EWGT 2013
Porto, Portugal 4-6 September

FCTUC DEPARTAMENTO DE ENGENHARIA CIVIL
FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE DE COIMBRA

Moving from Conventional Roundabouts to Turbo-Roundabouts

EWGT 2013, 16TH MEETING OF THE EURO WORKING GROUP ON TRANSPORTATION, PORTO

SEPTEMBER, 4TH

Ana Bastos Silva
abastos@dec.uc.pt

Luís Vasconcelos
vasconcelos@estv.ipv.pt

Sílvia Santos
silviasantos@dec.uc.pt

Background

Conventional roundabouts are excellent solutions for:

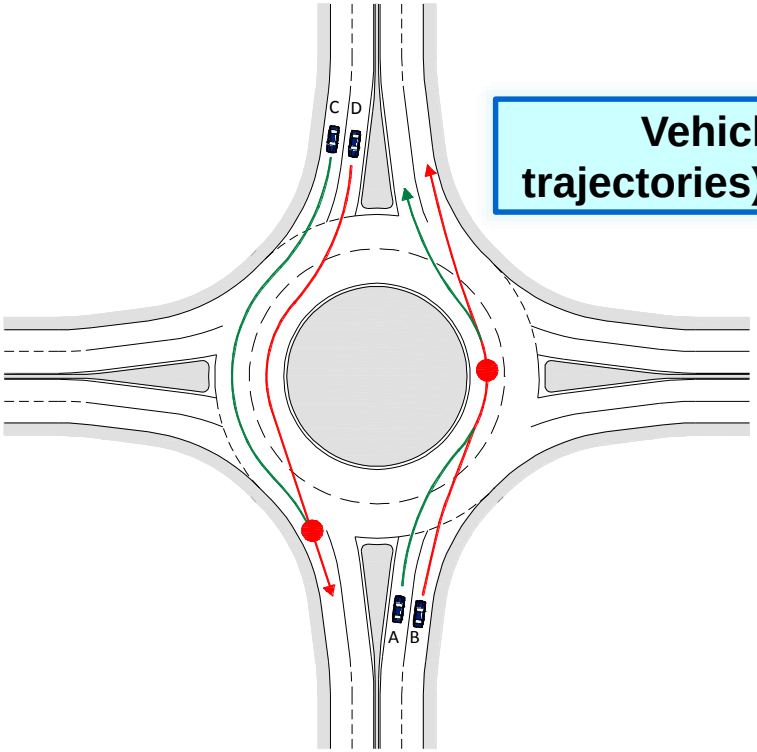
- Traffic regulation;
- Traffic calming;
- Urban regeneration and landscaping;
- Etc…

However, the international experience over the last years has been showing some functional problems in multilane-lane roundabouts:

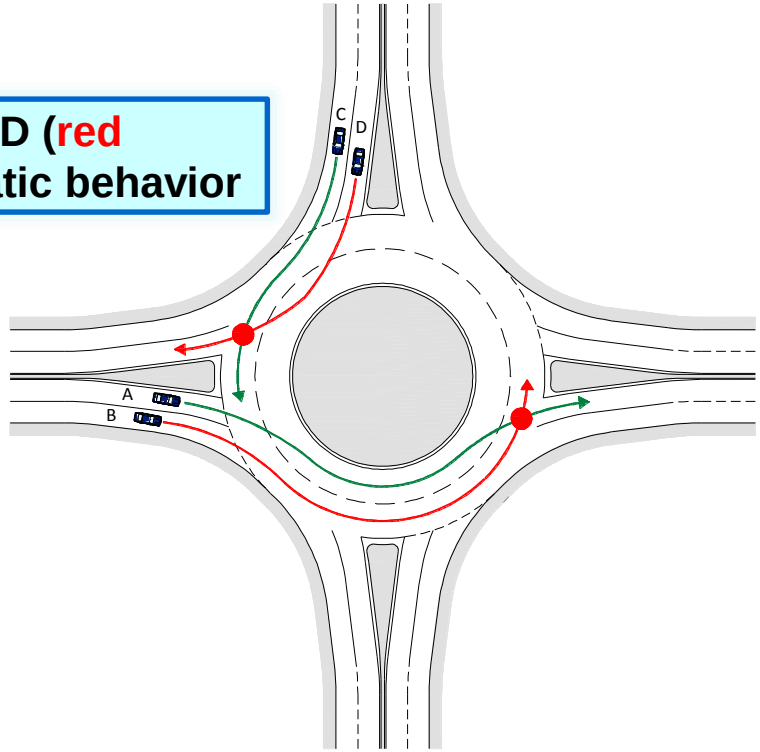
- Lane changing on the roundabout disregarding lane markings;
- Invasion of adjacent lanes;
- High speeds on the carriageway.

Operational problems with conventional roundabouts

- The main problem happens in conventional double-lane roundabouts;
- Incorrect driver behavior is a common practice, resulting in conflicts and increasing the number of accidents.

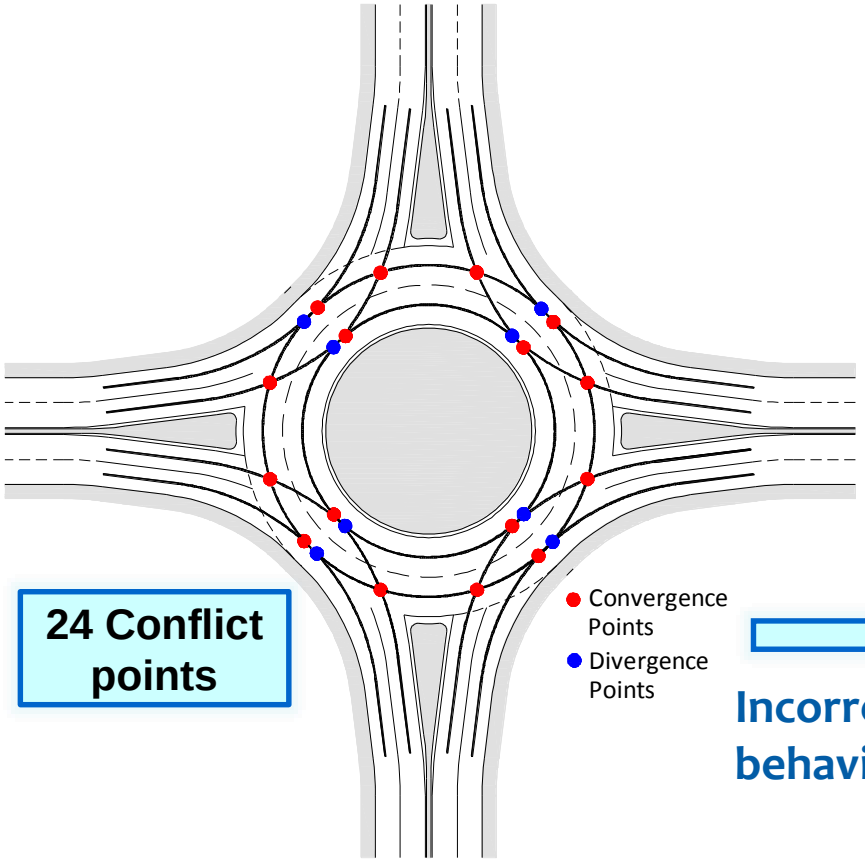


Vehicles B and D (red trajectories) with erratic behavior

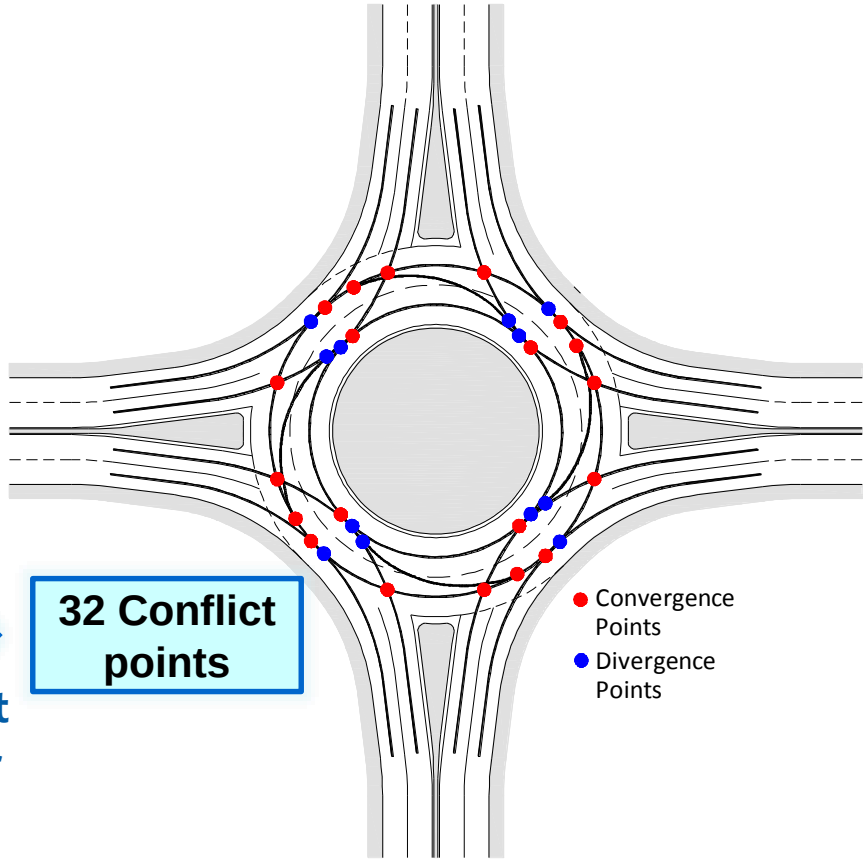


Operational problems with conventional roundabouts

- There are 8 conflict points in a single-lane roundabout and 24 in a double-lane roundabout. However, this number can rise to 32 if we consider incorrect behavior.



Incorrect behavior



Turbo-roundabout: the concept

- The turbo-roundabout concept was developed in the Netherlands in 1996 .
- The first turbo-roundabout was installed in 2000, also in the Netherlands;
- Nowadays, more than 190 turbo-roundabouts are in operation in the Netherlands and some design guidelines have been published. The government doesn't allow the construction of conventional multi-lane roundabouts.

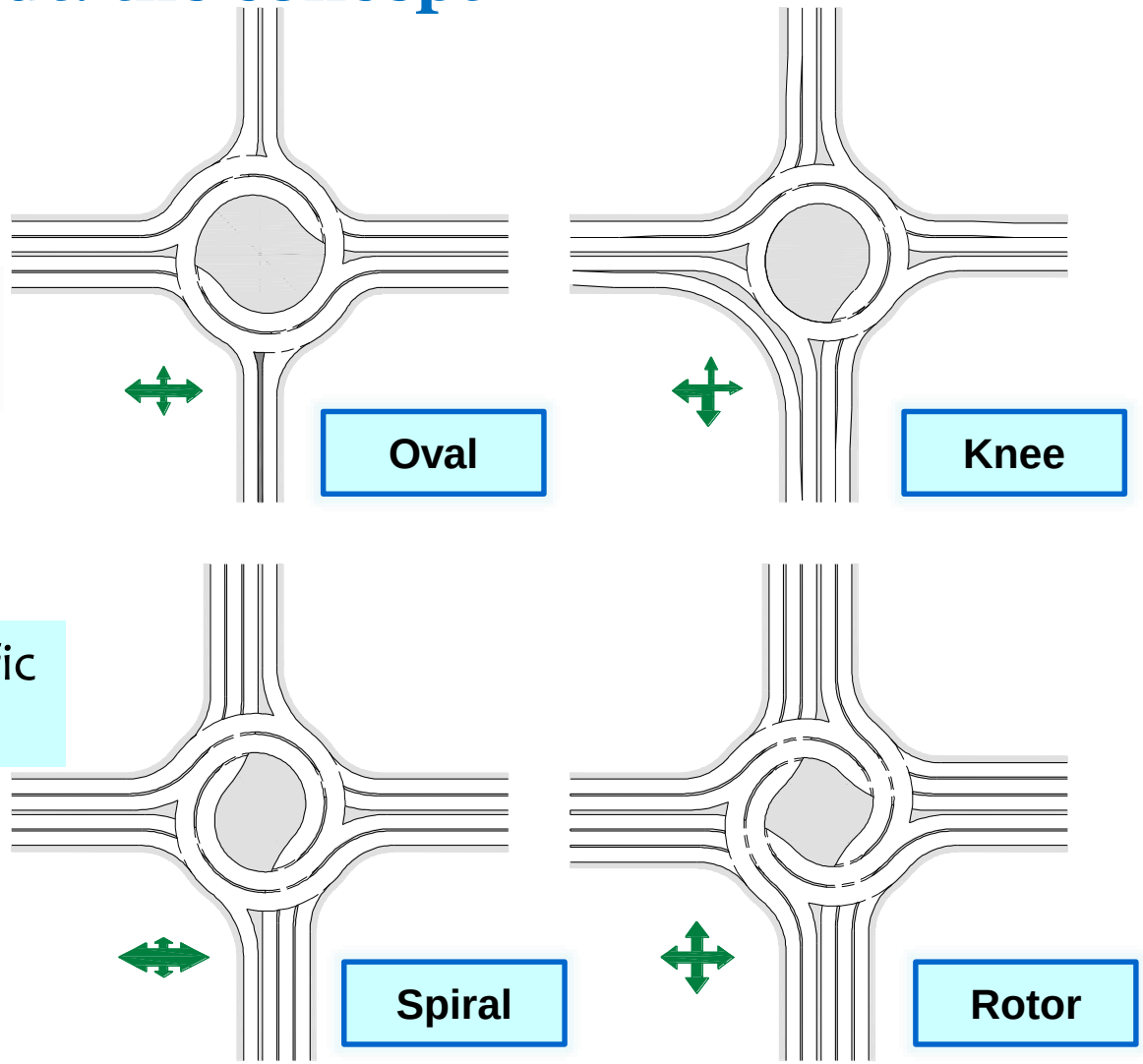
Turbo-roundabout: the concept – operation mode

- Continuous spiral paths using curbs to separate lanes and to canalize movements according to the pretended destination;
- No lane changing on the turbo-roundabout and near the entry and exit.

Turbo-roundabout: the concept

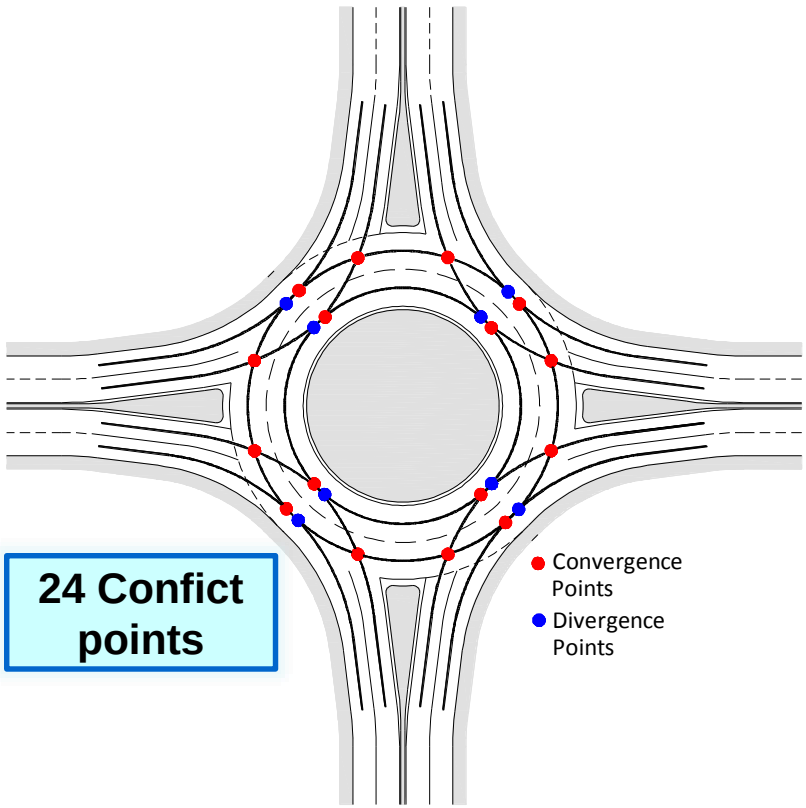
Turbo-roundabout layouts

Depending on the traffic demand distribution

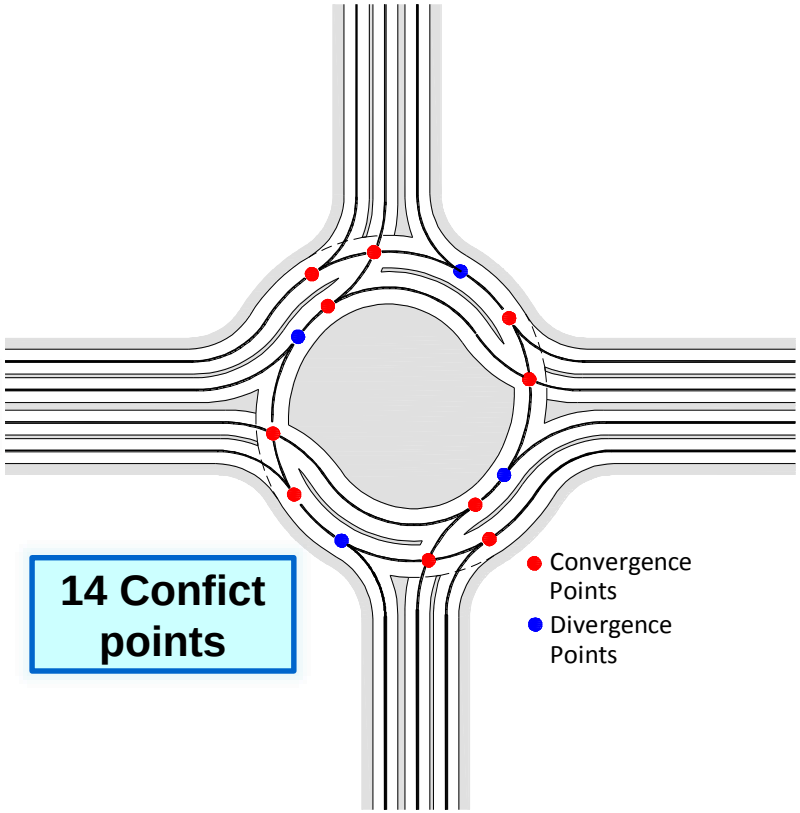


Safety improvements

- Reduced conflict number;
- Low risk of lateral accidents (80% less accidents).

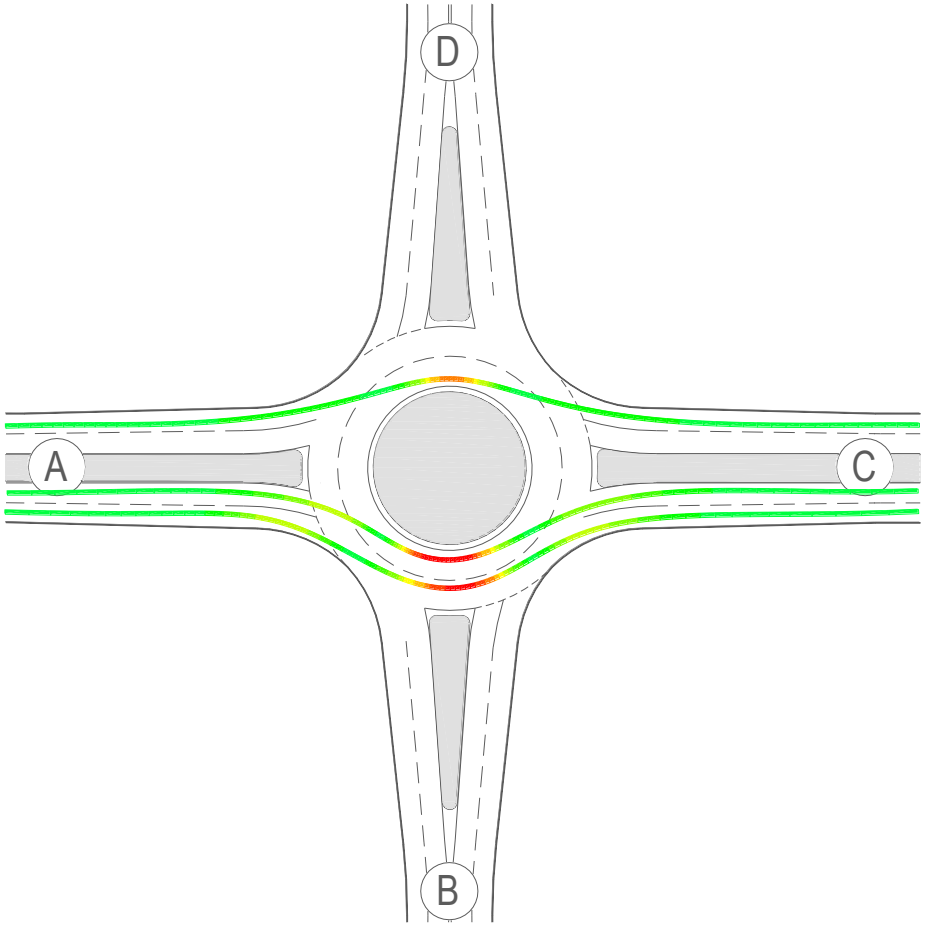


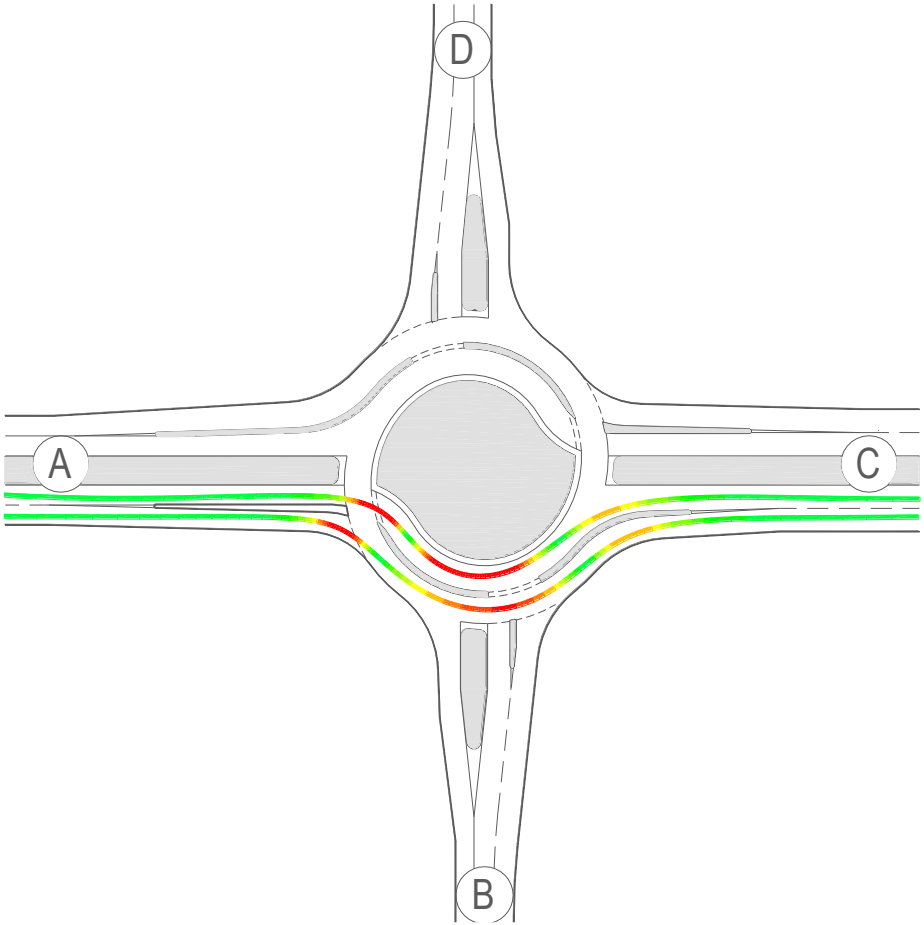
VS



Safety improvements

- Low driving speed near and through the turbo-roundabout (48 to 38 km/h);





Capacity improvements

- Some authors concluded that turbo-roundabouts offer better capacity than conventional roundabouts with similar size;
- However, these conclusions are not consensual in the scientific community – recent research (namely the national) disregards these conclusions.

Capacity improvements

Based on gap-acceptance theory and, specifically, on the generalization of Tanner's formula for multiple lanes, a new calculation method is given by:

$$C = \frac{q_c \phi e^{-\lambda(t_c - \Delta)}}{1 - e^{-\lambda t_f}}$$

Parameters calibrated to national conditions and with reliable results.

C : capacity of the entry (veh/s);

q_c : conflicting flow (veh/s);

t_c : critical headway (s);

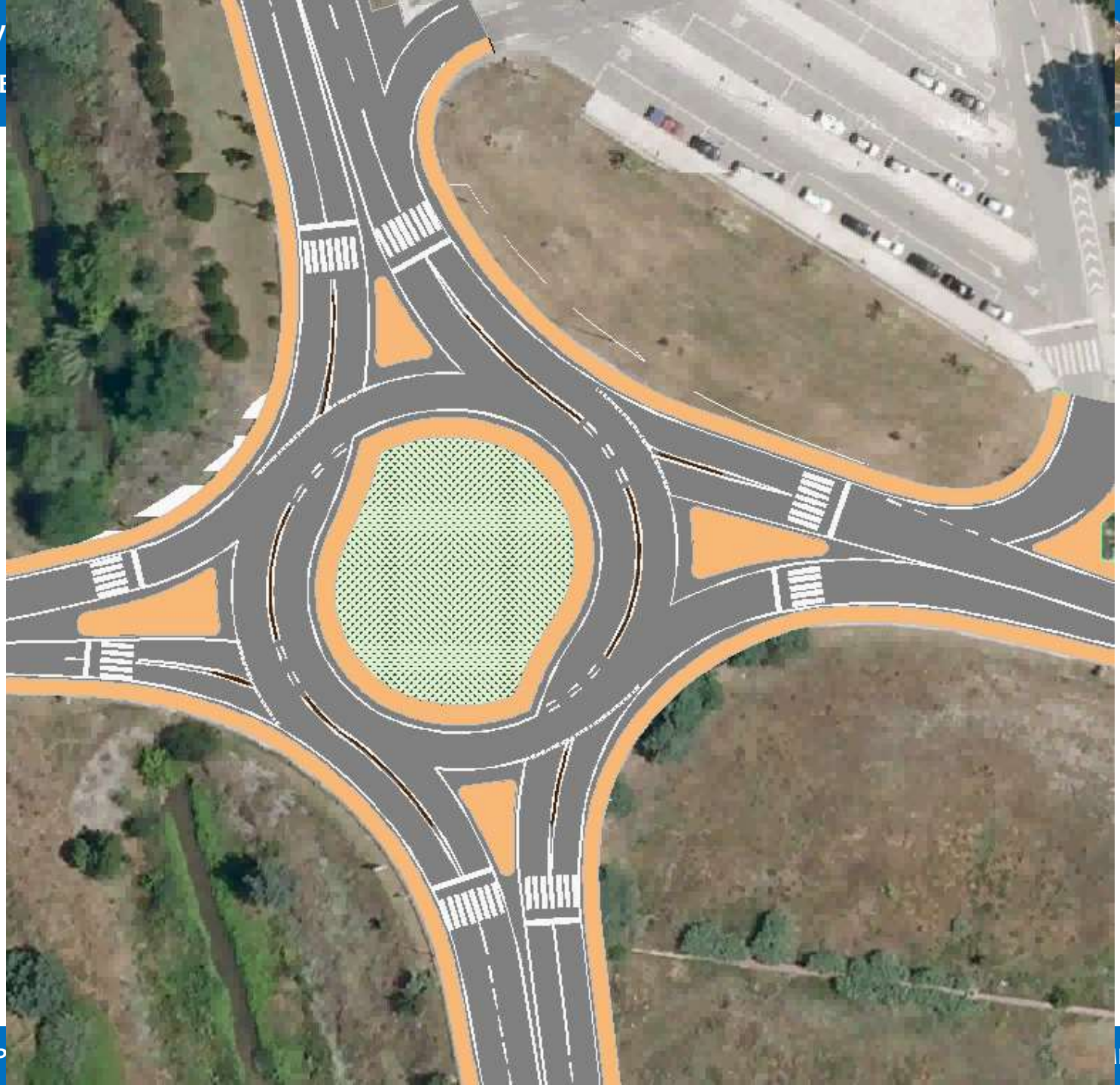
t_f : follow-up time (s);

Φ, λ and Δ : parameters of the Cowan M3 distribution.

The turbo-roundabout capacity can be slightly above the conventional double-lane roundabout capacity, when the proportion of right turns in the minor direction is very high (above 60%).

Conclusions

- The turbo-roundabout concept emerged as a way to solve the safety problems of multi-lane roundabouts;
- The turbo-roundabouts have high deflection levels and speed control, and reduce conflict points, leading to safer operations. These conclusions are consistent with the international experience.
- The performance in terms of capacity is not consensual. Some authors, using simplified approaches, concluded that turbo-roundabouts offer better capacity than conventional roundabouts of similar size. The use of a new lane-based method reveals that only in very specific scenarios, that are uncommon in real-world networks, a turbo-roundabout can provide more capacity than the equivalent double-lane roundabout.



FCTUC DEPARTAMENTO DE ENGENHARIA CIVIL
FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE DE COIMBRA

EWGT 2013
Porto, Portugal 4-6 September

FCT

Moving from Conventional Roundabouts to Turbo-Roundabouts

EWGT 2013, 16TH MEETING OF THE EURO WORKING GROUP ON TRANSPORTATION, PORTO

SEPTEMBER, 4TH

Thank You

Ana Bastos Silva
abastos@dec.uc.pt

Luís Vasconcelos
vasconcelos@estv.ipv.pt

Sílvia Santos
silviasantos@dec.uc.pt