Georgia Department of Transportation

Roundabout Design Guide

Chris Raymond, P.E.

State Traffic Operations Manager, GDOT

GDOT R.O.A.D.S. Webpage → Manuals & Guides →

Traffic Operations → Alternative Intersections

Roundabouts@dot.ga.gov

www.dot.ga.gov/DS/SafetyOperation/Roundabouts

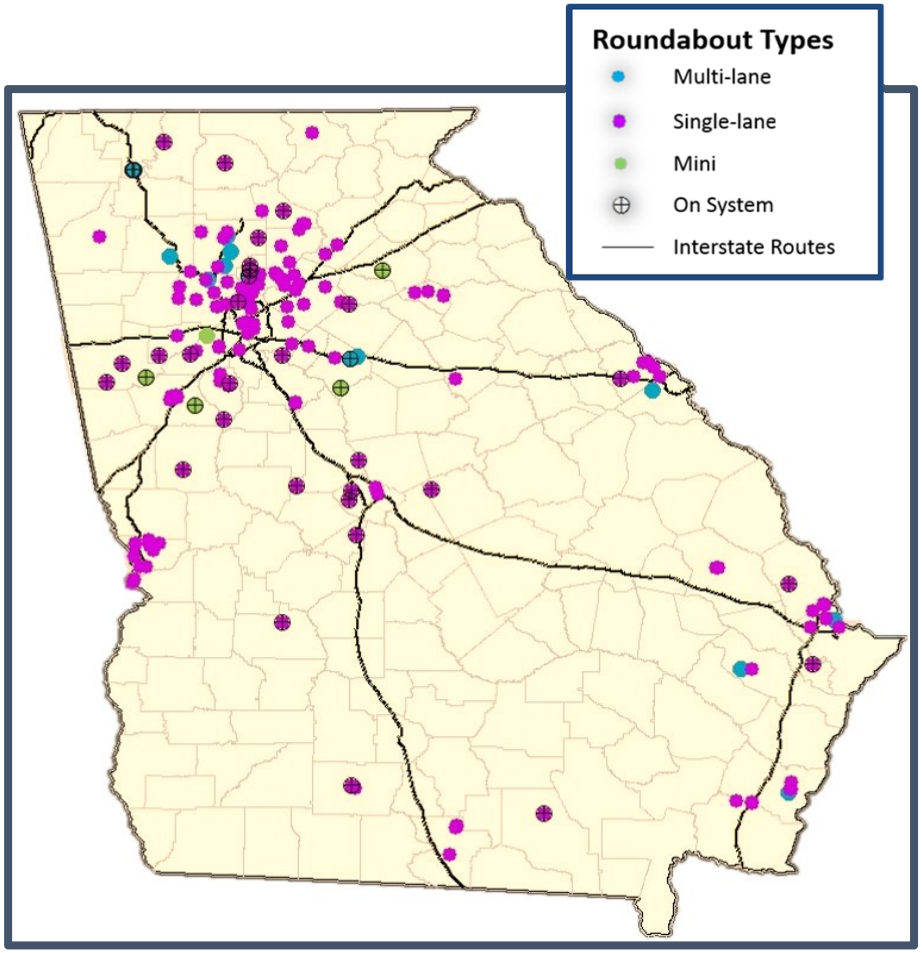
Roundabout Design Guide

Office of Traffic Operations | February 2021

Roundabouts in Georgia

- **70+ On state routes/ built with GDOT $$**
  - 50+ single lane/compact
  - 5+ multi-lane/hybrid
  - 10+ mini
- 20+ under construction
- 100+ in design
- 50+ in concept

- **185+ On local roads**
- 250+ Other circular intersections



Timing, Purpose & Need

- Supplements GDOT Design Policy Chapter 8
- Underpinned by NCHRP 672, Roundabouts: An Informational Guide – 2nd Edition
- Presents the principals and methods of achieving practical design
- **Draft version of revised guide currently in circulation for comment**

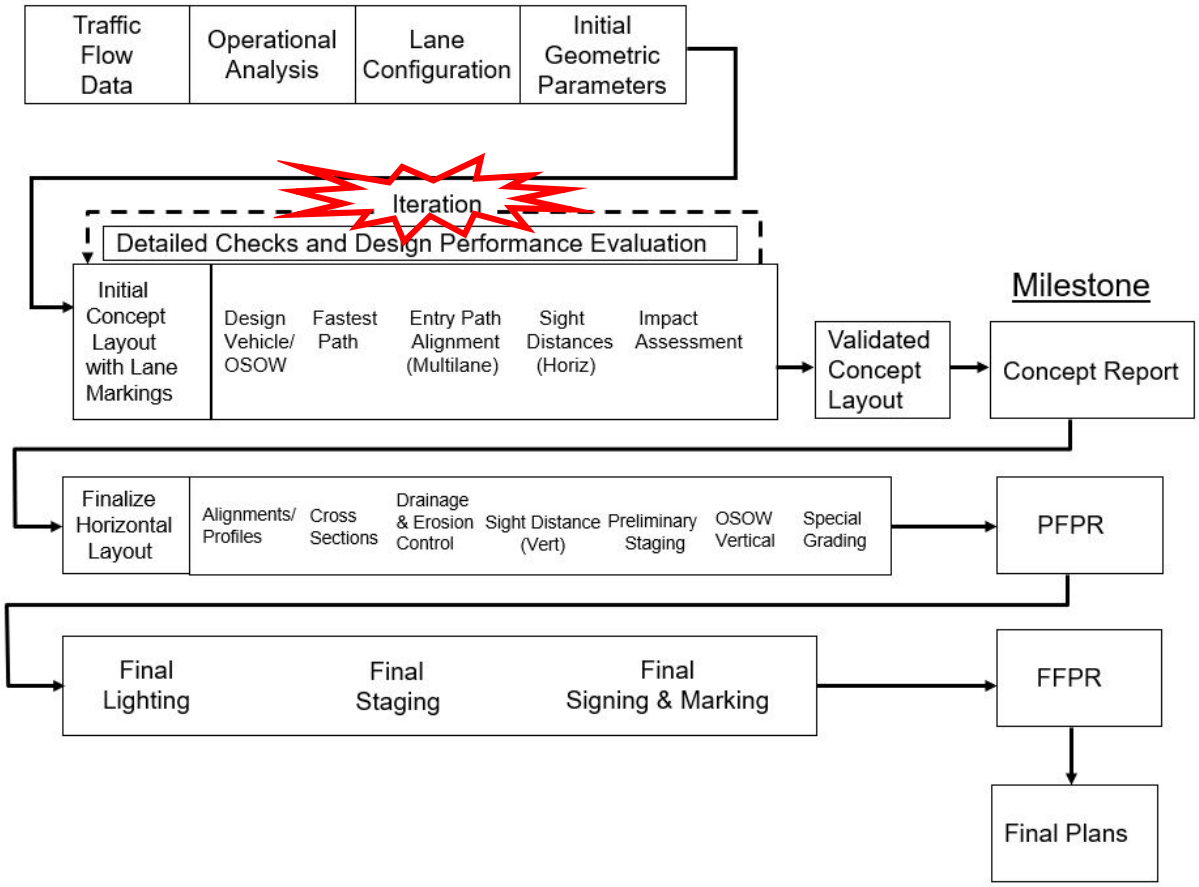
Roundabout Types

- Single
  - Conventional
  - Compact
  - Mini
- Multi
  - Hybrid
  - Full Multilane

More TURBO!!

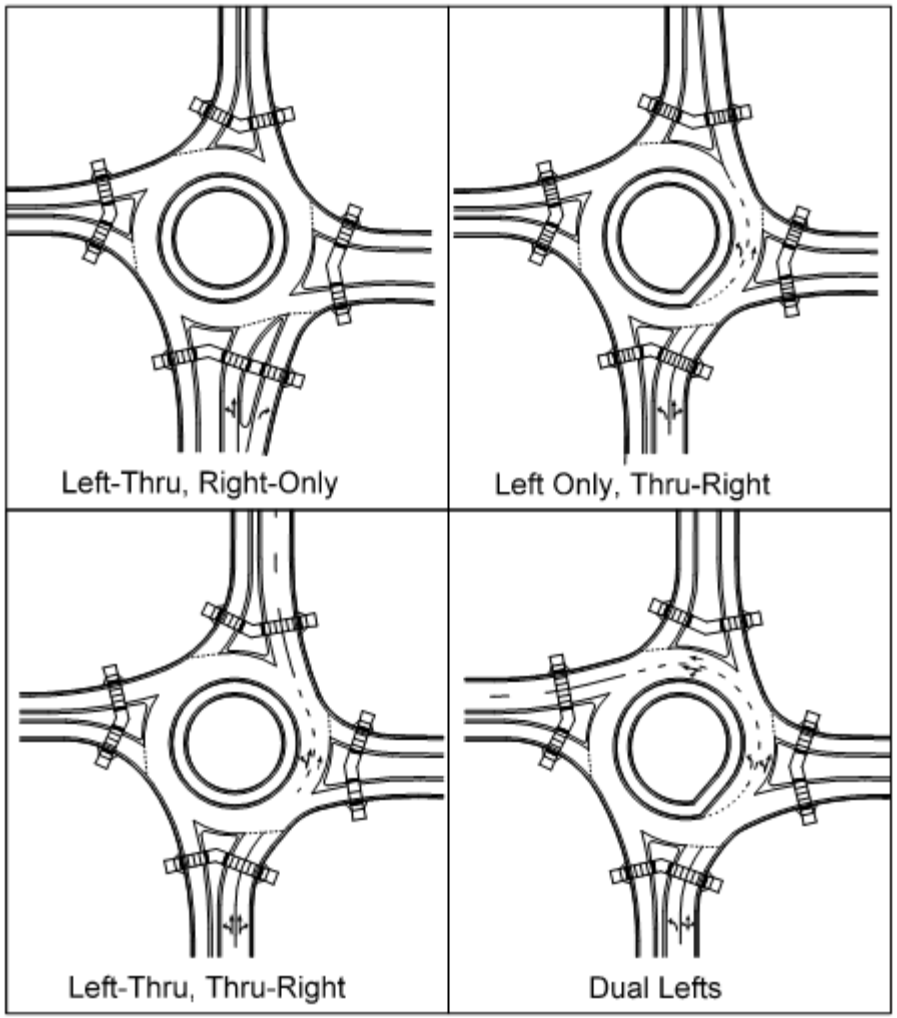
Geometric Design

Geometric Design Process and Workflow



Operational Analysis

- Evaluate approaches individually to determine required number of entering and circulating lanes
- Operational analyses workflow:
  - Analyze AM and PM peak hours -> Build Year, Build Plus Ten and Design Year forecasted traffic
  - Iterative process -> check Level of Service (LOS), delay and v/c results until they are within the acceptable/desirable range
  - Expandable design

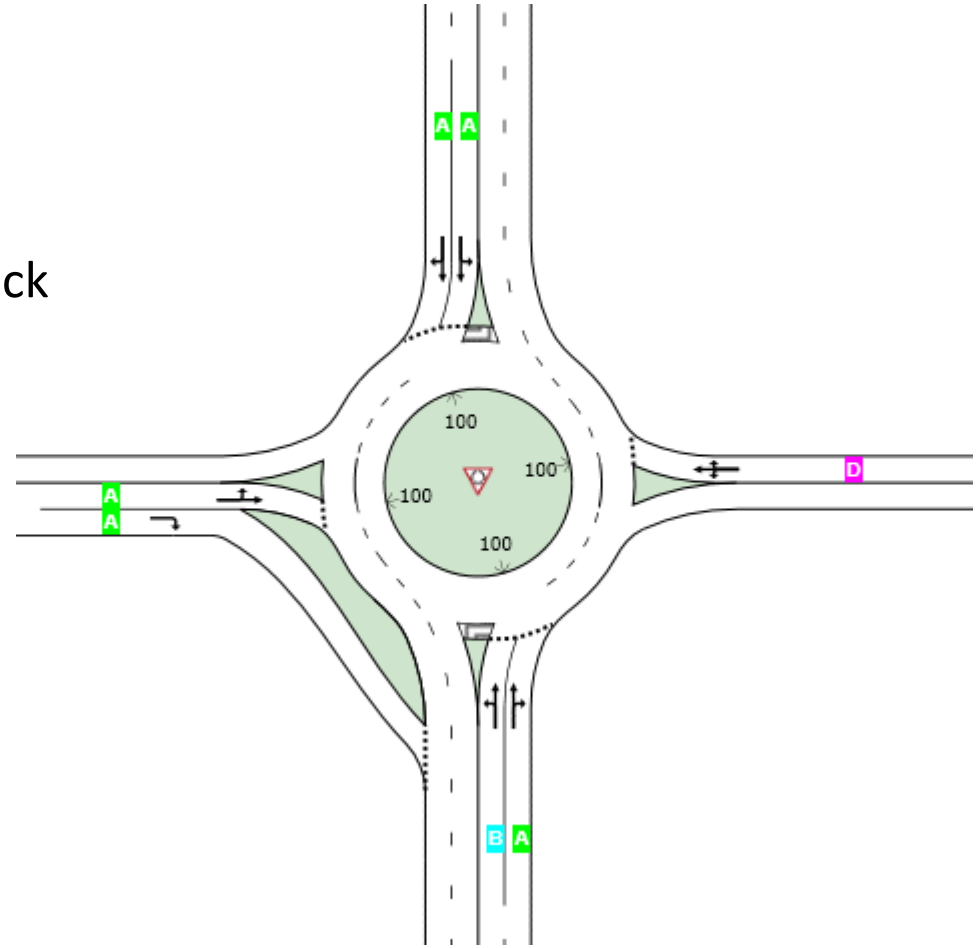


SIDRA

- GDOT's preferred analysis tool

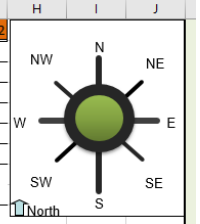
(using SIDRA formulas)

- HCM formulas can be used to check results
- Nice layout images
- Confirms geometry



How is circle size & number of lanes determined?

General & Site Information								v 4.2
Analyst:								
Agency/Co:								
Date:								
Project or PI#:								
Year, Peak Hour:								
County/District:								
Intersection:								



Volumes	Entry Legs (FROM)							
	N1 (1)	N2 (1)	NE1 (2)	NE2 (2)	E1 (3)	E2 (3)	SE1 (4)	SE2 (4)
Lane Designation	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT
N (1), vph								
Exit NE (2), vph								
Legs E (3), vph								
(TO) SE (4), vph								
S (5), vph								
SW (6), vph								
W (7), vph								
NW (8), vph								
Entry Volume, vph	0	0	0	0	0	0	0	0
	S1 (5)	S2 (5)	SW1 (6)	SW2 (6)	W1 (7)	W2 (7)	NW1 (8)	NW2 (8)
Lane Designation	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT
N (1), vph								
NE (2), vph								
E (3), vph								
SE (4), vph								
S (5), vph								
SW (6), vph								
W (7), vph								
NW (8), vph								
Entry Volume, vph	0	0	0	0	0	0	0	0

	N	NE	E	SE	S	SW	W	NW
# of Entry Flow Lanes	0	0	0	0	0	0	0	0
# of Conflict Flow Lanes	2	2	2	2	2	2	2	2

Volume Characteristics	N	NE	E	SE	S	SW	W	NW
% Cars	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
% Heavy Vehicles	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Bicycles	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
# of Pedestrians (ped/hr)	0	0	0	0	0	0	0	0
PHF	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*
F_{hv}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
F_{ped}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Entry/Conflicting Flows		N	NE	E	SE	S	SW	W	NW
Flow to	N (1), pcu/h	0	0	0	0	0	0	0	0
Leg #	NE (2), pcu/h	0	0	0	0	0	0	0	0
	E (3), pcu/h	0	0	0	0	0	0	0	0
	SE (4), pcu/h	0	0	0	0	0	0	0	0
	S (5), pcu/h	0	0	0	0	0	0	0	0
	SW (6), pcu/h	0	0	0	0	0	0	0	0
	W (7), pcu/h	0	0	0	0	0	0	0	0
	NW (8), pcu/h	0	0	0	0	0	0	0	0
	Entry flow, pcu/h	0	0	0	0	0	0	0	0
	Entry flow Lane 1, pcu/h	0	0	0	0	0	0	0	0
	Entry flow Lane 2, pcu/h	0	0	0	0	0	0	0	0
	Conflicting flow, pcu/h	0	0	0	0	0	0	0	0

Results: Approach Measures of Effectiveness

HCM 6th Edition	N		E		S		W	
Lane Designations	*Lane 1*	*Lane 2*	*Lane 1*	*Lane 2*	*Lane 1*	*Lane 2*	*Lane 1*	*Lane 2*
Entry Capacity, veh/h	NA	NA	NA	NA	NA	NA	NA	NA
Entry Flow Rates, veh/h	0	0	0	0	0	0	0	0
V/C ratio	0.00	0.00			0.00	0.00		
Control Delay, s/veh	0.0	0.0			0.0	0.0		
LOS	#N/A	#N/A			#N/A	#N/A		
Average Queue (ft)	0	0			0	0		
95th % Queue (ft)	#VALUE!	#VALUE!			#VALUE!	#VALUE!		
Approach Delay, LOS	#DIV/0!				#DIV/0!			

	NE		SE		SW		NW	
Lane Designations	*Lane 1*	*Lane 2*	*Lane 1*	*Lane 2*	*Lane 1*	*Lane 2*	*Lane 1*	*Lane 2*
Entry Capacity, veh/h	NA	NA	NA	NA	NA	NA	NA	NA
Entry Flow Rates, veh/h	0	0	0	0	0	0	0	0
V/C ratio			0.00	0.00			0.00	0.00
Control Delay, sec/pcu			0.0	0.0			0.0	0.0
LOS			#N/A	#N/A			#N/A	#N/A
Average Queue (ft)			0	0			0	0
95th % Queue (ft)			#VALUE!	#VALUE!			#VALUE!	#VALUE!
Approach Delay, LOS			#DIV/0!				#DIV/0!	

Overall Intersection Measures of Effectiveness

Int Control Delay (sec)		Int LOS		Max Approach V/C	
Notes:					v 4.2

GDOT RB Analysis Tool
www.dot.ga.gov/PS/DesignManuals/DesignResources

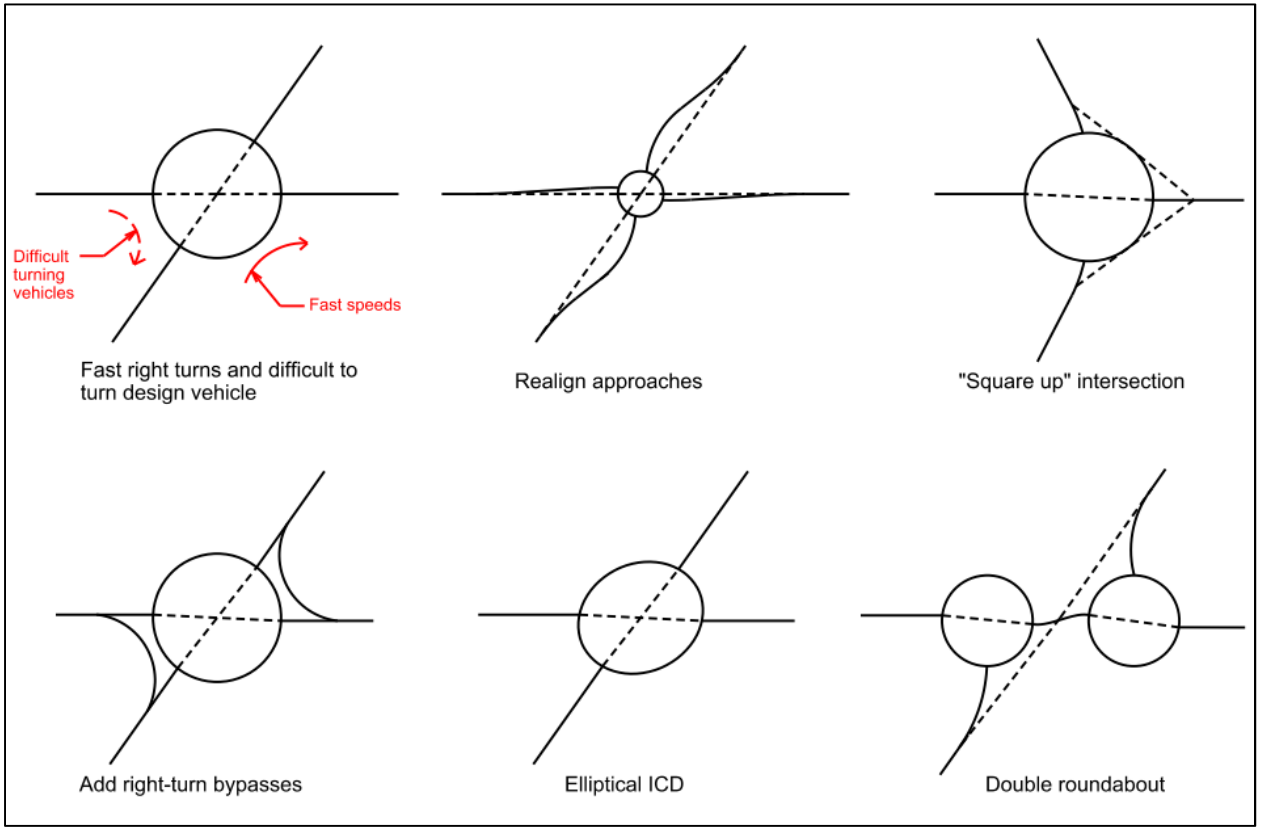
Core Elements

- Space for the trucks
  - Circle Size
- Speed Reduction
  - Circle location and alignment of legs
- Sight distances (SSD and ISD)
- Accommodation of vulnerable users
  - Refuge islands for pedestrians, bike transitions
- Positive Guidance
  - Path alignment and channelization, e.g. turbo features
  - Signs and markings that are uniform and spaced to minimize driving task load

Left-Offset Example

- GDOT preference
- Creates more entry path deflection
- Often allows for smaller ICDs

Practical Considerations for Approach Alignment



Elliptical

SR 33 @ US 319, Colquitt County, GA

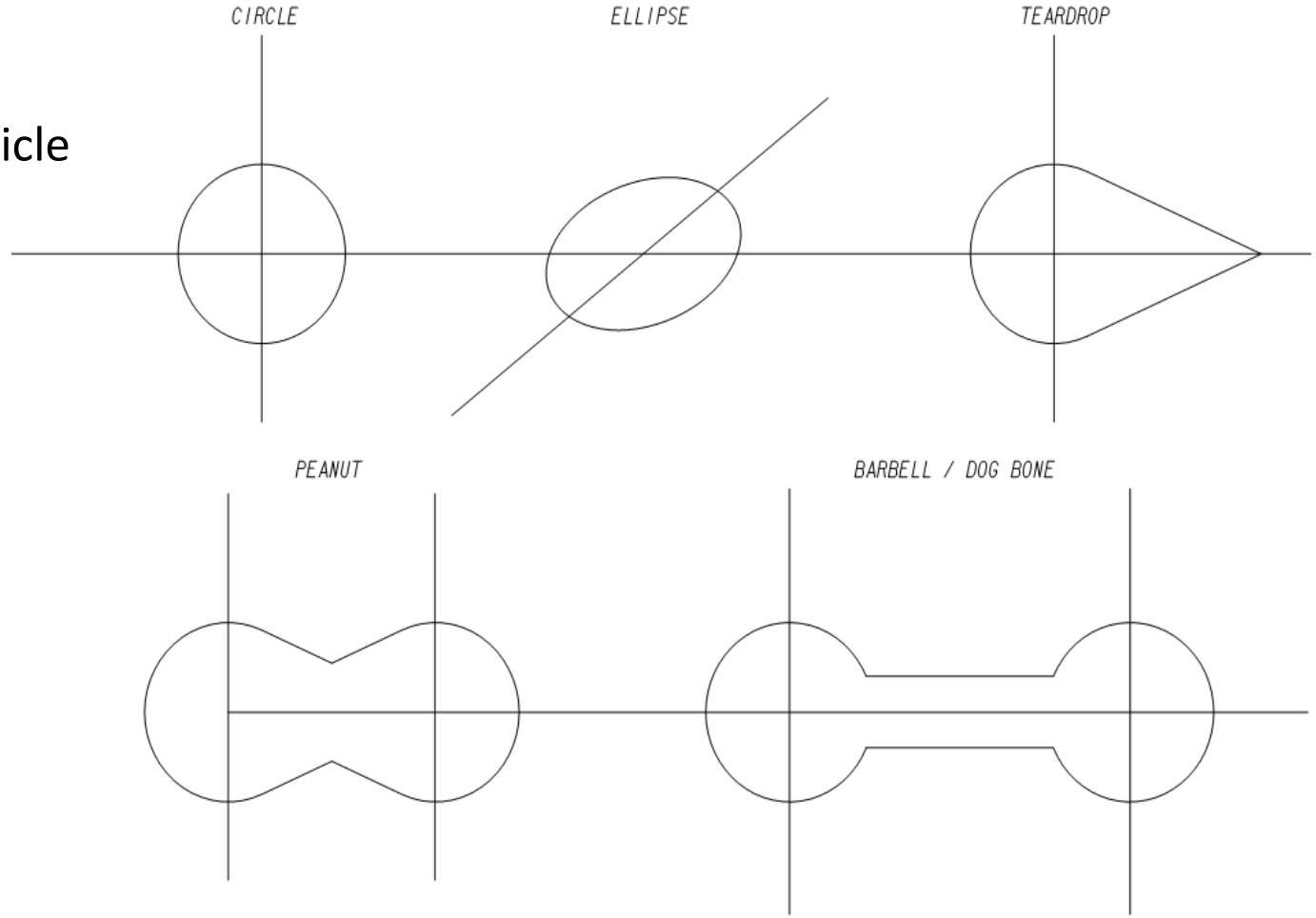
Elliptical

SR 33 @ US 319, Colquitt County, GA

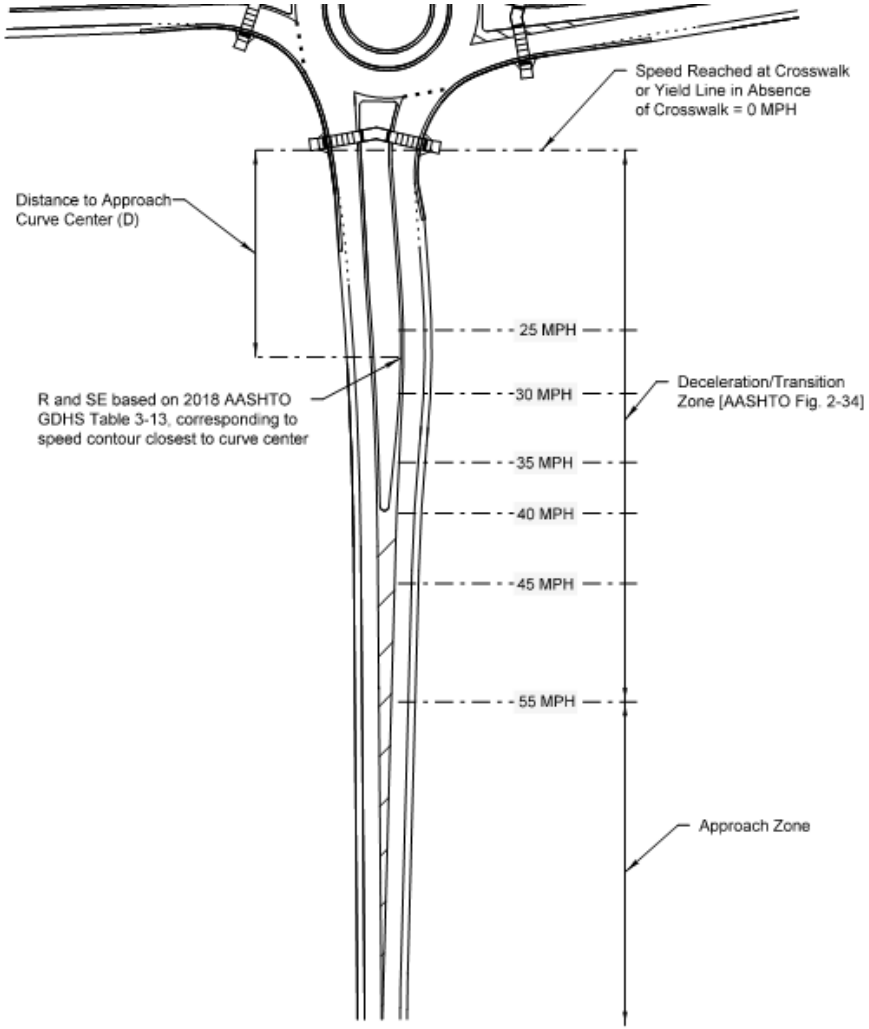

YIELD
YIELD
YIELD

New Additions

- Functional Area
- Design/Check Vehicle
- Circle Size
- Circle Shape

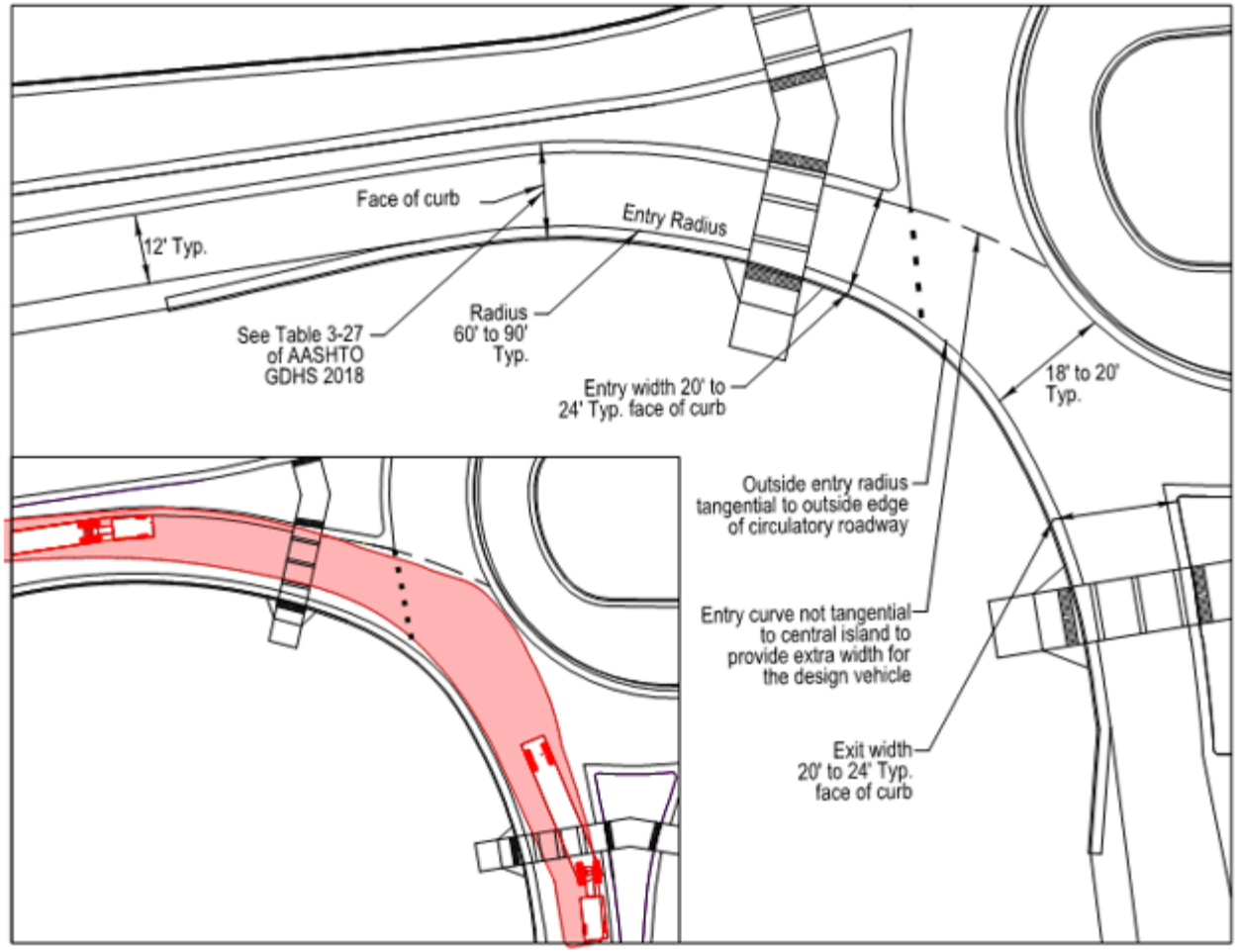


High-speed Approach Design



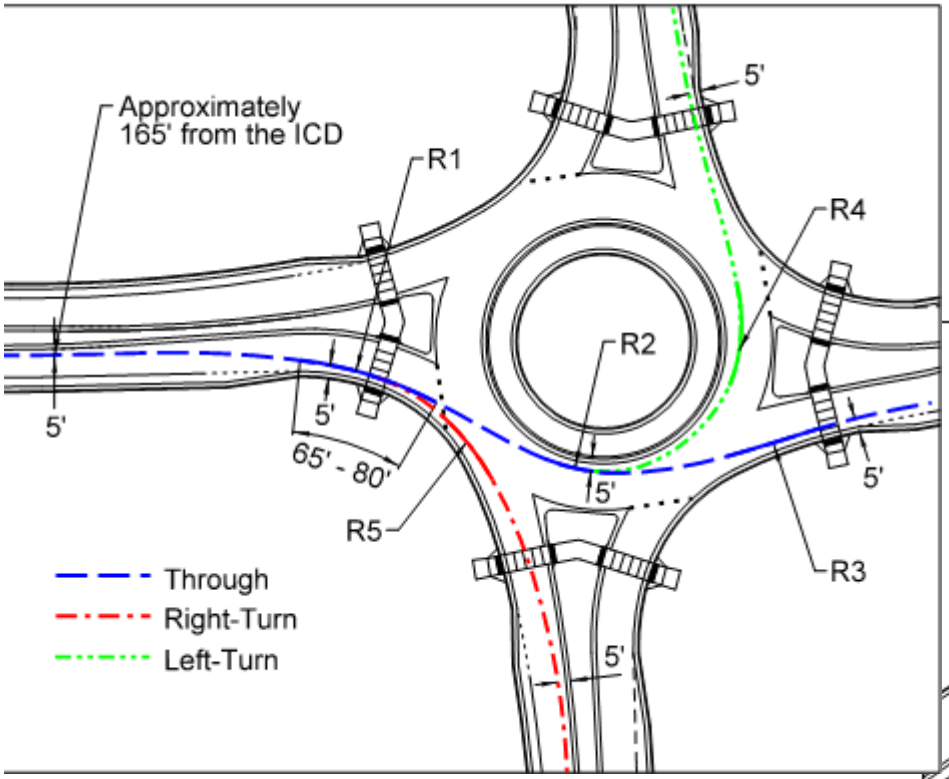
SPEED CONTOUR (S)	55 MPH	45 MPH	40 MPH	35 MPH	30 MPH	25 MPH
DECELERATION DISTANCE FROM CROSS-WALK OR YIELD LINE (D)	>310'	310'	260'	225'	175'	130'
CORRESPONDING RADIUS	*Standard Superelevation Tables*	*Green Book Table 3-13 Minimum Radii and Superelevation fo Low-Speed Streets in Urban Areas*				
		R 1039'	R 762'	R 510'	R 333'	R 198'
		Radii from Normal Crown -2.0%				

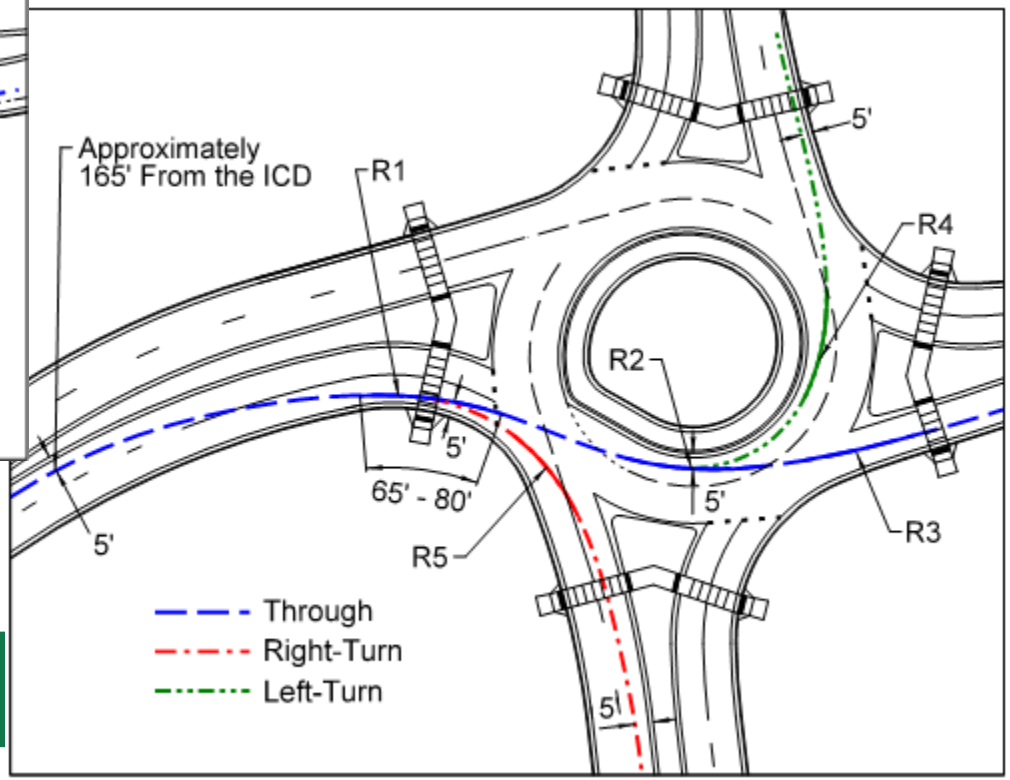
Entry Curves

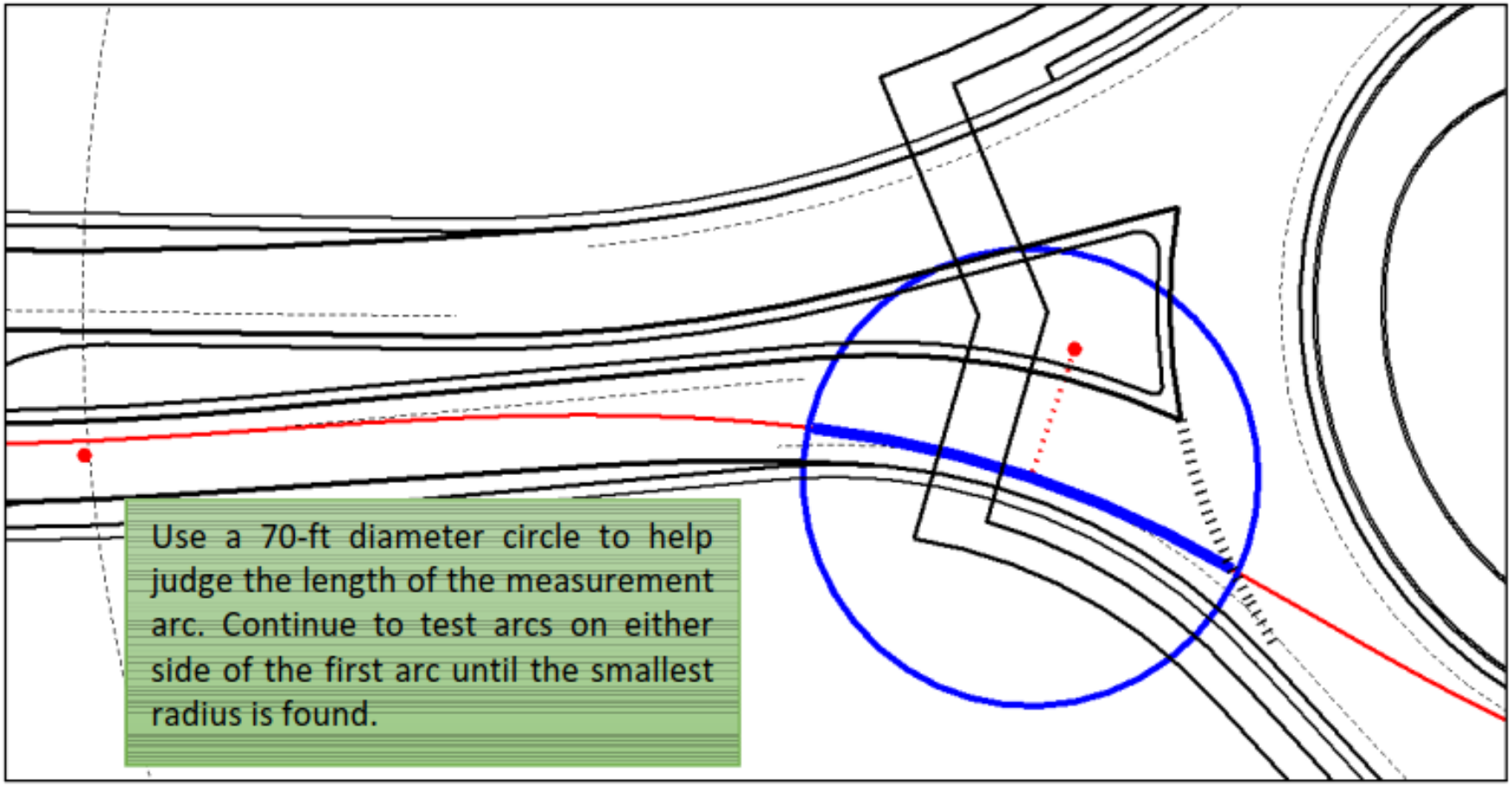


Guidance on Performance Checks

Fastest Path

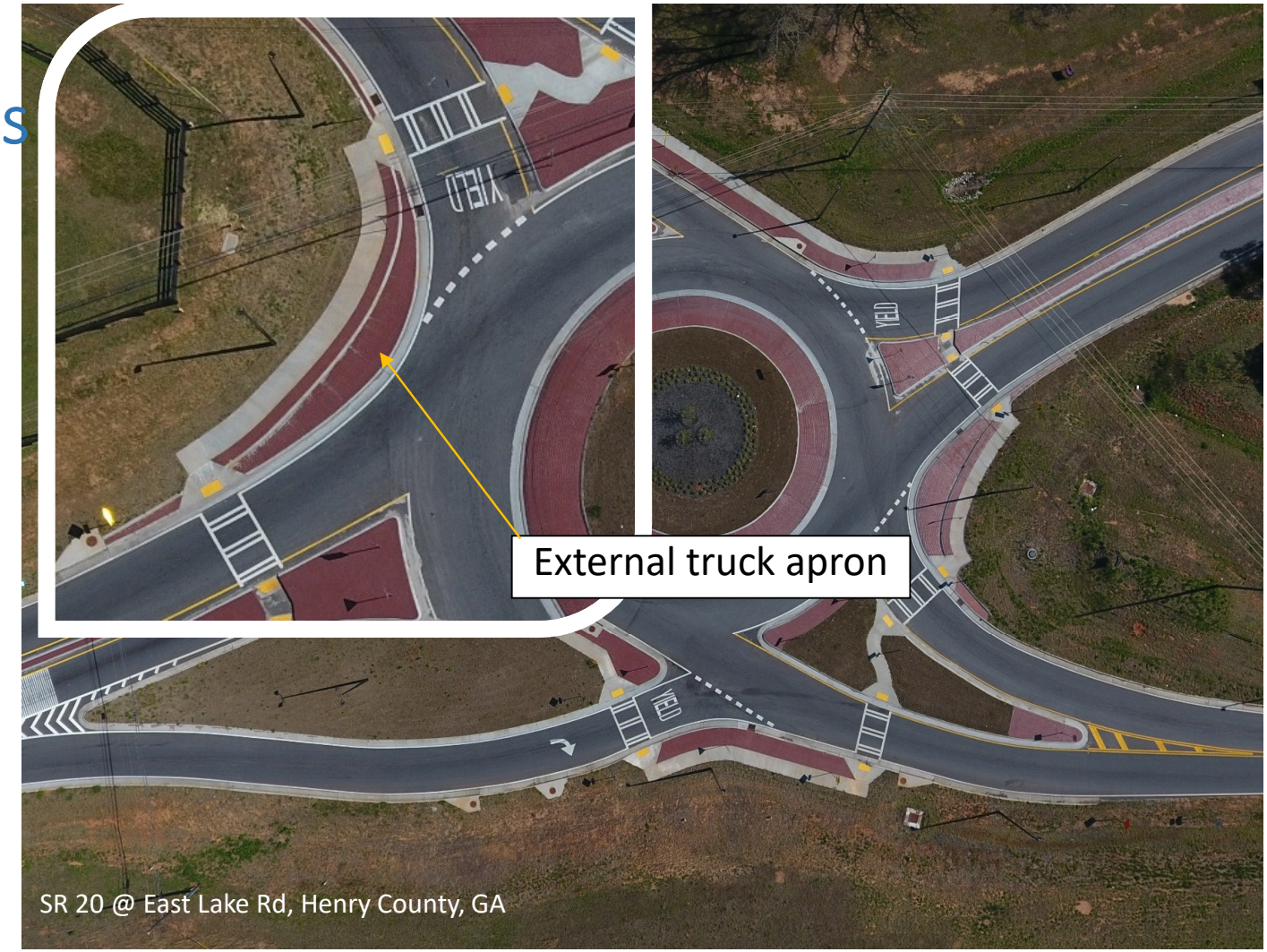




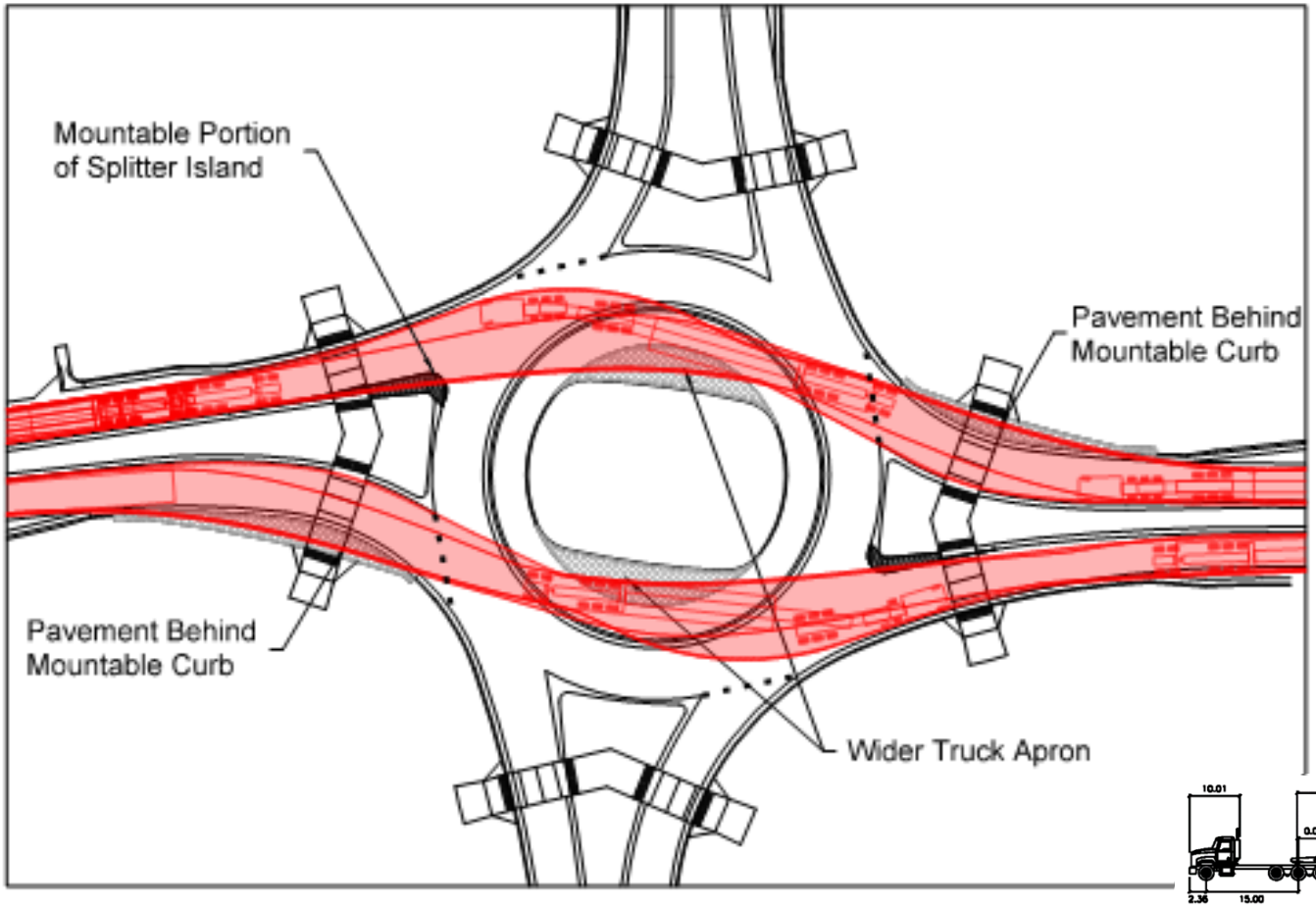

Use a 70-ft diameter circle to help judge the length of the measurement arc. Continue to test arcs on either side of the first arc until the smallest radius is found.

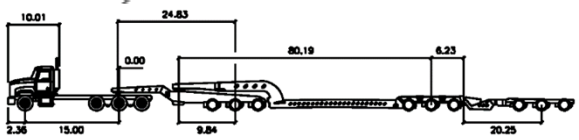
Truck Considerations

Outside Truck Aprons



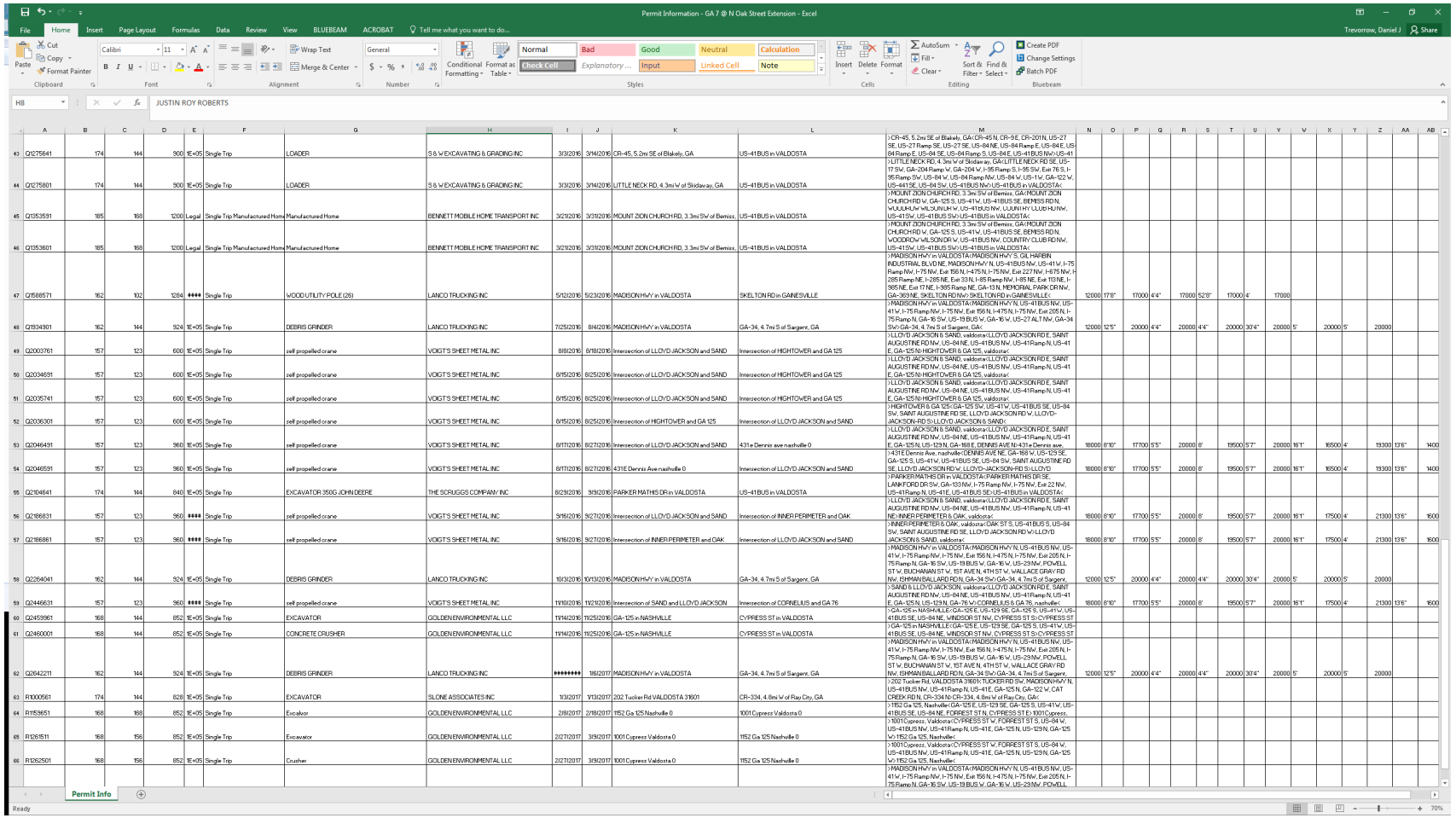
Check Vehicle Accommodations





150° Booster
feet

First Unit Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 40.0
First Unit Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		

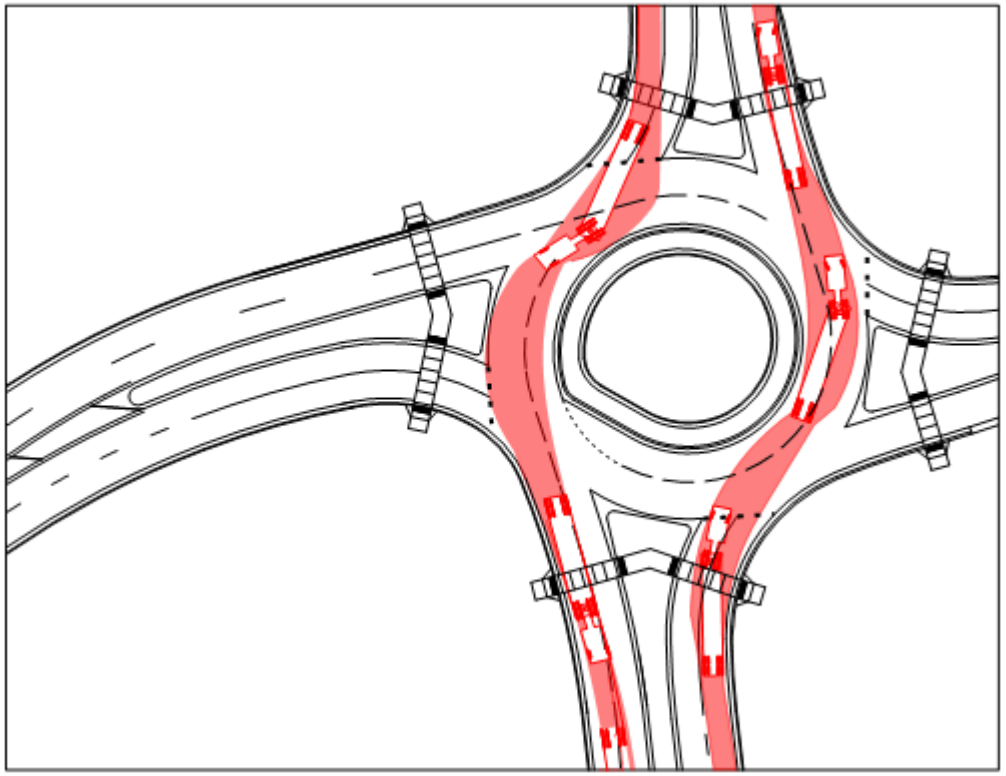


Obtain OSOW Permits then check Vehicle Swept Paths

OSOW@dot.ga.gov

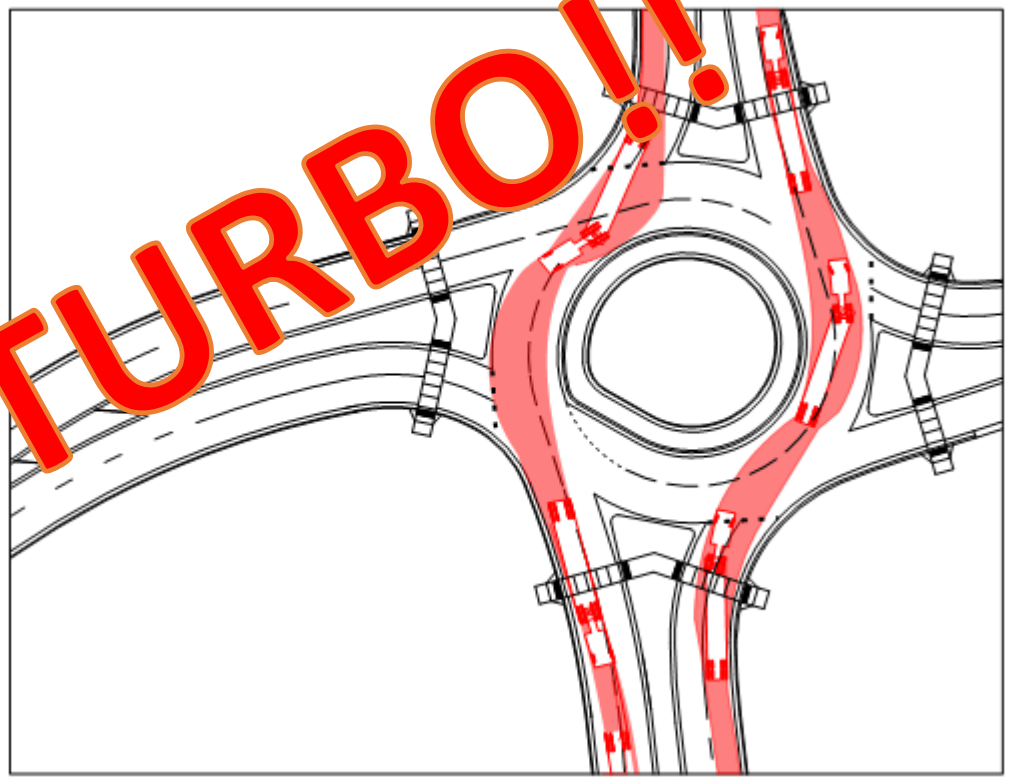
Truck Considerations for Multilane

- **Case 1** – Truck does not stay in-lane on entry or circulating
- **Case 2** – Truck stays in-lane on entry, but uses both lanes for circulating
- **Case 3** - Trucks in-lane on both entry and circulating



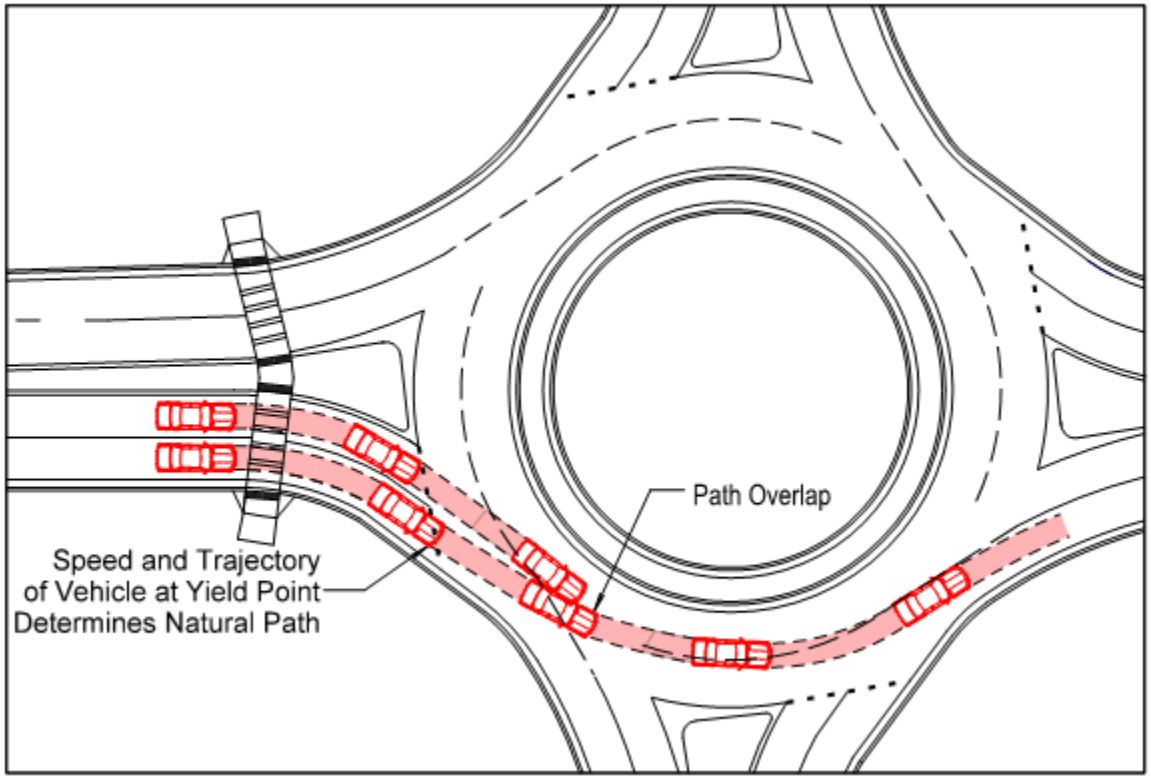
Truck Considerations for Multilane

- **Case 1** – Truck does not stay in-lane on entry or circulating
  - Rumble strips
- **Case 2** – Truck stays in-lane on entry, but uses both lanes for circulating
  - Raised lane divider on entry and exit
  - Rumble strips and RPMs in the circle
- **Case 3** - Trucks in-lane on both entry and circulating
  - Raised lane dividers



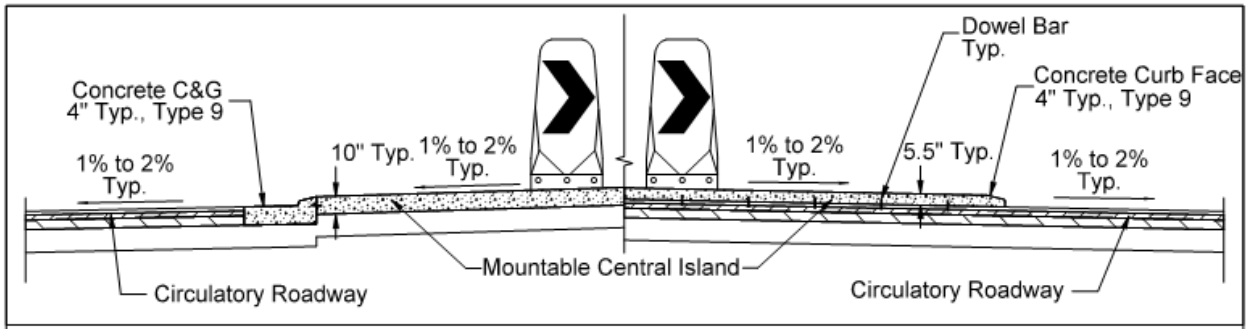
More TURBO!!

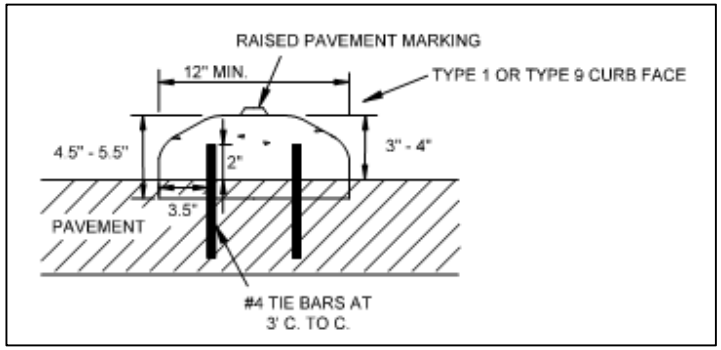
Path Alignment

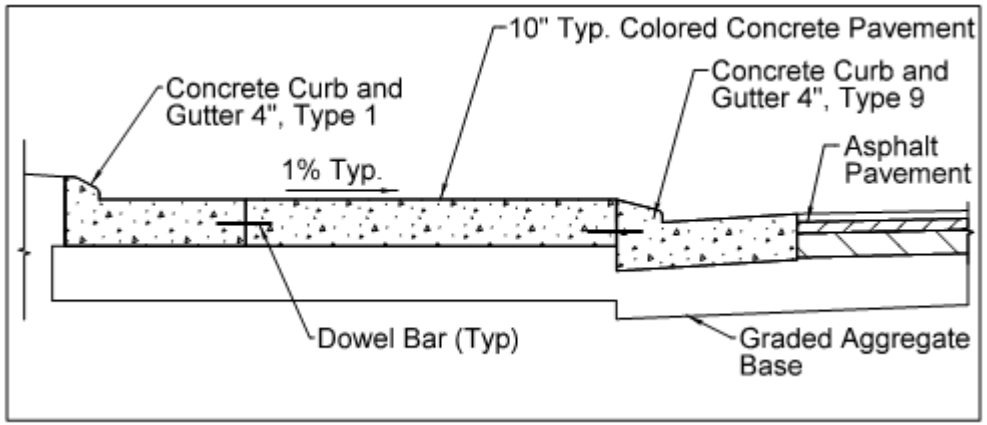


Vertical Design & Grading

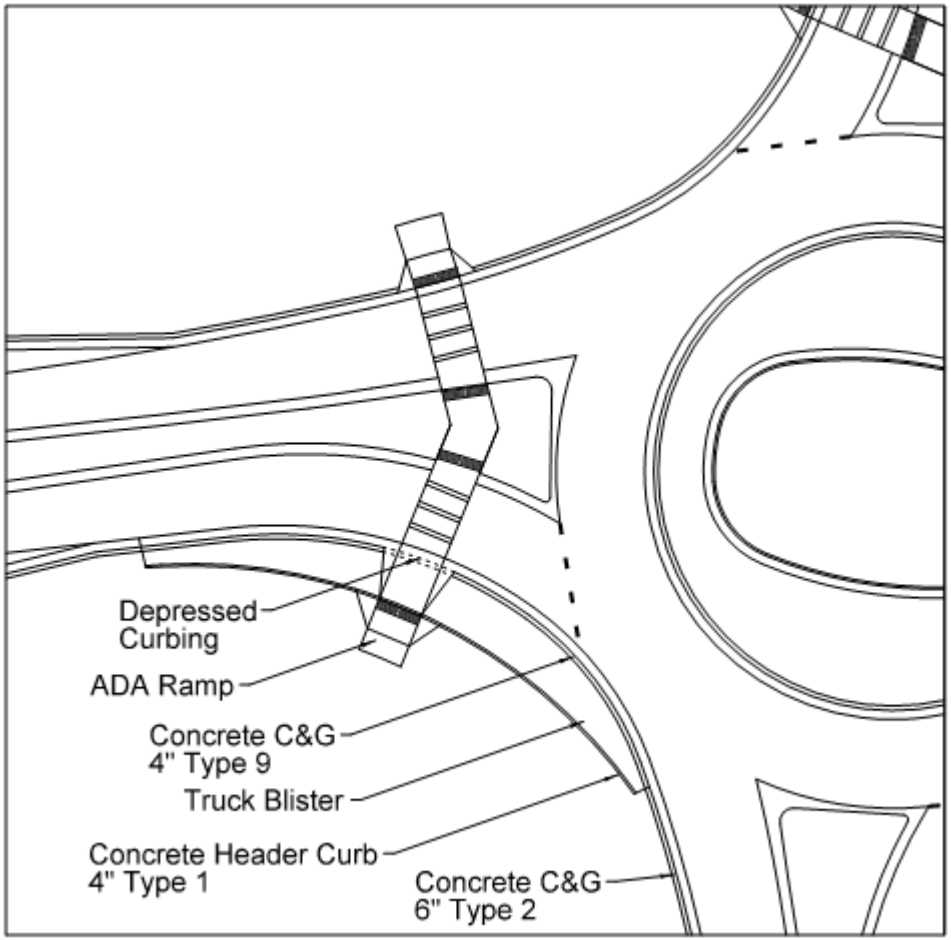
Typical Sections & Curb Types







Pedestrian Accommodations

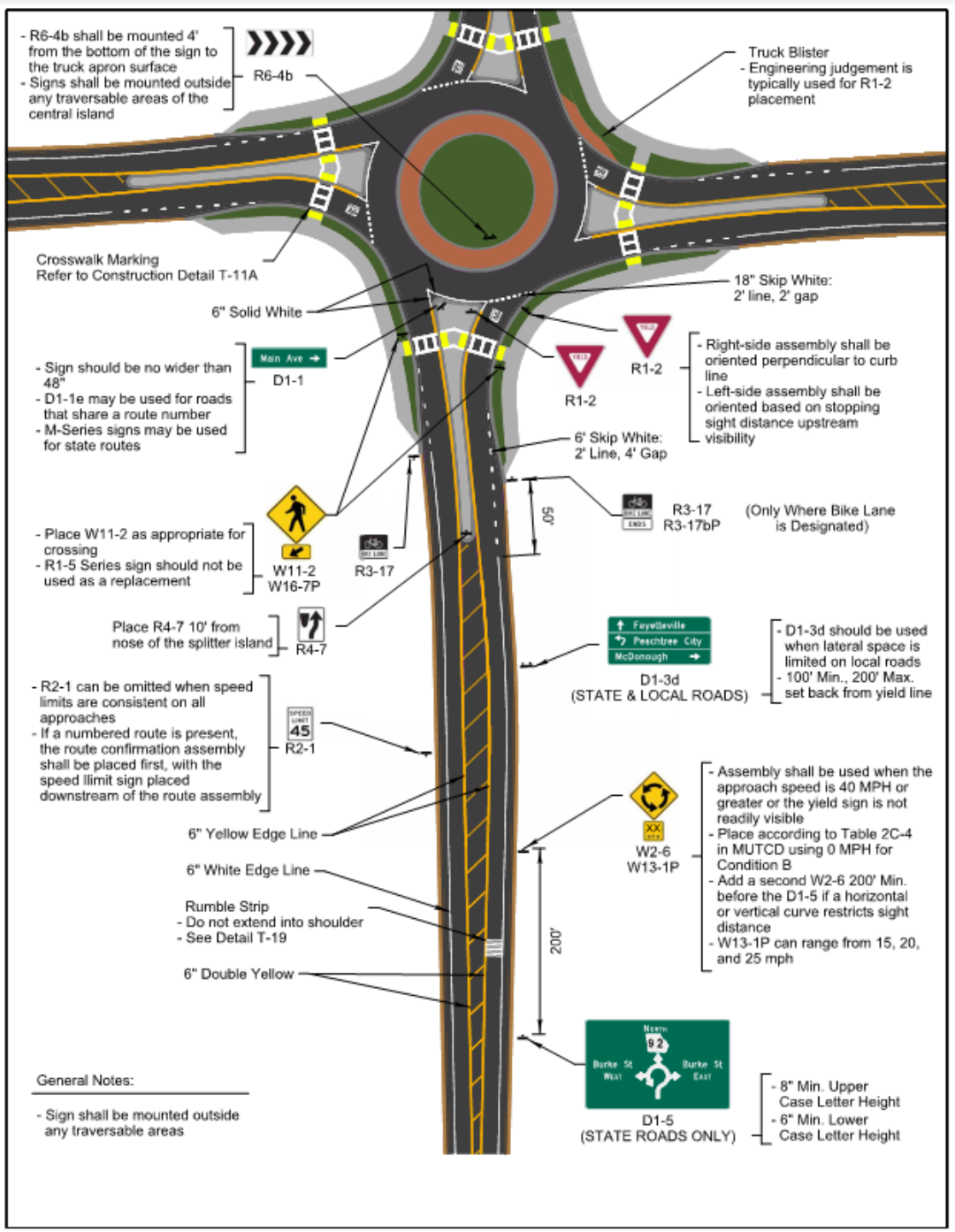


- Design elements for pedestrian crossings
- Crosswalk alignments
- Crosswalks through blisters

Traffic Control Devices

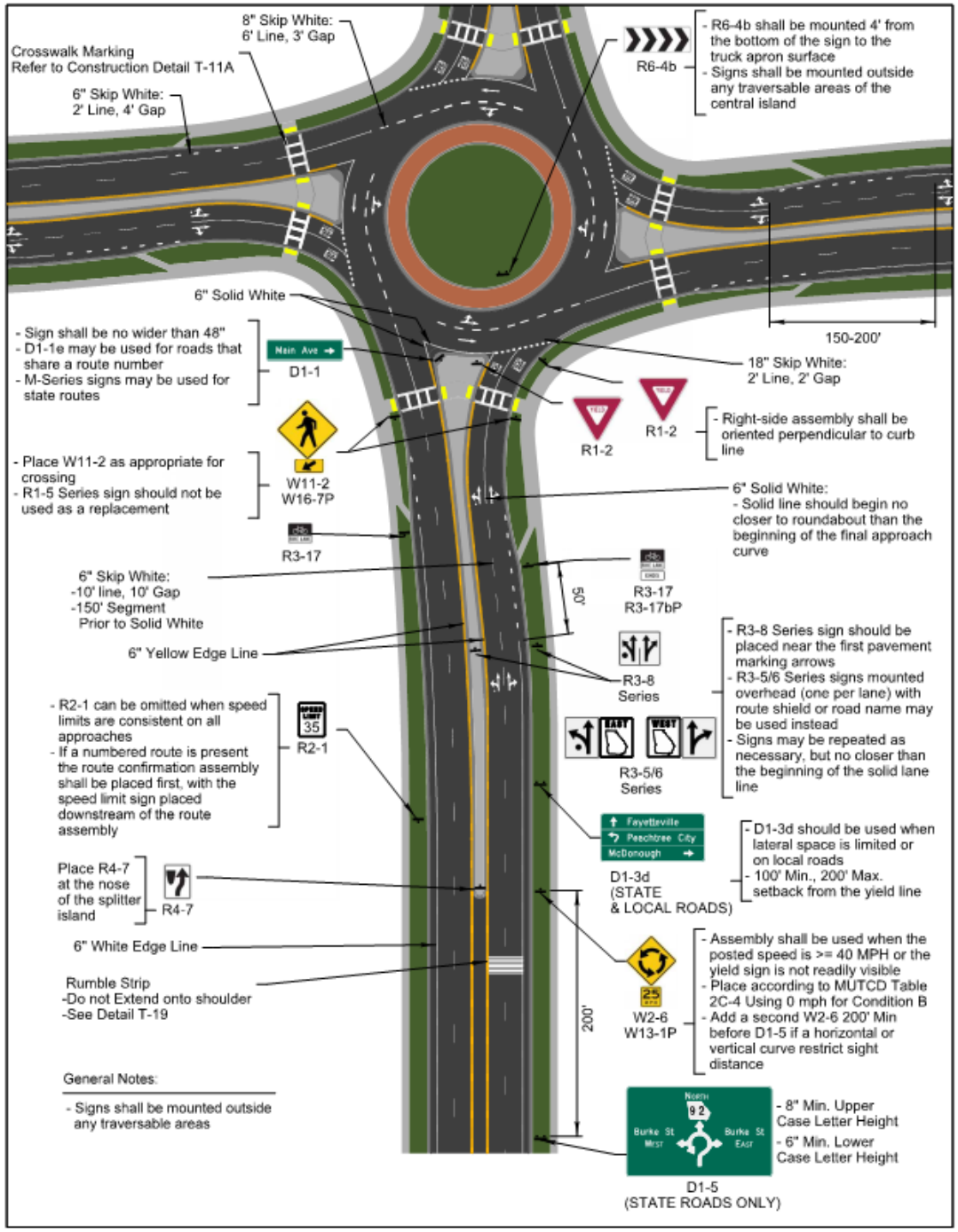
Signing & Marking

- Single
- Mini
- Multilane



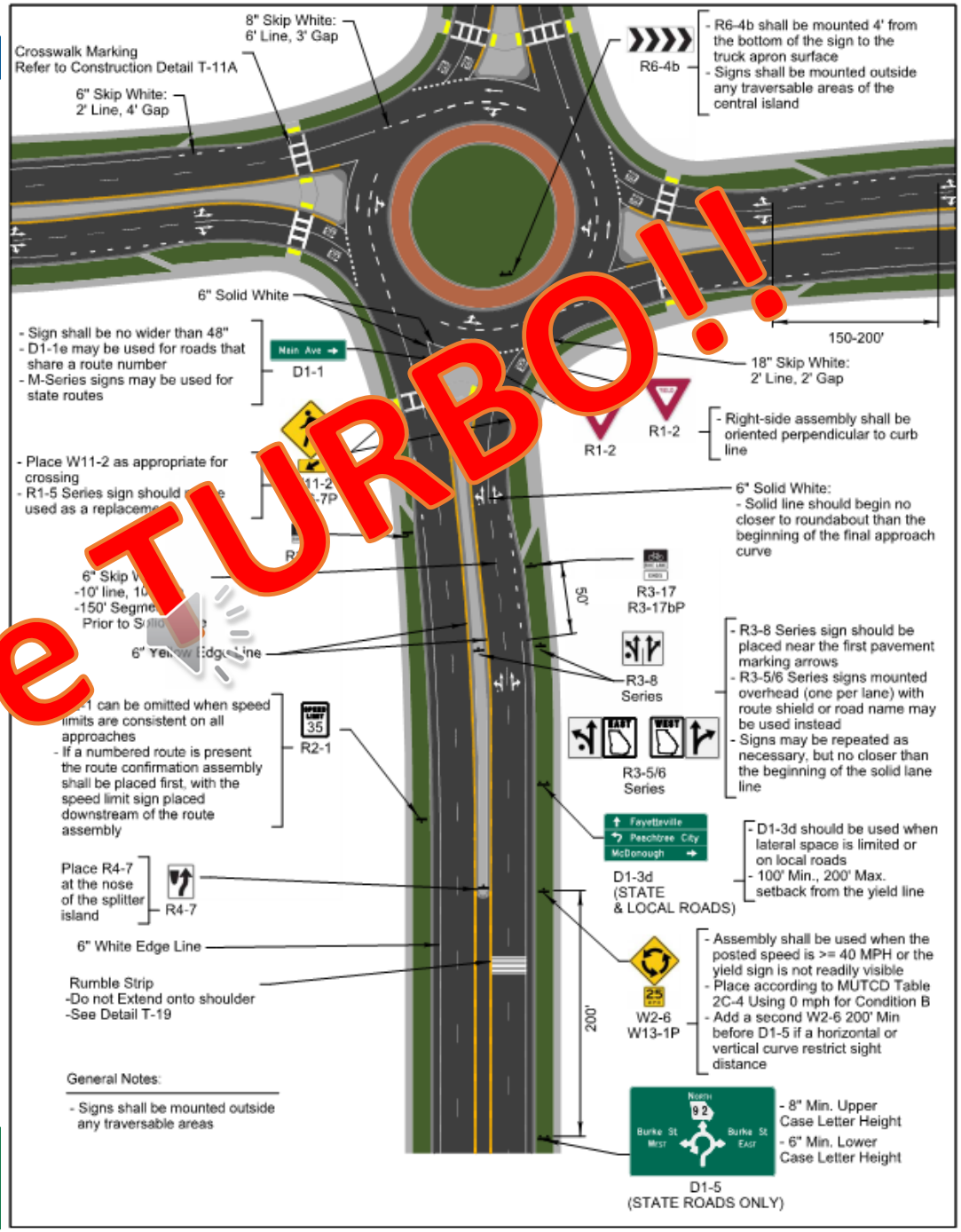
Signing & Marking

- Single
- Mini
- Multilane
  - Case 1
  - Case 2
  - Case 3



Signing & Marking

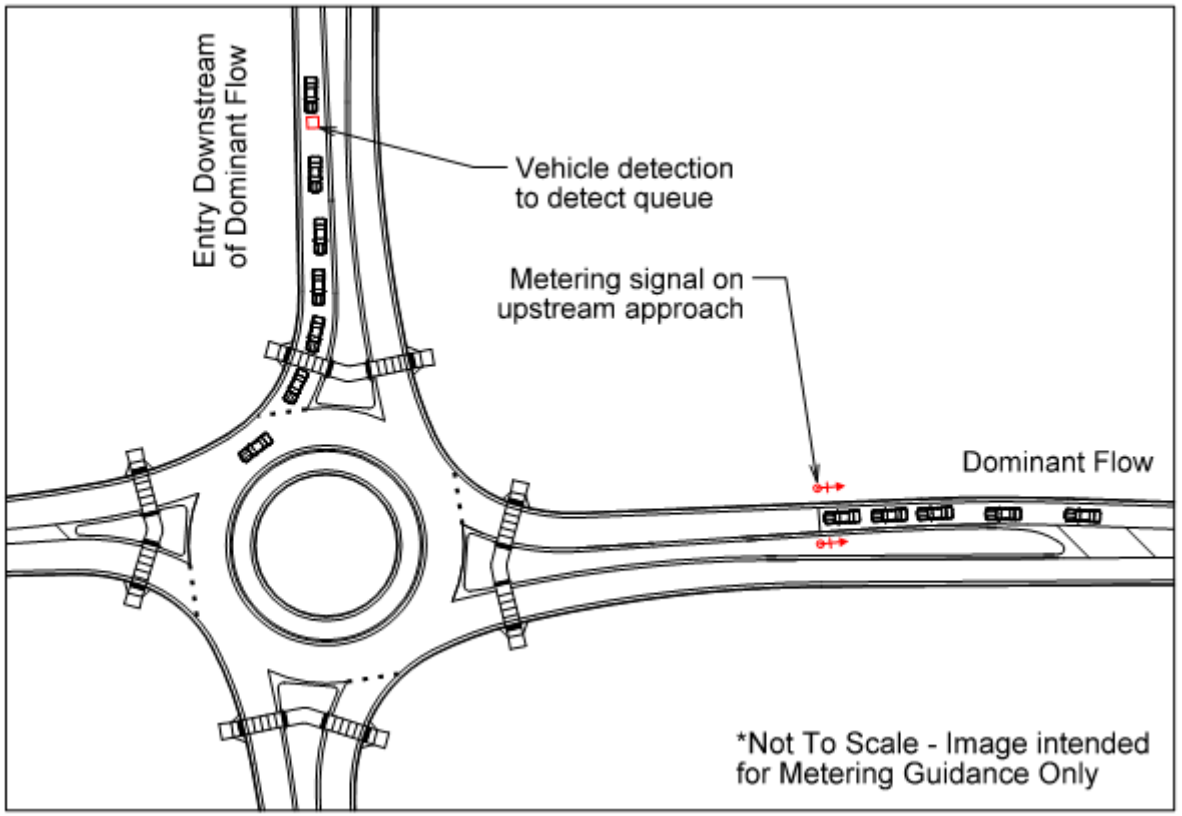
- Single
- Mini
- Multilane
  - Case 1
  - Cas
  - Case



More TURBO!!

Active Devices

- RRFB
- PHB
- Metering



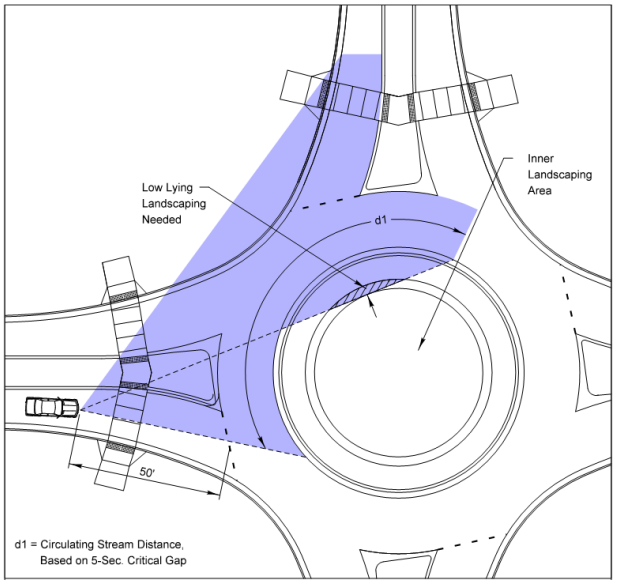
Railroad Crossing & Pre-emption

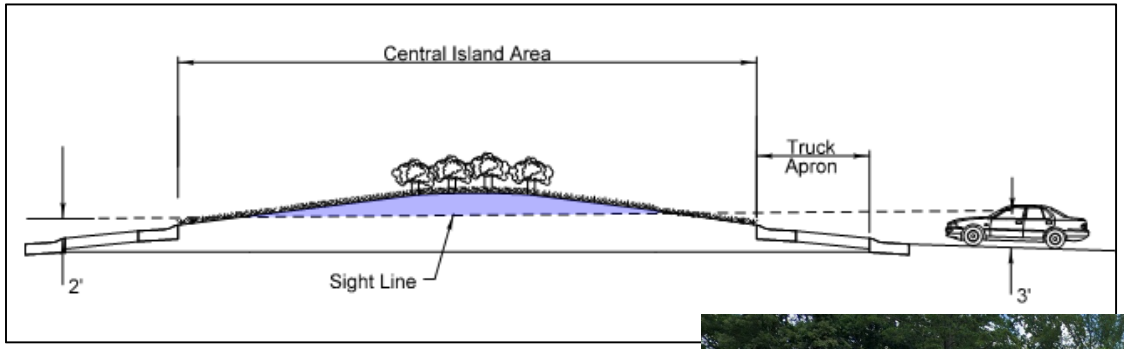
- Treatments – Gating, Signals

SR 242 @ Waco Mill Rd, Washington County

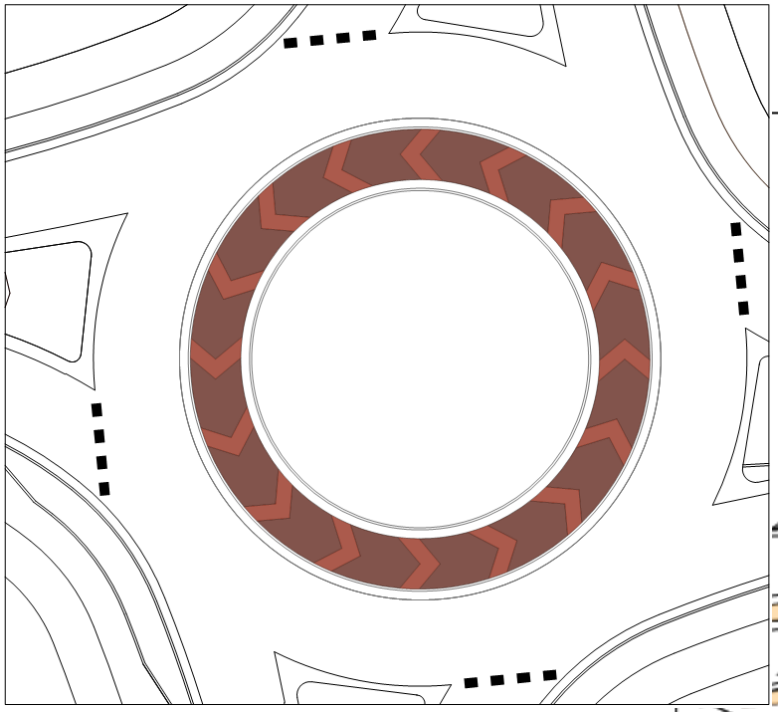
Landscaping

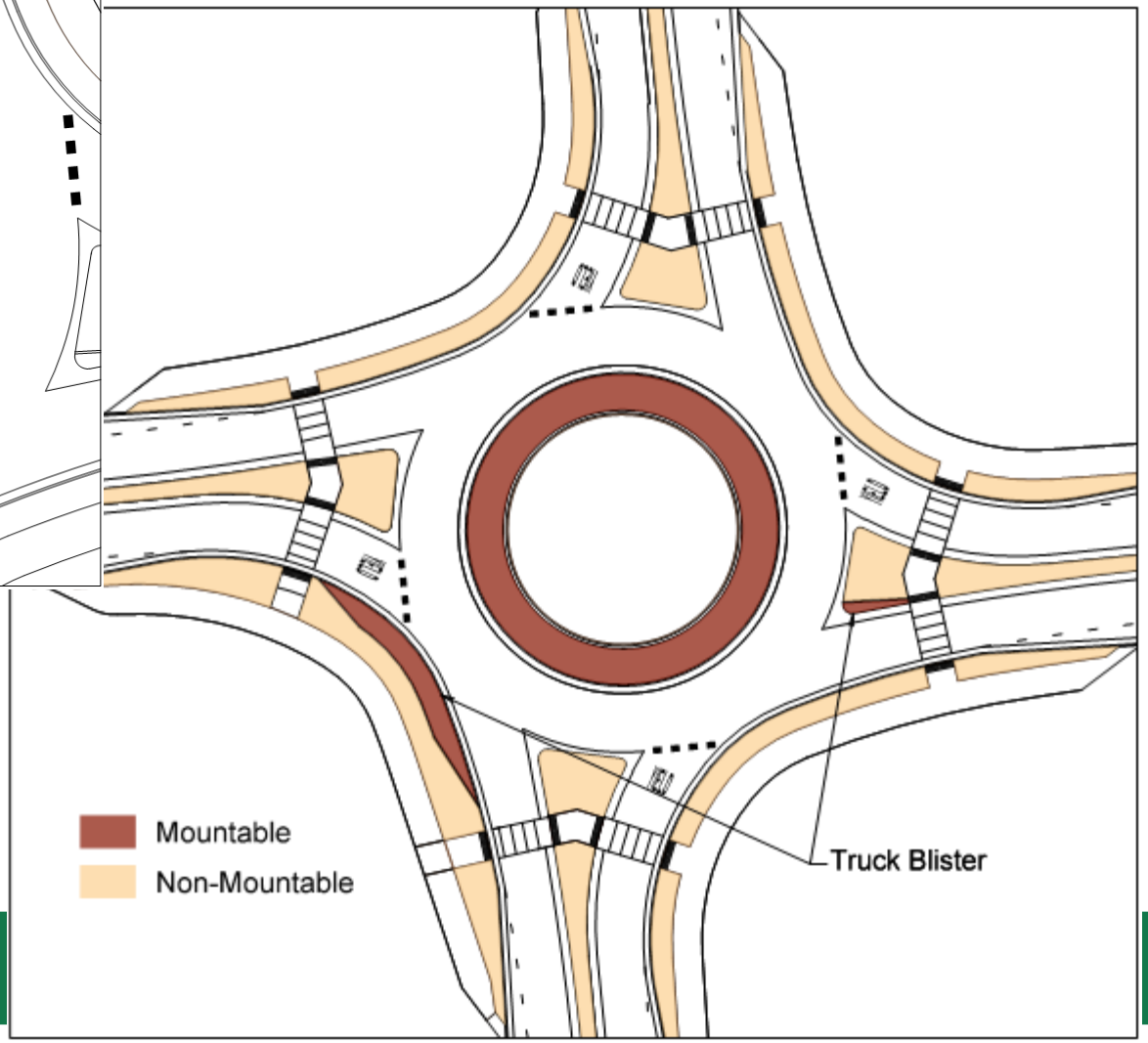
- Purposes
- Preferences
- Pavement Treatments (colors, textures)
- Textures





Landscaping





Practical Design

Practical Design Considerations

Right-sizing = trend a few years ago

Practical design = next wave

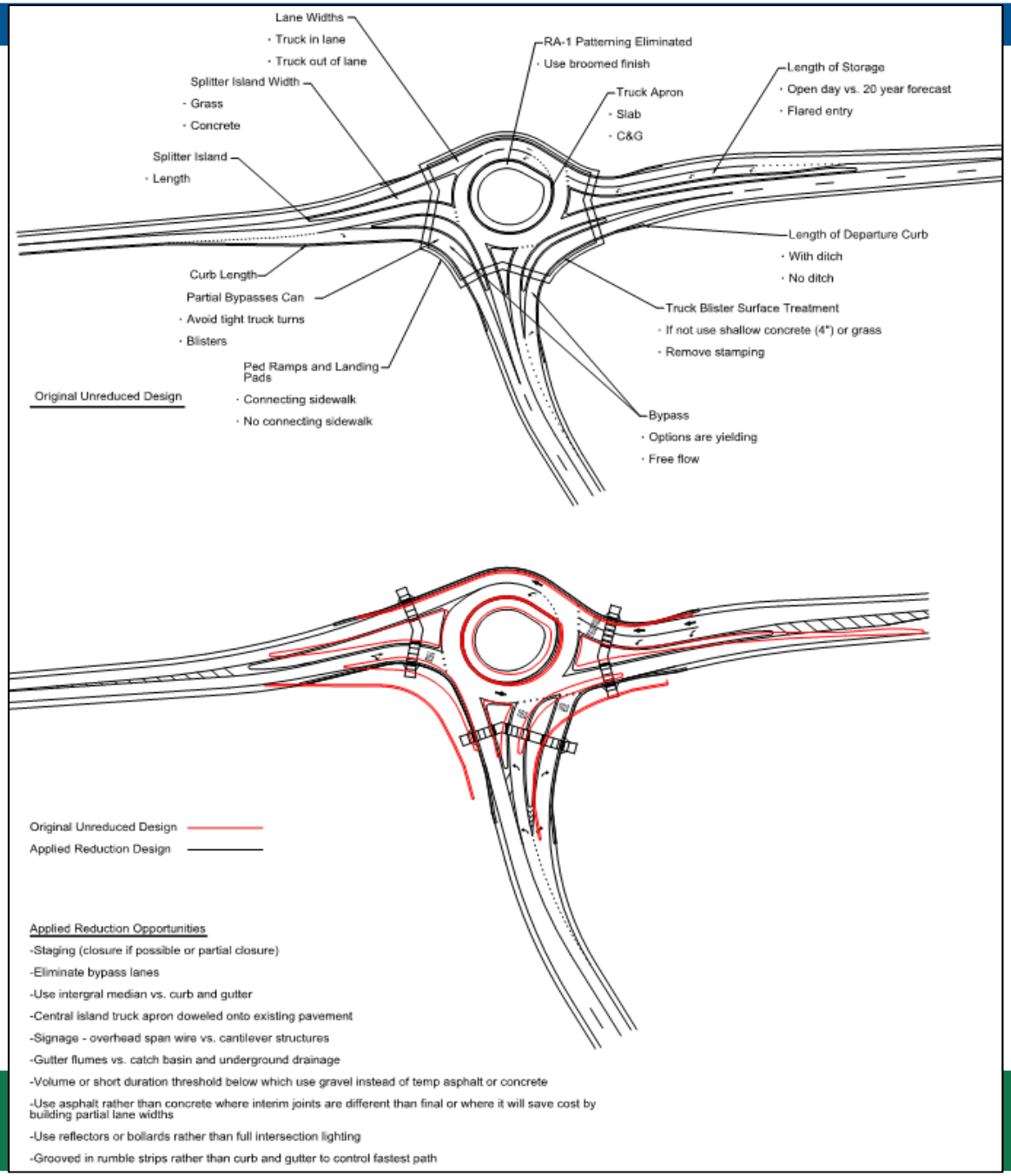
- Minimize staging, cost and construction duration –> make the most use of existing pavements and profiles
- Minimize required R.O.W. –> mitigate intersection skew angle with ellipse
- Size for traffic demands –> staged expandability
- Utilize context sensitivity and encompassing existing features
    - blends with the profile and existing landscape

Practical Design Considerations

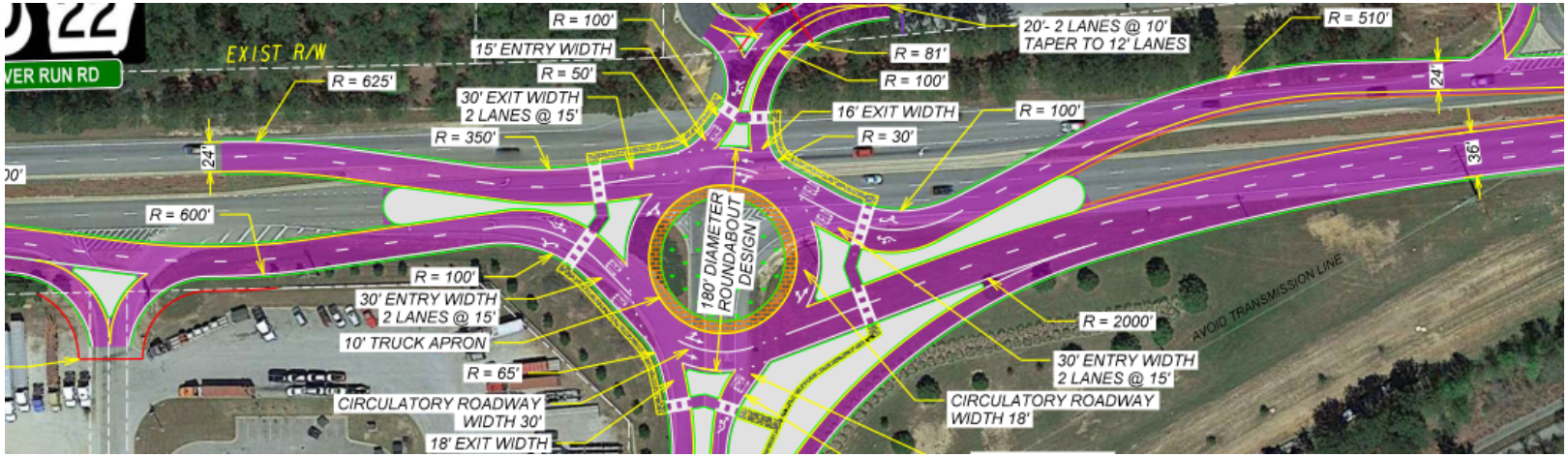
- Reduce need for piped drainage –> make use of existing ditches
- reduce length of construction:
  - reduce splitter island lengths
  - modifying chicanes
  - or using symmetrical widening
- Facilitate lane drops –> 2x2 or 2x1 design with single lanes in the links upstream and down

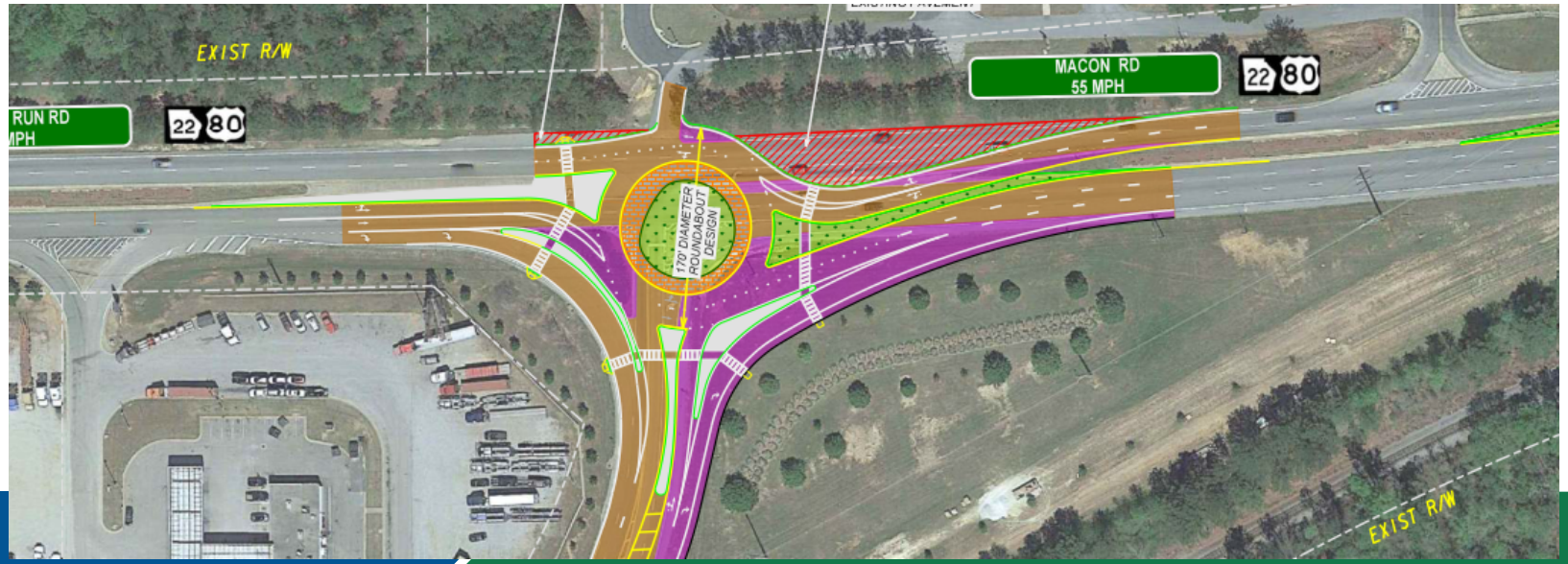
- Quick Response projects - demonstrate what is essential for a roundabout design to function

Practical Design Considerations



Practical Alternatives – Lower Cost/More Functional





Practical Construction Staging Principles

- Operate as roundabout as soon as possible
- Minimize number of stages
- Minimize changes to traffic control when using parts of circle
- Avoid contra-flow traffic
- Install signage, including way-finding (D and M series) before the roundabout opens
- Use changeable message boards: “New Control” and “Yield Ahead”

Georgia Department of Transportation

Chris Raymond, P.E.

State Traffic Operations Manager

Phone: 404.635.2809
Email: craymond@dot.ga.gov

R.A.I.D.

Roundabouts@dot.ga.gov

http://www.dot.ga.gov/DS/SafetyOperation/Roundabouts

GDOT R.O.A.D.S. Webpage → Manuals & Guides →

Traffic Operations → Alternative Intersections

Roundabouts@dot.ga.gov

www.dot.ga.gov/DS/SafetyOperation/Roundabouts

Roundabout Design Guide

Office of Traffic Operations | February 2021