Compact Roundabouts
Traffic Calming Techniques
Emergency Vehicle Preemption (EVP)

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Ben Wilkinson, PE
Roundabout Practice Lead
(608) 216-2057
bwilkinson@msa-ps.com

Chad Wagner, PE
Traffic Engineer
(608) 242-6651
cwagner@msa-ps.com

Compact Roundabouts
A cheaper way to deliver congestion relief
Roundabouts

- Roundabouts can have very significant safety and congestion-relief benefits
- Can be expensive
- Roundabout design involves trade-offs between capacity, safety and cost
- So how to provide sufficient capacity and good safety potential at a reasonable cost?

Optimizing Roundabout Design

- Three common pitfalls in roundabout analysis that can lead to bigger (and more expensive) designs:
  - Traffic forecasts that overestimate traffic growth and indicate more lanes will be needed sooner
  - Capacity models that are very “conservative” and indicate failure of a single-lane design sooner
  - Design horizons that are inappropriately long for the project or site context
- Being overly “conservative” in some or all of these areas can lead to a roundabout that is more expensive (and potentially less safe) than it should be
More Ways to Cheaper Roundabouts

- Accommodate a smaller design vehicle (especially for turning movements)
- Use less outer curb
- Use less expensive materials
- Keep the approaches more on alignment (although this must be traded off against the benefits associated with a more “squared up” intersection)
- Make the central island fully-mountable so the footprint can be considerably smaller

Mini and Compact Roundabouts

- Mini-roundabout
  - ICD: 50 FT – 90 FT
  - Central Island and splitter islands are fully traversable
- Compact roundabout
  - ICD: 80 FT – 100 FT
  - Similar to mini but larger and may be applicable to higher speed roadways and roadways with higher truck volumes
  - Essentially the same but compact roundabouts can be larger and may have central islands that are not fully traversable
What is a Mini-Roundabout?

- A mini-roundabout is defined as a roundabout with a fully-mountable central island
- Splitter islands may also be mountable
- Originally developed in the UK as a lower-cost alternative to normal roundabouts
- Existing intersection footprint is expanded a little or not at all
- Commonly used there as a right-of-way control device (similar to an all-way stop, but more efficient)
UK Mini-Roundabout

Mountable Central Island

Reading, UK (photo reversed)

UK Mini-Roundabout
UK Mini-Roundabout in the US

Diamondale, MI

As early as 1955 (Hunts Point, WA)
**Mini-Roundabouts**

**Benefits**
- Small intersection footprint
- Efficiency > all-way stop control (AWSC)
- Safety = AWSC when designed correctly
- Cost < traffic signals

**Constraints**
- Can't accommodate more than about 15,000 vpd
- Not ideal with high volumes of trucks
- Generally not suitable on high-speed approaches
- Can't install signs in central island, so can be difficult to see and difficult to maintain in winter

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**Bel Air, MD**

3 Weeks; $172,000 to construct
Jefferson, GA

- AWSC (50mph)
- Six Weeks
- $64,000
- 50 veh queue before...no queue after

Source: Scott Zehngraft, Asst. State Traffic Engineer, GDOT

Arcata, CA
Mini-Roundabout Construction Costs

- Costs to retrofit have been reported between $65,000 and $600,000, depending on materials and footprint
- The general rule of thumb seems to be about one-third the cost of a normal roundabout
- Mill and overlay, pulverize and relay

Central Island with Curbs
Central Island without Curbs

Suburban and Rural Applications

- Mini-roundabouts are being increasingly used in rural areas, particularly busy intersections in villages or as part of rural traffic calming schemes
- Experience is showing they can work safely where the posted speed limit is 40 mph if approach speeds are reduced prior to entry
- Ideal as a replacement for AWSC
- Higher capacity than AWSC because they can service two to three vehicles at any time
- Need to address lack of central island visibility
<table>
<thead>
<tr>
<th>Mini-Roundabouts on High-Speed Approaches</th>
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<tbody>
<tr>
<td>• Unlike normal roundabouts, mini-roundabouts don’t always create sufficient speed control by deflecting vehicles around the central island</td>
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<tr>
<td>• Therefore approach and transition zone treatments may be needed to ensure drivers are slowed prior to the entries</td>
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<td>• Mini-roundabouts also need to be in an environment where they will be expected and visible to approaching drivers</td>
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<table>
<thead>
<tr>
<th>Approach Speed Control</th>
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<td>![Approach Speed Control Image]</td>
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</table>
Illumination

Illumination is essential but lower levels are needed

Poor Locations for Mini-Roundabouts

• As a replacement for two-way stop control (TWSC) – dominant movements are habitual – in particular at higher speed locations
• Four-lane roadways
• Locations in which U-turn truck traffic is expected since trucks may not be able to physically make the movement
• Where the 85th percentile speed exceeds 40 mph and there is no scope to reduce approach speeds through approach and transition zone treatments
FHWA Study on Mini-Roundabouts

- Study from 2009 to 2016 on 15 sites in six states
- 4 rural, 3 urban, and 8 suburban
- 8 AWSC, 6 TWSC, 1 New
- Cost – 7 less than $50K, 3 were $50K to $200K
- Varying speeds and AADT
- Before and after operational assessment
- Before and after safety assessment
- Before and after observational assessment

FHWA Study on Mini-Roundabouts

- Results to be published later this year
- Mini-roundabouts are successfully suited for:
  - Urban/suburban sites; and rural sites with heavy volumes and low/moderate speeds
  - TWSC/AWSC with single lane approaches
  - Limited budgets (as low as $10K to $100K)
  - Locations in need of capacity improvements with little budget
  - Right-of-way constraints
- High speed sites have safety concerns
Case Study

Washtenaw County, MI
The Problem: Congestion at Many All-Way Stop Intersections

- 66 AWSC intersections in Washtenaw County
- 13 meet warrants for traffic signals
- Some intersections have 5-minute delays during peak periods

Textile Road Site
All-Way Stop with 45 mph Posted Speed Limit

Video - Before
As-Constructed Mini Roundabouts

Final cost $700,000 with congestion eliminated

Stony Creek Rd.

Hitchingham Rd.
Video - After

Before/After Crash Results

• Average Crash Rates (crashes/MEV)

<table>
<thead>
<tr>
<th></th>
<th>Textile Rd &amp; Hitchingham Rd</th>
<th>Textile Rd &amp; Stony Creek Rd</th>
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<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Fatal + Injury</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>PDO</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>0.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Source: Washtenaw County Road Commission
Public Opinion

Before AWSC

Source: Washtenaw County Road Commission and VHB

Public Opinion

After Mini-Roundabouts

Source: Washtenaw County Road Commission and VHB
Washtenaw County

Moon Road at Bemis Road

Washtenaw County

Baker Road at Dan Hoey Road
Coming soon to Wisconsin Dells

Superior Street at La Crosse Street

Cost-Optimizing Roundabouts

- Roundabouts can have very significant safety and congestion-relief benefits
- These benefits are best realized through well-designed roundabouts, especially at this (still) early stage of roundabout implementation
- However that doesn’t mean roundabouts have to be expensive
- Can we save more lives with one $2.5M roundabout or four $625K roundabouts?
Thank you!

Traffic Calming Techniques
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Education, Enforcement, Engineering
Traffic Calming Techniques: Engineering

- Common Techniques
  - Roadway Narrowing
  - Bump-Out/Bulb-Out
  - Speed Hump
  - Speed Table
  - Median Refuge Islands
  - Traffic Circles
  - All-Way Stop Control
    - (Not considered traffic calming)

- New Techniques
  - Mini Roundabouts
  - Feedback Signage
  - Raised Intersections
  - Gateway Treatment

Safety

Source: Federal Highway Administration (FHWA) Traffic Calming e-Primer – Module 2
Common Techniques: Narrowing the Roadway

• Physical Curb-to-Curb Width

![Graph: Speed Versus Street Width]


Things to Consider:
• Turning movements for emergency vehicles, refuse collection, delivery services

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Common Techniques: Narrowing the Roadway

• Parking
  • Parallel is preferred

• Pavement Markings
  • Edgelines
  • Road Diet

• Landscaping

![Images: Examples of landcaping and parking]

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Common Techniques: Bump-Out/Bulb-Out

- Narrows overall roadway width
- Reduces pedestrian crossing distance and brings attention to pedestrians waiting to cross, especially with street parking.
- Assists with ramp ADA compliance in areas with limited space.

Things to Consider:
- Turning movements, drainage

Common Techniques: Speed Hump

- Generally 3-4 inch vertical rise over 6-7 feet
- Speed Reductions
  - NACTO: 5-10 mph
  - FHWA: 6-13 mph
- Costs: $2,000 - $4,000
- Temporary options exist for varying speed limits.
  - $3,000 - $8,000

Things to Consider:
- Emergency vehicle implications
  - ITE lists approximately 3-5 seconds of delay / hump for fire trucks, up to 10 seconds for ambulances
### Common Techniques: Speed Table

- Generally 3-4 inch vertical rise over 6-7 feet, 10-foot flat top

- Speed Reductions
  - FHWA: 4-11 mph

- Costs: $2,500 - $8,000

- Temporary options exist for varying speed limits.
  - $6,000 - $10,000

**Things to Consider:**
- Emergency vehicles, drainage, bicycles


### Common Techniques: Median Refuge Islands

- **Benefits:**
  - Physically narrows roadway
  - Improves safety by simplifying crossings for both pedestrians and bicycles
  - Can be used to restrict vehicle movements

**Things to Consider:**
- Turning movements, proper width for refuge
Common Techniques: Traffic Circle

- Used at intersections
  - Not considered a roundabout or mini roundabout
  - Commonly retrofitted into existing intersections

Things to Consider:
- Driver confusion with turning movements, large vehicles

Common Techniques: All-Way Stop Control

- Common but not a traffic calming device
  - May actually increase mid-block speeds as drivers try to make up "lost time"

- Lack of Compliance
  - Manual on Uniform Traffic Control Devices (MUTCD)

- False sense of safety for pedestrians
New Techniques: Mini Roundabouts

- Provides direct, immediate feedback to drivers
- No impacts to emergency vehicles or drainage
- Speed Reductions
  - Iowa State: < 5 mph
- Costs: $3,000 - $11,000

New Techniques: Dynamic Feedback Signs

- Provides direct, immediate feedback to drivers
- No impacts to emergency vehicles or drainage
- Speed Reductions
  - Iowa State: < 5 mph
- Costs: $3,000 - $11,000
### New Techniques: Raised Intersections

- Generally the intersection has a vertical rise up to the sidewalk elevation over 7-10 feet on all approaches
- Designed to slow traffic and drawn attention to an entire intersection for assisting with pedestrian crossings
- Important to define edge between street and sidewalk
- Costs: $25,000 - $75,000

#### Things to Consider:
- Emergency vehicles, drainage, ADA compliance, bicycles

### New Techniques: Gateway Treatment

- Michigan DOT Experiment -> AASHTO Focus Innovation in 2017
- Utilizes R1-6 signs to draw attention to pedestrian crossings
- Speed Reduction: 4-10 mph
- Yield rates up to 90%
- Costs: $1,200 - $1,800 (six-sign configuration)

#### Things to Consider:
- Requires FHWA Permission to Experiment if placed on right-side curb head
  - Not required on median islands, pedestrian refuge islands or curb extensions
Traffic Calming Policy & Process

- City of Green Bay
- City of Madison
- City of Middleton
- Federal Highway Administration
  - https://safety.fhwa.dot.gov/speedmgmt/traffic_calm.cfm

Emergency Vehicle Preemption (EVP)
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EVP Definition

System that allows emergency vehicles to disrupt a normal signal cycle using wireless communications devices installed both on traffic signal and emergency vehicles.


Common Misconception

New tech will allow first responders to control traffic lights in Naples

The City of Naples got the green light to purchase new traffic preemption technology, which makes it so emergency vehicles can get through busy intersections quicker.
Common Misconception

New tech will allow first responders to control traffic lights in Naples. The City of Naples got the green light to use new technology, which makes it easier for first responders to navigate intersections faster.

Dunwoody traffic signals are getting an upgrade that will help emergency vehicles.

Statistics

These systems have proven effective at reducing response times while also enhancing traffic safety both for the traveling public and emergency responders.

Up to 25% reduction in response times

Up to 70% decrease in crashes with Emergency vehicles
Industry

- Audio
- Optical (Infrared)
- Global Positioning System (GPS)

Industry: Audio

Pros
- No Vehicle Retrofits
- No Lenses to Clean

Cons
- Unreliable
  - Wind
  - Skewed intersections

### Industry: Optical (Infrared)

**Pros**
- Reliable
- Can be encoded
- Track calls

**Cons**
- Line-of-sight
- Each vehicle needs optical emitter

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### Industry: GPS

**Pros**
- Reliable
- Improved reaction time
- Accommodates visual obstructions
- Tracks calls

**Cons**
- Each vehicle needs GPS
- First light trap

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Cost

- Optical (Infrared) EVP
  - Infrastructure: $7,000 - $10,000
  - Vehicle: $900

- GPS EVP
  - Infrastructure: $8,000 - $12,000
  - Vehicle: $3,500

Future Direction:
Roadside (RSU) and Onboard Units (OBU)

- Vehicle to Infrastructure (V2I) / Vehicle to Vehicle (V2V)
  - Roadside Units mounted on signal infrastructure
  - Onboard units within vehicles
  - Continuously report position, speed and direction

- Greater opportunity for applications beyond EVP in the future
Future Direction

• Priority Calls
  • Transit
  • Snow Plowing / Maintenance Vehicles

Recap of EVP

• EVP allows emergency responders to gain priority at signalized intersections through initiating a phase change of the traffic signal
  • Minimum timing values including pedestrian crossing times must finish prior to a change in phase

• Reduces overall response times for emergency responders

• Improves safety for both the traveling public and emergency responders
Questions

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