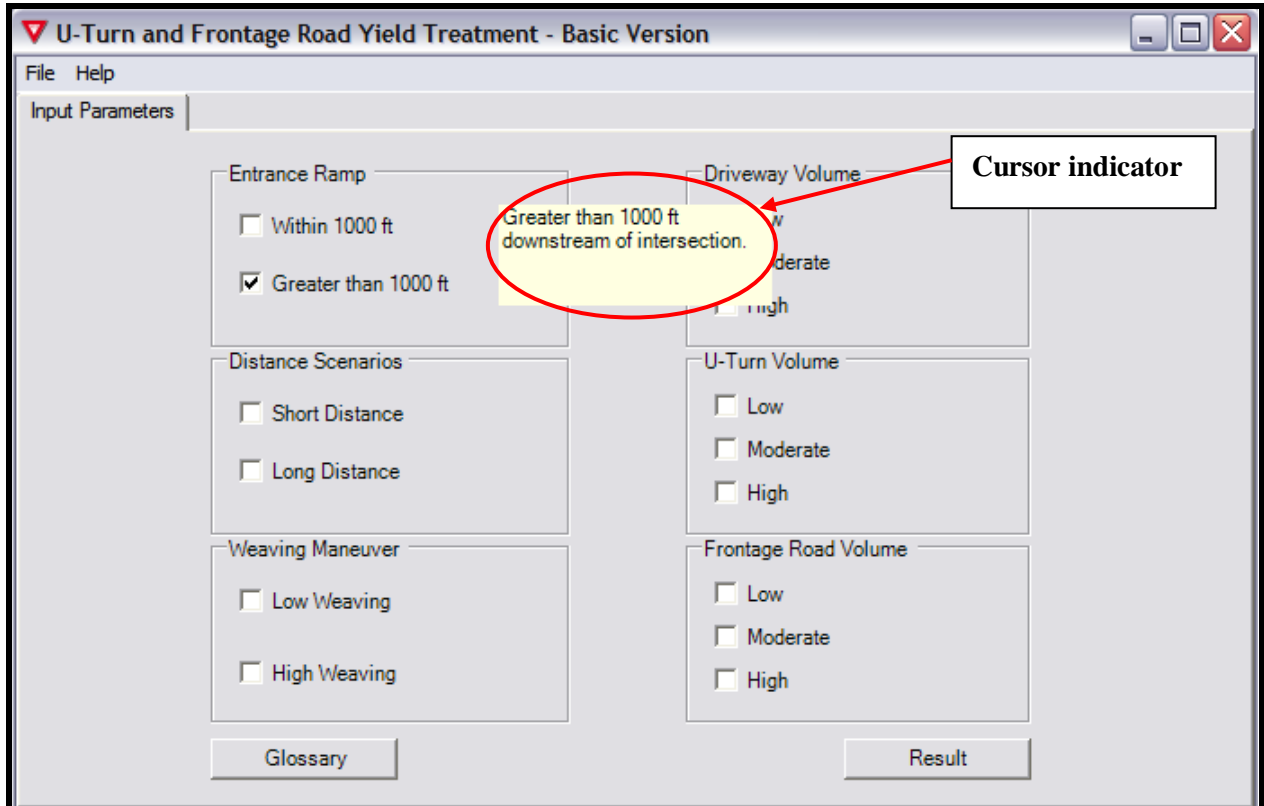
Figure 5. U-Turn and Frontage Road Yield Treatment GUI—Basic Version.

The definitions for the various input parameters are given below and presented in the Glossary of Terms under the Help option on the toolbar (or Glossary button on the menu shown in Figure 5). FRYTAT displays these definitions in a textbox that pops up whenever the cursor is on the input parameter (as circled in Figure 5).

Entrance Ramp

This refers to the location of the entrance ramp downstream of the intersection. The user selects from two categories of Entrance Ramp distance options:

- Within 1000 ft: The user selects this option if the entrance ramp is located within 1000 ft of the upstream intersection.
- Greater than 1000 ft: The user selects this option if the entrance ramp is located more than 1000 ft downstream of the upstream intersection.

Distance Scenarios

This refers to the distances, measured in feet, from the U-turn to driveways downstream of the yield gore and the entrance ramp. The user selects from two categories of distance scenarios:

- Short Distance: The user selects this option if the distance from the U-turn to the first driveway, second driveway, and entrance ramp is within 100, 300, and 400 ft, respectively.
- Long Distance: The user selects this option if the distance from the U-turn to the first driveway, second driveway, and entrance ramp is within 200, 500, and 600 ft, respectively

Weaving Maneuver

This refers to the weaving pattern of vehicles from the U-turn lane. The user selects from two categories of weaving maneuver:

- Low Weaving: The user selects this option when there is less than 25 percent of U-turn traffic weaving to driveways immediately downstream of the intersection and upstream of the entrance ramp.
- High Weaving: The user selects this option when there is more than 25 percent of U-turn traffic weaving to driveways immediately downstream of the intersection and upstream of the entrance ramp.

Driveway Volume

This refers to the number of vehicles measured per hour exiting driveways immediately downstream of the intersection and upstream of the entrance ramp. The user selects from three main categories of driveway volume:

- Low: 0-30 vph,
- Moderate: 31-149 vph, and
- High: 150 vph or more.

U-Turn Volume

This refers to the volume of U-turn traffic during the peak hour, measured in vph. The user selects from three main categories of U-turn volume:

- Low: 0-200 vph,
- Moderate: 201-599 vph, and
- High: 600 vph or more.

Frontage Road Volume

This refers to the volume of frontage road vehicles, measured in vph during the peak hour, approaching the direction of the entrance ramp from the upstream intersection. This includes all left, right, and through vehicles heading in the general direction of the ramp. The user selects from three main categories of frontage road volume:

- Low: 0-800 vph,
- Moderate: 801-1799 vph, and
- High: 1800 vph or more.

After selecting various inputs for the various sections, the user can look up the results of the best performing yield treatments by clicking on the Result button shown in Figure 5.

4.2.2   Detailed Version

Use this version when there is detailed knowledge of exit ramp and frontage road volumes as well as OD patterns of exit ramp and frontage road vehicles. To use the detailed version, the user will need accurate data on the following:

- *peak hour volume (vph) and OD patterns of U-turn vehicles,*
- *peak hour volume (vph) and OD patterns of frontage road vehicles (vph), and*
- *distance from the U-turn–frontage road gore to both the first driveway on the frontage road and the entrance ramp downstream.*

Select the Detailed Version and click on the U-Turn and Frontage Road Yield Treatment button to open the GUI shown in Figure 6. Here the user can input specific values for driveway volume, U-turn volume, and frontage road volume.
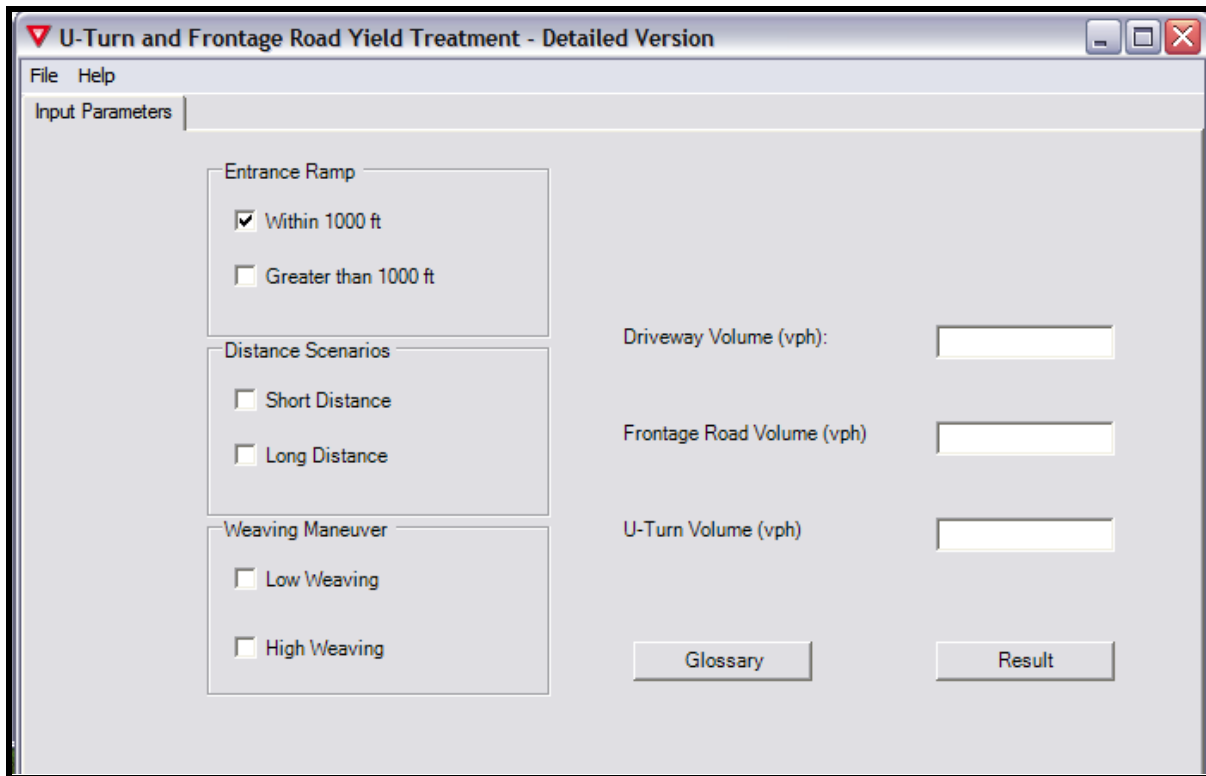
Figure 6. U-Turn and Frontage Road Yield Treatment GUI—Detailed Version.

5.0   EXTRACTING AND INTERPRETING RESULTS

There are two general ways of analyzing frontage road yield treatments in FRYTAT. The two general cases are:

- analyzing a specific case and
- analyzing a general case.

5.1   Analyzing a Specific Case

To analyze a specific case of either an exit ramp and frontage road or U-turn and frontage road, select all required inputs. Under this scenario, FRYTAT selects a single yield treatment category as the best yield treatment for the selected case. The next section presents two simple examples of the Exit Ramp and Frontage Road Yield Treatment Basic Version and U-Turn and Frontage Road Yield Treatment Detailed Version.

5.1.2   Sample Analysis of Specific Case I—Exit Ramp and Frontage Road Yield Treatment Basic Version

Step 1. Select the Basic Version.
Step 2. Click on the Exit Ramp and Frontage Road Yield Treatment button.
Step 3. Select the following parameters:
- Normal Weaving for Frontage Road Vehicle Maneuver,
- High Weaving for Exit Ramp Vehicle Maneuver,
- 6 and more for Number of Driveways,
- 501-1500 ft for Distance,
- Moderate for Exit Ramp Volume, and
- Moderate for Frontage Road Volume.
Step 4. Click on the Result button (highlighted in Figure 7).

FRYTAT will show the best yield treatment option (Category Result) for the specific case selected from Steps 1 through 4 as shown in Figure 8. In this case, the analysis selected Category 2 as the best performing yield treatment for the given specific case selected. There are three menu options circled in Figure 8. These are the Input Parameters, Category Result, and Performance Result.
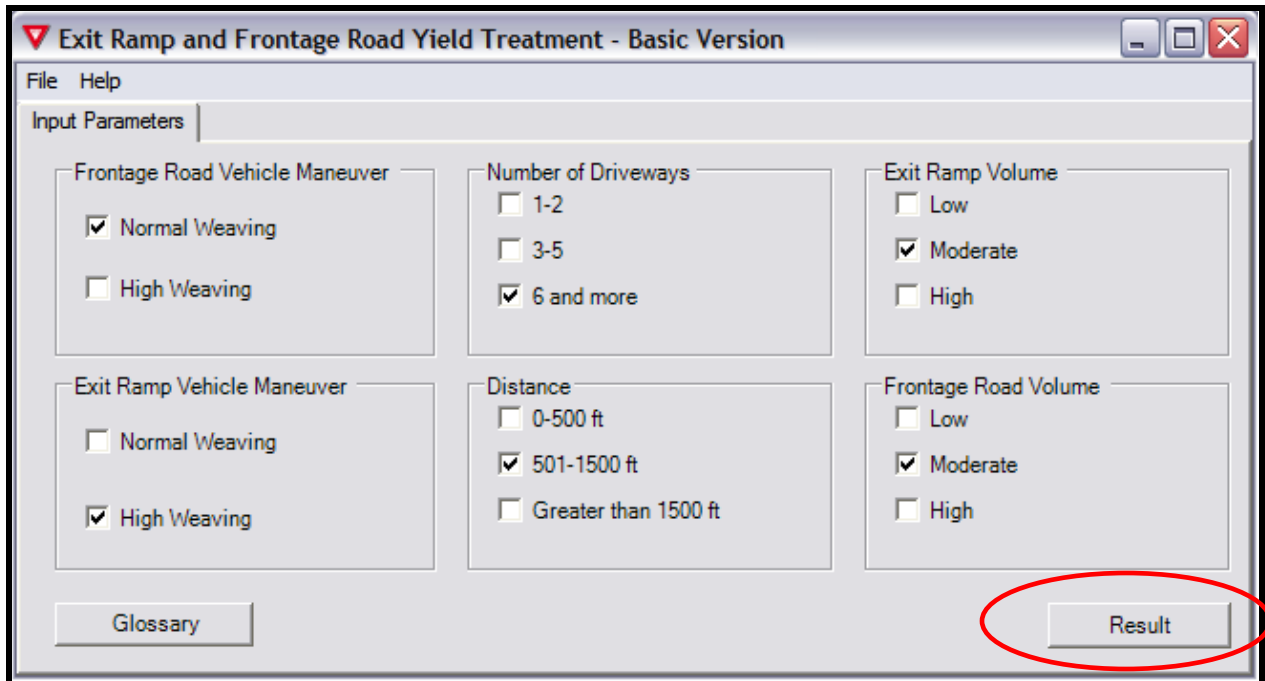
Figure 7. Sample Analysis of Specific Case I—Selection Parameters.

Input Parameters:

Click on the Input Parameters tab to return to the input selection view (Figure 7).

Category Result

This is the current view of the best category for the specific case as shown in Figure 8.

Performance Result

Click on the Performance Result tab to give a detailed report on the performance measures of the various yield treatments under the specific case selected (see Figure 9). The user can review the detailed performance measures including the following system-wide measures of effectiveness (system MOE):

- total travel time (hour),
- average speed (mph),
- average delay (seconds), and
- average stops (number of stops) delay.

The user can also analyze the following for the various vehicle groups (the analysis groups vehicles with similar weaving patterns separately):

- average stop delay time (seconds),
- average travel time (seconds),
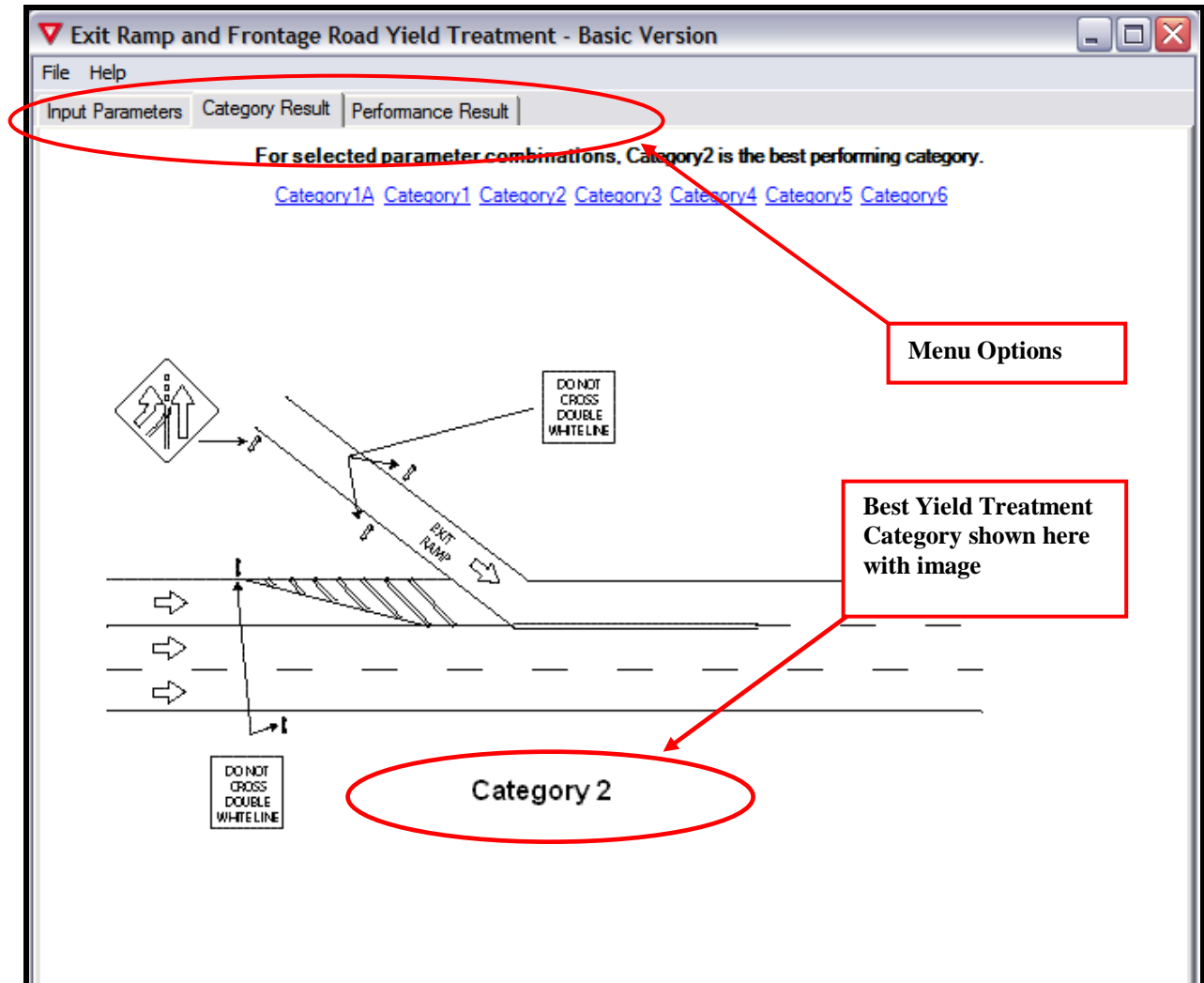- average delay time (seconds), and
- average number of stops.

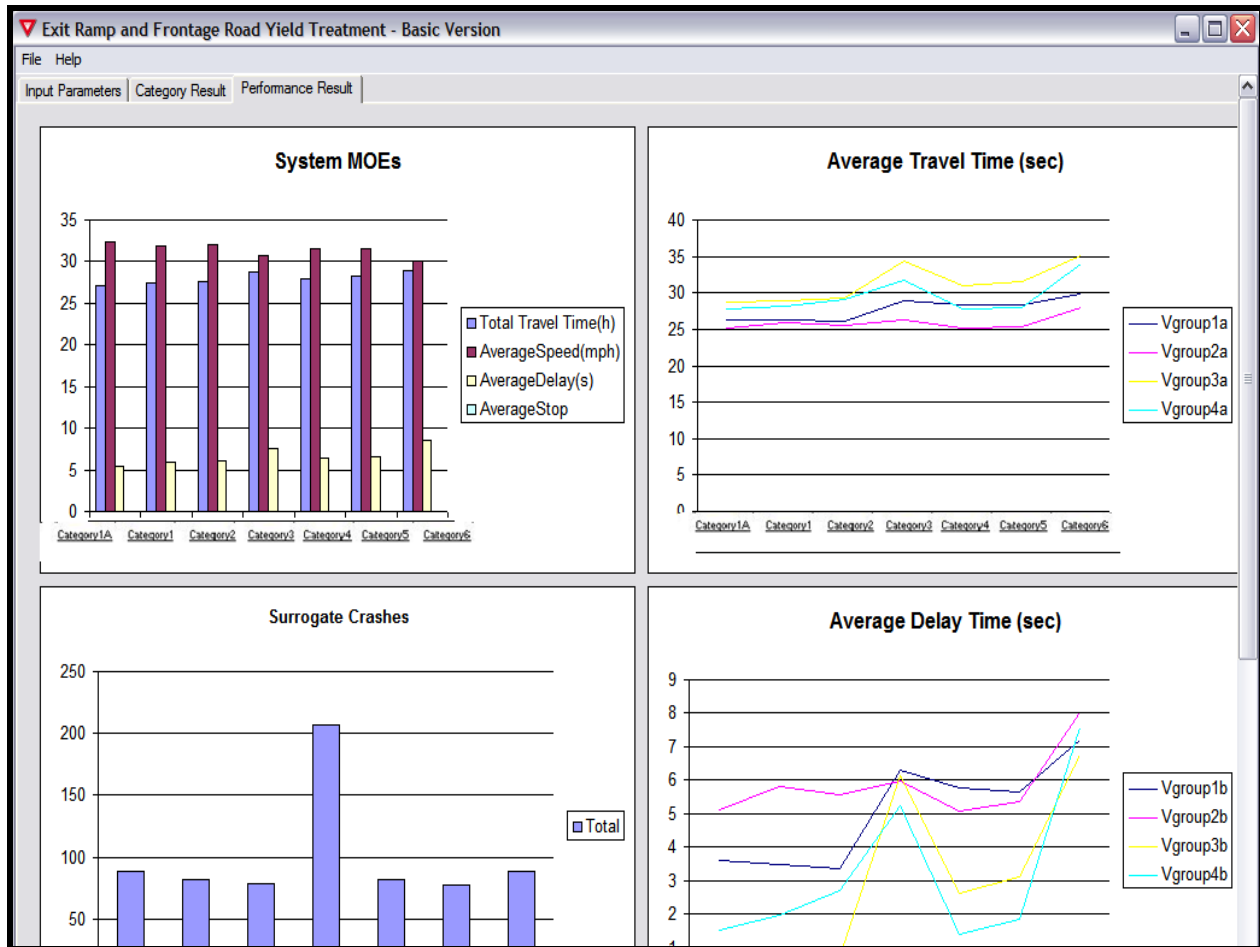**Figure 8. Category Result for Sample Analysis of Specific Case I.**

Figure 9. Performance Result for Sample Analysis of Specific Case I.

Below are the definitions for the various vehicle groups:

- Vgroup1 (Vehicle Group 1): vehicles exiting the ramp and making a right turn either at a driveway or at the downstream intersection (assumed to be weaving traffic),
- Vgroup2 (Vehicle Group 2): vehicles exiting the ramp and going through or making a left at the light or a U-turn (assumed to be non-weaving traffic),
- Vgroup3 (Vehicle Group 3): vehicles on the frontage road going through or making a right turn either at a driveway or at the downstream intersection (assumed to be non-weaving traffic), and
- Vgroup4 (Vehicle Group 4): vehicles on the frontage road making either a U-turn or left turn at the downstream intersection (assumed to be weaving traffic).

Finally, FRYTAT also depicts the safety performance of all the yield treatment categories in terms of surrogate crashes under the Performance Result tab (as shown in Figure 9).

Click on the underlined name of each category in the Category Result tab and Performance Result tab to show an image of the selected category.

Preferred Yield Treatment Is Impractical

The user might encounter a case where, due to geometric limitations (for instance not enough space to add an additional lane), an option other than the preferred yield treatment selected by the FRYTAT database is desired. In this case, the second, third, and fourth best performing yield treatment option can be selected using the Performance Result shown in Figure 9.

5.1.3   Sample Analysis of Specific Case II—U-Turn and Frontage Road Yield Treatment Detailed Version

Step 1. Select the Detailed Version.
Step 2. Click on the U-Turn and Frontage Road Yield Treatment button.
Step 3. Select the following parameters:
- Within 1000 ft for Entrance Ramp,
- Long Distance for Distance Scenarios, and
- High Weaving for Weaving Maneuvers.
Step 4: Input the following values:
- 95 for Driveway Volume (vph),
- 1150 for Frontage Road Volume (vph), and
- 550 for U-Turn Volume (vph).
Step 5. Click on the Result button (highlighted in Figure 10).

FRYTAT will show the best yield treatment option (Category Result) for the specific case selected from Steps 1 through 5 as shown in Figure 11. In this case, the analysis selected Category 2 as the best performing yield treatment for the given specific U-turn and frontage road case selected. Similarly, for the U-turn and frontage road analysis there are three menu options as shown in Figure 11. These are the Input Parameters, Category Result, and Performance Result.

Input Parameters

Click on the Input Parameters tab to return to the input selection view as shown in Figure 10.

Category Result

Click on the Category Result tab to show the best category for the specific case as shown in Figure 11.
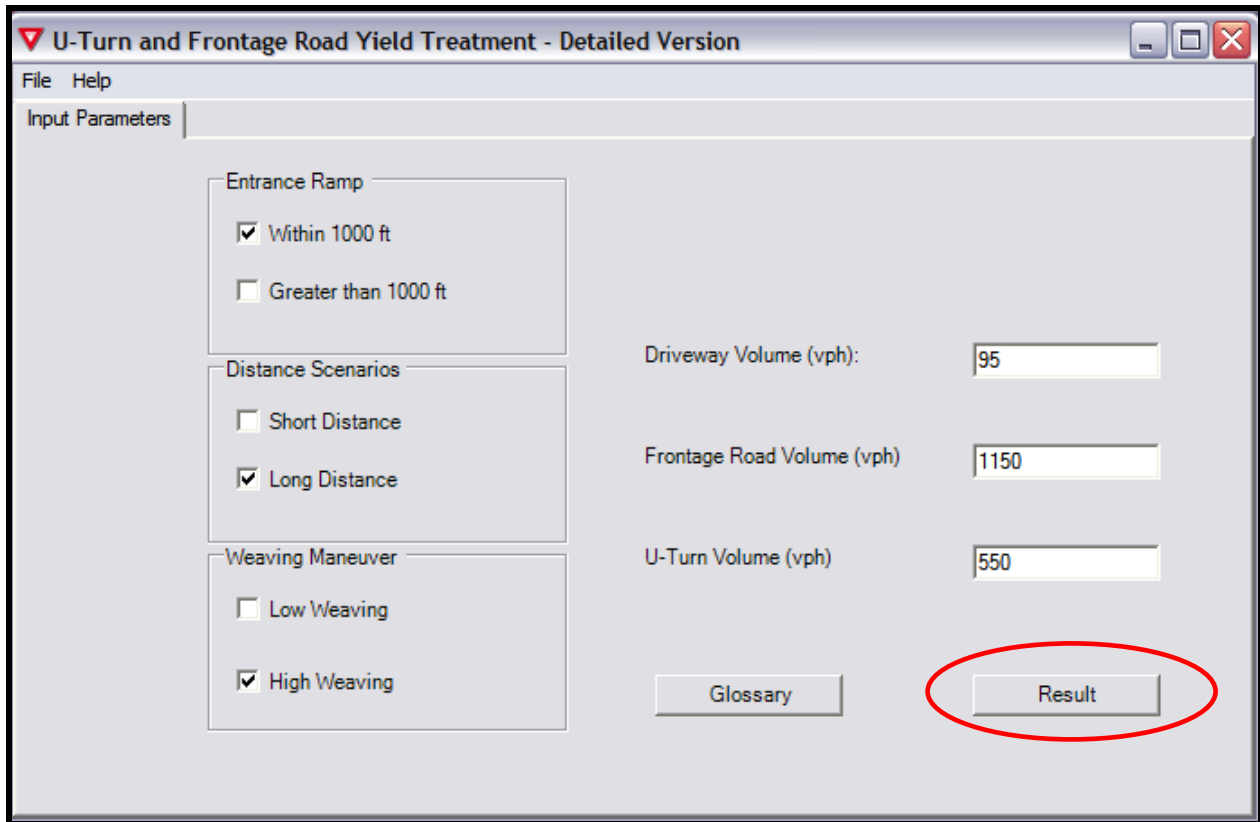
Figure 10. Sample Analysis of Specific Case II—Selection Parameters.

Performance Result

Click on the Performance Result tab to give a detailed report on the performance measures of the various yield treatments under the specific case selected (see Figure 12). The user can review the detailed performance measures including the following system MOEs:

- average speed (mph),
- average density,
- average delay (seconds), and
- average stop delay (seconds).

FRYTAT also depicts the safety performance of all the yield treatment categories in terms of surrogate crashes under the Performance Result tab (Figure 12).

Click on the underlined name of each category in the Category Result tab and Performance Result tab to show an image of the selected category.
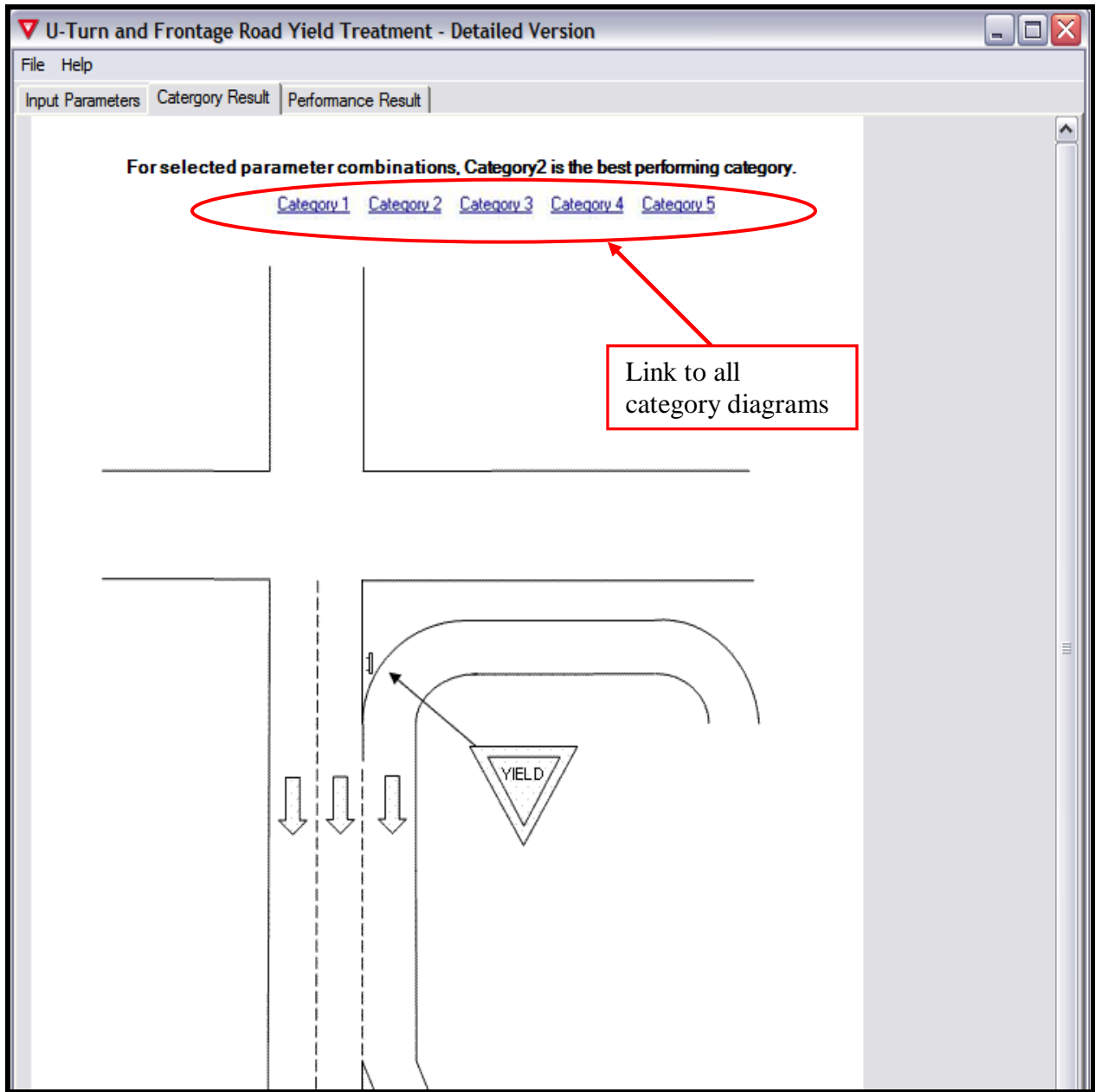
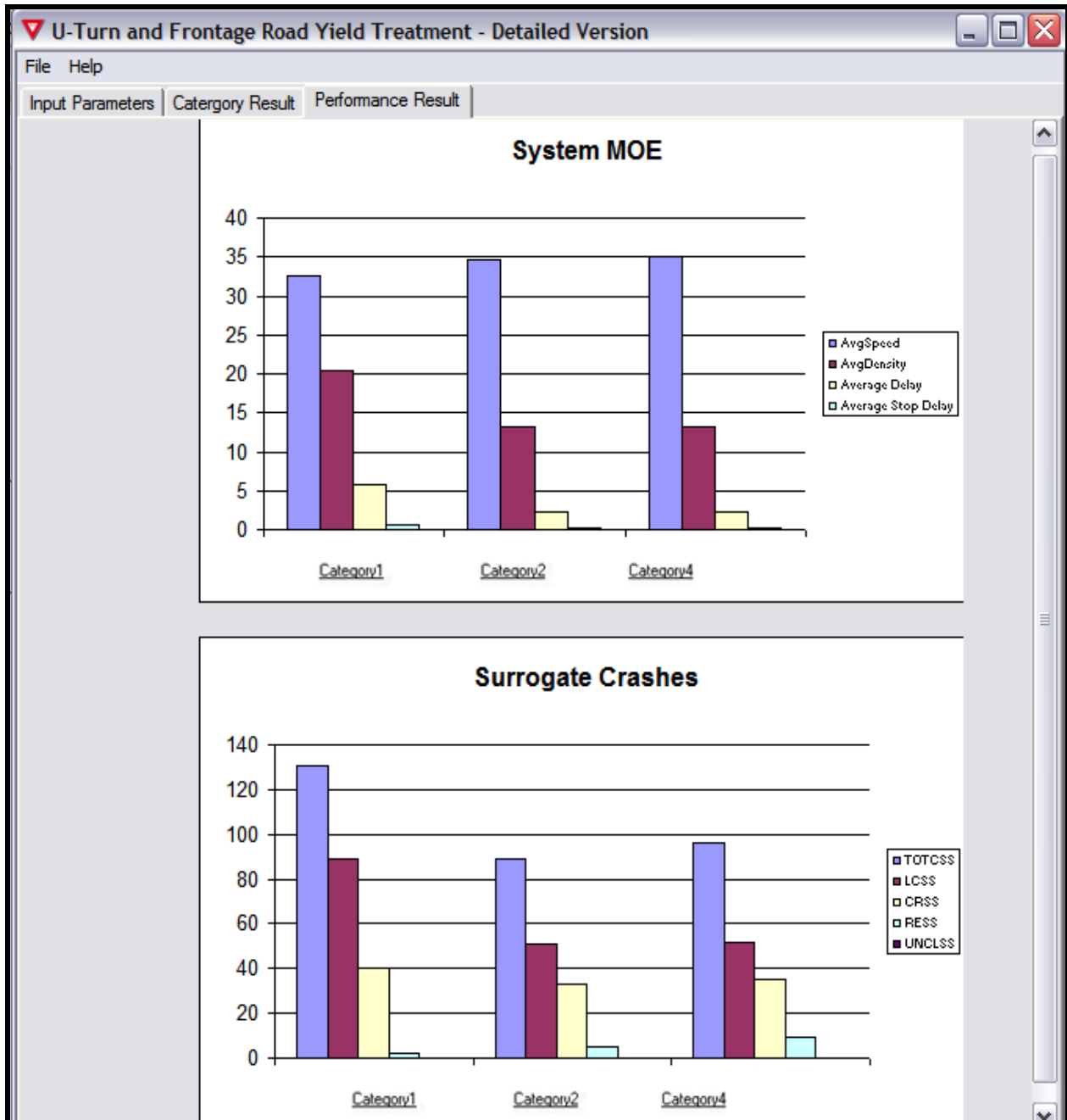**Figure 11. Category Result for Sample Analysis of Specific Case II.**

Figure 12. Performance Result for Sample Analysis of Specific Case II.

5.2   Analyzing a General Case

This is the case when the user wants to use FRYTAT more as a planning tool. For instance, the user might want to determine the performance of various yield treatments with no restrictions on number of driveways (select all other input parameters except the Number of Driveways). Performing this type of analysis allows FRYTAT to give the user the relative performance of the various yield treatment categories over the range of combinations of parameters not selected.

5.2.1 Sample Analysis of General Case I—Exit Ramp and Frontage Road Yield Treatment Detailed Version

Step 1. Select the Detailed Version.
Step 2. Click on the Exit Ramp and Frontage Road Yield Treatment button.
Step 3. Select the following parameters:
  - High Weaving for Frontage Road Vehicle Maneuver and
  - High Weaving for Exit Ramp Vehicle Maneuver.
Step 4: Input the following values:
  - 290 for Frontage Road Volume (vph),
  - 1050 for Exit Ramp Volume (vph),
  - 4 for Number of Driveways, and
  - leave the Distance (ft) input blank (results will show performance over various distances).
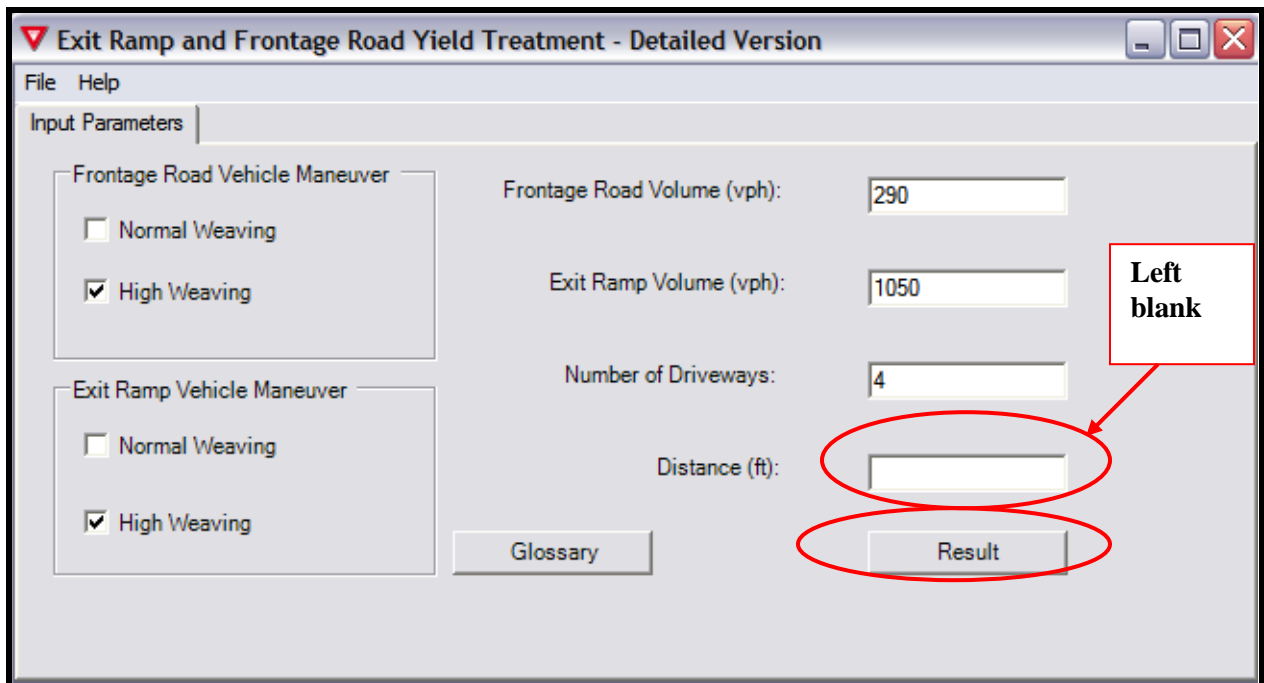Step 5. Click on the Result button (see Figure 13).

Figure 13. Sample Analysis of General Case I—Selection Parameters.

In the general case scenario, there are only two menu options as shown in Figure 14. These are the Input Parameters and the Category Result.

Input Parameters

Click on the Input Parameters tab to return to the input selection view as shown in Figure 13.

Category Result

Click on the Category Result tab to show the percentage of best performing cases over various distances (or other parameter[s] that is [are] left blank). Figure 14 shows that Categories 1 and 1A were the only best performing categories for all distances given the selected parameters. Category 1 performed the best (67 percent of the time), and Category 1A was the best 33 percent of the time. None of the other categories performed the best for the given input parameters.

Click on the underlined name of each category in the Category Result tab to show an image of the selected category.
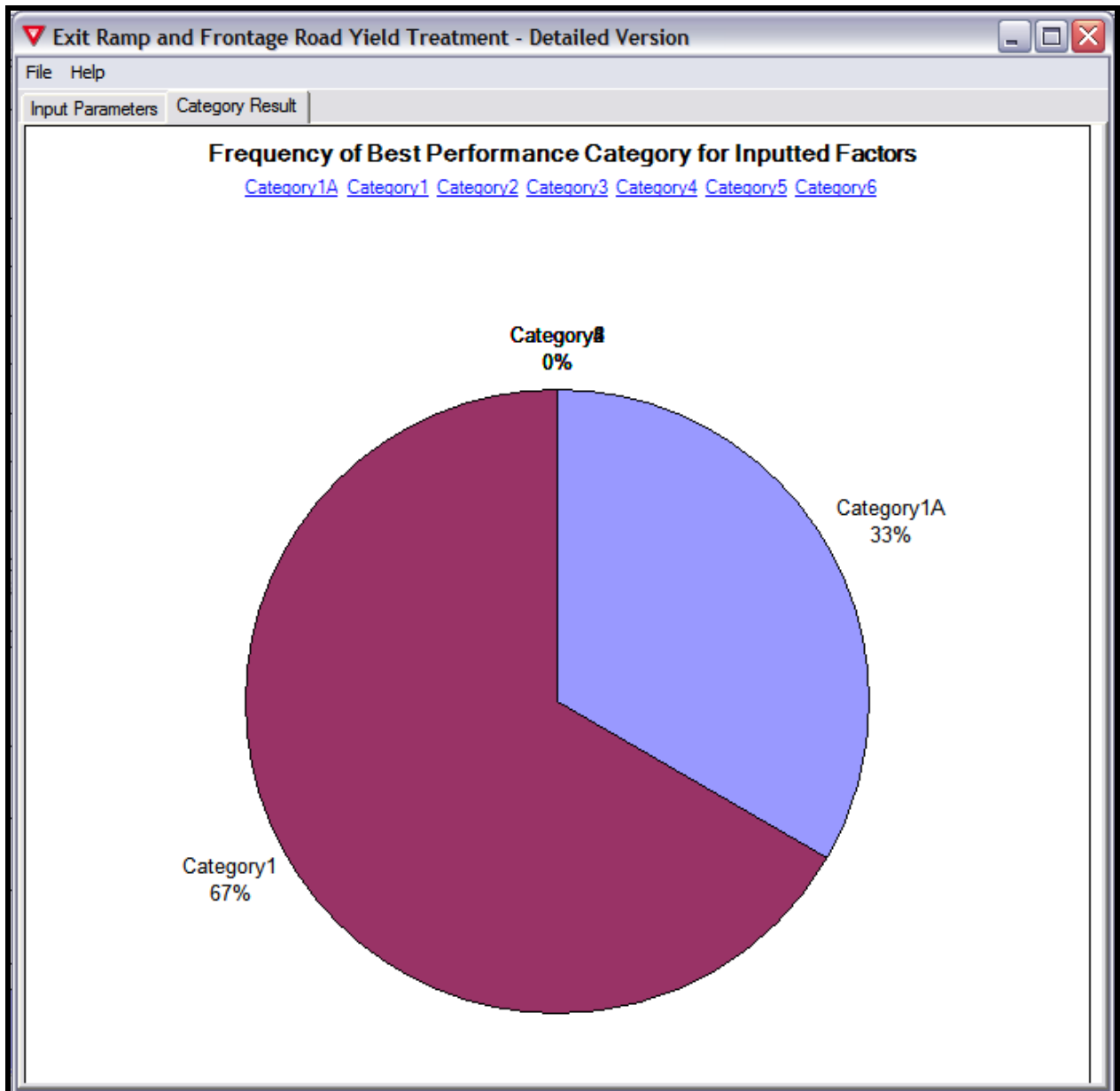

Figure 14. Category Result for Sample Analysis of General Case I.

5.3 Examples of Analysis of Existing Locations

5.3.1 Data Collection and Information

This section presents an analysis of two real-world locations of a frontage road–exit ramp analysis using FRYTAT. The two locations are:

- Site 1: Northbound US 183 Exit to Loop 360 in Austin, Texas; and
- Site 2: Eastbound Loop 410 Exit to Perrin Beitel in San Antonio, Texas.

Vehicle volume data on the exit ramp and frontage road were collected with pneumatic tube counters. Researchers used recorded video to determine turning volumes at the intersection for the two sites. Researchers also took measurements of the distances from the gore to the downstream intersection using a measuring wheel. Table 1 below shows data collected at the two sites.

Table 1. Site Data for Existing Locations.

Characteristics	Site 1	Site 2
Site Characteristics		
Current Yield Treatment Category	1A	3
Geometrics		
Distance from Exit Gore to Downstream Intersection (ft)	880	450
Number of Driveways (between Exit Gore and Downstream Intersection)	2	3
Traffic Characteristics—Exit Ramp Vehicles		
Peak Volume (vph)	416	1047
Volume of Right-Turning Traffic[1] (vph)	105	270
Volume of Through Traffic (vph)	156	81
Volume of Left-Turning Traffic (vph)	103	585
Volume of U-Turning Traffic (vph)	52	111
Traffic Characteristics—Frontage Road Vehicles		
Peak Volume (vph)	1891	326
Volume of Right-Turning Traffic (vph)	300	127
Volume of Through Traffic (vph)	754	26
Volume of Left-Turning Traffic (vph)	557	112
Volume of U-Turning Traffic (vph)	228	61

[1] Right turns at driveways and downstream intersection

5.3.2 Data Analysis and Input into FRYTAT

Table 2 below shows the values that are required for input into FRYTAT. In order to analyze the two sites in FRYTAT, some initial calculations need to be made of the following:

- The proportion or percentage of right-turning exit ramp vehicles: This is the percentage of all exit ramp vehicles that make a right turn either into a driveway or at the downstream intersection.
- The proportion or percentage of left-turning or U-turning frontage road vehicles: This is the percentage of all frontage road vehicles that make either a left turn at the downstream intersection or use the U-turn lane to make a U-turn.

Record and input the peak volumes at each site as the volume data for exit ramp and frontage road volume.

Table 2. FRYTAT Input Data for Existing Location Examples.

Characteristics	Site 1	Site 2
Site Characteristics		
Current Yield Treatment Category	1A	3
Geometrics		
Distance (ft)	880	450
Number of Driveways	2	3
Traffic Characteristics—Exit Ramp Vehicles		
Exit Ramp Volume (vph)	416	1047
Exit Ramp Vehicle Maneuver	Normal weaving (less than 50 percent of exit ramp vehicles make right turn)	Normal weaving (less than 50 percent of vehicles make right turn)
Traffic Characteristics—Frontage Road Vehicles		
Frontage Road Volume (vph)	1891	326
Frontage Road Vehicle Maneuver	Normal weaving (less than 50 percent of frontage road vehicles make left turn or U-turn)	High weaving (more than 50 percent of vehicles make left turn or U-turn)

Using the FRYTAT Exit Ramp and Frontage Road Yield Treatment Detailed Version option, enter the above information into the appropriate sections. Figure 15 shows the initial option choice (circled) using FRYTAT to analyze the two sites.
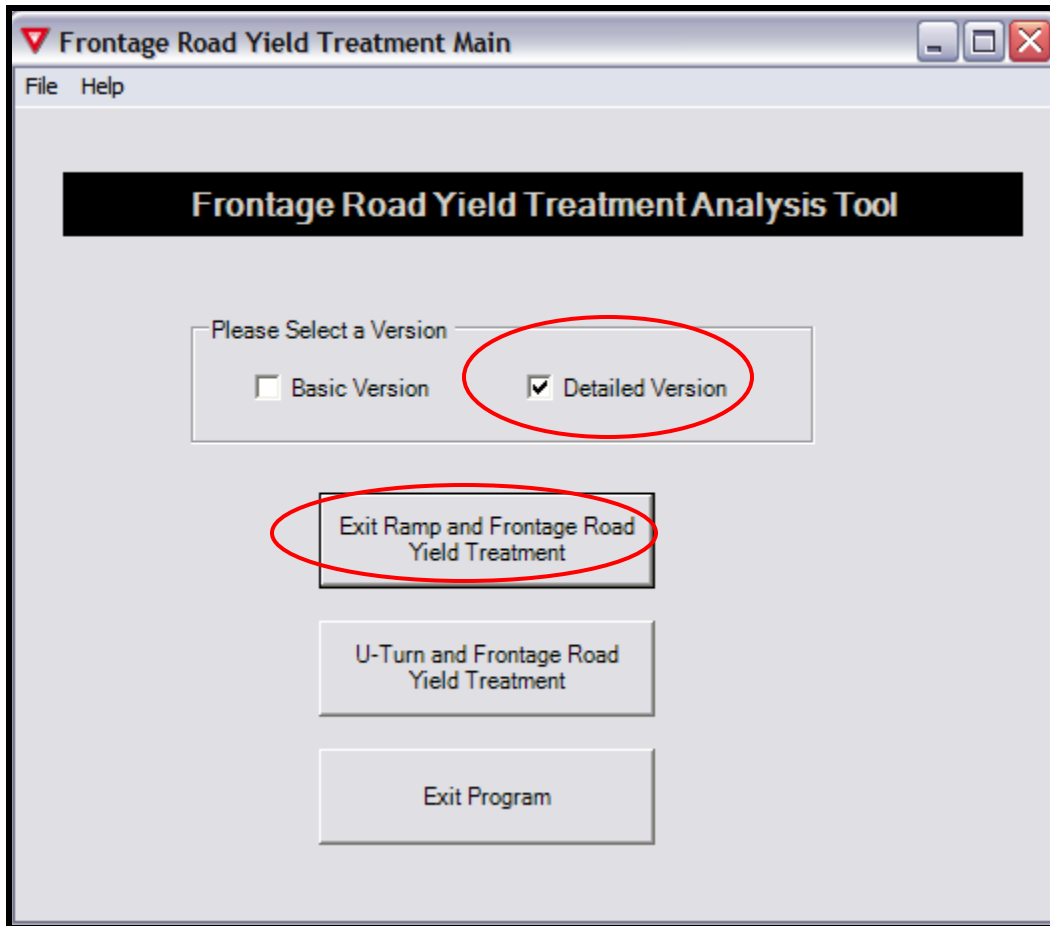
Figure 15. Selection of Appropriate Option for Analyses of Existing Location Examples.

Figure 16 shows the input values in the FRYTAT interface for Site 1 and Site 2 data.

Figure 16. Input Data for Existing Example Locations.

5.3.3   Results

FRYTAT gives the following as results for the two analyses:

- Site 1: Recommended Yield Treatment Category: Category 1 and
- Site 2: Recommended Yield Treatment Category: Category 1A.

For Site 2, the high volume, short distance to intersection and relatively high number of driveways indicate an undesirable geometric and volume combination. Selecting such an undesirable combination of factors, results in a warning message display, as shown in Figure 17. However, clicking on the OK button will still reveal the best category for the selected parameter combinations.
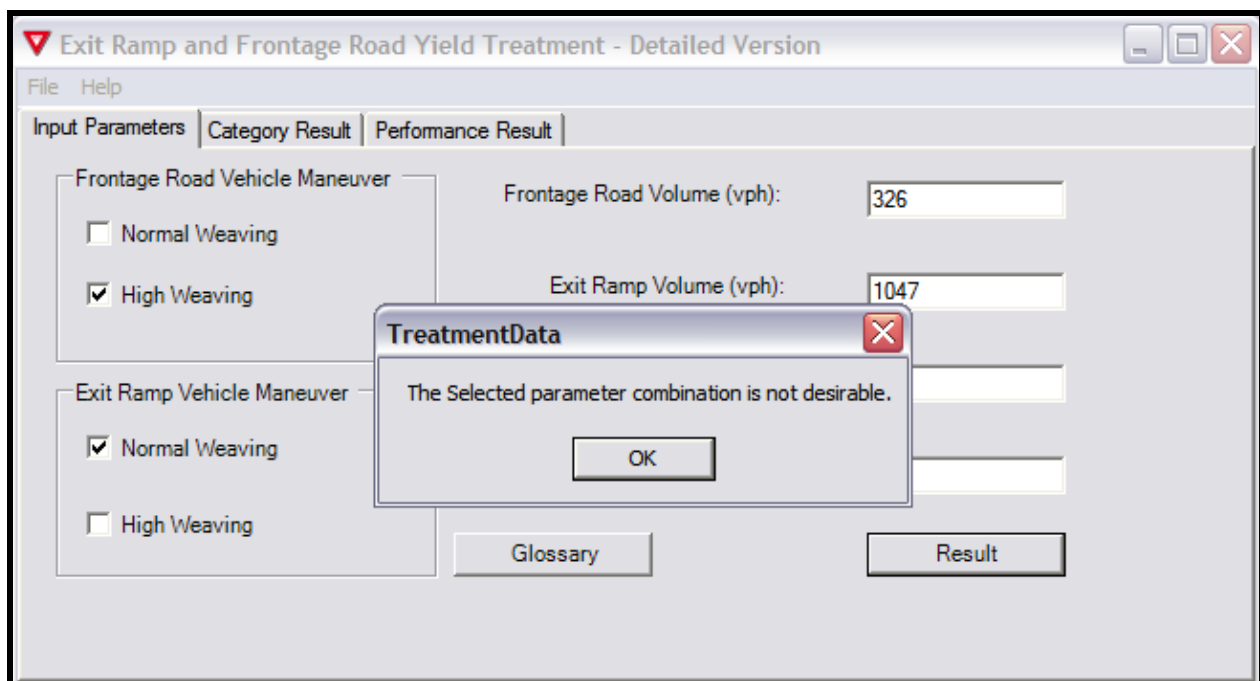

Figure 17. Warning Message for Undesirable Parameter Combination for Existing Site 2.

Figure 18 shows the results obtained from the FRYTAT database for two real-world locations.
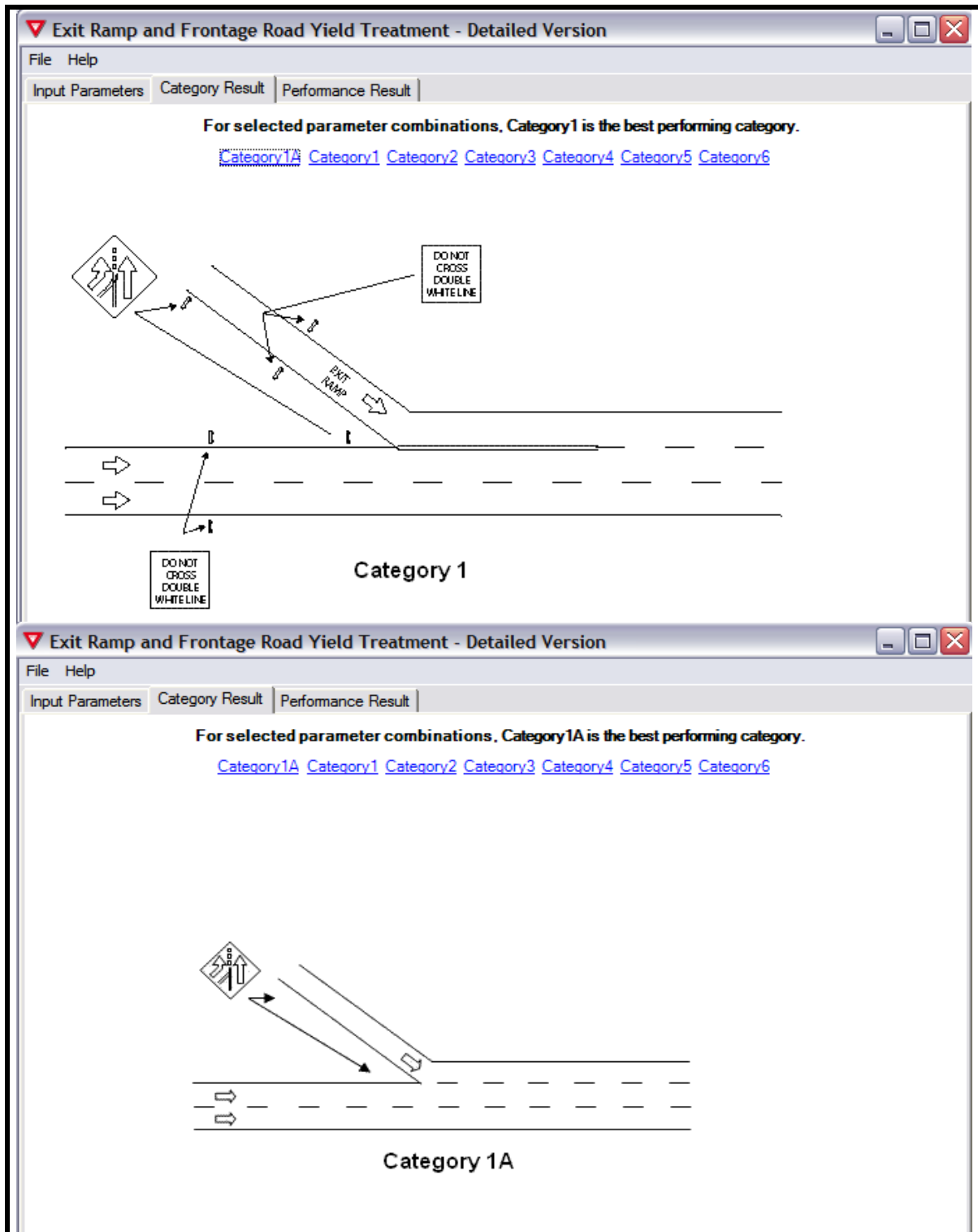

Figure 18. FRYTAT Results for Existing Example Locations.

6.0   SUMMARY

6.1   Where FRYTAT Fits

The FRYTAT program aids transportation professionals, both traffic operations and traffic planning, to determine the best yield treatment at exit ramp and frontage road merge areas as well as U-turn and frontage road merge areas.

The results provided by FRYTAT serve as a guide for practitioners to make more informed decisions regarding signing such merge areas. However, in some instances of limited sight distance on the frontage road, the engineer uses "engineering judgment" in determining the best yield treatment option for that scenario.

Use FRYTAT results in tandem with signing guidelines spelled out in the TxDOT *Signs and Markings Manual* (http://onlinemanuals.txdot.gov/txdotmanuals/smk/index.htm) for the proper signing and striping procedures.