Conference on Pavements
October 6, 2004
AASHO PAVEMENT DESIGN

- AASHO ROAD TEST
- Illinois 1958 - 1960
- Test track loading pavements to failure
- Thickness design equations resulted from regression analysis of experimental variables: SN, PSI, Load, etc.
- Portland Cement and Asphalt Concrete
1972 Interim Design Guide

- Defined materials strength relationships
- Soil, aggregate, asphalt and pcc
- Defined traffic volume and load relationships
- Provided nomographs for thickness design
- All relationships were empirical
1986 Revised Design Guide

- Introduced Reliability concept
- Provided for internal drainage
- Reduction in deflection due to tied concrete shoulders
- Introduced Resilient Modulus for soils
1993 Revised Design Guide

- DARWIN Program introduced
- Software program for AASHTO design for new pavement and overlays
200? Revised Design Guide

- First major deviation from original empirical Road Test relationships
- New relationships based on fundamental materials properties and loading
- Stress, strain, deflections, fundamental materials properties
Resilient Modulus -- HMA
# Type of Pavement (Lane Miles)

- **Total**: 37,148
- **Concrete**: 4,211 (11%)
- **Asphalt**: 22,634 (61%)
- **Composite**: 10,302 (28%)
Positive Attributes

Concrete Pavements

• Low initial maintenance
• Long lasting friction properties
• Resists surface deformations

Asphalt Pavements

• Lower initial cost
• Smoother ride
• Ease of resurfacing
• Lower traffic tire noise
Negative Attributes

- **Concrete Pavements**
  - Higher initial cost
  - Expensive to patch
  - Cracks reflect through resurfacing
  - Serviceability issues related to longitudinal profile

- **Asphalt Pavements**
  - Sensitive to mix design
  - When rutting occurs water can cause hydroplaning
  - Organic material subject to environmental wear
FLEXIBLE PAVEMENT FAILURES

• FATIGUE CRACKING

• POTHOLES

• PERMANENT DEFORMATION
SOIL CEMENT BASE
ASPHALT CONCRETE IMPROVEMENTS TO EXTEND LIFE

- POLYMERS
- SUPERPAVE AND SMA DESIGNS
- MATERIALS TRANSFER DEVICE
- STONE BASES OVER CTB
TYPES OF CONCRETE PAVEMENT

• JOINTED PLAIN DOWELED
  20 ft Joint Spacing

• JOINTED REINFORCED DOWELED
  60 ft Joint Spacing

• CONTINUOUSLY REINFORCED
  Non-jointed
Concrete Pavement Performance Problems

• Joint faulting -- load transfer device
• Joint crushing -- unsealed joint
• Rough ride -- poor construction and/or embankment settlement, patching
• Some PCC pavements are strong but non-functional
Joint Failures
Lower Highland Road
Burbank Drive
Load Related Failures
Load Related Cracking
Reactive Aggregate Failure

Jefferson Highway, BR
Reactive Aggregate Failure

2 Projects on I-20
Jefferson Highway, in BR
Serenity Prayer

• God grant me the serenity to accept the things that I cannot change...
Chief Engineers Prayer
(for Pavements)

• God grant us the serenity to accept the annual budget for construction and maintenance of pavements.

• The courage to project optimism in the face of frequent disappointment with both pavement types.

• And the wisdom to glean useable scientific fact from pavement experts who rarely agree with each other.
Joint Seal Performance
PCC IMPROVEMENTS EXPECTED TO EXTEND LIFE

- Thicker slabs
- Larger plastic coated dowels
- 20 ft joint spacing
- Internal drainage
- Tied PCC shoulder or widened lane
- Long lasting joint sealants
- Surface tolerance
Assumptions & Activity Timing
(Arterial - New Construction)

• **Rigid**
  – Year 0
    • 20-year design
  – Year 20
    • Determine if more structure needed for 20 additional years
    • Clean & re-seal joints
    • Patch 1% of joints
  – Year 30
    • Patch 2% joints
    • retexture

• **Flexible**
  – Year 0
    • 20-year design
  – Year 15
    • Cold plane & overlay
    • 15-year design
  – Year 30
    • Cold plane & overlay
    • 10 year design
Interstate JCP
30 year performance of Two Interstate Projects
IRI to SI Relationship

I-20 JCP
30 Yrs.
192% Design Load

I-10 JCP
30 Yrs.
192% Design Load

I-20 JCP
27 Yrs.
96% Design Load

New
Interstate JCP

- **I-10 Essen to Siegen**
  - Built 1974 (30 yrs.)
  - Carried 192% Load
  - Faulting 0.2 in.
  - Joints Patched 2%
  - IRI 130
  - Serviceability Good
  - Friction 44/27

- **I-20 Tallulah East**
  - Built 1977 (27 yrs.)
  - Carried 96% Load
  - Faulting 0.1 in.
  - Joints Patched 1%
  - IRI 100
  - Serviceability Good
  - Friction 44/27
Interstate 10

Siegen to Essen
I-10
Siegen to Essen

10 inch JCP

4 inch HMAC

Soil Subbase
Future Rehabilitation Activities for LCCA

- Timing and scope of activities reflect anticipated improved performance for both flexible and rigid pavements
- **Flexible**: Superpave, better construction, improved quality control
- **Rigid**: thicker slabs and bases, larger dowels, drainage, tied shoulders, etc.
20 Year Design:
(Based upon 1993 AASHTO Pavement Design procedure)

Rigid

Flexible

12” JPCP
12” CRUSHED STONE

2” WEARING COURSE
4” BINDER COURSE
6.5” AC BASE
12” CRUSHED STONE

Question: Which One To Select?
General Trend for Initial Construction

Initial Construction Cost (Thousand Dollars, $)

Annual Average Daily Traffic

- PCC
- AC
Life Cycle Cost Analysis (LCCA)

- LADOTD utilizes the Deterministic approach
- LADOTD includes agency costs and user costs in LCCA
- Publication No. FHWA-SA-98-079
General Trend for Life Cycle Cost

Life Cycle Cost (Thousand Dollars, $)

Annual Average Daily Traffic

- PCC
- AC
## ADAB Project Data

### 6 HMAC  4JCP

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<th>State Project No.</th>
<th>Alternates</th>
<th>Project Type</th>
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<td>Interstate Overlay</td>
<td>AC</td>
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Alternate Design/Alternate Bid Project Data

Alternate Bid Projects

Project Difference

Diff. in Const. Estimate vs. Low Bid (Million $)

Alternate Bid Projects

- $2.00
- $0.00
- $2.00
- $4.00
- $6.00
- $8.00
- $10.00
- $12.00
- $14.00
- $16.00

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