EXPERIMENTAL INVESTIGATION INTO SPEED PERFORMANCE AND CONSISTENCY OF URBAN ROUNDABOUTS: AN ITALIAN CASE STUDY

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The most important variable in roundabout geometric design is speed and its prior selection represents a fundamental step for road designers’ and traffic engineers’ activities. This is a key factor in maintaining roundabouts as a safe intersection typology.

Design and operating speeds were evaluated in an experimental investigation carried out on some urban roundabouts. The results obtained focus mainly on possible divergences between predicted design speeds and observed operating speeds. The aim of this study is to determine if design consistency has been achieved and also to establish what kind of defects might be responsible for any inconsistencies. Field observation highlighted the case of a roundabout characterized by tangent entering legs that generate anomalous speeds, which are greater in the circulatory roadway than in the approach legs. Comparisons with available speed equations are presented and discussed in the paper.

SITE CHARACTERISTICS AND DATA COLLECTION

Municipality of Cuneo (Italy)
55,000 people
Northwest of Italy
35 urban roundabouts in the jurisdiction

Post speed limit in urban areas: 50 km/h

Two speed survey methods:
1. Longitudinal with Laser Speed Gun
2. Transversal and longitudinal video recording

The hypothesis synthesized in the figure below is well supported by observations reported in Mousone et al. (NCHRP 572 Report). In the case of a four-leg urban roundabout they found that the speeds in the circulatory roadway are almost constant, with a slight increase from the center of the circulatory roadway to the exit section.

Conversely, the model proposed in the NCHRP 572 Report considers operating speeds that decrease until the minimum value of $V_{35}$ is reached in the central point $P$ of the trajectory, after which the operating speeds increase.

DATA ANALYSIS

The use of linear equations for the modeling of the speed-space relationship was found useful for each speed profile and the five sub-sections indicated in the figure were derived in accordance with the approach of McDonald, Houssell, and Kimber.

Data treatment

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DATA TREATMENT

The hypothesis synthesized in the figure below is well supported by observations reported in Mousone et al. (NCHRP 572 Report). In the case of a four-leg urban roundabout they found that the speeds in the circulatory roadway are almost constant, with a slight increase from the center of the circulatory roadway to the exit section. Conversely, the model proposed in the NCHRP 572 Report considers operating speeds that decrease until the minimum value of $V_{35}$ is reached in the central point $P$ of the trajectory, after which the operating speeds increase.

Italian urban roundabouts are mainly created by the conversion of existing at-grade intersections. This fact explains why most Italian roundabouts, in particular those located in historical urban areas with significant environmental constraints (lack of space, buildings, and monuments in the vicinity) affecting their layout, do not conform to the standard guidelines.

In roundabout design it is fundamental to appropriately select their geometric characteristics in order to assure that during their service life they can function as an efficient speed control measure. The control of speeds at entry is also important in light of the safety implication that have already been discussed and reported in literature.

These observations, taken together, prove what has already been stated in NCHRP 572: current state-of-the-art speed prediction methods significantly overestimate entry and exit speeds, particularly for entry paths and exit paths that are tangential or nearly tangential.

The model here presented is a tool for predicting the operating speed in the circulatory roadway of urban roundabout. The variables such as those proposed in this research project and by Chen et al. (3) should be included in an up-to-date of current speed prediction models.