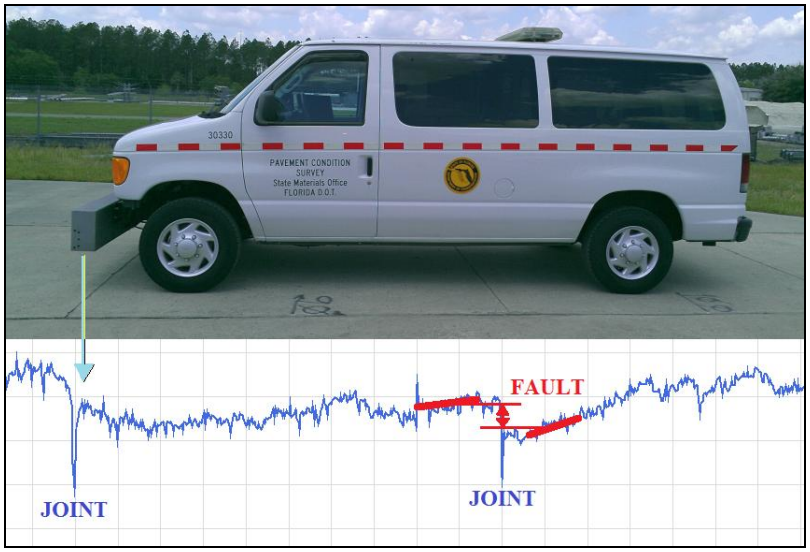
PAVESUITE | PAVEMENT EVALUATION TOOLS

Automated Faulting Method

User's Guide



May 2013

DISCLAIMER

This user guide is based on Florida DOT's (FDOT) practice using International Cybernetics Corporation's (ICC) high speed profiler and the WinRP 2.1.2.1 data processing software.

INTRODUCTION

The Automated Faulting Method is a technique which uses an algorithm to detect transverse joints and cracks in jointed concrete pavements and estimate faulting at these locations from longitudinal roadway profiles. The analysis is conducted using the Automated Faulting Program (AFP) based on an algorithm which 1) identifies transverse joint/crack locations from longitudinal profile traces, and 2) estimates the corresponding faulting magnitudes. The computation for faulting is based on the AASHTO R36 protocol. The program outputs joint or crack longitudinal distance offsets and the corresponding faulting magnitudes in a Microsoft Excel spreadsheet. The AFP was developed in Microsoft Excel, using the Visual Basic for Application (VBA) programming language (Figure 1).

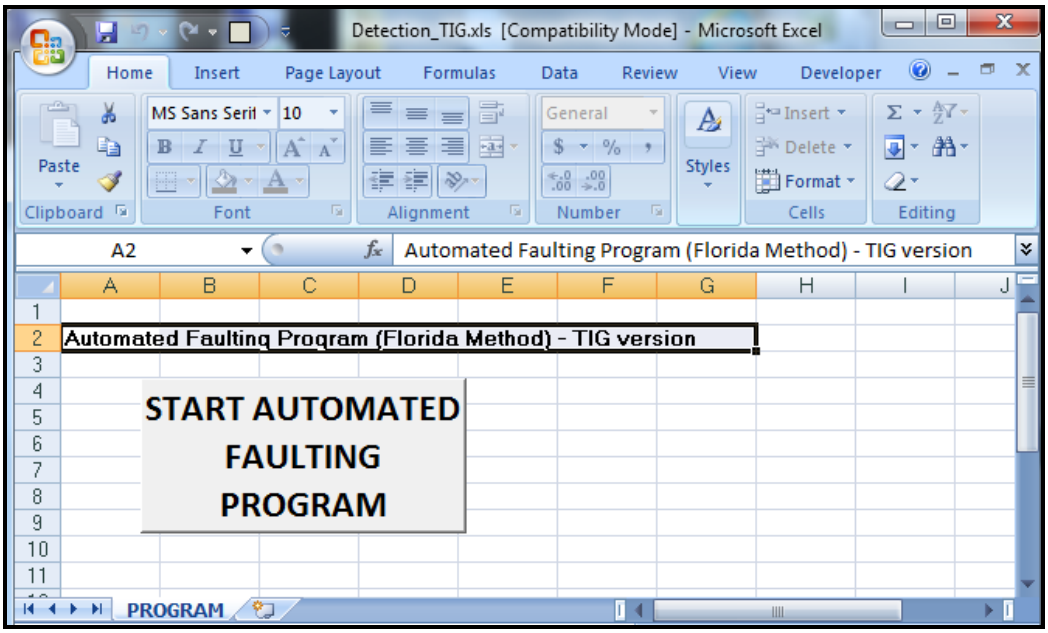


Figure 1. Automated Faulting Program

DATA COLLECTION EQUIPMENT

The equipment used for profile data collection consists of a host vehicle equipped with an ASTM E- 950 Class II or better inertial profiling system. The system must be properly calibrated following the static and dynamic test procedures recommended by the manufacturer. A profile sampling interval less than 1 inch is recommended for reasonable joint detection accuracy.

REQUIREMENTS TO RUN AFP

(1) Windows XP or newer
(2) MS Excel 2007
(3) Minimum 2 GB of RAM
(4) Running Macros option enabled in the Microsoft Excel (Figure 2)

Figure 2. Enabling Macros in Microsoft Excel

ANALYSIS

This section describes the steps for profile data analysis using the AFP. There should be no digital pre-filtering of the longitudinal profile when post-processing the profile data.

1. The input file must be in the exact same format as shown in Appendix A.
2. Prior to launching the AFP, ensure the following settings in ***Option's Trust Center's Macro Settings*** are set:
   (a) select ***Enable all macros***,
   (b) set ***Trust Access*** *the* ***VBA project object model*** to ***ON***.
3. Launch AFP by executing the ***Detection_TIG.xls*** file. This becomes the main project file.
4. The program should automatically launch and request the path to the profile input file "*.7xx", as shown in Figure 2. If this does not occur, click on the ***Start Automated Faulting Program*** button (Figure 1).
5. Select the input file to process and click the ***Open*** button (Figure 2).

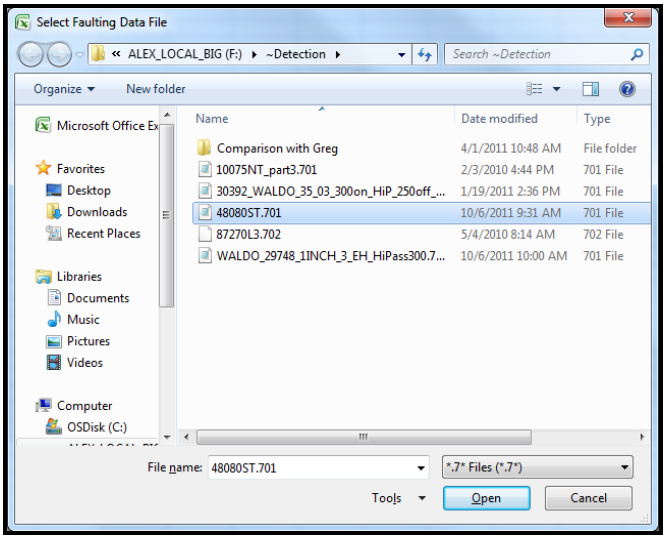


Figure 2. AFP Profile Input File window

6. The program settings window opens with default values already preset as shown in Figure 3. Click the ***OK*** button. User has an option to change **Total Number of Program Iterations** and **Percent of Cracks**. More program iterations yields better optimal sensitivity factor but may take longer time to process the input file. Percent of Cracks setting allows user to adjust the program for concrete pavements with larger amount of the cracked slabs.

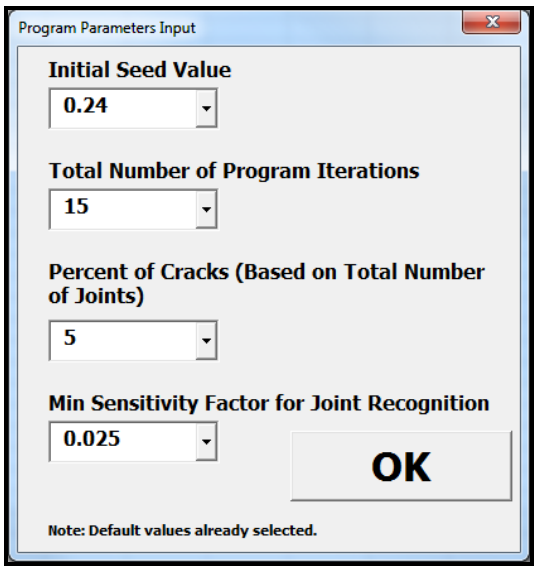


Figure 3. AFP Setting window

7. The program automatically determines the BMP (Beginning Milepost) and EMP (Ending Milepost) from the input file. The window shown in Figure 4 opens with calculated values for **BMP**, **EMP**, and default values for **Avg Slab Length** and **Minimum Faulting Threshold** set at 20 ft and 0 inch, respectively. User may enter new values for project limits to analyze, typical slab length, and minimum faulting threshold. By default all recognized joints and cracks will be included in the analysis, regardless of faulting magnitude. Click the ***OK*** button.

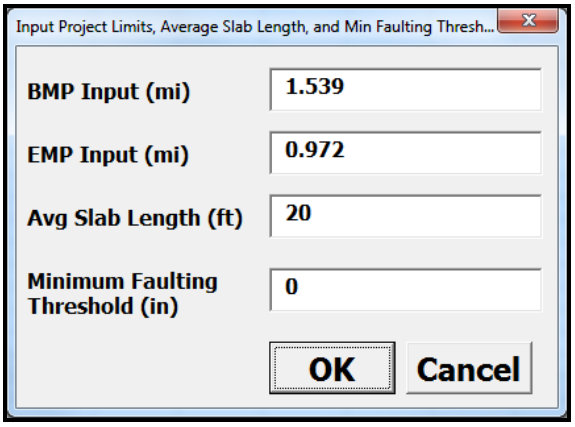


Figure 4. Project Limits and Slab Length Input Window

8. The results are saved in an Excel workbook named after the input file (ex: *Input__48080ST*). When saving, choose ***Save As***, and then select **Excel Workbook (or Excel 97-2003 Workbook)** option, as seen in Figure 5. Finally, click on the ***Save*** button.

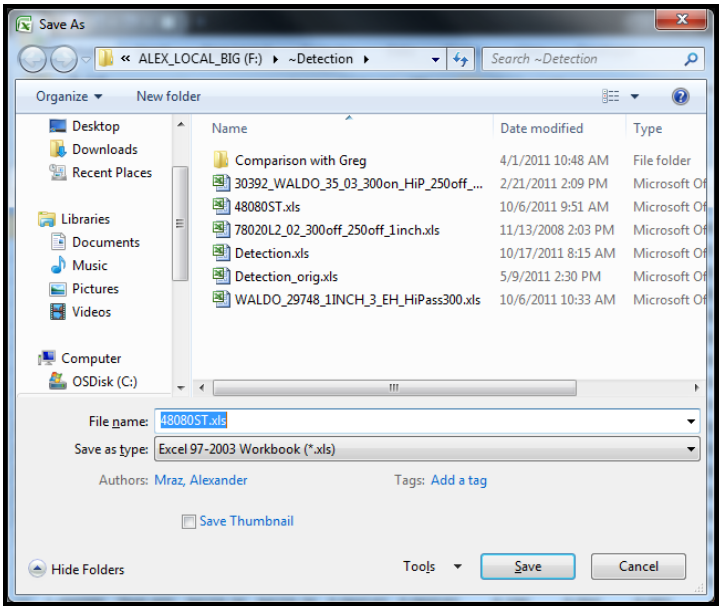


Figure 5. AFP Save Resutls window

9. The Excel workbook contains two worksheets:
   a) Input profile data worksheet (ex: *Input___48080ST*), and
   b) ***Output*** worksheet contains location and magnitude of each fault value, and average fault value for the tested project. In addition, it contains sensitivity/seed value used for faulting calculation and input parameters. An Example output worksheet is shown in Figure 6.

	A	B	C	F	L
1	**Milepost**	**Footpost**	**Kilometerpost**	**Faulting (in)**	**Sensitivity/Seed Value: 0.0816**
2	0.0019	9.99	0.0030	0.13	Initial Sensitivity/Seed Value: 0.24
3	0.0057	29.96	0.0091	-0.03	Total Number of Iterations: 15
4	0.0095	50.07	0.0153	0.07	Percent of Cracks: 10 %
5	0.0133	70.25	0.0214	0.06	Min Sensitivity Factor: 0.02
6	0.0171	90.15	0.0275	0.09	Avg Slab Length: 20 ft
7	0.0196	103.26	0.0315	0.22	Min Faulting Threshold: 0.0816
8	0.0215	113.32	0.0345	-0.47	Input File: WALDO_29748_1INCH_3_EH_HiPass30
12	**Average Fault for Tested Section (in)**				
13	0.0532				
16	Note1: Data in ITALIC are within exclusion areas (ex Bridges, box culverts, and other structures), (COUNT=0)				
17	Note2: STRIKEOUT data are locations where faulting is bellow user-defined minimum threshold value (COUNT=0)				
18	Note3: Column F, Faulting, is calculated per AASHTO R-36				

Figure 6. Example Output

APPENDIX A

(1) PROFILE DATA (*.7xx) file structure:

```
COUNTY:           48               DATE COLLECTED:   12/01/2010
ROUTE:            SR 295           TIME:             08:30:04
DIRECTION:        South(-)         OPERATOR:         JASON NOEL
LANE:             TRAVEL           DRIVER:           JASON NOEL
VEHICLE:          DOT 29863        DCF:              4466.9
UNITS:            ENGLISH          WAVELENGTH-LONG:  300 ft
SECTION:          080
SUB SEC:          000
COMMENT1:         RIGID SOUTH      RPT VERSION:      2.1.2.1
AVG SPEED:        27.4 mph         MDR VERSION:      WP2.7.0.0
SAMPLE DISTANCE:  0.818 in (1)     SENSOR CAL DATE:  11/29/2010
PROFILE DISTANCE: N.A.             ACCEL CAL DATE:   12/01/2010
OUTPUT FILE NAME: G:\PCS\PCS DATA\2010-2011\By County\Escambia\RIGID\48080ST.701
    FEET                IN
 REF POST    DMI       PROF # 1     PROF # 2
----------   -------   ----------   ----------
  8125.920     14921       -0.266       -0.163       REF_RST   1
  8125.852     14922       -0.258       -0.175
  8125.784     14923       -0.244       -0.188
  8125.716     14924       -0.238       -0.190
  8125.647     14925       -0.242       -0.189
  8125.579     14926       -0.261       -0.188
  8125.511     14927       -0.280       -0.186
  8125.443     14928       -0.289       -0.188
  8125.375     14929       -0.299       -0.192
  8125.307     14930       -0.279       -0.196
  8125.238     14931       -0.256       -0.206
  8125.170     14932       -0.260       -0.205       RGH_ON
  8125.102     14933       -0.264       -0.198
  8125.034     14934       -0.279       -0.206
```