

PaveXpress

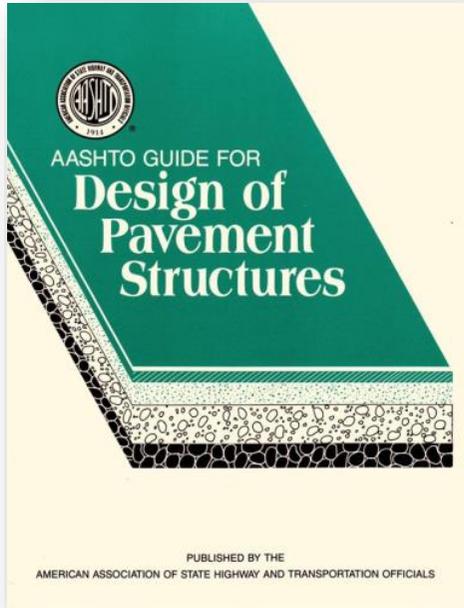
Simplified Pavement Design Tool



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Don't we already have tools for this?



The image displays two software interfaces. The top window is 'Everstress Data Entry', showing fields for 'Title', 'No of Layers', 'Units' (Metric/US Units), and a 'Layer Information' table. The bottom window is 'City Streets - Green St. from Prospect to Mattis', showing a 'Description' field and several input fields for design parameters.

No	Layer ID	Interface Contact	Poisson's Ratio	Thickness (in)	Modulus (ksi)	Mu
1		1.00				

City Streets - Green St. from Prospect to Mattis

Description: Flexible Design for Green St. - Project Length = 1 mile

8kip ESALs Over Initial Performance Period: 2,882,008

Initial Serviceability: 4.5

Terminal Serviceability: 2.5

Reliability Level (%): 95

Overall Standard Deviation: 0.45

Roadbed Soil Resilient Modulus: 7,009 psi

Number of Construction Stage: 1

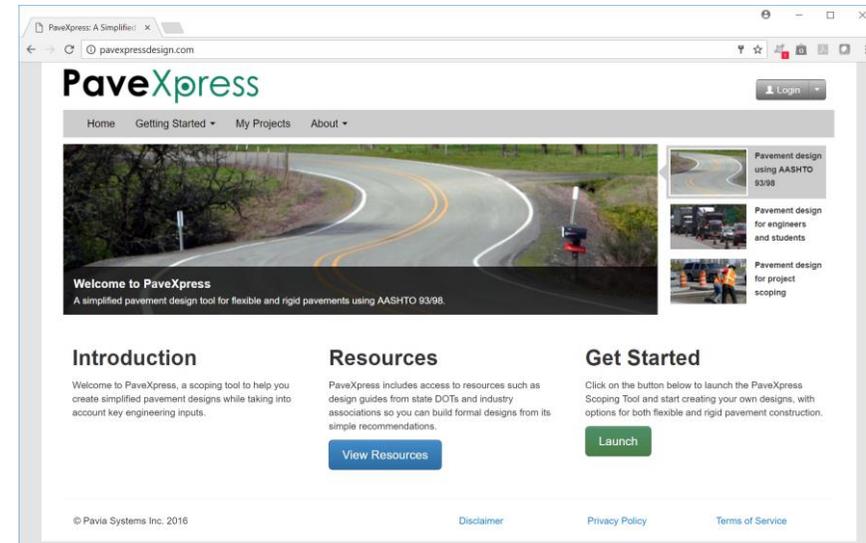
Design Structural Number: 4.29 in

Pavement ME is generally used for high volume roads, and a need exists for easy to use tools for local and lower volume roads

What Is PaveXpress?

A free, online tool to help you create and evaluate pavement designs and overlays using key engineering inputs, based on the AASHTO 1993 and 1998 supplement pavement design process.

- ✓ **Free** — no cost to use
- ✓ **Accessible** – via the web and mobile
- ✓ **Standards Based** - AASHTO and/or industry standard practices
- ✓ **User-friendly** – streamlined UI/UX
- ✓ **Collaborative** - share, save, and print
- ✓ **Interactive** – help and resources

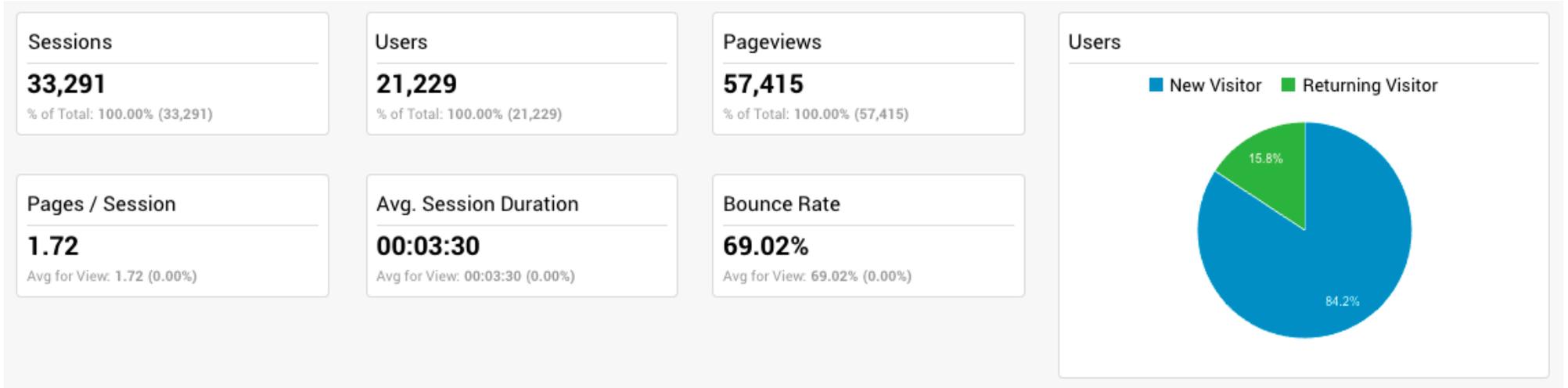


Who is it for?

- Local Government Agencies
- A/E/C Firms
- Engineering Students
- State Transportation Agencies
- FHWA
- Foreign Companies and Governments

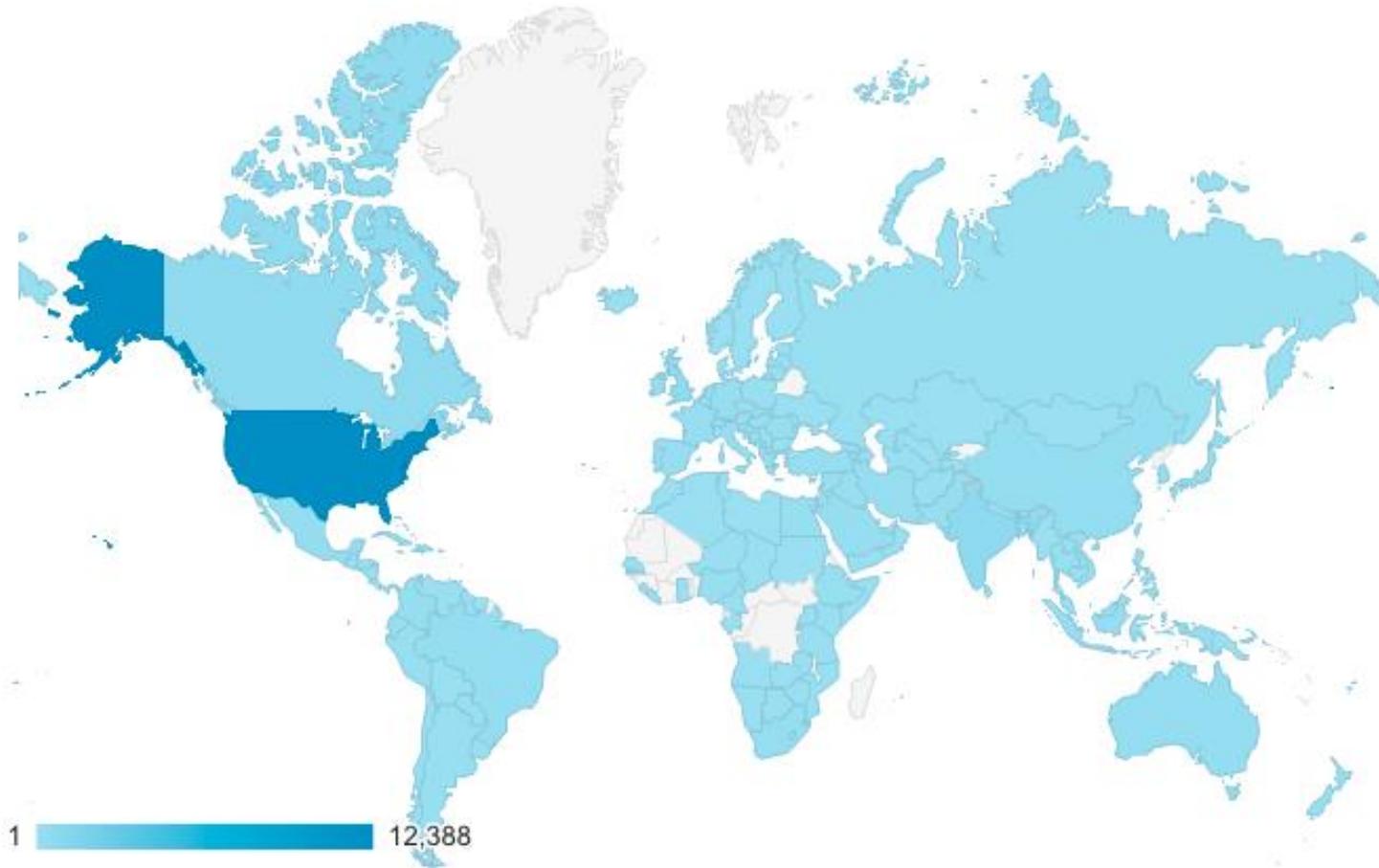


Since 2015: Over 21,000 users

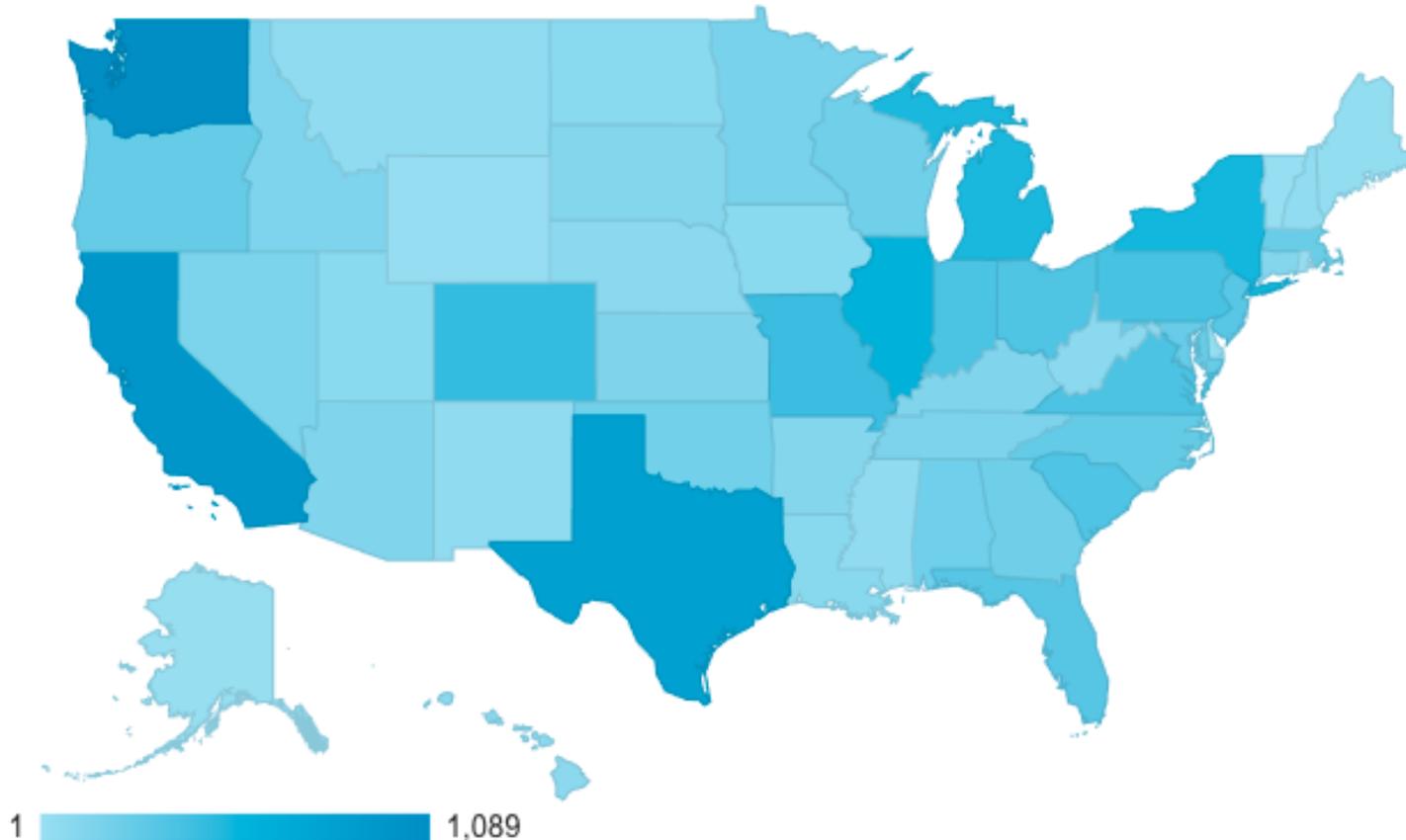


Last Month: 620 users, 52% are returning users

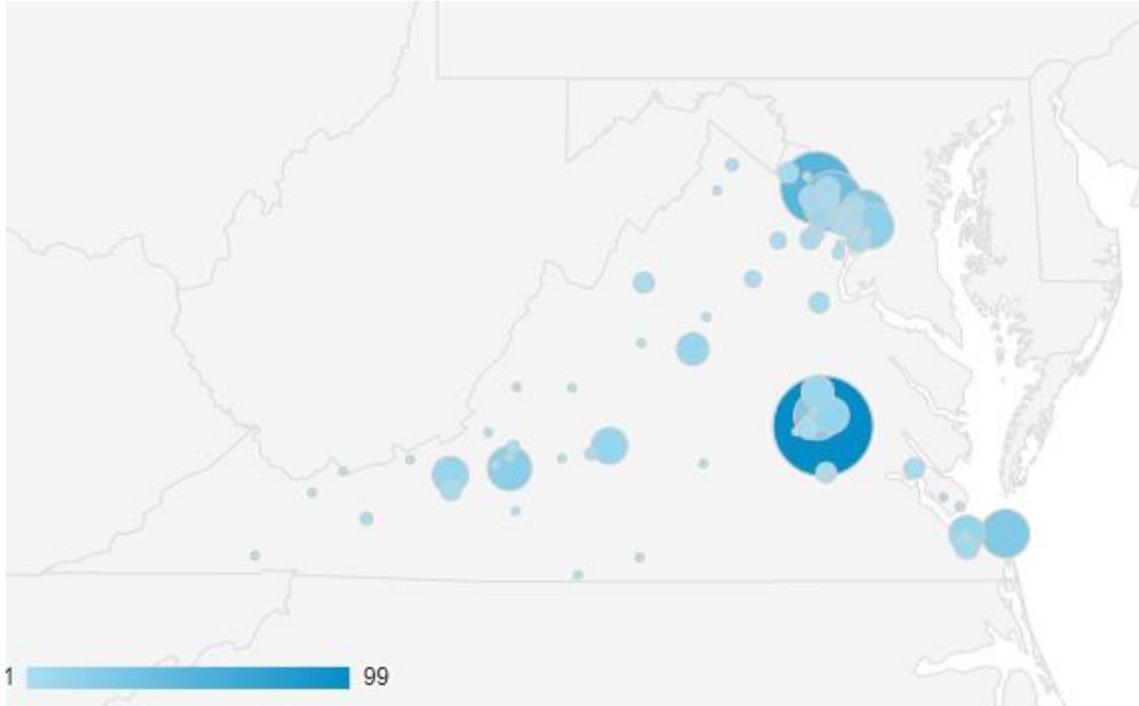
Users from 157 countries -> 66% from U.S.



Users from every state in the U.S.



Virginia

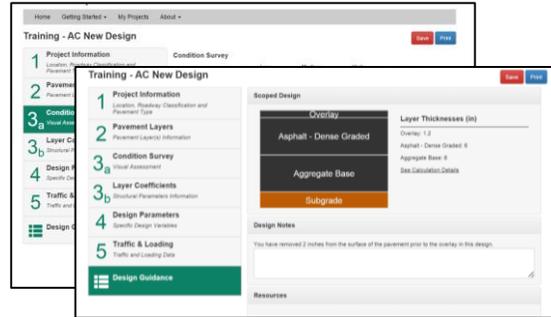


Users

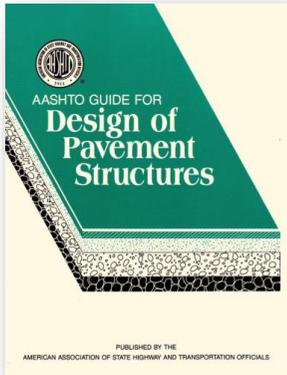
372

The evolution of PaveXpress....

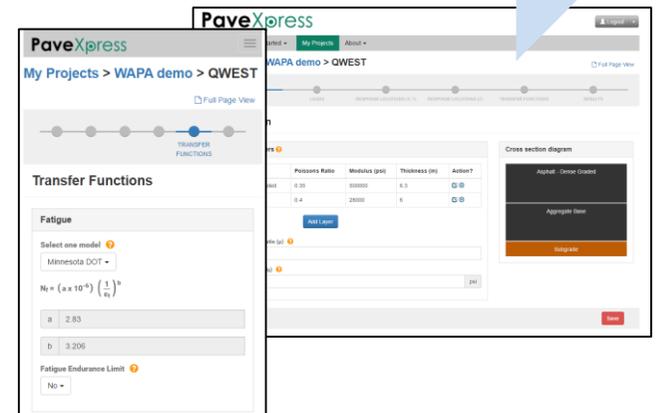
- New Flexible
- New Rigid
- Parking Lots



- Cost Module
- LEA Module
- UI/UX Update



- Overlay design
- Condition Survey
- NDT



Approach: Technical – Version 1.0

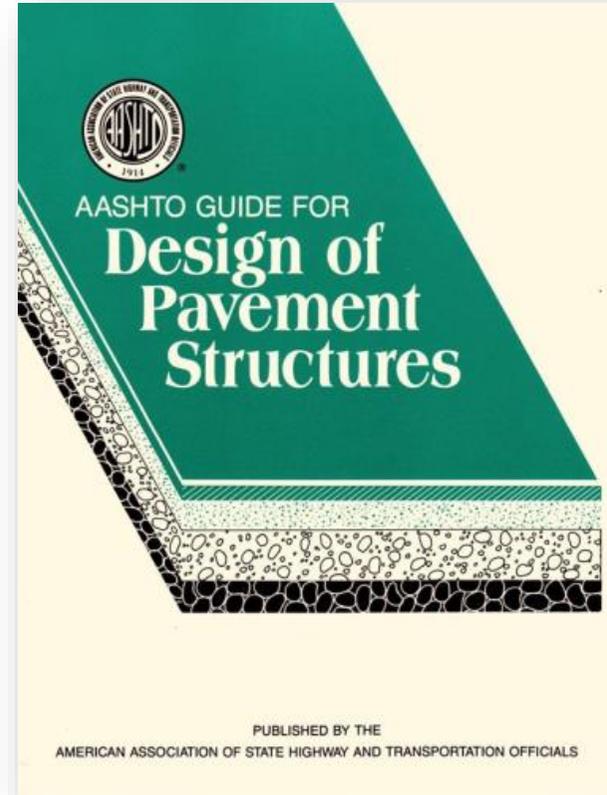
Provide technically sound designs using:

- Flexible: AASHTO '93
- Rigid: AASHTO '93 w/ '98 Supplement
- Parking lot guidance (Flexible only)

Use industry accepted standards and guidance

Linkages to State and Local guidance

Linkages to Pavement Interactive



What came with Version 2.0

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

Condition Survey

Alligator Cracking ⓘ <table border="1"><tr><td>Low</td><td>Medium</td><td>High</td></tr><tr><td></td><td></td><td></td></tr><tr><td>>10 ▾ %</td><td><10 ▾ %</td><td>0 ▾ %</td></tr></table>	Low	Medium	High				>10 ▾ %	<10 ▾ %	0 ▾ %	Transverse Cracking ⓘ <table border="1"><tr><td>Low</td><td>Medium</td><td>High</td></tr><tr><td></td><td></td><td></td></tr><tr><td>0 ▾ %</td><td>0 ▾ %</td><td>0 ▾ %</td></tr></table>	Low	Medium	High				0 ▾ %	0 ▾ %	0 ▾ %
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Cores Were cores taken on the roadway? ⓘ <input type="button" value="Yes ▾"/> Were cores of cracks taken? ⓘ <input type="button" value="Yes ▾"/> Crack Type ⓘ <input type="button" value="Top-Down Only ▾"/> Depth of cracks (max) ⓘ <input type="text" value="2"/> inches Delamination/Stripping? ⓘ <input type="button" value="No ▾"/>	Distressed Pavement Mill/Remove Distressed Asphalt? ⓘ <input type="button" value="Yes ▾"/> Depth to remove ⓘ <input type="text" value="2.5"/> inches																		

User Stories for Version 3.0

Cost Module

As a _____ I want to be able to apply material unit costs and quantities for a new or rehabilitation pavement design **so that I can** estimate how much the design will cost.

Layered Elastic Analysis (ME)

As a _____ I want to model the deflection, stress and strain of a pavement structure **so that I can** determine how many load cycles my pavement can sustain

As a _____ I want to model how various loading configurations impact the deflection, stress and strain of my pavement structure **so that I can** determine how these loads impact my pavement

Cross Section

Cross section layers ⓘ

Layer Type	Cost	Density	Thickness (in)	Action?
Overlay	\$ 75 /ton	150 lbs/ft ³	5.1	🔗 🗑️
Asphalt - Dense Graded	\$ 0 /ton		6.5	🔗 🗑️
Aggregate Base	\$ 0 /ton		6	🔗 🗑️

[Add Layer](#)

Cross section diagram

The diagram shows a vertical stack of four layers. From top to bottom: a thin grey layer labeled 'Overlay', a dark grey layer labeled 'Asphalt - Dense Graded', a black layer labeled 'Aggregate Base', and a thick orange layer at the bottom labeled 'Subgrade'.

[Next](#) [Save](#)

Empirical and Mechanistic

Empirical

Based on observation and experience to derive equations to describe the behavior of the pavement.

(AASHO Road Test)

Mechanistic

Uses stresses, strains and deflections within a pavement structure to mathematically model behavior.

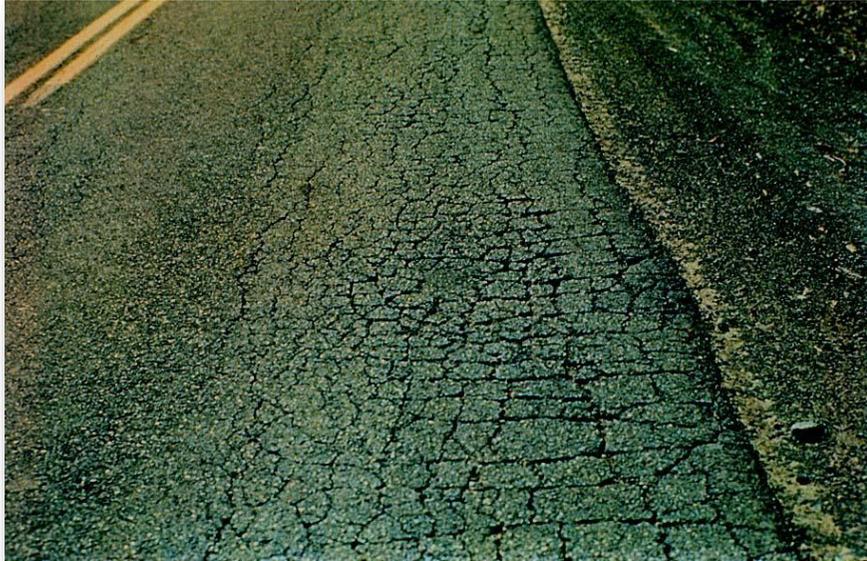
(Layered analysis)

Benefits to a mechanistic-empirical pavement analysis and design

- ✓ A design check against methodologies such as AASHTO 93.
- ✓ The assessment of different load magnitudes and configurations.
- ✓ The ability to examine how new materials behave in a pavement structure.
- ✓ Achieve a better understanding of construction-related factors.
- ✓ The accommodation of environmental and aging effects on materials.

Failure Criteria

Fatigue Cracking



Rutting



For estimating the loads to failure for a specific type of strain, there are two general models typically used for both estimating fatigue cracking and rutting (image is for illustration of rutting only).

Design Checks—An Example

The LEA can be used to check on other design approaches such as AASHTO 93. For example AASHTO 93 was used to develop straightforward pavements to accommodate 40 year lives with 500,000 and 1 million ESALs (18,000 lb single axle with dual tires). The subgrade modulus was 10,000 psi. The AASTHO results are shown below.

Design ESALs	HMA @ a = 0.44	Aggregate Base fixed at 6"
500,000	4.0"	6.0"
1,000,000	4.5"	6.0"

Results

Summary				
Pavement Life				
$N_f = 207974$ cycles (occurs at 4, 300, 10)				
$N_f = 45372$ cycles (occurs at 92, 0, 10)				
Critical Strains				
Direction	Location	Layer	Depth	Normal Strain (10^{-6})
X	(4, 300)	Subgrade	10 "	-408
Y	(8, 0)	Subgrade	10 "	-470
Z	(92, 0)	Subgrade	10 "	961

[Download all results as .csv](#)

Design Checks—An Example

Now you can apply the LEA portion of PaveXpress to do an independent check on AASHTO. Let's be clear...the LEA models have limitations but it is informative to see what they have to say. We used the AASHTO thicknesses as inputs into the LEA.

Original design ESALs input into AASHTO 93	HMA @ a = 0.44	Aggregate Base fixed at 6"	Fatigue estimate w/ subgrade at 10,000 psi	Rutting estimate w/ subgrade at 10,000 psi
500,000	4.0"	6.0"	770,000	177,000
1,000,000	4.5"	6.0"	1.1 million	308,000

This suggests that rutting might be an issue but fatigue is not. How might we address the rutting issue? Try increasing the modulus of the subgrade from 10,000 psi to 15,000 psi.

Design Checks—An Example

The LEA was redone with a 15,000 psi subgrade modulus vs the original 10,000 psi value.

Original design ESALs input into AASHTO 93	HMA @ a = 0.44	Aggregate Base fixed at 6"	Fatigue estimate w/ subgrade at 15,000 psi	Rutting estimate w/ subgrade at 15,000 psi
500,000	4.0"	6.0"	1.3 million	530,000

This suggests that rutting can be significantly improved if the subgrade modulus can be increased. Given the simple configuration of the rutting model...that is always the case.

What's Next?

Upcoming modules:

- Integration with PerRoad
- LCCA framework (ie: RealCost)
- Porous Asphalt Pavement Design

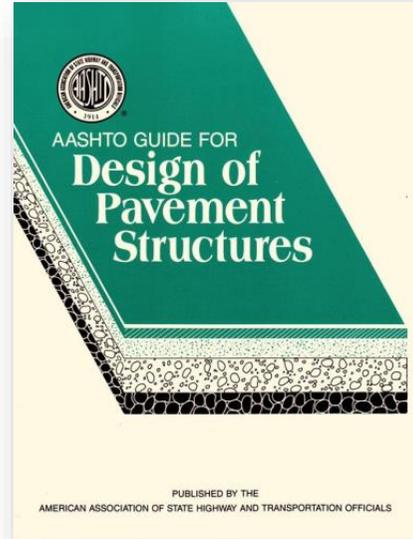


How About for Virginia?

- Can be used for pavement rehabilitation on Interstate and Primary Routes
- Can be used for secondary and sub-division pavement design
- Can be used for parking lots – parking areas and lanes

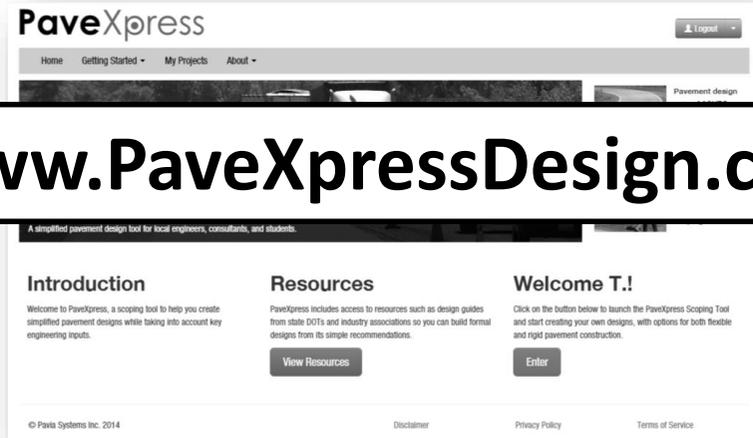


QUESTIONS?



PaveXpress

A Simplified Pavement Design Tool



www.PaveXpressDesign.com