Pavement Design Approval

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INDOT
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Rubblization

Rubblization

Rubblization

Rubblization
Underdrain

Crack & Seat at I-74

I-74

Crack & Seat at I-74

Underdrain Trench at I-74

SR 37 Rubblization
SMA (I-69)

Organization Chart

Mat & Tests Division, INDOT
- Material Section
- Geotech Section
- Field Control
- Pavement Design

Pavement Design

Pavement Design 2002

Chapter 52 of IDM
- Pavement and Underdrain Design Elements
- Recently revised (2004)

Chapter 52 Revisions
- Pay items
- Milling
- Chapter 56 & 52 compatibility
- Typical Sections/Standard Drawings
- Widening with HMA
- Subgrade Treatment (Type A, B, C, D)
Chapter 52 of IDM

• Introduction
• History
• Pavement Development Process
• Pavement Types
• Pavement Surface Distresses
• Pavement Scoping

Pavement and Underdrain Design Elements

• Introduction: Guidelines for design of pavements
• Pavement Design Considerations:
  – Pavement Performance
  – Traffic
  – Roadbed Soil
  – Materials of construction
  – Environment
  – Drainage
  – Reliability
  – Life-Cycle cost

Pavement Development process

• Scope: Preliminary Pavement Design
• Design: Final Pavement Design
• District Resurface Design
• Pavement Design Section prepares pavement design for all INDOT Projects
• Approves LPA

Chapter 52

• Milling of Pavements
• Pavement Design Procedural Guidelines
• Pavement Cross Section Design
• Underdrains
• Preventive Maintenance
• Life Cycle Costs
• Typical Pavement Sections
• Pavement Design Requests and Instructions

History

• Indiana Pavements:
  – Flexible: HMA
  – Rigid: PCCP
  – Aggregate
  – Brick
• Underdrains since 1950s.
• Mid 1990 study showed poor performance
• of underdrain system

Pavement Types

• Aggregate Pavement
• HMA
• PCCP
• Composite Pavement
Pavement Surface Distresses

- Asphalt Pavement
  - Rutting, raveling, cracking, stripping etc
- Concrete Pavement
  - ASR, D-cracking, faulting, joint failure etc
- Asphalt over Concrete Pavement:
  - Reflective cracking

Pavement Scoping

- PM Treatment: Surface milling and thin HMA inlay etc for asphalt pavement
  - Sawing and sealing, CPR etc for PCCP
- Functional Treatment: Restore pavement smoothness. Surface and Intermediate for asphalt
  - CPR and HMA overlay for PCCP

Pavement Scoping

- Structural Treatment:
  - HMA: Base, Intermediate and Surface
  - PCCP: Slab reduction (crack & seat, Rubblization)
  - Need Geotech recommendations for rubblization & reconstruction

Milling is used to

- Remove distressed layers
- Make crown corrections
- Maintain Curb heights or vertical clearance
- Scarify existing surfaces
- Surface profiling
- Removal of asphalt overlays
- Pavement transition

Milling

- Asphalt Scarification/Profile
- Asphalt Milling
- Asphalt Removal
- PCCP Milling
- Transition Milling

Pavement Design Procedural Guidelines

- Pavement Design Engineer
  - INDOT
  - LPA
  - District
- Pavement Design Requests
  - INDOT
  - LPA
  - District
Pavement Design Procedural Guidelines

INDOT

Pavement Design Engineer has the responsibility for

INDOT, LPA, District Designs

Pavement Steering Committee

1. Chief, Mat & Tests (Chairman)
2. Materials Engineer, M & T
3. Pavement Design Engineer, M & T
4. Chief, Geotech, M & T
5. District Operation Engineer
6. Construction Field Engineer
7. Section Manager, Research
8. Pavement Management Engineer
9. District Development Engineer
10. Standard Manager

DARWin INPUTS

Simple ESAL’s Calculations (HMA & PCCP)

- Performance Period
- Two-Way Traffic (ADT)
- Number of Lanes in Design Direction
- Percent of All Trucks in Design Direction
- Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater
- Average Initial Truck Factor (ESAL’s/Truck)
- Annual Truck Factor Growth Rate
- Annual Truck Volume Growth Rate

DARWIN will compute/calculate ESAL’s

ESAL’s and PG Binder

- ESAL’s has effects on:
  - Thickness
  - HMA mix design
  - CA Angularity
  - FA Angularity
  - Surface Aggregates types
  - PG binder selection

ESAL (401)

<table>
<thead>
<tr>
<th>ESAL’s Category</th>
<th>ESAL’s</th>
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<tbody>
<tr>
<td>1</td>
<td>&lt;300,000</td>
</tr>
<tr>
<td>2</td>
<td>&lt;3,000,000</td>
</tr>
<tr>
<td>3</td>
<td>&lt;10,000,000</td>
</tr>
<tr>
<td>4</td>
<td>&lt;30,000,000</td>
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<tr>
<td>5</td>
<td>&gt;30,000,000</td>
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ESAL’s (402)

<table>
<thead>
<tr>
<th>Type</th>
<th>ESAL’s Range</th>
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<tbody>
<tr>
<td>A</td>
<td>&lt; 300,000</td>
</tr>
<tr>
<td>B</td>
<td>300,000 &lt; 3,000,000</td>
</tr>
<tr>
<td>C</td>
<td>3,000,000 to &lt;10,000,000</td>
</tr>
<tr>
<td>D</td>
<td>&gt;10,000,000</td>
</tr>
</tbody>
</table>
ESAL’s

80,000 lb Truck

= 6,000

ESAL’s

\[
\begin{align*}
67 \text{ kN} &+ 27 \text{ kN} \\
15,000 \text{ lb} &+ 6,000 \text{ lb} \\
0.48 \text{ ESAL} &+ 0.01 \text{ ESAL}
\end{align*}
\]

= 0.49 ESAL’s

\[
\begin{align*}
151 \text{ kN} &+ 151 \text{ kN} + 54 \text{ kN} \\
34,000 \text{ lb} &+ 34,000 \text{ lb} + 12,000 \text{ lb}
\end{align*}
\]

= 2.39 ESAL’s

QC/QA HMA Mixtures

- **Sublot** as 600 Mg(700 tons) for surface courses and 1000 Mg(1000 tons) for base or intermediate courses.
- Urban intersection projects with ESAL’s > 3,000,000

PG Binder

Performance Graded (PG) Binders for QC/QA are designed based on:

- 1. Project’s climate (temperature)
- 2. Speed of traffic
- 3. Esal

LTPPBIND version 2.1 can be downloaded at


**PG 70-22**

Performance Graded

High temperature

Low temperature
**PG Binder**
- We may not need higher PG Binder grade in lower layers
- Example: If project requires PG 70-22. Use 70-22 for Surface and Intermediate.
- For Base layer we can use PG 64-22

**HMA Pay item**
- QC/QA-HMA, Type, Course, mm
  - Example: QC/QA-HMA, 4, 76, Surface, 9.5 mm
  - Example: HMA, Type, Course, mm

**ESAL & PG Binder**
- DO NOT SHOW ESAL ON TITLE SHEET
- DO NOT SHOW PG BINDER ON TYPICAL SECTION

**DARWin INPUTS**
Flexible Structural Design
- 18-Kip ESAL's
- Initial serviceability
- Terminal Serviceability
- Reliability Level
- Overall Standard Deviation
- Roadbed Soil Resilient Modulus
- DARWIN will compute/calculate
- Calculated Design Structural Number (SN)
- $SN = a_1D_1 + a_2D_2 + a_3D_3$
  - $a_i$: ith layer coefficient, $D_i$: layer thickness (inches), $m_i$: layer drainage coefficient

**Typical HMA Pavement**
- 90 kg/m$^2$ QC/QA-HMA, 4, 76, Surface, 9.5 mm
- 150 kg/m$^2$ QC/QA-HMA, 4, 76, Intermediate, 19
- 180 kg/m$^2$ QC/QA-HMA, 4, 64, Base, 19.0 mm
- 140 kg/m$^2$ QC/QA-HMA, 5, 76, Intermediate, C19
- 180 kg/m$^2$ QC/QA-HMA, 4, 64, Base, 19.0 mm
  - on Subgrade Type A or B or C or D or E

**Notes**
- 30 kg/m$^2$ HMA Surface 2.0 mm
- 125 kg/m$^2$ HMA Intermediate 19.0 mm
- 30 kg/m$^2$ HMA Base 20.0 mm
- 60 kg/m$^2$ HMA Intermediate C19.0 mm
- 50 kg/m$^2$ HMA Base 20.0 mm
- Subgrade Treatment
- Plan, Type 4, Circular 160 mm

**Figure 5-10**
DARWin INPUTS
Rigid Structural Design

- Pavement Type
- 18-kip ESAL's
- Initial Serviceability
- Terminal Serviceability
- 28-day Mean PCC Modulus of Rupture
- 28-day Mean Elastic Modulus of Slab
- Mean Effective k-value
- Reliability Level
- Overall Standard Deviation
- Load Transfer Coefficient, J
- Overall Drainage Coefficient, Cd

DARWIN will calculate the design thickness
- Calculated Design Thickness

Typical PCCP

- 10 to 15 inches of plain jointed QC/QA PCCP on
- Subbase for PCCP
  - 3 inches of open graded aggregate No. 8
  - 6 inches of dense graded aggregate No.53
- Subgrade Treatment Type
- With Underdrain
- 18 feet Joint Spacing

UNDERDRAINS

- The purpose
- UD Warrants
- UD for PCCP, HMA, C & S and Rubb.
- Geotextile
- UD are not for PM or functional overlay

Pavement Design Requests and Instructions

- Pavement Design Approval Request Form for INDOT/LPA
- Submit to INDOT Pavement Design Engineer at the Mat & Tests
- Fill out the appropriate forms completely
- Turn Around time is 4 to 6 weeks
District Pavement Design Request

- Pavement Design Approval Request Form
- Pavement Core Report
- Color Pictures
- Do not fax Request Form
- Pavement history /Give your recommended pavement design
- Underseal and FWD Report
- Typical section (8.5X11)

Subgrade Treatment

- Subgrade Treatment Type A,B,C,D,E
- Type A: 16 inch chemical modification or
  - 12 inches excavation and CA 53
- Type B: 8 inch chemical or
  - 6 inch excavation and CA 53
- Type C: 24 inches compacted to density/moisture
- Type D: 12 inch compacted to density/moisture
- Type E: 6 inch compacted to density/moisture

Questions?

Thank You