

Development of Simplified Mechanistic-Empirical Design Tool for Pennsylvania Rigid Pavements

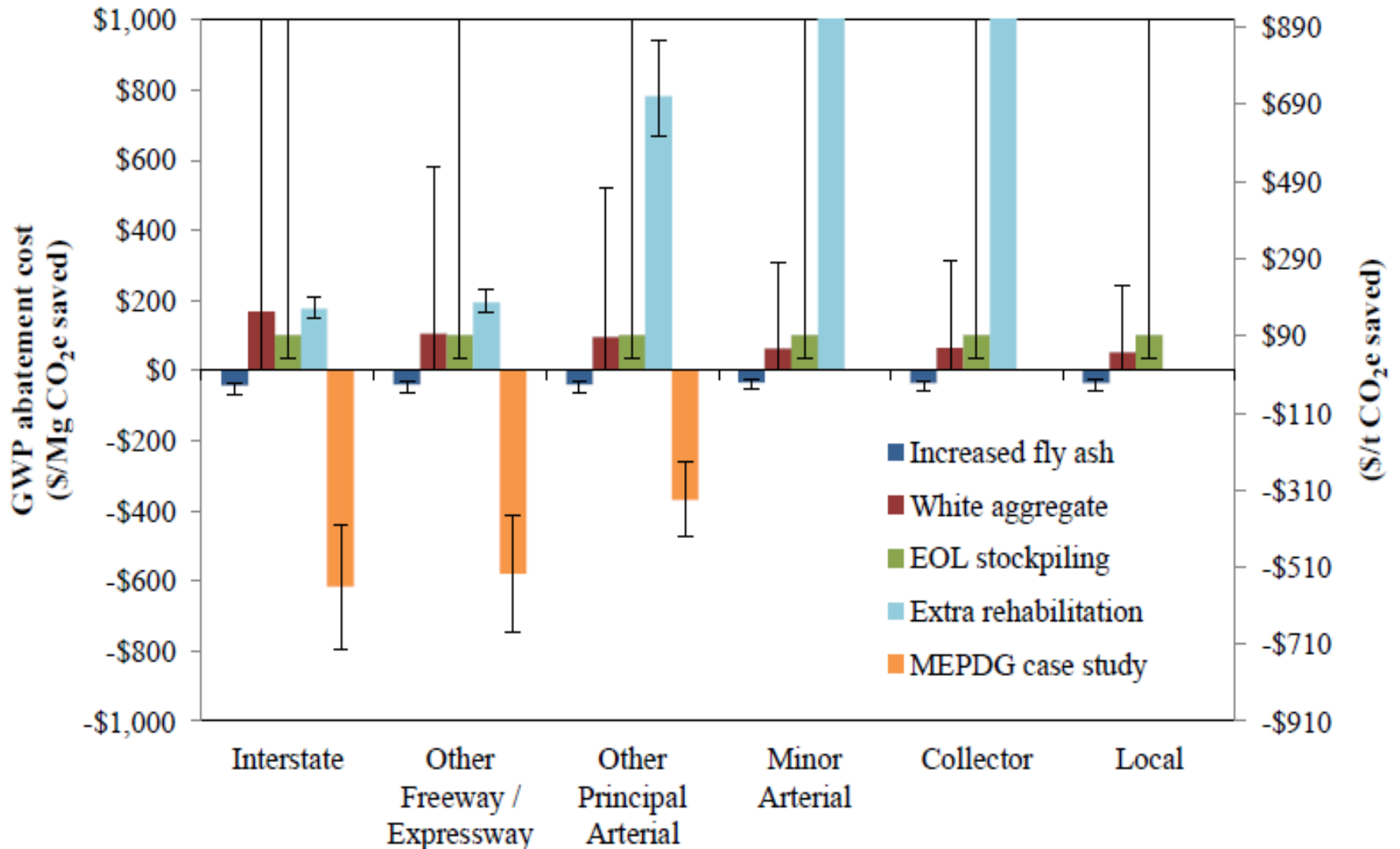
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The Research Problem

- ❑ The current Pennsylvania design method for rigid pavements is outdated
 - ❑ AASHTO 93-based procedure (1960-s technology)
 - ❑ Not cost-effective: many empirical evidences of overdesign built into AASHTO 93
- ❑ Pennsylvania is considering a transition to AASHTO ME design, which requires the user:
 - ❑ to provide many inputs thus increasing possibilities of the design errors
 - ❑ to use AASHTOWare Pavement ME software with annual license fees

Why AASHTO ME Design?



Concrete Sustainability Hub@MIT – Special Research Brief – March 2011

Pavement ME JPCP Design Inputs

General JPCP inputs			
<ul style="list-style-type: none"> <ul style="list-style-type: none"> <ul style="list-style-type: none"> JPCP Design <ul style="list-style-type: none"> PCC surface shortwave absorptivity <input checked="" type="checkbox"/> 0.85 Spacing(12). Diameter(1.25) Erodibility index PCC-base contact friction PCC joint spacing (ft) 15 Permanent curl/warp effective temperature difference (deg F) <input checked="" type="checkbox"/> -10 Sealant type Tied shoulders <ul style="list-style-type: none"> Tied shoulders Load transfer efficiency (%) <input checked="" type="checkbox"/> 50 Widened slab <ul style="list-style-type: none"> Not widened 			
<ul style="list-style-type: none"> Doweled joints <ul style="list-style-type: none"> Spacing(12). Diameter(1.25) Dowel diameter (in) <input checked="" type="checkbox"/> 1.25 Dowel spacing (in) <input checked="" type="checkbox"/> 12 Is joint doweled? True 			Dowel bar design
<ul style="list-style-type: none"> PCC-base contact friction <ul style="list-style-type: none"> Full friction with friction loss at (0) months PCC-Base full friction contact True Months until friction loss <input checked="" type="checkbox"/> 0 Unbonded JPCP False 			PCC-base bonding conditions
<ul style="list-style-type: none"> PCC joint spacing (ft) <ul style="list-style-type: none"> 15 Is joint spacing random? False Spacing of Joint 1 <input checked="" type="checkbox"/> Spacing of Joint 2 <input checked="" type="checkbox"/> Spacing of Joint 3 <input checked="" type="checkbox"/> Spacing of Joint 4 <input checked="" type="checkbox"/> Joint spacing (ft) <input checked="" type="checkbox"/> 15 			Joint spacing
<ul style="list-style-type: none"> Tied shoulders <ul style="list-style-type: none"> Tied shoulders Load transfer efficiency (%) <input checked="" type="checkbox"/> 50 			Shoulder type and lane width
<ul style="list-style-type: none"> Widened slab <ul style="list-style-type: none"> Tied with long term load transfer efficiency of 50 True Not widened Is slab widened? False Slab width (ft) <input checked="" type="checkbox"/> 			

Research objectives

- Provide effective, localized design tool to Pennsylvania pavement engineers compatible with the AASHTOWare Pavement ME program similar to MnPAVE Rigid, the tool used by MnDOT
- Accelerate implementation of the AASHTO Mechanistic-Empirical Pavement Design Guide (MEPDG)
- Reduce potential of design errors from the improper use of the AASHTOWare Pavement ME software
- Reduce or eliminate license fees required to perform MEPDG design using the AASHTOWare Pavement ME software

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Project Approach/Deliverables

- Task 1. Literature and Software Review and Sensitivity Analysis
- Task 2: Perform Pavement ME Factorial and Develop Simplified Design Tool, PittRigid-ME
- Task 3: Conduct PittRigid-ME Verification
- Task 4: Final Report

Main **Faulting** Cracking Truck Volume ESALs

Design

Project name:

Performance models coefficients
PennDOT defaults

Climate region

Design life, years

Cracking reliability, % Faulting reliability, %

Two-way AADTT year 1 Compound growth, %

Number of lanes (two-way) Traffic pattern

Joint spacing, ft

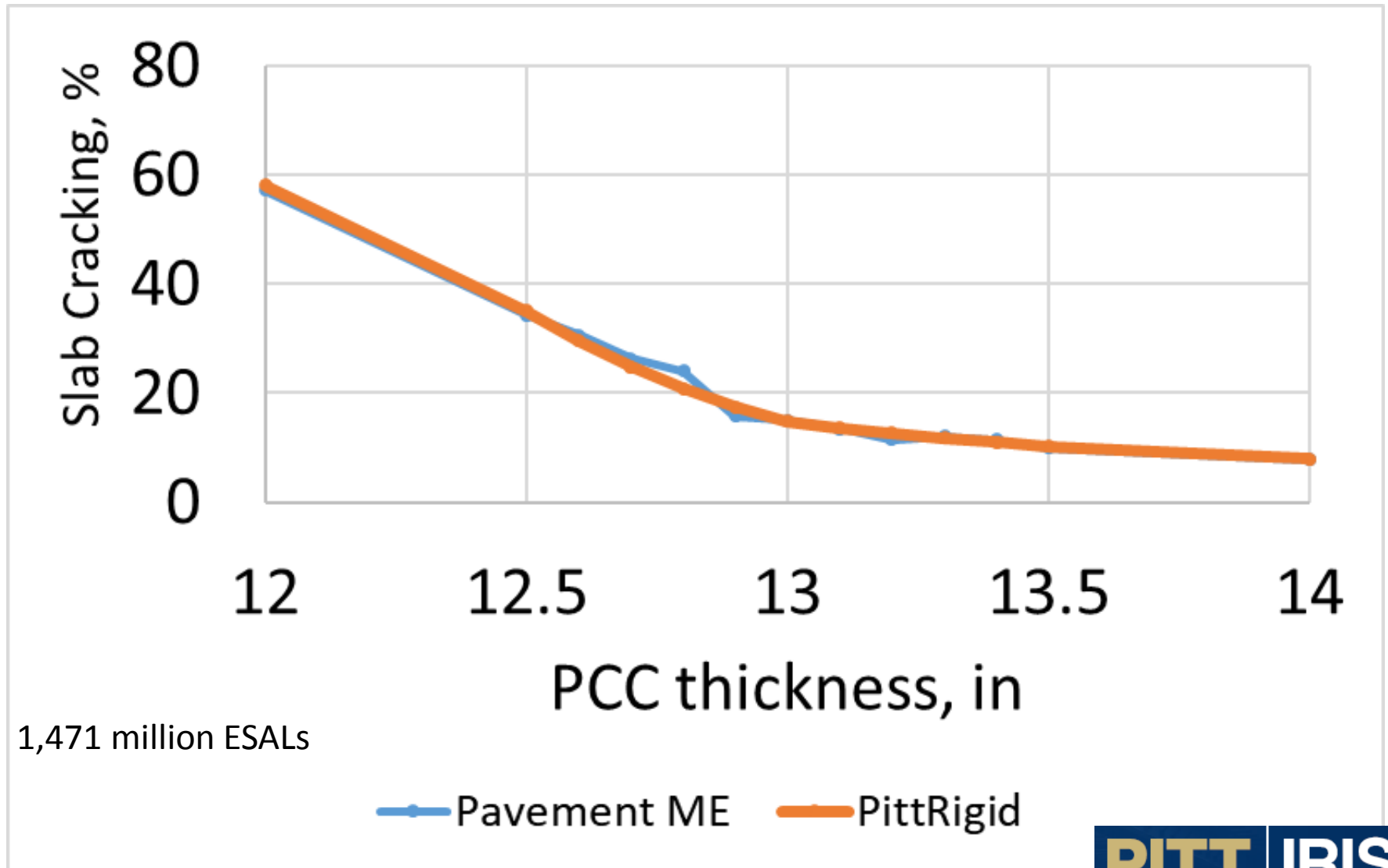
Slab Width

Shoulder type

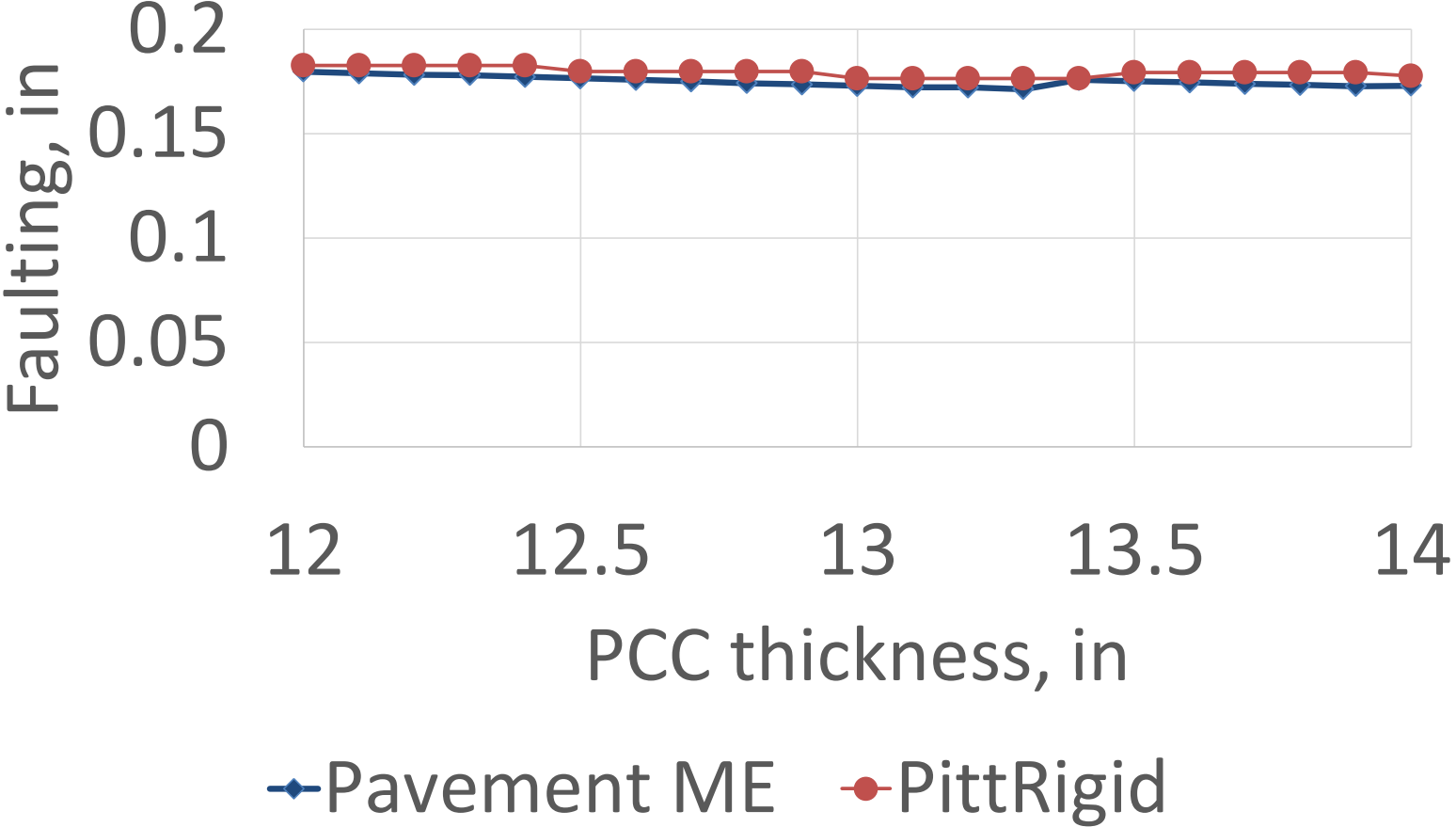
Modulus of rupture, psi COTE, $10^{-6} 1/^\circ\text{F}$

Base type

Comparison of Cracking Predictions



Comparison of Faulting Predictions



260 million ESALs



Web-Based Version

<https://pittrigid.azurewebsites.net/>

PITT | IRISE

PittRigid ME Version 1.0

Help:

Open a PDF file with the project report [report](#).

Design

Yes

Climate

Region 1: Erie County

Design Life, years:

20

Cracking Reliability, %

90

Faulting Reliability, %

90

Two-way AADTT Year 1

1000

Compound Growth, %

3

Number of Lanes (two way)

2

Traffic Pattern

Urban Principal Arterial-Interstate

Joint Spacing, ft

12

Slab Width

Conventional width (12

Shoulder Type

Tied PCC

Base Type

Aggregate

PCC Flexural Strength, psi

631.0

COTE, 10^{-6} 1/°F

4.5

Submit

Settings

Application of Research Results

- Design of new concrete pavements
- Implementation of the AASHTO ME design procedure for concrete pavements in Pennsylvania without software license fees
- Simplification of design and reduction of design errors
- Pavement type selection
- Improvement/local calibration of AASHTO ME for Pennsylvania conditions