

Quadrant Roadway Intersection: Case Studies











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Quadrant Roadway Intersection Evolution







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TECHBRIEF Quadrant Roadway Intersection



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This document is a technical summary of the Federal Highway Administration report, Alternative Intersections/Interchanges: Information Report (AIIR) (FHWA-HRT-09-060).

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 one of these alternative intersection designs-the 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 Intersections/Interchanges: Informational Report (AIIR) (FHWA-HRT-09-060), covers four intersection desions and two interchange designs that offer substantial advantages over conventional at-grade intersections and gradeseparated diamond

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interchanges. The AIIR 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 quadrant roadway (QR) intersection (see figure 1).

www.tfhrc.gov

Figure 1. QR intersection geo



First Quadrant Roadways in the US



SR 4 @ SR4 BYP, Fairfield OH Opened January 2012 SR-73 @ US-21, Huntersville NC Opened March 2012



Quadrant Roadway Intersections

What is a Quadrant Roadway Intersection?













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/rights allowed at main intersection
- All left turns made using Quadrant Roadway (various turn patterns)





Quadrant Roadway: Signal Operations

 Master cabinet, controllers create coordinated system to progress traffic / limit number of stops







Quadrant Roadway: Operational Benefits

ITE June 2000 Vol 6

MOE	Conventional	Quad Roadway	% Change
System delay, veh-hrs	35.8	24.4	- 46%
LT travel time, sec/veh	120.9	125.6	+ 4%
Intersection delay	41.2 (D)	13.5 (B)	-

TRB Research Record 1371

Avg Delay (sec/veh)	Conventional	Quad Roadway	% Change
Peak-hour	179.0	124.5	- 31%
Off-peak	112.2	89.7	- 20%



Quadrant Roadway: Safety

- Three signalized intersections compared to one
- Total conflict points reduced from 32 to 30
- Potential for reduced accident severity at main intersection
- Pedestrians benefit from fewer conflicts & shorter cycle length





Quadrant Roadway Intersections

Planning Considerations













Which Intersection Quadrant?

Different quadrants have different traffic impacts







Access Impacts







Driver Expectations

- **Top row:** QR left movements fairly intuitive - left turns made from left side
- Lower left: advance right turn; common at interchanges
- Lower right: consider overhead signing and guidance; consider adding downstream U-turn opportunities





Quadrant Roadway Intersections

Case Studies















Quadrant Roadway Case Studies



SR 4 @ SR4 BYP, Fairfield OH

SR-73 @ US-21, Huntersville NC



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
- Appropriate public involvement



- 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
- Significant public involvement



Quadrant Roadway Case Studies

Before and After Operations Studies (PM Peak)

Fairfield, OH	Main Intersect	Bypass T-Int	Route 4 T-Int	
Before QRI (2010)	41.7 / D	-	-	
After QRI (2013)	17.6 / B	7.1 / A	4.6 / A	

Huntersville, NC	Main Intersect	NC-73 T-Int	US-21 T-Int	
Before QRI (2006)	121.0 / F	-	-	
After QRI (2013)	26.0 / C	17.9 / B	12.2 / B	



Fairfield QR: Geometric Design





Fairfield QR: Signals, Signs & Marking





Fairfield QR: Safety Study Results

		Sept 2012 to Aug 2015					
Crash Type	Sept 2007- Aug 2010	SI SR-	R-4 / 4 Byp	SR-4 Byp / Diversion	SR-4 / Diversion		
Total Crashes	77	55		10	63		
Injury Crash / Injuries	30 / 45	15	/ 19	2/3	20 / 30		
Fatal / Serious Injury	0/2	0/0		0 / 1	0 / 1		
	Rear End		65	72.2%		and the second second	
	Angle		8	8.9%			
	Sideswipe		6	6.7%			
	Fixed Object		3	3.3%			
	Left Turn		3	3.3%			
	All Other		5	5.6%			



Fairfield QR: Lessons Learned

- 1. Avoid fully opening before all lanes & movements are open
- 2. Changing driver habits needs to be as intuitive as possible
- 3. Discourage illegal left turns with signs in physical barriers
- 4. Sustainability is about more than being "green"





Fairfield QR: After Opening



Fairfield Ohio unlock request

QUOTE

Dby 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 QR: Geometric Design





Huntersville QR: Geometric Design







Huntersville QR: Signals, Signs & Marking





Huntersville QR: Safety Study Results

	Nov 2006 to Nov 2009			July 2012 to July 2015		
Crash Type	NC-73 / US-21	NC-73 / Holly Point	US-21 / Holly Point	NC-73 / US-21	NC-73 / Holly Point	US-21 / Holly Point
Total Crashes	65	35	13	81 (+25%)	28 (-20%)	36 (+177%)
Frontal Impact Crashes	10	23	9	22 (+120%)	5 (-78%)	21 (+133%)
Rear End Crashes	47	11	4	47 (0%)	17 (+55%)	11 (+175%)
Entering Intersect Volume	53,500 ADT				63,000 ADT (18%)	



Huntersville QR: Lessons Learned





Huntersville QR: Lessons Learned





Huntersville QR: After Opening

- Most businesses embraced the project as congestion diminished; citizens who once avoided the area now find their way to 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!"



Conclusions

- Quadrant Roadway Intersections significantly improve operations compared to conventional design
- Unique geometric design, access-management and signing/marking needs for each location (no two alike)
- Be proactive in public involvement, post project outreach
- Safety: reduced conflicts (number & severity) more than offset by introduction of 2 new signals
- More applications and research needed





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