

SECTION 520 – LAYERED ANALYSIS THICKNESS DESIGN USING AASHTOWARE PAVEMENT ME VERSION 3.16.0.0

520.01 Introduction.

520.02 Summary of Design Factors.

520.03 General Information.

520.03.01 Design Type

520.03.02 Pavement Type

520.03.03 Design Life.

520.03.04 Base Construction Date or Existing Construction

520.03.05 Pavement Construction Date

520.03.06 Traffic Opening Date

520.04 PERFORMANCE CRITERIA.

520.04.01 Initial IRI (in./mile).

520.04.02 Terminal IRI (in./mile).

520.04.03 AC top-down fatigue cracking (percent of total lane area).

520.04.04 AC bottom-up fatigue cracking (% total lane area).

520.04.05 AC thermal cracking (ft./mile).

520.04.06 Chemically stabilized layer - fatigue fracture (% lane area).

520.04.07 Permanent deformation - total pavement (in.).

520.04.08 Permanent deformation - AC only (in.).

520.04.09 AC Total fatigue cracking

520.04.10 AC Total transverse cracking.

520.04.11 Mean joint faulting (in.).

520.04.12 JPCP transverse cracking (percent cracked slabs).

520.04.12.01 Bottom-up transverse cracking.

520.04.12.02 Top-down transverse cracking.

520.04.13 CRCP punchouts (number per mile).

520.04.15 Performance Criteria Limits

520.04.16 Design Reliability Input

520.05 Traffic Input.

520.05.01 Initial Two-Way Annual Average Daily Truck Traffic (AADTT or Commercial AADT).

520.05.01.01 Number of Lanes

520.05.01.02 Percent Trucks in Design Direction

520.05.01.03 Percent Trucks in Design Lane

520.05.01.04 Operational Speed (mph)

520.05.02 Traffic Capacity

520.05.03 Axle Configuration

520.05.04 Lateral Wander

520.05.05 Wheelbase

520.05.06 Vehicle Class Distribution (%).

520.05.06.01 Growth rate.

520.05.06.02 Growth function.

520.05.07 Traffic Volume Monthly Adjustment Factors

520.05.08 Axles Per Truck

520.05.09 Axles Load Distribution

520.06 CLIMATE

520.06.01 Climate Station(s), Elevation, Latitude, and Longitude Input

520.06.02 Depth to Water Table (ft)

520.06.03 Determining Depth to Water Table.

520.06.03.01 PMED Spreadsheet.

520.07 AC/JPCP/SEMI-RIGID PAVEMENT SURFACE MATERIAL PROPERTIES

520.07.01 Asphalt Concrete Layer Properties (new pavement & Overlay)

520.07.01.01 AC Surface Shortwave Absorptivity.

520.07.01.02 Layer Interface.

520.07.01.03 Endurance Limit (Microstrain).

520.07.01.04 Uses Multi-Layer Rutting Calibration.

520.07.02 Asphalt Concrete Overlay Layer Properties

520.07.02.01 Rehabilitation Input Level 1

520.07.02.02 Rehabilitation Input Level 2.

520.07.02.03 Rehabilitation Input Level 3.

520.07.03 Milled Thickness (in.).

520.07.04 Rut Depth (in.).

520.07.05 Fatigue Cracking (% total lane area).

520.07.06 Transverse Cracking (ft./mile).

520.07.07 Pavement Rating (Structural/Environmental).

520.07.08 Asphalt Pavement Structure Properties

520.07.08.01 Asphalt Layer.

520.07.08.01.01 Thickness.

520.07.08.02 Mixture Volumetrics

520.07.08.02.01 Air Voids (%).

520.07.08.02.02 Effective Binder Content (%).

520.07.08.02.03 Total Asphalt Content by Weight.

520.07.08.02.04 Poisson's Ratio.

520.07.08.02.05 Unit Weight (pcf).

520.07.08.03 Mechanical Properties.

520.07.08.03.01 HMA Mixture Type.

520.07.08.03.02 Asphalt Binder.

520.07.09 PMED Spreadsheet.

520.07.10 Dynamic Modulus.

520.07.10.01 Asphalt Binder.

520.07.10.02 Air Voids, Effective Binder Content, Unit Weight.

520.07.10.03 Creep Compliance.

520.07.10.04 Indirect Tensile Strength at 14 Degrees Fahrenheit.

520.07.10.05 Thermal Input Properties.

520.07.11 Jointed Plain Concrete Pavement (JPCP) Design Properties (New Pavement).

520.07.11.01 PCC surface shortwave absorptivity.

520.07.11.02 Doweled Joints.

520.07.11.03 Erodibility Index.

520.07.11.04 PCC base contact friction.

520.07.11.05 PCC Joint Spacing (ft.)

520.07.11.06 Permanent Curl/Warp Effective Temperature Difference (° F).

520.07.11.07 Sealant Type.

520.07.11.08 Tied Shoulders.

520.07.11.09 Widened Slab.

520.07.12 JPCP Structure Properties.

520.07.13 PMED Spreadsheet.

520.07.13.01 PCC General.

520.07.13.02 PCC Thermal.

520.07.13.03 PCC Mixture Properties.

520.07.13.04 PCC Strength and Modulus.

520.07.14 Semi-Rigid Pavement Design Properties (New Pavement).

520.07.15 Pavement Reclamation.

520.08 Pavement Structure Below Wear Surface

520.08.01 Base/Subbase Recommended Input

520.08.01.01 Unbound Properties.

520.08.01.02 Modulus Properties.

520.08.01.02.01 Resilient Modulus (psi):

520.08.01.03 Analysis Type.

520.08.01.03.01 Input Level 2 Method.

520.08.01.03.02 Input Level 3 Method.

520.08.01.04 Gradation & Other Engineering Properties:

520.08.02 Chemically Stabilized Soil (CRABS) Base Recommended Input

520.08.02.01 Unbound Properties.

520.08.02.02 Modulus Properties.

520.08.02.03 Sieve.

520.08.02.03.01 Gradation & Other Engineering Properties

520.08.03 Subgrade and Embankment Recommended Input.

520.08.03.01 Unbound Properties.

520.08.03.02 Modulus Properties.

520.08.03.03 Analysis Type.

520.08.03.03.01 Input Level 2 Method.

520.08.03.03.02 Input Level 3 Method.

520.08.03.03.03 Gradation & Other Engineering Properties.

520.08.04 Bedrock Recommended Input.

520.08.05 Ratio of Unbound Material Layer Moduli

520.09 Maintenance Strategy.

520.10 Project Specific Calibration Factors.

520.11 Run Analysis

520.12 Optimization

520.13 References.

SECTION 520 – LAYERED ANALYSIS THICKNESS DESIGN USING AASHTOWARE PAVEMENT ME VERSION 3.16.0.0

520.01 Introduction. The design procedures described herein are based on the AASHTOWare Pavement ME Design (Pavement ME) software following methods developed by the American Association of State Highway and Transportation Officials (AASHTO) and in accordance with the mechanistic-empirical (ME) design concepts. This software calculates the stress, strain, and deflection of the pavement and based on this response calculates incremental damage over time and empirically relates it to pavement distresses. Pavement ME is ITD's official pavement design and analysis method for flexible and rigid pavements and should be used on all pavement designs, whether new construction, overlay, or restoration. The Idaho R-Value or AASHTO '93 design procedures can be used initially to develop a layer thickness to be used in the Pavement ME analysis or the pavement section can be selected directly based on typical sections and then analyzed and optimized using Pavement ME. See Section 510 and Section 515 for further details.

ITD, through a series of research projects with the University of Idaho, Boise State University, and Washington State University has established Pavement ME local calibration factors specific to Idaho conditions using version 2.5.3 for new flexible and rigid pavements as well as for rehabilitation flexible and unbonded rigid pavements. This research also characterized the materials used in Idaho and established property values for Pavement ME inputs. The database, updated in January of 2020 by the University of Idaho, is available at https://www.webpages.uidaho.edu/bayomy/ITD_ME-Database.htm.

The following design input and steps to using the Pavement ME software are provided to aid the designer, with additional detail and information provided in RP211B Idaho AASHTOWare Pavement ME Design User's Guide Version 1.1 dated March 2014 (DUG). However, this document does not replace the need for in-depth understanding and training on the mechanistic empirical pavement design process and Pavement ME software.

Note 1: The AASHTOWare PMED software was calibrated using version 2.5.5 in 2019. Since that time, various enhancements have been made to the software for both flexible and rigid pavement design. Notes are included in section 520 that identify changes and/or enhancements made to the software since it was calibrated to Idaho conditions and materials. These notes are included in section 520 to identify future updates that will be made for using version 3.0.

Note 2: The screen shots included as figures in section 520 was replaced using Version 3.16.0.0 of the AASHTOWare PMED software which is a web-based application. Although most of the inputs are the same, the screens or user interface have changed.

Note 3: Applied Research Associates Inc. (ARA) has tested the local calibration factors specific to Idaho conditions using the Calibration Assistance Tool (CAT) and recommended whether they are still applicable for the version 3.16.0.0 or not.

520.02 Summary of Design Factors. The AASHTOWare Pavement ME Design software for flexible and rigid pavement requires several inputs that the designer must select before using. Some of the inputs values must be measured, such as the traffic evaluation to calculate annual average daily truck traffic (AADTT), percent of trucks in design direction, percent trucks in design lane, and vehicle class distribution where applicable. Others must be established by laboratory testing or in-place testing for properties such as soil resilient modulus. The remaining inputs are assigned by selecting values as outlined below. The following is a summary of the Pavement ME user input categories:

- General Information
- Performance Criteria
- Design Reliability
- Traffic Inputs
- Climate Inputs
- HMA or PCC Layer Properties and Design Data
- Local Calibration Factors for Idaho

A summary of each of the input categories with the input variables is provided in Table 520.02.1 below. Each one of these input categories and input variables are discussed in detail later in the section.

Table 520.02.1: Recommended Pavement Inputs

Input Category	Input Variables
General Information	Design Type (New Pavement/Overlay/Restoration)
	Pavement Type
	Design Life (years)
	Base Construction or Existing Construction (month/year)
	Pavement Construction (month/year)
	Traffic Opening (month/year)
Performance Criteria*	Initial IRI (in./mile)
	Terminal IRI (in./mile)
	AC Top-Down Fatigue Cracking ((% Lane Area)
	AC Bottom-Up Fatigue Cracking (% Lane Area)
	AC Thermal Cracking (ft/mile)
	Chemically stabilized layer - fatigue fracture (% Lane Area)
	Permanent Deformation – Total Pavement (in)
	Permanent Deformation – AC Only (in)

		AC Total Fatigue Cracking: Bottom Up + Reflective (% Lane Area)
		AC Total Trans. Cracking: Thermal + Reflective (ft/mile)
		JPCP Transverse Cracking (% Slabs)
		Mean Joint Faulting (in)
		CRCP Punchouts (1/mile)
		Design Reliability (%)
Traffic		Initial Two-Way Annual Average Daily Truck Traffic (AADTT or Commercial AADT)
		Number of Lanes
		Percent Trucks in Design Direction
		Percent Trucks in Design Lane
		Operational Speed (mph)
		Traffic Capacity, Axle Configuration, Lateral Wander, & Wheelbase
		Vehicle Class Distribution & Growth
		Traffic Volume Monthly Adjustment Factors
		Axles Per Truck Class
Climate		Axles Load Distribution
		Climate Station(s), Elevation, Latitude, and Longitude Input
		Depth to Water Table (ft)
AC/JPCP/CRCP/Semi-Rigid LAYER PROPERTIES	HMA Course	General Design Properties, Binder Grade, Binder Content, In-Place Air Voids, Aggregate Gradation, Poisson's Ratio, Unit Weight, & Thickness
	JPCP/CRCP Course	General Design Properties, PCC Strength & Modulus, Mix and Thermal Inputs, Poisson's Ratio, Unit Weight, & Thickness
	Crushed Base	Engineering Properties & Atterberg Limits, M_r at Optimum Moisture Content, & Thickness
	Semi-Rigid or Cement Recycled Asphalt Base Stabilization (CRABS)	Percent Cracking (Fatigue, Transverse), Crack Spacing, Modulus of Rupture, Min. Elastic/Resilient Modulus, Elastic/Resilient Modulus, Thermal, Poisson's Ratio, Unit Weight, & Layer Thickness
	Subgrade	Engineering Properties & Atterberg Limits, M_r at Optimum Moisture Content, & Thickness
	Bedrock	Elastic/ M_r , Unit Weight, & Poisson's Ratio
Project-Specific Calibration Factors		ITD Local Calibration Coefficients for HMA or JPCP Pavements

*Exact input variables may change based on selected pavement type.

Version 3.16.0.0 is a totally web-based version. First, open the Pavement ME webapp by going to the URL <https://pavementdesign.com/MEDesign>. The login screen in Figure 520.02.1 should appear.

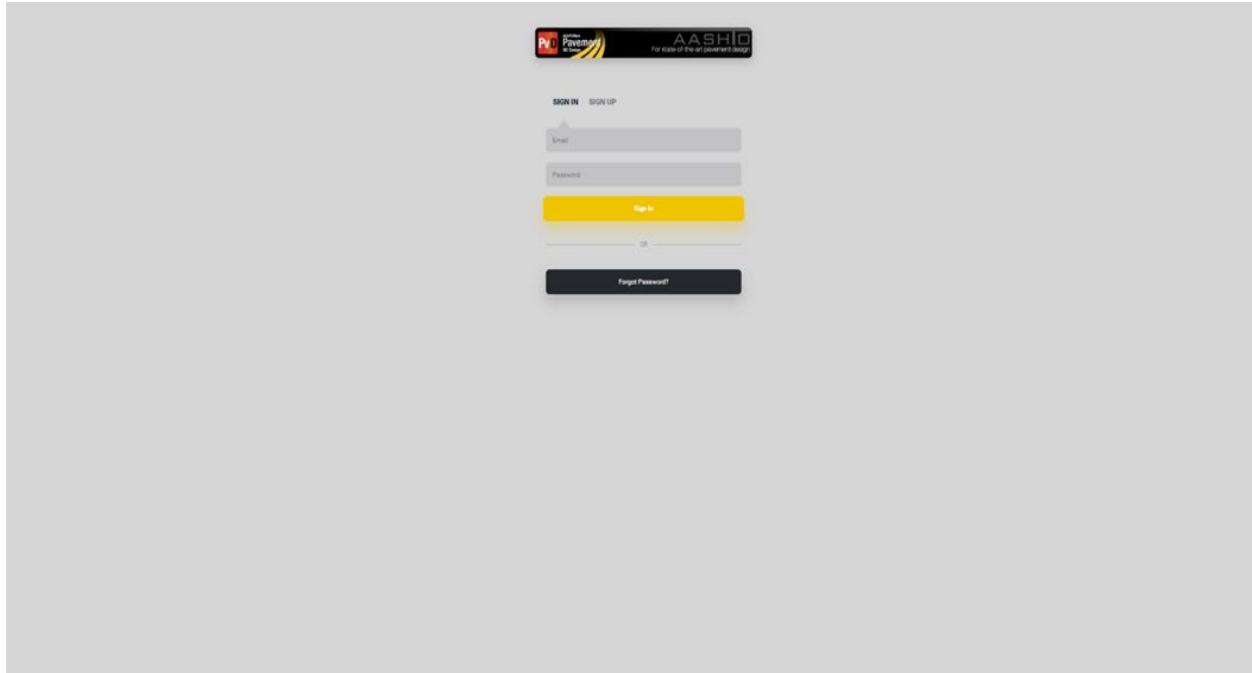


Figure 520.02.1 Pavement ME Design Login Screen

Enter Email and Password and press sign in and the screen in Figure 520.02.2 should appear.

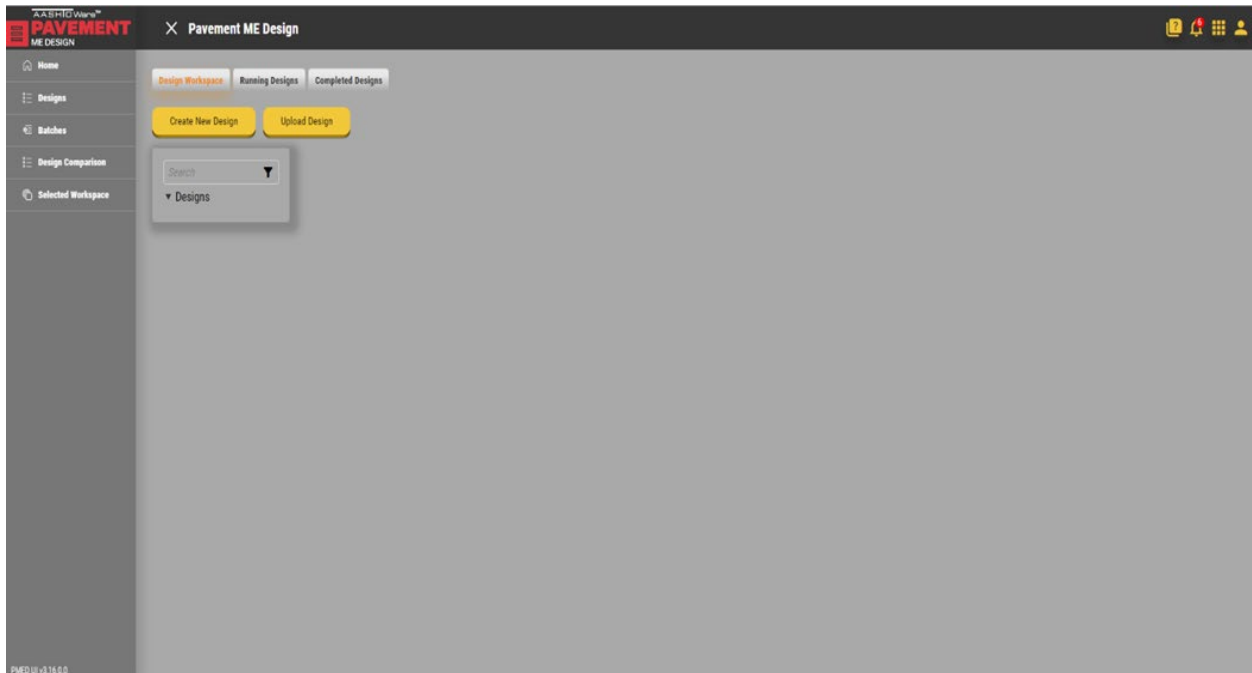


Figure 520.02.2: AASHTOWare Pavement ME Ver. 3.16.0.0 Opening Screen

To start a new project , click on the “Create New Design Project ” icon to open the screen in Figure 520.02.3.

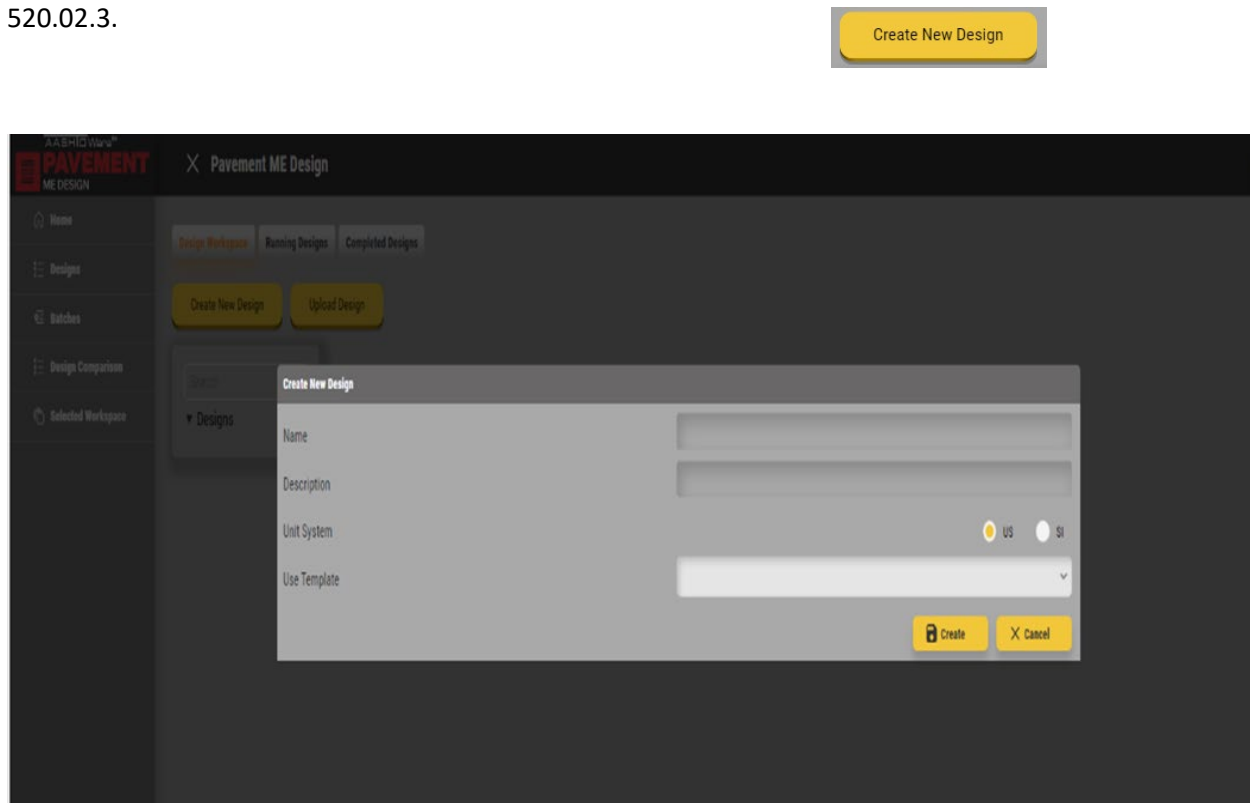
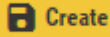


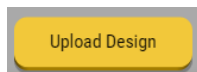
Figure 520.02.3: AASHTOWare Pavement ME Ver. 3.16.0.0 Creating a New Design Screen

Create the project by clicking on the “Create” icon  after naming the file following a given nomenclature:

Key Number→Project Name→Analysis Type/Info.

An example of this nomenclature is as follows: 20367_US-20, Star to SH-16_Flexible New. The DesignPane will reflect the new Pavement ME project title.

The Design Pane displays title of the project and some action buttons as shown in Figure 520.02.4 Previously created ME Design project can also be uploaded by clicking on the “Upload Design”



icon. All the design created or uploaded by the user will be displayed in the design pane.

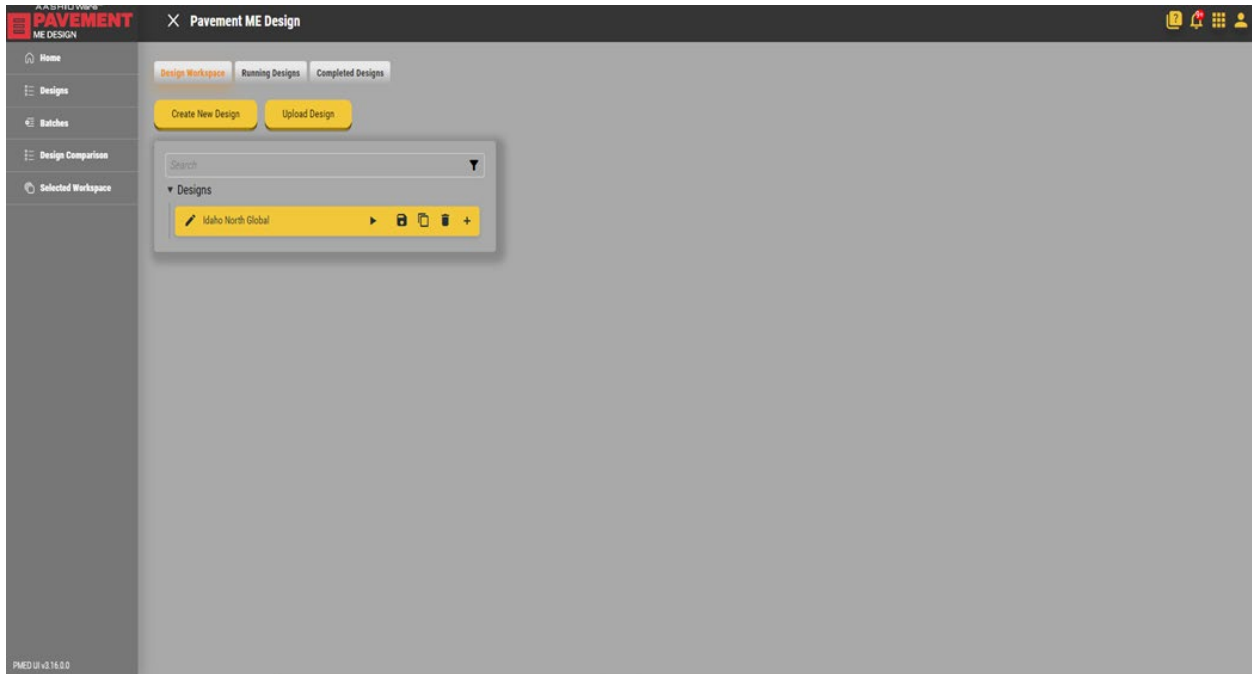


Figure 520.02.4: AASHTOWare Pavement ME Ver. 3.16.0.0 Creating a New Design or Uploading a Design Screen

The action buttons associated with a design are “Edit Design”, “Run Design”, “Save Design”, “Copy

Design”, and “Delete Design”. Clicking the “Edit Design”  icon will open the design interface of the project. The design interface displays information about the project and the Pavement ME application as a whole and lists all the categories that require specific input for the given project.

The design interface is shown in Figure 520.02.5. All the inputs required for the ME Design are listed on the left side of the screed. Start by filling in the “General Information” input shown on the upper left portion of the design interface.

The screenshot displays the 'Pavement ME Design' software interface. The top navigation bar includes 'Home', 'Designs', 'Batches', 'Design Comparisons', and 'Selected Workspace'. The left sidebar lists various design steps: General Information, Performance Criteria, Traffic, Climate, Structure, Maintenance Strategy, Calibration, Design Properties, Sensitivity Combination, Thickness Optimization, and Run analysis. The main panel shows the 'General Information' tab for a design named 'Idaho North Global'. Key inputs include: Design Type (New Pavement), Pavement Type (Flexible Pavement), Design life (years) (20), Base construction date (May 2008), Pavement construction date (June 2008), Traffic opening date (July 2008), Use special traffic (unchecked), and Unit system (US selected). A 'SAVE' button is located in the bottom right corner.

Figure 520.02.5: Pavement ME General Design Interface

Note 4: The top-down fatigue cracking transfer function and model was updated in version 2.6. The ITD calibration coefficients derived using version 2.5.3 are not applicable to the top-down cracking model in version 3.0. In addition, the top-down fatigue cracks are measured and reported in total percent lane area. They include longitudinal and area alligator cracks.

520.03 General Information. The general information inputs are described in greater detail in DUG Chapter 2. The inputs contain dropdown options which include the following:

520.03.01 Design Type

- New Pavement
- First Overlay/Rehabilitation
- Multiple Overlays/Rehabilitations
- Restoration

Note 5: The multiple asphalt overlays rehabilitation design strategy was added to the software for version 3.0, so it was unavailable during the 2019 calibration study. A webinar, delivered on August 22, 2023, is available for review on the AASHTOWare Pavement ME software website.

520.03.02 Pavement Type

- New Pavement
 - Flexible Pavement
 - Jointed Plan Concrete Pavement (JPCP)
 - Continuously Reinforced Concrete Pavement (CRCP)

- The Department does not use CRCP as a concrete pavement type, therefore no CRCP design input will be included. (See Section 515.10.02)
- Semi-Rigid Pavement
 - This option is a HMA over chemically (cement) treated base. To run the Semi-Rigid option the chemically stabilized base needs to meet the minimum resilient modulus value of 150,000 psi, which ITD's Cement Recycled Asphalt Base Stabilization (CRABS) with 2% cement does not meet. It is recommended that CRABS be modeled as a non-stabilized base with a high modulus. The CRABS should be defined as a high resilient modulus that remains constant throughout the design life. (See section 520.08.02 for additional details.)
- Overlay
 - AC over AC
 - AC over AC with Seal Coat
 - AC over AC with Interlayer
 - AC over Semi-Rigid
 - AC over JPCP
 - AC over CRCP
 - AC over JPCP (fractured)
 - Bonded PCC/JPCP
 - Bonded PCC/CRCP
 - JPCP over CRCP (unbonded)
 - JPCP over JPCP (unbonded)
 - CRCP over CRCP (unbonded)
 - CRCP over JPCP (unbonded)
 - JPCP over AC
 - CRCP over AC
 - SJPCP over AC
- Multiple Overlays
 - AC over (AC over AC)
 - AC over (AC over JPCP)
 - AC over (AC over CRCP)
 - AC over (AC over Semi-Rigid)
 - AC over (AC over JPCP (fractured))
- Restoration
 - JPCP Restoration

520.03.03 Design Life. Table 520.03.03.1 lists the design life as established by department policy.

Table 520.03.03.1 Design Life

Pavement Type	Functional Class	"Design Life" New Pavement or Reconstruction (years)
New or Reconstructed HMA	Any Functional Class	20
	Reduced "Design Life" for Special Projects	<20
New or Reconstructed JPCP	Any Functional Class	40

Flexible Pavement Rehabilitation	Any Functional Class	8 - 20
Rigid Pavement Rehabilitation	Any Functional Class	10 - 36

520.03.04 Base Construction Date or Existing Construction (month and year): Only for new flexible pavement design. The inputs are the base construction month and year. For new rigid pavement design, base construction month completion is not needed.

520.03.05 Pavement Construction Date (month and year): Month and year the base or underlying layer is covered. The pavement construction date should be at least 1 month after the base construction month for flexible pavements.

520.03.06 Traffic Opening Date (month and year): The month and year the roadway is opened to traffic. The traffic opening date should be at least 1 month after the pavement construction date for flexible and rigid pavements.

Important Note: Any adjustments to the Design or Pavement Type will likely result in permanent loss of information entered for some or all material layers. If different design types are to be analyzed, it is necessary to save multiple projects and run separately.

520.04 PERFORMANCE CRITERIA. After “General Information” input is filled in, complete the Performance Criteria input field shown in Figure 520.02.5. Performance criteria input is used to ensure that a pavement design will perform satisfactorily over the design life. The designer will select performance distress limits based on a particular reliability to analyze the adequacy of a trial design. See DUG Chapter 3 for additional details. Recommended performance criteria and reliability for Flexible Pavements and JPCP design are provided in Tables 520.04.14.1, 520.04.15.1, 520.04.15.2, and 520.04.16.1. The performance criteria represent the threshold values at which a major rehabilitation activity is required based on ITD’s operational and maintenance policy. Below is a list of performance indicators and their definitions according to Pavement ME software.

520.04.01 Initial IRI (in./mile). The limit control allows the designer to define the expected smoothness immediately after new pavement construction (expressed in terms of IRI). Initial IRI is a very important input as the time from initial construction to attaining threshold IRI value is very much dependent on the initial IRI obtained at the time of construction. Thus, the initial IRI value provided must be what is typically attained in the field. The designer can override the Pavement ME default value of 63 in./mi to reflect agency policy and guidelines. The initial IRI values for flexible and rigid pavements are listed in Table 520.04.14.1. These IRI values represent the overall average values after construction. The initial IRI values will be periodically updated for use in design.

520.04.02 Terminal IRI (in./mile). The terminal IRI value defines the not-to-exceed limit for IRI at the end of the design life at a specified reliability level. This terminal IRI value relates to the roughness of the surface for which rehabilitation is required.

520.04.03 AC top-down fatigue cracking (percent of total lane area). The top-down fatigue cracking value allow the designer to define the not-to-exceed limit for surface-initiated fatigue cracking at the end of the design life at a specified reliability level.

Top-down fatigue or longitudinal cracks was not considered in asphalt pavement design in Idaho. The report visibility under the Performance Criteria should not be checked, if it is not considered in design to determine if the design strategy is acceptable.

Note 6: The top-down fatigue cracks in version 2.5.5 and earlier version were assumed to represent longitudinal cracks in the wheel path and defined as ft./mi. The top-down fatigue cracking model and transfer function was replaced in version 2.6 based on the results of an NCHRP project. The top-down fatigue cracks are defined as percent total per lane area and include both longitudinal cracks and alligator cracks in the wheel path that initiate at the surface. The ITD calibration coefficients derived using version 2.5.5 do not apply to version 2.6 and later versions of the software.

520.04.04 AC bottom-up fatigue cracking (% total lane area). The bottom-up fatigue cracking value allow the designer to define the not-to-exceed limit for bottom-initiated fatigue cracking at the end of the design life at a specified reliability level.

520.04.05 AC thermal cracking (ft./mile). The length of thermal or transverse cracking value allow the designer to define the not-to-exceed limit for non-load related transverse cracking at the end of the design life at a specified reliability level.

Note: The length of transverse cracks predicted by the AASHTOWare PMED software predicts the transverse cracks caused by low temperature events. However, the measured length of transverse cracks includes those caused by low temperature events and shrinkage of the asphalt mixture. Shrinkage of the asphalt layer is only considered by the PMED software through calibration. The software does not include a ME based method for predicting shrinkage transverse cracks.

520.04.06 Chemically stabilized layer - fatigue fracture (% lane area). : Only applicable to semi-rigid pavement design strategy. Semi-rigid pavements include those with an asphalt surface and a cement stabilized or pozzolanic stabilized material with sufficient amount of stabilizer to response as a bound layer. The percent total lane area of fatigue cracks value allow the designer to define the not-to-exceed limit for fatigue fracture in the underlying chemically stabilized base layers at the end of the design life at a specified reliability level.

520.04.07 Permanent deformation - total pavement (in.). The total permanent deformation or rut depth value allow the designer to define the not-to-exceed limit for total rutting at the end of the design life at a specified reliability level. Total permanent deformation at the surface is the accumulation of the permanent deformation in all of the asphalt and unbound layers in the pavement system. Permanent deformation is not calculated in the unbound layers beneath a PCC layer (rigid pavements) or below a chemically stabilized layer.

520.04.08 Permanent deformation - AC only (in.). The permanent deformation or rut depth value confined to the asphalt layers allow the designer to define the not-to-exceed limit for rutting contributed by the AC layers at the end of the design life at a specified reliability level. As listed in Table 520.04.15.1, the total permanent deformation and AC only permanent deformation as equal.

520.04.09 AC Total fatigue cracking Bottom up + reflection (% lane area) The total bottom-up fatigue cracking value in percent total lane area defines the not-to-exceed limit for new bottom-up fatigue cracking and reflection bottom-up fatigue cracks from the existing flexible or semi-rigid pavements.

Note: Top-down fatigue cracking in flexible and semi-rigid pavements are typically confined to the asphalt wearing surface and are not included in the reflection cracking analysis for asphalt overlays.

520.04.10 AC Total transverse cracking. Thermal + reflective (ft./mile) The total length of transverse cracking value in ft./mi. defines the not-to-exceed limit for new transverse cracks and reflection of transverse cracks from the existing flexible or semi-rigid pavements.

520.04.11 Mean joint faulting (in.). The mean joint faulting value allow the designer to define the threshold value for transverse joint faulting at the end of the design life at a user or agency specified reliability level. Transverse joint faulting is the differential elevation across the transverse joint measured approximately 1 ft from the slab edge (longitudinal joint for a conventional lane width), or from the rightmost lane paint stripe for a widened slab. Since joint faulting varies significantly from joint to joint, the mean faulting of all transverse joints in a pavement section is the parameter predicted by the Pavement ME.

520.04.12 JPCP transverse cracking (percent cracked slabs). The JPCP transverse cracking or percent cracked slabs defines the not-to-exceed value at the end of the design life at a specified reliability value. Pavement ME predicts the combined percentage of PCC slabs with bottom-up and top-down transverse cracks that occurs mostly in the middle third of the slab. It is reported as percent slabs cracked. A description of the two main transverse cracking mechanisms are described below:

520.04.12.01 Bottom-up transverse cracking. When the truck axles are near the longitudinal edge of the slab, midway between the transverse joints, a critical tensile bending stress occurs at the bottom of the slab under the wheel load. This stress increases greatly when there is a high positive temperature gradient through the slab (the top of the slab is warmer than the bottom of the slab). Repeated loadings of heavy axles under those conditions result in fatigue damage along the bottom edge of the slab, which eventually result in a transverse crack that propagates to the surface of the pavement.

520.04.12.02 Top-down transverse cracking. Repeated loading by heavy truck tractors with certain axle spacing when the pavement is exposed to high negative temperature gradients (the top of the slab cooler than the bottom of the slab) result in fatigue damage at the top of the slab, which eventually results in a transverse or diagonal crack that is initiated on the surface of the pavement. The critical wheel loading condition for top-down cracking involves a combination of axles that loads the opposite ends of a slab simultaneously. In the presence of a high negative temperature gradient, such load combinations cause a high tensile stress at the top of the slab near the critical pavement edge. This type of loading is most often produced by the combination of steering and drive axles of truck tractors and other vehicles. Multiple trailers with relatively short trailer-to-trailer axle spacing are other common sources of critical loadings for top-down cracking.

520.04.13 CRCP punchouts (number per mile). The number of punchouts per mile defines the not-to-exceed value at the end of the design life at a specified reliability value. Punch-out is the major structural distress of CRCP and occurs when there is loss of load transfer across two closely spaced adjacent cracks making the concrete between then act as a cantilever beam. With continuous application of heavy truck load, a short, longitudinal crack forms between the two transverse cracks about 2- to 5-ft from the pavement edge leading to the development of punch outs.

Table 520.04.14.1: Initial IRI Values for New and Rehabilitated Pavement Design

Pavement Type	Initial IRI (in./mile)	
New/Reconstructed HMA & HMA Overlays	50	

New/Reconstructed JPCP, JPCP Overlays, & JPCP Restoration with Diamond Grinding	65	
---	----	--

520.04.15 Performance Criteria Limits Designer can access this one by clicking the “Performance Criteria” icon on the design pane as shown as Figure 520.04.1. Recommended performance criteria for design are presented in Tables 520.04.15.1 and 520.04.15.2. These values were presented in the DUG and represent a pavement condition that experienced engineers would generally agree requires rehabilitation or reconstruction. The acceptability of a trial design must also consider the design reliability to determine whether a pavement design meets minimum performance standards during its “Design Life” for a given level of reliability.

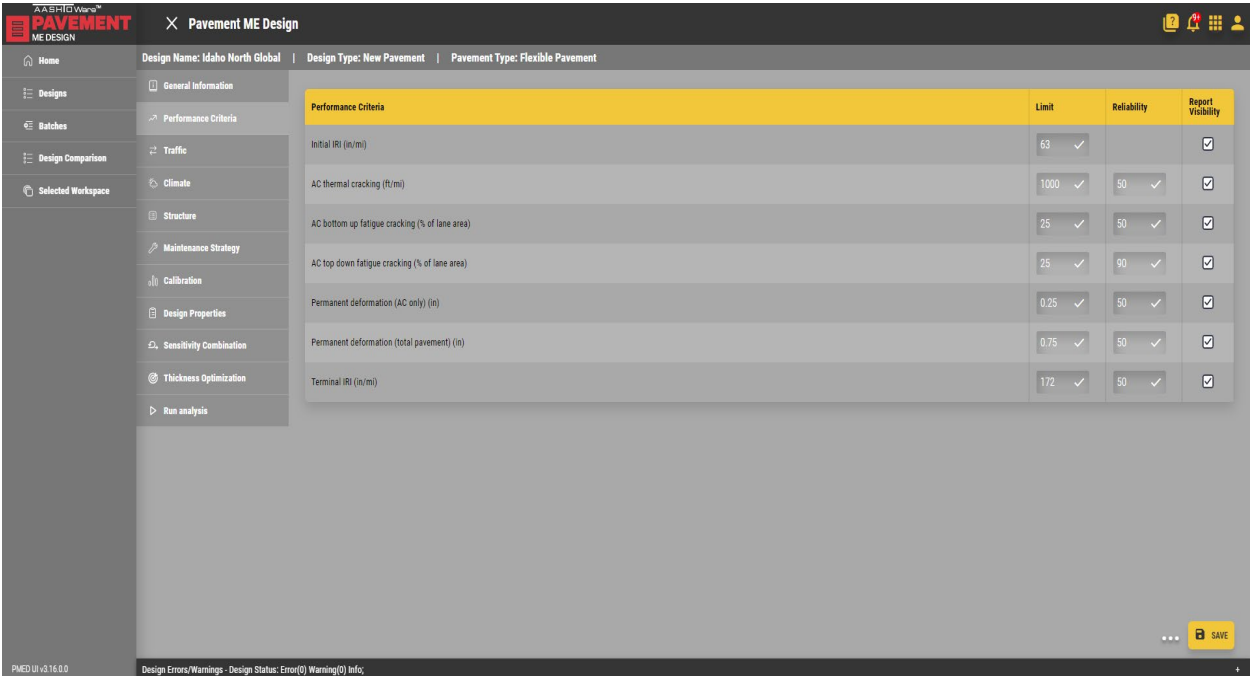


Figure 520.04.1: Pavement ME Performance Criteria Interface

Table 520.04.15.1: Performance Criteria for Use in New HMA Pavement, HMA Overlays, and Composite (HMA-Overlaid Jointed Plain Concrete) Pavement Design

Performance Indicators (Maximum Value at End of “Design Life” at Design Reliability)*	Functional Classification		
	Interstate/Freeways	Primary (Principal Arterials & Minor Arterials)	Secondary (Major Collectors)
Terminal IRI (in./mile)	160	175	200
AC Top-Down Fatigue Cracking ((% Lane Area)**	10	15	20
AC Bottom-Up Fatigue Cracking (% Lane Area)***	10	15	20

AC Thermal Cracking (ft./mile)****	1,000	1,500	1,500
Chemically Stabilized Layer – Fatigue Fracture (% Lane Area)	25	25	25
Permanent Deformation – Total Pavement (in.)	0.40	0.50	0.65
Permanent Deformation – AC Only (in.)	0.40	0.50	0.65
AC Total Fatigue Cracking: Bottom Up + Reflective (% Lane Area)	10	15	20
AC Total Trans. Cracking: Thermal + Reflective (ft./mile)	1,000	1,500	1,500

* HMA longitudinal fatigue cracking is not considered a separate criterion or threshold value in HMA pavement design in Idaho.

** Top-down longitudinal cracks is not considered in asphalt pavement design in Idaho. The report visibility under the Performance Criteria should not be checked, if it is not considered in design. The top-down fatigue cracking performance criteria was the length of longitudinal cracks as defined in version 2.5.5 and earlier versions of the software. For version 2.6 and later versions, top-down fatigue cracks are defined longitudinal and alligator cracks as percent total lane area. The criterion or threshold values should be the same as for bottom-up fatigue cracks and are suggested when top-down cracking is considered as a design or threshold value.

*** HMA alligator cracking: bottom-up alligator (fatigue) cracking in the new HMA layer as well as in the HMA overlay. Alligator fatigue cracking initiates at the bottom of the new HMA layer or new overlay layer in the wheel paths.

**** The limits presented do not apply to composite pavements as transverse cracking in composite pavements includes transverse joints and slab cracks reflected through the HMA overlay. A considerably higher limiting AC Thermal (Transverse) Cracking value must be assumed for composite pavements.

Table 520.04.15.2: Performance Criteria for Use in JPCP New, Concrete Pavement Restoration & JPCP Overlays Pavement Design

Performance Indicators (Maximum Value at End of “Design Life” at Design Reliability)	Functional Classification		
	Interstate/Freeways	Primary (Principal Arterials & Minor Arterials)	Secondary (Major Collectors)
Terminal IRI (in./mile)	160	175	200
JPCP Transverse Cracking (% Slabs)	10	15	20
Mean Joint Faulting (in.)*	0.12	0.15	0.25

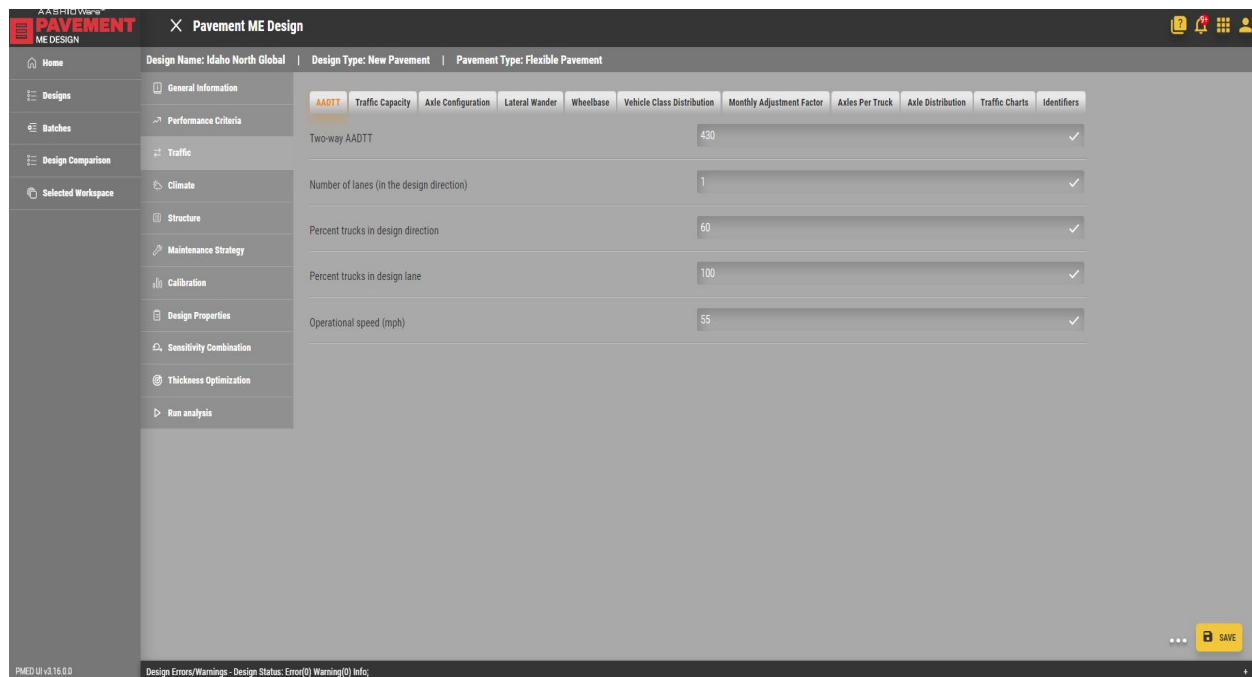
* A grinding opportunity is allowed approximately 20 - 25 years after initial construction.

520.04.16 Design Reliability Input Design reliability presented in Table 520.04.16.1 are compatible with the performance criteria discussed above and were presented in the DUG. The design reliability is input in the column to the right of each of the performance criteria limits included in the performance criteria pane as shown in Figure 520.04.1. See Chapter 4 of the DUG for additional discussion on design reliability.

Table 520.04.16.1: Recommended Level of Design Reliability

Functional Classification	Reliability (%)	
	Urban	Rural
Interstate/Freeways	95	95
Primary (Principal Arterials & Minor Arterials)	90	85
Secondary (Major Collectors)	80	75

520.05 Traffic Input. To input the traffic information first click on the traffic icon  found in the Design pane. This will open the Traffic Tab in the central field with AADTT as shown in Figure 520.05.1.



The screenshot displays the 'Pavement ME Design' software interface. The 'Traffic' tab is selected in the central field, showing the following inputs:

- Two-way AADTT: 430
- Number of lanes (in the design direction): 1
- Percent trucks in design direction: 60
- Percent trucks in design lane: 100
- Operational speed (mph): 55

Each input field has a checkmark indicating it is valid. The bottom status bar shows 'Design Errors/Warnings - Design Status: Error(0) Warning(0) Info(0)'.

Figure 520.05.1: Pavement ME Traffic Tab

520.05.01 Initial Two-Way Annual Average Daily Truck Traffic (AADTT or Commercial AADT). Expected over the base year in both directions of travel for the project. Trucks are defined as Federal Highway

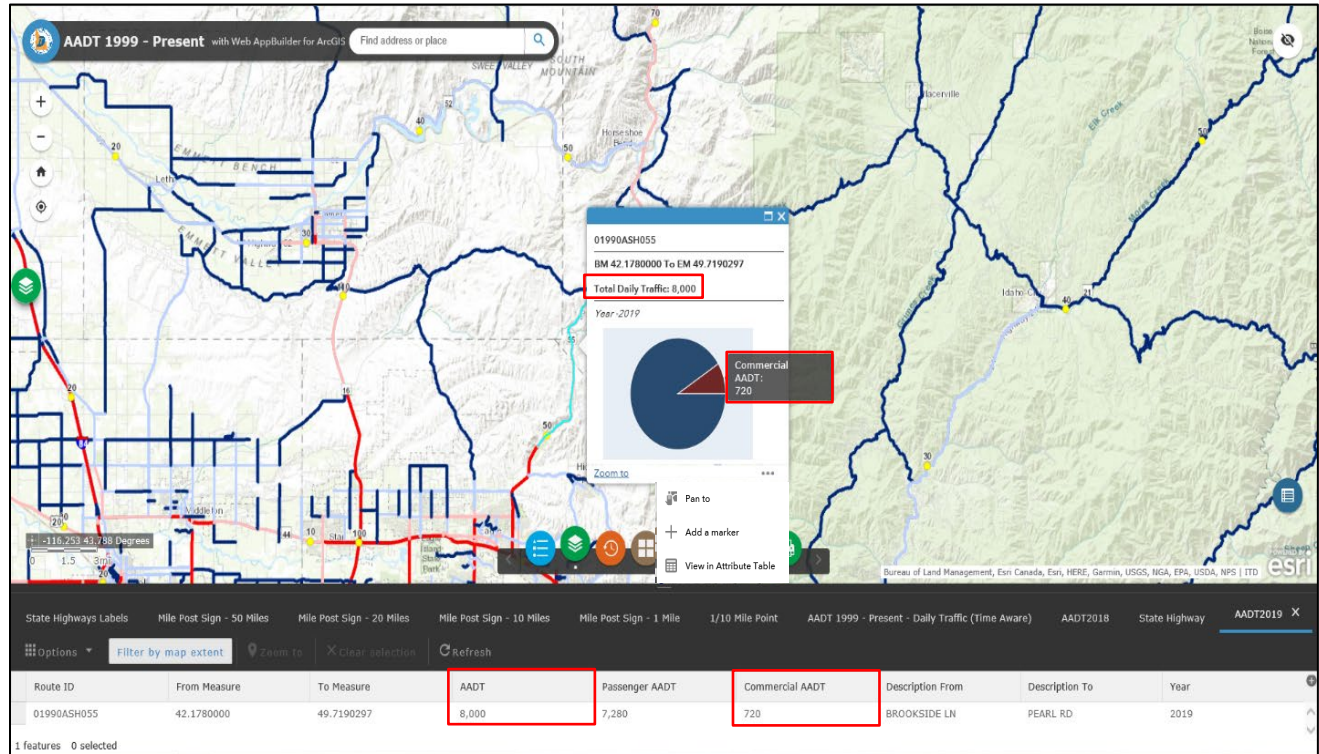


Figure 520.05.01.1: ARCGIS AADT IPlan Map View

Administration (FHWA) Classes 4 through 13. Enter the first five traffic input items into the AADTT Traffic Input section of the Traffic Tab shown in Figure 520.05.1. The next eight Traffic input items will be input into their respective tabs as shown in the same figure. Traffic charts tab will generate plots of cumulative trucks and ESALs if the designer wants. The last traffic input tab “Identifiers” allows designers to add metadata to the traffic component.

To obtain the most current AADTT value by year for the segment of interest, visit AADT IPlan Map:

<https://iplan.maps.arcgis.com/apps/webappviewer/index.html?id=e8b58a3466e74f249cca6aad30e83ba2>.

Important Note: When viewing the IPlan Map, on the top left hand side of the screen there is a search bar where the designer can drill down to the location of interest to view the AADT for that particular location. Click on the location of interest on the map. The AADT section will highlight aqua and a pop up will display the Route ID, AADT, Year, and BM (beginning measure) and EM (end measure) for that particular section. Hover the mouse over the maroon portion of the pie graph to view the Commercial AADT, or if the designer clicks on the ellipse (...) located on the bottom right of the pop up and select “View in Attribute Table”, a table will display additional information regarding that section including the Commercial AADT as shown in Figure 520.05.01.1.

520.05.01.01 Number of Lanes Actual, from design plans.

520.05.01.02 Percent Trucks in Design Direction This control allows the designer to define the percentage of trucks (from the entire two-way AADTT count) that is expected to travel in the design direction. Note that although this value is close to 50 percent, it is not necessarily so especially in cases where truck traffic does not use the same route for the onward and return trips.

Where ITD Automated Traffic Recorders (ATR's) or Weight-in-Motion (WIM) stations are available, calculate the Percent Trucks in Design Direction by obtaining the monthly length distribution data for 2-4 months (preferably the summer months of June, July, August, and September where higher levels of truck traffic are anticipated). Some ATR stations may not contain the required information to calculate this input or no stations may be present near the project location. If this is the case follow guidance provided in section [520.05.01.04](#) below.

The ATR information for the state can be found at the link below.

<https://iplan.maps.arcgis.com/apps/webappviewer/index.html?id=0a36396e6fa744ee937a5dc7afa0ebb7>

After opening the IPlan ATR/WIM Stations Map click on the ATR station of interest. A pop up will display various information regarding the ATR. Click on the URL Link “More info” as shown in Figure

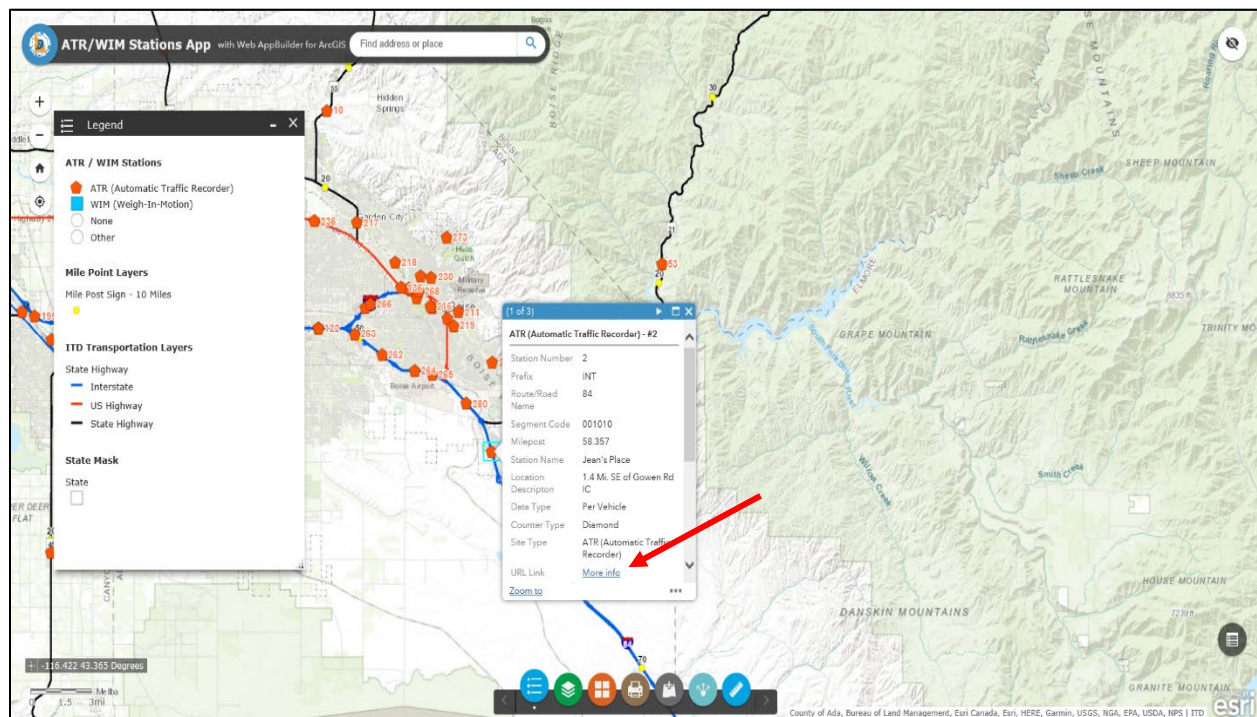


Figure 520.05.01.03.1: ARCGIS ATR/WIM Stations IPlan Map View 1

520.05.01.03.1.

This will open a new web page displaying the Automatic Counter Volumes for the selected ATR. Near the top of this page hover the mouse over the “Published Reports” tab and select the year of interest as shown in the left of Figure 520.05.01.03.2.

This will then display all the reports for that year by month. Go to the desired month and click on the “Monthly Vehicle Length Report.pdf” to get the direction and lane distribution data for that particular ATR as shown in the right page of Figure 520.05.01.03.2.

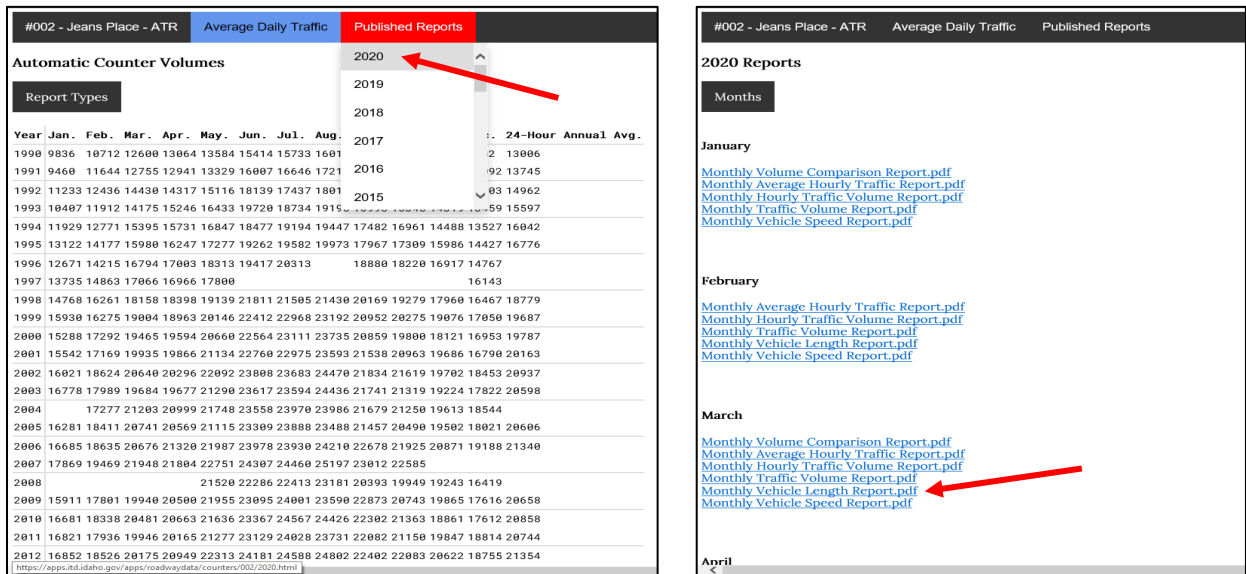


Figure 520.05.01.03.2: ATR Station Data Web Pages

An example of one month of this data is shown in Figure 520.05.01.03.3.

Idaho Transportation Department Monthly Length Distribution for June, 2020							
Site names:	00002			Seasonal Factor Grp: 3			
County:	Ada			Daily Factor Grp: 4			
Funct Class:	U Principal Arterial - Interstate			Axle Factor Grp: 1			
Location:	I-84 1.4 Mi. SE of Gowen Rd IC			Growth Factor Grp:			
	Road	SE	NW	SE Lane1	SE lane2	NW Lane2	NW Lane1
0-6	158 .55%	82 .57%	77 .53%	41 .49%	41 .67%	35 .61%	42 .48%
6-23	20,669 71.77%	10,330 71.76%	10,339 71.77%	4,716 57.28%	5,614 91.12%	5,267 90.74%	5,072 58.97%
23-40	1,480 5.14%	750 5.21%	730 5.06%	585 7.10%	166 2.69%	151 2.60%	579 6.73%
40-70	1,892 6.57%	914 6.35%	979 6.79%	757 9.19%	157 2.54%	157 2.70%	822 9.56%
70-121	4,601 15.97%	2,320 16.11%	2,281 15.84%	2,135 25.93%	184 2.99%	194 3.35%	2,087 24.26%
Total	28,801 100.00%	14,396 100.00%	14,405 100.00%	8,234 100.00%	6,162 100.00%	5,804 100.00%	8,601 100.00%

Figure 520.05.01.03.3: Monthly Length Distribution Report from ATR #2 for June, 2020

Use only the truck traffic which according to FHWA/AASHTO range from 23 to greater than 70 feet in length (Class 4 through 13 as shown on Figure 520.05.01.03.4).

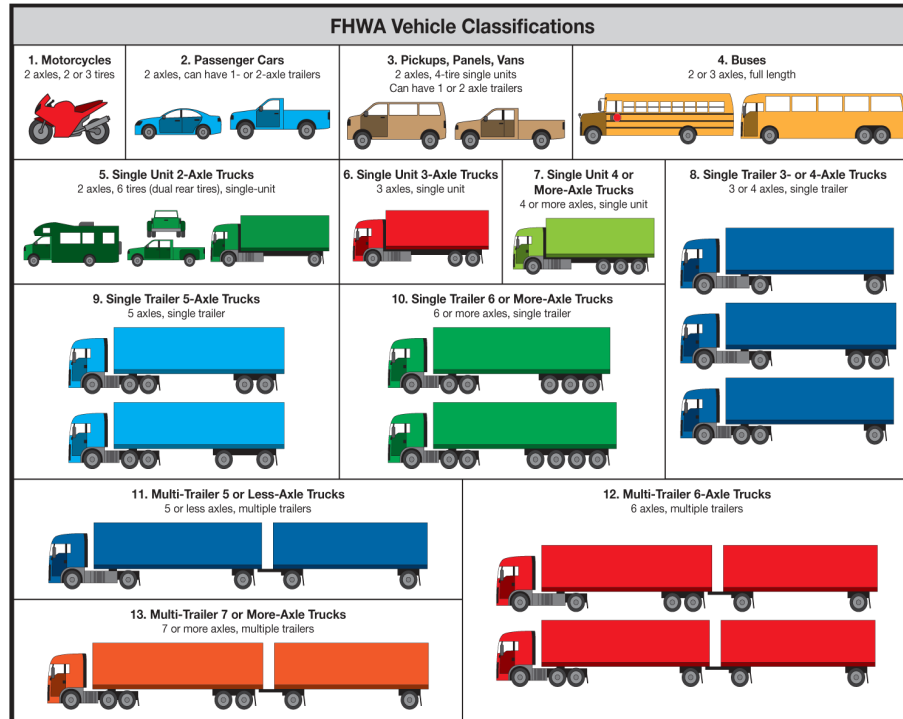


Figure 520.05.01.03.4: FHWA/AASHTO 13 VEHICLE CATEGORY CLASSIFICATION

Source: DUG

With this data shown in Figure 520.05.01.03.3, calculate the percent trucks in design direction and percent trucks in design lane as shown in Table 520.05.01.03.1 for ATR #2 data for June 2020 (Figure 520.05.01.03.3).

Table 520.05.01.03.1: Percent Trucks Design Lane & Design Direction Calculations

Length (ft.)	Traffic Counts Per Lane			
	SE		NW	
	Ln 1	Ln 2	Ln 2	Ln 1
23-40	585	166	151	579
40-70	757	157	157	822
70-121	2,135	184	194	2,087
Total	3,477	507	502	3,488
% Trucks in Design Lane	<u>87.3%</u>	<u>12.7%</u>	<u>12.6%</u>	<u>87.4%</u>
% Trucks in Design Direction	<u>50.0%</u>		<u>50.0%</u>	

In the example shown in Table 520.05.01.03.1, the percent trucks in design direction is 50 percent. Continue to do this calculation for additional summer months (June, July, August, and September) to get a more complete data set and recalculate the average for both percent trucks in design lane and design direction across all the months.

520.05.01.03 Percent Trucks in Design Lane This control allows the designer to define percentage of trucks in the design direction expected to use the design lane (typically the outer right lane).

The steps to obtaining this number are shown above in section [520.05.01.03](#) as part of the percent trucks in the design direction calculation so long as ATR data is available with the calculated results shown in Table 520.05.01.03.1. If no ATR data is available for the project the following percent trucks in design lane values based on Idaho measurements can be used:

- 100% for 1 lane in design direction
- 90% for 2 lanes in design direction
- 80% for 4 lanes in design direction
- 60% for more than 4 in design direction

For unusual truck traffic situations (mountainous terrain or urban usage complexity), conduct onsite truck lane usage counts over a 24-hour period. It is vital that the designer understands the projected percent truck traffic in the design lane.

520.05.01.04 Operational Speed (mph) This control allows the designer to select the expected speed of traffic traveling in the design lane. The expected speed is for the heavier or larger trucks using the facility. The operational speed in mountainous areas or in controlled facilities with lights at intersections can be lower than the posted speed limit for the heavier or larger trucks. This will likely be the current posted speed limit unless the design is expected to change the speed limit, then the new design speed will be used. Note that the inputs in this control impact the loading frequency of asphalt layers.

520.05.02 Traffic Capacity Can be accessed by clicking the “Traffic Capacity” tab in the Traffic Input Pane as shown in Figure 520.05.1. Typically, these inputs can be left at the default values unless special circumstances are identified and discussed with the project engineer.

520.05.03 Axle Configuration Can be accessed by clicking the “Axle Configuration” tab in the Traffic Input Pane as shown in Figure 520.05.1. Typically, these inputs can be left at the default values unless special circumstances are identified and discussed with the project engineer.

520.05.04 Lateral Wander Can be accessed by clicking the “Lateral Wander” tab in the Traffic Input Pane as shown in Figure 520.05.1. Typically, these inputs can be left at the default values unless special circumstances are identified and discussed with the project engineer.

520.05.05 Wheelbase Can be accessed by clicking the “Wheelbase” tab in the Traffic Input Pane as shown in Figure 520.05.1. Typically, these inputs can be left at the default values unless special circumstances are identified and discussed with the project engineer.

520.05.06 Vehicle Class Distribution (%). Can be accessed by clicking the “Vehicle Class Distribution” tab in the Traffic Input Pane as shown in Figure 520.05.1. This input allows the designer to define the percentage of each vehicle class designated for the selected Truck Traffic Classification (TTC) group. The column will run a total, which displays in the bottom row and should always equal 100.

According to the DUG, selection of the appropriate vehicle class distribution for a given site must thus be based on project location and highway functional class, as a minimum. Where Weight-in-Motion (WIM) sites are available and applicable to the project based on location and highway functional class, calculate the percent distribution by obtaining the monthly weight distribution data for 3-4 months (preferably the summer months of June, July, August, and September where higher levels of truck traffic are anticipated).

The WIM information can be found at the link below.

<https://iplan.maps.arcgis.com/apps/webappviewer/index.html?id=0a36396e6fa744ee937a5dc7afa0ebb7>

Important Note: Both WIM and ATR sites are displayed on the IPlan map shown in Figure 520.05.02.1. Only WIM sites will have Monthly Weight Reports needed for this calculation. WIM sites are displayed as light blue squares in the map. Where no WIM stations are available, additional direction for selecting vehicle class distribution is given at the end of this section.

After opening the IPlan ATR/WIM Stations Map click on the WIM station of interest. A pop up will display various information regarding the WIM. Click on the URL Link “More info” as shown in Figure 520.05.02.1.

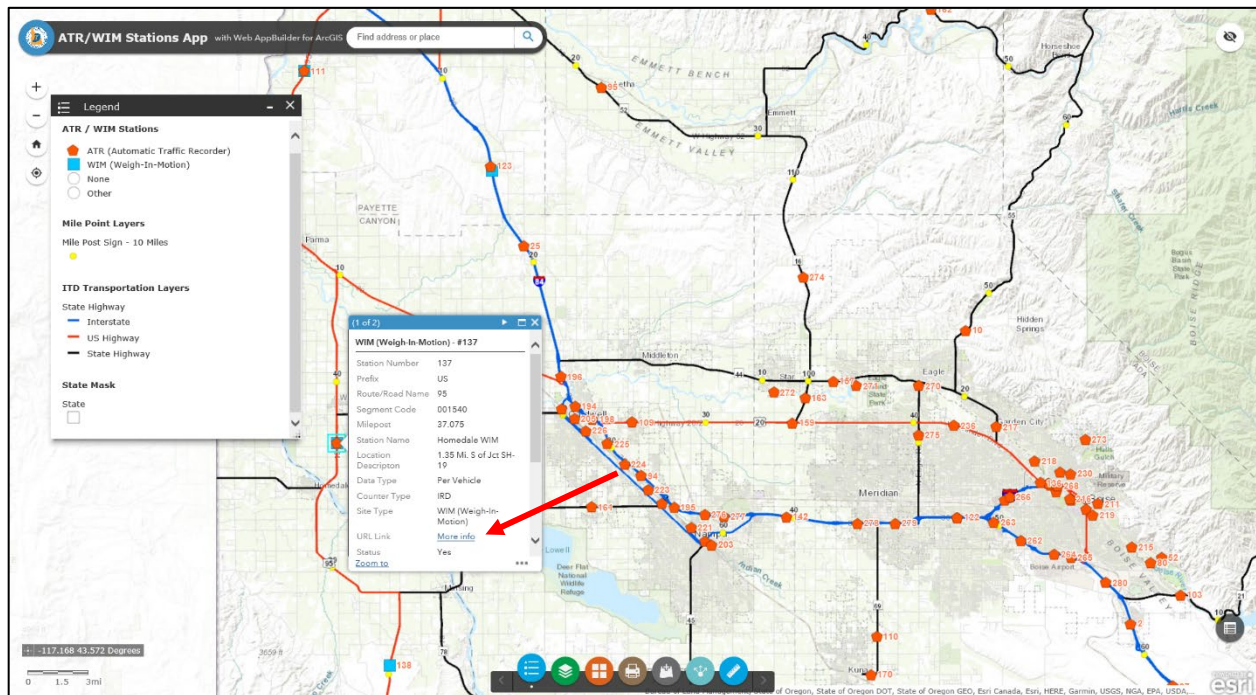


Figure 520.05.06.1: ARCGIS ATR/WIM Stations IPlan Map View 2

This will open a new web page displaying the Automatic Counter Volumes for the selected WIM. Near the top of this page hover the mouse over the “Published Reports” tab and select the year of interest as shown on the left of Figure 520.05.02.2.

This will then display all the reports for that year by month. Go to the desired month(s) and click on the “Monthly Weight Report.pdf” to get the vehicle class distribution data for that particular WIM for that month as shown on the right of Figure 520.05.02.2.

#137 - Homedale - WIM	Average Daily Traffic	Published Reports	#137 - Homedale - WIM	Average Daily Traffic	Published Reports
Automatic Counter Volumes			2020 Reports		
Report Types			Months		
Year Jan. Feb. Mar. Apr. May. Jun. Jul. Aug. Sep.			January Monthly Volume Comparison Report.pdf Monthly Average Hourly Traffic Report.pdf Monthly Hourly Traffic Volume Report.pdf Monthly Traffic Volume Report.pdf Monthly Vehicle Speed Report.pdf Monthly Weight Report.pdf		
2014 4279 4656 5162 5443 5518 5361 5211 5427 5465					
2015 4765 5320 5748 6031 6042 6025 5959 6160 6274					
2016 4599 4957 5408 5921 5901 5819 5766 6010 6045					
2017 5966 6136 5711 5569 5819 5831					
2018 5029 5428 5877 6188 6389 6237 6147 6358 6481					
2019 5453 5425 6611 6614 6674 5950 6558 6786 6529 5831					
2020 5515 5768 5972 5249 6007 6415 6328					

Figure 520.05.06.2: WIM Station Data Web Pages

An example of this data is shown in Figure 520.05.02.3.

Idaho Transportation Department															
Monthly WIM Distribution for Jun-2020															
Site names: 00137		County: Canyon		Seasonal Factor Grp: 1		Daily Factor Grp: 2		Axle Factor Grp: 2		Growth Factor Grp:		Truck distribution data to be used in Table 520.05.02.1 for the month of June 2020.			
Funct Class: R Principal Arterial - Other		Location: US-95 1.4 Mi. S of Jct SH-19													
		MC	CAR	PU	BUS	2D	SU 3	SU 4+	ST 4-	ST 5	ST 6+	MT 5-	MT 6	MT 7+	OFSC
Road	Num	9	3,621	2,189	4	82	54	6	83	289	54	1	6	18	0
	Flex	.23	.00	.00	.30	.34	.34	.63	.22	1.63	.92	.71	.65	.39	0.00
	Rigid	.48	.00	.00	.78	.34	.59	1.69	.24	1.96	1.62	.95	1.23	1.64	0.00
	GVW	12.9	2.5	4.4	31.2	18.6	30.4	68.7	23.4	61.9	76.3	49.5	62.0	71.6	0.0
N	Num	8	1,729	1,116	2	39	25	4	43	147	30	1	4	9	0
	Flex	.22	.00	.00	.66	.31	.38	.54	.18	1.06	.65	.54	.67	1.29	0.00
	Rigid	.47	.00	.00	.90	.30	.68	1.44	.20	2.02	1.74	.78	1.43	2.13	0.00
	GVW	12.8	2.6	4.5	35.2	17.9	30.9	65.8	22.4	61.8	80.2	47.5	63.6	69.6	0.0
S	Num	2	1,891	1,074	2	43	28	2	39	142	24	1	2	10	0
	Flex	.34	.00	.00	.48	.37	.30	1.02	.25	1.01	.58	1.65	.58	.67	0.00
	Rigid	.73	.00	.00	.60	.37	.51	2.87	.29	1.90	1.48	1.58	.65	1.17	0.00
	GVW	17.9	2.4	4.4	24.9	19.1	29.8	84.1	24.5	61.8	71.8	64.6	55.0	71.5	0.0
N Lane1	Num	8	1,729	1,116	2	39	25	4	43	147	30	1	4	9	0
	Flex	.22	.00	.00	.66	.31	.38	.54	.18	1.06	.65	.54	.67	1.29	0.00
	Rigid	.47	.00	.00	.90	.30	.68	1.44	.20	2.02	1.74	.78	1.43	2.13	0.00
	GVW	12.8	2.6	4.5	35.2	17.9	30.9	65.8	22.4	61.8	80.2	47.5	63.6	69.6	0.0
S Lane1	Num	2	1,891	1,074	2	43	28	2	39	142	24	1	2	10	0
	Flex	.34	.00	.00	.48	.37	.30	1.02	.25	1.01	.58	1.65	.58	.67	0.00
	Rigid	.73	.00	.00	.60	.37	.51	2.87	.29	1.90	1.48	1.58	.65	1.17	0.00
	GVW	17.9	2.4	4.4	24.9	19.1	29.8	84.1	24.5	61.8	71.8	64.6	55.0	71.5	0.0

Figure 520.05.06.3: Monthly WIM Distribution Report from WIM #137 for June, 2020

Repeat these steps until a minimum of 3 to 4 months of data is obtained as described above. With this data calculate the average vehicle class distribution as shown in Table 520.05.02.1.

Table 520.05.06.1: Monthly WIM Distribution Summary Table for WIM #137 (May-July)

WIM #	Date	FHWA Class											Total
		1-3	4	5	6	7	8	9	10	11	12	13	
137 Homedale	May-20	5428	3	71	49	8	80	289	57	1	6	16	6008
	Jun-20	5819	4	82	54	6	83	289	54	1	6	18	6416
	Jul-20	8559	3	76	53	5	74	265	42	1	6	23	9107
Avg. Vehicle Class Dist.:		0.6%	13.3%	9.1%	1.1%	13.7%	48.9%	8.8%	0.2%	1.0%	3.3%	100.0%	

The Average Vehicle Class Distribution shown in bold in Table 520.05.02.1 will be input into the "Distribution (%)" column in Pavement ME as shown in Figure 520.05.02.4.

The screenshot shows the 'Pavement ME Design' software interface. The 'Vehicle Class Distribution' tab is active, displaying a table with columns for Vehicle Class, Distribution (%), Growth Rate (%), and Growth Function. A red circle highlights the 'Load Default Distribution' button in the top right corner of the table. A blue box with an arrow points to this button, with the text 'Load Default Distribution' written inside.

Vehicle Class	Distribution (%)	Growth Rate (%)	Growth Function
Class 4	0.9	3	Linear
Class 5	11.6	3	Linear
Class 6	3.6	3	Linear
Class 7	0.2	3	Linear
Class 8	6.7	3	Linear
Class 9	62	3	Linear
Class 10	4.8	3	Linear
Class 11	2.6	3	Linear
Class 12	1.4	3	Linear
Class 13	6.2	3	Linear

Figure 520.05.06.4: Vehicle Class Distribution and Growth Rate Pavement ME Input Page

Where no WIM stations are available, selection of the appropriate vehicle class distribution will be made based on the functional classification of roadway and range of tractor multi-trailer trucks. Table 520.05.02.5 categorizes the various ITD WIM sites across the state according to their functional classification of roadway and range of tractor multi-trailer trucks and assigns a Pavement ME Truck Traffic Classification (TTC) Group default distribution number that can be used in the analysis.

Following Table 520.05.02.5, first select the functional classification of roadway from three options: Interstate, Primary Arterial, or Minor Arterial. Then look at the range of tractor multi-trailer trucks (Class 11, 12, & 13) percentage. Where no WIM stations are available, the closest or most applicable ATR station can be used to define the percentage of tractor multi-trailer trucks for the roadway design. This can be done following steps detailed in section [520.05.01.03](#) of this manual. In this section instructions on how to find the “Monthly Vehicle Length Report” are provided with an example shown in Figure 520.05.01.03.3. The percentage of tractor multi-trailer trucks is provided in the table following column “Road” and row “70-121” which displays the percentage of truck traffic over 70 feet in length for that roadway. The example in Figure 520.05.01.03.3 provides a percentage of tractor multi-trailer trucks of 15.97%. Additional monthly reports for June, July, August, and September should be reviewed and the highest percent of tractor multi-trailer trucks selected.

With the functional classification of roadway and range of tractor multi-trailer trucks percentage established, a corresponding TTC Group number can be selected from Table 520.05.02.5.

Table 520.05.06.2: Normalized Volume Distribution WIM Sites According to Functional Classification and Tractor Trailer Percentage

Functional Classification of Roadway	Range of Tractor Multi-Trailer Trucks (Class 11, 12, 13) percentage	Description of TTC Group	WIM Sites	Pavement ME TTC Group
Interstate	>10	Predominantly Tractor Single Trailer Units	79, 93, 128	TTC 5
Interstate	<3	Equal Single Unit Trucks and Tractor Single Trailer Units	115	TTC 9
Interstate	3 to 10	Predominantly Tractor Single Trailer Units	117, 171, 185	TTC 3
Primary Arterial			134, 137, 138	
Primary Arterial	3 to 10	Equal Single Unit Trucks & Tractor Single Trailer Units	129	TTC 10
Primary Arterial	<3	Predominantly Tractor Single Unit Trucks	192	TTC 1
Primary Arterial	<3	Predominantly Tractor Single Unit Trucks	118	TTC 14
Primary Arterial	<3	Mixed Trucks; higher percentage of tractor single trailer units	96, 135	TTC 12
Primary Arterial	3 to 10	Predominantly Tractor Single Unit Trucks	199	TTC 15
Minor Arterial			133	

To select the TTC Group in Pavement ME, click on the “Load Default Distribution” button as shown in Figure 520.05.02.4 and check the corresponding TTC group number.

520.05.06.01 Growth rate. This column allows the designer to define the common growth of truck volume based on the function of the truck class.

A growth rate can be calculated by using an AADT Volume Projection Report. First, to obtain this report follow the instructions below:

The ITD Roadway Data Group is currently working on creating new tools to generate traffic volume and ESAL projection reports, but until those tools are complete to request these reports fill out the template in Table 520.05.02.01.1 below and email the information to the District Materials Engineer.

Table 520.05.06.01.1: Traffic Volume & ESAL Projection Report Request Template**BLANK TEMPLATE**

Traffic Volume/ESAL Projection Request	Section 1	Section 2	Section 3
Project Number:			
Key Number:			
Route:			
Location (Project Name):			
Project Start Year:			
Projection Years (Projection end year or # of years):	Traffic Volume: ESALs:	Traffic Volume: ESALs:	Traffic Volume: ESALs:
Route ID (<i>found on IPlan AADT map</i>):			
From Measure (BM) (<i>found on IPlan AADT map</i>):			
To Measure (EM) (<i>found on IPlan AADT map</i>):			
County:			
District:			
Note:			

In the template identify if the designer only wants traffic volume or if they'd also like to have ESAL projections as well. These can be noted on the Projection Years section of the template above. Additionally, if the area of interest spans across multiple sections, include each section on the request and note any special instructions.

An Example of the Volume Projection Report is given in Figure 520.05.06.01.1.

8/27/2020
1

Projected Traffic Volumes

Project No: A020(351) **Key No:** 20351
Route: I-84 **Location:** Boise River IC #27 to Franklin Rd US-20 IC #29
RouteID: 01010AIN084 **Measures:** 26.754 28.682 **County:** Canyon

From:	Boise River IC #27 to 10th Ave IC #28	10th Ave IC #28 to Franklin Rd US-20 IC #29	Weighted Average
To:			
RouteID:	01010AIN084	01010AIN084	01010AIN084
FromMeasure:	26.754	27.613	26.754
ToMeasure:	27.613	28.682	28.682
AADT 2018	47,000	59,600	53,990
AADT 2020	50,090	63,440	57,500
AADT 2060	111,930	140,240	127,640
DHV 2018	4,700	10.0% 5,960	10.0% 5,400
DHV 2020	5,010	10.0% 6,340	10.0% 5,750
DHV 2060	11,190	10.0% 14,020	10.0% 12,760
Commercial:			
AADT 2018	6,800	14.5% 6,600	11.1% 6,690
AADT 2020	7,480	14.9% 7,260	11.4% 7,360
AADT 2060	21,080	18.8% 20,460	14.6% 20,740
DHV 2018	480	9.5% 460	7.8% 470
DHV 2020	520	4.7% 510	8.0% 520
DHV 2060	1,480	3.7% 1,430	10.2% 1,450
Direction:	60/40%	60/40%	60/40%
Trk Density:	Heavy	Heavy	Heavy
Remarks:	Based on 2018 data		
Requested by:	Tyler Coy, P.E.		
Prepared by:	Vicky Calderon		

Figure 520.05.06.01.1: Volume Projection Report

Using the Volume Projection Report along with the following equation the commercial growth rate can be established.

$$Growth\ Rate = \left[\left(\frac{Future\ CAADT}{Current\ CAADT} \right)^{\left(\frac{1}{\#\ years} \right)} - 1 \right] * 100 \quad (1)$$

Using the Volume Projection Report in Figure 520.05.02.01.1 and Equation 1 an example of the growth rate calculation is shown in Equation 2.

$$Growth\ Rate = \left[\left(\frac{21,080}{7,480} \right)^{\left(\frac{1}{40} \right)} - 1 \right] * 100 = 2.6\% \quad (2)$$

Typically one growth rate is established and applied uniformly to the various vehicle classes.

If no such data is available, use a growth rate value of +3 percent and compound growth as shown in Figure 520.05.06.5.

520.05.06.02 Growth function. This control allows the designer to select the traffic growth function to compute the growth or decay in truck traffic over time (forecasting truck traffic). Growth function options available in Pavement ME are as follows:

None: This option sets traffic volume to remain the same throughout the design life.

Linear: This option allows traffic volume to increase by constant percentage of the base year traffic across each truck class growth to happen at the defined rate.

Compound: This option allows traffic volume to increase by constant percentage of the preceding year traffic across each truck class.

For all ITD projects a compound growth function will be selected unless otherwise directed by the project engineer.

520.05.07 Traffic Volume Monthly Adjustment Factors Monthly adjustment factors allow the designer to distribute the truck traffic within each class throughout the year. Truck traffic monthly adjustment factors represent the proportion of the annual truck traffic for a given truck class that occurs in a specific month.

Recommended monthly adjustment factors for design on ITD projects is provided in Table 520.05.07.1.

Table 520.05.07.1: ITD Monthly Adjustment Factors for Pavement ME

Month	Vehicle Class									
	4	5	6	7	8	9	10	11	12	13
January	0.74	0.86	0.91	1.04	0.64	0.98	0.88	0.9	0.93	1.12
February	0.83	0.82	0.87	0.63	0.67	1	0.96	0.91	0.67	0.96
March	0.77	0.8	0.83	0.75	0.86	0.95	1.1	0.97	1.48	1.01
April	0.91	0.85	0.86	1.2	1	0.95	1.1	0.93	0.79	0.88
May	1.12	0.98	0.9	1.63	1.07	0.95	1.1	1.07	1.2	0.8
June	0.99	1.01	0.84	0.72	1.17	0.94	0.84	1.42	1.69	0.81
July	1.49	1.33	1.3	1.09	1.53	0.97	0.85	1.66	1.08	0.88
August	1.46	1.21	1.45	1.21	1.42	0.98	1.01	0.81	0.96	0.99
September	1.31	1.14	1.29	0.98	1.18	1.06	1.08	0.88	0.71	0.93
October	0.94	1.08	1.26	0.92	1.03	1.16	1.13	0.6	0.76	1.13
November	0.72	0.99	0.75	0.98	0.79	1.07	0.92	0.82	0.67	1.09
December	0.72	0.93	0.74	0.85	0.64	0.99	1.03	1.03	1.06	1.4

Traffic Volume Monthly Adjustment Factors can be entered into the table titled “Monthly Adjustment Factor” in the Traffic pane as shown in Figure 520.05.1.

520.05.08 Axles Per Truck Axles per truck table allows the designer to define the average number of axles for each truck class (classes 4 to 13) for each axle type (single, tandem, tridem, and quad). Recommended values are provided in Table 520.05.08.1.

Table 520.05.08.1: ITD Axles per Truck Adjustment Factors for Pavement ME

Vehicle Class	Axle Type			
	Single	Tandem	Tridem	Quad
4	1.59	0.34	0	0
5	2	0	0	0
6	1	1	0	0
7	1	0.22	0.83	0.1
8	2.52	0.6	0	0
9	1.25	1.87	0	0
10	1.03	0.85	0.95	0.26
11	4.21	0.29	0.01	0
12	3.24	1.16	0.07	0.01
13	3.32	1.79	0.14	0.02

Axles per truck class can be entered into the tab titled “Axles per Truck” in the Traffic Input pane as shown in Figure 520.05.1.

520.05.09 Axles Load Distribution

Axle load distributions are percentages used to distribute the total number of axles by each axle type (single, tandem, tridem, and quad) and weight as described in Section 5.7 of the DUG. Average axle load distributions for primarily loaded (heavy loaded), moderately loaded, and lightly loaded Truck Weight Road Groups (TWRG) as well as a statewide average axle load distribution were developed for Idaho using historical WIM data from several sites in the state. The input data for each of these categories is provided on Tables 15 through 30 in the DUG.

To input each of the four axle types, select each one individually by clicking on its corresponding axle distribution tabs (, , &) located in the Axle Distribution tab of Traffic Input Pane of Pavement ME as shown in Figure 520.05.09.1. A new table will open for each axle type where the factors will need to be entered manually, or .XML files available from the District upon request can be imported to the tables directly.

To import the .XML files right click on the Three dots on the bottom right side of the traffic screed as shown in Figure 520.05.09.2 and select “Axle Load Distributions” and then “Import XML...” where either the primarily loaded, moderately loaded, lightly loaded, or statewide average axle load distribution .XML files are imported. Once the desired .XML file is selected click open and this should update all four axle types. Once the .XML file is imported it would be good to click through each axle distribution tab and

compare with the DUG Tables 15 through 30 to ensure the files were imported correctly as shown in Figure 520.05.09.2.

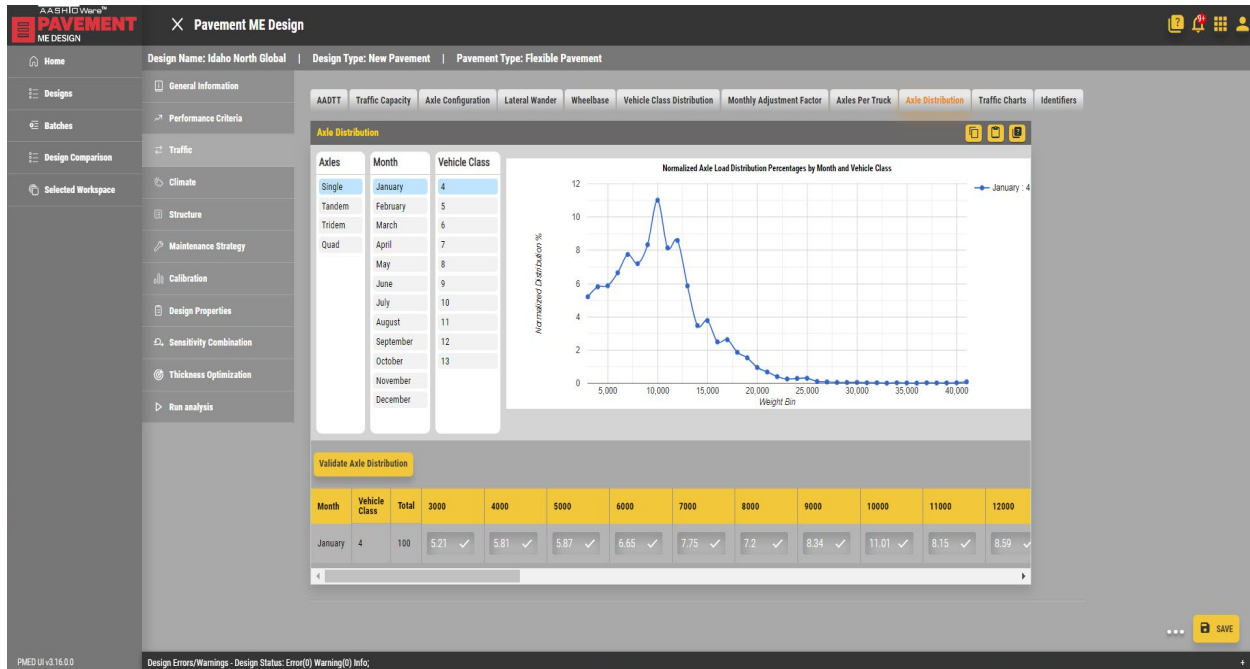


Figure 520.05.09.1: Axle Distribution Pavement ME Input Page Pavement ME Axle Distribution XML Input

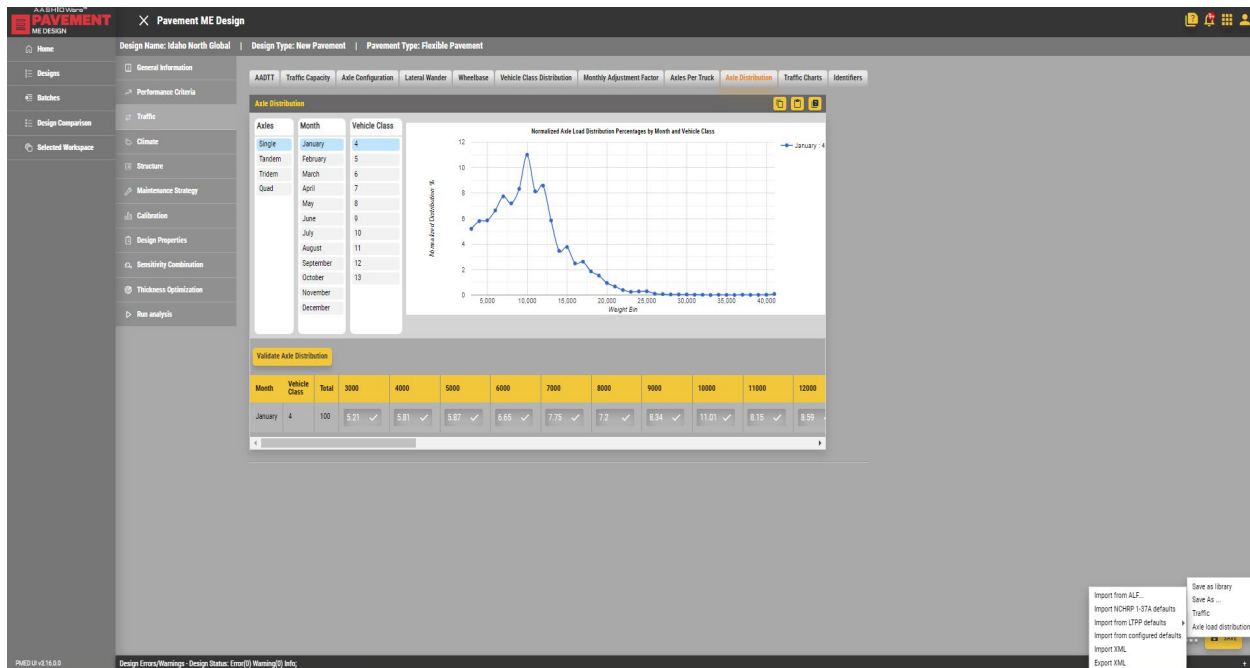


Figure 520.05.09.2: Pavement ME Axle Distribution XML Input

520.06 CLIMATE : Note: In version 2.5.5, the MERRA2 climate dataset is used for flexible and semi-rigid pavements, while the NARR climate dataset is used for rigid pavements. For version 3.0 and later versions, the MERRA2 climate dataset is used for all pavement designs.

According to Pavement ME, environmental conditions have a significant effect on the performance of both flexible and rigid pavements. Factors such as precipitation, temperature, freeze-thaw cycles, and depth to water table affect temperature and moisture contents of unbound materials, which, in turn, directly affect the load-carrying capacity of the pavement. Further, the temperature levels have a direct bearing on the stiffness in the case of asphalt materials, and temperature gradients induce stresses and deformations in the case of PCC layers.

Pavement ME considers the effects of these environmental factors. Therefore, Pavement ME models daily and seasonal fluctuations in the moisture and temperature profiles in the pavement structure brought about by changes in ground water table, precipitation/infiltration, freeze-thaw cycles, and other external factors.

Project lengths can vary covering various climatic regions and elevations. It may be necessary to run Pavement ME looking at 2 or 3 different locations along the project where higher elevations, shallow groundwater, and/or extreme hot and cold temperatures exist in order to analyze the pavement design according to the various parameters that might exist along a project alignment.

To access the climate input tab click on the climate icon  found in the Design pane. This will open the Climate Tab in the central field as shown in Figure 520.06.1.

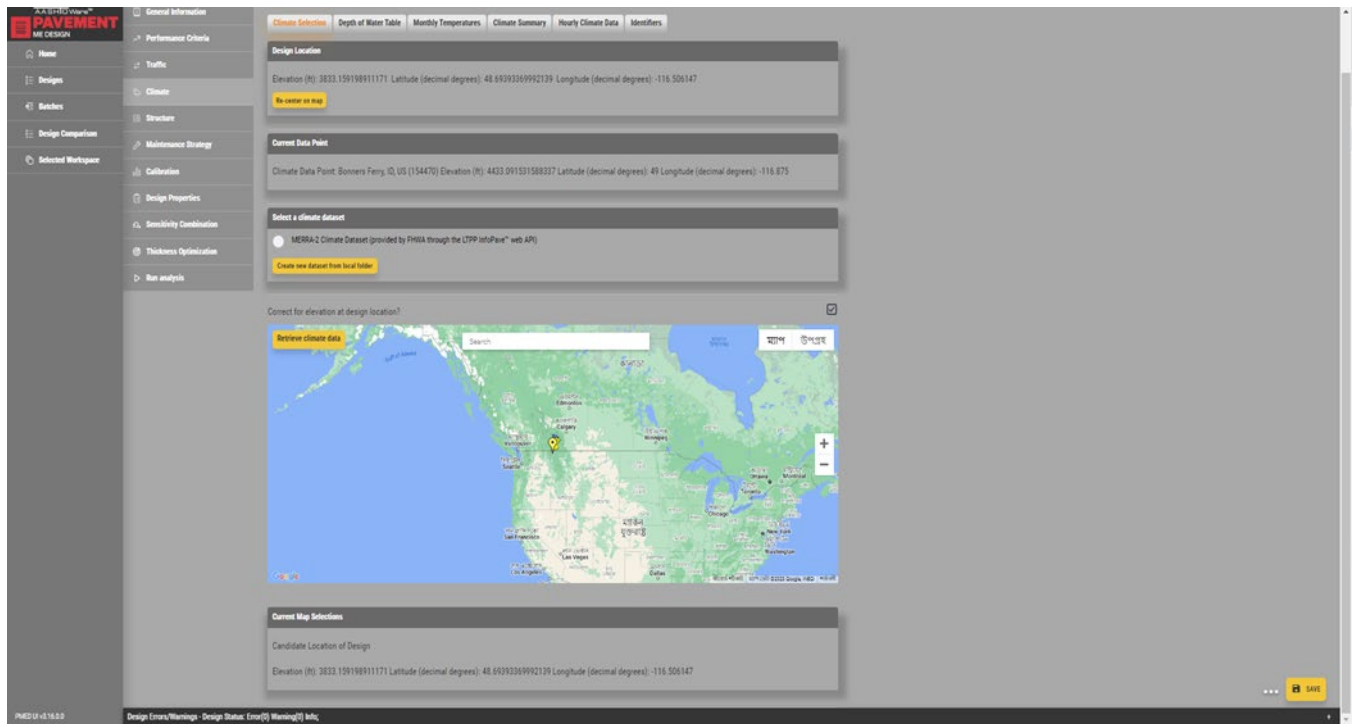


Figure 520.06.1: Pavement ME Climate Interface

520.06.01 Climate Station(s), Elevation, Latitude, and Longitude Input

In order to input the necessary climate data follow these steps:

Using the map in the Climate Tab, select the project location by double clicking on the map or by using the search bar. This will set a yellow pushpin.

The nearest available climate grid point locations in the MERRA climate dataset will be displayed. Select the nearest one or several grid point locations, it will turn into blue. Once all the desired grid points are selected, click the “Retrieve climate data” as shown in Figure 520.06.2. Once the weather stations are selected and retrieved, the Climate Station(s), Elevation, Latitude, and Longitude will be updated in the “Current Data Points” portion of the Climate Tab.

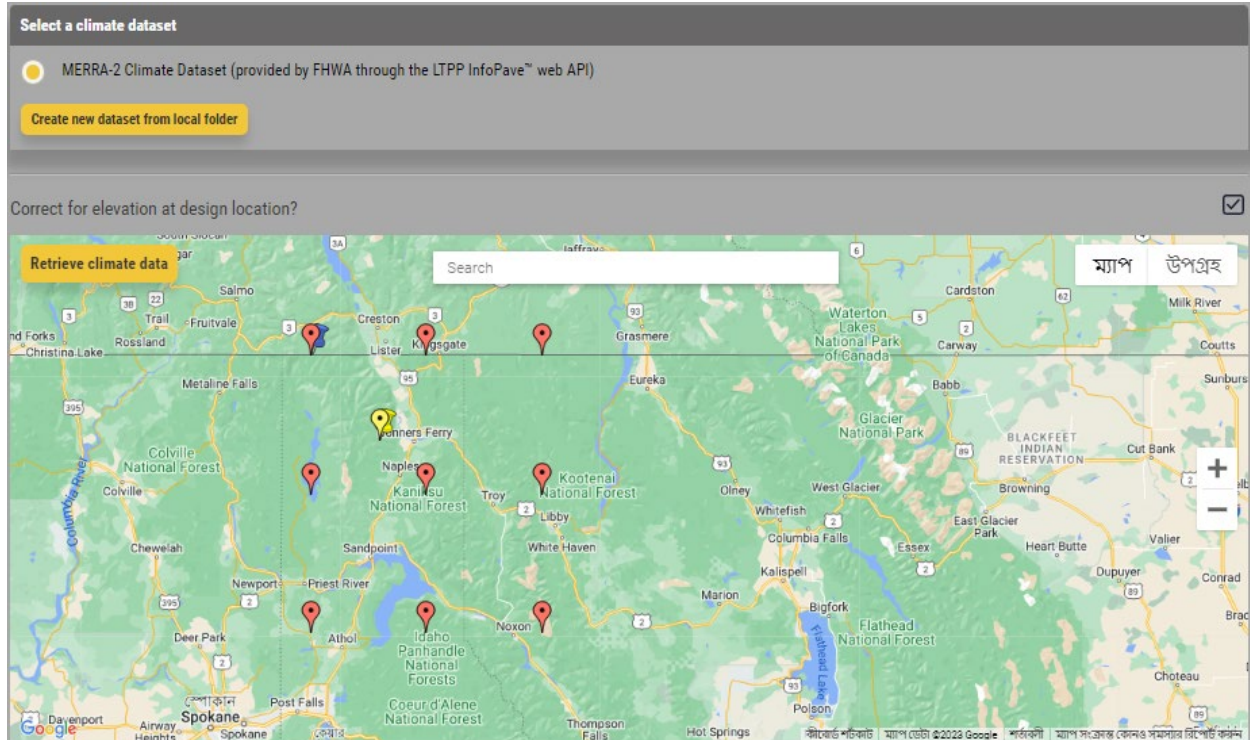


Figure 520.06.2: Pavement ME Climate Tab Climate Station Selection

520.06.02 Depth to Water Table (ft) Clicking on this input of the climate pane will open the Water Table dialog, which allows the designer to define average depth of ground water table on an annual or seasonal basis. The depth is defined from the top surface of the subgrade to the ground water table.

Note 7: There are site conditions where perched water and/or the lateral flow of water can occur. Lateral flow is more of seasonal condition, while perched water can be on an annual basis.

The geotechnical investigation for a new pavement, reconstruction or rehabilitation design should identify whether there is expected lateral flow or perched water along the project. The designer should consider the site conditions is setting or determining the depth to water and whether the values are seasonal dependent. Depending on if the designer chooses Seasonal or Annual, the view of this information will differ. If “Seasonal” is selected an average depth to groundwater for each of the four seasons will be required as shown in Figure 520.06.02.1. If “Annual” is selected an annual average water table depth value is required as shown in Figure 520.06.02.2.

Design Name: Idaho North Global | Design Type: New Pavement | Pavement Type: Flexible Pavement

General Information | Performance Criteria | Traffic | **Climate** | Structure | Maintenance Strategy | Calibration | Design Properties | Sensitivity Combination | Thickness Optimization | Run analysis

Climate Selection | **Depth of Water Table** | Monthly Temperatures | Climate Summary | Hourly Climate Data | Identifiers

Average depth of water table: ☒ Annual ☐ Seasonal

Annual depth (ft) ✓

Figure 520.06.02.1.: Annual Depth to Water Table

Design Name: Idaho North Global | Design Type: New Pavement | Pavement Type: Flexible Pavement

General Information | Performance Criteria | Traffic | Climate | **Structure** | Maintenance Strategy | Calibration | Design Properties | Sensitivity Combination | Thickness Optimization | Run analysis

Climate Selection | **Depth of Water Table** | Monthly Temperatures | Climate Summary | Hourly Climate Data | Identifiers

Average depth of water table: ☐ Annual ☒ Seasonal

Depth of Water by Season

Period	Water Table Depth (ft)
Spring	0 ✓
Summer	0 ✓
Autumn	0 ✓
Winter	0 ✓

Figure 520.06.02.2.: Seasonal Depth to Water Table

For the “Seasonal” selection, the “Period” column is defined as the following:

- Spring – March to May

- Summer – June to August
- Autumn – September to November
- Winter – December to February

520.06.03 Determining Depth to Water Table. The depth to water table or groundwater is addressed in Section 220.05 Groundwater.

520.06.03.01 PMED Spreadsheet. When field measurements are unavailable, obtain approximate groundwater depths from ITD Database for the AASHTOWare Pavement ME Design (PMED) spreadsheet Version 3.0, Updated January 2020. The spreadsheet “Main-Screen” tab is shown in Figure 520.06.03.01.1 Click on the “Climate” circle that is outlined in dark blue. This information is from the Idaho Department of Water Resources (IDWR) website link:

<http://www.idwr.idaho.gov/hydro.online/gwl/default.html>



Figure 520.06.03.01.1 2020 PMED Spreadsheet Main Screen Tab

This will open the “Climatic Weather Stations Available in MEPDG Version 1.1 in Idaho and close to Idaho Borders” tab as shown in Figure 520.06.03.01.2.

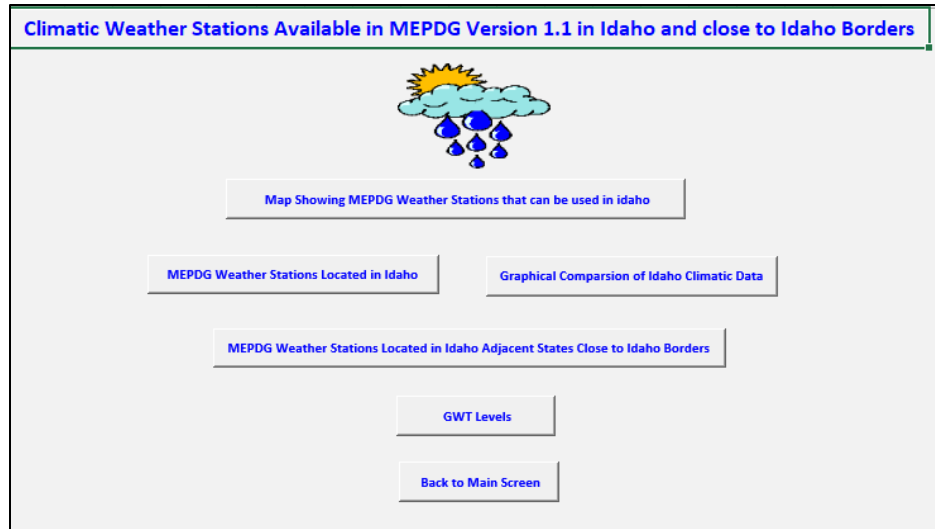


Figure 520.06.03.01.2 Climatic Weather Stations Available in MEPDG Version 1.1 in Idaho and close to Idaho Borders

This tab displays weather station tabs representing data across the state of Idaho that were developed during research projects. This information is superseded by the MARA data described above.

The GWT Levels tab may be used to determine ground water table levels. Click on the GWT Levels tab in Figure 520.06.03.01.2.

This will open the Idaho Active Water Level Network screen in Figure 520.06.03.01.3 that allows the designer to determine the ground water table in different ways. Click on the buttons on the right to access the information from the Idaho Department of Water Resources.

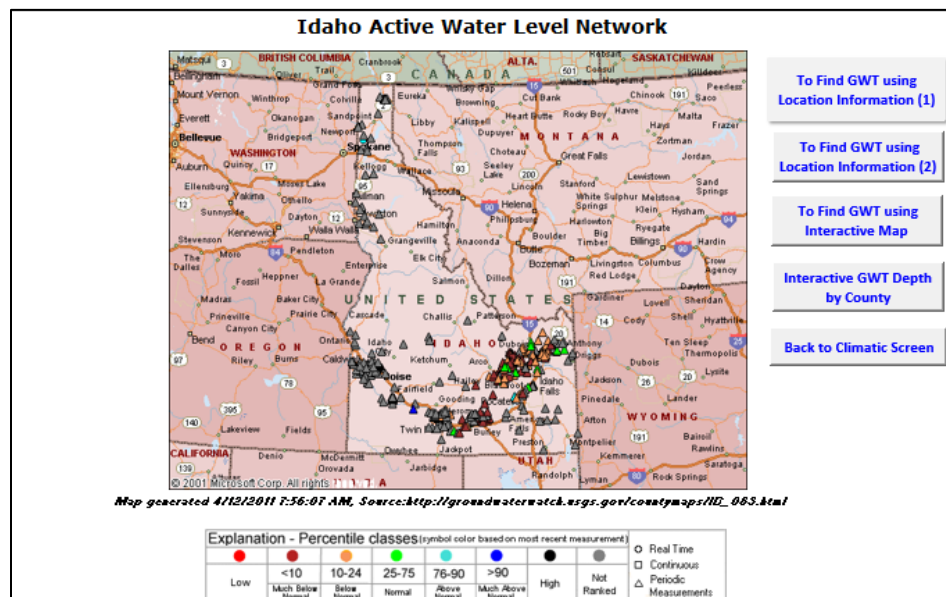


Figure 520.06.03.01.3 Idaho Active Water Level Network

520.07 AC/JPCP/SEMI-RIGID PAVEMENT SURFACE MATERIAL PROPERTIES The materials properties for asphalt concrete, JPCP, and Semi-Rigid input can be entered by clicking on “Structure” pane as shown in Figure 520.07.1.

The screenshot displays the Pavement ME Design software interface. The left sidebar contains a navigation menu with options: Home, Design, Batches, Design Comparison, Selected Workspace, Performance Criteria, Traffic, Climate, Structure, Maintenance Strategy, Calibration, Design Properties, Sensitivity Combination, Thickness Optimization, and Run analysis. The main workspace is titled 'Pavement ME Design' and shows the 'Structure' pane. The 'Structure' pane displays a cross-section of the pavement structure with three layers: Layer 1 (Flexible: Default asphalt concrete), Layer 2 (Non-stabilized Base: Crushed stone), and Layer 3 (Subgrade: A-1-a). The 'Layer Property Input' section is highlighted with a red box and an arrow pointing to the 'Effective binder content by volume (%)' field, which is set to 11.6. The 'Pavement Structure' section is also highlighted with a red box and an arrow pointing to the 'Layer 1' layer. A red box with the text 'Select layer in cross-section to enter properties' points to the 'Layer 1' layer. Another red box with the text 'Enter properties here' points to the 'Aggregate gradation' section. The 'Aggregate gradation' section includes a table with columns 'Gradation' and 'Percent Passing'.

Gradation	Percent Passing
3/4 in sieve	100
3/8 in sieve	77
#4 sieve	60
#20 sieve	6

Below the table, there is a checkbox for 'Enter user-calculated value for gradation parameter' and a text field for 'Aggregate gradation parameter' with the value 0.4021477136182366. The 'Poissons' section includes a checkbox for 'Is Poisson's ratio calculated?' and a text field for 'Poisson's ratio' with the value 0.35. The 'Unit weight (lb/ft³)' is set to 150.

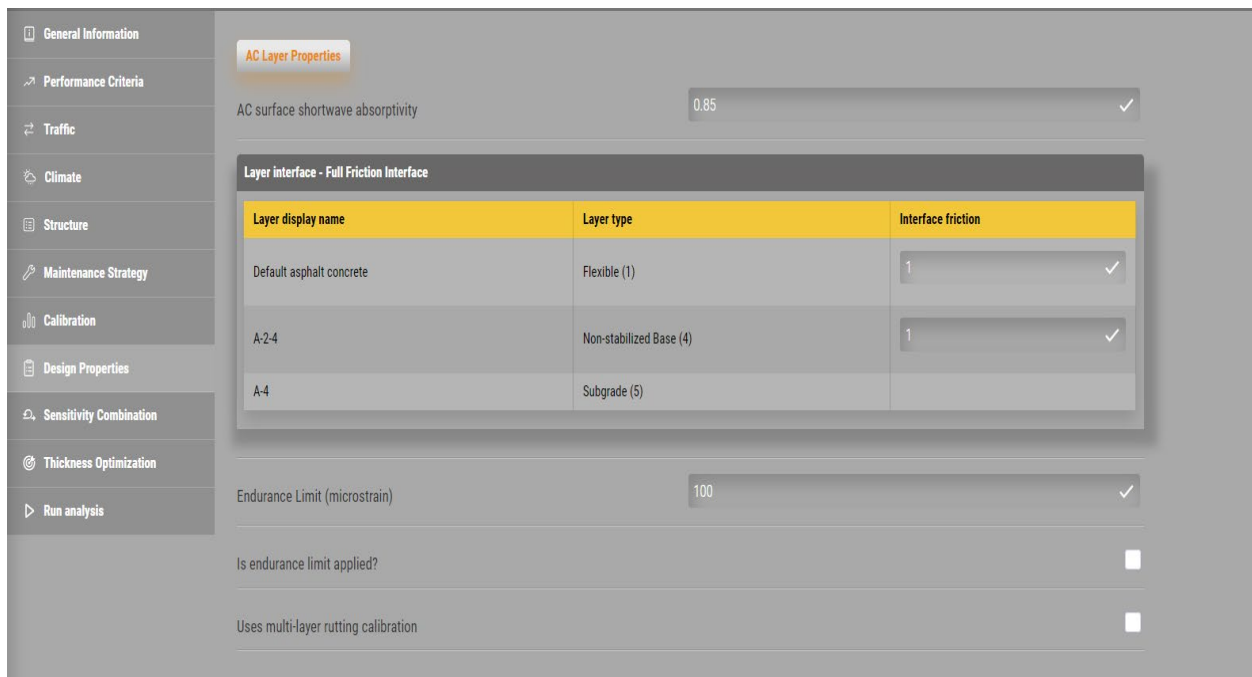
Figure 520.07.1: Pavement ME Project Structure Interface

In addition to the materials properties, design and layer properties for each pavement option needs to be added by clicking the AC/JPCP Design structure or Layer Properties options in the Structure Pane as shown in Figure 520.07.1.

Refer to DUG Chapter 7 and ITD Database for the AASHTOWare Pavement ME Design (PMED) spreadsheet Version 3.0, Updated January 2020 (completed under ITD Research Project RP193, RP235, RP253, RP263, and RP268) to obtain ITD specific material properties. The link to the database and reports are available at https://www.webpages.uidaho.edu/bayomy/ITD_ME-Database.htm. The various pavement layer property inputs are detailed below.

520.07.01 Asphalt Concrete Layer Properties (new pavement & Overlay) When designing the AC Layer, the Layer Property Inputs required can be accessed through clicking the “Design properties” pane

 as shown in Figure 520.07.01.1 with Pavement ME definitions and ITD recommended input for each item provided below.



AC Layer Properties

AC surface shortwave absorptivity

Layer interface - Full Friction Interface

Layer display name	Layer type	Interface friction
Default asphalt concrete	Flexible (1)	1
A-2-4	Non-stabilized Base (4)	1
A-4	Subgrade (5)	

Endurance Limit (microstrain)

Is endurance limit applied? ☐

Uses multi-layer rutting calibration ☐

Figure 520.07.01.1: AC Layer Properties Input

520.07.01.01 AC Surface Shortwave Absorptivity. This control allows the designer to define the amount of available solar energy that is absorbed by the flexible pavement surface. Keep this value at the Pavement ME default input of 0.85.

520.07.01.02 Layer Interface. This control opens a table that allows the designer to define the friction at the interface of adjacent layers in the pavement system. The interface friction allows the designer to define the friction of adjacent layers at their interface. The designer can enter 0 for no friction (full slip condition), 1 for full friction (no slip), or between 0 and 1 for partial friction. As ITD typically requires full bonding between all layers for HMA pavements, a default value of 1 is recommended as shown in Figure 520.07.01.02.1. The condition of when no friction or full slip can be simulated in rehabilitation designs for the lower asphalt layers of a thick asphalt pavement when coring confirms asphalt layers are debonding. The use of full slip will increase the tensile strains and increase the amount of bottom-up fatigue cracking from the lower asphalt layers.

Note 8: Interface friction values between 0 and 1 are not suggested for use because there is not formalized procedure to for converting the interlayer bond strength to a partial value. So, the design

should select “0” or “1.”

520.07.01.03 Endurance Limit (Microstrain). This control allows the designer to define the threshold tensile strain value (endurance limit) in microstrain. This limit is only required for perpetual pavements

Layer interface - Full Friction Interface		
Layer display name	Layer type	Interface friction
Default asphalt concrete	Flexible (1)	1 ✓
A-2-4	Non-stabilized Base (4)	1 ✓
A-4	Subgrade (5)	

Figure 520.07.01.02.1.: AC Layer Interface Friction Input

and the design procedure has not yet been calibrated for ITD, therefore designers can leave the endurance limit at the default value of 100 and keep the line item labeled “Is Endurance Limit Applied?” as unchecked in Pavement ME as shown in Figure 520.07.01.1. No endurance limit was used for the calibration of the transfer functions in version 2.5.5 and in other latter versions of the software. Thus, the endurance limits should not be selected for new and rehabilitation flexible pavement designs unless it is used in the calibration process.

520.07.01.04 Uses Multi-Layer Rutting Calibration. This control allows the rutting calculation in Pavement ME to use different sets of calibration factors. For all ITD projects, the designer will use the default “unchecked” selection which will apply one set of rutting calibration factors for all added asphalt layers. If the option is selected, up to three sets of rutting calibration factors can be used which have not yet been calibrated for ITD. This control is shown in Figure 520.07.01.1. The use of multiple layer rutting calibration coefficients was not included during the recalibration of version 2.5.5. Thus, the multiple layer rutting calibration coefficients should not be selected for new and rehabilitation flexible pavement designs.

Note 9: In the recalibration of the flexible pavements on a global basis for the LTPP test sections using version 3.0, multiple layer rutting calibration coefficients were considered and can be used. The asphalt rutting calibration coefficients were derived for conventional neat asphalt mixtures and polymer modified mixtures.

Design Name: Idaho North Global | Design Type: First Overlay/Rehabilitation | Pavement Type: AC over AC

AC Layer Properties | **Rehabilitation** ← Additional input for AC overlays

Condition of Existing Flexible Pavement (Rehabilitation Level: 1)

Rehabilitation input level: **Input Level 1** [1]

Milled thickness (in): 0 ✓

Amount	Severity	LTE
Fatigue cracking (%)	Low	0.8
Transverse Cracking (ft/mi)	Low	0.8

Layer Name	Layer Type	Rut Depth (in)
Default asphalt concrete	Flexible	
Default asphalt concrete (Existing Structure - 2008)	Flexible	0 ✓
Crushed stone	NonStabilized	
A-1-a	Subgrade	

Figure 520.07.02.2: AC Overlay Input Level 1 Layer Properties Input

520.07.02 Asphalt Concrete Overlay Layer Properties For pavement overlays an additional option will appear in the Design Properties pane requiring information regarding rehabilitation as shown in Figure 520.07.02.1.

This Rehabilitation input level line item will open a drop-down page requiring the designer to choose a specific input level between 1 and 3. Depending on the input level chosen, the designer will be required to specify the required input. The three different drop-down options for level 1, 2, and 3 are shown in Figure 520.07.02.1, 520.07.02.2, and 520.07.02.1.

Design Name: Idaho North Global | Design Type: First Overlay/Rehabilitation | Pavement Type: AC over AC

AC Layer Properties | Rehabilitation

Condition of Existing Flexible Pavement (Rehabilitation Level: 2)

Rehabilitation input level: **Input Level 2** (2)

Milled thickness (in): 0 ✓

Amount	Severity	LTE
Fatigue cracking (%)	0 ✓	Low (0.8)
Transverse Cracking (ft/mi)	100 ✓	Low (0.8)

Layer Name	Layer Type	Rut Depth (in)
Default asphalt concrete	Flexible	
Default asphalt concrete (Existing Structure - 2008)	Flexible	0 ✓
Crushed stone	NonStabilized	
A-1-a	Subgrade	

Figure 520.07.02.3: AC Overlay Input Level 2 Layer Properties Input

Design Name: Idaho North Global | Design Type: First Overlay/Rehabilitation | Pavement Type: AC over AC

AC Layer Properties | Rehabilitation

Condition of Existing Flexible Pavement (Rehabilitation Level: 3)

Rehabilitation input level: 3

Milled thickness (in): 0 ✓

Structural rating: Fair (3)

Environmental rating: Good (2)

Total rut depth (in): 0 ✓

Figure 520.07.02.4: AC Overlay Input Level 3 Layer Properties Input

Pavement ME gives the following input level definitions:

520.07.02.01 Rehabilitation Input Level 1: Rehabilitation input level 1 only applies to flexible and semi-rigid pavements. Nondestructive deflection or falling weight deflectometer (FWD) deflection basin test is used to backcalculate the elastic modulus of each structural layer. The backcalculated elastic modulus of the asphalt layer(s) determine the damaged bound layer modulus. The damaged layer modulus is used to determine the bottom-up fatigue damage index for the existing pavement structure.

Note 10: The Backcalculation Tool (BcT) provided by AASHTOWare can be used, as well as other programs for backcalculating the elastic layer modulus for the different structural layers of the existing pavement structure.

The amount of rutting by pavement layer and length of transverse cracks are needed for rehabilitation input level 1 for the asphalt overlay thickness design.

- The Rut depth estimates in each structural layer used to estimate the additional rutting that will occur in the existing asphalt, unbound aggregate, and subgrade layers after overlay placement (see section 520.07.04).
- The length of transverse cracks is used in the reflection cracking analysis.

Other distresses, like bottom-up and top-down fatigue cracks, IRI, and raveling should be used to determine the rehabilitation design strategy but are not used directly by the PMED software.

520.07.02.02 Rehabilitation Input Level 2. Rehabilitation input level 2 applies to flexible, semi-rigid, and rigid pavements. This amount of cracking (percent total lane area for flexible and semi-rigid pavements, percent cracked slabs for JPCP, and punchouts for CRCP) are used to determine the fatigue damage index of the existing pavement. The fatigue damage index is derived using the calibration relationship between fatigue damage index and the amount of cracking or number of punchouts.

Nondestructive deflection or FWD deflection basin tests can be used with input level 2 but represents supplemental information for making rehabilitation design decisions external to the PMED software.

520.07.02.03 Rehabilitation Input Level 3. Uses typical published or recommended values for modulus and information from general pavement ratings for estimating damage. The use of rehabilitation input level 3 is discouraged because site specific distresses are usually available.

520.07.03 Milled Thickness (in.). This control allows the designer to enter the thickness of the existing AC layer that is milled during pre-overlay repairs. A value of 0 implies no milling. The thickness of the existing asphalt layer that is entered into the PMED software is the asphalt layer thickness prior to pre-overlay repairs minus the milled thickness, if any.

520.07.04 Rut Depth (in.). This control allows the designer to enter the rut depth for the individual layers of the existing pavement, including subgrade. Because this is difficult to measure in each individual layer, Table 520.07.04.1 lists the ratios to be used in distributing the total rut depth measured at the surface to each pavement layer and subgrade. The rut depths estimated for the individual layers are used to determine the additional rutting that will be predicted in these existing layers throughout the design period. This is referred to as the strain-hardening approach.

Table 520.07.04.1: Ratios to Distribute Total Rut Depth to Individual Layers

Flexible Pavement Layer	Ratio of Total Rut Depth Distributed to Each Layer*
HMA Layer	0.70
Base Layer (unbound aggregate)	0.05**
Subgrade Layer	0.25

*A total rut depth of 0.5 inches would have $0.70 \times 0.5 = 0.35$ inches rut depth in the HMA layer, 0.025 inches in the base layer, and 0.125 inches in the subgrade layer.

**For bound aggregates similar to CRABS adjust the base layer ratio to 0.00 and the HMA layer ratio to 0.75.

Total rut depth at the surface is typically measured each year for all ITD roadways by way of a profiler van. The data is recorded in the Transportation Asset Management System (TAMS) and is available by request through the District Materials Engineer. To request this data the following information is required: Key Number, Route, Year, Beginning Milepost, & End Milepost.

The profiler van measures the average rutting in both the left and right wheel path over a tenth of a mile. To select an average rutting across the roadway an average of both the right and left wheel path values will be taken and then averaged along the length of the roadway segment. This can be an average along the entire project or subdivided into smaller sections of roadway depending on the number and length of the design segments. Where areas of greater rutting is noted, additional design segments may be needed.

520.07.05 Fatigue Cracking (% total lane area). This control allows the designer to enter a percentage and severity for the alligator cracking on the existing pavement surface before the placement of overlay. This requires measurement of wheelpath fatigue alligator cracking which can be obtained by direct measurement in the field or requesting the profiler data recorded in TAMS from the District Materials Engineer. The profiler van records the percent fatigue cracking and categorizes it as low, medium, or high. This data can be averaged along the design segment and used for the Pavement ME input Level 1 or 2.

The percent total lane area for alligator fatigue cracks is used to determine the structural condition or bottom-up fatigue damage of the existing asphalt layers. The area or percent total lane area of alligator cracks (bottom-up cracks) determine the starting fatigue damage index of the asphalt layers for predicting additional bottom-up fatigue cracks in the existing asphalt layers.

The severity level of the bottom-up fatigue alligator cracks determines the load transfer efficiency of the alligator cracks for reflection cracking analysis of bottom-up alligator fatigue cracks. The severity of alligator, fatigue cracks is defined in the Federal Highway Administration Distress Identification Manual for the Long-Term Pavement Performance Program (Fifth Edition), May 2014 (Publication Number FHWA-HRT-13-092).

520.07.06 Transverse Cracking (ft./mile). This control allows the designer to enter the transverse or thermal cracking as measured in lineal feet of cracking per lane mile and severity. This data is also recorded by the profiler van and can be obtained and processed similar to fatigue cracking. The length of transverse cracks is used to determine the environmental damage of the existing asphalt pavement layers. The length of transverse cracks is used in predicting reflection transverse cracks in the asphalt layer.

The severity level of the transverse cracks determines the default load transfer efficiency of the transverse cracks for reflection cracking analysis of bottom-up alligator fatigue cracks. The severity of transverse cracks is defined in the Federal Highway Administration Distress Identification Manual for the Long-Term Pavement Performance Program (Fifth Edition), May 2014 (Publication Number FHWA-HRT-13-092). The load transfer efficiency can also be measured for transverse cracks. If measured with the FWD, the load transfer efficiency is entered as a “user defined” input variable.

520.07.07 Pavement Rating (Structural/Environmental). Pavement ratings are used as rehabilitation input level 3. Rehabilitation input level 3 is discouraged for any rehabilitation design. The measured distresses and/or FWD deflection basin tests are the preferred rehabilitation input levels. If Rehabilitation Input Level 3 is selected, this control allows the designer to select a pavement condition rating based on the windshield survey of the existing pavement layer and choosing from a drop-down list containing five options: Excellent, Good, Fair, Poor, and Very Poor.

Table 520.07.07.1 relates the subjective structural condition survey ratings to the percent of fatigue or alligator cracking (all levels) of total lane area. Table 520.07.07.2 relates the subjective environmental condition survey ratings included in the Pavement ME to feet per mile of thermal or transverse cracking (all levels). Select appropriate condition rating for the project and enter in the software.

**Table 520.07.07.1: Level 3 Condition Ratings Related to Existing Alligator Cracking
(Structural)**

Structural Rating	Estimated Alligator Cracking in Wheelpaths (% Area)
Excellent	< 3
Good	4 – 5
Fair	6 – 10
Poor	11 – 20
Very Poor	> 20

**Table 520.07.07.2: Level 3 Condition Ratings Related to Existing Transverse Cracking
(Environmental)**

Structural Rating	Estimated Transverse Cracking (ft./mile)
Excellent	< 250
Good	250 – 500
Fair	500 – 700
Poor	700 – 800
Very Poor	> 800

520.07.08 Asphalt Pavement Structure Properties New or rehabilitated asphalt pavement structure properties are entered by clicking the “Mixture Volumetrics”, “Mechanical Properties”, and “AC Thermal” tabs in the Structure Pane by selecting the layer presented in the pavement structure cross section. The material properties page in the Structure pane with different Tab is shown in Figure 520.07.1

520.07.08.01 Asphalt Layer.

520.07.08.01.01 Thickness. This control allows the designer to define the thickness, in inches, of the selected layer. For rehabilitation design, the thickness of the existing asphalt layers to be entered in the PMED software is the asphalt layer thickness prior to pre-overlay activities or milling minus the planned milled thickness.

520.07.08.02 Mixture Volumetrics. The asphalt mixture volumetric properties entered in the PMED software need to represent the asphalt layer after construction or placement, prior to traffic opening. These volumetric properties usually represent the average values reported after the construction season. These values are updated on a periodic basis.

520.07.08.02.01 Air Voids (%). This control allows the designer to define the percent volume of air voids in the as-constructed asphalt concrete pavement layer. See mechanical properties section below regarding what input value to use.

520.07.08.02.02 Effective Binder Content (%). This control allows the designer to define the effective binder content of the asphalt concrete mixture. See mechanical properties section below regarding what input value to use.

520.07.08.02.03 Total Asphalt Content by Weight. The total asphalt content by total weight is needed for the asphalt wearing surface mixture/layer.

Note 11: The new top-down fatigue cracking transfer function and model in version 2.6 and later versions of the software requires the total asphalt content by weight for the wearing surface only.

520.07.08.02.04 Poisson's Ratio. This control allows the designer to define the Poisson's ratio of the material in two ways: a constant value (Level 3) or calculate as a function of dynamic modulus (Level 2). For ITD projects the Poisson's Ratio will be input as Level 2. Clicking the arrow sign (>) to the left of this control presents the following options:

- **Is Poisson's ratio calculated?:** By clicking the arrow sign (V) to the right of this control presents True or False options. Select True to calculate Poisson's ratio as a function of dynamic modulus. Select False to use a constant value. For ITD projects, select True for this option.
- **Poisson's ratio Parameter A:** This control allows the designer to define the parameter A of the Poisson's ratio model. Leave this option at the default value of -1.63.
- **Poisson's ratio Parameter B:** This control allows the designer to define the parameter B of the Poisson's ratio model. Leave this option at the default value of 3.84E-06.

520.07.08.02.05 Unit Weight (pcf). This control allows the designer to define the weight of the selected material in pounds per cubic foot. See mechanical properties section below regarding what input value to use.

520.07.08.03 Mechanical Properties. For all ITD projects, Level 1 input for asphalt binder and dynamic modulus mechanical properties input will be used unless otherwise directed by the District Materials Engineer. Level 3 input for creep compliance and indirect tensile strength will be used.

Note 12: Version 3.0 of the PMED software revised the input level 2 creep compliance values. Creep compliance values can be estimated from the measured input level 1 dynamic modulus data. Prior to version 3.0, there was a bias between input level 1, input level 2, and input level 3 creep compliance values. After integrating the new input level 2 creep compliance procedure, no bias was detected between input level 1 and input level 2. However, there is still a bias between input level 3 and the other two input levels. The transverse or thermal cracking transfer function was calibrated with version 2.5.5 for ITD using input level 3 creep compliance values. Thus, creep compliance input level 3 should be used for the transverse or thermal cracks calibration coefficients.

520.07.08.03.01 HMA Mixture Type. HMA mix types is a function of cumulative truck traffic (FHWA Truck Classes 4 through 13) applications within a 20-year design period. The designer will need to determine the mix type based on the cumulative truck traffic over the pavement design life as shown in Table 520.07.08.03.01.1. The selected mixture type will be needed when selecting a representative ITD mix design below.

Table 520.07.08.03.01.1: HMA Mixture Type Requirements

HMA Mixture Type	SP2	SP3	SP5
Design ESALs* (millions)	< 1	1 to < 10	> 30
*The anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, determine the design ESALs for trucks for 20 years.			

520.07.08.03.02 Asphalt Binder. Asphalt binder is a function of geographic area, pavement temperature, and air temperature. The type of PG binder is selected following Section 560.00 of ITD's Materials Manual. Typical binder grades used in Idaho are PG 58-28, PG 58-34, PG 64-28, PG 64-34, PG 70-28, and PG 76-28. Once the asphalt binder is selected, enter the value in the Asphalt Binder option by selecting Superpave Performance Grade, and under Binder Type click the dropdown menu to see a list of binder types to choose from as shown in Figure 520.07.08.03.02.1

Design Name: Idaho North Global | **Design Type:** New Pavement | **Pavement Type:** Flexible Pavement

Mixture Volumetrics | **Mechanical Properties** | **AD Thermal**

Dynamic modulus (Input level 5)

Dynamic modulus input level: 3

Run Dynamic Modulus

Asphalt Binder - SuperPave: 58-34

☒ Superpave performance grade

☐ Viscosity grade

☐ Penetration grade

Binder type: 58-34

A: 10.707

VTS: -3.602

Layer Selection

Layer 1: Flexible Default asphalt concrete

Layer 2: Non-stabilized Base: Crushed stone (A-1)

Layer 3: Subgrade: A-1

Dropdown Option

Creep Compliance (1/psi)

Creep compliance input level: 3

Level 2 Temperature

Loading time (sec)	Low temp (-4 °F)	Mid temp (14 °F)	High temp (32 °F)
1	3.23286E-007	5.16353E-007	7.54288E-007
2	3.78844E-007	6.43174E-007	1.03114E-006
5	4.61494E-007	8.59833E-007	1.70682E-006
10	5.37651E-007	1.07101E-006	2.40804E-006
20	6.27072E-007	1.33405E-006	3.65864E-006
50	7.67935E-007	1.78344E-006	6.05611E-006
100	8.95166E-007	2.22145E-006	8.86672E-006

Generate Master Curve

Show/Hide Creep Compliance Charts

Figure 520.07.08.03.02.1: Pavement ME Project Material Properties Interface

520.07.09 PMED Spreadsheet. Once the HMA Mixture Type and Asphalt Binder are known, open the 2020 PMED spreadsheet and follow the steps below in order to complete the remaining pavement structure input.

The spreadsheet “Main-Screen” tab is shown in Figure 520.07.09.1 Click on the HMA circle which is outlined in red.



Figure 520.07.09.1 2020 PMED Spreadsheet Main Screen Tab 1

This will open the “Mix-Selection-Screen” tab as shown in Figure 520.07.09.2. This tab displays a list of commonly used HMA mixes across the state of Idaho. The designer will select the “Mix ID” that most closely represents the mix and binder type selected above for their specific project. This is done by simply clicking on the chosen mix ID from the “Mix ID” column.

Note: When the research was performed on ITD mixes, there were six gyration levels for Idaho Superpave mixes as follows:

- SP1: <0.3 million ESALs,
- SP2: 0.3 million ESALs to < 1 million EASLs;
- SP3: 1 million ESALs to < 3 million ESALs;
- SP4: 3 million ESALs to < 10 million ESALs;

- SP5: 10 million ESALs to < 30 million ESALs;
- SP6: ≥ 30 million ESALs.

Currently there are three gyrations levels. To use the data in the following tabs, consider mixes SP1 and SP2 from the database as SP2. Consider mixes SP3 and SP4 from the database as SP3. Consider mixes SP5 and SP6 from the database as SP5.

HMA Mix Selection Sheet			
Mix ID	Project ID	Project No.	Key No.
SP1-1	STC-440, Ola Highway, Kirkpatrick Rd North	A 011(945)	11945
SP2-1	US20, Cat Creek Summit to MP129 to Camas County Line	A 009(864+867)	9864&9867
SP2-2	SH6, Washington State Line to JCT US95/SH6	S07209A	8883
SP3-1	I15, Sage JCT to Dubois, South Bound Lane	I 076580 / A 010(010)	10010
SP3-2	US20, JCT US26 to Bonneville County Line	Stp 6420(106)	9239
SP3-3	SH75, Bellevue to Hailey	A 009(865)	9865
SP3-4	US20, Rigby, North and South	NH 6470(134)	9005
SP3-5-1	Oak Street, Nez Perce, Lewis County (SH62 & SH162)	ST 4749(612)	9338
SP3-5-2	Oak Street, Nez Perce, Lewis County (SH62 & SH162)	ST 4749(612)	9338
SP3-5-3	Oak Street, Nez Perce, Lewis County (SH62 & SH162)	ST 4749(612)	9338
SP3-5-4	Oak Street, Nez Perce, Lewis County (SH62 & SH162)	ST 4749(612)	9338
SP3-5-5	Oak Street, Nez Perce, Lewis County (SH62 & SH162)	ST 4749(612)	9338
SP3-6	US30, Topaz to Lava Hot Springs	NH A010(455)	10455
SP3-7	US95, Payson	NH 4110(144)	8353
SP3-8	US20, MP112.90	NH 3340(109)	9106
SP3-9	Pullman to Idaho State Line, WA 270 (0.5 inch Mix)	01A-G71985(270)	7120
SP3-10	Pullman to Idaho State Line, WA 270 (1 inch Mix)	01B-G71974(270)	7120
SP4-1	Broadway Ave., Rossi St. to Ridenbaugh Canal Bridge	A 009(812)	9812
SP4-2	I84, Left to Sebree	A 010(533)	10533
SP4-3	US30, Alton Road to MP454/Dingle	NH 1480(127)	9543
SP4-4	I84, Jerome IC	IM 84-3(074)165	8896
SP5-1	I84, Ten Mile Rd to Meridian IC, Reconstruction	A 0011(003)	11003
SP5-2	I15, Deep Creek to Devil Creek IC	A 011(094)	11094
SP5-3	SH55, East Bound Ramps to Fairview Ave.	A 010(527)	10527
SP5-4	US95, Moscow Mountain Passing Lane	A 011(031)	11031
SP6-1	I84, Brierley to Declo & Heyburn IC Overpass	IM 84-3(071)211	9219
SP6-2	Garry Bridge IC & 11th Ave to Garrity	A 010(915) & A 011(974)	10915 & 11974

Binder (AC)

Master Curves Fitting
Parameters for All Mixes

Back to Main Screen

Select Mix ID

Figure 520.07.09.2: 2020 PMED Spreadsheet HMA Mix Selection Tab

This will open a page specific to that mix ID presenting various tables providing the mechanical properties for that mix with an example shown in Figure 520.07.09.3.

Mix ID	Project ID	Project No.	Key No.
SP3-3	SH75, Bellevue to Halley	A 009(865)	9865

Dynamic Modulus

Asphalt Mix Dynamic Modulus (Level 1)						
Temp (°F)	Mixture E* (psi)					
	0.1	0.5	1	5	10	25
14	2.09E+06	2.23E+06	2.27E+06	2.33E+06	2.37E+06	2.40E+06
40	8.81E+05	1.26E+06	1.43E+06	1.85E+06	2.02E+06	2.25E+06
70	1.37E+05	2.79E+05	3.63E+05	6.33E+05	7.70E+05	9.76E+05
100	1.42E+04	3.26E+04	4.87E+04	1.18E+05	1.68E+05	2.53E+05
130	7.31E+03	1.13E+04	1.50E+04	3.44E+04	5.16E+04	8.83E+04

Note: Data in red color have E* values lower than MEPDG minimum value (10,000 psi). When inputting these values into MEPDG, users should enter minimum E* value =10,000 psi.

Aggregate Gradation (Levels 2&3 E* Inputs)	
% Passing 3/4" sieve	100
% Passing 3/8" sieve	69
% Passing #4 sieve	46
% Passing #200 sieve	5.2

Asphalt General (All Input Levels)	
Reference Temperature (°F)	70
Effective Binder Content (%)	10.3
Air Voids (%)	6.8
Total Unit Weight (pcf)	140.8

Asphalt Binder

Superpave Binder Test Data on RTFO Aged Samples (Levels 1&2)		
Temp (°F)	At Angular Frequency = 10 rad/sec	
	G* (Pa)	Delta (°)
40	2.46E+07	57.96
70	1.40E+06	60.92
100	6.84E+04	73.70
130	5.78E+03	82.02

PG 58-28 (Level 3)

Gyratory Stability (GS)	
Binder Content by Weight (%)	5.37
Maximum Specific Gravity (G _{max})	2.421
Bulk Specific Gravity (G _{mb})	2.257
Gyratory Stability (kN.m)	12.68

SP3-1 to SP3-4 E* Master Curves

Go Back to Mix Selection Screen

Creep Compliance & IDT Test Data

Mix General

Figure 520.07.09.3: PMED Spreadsheet HMA Mix ID Mechanical Properties Tab

520.07.10 Dynamic Modulus. This control should be entered first and allows the designer to define the Level 1 dynamic modulus values of the asphalt concrete mixture. After the specific mix is selected in the PMED spreadsheet, the “Asphalt Mix Dynamic Modulus (level 1)” values presented in the dynamic modulus table shown in Figure 520.07.09.3 can be entered into Pavement ME by first selecting the dynamic modulus dropdown option and entering the data as shown in Figure 520.07.10.1.

From the dropdown menu for the “Dynamic Modulus Input Level” first select 1. Then adjust the number of temperature and frequency levels and modify the frequency values (row highlighted in red in Figure 520.07.10.1) to match the values provided in the PMED spreadsheet for the selected mix and complete the table accordingly. The easiest way to complete the table is once the number of rows and columns are set, simply copy and paste the data from the PMED spreadsheet into the Pavement ME input table.

Dynamic modulus input level 1

Select temperature levels 5 Select frequency levels 6

	Frequency (Hz)	----->				
Temperat...	<u>0.1</u>	<u>0.5</u>	<u>1</u>	<u>5</u>	<u>10</u>	<u>25</u>
14	2090000	2230000	2270000	2350000	2370000	2400000
40	881000	1260000	1430000	1850000	2020000	2250000
70	137000	279000	363000	633000	770000	976000
100	14200	32600	48700	118000	168000	253000
130	7310	11300	15000	34400	51600	88300

* Dynamic modulus input values are in psi.

Dynamic modulus (Input level 1)

Dynamic modulus input level 1

Level 1 (psi)

Temperature − +

Frequency − +

	0.1	0.5	1	5	10
14	2072501	2416819	2557524	2860660	2979845
40	996458	1316403	1464110	1818802	1972761
70	304197	457342	539790	771436	888045
100	89575	138361	167195	258415	310285
130	34834	50504	59929	90974	109579

Run Dynamic Modulus

Figure 520.07.10.1: Pavement ME Dynamic Modulus Dropdown Input Menu

520.07.10.01 Asphalt Binder. This control is conditional on the level of input entered for the dynamic modulus and will automatically adjust accordingly. Once the specific mix is selected in the PMED spreadsheet, the “Superpave Binder Test Data on RTFO Aged Samples (level 1 & 2)” values presented in the asphalt binder table shown in Figure 520.07.09.3 can be entered into Pavement ME by first selecting

Asphalt Layer
 Thickness (in) ☒ 10

Mixture Volumetrics
 Air voids (%) ☒ 6.8
 Effective binder content (%) ☒ 10.3

Poisson's ratio
 Is Poisson's ratio calculated? ☒ True
 Poisson's ratio Parameter A ☒ -1.63
 Poisson's ratio Parameter B ☒ 3.84E-06
 Poisson's ratio ☒ (calculated)
 Unit weight (pcf) ☒ 140.8

Mechanical Properties
 Asphalt binder ☒ Level 1 - SuperPave:
 Creep compliance (1/psi) ☒ Input level:3
 Dynamic modulus ☒ Input level:1
 Select HMA Estar predictive model ☒ Use Viscosity based model (nationally calibrated).
 Reference temperature (deg F) ☒ 70
 Indirect tensile strength at 14 deg F (psi) ☒ Input level:3

Thermal
 Heat capacity (BTU/lb-deg F) ☒ 0.23
 Thermal conductivity (BTU/hr-ft-deg F) ☒ 0.67
 Thermal contraction ☒ 1.3E-05
 Aggregate coefficient of thermal contraction (in/in/deg F) ☒
 Is thermal contraction calculated? ☒ False
 Mix coefficient of thermal contraction (in/in/deg F) ☒ 1.3E-05
 Voids in Mineral Aggregate (%) ☒

Callout Boxes:
 - Enter selected asphalt mix general inputs (points to Air voids and Effective binder content)
 - Enter level 3 input for creep compliance & indirect tensile strength (points to Creep compliance and Indirect tensile strength)
 - Leave default values (points to Thermal section)

Figure 520.07.10.02.1: Pavement ME General Mix Input Menu

the “Superpave Performance Grade” option and then complete the table by entering the data from the PMED spreadsheet into the input table as shown in Figure 520.07.10.01.1.

520.07.10.02 Air Voids, Effective Binder Content, Unit Weight. Asphalt mix general inputs can be found in the Mechanical Properties Tab of the PMED spreadsheet for the selected mix as shown in Figure 520.07.09.3. This input can be entered directly in their respective row in the “Mixture Volumetrics” tab of Structure pane as shown in Figure 520..1. The asphalt content by mixture weight is needed for version 3.0 for the wearing surface for the top-down cracking prediction.

520.07.10.03 Creep Compliance. This control input can be set to Level 3 which will allow the software to internally compute the creep compliance based on statistical relationships with previously entered inputs (see Figure 520.07.10.02.1). Furthermore, see page 96 of the DUG for additional information regarding this calculation.

☒ Level 1 - SuperPave:		
☒ Superpave Performance Grade ☐ Penetration/Viscosity Grade		
Temperature (deg F)	Binder Gstar (Pa)	Phase angle (deg)
40	24600000	57.96
70	1400000	60.92
100	68400	73.7
130	5780	82.02
*		

Version 3.0 of the PMED software revised the input level 2 creep compliance values. Creep compliance values can be estimated from the measured input level 1 dynamic modulus data. Prior to version 3.0, there was a bias between all input levels. After the new creep compliance input level 2 was implemented in version 3.0, no bias was detected between input levels 1/2 but there is still as bias between input level 3 and the other input levels. The transverse or thermal cracking transfer function was calibrated with version 2.5.5 for ITD using input level 3. Thus, creep compliance input level 3 should be used for the transverse or thermal cracks calibration coefficients.

Asphalt Binder (Level 1 - Superpave)

☒ Superpave performance grade
☐ Penetration/Viscosity Grade

Superpave Binder

Temperature (°F)	Binder G* (Pa)	Phase angle (deg)
50 ✓	8760500 ✓	56.1 ✓
71.6 ✓	1137500 ✓	65.3 ✓
93.2 ✓	133450 ✓	72.9 ✓
114.8 ✓	17800 ✓	79.1 ✓
136.4 ✓	3180 ✓	84.1 ✓

Figure 520.07.10.01.1: Pavement ME Asphalt Binder Dropdown Input Menu

520.07.10.04 Indirect Tensile Strength at 14 Degrees Fahrenheit. This control input can be set to Level 3 which will allow the software to internally compute the indirect tensile strength based on statistical relationships with previously entered inputs (see Figure 520.07.10.02.1). Additionally, see page 95 of the DUG for additional information regarding this calculation.

520.07.10.05 Thermal Input Properties. Can be accessed by clicking the “AC Thermal” tab as shown in Figure 520.07.10.05.1. Use default properties as detailed below and shown in Figure 520.07.10.05.1.

- **Heat Capacity:** Use default value set in program of 0.23 BTU/(lb)(°F).
- **Thermal Conductivity:** Use default value set in the program of 0.67 BTU/(hr)(ft)(°F).
- **Thermal Contraction:** Use default value set in the program by selection the following:
 - **Is mix coefficient of thermal contraction calculated:** Select the option (It should be selected by default).

- **Aggregate coefficient of thermal contraction:** No input necessary.
- **Void in mineral aggregate (%)** Use Default determined from the effective asphalt content by volume and air voids at the time of construction, not from the mixture design.

520.07.11 Jointed Plain Concrete Pavement (JPCP) Design Properties (New Pavement). When selecting the JPCP Design Properties Pane the design property input page in the central pane will change requesting the input shown in Figure 520.07.11.1 with Pavement ME definitions and ITD recommended input from DUG for each item provided below.

Figure 520.07.11.1: JPCP Design Properties Input

520.07.11.01 PCC surface shortwave absorptivity. Use default value set in program of 0.85.

520.07.11.02 Doweled Joints.

- **Dowel diameter (in.):** Required dowel diameter typically increases with slab thickness. Dowels are typically available commercially with diameters of 1.00, 1.25, and 1.50 inches. Others are available but at a much higher cost. Pavement ME will indicate joint faulting as “Failed” if the chosen bar is too small. The dowel diameter should be increased until faulting has “Passed” the criteria. Minimum dowel bar diameters is keyed to slab thickness from ITD’s Standard Drawing 409-1:
 - 1.00 in. for less than 8 in. thickness
 - 1.25 in. 8-11 in. thickness.
 - 1.50 in. for 11 to 13 in. thickness.

- 1.75 in. for > 13 in. thickness.

Other options to reduce faulting maybe more cost effective, and include reduce the joint spacing, widen the PCC traffic lane slab width, or change the layer beneath the PCC slab – changing the erodibility index. Transverse joint load transfer efficiency (LTE) is shown graphically over time in the output. This should be above 90% over the analysis period.

- **Dowel spacing (in.):** Per ITD's Standard Drawing 409-1, use 12 in. unless otherwise directed by the Project Engineer.
- **Is joint doweled?:** This control gives the designer a option to select it or not. . By checking the box (✓) to the right of this control presents the options for selection. Select it to include dowels in the design. Do not select to design without dowels. For ITD projects, select this option to include load transfer in all pavements.

520.07.11.03 Erodibility Index.

- Asphalt (permeable or dense graded) base: select 1 or 2, extremely to very erosion resistant.
- Granular unbound aggregate base: select 3 or 4, erosion resistant to fairly erodible. The resistance to erosion for the aggregate bases is dependent on the amount of fines and gradation of the aggregate base layer. The fewer the amount of fines, the more erosion resistant the aggregate base.

520.07.11.04 PCC base contact friction.

- **Months until friction loss:** For asphalt (permeable or dense graded) base and unbound material base use full design analysis period.
- **Unbonded JPCP:** This control gives the designer option to select or not. Keep it unmarked.

520.07.11.05 PCC Joint Spacing (ft.)

- **Is this joint spacing random?:** This control gives the designer a option to select or not. Typically, do not select it unless otherwise directed by the Project Engineer.
- **Joint Spacing (ft.):** If less than 10 in. concrete pavement thickness select 12 ft. design joint spacing. For concrete pavement thickness greater than 10 in. select 15 ft. design joint spacing per Drawing 409-1. All joints should be perpendicular & of uniform spacing.

520.07.11.06 Permanent Curl/Warp Effective Temperature Difference (°F). Use default value set in program of -10.

520.07.11.07 Sealant Type. By clicking the arrow sign (V) to the right of this control presents options. Select “Other (Including No Sealant... Liquid... Silicone)” to include these sealant types in the design. Select “Preformed” to include preformed seals such as compression seals in the design. For ITD projects, select Other (Including No Sealant... Liquid... Silicone) for this option in most cases. Typically, a single sawcut with hot applied sealant, or as specified in plans. Select Preformed in the dropdown menu if this type of seal is desired. Historically, neoprene compression seals have performed well in Idaho. See Standard Drawing 409-1.

520.07.11.08 Tied Shoulders.

- **Tied shoulders?:** This control gives the designer a option to select or not. Select it as per Drawing 409-1.
- **Load transfer efficiency (%):** Global default is 50%. Per DUG for tied PCC shoulders use long term load transfer efficiency of 40%.

520.07.11.09 Widened Slab.

- **Is slab widened?:** This control gives the designer a option to select or not. Select it if slab width is greater than 12 feet or do not select if slab width is 12 feet. The typical roadway detail in Standard Drawing 409-1 has a 14-foot wide travel lane.
- **Slab width (ft.):** This option allows the designer to define the slab width. Note that slab width is defined only when widened PCC slab option is applied. Otherwise, ME Design assumes a standard 12-ft slab width. The width of the PCC slab should not exceed 14 feet under any case, because of the increased potential for the occurrence of longitudinal cracks. In general, it is suggested the slab width not exceed 13 feet. The PMED software does not calculate the occurrence of longitudinal cracks in the PCC slab.

520.07.12 JPCP Structure Properties. New JPCP structure properties are entered by clicking the “Structure” Pane and select the PCC pavement layer,. This will open the material properties page in the screen as shown in Figure 520.07.12.1.

▼ PCC	
Poisson's ratio	☒ 0.16
Thickness (in)	☒ 11
Unit weight (pcf)	☒ 140.2
▼ Thermal	
PCC coefficient of thermal expansion (in/in/deg F x 10 ⁻⁶)	☒ 3.79
PCC heat capacity (BTU/lb-deg F)	☒ 0.28
PCC thermal conductivity (BTU/hr-ft-deg F)	☒ 1.25
▼ Mix	
Aggregate type	Limestone (1)
Cementitious material content (lb/yd ³)	☒ 729
Cement type	Type I (1)
Water to cement ratio	☒ 0.34
Curing method	Wet Curing
Reversible shrinkage (%)	☒ 50
▼ PCC zero-stress temperature (deg F)	☒ Calculated
Calculated internally?	True
User-specified PCC set temperature	☒
Time to develop 50% of ultimate shrinkage (days)	☒ 36
▼ Ultimate shrinkage (microstrain)	☒ 545.8 (user defined)
Calculated internally?	False
User-specified PCC ultimate shrinkage	☒ 545.8
▼ Strength	
PCC strength and modulus	☒ Level 2 28 day Compressive(5080)

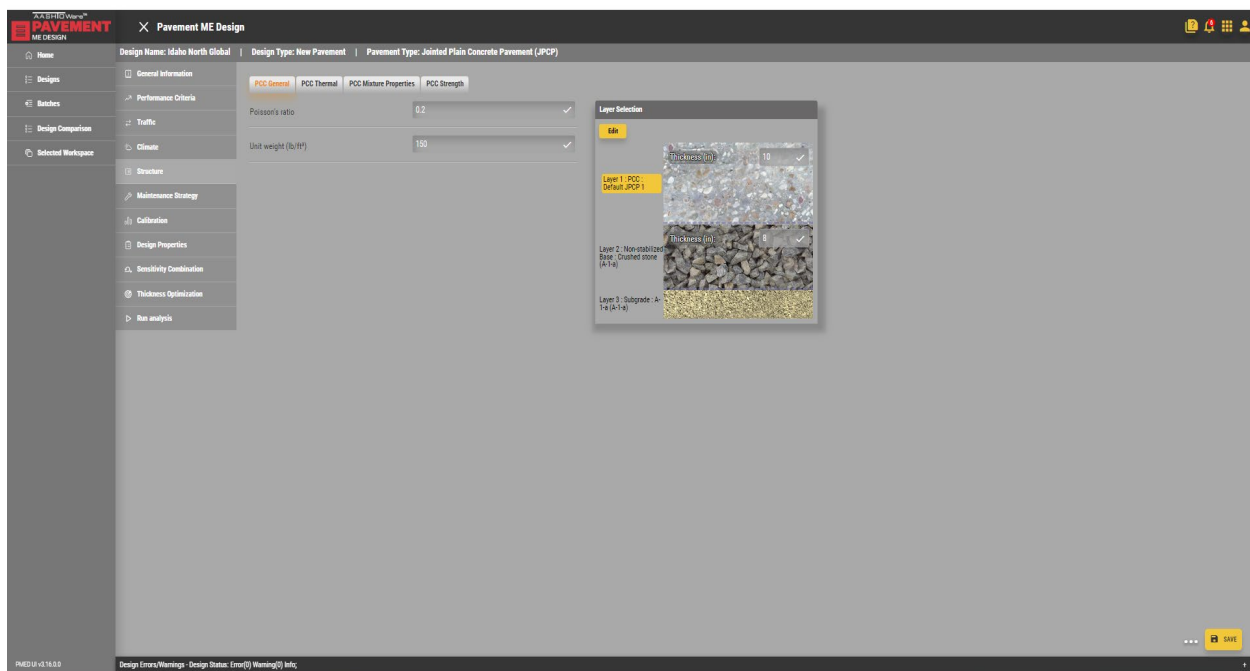


Figure 520.07.12.1: PCC Structure Properties Input

The PCC structure properties input has four tabs as shown in Figure 520.07.12.1. These are “PCC General”, “PCC Thermal”, “PCC Mixture Properties”, and “PCC Strength”.

Open the 2020 PMED spreadsheet and follow the steps below in order to complete the JPCP structure input.

520.07.13 PMED Spreadsheet. The spreadsheet “Main-Screen” tab is shown in Figure 520.07.13.1 Click on the PCC circle which is outlined in light blue as indicated by the red arrow.



Figure 520.07.13.1: 2017 PMED Spreadsheet Main Screen Tab

This will open the “PCC-Selection-Screen” tab as shown in Figure 520.07.13.2. This tab displays a list of commonly used PCC mixes from various ITD Districts. The designer will select the “Mix ID” that most closely represents the PCC type for their specific project. This is done by simply clicking on the chosen mix ID from the “Mix ID” column.

PCC Mix Selection Sheet				
Mix ID	District Number with Mixture Description	Cement Type Specified by Mixture Design	Fly Ash Type Specified by Mixture Design	
PCC-1	District 1, SH-5 Bridge Crossing	Lafarge Type I/II	No Fly Ash	
PCC-2	District 1, I-90 Lookout Paving Mixture 2015	Lafarge Type I	Centralia	
PCC-3	District 1, I-90 Lookout Paving Mixture 2016	Lafarge Type I	Sundance	
PCC-4	District 2, Thain Road Paving Mixture	Ash Grove Type I/II	Sundance	
PCC-5	District 2, US-95 Race Creek Bridge	Ash Grove Type I/II	ENX Genesee Class F	
PCC-6	District 3, I-84 Paving Mixture	Ash Grove Type I	Type F, Headwaters	
PCC-7	District 5, US-90 Paving Mixture	Ash Grove Type I /II	Naavajo	
PCC-8	District 6, Thornton Interchange Mixture	Lafarge Type I/II	Naavajo	

[Back to Main Screen](#)

Figure 520.07.13.2: 2020 PMED Spreadsheet PCC Mix Selection Tab

This will open a page specific to that mix ID presenting various tables providing the JPCP structure properties for that mix with an example shown in Figure 520.07.13.3.

Back to PCC Mix Selection

Raw data Files

District 5 - US-90 Paving Mixture

PCC

Unit weight (pcf)	140.2
Poisson's ratio	0.16

Thermal

PCC coefficient of thermal expansion (in./in./deg F x 10 ⁻⁶)	3.79
PCC thermal conductivity (BTU/hr-ft-deg F)	1.25
PCC heat capacity (BTU/lb-deg F)	0.28

Mix

Cement type	Type I (1)
Cementitious material content (lb/yd ³)	729
Water to cement ratio	0.34
Aggregate type	Limestone (1)
PCC zero-stress temperature (deg F)	
Ultimate shrinkage (microstrain)	545.833
Reversible shrinkage (%)	50
Time to develop 50% of ultimate shrinkage (days)	36
Curing method	Wet Curing

Strength

Level 1: PCC strength and modulus

Time	Modulus of rupture (psi)	Elastic modulus (psi)	Split tensile strength (psi)
7-day	654	4.03E+06	420
14-day	730	3.75E+06	434
28-day	775	4.32E+06	514
90-day	791	4.30E+06	574
20-year/28-day	1.2	1.2	1.2

Level 2: PCC strength and modulus

Time	Compressive strength (psi)
7-day	4540
14-day	4850
28-day	5080
90-day	5930
20-year/28-day	1.35

Level 3: PCC strength and modulus

Time	Compressive strength (psi)	OR	Modulus of rupture (psi)
28-day	5080		775

Note: AASHTOWare ME Design requires only one value (Compressive strength or Modulus of rupture)

Figure 520.07.13.3: 2020 PMED Spreadsheet PCC Mix ID Structure Properties Tab

Following the steps above and using the data provided in the PMED spreadsheet for the selected mix, the following structure properties can be selected.

520.07.13.01 PCC General.

- **Poisson's Ratio:** This control allows the designer to define the Poisson's ratio as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **Thickness (in.):** This control allows the designer to define the design thickness in inches. It is entered in the "Layer Selection" pane.
- **Unit Weight (pcf):** This control allows the designer to define the unit weight as provided in the PMED spreadsheet (see Figure 520.07.13.3).

520.07.13.02 PCC Thermal.

- **PCC Coefficient of Thermal Expansion (in./in./°F x 10⁻⁶):** This control allows the designer to define the PCC coefficient of thermal expansion as provided in the PMED spreadsheet (see Figure 520.07.13.3). The PCC coefficient of thermal expansion is dependent on the type of aggregate included in the PCC mixture.
- **PCC Heat Capacity (BTU/(lb.)(°F):** This control allows the designer to define the PCC heat capacity as provided in the PMED spreadsheet (see Figure 520.07.13.3).

- **PCC Thermal Conductivity (BTU/(hr)(ft.)(°F)):** This control allows the designer to define the PCC thermal conductivity as provided in the PMED spreadsheet (see Figure 520.07.13.3).

520.07.13.03 PCC Mixture Properties.

- **Aggregate Type:** This control allows the designer to define the aggregate type as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **Cementitious Material Content (lb/yd³):** This control allows the designer to define the cementitious material content as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **Cement Type:** This control allows the designer to define the cement type as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **Water to Cement Ratio:** This control allows the designer to define the water to cement ratio as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **Curing Method:** This control allows the designer to define the curing method as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **Reversible Shrinkage (%):** This control allows the designer to define the reversible shrinkage as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **PCC Zero-Stress Temperature (°F):** Computed internally in the software.
 - **Calculated internally?:** Select True.
 - **User-specified PCC set temperature:** No input required.
- **Time to Develop 50% of Ultimate Shrinkage (days):** This control allows the designer to define the time to develop 50% of ultimate shrinkage as provided in the PMED spreadsheet (see Figure 520.07.13.3).
- **Ultimate Shrinkage (microstrain):**
 - **Calculated internally?:** Do not select .
 - **User-specified PCC ultimate shrinkage:** This control allows the designer to define the ultimate shrinkage as provided in the PMED spreadsheet (see Figure 520.07.13.3).

520.07.13.04 PCC Strength and Modulus. This control allows the designer to define the PCC strength and elastic modulus. For this input click the dropdown menu and for PCC strength input level and select Level 2. This will give a table to input the compressive strength at 7-, 14-, 28-, and 90-days as well as the 20-yr and 28-day PCC compressive strength ratio as shown in Figure 520.07.13.04.1. The input for this table is provided in the PMED spreadsheet as shown in Figure 520.07.13.3 and the designer can copy and paste the input into the PCC strength input table.

PCC strength and modulus

PCC strength input level: 2

Time	Compressive strength (psi)
7-day	4259.28 ✓
14-day	4609.7 ✓
28-day	5275.35 ✓
90-day	6569.53 ✓

20-year/28-day ratio of compressive strength: 1.44 ✓

Figure 520.07.13.04.1: Pavement ME PCC Strength Dropdown Input Menu

There is a unique relationship between the PCC compressive strength and elastic modulus of a PCC mixture that will result in the same amount of fatigue cracks (percent cracked slabs) over the design period, all other variables being constant. The unique relationship is dependent on the PCC slab thickness and the threshold value for percent cracked slab. This relationship between the compressive or flexural strength and elastic modulus can be used to evaluate other PCC mixtures in terms of whether those mixtures are more or less resistant to fatigue cracking than the PCC mixtures included in the XML files. The following figure demonstrates the example relationship. PCC mixtures with strength-elastic modulus values plotted above the relationship are less resistant to fatigue cracking, while the PCC mixtures below the relationship are more resistant to fatigue cracking.

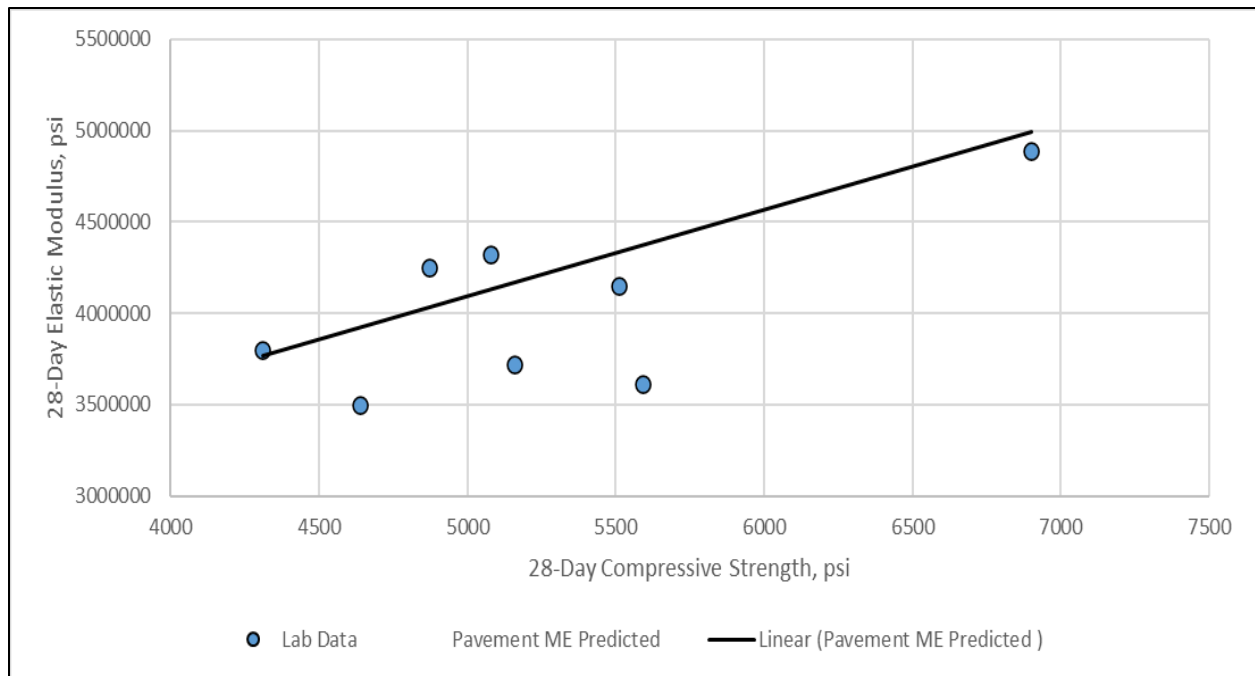


Figure 520.07.13.04.2: Relationship Between The PCC Compressive Strength and Elastic Modulus of a PCC Mixture

520.07.14 Semi-Rigid Pavement Design Properties (New Pavement). Semi-rigid pavement option in Pavement ME does not include the Cement Recycled Asphalt Base Stabilization (CRABS) rehabilitation options as noted previously. Characteristically at two percent Portland cement added to the soil mixture results in a resilient modulus typically below the recommended values >150,000 psi set in the software. The direction from Pavement ME experts and the DUG is to treat ITD's typical CRABS layer as a non-stabilized base with a higher modulus. Per the DUG, "This material is considered an unbound layer with only a small percentage of Portland cement added to the recycled material. The amount of Portland cement added results in an increase of stiffness, but not a layer that is subject to fatigue cracking." In other words, the amount of Portland cement added to the chemically stabilized layer is insufficient for the layer to exhibit flexural strength and subject to fatigue cracking.

If the designer wants to increase the resilient modulus of the chemically stabilized layer by increasing the cement added to the material, thereby increasing the resilient modulus above 150,000 psi, then a semi-rigid pavement may be selected.

After entering the layer/design and structure properties for the asphalt concrete and chemically stabilized layer the, the next step is to add the different sub layers of the pavement structure as described below.

520.07.15 Pavement Reclamation. Cold-in-Place (CIR) and Hot-in-Place (HIR) pavements will be considered as HMA equivalent in Pavement ME. Per DUG, “The air voids and percent binder should represent the in place material considering the amount of asphalt binder added to the recycled HMA. The amount of asphalt binder should have been determined using laboratory mixture design procedures.”

520.08 Pavement Structure Below Wear Surface The pavement design layers below the wear surface and their thicknesses will need to be defined. These layers typically include base, subbase, embankment, subgrade, and bedrock as detailed below. In order to add these layers click on the “Edit” of the Layer Selection Tab and depending on the type of analysis being performed a cross section showing the first one or two layers will be shown as seen in Figure 520.08.1. To add additional layers, simply search for the layer on the right using the search filter or manually. Then, drag the layer from the right to the left onto the existing structure. To overwrite a new layer, check the box next to Overwrite and repeat the procedure to add a new layer. this will update the cross-section figure to include the new layer. Continue adding layers until all design layers for the project are included (base, subbase, embankment, subgrade, and bedrock).

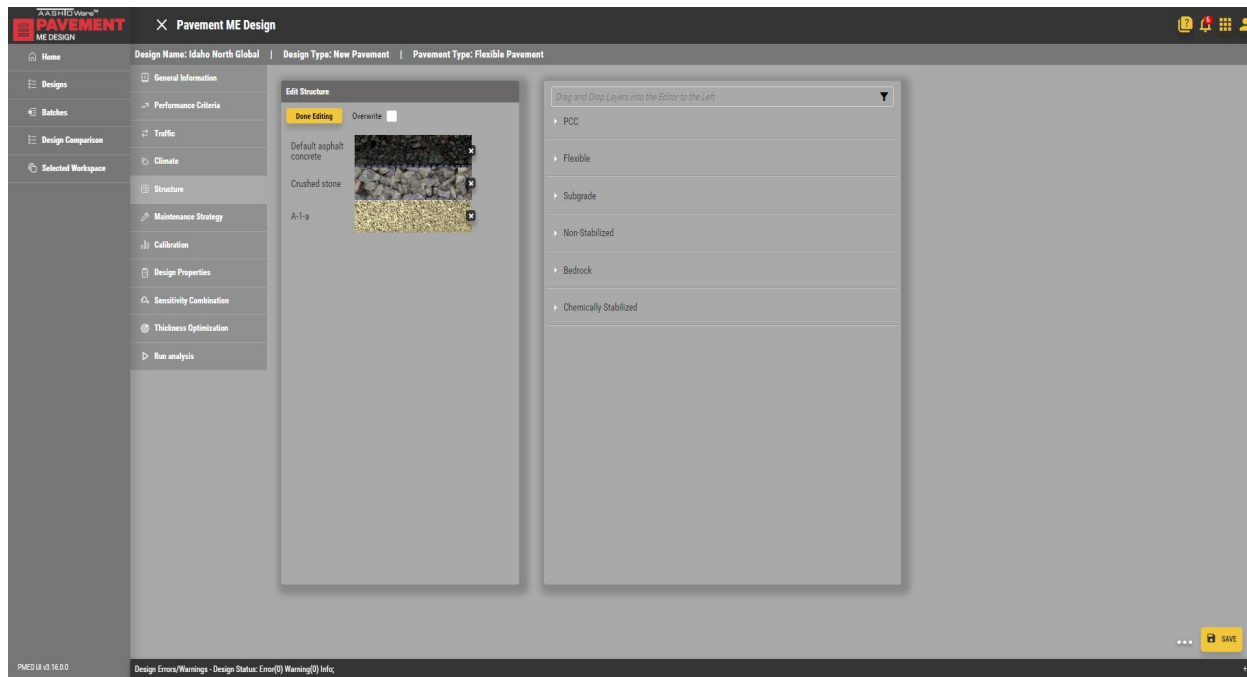


Figure 520.08.1: Material Layer Selection

After the layers have been defined, the soil properties can still be altered by clicking on the layers in the Structure Pane and select each layer. This will open the material properties page in the Structure Pane where the properties can be entered or adjusted as shown in Figure 520.07.12.1.

The following sections break down the recommended input for the Base/Subbase layer(s), Chemically Stabilized Soil (CRABS), Embankment/Subgrade layer(s), and bedrock.

520.08.01 Base/Subbase Recommended Input Common base and subbase types used by ITD include: Emulsion Treated Base, Untreated Aggregate Base, Open-Graded Base, and Granular Subbase. For rehabilitated pavement design or reconstruction of existing pavements, the following bases are commonly used by ITD: CRABS, Cold-in-Place Recycle (CIR), and Hot-in-Place Recycle (HIR). CRABS and CIR without adding any stabilizer are to be treated in the PMED software as “non-stabilized granular bases” with slight variation. However, Paragraph 520.07.15 states that CIR and HIR mixtures are to be considered as HMA equivalent mixtures/layers assuming they are designed and built as dense-graded asphalt mixtures are described under paragraphs 520.07.08. CRABS and CIR layers with a minimum amount of a stabilizer are to be simulated as an non-stabilized granular base with a constant or representative modulus value. Input parameters for CRABS as described in [Chemically Stabilized Soil](#)  Pavement Structure [\(CRABS\) Base Recommended Input](#) section below.

520.08.01.01 Unbound Properties. This input is shown in Figure 520.08.2.

- **Coefficient of Lateral Earth Pressure:** The coefficient of lateral earth pressure is not used in the PMED software for determining the resilient modulus of the unbound layers. The coefficient of lateral earth pressure is only applicable to the finite element response module which is not used in any of the version after the rudimentary version of the software was submitted to AASHTOWare.
- **Layer Thickness (in.):** This control allows the designer to define the thickness, in inches, of the selected layer.
- **Poisson’s Ratio:** This control allows the designer to define the Poisson’s ratio of the material. For all unbound aggregate for base and subbase layers use a value of 0.35.

Design Name: Idaho North Global

Design Type: New Pavement

Pavement Type: Jointed Plain Concrete Pavement (JPCP)

General Information

Performance Criteria

Traffic

Climate

Structure

Maintenance Strategy

Calibration

Design Properties

Sensitivity Combination

Thickness Optimization

Run analysis

Unbound

Modulus

Sieve

Coefficient of lateral earth pressure0.5

Poisson's ratio0.35

Layer Selection

Edit

Thickness (in):10

Layer 1: PCC: Default JPCP 1

Thickness (in):8

Layer 2: Non-stabilized Base: Crushed stone (A-1-a)

Layer 3: Subgrade: A-1-a (A-1-a)

SAVE

Figure 520.08.2: Unbound Material Properties

520.08.01.02 Modulus Properties. This input is shown in Figure 520.08.01.02.011.

520.08.01.02.01 Resilient Modulus (psi): This control allows the designer to define the resilient modulus (M_r). For this input click the resilient modulus dropdown menu and enter the input accordingly. For the “Input Level” select Level 2 or 3 accordingly as shown in Figure 520.08.01.02.01.1 (Level 1 is not available as a choice). ITD recommends level 2 input be used where applicable, but if lab testing or FWD data is not available then level 3 input may be used. Follow the steps below to obtain the input and modulus values for the respective levels.

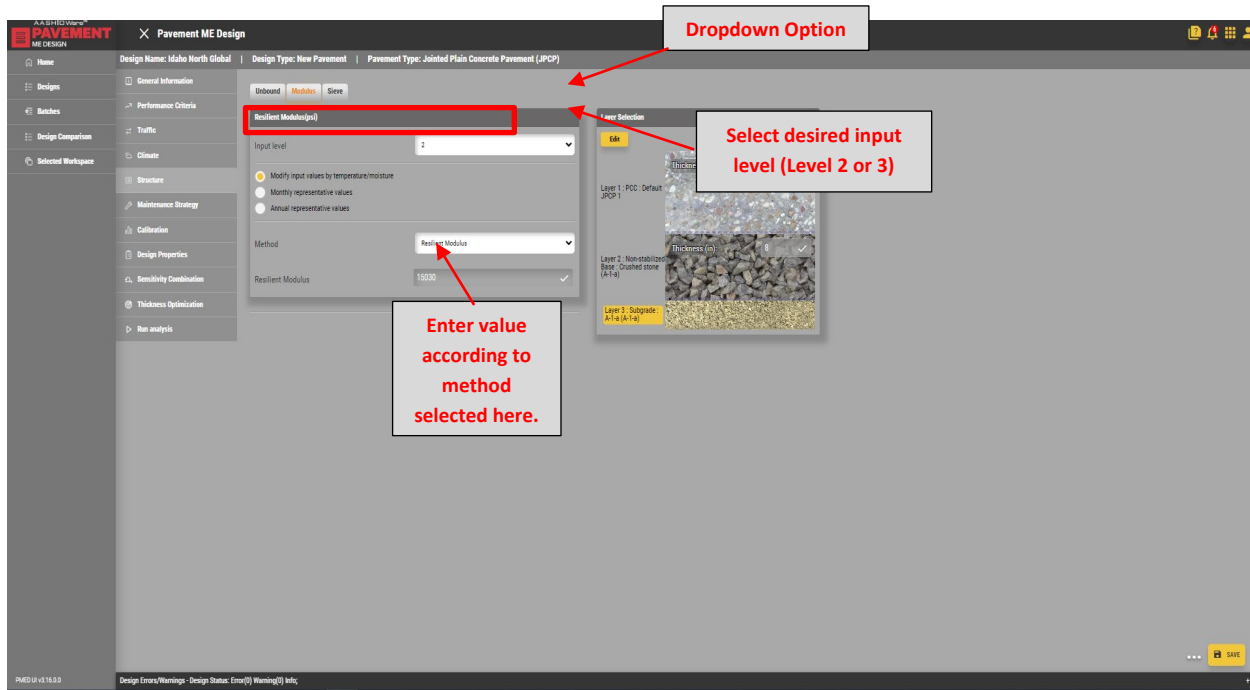


Figure 520.08.01.02.01.1: Pavement ME Resilient Modulus Dropdown Input Menu

520.08.01.03 Analysis Type. This control tells the software whether to use the Enhanced Integrated Climatic Model (EICM) or not for each layer. According to Pavement ME this “option allows the EICM to calculate the temperature within the unbound layer and determines the months when any sublayer is frozen. The resilient modulus of the frozen sublayers is then increased during the frozen period and decreased during the thaw weakening period. The EICM also calculates the average moisture content or degree of saturation in the unbound layers for each month of the analysis period. The average monthly degree of saturation relative to the water content is used to measure/determine the resilient modulus of each unbound sublayer for each month throughout the analysis period.”

ITD recommends the “Modify Input Values by Temperature/Moisture” option be selected which uses the EICM. This option is used for both Level 2 and Level 3 input. See Figure 520.08.01.02.01.1.

520.08.01.03.01 Input Level 2 Method. For input level 2 this control allows for the following options:

- Resilient Modulus (psi) (AASHTO T 307 or NCHRP 1-28A or backcalculated from FWD)

Note 13: The use of FWD deflection basins to backcalculate the elastic modulus of unbound layers is referred to as rehabilitation input level 1. However, the elastic modulus of unbound layers can be backcalculated for reconstruction of a roadway segment and used in new pavement design strategies. The c-factors are applicable to this condition.

- California Bearing Ratio (CBR)
- R-value
- Layer Coefficient – a_i
- Dynamic Cone Penetrometer (DCP) penetration
- Based on Plasticity Index (PI) and Gradation

The preferred option for ITD projects is measuring and entering the design resilient modulus directly. To measure the resilient modulus of the material, Pavement ME recommends AASHTO T 307 or NCHRP 1-28A tests be completed on the material. These tests will provide the regression coefficients k_1 , k_2 , and k_3 for the generalized constitutive model that defines resilient modulus as a function of stress state. Using these coefficients, the design resilient modulus for the expected in-place stress state can be determined and used in Pavement ME. The average water content and dry density used to measure the resilient modulus in accordance with AASHTO T 307 or NCHRP 1-28A are to be entered with the resilient modulus value. The condition of the test specimens should be representative of the sample condition used to measure the resilient modulus.

Note 14: A standard practice was prepared for AASHTO to estimate the design resilient modulus from the repeated load resilient modulus test outcomes (AASHTO T 307).

For existing unbound base and subbase layers, ITD recommends the use of backcalculated modulus values from the FWD deflection basins for estimating the resilient modulus in addition to the laboratory measured resilient modulus describe above. Backcalculations using FWD data is detailed in Section 530.08 of the Materials Manual and Chapter 7 of the DUG.

When backcalculated modulus values are used from the FWD deflection basin, adjustment factors will need to be applied to adjust the modulus values to laboratory conditions as input in Pavement ME. Table 520.08.01.03.01.1 lists the adjustment factors (C-Value) recommended by Pavement ME. When the FWD deflection basin data are used to backcalculate the elastic modulus of the unbound layers, the average water content and dry density of the unbound layers simulated in the backcalculation process should be entered. In other words, the backcalculated elastic modulus values for each respective layer are tied to the volumetric properties of the unbound layer at the time of deflection testing.

Table 520.08.01.03.01.1: C-Values to Convert the Calculated Layer Modulus Values to an Equivalent Resilient Modulus Measured in the Laboratory (from Table 10-8 from Mechanistic-Empirical Pavement Design Guide, 2020 3rd Edition (MEPDG))

Layer Type	Location	C-Value or M_r/E_{FWD} Ratio
Aggregate Base/Subbase	Between a Stabilized and HMA Layer	1.43
	Below a PCC Layer	1.32

	Below an HMA Layer	0.62
Subgrade- Embankment	Below a Stabilized Subgrade/Embankment	0.75
	Below an HMA or PCC Layer	0.52
	Below an Unbound Aggregate Base	0.35

The other options allow the various methods to be converted to resilient modulus using correlations internal to the software. If resilient modulus testing is unavailable, the preferred option for obtaining M_r is based on R-value tests using Idaho IT-8 or input level 2. The software allows the designer to enter the measured R-value and internally calculates the M_r . However, the regression equation between R-value and resilient modulus is not the ITD regression equation.

The resilient modulus should be calculated from the ITD measured R-value externally from the PMED software and entered in the resilient modulus for input level 3. The other important outcome is the water content and dry density at the end of the R-value test should be entered with the resilient modulus calculated from the ITD R-value. The optimum water content and maximum dry density should not be entered to represent the condition of the test specimen after the R-value test.

If R-value lab testing is unavailable, the designer can estimate the M_r for base and subbase by measuring aggregate material plasticity index and percent passing the No. 200 sieve and entering the values into the "Gradation & other engineering properties" selection and the software internally calculates the M_r .

If DCP or CBR tests are used to estimate the M_r , per Pavement ME "those values may be used as inputs to the MEPDG but should be checked based on local material correlations and adjusted to laboratory conditions, if necessary." If the CBR or DCP tests are conducted and used to calculate the resilient modulus as input level 2, the water content and dry density of the test specimen at the end of the test should be measured and entered in the PMED software for the same reason in using the ITD R-value test. The resilient modulus used in the PMED software must be compatible with the condition of the test specimen (water content and dry density).

520.08.01.03.02 Input Level 3 Method. For Level 3 this control only allows the direct entry of a resilient modulus value with recommended values based on measured M_r values throughout the state as presented in the DUG. These recommended M_r values for untreated aggregate base and granular subbase materials are reproduced from DUG and provided in Table 520.08.01.03.02.1.

Table 520.08.01.03.02.1: Recommended Level 3 Lab Resilient Modulus for Unbound Base/Subbase at Optimum Moisture

ITD Base Classification	AASHTO Classification	Level 3 Estimated Lab M_r at Optimum Moisture (psi)
Item 301 – Granular Subbase	A-2-4, A-2-6, A-3	26,000 – 32,000
Item 303 – Aggregate Base	A-1-a, A-1-b	38,000 – 40,000
Item 307 – Open-Graded Base (Class I – Rock Cap)	NA	25,000 – 60,000

Per Pavement ME, “when input Level 3 is used to estimate the resilient modulus from classification tests, these modulus values represent the optimum moisture content and dry density. Those default values will need to be adjusted if the in-place layer deviates from the optimum moisture content and maximum dry unit weight, as defined by AASHTO T 180 at the time of construction.”

520.08.01.04 Gradation & Other Engineering Properties: Additional properties are required for each base/subbase layer. To access these inputs click on the “Sieve” tab option containing the AASHTO classification for the “Gradation & Other Engineering Properties” as shown in Figure 520.08.01.04.1 and complete the input following the information below.

The screenshot displays the 'Sieve' tab in the 'Gradation & Other Engineering Properties' section of the AASHTOWare Pavement ME Design software. The interface includes a left-hand navigation pane with options like 'Home', 'Design', 'Materials', 'Performance Criteria', 'Traffic', 'Climate', 'Structure', 'Maintenance Strategy', 'Calibration', 'Design Properties', 'Sensitivity Evaluation', 'Thickness Optimization', and 'Run analysis'. The main workspace is divided into two panels: 'Sieve Size' and 'Percent Passing'.

Sieve Size	Percent Passing
0.075 mm	
0.075 mm	
0.075 mm	
#20	100
#40	100
#60	100
#80	100
#100	100
#120	100
#140	100
#160	100
#180	100
#200	100
#250	100
#300	100
#350	100
#400	100
#450	100
#500	100
#560	100
#630	100
#710	100
#800	100
#900	100
#1000	100
Liquid limit	0
Plasticity index	0
Is layer compacted?	☐
Maximum dry unit weight (lb/ft³)	127.0544/1177.8058
Saturated hydraulic conductivity (ft/hr)	0.00079621/0.000965
Specific gravity of solids	2.7
Water content (%)	7.6534/7.9895/7.736

On the right side, there is a 'Layer Selection' panel showing a visual representation of the pavement layers. The layers are labeled as follows:

- Layer 1: PCC (Default)
- Layer 2: Normal gradation base (Concrete base)
- Layer 3: Concrete aggregate

Figure 520.08.01.04.1: Pavement ME Gradation & Other Properties Dropdown Input Menu

- **Sieve Size Table:** This table allows the designer to define the percentage of material passing a given sieve size of the base/subbase material. The designer is required to enter a minimum of 3 sieve size values including the No. 200 sieve.
- **Liquid Limit:** This control allows the designer to define the liquid limit of the base/subbase material. Actual or defaults for soil classification will be used.
- **Plasticity Index:** This control allows the designer to define the plasticity index of the base/subbase material. Actual or defaults for soil classification will be used.
- **Is Layer Compacted?:** ITD requires that the base and subbase material be compacted to a certain density, therefore check this box.
- **Maximum Dry Unit Weight (pcf):** Pavement ME internally computes the maximum dry unit weight of the non-stabilized material, therefore leave box unchecked. The dry unit weight of the unbound layer at the time the resilient modulus was estimated or calculated should be entered. The dry density box should be checked to allow a different value to be entered when different from the maximum dry unit weight. The dry unit weight must be compatible with the density of the test specimen used to determine the resilient modulus that was entered in the PMED software.
- **Saturated Hydraulic Conductivity (ft/hr):** Pavement ME internally computes the saturated hydraulic conductivity of the non-stabilized material, therefore leave box unchecked.
- **Specific Gravity of Solids:** Pavement ME internally computes the specific gravity of the non-stabilized material, therefore leave box unchecked.
- **Water Content (%):** Pavement ME internally computes the moisture content of the non-stabilized material, therefore leave box unchecked. The water content of the unbound layer at the time the resilient modulus was estimated or calculated should be entered. The water content box should be checked to allow a different value to be entered when different from the optimum water content. The water content must be compatible with the water content of the test specimen used to determine the resilient modulus that was entered in the PMED software.
- **User-Defined Soil Water Characteristics Curve (SWCC):** Pavement ME internally computes the coefficients (af, bf, cf, and hr) of the SWCC, therefore leave box unchecked.

520.08.02 Chemically Stabilized Soil (CRABS) Base Recommended Input Chemically stabilized soil or CRABS structure is considered an unbound layer with only a small percentage of Portland cement (2%) added to the recycled material. The amount of Portland cement added results in an increase of stiffness therefore the properties will be slightly different than that of an unbound layer. The following steps detail how to input an ITD CRABS layer in Pavement ME.

To add a CRABS layer, first add a new layer below the flexible pavement as detailed above. For the layer type select “Non-stabilized Base” and then select “Crushed gravel” from the default list as shown in Figure 520.08.02.1.

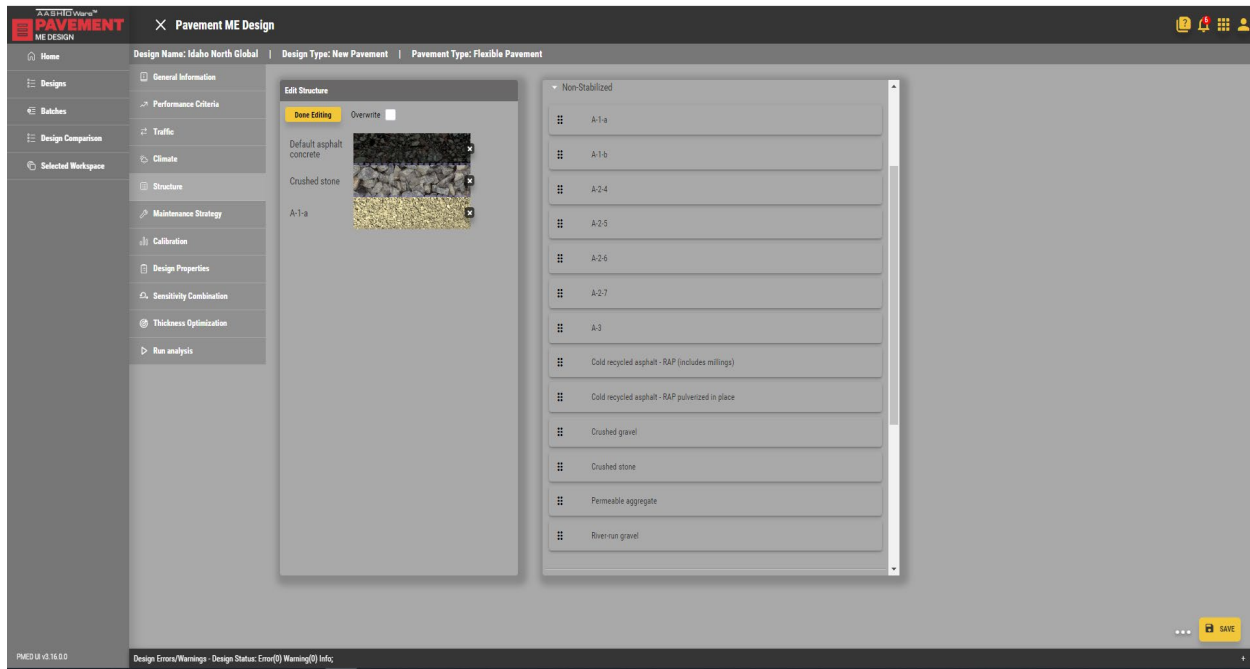


Figure 520.08.02.1: Material Layer Selection for CRABS

The following is a breakdown of the CRABS input properties:

520.08.02.01 Unbound Properties. This input is shown in Figure 520.08.02.1.

- **Coefficient of Lateral Earth Pressure:** This control allows the designer to input the ratio of the lateral earth pressure to the vertical earth pressure. For all projects use a default value of 0.5.
- **Layer Thickness (in.):** This control allows the designer to define the thickness, in inches, of the selected layer.
- **Poisson's Ratio:** This control allows the designer to define the Poisson's ratio of the material. For CRABS base layer use a value of 0.35.

520.08.02.02 Modulus Properties. This input is shown in Figure 520.08.02.1.

- **Resilient Modulus (psi):** This control allows the designer to define the required resilient modulus value of CRABS material. To enter this value first click on the dropdown option for resilient modulus, select Level 3 input, select "Annual representative values" option, and then enter the resilient modulus value in the final box as shown in Figure 520.08.02.02.1.

Modulus

Resilient modulus (psi) ✓

Input Level: 3

Analysis Types

☐ Modify input values by temperature/moisture

☐ Monthly representative values

☒ Annual representative values

Method: Resilient modulus (psi)

80000

Design Name: Idaho North Global | Design Type: New Pavement | Pavement Type: Flexible Pavement

General Information | Performance Criteria | Traffic | Climate | Structure | Maintenance Strategy | Calibration | Design Properties | Sensitivity Combination | Thickness Optimization | Run analysis

Unbound | **Modulus** | Sieve

Resilient Modulus (psi)

Input level: 3

☐ Modify input values by temperature/moisture

☒ Annual representative values

Resilient Modulus (psi): 25000

Enter Value

Layer Selection

Edit

Layer 1: Flexible: Default asphalt concrete

Thickness (in): 3

Layer 2: Non-stabilized Base: Crushed gravel (A-1-a)

Thickness (in): 6

Layer 3: Subgrade: A-1-a

Thickness (in): 18

Select input level 3

Figure 520.08.02.02.1: CRABS Resilient Modulus Input

Recommended M_r value for CRABS are reproduced from DUG and provided in Table 520.08.02.02.1.

Table 520.08.02.02.1: Recommended Level 3 Lab Resilient Modulus for In-Place Recycled Materials

ITD Base Classification	AASHTO Classification	Level 3 Annual Representative Modulus Values (psi)
Item 308 – CRABS	Crushed Gravel	80,000

520.08.02.03 Sieve. This input is shown in Figure 520.08.02.1.

520.08.02.03.01 Gradation & Other Engineering Properties This control allows the designer to define gradation and other properties of the CRABS layer. The designer can keep the AASHTO classification of A-1-a which is the default when “crushed gravel” is selected along with the default gradation for this selection, however, other properties will be adjusted. First click on the “Sieve” tab for the “Gradation & Other Engineering Properties”, for Liquid Limit and Plasticity Index input enter a value of “0” for both and then select the box labeled “Is layer compacted” as shown in Figure 520.08.02.03.01.1.

The screenshot displays the software interface for defining material properties. On the left, a sieve analysis table lists sieve sizes from #8 to 3 1/2 in. Below this, input fields for Liquid limit (0), Plasticity index (0), and a checked box for 'Is layer compacted?' are shown. Further down, input fields for Maximum dry unit weight (129.76455817629767), Saturated hydraulic conductivity (0.05835647948052187), Specific gravity of solids (2.7), and Water content (%) (6.431715979319492) are present. At the bottom, a 'User-defined soil water characteristic curve (SWCC)' section includes input fields for 'af' (7.358073005708661), 'bf' (1.2092196378981814), 'cf' (0.8075285863508163), and 'hr' (100). On the right, the 'Layer Selection' panel shows three layers: Layer 1 (Flexible: Default asphalt concrete), Layer 2 (Non-stabilized Base: Crushed gravel (A-1-a)), and Layer 3 (Subgrade: A-1-a (A-1-a)). Layer 2 is highlighted with a yellow background and shows a thickness of 6 inches.

Figure 520.08.02.03.01.1: CRABS Gradation & Other Engineering Properties

After all the information detailed above is entered, continue to add any additional layers (subbase, embankment, subgrade, bedrock).

520.08.03 Subgrade and Embankment Recommended Input. Subgrade and embankment layers can be added to the pavement structure similar to the base/subbase layers described above. The subgrade/embankment can be classified based on previously completed soil borings and resulting samples and summarized following guidance in Section 240 of ITD’s Materials Manual.

If varying subgrade/embankment soils exist along the project profile, then multiple subgrade/embankment properties will be used, and each section analyzed to optimize the pavement design with the more conservative section controlling the design or multiple pavement sections recommended along the project alignment. Add a layer as shown in Figure 520.08.02.1. This will open a Material Layer Selection dialog box as shown in Figure 520.08.03.1. For the layer type, select “Subgrade” then select the appropriate soils type from the default list as shown in Figure 520.08.03.1.

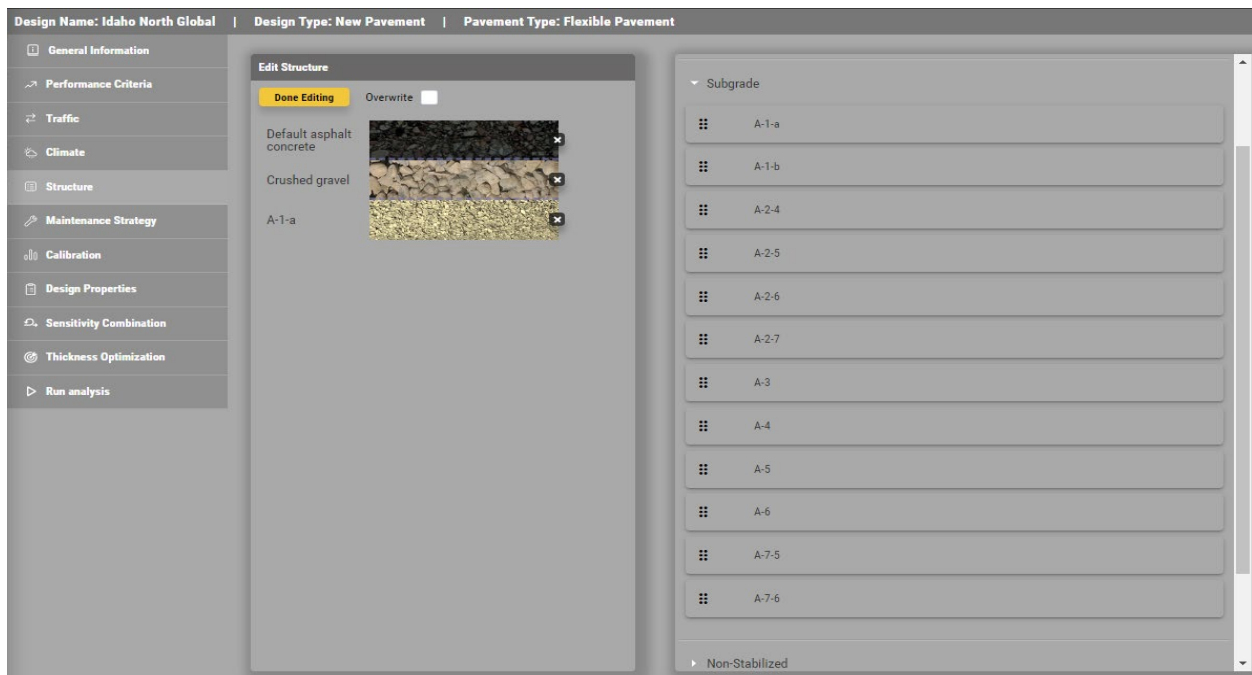


Figure 520.08.03.1: Material Layer Selection for Subgrade

520.08.03.01 Unbound Properties. This input is shown in Figure 520.08.03.1.

- Coefficient of Lateral Earth Pressure:** This control allows the designer to input the ratio of the lateral earth pressure to the vertical earth pressure. For all projects use a default value of 0.5 for subgrade and embankment. However, the coefficient of lateral earth pressure is not used by the PMED software. The coefficient of lateral earth pressure was needed for the finite element response model when subgrade soil input level 1 resilient modulus data was used. The finite element response model is turned off in all current versions of the PMED software, so this variable is not needed or used.
- Layer Thickness (in.):** This control allows the designer to define the thickness, in inches, of the selected layer.

- **Poisson's Ratio:** This control allows the designer to define the Poisson's ratio of the material. For all embankment and subgrade layers use a value of 0.40.

520.08.03.02 Modulus Properties. This input is like that shown in Figure 520.08.01.02.01.1.

- **Resilient Modulus (psi):** This control allows the designer to define the design resilient modulus (M_r). For this input, click the resilient modulus tab of "Structure" pane and enter the input accordingly. For the input level, select Level 2 or 3 accordingly as shown in Figure 520.08.01.02.01.1 (Level 1 is unavailable as a choice). ITD recommends level 2 input be used for embankment and subgrade where applicable, but if lab testing or FWD data is unavailable then level 3 input may be used. Follow the steps below to obtain the input and modulus values for the respective levels. The design resilient modulus can be derived using the values measured in accordance with AASHTO T 307 which is referred to as a quasi-input level 1. AASHTOWare has a standard practice to determine the Design Resilient Modulus from AASHTO T 307 test results. However, ITD does not require the measurement of resilient modulus of subgrade soils or embankments in accordance with AASHTO T 307.
Note 15: If the quasi-input level 1 resilient modulus is used, the value is entered under Input Level 3.

520.08.03.03 Analysis Type. Like base and subbase shown in Figure 520.08.01.02.01.1, ITD recommends the "Modify Input Values by Temperature/Moisture" option be selected which uses the EICM. This option is used for both Level 2 and Level 3 input.

520.08.03.03.01 Input Level 2 Method. For level 2 input, subgrade and embankment material will follow the same methods outlined in the "Input Level 2 Method" of the [base/subbase section](#) above. ITD typically uses the R-value test to measure the strength of the subgrade soils and their regression equation to calculate the resilient modulus. When this approach is used as input level 2, the water content and dry density associated with the condition of the sample after the test should be entered into the PMED software to ensure the input variables are compatible.

520.08.03.03.02 Input Level 3 Method. For Level 3 this control only allows the entry of a resilient modulus value for subgrade and embankment materials based on typical values measured throughout the state and presented in the DUG and reproduced in Table 520.08.03.03.02.1. ITD typically uses the R-value test to measure the strength of the subgrade soils and their regression equation to calculate the resilient modulus. The default R-value and resilient modulus values for the weaker or more plastic soils usually take on more water during the test. As such, the water content and dry density associated with the end of the test conditions of the sample should be entered into the PMED software. In other words, the condition of the sample after the test should be entered into the PMED software to ensure the input variables are compatible.

Table 520.08.03.02.1: Recommended Level 3 Lab Resilient Modulus for Embankment/Subgrade at Optimum Moisture for Flexible and Rigid Pavements

Soil Type (Unified Soil Classification System)	ITD Recommended R-Value	Estimated M_r (psi)**	ITD Recommended M_r Range (psi)	
			Lower Bound M_r	Upper Bound M_r
OH	32	9,268	5,702	12,180
OL	44	11,368	8,893	13,571
CH	15	5,702	2,032	8,113
MH	28	8,508	4,942	11,533
CL	27	8,312	4,942	10,865
CL - ML	45	11,533	9,082	13,869
ML	60	13,869	11,859	15,728
SC	35	9,817	6,178	12,963
GC	38	10,348	6,857	13,269
SC - SM	53	12,809	9,817	15,310
GC - GM	60	13,869	11,697	15,728
SM	66	14,743	12,653	16,679
GM	72	15,589	13,721	17,209
SP - SC*	15	5,702	1,004	9,268
SW - SC	71	15,450	14,164	16,679
SP - SM	74	15,866	14,455	17,209
SW - SM	77	16,275	15,589	16,945
GP - GC	65	14,600	12,180	16,945
GW - GC	68	15,028	12,809	17,077
GP - GM	78	16,410	15,170	17,471
GW - GM	79	16,545	15,728	17,340
SP	74	15,866	15,450	16,410
SW	75	16,003	15,170	16,679
GP	77	16,275	15,310	17,209
GW	79	16,545	15,589	17,601

*Note: These values are based only on limited number of data points.

** M_r obtained from correlation with R-value ($M_r = 1004.4(R\text{-value})^{0.6412}$). The R-value is obtained from lab testing with Idaho T-8 procedure.

Same as the base and subbase layers, the Level 3 input for subgrade and embankment used to estimate the resilient modulus represent the optimum moisture content and dry density.

520.08.03.03 Gradation & Other Engineering Properties. Additional properties are required for each embankment/subgrade layer. To access these inputs, click on the “Sieve” tab containing the AASHTO classification for the “Gradation & Other Engineering Properties” as shown in Figure 520.08.01.04.1 and complete the input following the information below.

- **Sieve Size Table:** This table allows the designer to define the percentage of material passing a given sieve size of the embankment/subgrade material. The designer is required to enter a minimum of 3 sieve size values including the No. 200 sieve. Actual or defaults for soil classification will be used.
- **Liquid Limit:** This control allows the designer to define the liquid limit of the embankment/subgrade material. Actual or defaults for soil classification will be used.
- **Plasticity Index:** This control allows the designer to define the plasticity index of the embankment/subgrade material. Actual or defaults for soil classification will be used.
- **Is Layer Compacted?:** Due to the variability of embankment construction and level of inspection at the time of construction, ITD recommends that this box is left unchecked for both embankment and subgrade layers. However, if the designer has documentation indicating the embankment was constructed, compacted, and inspected per ITD specifications, then this box may be checked for the embankment layer only.
- **Maximum Dry Unit Weight (pcf):** Leave this box unchecked if the input level 3 default resilient modulus based on soil classification is used. If the resilient modulus is determined by other methods, the box should be checked and the dry unit weight entered in this field should be representative of the dry unit weight of the test specimen.
- **Saturated Hydraulic Conductivity (ft/hr):** Pavement ME internally computes the saturated hydraulic conductivity of the non-stabilized material, therefore leave box unchecked.
- **Specific Gravity of Solids:** Pavement ME internally computes the specific gravity of the non-stabilized material, therefore leave box unchecked.
- **Optimum Gravimetric Water Content (%):** Leave box unchecked if the input level 3 default resilient modulus based on soil classification is used. If the resilient modulus is determined by other methods, the box should be checked and the water content entered in this field should be representative of the water content of the test specimen.
- **User-Defined Soil Water Characteristics Curve (SWCC):** Pavement ME internally computes the coefficients (af, bf, cf, and hr) of the SWCC, therefore leave box unchecked.

520.08.04 Bedrock Recommended Input. Bedrock may exist as the subgrade layer, or it may be found below the subgrade layer of a project. If bedrock exists within 20 feet below the top of the natural subgrade immediately below the proposed grade line, then the bedrock layer should be included in the Pavement ME analysis. Per DUG chapter 7, “generally, if the depth to bedrock is less than 20 feet, it can affect deflections at the pavement surface. Otherwise, its effect is minimal, and use of bedrock is not warranted.” Table 520.08.04.1 gives inputs for a bedrock layer following DUG recommendations.

Table 520.08.04.1: Recommended Bedrock Layer Properties

Bedrock Parameters	Recommended Input
Depth to Bedrock (ft.)	Estimate based on soil borings or topography. Bedrock can have an effect if ≤ 20 feet deep.
Thickness (in.)	Actual or semi-infinite if last layer.
Poisson’s Ratio	0.30 Highly Fractured & Weathered 0.15 Massive Continuous
Unit Weight (pcf)	140 pcf
Resilient Modulus (M_r) Highly Fractured & Weathered Bedrock (psi)	500,000 psi
Resilient Modulus (M_r) Massive Continuous Bedrock (psi)	1,000,000 psi

To add a bedrock layer, insert a new layer as described [above](#). Insert layer below subbase or subgrade as appropriate and select bedrock for the layer type. Choose and drag either “Highly fractured and weathered” or “Massive continuous” selections from the default list as appropriate for the type of bedrock found along the project limits. In the “Layer Selection” pane click on the Bedrock and enter the Poisson’s ratio, unit weight, and elastic/resilient modulus following input from Table 520.08.04.1 as shown in Figure 520.08.04.1. Typically, bedrock will be the bottom layer and the program will automatically set the final layer to “Semi-infinite”.

Design Name: Idaho North Global | Design Type: New Pavement | Pavement Type: Flexible Pavement

General Information

Performance Criteria

Traffic

Climate

Structure

Maintenance Strategy

Calibration

Design Properties

Sensitivity Combination

Thickness Optimization

Run analysis

Unbound | Modulus | Sieve

Coefficient of lateral earth pressure0.5✓

Poisson's ratio0.35✓

Layer Selection

Edit

Layer 1 : Flexible : Default asphalt concrete

Thickness (in):2.4✓

Layer 2 : Non-stabilized Base : Crushed stone (A-1-a)

Thickness (in):8✓

Layer 3 : Subgrade : A-1-a (A-1-a)

Thickness (in):10✓

Layer 4 : Bedrock : Highly fractured and weathered (A-4)

... SAVE

Figure 520.08.04.1: Material Layer Selection for Bedrock

10/2023

520.08.05 Ratio of Unbound Material Layer Moduli The resilient modulus of aggregate or granular base/subbase and any unbound layer that is stress sensitive is dependent on the resilient modulus of the supporting layers. These unbound layers can include those of asphalt millings or recycled layers without adding any additional binder or other stabilizer. As a rule of thumb, the resilient modulus entered in Pavement ME for an aggregate base layer or granular subbase must not exceed 3 times the resilient modulus of the supporting layer to avoid decompaction of that layer. This layer modulus ratio is dependent on base and subbase courses thickness. Figure 520.08.05.1 can be used to adjust the resilient

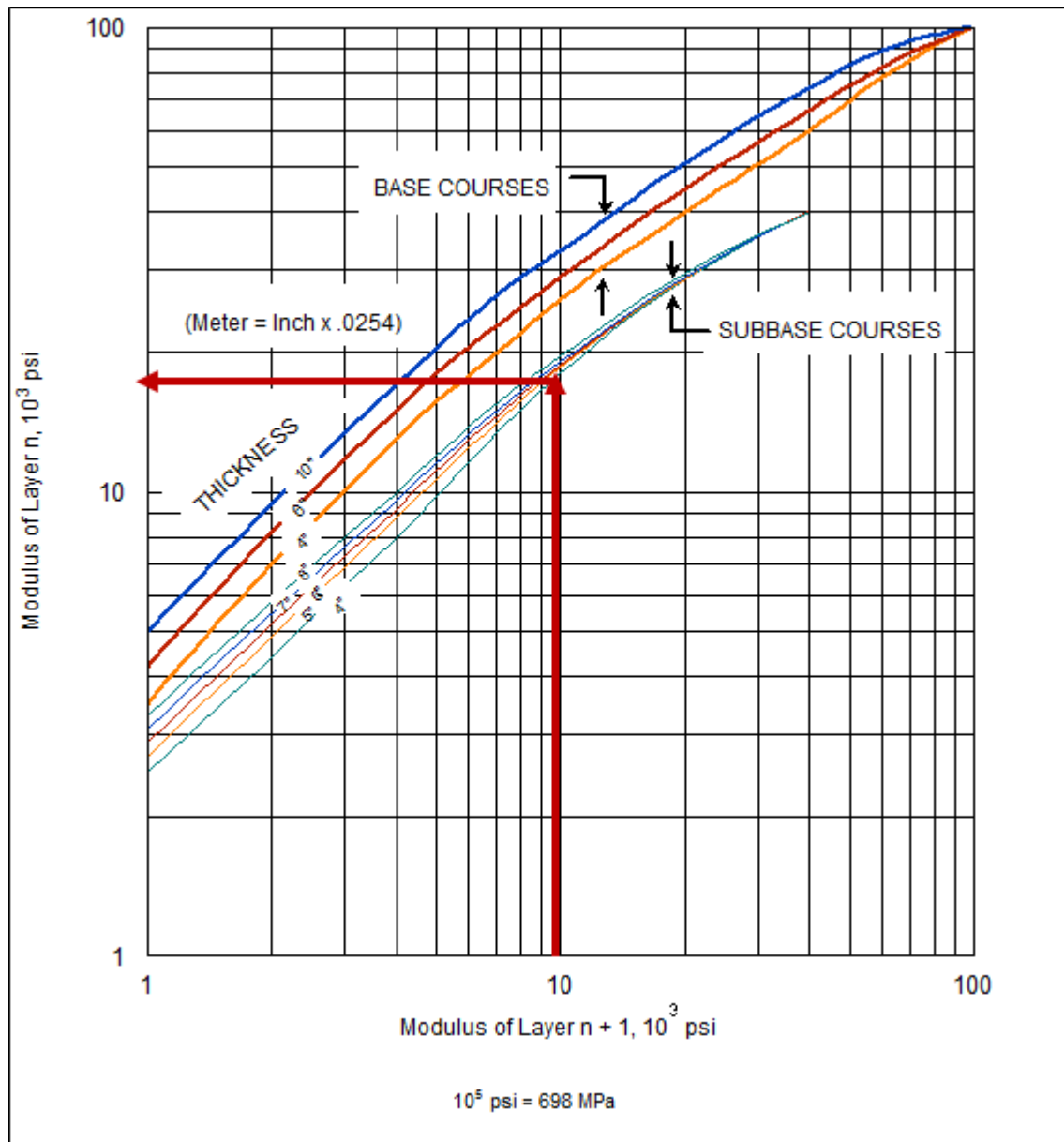
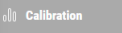


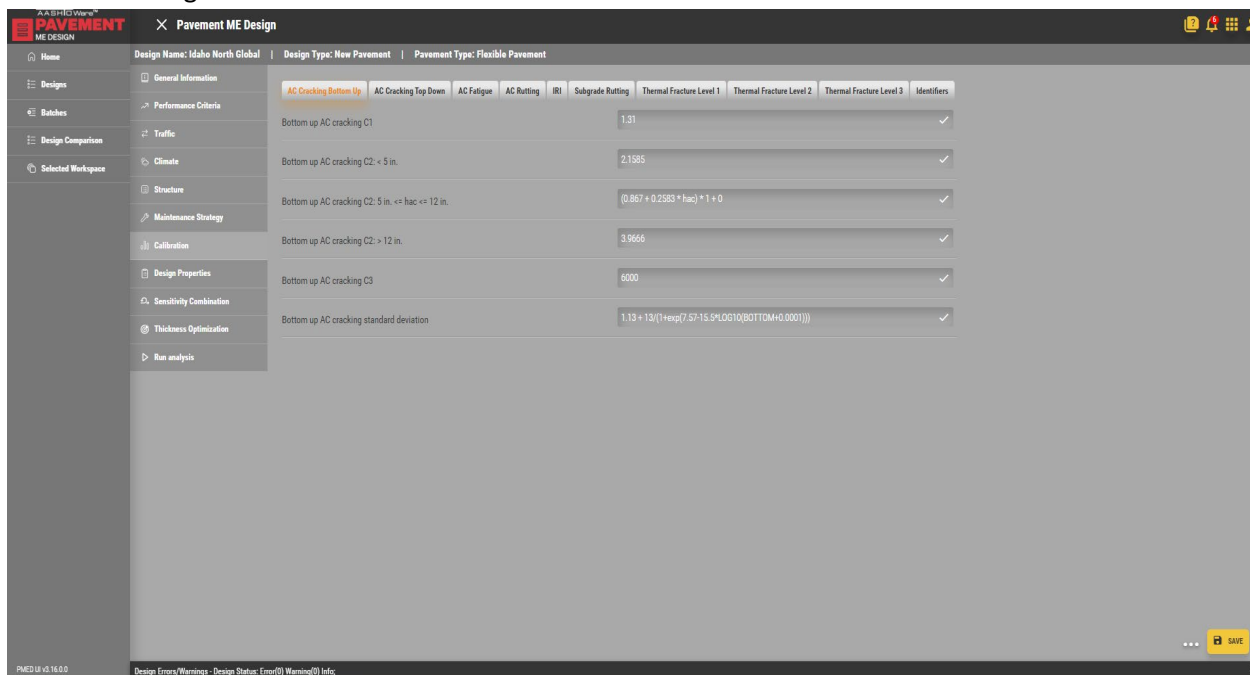
Figure 520.08.05.1: Limiting Modulus Criteria of Unbound Aggregate Base and Subbase Layers
(Source: DUG)

modulus of the base or subbase layer according to the layer thickness and the resilient modulus of its supporting layer.

For pavement design using Pavement ME, the resilient modulus of the bottom-most base sublayer must first be adjusted using the sublayer thickness and subgrade resilient modulus. This is followed by each overlying layer until the resilient modulus values for each base sublayer are determined. As the base comprises a single layer, only a single adjustment based on base layer thickness and subgrade resilient modulus is required.

520.09 Maintenance Strategy. The maintenance strategy feature is used to include non-structural preventive maintenance activities later in the life of the flexible or rigid pavement. The maintenance strategies do not add structural value and do not change the layer/material characteristics or properties later in the pavement life. Typically, no preservation/maintenance activity will be considered in the Pavement ME design unless specifically directed by the Project Engineer.

520.10 Project Specific Calibration Factors. Idaho specific calibration factors for new flexible pavement, rehabilitation flexible pavement, new rigid pavement, and unbonded rigid developed and will need to be input prior to running Pavement ME. The ITD calibration coefficients of the transfer function and the distress specific material properties were derived using version 2.5.5 for both flexible and rigid pavements. These calibration coefficients of the transfer functions are not applicable to the later versions because of different reasons. To enter the calibration factors go to the “Calibration” tab  of the design interface, (). This will open the Calibration Settings page in the screen as shown in Figure 520.10.1. Input the Idaho specific calibration factors as provided in Tables 520.10.1 through 520.10.4 below.



The screenshot shows the 'Pavement ME Design' software interface. The 'Calibration' tab is selected in the left sidebar. The main panel displays a table of calibration factors for various distress types. A red box highlights the text 'Calibration Factor Input' with a red arrow pointing to the 'Calibration' tab icon.

Distress Type	Calibration Factor	Identifiers
Bottom up AC cracking C1	1.31	✓
Bottom up AC cracking C2: < 5 in.	2.1585	✓
Bottom up AC cracking C2: 5 in. <= hacc <= 12 in.	$(0.867 + 0.2583 * hacc) * 1 + 0$	✓
Bottom up AC cracking C2: > 12 in.	3.9666	✓
Bottom up AC cracking C3	6000	✓
Bottom up AC cracking standard deviation	$1.13 + 13 / (1 + \exp(7.57 - 15.5 * \log_{10}(\text{BOTTOM} + 0.0001)))$	✓

Figure 520.10.1: Calibration Factor Input

The following are the Idaho specific calibration factors for Pavement ME Version 2.5.3. The research reports and the database, updated in January of 2020 by the University of Idaho, is available at https://www.webpages.uidaho.edu/bayomy/ITD_ME-Database.htm.

Figure 520.10.2 shows MEPD-V2.53_Idaho Calibration Factors sheet.

All factors are listed as they are shown in Pavement ME. **ONLY CHANGE THE HIGHLIGHTED VALUES**, when using version 2.5.3 As a reminder, the calibration coefficient included in the database created by the University of Idaho are not applicable to version 3.0.

Note 16: In the interim (before recalibration using version 3.0), it is suggested that the global calibration coefficients be used for both flexible and rigid pavement designs.

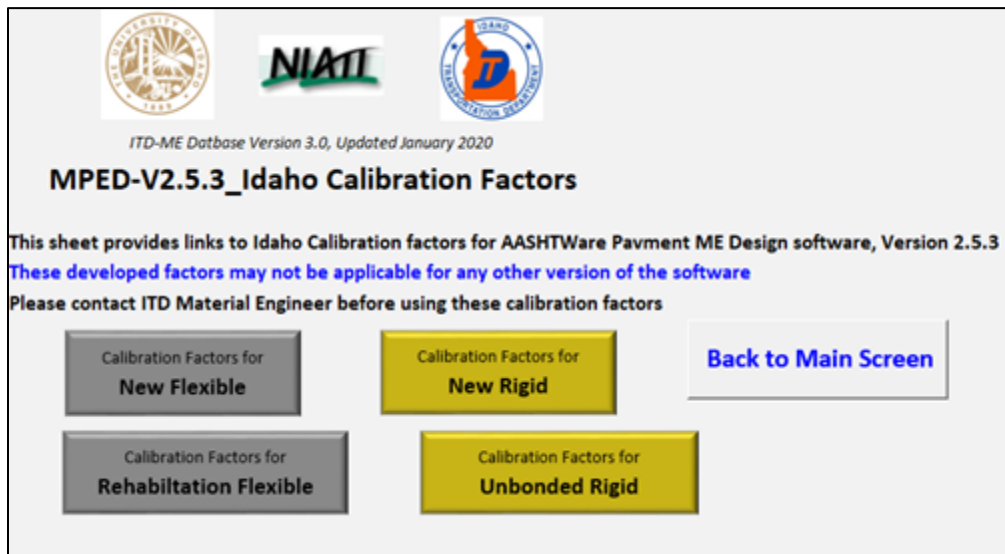


Figure 520.10.2: Idaho Calibration Factor Selection Screen

Table 520.10.1 ITD New Flexible Calibration Factors Using Version 2.5.3 (see Note 16)

Calibration factors for Asphalt Models - New Flexible			
AC Performance Model	Calibration Coefficient	Global Calibration Factors	Local Calibration Factors
AC Cracking - Bottom Up	Bottom up AC Cracking C1	1.31	0.31
	Bottom up AC Cracking C2: < 5 in.	2.1585	1.1585
	Bottom up AC Cracking C2: > 12 in.	3.9666	3.9666
	Bottom up AC Cracking C2: 5in. <= hac <= 12 in.	$(0.867 + 0.2583 * h_{ac}) * 1$	$(0.867 + 0.2583 * h_{ac}) * 0.175$
	Bottom up AC Cracking C3	6000	6000
	Bottom up AC Cracking Standard Deviation	$1.13 + 13/(1+\exp(7.57-15.5*\text{LOG}_{10}(\text{BOTTOM}+0.0001)))$	$1.13 + 13/(1+\exp(7.57-15.5*\text{LOG}_{10}(\text{BOTTOM}+0.0001)))$
A UC Cracking - Top Down	Top Down AC Cracking C1	7	3.3
	Top Down AC Cracking C2	3.5	0.825
	Top Down AC Cracking C3	0	0
	Top Down AC Cracking C4	1000	1000
	Top Down AC Cracking Standard Deviation	$200 + 2300/(1+\exp(1.072-2.1654*\text{LOG}_{10}(\text{TOP}+0.0001)))$	$200 + 2300/(1+\exp(1.072-2.1654*\text{LOG}_{10}(\text{TOP}+0.0001)))$
AC Fatigue	AC Fatigue BF1: < 5 in.	0.02054	0.02054
	AC Fatigue BF1: > 12 in.	0.001032	0.001032
	AC Fatigue BF1: 5 in. <= hac <= 12 in.	$(5.014*\text{Pow}(hac,-3.416))*1 + 0$	$(5.014*\text{Pow}(hac,-3.416))*1 + 0$
	AC Fatigue BF2	1.38	1.38
	AC Fatigue BF3	0.88	0.88
	AC Fatigue K1	3.75	3.75
	AC Fatigue K2	2.87	2.87
	AC Fatigue K3	1.46	1.46
AC Rutting	AC Rutting Standard Deviation	$0.24 * \text{Pow}(\text{RUT}),0.8026) + 0.001$	$0.24 * \text{Pow}(\text{RUT}),0.8026) + 0.001$

AC Rutting - Layer 1	AC Rutting BR1 (1)	0.4	0.3
	AC Rutting BR2 (1)	0.52	0.52
	AC Rutting BR3 (1)	1.36	1.36
	AC Rutting K1 (1)	-2.45	-2.45
	AC Rutting K2 (1)	3.01	3.01
	AC Rutting K3 (1)	0.22	0.22
AC Rutting - Layer 2	AC Rutting BR1 (2)	0.4	0.3
	AC Rutting BR2 (2)	0.52	0.52
	AC Rutting BR3 (2)	1.36	1.36
	AC Rutting K1 (2)	-2.45	-2.45
	AC Rutting K2 (2)	3.01	3.01
	AC Rutting K3 (2)	0.22	0.22
AC Rutting - Layer 3	AC Rutting BR1 (3)	0.4	0.3
	AC Rutting BR2 (3)	0.52	0.52
	AC Rutting BR3 (3)	1.36	1.36
	AC Rutting K1 (3)	-2.45	-2.45
	AC Rutting K2 (3)	3.01	3.01
	AC Rutting K3 (3)	0.22	0.22
CSM Cracking	CSM Cracking C1	0	0
	CSM Cracking C2	75	75
	CSM Cracking C3	2	2
	CSM Cracking C4	2	2
	CSM Standard Deviation	CTB*1	CTB*1
CSM Fatigue	CSM Fatigue BC1	1	1
	CSM Fatigue BC2	1	1
	CSM Fatigue K1	0.972	0.972
	CSM Fatigue K2	0.0825	0.0825

IRI	IRI Flexible C1	40	80
	IRI Flexible C2	0.4	0.6
	IRI Flexible C3	0.008	0.008
	IRI Flexible C4	0.015	0.02
	IRI Flexible Over PCCC1	40.8	40.8
	IRI Flexible Over PCCC2	0.575	0.575
	IRI Flexible Over PCCC3	0.0014	0.0014
	IRI Flexible Over PCCC4	0.00825	0.00825
	IRI Initial Standard Deviation	IRI (ini)/10	IRI (ini)/10
	IRI Model Standard Deviation	$25.1148 * \ln(\text{IRI}) - 87.95062$	$25.1148 * \ln(\text{IRI}) - 87.95062$
Reflective Fatigue Cracking Semi-rigid	Reflective Fatigue Cracking Semi-Rigid C1	1.64	1.64
	Reflective Fatigue Cracking Semi-Rigid C2	1.1	1.1
	Reflective Fatigue Cracking Semi-Rigid C3	0.19	0.19
	Reflective Fatigue Cracking Semi-Rigid C4	62.1	62.1
	Reflective Fatigue Cracking Semi-Rigid C5	-404.6	-404.6
	Reflective Fatigue Cracking Semi-Rigid K1	0.45	0.45
	Reflective Fatigue Cracking Semi-Rigid K2	0.05	0.05
	Reflective Fatigue Cracking Semi-Rigid K3	1	1
	Reflective Fatigue Cracking Semi-Rigid Standard Deviation	$1.3897 * \text{Pow}(\text{FATIGUE}, 0.2960) + 0.4212$	$1.3897 * \text{Pow}(\text{FATIGUE}, 0.2960) + 0.4212$

Reflective Transverse Cracking Semi-rigid	Reflective Cracking Semi-Rigid M-value	120	120
	Reflective Transverse Cracking Semi-Rigid C1	0.1	0.1
	Reflective Transverse Cracking Semi-Rigid C2	0.9809	0.9809
	Reflective Transverse Cracking Semi-Rigid C3	0.19	0.19
	Reflective Transverse Cracking Semi-Rigid C4	165.3	165.3
	Reflective Transverse Cracking Semi-Rigid C5	-5.1048	-5.1048
	Reflective Transverse Cracking Semi-Rigid K1	0.45	0.45
	Reflective Transverse Cracking Semi-Rigid K2	0.05	0.05
	Reflective Transverse Cracking Semi-Rigid K3	1	1
	Reflective Transverse Cracking Semi-Rigid Standard Deviation	$0.000027 * \text{Pow}(\text{TRANSVERSE}, 2.1187) + 399.9$	$0.000027 * \text{Pow}(\text{TRANSVERSE}, 2.1187) + 399.9$
Subgrade Rutting	Granular Base Rutting BS1	1	0.86
	Granular Base Rutting K1	0.965	0.965
	Granular Base Rutting Standard Deviation	$0.1477 * \text{Pow}(\text{BASERUT}, 0.6711) + 0.001$	$0.1477 * \text{Pow}(\text{BASERUT}, 0.6711) + 0.001$
	Subgrade A-3 Rutting K1	0.635	0.635
	Subgrade Coarse Grained Rutting K1	0.965	0.965
	Subgrade Fine Grained Rutting K1	0.675	0.675
	Subgrade Rutting BS1	1	0.736
	Subgrade Rutting Standard Deviation	$0.1235 * \text{Pow}(\text{SUBRUT}, 0.5012) + 0.001$	$0.1235 * \text{Pow}(\text{SUBRUT}, 0.5012) + 0.001$

Thermal Fracture - Level 1	AC Thermal Cracking Level 1K (MAAT ≤ 57 deg F)	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$
	AC Thermal Cracking Level 1K (MAAT > 57 deg F)	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$
	AC Thermal Cracking Level 1 Standard Deviation (MAAT ≤ 57 deg F)	$0.14 * \text{THERMAL} + 168$	$0.14 * \text{THERMAL} + 168$
	AC Thermal Cracking Level 1 Standard Deviation (MAAT > 57 deg F)	$0.14 * \text{THERMAL} + 343$	$0.14 * \text{THERMAL} + 343$
Thermal Fracture - Level 2	AC Thermal Cracking Level 2K (MAAT ≤ 57 deg F)	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$	$((2.591 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$
	AC Thermal Cracking Level 2K (MAAT > 57 deg F)	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$
	AC Thermal Cracking Level 2 Standard Deviation (MAAT ≤ 57 deg F)	$0.20 * \text{THERMAL} + 168$	$0.20 * \text{THERMAL} + 168$
	AC Thermal Cracking Level 2 Standard Deviation (MAAT > 57 deg F)	$0.20 * \text{THERMAL} + 343$	$0.20 * \text{THERMAL} + 343$
Thermal Fracture - Level 3	AC Thermal Cracking Level 3K (MAAT ≤ 57 deg F)	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$
	AC Thermal Cracking Level 3K (MAAT > 57 deg F)	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$
	AC Thermal Cracking Level 3 Standard Deviation (MAAT ≤ 57 deg F)	$0.289 * \text{THERMAL} + 168$	$0.289 * \text{THERMAL} + 168$
	AC Thermal Cracking Level 3 Standard Deviation (MAAT > 57 deg F)	$0.289 * \text{THERMAL} + 343$	$0.289 * \text{THERMAL} + 343$

Table 520.10.2: ITD Rehabilitated Flexible Calibration Factors Using Version 2.5.3 (see Note 16)

Calibration factors for Asphalt Models - Rehabilitated Flexible			
AC Performance Model	Calibration Coefficient	Global Calibration Factors	Local Calibration Factors
AC Cracking - Bottom Up	Bottom up AC Cracking C1	1.31	0.31
	Bottom up AC Cracking C2: < 5 in.	2.1585	1.1585
	Bottom up AC Cracking C2: > 12 in.	3.9666	3.9666
	Bottom up AC Cracking C2: 5in. <= hac <= 12 in.	$(0.867 + 0.2583 * h_{ac}) * 1$	$(0.867 + 0.2583 * h_{ac}) * 0.175$
	Bottom up AC Cracking C3	6000	6000
	Bottom up AC Cracking Standard Deviation	$1.13 + 13/(1+\exp(7.57-15.5*\log_{10}(\text{BOTTOM}+0.0001)))$	$1.13 + 13/(1+\exp(7.57-15.5*\log_{10}(\text{BOTTOM}+0.0001)))$
AC Cracking - Top Down	Top Down AC Cracking C1	7	3.3
	Top Down AC Cracking C2	3.5	0.825
	Top Down AC Cracking C3	0	0
	Top Down AC Cracking C4	1000	1000
	Top Down AC Cracking Standard Deviation	$200 + 2300/(1+\exp(1.072-2.1654*\log_{10}(\text{TOP}+0.0001)))$	$200 + 2300/(1+\exp(1.072-2.1654*\log_{10}(\text{TOP}+0.0001)))$
AC Fatigue	AC Fatigue BF1: < 5 in.	0.02054	0.02054
	AC Fatigue BF1: > 12 in.	0.001032	0.001032
	AC Fatigue BF1: 5 in. <= hac <= 12 in.	$(5.014*\text{Pow}(h_{ac},-3.416))*1 + 0$	$(5.014*\text{Pow}(h_{ac},-3.416))*1 + 0$
	AC Fatigue BF2	1.38	1.38
	AC Fatigue BF3	0.88	0.88
	AC Fatigue K1	3.75	3.75
	AC Fatigue K2	2.87	2.87
	AC Fatigue K3	1.46	1.46

AC Rutting	AC Rutting Standard Deviation	$0.24 * \text{Pow}(\text{RUT}), 0.8026) + 0.001$	$0.24 * \text{Pow}(\text{RUT}), 0.8026) + 0.001$
AC Rutting - Layer 1	AC Rutting BR1 (1)	0.4	0.3
	AC Rutting BR2 (1)	0.52	0.52
	AC Rutting BR3 (1)	1.36	1.36
	AC Rutting K1 (1)	-2.45	-2.45
	AC Rutting K2 (1)	3.01	3.01
	AC Rutting K3 (1)	0.22	0.22
AC Rutting - Layer 2	AC Rutting BR1 (2)	0.4	0.3
	AC Rutting BR2 (2)	0.52	0.52
	AC Rutting BR3 (2)	1.36	1.36
	AC Rutting K1 (2)	-2.45	-2.45
	AC Rutting K2 (2)	3.01	3.01
	AC Rutting K3 (2)	0.22	0.22
AC Rutting - Layer 3	AC Rutting BR1 (3)	0.4	0.3
	AC Rutting BR2 (3)	0.52	0.52
	AC Rutting BR3 (3)	1.36	1.36
	AC Rutting K1 (3)	-2.45	-2.45
	AC Rutting K2 (3)	3.01	3.01
	AC Rutting K3 (3)	0.22	0.22
CSM Cracking	CSM Cracking C1	0	0
	CSM Cracking C2	75	75
	CSM Cracking C3	2	2
	CSM Cracking C4	2	2
	CSM Standard Deviation	CTB*1	CTB*1
CSM Fatigue	CSM Fatigue BC1	1	1
	CSM Fatigue BC2	1	1
	CSM Fatigue K1	0.972	0.972
	CSM Fatigue K2	0.0825	0.0825

IRI	IRI Flexible C1	40	80
	IRI Flexible C2	0.4	0.6
	IRI Flexible C3	0.008	0.008
	IRI Flexible C4	0.015	0.02
	IRI Flexible Over PCCC1	40.8	40.8
	IRI Flexible Over PCCC2	0.575	0.575
	IRI Flexible Over PCCC3	0.0014	0.0014
	IRI Flexible Over PCCC4	0.00825	0.00825
	IRI Initial Standard Deviation	IRI (ini)/10	IRI (ini)/10
	IRI Model Standard Deviation	$25.1148 \cdot \ln(\text{IRI}) - 87.95062$	$25.1148 \cdot \ln(\text{IRI}) - 87.95062$
Reflective Fatigue Cracking AC	Reflective Fatigue Cracking AC C1	0.38	0.38
	Reflective Fatigue Cracking AC C2	1.66	1.66
	Reflective Fatigue Cracking AC C3	2.72	2.72
	Reflective Fatigue Cracking AC C4	105.4	105.4
	Reflective Fatigue Cracking AC C5	-7.02	-7.02
	Reflective Fatigue Cracking AC K1	0.012	0.012
	Reflective Fatigue Cracking AC K2	0.005	0.005
	Reflective Fatigue Cracking AC K3	1	1
	Reflective Fatigue Cracking AC Standard Deviation	$1.1097 \cdot \text{Pow}(\text{FATIGUE}, 0.6804) + 1.23$	$1.1097 \cdot \text{Pow}(\text{FATIGUE}, 0.6804) + 1.23$

Reflective Fatigue Cracking AC Semi-rigid	Reflective Fatigue Cracking AC Semi-Rigid C1	0.38	0.38
	Reflective Fatigue Cracking AC Semi-Rigid C2	1.66	1.66
	Reflective Fatigue Cracking AC Semi-Rigid C3	2.72	2.72
	Reflective Fatigue Cracking AC Semi-Rigid C4	105.4	105.4
	Reflective Fatigue Cracking AC Semi-Rigid C5	-7.02	-7.02
	Reflective Fatigue Cracking AC Semi-Rigid K1	0.012	0.012
	Reflective Fatigue Cracking AC Semi-Rigid K2	0.005	0.005
	Reflective Fatigue Cracking AC Semi-Rigid K3	1	1
	Reflective Fatigue Cracking AC Semi-Rigid Standard Deviation	$1.1097 * \text{Pow}(\text{FATIGUE}, 0.6804) + 1.23$	$1.1097 * \text{Pow}(\text{FATIGUE}, 0.6804) + 1.23$
Reflective Transverse Cracking AC	Reflective Transverse Cracking AC C1	3.22	3.22
	Reflective Transverse Cracking AC C2	25.7	25.7
	Reflective Transverse Cracking AC C3	0.1	0.1
	Reflective Transverse Cracking AC C4	133.4	133.4
	Reflective Transverse Cracking AC C5	-72.4	-72.4
	Reflective Transverse Cracking AC K1	0.012	0.012
	Reflective Transverse Cracking AC K2	0.005	0.005
	Reflective Transverse Cracking AC K3	1	1
	Reflective Transverse Cracking AC Standard Deviation	$70.98 * \text{Pow}(\text{TRANSVERSE}, 0.2994) + 30.12$	$70.98 * \text{Pow}(\text{TRANSVERSE}, 0.2994) + 30.12$

Reflective Transverse Cracking AC Semi-rigid	Reflective Transverse Cracking AC Semi-Rigid C1	3.22	3.22
	Reflective Transverse Cracking AC Semi-Rigid C2	25.7	25.7
	Reflective Transverse Cracking AC Semi-Rigid C3	0.1	0.1
	Reflective Transverse Cracking AC Semi-Rigid C4	133.4	133.4
	Reflective Transverse Cracking AC Semi-Rigid C5	-72.4	-72.4
	Reflective Transverse Cracking AC Semi-Rigid K1	0.012	0.012
	Reflective Transverse Cracking AC Semi-Rigid K2	0.005	0.005
	Reflective Transverse Cracking AC Semi-Rigid K3	1	1
	Reflective Transverse Cracking AC Semi-Rigid Standard Deviation	$70.98 * \text{Pow}(\text{TRANSVERSE}, 0.2994) + 30.12$	$70.98 * \text{Pow}(\text{TRANSVERSE}, 0.2994) + 30.12$

Reflective Transverse Cracking CRCP/Fractured	Reflective Transverse Cracking CRCP/Fractured C1	1.0375	1.0375
	Reflective Transverse Cracking CRCP/Fractured C2	1.8929	1.8929
	Reflective Transverse Cracking CRCP/Fractured C3	0.1	0.1
	Reflective Transverse Cracking CRCP/Fractured C4	262.1	262.1
	Reflective Transverse Cracking CRCP/Fractured C5	-9.6645	-9.6645
	Reflective Transverse Cracking CRCP/Fractured K1	0.012	0.012
	Reflective Transverse Cracking CRCP/Fractured K2	0.0002	0.0002
	Reflective Transverse Cracking CRCP/Fractured K3	0.1	0.1
	Reflective Transverse Cracking CRCP/Fractured Standard Deviation	$52.54 * \text{Pow}(\text{TRANSVERSE}, 0.39) + 283.3$	$52.54 * \text{Pow}(\text{TRANSVERSE}, 0.39) + 283.3$
Reflective Transverse Cracking JPCP	Reflective Transverse Cracking JPCP C1	0.1	0.1
	Reflective Transverse Cracking JPCP C2	0.52	0.52
	Reflective Transverse Cracking JPCP C3	3.1	3.1
	Reflective Transverse Cracking JPCP C4	79.5	79.5
	Reflective Transverse Cracking JPCP C5	-2.71	-2.71
	Reflective Transverse Cracking JPCP K1	0.012	0.012
	Reflective Transverse Cracking JPCP K2	0.005	0.005
	Reflective Transverse Cracking JPCP K3	1	1
	Reflective Transverse Cracking JPCP Standard Deviation	$5.1025 * \text{Pow}(\text{TRANSVERSE}, 0.6513) + 30.12$	$5.1025 * \text{Pow}(\text{TRANSVERSE}, 0.6513) + 30.12$

Subgrade Rutting	Granular Base Rutting BS1	1	0.86
	Granular Base Rutting K1	0.965	0.965
	Granular Base Rutting Standard Deviation	$0.1477 * \text{Pow}(\text{BASERUT}, 0.6711) + 0.001$	$0.1477 * \text{Pow}(\text{BASERUT}, 0.6711) + 0.001$
	Subgrade A-3 Rutting K1	0.635	0.635
	Subgrade Coarse Grained Rutting K1	0.965	0.965
	Subgrade Fine Grained Rutting K1	0.675	0.675
	Subgrade Rutting BS1	1	0.736
	Subgrade Rutting Standard Deviation	$0.1235 * \text{Pow}(\text{SUBRUT}, 0.5012) + 0.001$	$0.1235 * \text{Pow}(\text{SUBRUT}, 0.5012) + 0.001$
Thermal Fracture Level 1	AC Thermal Cracking Level 1K (MAAT ≤ 57 deg F)	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$
	AC Thermal Cracking Level 1K (MAAT > 57 deg F)	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$
Thermal Fracture Level 2	AC Thermal Cracking Level 2K (MAAT ≤ 57 deg F)	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$	$((2.591 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$
	AC Thermal Cracking Level 2K (MAAT > 57 deg F)	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$
Thermal Fracture Level 3	AC Thermal Cracking Level 3K (MAAT ≤ 57 deg F)	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$	$((3 * \text{Pow}(10, -7)) * \text{Pow}(\text{MAAT}, 4.0319)) * 1 + 0$
	AC Thermal Cracking Level 3K (MAAT > 57 deg F)	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$	$(0.13 * \text{Pow}(\text{MAAT}, 2) - 11.68 * \text{MAAT} + 244.14) * 1 + 0$

Table 520.10.3: ITD New Rigid Calibration Factors Using Version 2.5.3 (see Note 16)

Calibration factors for PCC Models - New Rigid			
PCC Performance Model	Calibration Coefficient	Global Calibration Factors	Local Calibration Factors
PCC Cracking	PCC Cracking C1	2	2.366
	PCC Cracking C2	1.22	1.22
	PCC Cracking C4	0.52	0.52
	PCC Cracking C5	-2.17	-2.17
	PCC Reliability Cracking Standard Deviation	$3.5522 * \text{Pow}(\text{CRACK}, 0.3415) + 0.75$	$3.5522 * \text{Pow}(\text{CRACK}, 0.3415) + 0.75$
PCC Faulting	PCC Faulting C1	0.595	0.516
	PCC Faulting C2	1.636	1.636
	PCC Faulting C3	0.00217	0.00217
	PCC Faulting C4	0.00444	0.00444
	PCC Faulting C5	250	250
	PCC Faulting C6	0.47	0.47
	PCC Faulting C7	7.3	7.3
	PCC Cracking C8	400	400
	PCC Reliability Faulting Standard Deviation	$0.07162 * \text{Pow}(\text{FAULT}, 0.368) + 0.00806$	$0.07162 * \text{Pow}(\text{FAULT}, 0.368) + 0.00806$
PCC IRI-CRCP	PCC IRI C1	3.15	3.15
	PCC IRI C2	28.35	28.35
	PCC IRI CRCP Model Standard Deviation	$7.08 * \text{Ln}(\text{IRI}) - 11$	$7.08 * \text{Ln}(\text{IRI}) - 11$
	PCC IRI Initial CRCP Std Dev.	5.4	5.4

PCC IRI-JPCP	PCC IRI Initial JPCP Std Dev.	5.4	5.4
	PCC IRI J1	0.8203	0.845
	PCC IRI J2	0.4417	0.4417
	PCC IRI J3	1.4929	1.4929
	PCC IRI J4	25.24	28.24
	PCC IRI JPCP Model Standard Deviation	$29.03 * \ln(\text{IRI}) - 103.8$	$29.03 * \ln(\text{IRI}) - 103.8$
PCC Longitudinal Cracking	PCC Longitudinal Cracking C4	0.4	0.4
	PCC Longitudinal Cracking C5	-2.21	-2.21
	PCC Reliability Longitudinal Cracking Standard Deviation	$3.5522 * \text{Pow}(\text{LCRACK}, 0.4315) + 0.5$	$3.5522 * \text{Pow}(\text{LCRACK}, 0.4315) + 0.5$
PCC Punch-out	PCC CRCP C1	2	2
	PCC CRCP C2	1.22	1.22
	PCC CRCP C3	107.73	107.73
	PCC CRCP C4	2.475	2.475
	PCC CRCP C5	-0.785	-0.785
	PCC CRCP Crack	1	1
	PCC Reliability PO Standard Deviation	$2.208 * \text{Pow}(\text{PO}, 0.5316)$	$2.208 * \text{Pow}(\text{PO}, 0.5316)$

Table 520.10.4: ITD Unbonded Rigid Calibration Factors Using Version 2.5.3 (see Note 16)

Calibration factors for PCC Models - Unbonded Rigid			
PCC Performance Model	Calibration Coefficient	Global Calibration Factors	Local Calibration Factors
PCC Cracking	PCC Cracking C1	2	2.366
	PCC Cracking C2	1.22	1.22
	PCC Cracking C4	0.52	0.52
	PCC Cracking C5	-2.17	-2.17
	PCC Reliability Cracking Standard Deviation	$3.5522 * \text{Pow}(\text{CRACK}, 0.3415) + 0.75$	$3.5522 * \text{Pow}(\text{CRACK}, 0.3415) + 0.75$
PCC Faulting	PCC Faulting C1	0.595	0.516
	PCC Faulting C2	1.636	1.636
	PCC Faulting C3	0.00217	0.00217
	PCC Faulting C4	0.00444	0.00444
	PCC Faulting C5	250	250
	PCC Faulting C6	0.47	0.47
	PCC Faulting C7	7.3	7.3
	PCC Cracking C8	400	400
	PCC Reliability Faulting Standard Deviation	$0.07162 * \text{Pow}(\text{FAULT}, 0.368) + 0.00806$	$0.07162 * \text{Pow}(\text{FAULT}, 0.368) + 0.00806$
PCC IRI-CRCP	PCC IRI C1	3.15	3.15
	PCC IRI C2	28.35	28.35
	PCC IRI CRCP Model Standard Deviation	$7.08 * \text{Ln}(\text{IRI}) - 11$	$7.08 * \text{Ln}(\text{IRI}) - 11$
	PCC IRI Initial CRCP Std Dev.	5.4	5.4
PCC IRI-JPCP	PCC IRI Initial JPCP Std Dev.	5.4	5.4
	PCC IRI J1	0.8203	0.845
	PCC IRI J2	0.4417	0.4417
	PCC IRI J3	1.4929	1.4929
	PCC IRI J4	25.24	28.24
	PCC IRI JPCP Model Standard Deviation	$29.03 * \text{Ln}(\text{IRI}) - 103.8$	$29.03 * \text{Ln}(\text{IRI}) - 103.8$

PCC Longitudinal Cracking	PCC Longitudinal Cracking C4	0.4	0.4
	PCC Longitudinal Cracking C5	-2.21	-2.21
	PCC Reliability Longitudinal Cracking Standard Deviation	$3.5522 * \text{Pow}(\text{LCRACK}, 0.4315) + 0.5$	$3.5522 * \text{Pow}(\text{LCRACK}, 0.4315) + 0.5$
PCC Punch-out	PCC CRCP C1	2	2
	PCC CRCP C2	1.22	1.22
	PCC CRCP C3	107.73	107.73
	PCC CRCP C4	2.475	2.475
	PCC CRCP C5	-0.785	-0.785
	PCC CRCP Crack	1	1
	PCC Reliability PO Standard Deviation	$2.208 * \text{Pow}(\text{PO}, 0.5316)$	$2.208 * \text{Pow}(\text{PO}, 0.5316)$

520.11 Run Analysis After entering all the input regarding to general information, performance criteria, traffic, climate, structure information, design properties and specific calibration factors, The design is ready for analysis.

The designer should also check that all errors have been addressed prior to running the analysis. This can be done by checking the “Error List” which shows up in the Bottom of the design pane as shown in Figure 520.11.1. Any errors that appear in the error list need to be addressed prior to running the analysis.

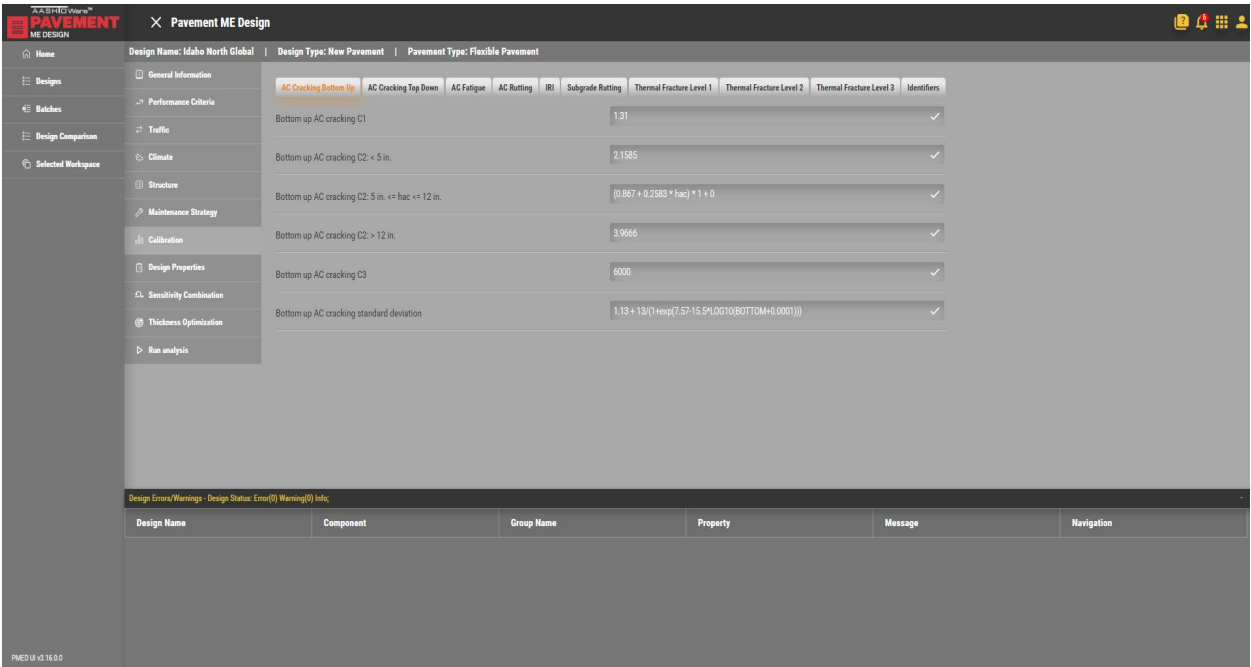


Figure 520.11.1: Error and Warning List

After all errors have been address save the project and then run the analysis. To run the current analysis simply click the “Run Analysis” button  located along the tabs at the left side of Pavement ME page as shown in Figure 520.11.2. After the “Run” button has been pressed, the progress will be displayed as a status grid in the “Running Design” tab of the “Designs” section as shown in Figure 520.11.2 and 520.11.4.

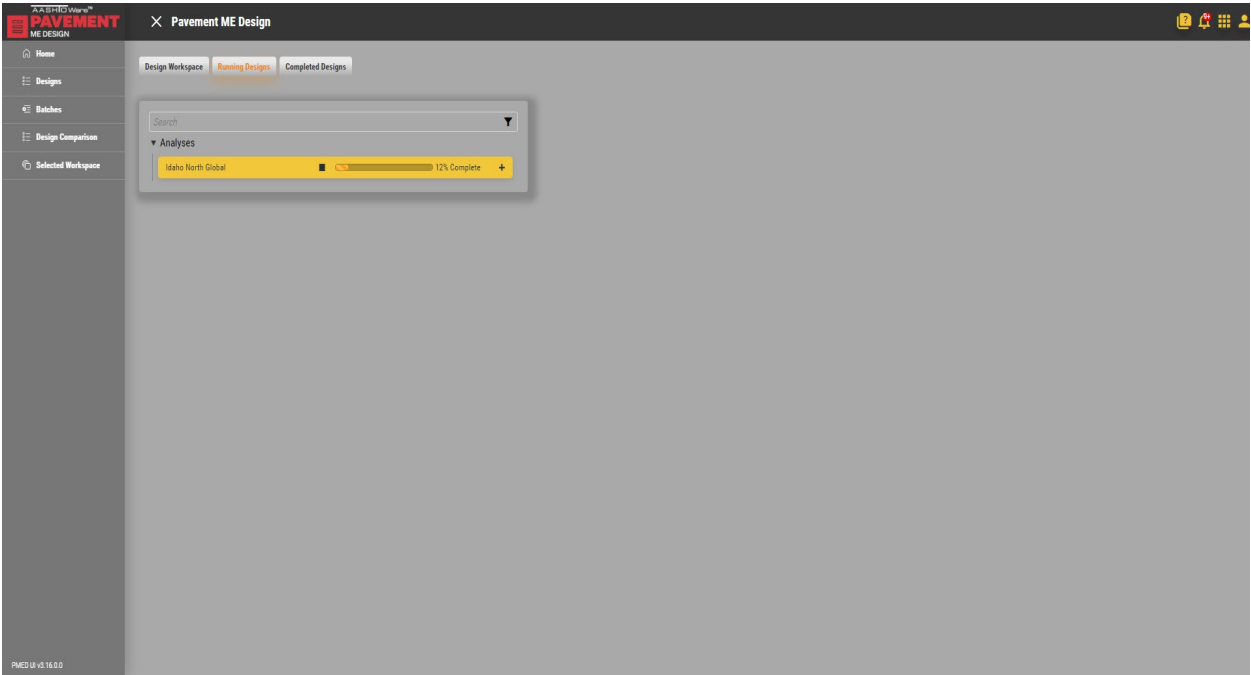
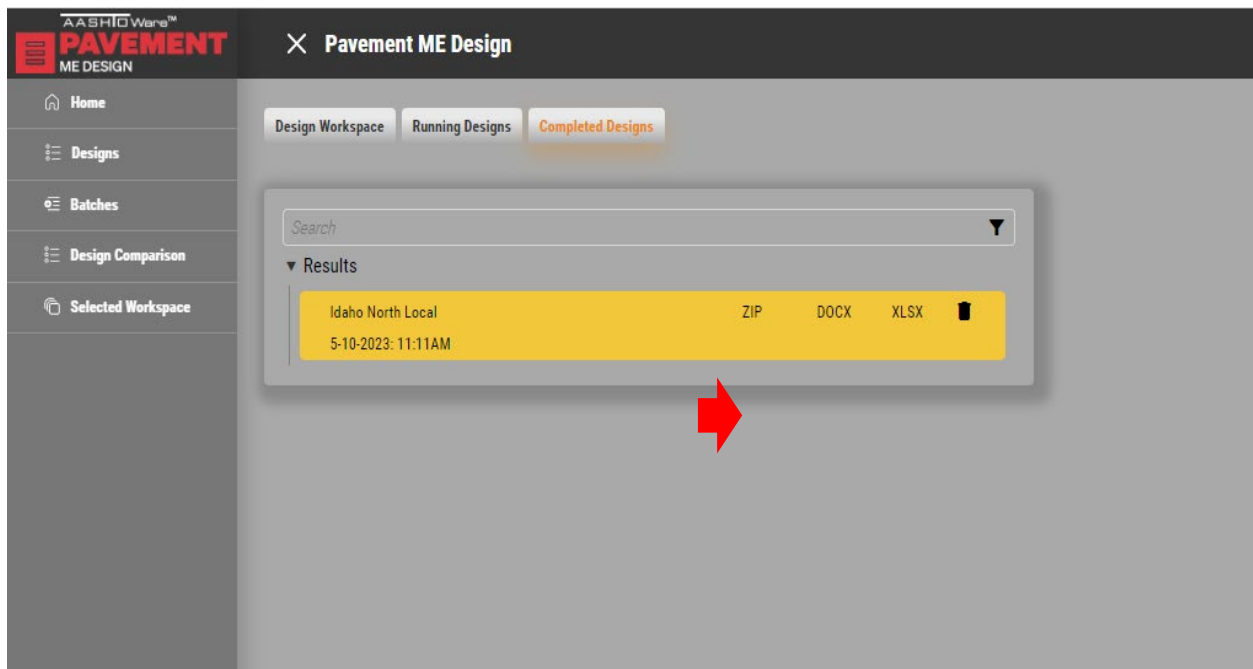


Figure 520.11.2: Run Analysis Overview

Once the analysis is complete the designer can access the compressed analysis folder, word version and excel version of the analysis report from the “Completed Design” tab of the Designs section as shown in Figure 520.11.3.

**Figure 520.11.3: Completed Analysis Overview**

The Output Report will provide detailed information regarding the analysis and should be included in the respective phase report or memo as applicable.

This output provides a distress prediction summary which shows the predicted distress and achieved reliability and gives a pass or fail whether the criterion was satisfied or not as shown in Figure 520.11.5.



File Location:



Design Inputs

Design Life: **20 years**
 Design Type: **FLEXIBLE**

Base Construction: **May 2008**
 Pavement construction: **June 2008**
 Traffic Opening: **July 2008**

Climate Data Sources **49, -116.875**
 (lat., long.):

Design Structure

Traffic

Layer Type	Material Type	Thickness (in)
Flexible	Default asphalt concrete	2.4
NonStabilized	Crushed stone (A-1-a)	8
Subgrade	A-1-a (A-1-a)	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Age (year)	Heavy Trucks (cumulative)
2008 (initial)	430
2018 (10 years)	1,069,560
2028 (20 years)	2,421,830

Design Outputs**Distress Prediction Summary**

Figure 520.11.4: First Page of Output Report

520.12 Optimization After establishing a trial design, Pavement ME allows the designer to optimize the thickness of any layer above the foundation (semi-infinite thickness). The designer can only optimize a single layer at a time in 0.5-inch increments.

Optimization is the selection of the lowest thickness within a given range of maximum and minimum thicknesses the designer defines. Pavement ME first selects the minimum thickness value and determines if the minimum thickness satisfies the performance criteria. If the run is successful, the process stops there. Otherwise, the program selects the maximum thickness value for its next run. If both minimum and maximum thicknesses are unsuccessful, the process stops. If the maximum thickness value is successful, the program selects the mid-point thickness value between the maximum and minimum thickness for its third run. Irrespective of the outcome, the program chooses the mid-point between the thickness of the last successful run and the last unsuccessful run for all further runs (Pavement ME Help Manual).

Note 17: Not all distresses are used to determine the acceptability of the design at a specified reliability level. For the distresses not used, like top-down fatigue cracks, make sure the box in

the Report Visibility under the Performance Criteria is unchecked. Not checking the box, means that criterion will not be used in the optimization process to determine the design acceptability.

520.13 References.

Federal Highway Administration. 2018. Calibration of the AASHTOWare Pavement ME Design Performance Models for Flexible Pavements in Idaho. Bayomy, Fouad, Ahmed Muftah, and Emad Kassem. FHWA-ID-18-235, RP 235, Idaho Transportation Department, Boise, Idaho.

Federal Highway Administration. 2019. Calibration of the AASHTOWare Pavement ME Design Software for PCC Pavements in Idaho. Bayomy, Fouad, Ahmed Muftah, Emad Kassem, Christopher Williams, and Mumtahir Hasnat. FHWA-ID-19-268, RP 268, Idaho Transportation Department, Boise, Idaho.

Federal Highway Administration. 2012. Implementation of the MEPDG for Flexible Pavements in Idaho. Bayomy, Fouad, Sherif El-Badawy, and Ahmed Awed. FHWA-ID-12-193, RP 193, Idaho Transportation Department, Boise, Idaho.

Federal Highway Administration. 2017. Portland Cement Concrete Material Characterization for Pavement ME Design Implementation in Idaho. Nassiri, Somayeh, Milena Rangelov, Ahmed Ibrahim, Fouad Bayomy, Ahmed Muftah, and Bikash Sigdel. FHWA-ID-17-253, RP 253, Idaho Transportation Department, Boise, Idaho.

Federal Highway Administration. 2019. Unbound Materials Characterization for Pavement ME Implementation in Idaho. Mishra, Debakanta, Md Jibon, Emad Kassem, Fouad Bayomy, and S M Robinur Mohshin Chowdhury. FHWA-ID19-263, RP 263, Idaho Transportation Department, Boise, Idaho.

Idaho AASHTOWare Pavement ME Design User's Guide (DUG), Version 1.1, Mallela, J., L. Titus-glover, B. Bhattacharya, M. Darter, H. Von Quintas, Applied Research Associates, Idaho Transportation Department [ITD-RP 211B](#), (March 2014).

Mechanistic-Empirical Pavement Design Guide - A Manual of Practice, 2nd Edition, American Association of State Highway and Transportation Officials (AASHTO), August 2015.

Principles of Pavement Design, 1975, E.J. Yoder and M.W. Whitczak.

Rasmussen, R.O., R. Rogers. T.R. Ferragut, [Continuously Reinforced Concrete Pavement Design and Construction Guidelines](#), Federal Highway Administration and Concrete Reinforcing Steel Institute, Draft May 2009.