Value of the Quadrant Roadway Intersection
Evolution of the Quadrant Roadway

Objective

Today's transportation professionals, with limited resources available to them, are challenged to meet the mobility needs of an increasing population. At many highway junctions, congestion continues to worsen, and drivers, pedestrians, and bicyclists experience increasing delays and heightened exposure to risk. Today's traffic volumes and travel demands often lead to safety problems that are too complex for conventional intersection designs to properly handle. Consequently, more engineers are considering various innovative treatments as they seek solutions to these complex problems.

The corresponding report, Alternative Intersection Interchanges: Informational Report (AIR) (FHWA-HRT-09-060), covers four interchange designs and two interchange designs that offer substantial advantages over conventional grade-separated diamond

interchanges. The AIR provides information on each alternative treatment covering salient geometric design features, operational and safety issues, access management, costs, construction sequencing, environmental benefits, and applicability. This TechBrief summarizes information on one of these alternative intersection designs—the quadrant roadway (QR) intersection (see figure 1).
In the transportation industry.....

....very few agencies want to be the first!

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First Quadrant Roadways in US

SR 4 @ SR4 BYP, Fairfield OH
Opened January 2012

SR-73 @ US-21, Huntersville NC
Opened March 2012
What is a Quadrant Roadway Intersection?

- Requires a roadway in one intersection quadrant
- Signals at main and two secondary T-intersections
- Preferable intersection spacing 500’ to 600’
- Only thru/right allowed at main intersection
- All lefts made using quadrant roadway (various turn patterns)
Quadrant Roadway: Signal Operations

- Master cabinet, controllers create coordinated system to progress traffic / limit stops
Quadrant Roadway: Signal Operations

- **% Green Time Available for Main Through Movement**
  - 100%
  - 90%
  - 80%
  - 70%
  - 60%
  - 50%
  - 40%
  - 30%
  - 20%
  - 10%
  - 0%

- **2-ph**
  - 50%
- **3-ph**
  - 40%
  - 20%
- **8-ph**
  - 50%
  - 30%
  - 20%
- **QRI Rd1**
  - 25%
  - 50%
  - 25%
- **QRI Rd2**
  - 25%
  - 50%
  - 25%

Legend:
- Red: Time that major road sees red and can't go
- Green: Time that major road sees green and can go
Quadrant Roadway Intersection
Wait - I’ve seen this before....
Quadrant Roadway Intersections

When to Consider

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# QRI: Operations Benefits

## ITE June 2000 Vol 6

<table>
<thead>
<tr>
<th>MOE</th>
<th>Conventional</th>
<th>Quad Roadway</th>
<th>% Change</th>
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</thead>
<tbody>
<tr>
<td>System delay, veh-hrs</td>
<td>35.8</td>
<td>24.4</td>
<td>-46%</td>
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<tr>
<td>LT travel time, sec/veh</td>
<td>120.9</td>
<td>125.6</td>
<td>+4%</td>
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<td>Intersection delay</td>
<td>41.2 (D)</td>
<td>13.5 (B)</td>
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## TRB Research Record 1371

<table>
<thead>
<tr>
<th>Avg Delay (sec/veh)</th>
<th>Conventional</th>
<th>Quad Roadway</th>
<th>% Change</th>
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<tbody>
<tr>
<td>Peak-hour</td>
<td>179.0</td>
<td>124.5</td>
<td>-31%</td>
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<tr>
<td>Off-peak</td>
<td>112.2</td>
<td>89.7</td>
<td>-20%</td>
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## QRI: Operations Benefits

### Before and After Studies (PM Peak)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Fairfield, OH</td>
<td>Main Intersect</td>
<td>41.7 / D</td>
<td>17.6 / B</td>
</tr>
<tr>
<td></td>
<td>Bypass T-Int</td>
<td>-</td>
<td>7.1 / A</td>
</tr>
<tr>
<td></td>
<td>Route 4 T-Int</td>
<td>-</td>
<td>4.6 / A</td>
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<thead>
<tr>
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<tbody>
<tr>
<td>Huntersville, NC</td>
<td>Main Intersect</td>
<td>121.0 / F</td>
<td>26.0 / C</td>
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<tr>
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<td>NC-73 T-Int</td>
<td>-</td>
<td>17.9 / B</td>
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<td></td>
<td>US-21 T-Int</td>
<td>-</td>
<td>12.2 / B</td>
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</table>

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QRI: Reduced Right-of-Way Impacts
QRI: Pedestrian Benefits
QRI: Safety Benefits

- Conflict points reduced 32 to 30
- Reduced accident severity at main intersection

<table>
<thead>
<tr>
<th>INTERSECTION CONFLICTS / TYPE</th>
<th>FULL ACCESS</th>
<th>NO LEFT TURNS</th>
<th>QUADRANT ROADWAY</th>
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</thead>
<tbody>
<tr>
<td>CROSSING (MAJOR)</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td>TURNING (MAJOR)</td>
<td>12</td>
<td>0</td>
<td>6</td>
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<tr>
<td>DIVERGE (MINOR)</td>
<td>16</td>
<td>8</td>
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<tr>
<td>TOTAL</td>
<td>32</td>
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<td>30</td>
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## QRI: Safety Benefits

### Fairfield, OH

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<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Total Crashes</td>
<td>Main Int</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>55</td>
</tr>
<tr>
<td>Injury Crash / Injury</td>
<td>30 / 45</td>
<td>15 / 19</td>
</tr>
<tr>
<td>Fatal / Serious Injury</td>
<td>0 / 2</td>
<td>0 / 0</td>
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<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Sept 2012 to Aug 2015</th>
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<tbody>
<tr>
<td></td>
<td>Rear End</td>
</tr>
<tr>
<td></td>
<td>Angle</td>
</tr>
<tr>
<td></td>
<td>Sideswipe</td>
</tr>
<tr>
<td></td>
<td>Fixed Object</td>
</tr>
<tr>
<td></td>
<td>Left Turn</td>
</tr>
<tr>
<td></td>
<td>All Other</td>
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Quadrant Roadway Intersections
Planning Considerations
Which Quadrant?

1. Where there is an undeveloped quadrant (plan for future)
Which Quadrant?

1. Where there is an undeveloped quadrant (plan for future)
2. Where an existing road can be repurposed
Which Quadrant?

1. Where there is an undeveloped quadrant (plan for future)
2. Where an existing road can be converted
3. Where a quadrant can be redeveloped
Which Quadrant?

• Different quadrants have different traffic impacts
Access Impacts

Potentially Great Access

Potentially Good Access
Access Impacts

Potential Access Impacts

Potentially Good Access

© Arcadis 2015
Access Impacts

Potential Access Impacts

Power and
Real Change in Access

Potentially Good Access

Potentially Good Access

Potential Access Impacts

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Driver Expectations

• QRI fairly intuitive when lefts made from left side
• Advance right: common at interchanges
• Right-to-go-left: consider overhead signing/guidance; downstream U-turn opportunities?
Quadrant Roadway Case Studies

SR 4 @ SR4 BYP, Fairfield OH
Opened January 2012

SR-73 @ US-21, Huntersville NC
Opened March 2012
Quadrant Roadway Case Studies

- Suburban area (Cincinnati)
- Part of larger Superstreet project
- Full quadrant roadway
- Built new roadway
- Six-lane quadrant roadway
- Secondary T-intersections
- No access on quadrant roadway
- Center is vacant
- Mild public involvement process

- Suburban area (Charlotte)
- Part of larger Superstreet project
- Partial quadrant roadway
- Repurpose existing roadway
- Three-lane quadrant roadway
- Secondary 4-leg intersections
- Driveways on quadrant roadway
- Development in center
- Major public involvement process
Fairfield QRI: Design
Fairfield QRI: Signs, Marking & Signals
Fairfield QRI: Lessons Learned

1. Avoid fully opening before all movements have full capacity
2. Changing driver habits needs to be as intuitive as possible
3. Restrict illegal left turns with physical barriers
4. Sustainability is about more than being green
Fairfield QRI: After Opening

Fairfield Ohio unlock request

by Mattiedale » Thu Oct 18, 2012 4:08 pm

Need to add turn ramp from north bound route 4 to Bypass 4 NB. currently the system would have you go past intersection turn right and then left. Not the way the intersection works.

https://www.waze.com/editor/?lon=-84.50 ... 4,57645380

Thanks,

Mattiedale
Huntersville QRI: Design
Huntersville QRI: Design
Huntersville QRI: Access

- Bank of America
- Huntington Learning Center
- SunTrust Bank
- Compass Real Estate
- Public Library
- Doctor’s Office
Huntersville QRI: Access
Huntersville QRI: Access
Huntersville QRI: Public Involvement

Before Project

“I along with several of the businesses on Holly Point are not happy with the design that is gonna kill our businesses. I'm planning on grouping together and hiring an attorney unless something is done…I’ve been in development over 30 years and traveled all over the US. I have NEVER seen such a STUPID design in my life….. Whoever came up with the STUPID design is an IDIOT plain and simple. If the design is not corrected and my business suffers, I will hold everyone accountable. How long will we live with this stupid idea before the designers stand up and say they made a mistake and turn the intersection back to a normal intersection?”
Huntersville QRI: Public Involvement

After Project

- Most businesses embraced the project as congestion has diminished. Citizens who once avoided the area now find their way to the area for shopping and entertainment.

- Citizen comments:
  
  - “Traffic actually seems much lighter and really flows. It took some getting used to, but getting to the bank, library, Target, etc. is really easy and low stress….. Everyone’s hard work and patience with the process paid off!”
  
  - “I was really opposed to this intersection when you were planning it and I still don’t understand why you did what you did…but I want to let you know that it works!”
Other Future QRIs?

Fort Royal, VA

Florence, KY

Raleigh, NC

<table>
<thead>
<tr>
<th>Project Length</th>
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<tbody>
<tr>
<td>Section</td>
</tr>
<tr>
<td>Weaver/Goodyear</td>
</tr>
<tr>
<td>US 42</td>
</tr>
<tr>
<td>South Quad.</td>
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<tr>
<td>Total</td>
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</table>
Conclusions

• Quadrant Roadways really do work…under right conditions
• Unique design and access-management issues for each individual application (no two alike)
• Be prepared for battle through the public process
• Safety benefits (or impacts) still unknown
• More applications and research needed