

304-14.0 MECHANISTIC EMPIRICAL PAVEMENT DESIGN GUIDE

The Mechanistic Empirical Pavement Design Guide (MEPDG), AASHTO's pavement design guide, shall be used for the design of each pavement structure. The design process is based on the predictive performance of a pavement section to be designed to predefined parameters identified as failing. The pavement design itself is an iterative process where the pavement designer selects a cross section for the pavement based on economic benefits, performance, maintenance, and constructability. The objective of pavement design using the MEPDG process is to make iterative inputs to the input parameters identified as important and critical, process the inputs to determine the pavement performance prediction, and compare the pavement-performance prediction with a preset performance requirement. Therefore, more than one design may satisfy the preset performance requirement. The final design must satisfy the performance-indicator criteria (threshold value) and design reliability level for the project and be economically justified.

Below are the typical factors and inputs to be used with the MEPDG using AASHTOWare Pavement ME Design software formerly known as DARWinME. The organization of the factors and inputs is based on the sections of the AASHTOWare Pavement ME Design software.

304-14.01 MEPDG General Inputs Using AASHTOWare Pavement ME Design software

1. General Information.
 - a. Design Type. Select from one of three options; New Pavement, Overlay and Restoration. If performing alternative analyses, save the project with a different name before changing it to a different design type.
 - b. Pavement Type. When analyzing a new pavement, choices are Flexible Pavement, Jointed Plain Concrete Pavement (JPCP), and Continuously Reinforced Concrete Pavement (CRCP). When analyzing an overlay, you have many options such as Asphalt Concrete (AC) over AC, AC over JPCP, AC over CRCP, various bonded concrete overlays, and unbounded concrete overlays over AC, JPCP and CRCP. The Restoration design type is for JPCP restoration analysis. The software is only capable of analyzing for one existing pavement type, so when looking at an overlay of an existing HMA over concrete pavement, there are two ways to set up the analysis as either AC over AC with concrete being seen as crushed stone with the resilient modulus shown from the FWD results, or AC over the concrete pavement representing the existing AC as new AC with the properties of the existing pavement.

- c. Design Life, Years. See Figure 304-14A, Pavement Design Life, for pavement performance periods. The design life can also be set to a higher value that insures failure to determine the actual mode and time of failure.
 - d. Base Construction/Existing Construction. This is the month and year of the scheduled construction of the granular base or prepared subgrade for new pavements or the existing pavement construction year for overlays or restorations. The base construction input is only for a new HMA pavement and is an important parameter used to calculate the predictive performance of the pavement. For an INDOT project, it is to be assumed that the base or subgrade will be constructed in May. The existing construction month and year would be based upon the initial construction date for concrete pavements or the date for the construction of the layer that is at the bottom of the proposed mill for an HMA pavement.
 - e. Pavement Construction Month. This is the month and year of the scheduled placement of the HMA or PCCP. This input is an important parameter used to calculate the predictive performance of the pavement. For an INDOT project, it is to be assumed that the pavement will be constructed in July.
 - f. Traffic Open Month: This is the month and year of the scheduled opening to traffic upon completion of the project. This input is an important parameter used to calculate the predictive performance of the pavement. For an INDOT project, it is to be assumed that the pavement will be opened to traffic in September. Traffic Open Month must be more than one month after Pavement Construction Month.
2. Analysis Parameter. The inputs in this section are important and sensitive to the analysis and the final design of the project.
- a. Initial IRI (in./mi). This is the predictive International Roughness Index for newly-constructed pavement. A typical value is 70 in./mi for both HMA and PCCP surfaces.
 - b. Performance Criteria for Pavement Design. These are the performance criteria used for acceptability of the iterative trials. These are the most important inputs that the trial design must achieve or exceed. Performance criteria for asphalt pavement is shown in Figure 304-14B. Performance criteria for concrete pavement is shown in Figure 304-14C. The failure modes of top-down cracking

and total deformation are not to be considered for INDOT pavement design and should be ignored in the analysis.

3. Traffic Inputs. Determine Traffic Group A, B, C, or D from Item 4.a. below. Prior to importing the AADTT and other inputs such as the number of lanes in the design direction, import the site-specific traffic group data from the traffic input files. See Item 4 for more information related to traffic. Check to make sure the value from the import is correct for the specific project.

4. INDOT Default Traffic-Distribution Input Files. These are available to an INDOT designer within the Citrix drive location for the MEPDG software through a shortcut under the user name of each designer. The information is also available to a pavement designer outside of INDOT on the Department's website. The user of the MEPDG software will be able to import the Traffic Volume Adjustment, Axle Load Distribution Factor, and the General Traffic Inputs.
 - a. Initial Two-Way AADTT. This value is the Average Annual Daily Truck Traffic (AADTT) after the roadway is opened to traffic or the rehabilitation has been completed. It represents both directions and all lanes. For ramps and one way roads double the AADTT input. Traffic is divided into four Truck Weight Road Groups (TWRG), based on the AADTT, as follows:
 - (1) Traffic Group A, $AADTT \leq 3,000$
 - (2) Traffic Group B, $3,000 < AADTT \leq 6,000$
 - (3) Traffic Group C, $6,000 < AADTT \leq 20,000$ AADTT
 - (4) Traffic Group D, $AADTT > 20,000$

The TWRG traffic import should be made before any actual traffic information is entered because it will be overwritten at the time of the import.

- b. Number of Lanes in Design Direction. This is the number of traveled main lanes in the design direction, not including the acceleration, deceleration, or turn lanes.

Example: 4-lane road with 2 lanes east bound and 2 lanes west bound. The input is 2. Check to make sure the value from the import is correct for the specific project.

- c. Percent of Trucks in the Design Direction. This value represents the percentage of trucks in the design direction relative to all trucks using the roadway in both directions. The recommended values are as follows:

- (1) 2-Lane Road, 52%
- (2) 4-Lane Road, 55%
- (3) 6-Lane Road, 55%
- (4) 8-Lane Road, 57%
- (5) 10-Lane Road, 55%
- (6) 12-Lane Road, 54%

Check to make sure the value from the import is correct for the specific project.

- d. Percent of Trucks in the Design Lane. This value represents the percent of trucks of FHWA Class 4 and above in the design lane in the design direction relative to all trucks using the roadway in both directions.

- (1) 2-Lane Road, 100%
- (2) 4-Lane Road, 90%
- (3) 6-Lane Road, 60%
- (4) 8-Lane Road, 45%
- (5) 10-Lane Road, 40%
- (6) 12-Lane Road, 40%
- (7) 1-Lane Ramp or Street, 100%
- (8) Multi-Lane Ramp, 90%
- (9) Multi-Lane One-Way Street, 90%

Check to make sure the value from the import is correct for the specific project.

- e. Operational Speed. This value represents the posted truck speed limit. The posted speed limit should be used for all traffic groups.
- f. Growth Rate. This value represents the growth of truck traffic during the pavement life. Assuming that the growth rate is uniform over time, the rate of increase remains the same throughout the design period.

The recommended growth method is linear growth. The project-specific Traffic Growth Factor should be used. If the growth rate from the import does not match the given growth rate for the project, the corrected growth rate must be entered for each class of truck.

- g. Design Lane Width. This value represents the width of the through lane. The input entry is in the Lateral Wander section of the traffic inputs. The default lane

width is set to 12 ft. If the lane width for a specific project is less than 12 ft, enter the correct width. If the lane width is more than 12 ft, e.g., on a single lane ramp, then leave this entry as 12 ft.

- h. Mean Wheel Location. This value represents the distance for the outer edge of the wheel to the edge travel lane. The change in design lane width requires changes to the mean wheel location. If the design lane width is 10 ft then the mean wheel location would be 6 in. If the design lane width is 11 ft, then the mean wheel location would be 12 in. The default value for the mean wheel location in a 12-ft lane is 18 in.
 - i. Axle Distributions. Single, tandem, tridem and quad-axle distributions are available for each TRWG and must be imported.
5. Climate. The climate inputs in the MEPDG are based on the project location. A climatic data file must be generated for each pavement design project in the MEPDG. There are 7 specific climate inputs from 7 weather stations in Indiana, and most are in major cities. There are also weather stations in surrounding states that might be closer to a project. Virtual weather stations can be created. When the latitude and longitude of the project are entered, the software will present the closest weather stations. If a weather station has missing data, this can be corrected. Specific climate data has to be imported from a file.
6. Depth of Water Table. Use the water table depth as shown in the soil boring logs, appropriately adjusted for soil types whose capillary action may raise the water table and climactic conditions. An example of climactic conditions would be if soil boring was taken during a drought which would not accurately represent the typical water table.

Pavement-Work Type	Design Life, Years
PCCP	30
PCCP over Existing Pavement	25
HMA Pavement with SMA	20
HMA with SMA Surface Overlay on Rubblized PCCP	20
HMA Pavement	20
HMA Overlay on CRCP	20
HMA Overlay on Rubblized PCCP	20
HMA Overlay on Cracked and Seated PCCP	12
HMA Overlay over Asphalt	
Rehabilitation (≥ 3 layers)	18
Rehabilitation (2 layers)	15
Preventative Maintenance (1 layer) ¹	9
HMA Overlay over PCCP	
Rehabilitation (≥ 3 layers)	15
Rehabilitation (2 layers)	12
PCCP Joint Sealing	8
Ultrathin Bonded Wearing Course (UBWC)	9
Microsurface Overlay	8
Thin HMA Overlay with Profile Milling	9
Concrete Pavement Rehabilitation (CPR) Techniques	6
Chip Seal	4
Asphalt Crack Sealing, Rout and Seal	3
Asphalt Crack Filling	1

¹ The performance period should be decreased to 8 yr for existing composite HMA over PCCP.

PAVEMENT DESIGN LIFE

Figure 304-14A

Performance Criteria	Performance Limit at End of Design Life	Reliability
Terminal IRI (in./mi)	Freeway: 160	90%
	Arterial, Urban: 190	90%
	Arterial, Rural: 200	85%
	Collector, Urban: 190	80%
	Collector, Rural: 200	75%
	Local: 200	70%
AC Bottom-Up Cracking, Alligator Cracking (% lane area)	Freeway: 10	90%
	Arterial, Urban: 20	90%
	Arterial, Rural: 25	85%
	Collector, Urban: 30	80%
	Collector, Rural: 35	75%
	Local: 35	70%
Permanent Deformation – AC only Pavement (in.)	Freeway: 0.40	90%
	Arterial, Urban: 0.40	90%
	Arterial, Rural: 0.40	85%
	Collector, Urban: 0.40	80%
	Collector, Rural: 0.40	75%
	Local: 0.40	70%
AC Thermal Fracture (ft/mi/lane)	Freeway: 500	90%
	Arterial, Urban: 500	90%
	Arterial, Rural: 500	85%
	Collector, Urban: 500	80%
	Collector, Rural: 500	75%
	Local: 500	70%

**PERFORMANCE CRITERIA FOR NEW OR REHABILITATION
HMA PAVEMENT**

Figure 304-14B

Performance Criteria	Performance limit at End of Design Life	Reliability
Terminal IRI (in./mi)	Freeway: 160	90%
	Arterial, Urban: 190	90%
	Arterial, Rural: 200	85%
	Collector, Urban: 190	80%
	Collector, Rural: 200	75%
	Local: 200	70%
Transverse Slab Cracking (%)	Freeway: 10	90%
	Arterial, Urban: 10	90%
	Arterial, Rural: 10	85%
	Collector, Urban: 10	80%
	Collector, Rural: 10	75%
	Local: 10	70%
Mean Joint Faulting (in.)	Freeway: 0.15	90%
	Arterial, Urban: 0.20	90%
	Arterial, Rural: 0.22	85%
	Collector, Urban: 0.25	80%
	Collector, Rural: 0.25	75%
	Local: 0.25	70%

**PERFORMANCE CRITERIA FOR NEW OR REHABILITATION
CONCRETE PAVEMENT**

Figure 304-14C