

HOW TO MAKE TRAFFIC CALMING MORE WALKING FRIENDLY: DIRECTIONS TO INCREASE INTERSECTIONS PERFORMANCES FOR PEDESTRIANS

Maria Vittoria Corazza, Paola Di Mascio

University of Rome "La Sapienza", Faculty of Engineering, Hydraulic Transportation and Roads Department.

address: Dipartimento di Idraulica Trasporti e Strade - Università degli Studi "La Sapienza", Roma; Via Eudossiana 18, 00184 Roma; Tel: + 39 06.44585115 - Fax: + 39 06.44585121 – E-mail: corazza@uniroma3.it; paola.dimascio@uniroma1.it;

Introduction

Traffic calming is usually implemented to manage and to slow down fast vehicular flows in residential areas, to avoid queues, to increase traffic fluidity, etc. Sometimes it is useful to make intersections safer for pedestrians, but it is seldom designed to guarantee also comfort, ease and accessibility for vulnerable users.

The common cliché that roundabouts are more suitable to calm drivers than to make pedestrians crossing is the result of this kind of old design practice, that doesn't take into account the context of application. These are also the reasons why roundabouts are preferably located at intersections with high traffic volumes, than in quiet residential streets. On the contrary, in zones with low traffic and speed limits, intersections, if re-designed according to the formal schemes of small/medium roundabouts, are very suitable to become protected, comfortable and appealing places for pedestrians, besides being safe junctions for drivers.

This paper deals with two case studies of the research "Widespread interventions in urban areas for the creation of best solutions for the pedestrian mobility", funded by MIUR - Ministry of the Education and University and run by DITS – Department of Hydraulic Transportation and Roads, of University "La Sapienza", of Rome.

Roundabouts typology

There are many ways to classify a roundabout: according to the yield pattern, to its approach lanes, speed, etc.

The typology proposed by the U.S. Federal Highway Administration (FHWA) is maybe the most complete, since it is based on the statement that “a roundabout is a type of a circular intersection, but not all circular intersections can be classified as roundabouts”. FHWA¹ individuates:

- *Rotaries*: old-style circular intersections, typical of USA roads up to the '60s, with a large diameter (even > 100 m), and where circulating traffic yields to entering traffic.
- *Roundabouts*: circular intersections with specific features as yield control of entering traffic, channelized approaches, appropriate geometric curvature to slow speed (< 50 km/h).
- *Neighborhood traffic circles* at intersections of local streets for traffic calming or “aesthetics” reasons.

Leaving aside rural roundabouts, according to FHWA there are four basic sub-categories for urban environments:

- **Mini roundabouts**
Small roundabouts in low speed areas, useful in environments with right of way constraints or with insufficient right of way for compact roundabouts. The central island is mountable and benefits for pedestrians are due to the short crossing distances (perpendicular pedestrian crossings on the legs, at splitter islands) and to the low vehicular speed.
- **Urban compact roundabouts**
This is an extended version of the previous sub-category, since extra elements are required to ensure a good performance of this scheme and same goals, in terms of pedestrian safety, are achievable. The central island is not mountable and it could require an apron around it; also the surrounding sidewalks need landscape buffers; moreover raised splitter islands incorporate at-grade pedestrian storage areas. As for the previous type, capacity is not a critical issue.
- **Urban single-lane roundabouts**
They have a single lane entry at all legs and around the central island, as the compact type, but they have a larger inscribed circle diameters and more tangential approach ways; higher vehicular capacity and consistent entering and exiting speeds are important features of this kind of roundabout.
- **Urban double-lane roundabouts**
They are characterized by two entry lanes at least on one approach and by wider circulatory roadways; special attention must be paid to design bike and pedestrians pathways, but benefits in term of shortness of walking distances are far from being achieved.

Roundabouts thence differ from other circular intersection because of the following features: traffic control (yield control on all entries); priority to circulating vehicles (they have right-of-way); pedestrian accesses (only across the legs of the roundabouts); no parking allowed; counter-clockwise circulation on the ring. On the contrary, stop control or no control at all

¹U.S. Department of Transportation - Federal Highway Administration, “Roundabouts an informational guide”, 2000 [available on: www.fhwa.dot.gov](http://www.fhwa.dot.gov)

can occur on traffic circles, circulating traffic can be required to yield to entering traffic, pedestrians can cross through to access to the central island, parking can be allowed.

Moreover, from this first categorization, it is clear that most of the “roundabouts” of the residential or downtown areas are, indeed, real neighborhood traffic circles.

According to Swiss Standard SN 640263, roundabouts can be divided into just two categories, according to their external diameter and to their configuration: the compact ones (for high traffic environments, external diameter between 26 and 40 m, not mountable central island) and the mini ones (for local traffic, external diameter between 14 and 26 m, mountable or semi mountable central island); mini roundabouts are recommended to be avoided in case of high pedestrian traffic. In the 1997 Roundabouts Swiss Guide², however, such categorization is enlarged up to three types, according to size, to environment of application and to limitations of maneuvers: big roundabouts, compact roundabouts, and mini roundabouts (with semi/fully mountable island). No special devices are foreseen for pedestrians, but crossing points on the legs.

CERTU's French recommendations³ are basically in accordance to what stated in the Swiss case (big/compact and mini roundabouts) with slight differences for what concerns the related size; also in this case usual pedestrian crossings on the legs are recommended, taking care to locate them at a suitable distance from the “give the right” sign (not farther than 2-5 m).

Italian prescriptions on roundabouts are currently under revision⁴, anyway three kinds of roundabouts can be listed: the so-called “conventional” ones (i.e. big roundabouts with legs with the same width up to the accessing point), the compact ones (with a smaller diameter in comparison to the conventional ones and with legs with enlargements at the accessing points) and the mini roundabouts.

Same approach can be found in prescriptions from other Countries; in Norway, for instance, classification pattern is very similar to the other European cases, assuming as main criteria the diameter of the central island and the inscribed circle diameter. They lead to classify roundabouts into large, medium, small and mini⁵.

Table 1 summarizes the main characteristics of roundabouts according to different national standards.


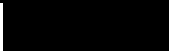





²EPFL, “Guide Suisse des Giratoires”, cahier TEA n.10, Department de Genie Civil, Lausanne 1997

³ Gauvry, P., et al., “Carrefours urbains - guide”, CERTU, Lyon 1999

⁴ see the 2001 in-depth study “Norme sulle caratteristiche funzionali e geometriche delle intersezioni stradali” run by University of Rome “La Sapienza” and by University of Trieste, on behalf of the Ministry of Infrastructure and Transportation - Ispettorato Generale per la Circolazione e la Sicurezza Stradale

⁵ Statens Vegvesens “Veg-og gate- utforming”, n.17

Table 1 - Main characteristics of roundabouts according to different national standards

		Inscribed circle diameter (m)	Circulatory roadway width (m)	exit width (m)	entry width (m)	exit radius (m)	entry radius (m)	central island radius (m)	distance of crossings from yield line (m)	Capacity (v/d)	entry speed (km/h)	speed on the circle (km/h)
Compact roundabouts	medium	30 -40 26 - 40 31 - 45 33 28 - 30 26 - 35	≤ 6 8 - 11	 4 - 5	6 7 - 8 3 - 4 3,5 - 3	10-12 ≤15 12	 8 - 15 10 - 12	 ≥ 25 ≥ 6,5	7,5 > 5 5	20000 25000	35	30-40
	small (1 lane)	25 - 30 26 - 30	7 +1,5 8 - 11 7		4.3 -4.9	15 - 20	10-15	≥ 5 3,5 - 4	 2	15000	25	
Mini roundabouts		13-25 14 - 20 ≤ 25 7,5 - 12 14 - 26	7 +1 7 - 8	 2,75 - 3,5	 2,5 - 3,5			4 < 4 1,5 - 4 1,5 - 2,5		10000	25	30 - 50
caption												
	Italy	USA	France	The Netherlands	Switzerland	Norway	Germany	For references see footnotes 1-5				

The roundabouts names can vary, as well as their size and some criteria to define them, but their concepts is still linked to vehicles circulation, even when, as in the case of mini roundabouts, they can be implemented in sites where pedestrian traffic can become very high in some periods of the day.

Moreover, since the wording "mini" reminds of "tiny places", mini roundabouts are implemented in small squares or intersections where the scheme of *traffic circles* could be more appropriate. The "car-friendly nature" of mini roundabouts is proved by the matter that crossing points are located outside the ring, on the legs, so to locate pedestrian flows far from the core of the intersections. Coexistence between motorized and non motorized modes of transportation seems to be forbidden in the design practice when dealing with circular sites (they can just turned into pedestrian areas), while on the contrary it is very common when tackling longitudinal axes: boulevards and alleys can become spaces shared by pedestrians and cars: Why this does not occur to small intersections and little squares? The answer is simple: in the current road engineering practice, small/mini roundabouts formal features seem to fit so well to these spaces that their implementation becomes natural, easy, just taking into account drivers' problem and discarding the overall pedestrian needs.

Nevertheless, this analysis on roundabouts reveals that is not possible to apply such regulatory scheme to whatever intersection or crossing point because of problems related to geometry or to capacity; in the same time, in urban contexts, spaces thanks to both formal (for instance: central plans, double axes of symmetry, homogeneity of buildings façades, etc.) and functional (mix of activities, different modes of transportations, crossing facilities) features could be shaped according to the requirements typical of roundabouts. These sites are indeed a special kind of traffic circles and they could be called "small central places" because of the following features

- Area < 10.000 sqm
- Central plan
- Main residential use, plus other everyday life activities
- Strong pedestrian flows (> 3000 p/d)
- Low vehicular flows (< 6000 v/d)

Such characteristics call for a special design process in which main requirements from drivers and pedestrians are equally met and the urban characteristics represent an added value in favor of vulnerable users.

Intersections and squares: a need of filling voids

Big and small squares are typical features of many urban patterns, since ever. According to their size, they can host more or less functions or play major or minor roles: they can act as the city parlor, as the market place, as the political core of a community, as sport or play grounds, as well as just sites where to stroll. However, independently to their shape, geometry and dimensions they are central places, geometric forms traditionally apt to gather people and their walking-linked activities.

They phisically represent the citizens' "droit à la ville", described by Henri Lefebvre in 1901⁶, i.e. a place where citizens can participate to the community life.

6 Ansay, P., Schoonbrodt, R., "Penser la ville", AAM Editions, Bruxelles 1999, page 477

According to Lynch⁷, these sites are “nodes” or centers of activity, strategic places for the city, with manifold functions, in terms of meaning of the urban environments. In particular for what concerns transportations, they can be:

- union points (more flows concentrate in one site)
- “merge” points (more flows merge in one)
- interruption points (one flow is stopped by another one)
- crossing points (one flow goes through another)
- exchange points (from a flow/structure to another)
- concentration points (due to high density of functions)

Lynch observes that nodes are strictly linked to paths, since they are events while walking, and, transferring a concept he developed about the open-space design, he also stresses that “a balance between openness and the articulations that allow mixed occupancy and use”⁸ is required, and further “we want spaces that reflect the complexities of our social life”.

All the Lynch’s statements become very important because they concern nodes or central places whatever size they are, whatever kind of traffic, motorized or not, is present. Moreover, these places are strongly characterized by the presence of more modes of transportations.

So, point is: if central places are, theoretically, these very special parts of the cities, really based on mix of activities, events and traffics, why, nowadays, the only tool to design them do seem to be based on “separation”? Because of safety from traffic reasons. This is a top priority to take into consideration when dealing with traffic phenomena, of course, and not worth to be further discussed in this case, since its gravity is clearly known.

But this is not the only reason. Indeed, in longitudinal axes, where traffic risks are the same, coexistence among motorized and non motorized modes of transportation is widely applied, while when dealing with squares or, more in general, with circular/central sites this is not so common, as stated above. A possible reason could rely on the size of these places. In ancient times, a central place, i.e. the city square, was the biggest, in term of size, among the spaces available in a settled community. Only when urban planning became a tool to govern cities development, the diversification of indoor and outdoor spaces allowed the citizens to differently perceive several kinds of open sites, as for instance, the place in front of the church, the market square, the park, etc. A perception based both on the functions these spaces hosted and on the size these spaces were required to have, in relation to their use.

The literature on the appropriate size of streets and squares, as well as on the attempts to describe the “ideal city” by the most appropriate proportion is wide and lasted up to the XX century. However the common practice is very far from theory: sometimes squares have been judged or felt as too big, or just as not appropriate, in terms of size, to the activities they concentrated. The extreme consequence of this feeling is agoraphobia, but the fear of open spaces reveals a special attitude of urban governors and citizens, i.e. the need of filling empty spaces with objects. Prompt examples could be Renaissance plazas whose centers are equipped with fountains, columns, arches, but these elements played and still play just the role of landmarks. Indeed, from the XVII century the more empty room was available in a

7 Lynch, K., *L'immagine della città*, Marsilio, Venezia 1964, pag. 66.

8 Banerjee, T., Soutworth, M., (ed.), *City sense and city design*, The MIT Press, Cambridge 1990, page 415

square, the more it was filled with others "spaces". Typical examples of this attitude⁹ are the transfer of the "rond points" (intersection points in the spider web of pathways that formed the hunting forests so loved by the French nobility) to cities: a social gathering place in the green could be easily become a focal point in a square; another example is represented by the XVII squares of London (St. James, Grosvenor, Cavendish, Hannover, etc.), whose centers have been landscaped by little gardens.

Mutatis mutandis, these supposed available spaces of many central places, in the XX century, have been devoted to parking lots, so where once there were nice elements of the urban landscape, nowadays there are surrounded by cars. This "urban disease" affects negatively all the central places, even the simple intersections, where the glut of surfaces is invaded by vehicles and, sometimes, misused as free parking lots. But the filling attitude goes on, turning into a kind of vicious circle. Indeed, the most appropriate device to rule car massive invasion to central places is solved by imposing a new object: the roundabout, whose own traffic schemes and rules cannot always perfectly fit to whatever central site. For small central places a solution could be to leave aside the roundabout as an object but to consider these empty spaces as areas where coexistence can rule and can impose priorities (of course, this doesn't mean that urban furniture must be banned from these sites).

Two case studies in Rome

Two circular squares have been selected to study how to improve pedestrian performances at roundabouts. They are located in Rome, at the Trieste District, a quite central area, born at the beginning of the XX century, and developed during the '20-'30s as residential district for the upper class. Nowadays, dwellings have partly turned into business and the area is not so a la page as it was before, but both the original planning scheme and the architectural features have been preserved well. The two squares are: Piazza Mincio and Piazza Caprera. Both sites have many features in common (table 2): they have an area under 4000 sqm, have a mix of activities at ground level and in the areas nearby (so that they play the role of illegal parking basin in some period of the day), they are currently managed as roundabouts but actually they do not operate in that way, as surveys demonstrate, and eventually both are characterized by a homogeneous building high quality and by a fountain in the middle.

⁹ Spreiregen, P.D., *The Architecture of towns and cities*, McGraw-Hill, New York 1965, page 19

	<i>Piazza Mincio</i>	<i>Piazza Caprera</i>
area (sqm)	3900	2500
activities in the squares	school, residences, offices	school, residences, offices, shops, cafes
activities in the surrounding areas	residences, church, offices, cafes, restaurants, club, shops, embassy	residences, offices, cafes, restaurants, park, gym centre
average pedestrians flow	4000 pedestrians/day	3200 pedestrians/day
average cars flow	5000 cars/day	4000 cars/day
traffic scheme	roundabout	roundabout
speed limit	50 km/h	30 km/h
circulatory roadway width (m)	4-5.50	10
parking on the circle allowed	yes	no



Photos on left: Piazza Mincio (top), Piazza Caprera (bottom)

Surveys have been run in order to check the real traffic pattern and to quantify modal shifts. Surveys took place during Winter and early Spring 2003, mainly in the mornings (so to verify the influence due to school time) and in the late afternoons (so to assess traffic caused from the way home of residents and employees). First important result from the survey was that car traffic is very low, with an average of 5000 vehicles/day in Piazza Mincio and of 4000 vehicles/day in Piazza Caprera, so very below the rate usually suggested for implementing roundabouts.

This aspect supports two other important features of both squares: a very high pedestrian traffic and the particular walking occupancy pattern. For what concerns Piazza Mincio pedestrian traffic is about 4000 persons/day and in Piazza Caprera is about 3200 persons/day, figures practically comparable to vehicular capacity. Such high values can be explained by the presence of the two high schools and of the several offices in the area.

Walking directions in both squares are absolutely unpredictable, but it is clear that pedestrians don't use sidewalks and zebras as the "maps" of most used paths demonstrate. Surveys underlined, as in Figure 1, that in both cases there are some preferred directions, due to some specific origins/destinations (bus stops, schools entrances, shops, etc.), but to reach them pedestrians prefer shortcuts across the squares rather than follow sidewalks circular profiles, walking in the middle of the carriageway. This allows to save an average of 10 meters per path, but in some case shortcuts can be 20 meters shorter than the same O/D path along the square perimeters. Even when zebras cross the square, as in Piazza Caprera, pedestrians prefer to follow other directions.

Cars very often yield the priority to pedestrians and run very below the speed limit because of the geometry of the sites, but not because of the roundabouts since in both cases circulatory lanes are very wide as well as entry widths.



Figure 1 – Most used pedestrian paths at Piazza Caprera (left), Piazza Mincio (right)



Figure 2 – Pedestrians crossing at Piazza Caprera (left), Piazza Mincio (right)

Parameters and suggestions to upgrade small central places and to convert them into coexistence spaces. An application on the case studies

Given the erratic behavior of pedestrians and their high number in both sites, it is clear that they are the main users of both squares and that such spaces are not suitable to meet walkers requirements. A redesign of both sites is required aiming at turning them into livable environments for pedestrians and at changing the current circulatory systems into central places, where traffic rules are based on coexistence and pedestrian priority.

This design methodology is based on the awareness that to rehabilitate urban areas it is necessary to take into account inhabitants' needs, in terms of accessibility, safety, comfort, look and to compare them with the places performances. A list of the considered requirements for the two upgrading proposal is here reported:

Table 3 – List of requirements

<i>pedestrians requirements in terms of:</i>		<i>places performances to meet pedestrian requirements by interventions at:</i>		
		<i>piazza mincio</i>	<i>piazza caprera</i>	
<i>accessibility</i> (exchanges opportunity for all) ¹⁰	removal of architectural barriers	same level for sidewalks and carriageways		
	creation of facilities for disabled	artificial guiding paths for ill-sighted/blinds		
<i>safety</i> (prevention from traffic risks)	reduction of speed limit	30 km/h enforcement		
		sharing space		
		partially dedicated lane by bollards		
	change of environment	raised carriageway		
		narrowed carriageway at legs		
			pedestrianization	
		gate at legs		
colored paving materials				
<i>comfort</i> (physical and psychological proper use)	well-being related to:	visual perception	absence of glare sources	
			different lighting systems	
		thermal factors	vegetation	shadowing system
		acoustic factors	water	
	ease	anti noise paving materials		
		facilities for resting		
		facilities for drinking		
		even surfaces		
	security		anti slippery surfaces	
	<i>function</i> (management, flexibility to events)	accessibility to emergency vehicles/garbage collection trucks	creation of dedicated lanes	
cleanliness		garbage collection along the legs		
closure for temporary events		water run off		
		school meetings		
<i>contact</i> (privacy/relationship)	space re-gain	removal of parking lots on the ring	outdoor garage sale	
	reduction of conflicts among the users		pay for parking along the legs	
			dedicated spaces for outdoor cafes	

This is just a synthesis of what pedestrians can demand, so every requirement can be split in specific sub-categories or others can be added to the list.

For instance, since in this case both places are very rich of vegetation and water (due to the many private little gardens surrounding every building and to the two fountains), no further care has been paid to environmental factors as usually happens in urban re-design proposals.

The design proposals

The two following drawings illustrate the design proposals for the two case studies. They results from the analysis of the requirements listed above and are aimed at upgrading these two small central places to sharing spaces for pedestrians. The main design choice are summarized as follows:

¹⁰ Engwicht, D., Reclaiming our cities and towns, New Society Publishers, Philadelphia 1993, page 167

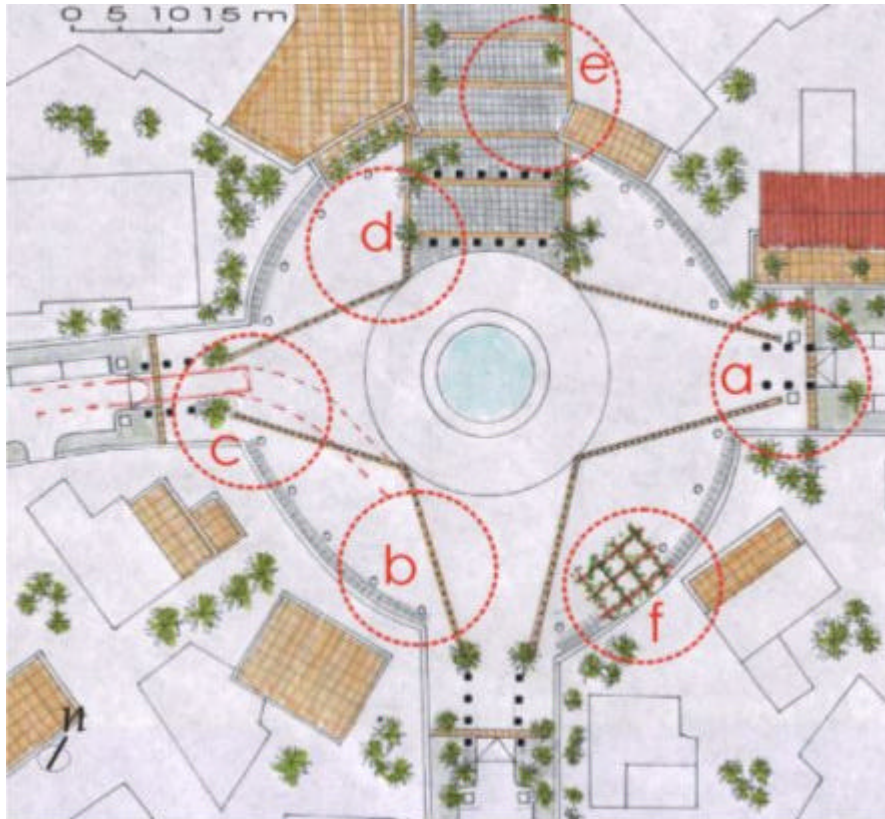


Figure 3 – Piazza Caprera design proposal

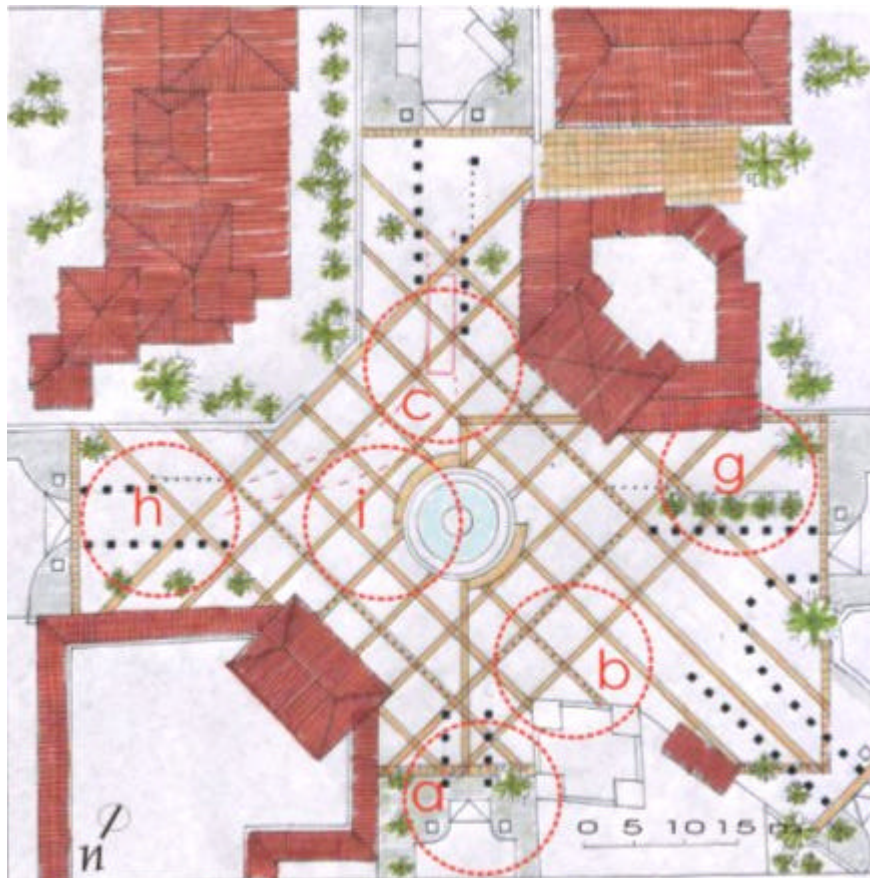


Figure 4 – Piazza Mincio design proposal

a – *entrance gate*: given the change of environment for drivers, entrance gates are requested at every leg. They lead to a raised parterre at +0,15 m, i.e. to the shared space for pedestrian and drivers, by a ramp. The gates are characterized by trees, by small lighting poles, integrating the existing lighting system, and by cut-off lamps so to allow pedestrians to see and being seen; both lightings and vegetation are meant as alerting elements for drivers. The raised parterre at Piazza Caprera is made of asphalt concrete, and at Piazza Mincio is made of imprinted cement concrete slabs, lined with paving concrete blocks. Both pavements are cheaper than traditional stone surfaces, moreover asphalt concrete has lower construction costs in comparison to the cement concrete ones, but the latter require less maintenance.

b – *artificial guiding paths for blind/ill-sighted people*: these paths are made by modular square tiles, made of cement concrete (at Piazza Caprera) or of paving concrete blocks (at Piazza Mincio), creating an uneven surface (an “alphabet”) detectable by canes, so to guide sight-impaired people towards the most important destinations. Other natural guiding elements can be the shadow and smell provided by vegetation and the noise from the fountains water

c- *emergency vehicles lanes*: all the areas are fully accessible to emergency and garbage collection vehicles; spaces are designed according to the *SN640271a* Swiss Norm curves.

d – *dedicated lanes*: to avoid drivers illegal behaviours, a lane, fenced with bollards, have been designed in the crossing point between the sharing space and the pedestrian area (see point e). Small *prunus prunea* trees (typical of the surrounding streets) play the role of alerting elements. Such trees are very resistant to the polluted environment and require quite no maintenance.

e - *pedestrianization*: given the high pedestrian traffic flow resulted in the survey, one of the leg has been turned into pedestrian area, creating a safe link between the square and a high school nearby. The paving is made of *sampietrini* (the local small size wedge stone), bordered with asphalt stripes. The pedestrianization implies the removal of about 40 parking lots.

f – *the school entrance*: one of the most crowded spot in the square is the area in front of the high school entrance, where students stay also when school time is over. To make such spot enjoyable also in hot weather conditions, a pergola has been designed.

g – *a quiet corner*: a place to rest, especially for the many elderly living in the area, has been designed trying to create a corner equipped with benches and hip supports. Vegetation play the role of “filter” to pollution.

h - *approaches*: the one-way entrance lanes to the sharing space are fenced by bollards, so to have a narrowed carriageway “corridor” (3,50 m width). Circulation around the circle is clockwise, but given the low speed regime in the square no priority scheme has foreseen.

i – *sitting by the fountain*: surveys revealed that people love sitting by the fountain, especially in late afternoon, when the place become more silent. To this aim, benches have been designed around the fountain.

References

Ansary, P., Schoonbrodt, R., "Penser la ville", AAM Editions, Bruxelles 1999

Banerjee, T., Soutworth, M., (ed.), City sense and city design, The MIT Press, Cambridge 1990

Engwitsch, D., Reclaiming our cities and towns, New Society Publishers, Philadelphia 1993

EPFL, "Guide Suisse des Giratoires", cahier TEA n.10, Department de Genie Civil, Lausanne 1997

Gauvry, P., et al., "Carrefours urbains - guide", CERTU, Lyon 1999

Lynch, K., L'immagine della città, Marsilio, Venezia 1964

Spreiregen, P.D., The Architecture of towns and cities, McGraw -Hill, New York 1965

Acknowledgments

The Authors wish to thank Dr. Ing. Stefano Tarquini and Dr. Arch. Loredana Enrico of the Technical Office - II Municipality of Rome for providing maps and Prof. Eng. Alessandro Ranzo (DITS- University of Rome, "La Sapienza") for supporting them in the research work.