



#### FDM 14-15-1 General

May 15, 2019

##### 1.1 Objective

The objective of this procedure is to define the Pavement Type Selection process. The process described herein applies to the following road projects: state trunk highways including 3R, Majors, Backbone, SE Freeways; connecting highways (refer to [FDM 4-5-5](#)); and local road projects that receive state or federal funds. Areas in this section that only pertain to one or the other project type are titled accordingly.

##### 1.2 Pavement Type Selection Policy

It is the policy of the department to include both a hot-mix asphalt (HMA) pavement and a concrete pavement option in the pavement type selection process for pavement replacement and reconstruction projects. (refer to [FDM 14-10-1.2](#))

#### FDM 14-15-5 Structural Design

August 17, 2020

##### 5.1 Structural Design Process

The goal of a structural design is to determine the thickness, number of layers and material composition of a pavement structure required to withstand a given load. WisPave is WisDOT's official software to be used for pavement structural design. Refer to [FDM 14-1-1.5](#) for WisPave access information. A pavement design must meet or exceed the required structure number (SN). If the pavement design deviates from the required SN, justification must be provided in the report.

##### 5.2 Structural Design Need

###### 5.2.1 State Highways

[Table 10.1](#) identifies which types of projects require a structural design. [Table 10.2](#) lists types of pavement work that define the different project types listed in [Table 10.1](#). See [FDM 11-1 Attachment 10.1](#) for more information on Improvement Type and Application of Design Criteria.

###### 5.2.2 Local Roads

Use the structural design method specified in [Table 10.3](#).

###### 5.2.3 Exemptions

A structural design is not required for the following project types, regardless of the road type:

- Bridge: pavement between approaches and existing roadway
- Bridge: pavement under structure requiring work to allow for proper clearance
- Preservation/Restoration (see [Table 10.1](#) and [Table 10.2](#))
- Resurfacing (RSRF10, 15, 20 & 25; see [Table 10.1](#) and [Table 10.2](#))
- Temporary pavements (generally removed prior to project close such as crossovers)
- Culvert (box or circular) replacement associated with pavement sections under 500 ft

All projects not specified above require a structural design. If a project does not require a structural design, then an abbreviated report must be completed as discussed in [FDM 14-15-25.2](#).

#### FDM 14-15-10 Life-Cycle Cost Analysis (LCCA)

May 17, 2021

##### 10.1 LCCA Process

Pavement type selection is primarily based on the outcome of the LCCA. The LCCA is a process for comparing alternatives over a specified period of time. During this period, each alternative has expenditures for initial construction, maintenance and rehabilitation. The expenditures are converted to present worth costs and then summed together.

To make this process rational, uniform and consistent, the use of WisPave Pavement Design and LCCA computer program is considered policy. Refer to [FDM 14-1-1.5](#) for WisPave access information.

**10.2 LCCA Need**

**10.2.1 State Highways**

[Table 10.1](#) identifies which types of projects require an LCCA. [Table 10.2](#) lists types of pavement work that define the different project types listed in [Table 10.1](#). See [FDM 11-1 Attachment 10.1](#) for more information on Improvement Type and Application of Design Criteria.

**Table 10.1 Structural Design and LCCA Requirement Criteria**

Highway Improvement Type	Improvement Concept Code	Structural Design Required?	LCCA Required?
Preservation/Restoration	PSRS10, 20, 30, 40	No	No
Resurfacing	RSRF10, 15, 20, 25	No	No
	RSRF30	Yes	
	COLD10, 20	Yes	
Pavement Replacement	PVRPLA	Yes	Yes
	COLD30		
Reconstruction	RECST	Yes*	Yes*
Expansion and New Construction	RECSTE	Yes*	Yes*
	BRNEW		
Bridge Preventative	BRPVTV	No	No
Bridge Rehabilitation	BRRHB	No	No
Bridge Replacement	BRRPLE	Yes*	Yes*
	BRRPL		

\*Not required when replacing a short segment of pavement between a new or reconstructed bridge and an existing pavement.

**Table 10.2 Types of Pavement Work**

Types of Pavement Work	Improvement Concept Code				
<b>Preservation/Restoration:</b>					
Concrete joint/crack or spot repair	PSRS10				
HMA seal coat, crack fill, surface mill, micro surface	PSRS10				
Concrete repair and grind, slab replace, patch	PSRS20				
HMA patch, rut fill	PSRS20				
Concrete some combo of patch, slab replace, crack repair	PSRS30				
HMA some combo of patch, crack fill, seal coat	PSRS30				
HMA Short term overlay/mill and overlay	PSRS40				
<b>Resurfacing:</b>					
Concrete overlay	RSRF10				
Concrete repair, grind, overlay, patch	RSRF20				
Concrete base or spot repair, patch, slab replace, overlay	RSRF30				
HMA overlays	RSRF10	RSRF15	RSRF20	RSRF25	RSRF30
HMA partial depth mill & overlay	RSRF10	RSRF15	RSRF20	RSRF25	RSRF30
HMA overlay over Cold In-Place Recycling (partial depth)	COLD10	COLD20			
<b>Bridge Rehabilitation:</b>					
	BRRHB				
<b>Pavement Replacement:</b>					
Concrete rubblization with HMA overlay	PVRPLA				
HMA pulverization with HMA overlay	PVRPLA				
HMA full-depth mill with HMA overlay	PVRPLA				
HMA overlay over Cold In-Place Recycling (full-depth)	COLD30				
<b>Bridge Replacement:</b>					
	BRRPLE	BRRPL			
<b>Reconstruction:</b>					
New pavement	RECST	BRNEW			
<b>Expansion:</b>					
New pavement	RECSTE	BRNEW			

**10.2.2 Local Roads**

If the project is not exempt from an LCCA, then refer to [Table 10.3](#) for the pavement type selection method. If the pavement type selection method is based on a life-cycle cost analysis, then see [FDM 14-15-10](#) for LCCA guidance.

**Table 10.3 Pavement Structural Design and Pavement Type Selection for Local Road Projects**

	Posted Speed	Construction Year AADT	Method of Pavement Structural Design and Pavement Type Selection
Rural	Not applicable	Less than 1,500	Based on local experience and knowledge.
	Not applicable	1,500 or greater	Pavement structural design using WisPave and pavement type selection based on life cycle cost analysis.
Urban	Posted Speed Limit of 40 mph or Less	4,500 or less	Based on local experience and knowledge.
		Greater than 4,500	Pavement structural design using WisPave and pavement type selection based on life cycle cost analysis.
	Posted Speed Limit of 45 to 55 mph	Less than 1,500	Based on local experience and knowledge.
		1,500 or greater	Pavement structural design using WisPave and pavement type selection based on life cycle cost analysis.

As previously noted, a Pavement Design Report is required for all local road projects receiving state or federal funds, regardless of the structural design or the pavement type selection method used. [Table 10.3](#) describes the methods to use and document within the report.

### 10.2.3 Exemptions

A LCCA is not required for the following project types, regardless of road type:

- Auxiliary lanes
- Bridge: approaches
- Bridge: pavement between approaches and existing roadway
- Bridge: pavement under structure requiring work to allow for proper clearance
- Highway Safety Improvement Program (HSIP)
- Jurisdictional Transfer (JT)
- Preservation/Restoration (see [Table 10.1](#) and [Table 10.2](#))
- Ramps
- Reconditioning (see [Table 10.1](#) and [Table 10.2](#))
- Resurfacing (see [Table 10.1](#) and [Table 10.2](#))
- Roundabouts
- Temporary pavements (generally removed prior to project close such as crossovers)
- Transportation Economic Assistance (TEA)

### 10.3 The LCCA Parameters

The LCCA involves the development of two or more structurally equivalent alternatives, a HMA pavement and a concrete pavement. In addition to the pavement surface type, pavement structures are classified as “drained” and “un-drained. The selection of a drained system should be based on need. In an LCCA, a drained pavement structure should not be compared to an un-drained pavement structure.

Once the structural designs are complete, quantities, bid item costs, future rehabilitation and maintenance costs need to be estimated. WisPave will perform these calculations, then bring them together to complete the LCCA. The LCCA is used only to analyze pavement related costs for each alternative. WisPave is not to be used for PS&E estimates.

#### 10.3.1 Bid Item Costs

WisPave has a list of pavement related bid items for which the user inputs the bid item costs. These costs should consider the quantity of materials as well as the location and type of project being analyzed.

#### 10.3.2 Unit Weights of Materials

[Table 10.4](#) gives unit weights that are used in the quantity computations in WisPave and are considered policy values. These unit weights are based on statewide averages that have been adjusted to better represent typical construction quantities (the goal is statewide uniformity and consistency).

**Table 10.4 Material Unit Weights used in WisPave**

Material	Unit Weight
HMA Pavement	112 LB/SY/INCH
Base Aggregate Dense 3/4-Inch	2.1 TON/CY
Base Aggregate Dense 1 1/4-Inch	2.0 TON/CY
Base Aggregate Dense 3-Inch	2.2 TON/CY
Base Aggregate Open Graded	1.9 TON/CY
Breaker Run	1.8 TON/CY
Select Crushed Material	1.9 TON/CY
Pit Run	1.8 TON/CY
Granular Backfill Grade 1 or 2	1.7 TON/CY *

\*WisPave currently calculates quantities of this material in Tons.

**10.3.3 Typical Rehabilitation Scenarios and Standard Sequences**

To establish the most probable sequence of rehabilitations for each pavement type, a standard sequence of rehabilitations has been developed. Following this sequence assumes that the initial pavement and the subsequent rehabilitations all perform as expected and are scheduled according to the typical planning and pavement management thresholds.

The actual decision for the rehabilitation will be made in the future based on new technologies and the best practices at that time. To build a uniform, consistent, repeatable and defensible LCCA, the most probable sequence of rehabilitations, based upon today's knowledge and technology, is required. [Table 10.5](#) and [Table 10.6](#) show typical rehabilitation scenarios and standard sequences that should be used as guidance.

**Table 10.5 Concrete (JPCP with dowels) Pavement Life Cycle**

Scenario	Options*
Initial Construction	New Construction or Reconstruction or Pavement Replacement
First Rehabilitation	Concrete Repair and Grind** or Concrete Repair and HMA Overlay
Second Rehabilitation	Concrete Repair and Grind** or Concrete Repair and HMA Overlay or Mill, Concrete Repair and HMA Overlay
Third Rehabilitation	Concrete Repair and HMA Overlay or Mill, Concrete Repair and HMA Overlay
Reconstruction	Reconstruction or Pavement Replacement (including Rubblization)

\*See [Table 10.9](#) for service lives.

\*\*Grinding is not always necessary. The cost can be omitted from WisPave's LCCA by selecting "None" under *Grind Limits*.

**Table 10.6 HMA Pavement Life Cycle**

Scenario	Options*	
	Traditional HMA Pavements	Deep-Strength or Perpetual HMA Pavements
Initial Construction	New Construction, Reconstruction, or Pavement Replacement	New Construction, Reconstruction, or Pavement Replacement
First Rehabilitation	HMA Overlay** or Mill and HMA Overlay	Mill top layer of HMA plus 1/2-Inch and overlay a minimum of same thickness as removed
Second Rehabilitation	HMA Overlay or Mill and HMA Overlay	Mill top layer of HMA plus 1/2-Inch and overlay a minimum of same thickness as removed
Third Rehabilitation	HMA Overlay or Mill and HMA Overlay	Mill top layer of HMA plus 1/2-Inch and overlay a minimum of same thickness as removed
Reconstruction	Reconstruction or Pavement Replacement (including Pulverization and CIR)	Reconstruction or Pavement Replacement (including Pulverization and CIR)

\*See [Table 10.9](#) for service lives.

\*\*Minimum overlay thickness to be determined based on layer thicknesses set forth in [Standard Spec 460.3.2](#)

**10.3.4 Maintenance Costs**

The maintenance costs outlined in [Table 10.7](#) are to be considered as policy values. The costs are estimated based on a typical maintenance sequence identified by Bureau of Highway Maintenance, Highway Maintenance Section. These costs tend to be very erratic, so the use of a statewide average is the most practical approach for use in a LCCA. The cost also includes the maintenance activities for shoulders. These costs will be reviewed periodically and adjusted if warranted.

The maintenance costs are categorized by the pavement surface material. A pavement, regardless of the type, will typically undergo two separate maintenance cycles between rehabilitation or reconstruction activities. The time periods at which the maintenance activities occur are estimated based on the service life of the previous construction or rehabilitation activity. When a pavement is rehabilitated, the maintenance cycle starts over and follows the maintenance sequence for the pavement surface material.

**Table 10.7 Maintenance Costs**

PAVEMENT SURFACE TYPE	PAVEMENT SURFACE AGE (yrs.) *	One Time Cost per Lane Mile**
Concrete	1/3 of Service Life	\$4,000
Concrete	2/3 of Service Life	\$8,000
HMA	1/3 of Service Life	\$2,000
HMA	2/3 of Service Life	\$2,500

\*The pavement surface age at the time of maintenance cycles are estimated to occur at 1/3 and 2/3 of the service life of the previous construction or rehabilitation activity.

\*\*Cost per lane mile was reviewed and revised in 2014.

**10.3.5 Pavement Design Service Lives**

Pavement service lives play a very influential role in the LCCA. The service life is defined as the historical performance life of a pavement treatment, before the next rehabilitation or reconstruction. The following table of service lives contains policy values. The values represent statewide values that are computed from WisDOT's Pavement Management System.

**Table 10.8 Initial Service Life**

Initial Construction	Service Life (years)
Concrete	25
Concrete (drained)	31
Concrete over Rubblized Concrete	31
HMA – Traditional or Deep-Strength	18
HMA (drained) – Traditional or Deep-Strength	22
HMA – Perpetual	16
HMA over Pulverized HMA	18
HMA over Rubblized Concrete	22
HMA Overlay over Cold In-Place Recycling	18

**Table 10.9 Rehabilitation Service Life**

Rehabilitation	Service Life (years)
Concrete Pavement Repair and Grind	8
Concrete repair & HMA Overlay	15
Mill, Concrete Repair & HMA Overlay	15
HMA Overlay (over Traditional or Deep-Strength HMA Pavement)	12
Mill and HMA Overlay (over Traditional or Deep-Strength HMA Pavement)	12
HMA Overlay over Continuous Reinforced Concrete Pavement (CRCP)	8
HMA Overlay over Jointed Reinforced Concrete Pavement (JRCP)	8
HMA Overlay over JPCP	15
Mill and HMA Overlay (1 <sup>st</sup> or 2 <sup>nd</sup> Overlay over Perpetual HMA Pavement)	16
Mill and HMA Overlay (3 <sup>rd</sup> Overlay over Perpetual HMA Pavement)	12

The service lives for drained pavement structures are estimates that add 25 percent more life onto like undrained pavement structures. Service lives of pavement rehabilitations over drained bases are considered the same as like pavement rehabilitations over undrained bases.

#### 10.4 The LCCA Computation

After all the LCCA parameters are identified, the LCCA calculation is performed using standard engineering economic analysis procedures for computing present worth costs. WisDOT policy uses a 5% discount rate and a 50-year analysis period. For alternatives that have rehabilitation cycles that extend beyond 50 years, a “Rehabilitation Salvage Value” is calculated and credited back into the alternative’s “Total Facility Cost.” The “Rehabilitation Salvage Value” calculation consists of discounting the linearly prorated rehabilitation cost.

### FDM 14-15-15 Exception Process

May 15, 2019

#### 15.1 General

In most cases the lowest Total Facility Cost pavement alternative identified by the LCCA will be the selected pavement structure. However, other factors may influence the choice of a pavement structure.

If the lowest Total Facility Cost LCCA alternative is chosen, then the process is complete. If the cost difference between the desired option and the LCCA low-cost option is  $\leq 5\%$  then the selection is at the pavement designer’s discretion, however supporting documentation must be placed in the project files and included in the Pavement Design Report.

### 15.1.1 State Highways

If the difference between the desired pavement structure option and the low-cost LCCA option is greater than 5% then a review committee meeting can be requested by the Region Pavement Engineer. This committee is established on a case-by-case basis and consists of region representatives and a Materials Management Section representative designated by the Chief Materials Management Engineer. The responsibility of the committee is to reach a consensus, that is then documented in the Pavement Design Report. The region's designated approving authority approves the Pavement Design Report once the committee has convened and a consensus has been reached.

### 15.1.2 Local Roads

If the difference between the desired pavement structure option and the low-cost LCCA option is greater than 5% then the local agency is responsible for all costs that exceed the LCCA lowest Total Facility Cost alternative for the entire project length, without regard to the 5% margin.

The regional Local Program Project Manager reviews Pavement Design Reports for projects on the local road system with an exception. As noted above, the local agency is responsible for the difference in costs for the entire project length. If a high-cost alternative is chosen, this information must be documented in the Pavement Design Report.

## FDM 14-15-20 Pavement Design Report

May 18, 2020

### 20.1 Requirement and Purpose

A Pavement Design Report using the template is required for all road projects: Perpetuation, Rehabilitation and Modernization. The purpose of the Pavement Design Report is to document the pavement structure design and method of determination and the Pavement Type Selection process. This report will be used as the basis for pavement type selection approval. By following "Pavement Design Report Content" ([FDM 14-15-25](#)) and using the department's pavement design and Life Cycle Cost Analysis (LCCA) software, WisPave 4, uniform and consistent pavement type selections can be determined (Refer to [FDM 14-15-25 Attachment 25.1](#)).

A full Pavement Design Report is not needed when a pavement structural design is not required, for these projects, an abbreviated report is sufficient. An abbreviated report must at least include applicable information under *Correspondence/Memorandum, Subject, Executive Summary, Traffic and Exhibits* of the *Abbreviated Pavement Design Report Template* (Refer to [FDM 14-15-25 Attachment 25.2](#)).

### 20.2 Need for Reevaluation

If the treatment type is subject to a structural design and during the project development process, it is observed that the construction year of a project has changed by four or more years, the Pavement Design Report is subject to reevaluation from a structural standpoint, by the regional pavement design engineer. Any reevaluations performed must be documented.

### 20.3 Pavement Design Report and Certification Approval

#### 20.3.1 State Highways

All Pavement Design Reports and Pavement Design Certifications ([Attachments 25.1](#) & [25.2](#)) for state trunk highway or connecting highway projects are approved and certified in the region by the region's designated approving authority. For any exceptions, follow the process described in [FDM 14-15-15](#).

#### 20.3.2 Local Roads

The Local Public Agency (LPA) approves Pavement Design Reports for local road projects. For any exceptions follow the process described in [FDM 14-15-15](#).

### 20.4 Pavement Design Report Submittal

#### 20.4.1 WisPave Designs

Pavement Design Reports are reviewed annually for statewide policy conformance. If WisPave is used for the structural design and/or the LCCA, then the 'Status' of the WisPave electronic file should be set as 'Final' on the General Information screen, once it is approved. The electronic file should be left in the WisPave database for at least two years after the approval date.

#### 20.4.2 Reports

##### 20.4.2.1 State Highways

Consultants should electronically transmit their Pavement Design Reports to the regions. Regions should send

electronic copies in pdf format of all completed and approved Pavement Design Reports to the Pavements' FTP site (see section [FDM 14-15-20.4.2.3](#)) when they are approved or by the end of each state fiscal year.

### 20.4.2.2 Local Roads

The regional Local Program Project Manager should send electronic copies in pdf format of all completed and approved Pavement Design Reports to the Pavements' FTP site (see section [FDM 14-15-20.4.2.3](#)) when they are approved or by the end of each state fiscal year.

### 20.4.2.3 Viewing and Downloading Reports to the Pavements FTP Site

Pavement design reports can be viewed by authorized persons on the Pavements' FTP site by opening the link below.

<ftp://pavuser:dotpave@ftp.dot.wi.gov>

From there, select <reports>, then <State> or <Local>, and then the appropriate region folder.

Follow the instructions detailed below to copy reports to the FTP site.

1. Do not open the FTP site by selecting the link above; instead, right click the link above and select <Copy Link Location>.
2. Open Windows Explorer (or an equivalent file managing application), left click in the address bar to highlight the default location, paste the FTP address that's on your clipboard, and then select <Enter>.
3. Select <reports>, then <State> or <Local> to see folders of all five regions. Leave the screen there.
4. Open a second file manager and adjust its size and location on the screen so that it can be viewed next to the FTP site window. Navigate to the folder containing the reports.
5. Copy the Pavement Design Reports to the FTP site by dragging and dropping them, or by copying and pasting them, into the correct regional folder.
6. Name the pavement design report containing design date (current calendar year), region (SWR, SER, NER, NCR, NWR), state (or local), project ID without dash, highway number, and improvement type  
Example: PDR\_2020\_NCR\_State\_16200303\_STH 13\_RSRF10.pdf

To delete files from the Pavements' FTP site, follow steps 1-3 above, and then just select and <Delete>.

## FDM 14-15-25 Pavement Design Report Content

May 15, 2019

### 25.1 Introduction

The purpose of a Pavement Design Report is to bring together all the information that is essential for evaluating alternate pavement designs. The report provides the supporting data and logic for the recommended pavement alternative in a clear and organized way.

### 25.2 Report Content

Pavement Design Report Templates have been developed to include content in a standard order and format. Use the Pavement Design Report Template in [Attachment 25.1](#) for a full report or [Attachment 25.2](#) for an abbreviated report. An Abbreviated report can be completed in two formats either a word or an excel document. If using the excel document regional traffic information must be imported into the document. Contact the regional planning or traffic sections for the required information. Provide all information in the templates that pertain to the project, all reports should be submitted in pdf format. [Table 25.1](#) provides information regarding the report contents.

The executive summary should be brief and concise; detailed information must be included in the main body of the report. Identify the project improvement type in the executive summary of the report, which should be consistent with one of the improvement types in [FDM 3-5-1](#) and [FDM 3-5-5](#).

If a project is exempt from a structural design or LCCA, according to [FDM 14-15-5.2](#) or [FDM 14-15-10.2](#), respectively, then include justification after the improvement type (e.g. Resurfacing – RSRF20, or Reconstruction - HSIP). If none of the improvement types apply, then *Miscellaneous* can be used followed by a brief description.

If WisPave is used for the pavement design and/or the LCCA, then include the WisPave report in the Pavement Design Report.

**Table 25.1 Pavement Design Report Guidance**

Subject	Description
Correspondence/Memorandum	If different signatures are needed the pavement engineer may change the signature blocks. Additionally, if more signatures are required the pavement engineer can copy and paste the blocks
Subject	Provide all information.
Executive Summary	<p>The recommend pavement structure items shall be modified as necessary depending on the type of pavement proposed. For projects with multiple pavement types, shoulders which differ from the main pavement type, ramps, side roads, etc. the pavement engineer can copy and paste the information and note which area the information pertains to.</p> <p>Clearly identify the proposed structural design and the basis for its selection.</p>
Project Description	<p>Where the template asks for a year, the calendar that opens up gives the date, month, year, etc. if the actual date is known it can be selected, otherwise choosing any date in the year will place the year only in the document.</p> <p>Where the template references an Exhibit, choose the Exhibit letter corresponding to the Exhibit at the end of the report.</p>
Soil Parameters	Identify the source or author of the Soils Report if different from the person preparing the Pavement Design Report. Reference the WisPave Exhibits.
Traffic Data	<p>This is the data used to calculate the ESALs for the concrete and HMA pavement designs. If traffic data other than traffic projections are used, explain their use here. Reference the WisPave Exhibits.</p> <p>ESALs should be rounded to the nearest 10,000.</p> <p>Note: provide Directional Factor, not Directional Distribution. See <a href="#">FDM 14-7</a>.</p>
Alternatives	<p>State all the alternatives evaluated including pavement type/thickness and base type/thickness, etc. Clearly state why/why not specific layers of the existing pavement structure were utilized and whether the thickness of the existing pavement structure used in the design is average, minimum or other.</p> <p>Provide reference Exhibits for each alternative.</p>
Life-Cycle Cost Analysis	Reference the WisPave exhibits in this section.
Recommendations & Considerations	<p>The pavement type selection process and the exception process are defined in <a href="#">FDM 14-15</a>.</p> <p>If something other than the lowest cost alternative is recommended, provide the reason for this recommendation here.</p> <p>Note also if the design was presented to the pavement review committee.</p>
Other Discussion	Include any other important information or unique circumstances not already discussed.
Exhibits	Provide Exhibits for each alternative presented.

**LIST OF ATTACHMENTS**

- [Attachment 25.1](#) Pavement Design Report Template
- [Attachment 25.2](#) Abbreviated Pavement Design Report Template