City of Carmel Roundabouts

- **in place**
- **under construction or design**
- **planned**
definition of a modern roundabout

- **Yield at entry**
  - Yield signs
  - Yield lines
  - Circulating traffic has right-of-way

- **Deflection of entering vehicle path**
  - Accomplished using ‘splitter islands’

- **Entry flare**
  - Lane width is increased near yield line
  - Not mandatory
origin of the modern roundabout

• England – November 1966
  - Reversal of traffic priority at roundabouts to “yield on entry”
  - Result: low delay and high safety
  - Experiment was a huge success!
  - US was slow to accept the idea
  - First US modern roundabout in 1990
## roundabout vs. traffic circle

<table>
<thead>
<tr>
<th>Roundabouts</th>
<th>Traffic circles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low to high capacity</td>
<td>Low capacity</td>
</tr>
<tr>
<td>Yield signs and yield lines at entry</td>
<td>Stop signs and stop bars</td>
</tr>
<tr>
<td>Flare on entries</td>
<td>No flare</td>
</tr>
<tr>
<td>No parking near roundabout</td>
<td>Parking on circulatory roadway</td>
</tr>
<tr>
<td>Pedestrians discouraged from using circulatory roadway</td>
<td>Pedestrians on central island</td>
</tr>
</tbody>
</table>
Indianapolis – monument circle

Not a roundabout!
## roundabout vs. rotary

<table>
<thead>
<tr>
<th>Roundabouts</th>
<th>Rotary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low to high capacity</td>
<td>Medium to high capacity</td>
</tr>
<tr>
<td>Yield signs and yield lines at entry</td>
<td>Free-flow entry with no control</td>
</tr>
<tr>
<td>Flare on entries</td>
<td>Tangential entries</td>
</tr>
<tr>
<td>Low speeds</td>
<td>High speeds</td>
</tr>
<tr>
<td>Little or no weaving</td>
<td>Heavy weaving movements</td>
</tr>
<tr>
<td>Small Inscribed Circle Diameter (ICD)</td>
<td>Very large ICD</td>
</tr>
</tbody>
</table>
a rotary is not a roundabout

Kingston, NY (photo by New York State DOT)
benefits of a roundabout

• Keep traffic moving (efficient)
  – Yield instead of stop
• Aesthetically pleasing
  – Central island provides opportunity for landscaping
• Less pollution
  – Air
  – Noise

• Safer than conventional intersections
  – Greater than 90% reduction in fatalities!!
  – Studies performed by Insurance Institute of Highway Safety
safety
### Odds of Pedestrian Death

<table>
<thead>
<tr>
<th>Vehicle Speed</th>
<th>Odds of Pedestrian Death, Source 1</th>
<th>Odds of Pedestrian Death, Source 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mph</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>30 mph</td>
<td>45%</td>
<td>37%</td>
</tr>
<tr>
<td>40 mph</td>
<td>85%</td>
<td>83%</td>
</tr>
</tbody>
</table>


speed reduction

Source: FHWA Design Guide
roundabout design

- No “cookie-cutter” solutions – each design is unique to its surroundings
- Design is quite complicated – not just a circle with standard radii on entries and exits
- Principles vs. design standards
- Counter-intuitive when compared to traditional intersection design
roundabout design

• Design considerations
  - Vehicle speeds
    • Entry and exit radii
    • Circulatory roadway diameter
  - Design vehicle negotiation of roundabout
  - Vehicle path overlap (multi-lane roundabouts)
  - Capacity
  - Lighting
  - Signs and pavement markings
  - Vehicle sight distances
  - Pedestrian crossing locations and refuges
case study: clay terrace roundabouts
clay terrace

• Geometric features of Clay Terrace roundabouts
  - FHWA Classification: Urban Double-Lane
  - 150’ inscribed circle diameter (ICD)
• Unique characteristics
  - Amount of pedestrians and pedestrian interaction with roundabout traffic
  - Proximity of roundabouts to traffic signals
  - Paved with brick pavers
design vehicle
design vehicle
fastest path

R1 = 230'
R2 = 135'
R3 = 220'
fastest path
pedestrians

• Lifestyle Center
  - Located near affluent neighborhoods
  - Upscale in nature
  - Open-air concept
  - Combination of shopping and office space
  - “Glorified Strip Mall”
  - Many pedestrians
pedestrians

- Pedestrian crossing locations – 25’ back from yield line at roundabouts

- Entering speeds: ~27 mph
- Exiting speeds: ~27 mph
- Circulating speeds: ~15 mph
Myth: Roundabouts and pedestrians don’t mix

Facts:

- Roundabouts slow vehicles – reducing number and severity of vehicle/pedestrian crashes
- Pedestrians must only look one direction at a time
- High safety ratings even at school crossings and in areas with a high percentage of elderly residents
- U.K. studies show 50% reduction in pedestrian crashes at roundabouts as opposed to traditional intersections
Facts (cont’d.):

- When compared to 4-way intersections of similar traffic volumes, pedestrians can negotiate a roundabout much quicker.

- Too heavy of pedestrian volumes can cause traffic to queue or to back up into the circulatory roadway.
pedestrians

Effect of pedestrians on capacity of a two-lane roundabout

Source: FHWA Design Guide
pedestrians

- Mall atmosphere
- Many pedestrians not using marked crosswalk locations
- Mid-block crossings?
- Pedestrian railing or landscaping to discourage crossing at an unmarked location
pedestrians
pedestrians
traffic signals

Approx. distance: 3,000 ft.
traffic signals

• In general, nearby traffic signals do not harm the operation of roundabouts
  - Depends on demand at each intersection
  - Must make sure queues from traffic signal do not back up into roundabout

• Roundabouts disrupt coordination when placed along a corridor with a traffic signal system
  - Traffic signal systems rely on vehicle platooning for maximum efficiency
  - Platoons are dispersed at yield signs
traffic signals

- **Suggestions**
  - Use a roundabout/roundabout combination
  - Roundabouts work well with random arrivals – they don’t need platoons for maximum efficiency
  - If a signal is nearby, simulate signal timings to assure that queues will not back up into roundabout
brick pavers

• Why use pavers?
  – Aesthetically pleasing
  – Encourage low circulating speeds

• Issues with pavers
  – Cost
    – Pavement markings in circulatory roadway are infeasible – acceptable at Clay Terrace
  – Must have strong foundation
  – Must use caution when snow plowing
brick pavers

• Aesthetically pleasing
brick pavers

• Aesthetically pleasing
brick pavers

CONCRETE HEADER
WEEP HOLES - CONNECT SUBBASE TO DRAINAGE COURSE
SAND SWEPT JOINTS
INTERLOCKING CONCRETE PAVERS
ROLLED BITUMINOUS SETTING BED
PORTLAND CEMENT CONCRETE PAVEMENT
AGGREGATE SUBBASE
COMPACTED SUBGRADE

STANDARD PAVER SECTION
brick pavers

• **Snow plowing**
  - If foundation settles, this causes “lipping”
  - Snow plow blades can get caught
    • Use a rubber blade tip -OR-
    • Raise blade slightly to remove bulk of snow and go back over with de-icer -OR-
    • Use stamped concrete or asphalt instead of brick pavers – not as aesthetically pleasing after several years of wear
clay terrace