VDOT's Implementation of MEPDG

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Mechanistic-Empirical Pavement Design

- Mechanistic-Empirical incorporates pavement response to loading/environment and historical pavement performance
- Expected to provide more accurate pavement performance predictions of pavement distresses observed
  - Empirical design is based on serviceability - not easily measured
- Relate changes in materials or mix design to pavement performance
- Can be used to better select a pavement structure to meet requirements

VDOT Pavement Design Comparison

1993 AASHTO	MEPDG
Currently used for pavement design	Required analysis tool during design
Empirical equation based on AASHO road test	Mechanistic-Empirical models based on LTPP sites
Few inputs	Hundreds of inputs
Empirical parameters (ESAL, pt, J-Factor)	Measurable parameters
Output is Slab Thickness	Output is predicted performance
Designer know-how required	Designer know-how required

Steps for Implementation of Pavement ME Design

Current status

Develop Inputs

- Materials
- Traffic
- Climate

Training

- Staff
- Software

Review Models

- Local Calibration
- Understanding output

Policy

- Connect with VDOT business practices

Work ongoing on all 4 stages

Development of Design Inputs

Multiple VTRC research projects to develop inputs into MEPDG completed or ongoing

VDOT draft user guide for Pavement ME Design has guidelines for inputs

Work Includes:

- Traffic characterization from WIM data with axle load spectra, vehicle class distributions.
- Developing database of subgrade information based on lab test results from around state.
- Aggregate base materials studied to identify properties
- Climate data from files provided with software

Concrete Material Inputs

PCC		
Thickness (in.)	✓	11.5
Unit weight (pcf)	✓	150
Poisson's ratio	✓	0.2
Thermal		
PCC coefficient of thermal expansion (in./in./deg F :	✓	5.5
PCC thermal conductivity (BTU/hr-ft-deg F)	✓	1.25
PCC heat capacity (BTU/lb-deg F)	✓	0.28
Mix		
Cement type		Type II (2)
Cementitious material content (lb/yd^3)	✓	564
Water to cement ratio	✓	0.45
Aggregate type		Granite (3)
PCC zero-stress temperature (deg F)		Calculated
Ultimate shrinkage (microstrain)		550.5 (calculated)
Reversible shrinkage (%)	✓	50
Time to develop 50% of ultimate shrinkage (days)	✓	35
Curing method		Curing Compound
Strength		
PCC strength and modulus	✓	Level:3 Rupture(650) Modulus(5000000)

Training on Software Output

Layer type	Material Type	Thickness (in)
PCC	VDOT JPCP input	11.5
NonStabilized	21B	8.0
Subgrade	A-6	Semi-infinite

Joint Design:	
Joint spacing (ft)	15.0
Dowel diameter (in)	1.25
Slab width (ft)	12.0

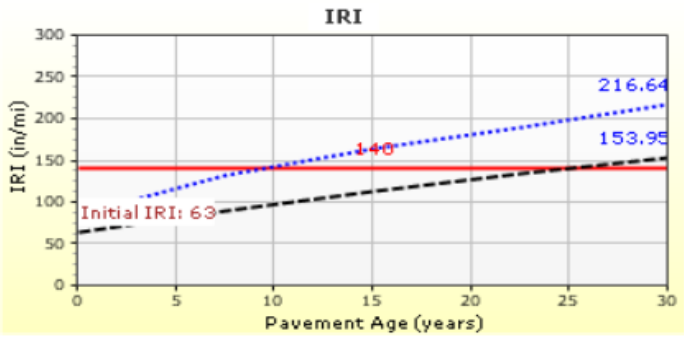
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	4,000
2033 (15 years)	12,001,200
2048 (30 years)	28,153,200

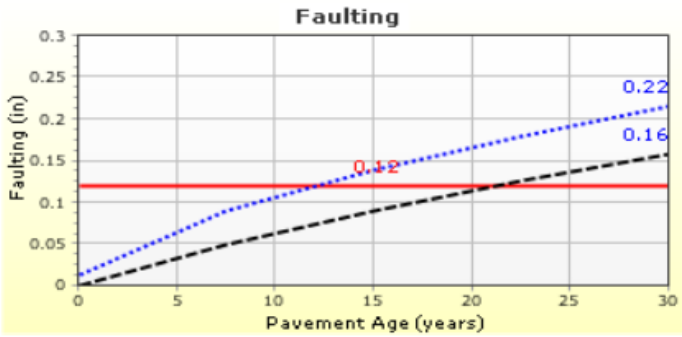
Design Outputs

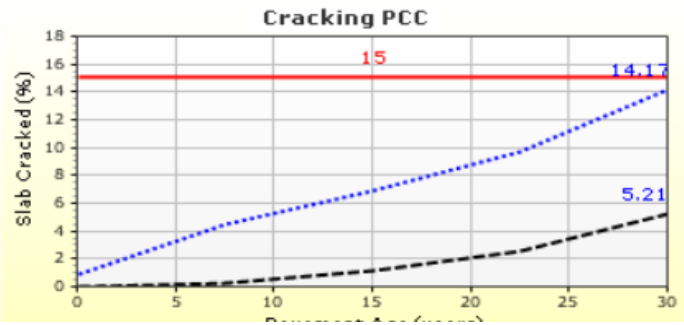
Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	140.00	216.64	90.00	38.77	Fail
Mean joint faulting (in)	0.12	0.22	90.00	18.80	Fail
JPCP transverse cracking (percent slabs)	15.00	14.17	90.00	91.93	Pass

Distress Charts







Reviewing ME Models: Local Calibration

- Compare predicted and measured pavement performance
  - Remove bias, minimize standard error of the estimate
- Rigid Pavement models considered:
  - IRI
  - Punchouts
  - Cracked Slabs (JPCP)
  - Faulting (JPCP)
- Calibrated using Pavement ME Design Version 1.3
  - Pavement ME Design Version 2.2 now available

Understanding Design Output: Parallel Design

Purpose

- Gain more experience using software
- Better understanding of how some VDOT practices/inputs work in ME design methodology
- Develop expectations for typical performance prediction values in Virginia

Other states in region are using (or planning to use) a similar parallel design method to gain experience.

Other Challenges to Implementing ME Design

- AASHTO still changing models
- Increased complexity to use software.
  - Partner with IT to enable access for VDOT staff
- Develop comfort with new design approach after long history using empirical based methods
  - New results won’t match old design but should be similar

Next Steps Towards Implementation

- Continue parallel designs to evaluate Pavement ME design results
- Identify performance criteria to develop pavement design using ME procedure
- Provide training
- Continually improve input parameters and review models
- Feedback from industry and other external stakeholders

- Target implementation date is August 2017