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## Proposals for Improvement of the Italian Roundabout Geometric Design Standard

Alfonso Montella<sup>a\*</sup>, Shane Turner<sup>b</sup>, Salvatore Chiaradonna<sup>a</sup>, Dave Aldridge<sup>b</sup>

<sup>a</sup>University of Naples Federico II, Department of Transportation Engineering, Via Claudio 21, Naples 80125, Italy

<sup>b</sup>Beca Infrastructure Ltd, 21 Pitt Street, Auckland 1010, New Zealand

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### Abstract

The paper presents a critical review of the Australasian, EU and US roundabout geometric design standards and guidelines and identifies inconsistencies of the Italian roundabout standard which deserve improvement. As a result, recommendations for improvement of the Italian standard are proposed. These recommendations are mainly based on the concepts of design flexibility and performance based design. Indeed, rigid standards which do not really take into account safety and operational consequences of the design decisions and the need to balance opposite demands might produce undesirable outcomes.

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### 1. Introduction

Intersections constitute only a small part of the overall highway system, yet intersection crashes constitute a significant portion of the total crashes [1]. To reduce crashes and increase capacity, many intersections have recently been converted into roundabouts [2]. In France, the number of roundabouts increased from 500 to 25,000 in twenty years [3]. In Denmark, single-lane roundabouts were used for decades mainly due to safety problems but the number of multi-lane roundabouts is increasing for capacity reason; today there are more than 1400 roundabouts. In Switzerland, there are approximately 2,000 roundabouts within a road network of approximately 71,000 km [4]. In the U.S., the number of roundabouts increased from less than 100 in the year 1997 to about 1,000 in the year 2007. The use of roundabouts improves intersection safety by eliminating or altering conflict types, reducing crash severity, and causing drivers to reduce speeds [5-8]. Indeed, large and highly significant

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\* Corresponding author. Tel.: + 39 081 7683941; fax: + 39 081 7683946.  
E-mail address: [alfonso.montella@unina.it](mailto:alfonso.montella@unina.it)

crash reductions were observed following a conversion of signalized and stop-controlled intersections to roundabouts [9].

Despite the good safety record, roundabout performance strictly depends on the design features and several issues that significantly affect both crash frequency and severity are observed in existing roundabouts [10-12]. Indeed, in several countries official design standard and/or guidelines for roundabouts have been developed only in the last years. Since several inconsistencies in the roundabout design practices and standards are observed, in this paper a critical review of Australasian [13, 14], European [5, 6, 8, 15-18], and North American [2, 7, 9] roundabout guidelines and standards is presented. It is noteworthy to observe that in Italy there are both regional and national standards and that the Lombardia Region standard prevails against the national standard. Based on the critical review of the standards, some recommendations for update the Italian roundabout standard are presented.

## 2. Roundabouts classification

### 2.1. Mini-Roundabouts

In Australia and New Zealand (NZ), there are not any mini-roundabout design standards. While there are a few mini-roundabouts, they are not popular and are progressively being replaced with single lane roundabouts. In all the other countries, mini-roundabouts are a design option only on local roads (Table 1). Indeed, mini-roundabouts are best suited to environments where speeds are already low and environmental constraints would preclude the use of a larger roundabout. In some countries, speed requirements are specified. In the US and UK, roundabouts are allowed only on roads with operating speeds ( $V_{85}$ , 85<sup>th</sup> percentile of speed distribution of isolated vehicles in dry weather) respectively below 50 and 56 km/h. In UK and France (CERTU, 1999), maximum speed limit is respectively 48 and 50 km/h.

Table 1. Mini-roundabouts design characteristics

Parameter	USA	UK	France CERTU	Switzerland	Italy-Lombardia Region	Italy-National standard
Highway type	Local	Local	Local	Local	Local	Local
Operating speed ( $V_{85}$ )	$\leq 50$ km/h	$\leq 56$ km/h	-	-	-	-
Speed limit	-	$\leq 48$ km/h	$\leq 50$ km/h	-	-	-
Minimum traffic	-	2-way AADT of all legs $\geq 500$ v/d	-	-	-	-
Maximum traffic	AADT $\leq 15,000$ v/d <sup>a</sup>	-	-	AADT $\leq 15,000$ v/d $V_{ent}+V_{cir}$ $\leq 1,200$ v/h	-	-
Inscribed Circle Diameter	$\geq 13$ m $\leq 27$ m	$\leq 28$ m	$\geq 15$ m $\leq 24$ m	$\geq 14$ m $\leq 26$ m	$\geq 14$ m $\leq 26$ m	$\geq 14$ m $\leq 25$ m
Central island treatment	Fully traversable	Flush or slightly domed $h \leq 0.10$ m $d \leq 4$ m	Domed $0.10 \leq h \leq 0.15$ m	Fully traversable ICD $\geq 18$ m Non-traversable + truck apron	Fully traversable ICD $\geq 18$ m Non-traversable + truck apron	Fully traversable ICD $\geq 18$ m Non-traversable + truck apron
Splitter islands treatment	Raised, traversable, or flush <sup>b</sup>	Kerbed or flush	Kerbed or flush	-	-	-

<sup>a</sup> Typical daily service volume on 4-leg roundabout below which may be expected to operate without requiring a detailed capacity analysis.

<sup>b</sup> Generally discouraged.

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