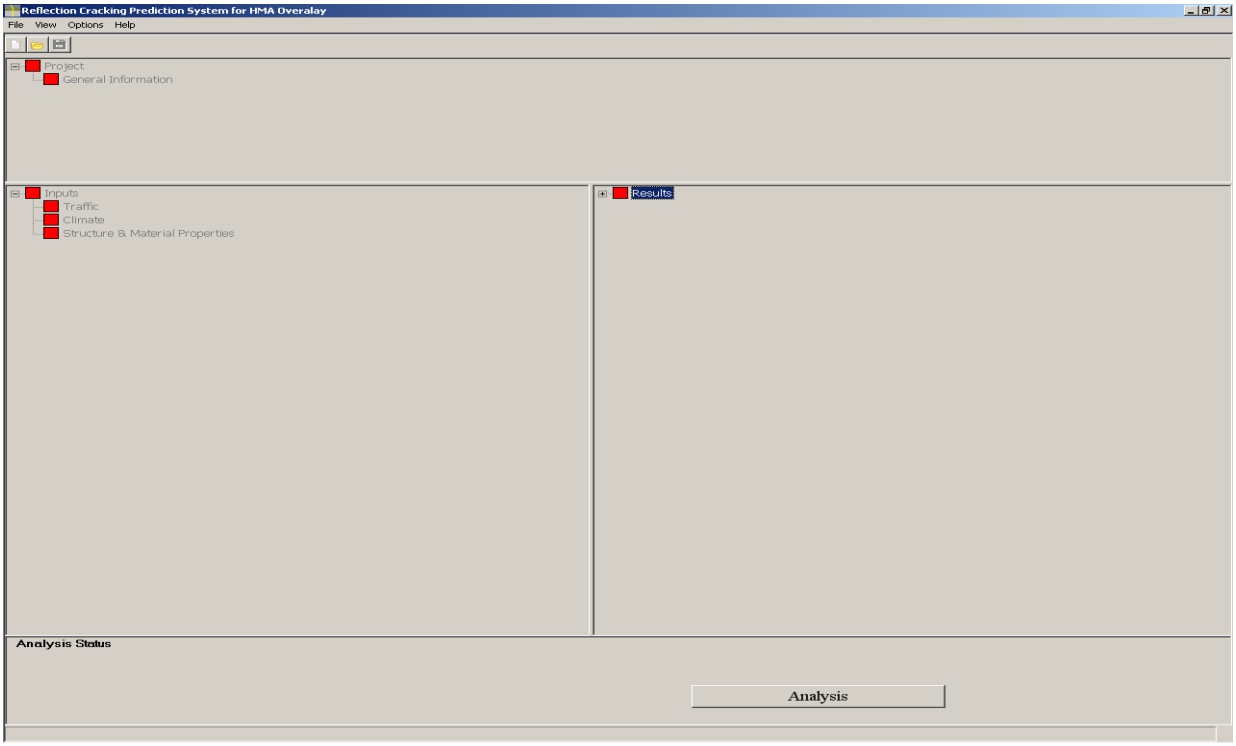
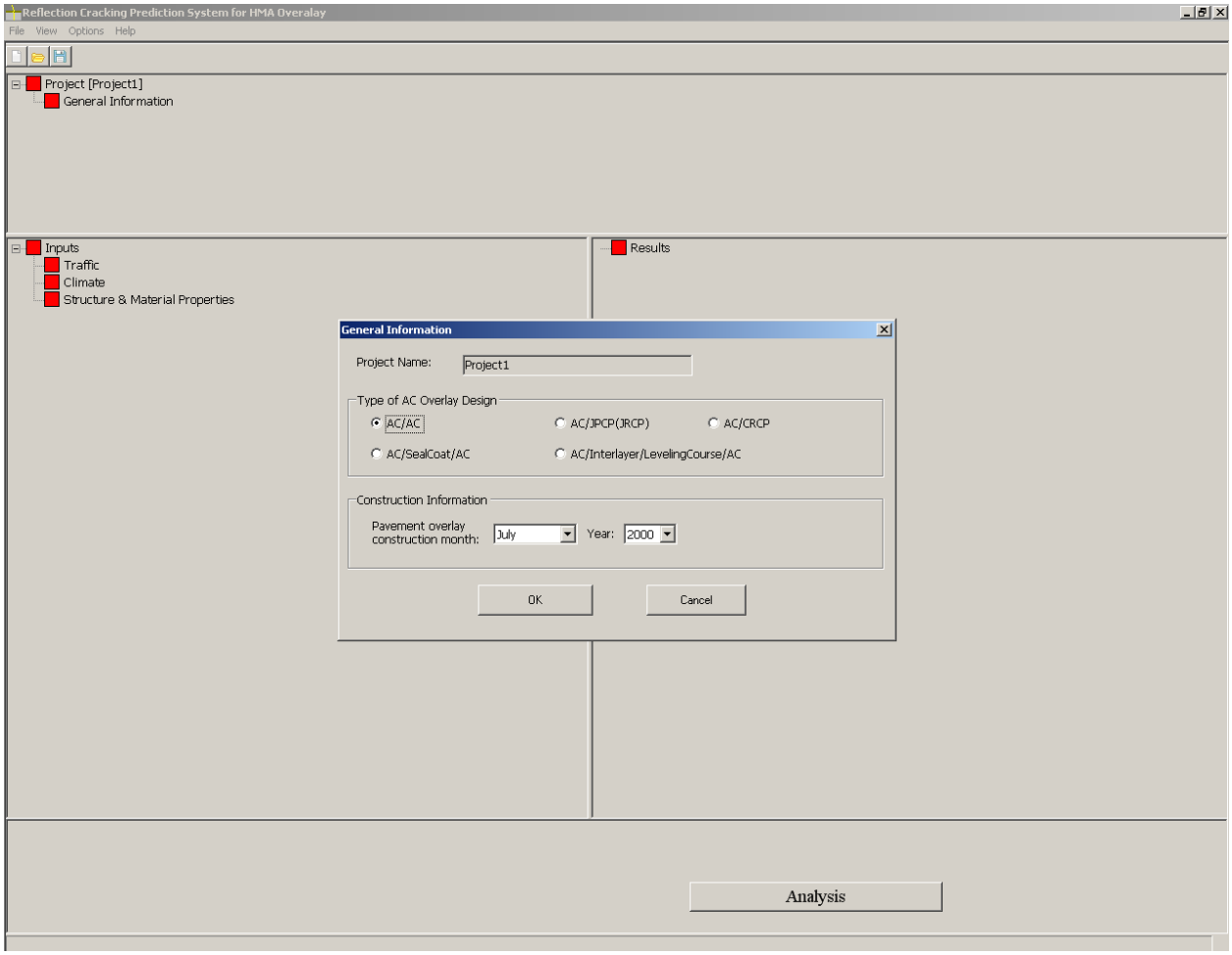
APPENDIX P
USER'S GUIDE TO THE COMPUTATIONAL MODEL TO FIELD DATA CALIBRATION PROGRAM

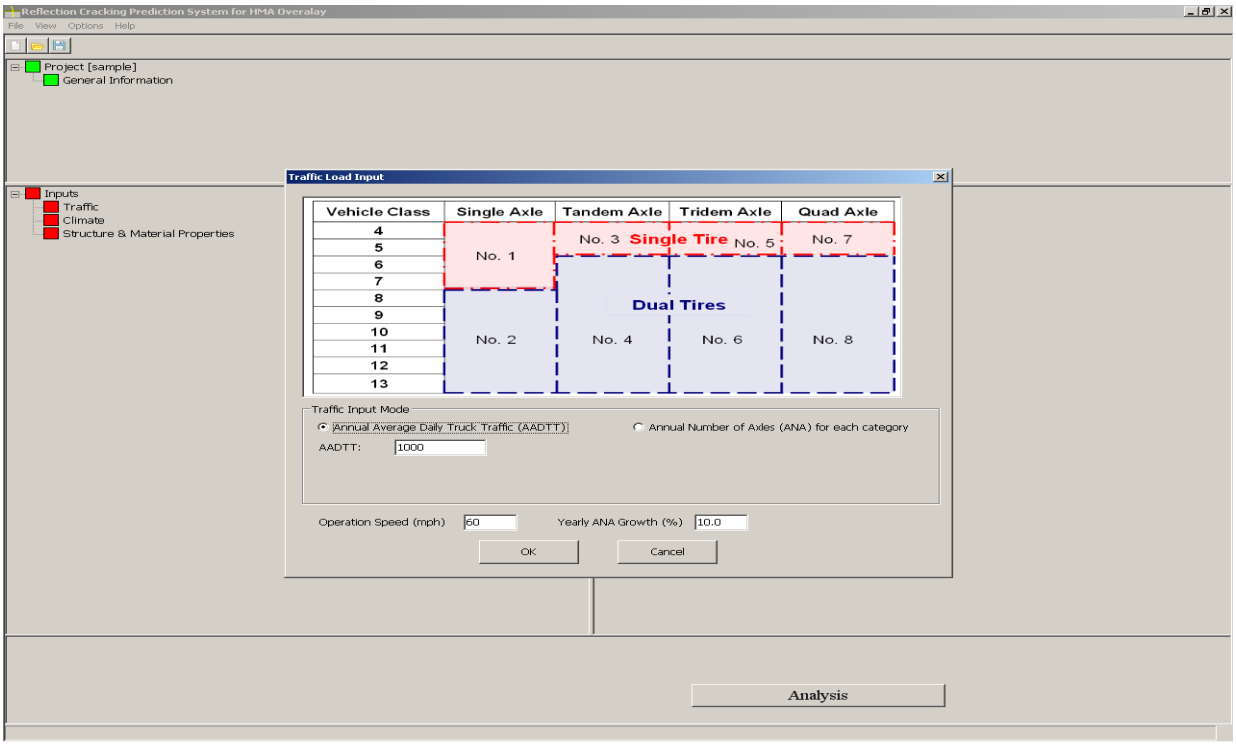
Start the **Reflection Cracking Prediction System for the HMA Overlay** Program. This program included three parts which are **General Information** input, **Pavement Related** input, and **Output**. Pavement related input includes **Traffic**, **Climate**, and **Structure & Material Properties**.

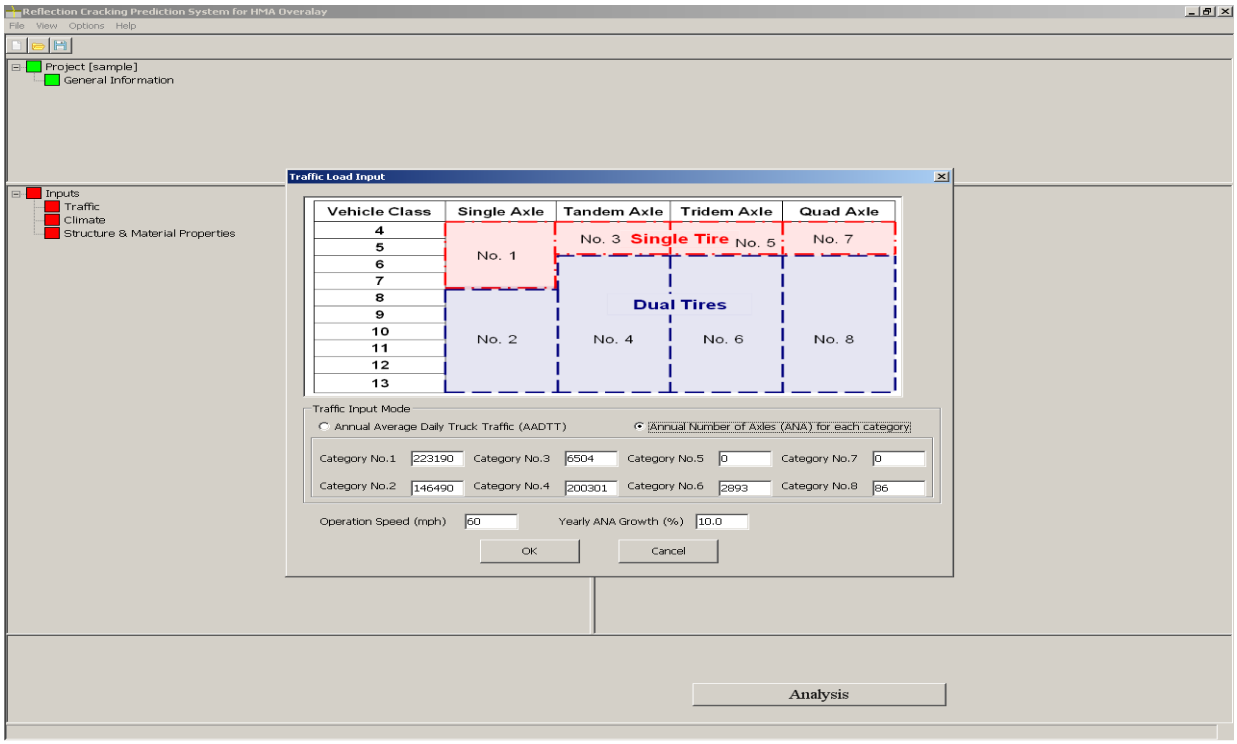


In the **General Information**, five types of overlay are considered in this program. **Design Life** is the maximum days to analyze the reflection cracking. The maximum designing life is 20 years (7300 days) in the calibration. **Construction Information** is the date when the overlay construction was completed and when it was opened to traffic. Both summer (July) and winter (December) should be considered in the calibration.

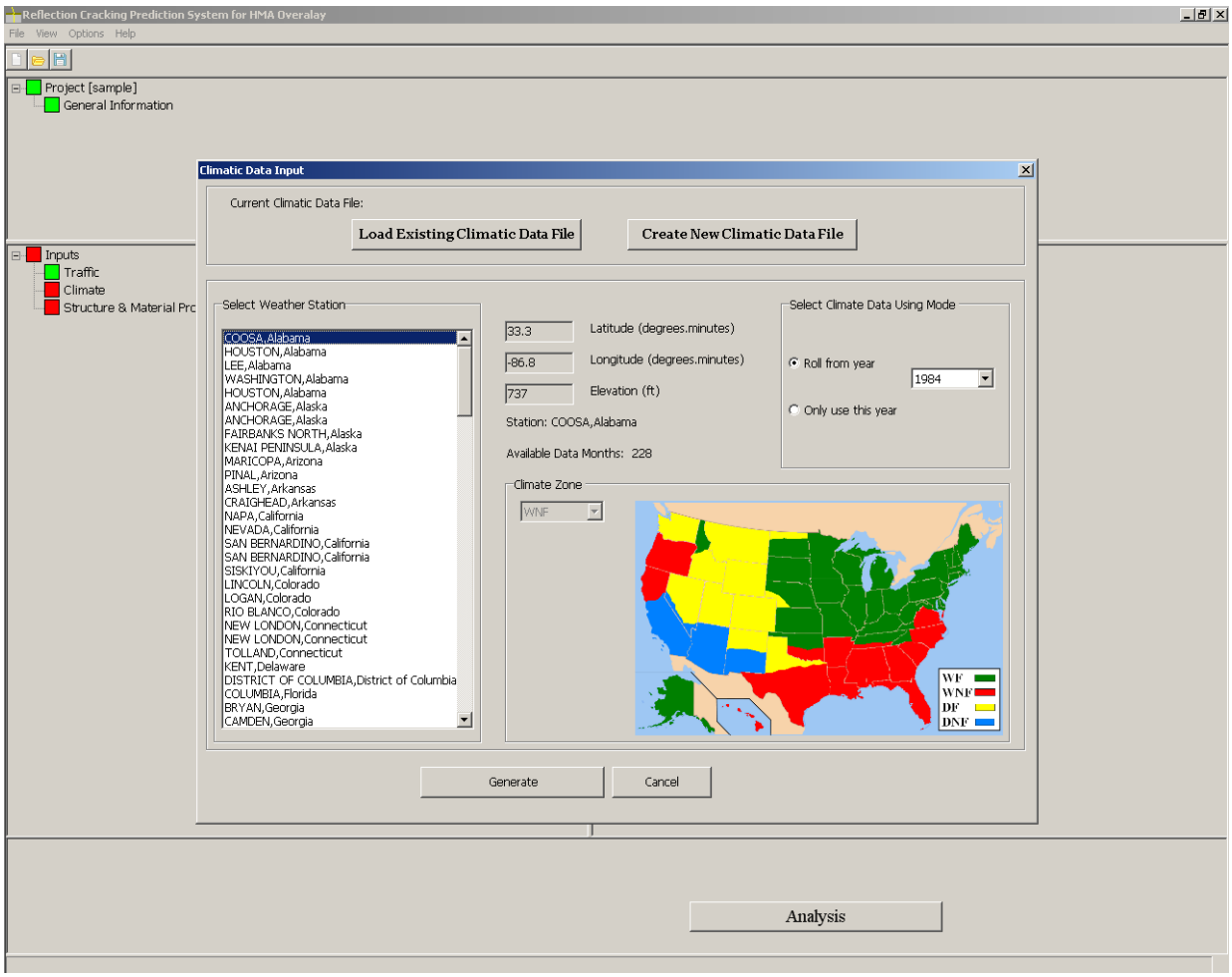


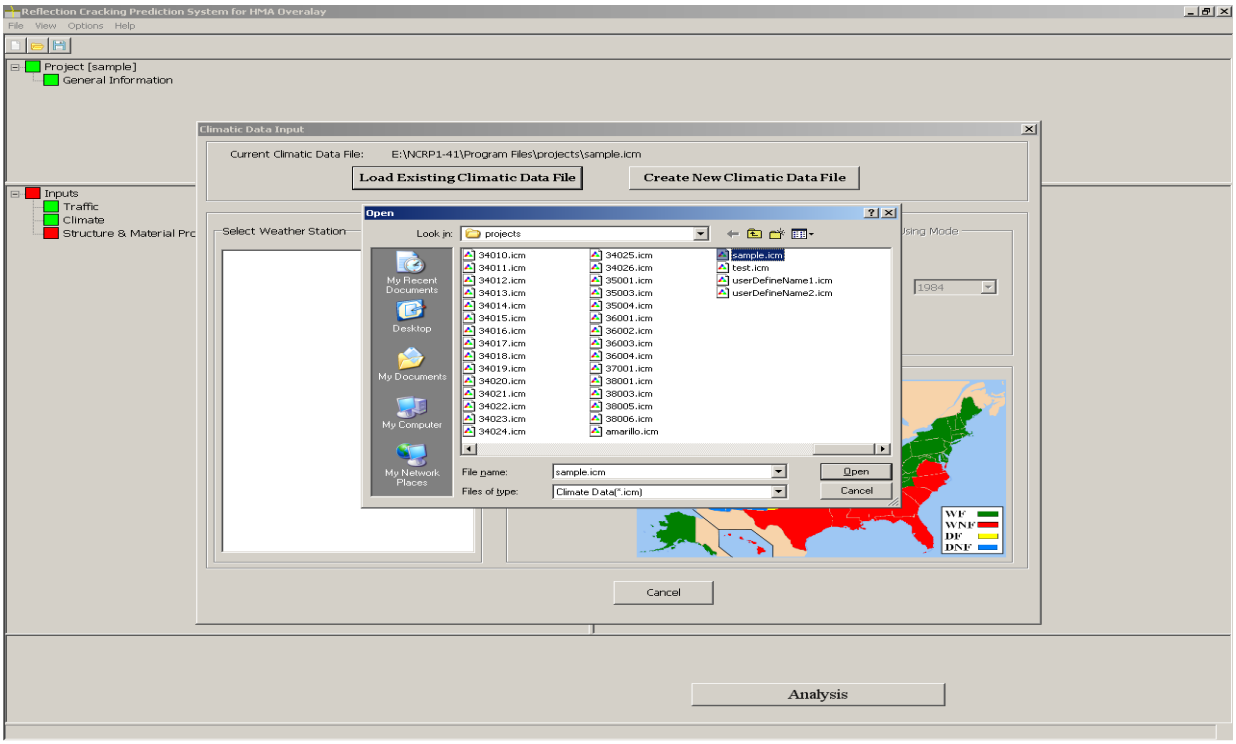
Traffic Input has two types of traffic input are using in this program which are **Annual Average Daily Truck Traffic (AADTT)** and **Annual Number of Axles (ANA) for each category**. **Operation Speed** is the design speed limit in miles per hour.



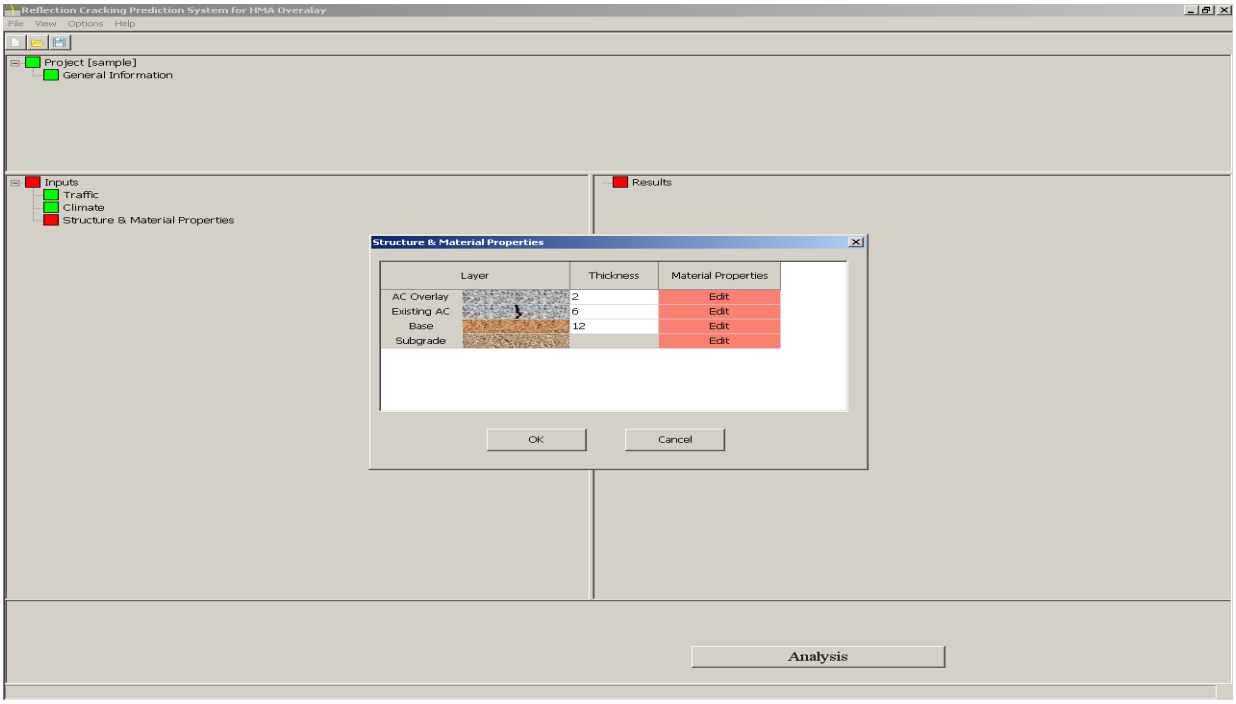

Reflection Cracking Prediction System for HMA Overalay
File View Options Help
Project [sample]
General Information
Inputs
Traffic
Climate
Structure & Material Properties
Traffic Load Input
Vehicle Class
Single Axle
Tandem Axle
Tridem Axle
Quad Axle
4
5
6
7
8
9
10
11
12
13
No. 1
No. 3
Single Tire
No. 5
No. 7
Dual Tires
No. 2
No. 4
No. 6
No. 8
Traffic Input Mode
Annual Average Daily Truck Traffic (AADTT)
Annual Number of Axles (ANA) for each category
Category No.1 223190
Category No.3 6504
Category No.5 0
Category No.7 0
Category No.2 146490
Category No.4 200301
Category No.6 2893
Category No.8 86
Operation Speed (mph) 60
Yearly ANA Growth (%) 10.0
OK
Cancel
Analysis

Climate data included air temperature, wind speed, solar radiation, albedo, emissivity, and absorption data. The user can choose any weather station of 150 stations in this program, or can use the EICM model from MEPDG to generate the *.icm climate data, and load the generated *.icm data in this program.

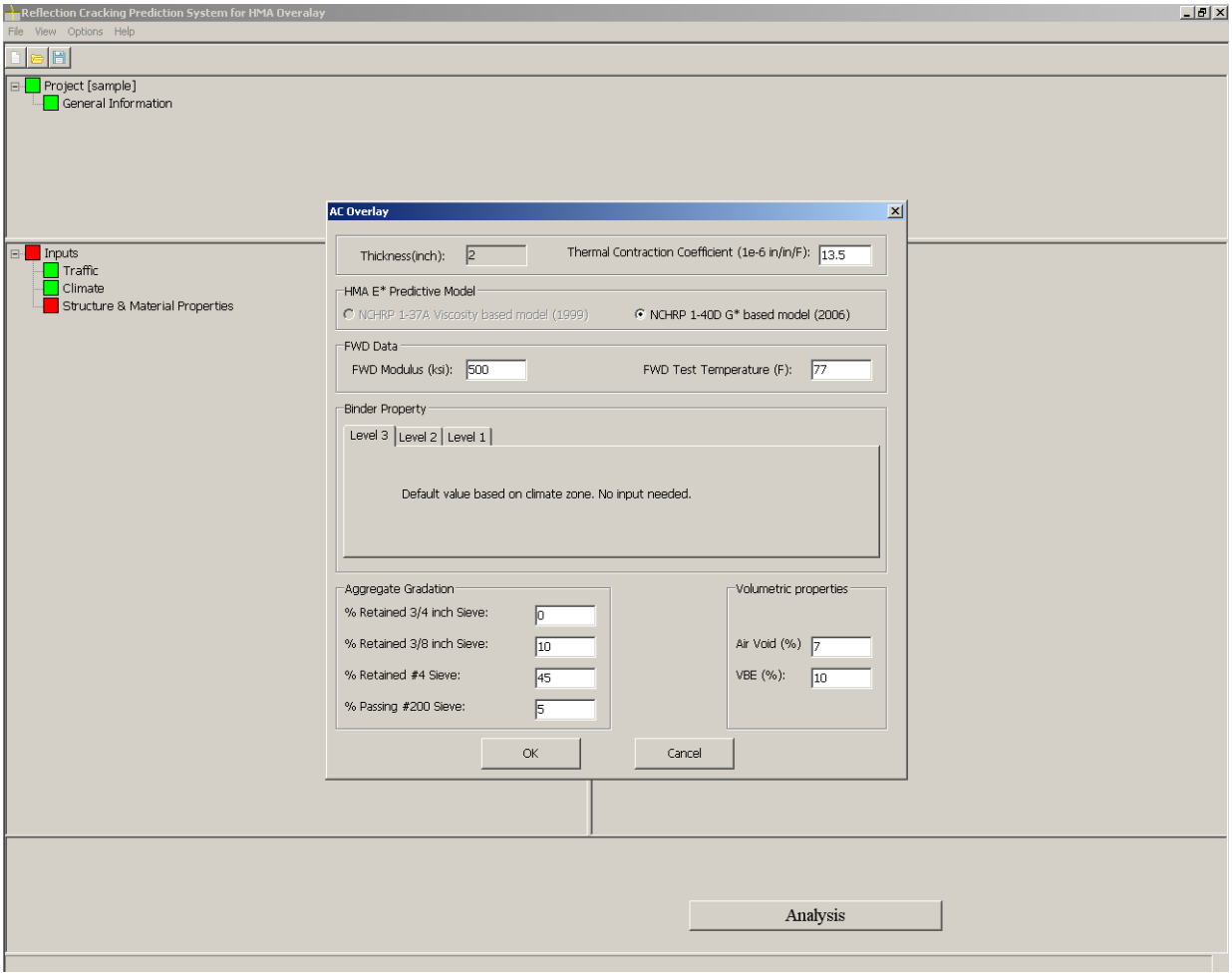



Reflection Cracking Prediction System for HMA Overalay
File View Options Help
Project [sample]
General Information
Inputs
Traffic
Climate
Structure & Material Prc
Climatic Data Input
Current Climatic Data File: E:\NCRP1-41\Program Files\projects\sample.icm
Load Existing Climatic Data File
Create New Climatic Data File
Select Weather Station
Open
Look in: projects
My Recent Documents
Desktop
My Documents
My Computer
My Network Places
34010.icm
34011.icm
34012.icm
34013.icm
34014.icm
34015.icm
34016.icm
34017.icm
34018.icm
34019.icm
34020.icm
34021.icm
34022.icm
34023.icm
34024.icm
34025.icm
34026.icm
35001.icm
35003.icm
35004.icm
36001.icm
36002.icm
36003.icm
36004.icm
37001.icm
38001.icm
38003.icm
38005.icm
38006.icm
amarillo.icm
sample.icm
test.icm
userDefineName1.icm
userDefineName2.icm
File name: sample.icm
Files of type: Climate Data(*.icm)
Open
Cancel
1984
WF
WNF
DF
DNF
Cancel
Analysis

Structure & Material Properties information include pavement thickness, mixture and binder data, and FWD data in this calibration program. There is more required information in the **Edit** for each layer. When the color of the **Edit** button turns from red to green, the input data is completed.



In the AC overlay, most of the FWD modulus, FWD testing temperature, and mixture information were collected from the LTPP data base. The FWD modulus was obtained by backcalculation. The User who is generating a new set of calibration coefficients must provide the FWD and mixture data for the AC overlay on each pavement section. Levels one, two and three input options may be used on the AC mixture properties.

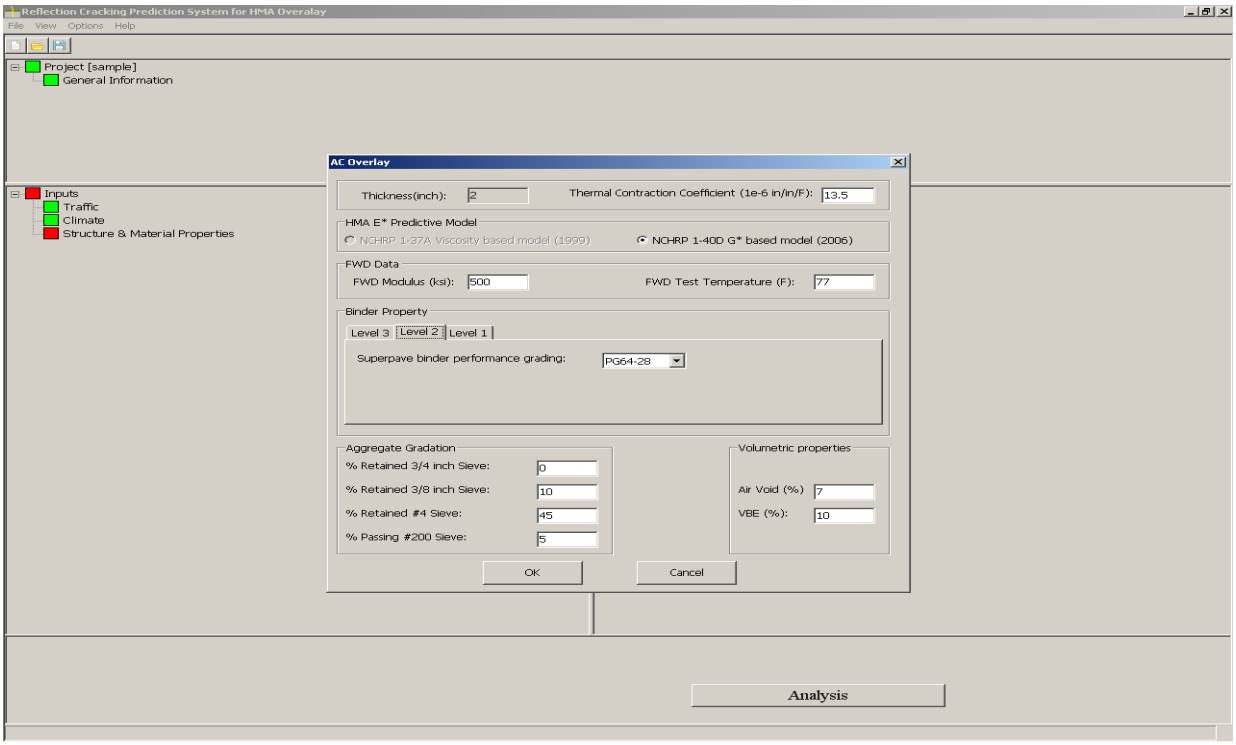


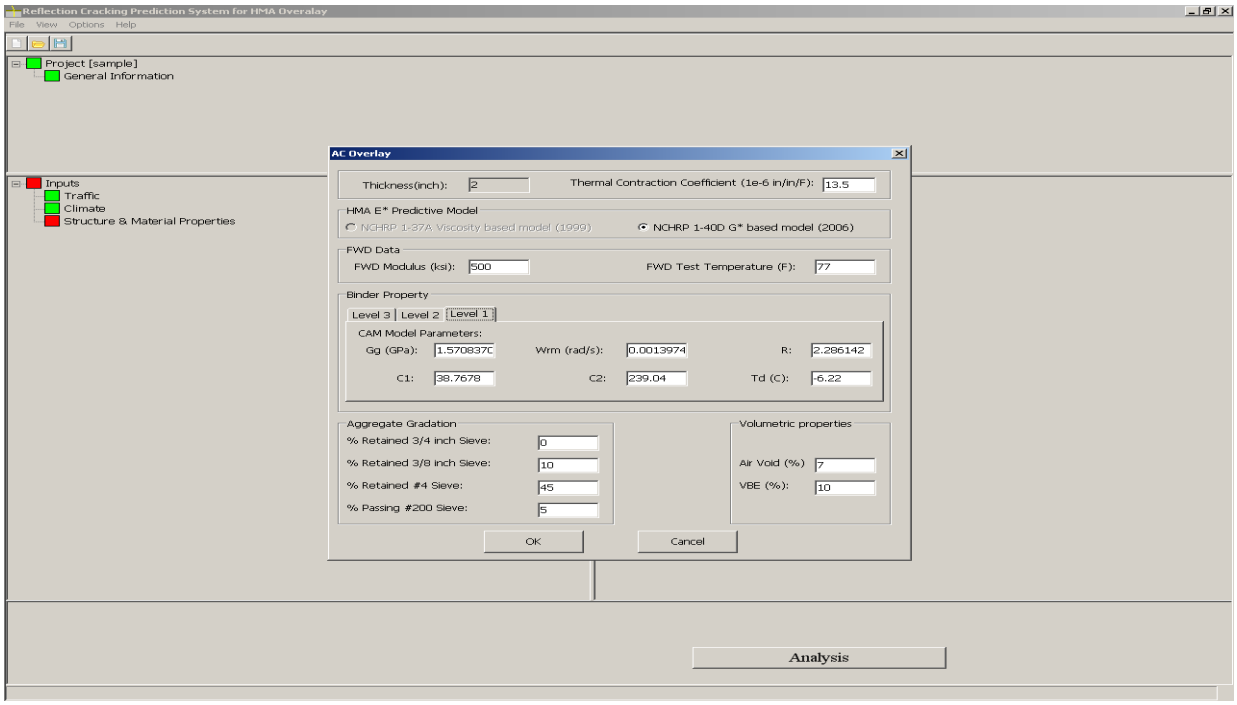
For the input of **Binder Property**, three levels are considered in this program.

Level one: Requires all of the parameters to be provided.

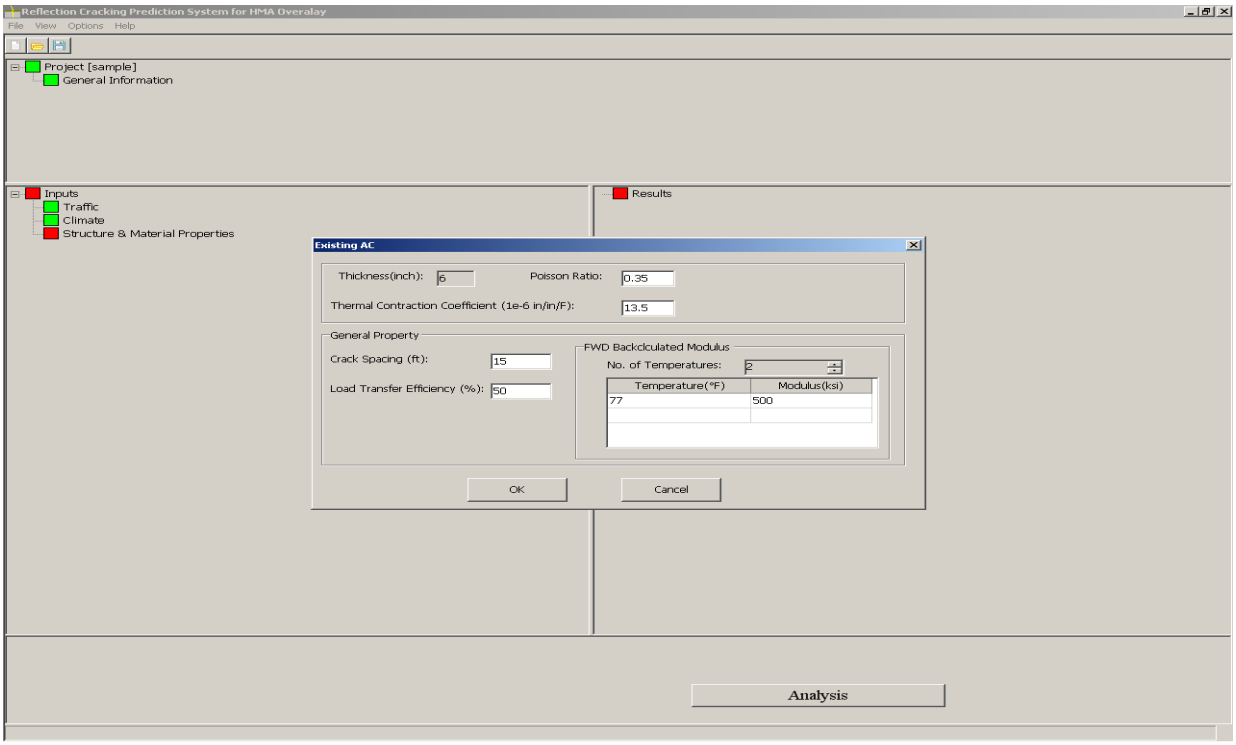
Level two: Parameters are chosen by giving the Superpave binder performance grading. The remainder of the binder properties are the means of the properties used in the climatic zone.

Level three: All the parameters are decided from our database according to the mean of the properties used in the climate zone.

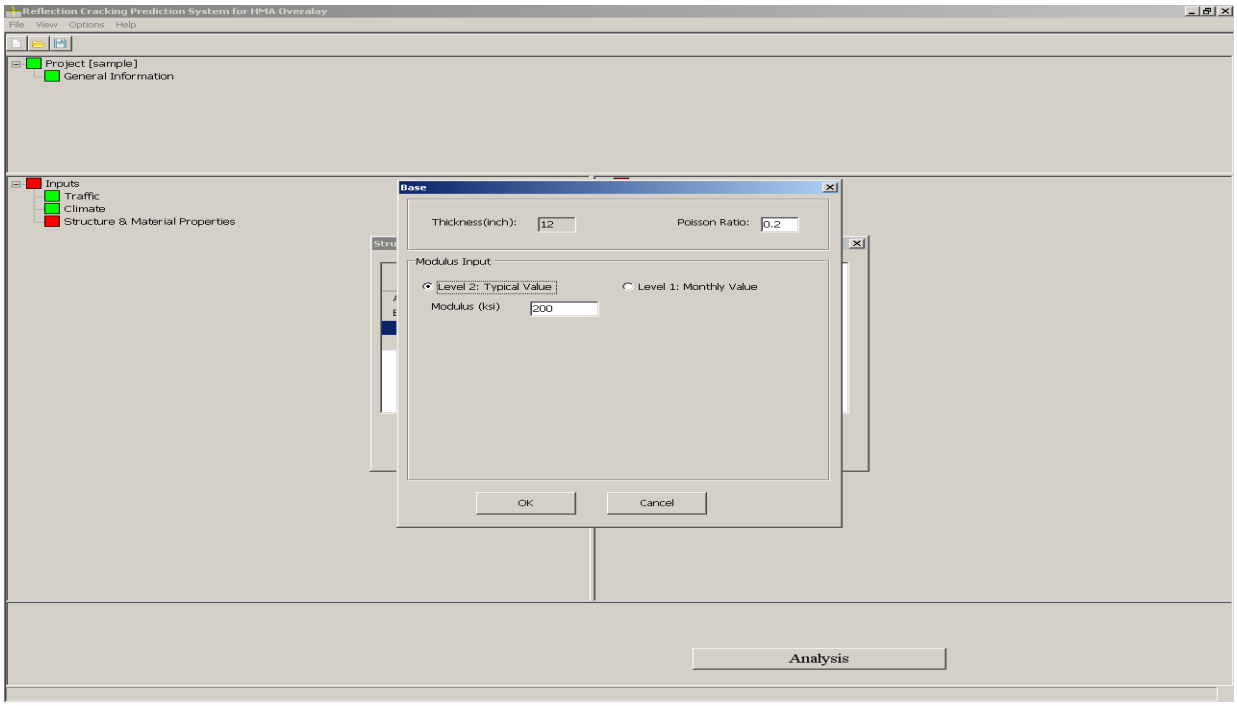


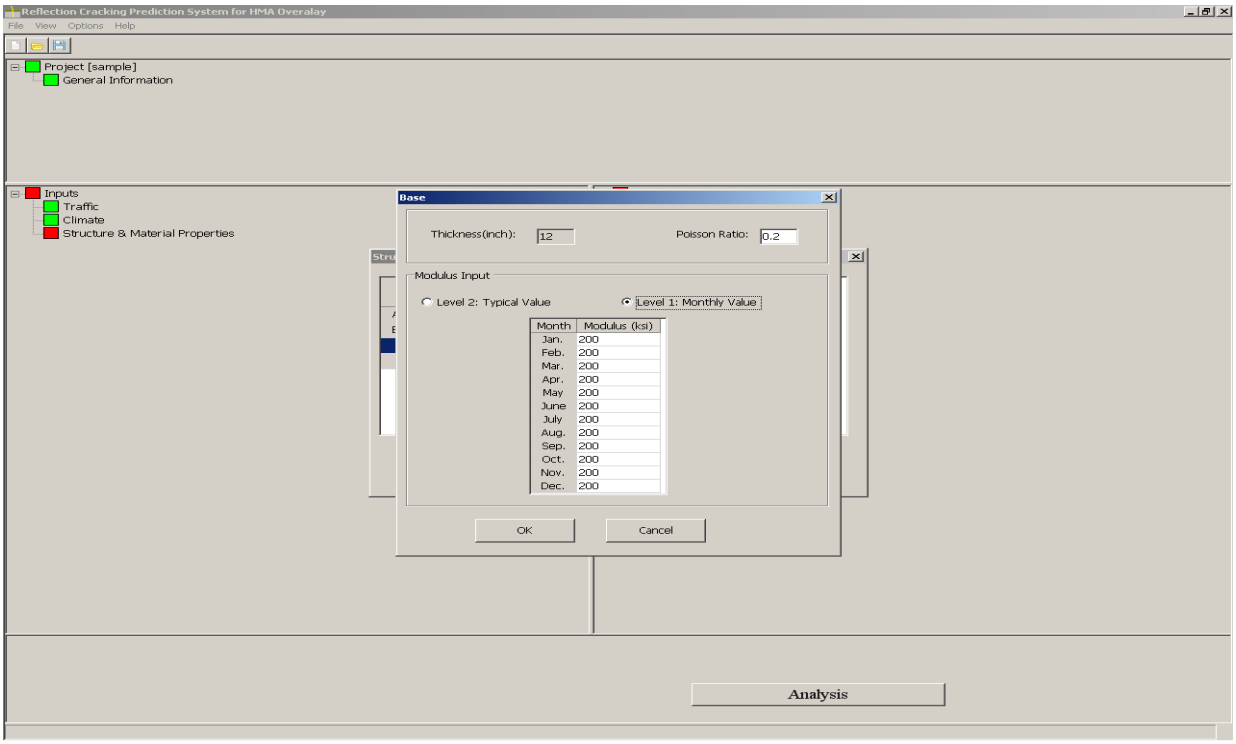

Reflection Cracking Prediction System for HMA Overalay
File View Options Help
Project [sample]
General Information
Inputs
Traffic
Climate
Structure & Material Properties
AC Overlay
Thickness(inch): 2
Thermal Contraction Coefficient (1e-6 in/in/F): 13.5
HMA E* Predictive Model
NCHRP 1-37A Viscosity based model (1999)
NCHRP 1-40D G* based model (2006)
FWD Data
FWD Modulus (ksi): 500
FWD Test Temperature (F): 77
Binder Property
Level 3 Level 2 Level 1
CAM Model Parameters:
Gg (GPa): 1.570837
Wrm (rad/s): 0.0013974
R: 2.286142
C1: 38.7678
C2: 239.04
Td (C): -6.22
Aggregate Gradation
% Retained 3/4 inch Sieve: 0
% Retained 3/8 inch Sieve: 10
% Retained #4 Sieve: 45
% Passing #200 Sieve: 5
Volumetric properties
Air Void (%) 7
VBE (%): 10
OK
Cancel
Analysis

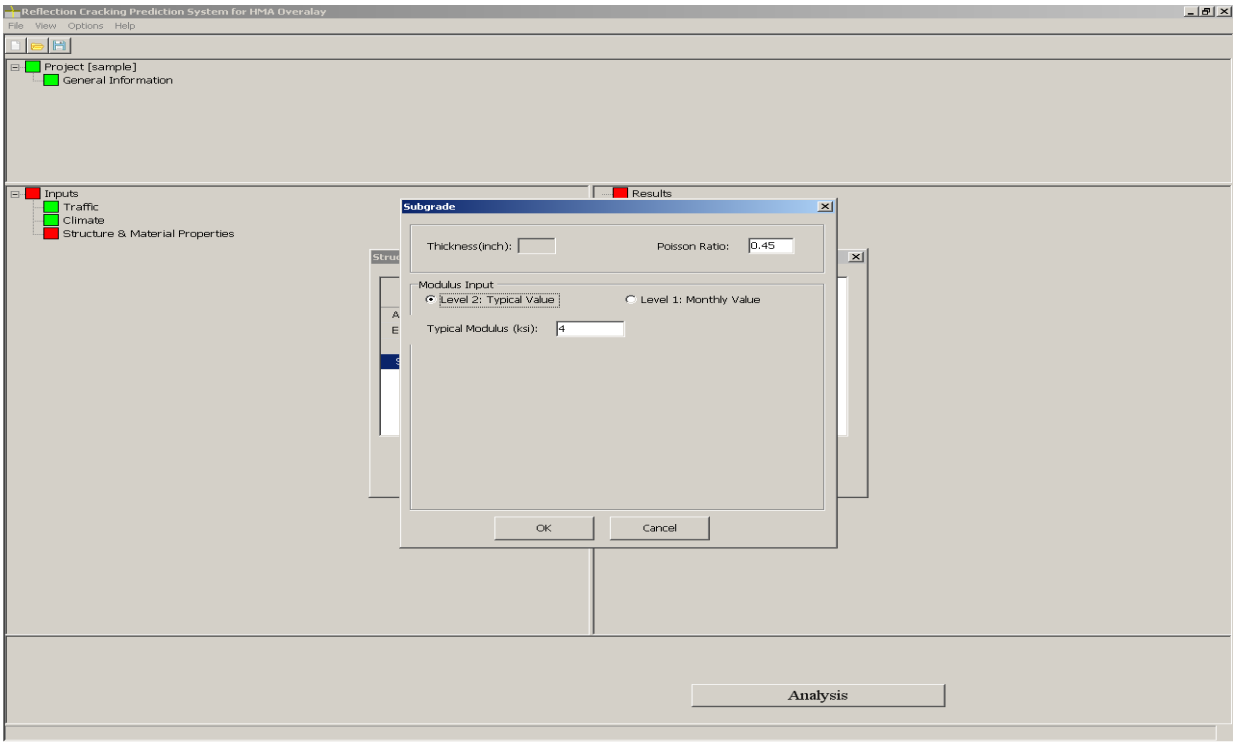
In the input for the **Existing AC** layer, the results of the FWD backcalculated modulus can be more than one input.

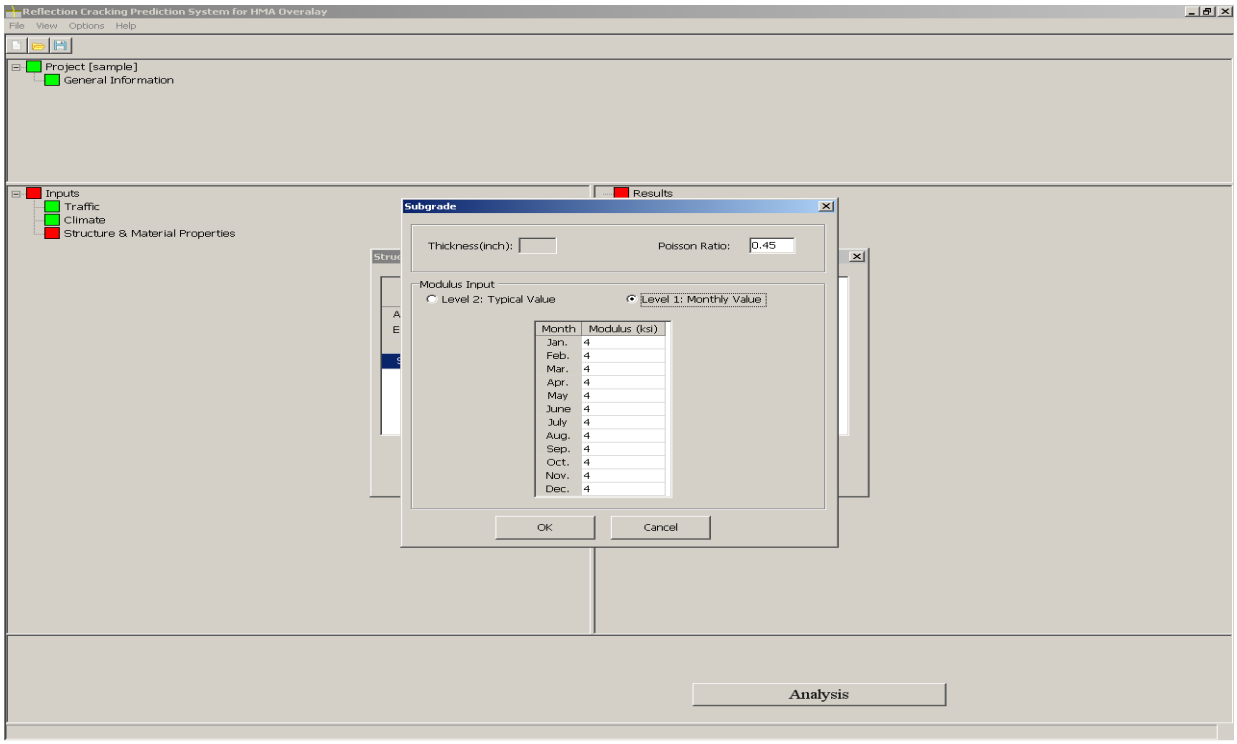


Inputs for **Base** and **Subgrade** layers require moduli and Poisson Ratios. Since the modulus varies with the temperature, **Typical Value** or **Monthly Values** are all available.

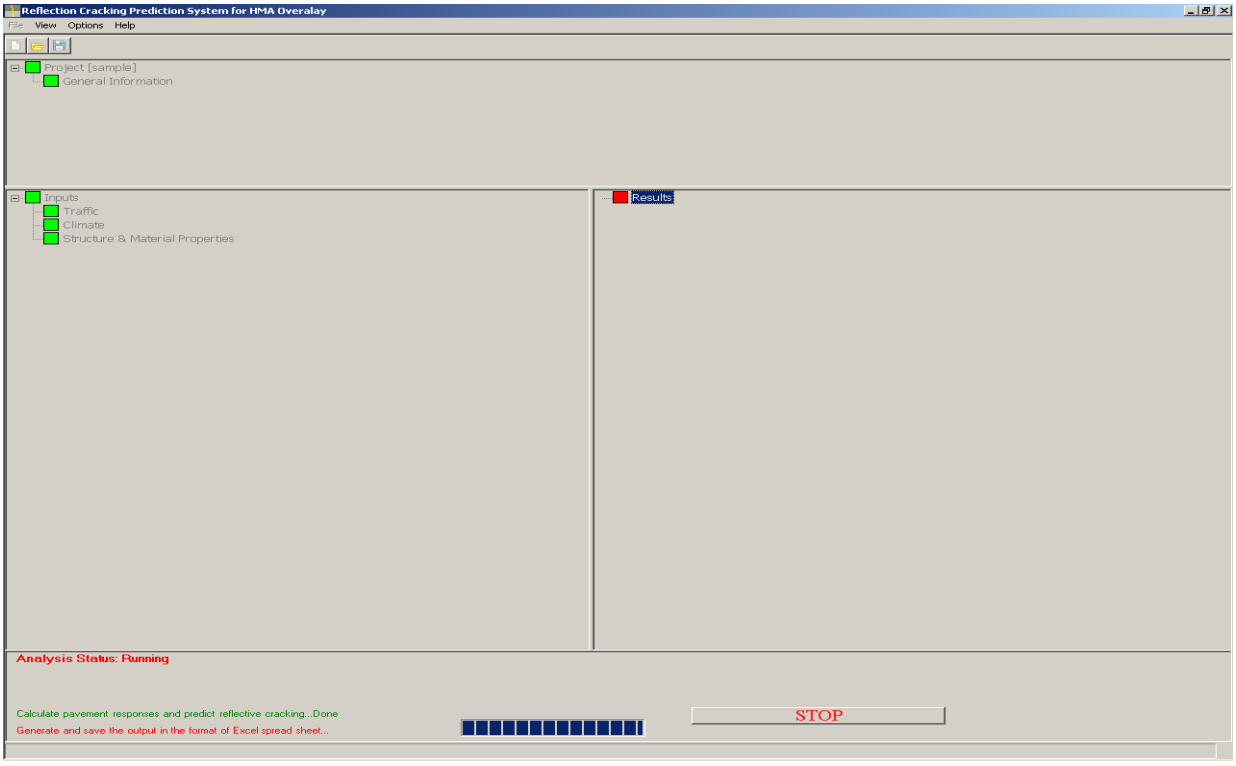



Reflection Cracking Prediction System for HMA Overalay
File View Options Help
Project [sample]
General Information
Inputs
Traffic
Climate
Structure & Material Properties
Base
Thickness(inch): 12
Poisson Ratio: 0.2
Modulus Input
Level 2: Typical Value
Level 1: Monthly Value
Month Modulus (ksi)
Jan. 200
Feb. 200
Mar. 200
Apr. 200
May 200
June 200
July 200
Aug. 200
Sep. 200
Oct. 200
Nov. 200
Dec. 200
OK
Cancel
Analysis

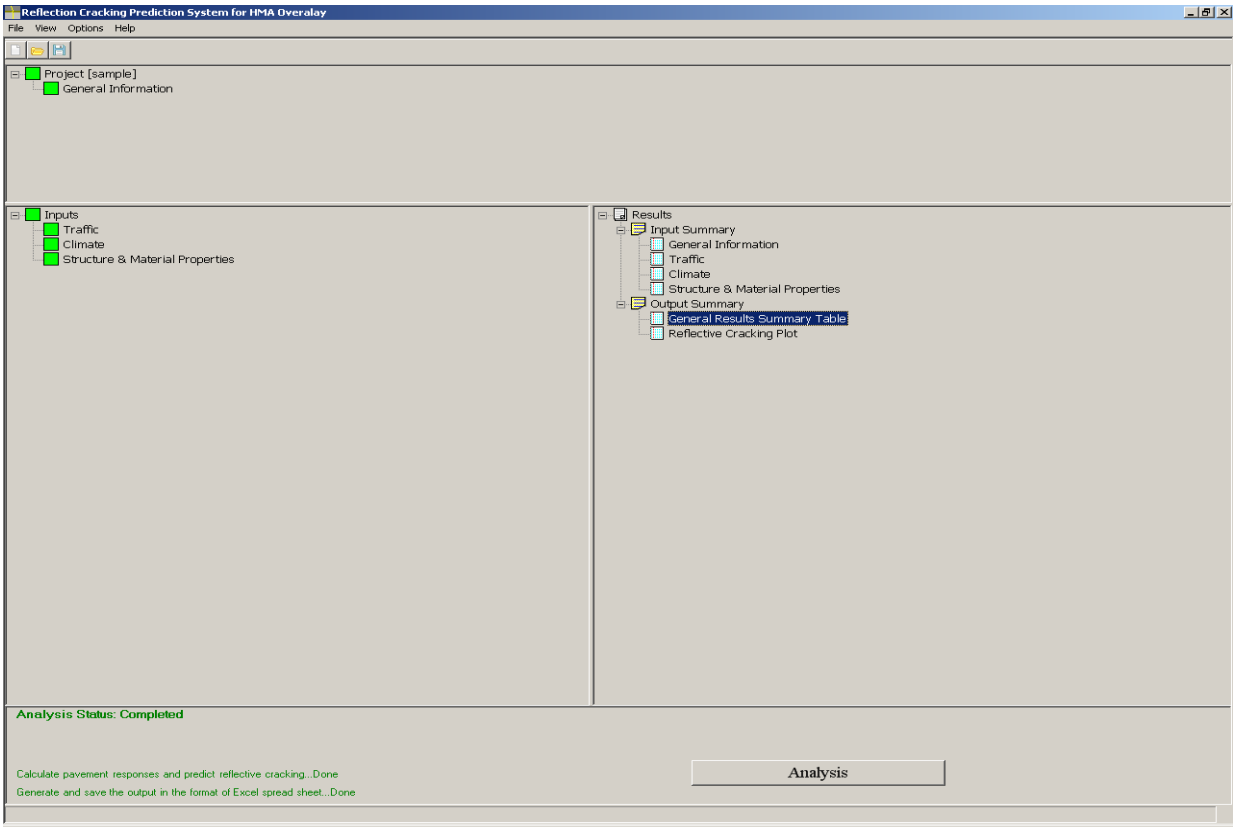

Reflection Cracking Prediction System for HMA Overalay
File View Options Help
Project [sample]
General Information
Inputs
Traffic
Climate
Structure & Material Properties
Results
Subgrade
Thickness(inch):
Poisson Ratio: 0.45
Modulus Input
Level 2: Typical Value
Level 1: Monthly Value
Typical Modulus (ksi): 4
OK
Cancel
Analysis


Reflection Cracking Prediction System for HMA Overalay
File View Options Help
Project [sample]
General Information
Inputs
Traffic
Climate
Structure & Material Properties
Results
Subgrade
Thickness(inch):
Poisson Ratio:
0.45
Modulus Input
Level 2: Typical Value
Level 1: Monthly Value
Month
Modulus (ksi)
Jan. 4
Feb. 4
Mar. 4
Apr. 4
May 4
June 4
July 4
Aug. 4
Sep. 4
Oct. 4
Nov. 4
Dec. 4
OK
Cancel
Analysis

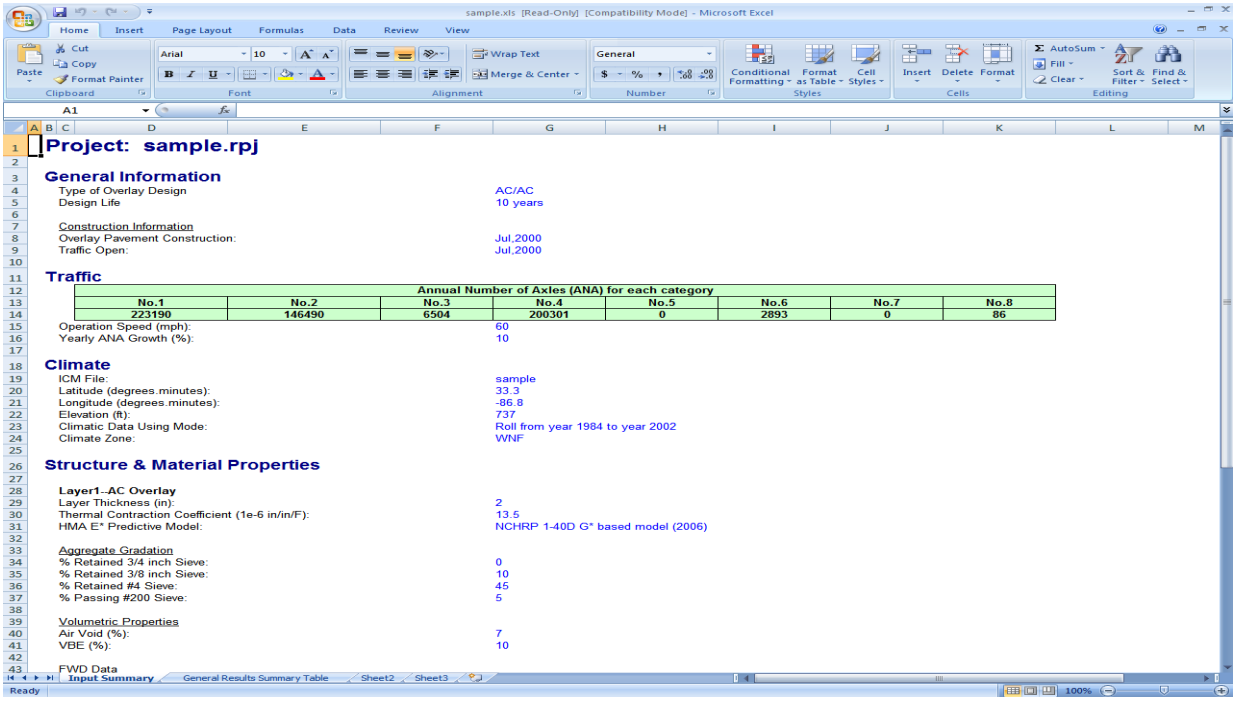
If all of the required input information is completed, the color of the button of each part should turns from a red color to a green color. Then click the **Analysis**, this program will start to analyze the reflection cracking.



When **Analysis Status** shows **Completed**, the results are ready to be viewed on the right side.



The results are shown in Excel files. The **General Results Summary** Table shows the summary information of this pavement and information of reflection crack by thermal, shearing, and bending.



Project: sample.rpj

General Information

Type of Overlay Design	AC/AC
Design Life	10 years
Construction Information	
Overlay Pavement Construction:	Jul,2000
Traffic Open:	Jul,2000

Traffic

Annual Number of Axles (ANA) for each category							
No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8
223190	146490	6504	200301	0	2893	0	86

Operation Speed (mph):	60
Yearly ANA Growth (%):	10

Climate

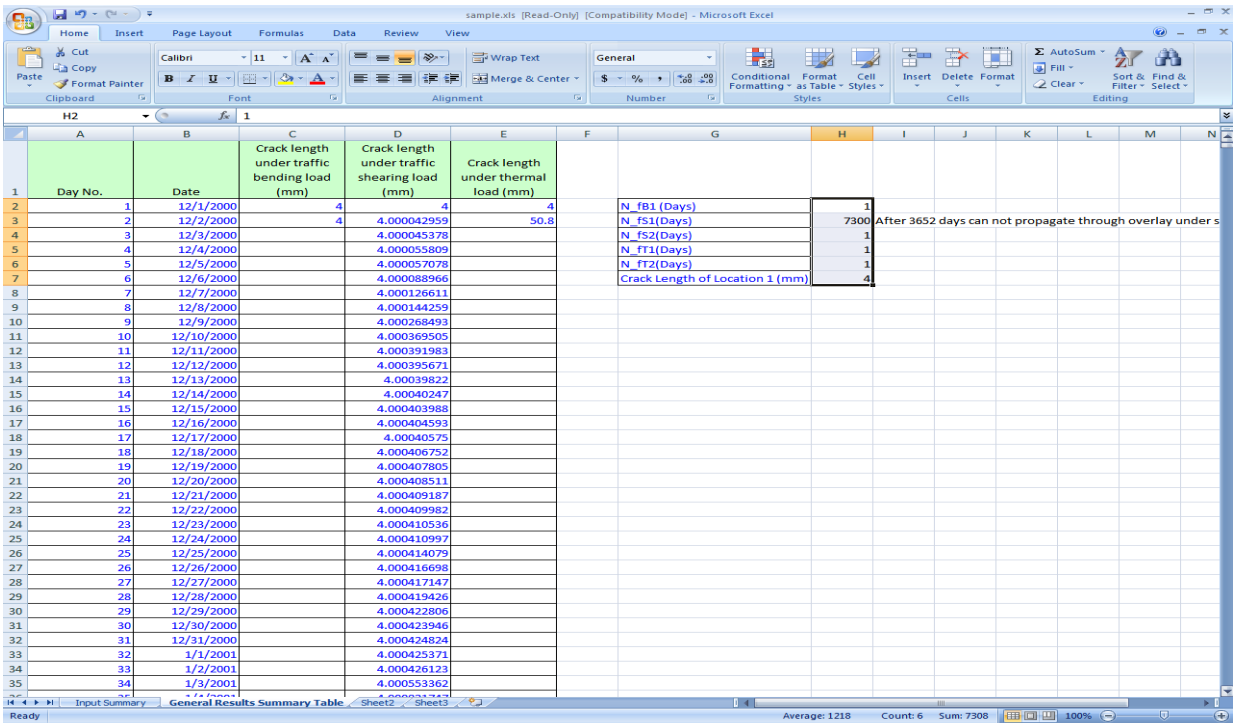
ICM File:	sample
Latitude (degrees.minutes):	33.3
Longitude (degrees.minutes):	-86.8
Elevation (ft):	737
Climatic Data Using Mode:	Roll from year 1984 to year 2002
Climate Zone:	WNF

Structure & Material Properties

Layer1--AC Overlay

Layer Thickness (in):	2
Thermal Contraction Coefficient (1e-6 in/in/F):	13.5
HMA E* Predictive Model:	NCHRP 1-40D G* based model (2006)
Aggregate Gradation	
% Retained 3/4 inch Sieve:	0
% Retained 3/8 inch Sieve:	10
% Retained #4 Sieve:	45
% Passing #200 Sieve:	5
Volumetric Properties	
Air Void (%):	7
VBE (%):	10

FWD Data



Day No.	Date	Crack length under traffic bending load (mm)	Crack length under traffic shearing load (mm)	Crack length under thermal load (mm)
1	12/1/2000	4	4	4
2	12/2/2000	4	4.000042959	50.8
3	12/3/2000		4.000045378	
4	12/4/2000		4.000055809	
5	12/5/2000		4.000057078	
6	12/6/2000		4.000088966	
7	12/7/2000		4.000126611	
8	12/8/2000		4.000144259	
9	12/9/2000		4.000268493	
10	12/10/2000		4.000369505	
11	12/11/2000		4.000391983	
12	12/12/2000		4.000395671	
13	12/13/2000		4.00039822	
14	12/14/2000		4.00040247	
15	12/15/2000		4.000403988	
16	12/16/2000		4.000404593	
17	12/17/2000		4.00040575	
18	12/18/2000		4.000406752	
19	12/19/2000		4.000407805	
20	12/20/2000		4.000408511	
21	12/21/2000		4.000409187	
22	12/22/2000		4.000409982	
23	12/23/2000		4.000410536	
24	12/24/2000		4.000410997	
25	12/25/2000		4.000414079	
26	12/26/2000		4.000416698	
27	12/27/2000		4.000417147	
28	12/28/2000		4.000419426	
29	12/29/2000		4.000422806	
30	12/30/2000		4.000423946	
31	12/31/2000		4.000424824	
32	1/1/2001		4.000425371	
33	1/2/2001		4.000426123	
34	1/3/2001		4.000553362	

N_fB1 (Days)	1
N_fS1(Days)	7300
N_fS2(Days)	1
N_fT1(Days)	1
N_fT2(Days)	1
Crack Length of Location 1 (mm)	4

After 3652 days can not propagate through overlay under s

The numbers of days that are produced by the calibration program as shown in the output screen above, are determined for each of a number of test sections on which field observations of the ρ and β values have been determined. At least ten such sections are recommended. With this done, the user may then perform a linear regression analysis relating these five numbers of days on each of the sections to the observed values of ρ and β. If the coefficient of determination, R^2, is high enough then the resulting α and β calibration coefficients can be inserted into the Design program which is then ready to use for the design of overlays of the same type.