Roundabout Design and Construction

Why Roundabouts Anyway?

- According to FHWA:
  - Up to 90% reduction in fatalities
  - 76% reduction in injury crashes
  - 30-40% reduction in pedestrian crashes
  - 75% fewer conflict points than 4-way intersections
  - 30-50% increase in traffic capacity
  - No signal equipment to install/maintain
  - No left-turn lane and reduced need for storage lanes

Concrete Pavement Versatility

Where are Concrete Pavements Historically Used?

Answers:
- High traffic areas
- Areas with lots of turning movements
- Situations where we need a “long-term fix”
- Situations where future maintenance must be kept to an absolute minimum
- Areas where future disruption to traffic must be kept to a minimum
- Economical over long-term – Life-Cycle Cost (LCC)
- Areas where safety is a priority – surface characteristics
Things to Consider for all Intersections and Roundabouts

- Thickness
- Jointing
  - Spacing
  - Type
  - Layout
- Constructability and MOT
- Other:
  - Drainage
  - Reconstruction versus inlay
  - Subgrade and subbase requirements

Pavement Thickness Design

- AASHTO
  - 1993 Pavement Design Guide
- Pavement ME Design (MEPDG)
  - Implemented in many states
  - Under calibration in many other states
- Concrete Pavement Industry Method
- PavementDesigner.org
  - Developed for Street & Local Road Design

REGARDLESS OF METHOD MUST CONSIDER CUMULATIVE TRAFFIC!!

Thickness Impacts Jointing!

<table>
<thead>
<tr>
<th>Class</th>
<th>ADT</th>
<th>ADTT</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light residential</td>
<td>&lt; 200</td>
<td>2-4</td>
<td>4.0-5.0 in.</td>
</tr>
<tr>
<td>Residential</td>
<td>200-1,000</td>
<td>10-50</td>
<td>5.0-6.0 in.</td>
</tr>
<tr>
<td>Collector</td>
<td>1,000-8,000</td>
<td>50-500</td>
<td>5.5-8.0 in.</td>
</tr>
<tr>
<td>Business</td>
<td>11,000-17,000</td>
<td>400-700</td>
<td>6.0-8.0 in.</td>
</tr>
<tr>
<td>Industrial</td>
<td>2,000-4,000</td>
<td>300-800</td>
<td>6.5-9.5 in.</td>
</tr>
<tr>
<td>Arterial (minor)</td>
<td>4,000-15,000</td>
<td>300-400</td>
<td>6.5-9.5 in.</td>
</tr>
<tr>
<td>Arterial (major)</td>
<td>4,000-30,000</td>
<td>700-1,500</td>
<td>7.0-10.0 in.</td>
</tr>
</tbody>
</table>
**Concrete Intersections and Roundabouts: Thickness**

![Diagram of Physical Area and Functional Area](image)

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

T3 > T2 > T1

**Joint Spacing “Best Practices” Summary**

- Keep it Short!
- Keep it Uniform!
- Keep it Perpendicular!
- Keep it Simple!
- Keep it Practical!
Rules for Joint Layout

**Things to Do**
- Match existing joints or cracks — location AND type!
- Cut joints at the proper time and to the proper depth
- Place joints to meet in-pavement structures
- Remember maximum joint spacing
- Place isolation joints where needed
- Understand that joint locations can be adjusted in the field!
- Be Practical

**Rules for Joint Layout**

**Things to Avoid:**
- Slabs < 2 ft wide
- Slabs > 15 ft wide
- Angles < 60º (90º is best)
  - Use “dog-leg” joints through curve radius points
- Creating interior corners
- “Odd” shapes
  - Keep slabs nearly square or rectangular, when possible

**Additional Step by Step Guidance**

- 6 Step Method for Roundabouts


Joint Layout for Roundabouts
Layout Joints as Normal Intersection

Jointing

- Decide on joint layout philosophy
  - Like normal intersection
  - Isolate circle from legs
  - Pave-through, isolate two legs
  - Other philosophy, based on experience
- Follow 6-step method
  - Joints in circular portion radiate from center
  - Joints in legs are normal (perpendicular)

6-STEP METHOD FOR JOINTING ROUNDABOUTS

Step 1: Draw all pavement edges and back-of-curb lines in plan view.
**Jointing a Roundabout**

**Step 2:** Draw all lane lines on the legs and in the circular portion, accounting for roundabout type.

**Step 3:** Add “transverse” joints in the circle, being mindful of the maximum joint spacing.

**Example – Isolated Truck Apron**

**Step 4:** On the legs, add transverse joints where width changes occur.
**Jointing a Roundabout**

**Step 5:** Add transverse joints between those added in Step 4, minding the maximum joint spacing.

**Doglegs**

- **A**: Width change and dogleg in gutter near point of curvature
- **B**: Width change and dogleg in gutter near front of a taper
- **C**: Width change and dogleg in paving lanes for hard-shoulders

**Layout Joints as Normal**

**Jointing a Roundabout**

**Step 5:** Add transverse joints between those added in Step 4, minding the maximum joint spacing.
Jointing a Roundabout

Step 6: Make adjustments for in-pavement objects, fixtures, and to eliminate odd shaped slabs.

Properly Jointed Roundabout

What If I Have to Dead-end a Joint?

Dead-End Joint with Roundabouts
What If I Have to Dead-end a Joint?

Concrete Intersections: Jointing

Box Out Fixture Details

What If I Have an Odd Shaped Slab?
If You DO Box Out Properly...Good Results Happen!

If You DON'T Box Out Properly...Bad Things Happen!

Where There's a Will, There's a Way...

Old...BUT NO CRACKS!
Good Practice...

Lining joints perpendicular to pavement edge!

Dealing With Traffic Calming and Flare Outs

Kansas – Oval Shaped
**Wisconsin – Pinwheel Method**

[Diagram of Wisconsin Pinwheel Method]

https://wisconsindot.gov/dotyสถที่13c28.pdf#page=1

**Minnesota – Fiber Reinforced Jointless**

[Diagram of Minnesota Fiber Reinforced Jointless]

Report: [Link to Minnesota Fiber Reinforced Jointless Report]

**Minnesota – Fiber Reinforced Jointless**

[Image of Minnesota Fiber Reinforced Jointless]

**Netherlands – Continuously Reinforced**

[Diagram of Netherlands Continuously Reinforced]

Guidelines for Concrete Roundabouts in The Netherlands
W.A. Kramer, Cement&BetonCentrum
G. Jurriaans, ECCRA
More Information?

- “Concrete Roundabouts: Rigid Pavement Well-Suited to Increasingly Popular Intersection Type,” R&T Update #6.03, ACPA, June 2005.
- Various agency standards…KS, WI, IA, OH, etc…

Acknowledgements:
- Thanks to all ACPA Chapter / State Paving Associations and CPAM and MCA for various slides and photos throughout
- Thanks to Bill Cuerdon, Todd LaTorella, Kevin McMullen, and Matt Zeller

Resources

http://wikipave.org

Thank You!

Next Up: Roundabout Construction

Eric Ferreebee, P.E.
Director of Technical Services
ACPA | sferrebee@acpa.org

Steve Waalkes, P.E.
Director of Engineering
MCA | swaalkes@miconcrete.net