ALABAMA ASPHALT PAVEMENT ASSOCIATION

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2024 ASCE MONTGOMERY BRANCH MEETING

USING PAVEXPRESS TO DESIGN ASPHALT PAVEMENTS

MEL MONK, P.E. – EXECUTIVE DIRECTOR, ALABAMA ASPHALT PAVEMENT ASSOCIATION

October 8, 2024 | Montgomery, Al

DESCRIPTION OF SESSION

The design of a new asphalt pavement or an overlay of an existing pavement must account for the subgrade conditions, traffic volume, traffic loading and environmental conditions. With asphalt overlays, the condition of the existing pavement must be known. PaveXpress software integrates all of these considerations in an easy-to-use stepwise process.

LEARNING OBJECTIVES

1. Learn the key factors that must be evaluated for a proper new or overlay pavement design.
2. Learn to use PaveXpress for designing pavements.
3. Understand the economic consequences of over- or under- designing a pavement.

BASICS OF PAVEMENT DESIGN

- New Pavement Structures
  - New Alignments
  - Capacity Improvements
  - Sub-Divisions
- Maintenance and Rehabilitation
  - Reconstruction
  - Full or Partial Depth Rehabilitation
  - Structural Overlays
  - Functional Overlays

Things You Need to Know

Traffic

Soils and Subgrade

Expectations

Traffic Considerations

CARS

They do not count!

11,900 cars = 1 truck (18 - wheeler)

TRUCKS

Extremely critical to know

Number of trucks

Types of trucks

Loadings on axles

BUSES

Can be a silent killer

Often overlooked

Parking lots and bus stops

SPECIAL VEHICLES

Non-conventional vehicles

Slow movements

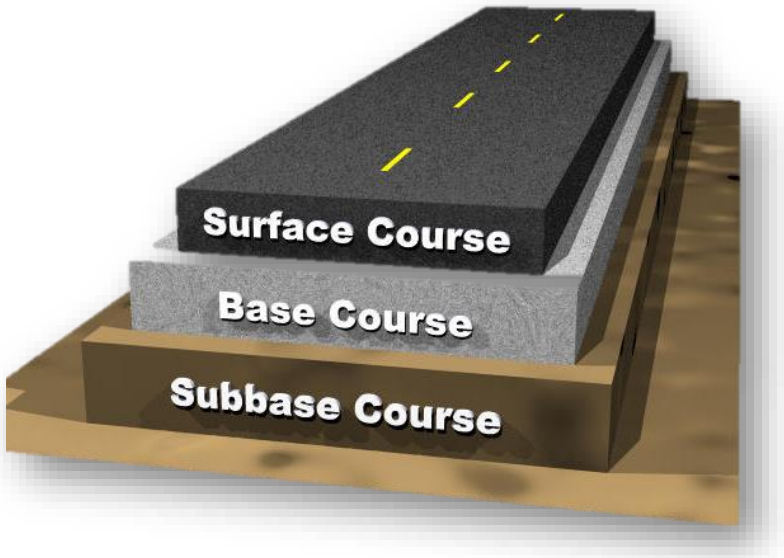
Extremely heavy tire loads

Soils and Subgrade

- Types of Soils
- Strength of Soils
- Drainage

PAVEMENT EVALUATION APPROACHES

Typical Pavement Structure



SURFACE COURSE

- Typically, 1” – 2” thickness
- Placed in the final operation for most projects
- Provides pavement appearance and smoothness

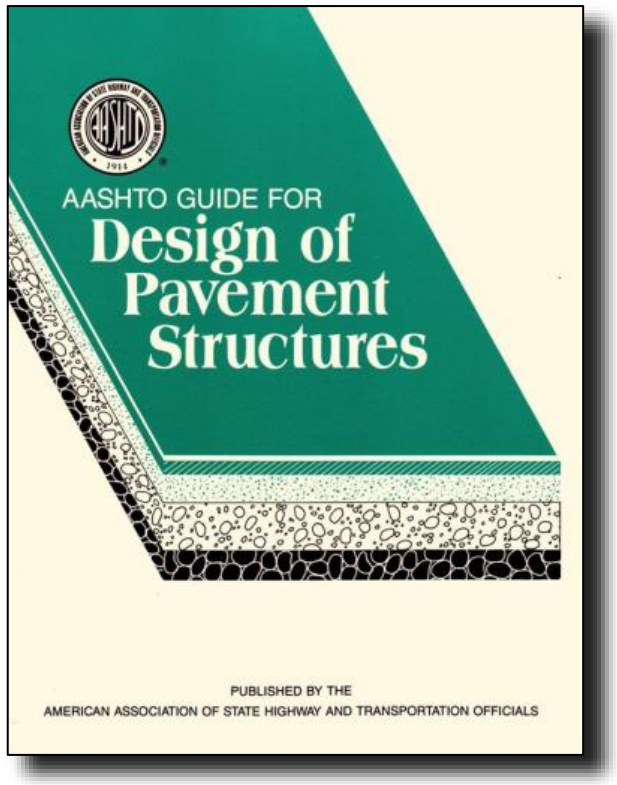
INTERMEDIATE/BASE COURSE

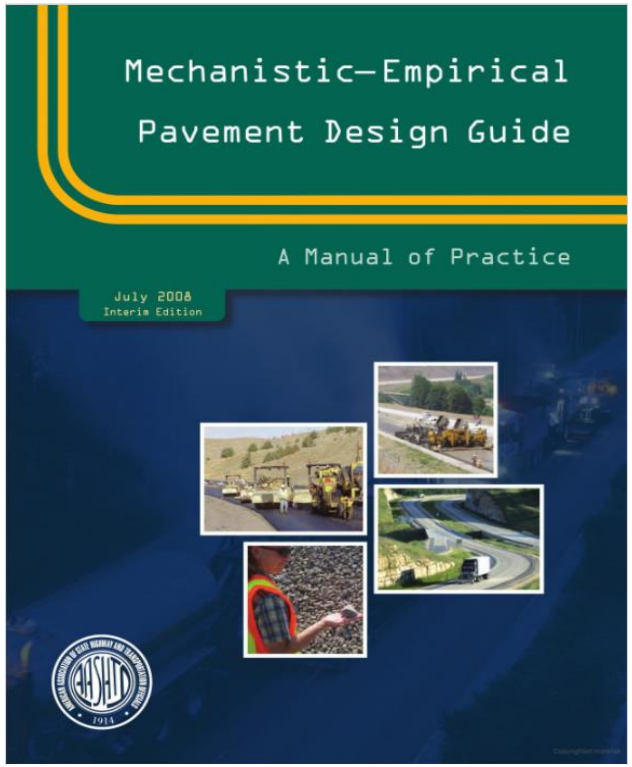
- Typically, 2” thickness for intermediate course
- 3” + thickness for base course
- Provides structure to pavement

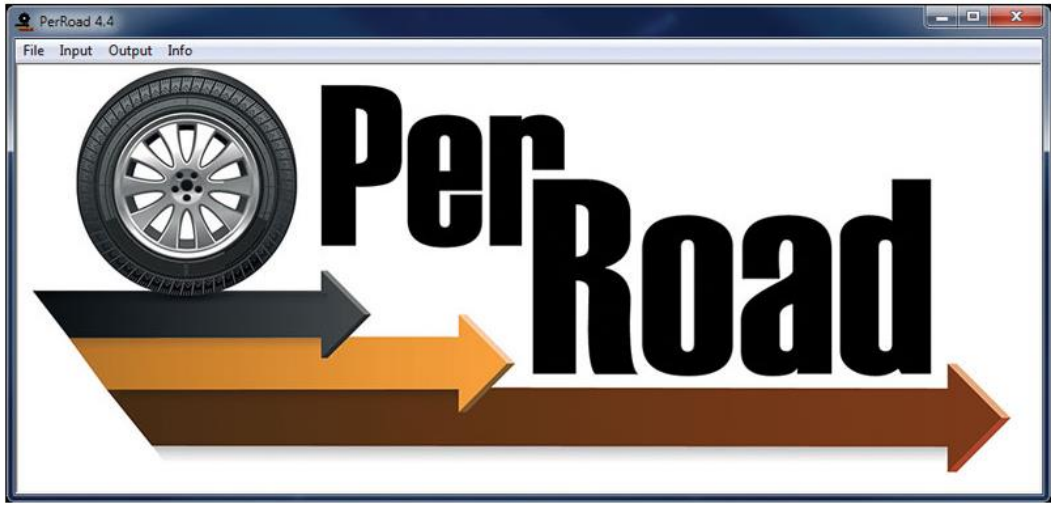
SUBBASE COURSE

- 6” – 8” Thickness
- Aggregate or stabilized materials / crushed aggregate base
- Sometimes used for drainage

PAVEMENT DESIGN APPROACHES








PaveXpress
A SIMPLIFIED PAVEMENT DESIGN TOOL
www.PaveXpress.com

WHAT IS PAVEXPRESS?

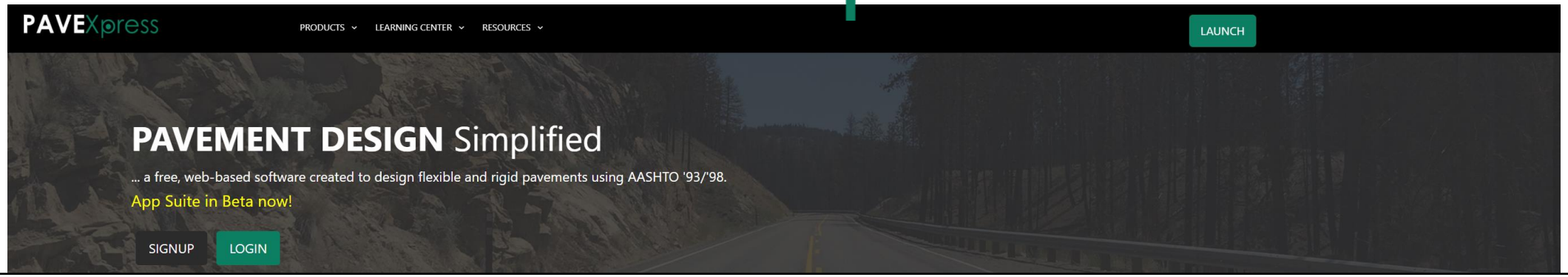
A free, online tool to help you create simplified pavement designs using key engineering inputs, based on the AASHTO and Perpetual Pavement design processes.

- Accessible via the web and mobile devices.
- Free — no cost to use.
- Based on AASHTO and PerRoad design equations.
- User-friendly.
- Share, save, and print project designs.
- Interactive help and resource links.

WHAT DOES PAVEXPRESS DO?

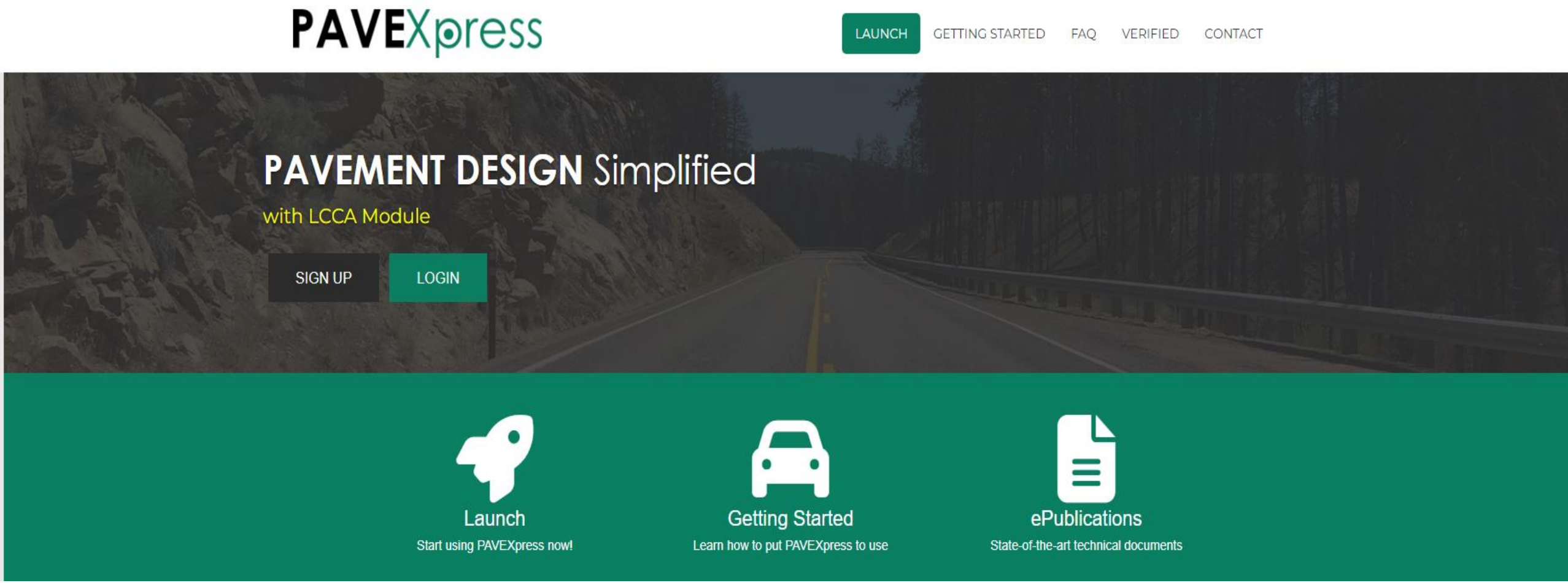
- New pavement designs – asphalt and concrete.
- Asphalt overlay designs.
- Life cycle cost analysis (Agency and Realcost).
- Mechanistic pavement design (PerRoad).

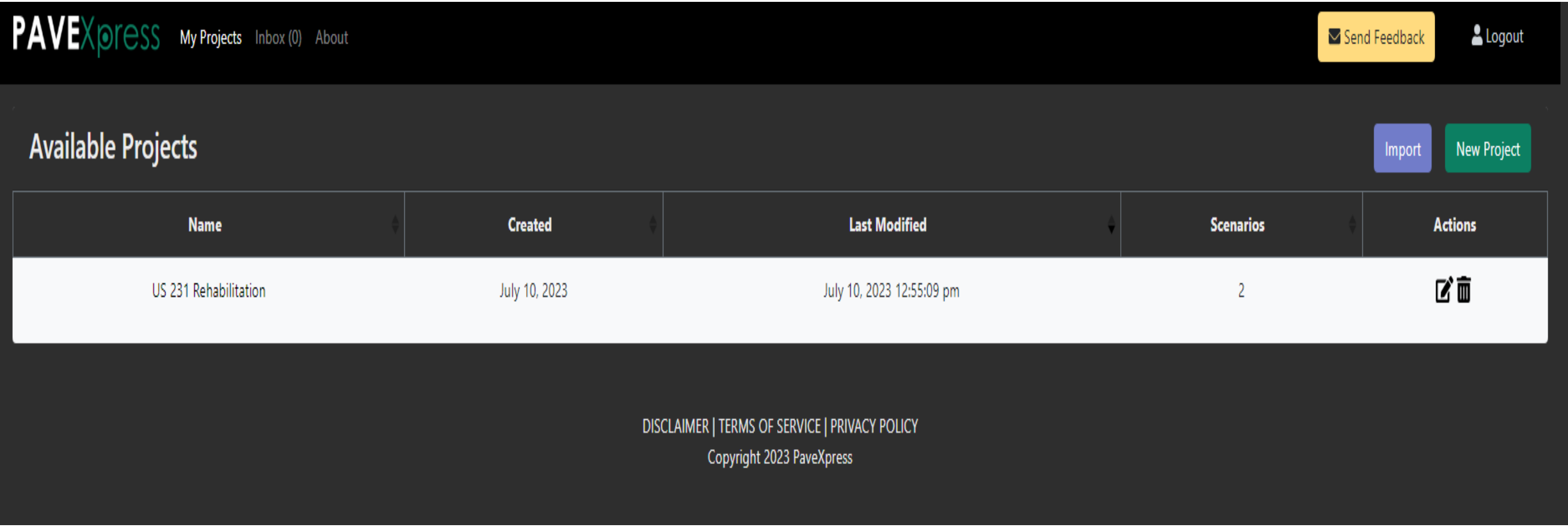
PaveXpress



www.PaveXpress.com

PAVEXPRESS OVERVIEW




PAVEXpress
My Projects
Inbox (0)
About
Send Feedback
Logout
Available Projects
Import
New Project
Name
Created
Last Modified
Scenarios
Actions
US 231 Rehabilitation
July 10, 2023
July 10, 2023 12:55:09 pm
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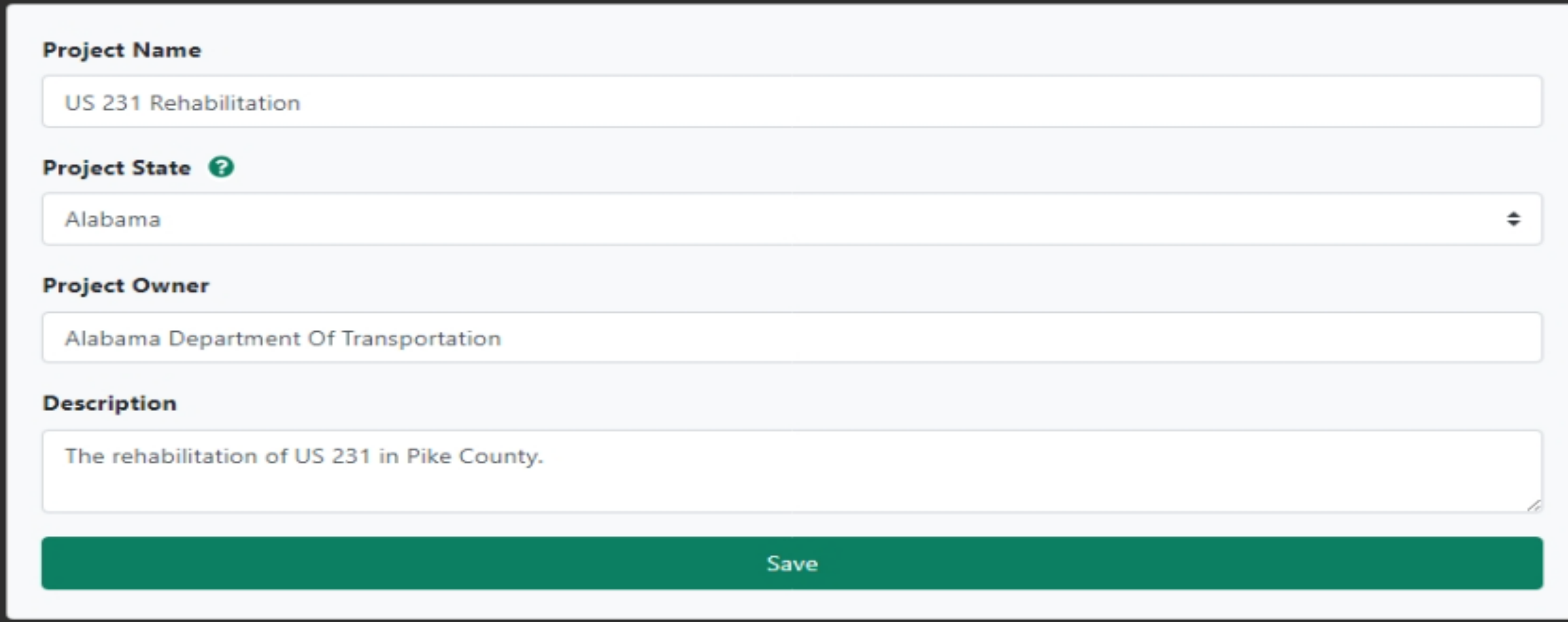
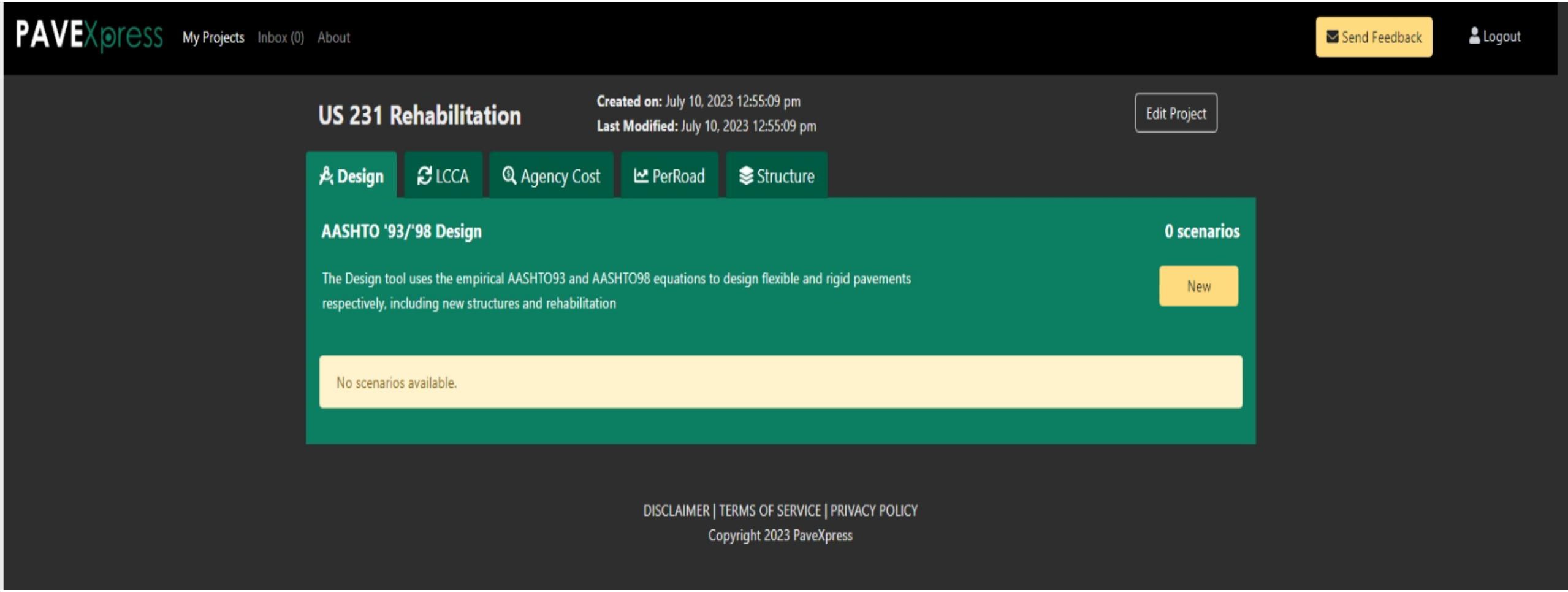
NEW PROJECT WINDOW



PROJECT OPTIONS



US 231 Rehabilitation

New AC Overlay Pavement Design

AASHTO '93/'98: Flexible Overlay Pavement Design

Metric | Imperial

Scenario Information | Layers | Design Parameters | Structural Evaluation | Traffic & Loading | Design Guidance

Scenario Name

New AC Overlay Pavement Design

Scenario Description

Existing pavement has surface distresses and needs structural capacity improvement.

Estimated Completion Year

2024

Roadway Classification

Principle Arterial

Project State

Alabama

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Existing Layers

Layer Number	Type	Thickness	Actions
1	Asphalt - Dense Graded	8 in	
2	Aggregate Base	6 in	

Add layer

Subgrade

Subgrade modulus calculation method

R-Value | CBR | Manual

Enter modulus value manually below.

Please determine the subgrade modulus.

Soil Type

-- Please select an option --

Modulus (M_R)

7500 psi

New AC Overlay

Layer Coefficient (a)

0.54

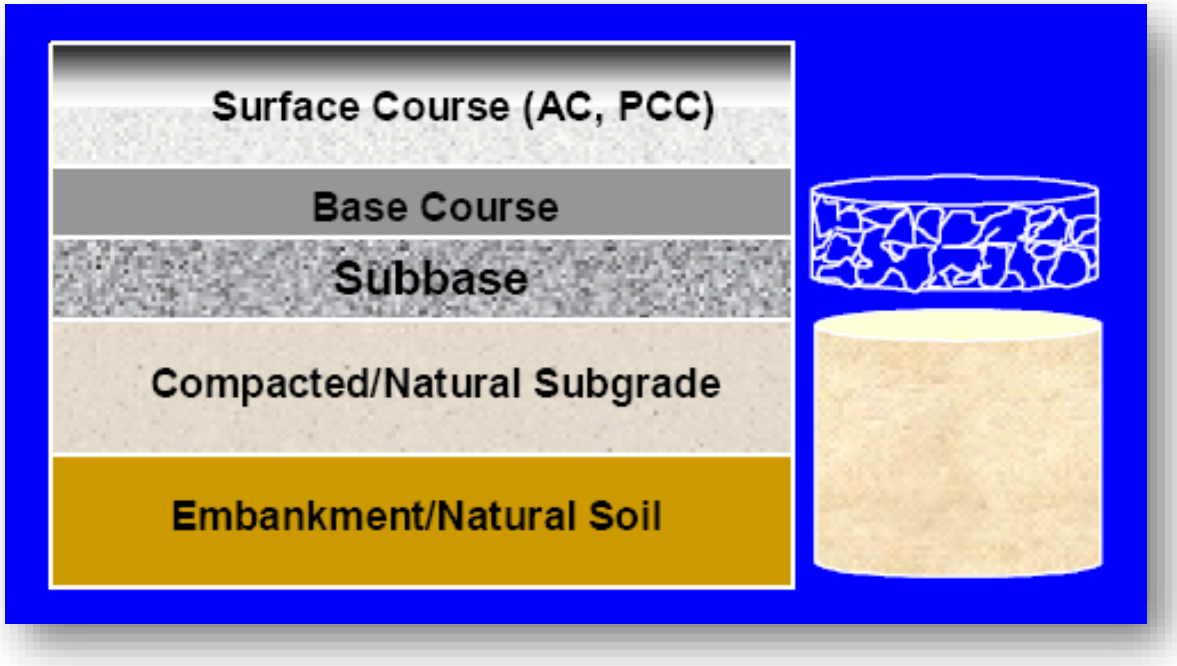
Minimum Thickness

1 in

SUBGRADE CONSIDERATIONS

The most common methods of classifying the subgrade for pavement design are:

- California Bearing Ratio (CBR)
- Resistance Value (R)
- Resilient Modulus (M_R)



SUBGRADE CONSIDERATIONS

The Asphalt Institute publication IS-91 gives the following test values for various subgrade qualities:

Relative Quality	*R*-Value	California Bearing Ratio	Resilient Modulus (psi)
Good to Excellent	43	17	25,000
Medium	20	8	12,000
Poor	6	3	4,500

Note that different design guides will show different ranges for the various subgrade qualities — use engineering judgment when evaluating subgrade design inputs.

LAYER COEFFICIENT CONSIDERATIONS

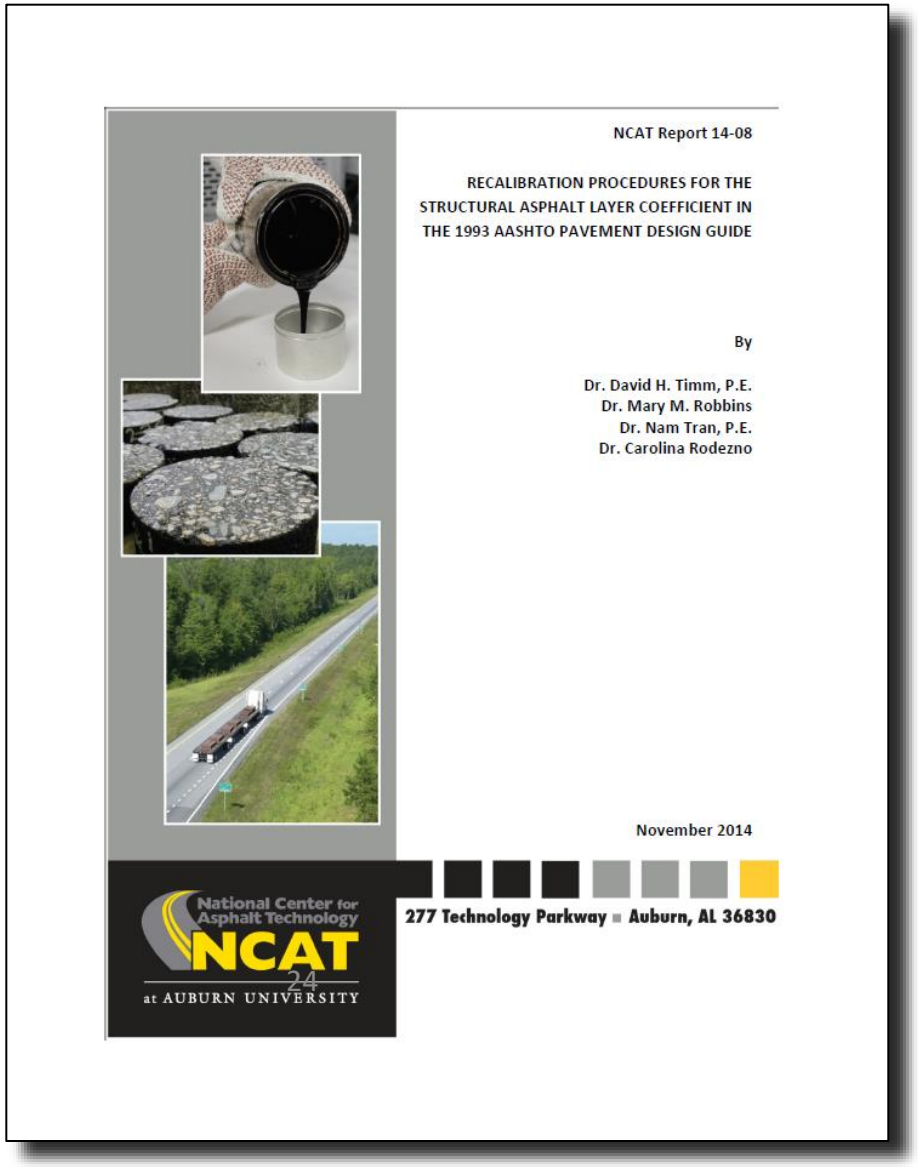
Average values of layer coefficients for materials used in the AASHO Road Test were as follows:

Asphalt Surface Course	0.44
Crushed Stone Base Course	0.14
Sandy Gravel Subbase	0.11

Keep in mind that these values were empirically derived from a road test with one climate, one soil type, and one asphalt mix type.

The asphalt layer coefficient used for the Road Test was actually a weighted average of values ranging from 0.33 to 0.83.

More recent studies at the NCAT Test Track found that for Alabama, an asphalt layer coefficient of 0.54 better reflected actual performance.



US 231 Rehabilitation

New AC Overlay Pavement Design

AASHTO '93/'98: Flexible Overlay Pavement Design

Metric | Imperial

Scenario Information | Layers | **Design Parameters** | Structural Evaluation | Traffic & Loading | Design Guidance

Design Period

20 ✓ Years

Initial Serviceability Index (p_i)

4.5 ✓

Reliability Level (R)

85%

Terminal Serviceability Index (p_t)

2.8 ✓

Combined Standard Error (S_0)

0.5 ✓

Change in Serviceability Index (ΔPSI)

1.7000000000000002

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Use Condition Survey | **Use Nondestructive Testing**

Backcalculation Results

Design Subgrade Modulus

5000 psi

Calculate Modulus

SN_{eff}

3.92

Calculate SN_{eff}

Cores

Were cores taken on the roadway?

Yes

Were cores of cracks taken?

Yes

Crack Type

Top-Down Only

Depth of cracks (max)

2 in

Delamination/Stripping?

No

Distressed Pavement

Mill/Remove distressed asphalt?

Yes

Depth to remove

2 in

Structural Coefficient of removed material (a_{rem})

0.15 SN/in

WHY CORE CRACKS?

US 231 Rehabilitation

New AC Overlay Pavement Design

AASHTO '93/'98: Flexible Overlay Pavement Design

Metric | Imperial

Scenario Information | *Layers* | *Design Parameters* | *Structural Evaluation* | **Traffic & Loading** | *Design Guidance*

Calculate from AADT | **Calculate from Annual ESALs** | **Use Design ESALs**

Completion Year Traffic

400000 ✓ vehicles

Calculate from Historic AADT

Load Equivalency Factor

0.85 ✓

Calculate LEF

Completion Year ESALs

340000

Design Period

20 years

Future Traffic Growth Rate

2 ✓ %

ESAL Growth Rate

1 ✓ %

Total Design ESALs (W_{18})

9155000

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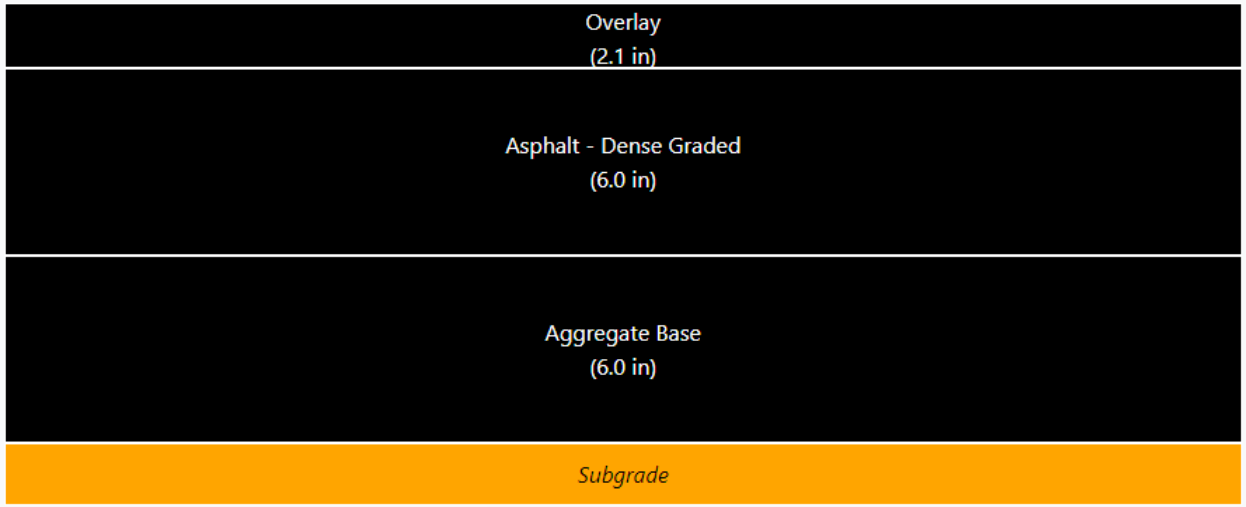
Pavement Diagram



Layer Thicknesses (in)

You have removed 2.0 in from the surface of the pavement prior to performing the overlay in this design.

Print

Details

Scenario: New AC Overlay Pavement Design

Created By: Mel Monk, melmonk@bellsouth.net

Last Modified: July 10, 2023 1:37:43 pm

Design Parameters

Design Period: 20 years

Reliability Level (R): 85%

Combined Standard Error (S_0): 0.5

Initial Servicability Index (p_i): 4.5

Terminal Servicability Index (p_t): 2.8

Delta Servicability Index (ΔPSI): -1.7000000000000002

Total Design ESALs (W_{18}): 9155000

Layers

Overlay - Asphalt
Thickness: 2.1 in

Asphalt - Dense Graded - Asphalt
Thickness: 6 in

Aggregate Base - Asphalt
Thickness: 6 in

Subgrade - Subgrade
Thickness: 0 in

Calculated Design

Recommendation:

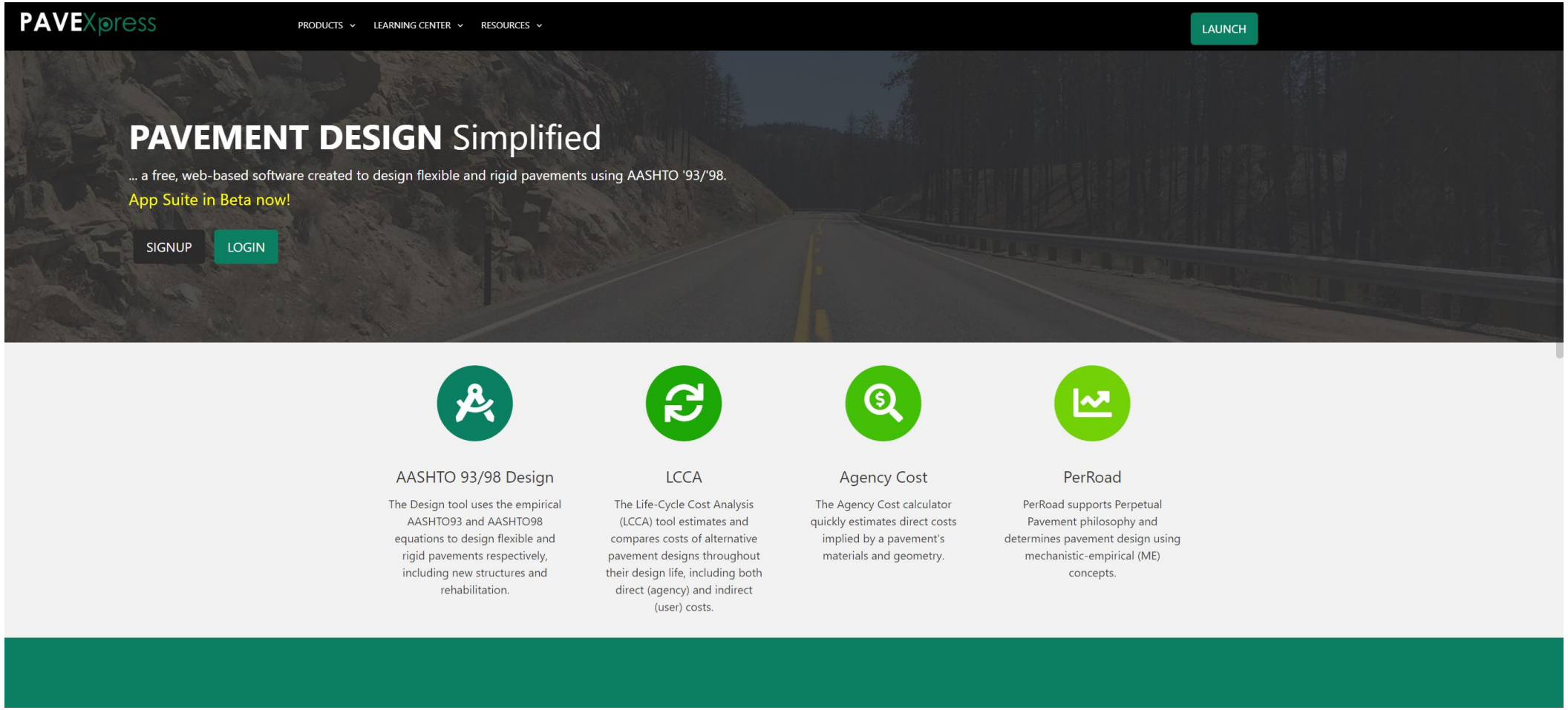
Perform multiple iterations of the design with different plausible input values to get a sense of the range of pavement structures needed to carry the anticipated loads in various scenarios.

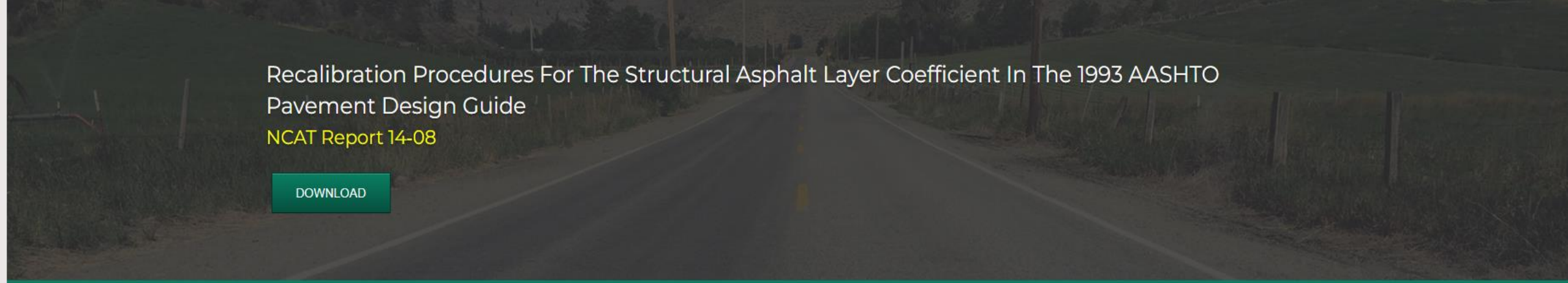
Use engineering judgment to select the optimum pavement structure.

FINAL THOUGHTS ON AC OVERLAY DESIGN

- AC Overlay Design for Flexible Pavement Rehabilitation Only
- Evaluation Methods for Existing AC Pavement
  - Condition Survey
  - Non-Destructive Deflection Testing
- Includes Questions on Coring and Milling
  - Delamination/Stripping
  - Top-Down or Bottom-Up Cracking
- Adjustment to Existing Pavement Layer Coefficients

ADDITIONAL PAVEXPRESS FUNCTIONS





Recalibration Procedures For The Structural Asphalt Layer Coefficient In The 1993 AASHTO Pavement Design Guide

NCAT Report 14-08

DOWNLOAD

Launch

Start using PAVEXpress now!

Getting Started

Learn how to put PAVEXpress to use

ePublications

State-of-the-art technical documents

PAVEInstruct

The PAVEInstruct learning module is a web-based pavement design education system with video instruction by leading industry experts. PAVEInstruct accompanies PAVEXpress, a web-based software created to design flexible and rigid pavements using AASHTO 93/98. The education modules within PAVEInstruct correlate with the design modules in PAVEXpress and provide technically sound pavement design and instruction.

LEARN MORE

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LEARN MORE

PAVEInstruct Pavement Design Education

PerRoad Design Example

Dr. Dave Timm, Auburn University

Here is a sample of one of the many sessions available through this free learning system. Professional development hours are available for participants.

PAVEINSTRUCT LEARNING MODULE

complement to PaveXpress

- Available on-demand via web.
- Flexible and rigid pavement design.
- Detailed use of PaveXpress.
- Leading industry expert instructors.
- No cost to user.
- PDHs available.

SO, WHAT ELSE SHOULD A PRACTITIONER KNOW?

A FEW QUESTIONS TO PONDER

- Is my design too thick?
- Is my design too thin?
- Is my design just right?
- Design good for today, but about the future?

NCAT REPORT – MAXIMUM THICKNESS

Base Mr (ksi)	Subgrade Mr (ksi)	Maximum Asphalt Thicknesses (in.)					
		6-in. Base		8-in. Base		10-in. Base	
		Average	Range	Average	Range	Average	Range
30	5	14	12.5-15.5	13.8	12.5-15	13.3	12-14.5
30	10	12.2	10.5-14	11.7	10.5-13	11	10-12
30	20	10.5	9-12.5	10.7	9-12.5	10	8.5-11
50	5	13.7	12-15	13.2	11.5-14.5	12.3	11-13.5
50	10	11.8	10.5-13	11.2	10-12	10	9-11
50	20	10.2	8.5-12.5	10.2	8.5-12	9	7.5-10
100	5	13.2	12-14	12.2	11-13	11.2	10-12
100	10	11	10-12	10.2	9-11	9	8-10
100	20	9.7	8-12	9	7.5-10.5	8	6.5-9

- NCAT Synopsis 15-05R

THINLAYS

- Multi-Purpose Asphalt Mix.
  - Preventive Maintenance
  - New Construction Surface
- 80M ESAL Mix at NCAT Test Track.
- “Double Pavement Structural Capacity 1” at a Time”.
- ALDOT Section 424A – 3/8” Maximum Aggregate Size Mix.
- Recommended Placement Rate (80 – 110 Pounds Per Square Yard) (0.72 – 1.00 Inch).
- ALDOT Section 424T – Thin Lift Asphalt Mix.
- Recommended Placement Rate (60 -75 Pounds Per Square Yard) (0.54 – 0.68 Inch).

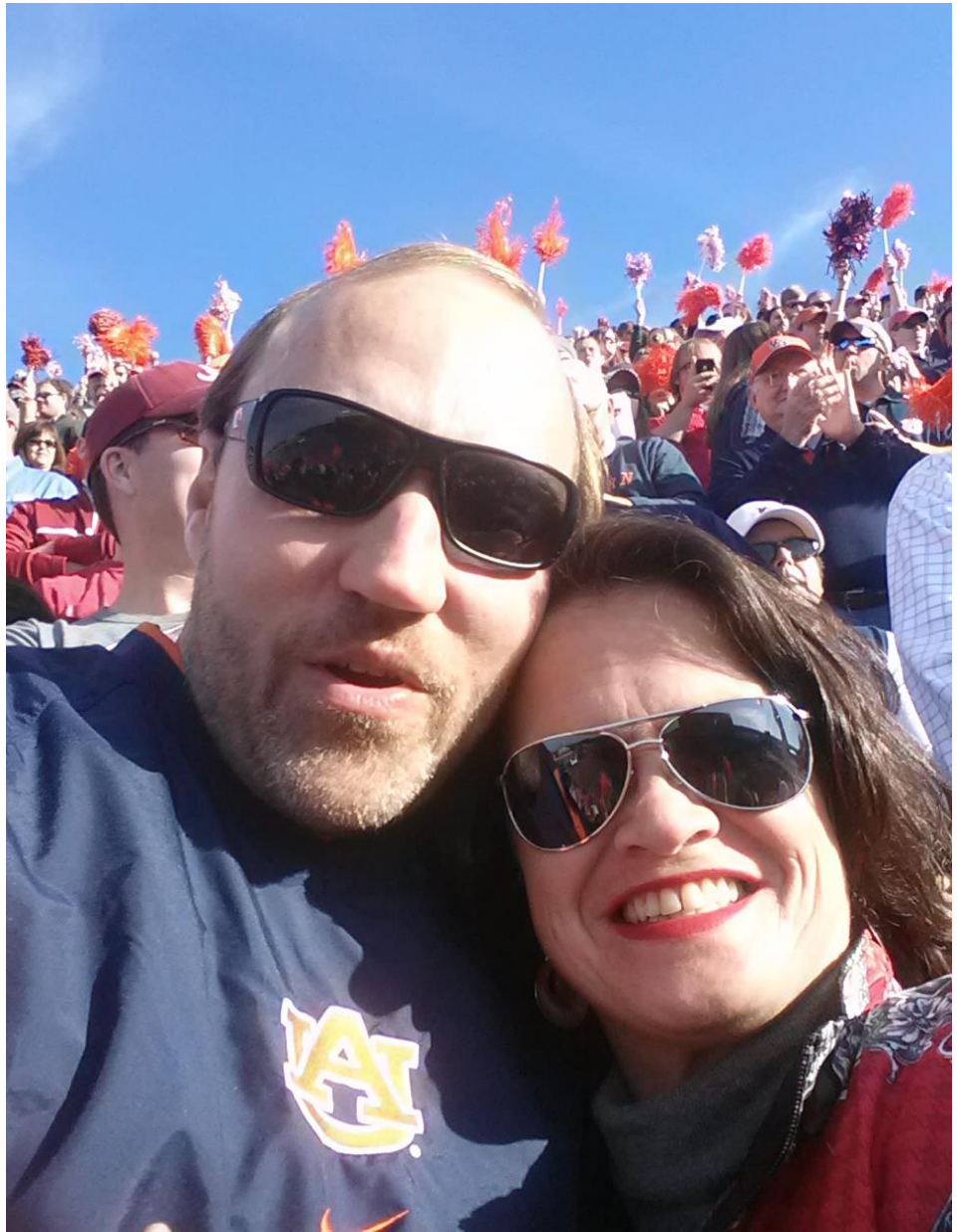
OTHER RESOURCES

- Asphalt Pavement Alliance Website
- NAPA Website
- NCAT Website
- AAPA Website

AAPA PUBLICATIONS

- www.alasphalt.com
- Asphalt Pavement Design Guide For Low-Volume Roads And Parking Lots
- Alabama Porous Pavement Parking Lots Guide Specifications
- OGFC Best Practices Guidelines

QUESTIONS ?????



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