Identifying Pavement Failures and Effective Base Preparation

Purdue Road School

William R. Vavrik, Ph.D., P.E.
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## Report on Infrastructure

### 2017 Infrastructure Grades

<table>
<thead>
<tr>
<th>Category</th>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>Aviation</td>
<td>D</td>
</tr>
<tr>
<td>Bridges</td>
<td>C+</td>
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<tr>
<td>Dams</td>
<td>D</td>
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<tr>
<td>Drinking Water</td>
<td>D</td>
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<tr>
<td>Energy</td>
<td>D+</td>
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<tr>
<td>Hazardous Waste</td>
<td>D+</td>
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<tr>
<td>Inland Waterways</td>
<td>D</td>
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<tr>
<td>Levees</td>
<td>D</td>
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<tr>
<td>Parks and Recreation</td>
<td>D+</td>
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<tr>
<td>Ports</td>
<td>C+</td>
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<tr>
<td>Rail</td>
<td>B</td>
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<tr>
<td>Schools</td>
<td>D+</td>
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<tr>
<td>Solid Waste</td>
<td>C+</td>
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<tr>
<td>Transit</td>
<td>D-</td>
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<tr>
<td>Wastewater</td>
<td>D+</td>
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### America’s Cumulative Infrastructure Grade

- A: Exceptional
- B: Good
- C: Mediocre
- D: Poor
- F: Failing

[http://www.infrastructurereportcard.org/](http://www.infrastructurereportcard.org/)
So you have roads, now what?

- New roads are great!
- Roads don’t last forever
- Planning to fix roads is a must
- Knowing how to fix them is key
- Putting it all together makes you the expert!
Pavement Planning Life Cycle

- **Project data collection**
- **Pavement evaluation**
- **Select feasible alternatives**
- **Reconstruction, Restoration, Recycling, Resurfacing**

**Monitor performance**

- **Detailed PS & E**
- **Construction**

**Select preferred alternative**

- **Life cycle costs**
- **Non-monetary factors**
Benefits of Pavement Evaluation

• Provides qualitative information to:
  • Determine causes of deterioration
  • Develop appropriate alternatives

• Provides quantitative information for:
  • Quantity estimates
  • Assessment of deterioration rates
  • Performing life cycle cost analyses
Goals of Pavement Evaluation

• Overall goal of rehabilitation design is to provide cost-effective solution that:
  • Addresses pavement deficiencies
  • Satisfies constraints

• Thorough pavement evaluation required to achieve this goal
  • Less chance of premature failure
  • Better chance of achieving intended design life
  • Better use of available funds and lower overall cost in the future
Data Required for Pavement Evaluation

- Pavement and shoulder condition
- Pavement design
- Materials and soil properties
- Traffic volumes and loadings
- Climatic conditions
- Drainage conditions
- Geometric factors
- Safety aspects
- Other factors
Impact factors for pavement performance

- Traffic
- Subgrade soil support
- Materials of construction
- Structural characteristics
- Construction and maintenance variation
- Moisture
- Maintenance / rehabilitation programs
Pavement layers distribute load

Wheel Load

Hot-mix asphalt
Base
Subbase
Natural soil
Fatigue cracking is load related
Fatigue cracking is in the wheel path

Center line

Traffic

Moderate

High

Low

Shoulder
Early Stage of Fatigue Cracking
Intermediate Stage of Fatigue Cracking
Advanced Stage of Fatigue Cracking
Rutting can be load related

Wheel load

- HMA Surface
- Base
- Subbase
Minor Rutting
Severe Rutting
Rutting confined to HMA Layer
Thermal cracking is environmental

Location Along HMA Surface

- Contraction
- HMA surface layer
- Friction on Underside of HMA Surface
- Existing Crack or Cold Joint
- Tensile Stress in HMA Surface
- Existing Crack or Cold Joint
Thermal Cracking
Thermal cracking
Wide thermal crack
ROAD
UNSAFE
WHEN UNDER
WATER
Frost heave: temperature-related

Frost penetration

HMA surface

Base

Subbase

Ice lenses
Moisture related strength loss

Moisture Infiltration  →  Lubricates Particles  →  Weakens materials
Oxidized Surface Layer
Potholes
Flushing
Some problems that we regularly see
Construction Joints at Low Area
Poor Patching/No Sealing
Soft Subgrade During Paving
Poor Construction Joint
Poor Pavement Transition
Poor Pavement Transition
Insufficient Pavement Structure
Insufficient Pavement Structure
Insufficient Pavement Structure
Patch Needs Crack Sealing
Poor Compaction at Utility
Poor Utility Trench Compaction
Patch Didn’t Solve the Problem
In Fact, it made it Worse
Poor Patching and ... No Crack Sealing
Utility Trench Settlement - CB
Low Point – Water Issues
Poor Drainage
Poor Drainage
Result of Trapped Water
Result of Trapped Water
Preparation of the Subsurface Layers for a New Pavement
What materials and construction factors do we strive to control?

- **Base**
- **Subbase**
- **Subgrade Soil**
Is this subgrade ready?
Proof Rolling
Re-Work Weak Areas
LANE CLOSED TO EASE CONGESTION
HMA Surface Preparation

Surface Repair?

Crack Seal?

Tack and Leveling Course?

Surface Milling

Surface Repair?

Clean Surface

Apply Tack Coat
Pavement Surface Repairs Must

• Address the distress mechanism (as well as symptom)

• Employ proper materials and construction procedures
Is this old patch okay?
Patch Construction

- Mark patch boundaries
- Cut boundaries
- Remove HMA and weak materials
- Repair foundation
- Apply tack coat
- Place HMA patch material
- Compact the patch
Mark Patch Boundaries
What’s wrong with these?
Cut Boundaries

Small Patch

Medium to Large Patch
Remove HMA & Weak Materials

Back Hoe

Small Milling Machine
Address drainage problems
Repair Foundation
(Replace Base Material)
Repair Foundation
(Base Compaction)
Apply Tack Coat

Spray Application

Patch Area After Tack
Place HMA Patch Material
Patch Compaction

Small Patches

Medium to Large Patches
HMA Patch Examples

Good

Poor
The end product is a beautiful long-lasting pavement
Questions
Thank You!

William R. Vavrik, Ph.D., P.E.
Vice President & Principal Engineer
505 W. University Avenue
Champaign, IL 61820
(217) 356-4500
wvavrik@ara.com