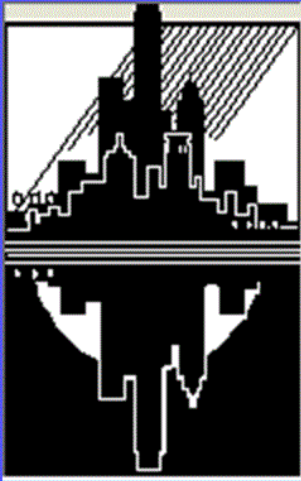# WisPave 4 User Manual

**WisDOT Pavement
Engineering Software**

WisPave 4

Wisconsin Department of Transportation
Division of Transportation Systems Development
Bureau of Technical Services
Materials Management Section
Pavements Unit

August 5, 2021

Table of Contents

Contents

List of Figures

1   Introduction

WisPave is WisDOT's pavement design and life cycle cost analysis (LCCA) software program for pavement type selection. The pavement design procedures follow those provided in the American Association of State Highway & Transportation Officials (AASHTO) Interim Guide for Design of Pavement Structures, 1972, Chapter III Revised, 1981. Chapter 14 of WisDOT's Facilities Development Manual provides policies and procedures for pavement structural design and pavement type selection. The purpose of this manual is to assist users with the use of WisPave 4; it is not a substitute for Chapter 14 of the FDM.

Users must have a Wisconsin Web Access Management System (WAMS) account to access WisPave 4. To self-register for a WAMS account, go to https://on.wisconsin.gov/WAMS/home. Once an account is established, send an e-mail to WisPave's administrator, identified in FDM 14-15-10, with your complete name, company name, and your WAMS User ID to request access to WisPave. Users will be granted proper security authorization and will receive an e-mail when access has been approved.

WisPave 4 is a web application with a shared database; thus, it does not need to be downloaded onto your computer. Data files/pavement designs can only be saved in the shared database. WisPave 4 files will currently be saved and available in the database indefinitely.

WisPave 4 should run using most modern browsers but has not been tested in all of them. It has been tested and performs in IE8, IE9, IE10, IE 11, Microsoft Edge 42, Firefox 25, and Chrome version 32 and higher. But, if using Internet Explorer 8, there are slight issues with viewing the screens and the ability to see all the fields, particularly the pull-down menu options. For optimal viewing in IE8, go to <Tools> and make sure 'Compatibility View' is NOT checked. Also view at 100 percent size (<View> <Zoom> <100%>) and not any larger, as zooming in will distort some of the lines. Similar viewing issues might occur with other browsers. If so, try adjusting the viewing options identified above. If that does not resolve the issue, then contact WisPave's administrator to report the problem.

The manual will be posted on QMP website, in FDM 14-1-1.5, and on WisPave's home page. If any problems or issues with WisPave 4 software program are identified; or if any information in this manual is incorrect, unclear, or missing; or if you have any suggestions for improvement; then please notify WisPave's Administrator. If reporting WisPave 4 problems, be prepared to provide specifics such as the Project ID, screen title where problem occurred, and a detailed explanation of the issue. In addition, be sure to identify the project file 'Status' as 'Final' on the general information screen so that the file can be accessed, and the issue can be investigated.

The screenshots used in this manual were obtained from a fictitious pavement design developed for this manual for illustration purposes only. Thus, the alternative designs and rehabilitation scenarios are not reflective of any actual designs used in Wisconsin. The unit costs used are also fictitious and are not necessarily even in the ballpark of actual Wisconsin unit prices.

2   WisPave 4

2.1   General Information

All users can create, save, view, edit, and delete their own WisPave 4 files. WisPave 4 allows 30 minutes of idle time. After 30 minutes of idling, the latest screen accessed will appear to be active, but once the user attempts to proceed with a design, WisPave 4 will automatically close the file and return to the logon screen. Any data entered on the last screen accessed will not be saved. Users must save data on all screens by selecting <Next> at

the bottom of each page. Selecting <Next> saves the data entered on the current screen and advances the program to the next WisPave 4 screen. Since the data is saved in the database, there is no need to save a file before closing a file or exiting the program; therefore, the typical <File><Save> feature is not needed and was not included in WisPave 4. To return to a specific screen after more than 30 minutes of idling, user must logon again, reopen the file, and then proceed to that particular screen. It is good practice to always save current data by selecting <Next> before leaving your computer and WisPave 4 for any amount of time.

Several screens have <Next Alternative> or <LCCA> as options instead of the standard <Next>. Selecting either one of those will save the data on the current screen and advance the program. As a simple rule of thumb, the options on the bottom right of each screen will save the date and advance the program. Selecting <Back> on the bottom left will take you to the previous screen but will not save any data entered on the current screen.

Only one file can be open at a time by any user. To close one design file and continue with another design, select <File> from the menu bar, and then select either <New Design> or <Open Existing Design>. To simply close the file, select <Exit>. Selecting <Exit> will close the file, but the user will still be logged into WisPave 4 and can proceed with another design if desired. To exit WisPave 4 completely, close the browser window.

2.2   WisPave 4 Link

After receiving authorization, WisPave 4 can be accessed at: https://trust.dot.state.wi.us/wispave/home.do
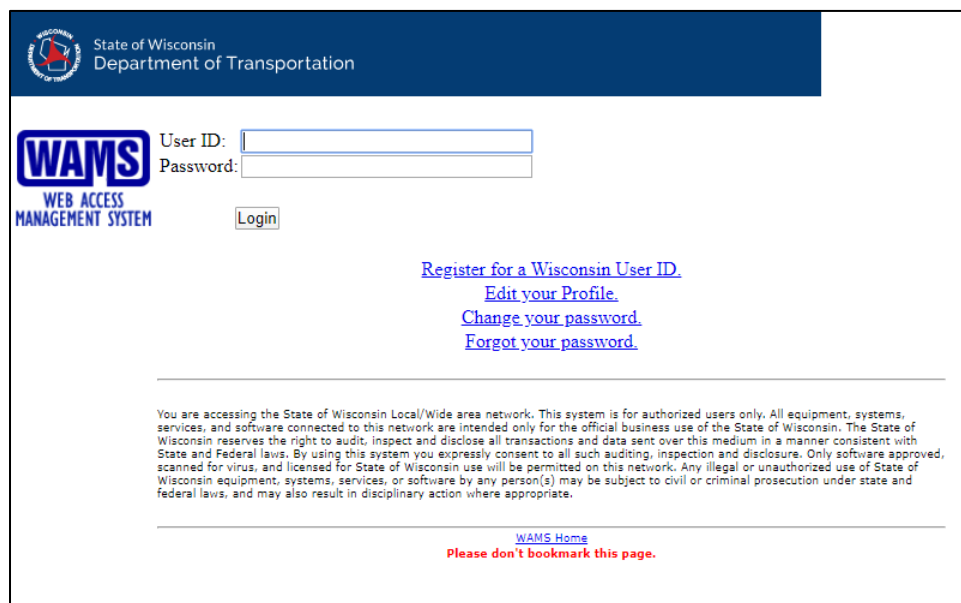
Figure 1.   WisPave 4 Logon Screen

2.3   Home Page

After logging in, user will go directly to *WisPave 4 Home Page*. Links to *WisPave 4 User Manual* and *FDM Chapter 14* are located directly above the graphic.

 Select <File> from the menu bar, located in the upper left of the screen, to either create a new design or open an existing design.
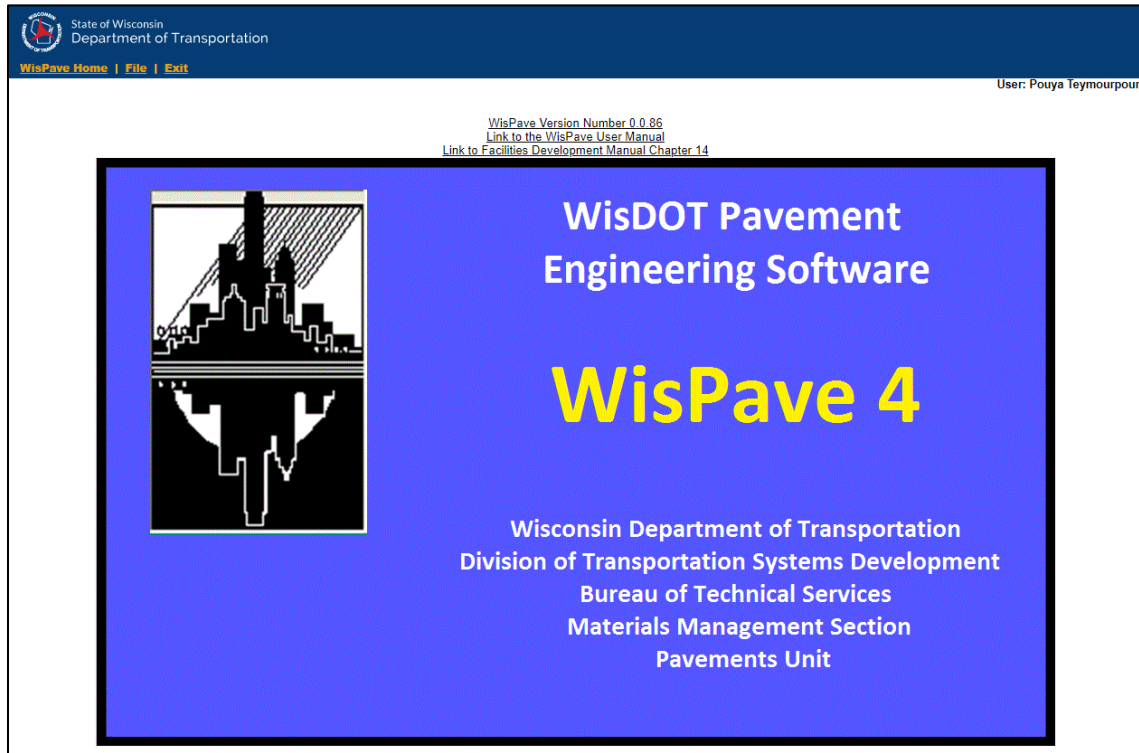
Figure 2. WisPave 4 Home Page

2.4   Pavement Design Start Options
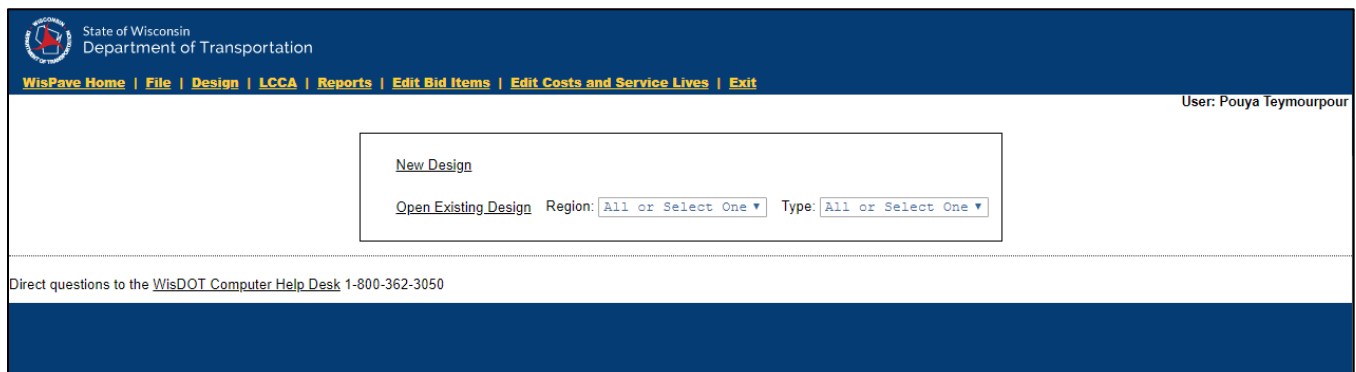
Figure 3. Start Options

2.4.1   New Design

By selecting <New Design>, WisPave 4 proceeds to the *New Pavement Design General Information* screen, with the 'Designer's Name' and 'Design Date' automatically inserted. The 'Designer's Name' is the name that was used to create your WAMS ID. The name cannot be manually changed in WisPave 4, but it can be revised in your WAMS profile. Several suffixes can be selected in WAMS to be shown after a name, but "P.E." isn't one of them. However, it can be manually added after a last name by inserting a space and then "PE"; no commas or periods are allowed in that field. See an example in the following screenshot.

Figure 4. New Pavement Design General Information

The 'Design Date' defaults to the current date in which the file was created, but it can be changed. All the fields denoted with an asterisk must be completed before proceeding to the next screen. Use a mouse or the <Tab> key to advance through the various fields. Once a 'Region' is selected, then a 'County' field is displayed with a list of counties in the corresponding region. Once a 'County' is selected, a second 'County' box is displayed. That field is optional and only needed if a project spans two counties.

Select <Next> to save the data entered on the current screen (and the newly created design file) and proceed to the following screen. In order to save the file, at least one of three fields (Project ID, Design Name, or Design Date) must be unique from all other design files. In other words, there can be numerous files/designs with the same 'Project ID' and the same 'Highway Name,' but each would require different 'Design Names'. If those three fields are identical to those of any existing file and <Next> were selected, then a message will appear stating, "Pavement design is not submitted, please check the constraints." One of the three aforementioned fields would need to be changed to be unique from all other files in order to save the information and proceed.

Note that the menu bar in the upper left only allows three options and hasn't changed from the previous screen. But, once this screen is completed and saved by selecting <Next>, the menu bar expands to allow for easy navigation throughout the program. The navigation bar is discussed further in section 2.5.

2.4.2   Open Existing Design

Selecting <Open Existing Design> will display a comprehensive list of *Existing Pavement Designs* that the user has created or has authorization to access. The list of existing pavement designs can be filtered by identifying a 'Region' and/or 'Type' (local, state, or other) prior to selecting <Open Existing Design>.

Figure 5. List of Existing Pavement Designs

The comprehensive list of existing designs shows the first ten designs sorted numerically by Project ID. If viewing in a minimized screen size, scrolling down to see the bottom rows of the first 10 designs might be needed. Select the right arrow key to see the next ten designs. The number of designs shown on the first screen can be changed to show 25, 50 or 100. Designs can also be sorted in either ascending or descending order by using the arrow keys next to column titles. Or, use the 'Search' tool to help find a particular file.

By selecting an existing 'Project ID', WisPave 4 goes to the *Edit Pavement Design General Information* screen of that design file. WisPave 4 will advance directly to the *Design Mode* or *LCCA Mode* menu screen of the applicable file if <Design> or <LCCA> is selected, respectively, from the list of designs. One or more files can be deleted by the designer by checking the 'Delete' box of the appropriate Project ID and then selecting <Delete Designs> on the bottom right of the screen. WisPave 4 does not have an 'Undo' feature, so be sure you want to delete a file before doing so.

All designs that are created in WisPave 4 are saved and stored in a centralized database and filed based on the column titles shown on the *Existing Pavement Designs* screen: 'Project ID', 'Highway Name', 'Design Name', 'Region', 'Type', 'Status', 'Designer', and 'Design Date'. As previously mentioned, the combination of 'Project ID', 'Highway Name', and 'Design Date' must be unique from all other existing files. The 'Design Date' shown in the list of *Existing Pavement Designs* is the same as the 'Design Date' displayed on the *Pavement Design General Information* screen.

2.5   Edit Pavement Design General Information

Once an existing file is opened, any information can be edited. However, if a different 'Region' is selected, the program routes to the server to get the appropriate counties in the newly selected region. In order to do so, the program also takes the previously saved data from the server, before routing back to the current screen and repopulating all the fields. Thus, any changes made before selecting a different region are lost and the fields are reverted to the previously saved data. To avoid this problem, select the appropriate 'Region' before editing the rest of the information on this screen.

Figure 6. Edit Pavement Design General Information

Changing the 'Project ID', the 'Design Name', or the 'Design Date' activates the <Save As New> tab, allowing a user to make a duplicate of the file with the revised ID, name or date. By selecting <Save As New>, the original file remains intact and the open/active file is automatically switched to the newly created duplicate. After saving, the program automatically advances to the next screen. The <Save As New> option is only available on this screen.

Some users can open and view other designers' files. If an authorized user opens a file that was created by someone else, the only fields that can be edited are the 'Project ID', 'Design Name', and/or the 'Design Date'. By leaving these fields as they are, the user can view the entire file, but cannot change any data on any screen. However, if the user edits at least one of the three fields, then the <Save As New> tab is activated as previously discussed. If <Save As New> is selected, a duplicate file is created and the 'Designer's Name' of the new file automatically changes to that of the current user. Then, all the fields in the file will be unlocked and the user will have full editing ability.

The 'Design Date' is only automatically inserted when a file is created. It does not automatically change or update if a file is opened and edited, or if a duplicate copy is made. The user must manually change the 'Design Date' if needed. However, the date and time stamp shown on the bottom center of the *Edit Pavement Design General Information* screen updates automatically when a file is edited in any way. The date and time stamp are only shown on this screen. Selecting <Next> on the bottom of each screen saves the current data, overrides any previously saved data, and then advances the program to the next WisPave 4 screen.

When an existing file is opened, and the *Pavement Design General Information* screen was previously completed, the WisPave 4 navigation toolbar in the upper left expands to include 'Design' and 'LCCA' tabs. Selecting either of these tabs will route the program directly to the menu screen of the respective mode. From there, WisPave 4 can easily navigate to any particular screen. The navigation toolbar allows for easy navigation through WisPave 4. However, the navigation toolbar should not be used in the initial pavement design and LCCA process as the data entered on the screens will not be saved without selecting <Next> at the bottom of each screen. In other words, if data is entered on a WisPave 4 screen and the navigation bar is used to advance to a different screen, then the data entered on the current screen will not be saved.

If <File> is selected from the toolbar while a pavement design file is open, a message will state, "Only one pavement design can be open at one time. Do you want to close your open file and continue?" Selecting <OK> will close the open file and the program will return to the start options— 'New Design' or 'Open Existing Design'. Similarly, if <Exit> is selected, a warning message will ask, "Are you sure you want to close your open

file?" By selecting <OK>, the open file will close, and the program will go to a screen that says, "Thank You for using WisPave!" But the WisPave 4 program remains open and the user is still logged-in and can continue to use WisPave 4. To exit WisPave 4 completely, select the <X> in the upper right corner of the browser window.

3   Design Mode

Selecting <Next> at the bottom of each screen will take the user through all the screens in the design mode in the order shown in the screenshot of the *Design Mode* menu (Figure 7). Also, the *Design Mode* menu can be directly accessed from the navigation toolbar to advance to a particular screen. After the general project information screen is completed, proceed to the *Soil Parameters* screen by selecting <Next>.
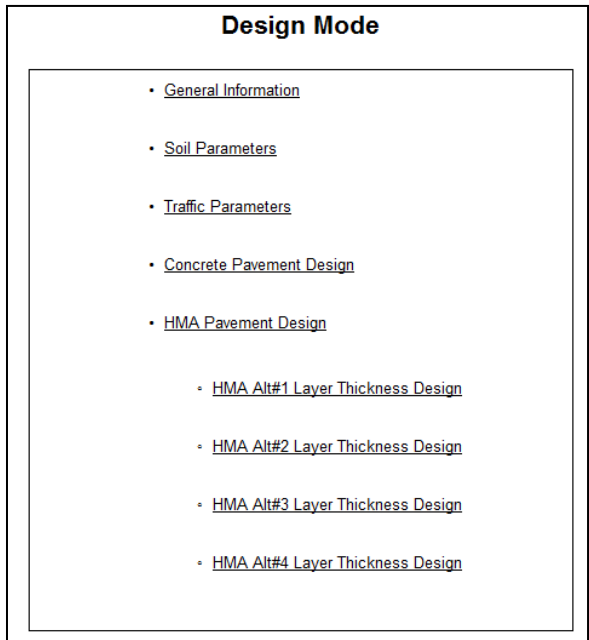
Figure 7. Design Mode Menu

A text box with the "Pavement Design Details" is shown on the top of all the screens in the design mode; however, they were not included in most of the screenshots in this manual for space saving reasons. An example, however, is shown in Figure 8. Only the 'Project ID' is displayed at the bottom of the screens in the LCCA mode.

3.1   Soil Parameters
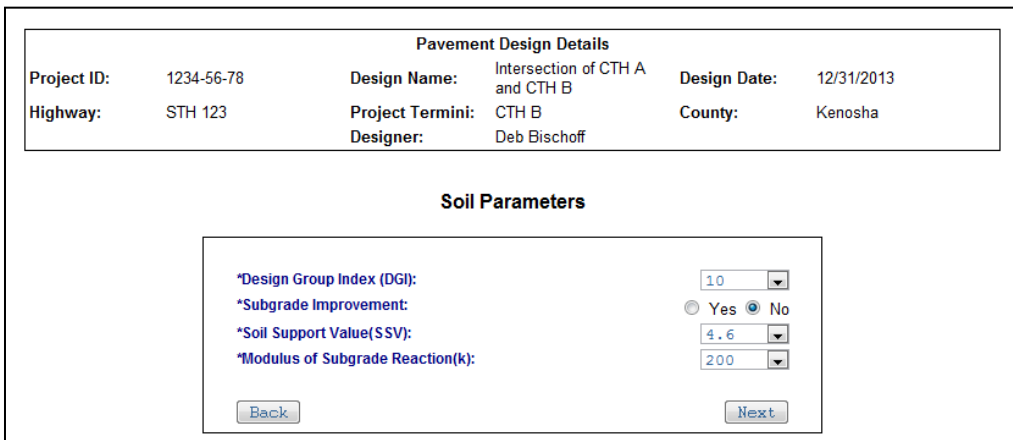
Figure 8. Soil Parameters

7

Enter the correct 'Design Group Index (DGI)'—not the group index value used in the AASHTO system of soil classification, as these values are different. See WisDOT's *Geotechnical Bulletin #1* for more information, and also identify whether the project involves 'Subgrade Improvement' according to FDM 14-5-5.1. Based on these two inputs, the SSV and k values will default to values within the ranges shown in Table 1.1 of FDM 14-5-1.1 and Attachment 5.1 of FDM 14-5. These are only defaults and can be changed to values recommended in the soils report.

3.2   Traffic Parameters

Figure 9. Traffic Parameters

The 'Design Year' automatically defaults to 20 years after the 'Construction Year'. The default year can be changed. The maximum AADT value, for construction and design year, is 9,999,999,999.

The 'Design Lane Total Life ESALs' are calculated for both flexible and rigid pavement designs and the final values are rounded up to two significant figures as shown in the *Concrete Pavement Design* and *HMA Pavement Design* screenshots (Figure 10 and Figure 11).

3.3   Concrete Pavement Design

Concrete Pavement Design

Truck Type	% of AADT	DLT	# of Trucks	ESAL Load Factor	ESALs
2D	3.2	5,035	161	0.3	48
3SU	1.5	5,035	76	1.2	91
2S-1,-2	1.7	5,035	86	0.6	51
3S-2	6.4	5,035	322	1.6	516
2-S1-2	0.3	5,035	15	2.1	32

Design Lane Daily ESALs: 738
Design Lane Total Life ESALs: 5,384,681   Rounded to: 5,400,000
Soil Parameters
Subgrade Improvement Flag selected: No
k :   200
Design Calculation
Calculated Pavement Thickness: 8.9
Pavement Thickness(ALT# 1):   9.0
Pavement Thickness(ALT# 2):   0.0
Back   Next

Figure 10. Concrete Pavement Design

The calculated concrete pavement thickness is shown and then rounded up to the nearest ½-inch. That thickness is the default for 'Layer 1' of the *Concrete Alt #1 Description* (explained further in section 4.3.1). Up to two concrete thickness alternates can be included in the design and LCCA sections.

3.4   Hot Mix Asphalt (HMA) Pavement Design

HMA Pavement Design

Truck Type	% of AADT	DLT	# of Trucks	ESAL Load Factor	ESALs
2D	3.2	5,035	161	0.3	48
3SU	1.5	5,035	76	0.8	60
2S-1,-2	1.7	5,035	86	0.5	43
3S-2	6.4	5,035	322	0.9	290
2-S1-2	0.3	5,035	15	2.0	30

Design Lane Daily ESALs: 471
Design Lane Total Life ESALs: 3,438,300   Rounded to: 3,500,000
Soil Parameters
DGI :   10
Subgrade Improvement Flag selected: No
SSV :   4.6
Design Calculation
Calculated Required SN: 4.58
Back   Next

Figure 11. HMA Pavement Design

The required structural number of an HMA pavement is calculated and shown. Select <Next> to save the screen and proceed to the *HMA ALT#1 Layer Thickness Design* screen. When Design Lane Total Life ESALs is equal or greater than 8 million ESALs, a message will display to consider perpetual HMA pavement design.

3.5   HMA Layer Thickness Design

HMA ALT#1 Layer Thickness Design

Title: _____

Add Layer   Delete Layer

Layers	Existing Pavement	Uppermost Base Agg.	Other	Material Type	Unit Type	Layer Coefficient	Thickness in.	Structural Number
1	☐	☐	☐	4 MT 58-28 S ▼	--------	0.44	4	1.76
2	☑	☐	☐	Existing HMA Pavement ▼	--------	0.3	4.5	1.35
3	☑	☐	☐	Base Aggregate Dense 1 1/4-inch ▼	--------	0.1	10.0	1.0

Note: You can add only 10 layers (including 'Other' layers)

No.of Layers: 3   No.of Other Layers: 0   Total SN: 4.11
                                                    Required SN: 4.01

Back   Next Alternative   LCCA

Note 1. If the structural design includes a granular subbase, then the layer can only contribute a maximum of 10% of the required SN (see FDM 14-10-10.5), regardless of the material's strength coefficient or the thickness of the layer.
2. If the project involves subgrade improvement, the associated quantity and cost of the material can be accounted for and included in the LCCA by adding the material as a layer and setting the respective layer coefficient to 0.0 so that it isn't given additional credit in the structural design.

Figure 12. HMA Alternative 1 Layer Thickness Design

The *HMA Alt# Layer Thickness Design* screen is summarized below, then followed by more detailed information regarding the different fields and certain aspects of the *HMA Alt Layer Thickness Design* screens (sections 3.5.1 through 3.5.8).

The *HMA Alt# Layer Thickness Design* screen opens with one layer that is defaulted to the appropriate mixture type based on the 'Design Lane Total Life ESALs' and conforming to standard spec Table 460-2. The default mix type will be the same for each additional HMA alternative design. The default can be changed if needed. However, if an existing design is opened, and the soils or traffic data is revised, then the mix type will not automatically update to be consistent with the newly calculated total life ESALs. That is because any HMA layer thickness designs that were previously created and saved were saved to, and stored on, the server. So, when a file is opened, all the saved data, including the HMA and concrete designs, will be retrieved from the server. Thus, none of the default values will update automatically and must be done manually.

Enter the thickness of the first layer, and then add pavement layers as needed. Additional pavement structure layers can be added for a maximum of ten layers, including any 'Other' materials. <Add Layer> will add one layer under any existing layers, while <Delete Layer> will delete the bottom layer. User cannot specify where a layer is added or deleted. Once new layers are added, the specifics for the layers must be entered. If a layer is added that is not needed, it must be deleted.

Different HMA layers in one alternative structure can be shown as separate layers. See standard spec 460.3.2 for appropriate HMA layer thicknesses and FDM 14-10-7.3 for PG binder selection guidance. If Structural Number (SN) of current HMA pavement design is either ten percent less than or greater than the required SN, then a cautionary message will be displayed but the user may proceed. Up to four alternate HMA pavements can be included in the design and LCCA sections (See FDM 14-10-1.2 for instructions on Deep-Strength and Perpetual pavement design alternatives).

If only one HMA alternate design is to be entered, select <LCCA> after the *HMA Alt#1 Layer Thickness Design* is completed to save the design and proceed to the LCCA portion of WisPave 4. To include more than one HMA alternate design, select <Next Alternative> to save the current design and proceed to the next alternative layer design screen. Proceeding to the next alternate design screen requires layer thicknesses to be entered. To cancel the current design, select <Back> to return to the previous design and then proceed to the LCCA.

10

3.5.1 Layer Material Type

Once new layers are added, the material type must be selected from the drop-down list. The drop-down list of material types for each pavement layer is a comprehensive list of all HMA, concrete, base, and subgrade bid item materials that are included in WisPave 4. They are sorted numerically by bid item number. Appendix A contains a list of all the layer materials used in WisPave 4 along with their respective minimum and maximum thicknesses, structural layer coefficients, and increments accepted in WisPave 4. Appendix B contains a comprehensive list of all bid items used in WisPave 4, along with the bid item category of each. See section 4.7 for more information on *Bid Items.*

3.5.2 Layer Coefficient

Once the material type of each layer is identified, a default layer coefficient is shown. WisPave 4 does not distinguish between crushed stone or crushed gravel of different aggregate types. Adjust the layer coefficient accordingly (see Attachment 10.1 of FDM 14-10) to best represent the material expected to be used. Error messages will be displayed if any layer coefficients are outside of acceptable ranges or are in inappropriate increments.

3.5.3 Layer Thickness

Layer material thicknesses must be entered within the minimum and maximum thickness ranges and in appropriate increments as following:

- HMA Pavement = nearest ¼ inch
- Aggregates = nearest 1 inch
- Concrete Pavement = nearest ½ inch

Layer thicknesses entered in incorrect increments or outside of the minimum and maximum ranges will be shaded red and a warning message will display.

3.5.4 Existing Pavement

Identify any 'Existing Pavement' layers that will remain in place by checking the appropriate box in the second column of the corresponding layers. Checking this box allows the material to contribute to the structural number of the pavement without adding any costs since it is an existing layer. If a layer is identified as 'Existing', then any layers added after (under) that layer will automatically be identified as 'Existing'.

In addition, the following material types are automatically flagged as 'Existing Pavement':

- Pulverize and Relay
- Mill and Relay
- Rubblizing
- (Existing) Cracking and Seating
- Existing HMA Pavement
- Existing Concrete Pavement

If an 'Existing HMA Pavement' or an 'Existing Concrete Pavement' is to remain in place and intact, then nothing else is needed for that layer. Thus, the pavement layer can contribute to the pavement structure, but no costs will be calculated and included in the initial construction cost (with only exception to be base layer under a concrete pavement which will not be credited for pavement structure). Accordingly, the same holds true for any existing layers that were previously pulverized or rubblized and will remain in place without needing any additional work.

However, if an existing pavement will be repaired or milled prior to paving over it, then the existing pavement should be included as a layer and it should be identified as 'Existing Pavement'. By identifying the layer as

existing, no costs will be included for constructing the pavement. The work of repairing or milling the pavement should be added later in the HMA or concrete alternate description screens as an 'Additional Construction Process'. Similarly, if an existing pavement will be rubblized, pulverized and relaid, or milled and relaid before being paved over, then the 'Material Type' of the layer should be the processed material so that it will get the appropriate layer coefficient, but it should also be identified as 'Existing Pavement' since the pavement is already in place. The costs of the associated work— 'Pulverize and Relay', 'Mill and Relay', or 'Rubblizing'—will be accounted for as an 'Additional Construction Process' and should be added accordingly in the HMA or concrete alternate description screens. This is explained again in Section 4.3.5.

Note that crack and seat is labeled as '(Existing) Cracking and Seating'. The user can identify the layer if it exists and is to remain in place, but it is assigned a default layer coefficient of 0.0 since WisDOT does not recommend its use on the state trunk highway system. For the same reason, 'Cracking and Seating' is not an option under 'Additional Construction Process'.

HMA ALT#2 Layer Thickness Design

Title: _____

Layers	Existing Pavement	Uppermost Base Agg.	Other	Material Type	Unit Type	Layer Coefficient	Thickness in.	Structural Number
1	☐	☐	☐	4 MT 58-28 S ▾	--------	0.44	5.5	2.42
2	☑	☑	☐	Pulverize and Relay ▾	--------	0.1	4.5	0.45
3	☑	☐	☐	Base Aggregate Dense 1 1/4-inch ▾	--------	0.1	12	1.2

Note: You can add only 10 layers (including 'Other' layers)

No.of Layers: 3   No.of Other Layers: 0   Total SN: 4.07
              Required SN: 4.01

Back   Next Alternative   LCCA

Note 1. If the structural design includes a granular subbase, then the layer can only contribute a maximum of 10% of the required SN (see FDM 14-10-10.5), regardless of the material's strength coefficient or the thickness of the layer.
2. If the project involves subgrade improvement, the associated quantity and cost of the material can be accounted for and included in the LCCA by adding the material as a layer and setting the respective layer coefficient to 0.0 so that it isn't given additional credit in the structural design.

Figure 13. HMA Alternative 2 Layer Thickness Design

3.5.5 Uppermost Base Aggregate

The uppermost aggregate base course quantity calculations include the thickness of the uppermost aggregate layer for the full roadway width plus any aggregate needed under paved shoulders that are designed at a different thickness than the pavement. Although the aggregate under paved shoulders is not necessarily the same material as the uppermost base course aggregate, the material is assumed to be the same for programming simplicity and quantity calculations. Therefore, the 'Uppermost Base Aggregate' layer must be identified by checking the appropriate box in the third column, titled accordingly.

A new pavement should only have one 'Uppermost Base Aggregate'; however, no programming measures were included in WisPave 4 to limit this column to one layer selection. Furthermore, WisPave 4 does not require that a layer be identified as the 'Uppermost Base Aggregate' in case an existing base course is to remain in place and serve the purpose.

The need of a drained pavement structure is determined regarless of the pavement type or traffic loads. Therefore, if a drained structure is needed, it should be included in both the HMA and the concrete pavement structural designs. 'Base Aggregate Open Graded' can be identified as the base course material type, but the quantity and costs for pipe underdrain, geotextile fabric, and apron endwalls are considered equal for both concrete and HMA pavement structures. So, those bid items, and their associated costs, were omitted from WisPave 4 altogether.

3.5.6 Subgrade Improvement

If 'Subgrade Improvement' was identified on the soils screen, then the soil support value was already increased, by default, to account for the influence of the select material. As explained in FDM 14-5-5.1, no additional credit should be given to the material. Therefore, if 'Subgrade Improvement' was identified on the *Soil Parameters* screen, then the minimum acceptable layer coefficients for typical subgrade improvement materials ('Breaker Run', 'Select Crushed Material', 'Pit Run', 'Backfill Granular', and 'Base Aggregate Dense 3-inch') go down to 0.0 so that the material and associated cost can be included, without giving it additional credit in the structural design. The default values of these materials are 0.10, so adjust the layer coefficient accordingly, if needed.

3.5.7 Granular Subbase

As explained in FDM 14-10-10.5, a granular subbase cannot contribute more than 10% of the Total SN. The acceptable layer coefficients for 'Subbase' range from 0.01 to 0.10 and the material contribution toward structural number (i.e. product of layer coefficient and layer thickness) needs to remain below 10% of total SN. 'Subbase' is the only layer material adhered to the ten percent rule. If other materials, such as 'Pit Run', 'Breaker Run', or 'Select Crushed Material', are used as a subbase, then lower the layer coefficient so that the layer meets the ten percent rule; the minimum layer coefficient of all three of these materials is 0.01.

3.5.8 Other

Any of the possible ten layers of an HMA pavement design can be identified as 'Other' by checking the appropriate box in the fourth column. This option can be used to include any bid items that are not included in WisPave 4. If the 'Other' box is checked, enter the name of the 'Material Type' (up to 25 characters) along with the corresponding 'Unit Type' of the item. The quantities for 'Other' materials will be entered later in the program.

Keep in mind that this screen is for the initial construction cost of each HMA pavement design. There will be more opportunities in later screens to add other items.

The bid item 'Asphaltic Base' is primarily used for constructability purposes. As such, it should not be part of a life cycle cost analysis and was therefore not included in WisPave 4. It can be included and specified in the *Pavement Design Report*, if needed.

4   Life Cycle Cost Analysis (LCCA)

WisPave 4 is currently used to design pavement structure alternatives and then proceed to the LCCA if desired.

4.1   LCCA Mode Menu

Selecting <LCCA> from the navigation toolbar will open the *LCCA Mode* menu. The menu shows the order of the screens in the LCCA mode.

If an existing file is opened, the *LCCA Mode* menu will only show the alternative concrete and HMA designs that were included in the LCCA when the file was created. So, it won't necessarily show both concrete alternatives and all four HMA alternatives as shown in Figure 14. In addition, the project type (urban or rural) that was previously identified will be shown in the menu. The *LCCA Mode* menu will update if additional designs are added or deleted and saved by selecting <Next>.

LCCA Mode

- LCCA
- Concrete Alternatives
  - Description
    - Alt#1
  - Quantities
    - Alt#1
  - Rural Cross Section
    - Alt#1
  - Maintenance & Rehabilitation
    - Alt#1
- HMA Alternatives
  - Description
    - Alt#1
    - Alt#2
    - Alt#3
    - Alt#4
  - Quantities
    - Alt#1
    - Alt#2
    - Alt#3
    - Alt#4
  - Rural Cross Section
    - Alt#1
    - Alt#2
    - Alt#3
    - Alt#4
  - Maintenance & Rehabilitation
    - Alt#1
    - Alt#2
    - Alt#3
    - Alt#4
  - Bid Items
    - HMA
    - Concrete
    - Base Course
    - Subbase
    - Remove Pavement
    - Other
- Costs
- LCCA Results

Figure 14. LCCA Mode Menu

After all the HMA alternative designs are completed in the design mode, selecting <LCCA> at the bottom of the screen will advance the program to the *LCCA* screen.

4.2   LCCA

LCCA

* Project Type: Urban   Rural

* LCCA Length: 2.71   Miles

No. of HMA Alternatives: 4

* Select HMA Alternatives to include in LCCA: ☑HMA Alt# 1 ☑HMA Alt# 2 ☑HMA Alt# 3 ☑HMA Alt# 4

No. of Concrete Alternatives: 1

* Select Concrete Alternatives to include in LCCA: ☑Concrete Alt# 1

Back   Next

Figure 15. LCCA Parameters

14

Identify the 'Project Type' and the 'LCCA Length'. An LCCA can be conducted on the entire project length or on any unit length (e.g. 1-mile segment), in just one direction or in both directions. WisPave 4 allows up to four travel lanes and one shared/center lane to be included in each pavement design. If a project exceeds the number of lanes allowed in WisPave 4, then conduct the LCCA in one direction.

Select the design alternatives to include in the LCCA, regardless of the number of alternative designs that were created. If four different HMA pavement designs were created, any or all alternate designs can be included in the LCCA. If a second concrete thickness wasn't previously entered, then 'Concrete Alt# 2' will not be an option on this screen. At least one HMA alternate and one concrete alternate are required to be included in the LCCA.

After the *LCCA* screen is completed, the program proceeds, in order, to the *Concrete Description, Urban* or *Rural Cross Section*, *Quantities*, and then the *Maintenance and Rehabilitation* for the first concrete alternative design. If a second concrete design is included in the LCCA, the program will cycle through the same screens, in the same order, for the second concrete alternative.

After the concrete alternatives have been completed, the program will process through the same screens, in the same order, for the HMA alternative designs included in the LCCA. Since the Concrete and HMA screens are very similar, the following sections of this manual will cover the individual screens and any specifics within them for both pavement types.

4.3 Concrete and HMA Alternative Description

4.3.1 Concrete Description

Figure 16. Concrete Alternative 1 Description

The concrete pavement thickness, previously calculated and identified in the C*oncrete Pavement Design* screen, is the default for the first layer of the concrete pavement structure. The concrete thickness cannot be changed without going back to the design screen and manually changing the thickness there. Any additional layers can be added to the pavement structure in the same method as in the *HMA Layer Thickness Design* screens. Again, the maximum number of layers is ten. After a layer is added, select the 'Material Type' from the drop-down menu and enter the layer thickness.

15

Identify if any layers are 'Existing Pavement' and will remain in place. As such, no additional costs will be calculated for existing layers. Unlike HMA pavement designs, existing layers do not contribute to the structural design of a concrete pavement, so including them on this screen is optional. For the same reason, the layer coefficients of the different layers are not needed. Identify the 'Uppermost Base Aggregate' layer of the structure. If the 'Other' box is checked for any layer, the drop-down menu for the 'Material Type' will not be available and the field will open for the user to enter any material name (up to 25 characters). An 'Other' layer is included in the *Concrete Alt#1 Description* example (Figure 16). The only other field that needs to be completed for 'Other' layers is the 'Unit Type'.

4.3.2   HMA Description

HMA Alt#1 Description
6.5" HMA over 15" BAD

Layers	Existing Pavement	Material Type	Thickness in.	Unit Weight lbs/SY/in	# of Tack Coat Layers	Tack Coat Coverage Gal/SY
1	N	4 MT 58-28 S	2.5	112.0	1	0.05
2	N	3 MT 58-28 S	4.0	112.0	0	0.05
3	N	Base Aggregate Dense 1 1/4-inch	15.0	2.0	--------	--------
4	N	Select Crushed Material	12.0	1.9	--------	--------

Shoulders

Material Type	Thickness in.	# of Tack Coat Layers	Tack Coat Coverage Gal/SY
4 LT 58-28 S ∨	3.5	1	0.05

Additional Construction Process

| | | | | | Add Construction Process | Delete Construction Process |

Layers	Other	Process Description	% of LCCA Length Requiring Process	Existing Pavement Width ft.	% of Surface Area Requiring Repair	# of Stations
N/A ∨	☐	Prepare Foundation for Asphaltic Shoulders ∨				10

| Back | | | | | | Next |

Figure 17. HMA Alternative 1 Description

The top portion involving the HMA pavement layers will be completed, as the information is automatically transferred from the HMA layer thickness designs.

4.3.4   Shoulders

The shoulders only allow for one layer and one material to be identified. Select the shoulder material for all alternative designs. The HMA alternative description screens only include HMA options for the shoulder material, while the concrete description allows HMA and concrete shoulder options. HMA shoulder options will include all dense-graded mixes, while the concrete shoulder options include all concrete base and concrete pavement bid items.

4.3.5 Additional Construction Process

Identify any 'Additional Construction Process' that will contribute to the initial construction cost of all concrete and HMA alternative designs. The drop-down list of construction process options is the same for concrete and HMA alternates and are as follows:

- Removing Pavement - SY
- Removing Concrete Surface Partial Depth - SY
- Removing Asphaltic Surface Milling - SY
- Prepare Foundation for Asphaltic Paving (project) - LS
- Prepare Foundation for Concrete Pavement (project) - LS
- Prepare Foundation for Concrete Base (project) - LS
- Prepare Foundation for Asphaltic Shoulders - STA
- Prepare Foundation for Base Aggregate - STA
- Pulverize and Relay - SY
- Mill and Relay - SY
- Rubblizing - SY
- Base Patching Concrete - SY
- Concrete Pavement Continuous Diamond Grinding – SY

Depending on the construction process selected, and the respective unit type (shown above), different fields in the adjacent columns will unlock and require input so that quantities can be calculated. Those that are lump sum (LS) will not require any additional information. If a construction process involves a layer previously identified in the layer design, then identify the layer number in the first column. Relating a construction process to a layer is for informational purposes only and does not affect any of the quantity calculations. Any 'Additional Construction Process' can be identified as 'Other' by checking the appropriate box. Only the 'Process Description', up to 25 characters, needs to be entered for 'Other' construction processes. The quantity of any 'Other' processes identified will need to be calculated and entered in the *Quantities* screen of the respective alternative. WisPave 4 allows fifteen additional construction processes for each alternative pavement design.

As previously explained, if an 'Existing HMA Pavement' or an 'Existing Concrete Pavement' is to remain in place and intact, then nothing else is needed for that layer. Thus, no additional costs will be calculated and included for layers identified as 'Existing Pavement'. The same holds true for any existing layers that were previously pulverized and relaid or rubblized and will remain in place without needing any additional work. However, if a layer involves an existing pavement that will be milled, base patched, or diamond ground before placing additional layers over it, then the additional work will result in additional costs that need to be included in the initial construction cost of each alternate. As such, identify any applicable construction processes so that the associated costs will be included. See *HMA Alt#1 Description* (Figure 17) as an example.

HMA Alt#2 Description
6" HMA over 4.5 Pulverize and Relay

Layers	Existing Pavement	Material Type	Thickness in.	Unit Weight lbs/SY/in	# of Tack Coat Layers	Tack Coat Coverage Gal/SY
1	N	4 MT 58-34 S	6.0	112.0	3	0.05
2	Y	Pulverize and Relay	4.5	0.0	--------	--------
3	Y	Base Aggregate Dense 1 1/4-inch	10.0	2.0	--------	--------

Shoulders

Material Type	Thickness in.	# of Tack Coat Layers	Tack Coat Coverage Gal/SY
4 LT 58-34 S ⌄	3.5	1	0.05

Additional Construction Process

Add Construction Process | Delete Construction Process

Layers	Other	Process Description	% of LCCA Length Requiring Process	Existing Pavement Width ft.	% of Surface Area Requiring Repair	# of Stations
N/A ⌄	☐	Pulverize and Relay ⌄	100			

Back | Next

Figure 18. HMA Alternative 2 Description

Similarly, if a project involves 'Pulverize and Relay', 'Mill and Relay', or 'Rubblizing' any pavement layer, then that layer should have been previously identified as 'Existing Pavement' so that no costs are included for constructing those layers. However, the work associated with the processing of the layer material—Pulverize and Relay, Mill and Relay, or Rubblizing—needs to be added as an 'Additional Construction Process' so that the associated quantities and costs will be calculated and included. See *HMA Alt # 2 Description* (Figure 18) as an example. As previously explained, 'Crack and Seat' is not an 'Additional Construction Process' option in WisPave 4.

4.4   Concrete and HMA, Urban and Rural, Cross Section

The cross-section screen displayed is based on the 'Project Type' identified (urban or rural) on the *LCCA* screen. The screens are the same for concrete and HMA pavement design alternatives. The 'Number of Travel Lanes' options are one though four, with maximum lane widths of 20 feet. There can also be one center/shared lane if needed. If a project involves more than four lanes and one shared lane, then perform the LCCA in one direction using half the width of the center/shared lane. The results and percentage of difference between alternates will be the same.

The 'Pavement Structure Width' is calculated automatically for urban and rural projects and is simply the sum of the travel lane widths.

If a project includes more than one concrete alternate, then the cross-sectional data that is entered for Concrete Alt #1 will be used as default values for the second alternative. Likewise, the cross-section data needs to be entered for HMA Alt #1, and the values entered will become the default values for any additional HMA alternatives.

The diagrams displayed are very generic and do not reflect a specific design or any data entered by the user. Most quantity calculations involve either the 'Roadway Width', the 'Pavement Structure Width', and/or the 'Paved Shoulder Widths', and therefore the order of the lane widths that are entered is irrelevant.

18

4.4.1 Urban Cross Section

The 'Roadway Width' is used for quantity calculation of some layer materials, especially base course assuming curb and gutter on both sides for simplicity. Assuming a standard curb and gutter width of 2.5 feet and adding an additional 1 foot on each side for constructability, the calculation for the 'Roadway Width' sums up the widths of all travel lanes, center lane, and shoulders, and then adds the 7 feet for the curb and gutter. As such, the default 'Roadway Width' is 7 feet, before any addition information is entered.

Enter the '% of Project Length for new Curb & Gutter'. One hundred percent reflects curb and gutter on both sides of the road for the entire LCCA length. If a project also involves median curb and gutter, then the LCCA should be performed in one direction.
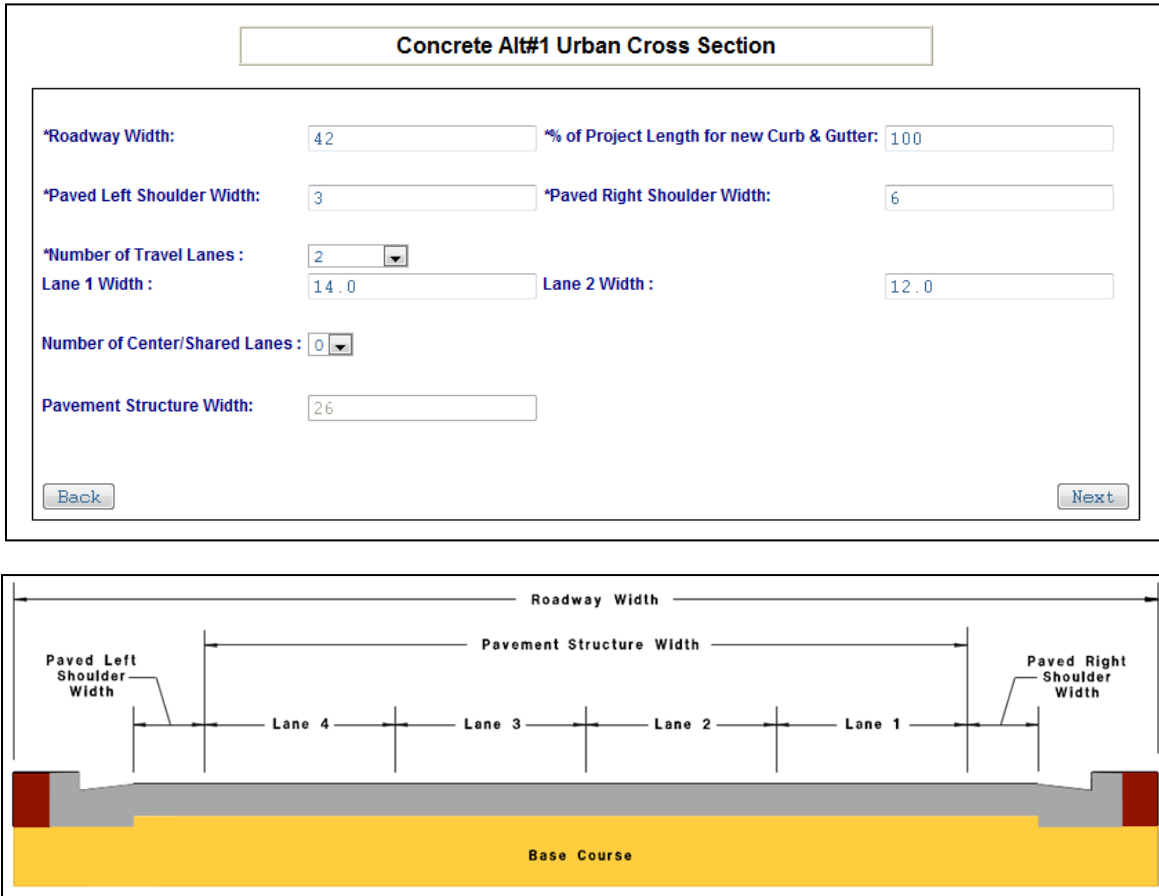
Figure 19. Urban Cross Section

4.4.2 Rural Cross Section

The 'Roadway Width' must be entered for rural projects. The roadway width must be a minimum of the sum of the travel lane widths, center lane width, and paved shoulder widths.

The maximum side slope for rural projects is 12:1.
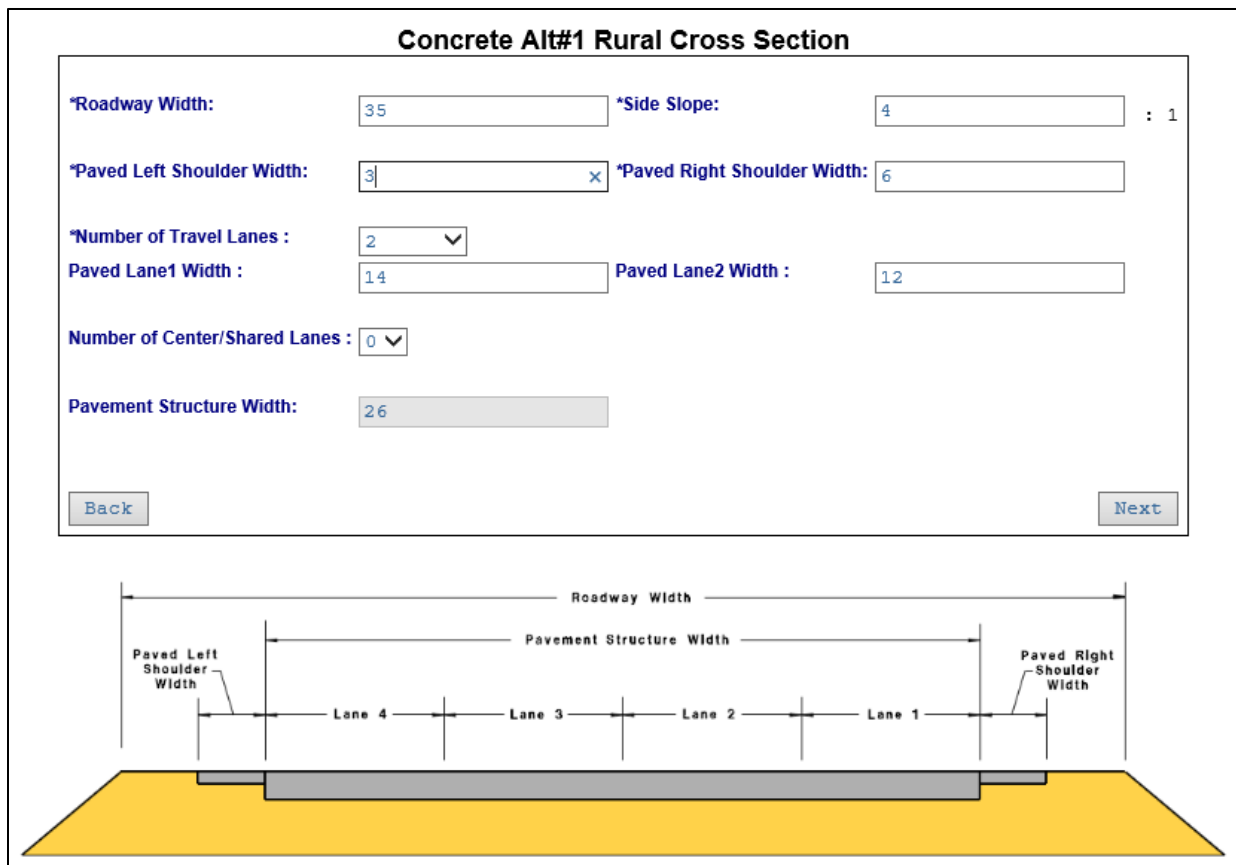
Figure 20. Rural Cross Section

4.5 Concrete and HMA Quantities

The material quantities involved with the initial construction of each pavement structure alternative are displayed. The top portion shows the material quantities of each layer of the pavement design. The middle portion shows the quantities of shoulder material and any additional construction processes that were identified.

Calculate and enter the quantities of any 'Other' layer materials or 'Other' additional construction processes that were previously identified. Also, at the bottom of the quantities screen of each alternative design, enter up to three additional initial construction items not previously covered, along with the respective units and quantities.

4.5.1 Concrete Alt #1 Example

The Concrete Alt#1 example design (Figure 21) involved a 8-inch concrete pavement (Layer 1), over two layers of 3-inch thick Base Aggregate Dense 1 ¼-inch, over a fourth layer of 'Other' material identified as 'Recycled Glass'. Notice in the *Concrete Alt#1 Quantities* screenshot (Figure 22), that the quantity of material for Layer 2 is much higher than that of Layer 3, even though they are both the same thickness and the same material. Layer 2 is identified as the 'Uppermost Base Aggregate' layer, and therefore the quantity calculations for Layer 2 include the material for the thickness of the layer plus the aggregate under the shoulders to the same depth as the pavement, which equals to 4½ inches in this example.

The 'Layer 4' material of 'Recycled Glass' and the 'Unit Type' (CY) is included in the *Concrete Alt#1 Quantities* screen, but the quantity field is initially blank and needs to be entered. The Concrete Alt#1 example design shown also included three additional construction processes. They are shown in the middle section of the *Quantities* screen, along with the shoulder quantities. Had any 'Additional Construction Process' been identified as 'Other', then the name entered for the 'Process Description' would also appear in the middle section of the *Quantities*

20

screen, where the user needs to input the quantities for that item. The units would not be needed because the 'Unit Cost' will need to be entered later, in the *Other Bid Items* screen.

Concrete Alt#1 Description

Title: [_____]

[Add Layer] [Delete Layer]

Layers	Existing Pavement	Uppermost Base Agg.	Other	Material Type	Unit Type	Thickness in.	# of Tack Coat Layers	Tack Coat Coverage Gal/SY
1	☐	☐	☐	Concrete Pavement, 8 inch ⌄	-------	8.0	-------	-------
2	☐	☑	☐	Base Aggregate Dense 1 1/4-inch ⌄	-------	3.0	-------	-------
3	☐	☐	☐	Base Aggregate Dense 1 1/4-inch ⌄	-------	3.0	-------	-------
4	☐	☐	☑	Recycled Glass	CY ⌄	-------	-------	-------

Shoulders

Shoulder Materials: [HMA ⌄]

Material Type	Thickness in.	# of Tack Coat Layers	Tack Coat Coverage Gal/SY
4 MT 58-28 S ⌄	3.5	1	0.05

Additional Construction Process

[Add Construction Process] [Delete Construction Process]

Layers	Other	Process Description	% of LCCA Length Requiring Process	Existing Pavement Width ft.	% of Surface Area Requiring Repair	# of Stations
N/A ⌄	☐	Removing Pavement ⌄	100.0	32.0		
N/A ⌄	☐	Prepare Foundation for Concrete Pavement (project) ⌄				
N/A ⌄	☐	Prepare Foundation for Asphaltic Shoulders ⌄				143.0

[Back]   [Next]

Project ID: **1111-11-11**

Figure 21. Concrete Alternative 1 Example

Concrete Alt#1 Quantities

Layers	Bid Item No	Bid Item Desc	Units	Quantity
1	415.0080	Concrete Pavement, 8 inch	SY	23,032.5
2	305.0120	Base Aggregate Dense 1 1/4-inch	TON	8,944.8
3	305.0120	Base Aggregate Dense 1 1/4-inch	TON	6,397.9
4	Other	Recycled Glass	CY	2296.0

Additional Initial Construction Quantities:

Bid Item No	Bid Item Desc	Units	Quantity
460.6224	4 MT 58-28 S (Shoulders)	TON	1,562.7
455.0605	Tack Coat (Shoulders)	GAL	398.6
305.0110	Base Aggregate Dense 3/4-inch(SHLDR GRAVEL)	TON	211
204.0100	Removing Pavement	SY	28,347.7
211.0200	Prepare Foundation for Concrete Pavement (project)	LS	1
211.0400	Prepare Foundation for Asphaltic Shoulders	STA	143

Other Quantities:

Other Description	Unit	Quantity
common Ex ConcAlt	CY ⌄	23450.0
Geogrid Type SR Conc	SY ⌄	24850.0
Select Crushed Concl	TON ⌄	15750.0

[Back] [Next]

Figure 22. Concrete Alternative 1 Initial Construction Quantities

21

In addition, the bottom of the *Quantities* screen (see Figure 22) for each alternative design allows an opportunity to add up to three additional items that contribute to the initial construction cost of a particular alternative and have not been previously covered. After including a description of the item, the units and quantity must also be entered.

4.5.2 HMA Alt #1 Example

HMA Alt #1 example design involved three layers as shown in the *HMA Alt #1 Description* screenshot (Figure 23). Layers 2 and 3 were identified as 'Existing Pavement' so no quantities were calculated for them. However, Layer 2 involved an existing HMA pavement that needs to be pulverized and relaid. Thus, the pavement layer was identified as 'Existing Pavement' and 'Pulverize and Relay' was added as an 'Additional Construction Process'. The quantities involved with the process of 'Pulverize and Relay' were calculated and are shown in the middle section of the quantities screenshot (Figure 24).

Figure 23. HMA Alternative 1 Example

Figure 24. HMA Alternative 1 Initial Construction Quantities

22

4.6   Concrete and HMA Maintenance & Rehabilitation Summary

The *Maintenance & Rehabilitation Summary* screens, for each alternative design, will open with only a blank 'Type of Work' field shown, along with the following two maintenance cycles.

Year	Type of Work	Activity	Service Life	Cost per Lane Mile	Calculate
	Concrete Alternative − Maintenance & Rehabilitation Summary − Alt #1				
					Add Delete
0					
	Concrete Maintenance	1st Cycle		$0.00	
	Concrete Maintenance	2nd Cycle		$0.00	
	0				
Back					Next Alternative

Figure 25. Maintenance & Rehabilitation Summary Initial Screen

4.6.1   Intital Type of Work

Select the initial type of work from the drop-down menu. Based on the option selected, the respective service life, as identified in FDM 14-15-10.3.5, will be displayed.

Concrete options for initial type of work include:

- Initial Construction
- Initial Construction (Drained)
- Pavement Replacement (Concrete over Rubblized Concrete)

HMA options are:

- HMA Resurfacing - Overlay of Traditional or Deep-Strength Pavement
- HMA Resurfacing – Overlay of JRCP
- HMA Resurfacing – Overlay of JPCP
- HMA Resurfacing – Overlay of CRCP
- Pavement Replacement (Including HMA over Pulverized HMA)
- Pavement Replacement (Including HMA over Rubblized Concrete)
- Initial Construction - Traditional or Deep-Strength
- Initial Construction - Traditional or Deep-Strength (Drained)
- Initial Construction – Perpetual Pavement

4.6.2   Rehabilitation Activity

Select <Add> in the upper right to add the first rehabilitation activity for the pavement structure. Select the rehabilitation activity from the drop-down menu. The rehabilitation options vary, depending on the pavement type. The rehabilitation activities for concrete pavements include:

- Concrete Repair & Grind
- Concrete Repair & HMA Overlay
- Mill, Concrete Repair & HMA Overlay
- Mill, Rubblize & Concrete Pavement Replacement
- Concrete Pavement Reconstruction

23

The rehabilitation activities for HMA pavements include:

- HMA Overlay
- Mill & HMA Overlay
- Mill, Concrete Repair, and HMA Overlay
- Mill, Rubblize & HMA Pavement Replacement
- Pulverize & HMA Pavement Replacement
- HMA Pavement Reconstruction

Once a rehabilitation activity is identified, the corresponding service life is shown next to it, and the total pavement service life is updated and shown at the bottom. In addition, the following two maintenance cycles are automatically added. Maintenance is explained in more detail in section 4.6.5.

Concrete Alternative – Maintenance & Rehabilitation Summary – Alt #1

Year	Type of Work	Activity	Service Life	Cost per Lane Mile	Calculate
0	Initial Construction		25		
8	Concrete Maintenance	1st Cycle		$2000.0	
16	Concrete Maintenance	2nd Cycle		$4000.0	
25	Concrete Rehabilitation	Concrete Repair & Grind	8		Calculate
28	Concrete Maintenance	1st Cycle		$2000.0	
31	Concrete Maintenance	2nd Cycle		$4000.0	
33					

Figure 26. Concrete Maintenance & Rehabilitation with 1st Rehab

Select <Calculate> to enter the screen for the particular rehabilitation activity selected. Enter all the parameters in the rehabilitation screen and select <Calculate> so that the quantities are calculated and shown. Then select <Save> to save the information of that rehabilitation activity and return to the *Maintenance & Rehabilitation Summary* screen. Repeat this process until the total service life of the pavement is a minimum of 50 years (see Figure 27). If <Next Alternative> is selected when a pavement's total service life is less than 50 years, an error message will appear and must be addressed in order to proceed to the next screen.

Select <Next Alternative> to move to the next screen. If you only included one concrete alternative, then the program will take you to the *HMA Alt#1 Description* screen. If you have completed the *Maintenance and Rehabilitation Summary* screen for all of your HMA alternative designs, then WisPave 4 will go to the first screen of *Bid Items* when <Next Alternative> is selected.

Concrete Alternative – Maintenance & Rehabilitation Summary – Alt #1

Year	Type of Work	Activity	Service Life	Cost per Lane Mile	Calculate
0	Initial Construction		25		
8	Concrete Maintenance	1st Cycle		$2000.0	
16	Concrete Maintenance	2nd Cycle		$4000.0	
25	Concrete Rehabilitation	Concrete Repair & Grind	8		Calculate
28	Concrete Maintenance	1st Cycle		$2000.0	
31	Concrete Maintenance	2nd Cycle		$4000.0	
33	Concrete Rehabilitation	Concrete Repair & HMA Overlay	15		Calculate
38	Concrete Maintenance	1st Cycle		$1000.0	
43	Concrete Maintenance	2nd Cycle		$1250.0	
48	Concrete Rehabilitation	Mill, Concrete Repair & HMA Overl	15		Calculate
53	Concrete Maintenance	1st Cycle		$1000.0	
58	Concrete Maintenance	2nd Cycle		$1250.0	
63					

Project ID: 1234-56-78

Figure 27. Concrete Maintenance & Rehabilitation Completed

24

It is importatnt to note that WisPave 4 will allow a user to merely identify the rehabilitation activities without actually going into the rehabilitation activity screens to enter the specifics and calculate the respective quantities. There will not be any rehabilitation costs for that alternative design. Be vigilant and open all rehabilitation activity screens to enter the appropriate data, <Calculate> quantities, and <Save> the information. Also, be sure to check the respective costs of each alternative design later in the program to make sure nothing was missed and to make sure that none of the expected costs are zero.

4.6.3 Concrete Rehabilitation Actitities

Screenshots of the different concrete rehabilitation activities, as listed in the previous section, are shown in Figures 28-32, followed by brief guidance regarding a few particular items.

Figure 28. Concrete Repair & Grind

Figure 29. Concrete Repair & HMA Overlay

Rehabilitation #1: Mill, Concrete Repair & HMA Overlay

Milling Limits: Pavement Structure and Shoulders   Milling Depth: 1.75 (in)

% of Surface Area to be Repaired: 2.0

Removing Concrete Surface Partial Depth Limits: None

Overlay Limits: Pavement Structure and Shoulders

Type	HMA Mix Type	Thickness	# of Tack Coat Layers	Tack Coat Coverage GAL/SY
Overlay	4 MT 58-28 S	4.0	1	0.05

Calculate

Item	Units	Quantity
Removing Asphaltic Surface Milling	SY	31,005.3
Base Patching Concrete	SY	464
Drilled Dowel Bars	EACH	928
Sawing Concrete	LF	2,088
Removing Concrete Surface Partial Depth	SF	0
4 MT 58-28 S	TON	6,945.2
Tack Coat(Pavement Structure)	GAL	1,550.3
Base Aggregate Dense 3/4-inch(Shoulder Gravel)	TON	87.2
		0.0

Back   Save

Figure 30. Mill, Concrete Repair & HMA Overlay

Rehabilitation #1: Mill, Rubblize & Concrete Pavement Replacement

Milling Limits: Pavement Structure and Shoulders   Milling Depth: 2.0 (in)

Removing Concrete Surface Partial Depth Limits: Pavement Structure Only

Rubblizing Limits: Pavement Structure Only

Type	Type	Thickness	# of Tack Coat Layers	Tack Coat Coverage GAL/SY
Concrete Pavement Structure	Concrete Pavement, 8 inch	8.0		
Shoulder Type HMA	4 LT 58-28 S	4.0	1	0.05

Bond Breaker and/or Intermediate Base Layer (BAD ¾-inch): 4.0

Calculate

Item	Units	Quantity
Removing Asphaltic Surface Milling	SY	31,005.3
Removing Concrete Surface Partial Depth	SF	207,292.8
Rubblizing	SY	23,032.5
Concrete Pavement, 8 inch	SY	23,032.5
4 LT 58-28 S	TON	1,785.9
Tack Coat(Shoulder)	GAL	398.6
Base Aggregate Dense 3/4-inch(Shoulder Gravel)	TON	2,480.4
Base Aggregate Dense 3/4-inch(Bond Breaker And/Or Intermediate Base Layer)	TON	7,234.6
		0.0

Back   Save

Figure 31. Mill, Rubblize & Concrete Pavement Replacement

Rehabilitation #1: Concrete Pavement Reconstruction

☐ Remove Existing Pavement

Type	Type	Thickness	# of Tack Coat Layers	Tack Coat Coverage GAL/SY
Concrete Pavement Structure	Concrete Pavement, 8 inch ⌄	8.0		
Shoulder Type HMA ⌄	4 MT 58-28 S ⌄	4.0	1	0.05

Base Course	Base Thickness
Base Aggregate Dense 1 1/4-inch ⌄	6.0

Calculate

Item	Units	Quantity
Removing Pavement	SY	0
Concrete Pavement, 8 inch	SY	23,032.5
4 MT 58-28 S	TON	1,785.9
Tack Coat(Shoulder)	GAL	398.6
Base Aggregate Dense 3/4-inch(Shoulder Gravel)	TON	275.6
Base Aggregate Dense 1 1/4-inch (Base Course)	TON	15,059.7
	⌄	0.0

Back   Save

Figure 32. Concrete Pavement Reconstruction

All rehabilitation activities that include 'HMA Overlay' have fields for HMA specifics (mix type, thickness, # of tack coat layers, and tack coat application rate). If the 'Thickness' is entered and then an 'HMA Mix Type' is selected from the drop-down list, the thickness that was entered will be deleted and the default thickness of zero will return. Alternatively, entering 'Thickness' after selecting 'HMA Mix Type' is acceptable; however, if a different 'HMA Mix Type' is then selected, the thickness will be deleted, and it will return to zero inches. Be vigilant and be sure to check the quantities after selecting "Calculate" to make sure they look reasonable. An overlay of zero inches will result in HMA and PG binder quantities of zero.

'Concrete Pavement Repair' and 'Concrete Base Patching' quantities are calculated based on '% of Surface Area to be Repaired'. Note that two percent of surface area to repair is roughly equivalent to five percent of joint repair, and three percent of surface repair is about the same as seven and a half percent joint repair.

'Drilled Tie Bars' were omitted from WisPave 4 since they are only used for concrete repairs or base patches that are greater than 15 feet in length. For quantity calculations in WisPave 4, full depth repairs are assumed to be a standard six feet in length.

Since traditional pavements are doweled, grinding is not always performed. If grinding pavements is not common practice after completing full-depth repairs, then select 'None' for the 'Grind Limits'.

'Removing Concrete Surface Partial Depth' can be used to limit the profile increase of pavements that will be overlaid. If this is not standard practice in certain regions, then select 'None' as the 'Limits'. This should not be confused with 'Concrete Pavement Partial Depth Repair…' bid items (416.0750.S-416.0758.S) as they are not related. In fact, 'Concrete Pavement Partial Depth Repair' was removed from WisPave 4 since these repairs are only practical for certain types of distresses that cannot be predicted in advance during an initial pavement design and LCCA process. However, if a design includes partial depth repair of an existing pavement prior to overlaying it, then add the item as an 'Other'.

'Mill, Rubblize, and Concrete Pavement Replacement' requires inputs for Bond Breaker and/or Intermediate Base Layer (BAD ¾-inch). See FDM 14-25-15.4.2 and 15.4.3 for more information on those topics. Although different

27

materials can be used for this purpose, 'Base Aggregate Dense ¾-inch' is used in WisPave 4 for uniformity and quantity calculations.

Note that the bottom of each rehabilitation activity screen has a blank row in which any additional rehabilitation item can be added, along with the respective unit and quantity.

4.6.4   HMA Rehabilitation Actitity Screenshots

Screenshots of the different HMA rehabilitation activities, as listed in section 4.6.2, are shown in Figures 33-38.

Figure 33. HMA Overlay

Figure 34. Mill & HMA Overlay

Rehabilitation #1: Mill, Concrete Repair & HMA Overlay

Milling Limits: [Pavement Structure Only ▼]   Milling Depth: [2.0] (in)

% of Surface Area to be Repaired: [2.0]

Removing Concrete Surface Partial Depth Limits: [None ▼]

Overlay Limits: [Pavement Structure Only ▼]

Type	HMA Mix Type	Thickness	# of Tack Coat Layers	Tack Coat Coverage GAL/SY
Overlay	[4 MT 58-28 S ▼]	[4.0]	[2]	[0.07]

[Calculate]

Item	Units	Quantity
Removing Asphaltic Surface Milling	SY	70,400
Base Patching Concrete	SY	1,408
Drilled Dowel Bars	EACH	2,816
Sawing Concrete	LF	6,336
Removing Concrete Surface Partial Depth	SF	0
4 MT 58-28 S	TON	15,769.6
Tack Coat(Pavement Structure)	GAL	9,856
Base Aggregate Dense 3/4-inch(Shoulder Gravel)	TON	0
[ ]	[▼]	[0.0]

[Back]   [Save]

Figure 35. Mill, Concrete Repair & HMA Overlay

Rehabilitation #1: Mill, Rubblize & HMA Pavement Replacement

Milling Limits: [Pavement Structure and Shoulders ▼]   Milling Depth: [4.0] (in)

Rubblizing Limits: [Pavement Structure and Shoulders ▼]

Type	HMA Mix Type	Thickness	# of Tack Coat Layers	Tack Coat Coverage GAL/SY
Pavement Structure	[4 MT 58-28 S ▼]	[6.0]	[1]	[0.05]
Shoulder Type	[4 MT 58-28 S ▼]	[4.0]	[1]	[0.05]

[Calculate]

Item	Units	Quantity
Removing Asphaltic Surface Milling	SY	30,119.5
Rubblizing	SY	30,119.5
4 MT 58-28 S	TON	7,143.6
Tack Coat(Pavement Structure)	GAL	1,063
4 MT 58-28 S	TON	1,984.3
Tack Coat(Shoulder)	GAL	442.9
Base Aggregate Dense 3/4-inch(Shoulder Gravel)	TON	2,273.7
[ ]	[▼]	[0.0]

[Back]   [Save]

Figure 36. Mill, Rubblize & HMA Pavement Replacement

29

Rehabilitation #1: Pulverize & HMA Pavement Replacement

Type	HMA Mix Type	Thickness	# of Tack Coat Layers	Tack Coat Coverage GAL/SY
Pavement Structure	4 MT 58-28 S	6.0	1	0.05
Shoulder Type	4 MT 58-28 S	4.0	1	0.05

Calculate

Item	Units	Quantity
Pulverize and Relay	SY	30,119.5
4 MT 58-28 S	TON	7,143.6
Tack Coat(Pavement Structure)	GAL	1,063
4 MT 58-28 S	TON	1,984.3
Tack Coat(Shoulder)	GAL	442.9
Base Aggregate Dense 3/4-inch(Shoulder Gravel)	TON	2,583.8
		0.0

Back   Save

Figure 37. Pulverize & HMA Pavement Replacement

Rehabilitation #1: HMA Pavement Reconstruction

☐ Remove Existing Pavement

Type	HMA Mix Type	Thickness	# of Tack Coat Layers	Tack Coat Coverage GAL/SY
Pavement Structure	4 MT 58-28 S	6.5	1	0.05
Shoulder Type	4 MT 58-28 S	3.5	1	0.05

Base Course	Base Thickness
Base Aggregate Dense 1 1/4-inch	10.0

Calculate

Item	Units	Quantity
Removing Pavement	SY	0
4 MT 58-28 S	TON	7,738.9
Tack Coat(Pavement Structure)	GAL	1,063
4 MT 58-28 S	TON	1,736.3
Tack Coat(Shoulder)	GAL	442.9
Base Aggregate Dense 3/4-inch(Shoulder Gravel)	TON	1,477.1
Base Aggregate Dense 1 1/4-inch (Base Course)	TON	26,953.3
		0.0

Back   Save

Figure 38. HMA Pavement Reconstruction

4.6.5 Maintenance

For uniformity in LCCAs, it is assumed that concrete and HMA pavements will receive two maintenance cycles after each construction and rehabilitation activity. The years in which maintenance will be performed are estimated to occur one-thirds and two-thirds through the service life of the construction or rehabilitation activity. When the initial type of work or a rehabilitation activity is identified, the following two maintenance cycles are automatically shown, along with the pavement's age when maintenance will be performed, and the 'Cost per Lane Mile' as specified in Table 10.7 of FDM 14-15-10.3.4. The maintenance costs are based on the surface type of the existing pavement structure. So, if a concrete pavement is to be overlaid with HMA as one of its rehabilitation activities, then the maintenance costs of the following two maintenance cycles will be based on HMA maintenance costs.

WisPave 4 was originally developed and programmed using the same maintenance 'Costs per Lane Mile' as the previous version of WisPave 4. These costs updated in WisPave 4 on May 13, 2014. Any existing pavement design and LCCA that is opened will automatically be updated with the new maintenance costs, even if no other changes are made to the file. Thus, any pavement design and LCCA that was finalized prior to May 13, 2014 will include the old maintenance costs, and if the electronic file is opened, it will not exactly match the design that was submitted.

Two maintenance cycles will occur after every rehabilitation activity, regardless of the pavement's age or cumulative service life. In the Concrete Alt#1 example shown in Figure 39, the third rehabilitation activity is scheduled to be performed on the pavement after it has had 48 years of service. So, even though the following two maintenance cycles are scheduled to be performed after the pavement has hit the 50-year LCCA service life target, it is assumed that two maintenance cycles must be performed on the pavement in order to achieve the salvage value of the pavement for each year of service over fifty.

Year	Type of Work	Activity	Service Life	Cost per Lane Mile	Calculate
0	Initial Construction		25		
8	Concrete Maintenance	1st Cycle		$2000.0	
16	Concrete Maintenance	2nd Cycle		$4000.0	
25	**Concrete Rehabilitation**	Concrete Repair & Grind	8		Calculate
28	Concrete Maintenance	1st Cycle		$2000.0	
31	Concrete Maintenance	2nd Cycle		$4000.0	
33	**Concrete Rehabilitation**	Concrete Repair & HMA Overlay	15		Calculate
38	Concrete Maintenance	1st Cycle		$1000.0	
43	Concrete Maintenance	2nd Cycle		$1250.0	
48	**Concrete Rehabilitation**	Mill, Concrete Repair & HMA Overl	15		Calculate
53	Concrete Maintenance	1st Cycle		$1000.0	
58	Concrete Maintenance	2nd Cycle		$1250.0	
63					

Concrete Alternative – Maintenance & Rehabilitation Summary – Alt #1

Add Delete

Back Next Alternative

Project ID: 1234-56-78

Figure 39. Concrete Maintenance & Rehabilitation Example

4.7   Bid Items

The bid items included in WisPave 4 are divided into the following categories:

- HMA
- Concrete
- Base Course
- Subbase

- Remove Pavement
- Other

Each bid item screen will only list the bid items that were used in the initial construction, or in any of the rehabilitation activities, of each alternate pavement design. So, the only unit costs that need to be entered are for the bid items used in aforementioned alternatives. Thus, every item listed must have an associated cost entered in order to be able to proceed. Figure 40 shows screenshots of the bid item screens for the pavement designs included in this manual. A comprehensive list of all WisDOT bid items used in WisPave 4, along with the bid item category of each, is included in Appendix B.

HMA Bid Items

Bid Item Desc	Bid Item No	Units	Unit Cost
Tack Coat	455.0605	GAL	
3 LT 58-28 S	460.5223	TON	
4 MT 58-28 S	460.6224	TON	
4 MT 58-34 S	460.6244	TON	

Concrete Bid Items

Bid Item Desc	Bid Item No	Units	Unit Cost
Base Patching Concrete	390.0303	SY	
Concrete Pavement, 8 inch	415.0080	SY	
Drilled Dowel Bars	416.0620	EACH	
Concrete Pavement Repair	416.1710	SY	
Sawing Concrete	690.0250	LF	

Base Course Bid Items

Bid Item Desc	Bid Item No	Units	Unit Cost
Base Aggregate Dense 3/4-inch	305.0110	TON	
Base Aggregate Dense 1 1/4-inch	305.0120	TON	
Pulverize and Relay	325.0100	SY	

Sub-base Bid Items

Bid Item Desc	Bid Item No	Units	Unit Cost
Prepare Foundation for Concrete Pavement (project)	211.0200	LS	
Prepare Foundation for Asphaltic Shoulders	211.0400	STA	

Remove Pavement Bid Items

Bid Item Desc	Bid Item No	Units	Unit Cost
Removing Pavement	204.0100	SY	
Removing Asphaltic Surface Milling	204.0120	SY	

32

Other Layer Items

Other Material Description	Units	Unit Cost
Recycled Glass	CY	0.0

Other Additional Construction Items:

Other Material Description	Unit Cost
No Other Additional Construction Items Found	

Other Additional Rehabilitation Items:

Other Material Description	Units	Unit Cost
No Other Rehabilitation Items Found		

Other Alternative Items:

Other Material Description	Units	Unit Cost
common Ex ConcAlt	CY	9.9
Common Ex HMAAlt	CY	9.6
Geogrid Type SR ConcAlt	SY	1.7
Geogrid Type SR ConcALt	SY	1.7
Select Crushed ConcAlt	TON	12.6
Select Crushed ConcAlt	TON	12.6

Figure 40. Bid Item Screens

5 Costs

After all the bid item unit costs are entered, the total calculated cost, including initial construction cost, rehabilitation costs, and maintenance costs, will be shown separately for each alternate pavement design. The costs shown are actual costs based purely on quantities and their respective unit costs and have not been converted to present worth costs.

The costs of all alternative will be shown on one screen; the concrete alternative #1 will be shown first, followed by concrete alternative #2, then all HMA alternatives. Figure 41 shows the layout of the costs for the *Concrete Alt#1* pavement design used in this manual based on fictitious unit costs. Although the costs of the other designs included in the example project are not shown, they are displayed on the same screen in WisPave 4 and can be viewed by scrolling down.

Figure 42 shows an example of an HMA alternate design that consists of a 4 MT 58-28 S pavement followed by two 'Existing Pavement' layers. Items in the first two lines shown in Figure 42 correspond with the 4 MT 58-28 S pavement. Items in the following two lines are the layer materials that were entered and identified as 'Existing Pavement'. Although the bid items are shown, the associated costs for all five bid items are $0.00 since the pavement layers are all existing.

33

Concrete Alt#1
8" PCC

Initial Construction Costs

Bid Item Desc	Bid Item No	Units	Costs
Base Aggregate Dense 1 1/4-inch	305.0120	TON	$0.00
Concrete Pavement, 8 inch	415.0080	SY	$2,464,000.00
Concrete Base, 8 inch (Shoulders)	320.0145	SY	$616,000.00
Base Aggregate Dense 3/4-inch	305.0110	TON	$410,666.40
		Total:	$3,490,666.00

Rehab#1: Concrete Pavement Repair and Grind

Bid Item Desc	Bid Item No	Units	Costs
Drilled Dowel Bars	416.0620	EACH	$42,240.00
Concrete Pavement Repair	416.1710	SY	$140,800.00
Sawing Concrete	690.0250	LF	$22,176.00
		Total:	$205,216.00

Rehab#2: Concrete Repair & HMA Overlay

Bid Item Desc	Bid Item No	Units	Costs
Tack Coat (Pavement Structure)	455.0605	GAL	$14,784.00
4 MT 58-28 S	460.6224	TON	$591,360.00
Base Patching Concrete	390.0303	SY	$70,400.00
Drilled Dowel Bars	416.0620	EACH	$42,240.00
Sawing Concrete	690.0250	LF	$22,176.00
		Total:	$740,960.00

Rehab#3: Concrete Repair & HMA Overlay

Bid Item Desc	Bid Item No	Units	Costs
Tack Coat (Pavement Structure)	455.0605	GAL	$29,568.00
4 MT 58-28 S	460.6224	TON	$1,182,720.00
Base Patching Concrete	390.0303	SY	$70,400.00
Drilled Dowel Bars	416.0620	EACH	$42,240.00
Sawing Concrete	690.0250	LF	$22,176.00
		Total:	$1,347,104.00

Maintenance Costs

Maintenance Cycle	Cost per Lane Mile	Total Cycle Cost
1	$4,000.00	$40,000.00
2	$8,000.00	$80,000.00
3	$4,000.00	$40,000.00
4	$8,000.00	$80,000.00
5	$2,000.00	$20,000.00
6	$2,500.00	$25,000.00
7	$2,000.00	$20,000.00
8	$2,500.00	$25,000.00
	Total:	$330,000.00

Figure 41. Cost Layout of Concrete Alternative Example

HMA Alt#1
6.5" HMA over 15" BAD

Initial Construction Costs

Bid Item Desc	Bid Item No	Units	Costs
Tack Coat (Pavement Structure)	455.0605	GAL	$10,560.00
4 MT 58-28 S	460.6224	TON	$739,200.00
3 MT 58-28 S	460.6223	TON	$1,103,872.00
Base Aggregate Dense 1 1/4-inch	305.0120	TON	$0.00
Tack Coat (Shoulders)	455.0605	GAL	$2,640.00
4 LT 58-28 S (Shoulders)	460.5224	TON	$241,472.00
Base Aggregate Dense 3/4-inch	305.0110	TON	$163,495.80
		Total:	$2,261,239.00

Rehab#1: Mill and HMA Overlay (over Traditional or Deep-Strength HMA Pavement)

Bid Item Desc	Bid Item No	Units	Costs
Tack Coat (Pavement Structure)	455.0605	GAL	$14,784.00
4 MT 58-28 S	460.6224	TON	$591,360.00
Removing Asphaltic Surface Milling	204.0120	SY	$211,200.00
		Total:	$817,344.00

Rehab#2: Mill and HMA Overlay (over Traditional or Deep-Strength HMA Pavement)

Bid Item Desc	Bid Item No	Units	Costs
Tack Coat (Pavement Structure)	455.0605	GAL	$14,784.00
4 MT 58-28 S	460.6224	TON	$591,360.00
Removing Asphaltic Surface Milling	204.0120	SY	$211,200.00
		Total:	$817,344.00

Rehab#3: Mill and HMA Overlay (over Traditional or Deep-Strength HMA Pavement)

Bid Item Desc	Bid Item No	Units	Costs
Tack Coat (Pavement Structure)	455.0605	GAL	$29,568.00
4 MT 58-28 S	460.6224	TON	$1,182,720.00
Removing Asphaltic Surface Milling	204.0120	SY	$211,200.00
		Total:	$1,423,488.00

Maintenance Costs

Maintenance Cycle	Cost per Lane Mile	Total Cycle Cost
1	$2,000.00	$20,000.00
2	$2,500.00	$25,000.00
3	$2,000.00	$20,000.00
4	$2,500.00	$25,000.00
5	$2,000.00	$20,000.00
6	$2,500.00	$25,000.00
7	$2,000.00	$20,000.00
8	$2,500.00	$25,000.00
	Total:	$180,000.00

Figure 42. HMA Alt#1 Costs Showing 'Existing' Layer Material

6   LCCA Results

All costs are converted to present worth values, using a 5% discount rate, and shown for each alternative. In addition, the 'Rehabilitation Salvage Value' of each alternative is determined and shown as present value. The low-cost alternative is identified. Figure 43 shows an example of the LCCA results screen based on fictitious unit prices.

LIFE CYCLE COST ANALYSIS RESULTS

Current Year: 2021	Project Length: 5.0 Miles
Construction Year: 2022	Analysis Basis: LCCA Length
Analysis Period: 50 yrs	Discount Rate(%): 5

Present Worth Costs

	Concrete Alt#1 8" PCC	HMA Alt#1 6.5" HMA over 15" BAD
Initial Construction Costs	$3,324,444.19	$2,165,977.94
Maintenance Costs	$95,939.89	$52,129.06
Rehabilitation Costs	$322,106.50	$678,228.51
Rehabilitation Salvage Value	($96,961.42)	($39,407.45)
Total Facility Costs	$3,645,529.17	$2,856,928.07
	+ 27.60%	+ 0.00%

Figure 43. LCCA Results Example

7   Reports in WisPave 4

Once all pavement designs are complete, users will report the pavement designs. Reports are generated by PDF files. Follow the following procedure to generate reports of pavement designs. Hit "Reports" on the WisPave 4 menu. It will show all titles of the inputs with check boxes. Select the information that needs to be in the report and hit the "Generate Report" on the top right side of the screen. It will show the report version of WisPave 4 of the selected information. Users have the option to save a copy of generated PDF file or print it using a printer.

Appendix A: Layer Material Types

Number	Description	Structural Layer Coefficient				Layer Thickness		
		Default	Minimum	Maximum	Increment	Minimum	Maximum	Increment
204.01	Removing Pavement							
204.0109.S	Removing Concrete Surface Partial Depth							
204.012	Removing Asphaltic Surface Milling							
204.015	Removing Curb & Gutter							
209.01	Backfill Granular	0.1	0	0.1	0.01	0	36	1
211.01	Prepare Foundation for Asphaltic Paving (project)							
211.02	Prepare Foundation for Concrete Pavement (project)							
211.03	Prepare Foundation for Concrete Base (project)							
211.04	Prepare Foundation for Asphaltic Shoulders							
211.05	Prepare Foundation for Base Aggregate							
305.011	Base Aggregate Dense 3/4-inch	0.1	0.1	0.14	0.01	0	36	1
305.012	Base Aggregate Dense 1 1/4-inch	0.1	0.1	0.14	0.01	0	36	1
305.013	Base Aggregate Dense 3-inch	0.1	0	0.14	0.01	0	36	1
306.0115	Salvaged Asphaltic Pavement Base	0.18	0.1	0.25	0.01	0	36	0.25
310.011	Base Aggregate Open Graded	0.1	0.1	0.14	0.01	0	36	1
311.011	Breaker Run	0.1	0	0.1	0.01	0	36	1
312.011	Select Crushed Material	0.1	0	0.14	0.01	0	36	1
313.011	Pit Run	0.1	0	0.1	0.01	0	36	1
320.0105	Concrete Base, 4 inch	0.4	0.1	0.4	0.01	4	4	0
320.011	Concrete Base, 4.5 inch	0.4	0.1	0.4	0.01	4.5	4.5	0
320.0115	Concrete Base, 5 inch	0.4	0.1	0.4	0.01	5	5	0
320.012	Concrete Base, 5.5 inch	0.4	0.1	0.4	0.01	5.5	5.5	0
320.0125	Concrete Base, 6 inch	0.4	0.1	0.4	0.01	6	6	0
320.013	Concrete Base, 6.5 inch	0.4	0.1	0.4	0.01	6.5	6.5	0
320.0135	Concrete Base, 7 inch	0.4	0.1	0.4	0.01	7	7	0
320.014	Concrete Base, 7.5 inch	0.4	0.1	0.4	0.01	7.5	7.5	0
320.0145	Concrete Base, 8 inch	0.4	0.1	0.4	0.01	8	8	0

320.015	Concrete Base, 8.5 inch	0.4	0.1	0.4	0.01	8.5	8.5	0
320.0155	Concrete Base, 9 inch	0.4	0.1	0.4	0.01	9	9	0
320.016	Concrete Base, 9.5 inch	0.4	0.1	0.4	0.01	9.5	9.5	0
320.0165	Concrete Base, 10 inch	0.4	0.1	0.4	0.01	10	10	0
320.017	Concrete Base, 10.5 inch	0.4	0.1	0.4	0.01	10.5	10.5	0
325.01	Pulverize and Relay	0.1	0.1	0.25	0.01	0	36	0.25
330.01	Mill and Relay	0.18	0.1	0.25	0.01	0	36	0.25
335.01	Rubblizing	0.2	0.2	0.24	0.01	0	36	0.25
340.01	(Existing) Cracking and Seating	0	0	0	0	0	36	0.25
350.0104	Subbase	0.04	0.01	0.1	0.01	0	36	0.25
390.0303	Base Patching Concrete							
415.006	Concrete Pavement, 6 inch	0.1	0.1	0.54	0.01	6	6	0
415.0065	Concrete Pavement, 6.5 inch	0.1	0.1	0.54	0.01	6.5	6.5	0
415.007	Concrete Pavement, 7 inch	0.1	0.1	0.54	0.01	7	7	0
415.0075	Concrete Pavement, 7.5 inch	0.1	0.1	0.54	0.01	7.5	7.5	0
415.008	Concrete Pavement, 8 inch	0.1	0.1	0.54	0.01	8	8	0
415.0085	Concrete Pavement, 8.5 inch	0.1	0.1	0.54	0.01	8.5	8.5	0
415.009	Concrete Pavement, 9 inch	0.1	0.1	0.54	0.01	9	9	0
415.0095	Concrete Pavement, 9.5 inch	0.1	0.1	0.54	0.01	9.5	9.5	0
415.01	Concrete Pavement, 10 inch	0.1	0.1	0.54	0.01	10	10	0
415.0105	Concrete Pavement, 10.5 inch	0.1	0.1	0.54	0.01	10.5	10.5	0
415.011	Concrete Pavement, 11 inch	0.1	0.1	0.54	0.01	11	11	0
415.0115	Concrete Pavement, 11.5 inch	0.1	0.1	0.54	0.01	11.5	11.5	0
415.012	Concrete Pavement, 12 inch	0.1	0.1	0.54	0.01	12	12	0
415.0125	Concrete Pavement, 12.5 inch	0.1	0.1	0.54	0.01	12.5	12.5	0
415.013	Concrete Pavement, 13 inch	0.1	0.1	0.54	0.01	13	13	0
415.0135	Concrete Pavement, 13.5 inch	0.1	0.1	0.54	0.01	13.5	13.5	0
415.014	Concrete Pavement, 14 inch	0.1	0.1	0.54	0.01	14	14	0
415.0145	Concrete Pavement, 14.5 inch	0.1	0.1	0.54	0.01	14.5	14.5	0
415.015	Concrete Pavement, 15 inch	0.1	0.1	0.54	0.01	15	15	0
415.0155	Concrete Pavement, 15.5 inch	0.1	0.1	0.54	0.01	15.5	15.5	0
415.016	Concrete Pavement, 16 inch	0.1	0.1	0.54	0.01	16	16	0

416.062	Drilled Dowel Bars							
416.171	Concrete Pavement Repair							
420.1	Concrete Pavement Continuous Diamond Grinding							
455.0605	Tack Coat							
460.5223	3 LT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.5224	4 LT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.5225	5 LT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.5243	3 LT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.5244	4 LT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.5245	5 LT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.5424	4 LT 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.5444	4 LT 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.6222	2 MT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6223	3 MT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6224	4 MT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6225	5 MT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6242	2 MT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6243	3 MT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6244	4 MT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6245	5 MT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.6424	4 MT 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.6425	5 MT 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.6444	4 MT 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.6445	5 MT 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7222	2 HT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.7223	3 HT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.7224	4 HT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.7225	5 HT 58-28 S	0.44	0.1	0.44	0.01	0	36	0.25
460.7242	2 HT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.7243	3 HT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.7244	4 HT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25
460.7245	5 HT 58-34 S	0.44	0.1	0.44	0.01	0	36	0.25

460.7422	2 HT 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7423	3 HT 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7424	4 HT 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7425	5 HT 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7442	2 HT 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7443	3 HT 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7444	4 HT 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7445	5 HT 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.7624	4 HT 58-28 V	0.44	0.1	0.44	0.01	0	36	0.25
460.7625	5 HT 58-28 V	0.44	0.1	0.44	0.01	0	36	0.25
460.7644	4 HT 58-34 V	0.44	0.1	0.44	0.01	0	36	0.25
460.7645	5 HT 58-34 V	0.44	0.1	0.44	0.01	0	36	0.25
460.8424	4 SMA 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.8425	5 SMA 58-28 H	0.44	0.1	0.44	0.01	0	36	0.25
460.8444	4 SMA 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.8445	5 SMA 58-34 H	0.44	0.1	0.44	0.01	0	36	0.25
460.8624	4 SMA 58-28 V	0.44	0.1	0.44	0.01	0	36	0.25
460.8625	5 SMA 58-28 V	0.44	0.1	0.44	0.01	0	36	0.25
460.8644	4 SMA 58-34 V	0.44	0.1	0.44	0.01	0	36	0.25
460.8645	5 SMA 58-34 V	0.44	0.1	0.44	0.01	0	36	0.25
601.0409	Concrete Curb & Gutter 30-inch Type A							
601.0411	Concrete Curb & Gutter 30-inch Type D							
690.025	Sawing Concrete							
99999-1	Warranted Concrete Pavement Mainline	0.1	0.1	0.54	0.01	6	16	0.5
99999-2	Existing Concrete Pavement	0.34	0.1	0.54	0.01	1	16	0.25
99999-3	Existing HMA Pavement	0.3	0.1	0.44	0.01	0	36	0.25

Appendix B: WisPave 4 Bid Items

Number	Description	Item Type Code	Unit Type Code	Unit Weight
204.01	Removing Pavement	Remove Pavement	SY	0
204.0109.S	Removing Concrete Surface Partial Depth	Remove Pavement	SF	0
204.012	Removing Asphaltic Surface Milling	Remove Pavement	SY	0
204.015	Removing Curb & Gutter	Remove Pavement	LF	0
209.01	Backfill Granular	Subbase	CY	0
211.01	Prepare Foundation for Asphaltic Paving (project)	Subbase	LS	0
211.02	Prepare Foundation for Concrete Pavement (project)	Subbase	LS	0
211.03	Prepare Foundation for Concrete Base (project)	Subbase	LS	0
211.04	Prepare Foundation for Asphaltic Shoulders	Subbase	STA	0
211.05	Prepare Foundation for Base Aggregate	Subbase	STA	0
305.011	Base Aggregate Dense 3/4-inch	Base Course	TON	2.1
305.012	Base Aggregate Dense 1 1/4-inch	Base Course	TON	2
305.013	Base Aggregate Dense 3-inch	Subbase	TON	2.2
306.0115	Salvaged Asphaltic Pavement Base	Base Course	CY	0
310.011	Base Aggregate Open Graded	Base Course	TON	1.9
311.011	Breaker Run	Subbase	TON	1.8
312.011	Select Crushed Material	Subbase	TON	1.9
313.011	Pit Run	Subbase	TON	1.8
320.0105	Concrete Base, 4 inch	Concrete	SY	0
320.011	Concrete Base, 4.5 inch	Concrete	SY	0
320.0115	Concrete Base, 5 inch	Concrete	SY	0
320.012	Concrete Base, 5.5 inch	Concrete	SY	0
320.0125	Concrete Base, 6 inch	Concrete	SY	0
320.013	Concrete Base, 6.5 inch	Concrete	SY	0

320.0135	Concrete Base, 7 inch	Concrete	SY	0
320.014	Concrete Base, 7.5 inch	Concrete	SY	0
320.0145	Concrete Base, 8 inch	Concrete	SY	0
320.015	Concrete Base, 8.5 inch	Concrete	SY	0
320.0155	Concrete Base, 9 inch	Concrete	SY	0
320.016	Concrete Base, 9.5 inch	Concrete	SY	0
320.0165	Concrete Base, 10 inch	Concrete	SY	0
320.017	Concrete Base, 10.5 inch	Concrete	SY	0
325.01	Pulverize and Relay	Base Course	SY	0
330.01	Mill and Relay	Base Course	SY	0
335.01	Rubblizing	Base Course	SY	0
340.01	(Existing) Cracking and Seating	Base Course	SY	0
350.0104	Subbase	Subbase	TON	0
390.0303	Base Patching Concrete	Concrete	SY	0
415.006	Concrete Pavement, 6 inch	Concrete	SY	0
415.0065	Concrete Pavement, 6.5 inch	Concrete	SY	0
415.007	Concrete Pavement, 7 inch	Concrete	SY	0
415.0075	Concrete Pavement, 7.5 inch	Concrete	SY	0
415.008	Concrete Pavement, 8 inch	Concrete	SY	0
415.0085	Concrete Pavement, 8.5 inch	Concrete	SY	0
415.009	Concrete Pavement, 9 inch	Concrete	SY	0
415.0095	Concrete Pavement, 9.5 inch	Concrete	SY	0
415.01	Concrete Pavement, 10 inch	Concrete	SY	0
415.0105	Concrete Pavement, 10.5 inch	Concrete	SY	0
415.011	Concrete Pavement, 11 inch	Concrete	SY	0
415.0115	Concrete Pavement, 11.5 inch	Concrete	SY	0
415.012	Concrete Pavement, 12 inch	Concrete	SY	0
415.0125	Concrete Pavement, 12.5 inch	Concrete	SY	0
415.013	Concrete Pavement, 13 inch	Concrete	SY	0
415.0135	Concrete Pavement, 13.5 inch	Concrete	SY	0
415.014	Concrete Pavement, 14 inch	Concrete	SY	0
415.0145	Concrete Pavement, 14.5 inch	Concrete	SY	0

415.015	Concrete Pavement, 15 inch	Concrete	SY	0
415.0155	Concrete Pavement, 15.5 inch	Concrete	SY	0
415.016	Concrete Pavement, 16 inch	Concrete	SY	0
416.062	Drilled Dowel Bars	Concrete	EACH	0
416.171	Concrete Pavement Repair	Concrete	SY	0
420.1	Concrete Pavement Continuous Diamond Grinding	Concrete	SY	0
455.0605	Tack Coat	HMA	GAL	0
460.5223	3 LT 58-28 S	HMA	TON	112
460.5224	4 LT 58-28 S	HMA	TON	112
460.5225	5 LT 58-28 S	HMA	TON	112
460.5243	3 LT 58-34 S	HMA	TON	112
460.5244	4 LT 58-34 S	HMA	TON	112
460.5245	5 LT 58-34 S	HMA	TON	112
460.5424	4 LT 58-28 H	HMA	TON	112
460.5444	4 LT 58-34 H	HMA	TON	112
460.6222	2 MT 58-28 S	HMA	TON	112
460.6223	3 MT 58-28 S	HMA	TON	112
460.6224	4 MT 58-28 S	HMA	TON	112
460.6225	5 MT 58-28 S	HMA	TON	112
460.6242	2 MT 58-34 S	HMA	TON	112
460.6243	3 MT 58-34 S	HMA	TON	112
460.6244	4 MT 58-34 S	HMA	TON	112
460.6245	5 MT 58-34 S	HMA	TON	112
460.6424	4 MT 58-28 H	HMA	TON	112
460.6425	5 MT 58-28 H	HMA	TON	112
460.6444	4 MT 58-34 H	HMA	TON	112
460.6445	5 MT 58-34 H	HMA	TON	112
460.7222	2 HT 58-28 S	HMA	TON	112
460.7223	3 HT 58-28 S	HMA	TON	112
460.7224	4 HT 58-28 S	HMA	TON	112
460.7225	5 HT 58-28 S	HMA	TON	112
460.7242	2 HT 58-34 S	HMA	TON	112

460.7243	3 HT 58-34 S	HMA	TON	112
460.7244	4 HT 58-34 S	HMA	TON	112
460.7245	5 HT 58-34 S	HMA	TON	112
460.7422	2 HT 58-28 H	HMA	TON	112
460.7423	3 HT 58-28 H	HMA	TON	112
460.7424	4 HT 58-28 H	HMA	TON	112
460.7425	5 HT 58-28 H	HMA	TON	112
460.7442	2 HT 58-34 H	HMA	TON	112
460.7443	3 HT 58-34 H	HMA	TON	112
460.7444	4 HT 58-34 H	HMA	TON	112
460.7445	5 HT 58-34 H	HMA	TON	112
460.7624	4 HT 58-28 V	HMA	TON	112
460.7625	5 HT 58-28 V	HMA	TON	112
460.7644	4 HT 58-34 V	HMA	TON	112
460.7645	5 HT 58-34 V	HMA	TON	112
460.8424	4 SMA 58-28 H	HMA	TON	112
460.8425	5 SMA 58-28 H	HMA	TON	112
460.8444	4 SMA 58-34 H	HMA	TON	112
460.8445	5 SMA 58-34 H	HMA	TON	112
460.8624	4 SMA 58-28 V	HMA	TON	112
460.8625	5 SMA 58-28 V	HMA	TON	112
460.8644	4 SMA 58-34 V	HMA	TON	112
460.8645	5 SMA 58-34 V	HMA	TON	112
601.0409	Concrete Curb & Gutter 30-inch Type A	Concrete	LF	0
601.0411	Concrete Curb & Gutter 30-inch Type D	HMA	LF	0
690.025	Sawing Concrete	Concrete	LF	0
99999-1	Warranted Concrete Pavement Mainline	Concrete	SY	0
99999-2	Existing Concrete Pavement	N/A		0
99999-3	Existing HMA Pavement	N/A		0