Asphalt—Building Performance for a Lifetime

Hosted Webinar:
Why Asphalt? Performance for a Lifetime
Agenda

Session 1
• Perpetual Pavement Design Concept
• Sustainability & Resiliency
• Asphalt Innovation
• Keys to Durable Parking Lots

Session 2 (Dec. 17th)
• Life Cycle Costing Concepts
• Rules to Live By
The APA is a partnership of the Asphalt Institute, National Asphalt Pavement Association, and the State Asphalt Pavement Associations.
Five regional councils focused on what works in the field to the benefit of the asphalt pavement industry locally and nationally.
When it comes to value, sustainability, flexibility, and innovation, ASPHALT PERFORMS.

Today, Tomorrow, Future.
Perpetual Pavements

Structure and materials are designed to provide a long service life (50 years +)
Defined in 2000 by APA

Perpetual Pavement

An asphalt pavement that is designed for a service life of 50 years or more without requiring major structural rehabilitation or reconstruction.
Introduction

• Not a new concept
  – Full-Depth
  – Deep Strength
  – Long Life Pavements
Load Bearing by Flexible v. Rigid Pavement
Performance Goals - Avoid These

- Avoid Repeated Bending
  Leads to Fatigue Cracking

- Avoid Repeated Deformation
  Leads to Rutting
Empirical

- 1993 AASHTO Flexible Equation

\[
\log_{10}(W_{18}) = Z_R \times S_o + 9.36 \times \log_{10}(SN + 1)-0.20+ \frac{\log_{10}\left(\Delta PSI\right)}{4.5-1.5} \times 1094 + 2.32 \times \log_{10}(M_R)-8.07
\]

- 1993 AASHTO Rigid Equation

\[
\log_{10}(W_{18}) = Z_p \times S_p + 7.35 \times \log_{10}(D+1)-0.06+ \frac{\log_{10}\left(\Delta PSI\right)}{4.5-1.5} \times 1094 + (4.22-0.32p) \times \log_{10}\left(\frac{D^{0.75}}{1+1.624 \times 10^{-6}(D+1)^{0.25}}\right)
\]

Defined: Empirical design methods based on field performance data measured at the AASHO Road Test in 1958-60.
Mechanistic Performance Criteria

Defined: Design method that is based on models/inputs to calculate the reaction of a pavement to traffic loads. Similar to buildings and bridges.
Bottom-up Design and Construction

- Foundation
  - Stable Paving Platform
  - Minimize Seasonal Variability
- Fatigue Resistant Lower Asphalt Layer
- Rut Resistant Upper Asphalt Layers
Subgrade

• Existing materials quality based on strength, gradation & drainage capacity
  – **Good soils** will retain most of their load-bearing capacity when wet
  – **Poor soil** (e.g., swelling soils);
  – Remove to reach better soils below
  – Replace with better material
  – Stabilize to increase stiffness

• Compaction of subgrade materials is key
Base Course

• Structure
  – Part of Pavement Thickness Design
  – Typical Aggregate Base
  – Minimum Thickness 4”
**Typical Cross Section**

Pavements requiring only periodic surface renewal

SMA, OGFC or Superpave

100 mm to 150 mm Zone Of High Compression

High Modulus Rut Resistant Material

Max Tensile Strain

Flexible Fatigue Resistant Material

Pavement Foundation
Rut Resistant Upper Layers

- **Aggregate Interlock**
  - *Crushed Particles*
  - *Stone-on-Stone Contact*

- **Binder**
  - *High Temperature PG*
  - *Polymers*
  - *Fibers*

- **Air Voids**
  - *Avg. 4% to 6% In-Place*

- **Surface**
  - *Renewable*
  - *Tailored for Specific Use*

*Core from 10mm SMA*
Example Top Down Cracking
Shear Stress Within an Asphalt Pavement

$E_{\text{HMA}} = 500 \text{ ksi}$

$E_{\text{SG}} = 10 \text{ ksi}$

$>35 \text{ psi}$

$>25 \text{ psi}$
The Path to Today

- AASHO Road Tests Begin: 1958
- Interim Pavement Design Guide: 1961
- Recycled Asphalt Mixes: 1973
- World Bank IRI Studies: 1986
- Superpave: 1995
- Material Transfer Vehicles: 1998
- Warm-Mix Asphalt: 2003
- Perpetual Pavement Designs: 2000
- PaveXpress: 2016

Since 1961, the layer coefficient of 0.44 for the structural number has not changed.
References

Software

TRB Circular No. 503
On-line at www4.nas.edu
Design tools

• AASHTO ME
• Pavexpress
• Perroad
• Asphalt Institute
• Others
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.
HWY 100 SN Estimate

FWD Testing

Dr. S. Schram IA DOT

- “When you have a perpetual pavement <100 microstrain, you can’t get there without at least a 0.5 layer coefficient. Specifically for HWY 100 I would estimate 0.58 SN”
- “with as much rock as we used we could have gotten by with 7” of HMA and still satisfied the fatigue endurance limit of 70 µm.”
This award honors asphalt pavements that were designed and built with outstanding care and exceptional quality. The result is a long-lasting pavement, one that serves the traveling public well, provides true value to the taxpayers, and demonstrates both the convenience and the quality of asphalt pavements.
Criteria:

• 35+ years old
• 13+ years between overlays (average)
• No increase > 4"
Perpetual City Streets

West Broadway
Council Bluffs, IA
Today
94% of U.S. roads are surfaced with asphalt. ¹
Asphalt contractors are in every community.
~3,500 asphalt plants operate in the U.S.
400K jobs connected to asphalt across the country. ¹

Tomorrow
12+ year gain in service life from a thin asphalt overlay at an annualized cost as low as 25¢ per square yard.
A 2-inch asphalt overlay can improve RII by 100 in - mi

When it comes to long-term value, asphalt performs.

Future
18 years the average service life for new asphalt pavements. ¹
∞ the structural life of a properly designed, constructed and maintained Perpetual Pavement. ¹

Asphalt’s superior performance and value make it today’s pavement of choice across America. With local producers in every community, road owners have a competitive marketplace for the smooth, long-lasting pavements drivers demand.
Asphalt is the best choice for value and performance, today, tomorrow and into the future.

Asphalt.
Can’t all be wrong

94% of U.S. roads are surfaced with asphalt.¹

Asphalt contractors are in every community.

≈ 3,500 asphalt plants operate in the U.S.

More than 400K jobs connected to asphalt across the country.²

TOMORROW

12+ year gain in service life from a thin asphalt overlay at an annualized cost as low as 25.

A 2 inch asphalt overlay can improve IRI by 5.

More than 100 in/mi

Smooth is Customer Satisfaction
Performance demands sustainability.
Asphalt pavements are designed, produced, constructed and maintained to conserve natural resources, reuse materials and deliver the smooth ride drivers demand. This makes asphalt the best choice for sustainability and performance, today, tomorrow and into the future.

**TODAY**

- 79.6M tons of reclaimed asphalt pavement is used annually in new roads and parking lots.
- $2.2B is saved every year by using recycled asphalt — making the pavement not just environmentally sustainable but economically sustainable as well.¹

**TOMORROW**

- $1,300 in maintenance costs is saved every year for each lane-mile of smooth asphalt.⁴
- 4.5% less fuel is consumed by vehicles driving on smooth asphalt surfaces¹ ...
  ... which saves drivers about 13¢ per gallon.²

**FUTURE**

- 100% of an asphalt pavement is recoverable and contains the raw materials for the next generation of roads, runways, trails or parking lots.¹
- $3.5B in energy will be saved by 2020 by using warm-mix asphalt, according to U.S. Department of Transportation estimates.⁵
FHWA Definition
Sustainability

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”
ASPHALT PERFORMS

79.6 MTONS

of reclaimed asphalt pavement is used annually in new roads and parking lots
Performance demands sustainability.

Asphalt pavements are designed, produced, constructed and maintained to conserve natural resources, reuse materials and deliver the smooth ride drivers demand. This makes asphalt the best choice for sustainability and performance, today, tomorrow and into the future.

100% of an asphalt pavement is reusable and contains the raw materials for the next generation of roads, runways, trails or parking lots.¹

$2.2B is saved every year by using recycled asphalt — making the pavement not just environmentally sustainable but economically sustainable as well.¹
ENVIRONMENTAL SAVINGS

If roads across the nation were smoother and maintained in good condition, annual vehicle fuel consumption would be reduced by about 7 billion gallons.²

You save 4.5% smoother pavements lead to 4.5% lower fuel consumption.³ That's about 13¢ per gallon.⁴

More than 99% of old asphalt removed from roads and parking lots is reclaimed for use in new pavements.⁵
RESILIENCY
Resiliency

- Resilience:
  - the capability of a deformed body to recover its size and shape after being deformed especially caused by a compressive stress
  - an ability to recover from or adjust easily to misfortune or change
Damage Happens

Alaska 2018
IOWA DOT NEWS RELEASE

SEVERAL IOWA ROADS INCLUDING INTERSTATES 29 AND 380 REMAIN CLOSED DUE TO FLOODING

POSTED ON: MARCH 18, 2019

AMES, Iowa – March 16, 2019 – 10AM – Multiple flood closures remain in place for Interstates 29 and 680 as well as several surrounding roads and others throughout Iowa. Travel in Missouri and Nebraska is also being impacted by flooding.

Interstate closures include:

- **I-680 in both directions** between the Nebraska border and I-29 near Crescent (Mormon Bridge). The North portion of I-680 between I-80 and I-29 remains open for northbound traffic.
- **I-29 in both directions** between the I-680 interchange (near Loveland) and North 25th Street in Council Bluffs.
- **Northbound I-29** between U.S. 136 in Missouri (near Rock Port, MO) and U.S. 34 in Iowa (near Pacific Junction).
- **Southbound I-29** between the I-80 interchange in Iowa (near Council Bluffs) and U.S. 136 in Missouri (near Rock Port, MO).

The following multi-state detour remains in effect for Interstate 29 travelers:

Northbound I-29 traffic is being detoured at I-35 in Kansas City, where travelers will continue north on I-35 into Iowa. From Des Moines, travelers will drive west on I-80 and continue onto I-680 to connect back with I-29 in Iowa.

Southbound I-29 traffic will be detoured at Loveland onto eastbound I-680 where travelers will continue on to eastbound I-80 to Des Moines. From Des Moines, travelers will head south on I-35 into Missouri where travelers can connect with I-29 in Missouri. (See map below.)

Travelers should be aware that westbound I-680 on the detour route in Iowa is reduced to one lane due to damage.
The Asphalt Impact

Versatility
Speed
Results

With asphalt pavements, maintenance and improvements that help traffic flow freely are made quickly outside of rush hour.
Modern roads take full advantage of scientific and engineering innovations. Through education, research, and applied knowledge, the asphalt industry delivers the best performance and cutting-edge innovation for today, tomorrow and into the future.

TODAY
Since 1986, the asphalt industry has invested over $30M in product research.


When it comes to innovation
ASPHALT PERFORMS

TOMORROW
+2,200 students have been awarded industry scholarships, totaling $5.1M

FUTURE
Visionary engineers are developing asphalt mixes to meet the needs of future cities.

8M autonomous vehicles expected to be on the road by 2025 to "see" asphalt roadways.
FUTURE

Visionary engineers are developing asphalt mixes to meet the needs of future cities.³

ENABLING THE 8M autonomous vehicles expected to be on the road by 2025 to “see” asphalt roadways.⁴

Autonomous Vehicles
This tech could allow self-driving cars to see the road during snowstorms
Innovation - Materials

- Ground Tire Rubber
- Polymer Enhancements
- Fibers
- Bio Science
  - Polymers
  - Rejuvenators
  - Extenders
Which Picture Represent WMA Construction Sites?
Innovation in Testing

Example of Balance Mix Design Approaches

Balancing Rutting and Cracking Requirements


Managing Performance of High Recycle Asphalt Mixtures
IDEAL-CT

IDEAL Cracking Test

- Developed by Fujie Zhou, et al at Texas A & M Transportation Institute
- Criteria for IDEAL-CT
  - Simplicity: no instrumentation, cutting, gluing, drilling, and notching;
  - Practicality: minimum training needed for routine operation;
  - Efficiency: test completion within 1 min.;
  - Test equipment: cost less than $10,000;
  - Repeatability: coefficient of variance (COV) less than 25 %;
  - Sensitivity: sensitive to asphalt composition (binder, others);
  - Correlation to field: a good correlation with field cracking,
Innovation—Techniques

• Joint Construction
Innovation – Equipment

- Intelligent Compaction
- Temperature Monitor
- Autonomous
Building Performance Asphalt Parking Lots
It's just a parking lot!

Have you ever heard this?
Handout

- Pick your Mix
- Dig Deep
- Drain the Rain
- Build a Base
- Trucking Along
- The Green Scene
- Pave and Save

Pay attention to details
Pick your Mix

• Understand Asphalt Cement – Binder
  – Proper % Binder
  – Performance Grade (PG)
  – Ask for guidance!
    • Physical Location of Use
    • Base or Surface
    • Polymer additives
  
• **Warning:** Improper Selection can result in:
  
**Just Right!**
Mix Targets

Typical design 4% Air Voids

- Start with trials to learn best fit.
- Learn from variations
- Monitor and QC Checks

Add AC to achieve 3.5% Air, increase durability.
- Possible use in lower lifts.
- Surface = Performance testing? Balance Mix Design
Dig Deep

- Subbase Platform
  - Understanding Support = Critical Part of Design
Drain the Rain

- Moisture Bad
- Drainage System
- “Pay me now or Pay me later”
- Success starts from the ground up!
Build A Base

- Structural Platform
- Paving Platform
- Type and Technique
Trucking Along

- Nothing Temporary—Plan and design for the long term...
- 1 Loaded Semi = 3000 Cars
  - ESAL Calculation Pavement Interactive
- Cars Minimal Impact –
  - Design Minimum (See SAPA)
Thickness Design Guides

PaveXpress
A Simplified Pavement Design Tool

PaveXpressdesign.com
Pave and Save

- Select Qualified Contractor
  - SAPA List
- Inspect – Inspect – Inspect
  - Oversight = Sleep like a baby!
- Ask Questions
Recap

- Pick your Mix
- Dig Deep
- Drain the Rain
- Build a Base
- Trucking Along
- The Green Scene
- Pave and Save

Pay attention to details
Training

Paving for Performance: Built to Perform
December 3-4, 2019
Austin, Texas
Omni Austin Hotel Downtown
www.AsphaltPavement.org/P4P

Jan 22-23, 2020
Jacksonville, FL

SCHEDULE
Wednesday, January 22
7:00am-8:00am: Registration
8:00am-4:30pm: Training
8:00pm-10:00pm: Tour & Reception

Thursday, January 23
8:00am-12:00pm: Training

COST
$550 (祎t after January 6, 2020)

Commercial and Industrial Parking Lot Training

Commercial and Industrial Parking Lot Training

Join us for this one day training

Oct 29, 2019
Spokane, WA

Pavilions at Ronan Airport
9000 W Airport Dr. Spokane, WA 99224

OR

Oct 30, 2019
Seattle, WA

Doubletree by Hilton Seattle Airport
16006 Southcenter Parkway
Seattle, WA 98168

SCHEDULE
8:00 am: Registration
8:30 am-4:30 pm: Training

COST
$220 (祎t after October 15, 2019)

American Rides on Us

Asphalt.
Asphalt
Performance for a Lifetime

Thank You!

Dan Staebell
Regional Director APA
608-440-0142
dstaebell@asphaltroas.org