

BRINGING THE TURBO ROUNDAABOUT TO THE USA

WELCOME

May 26, 2021

WELKOM

26 mei 2021



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Agenda for Today's Presentation

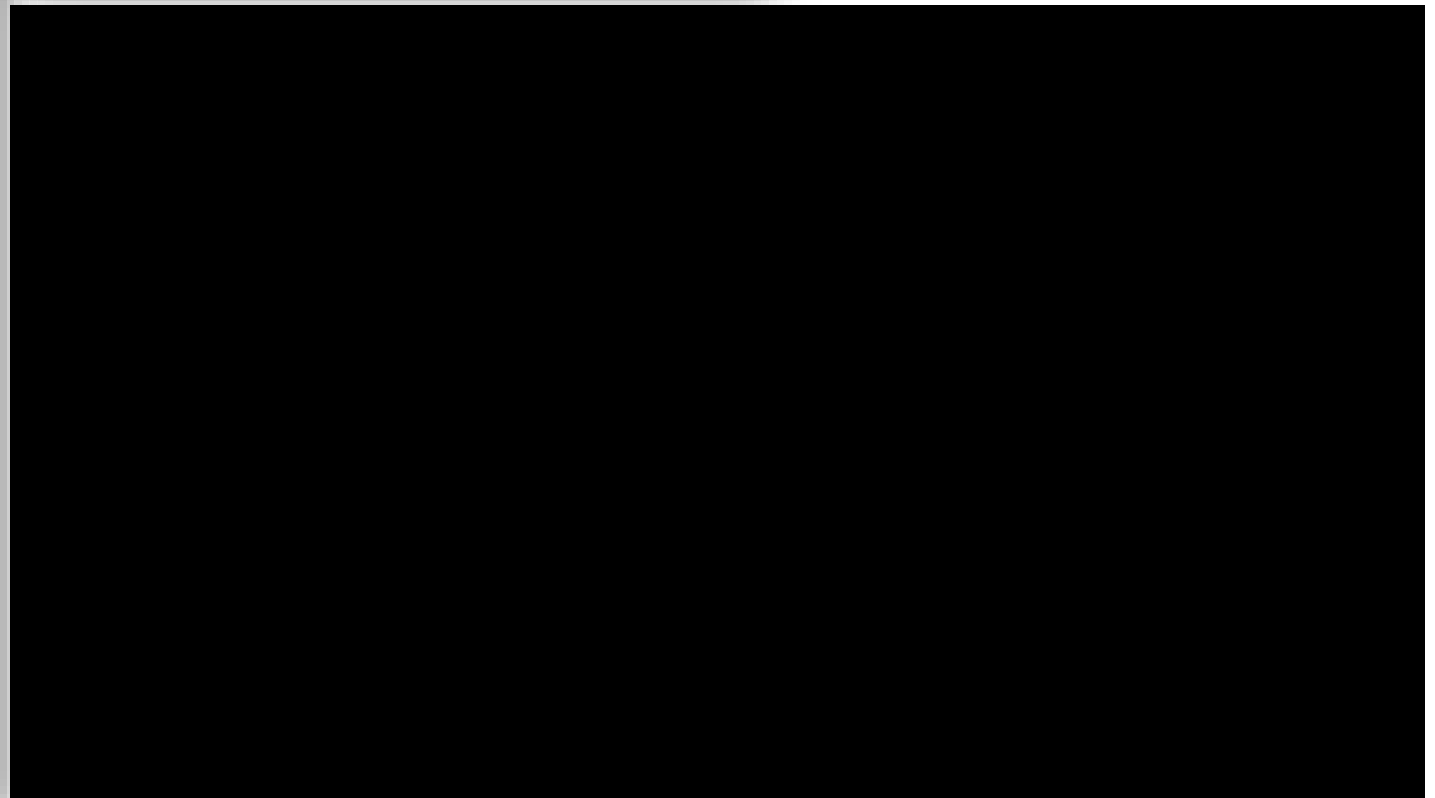
- Evolution of Roundabouts
- Why Turbo Roundabouts?
- History of Turbo Roundabouts
- Design Elements of the Turbo Roundabout
- Special Attention to Details
- Traffic Operations and Comparisons
- Next Steps to Bring the Turbo to the U.S.

Evolution of U.S. Roundabout

Single Lane Roundabouts



Compact (Mini)



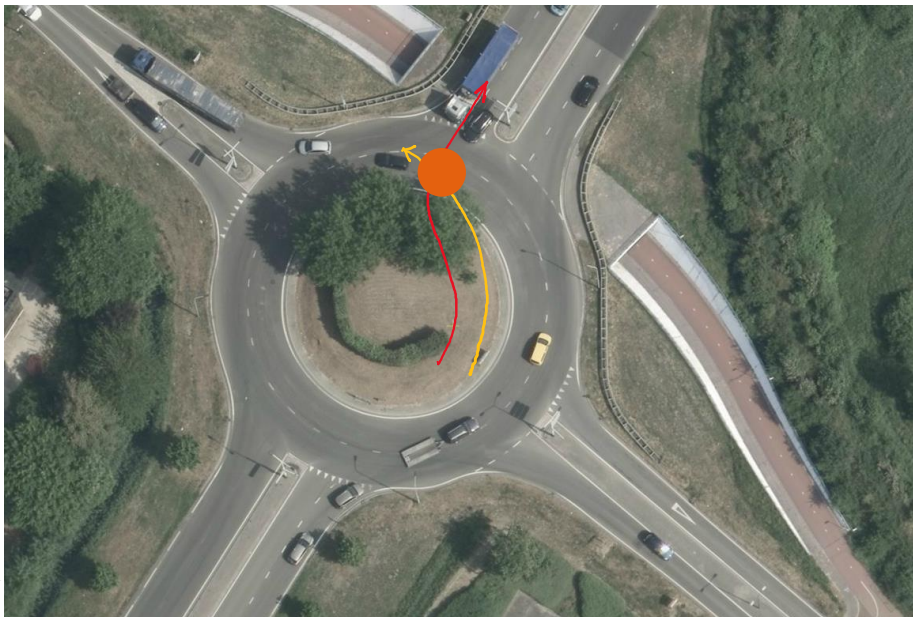
What Next?



Why Turbo Roundabouts?

Why Turbo Roundabouts?

- Single lane roundabouts introduced in the eighties in the Netherlands
- With the increase of traffic volumes, single lane roundabouts replaced by multilane roundabouts
- Standard multilane roundabout has safety issues: weaving conflicts



Why Turbo Roundabouts?



Why Turbo Roundabouts?

Challenge: Design layout that eliminates safety conflicts and increases capacity

Result: Spiral shaped Turbo Roundabout without lane changing on the roundabout

Why the name Turbo Roundabout?

Refers to improved traffic flow (compared to a standard multilane roundabout)



Turbo Roundabout Characteristics

No lane changing

Lane choice upstream

Spiral layout

Radial approaches



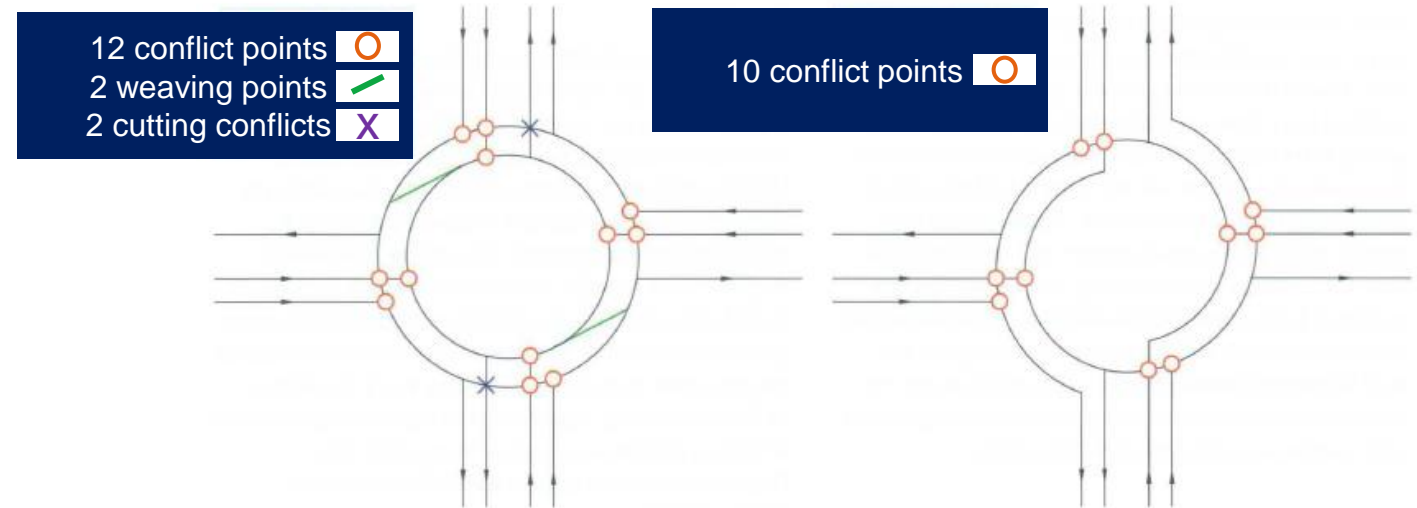
Why Turbo Roundabouts?

Reduction in Number of Intersection Conflict Points

- 16 vs 10 conflict points
- Reduction of 37.5%

Proven Safety Benefits

- 2016 study by Christiaan Vos
- Over 50% reduction crashes



© CROW Guideline: turborotondes

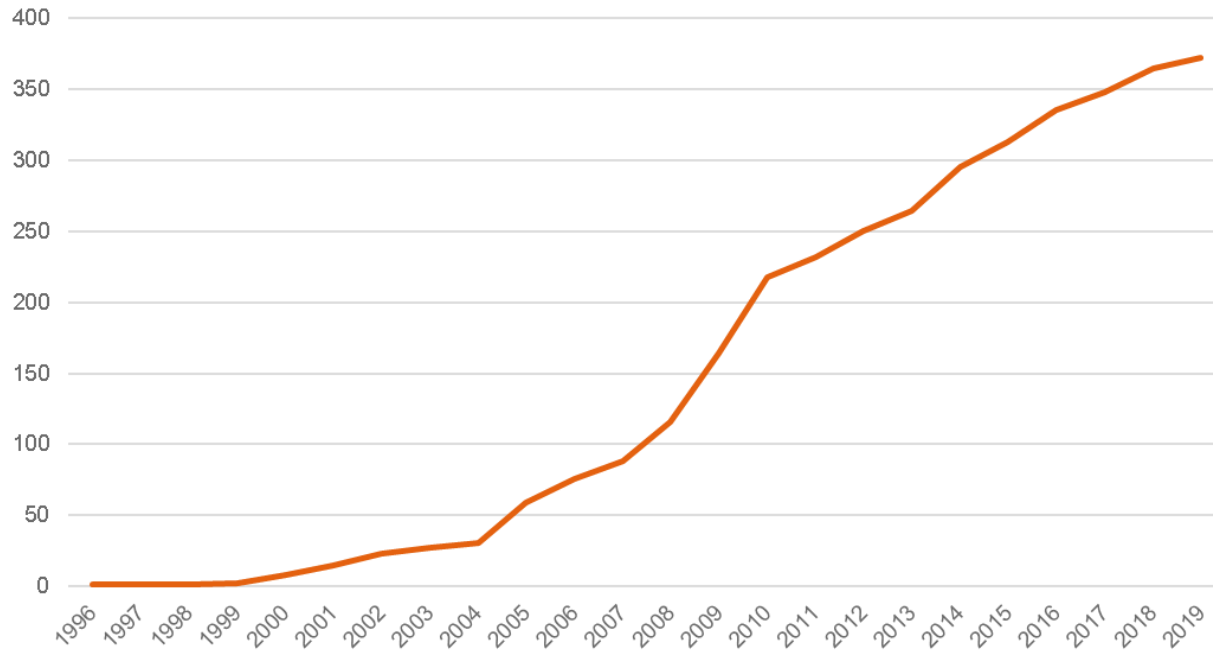
From	before	after	reduction
Unsignalized	76	19	-75%
Signalized	73	19	-74%
Multi Lane	17	8	-53%
Single Lane	18	7	-61%

History of Turbo Roundabout

Turbo Roundabout Orgins

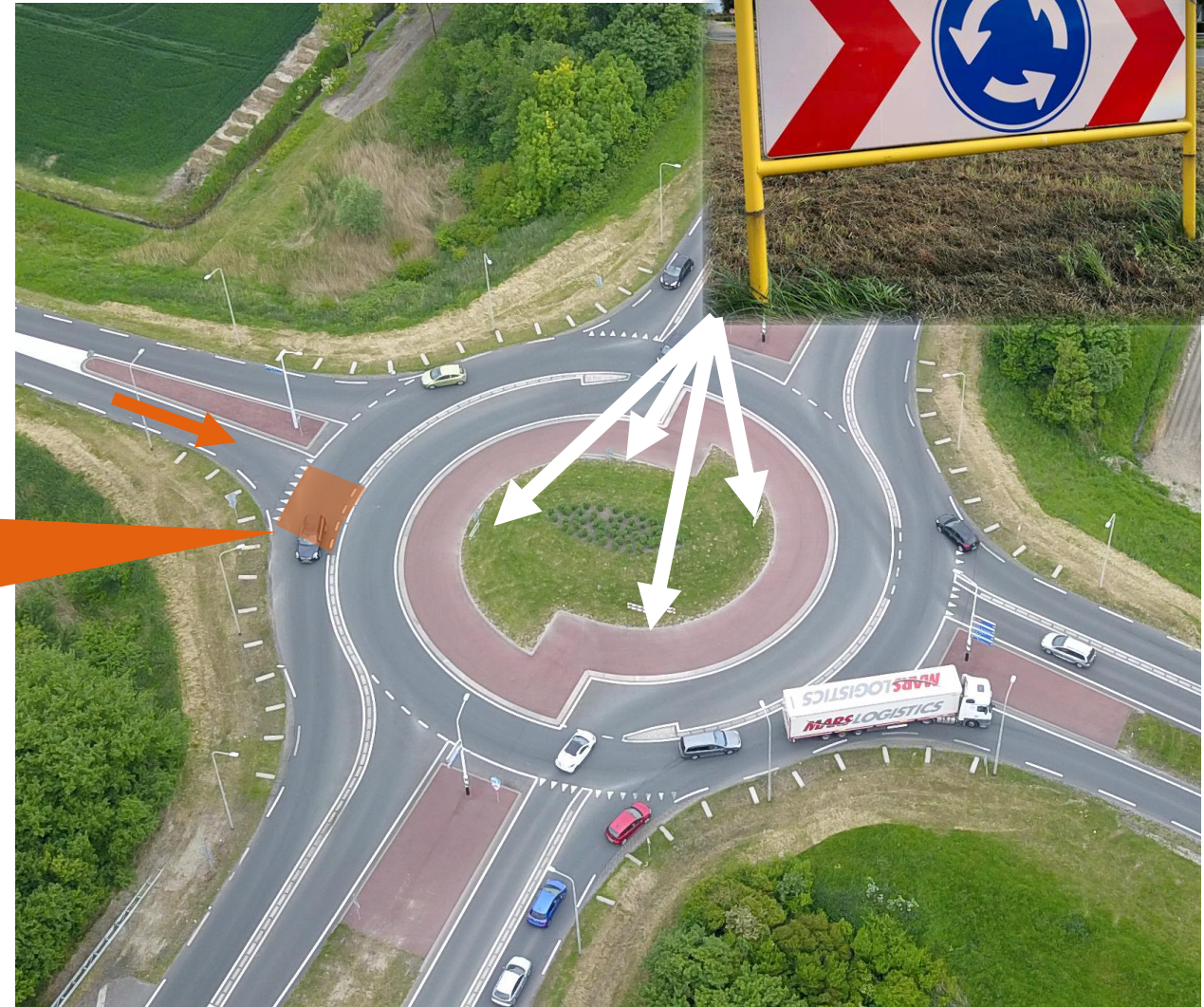
- Invented by Bertus Fortuijn in 1996
- Over 385 turbo roundabouts in the Netherlands
- 250 outside the Netherlands

Turbo Roundabouts in the Netherlands



Fortuijn's Design Philosophy

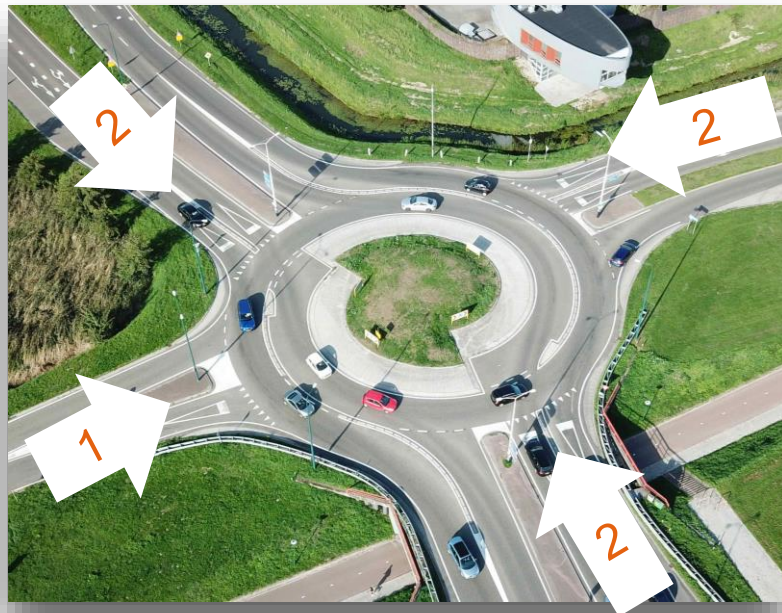
- A safe design by geometry
- Radial design results in:
 - Short crossing distance to middle lane of Turbo Roundabout
 - Small conflict area
 - Good sight lines (don't need to look over the shoulder)
- Low speeds on Turbo Roundabout and short crossing distance are also beneficial for capacity!
- Signage in front of driver important



Turbo Roundabout Aesthetics

Number of Entry Lanes

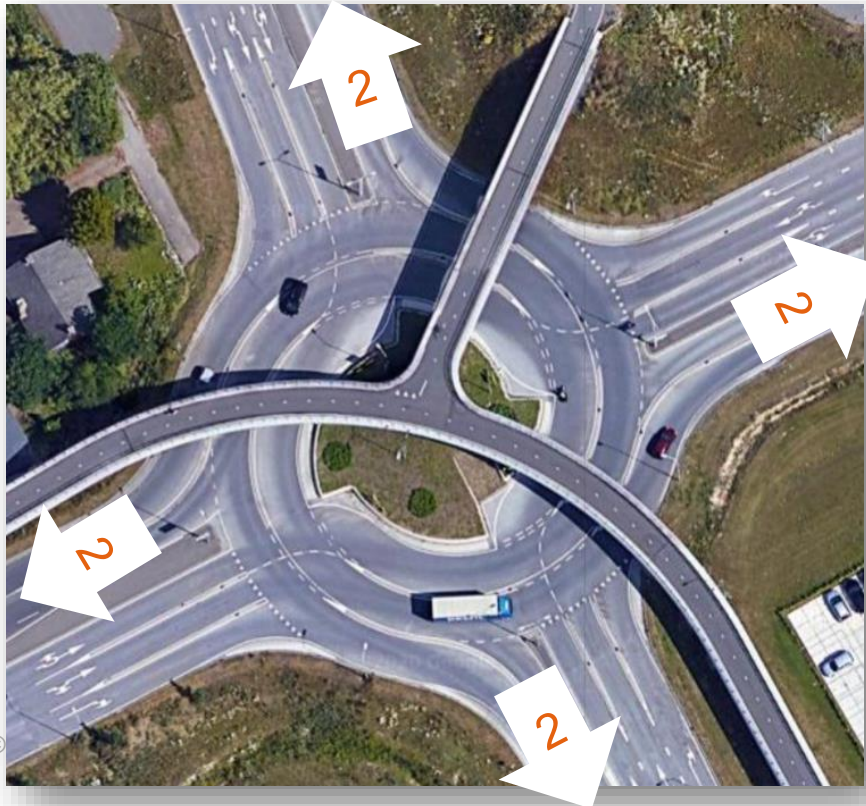
- One or two
- Or many (signalized)



Turbo Roundabout Aesthetics

Number of Exit Lanes

- One or two



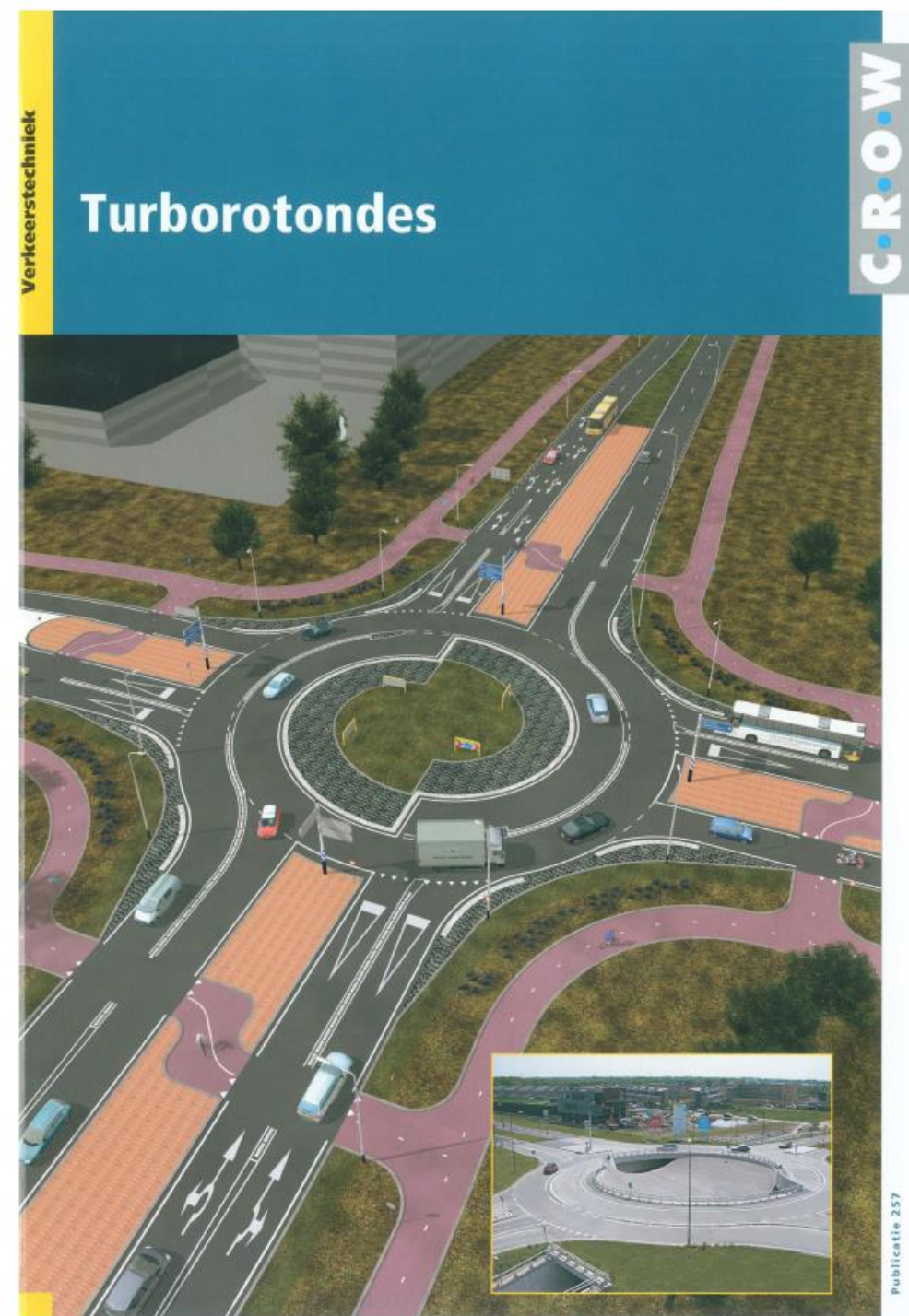
Let's take a drive



Design Elements

Design: Guide

- Design criteria incorporated in the Dutch national guideline for Turbo Roundabouts:
CROW publication 257
- Based on Fortuijn's design principles



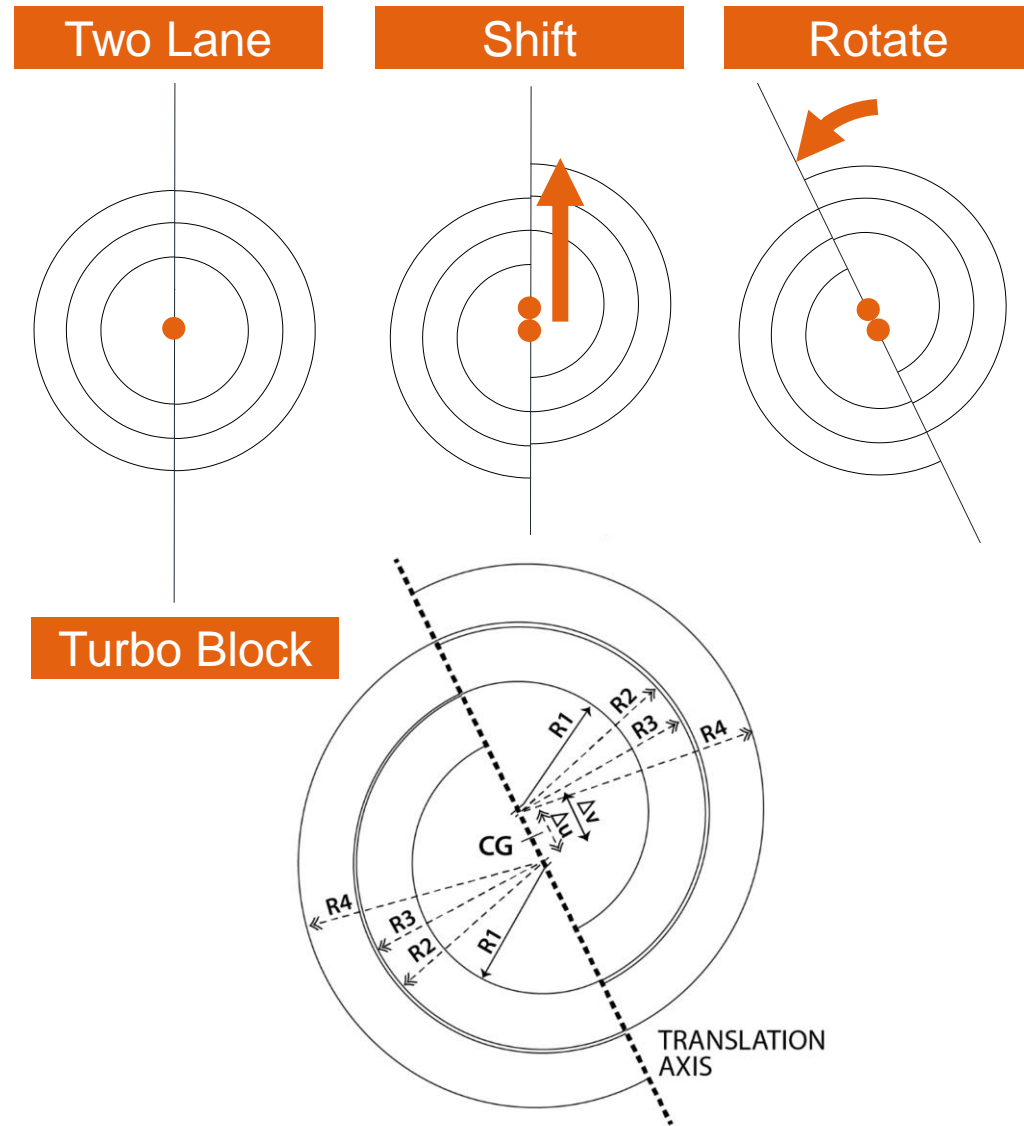
Design: Spiral Design

Create a spiral

1. Two lane roundabout
2. Shift center a lane
3. Rotate

Translation axis:

- Based on the major approaches
- Similar curvature all through traffic
- “Turbo-Block”



Design - Types

Types

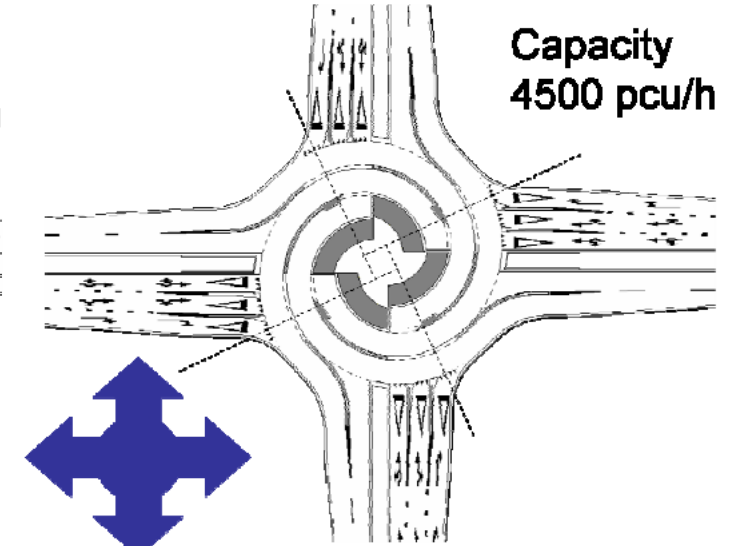
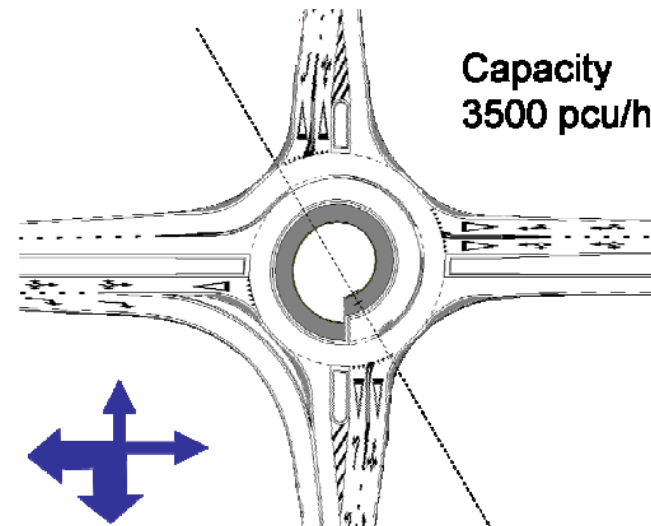
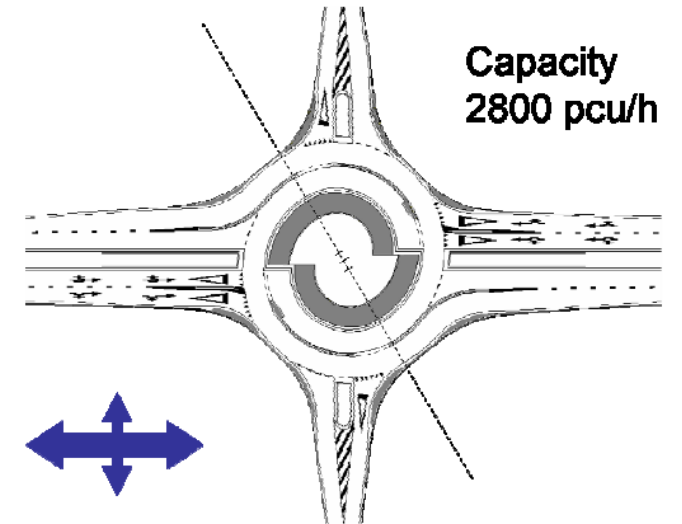
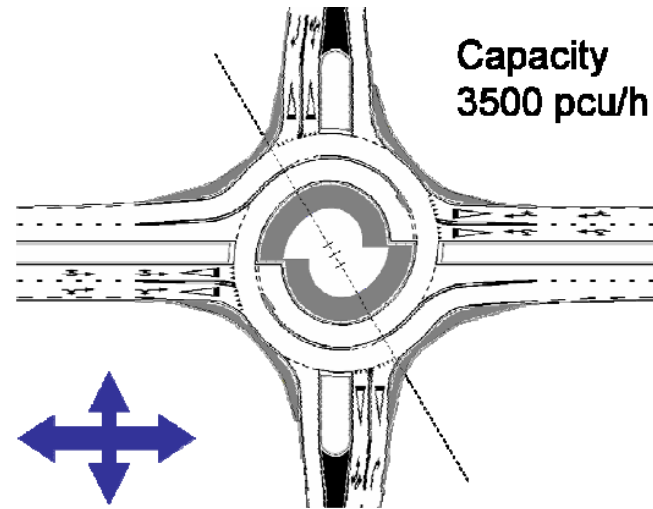
- Several standard shapes
- Variation in lanes
- Suitable for different locations

Size

- Small 155 ft diameter
- Standard 165 ft diameter
- Large 213 ft diameter

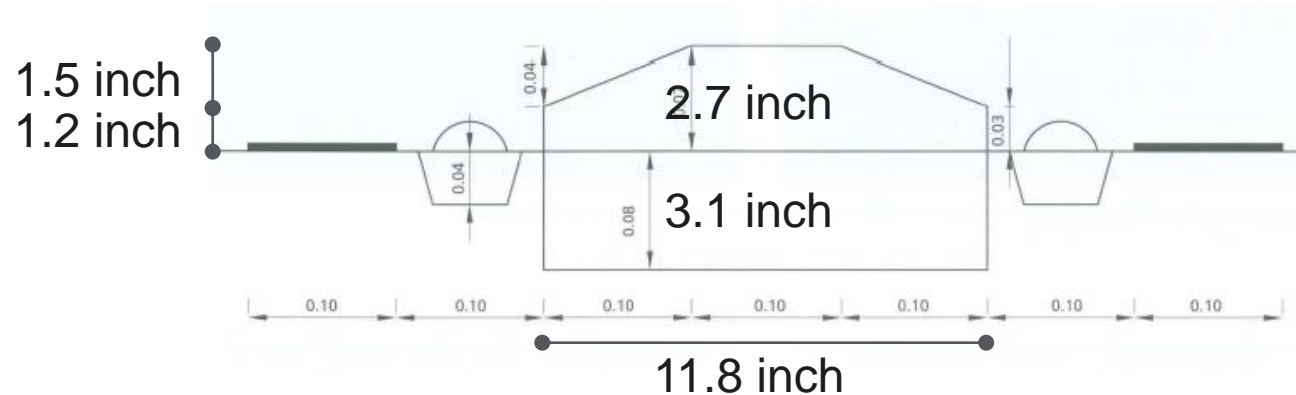
Speed

- Between 23-25 mph



Design: Lane Separation

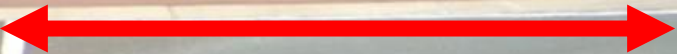
- Raised separation
- Discomfort high speed / 'comfort' low speed
- 2.7 inch height and 11.8 inch wide
- 3.1 inch in the pavement



Design: Opening Width



Keep it WIDE !!

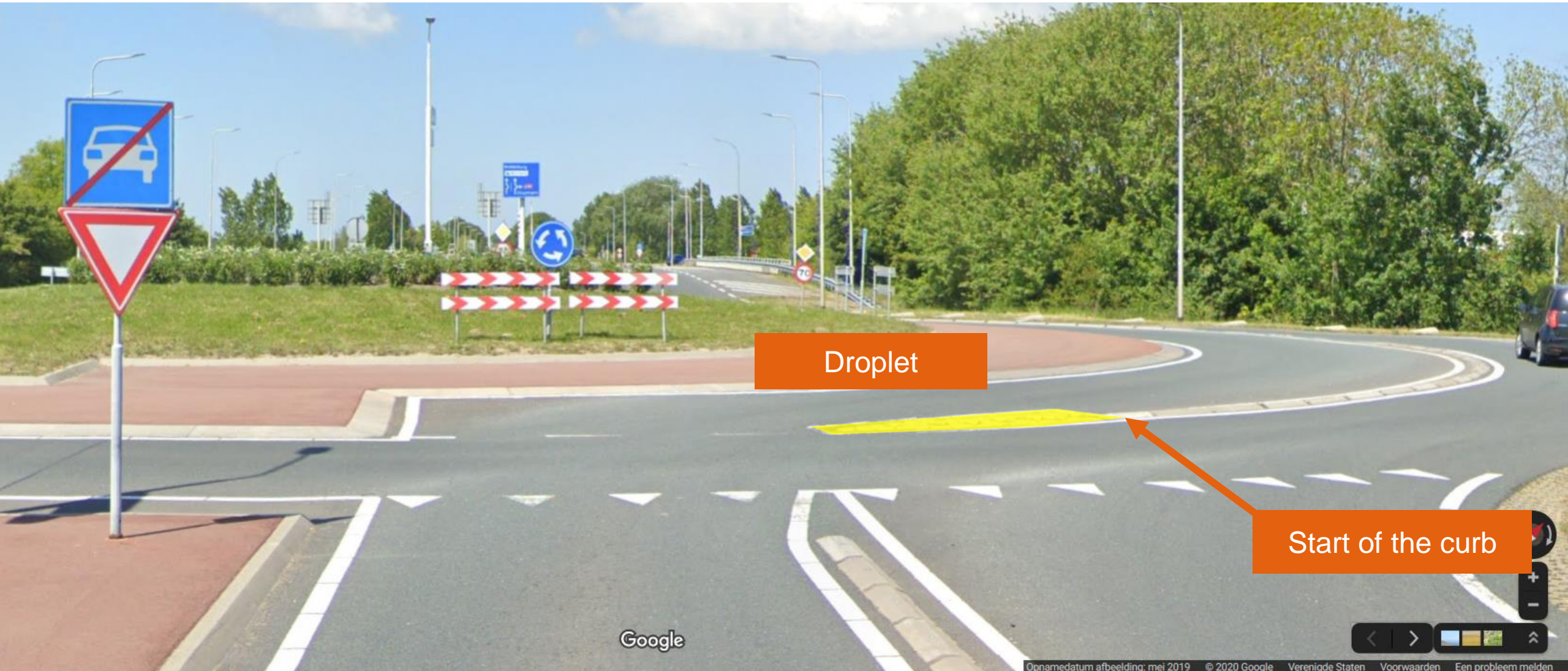


Google

Design: Opening Width



Design: Opening Width

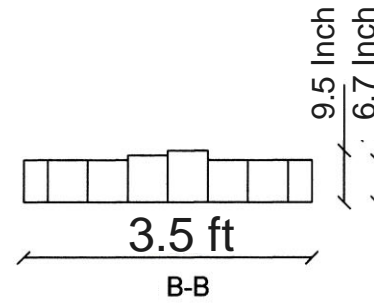
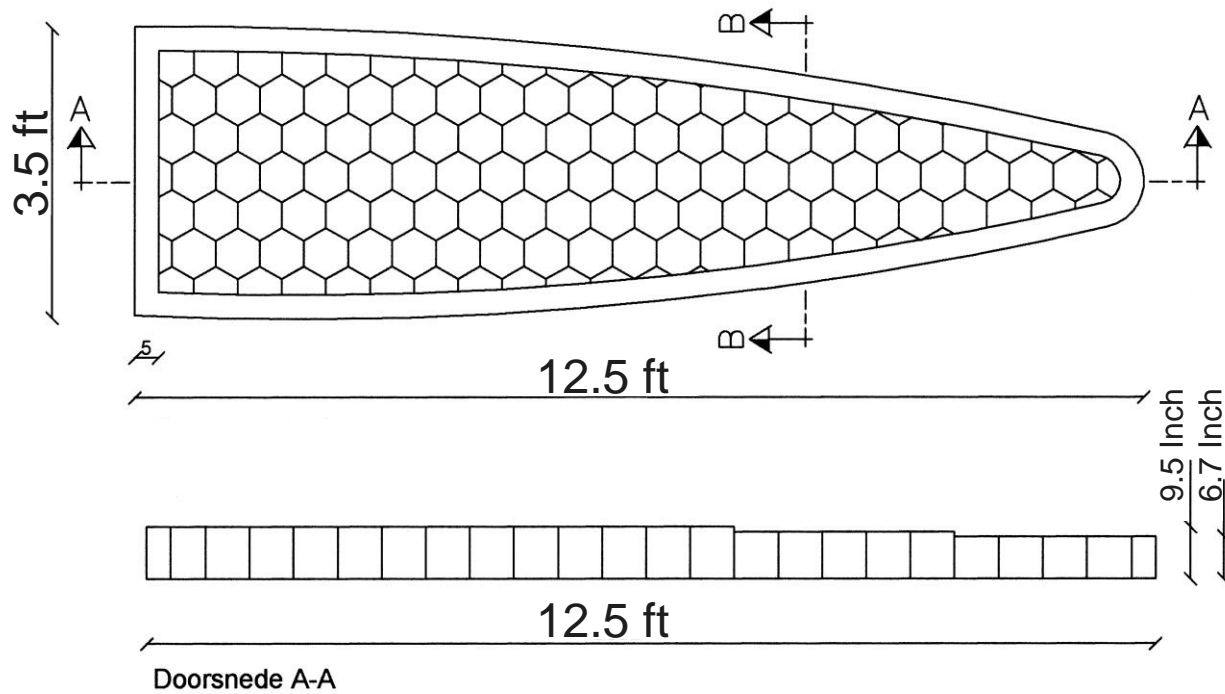


Droplet

Start of the curb

Google

Design: Droplet



Design: Marking and Signage

Upstream

- Clear directions with destinations
- If possible, above lanes
- Directions on pavement



On the roundabout

- No arrows on pavement
- Destination signs at exit



Design: Signalized

- Signalized Turbo Roundabouts
- High volumes
- Diameter 360 ft



Special Attention to Special Users

Bicyclists & Pedestrians



© CROW Guideline: turborotondes



Bicyclists & Pedestrians



Trucks

- Photo truck: 82.8 ft
- Roundabout: 190 ft
- Left Turn



Motorcycles

The raised lane separation not as forgivable for motorcycles as it is for cars.

- *Smaller change drivers unexpectedly make to change lanes is received very positive; This benefit outweighs the risk of hitting the raised lane separation*

Essential:

- Warning signs upstream of the turbo roundabout (50m / 150 ft)
- Repeat warning signs at center island
- Raised element not too high
- Use contrasting colors



Motorcycles



Verhoogde rijbaanscheiding

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Elevated Lane Separation



Traffic Flows

Traffic Flow

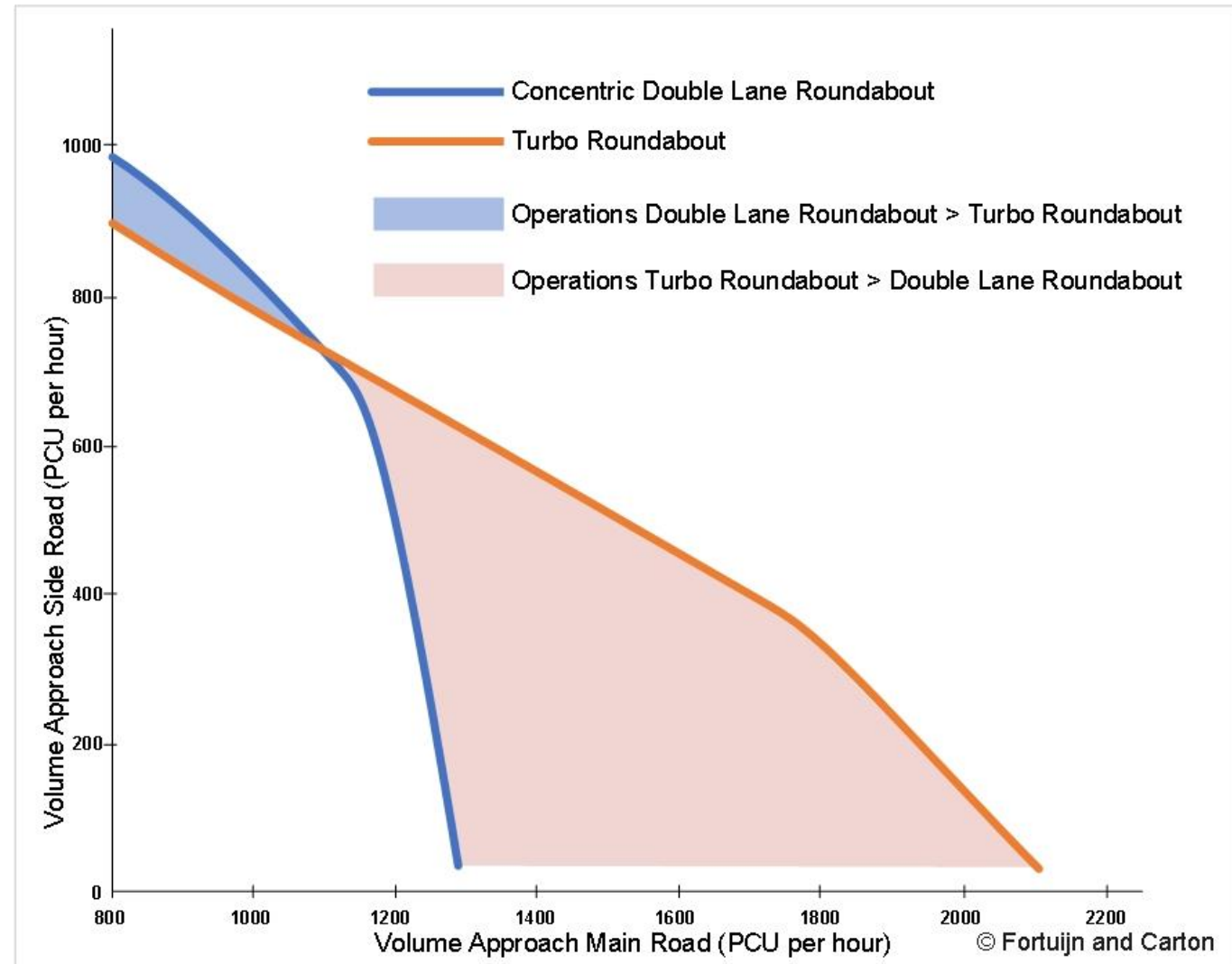
Capacity of intersection alternatives

Intersection Alternative		Practice Capacity	Theoretical Capacity
Single Lane Roundabout		2,000	2,700
Multi Lane Roundabout	2 entry + 1 exit	3,000	3,600
	2 entry + 2 exit	3,500	4,000
Turbo Basic Shape		3,500	3,800
Spiral Roundabout (Turbo)		4,000	4,300
Rotor Roundabout (Turbo)		4,500	5,000
Signalized Turbo Roundabout (360 ft)		8,500	11,000
Minor Road Stop/Yield with Left Turn		1,500	1,800
Traffic Signal	Entries 3'1 travel	3,500	4,000
	Entries 3'2 travel	7,500	8,000

Traffic Flow

Turbo Roundabout versus Standard Two-Lane Roundabout

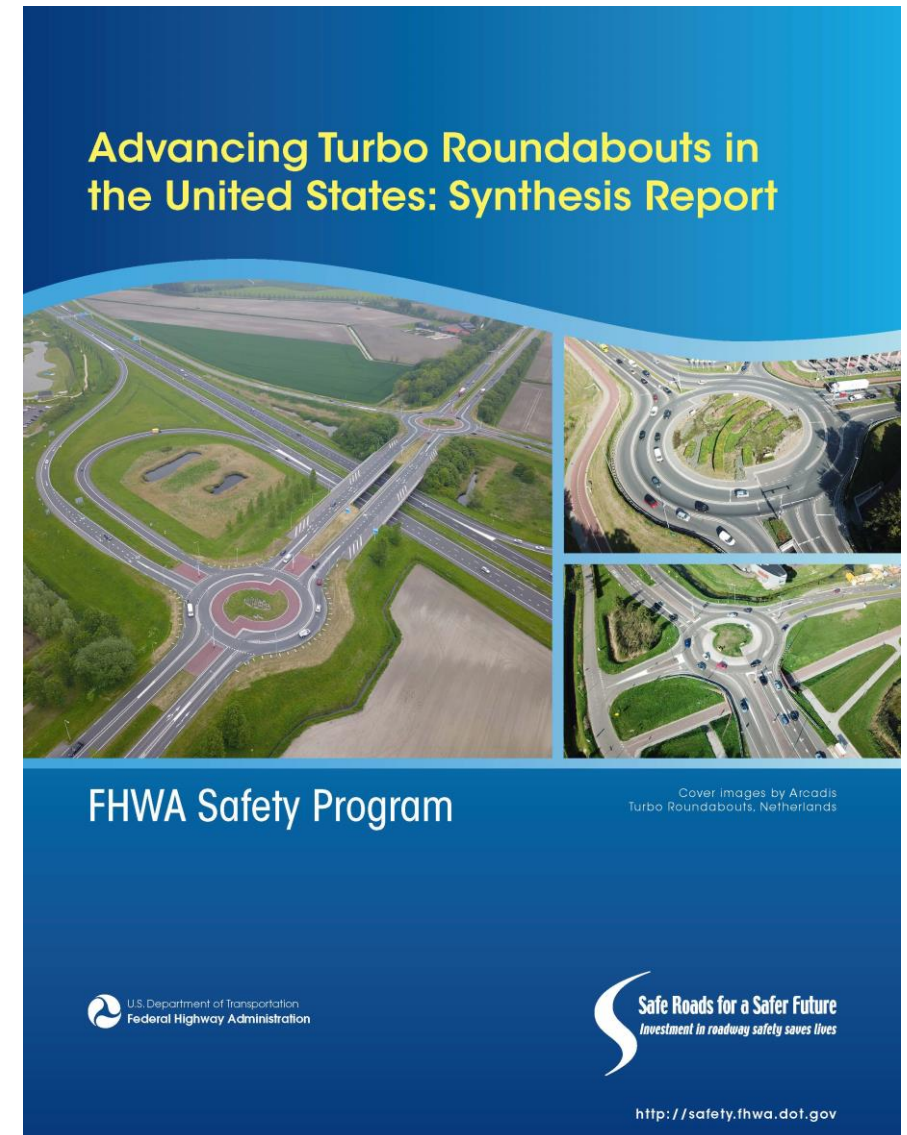
- Turbo Roundabout has higher capacity in situations where volume **main** road is larger than volume on **secondary** road
- Better lane utilization
- Traffic entering are less hesitant
- Radial approach



Bringing Turbo Roundabouts to the US

First Report

- Synthesis report available to download
- Pulls together turbo roundabout information from across the globe
- What elements need implemented in a turbo roundabout in the US?
 - We already see some spiral layouts
 - Next step: elevated lane separation
 - Lane choice upstream is important



U.S. Spiral Design

Turbo Block Case 3: WB-67 Side by Side

Diameter:

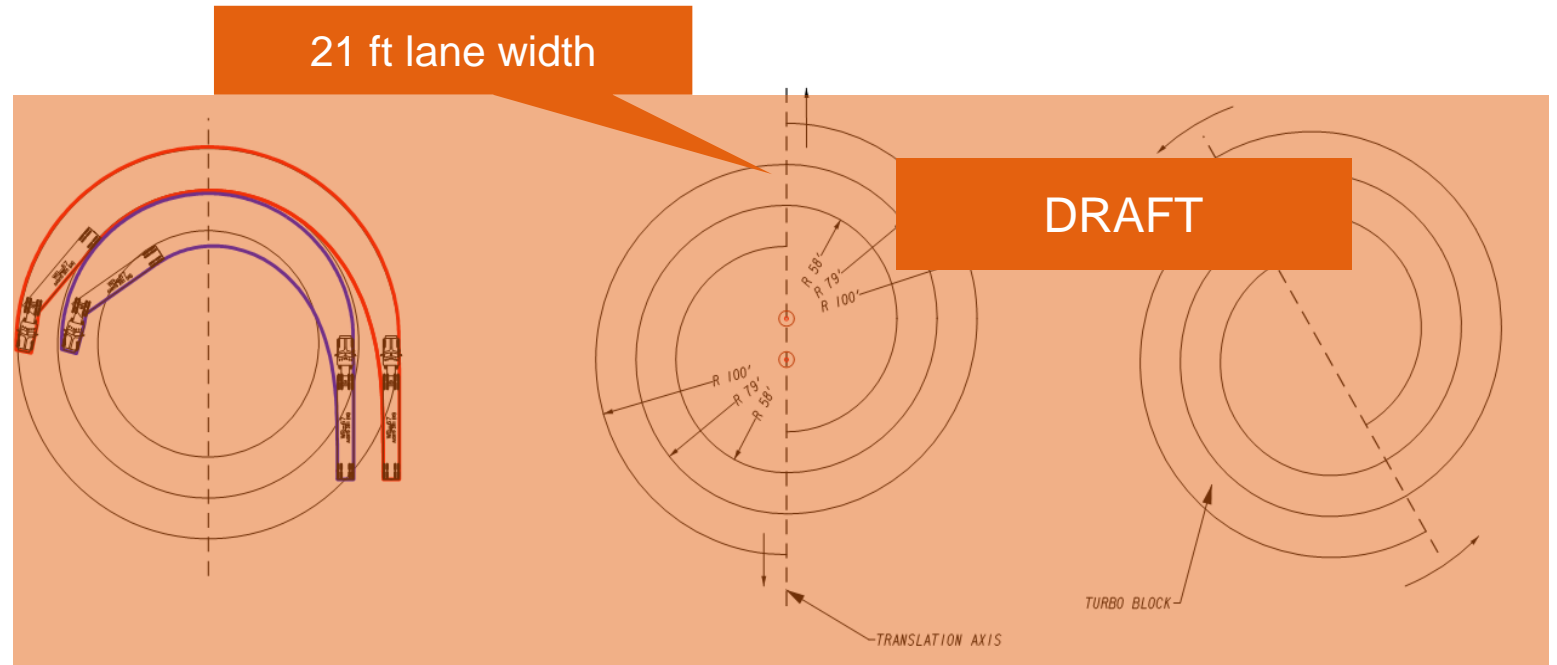
- Use WB-67 swept paths
- Side by side
- ICD 200-210 ft

Turbo Block not finished:

- 21ft lanes
- High Speeds

Solution: raised elements

- Trailer can override raised elements



U.S. Spiral Design

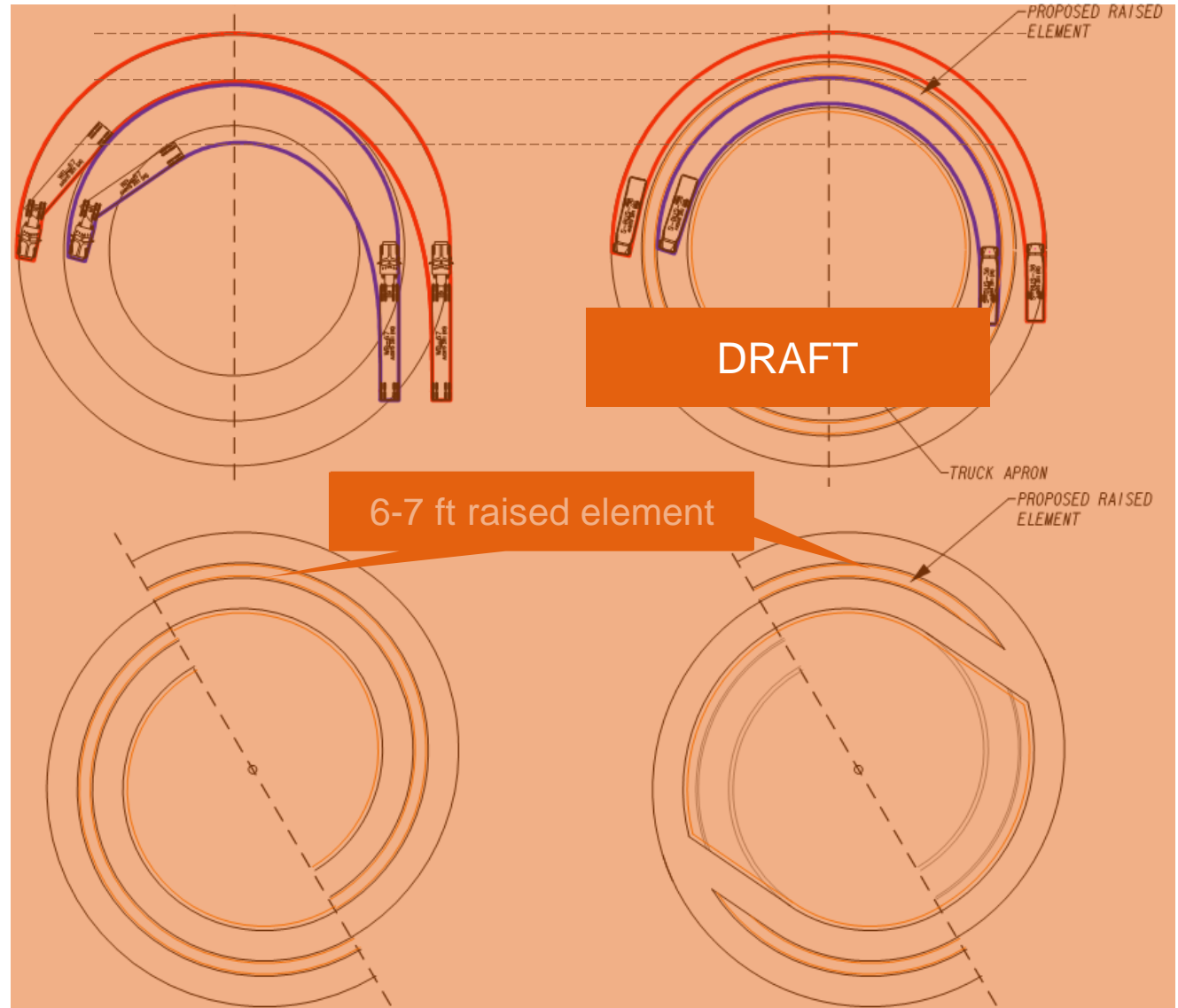
Turbo Block Case 3: WB-67 Side by Side

Raised Elements:

- Use same basic circle
- Use Bus / WB-40
- Align with outside of the lanes
- Difference can be filled with raised elements: 6-7 ft
- 14 feet lane width
- ICD 200-210 ft

WB-67 swept path

Bus swept path



U.S. Fastest Path Design

Raised elements impact fastest paths:

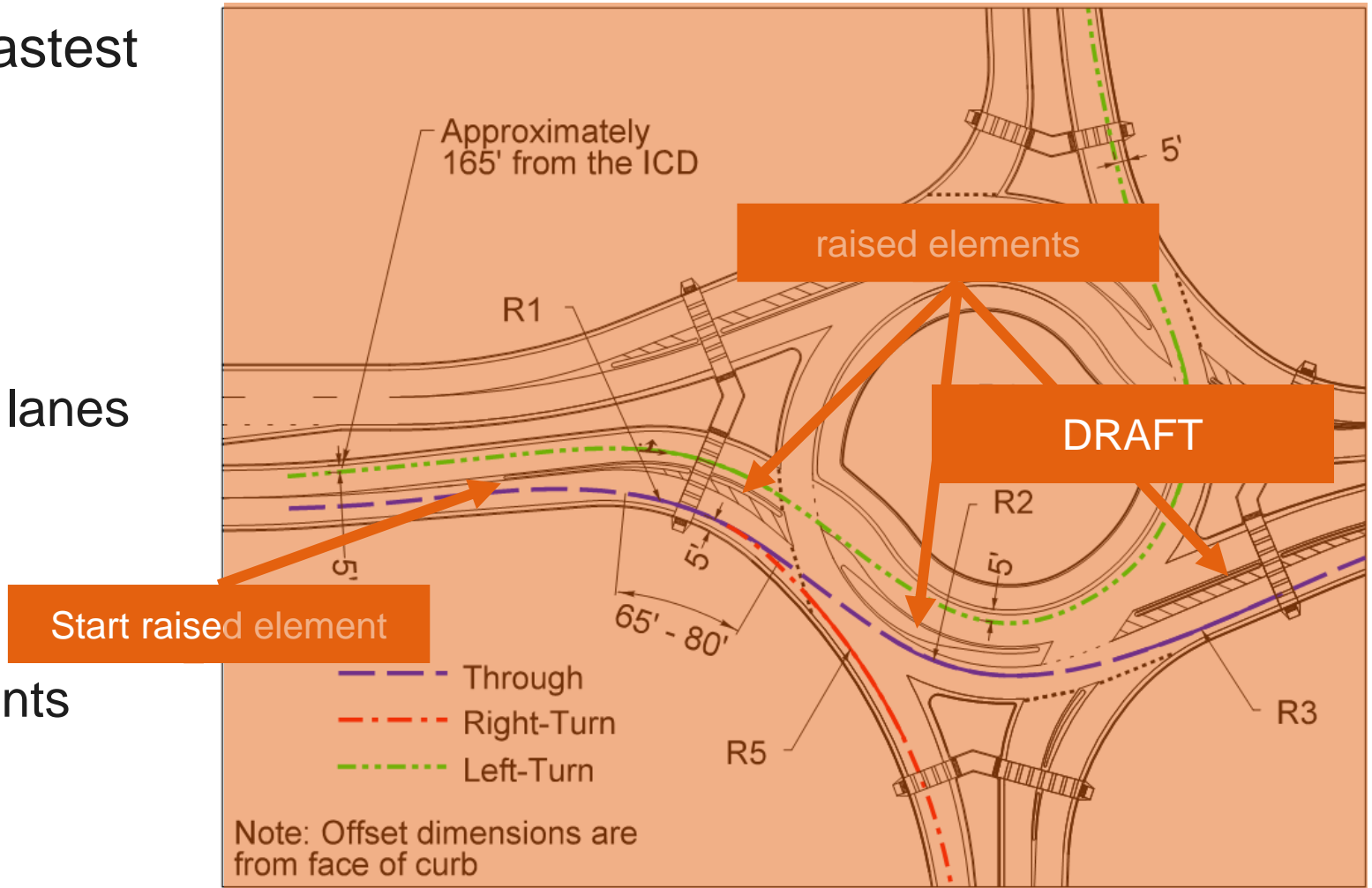
- Lower speeds

Start at approach:

- Vehicles cannot use both lanes

Speed reduction:

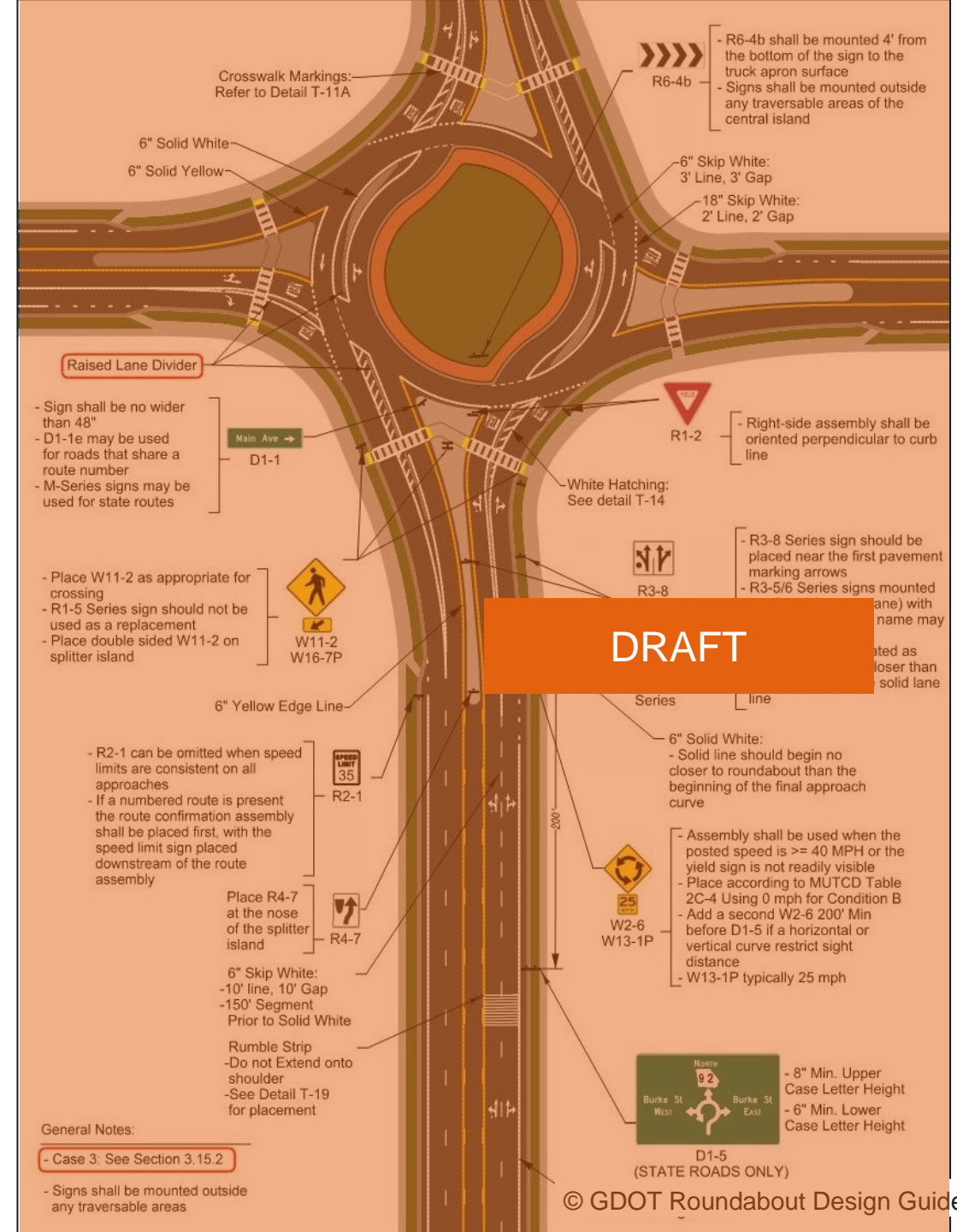
- 30 mph at multilane
- 22 mph with raised elements



U.S. Signing and Marking

Similar to traditional multilane roundabouts:

- Same signs
- Same arrow markings
- Same striping



Turbo Roundabout Implementation in US

Work in progress:

- Minor adjustments to fit US design vehicles
- Adjustments to preferences agencies
 - Radial or tangent designs
 - Design should fit in driver expectation

Steps to take:

- Introduction / understanding of the concept by public
- Start with a simple test case turbo roundabout
- Monitor / evaluate driving behavior, safety & operations
- Calibration / validation of US driving behavior

Questions & Discussion



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