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***MODERN TYPES OF ROUNDABOUTS – TRENDS AND
FUTURE EXPECTATIONS***



Prof. Tomaz Tollazzi, Ph.D.

tomaz.tollazzi@um.si

University of Maribor, Faculty of Civil Engineering, Maribor, Slovenia

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INTRODUCTION

- ❑ Today, after many years of experience regarding roundabouts, there are still different ideas about the "ideal roundabout" with a little consensus on the crucial effects of rules on how to negotiate intersections.
- ❑ The development of design rules and advice from an extensive body of research should allow civil and traffic engineers to produce the most effective forms of this junction type, even if for a variety of reasons this is not always carried out in practice.
- ❑ It needs to be stressed that the roundabout intersection has been "at the development phase" since 1905, and this development is still in progress.



INTRODUCTION

- ❑ There are several different types of roundabouts worldwide today, called the **alternative types of roundabouts**.
 - ❑ Some of them are:
 - ❑ already in frequent use all over the world (assembly, hamburger, dumb-bell ...),
 - ❑ recent and have only been implemented in certain countries (turbo, dog-bone, compact semi-two-lane roundabout), and some of them are
 - ❑ still in development phase - are "still coming" (turbo-square, flower, target, with segregated left-turn slip lanes...).
 - ❑ All three groups typically differ from the "standard" one- or two-lane roundabouts in one or more design elements, as their purposes for implementation are also specific.
 - ❑ The main reasons for their implementation are the particular disadvantages of "standard" one- or two-lane roundabouts regarding actual specific circumstances.
 - ❑ Usually, these disadvantages are highlighted by low-levels of traffic safety or capacities.
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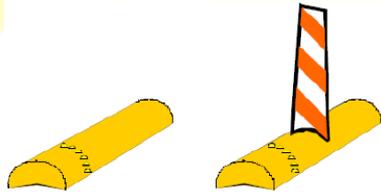
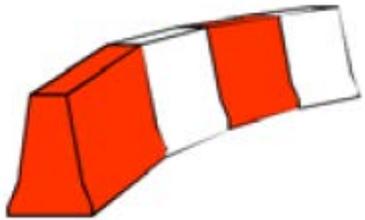
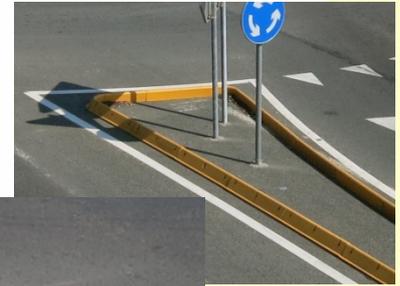
INTRODUCTION

- ❑ But, before started, it needs to be stressed:
 - ❑ In Europe, there are no uniform guidelines for the geometric designing of roundabouts, which is understandable because the situation in one country is very different from another.
 - ❑ A certain solution which would be safe from the traffic safety point of view in one country could be very dangerous in another.
 - ❑ Consequently, most countries have their own guidelines for the geometric designing of roundabouts which are, as far as possible, adapted to their real circumstances.
 - ❑ Roundabouts in different countries also differ in their dimensions and designs, the reasons for this being the different maximum dimensions of motor vehicles (mostly heavy vehicles), and human behavior.
 - ❑ **In the cases of roundabouts, there is not "only one truth"!!!**
 - ❑ **Therefore, each country needs to "walk its own path", although this is maybe the slowest and the more difficult, it is also the safest way!**
 - ❑ **Verbatim, the copying of foreign results could be dangerous and could lead to effects that are completely the opposite than expected.**
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ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

The **assembled** roundabout can be constructed from different prefabricated elements, such as:

- Concrete prefabricated elements segment formats / shapes (for construction of central island);
- Prefabricated curbstone for the leading edge;
- Prefabricated (plastic) security fences

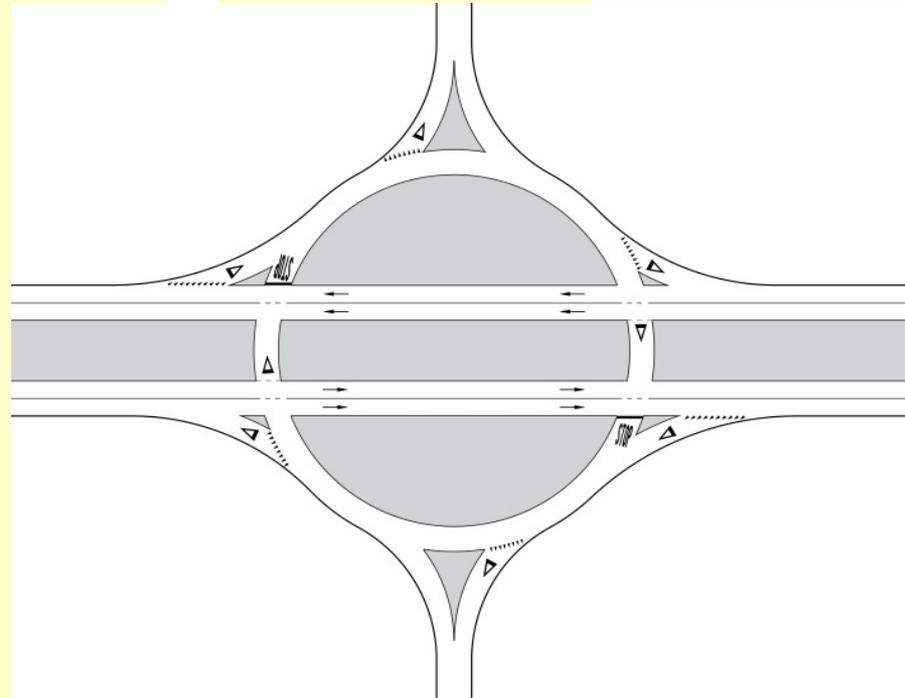
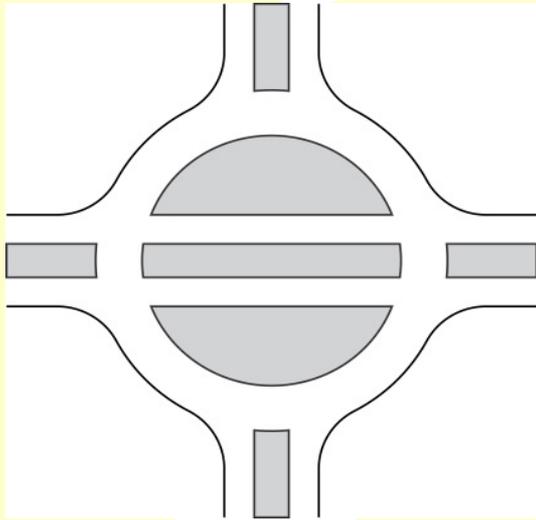


ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE



ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

- ❑ Roundabout with a transitional central island - **“hamburger”** - the two halves of the central island looks like the “bread”, and the splitter island between two roads represents the “meat”; very popular on Canary Islands, Spain, Portugal, also UK.



It could be constructed as a one- or two-level roundabout

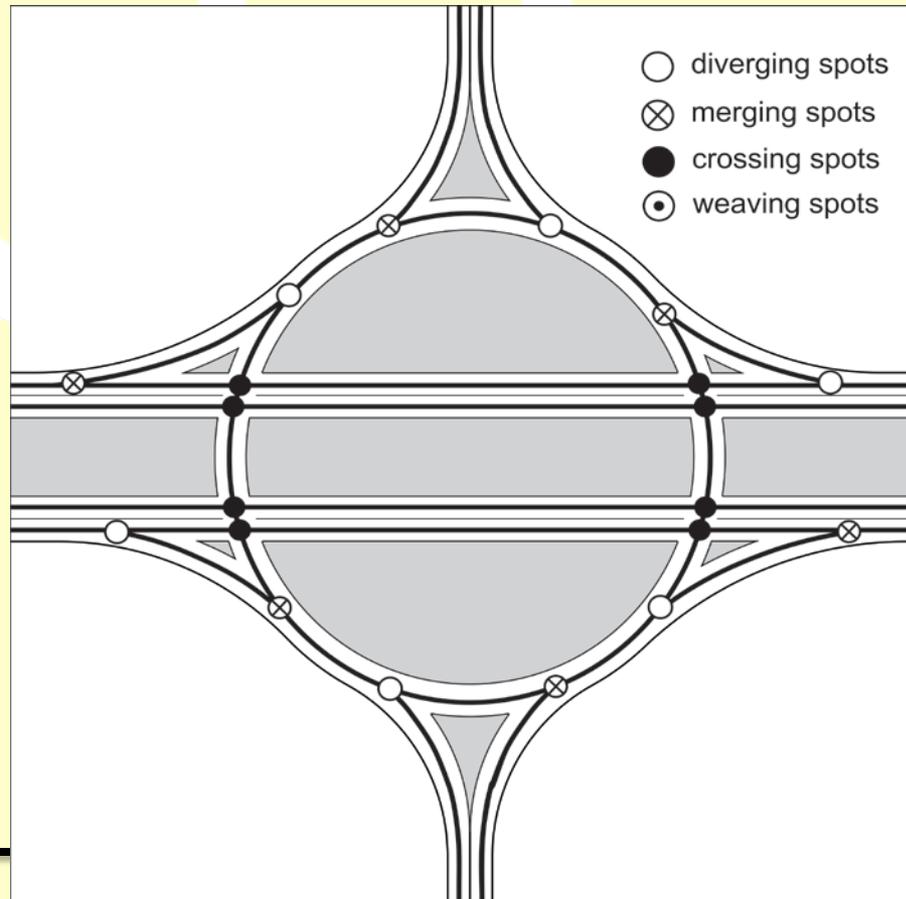
ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

□ “Hamburger” - one level:



ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

- This type of at-grade hamburger roundabout is sometimes traffic-signal controlled because of high number of conflict spots, and always lighting:



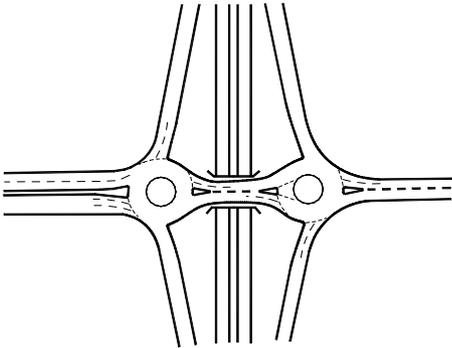
ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

□ “Hamburger” - two level:



ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

- ❑ The double-roundabout - "**dumb-bell**" - (due to its aerial resemblance to a dumb-bell, a piece of equipment used in weight training) is a "hybrid" between the diamond interchange and the roundabout.
- ❑ It combines the capacity benefits of a (usually) one-lane roundabout with the smaller footprint and single bridge (flyover) of a standard diamond junction.
- ❑ A dumb-bell roundabout is a better solution than a "standard diamond interchange" because of several reasons.



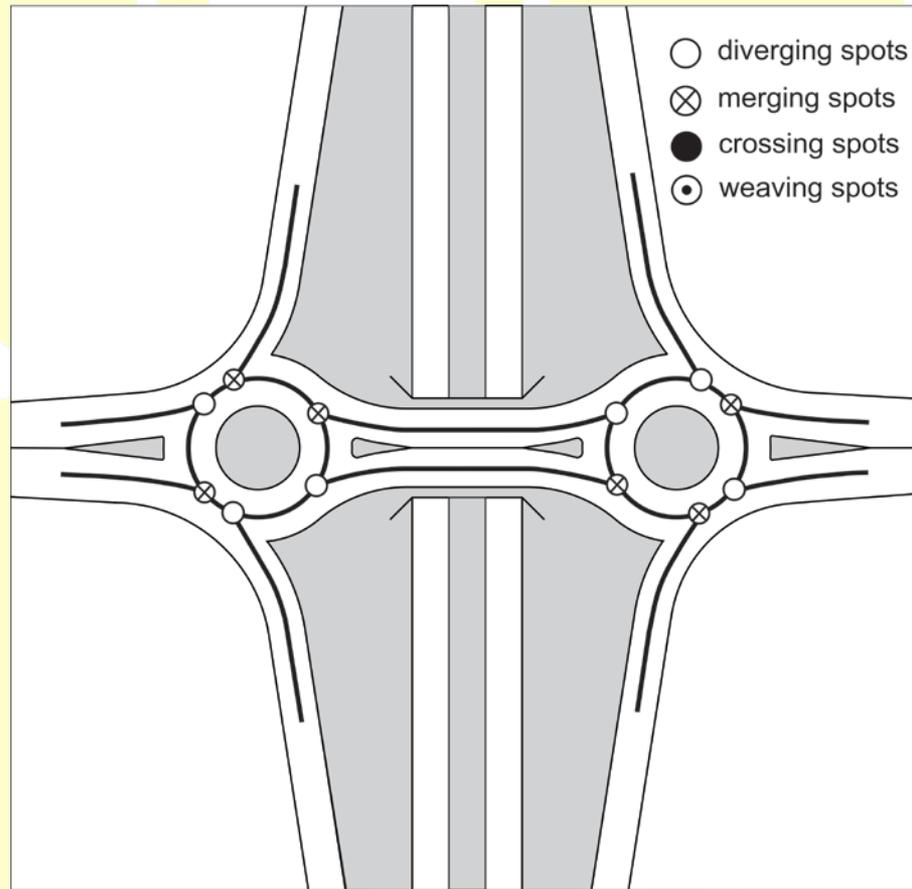
ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

- ❑ This type of roundabout is very common in different European countries (also Slovenia).
- ❑ It seems that the more numerous dumb-bell roundabouts are located on the Canary Islands, where virtually all ramp intersections are constructed as a “dumb-bell” roundabout.



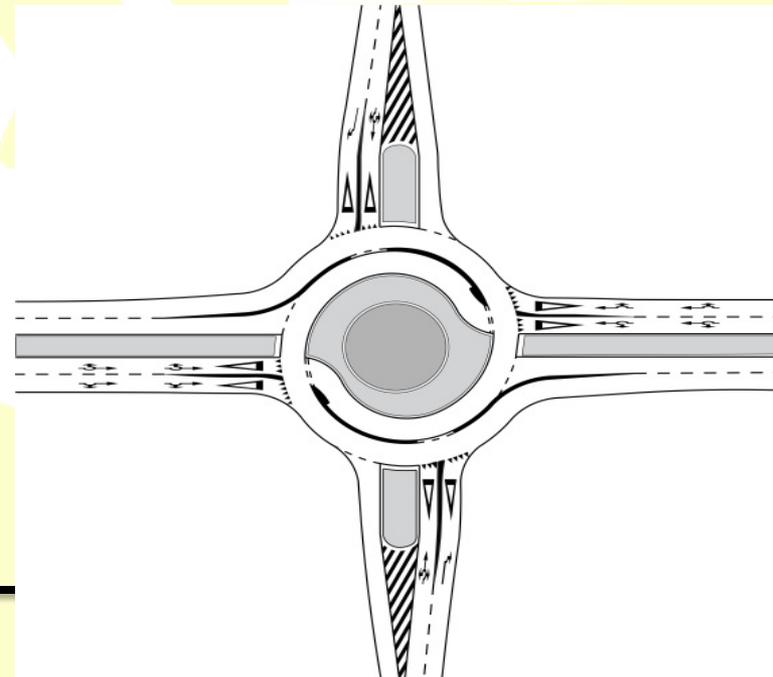
ALTERNATIVE TYPES OF ROUNDABOUTS THAT ARE ALREADY IN FREQUENT USE

❑ Conflict spots at a “dumb-bell” roundabout:



RECENT ALTERNATIVE TYPES OF ROUNDABOUTS: TURBO ROUNDABOUT

- ❑ Some of the alternative types of roundabouts are recent and have only been implemented within certain countries. These are e.g. turbo-roundabout, dog-bone, and compact semi-two-lane roundabout
- ❑ There is no doubt that dr. Lambertus Fortuijn, a researcher from University of Delft, the Netherlands, is the "father" of the "**turbo-roundabout**". And there is also no doubt that this type of roundabout has been the more popular alternative type of roundabout over the last decade all over Europe. It seems the turbo-roundabout is a kind a "fashion" these days



RECENT ALTERNATIVE TYPES OF ROUNDABOUTS: TURBO ROUNDABOUT

❑ Already known facts:

- ❑ first turbo-roundabouts were installed at the end of the 90's of the past century in the Netherlands;
- ❑ by the end of 2007 there were 70 turbo-roundabouts;
- ❑ whilst at the end of 2013 there were more than 200 turbo-roundabouts in the Netherlands.

❑ Maybe a little less-known facts:

- ❑ the idea of the turbo-roundabout was very rapidly transposed into several European countries such as Slovenia, Germany, Denmark, and Czech Republic, as also Hungary, Austria, Poland, Lithuania, Romania, the Former Yugoslav Republic of Macedonia and also into the USA;
- ❑ according to a web page of Dirk de Baan, at the moment there are 320 turbo-roundabouts all over the world (<http://www.dirkdebaan.nl/locaties.html>);
- ❑ experiences provide a good insight into the effects on road safety, capacity, and experience by road users in some countries, but also less satisfactory experiences in other countries, because of the already known reason:

Road marking (without divided curbs) does not prevent the change of traffic lanes in the turbo roundabout!!!

RECENT ALTERNATIVE TYPES OF ROUNDABOUTS: TURBO ROUNDABOUT

- ❑ The turbo roundabout has a bigger capacity, compared to the “normal” two-lane roundabout. There are several reasons for that:
 - ❑ at the roundabout entry of this type, there are usually two traffic lanes, which directly continue into two circulatory traffic lanes,
 - ❑ the use of the inner circulatory traffic lane becomes more attractive, since there is no need for weaving,
 - ❑ the entry traffic flow is no longer hesitant, when entering the circulatory carriageway, which increases the capacity of entries.



RECENT ALTERNATIVE TYPES OF ROUNDABOUTS: TURBO ROUNDABOUT

□ Specific details of turbo's:



RECENT ALTERNATIVE TYPES OF ROUNDABOUTS: TURBO ROUNDABOUT

- ❑ Signposting and arrow-markings – very important!



SLOVENIAN EXPERIENCES WITH TURBO ROUNDABOUTS 1/2

- ❑ Idea transfer to Slovenia very fast!
- ❑ Reasons:
 - ❑ insufficient use of inner circulatory lane
 - ❑ traffic habits and (un)culture
 - ❑ too small double-lane roundabouts were build
 - ❑ low traffic safety level of "standard" multi-lane roundabouts
 - ❑ year 2006 – first ideas of using turbo roundabouts



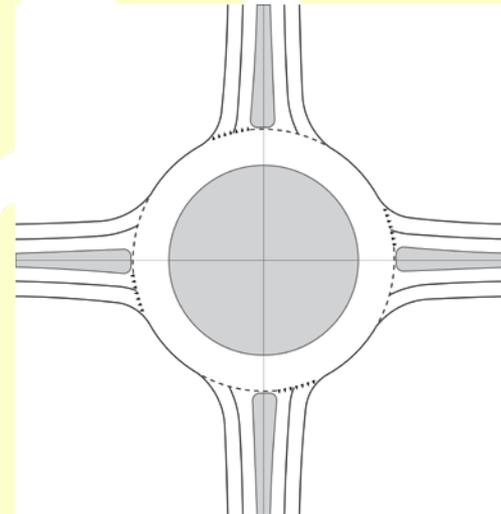
SLOVENIAN EXPERIENCES WITH TURBO ROUNDBABOUTS 2/2

- ❑ At the moment (March 2014) in Slovenia, there are ten existing turbo-roundabouts, two assembled turbo-roundabout, one traffic-lighted turbo-roundabout, and design documentation for four more turbo roundabouts are being processed.
- ❑ The Slovenian typical turbo differs from the Netherlands:
 - ❑ Slovenian turbo is smaller,
 - ❑ separation of entry/exit traffic lanes with intermediate splitter islands,
 - ❑ usually without "peaks",
 - ❑ different design of the entrance to the inner circulatory lane



THE COMPACT SEMI-TWO-LANE ROUNDABOUT

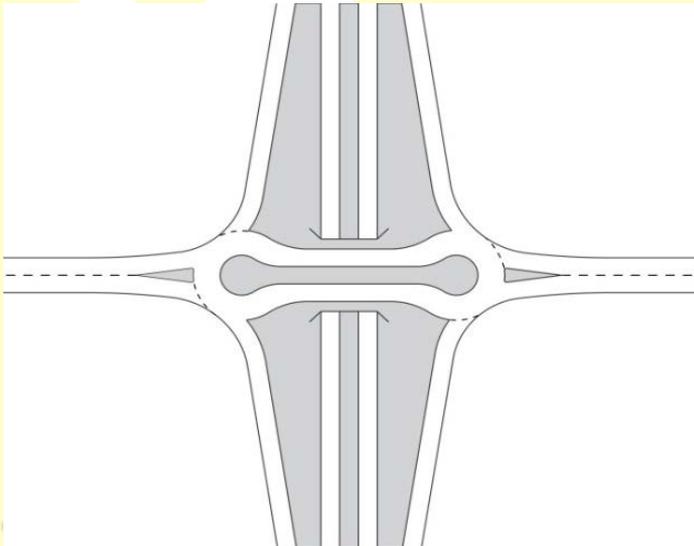
- ❑ As it is known by Brilon, the compact semi-two-lane roundabout is already state-of-the-art solution in Germany, but it seems that only there.
- ❑ The design of compact two-lane roundabouts is similar to the concept of single-lane roundabouts.
- ❑ The main difference is the width of the circle lane. It is wide enough for passenger cars to drive side by side, if required. However, the circle lane has no lane marking. Large trucks and busses are forced to use the whole width of the circulatory roadway making their way through the roundabout.



source: Werner Brilon

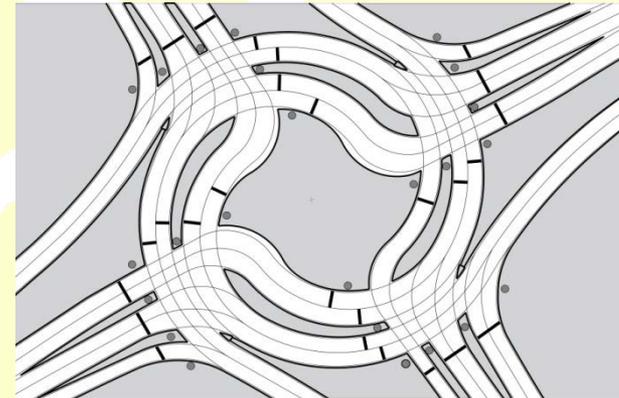
DOG-BONE ROUNDABOUT

- ❑ Dog-bone roundabout (due to its aerial resemblance to a toy dog bone), seems invented in the Netherland, is a variation of the dumb-bell roundabout.
- ❑ The dog-bone is, like a dumb-bell, also a "hybrid" between the diamond and the roundabout. Dog-bone occurs when the roundabouts do not form a complete circle but instead have a "raindrop" or "teardrop" shape.
- ❑ These two roundabouts are fused together, forming a single "squashed" roundabout.
- ❑ Variations: two one-lane or two turbo-roundabouts



ALTERNATIVE TYPES OF ROUNDABOUTS IN DEVELOPMENT PHASES

- ❑ Some of them, which are in development phases at the moment, are: turbo-square, flower-roundabout, target-roundabout, roundabout with segregated left-turn slip-lanes ("four bridges roundabout"), and "left-and-right roundabout"
- ❑ In 2000, the Province of Zuid-Holland has introduced the signalized multi-lane "**turbo-square**" (in original "turbo-plein") as a new intersection layout and has installed two of them near Delft (today three of them exist). The signalized multi-lane turbo square is an at-level solution with a large traffic throughput capacity, based on the principle of a turbo-roundabout with signalized traffic control.

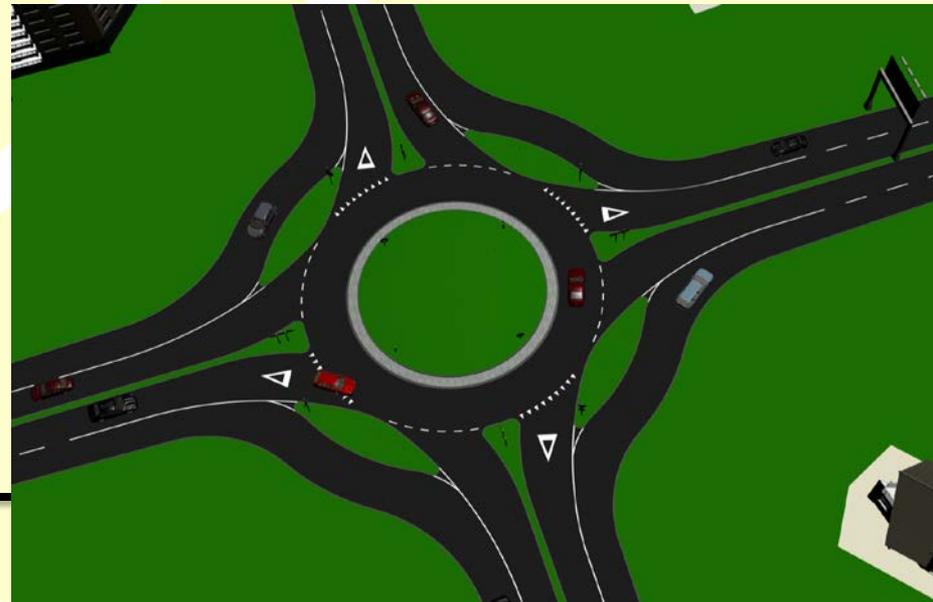


"FLOWER ROUNDABOUT"

- ❑ The roundabout with "depressed" lanes for right turning (slip-lanes) – "**flower roundabout**" was invented in Slovenia as a solution to achieve a high level of traffic safety on existing, less safe two-lane roundabouts.
- ❑ One of the basic characteristics of the "flower roundabout" (the same as in the turbo roundabout) – physically separated traffic lanes in the circulatory carriageway.
- ❑ The second characteristic is that the right-turners have their own separated lanes. This causes that the inner circulatory carriageway is used only by vehicles, which drive straight through (180°), turn for three quarters of a circle (270°) or turn semicircle (360°)

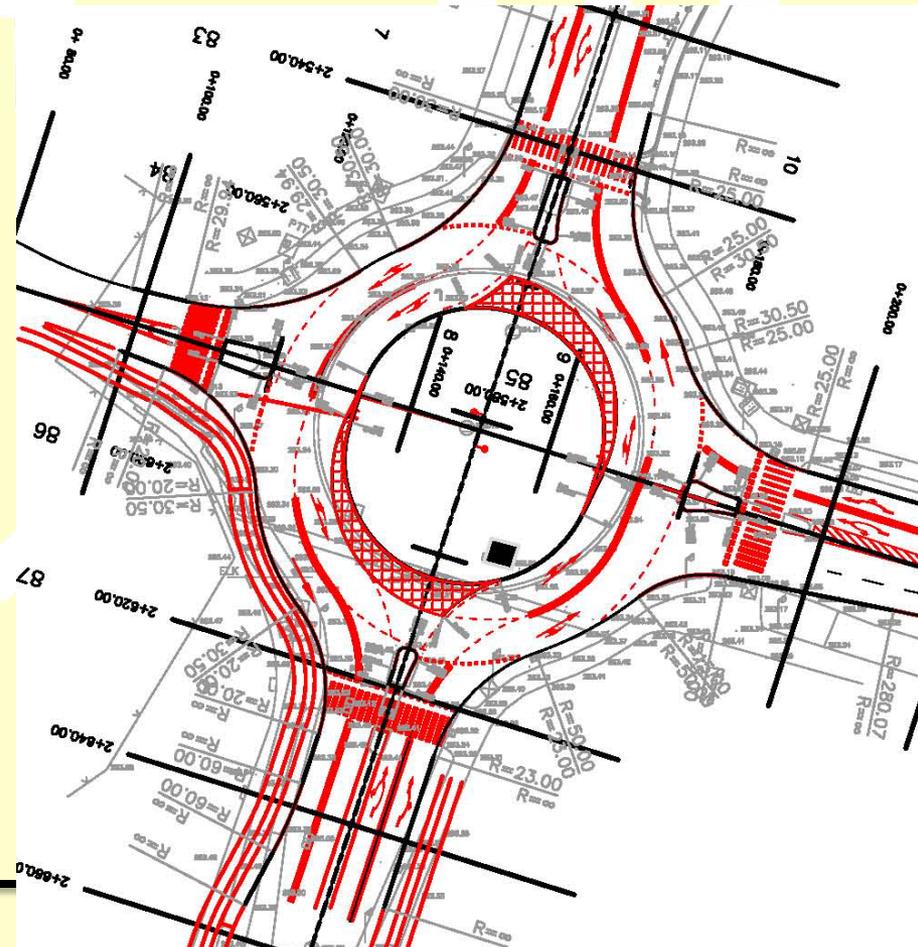
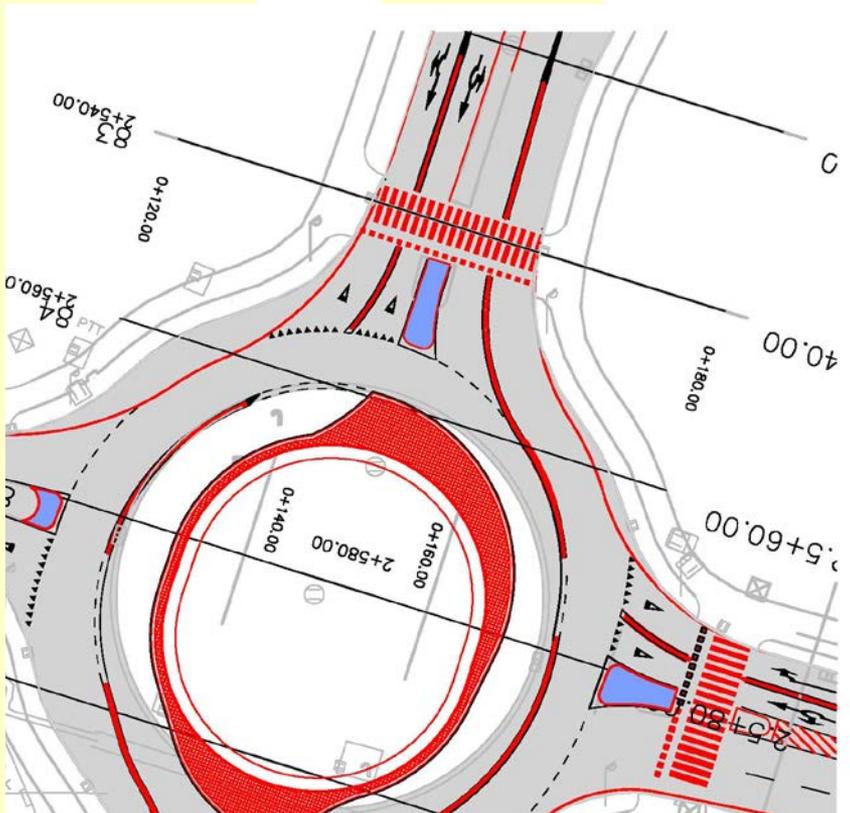
How it works:

<http://www.youtube.com/watch?v=TrUQNd9rOAo>



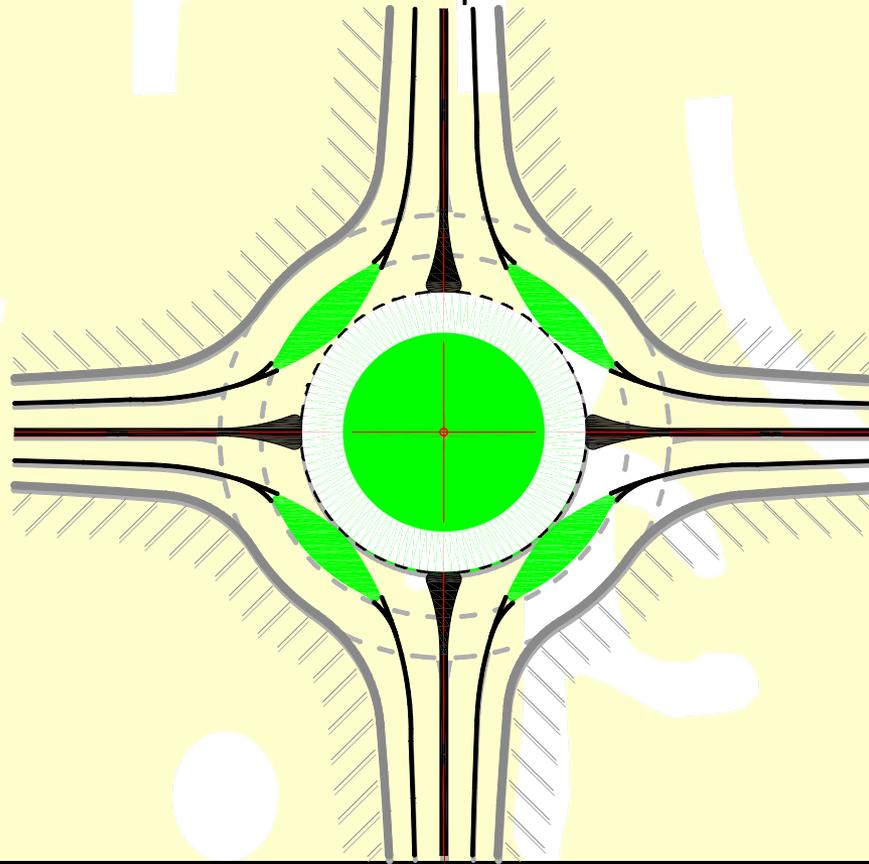
"FLOWER ROUNDABOUT"

- ❑ Unlike the turbo roundabout, there is no need to move the outer road curbs!!!



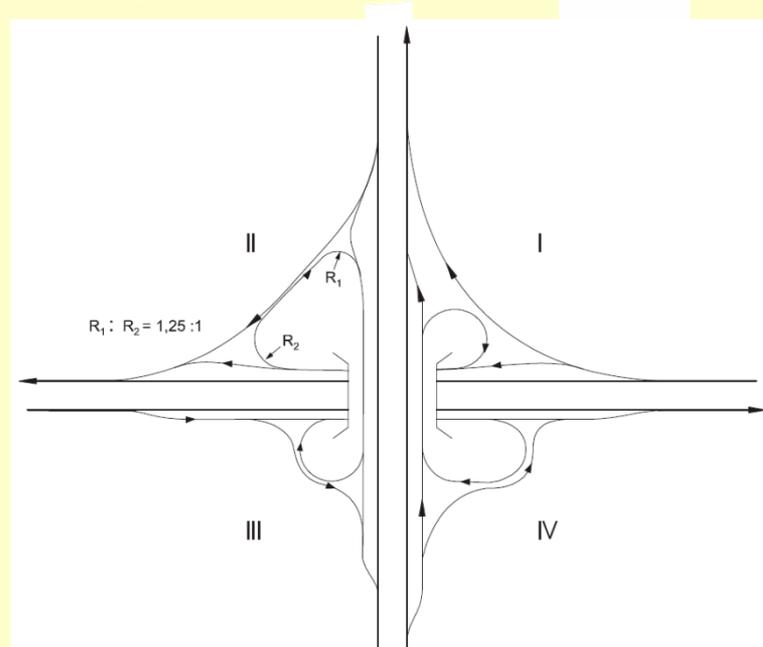
"FLOWER ROUNDABOUT"

- At the reconstruction of the existing "standard" two-lane roundabout into the flower roundabout, all the outer road curbs of the circulatory carriageway, splitter islands, public lighting poles ... remain on the same position.



"TARGET ROUNDABOUT"

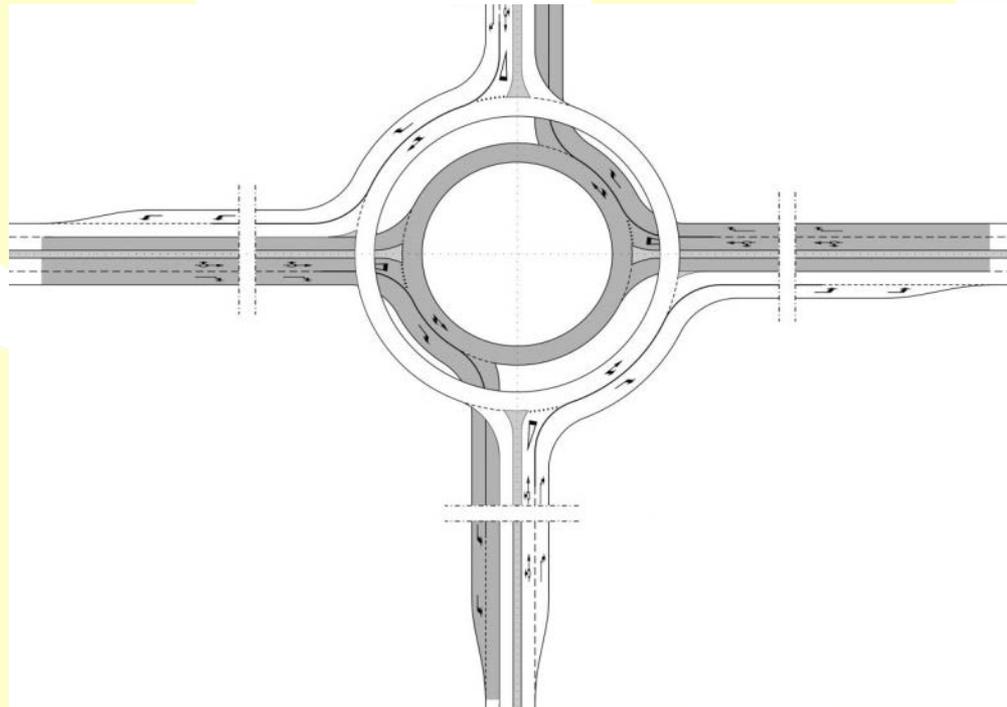
- ❑ The idea of the "target-roundabout":
- ❑ If we need to design an intersection of two four-lane roads (motorways or highways) and need to design "full intersection" ("from all directions to all directions") standard solution is "clover" – one of the four combinations



- ❑ But: For this solution we need a lot of space (a lot of land = a lot of money and a lot of problems with ministry of environment)!

"TARGET ROUNDABOUT"

- ❑ ... another (a new) solution could be a "two levels one lane roundabouts with depressed lanes for right turners" – shortly "**target roundabout**"



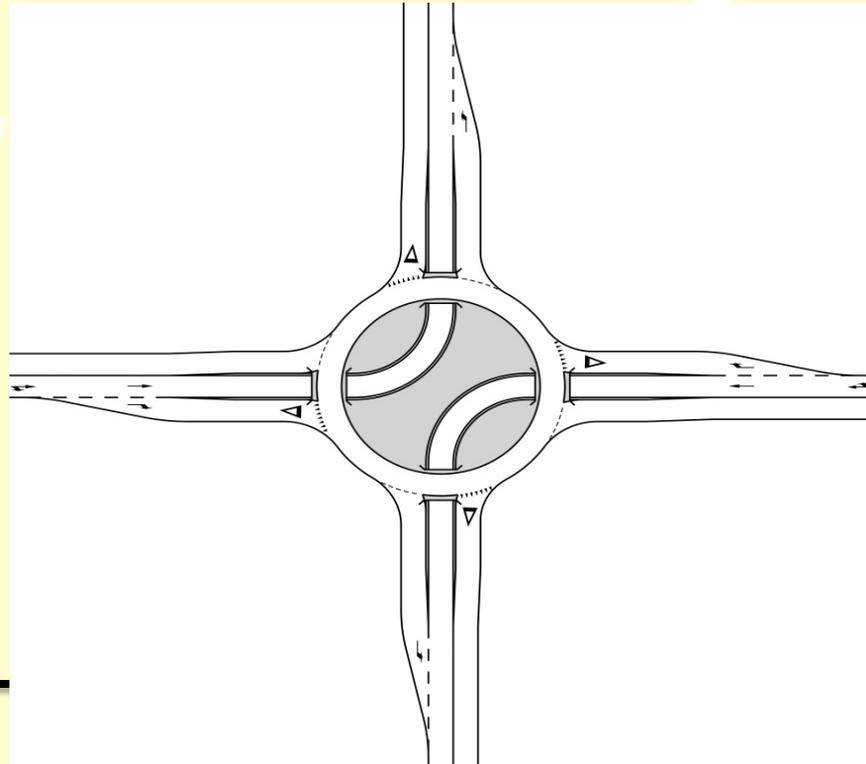
- ❑ On this moment, this new type of roundabout is also in the development phase.

How it works:

<http://www.youtube.com/watch?v=FP9AuAtdXDw&feature=youtu.be>

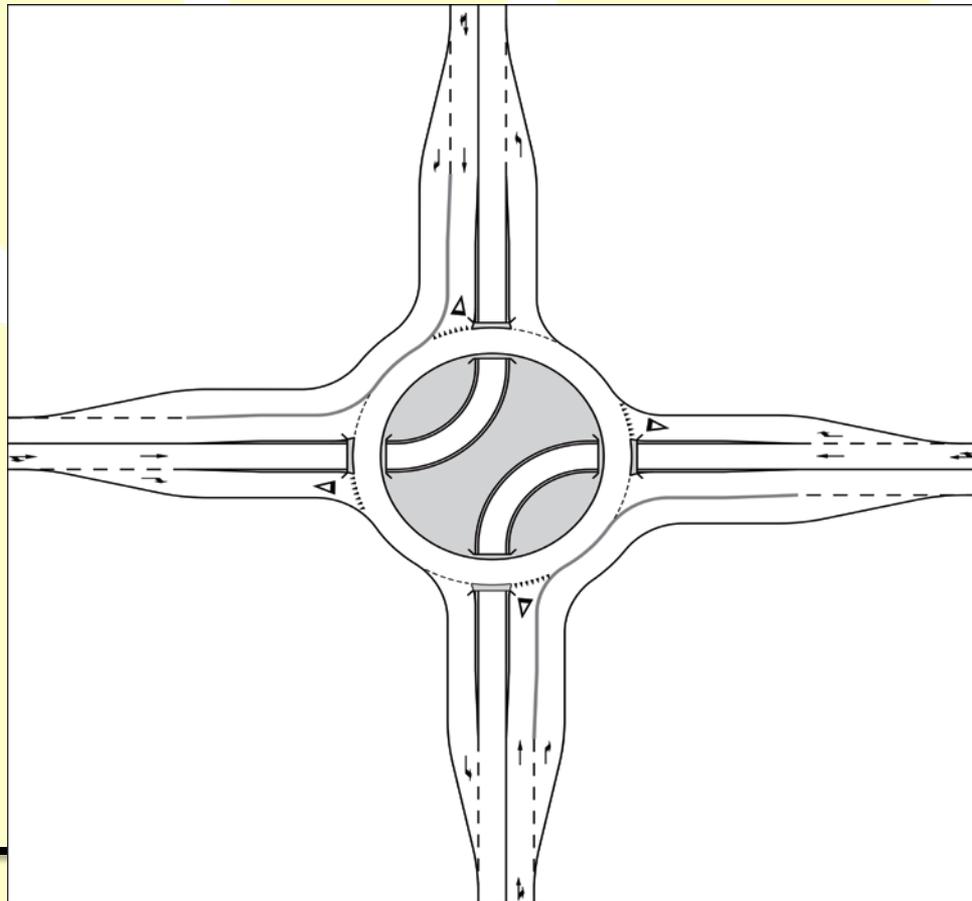
“FOUR FLYOVER ROUNDABOUT”

- ❑ Roundabout with segregated left-turn slip-lanes on the major road – “**four flyover roundabout**” is designed as a one large one-lane roundabout on one level and both left-hand turners on major road have their own, separate left-hand turn bypass lanes, located on another level.
- ❑ Left-hand turners are located like on standard intersection – at the left lane on approach.



”LEFT-AND-RIGHT ROUNDABOUT”

- A variation is the roundabout with segregated left-turn slip-lanes on the major roads and right-turn slip-lanes on the minor roads – **”left-and-right roundabout”**



CONCLUSION

- ❑ In many European countries research into the various aspects and various types of roundabouts as useful types of road junctions has spanned many decades.
 - ❑ During this long period the numbers of vehicles, their sizes and speeds and in particular their acceleration capabilities, have radically changed. The same situation also exists regarding drivers' experiences and their expectations of the highway infrastructure. Also, with increased traffic there may be more concern about matters of public safety and liability.
 - ❑ At the moment, several research aspects are running on the development on different layouts of roundabouts for different circumstances or problems. The benefits of maximum success from research can possibly be estimated, but it should be obvious that any expectation of future benefits from a particular item of research, as sometimes implied in funding requirements, cannot be guaranteed.
 - ❑ **Disappointing results must sometimes be expected and negative results also have value!**
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Further information available on:

<http://www.fg.uni-mb.si/cpg/>

and (for all those who are interested in roundabouts):

The screenshot displays the Springer website interface. At the top left is the Springer logo. To the right are links for 'Login / Register', 'Global Website', and 'Change'. Below the logo is a search bar with a magnifying glass icon and a settings gear icon. A navigation menu includes 'Home', 'My Springer', 'Subjects', 'Services', 'Publishers', 'Springer Shop', and 'About us'. The main content area is titled 'Civil Engineering' with a breadcrumb trail: 'Home > Engineering > Civil Engineering'. A horizontal menu lists 'SUBDISCIPLINES', 'JOURNALS', 'BOOKS', 'SERIES', 'TEXTBOOKS', and 'REFERENCE WORKS'. The featured book is 'Alternative Types of Roundabouts', described as 'An Informational Guide' in the 'Springer Tracts on Transportation and Traffic, Vol. 6' series by Tomaz Tollazzi, published in 2015 (250 pages). It is available in eBook and Hardcover formats. The hardcover price is listed as 'approx. 106,99 € (gross) price for Slovenia'. Additional details include ISBN 978-3-319-09083-2, free shipping worldwide, and a due date of February 4, 2015. A note states that final prices may differ due to VAT rules. A 'add to marked items' button is present. Social media sharing options for Facebook, Twitter, and Google+ are shown at the bottom. On the right side, there are sections for 'SERVICES FOR THIS BOOK' (Reserve an Online Book Review Copy, Download Product Flyer), 'NEW BOOK ALERT' (with an email input field and a 'SUBMIT' button), and 'RECOMMENDED BOOKS' (featuring 'The ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 2007-2014' by Ulusay, R. (Ed.) with a price from 83,29 €).