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16. Abstract

An improved CRCP computer program, CRCP-9, has been developed for the mechanistic analysis of continuously reinforced concrete pavements. CRCP-9 uses two-dimensional numerical methods to calculate stresses and strains, which is a totally different approach compared with the previous computer program, CRCP-8, which uses one-dimensional analytical methods to calculate them. CRCP-9 has Windows-based user-friendly interfaces for convenient use. This report summarizes the background of the CRCP-9 development, installation procedure, communication between files, detailed guide for user input procedure, explanation of output screens, and file control procedure. This report can serve as a user's guide for the CRCP-9 computer program.

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CRCP-9 COMPUTER PROGRAM USER'S GUIDE

by

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B. Frank McCullough

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Research Project 0-1831
Project Title: *Improvement of Concrete Pavement Performance Model*

Conducted for the

TEXAS DEPARTMENT OF TRANSPORTATION

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U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration

by the

CENTER FOR TRANSPORTATION RESEARCH
Bureau of Engineering Research
THE UNIVERSITY OF TEXAS AT AUSTIN

February 2001

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Research performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration.

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CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

The first mechanistic model of continuously reinforced concrete pavement (CRCP), CRCP-1, was developed in the mid-1970s under a project sponsored by the National Cooperative Highway Research Program (NCHRP) (Ref 1). In 1991, Won et al. developed an improvement to the CRCP program, CRCP-5, that simulates material variance to concrete tensile strength and includes fatigue failure models (Ref 2). The normalized curing curves were determined for different coarse aggregates commonly used in Texas pavements (Ref 3) and these curves and the calibrated failure prediction model were included in CRCP-7 (Ref 4). In 1995, previous versions of the CRCP programs were integrated into one program, CRCP-8, with simplification of the user input process (Ref 5). However, there were still some limitations in CRCP-8 owing to the simplified assumptions of the one-dimensional analysis. In 1996, a preliminary investigation was conducted to expand the ability of the mechanistic model by incorporating the variations in temperature and moisture changes occurring through the depth of concrete slab; the result of this investigation was a two-dimensional finite element model (Refs 6, 7). In 1998, the Texas Department of Transportation (TxDOT) extended the project to complete the development of a new mechanistic model, CRCP-9. The analysis engine of CRCP-9 could be developed using two-dimensional finite element theories to create a mechanistic model of the CRC pavement systems, the crack spacing prediction model was developed using the Monte Carlo method, and the failure prediction model was developed using probability theories (Refs 8, 9). While the previous computer program, CRCP-8, used one-dimensional analytical methods to calculate stresses and strains, CRCP-9 uses totally different two-dimensional numerical methods to perform calculate them. Some of the major characteristics of CRCP-9 that differ from those of CRCP-8 include consideration of nonlinear variations in temperature and drying shrinkage through the depth of the concrete slab, nonlinear bond-slip relationship between concrete and steel bars, viscoelastic effect of concrete, curling and warping effects, and the ability of changing locations of the longitudinal steel bars.

1.2 INSTALLATION OF PROGRAM AND COMMUNICATION BETWEEN FILES

The CRCP-9 computer program contains five files of crcp-9.exe, fort.exe, crcpfor.inp, crcpfor.out, and crcpfor.sum. Crcp-9.exe is an application program to generate a Windows-based user-friendly interface developed by using Visual Basic; fort.exe is another application program to perform the analysis developed in Fortran language; crcpfor.inp is an input file;

crcpfor.out is an output file; and crcpfor.sum is an analysis summary file. To install the CRCP-9 program, create a new directory, such as CRCP-9, on the hard disk drive and copy all files in the directory. Any other setup is not needed. To start using CRCP-9, double click on CRCP-9.exe; the CRCP-9 main screen will then appear. The CRCP-9 program can also run on the floppy disk drive, but it is highly recommended that users use it on the hard disk drive to reduce run time. CRCP-9 cannot run on a CD, even if CRCP-9 files are saved on it. CRCP-9 can run on any PC or compatible with Windows 95 or later versions.

Communication between various files is explained. When users click on the Analysis button in the last general input screen of CRCP-9 (details of input screens are explained in Chapter 2), the input file of crcpfor.inp is generated and fort.exe starts running. Fort.exe calls crcpfor.inp and performs the analysis. At the end of the analysis, fort.exe generates the output file of crcpfor.out and the summary file of crcpfor.sum. Crcp-9.exe periodically checks the progress of the analysis; if the analysis is completed, crcp-9.exe calls the output file of crcpfor.out to show the results on Windows-based interfaces. The summary file of crcpfor.sum is used when crcp-9.exe calls it because users would like to see the summary of the analysis in document form. It should be noted that the necessary files of CRCP-9 are crcp-9.exe and fort.exe. However, the other three files are also needed for CRCP-9 to operate all its functions just after installation. If there are no such files as crcpfor.inp, crcpfor.out, and crcpfor.sum when installed, these files will be generated automatically after users perform any analysis.

1.3 ORGANIZATION

This report consists of four chapters. The background, installation procedure of the computer program, and communication between files are explained in Chapter 1. The user input process with detailed explanations of each input screen is presented in Chapter 2. In Chapter 3, details of the output screens are explained. Chapter 4 describes the file control and print processes. References are listed at the end of the report.

CHAPTER 2. INPUT GUIDE

2.1 INTRODUCTION

Figure 2.1 shows the main screen of CRCP-9. There are four menus: File, Analysis, Print, and Help. To begin a user input process, click on the Analysis menu. Displayed under this menu, as shown in Figure 2.2, are four items: General Input, Advanced Input, Latest Output, and Review Analysis Summary. The menu items of General Input and Advanced Input are related to the input process. The General Input item is used to define geometry, concrete and steel material properties, bond-slip relationships between concrete and steel and between concrete slab and base layer, wheel loads, and such environmental loads as changes in temperature and drying shrinkage. The Advanced Input item is used to define creep, curling and swelling effects, number of primary crack spacings, finite element type, and reliability. Users can select either Advanced Input or General Input to begin a user input process. On any general input screen, users can go to the Advanced Inputs screen by clicking on the Advanced Inputs button. Users can also go to the first general input screen of Concrete Properties from the Advanced Inputs screen by clicking on the General Inputs button. In this guide, it is assumed that General Input is selected first, then a new screen to define concrete material properties will appear.

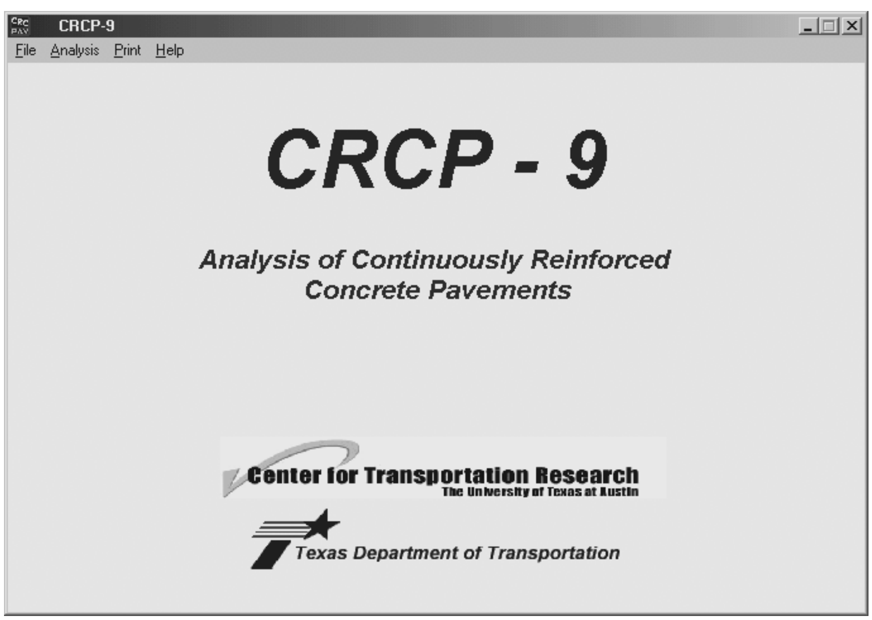


Figure 2.1. Main screen of CRCP-9

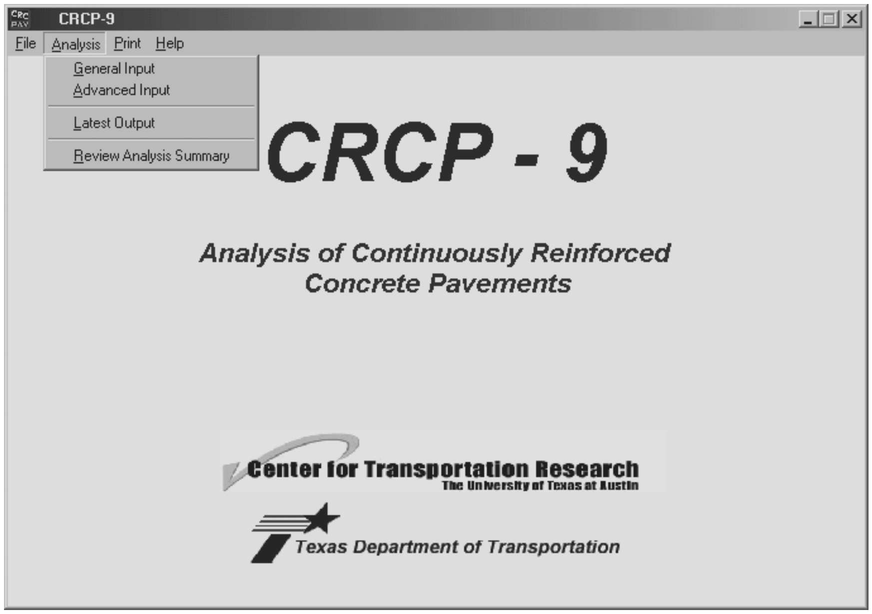


Figure 2.2. Menu items under Analysis menu

2.2 GENERAL INPUTS

2.2.1 Concrete Properties

The concrete material properties are defined in the Concrete Properties screen shown in Figure 2.3. Any descriptive information can be entered in the first line to identify the problem. Pavement thickness (thickness of concrete slab), Poisson's ratio, specific weight, and coefficient of variation for concrete tensile strength are defined in the upper portion of the screen. Thermal coefficient, elastic modulus, tensile strength, compressive strength, and drying shrinkage are defined next. If the coarse aggregate used is identical or similar to one of the eight different types listed, select the appropriate aggregate type as shown in Figure 2.4. Once an aggregate type is selected, the material properties automatically change to their default values. If the default values have to be changed or if there is no appropriate aggregate type, users can insert their own values by selecting Modify Values, as shown in Figure 2.5. If you click on Modify Values, the input fields are enabled for users to modify them. Because the earlier curing time data are automatically calculated in the program using normalized curves obtained from a previous project (Ref 3), the time histories of material properties depend on the aggregate types. Even if there is no appropriate aggregate type in the list, it is needed to select the most similar aggregate type and to change the default values. For instance, when you choose Limestone from the list and change the elastic modulus to 4,000,000 psi at 28 days, and when you choose SRG and change the elastic modulus to the same 4,000,000 psi at 28 days, the elastic moduli for the earlier days will be different, even though you put the same elastic modulus at 28 days, because the normalized curves for limestone and SRG are different.

Once the input process for concrete material properties is completed, click on the Next button to go to the next screen. If you click on the Cancel button at anytime, the input screen disappears. If you select the General Input item under the Analysis menu again, the Concrete Properties screen comes out again with the default values. If you need to save all the input values, do not click on the Cancel button until the analysis is performed. Once the analysis is completed, you can save your input values under the File menu on the main screen. Details of the file controls are explained in Chapter 4.

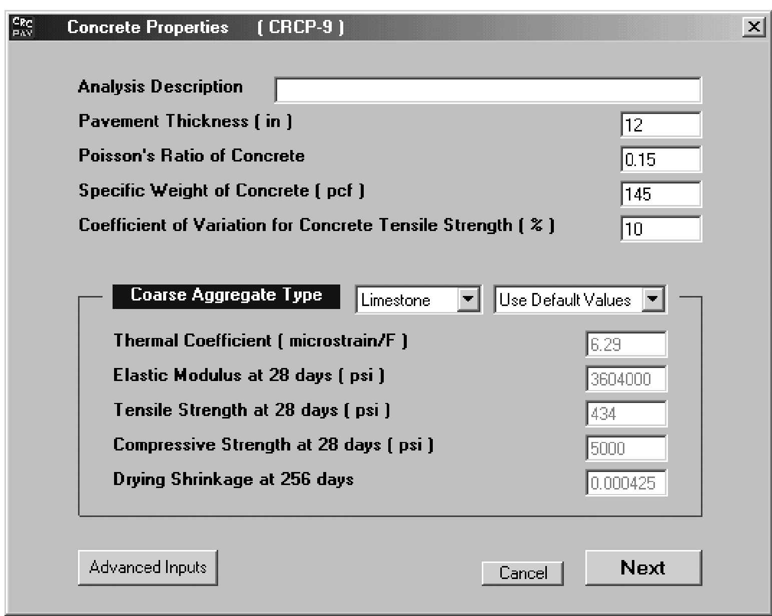


Figure 2.3. Concrete properties screen

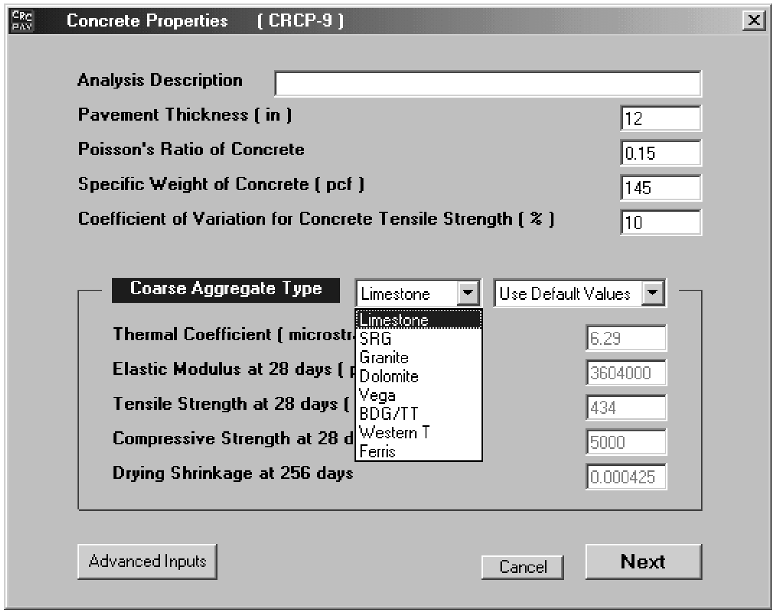


Figure 2.4. Selection of coarse aggregate type

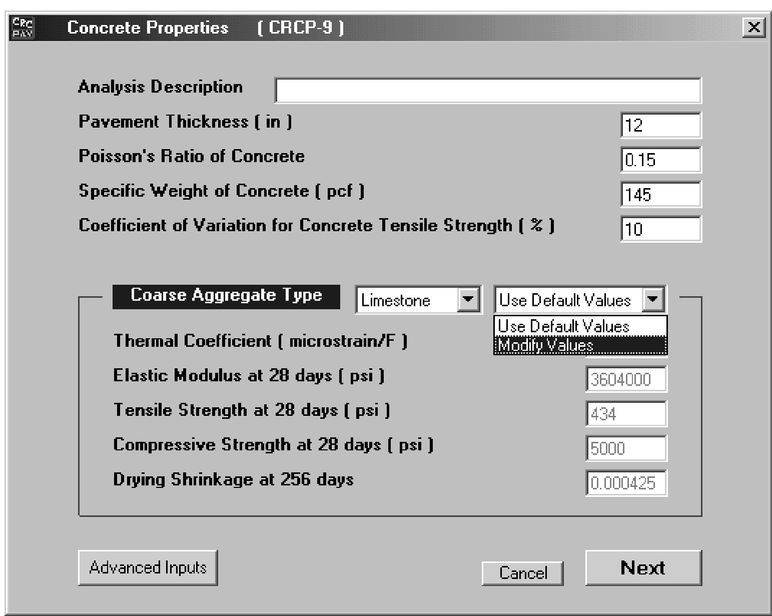


Figure 2.5. Modification of default values for coarse aggregate type

2.2.2 Steel Properties

The material properties of steel and the arrangement of longitudinal steel bars are defined on the screen shown in Figure 2.6. Elastic modulus, steel bar diameter, thermal coefficient, specific weight, and percent reinforcement are defined first. The thickness of the finite element is defined in the program by

$$\text{Finite element thickness} = \frac{\pi(\text{Steel bar diameter})^2/4}{(\text{Concrete slab thickness})(\text{Percent reinforcement})} \times 100 \quad (2.1)$$

The longitudinal steel bar location from the surface of the concrete slab is defined next by selecting a value from the list. In CRCP-9, because the number of finite elements in the vertical direction is ten, the steel bar can be located at the same level as any finite element node on the concrete slab. For instance, if the thickness of the concrete slab is 12 inches, there will appear nine different values of 1.2, 2.4, 3.6, 4.8, 6.0, 7.2, 8.4, 9.6, and 10.8 in the list. The default value is always selected to be of the mid-depth because most CRC pavements have longitudinal steel bars at the mid-depth of the concrete slab.

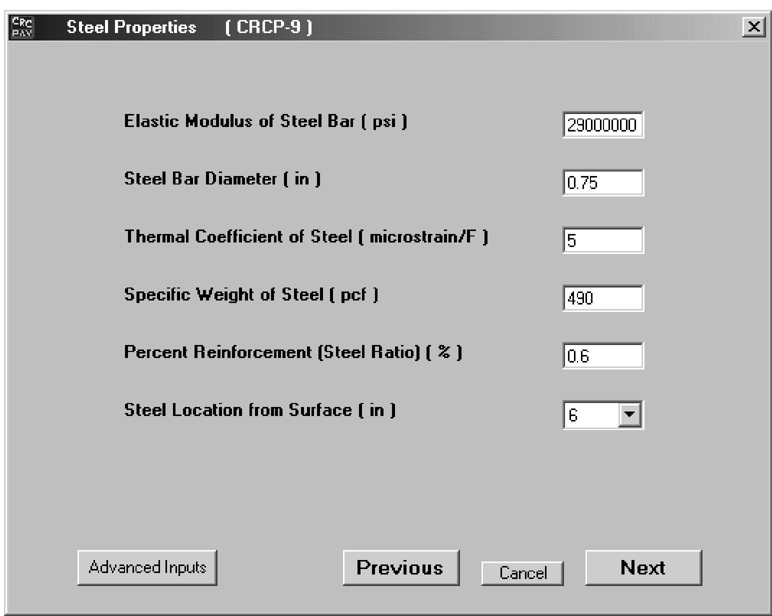


Figure 2.6. Steel properties screen

2.2.3 Bond-Slip Relationship

The bond-slip relationships between concrete and steel bar and between concrete slab and base layer are defined in the Bond-Slip Relationship screen shown in Figure 2.7. The concrete and steel bond-slip is defined first by selecting a bond-slip relationship from the list. There are four different bond-slip relationship models: linear, linear with ultimate slip, bilinear, and bilinear with ultimate slip; each bond-slip model has three different stiffness values: strong, moderate, and weak (see Figure 2.8). Once a relationship is selected, default values are shown. If User Defined is selected, input fields are enabled for users to write their own values.

There is frictional bond-slip at the interface between the bottom of the concrete slab and the base layer (or subbase for typical rigid pavements). The vertical stiffness of subgrade (or stiffness of subgrade reaction) and the bond-slip between concrete slab and base are defined at the lower part of the screen. If a subbase type is selected from the list, a default value of the bond-slip stiffness between concrete slab and selected subbase type is shown, as in Figure 2.9. Users can insert their own values by selecting User Defined from the list.

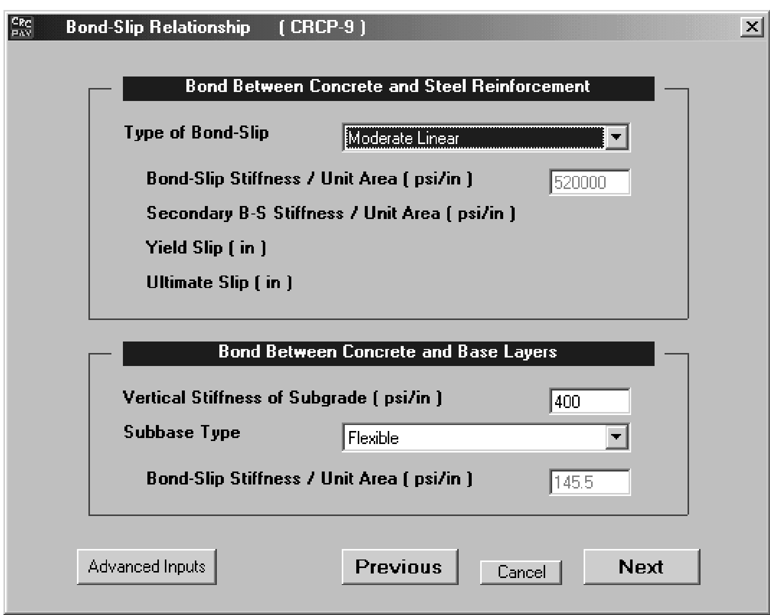


Figure 2.7. Bond-slip relationship screen

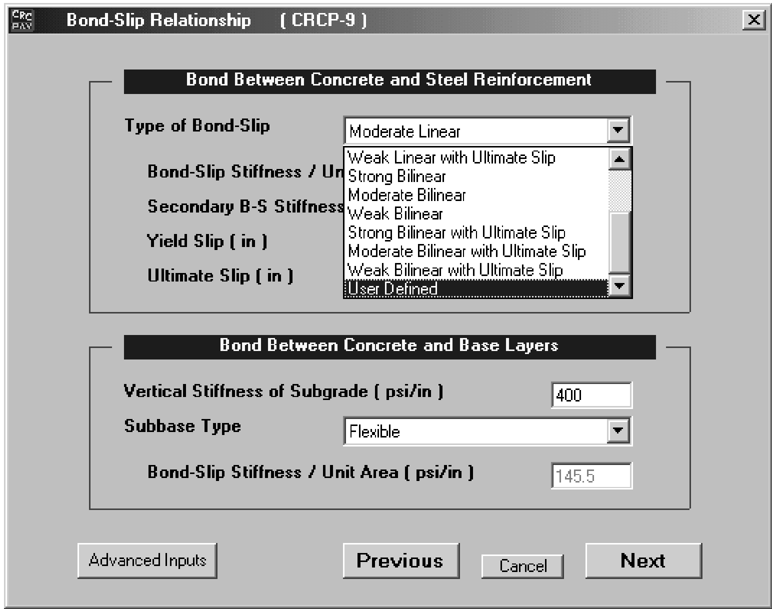


Figure 2.8. Selection of bond-slip relationship

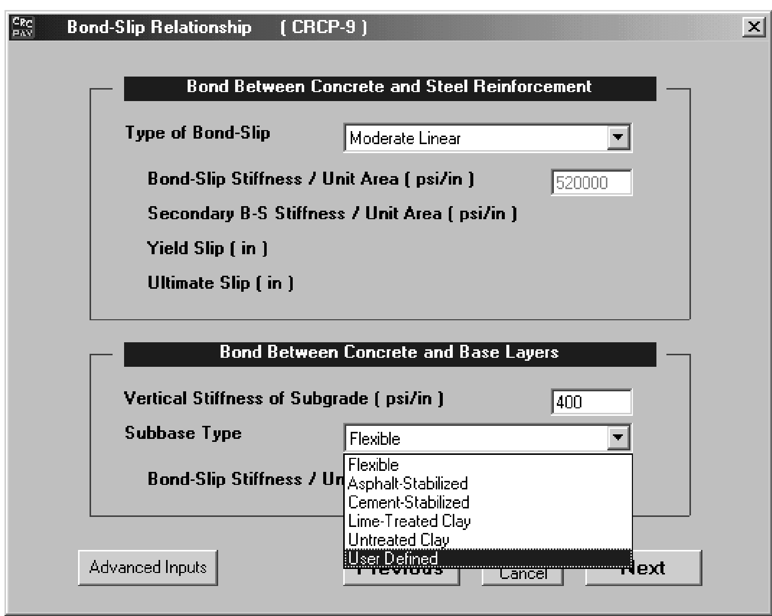


Figure 2.9. Selection of subbase type

2.2.4 Loads

Applied loads on the CRC pavement system include external wheel loads and such environmental loads as changes in temperature and drying shrinkage. These loads are defined in the Loads screen shown in Figure 2.10. Wheel load, wheel base radius, and the first day of wheel load application after the placement of concrete are defined first. Curing temperature, days before minimum temperature, and types of temperature and drying shrinkage through the depth of the concrete slab are defined next. Users can select one of three types of temperature and drying shrinkage variations through the depth of the concrete slab, which are uniform, linear, and nonlinear variations, as shown in Figure 2.11.

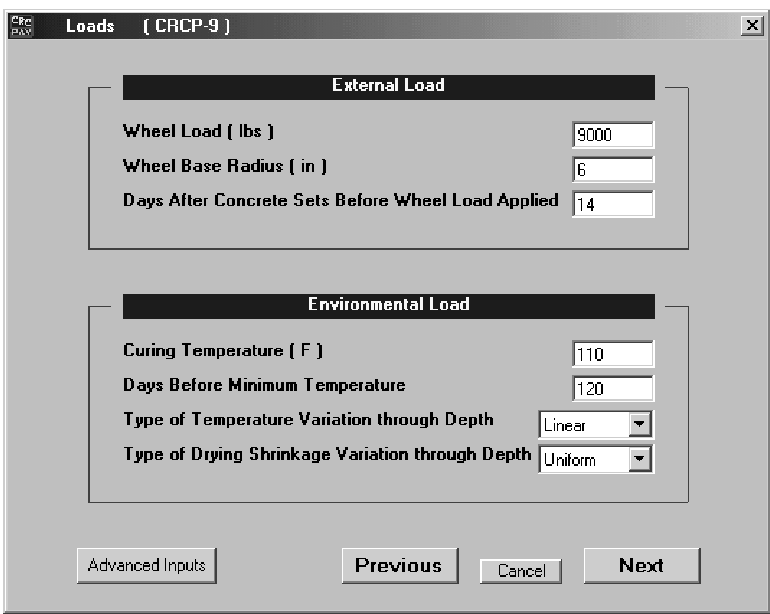


Figure 2.10. Load definition screen

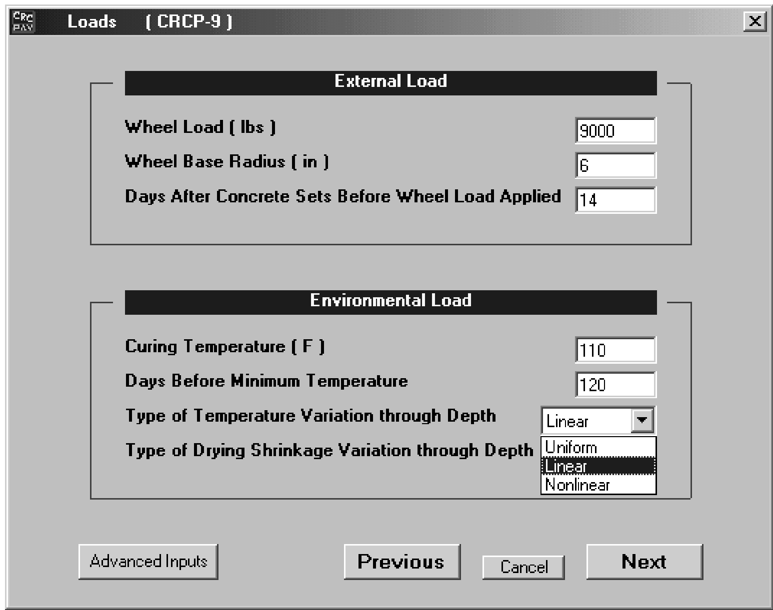


Figure 2.11. Selection of temperature variation type

2.2.5 Temperature and Drying Shrinkage

The temperature and drying shrinkage variations through the depth of the concrete slab are defined in the Temperature and Drying Shrinkage screen. In the previous screen, if users select the linear variation of temperature, the screen shows input fields at the surface and bottom of the concrete slab as shown in Figure 2.12. T1 and T2 are daily minimum and maximum temperatures. If users put temperatures at the surface and bottom, the program generates other temperatures at finite element nodes using linear interpolation because the variation has been selected to be linear. The days that correspond to input temperatures can also be changed by inserting any day on which users have temperature data. However, the temperature data on the first day after placement of concrete and on the day when the minimum yearly temperature is reported should be entered (once entered, these fields may not be changed). The temperatures between the input days will be linearly interpolated. For instance, in Figure 2.12 the minimum surface temperature on Day 3 is 85 degrees and on Day 7 it is 80 degrees. Therefore, the minimum surface temperatures on Days 4, 5, and 6 are defined to be 83.75, 82.5, 81.25 degrees, respectively. If users select the uniform temperature variation in the previous screen, the screen shows input fields at the surface only, as shown in

Figure 2.13, because the temperatures will be the same through the depth. On the other hand, if the nonlinear temperature variation is selected in the previous screen, users must put temperatures at each finite element node as shown in Figure 2.14.

The drying shrinkage variation is similarly defined with the temperature variation. However, users must understand what the drying shrinkage ratio means on the screen. The drying shrinkage strain is defined in the concrete properties screen as shown in Figure 2.3. This strain is not the same for the entire depth of the concrete slab. To account for this variation in drying shrinkage strain, the drying shrinkage ratio is used. For instance, if the linear variation is selected in the previous screen, users can define the strain through the depth by putting drying shrinkage ratio values that range from 0 to 1 at the surface and bottom of the concrete slab. If the drying shrinkage strain is 0.00005 on a given day and if the drying shrinkage ratios at the surface and bottom are 1 and 0, respectively, the actual drying shrinkage will be 0.00005 at the surface, 0.000025 at the middle, and 0 at the bottom. Figures 2.12, 2.13, and 2.14 show a uniform drying shrinkage ratio of 0.5, which means drying shrinkage strains are assumed to be uniformly distributed through the depth, and show half of their values obtained from the curing curves.

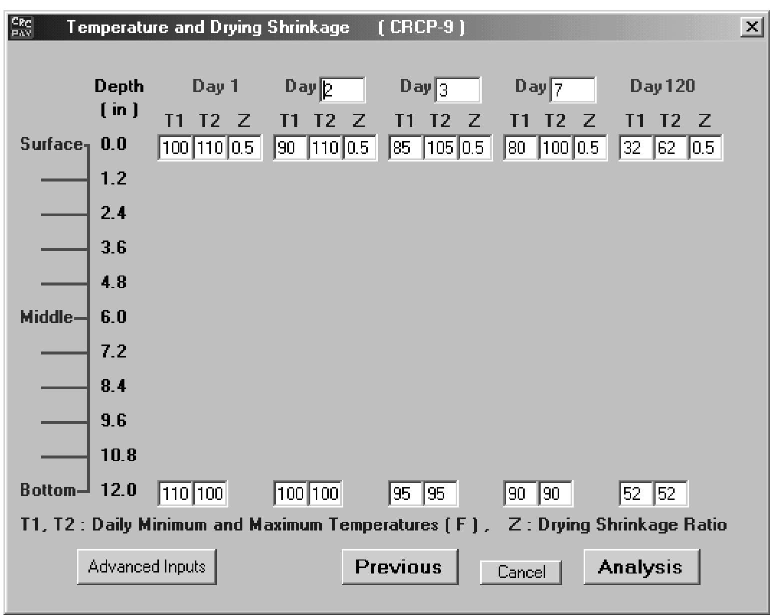


Figure 2.12. Linear temperature variation input screen

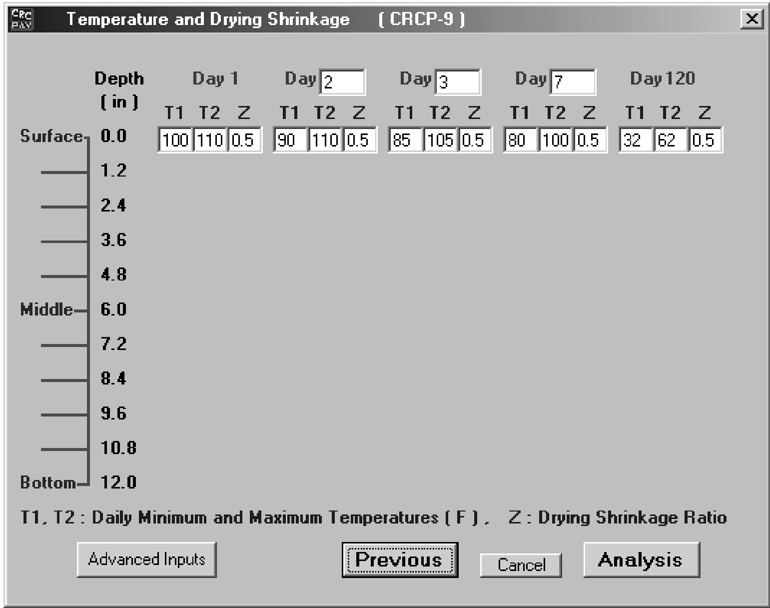


Figure 2.13. Uniform temperature variation input screen

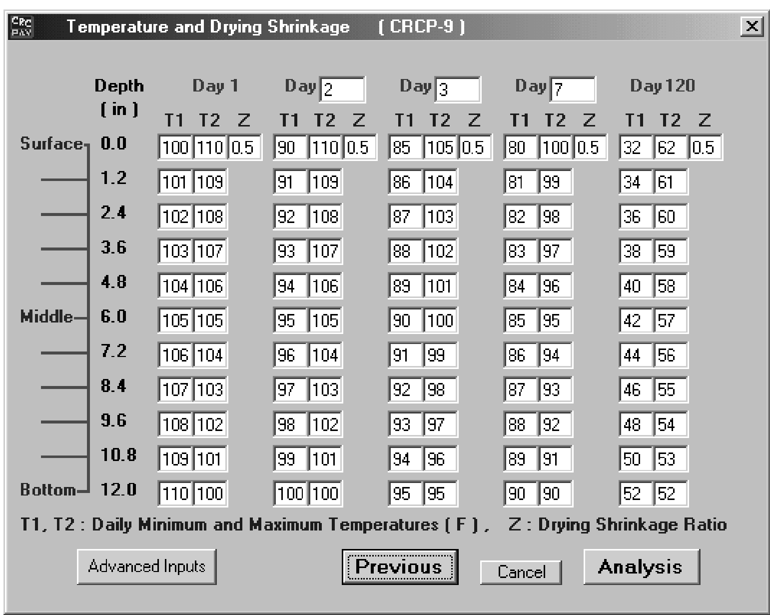


Figure 2.14. Nonlinear temperature variation input screen

2.3 ADVANCED INPUTS

2.3.1 Primary Crack Spacing

The Advanced Inputs screen is shown in Figure 2.15. In this screen, users can define the number of different primary crack spacings, finite element type, creep effect, curling effect, swelling condition, and reliability. The number of different primary crack spacings can be one of the three listed values of 2, 4, and 8, as shown in Figure 2.16. The primary crack spacing is the crack spacing with which the analysis begins. In CRCP-9, the first primary crack spacing is assumed to be 50 ft and other primary crack spacings are defined by

$$Primary\ crack\ spacing\ (i) = 50 - (i - 1)\frac{25}{Total\ number\ of\ \ primary\ crack\ spacings} \quad (2.2)$$

where the unit of the crack spacings is in feet. For instance, if the number of primary crack spacings is 4, the primary crack spacings are 50, 43.75, 37.5, and 31.25 ft. It should be noted that selecting a large number of primary crack spacings increases reliability of the results, but computational time also increases. From the preliminary study, the number of different primary crack spacings slightly affects the results if that number is equal to or larger than 2.

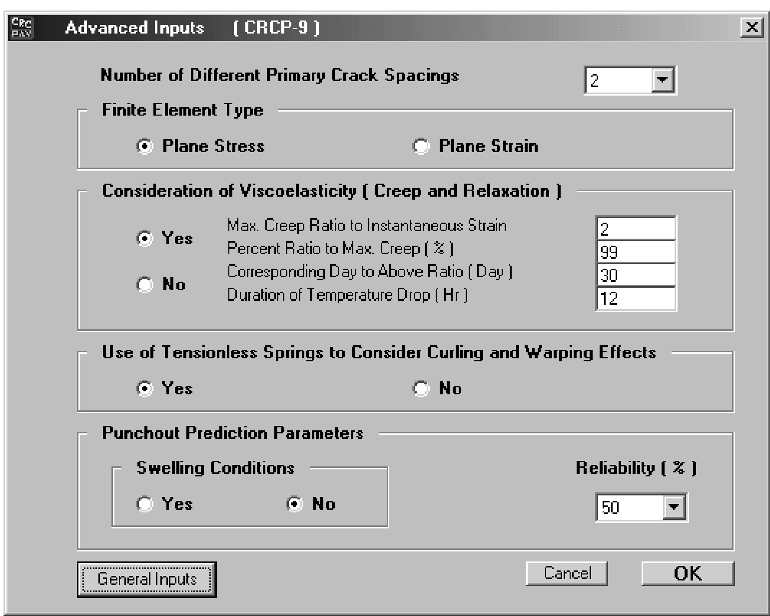


Figure 2.15. Advanced inputs screen

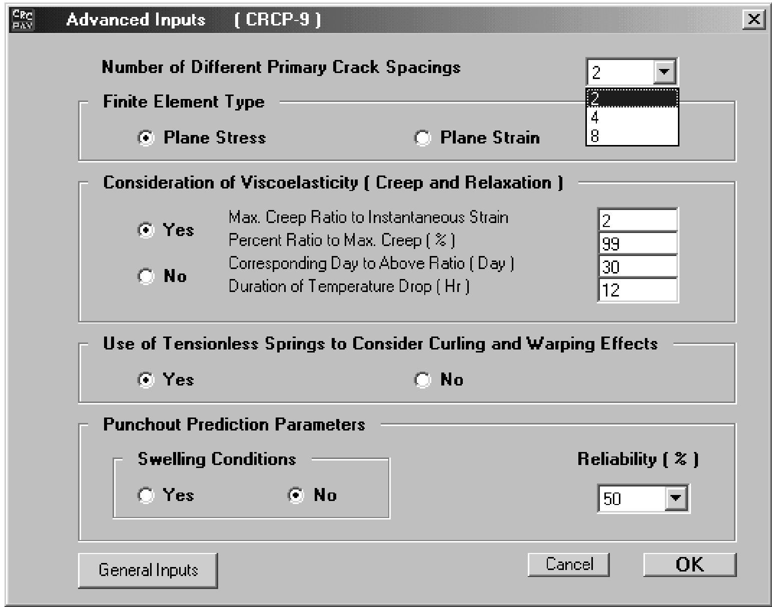


Figure 2.16. Selection of the number of primary crack spacings

2.3.2 Finite Element Type

Next, the type of finite element used for discretization of the concrete slab can be switched between plane stress and plane strain elements. It should be noted that the concrete stresses are slightly overestimated if the plane strain elements are used, and slightly underestimated if the plane stress elements are used, as compared with the 3-D analysis results (Refs 10, 11).

2.3.3 Creep and Curling Effects

Concrete viscoelasticity (creep of strain and relaxation of stress) can be defined next. If the creep effect is not needed, select the No option in the concrete viscoelasticity; then input fields will disappear from the screen as shown in Figure 2.17. The maximum creep ratio to instantaneous strain, percent ratio to maximum creep and corresponding day, and duration of temperature drop need to be filled when the creep effect is considered. Detailed explanations of creep effect considerations can be found in the previous reports (Refs 6, 9).

The curling and warping effects are defined next. If any side of the concrete slab curls, there can be a gap between the slab and the base layer. The tensionless vertical springs that can sustain only the compressive forces have been developed to properly model this curling effect. It is noted that the curling effect in the CRC pavement is significant when the transverse crack spacing is long and the temperature variation between the top and bottom of the concrete slab is large (Ref 10). If the curling and warping effects are desired, select the Yes option.

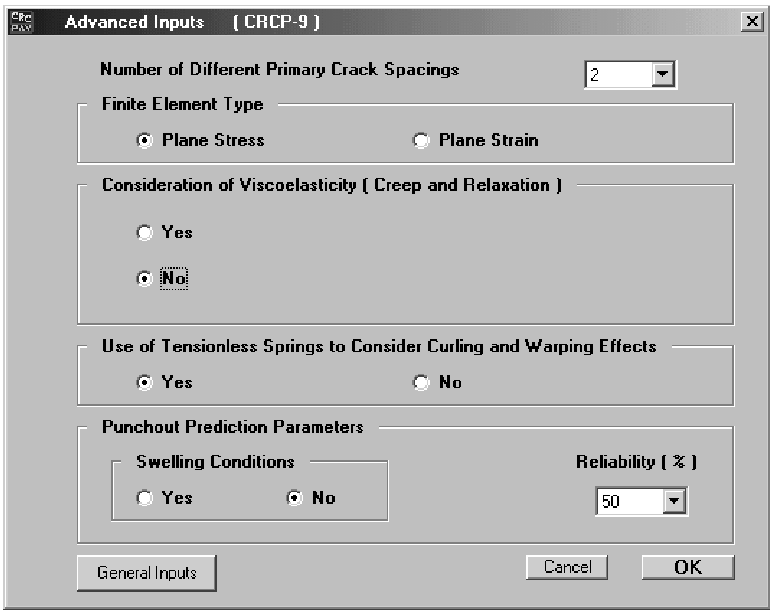


Figure 2.17. Selection of viscoelastic effect

2.3.4 Punchout Prediction Parameters

CRCP-9 predicts the number of punchouts per mile due to the wheel load applications. The predicted number of punchouts depends primarily on the transverse crack spacings, but swelling conditions and reliability also affect the punchout prediction equations (Refs 4, 9). Users wanting to consider the swelling conditions should select the Yes option. Users can also select one of the listed reliabilities (50, 75, and 95%), as shown in Figure 2.18.

When the input process has been completed, users may perform the analysis. To conduct the analysis from the Advanced Inputs screen, first click on the General Inputs button to go to the Concrete Properties screen, one of the General Inputs screens. Then click on the Next button until the Temperature and Drying Shrinkage screen appears. Users can find the Analysis button on that screen. Do not click on the Cancel button until the analysis is performed. Once the analysis is completed, users can save input values to a file for future use. The details of the file controls are explained in Chapter 4. If users click on the Cancel button, the main screen appears and modifications of input values will be lost. If users click on the Analysis button, the analysis begins and the progress will be shown as in Figure 2.19.

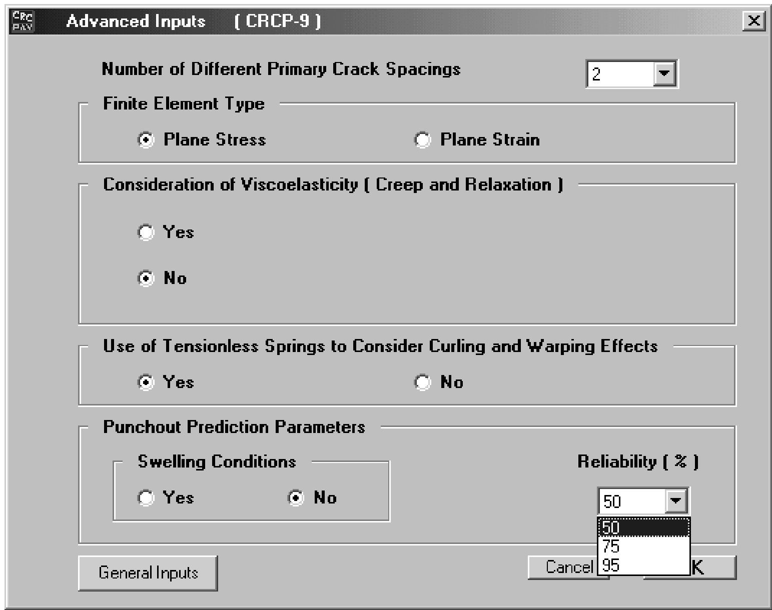


Figure 2.18. Selection of reliability

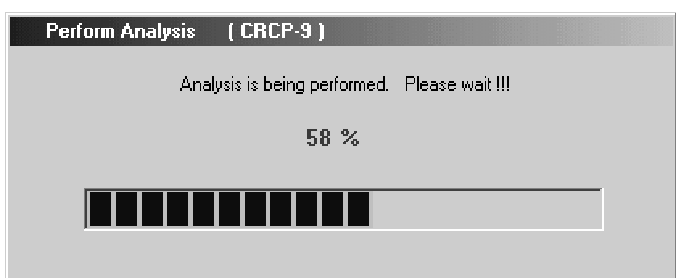


Figure 2.19. Perform analysis screen

CHAPTER 3. OUTPUT GUIDE

3.1 INTRODUCTION

The analysis results from CRCP-9 include time histories of mean crack spacing, crack width and steel stress at crack, crack spacing distribution, cumulative crack spacing distribution, and the number of punchouts related to the wheel load applications. The input values and analysis results are also summarized and can be shown in the crcpfor.sum file. Once the analysis is completed, the information box shown in Figure 3.1 appears. If users click on the OK button, the first output screen will appear. Users can also see the latest output screens by selecting the Latest Output item under the Analysis menu from the main screen. Also, the saved outputs can be shown from the File menu.

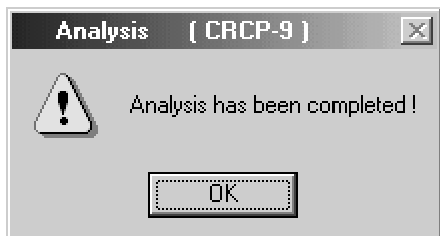
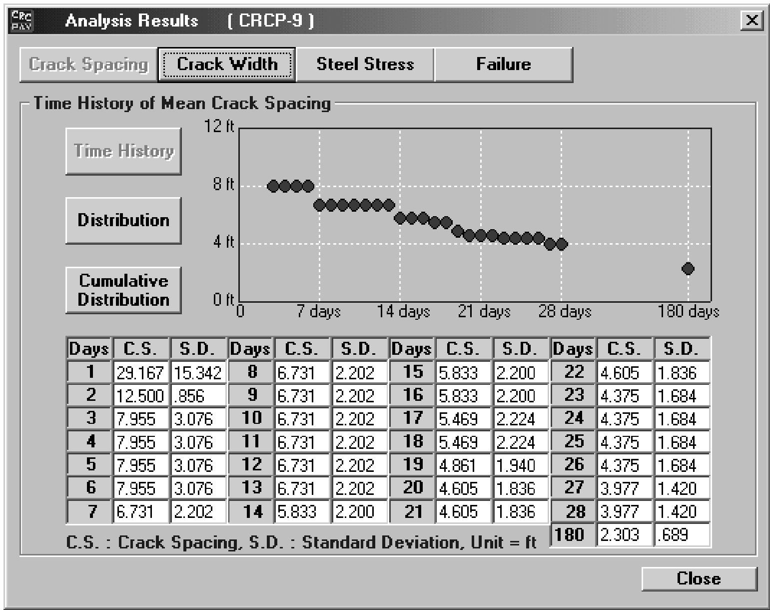


Figure 3.1. Completion of analysis dialogue box

3.2 CRACK SPACING

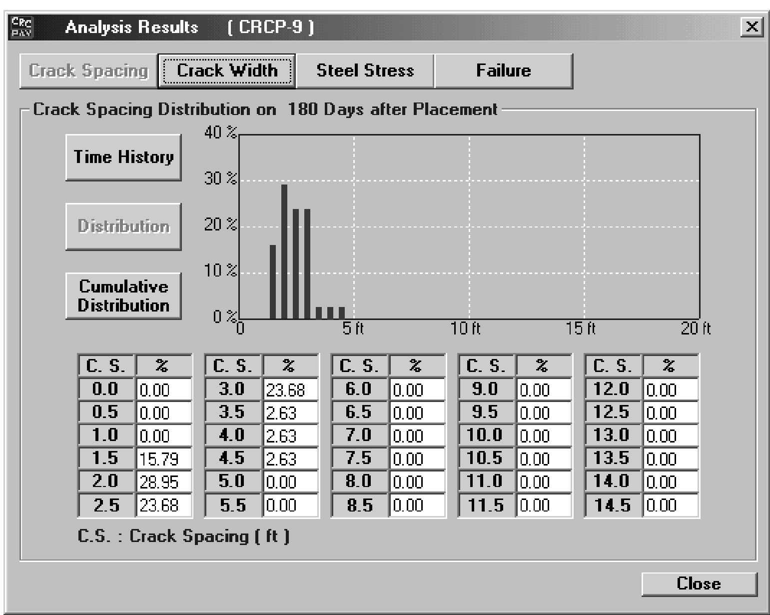
The first output screen shows the time history of mean crack spacing, as shown in Figure 3.2. Users can easily see the variations in mean crack spacing with time from the graph. Since the graph shows up to 12 ft of mean crack spacings, the mean crack spacings greater than 12 ft will not be shown. The mean crack spacings and standard deviations on each day until 28 days and on the last day of the analysis are listed in the table.

The crack spacing distribution on the last day of the analysis, which is typically the day when the minimum yearly temperature is reported, can be obtained, as shown in Figure 3.3, by clicking on the Distribution button. In the table, the range of each crack spacing is 0.5 ft. For instance, a crack spacing of 2 ft represents the crack spacings between 1.75 and 2.25 ft. Cumulative values of the crack spacing distribution can also be obtained by clicking on the Cumulative Distribution button, as shown in Figure 3.4. In the table, output values represent the percentage of the crack spacings smaller than a certain crack spacing. For instance, from Figure 3.4, we see that 44.74% of the crack spacings are smaller than 2.25 ft.



Days	C.S.	S.D.	Days	C.S.	S.D.	Days	C.S.	S.D.	Days	C.S.	S.D.
1	29.167	15.342	8	6.731	2.202	15	5.833	2.200	22	4.605	1.836
2	12.500	.856	9	6.731	2.202	16	5.833	2.200	23	4.375	1.684
3	7.955	3.076	10	6.731	2.202	17	5.469	2.224	24	4.375	1.684
4	7.955	3.076	11	6.731	2.202	18	5.469	2.224	25	4.375	1.684
5	7.955	3.076	12	6.731	2.202	19	4.861	1.940	26	4.375	1.684
6	7.955	3.076	13	6.731	2.202	20	4.605	1.836	27	3.977	1.420
7	6.731	2.202	14	5.833	2.200	21	4.605	1.836	28	3.977	1.420
									180	2.303	.689

Figure 3.2. Time history of mean crack spacing screen



C. S.	%	C. S.	%	C. S.	%	C. S.	%	C. S.	%
0.0	0.00	3.0	23.68	6.0	0.00	9.0	0.00	12.0	0.00
0.5	0.00	3.5	2.63	6.5	0.00	9.5	0.00	12.5	0.00
1.0	0.00	4.0	2.63	7.0	0.00	10.0	0.00	13.0	0.00
1.5	15.79	4.5	2.63	7.5	0.00	10.5	0.00	13.5	0.00
2.0	28.95	5.0	0.00	8.0	0.00	11.0	0.00	14.0	0.00
2.5	23.68	5.5	0.00	8.5	0.00	11.5	0.00	14.5	0.00

Figure 3.3. Crack spacing distribution screen

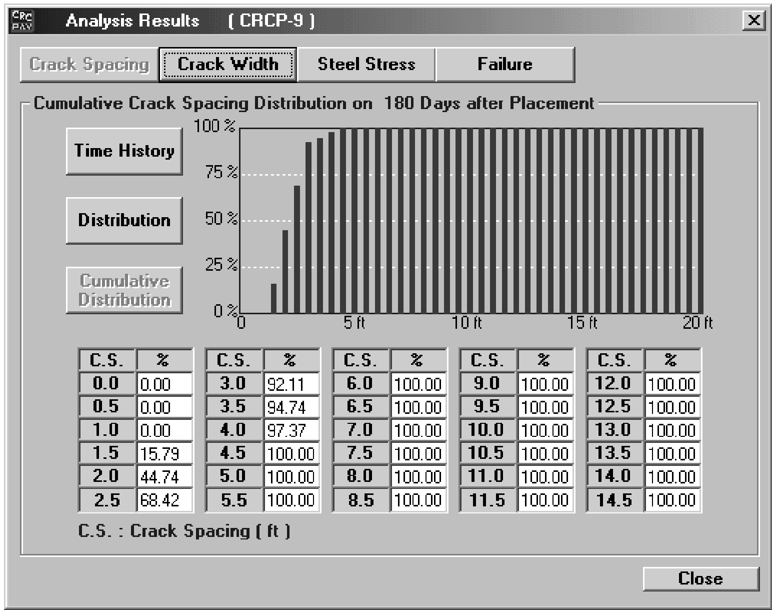


Figure 3.4. Cumulative crack spacing distribution screen

3.3 CRACK WIDTH AND STEEL STRESS

The time history of mean crack width can be obtained by clicking on the Crack Width button, as shown in Figure 3.5. The output format is similar to that of the time history of mean crack spacing. The graph shows crack widths up to 0.04 in. The values of crack widths are also listed in the table. The time history of mean steel stress at crack can also be obtained by clicking on the Steel Stress button. Then, the screen shown in Figure 3.6 appears. This output format is the same as that of the time history of mean crack width.

3.4 PUNCHOUTS

The number of punchouts per mile according to the wheel load applications can be obtained by clicking on the Failure button. The number of punchouts is shown for every 5 million ESALs and up to 100 million ESALs, as shown in Figure 3.7. The graph shows up to twelve punchouts per mile.

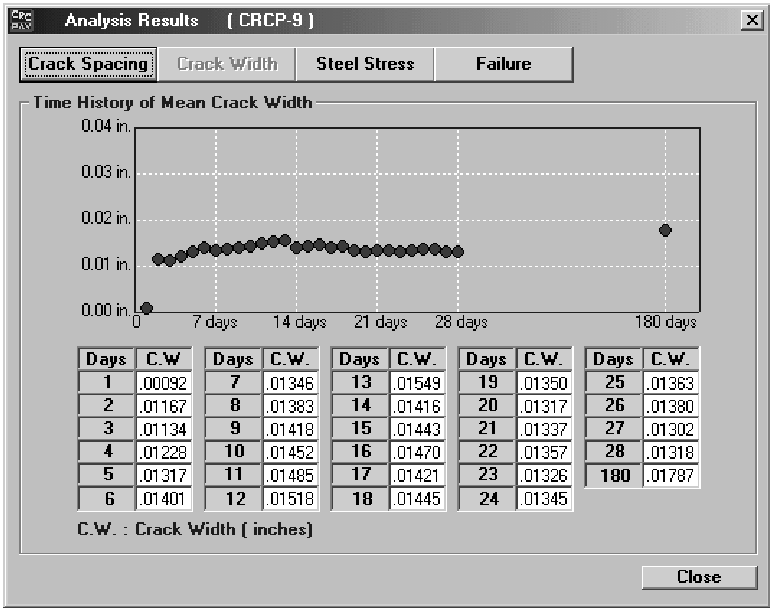


Figure 3.5. Time history of mean crack width screen

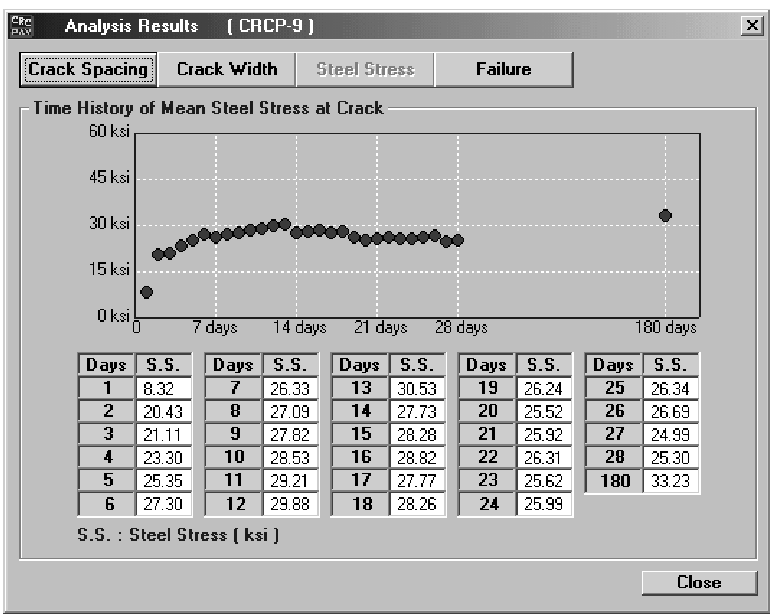


Figure 3.6. Time history of mean steel stress screen

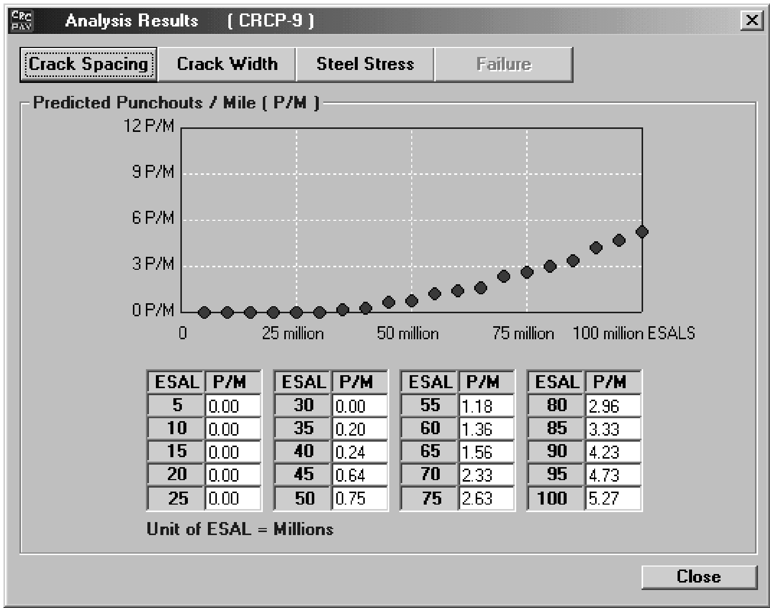


Figure 3.7. Punchout prediction screen

3.5 OTHER CHARACTERISTICS

The input values and output results for the analysis can be reviewed in document form by selecting the Review Analysis Summary item under the Analysis menu. The screen shown in Figure 3.8 appears when the item is selected. This screen is generated from the crcpfor.sum summary file and summarizes itemized input values and analysis results. Users can copy content in the summary by clicking the right button on the mouse and by selecting Copy from the pop-up menu after highlighting the content to be copied. The content can be pasted into any other Windows-based program, such as Word and Excel, allowing users to easily transfer the analysis data.

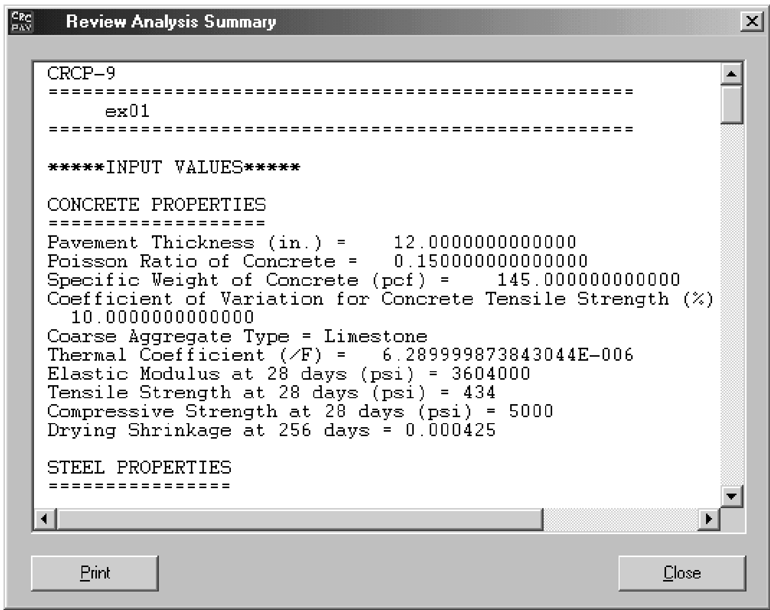


Figure 3.8. Analysis summary screen

CHAPTER 4. FILE CONTROL AND PRINT

4.1 FILE CONTROL

Users can open, save, and delete input and output files by selecting an appropriate item under the File menu as shown in Figure 4.1. To save an input or output file, first perform the analysis and then click on the Close button in any Analysis Results screen to go back to the main screen. Then select the Save Input File As option to open the dialogue box shown in Figure 4.2. Select the directory where the input file is saved and write the name of the input file in the File Name field. The name of the input file to be saved must have an "inp" extension. The analysis results can also be saved similarly by selecting the Save Output File As option under the File menu. The name of the output file must have an "out" extension. Users can also open existing input and output files by selecting Open Existing Input File and Open Existing Output File items, respectively, under the File menu. The existing input and output files can be deleted by selecting Delete Existing Input File and Delete Existing Output File items under the File menu. Other files, except CRCP-9 input and output files, cannot be deleted by using those menu items to protect the files. To quit CRCP-9, select the Exit item under the File menu or click on the cross mark at the upper-right corner of the screen.

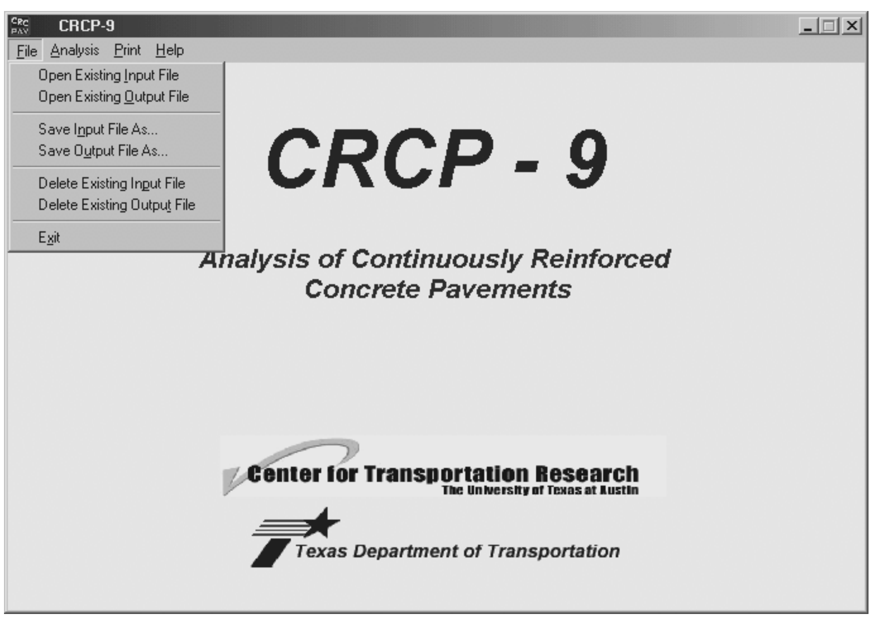


Figure 4.1. Menu items under File menu

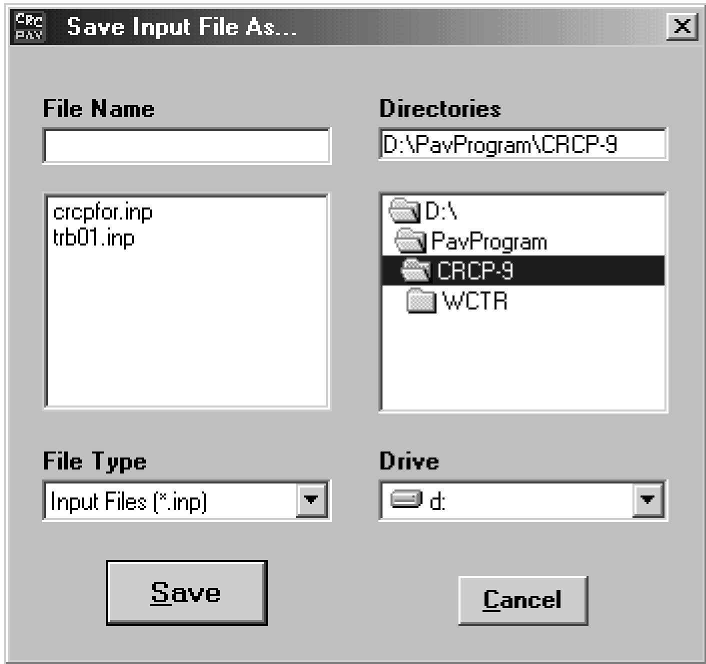


Figure 4.2. File control screen

4.2 PRINT

The analysis summary and all screens, such as the main, input, and output screens, can be printed by selecting items under the Print menu, as shown in Figure 4.3. The analysis summary, shown in Figure 3.8, can be printed by selecting the Analysis Summary item under the Print menu. The input screens — advanced inputs, concrete properties, steel properties, bond-slip relationship, loads, and temperature and drying shrinkage — can be printed by selecting the appropriate item under the Input Screen menu item, as shown in Figure 4.4. The output (analysis results) screens of time histories of mean crack spacing, crack width and steel stress at crack, crack spacing distribution, cumulative crack spacing distribution, and predicted punchouts per mile can also be printed similarly, as shown in Figure 4.5. If any item under the Print menu is selected, the dialogue box shown in Figure 4.6 will appear to ensure the users' print intention. If users click on the Yes button in the Print dialogue box, the selected screen or analysis summary will be printed. The print quality depends on the printer. The information on CRCP-9 shown in Figure 4.7 can be found by selecting the About CRCP-9 item under the Help menu in the main screen.

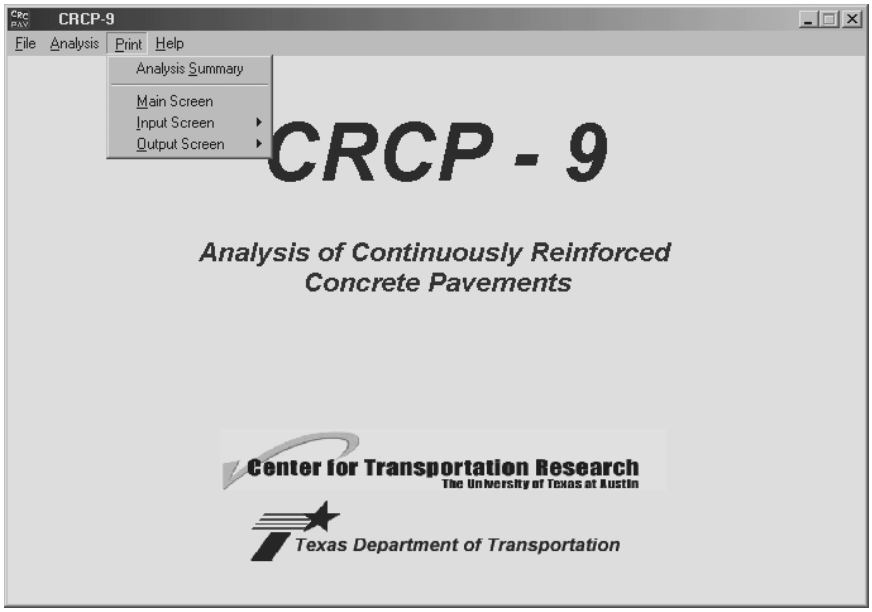


Figure 4.3. Menu items under Print menu

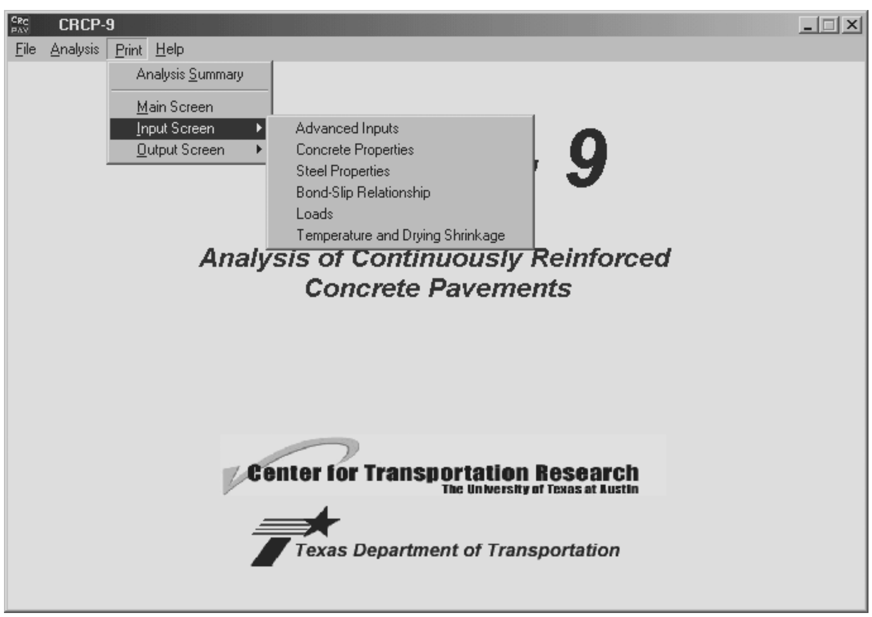


Figure 4.4. Menu items under Input Screen

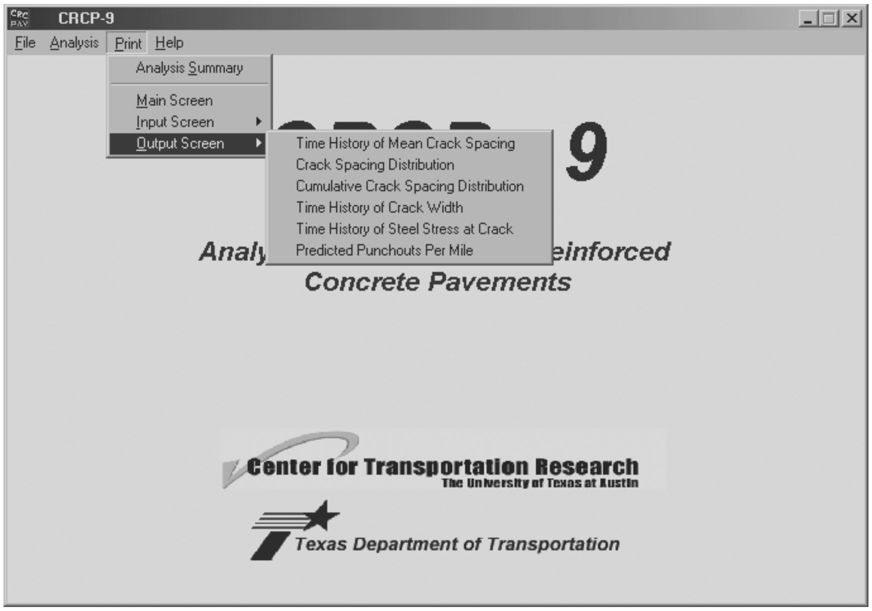


Figure 4.5. Menu items under Output Screen

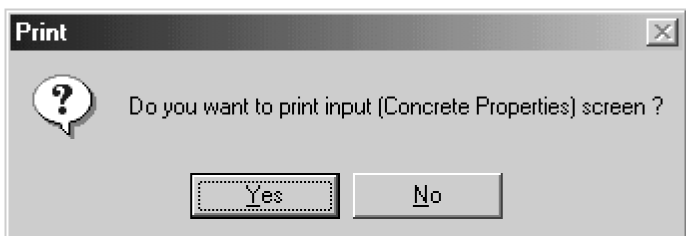


Figure 4.6. Print dialogue box

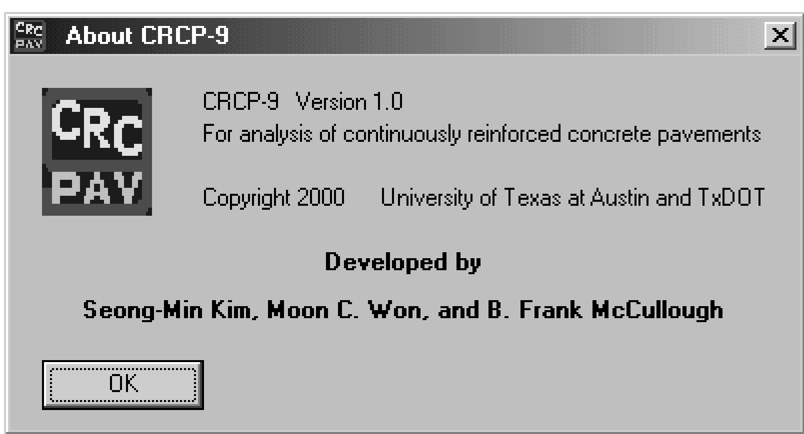


Figure 4.7. About CRCP-9 dialogue box

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