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## Efficiency Analysis of Roundabout with Traffic Signals

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### Abstract

Roundabouts begin to be used more often instead of crossroads with traffic signals. A simulated model was applied for the performance assessment of a roundabout. The modeling of a roundabout confirmed the existence of big transport delays at this site of the street and road network. To prevent congestion at roundabouts it is necessary to know that crosswalks located in direct proximity to driveways/exit roads of a roundabout seriously reduce its traffic capacity.

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*Keywords:* roundabout; traffic stream; VISSIM; traffic capacity

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### 1. Introduction

Junctions play an important role in functioning of the street and road network. In places where several roads connect, junctions make it possible to control a number of vehicles which can move at the same time on the connected roads. The traffic capacity of a junction in urban conditions directly influences the traffic capacity of all the street and road network of the city, especially on roads with high traffic densities.

It is necessary to direct crossing and turning traffic streams in such a way as to ensure maximum safety and performance of a junction [SE "ROSDORNII" (2006)].

The number of roundabouts is constantly growing in Russia at the junctions of the main roads with average or big densities.

When designing or reconstructing a junction engineers often face a choice between a roundabout and a crossroad

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with traffic signals. In order to make a choice it is necessary to define which of these junctions has bigger traffic capacity [SoyuzDorNII] (1975)].

A roundabout which is correctly designed has increased traffic capacity in comparison with the unregulated traffic. The increase in traffic capacity is observed even when the streams of turning vehicles prevail [MADI (1980).

However, the existence of big pedestrian and bicycle streams reduces positive effects of roundabouts to zero. The majority of traffic circles is built in places with high population concentration where dense pedestrian streams are expected. According to the Traffic Rules of the Russian Federation a driver is obliged to reduce the speed beforehand before a crosswalk and to let pedestrians pass even if there is only one of them [State Duma (1995)]. So, a combination of pedestrians crossing the road in direct proximity to the traffic circle and big traffic streams driving in the traffic circle reduces the total traffic capacity and a level of transport service of roundabouts.

This effect is widely known, however, it is hardly possible to determine precisely the critical levels of traffic and pedestrian streams at which problems arise, as traffic circles are often designed individually, without taking into account transport and construction recommendations [CJSC “SoyuzDorNII” (2013)].

Pedestrians crossing a road influence both incoming and outgoing streams of vehicles of the roundabout. The influence on outgoing streams is more important as the vehicles leaving the roundabout can block the streams from other road junctions, which leads to reduction of traffic capacity of the site of the street and road network.

## 2. Preparation of the model

The performance of a roundabout directly depends on the balance of traffic streams [MADI (2012)]. It can appear, for example, when a stream from the main direction blocks a driveway to the traffic circle from the secondary directions or in cases when a left stream prevails from the main direction. Similar situations cause traffic jams and delays when moving on this site of the street and road network.

The main stream on the traffic circle can be:

- Big continuous traffic stream
- Small but constant stream from the secondary direction which has an advantage over the main one

The PTV VISSIM software is intended for building computer models of sites of the street and road network. In the present work this software was used for the analytical analysis of a roundabout with traffic signals.

The input data was collected by means of video filming at the roundabout of Vasilevsky Square and two nearby crossroads [FSUE “ROSDORNII” (2013)]. The roundabout was modeled by means of VISSIM [PTV AG (2015)]. Two cases were considered at microscopic modeling: with pedestrian streams and without them. The configuration of the roundabout is presented in Figure 1.

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