BRINGING THE TURBO ROUNDABOUT TO THE USA

WELCOME
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WELKOM
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What next?
Turbo Roundabout Basics
Turbo Roundabout Basics

Turbo Roundabout characteristics:

• No lane changing on the Turbo Roundabout
• Lane choice upstream Turbo Roundabout
• Spiral layout
• Radial approaches

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Let’s take a drive
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?

- **Challenge:** design a layout which eliminates the safety conflicts and increases capacity

- **Result:** spiral shaped Turbo Roundabout without lane changing on the roundabout

- **Why the name Turbo Roundabout?** Refers to the improved traffic flow (compared to a standard multilane roundabout)
Why Turbo Roundabouts?

- Turbo Roundabout reduces the number of conflict points
- Weaving and cutting conflicts are eliminated
- 2016 study by Christiaan Vos
  - 53% reduction in crashes
  - Multilane roundabout to turbo roundabout

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From multilane roundabout to turbo roundabout

<table>
<thead>
<tr>
<th></th>
<th>3 jaar VOOR</th>
<th>3 jaar NA</th>
<th>Totaal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type kruispuntvorm</td>
<td>Tweestrooms / meerstrooks rotonde</td>
<td>Turbo-vorm</td>
<td></td>
</tr>
<tr>
<td>Slachtsoffers ongevallen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aantal rotondes in selectie</td>
<td>Ni</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Aantal Slachtsoffers ongevallen</td>
<td>Oi</td>
<td>17</td>
<td>8</td>
</tr>
</tbody>
</table>
History of Turbo Roundabout
History of Turbo Roundabout

• Over 300 turbo roundabouts in the Netherlands
• Invented by Bertus Fortuijn in 1996
Design
Design

- Design criteria incorporated in the Dutch national guideline for Turbo Roundabouts:
- CROW publication 257
Design

Number of entry lanes

- 1, 2 or 3 entry lanes is common
- Some with up to 7 lanes
Design

Number of exit lanes

- One or two
Design

Radial Design

- Smaller crossing than most in the US
- Signage in front of driver is important
- Use on low speed and high speed approaches
Traffic safety

Design philosophy:

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

Bypass
Design

Lane separation

- Elevated separation
Design

Marking

Figuur 109. Als tegenover de toerit een nieuwe binnenste rijstrook ont- springt, begint de belijning van het over rijbare gedeelte tussen de rij- stroken bij de verkeersdruppel [N472 Bergharenhoek]

Figuur 110. Als het verkeer een reeds gekozen rijstrook moet volgen, wordt een combinatie van een doorgetrokken en een onderbroken streep toegepast [N218 Oostvoorne]

Figuur 111. Belijning vóór de rotonde, langs de rijsturookscheiding [N218 Oostvoorne]

Figuur 112. Belijning op de rotonde, aan beide zijden van elke rijstrook [Heerlen Imstenradenweg – N281]
Bikes and Peds
Design

Size

- Dependent on:
  - Number of lanes
  - Design vehicle
- Single lane: ~120-feet
- Two lane: ~170-feet
- Typically design speeds between 20 and 25-mph
Trucks
Trucks

• Typical Dutch truck ~WB-50
• WB-62 truck through a Dutch roundabout (165’ diameter)
  • WB-40 works well
  • WB-62 requires a slightly larger diameter (180’)

[Images of WB-62 and WB-40 trucks through a roundabout]
Trucks

• Different type of material for trucks

• Cars stay off
## Traffic flow

### Capacity of intersection alternatives

<table>
<thead>
<tr>
<th>Intersection Type</th>
<th>Theoretical Capacity (sum of all approaches)</th>
<th>Entering and conflicting volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-lane roundabout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-lane roundabout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbo Roundabout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Signalized) intersections</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Theoretical capacity

Theoretical capacity is calculated as the sum of all approaches. It is given in movements per hour (mvt/h) up to 10% of the theoretical capacity of the intersection.

### Entering and conflicting volumes

Entering and conflicting volumes are given in passenger cars per hour (pae/h).

<table>
<thead>
<tr>
<th>Intersection Type</th>
<th>Theoretical Capacity (sum of all approaches)</th>
<th>Entering and conflicting volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enkelstrookstroonde</td>
<td>2,000</td>
<td>1,100 - 1,500</td>
</tr>
<tr>
<td>Twee strookstroonde met eenstrokes-afritten</td>
<td>2,200</td>
<td>1,500 - 1,800</td>
</tr>
<tr>
<td>Twee strookstroonde met twee strookstroiten en eenstrokes-afritten</td>
<td>3,000</td>
<td>1,800 - 2,000</td>
</tr>
<tr>
<td>Twee strookstroonde met twee strookstroiten en -afritten</td>
<td>3,600</td>
<td>2,100 - 2,400</td>
</tr>
<tr>
<td>Turboronde basisvorm (zie figuur 12)</td>
<td>3,500</td>
<td>1,900 - 2,100</td>
</tr>
<tr>
<td>Spiraalstroonte (zie figuur 12)</td>
<td>4,000</td>
<td>2,000 - 2,300</td>
</tr>
<tr>
<td>Rotorstroonde (driestrokes stroiten, tweestrokes-afritten, zie figuur 12)</td>
<td>4,500</td>
<td>2,500 - 2,800</td>
</tr>
<tr>
<td>Turboverkeersplein (per toevervakt 3 x 2 rijstroken, zie hoofdstuk 7)</td>
<td>8,500</td>
<td>4,200</td>
</tr>
<tr>
<td>Voorrangskruispunt (met eventueel linksafvachten)</td>
<td>1,500</td>
<td>1,100</td>
</tr>
<tr>
<td>Vierlaaks kruispunt met VR (per toevervakt 3 x 1 rijstrook)</td>
<td>3,500</td>
<td>3,800</td>
</tr>
<tr>
<td>Vierlaaks kruispunt met VR (per toevervakt 3 x 2 rijstroken)</td>
<td>7,500</td>
<td>3,800</td>
</tr>
</tbody>
</table>
Traffic flow

Comparison:

Turbo roundabout vs Two-lane roundabout

• Turbo Roundabout has higher capacity in situations where volume on main road is larger than volume on secondary road.
Turbo Roundabout Implementation in US

Steps for implementing in the US:

• Minor adjustments to fit US design vehicles
• Calibration and validation of US driving behavior (calculation sheet and simulation)
• Look at specific conditions (snow plowing, etc.)
• Introduction of the concept: understanding of the concept by the drivers
• Monitoring and evaluation of driving behavior, traffic safety and traffic flow (capacity)
• Start with a simple turbo roundabout
The Future of Turbo Roundabouts in the US

- FHWA Advancing Turbo Roundabouts in the US project
- FHWA Multi-Lane Roundabout Crash Pooled Fund project
- Florida DOT Turbo Roundabout project
FHWA Advancing Turbo Roundabouts in the US

• Literature and Synthesis of Practice
• Design Guidance Translation
• Exploration of Transferability to US
  - Trucks
  - Raised Channelization
  - Approach Alignment (lack of deflection)
‘Turbo Roundabout’ coming to Arlington intersection

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Roundabout Projects to Watch

NCHRP 03-130, Guide for Roundabouts

FHWA Pooled Fund Study – Drivers Failing to Yield at Multi-Lane Roundabout Exits
https://www.pooledfund.org/Details/Study/634

NCHRP 17-70, Development of Roundabout Crash Prediction Models and Methods

Roundabout and Channelized Turn Lane Accessibility Workshops
http://intersectionaccess.org/websites/43