Concrete Pavement Intersections

Presented By:
National Ready Mixed Concrete Association

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References for Presentation

Typical 4-Way Intersection
Roundabout Intersection

Common Problems at Intersections...

Intersections and Roundabouts

- Pavement Concerns:
  - Starting and stopping
  - Slow & heavy loads
  - Turning movements
  - High shear stresses
  - Repeated repairs

Keys to Successful Concrete Intersections
Utilizing Concrete For Intersections: Options

- Build New at Time of Initial Construction
- Reconstruct Existing Intersection
- Overlay (or Inlay) Existing Intersection

Concrete Intersections - Considerations

- For existing pavement: Complete reconstruction or overlay/inlay?
- Concrete intersection construction limits
- Thickness Design
- Subgrade and subbase requirements
- Jointing details
- Pavement profiles
- Concrete materials (early opening strength for fast-track paving?)
- Concrete to asphalt transitions
- Coordination with local businesses
- Incorporating decorative elements

What Kind of Concrete Pavement is Recommended? Jointed - Unreinforced Pavement

Concrete Intersections

For Existing Intersections: Rehabilitation or Reconstruction?

Pre-Design Data Gathering*

- Pavement Condition Evaluation
- Pavement Materials Analysis (Destructive/Non-Destructive Testing)
- Existing Pavement Structural Layers (cores, borings, etc.)
- Subgrade Soils (borings, DCP, etc.)
- Expected Future Traffic and/or Use (Service Life)
- Roughness (Smoothness)
- Drainage Conditions
- Grade & Elevation Restrictions

*Typically requires knowledge/alignment with consulting engineer

Pavement Condition Evaluation

- Identify Types of Distress
  - Fatigue (Alligator) Cracking
  - Rutting
  - Transverse or Longitudinal Cracking
  - Etc.
- Identify Severity of Distress
  - Low, Medium, High
- Identify Quantity of Each Type/Severity
  - R', in, ft, etc.

Keys to Successful Concrete Intersections
Concrete Intersections
Pavement Thickness Design Methods

Suitability of Subgrade Soils
- Classification (Gradation, Atterberg Limits, etc.)
- Depth to Bedrock
- Depth to Water Table
- Potential for Compaction
- Presence of Weak or Soft Layers or Organics
- Susceptibility to Frost Action or Excessive Swell
- Soil Strength Characteristics

Soil Strength for Design: Modulus of Subgrade Reaction (k-value)

Concrete Strength
- Design = Modulus of Rupture (MOR)
  - Sometimes referred to as Flexural Strength
- Construction = Compressive Strength (f_c)
  - MOR = 8 to 10 * \sqrt{f_c}
    - 500 psi = 3,500 psi
    - 600 psi = 4,200 psi
    - 650 psi = 4,900 psi

New Construction or Reconstruction: Pavement Thickness Design Software (PDCP)

Pave Ahead
PavementDesigner.org
### Paving Limits: Functional Limits

- Stopping Distance
- Average Queue Length
- Limits of Pavement Distress
- Consider Placement and Compaction of Adjacent Asphalt
- Radius Return Minimum

### Concrete Intersections: Thickness

<table>
<thead>
<tr>
<th>Route 1</th>
<th>Route 2</th>
<th>Physical Area Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low AADT (T1)</td>
<td>Median AADT (T2)</td>
<td>T2</td>
</tr>
<tr>
<td>Low AADT (T1)</td>
<td>High AADT (T3)</td>
<td>T3</td>
</tr>
<tr>
<td>High AADT (T3)</td>
<td></td>
<td>T3 + 0.5 to 1.0 in.</td>
</tr>
</tbody>
</table>

Note: T3 > T2 > T1

### Concrete Intersections

**Construction Details and Jointing**

### Concrete Materials & Mix Design

- Conventional Concrete Mixes Used for Reconstruction or Overlay
  - 4,000 psi Compressive (600 - 800 psi Tensile)
  - Type III Cement (Type III Cement for High Early Strength When Quick Opening is Required)
  - High Early Content Low Water Content Desired (max. w/c = 0.40)
  - Minimum Top Size 1/2" for Thin Overlays
  - Coefficient of Thermal Expansion Must be Considered
  - Admixtures for Adj, etc.
  - Reduce Water
    - Acrilite Bitubate
      - Fibers May be Used (Micro or Macro Synthetic, Steel, or Braid)
      - Improve Strength
      - Improve Post-Casting Behavior
      - Reduce Plastic Shrinkage Cracking

### Fiber-Reinforced Concrete

- Fiber reinforcement should be considered in any of the following situations:
  - The project has specific vertical restrictions
  - The asphalt lift is vary thin (and thus may not readily bond with the concrete)
  - The base thickness and/or condition is inadequate
  - The design thickness makes conventional reinforcement for load transfer difficult to use.

### Considerations: New Construction/Reconstruction of Intersection

- Removal of existing pavement (reconstruction)
- Preparing the grade
- Selecting forms or slip form paver
- Placing in pavement structures
- Other details prior to placing concrete
- Placing, finishing, and texturing the concrete
- Curing the concrete
- Saw cutting the pavement
- Sealing/Filing joints
- Opening to traffic

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**Keys to Successful Concrete Intersections**
**Jointing: Joint Types**

- Transverse Joints
- Longitudinal Joints
- Shrinkage Joints
- Temperature Expansion Joints

**Jointing: Common Intersections**

- **Things to do:**
  - Crack due to severe acute angle
  - Match existing joints or cracks
  - Place joints to meet in-pavement structures
  - Be mindful of the maximum joint spacing
  - Place isolation joints where needed
  - Allow necessary adjustments to joint locations in the field
  - Be practical

- **Things to avoid:**
  - Slabs < 2 ft (0.6 m) wide
  - Slabs > 15 ft (4.5 m) wide, unless local experience dictates otherwise
  - Angles < 60° (~90° is best); do this by dog-legging joints through curve radius points
  - Creating interior corners
  - Odd shapes (keep slabs near-square or pie-shaped)

**Forming Contraction Joints by Saw Cutting**

- Conventional Sawcut
- Early Entry Sawcut (~1 inch)

**Jointing: Common Intersection – 10 Step Process**

1. Step 1
2. Step 2
3. Step 3
4. Step 4
5. Step 5
6. Step 6
7. Step 7
8. Step 8
9. Step 9
10. Step 10

**Jointing: Roundabouts – 6 Step Process**

1. Step 1
2. Step 2
3. Step 3
4. Step 4
5. Step 5
6. Step 6

**Concrete Intersections**

*Maintenance of Traffic (Staging)*
Maintenance of Traffic

- Options:
  - Complete closure with detours,
  - Partial closures with detours,
  - Construction under traffic,
  - Complete closures during limited time periods,
  - Combinations of the above.
Keys to Successful Concrete Intersections
Thank you!

Question?

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