High Performance Asphalt Intersections – Fact or Fiction?

Trenton M. Clark, P.E.
Director of Engineering
Virginia Asphalt Association
Intersection Design Considerations
New Pavements
Existing Pavements
Examples of High Performance Intersections
Intersection Considerations

- Slow moving, heavy trucks
Intersection Considerations

- Select appropriate materials
**Intersection Considerations**

- **Braking Forces**
  - Impact of Truck Loading and Braking on Flexible Pavements

![Graph showing vertical shear strain and depth with braking and no braking conditions.](image)

Static loads vs. Dynamic loads (is thickness adequate?)

Fatigue resistant base layer

Rutting resistant intermediate and surface layers
New Intersection Cross Section

- **Wheel Loads**
- **Typical Depths**
  - 1.5 - 3 inches: High Quality HMA/SMA/OGFC
  - 4 - 7 inches: High Modulus Rut Resistant HMA
  - 3 - 4 inches: Fatigue Resistant HMA
- **Zone of High Compression**
- **Maximum Tensile Strain**
- **Subgrade**
Existing Intersection Pavements

- Are there existing distresses?
- How thick is the pavement?
- What is the condition/bonding of the existing layers?
- How thick would a new pavement be?
Types of Asphalt Rutting

Original pavement profile

Mechanical Deformation
(not enough pavement structure)

subgrade deformation
Rutting

- Subgrade, sub-base deformation (mechanical)
- Asphalt layer(s) compaction/consolidation (densification)
Types of Asphalt Rutting

Plastic Flow

shear plane

Original pavement profile
Common Intersection Distresses

- Rutting
  - Asphalt layer(s) plastic/shear flow
Common Intersection Distresses

- Rutting
  - Asphalt layer(s) plastic/shear flow
Common Intersection Distresses

- Shoving and Slipping
Common Intersection Distresses

- Shoving and Slipping
First, determine the cause of the distress
How to Treat Existing Intersections

- First, determine the cause of the distress
  - Surface mix
How to Treat Existing Intersections

First, determine the cause of the distress

- Surface mix
- Underlying layers
- Inadequate structure
How to Treat Existing Intersections

First, determine the cause of the distress

- Surface mix
- Underlying layers
- Inadequate structure
- Loss of bonding (particularly near the surface)
Second, develop a treatment approach

- How deep to mill (covering existing rutted or cracked surfaces makes the problem thicker)
- Determine the length of the project
- Select the proper AC mixture(s) and binder(s)
  - Consider lift thickness (SM-9.5, SM-12.5 or SMA)
  - Consider number of trucks (PG 70-22 or PG 76-22)
Can High Performance Asphalt Intersections be Built?

Three case studies

- Illinois
- Kentucky
- Maryland
Termed – “The World’s Strongest Intersection”

Background

- Located on a road serving world’s largest limestone quarry
- In 2010, producing 50,000 tons of aggregate per day
- 1,200 loaded trucks per day
- Flexible pavement that had been rehabsed numerous times
Solution

- New approach tried in 1998
- Cores showed deformation to a depth of six inches
- Pavement was milled and replaced with a SMA intermediate layer and SMA surface layer using PG 76-22
- As of 2010, almost 10 Million ESALs and virtually no maintenance
Intersection Projects - Kentucky

Background
- Intersections of US 27 and KY 80 with Cumberland Parkway required constant maintenance
- KTC initiated a competition between each industry to repair a intersection
- Asphalt chose SMA to replace the surface

Outcome
- By 2010, the SMA intersection was still in service
- By 2007, the PCC intersection had been removed and replaced with SMA
Intersection Projects - Maryland

Background
- Evaluation started in 1994
- Rutting Intersections on US 40 near Elkton, MD
- Each industry challenged to design a fix
- Existing pavement was 8” AC on PCC slab

Solution
- Asphalt industry recommended removal of entire AC layer based on cores and lab results
- New AC layers utilized PG 76-22 with SBS; total depth was 8”
- PCC industry decided to mill 6” and replace with 6” whitetopping
Rt. 40 & Landing Rd. - Md Intersection Challenge Superpave shows proven durability. No maintenance since 2000.
Definitely a FACT

Things to Keep In Mind

- Slow and stopped loads are different than moving
- Milling removes deteriorated layers and improves bonding
- Mainline AC mixes may not work at intersections
- If SUPERPAVE mixes being used, consider changing the binder near intersections
- If SMA being used, ensure adequate quantity for cost purposes
Questions?