

Evolution of Roundabouts in France and new uses

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SUMMARY

In 1997, at the third international symposium on "intersections without traffic signal", I had presented state of the art and basic rules of roundabouts in France. Now these rules are in the federal guide of the roundabouts. Which innovations since 1997?

1. Roundabouts and accidents at the dawn of the 21st century

In France, the number of roundabout increased from 500 to 25 000 in twenty years. The principal reason is the profit of safety compared to the other types of crossroads. From 1993 to 2003, the number of roundabouts doubled, but the number of accident is steady. Why?

2. The use of roundabouts with trams

Gradually, roundabouts replace the other types of intersection on the lines of tram. The principal interest is the priority within circulatory roadway, out of the presence of tram. A management by traffic lights starts when the tram is approaching. The mode of detection and light signal evolved following reports and tests.

3. Roundabouts close to railway level crossings

The proximity of a level crossing of train was a negative element to establish a roundabout. However it is built more and more often, at the point to worry the persons in charge for the SNCF. Without dynamic management of the crossroads, how to make sure that at the closing of the gates, no vehicle is stopped on the level crossing and is blocked on the path of a train which arrives at 160 km/h?



Roundabout and tram - Nantes

ROUNDBABOUTS AND ACCIDENTS AT THE DAWN OF THE 21ST CENTURY

More roundabouts but less accidents by roundabout

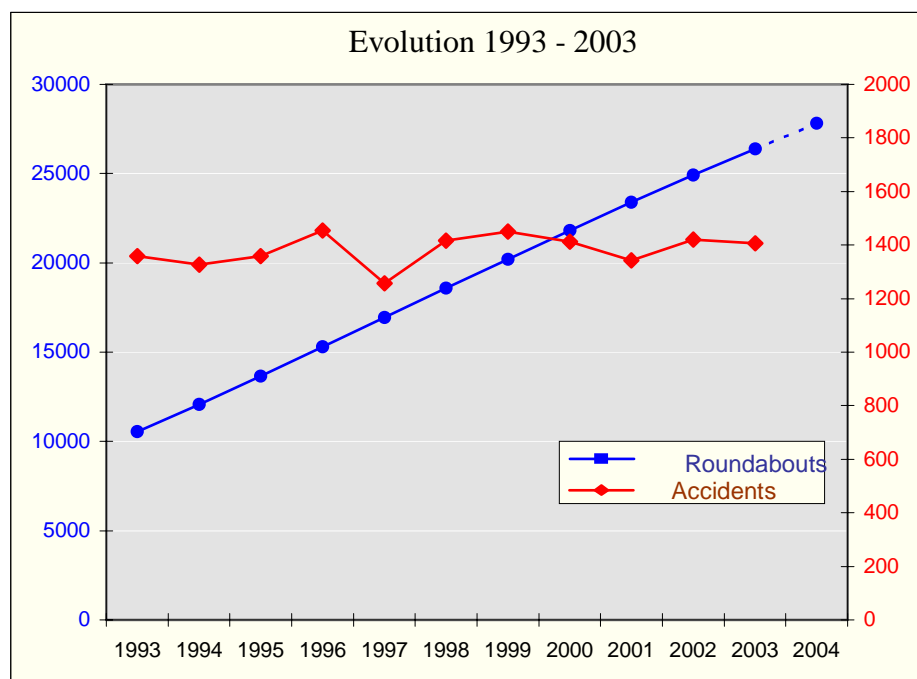
Roundabouts strongly marked the European road landscape at the beginning of 21st century.

In France, modern roundabouts appeared at the end of the Seventies. They multiplied very quickly after the modification of the Highway Code and the publication of technical guidelines. At the end of 1994, I had listed 12 080 roundabouts in France. Approximately 1500 had been built during this year. Today, they are certainly more than 27000 in France.

For example, the agglomeration of Nantes multiplied the roundabouts and counts nearly 2 per 1000 inhabitants. On one of my usual routes, I cross 12 of them in 3 kilometres.

The good results in road safety made roundabout the favourite intersection of the road designers. It is one of the main reasons of its very strong growth in France and also in whole Europe. In 1990, we had evaluated the risk of personal injury to be 0,15 per year and per roundabout. However for a few years, we have observed the following phenomenon:

- the number of roundabouts continues to grow (probably much more than 1000 per year)
- the number of personal injuries listed in the roundabouts remains stable.



The rate of accident per year and roundabout fell to 0,10 in 1995 and only 0,05 in 2002. Why, for which reasons?

- The general fall of traffic accidents in France explains this fact partly, but it is only since 2003 that the reduction is really very important.

- The publication of the new technical guidelines on the crossroads led certainly to installations better than those of 15 years ago. The experience of designers progressed.
- The experience of the drivers also progressed. There is no more rural part of France nor even city where there are no roundabouts. At the time of daily trips, the driver meets on its route several roundabouts; this type of intersection does not surprise him any more.

It should be noted that many signal-controlled junctions were transformed into roundabouts, but never the opposite. In my town, 14 out of 25 has been change into roundabouts and we have nearly 60 roundabouts.

Just additional information: on the 1414 accidents in 2003 on the French roundabouts, only 112 concerned pedestrians. Only 2 of them were killed. We have no information about blind or sighted pedestrian.

A specific statistic about elderly drivers (4 years in the west of France) give interesting results for roundabouts: the part of drivers 66 years old and more is 30% lower than in other intersections. But that is not better than in signal-controlled junctions.

The French software to calculate the capacity is GIRABASE.



This software is adapted and validated from mini to giant roundabouts, from 3 to 8 arms, with 1, 2 or 3 lanes at entries and on the circulatory roadway. It is probably the only one to make use of the situation (rural, suburban or downtown), the layout of arms, the apron, the incline of entries, the exiting traffic, U-turns and pedestrians. It gives alarms if some characteristics can be dangerous

Results are the capacity, the queuing delay and the queue length. Girabase proposes recommendations for safety and solutions for capacity in the event of saturation.

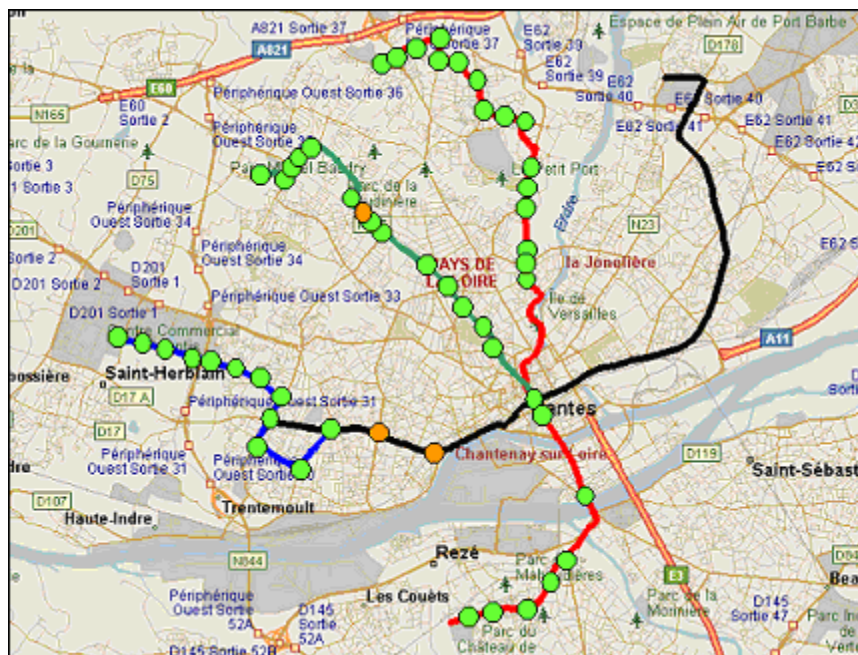
THE USE OF ROUNDABOUTS WITH TRAMS

A crossroads adapted to modern public transport.

The 21st century will be marked by the policy of the cities for public transport. For 20 years, public transport in own way began a strong development in the large French cities.

At intersections between trams and general traffic, the traffic signals were regarded as necessary. They make it possible to manage the conflicts and to give the priority to tram so that they pass without being stopped. We thought that the roundabouts could not be used in certain situations. In particular, they did not make it possible to give the priority to public transport. Also, during a long time, we advised against building roundabouts on the lines of public transport in exclusive way.

In 1992, Nantes made 6 roundabouts on its second line of tram. The following year, 16 new ones were carried out for the opening of the northern part of this line. During the years that followed, I studied the operation and the safety of these crossroads. The results were very positive, with the condition of not doing anything. We defined the geometrical rules to optimize safety. Since, the majority of the crossroads of the new lines of tram are roundabouts. Now, other cities use them too : Lyon, Montpellier, Bordeaux...



Tramway lines in Nantes and roundabouts

The advantages are: no lost time apart from the passage of tram, possibility of U-turn, few personal injuries. The rules are: axial line, entries with only one-way, control by traffic signals only at the arrival of tram.

The use of traffic signal evolved during years, according to the gained experience and to various tests. In the first times, we used traffic lights only at the entries. The second generation had also traffic signals on the circulatory roadway.

After several experiments, we replaced three-colour traffic lights of the ring by red flashing signals, identical to those used for the railway level crossings. For that, we had to amend a little the highway code.

The reaction of some users was rather critical at the beginning. But especially we observed much less crossing with the red, therefore less risk of accident. This system equipped the prolongation of line 1 and the whole line 3. Old signals are replaced gradually.

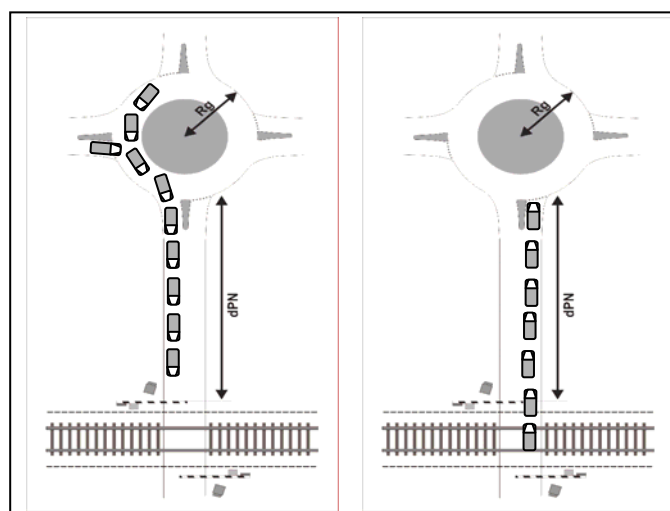
In 2000, a new experiment started on one roundabout. It was a question of removing the traffic signals at the entries to preserve only the flashing red lights on the ring. This system makes it possible to simplify the procedures of detection and programming, and to reduce the delay to the minimum. A new section of line 3 was brought into service at the spring of 2004. The roundabouts that cross the tram operate on this principle.

The signals are lit by the detection of the tram between 80 and 140 meters before crossroads. Detection at exit of the roundabout orders the extinction of the signal. Two other sensors are used on both sides of the tram signal. The first one serves in the event of a dysfunction of detection at long distance. The second one allows shortening the phase of end of cycle. The whole of the sensors are also used in the event of running on single track in the wrong direction, at the time of a breakdown of tram for example.

ROUNDAOBOUTS CLOSE TO RAILWAY LEVEL CROSSINGS

The increase in the number of the roundabouts worries the French national railway company (SNCF). Although it is inadvisable, the designers propose more and more often this type of crossroads for intersection near the level crossings.

The risks are of two types: the closing of the level crossing can create disturbances in the operation of roundabout or the queue of roundabout can spill out the level crossing. From the safety point of view, these two assumptions do not have the same consequences and not the same solutions.



In the first case, the closing of the barriers of the level crossing can generate a queue which comes to block the ring. But only the 3/4 of the ring can be blocked and after the opening of the barriers, the traffic becomes again normal within a few minutes.

In the second case, the queue of the roundabout goes up on the level crossing. There can then be a vehicle stopped on the rails when a train arrives. The trains being able to roll up to 160 km/h, there is a risk of fatal accident. We are studying the possible solutions.



According to the geometrical data and road as well as railway traffics, a risk analysis is necessary. We start by calculating the probability that a queue spill up to 50% of the distance between the roundabout and the level crossing. For that we use traffic data at the peak hour and the software GIRABASE.

If the risk is important, we consider various solutions, preventive or curative, static or dynamic. They are classified in 6 categories, 3 are preventive (to prevent cars to be stopped on the railway):

- addition of signs and marking,
- addition of a illuminated signs,
- use of a traffic light to prohibit the entry on the level crossing when the back of the queue is too much close to the level crossing ,

and 3 are curative (to empty out the railway when cars are stopped above) :

- installation of a slip road, starting from the level crossing,
- control by traffic light of one or more entries of the roundabout,
- control by traffic light placed on the ring of the roundabout.

The choice between these 2 last solutions depends on dimensions of the roundabout and on its distance with the level crossing. The statistical study of the starting time in the queue on a sample of various roundabouts made it possible to evaluate the time necessary after the passage for the red light to release the rails. It can be formulated like that :

- 5 seconds of yellow light
- + the time of course on 1/4 of the ring at the speed of 36 km/h (2 – 4 seconds)
- + 2 seconds for the starting of the first stopped vehicle
- + 1,85 seconds for the starting of each vehicle of the queue. The average interval in the 2 cars is counted at 7,50m.
- the speed of the last one to release the level crossing is 10 km/h.

The ministry for transport will make a specific publication soon .

ROUNABOUTS AND PERMANENT TRAFFIC SIGNALS

After the use of the temporary traffic signals for the management of particular cases of roundabouts, this question arises: what about permanent traffic signals on roundabouts?

Can we add the advantages of the roundabouts to those of the signal-controlled junctions?
Or are not we likely to add the disadvantages?

For the moment, we cannot answer and we study the case. A thing is sure; it will not be the same geometry of crossroads. Currently, we are working on the subject and we hope to publish a guide in 2006.

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Girabase <http://www.certu.fr>

Interurban junction design - grade intersection - Technical guide

http://catalogue.setra.equipement.gouv.fr/2_prod/telechargement.shtml