Technology Transfer of Turbo Roundabouts - Review from Europe

Two lane roundabout design
Video of operations in Spanish Fork showing lane inclusion.
Safety issue of two lane sideswipe
Scanning tour in March 2017
Factors that would change design
  Approach angle
  Striping and signage
  Lane separation tactile
  Diameter
TURBO ROUNDABOUTS
NETHERLANDS
GOALS

• Investigate Multi-Lane Roundabouts to address overlap and weaving and therefore Collisions
ROUNDABOUT DESIGN CONSIDERATIONS

1. Good Speed Control
2. Proper Deflection
3. Intuitive User Path
PATH OVERLAP

Video
MULTI-LANE ROUNDABOUT COLLISIONS

• Failure to Yield
• Conflict point crossings for exits
• Changing lanes
• Poor positioning on entry
DESIGN FACTORS TO MINIMIZE COLLISION

• Striping
• Lane Width
• Exit geometry
• Yield Lines

• If striping doesn’t work, why not channelize
Figure 42: Improper lane use at multi lane roundabouts [12]
WHY TURBO?

**Failure to Yield**

Entering a roundabout is similar to an intersection between two one-way roads, where the road from the left continues out of the roundabout. To proceed into the roundabout, entering drivers must yield to all traffic from the left, waiting until all traffic from the left is clear.

Unlike a traffic circle, drivers are not permitted to enter alongside vehicles circulating in the left lane, because those circulating vehicles are allowed to exit the roundabout.

Extra signs mounted below the yield signs remind drivers to yield to both lanes. Never enter unless all traffic from the left is clear.

**Improper Lane Use**

As with any other intersection, the proper lane must be chosen before entering a roundabout. Signs in advance of the intersection will always indicate which lanes may be used to turn or to continue ahead. As with any other intersection, keep left to turn left through the roundabout, and keep right to turn right. Never change lanes within an intersection, including within roundabouts.

At Radio Drive and Bailey Road, lane use signs require that drivers turning left must use only the left (inside) lane, preventing the type of crash shown below.

In this type of crash, Vehicle 1 is at fault for failing to obey the lane use signs and choosing the incorrect lane. Drivers wishing to turn left must be in the left (inside) lane before entering the roundabout.

Drivers in the outside (right) lane are not allowed to turn left, they are required to exit the roundabout. Drivers in the left lane may exit or turn left.

Multiple signs and pavement markings on every approach remind drivers of the need to choose the proper lane. Failure to use the proper lane can result in a traffic ticket or a crash.
Side Swipe Collisions

Pictures from Presentation of Dr.-Ing. Lothar Bondzio on internet
SOLUTION:
LANE-DIVIDERS
Figure 46: Standard layout of a turbo roundabout
Characteristics

1 Turbo roundabout has more than one lane in the circle
2 Correct lane to be chosen before entering the turbo
Characteristics

3 Give way to traffic on maximum two lanes
Characteristics

4 No more weaving or cutting on turbo roundabout
Characteristics

5 Leaving the turbo roundabout via previous chosen lane
With less conflicts

<table>
<thead>
<tr>
<th></th>
<th>Conflicts</th>
<th>Weaving</th>
<th>Cutting</th>
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<td>Multi lane (1)</td>
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idabouts | 29 March 2017

Royal HaskoningDHV
## With more safety (2008)

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<thead>
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<th>From</th>
<th>To</th>
<th>Injury accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction give way</td>
<td>Single lane roundabout</td>
<td>-70%</td>
</tr>
<tr>
<td>Junction give way</td>
<td>Turbo roundabout</td>
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<tr>
<td>Single lane roundabout</td>
<td>Turbo roundabout</td>
<td>+20%</td>
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<tr>
<td>Multi lane roundabout</td>
<td>Turbo roundabout</td>
<td>-53%</td>
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<tr>
<td>Junction wit traffic lights</td>
<td>Turbo roundabout</td>
<td>-50%</td>
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</table>
Important design elements
Drive over elements for big vehicles
TOUR NEAR ROTTERDAM
Locations turbo roundabouts

Total in NL: 324 (March 2017)

www.turborotonde.nl

The Netherlands:

- Turboverkeersplein
- Turborotonde
- Turbokluifrotonde
- Sterrotonde
- Spiraalrotonde
- Rotorrotonde
- Partiële turborotonde
- Ovonde
- Look-a-like
- Knierotonde
- Ei-rotonde
INTERCHANGE TERMINAL TURBO (NED)
RAISED LANE DIVIDER
DETAIL: RAISED MOUNTABLE LANE DIVIDER

Original

Changed for snow plowing and low-loaders
EXIT LANE DIVIDER

Fortuijn
TRUCK TRAVERSING LANE DIVIDER

Fortuijn
INDUSTRIAL VIDEO
CANAL VIDEO
TURBO-ROUNDABOUT CHECKLIST:

✓ At least one entry has a second lane inserted on the central island side;

✓ Mountable-raised lane dividers control traffic path and speed by keeping vehicles in their lane with smaller roundabout ICD;

✓ Traffic must choose the appropriate lane for the desired turning movement prior to entering the roundabout; and

✓ Spiral road markings guide traffic from inside to outside, avoiding weaving and reducing conflicts in the roundabout.
SEPARATED CYCLE TRACK AND PEDESTRIANS
WINTER OPERATIONS
DRIVERS USING TURBOS

- Driver’s opinion: In driver’s opinion, this type of roundabout is very safe due to the reasons:
  - driver is all the time in his “own“ lane,
  - there is no weaving in circulatory roadway,
  - it is always clear who have the priority,
  - no fears and doubt when driving in inner circulatory roadway,
  - lower speed compare to “standard” multi-line roundabouts,
  - signposts and road markings are easily understood and unmistakable.
FLUSH DIVIDERS

Lithuania and Canada: with milled noise strips; no traffic safety data
CAPACITY

The turbo roundabout has a larger capacity, compared to the ”typical” two-lane roundabout. Because:

• *the inner circulatory traffic lane becomes more attractive to drivers, since there is no need for weaving – lane utilization is equal;*

• *Entering drivers are no longer hesitant which increases the capacity of entries.*
CAPACITY DIFFERENCES

Legenda:
- Groene lijn: Turborotonde
- Gele lijn: Concentrische dubbelstrooksrotonde
- Rode lijn: Enkelstrooksrotonde
The Turbo Roundabout design elements provide more capacity than a 2-lane Roundabout;
The Lane Divider means fewer conflict points, and therefore should have a better safety performance, than a 2-Lane Roundabout;
A Raised Mountable Lane Divider may have issues with snow plows.
FASTEST PATH – WITH AND W/O RAISED LANE MARKERS

32 to 35mph Fast-path per NCHRP 672

R1 DETERMINED BASED ON ACCELERATION

R2

R1

R3 DETERMINED BASE ACCELERATION

HORNE
WHAT DOES TURBO ADDRESS???

Fastest Path??
So good Speed Control with tactile channelizing
Proper Deflection on Entry??
Turbo approach is about awareness prior to the roundabout through signage, striping and the actual center island
Intuitive path??
The channelizing directs traffic and replaces striping pathway direction with actual pathways
Foot Print??
150’ versus 180’ ICD
Lower Entry ROW because of less deflection
Normal roundabout (United Kingdom)  Compact roundabout (United Kingdom)

Figure 22: Types of roundabouts in the United Kingdom [7]