

INFLUENCE OF THE BYPASS ON THE CAPACITY OF ROUNDABOUT CROSSINGS

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Capacity of standard roundabout crossings is calculated after the Czech Manual TP 135. Micro-simulation model VISSIM has been used to evaluate the influence of the modification of the crossing – the use of bypass. The increase of roundabout capacity for 20 and 50 % of cars turning into bypass is presented. Naturally the impact of bypass is more pronounced for larger parts of turning cars. Similar graphs for other dispositions could serve as an amendment for designers of these crossings

Key words: roundabout crossings, capacity, bypass, micro-simulation, VISSIM

1 Introduction

There is a boom of roundabout crossings at present. Their capacity is evaluated after the official procedure given in the Czech Manual TP 135. The base for this method is the German Manual HBS 2001.

The recommended formulas for the calculation of the capacity and quality of the traffic are of course reliably applicable only for specific standard dispositions of the crossings and the traffic load.

The cases different from these "average" conditions are not typical for the method can be solved at present only by micro-simulation models.

Following lines describe one such nonstandard modification of the crossing – the use of "connecting branch" called sometimes in practice "bypass". It is an element that is not covered by the official methods for the calculation of the capacity and quality of traffic.

Micro-simulation model VISSIM

This model has a long tradition in Europe. Profession has been acquainted with its development and theoretical principles gradually since the sixties of the last century. Naturally the problem lies in its proper calibration, as the prerequisite for its functioning.

We have solved this problem using broad traffic investigations as well as by "visual check" of the simulation with the output in 3D.

The subject of calibration and visual check would need more detailed analysis which would be unfortunately out of the scope of this paper.

2 Definition of different types of bypasses and traffic conditions

The bypass as a functional element of roundabout crossing has an impact on the capacity – quality and security of the traffic. It is necessary to consider to which distance from the roundabout is the bypass still

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functional. The design of the proper type of turning from the entering branch and the connection to exit branch is important for the effective use of the bypass.

Calculation has to consider the main traffic flows (1 to 4) (see figure 1):

- Intensity of the traffic on the roundabout (1)
- Intensity of the traffic arriving on the roundabout (2)
- Intensity of the traffic using bypass (3)
- Intensity of the traffic on the exit branch (4)

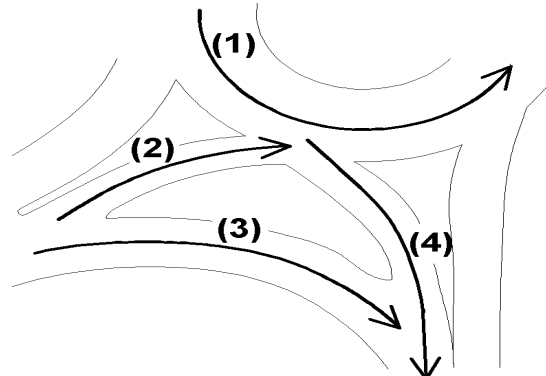


Figure 1 Decisive flows

Types of by-passes

- 1) Transition curve for turning and connecting
- 2) Turning and connecting wedge
- 3) Turning wedge and connecting lane
- 4) Turning lane and connecting wedge
- 5) Turning and connecting lane
- 6) Lane for entrance and exit of the bypass

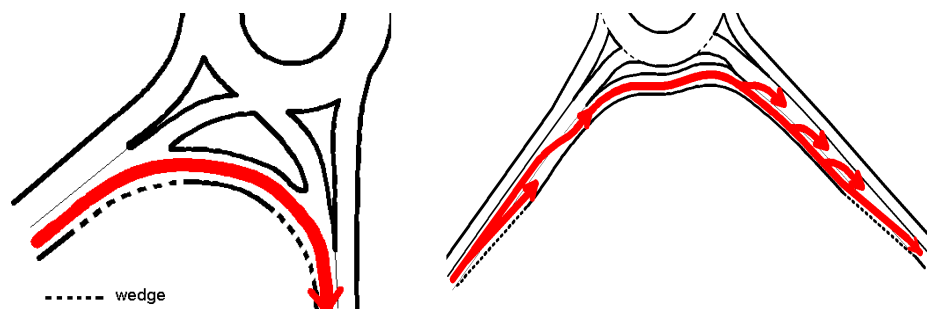


Figure 2. Basic types of bypass from the simplest one (wedge-wedge) to the most comfort one (turning – connecting lane)

Traffic conditions were taken in account by the ratio of the intensity of traffic turning right (into bypass) to the total entrance intensity.

3 Influence of the bypass and traffic conditions found by simulation

Selected final graphs of intensity on roundabout – capacity of entrance are presented below for the illustration of:

- various levels of quality of traffic LOS (UKD of the level A to D)
- various shares of turning flows (20% and 50%) as results of simulation.

The specific quantitative idea of the effect of the bypass can be obtained by the comparison of following two graphs. The green area represents the contribution of the bypass to the standard capacity of entrance for the ratio of the bypass entrance intensities 20% and 50%.

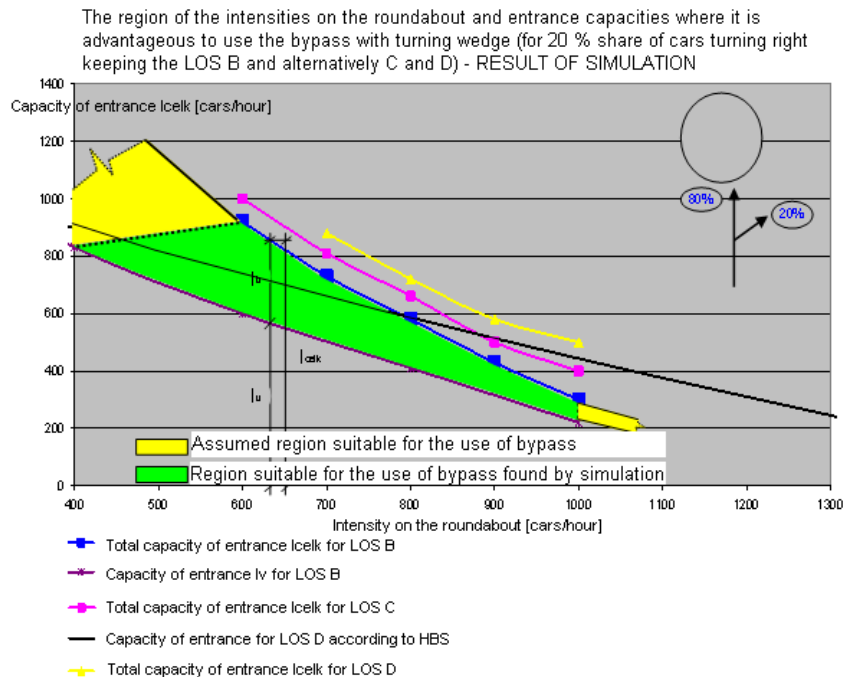


Figure 3 Capacity of the entrance and of the bypass for 20 % share of turning cars

(Iv is the intensity of the flow entering the roundabout, Io is the intensity of cars turning to bypass and Icelk is the total intensity of the entrance)

Case of 20 % turning

Intensity Io represents in fact the increase of the entrance capacity. This increase is from 350 to 50 cars/hour for the traffic quality level B and from 600 to 1000 cars/hour for the intensities on the roundabout. Similarly this effect can be deduced for the other traffic quality levels C, D respectively comparing with the average curve after HBS.

The contribution of the bypass is logically more important for lower entrance intensities (up to 800 cars/hour), for which the contribution is at least 200 cars/hour.

Case of 50 % turning

The effect of the bypass is distinctly greater for the same limit conditions. The increase is from more than 800 cars/hour (for the lower intensity on the roundabout) to more than 200 cars/hour (for the high intensity on the roundabout). Naturally this effect will be even greater for decreasing LOS.

We must take in account that these effects were obtained for the simplest disposition of the bypass that is turning and connecting by the wedge.

The region of the intensities on the roundabout and entrance capacities where it is advantageous to use the bypass with turning wedge (for 50 % share of cars turning right keeping the LOS B and alternatively C and D) - RESULT OF SIMULATION

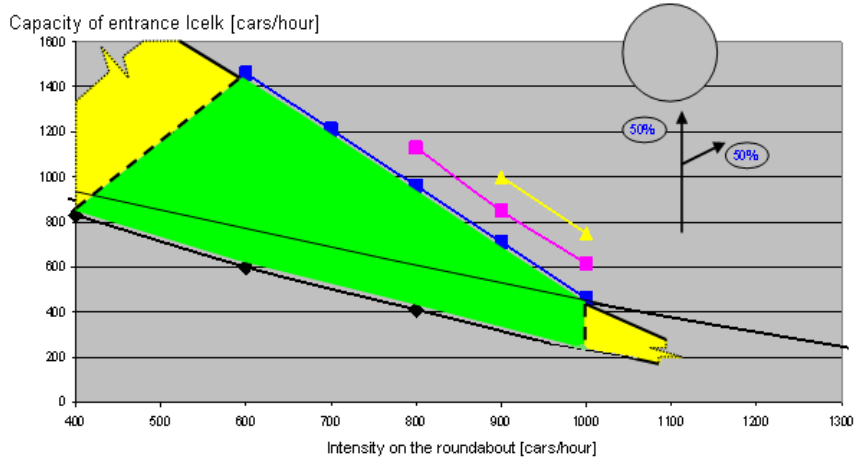


Figure 4 Capacity of the entrance and of the bypass for 50 % of turning cars

Legend according to Figure 3

Continuous representation of this functional property is presented in the graph on the figure 5. Full curves are the results of simulations, dotted parts of the curves are assumed relations

Capacity of the bypass related to the percentage share of cars turning into bypass for the LOS B

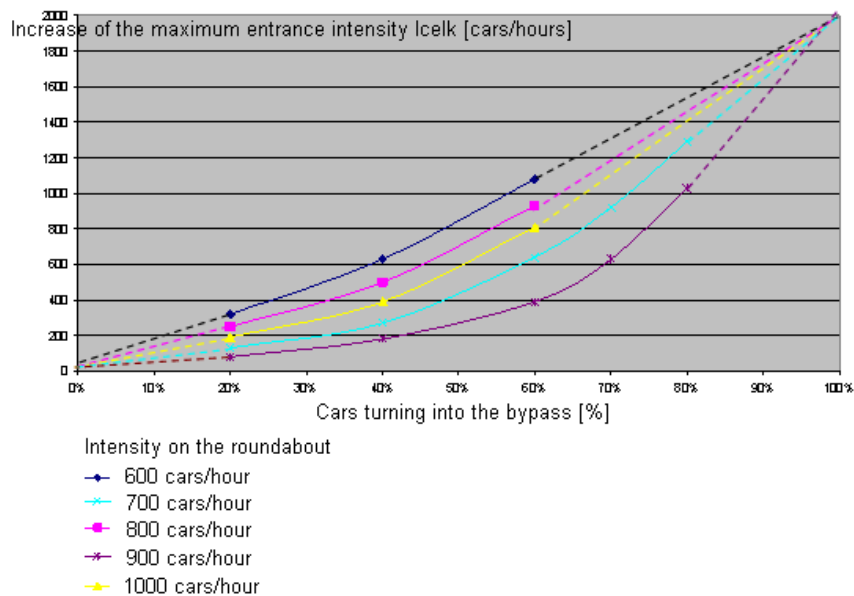


Figure 5 The increase of the entrance capacity for various shares of turning cars

4 Conclusions, recommendations

The results of simulation for very simple disposition of the bypass show an unexpected contribution of the bypass for the increase of the capacity of entrance and thus of the whole roundabout.

It would be useful to create similar graphs for other dispositions of the bypasses that would serve as an amendment for designers of these crossings for following input parameters:

- type of the bypass,

- ratio of flow turning into the bypass to the total entrance intensity
- demanded traffic quality levels B to E.

Reference literature

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