Planning & Design of Mini and Compact Roundabouts: Scalability of Roundabouts

Blair Perry, P.E.  

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Mark McCulloch, P.E.  
Washtenaw County (MI) Road Commission

Mini and Compact Roundabouts

Moon Road @ Bemis Road  
Ypsilanti, MI  
82' ICD

SR-11/SR-124/Galilee Church Rd  
Jackson County, GA  
-88' ICD
Traditional Single Lane Roundabouts (Typically 130’-180’ diameter)

Mini Roundabouts - Context
- Typical context
  - Urban neighborhoods
  - Business districts
  - Shopping centers
- Low speeds
- Low volumes
  - ADT <15,000 veh/day (total entering)
  - Low truck volumes ~3% (study)
- Comparable major/minor traffic volumes
- Often built within existing intersection
- 72% Crash Reduction Factor
Mini Roundabouts – Design Elements

- Diameter: Typically <90’
- Fully traversable center island & splitter islands
  - Mountable curb or striped
- Central island sized to provide deflection
- NCHRP Report 672
- New chapter in ALDOT Manual

Mini Roundabouts – Example

Before

Tollgate Road at MacPhail Road - Bel Air, MD

65°

After

60°

60°: Built in 2012
Mini Roundabouts – Design Vehicle Philosophy (FHWA/VHB Study)

- Design elements for 97% of vehicles using the roundabout daily
- Make raised elements traversable by the top 3% of large vehicles using the intersection
Compact Roundabouts

- Typical context:
  - Urban/suburban areas
  - Neighborhoods
  - Rural highway
  - Interchanges
- Mini < Compact < Full size single lane roundabout
  - Size
  - Speeds
  - Volumes
  - Truck volumes
  - ICD
- Where a traditional (full size) roundabout won’t fit
- Rule of Thumb: < 15,000 veh/day (total entering volume)

Compact Roundabouts Design Details

- ICD: 90’-100’ +/-
- Circulatory Roadway Width (CRW): 16’-19’
  - Design vehicle determines
- Center island & splitter islands
  - Raised
  - Traversable
  - Striped
- Curb and gutter typical on outside
  - Some agencies using paved shoulders on outside
Mini & Compact Roundabouts Design Elements
Center Island

- Big enough to provide good deflection
- Often fully traversable
- Center island clearly visible
  - Raised and mountable
  - Colored
  - Striped

2” tall rolled curbs WSDOT

Mini & Compact Roundabouts Design Elements
Center Island Curbs

- 2”-3” tall mountable or rolled curbs
Mini & Compact Roundabouts - Design Elements
Circulating Lane

- Circulatory Roadway Width (CRW)
  - Keep as narrow as possible
  - Accommodate passenger cars and school buses in CRW

Mini & Compact Roundabouts Design Details

- Wide Dotted Entrance Line
  - Typically also serves as entrance line
Mini & Compact Roundabouts
Design Details
Splitter Islands

- Raised, traversable or flush (stamped or painted)
  - General order of preference
- Design vehicle turning movements will determine
- Flush (painted)
  - Slow speeds
  - Vehicles regularly travel over splitter islands (small minis)

Mini & Compact Roundabout
Design Details – Ped Crossings

- Pedestrian Crossings *(NCHRP Report 672)*
  Same guidelines as larger roundabouts
  - Crosswalk 20’ back from entrance
  - Walkway thru splitter same width as crosswalk, ideally 10’ wide

- For splitter island width ≤ 6’:
  - Pedestrian refuge area
  - Use detectable warning strips

- For splitter island width > 6’:
  - Walkway thru splitter island
  - Single stage crossing
  - No detectable warning strips

Source: NCHRP Report 672, Exhibit 6-12
**Key Design Element**

**Do You Know Your Design Vehicle?**

- What kinds of large vehicles are traveling through your intersection?
- Most of the roundabout features are designed for passenger cars and SU trucks
  - FHWA/VHB study - Design elements for 97% of vehicles using the roundabout daily
- Do you need to accommodate large trucks?
- Which ones?

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**Design Vehicles**

- What’s My Design Vehicle(s)?
- School Bus (S-BUS-40)
  - Circulatory Roadway Width
- WB-67
- Moving truck
- Fire ladder truck
- Log trucks (log overhang)
  - Oncoming traffic
  - Signs
  - Peds
- Can be different for different movements
Accommodating Oversize/Overweight (OS/OW) Vehicles

- Oversize/Overweight (OSOW) Vehicles
  - Mobile home hauler
  - Bridge girder hauler
  - Airline parts hauler (Airbus)
  - Combine
  - Check Freight Network
  - Check with ALDOT Vehicle Enforcement Office

Outside Truck Aprons to Accommodate Larger Design Vehicles

Use outside truck aprons to keep entry & exit widths narrower and accommodate large or OS/OW trucks
Outside Truck Aprons

Mini & Compact Roundabouts

Washtenaw County, MI Experience
Mark McCulloch, P.E.
Washtenaw County Road Commission
Delivering Big Results with Smaller Roundabouts

Mark H. McCulloch, P.E.
Washtenaw County, Michigan

• County seat: Ann Arbor
• Population: 367,000
• WCRC - 1,649 centerline miles / MDOT - 598 lane miles
• 28 total roundabouts
Why Smaller Roundabouts?

Can We Afford Status Quo?

- Taxpayer Relief Act of 1997
- 23 years of revenue not adjusted for inflation.
- Price increase of 60.25% (Bureau of Labor Statistics consumer price index)
How to Reduce Cost but not Effectiveness?

How to Minimize Cost?

- Less earthwork
- Less storm sewer infrastructure
- Less ‘non-production’ paving
Textile / Hitchingham / Stony Creek (2015)

A New Era for Minis

Textile / Hitchingham / Stony Creek (2015)
- Wei Zhang (FHWA)
- AWSC
- Goal: increase capacity
- 45-55 MPH approach speeds
- ADT
  - Textile 6,600
  - Hitchingham 6,800
  - Stony Creek 4,200
- 4% trucks
Textile Mini Footprint

- ICD: 90 feet
- Total Cost: $800,000

Slivers, Not Chunks

Textile / Hitchingham
1,225 sqft (0.03 acres)

Textile / Stony Creek
605 sqft (0.01 acres)

92% area reduction compared to Pontiac Trail / Seven Mile

Total Land Cost:
$3,575 (2014 dollars)
Before v. After

Textile at Hitchingham; AM Peak

Raised Island

Raised Center Island’ 3” to 4”; Moon at Bemis (Washtenaw County Standard)
Textile Minis (Video)

Textile at Hitchingham / Stony Creek

Baker Road Roundabouts (2018) – A Model for State DOTs
- ADT  Baker Road – 14,000 vpd
  Shield Road – 3,200 vpd
  Dan Hoey Road – 5,800 vpd
- Design Speed: 35 – 55 MPH
- Truck Traffic: 3%
- ICD: 100 feet (Shield);
  105’ x 95’ (Dan Hoey)
- Total Cost $1.3 million
Summary

Recipe for ‘Mini’ Success

- Minimum ICD 90’ for high speed approaches
- 100’ – 110’ ICD is the ‘sweet spot’
- AWSC better than TWSC
- Use realistic growth factors
- Carefully choose your first location
- Buy-In critical
- Monitor results
THANK YOU!

Want to learn more?
Contact Mark McCulloch at mccullochm@wcroads.org
734-327-6679

Mini & Compact Roundabouts
Alabama Case Study

Project No. HSIP-0147(503)
SR-147 (N College Street) at CR-72 (Farmville Road)
Auburn, AL
Intersection Location

- North College Street (SR-147) at Farmville Road (CR-72)

Roadway Characteristics

- North College Street (SR-147)
  - 2-Lane Roadway
  - 12’ Lanes
  - Principal Arterial
  - 55 mph Speed Limit
- Farmville Road (CR-72)
  - 2-Lane Roadway
  - 11’ Lanes
  - Major Collector
  - 45 mph Speed Limit
Intersection Characteristics

Flashing Yellow/Red Warning Light at Intersection

North College Street (SR-147)
- 3-Lane Section (with Left Turn)
- No Stop Signs on Major Street
- Flashes Yellow

Farmville Road (CR-72)
- Stop Controlled
- Flashes Red
- Right Turn Lane onto the SR-147 SB Roadway

Intersection Challenges

Existing Crest Vertical Curve approximately 150’ south of the Intersection

ROW Constraints between Cemetery and Church
So, why do a Roundabout at this Location?

- 54 crashes in a 4 year, 10 month period
- Evaluated crashes from March 2012 – December 2016
- 80% of the crashes were right angle (43 of 54)
- 11% of the crashes were rear-end collisions (6 of 54)
- 28% of the crashes involved injuries (15 of 54)
- Upward trend in crashes in 2015-2016 (61% of crashes occurred in those 2 years)

So, Why Do a Roundabout at this Location?

- Crashes (54 in 4 year, 10 month period)
- 25% - 35% reduction in all crashes
- 75% - 80% reduction in injury crashes
- 4-Way Stop (SR-147 volume too high → Delays)
- Traffic Signal not warranted

Other Options:

- 4-Way Stop (SR-147 volume too high → Delays)
- Traffic Signal not warranted

<table>
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<th>Manner of Crash By Severity</th>
<th>Total</th>
<th>Percentage</th>
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Percentage: 3.70% 79.63% 3.70% 11.11% 1.00%
Traffic Analysis

2020 “Opening Year” and 2040 “Design Year” Roundabout Levels of Service

Traffic Data was collected on September 20-21, 2017

Additional Traffic Analysis

- 4 planned residential developments in the area
- Incorporated traffic from the 4 new developments traffic into the Design Year 2040 traffic
Peer Review

- Peer Reviewed by Howard McCulloch
  - Add chicanes to slow entry speeds
  - Add short EB right turn lane

Preliminary Concept 1
Preliminary Concept 2

Preliminary Concept 3
Preliminary Concept 4

Preliminary Concept 6
Preliminary Concept 7

- Single-Lane Design
- 120’ ICD (Inscribed Circular Diameter)
- Easier to Accommodate Large Trucks
- Deflection is Better
- Landscaped or Grass Central Island

Preliminary Concept 1
- Compact Roundabout
- 105’ ICD (Inscribed Circular Diameter)
- Harder to Accommodate Large Trucks
- Deflection is Harder to Attain
- Small Central Island
Preliminary Concept 1

Preliminary Concept 4

ALDOT Narrowed Down Concepts to 2

Performance Checks
- Fastest Path Analysis
- Truck Turning Movements
  - What is our Design Vehicle?

Performance Checks: Fastest Paths

- This represents theoretical attainable entry speed
- Does not represent expect vehicle speeds
- Tolerances of 2-3 mph
- R1, R2 & R3 are on the Thru Path
- R4 is on the Left Turn Path
- R5 is on the Right turn Path
- Assume you are driving in the middle of the night with no one around you
- The vertical components of the roundabout are what will keep you from inside the roundabout
- Measurements are from the vertical components
  - 5’ from concrete curb
  - 5’ from roundabout centerline
  - 3’ from a painted edge line
- Fastest Path Speed is determined from smallest radius along the B-spline path

EB Through Movement
- Very Flat
- Produces High Speed Entry for R1 & R2
- What are the options to help reduce speed?
  - Larger ICD
  - Move the Roundabout
  - Add Chicanes
Performance Checks: Turning Movements for Design Vehicles

What is our Design Vehicle?
- Do we have buses? What type? School buses or charter buses?
- Larger fire trucks? What size?
- Log trucks?
- Utility trucks? APCO/Utility trucks carrying 100’ poles?
- OS/OW loads? Mobile homes?
- Farm equipment?

Access to Church & Cemetery

- How does the church access their two driveways?
- What happens with the church parking lot in the front?
- How does the church access the cemetery?
Compact/Mini Roundabout Design
Roundabout at the Intersection of SR-147 (North College Street) and CR-72 (Farmville Road), Lee County

View Looking East

View Looking North
Questions?

Blair Perry, P.E.
Alabama State Leader – Transportation
205-298-9232
blair.perry@greshamsmith.com