Common Intersection Challenges

- Increased congestion
- Too many severe crashes
- Need improved safety for pedestrians & bicyclists
- Limited ability to add more lanes
- Not enough funding

Why Innovative Intersection and Interchange Geometrics?

About half of all severe crashes occur at intersections.

Intersections are a major safety issue and are usually the bottlenecks along high volume roadways.

Intersection Conflicts

- 16 Crossing Conflicts

Conflict Points at a Typical Intersection

Intersection Safety Facts

Angle crashes account for over 40% of fatal crashes at intersections.
Intersection Safety Facts

- Left turn crashes account for over 20% of fatal crashes at intersections

- Ped/Bike crashes account for 25% of fatal crashes at signalized intersections

What are Intersection & Interchange Geometrics?

Designs that adjust the geometric features of an intersection, interchange, or corridor to improve the safety and traffic flow based on the characteristics of a given location.

Benefits of Intersection & Interchange Geometrics

<table>
<thead>
<tr>
<th>SAFETY</th>
<th>MOBILITY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fewer conflict points</td>
<td>• Less delay</td>
<td>• Less ROW</td>
</tr>
<tr>
<td>• Significant Before/After Crash Reductions</td>
<td>• Reduced congestion</td>
<td>• Less construction costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Implemented quicker</td>
</tr>
</tbody>
</table>

Signal Phases

Strategically relocating left turn movements can provide more green time to through traffic.

- Additional phases take time away from mainline movements.

Signalized Intersections

Eliminating or strategically changing how left turns are handled can allow more green time allocated to through traffic.
- Modern designs are safer and more efficient than old circles and rotaries
- Measurable progress in last 10+ years, but still underutilized

- Effective for both corridor and spot improvements
- Can complement other program goals such as Access Management, Active Transportation, etc.
- Proven in both low-speed urban and high-speed rural environments

- 60+ existing roundabouts
- Many more planned

- Fewer crashes overall, and injuries decreased by 78%
- Overall costs are less than signalized alternatives
- Notable sustainability and livability improvements
**U-Turn Intersections**

- Restricted Crossing U-turn (RCUT) (aka J-turn, Superstreet)
- Median U-Turns (aka Michigan Left, indirect left)
- Thru Turn

**U-Turn Intersection Basics**

<table>
<thead>
<tr>
<th>Conflict Type</th>
<th>Conventional/Signalized 4-leg</th>
<th>Median U-Turn</th>
<th>Restricted Crossing U-Turn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merging/Diverging</td>
<td>16</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Crossing (left turn)</td>
<td>12</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Crossing (angle)</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

**U-Turn Intersections: RCUT**

**Distinguishing Features:**
- Cross street (minor road) traffic turns right, then accesses U-turn to proceed in desired direction.
- Main and U-turn intersections can be either signalized ("Superstreet") or unsignalized ("J-turn")

**Rural J-Turn**

(Restricted Crossing U-Turn)

**Signalized “Superstreet”**

**Distinguishing Features**
- Eliminates direct left turns at main intersection
- Left turning traffic proceeds past main intersection to a U-turn location downstream
- Traffic then turns right at main intersection
- U-turn locations can be signalized and coordinated with main intersection
**U-Turn Intersections: ThrU Turn**

**Distinguishing Features:**
- Similar to MU-Ts in that direct left-turns are eliminated from main intersection
- Main difference is design of U-turn, substituting a paved bump-out or “loom” beyond the outside lane (or coinciding with a sidestreet tee intersection or driveway) for the wide median of a MU-T

**U-Turn Intersections Safety**

**Crash Reductions by Severity (MD RCUT sites)**

<table>
<thead>
<tr>
<th>Type</th>
<th>PDO</th>
<th>Injury</th>
<th>Fatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>21%</td>
<td>42%</td>
<td>70%</td>
</tr>
</tbody>
</table>

**Displaced Left Turn (DLT) Intersection**

**Distinguishing Feature:**
Left-turn movement (on one or more approaches) strategically relocated to the far-side of the opposing roadway via interconnected signalized crossover in advance of the main intersection

**DLT Intersection – Pedestrian Crossings**

**Displaced Left Turn (DLT) Intersection**

- Observed crash reductions of 60% - Total travel time reduction

**Source:** Utah DOT

**Source:** FHWA-SA-09-020

**SR 30 and Summit Rd in Fenton, MO**

**Baton Rouge, LA**

**BANGERTER HIGHWAY IMPROVEMENTS**
Diverging Diamond Interchange

Distinguishing Feature:
Geometry that channelizes traffic to the left side of the roadway between the ramp terminals so that left-turn movements can be made without the need for an exclusive signal phase.

What is a Diverging Diamond Interchange?
- Essentially a diamond interchange with cross-over intersections at the ramp terminals

What Makes the DDI Different?

What is a Diverging Diamond Interchange?
- Essentially a diamond interchange with cross-over intersections at the ramp terminals

DDI - Noteworthy Attributes
- Relatively small footprint
- Existing bridge can often be retained on retrofits
- Versatile alternative for wide range of volumes and locations
- Advantages for non-motorized users

Early DDI Safety Results

<table>
<thead>
<tr>
<th>Crash Reductions By Crash Type</th>
<th>Left-Turn Type</th>
<th>Left-Turn Right Angle</th>
<th>Total Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>72%</td>
<td>46%</td>
<td></td>
</tr>
</tbody>
</table>

Conventional Diamond
- 26 conflict points

Diverging Diamond
- 14 conflict points
Our EDC Vision

Agencies include these EDC intersection designs in their evaluation processes or policies in a manner that ensures they are considered and evaluated alongside other improvement alternatives, and implemented when appropriate.

Facilitated Local Discussions

What intersection and interchange issues is your agency struggling with?
Do you think innovative intersection and interchange geometries would benefit your agency in addressing these challenges?

Question and Answer Forum

Local Agency Applications

Jeff Stratmeyer
Chief Engineer
Harford County, MD

Tom Blust
Engineering Director
Road Commission of Oakland County, MI

Case Study: Mini-Roundabout in an Urban Setting

Dept. of Public Works
Harford County Gov’t, Maryland

Jeff Stratmeyer
Chief Engineer

Just what is a mini??
So why a mini-roundabout?

- Background....
So why a mini-roundabout?

- Background....
- Need for Traffic Control
So why a mini-roundabout?

• Background....
• Need for Traffic Control
• Significant Problem....

So why a mini-roundabout?

• Background....
• Need for Traffic Control
• Significant Problem - Utilities

Option 1
So why a mini-roundabout?

- Background....
- Need for Traffic Control
- Significant Problem - Utilities
  - Option 1
  - Option 2....

So why a mini-roundabout & what’s different about it?

- First the “Why”....
  - Background
  - Need for traffic control
  - Significant Problem
- Second...the “What”

So why a mini-roundabout?

- Background....
- Need for Traffic Control
- Significant Problem - Utilities
  - Option 1
  - Option 2.... MINI-ROUNDABOUT?

So why a mini-roundabout & what’s different about it?

- First the “Why”....
  - Background
  - Need for traffic control
  - Significant Problem
- Second...the “What” (exactly is a MINI-Roundabout)
So why a mini-roundabout & what’s different about it?

- First the “Why”....
  - Background
  - Need for traffic control
  - Significant Problem
- Second...the “What” (exactly is a MINI-Roundabout)
  - “Still” a roundabout – with all applicable traffic rules
  - Size: 50’ – 80’ diameter
  - Fully mountable central & splitter islands
  - Generally no higher than 4-5” – but clearly visible
FHWA Mini-Roundabout Technical Summary
http://safety.fhwa.dot.gov/intersection/roundabouts/fhwasa10007/

Internet search on
“FHWA Mini-Roundabout Design”

FHWA Mini-Roundabout Instructional Video
http://www.youtube.com/watch?v=Mr3QAKszLag
Case Study:
Tollgate Road @ MacPhail Road
• Design
Case Study: Tollgate Road @ MacPhail Road

- Design
  - Fit into the existing paving.
Case Study: Tollgate Road @ MacPhail Road

- Design
  - Fit into the existing paving
  - Much smaller than “normal” roundabout

- Deflection, Stamped & Mountable Concrete, Defined Pedestrian Paths

- Center Island Design (Conspicuous, Mountable)
Case Study: Tollgate Road @ MacPhail Road

- Design
- Construction

- Closed entire intersection for 3 weeks to expedite
Case Study:
Tollgate Road @ MacPhail Road

- Design
- Construction
- Completed Project

Volumes
Case Study: Tollgate Road @ MacPhail Road
- Design
- Construction
- Completed Project
  - Volumes
  - Evening Rush Hour & Nighttime Video
  - “Special” Situations  (See link at the end of this presentation)

Case Study: Tollgate Road @ MacPhail Road
- Design
- Construction
- Completed Project
- Lessons Learned
  - Vehicular Deflection
Case Study: Tollgate Road @ MacPhail Road

• Design
• Construction
• Completed Project
• Lessons Learned
  - Vehicular Deflection
  - Traffic Control Signs

Case Study: Tollgate Road @ MacPhail Road

• Design
• Construction
• Completed Project
• Lessons Learned
  - Vehicular Deflection
  - Traffic Control Signs
  - Turn Signals
Case Study: Tollgate Road @ MacPhail Road

- Design
- Construction
- Completed Project
- Lessons Learned
  - Vehicular Deflection
  - Traffic Control Signs
  - Turn Signals
  - Accident History

  8 reported - 3 injuries (1 serious)

“After” Accidents (2012 - 2013):
  2 reported accidents - (1 minor injury)

Not the significant reduction in accidents that is typical of most roundabouts
Key is that the “potential” for a serious accident dramatically reduced
Pre-construction: 85th % speed of 38 MPH – right angle accident
Post-construction: 85th % speed of ~ 15 MPH – side swipe accident
Increased pedestrian safety.
Just what is a mini-roundabout??

We hope it’s the “future”....with long term positive impacts similar to the “normal” roundabout:

Modern Roundabouts:
  Circa 1990:  Est. less than 100
  2010:       Greater than 3,000

Mini-Roundabouts:
  2030:       ???
Thank You
Questions and Additional Information:
Harford County Government Roundabouts - Website
FHWA Mini-Roundabout Design Manual - Website
http://safety.fhwa.dot.gov/intersection/roundabouts/fhwaas10037/
Jeff Stratmeyer – Chief Engineer, Harford County, MD DPW
E-mail: mstratmeyer@harfordcountymd.gov

Tollgate Road & MacPhail Road
Mini-Roundabout Video Link

MEDIAN U-TURNS
OAKLAND COUNTY PERSPECTIVE
Every Day Counts Exchange
December 4, 2013
Tom Blust, P.E.
Director of Engineering
Road Commission for Oakland County

Road Commission for Oakland County Info
- Maintains over 2700 Miles of County Roads and over 1500 county, city and state traffic signals.
  - 675 with FAST-TRAC [ITS] system to improve traffic flow, decrease travel time, enhance safety and reduce emissions
- Since 1978, RCOC has made safety its top priority
- RCOC’s traffic fatality rate is 0.54 per 100 MVMT
  - ~1/2 of the state rate
  - ~1/3 of the national rate

Boulevards with Median U-Turns
“Michigan Left”
- RCOC has been building median U-turns since the 1960’s
- Have approximately 75 to 100 major boulevard intersections plus many mid block median crossovers
- Directional crossovers:
  - 1/3 crash rate of TWLT lanes
  - 2/3 crash rate for bi-directional crossovers
(MSU-Castronova, Dorothy, Scheuer, Maleck)

Benefits Of Median U-Turns
“Michigan Left”
- Safer
  - On roadways where crossovers and Michigan Lefts have been added, crashes have been reduced 30 to 60 percent overall (MSU-Castronova, Dorothy, Scheuer, Maleck)
  - Fewer, Less Severe Accidents
  - No red light running head on crashes
  - Eliminates direct left turn movement
  - Fewer conflict points
- Allows for 20 to 50 percent greater capacity than direct left-turns (per MDOT and MSU study)
- Signal timing is easier and allows for better progression and coordination (Two Phase Signals)
Community Benefits of Boulevards

- Communities want to build boulevards
- Safer access promotes business
- Median provides more green space
- Promotes walkability
- Pedestrians only cross one direction of travel at a time

Important Considerations

- Boulevards more costly versus 5 lane road
  - $10M to $12M for one mile of boulevard PLUS ROW!
  - $6M to $8M for one mile of 5 lane road PLUS ROW!
- Boulevards require more expensive ROW
  - Typically busy, commercial corridors ($/sq. ft is higher)
  - May impact setback for existing buildings, parking spaces, and landscaping (all compensable)
- Wider roadway can shorten existing driveways, making them steeper

Planning and Design

- Crossovers are placed:
  - 600 to 1000 feet past the intersections
  - 600 to 1000 feet apart
  - More is inconvenient and negatively affects businesses on other side of street
  - Back to back crossovers are 150 ft. apart for corner sight distance
  - Before Signalized Cross Streets (“Last Chance”)
    - So drivers don’t have to go through the signal twice to access other side of street

“Last Chance” Crossovers before Major Crossroads

Planning and Design

- RCOC Designs for a WB 50 Truck (~ 46 ft outside turn radius) from a Left Turn Lane in the Boulevard
  - Requires ~ 65 ft Boulevard with 2-12 ft lanes (204’ ROW)
  - OR ~53 ft Blvd. with 3 Lanes (150-180’ ROW)*
  - OR ~53 ft Blvd. with 2 Lanes and Using Right Turn Lane on Other Side of Street (150-180 ROW)*
  - Or ‘Loon’ (Not Recommended)
  - *Narrow ROW’s typically require utility easements adjacent to the ROW!

Typical Blvd. Crossover

~62 ft. Median in 204 ft. ROW
Blvd Crossover, Narrow Blvd. Section
Uses Right Turn Lane

Narrow Boulevard Turns
use Right Turn Flares or ‘Loons’

Trucks use Rt. Turn Ln. for Median U-Turn

Narrow Blvd.- Paved Nose for Trailers

Narrow Blvd.- Trucks use “Loon”
(Not Recommended)

Signal Operations

- Usually Two Phase Operation
- Signal timing is easier and allows for better progression and coordination
- Signals can operate at lower cycle lengths
- Pedestrian timing is easier to fit since only cross to the median (Two stage crossing)
- Signal warrants are more readily met due to more concentrated turn movements
Contact Info

Tom Blust
Director of Engineering
Road Commission for Oakland County
tblust@rcoc.org

Facilitated Local Discussions

Implementation by your agency -
What type of assistance do you need to move forward?

Closing Remarks

Key Issues/Challenges

• Lack of knowledge regarding these concepts
• Ambiguity on criteria for when to apply them
  – No formal screening process
  – No process to assess “best value”
  – Lack of tools to analyze operations
• Public/Political Reaction
  – Apprehension/Resistance to change
  – Fear of failure

Strategies for Advancing Deployment

• Awareness and Outreach
• Training
• Knowledge and Information Exchange
• Analysis Tools and Evaluation Processes
For more information ...

www.fhwa.dot.gov/everydaycounts/

Or contact us directly at:

Mark Doctor (RC Safety & Design)
mark.doctor@dot.gov or (404) 562-3732

Jeff Shaw (HQ Office of Safety)
jeffrey.shaw@dot.gov or (708) 283-3524