

Road Signs in Urban Areas – Proposal of an Approach Applied to the Portuguese Reality

Extended Abstract

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Abstract

Traffic signs are an essential component of any road network, performing a significant role in the relationship between the road and its users, by allowing them to circulate in better conditions of safety and mobility. The multifunctionality of urban space, as well as the diversity and intensity of traffic, provides a particular complexity to the urban road. Thus, the installation and use of signs in these areas requires the adaptation of rules and practices used for inter-urban roads, which has already happened in several European countries. In Portugal, the absence of indications directly applicable to urban areas is an important gap, complicating the intervention in the system and reducing its effectiveness.

This study aims to contribute to the evolution of the Portuguese reality in this subject, by collecting a range of examples and practices from four European countries. Subsequently, a methodology for analyzing real situations was developed, based on mobility and safety related indicators, which allowed to assess the current conditions of traffic operation and to detect the main problems involving traffic signs and road markings. This methodology was applied to four case studies, integrated into two distinct urban areas, and led to the proposal of practical recommendations.

1. Introduction

The road network of any territory, whether it is part of an urban, suburban or rural area, always attempt to answer to the fundamental function of mobility, which ensures the flows of people and goods. Equally important, especially in urban areas, is the possibility to access to the various activities that border the road. Any road shall ensure the fulfilment of this basic function in adequate conditions of safety and comfort for users. Generally, road safety results from the combination of the roles played by all the elements of the traffic systems, namely the user, the road environment and the vehicle. Although the user, by himself, plays the most important role in accidents, road environment is also rather significant in influencing the level of safety either directly or by restricting human behaviour (Gomes, 2004).

The road signs intervene in all these subjects, and are a key factor for the proper functioning of the road network. Although the principles followed in the implementation and use of signs

respect similar assumptions, the urban context has specific characteristics, especially those related to land use, the multiplicity of functions and the density and features of the various types of traffic generated in built-up areas. Thus, it is essential to adapt the rules and practices of the use of traffic signs to the urban environment, responding to their particular characteristics.

In Portugal, road signs in urban areas are not ruled by any specific regulation. All documents issued by the institutions responsible for road network standards – including the former Junta Autónoma de Estradas (JAE) – only address the problem of traffic signs in interurban roads, without regard to the specific traffic requirements in the urban context and road characteristics in these areas. This situation is quite different from that of some other European countries, where regulations and practice are already perfectly adapted to the urban context.

The need to change the Portuguese situation in this subject, as well as the timeliness and relevance of this theme, were the main motivations for this paper. The main objective is, based on two examples and on international good practices in this field, to analyze real cases, inserted into two different urban environments.

2. Mobility, safety and traffic signs in urban areas

The urban and rural areas differ primarily by the diversity of functions and the variety of traffic they generate and that cross them. Although the road networks have to meet the same general principles in what design, structural, constructive and functional features concerns, regardless of their location in rural or urban areas, the adequacy to the context and to the type of users leads to significant differences at design level (Safety Net, 2009).

As in rural areas, urban road ensures the movement of traffic, usually denser in such areas, allowing the crossing flow. In addition, urban space has the particularity of having the movements of local access to the surrounding area within the most important, where a multiplicity of functions is performed, including housing, shopping and services. This set of activities means that the road is also requested to allow the stay of persons and goods, particularly with regard to parking, loading and unloading, bus stops and pedestrian circulation and stay. The fulfilment of these two sets of functions (of movement and stay) is likely to generate conflict, often causing loss of efficiency and reduction of safety, which gives a particular complexity to the management of a road network in urban areas.

The urban road, unlike the majority of roads in rural areas, has the particularity of serving a diverse set of users in different modes of transport, whose interaction often generates conflict. The most significant circulations in urban areas are the following:

- *Pedestrian traffic*, which is exactly the most vulnerable compared to other modes of transport. The distances travelled by pedestrians are usually limited compared with those of motor vehicles and bicycles, and its speed is significantly lower. There are special groups of

pedestrians, particularly vulnerable in terms of protection and safety, namely children, elderly pedestrians and disabled people (Seco et al., 2008).

- *Cycling traffic*, which covers the urban daily circulation for work or other needs, as well as sport and recreational circulations. The major conflict situations with motorized traffic occur when the cycling movement is made in a non-segregated way, arising from the speed difference between the two types of vehicles as well as the high density of the motorized flow and the weak visibility of the bicycle (CERTU, 2007a).
- *Motorized traffic*, composed by a great variety of vehicles, including motorcycles, cars and heavy vehicles. These last two categories of vehicles can also be grouped according to their function, in private transport vehicles, public transport vehicles and freight vehicles, each one with its own constraints. Some motor vehicles circulate in a special infrastructure (such as tram and light rail vehicles).

In each of these types of traffic, the user uses mainly visual information to drive and to control his vehicle (in the case of drivers) and to ensure their safety and that of the other road users. Road signs, as a whole – vertical signs (including directional signs and variable message signs), road marking and signaling devices – are a key component of the visual information received by either the drivers or the pedestrians themselves, contributing to an effective traffic regulation and for a proper legibility of the road by its users (Roque, 2005). Therefore, road signs play a key role in user's safety and mobility. These two concepts tend to be antagonistic, in a way that a higher level of safety and protection of the user implies restriction on vehicles mobility, though the opposite is also true. However, it is the result of the relation between these two domains that results in greater or lesser effectiveness of a traffic sign system.

In what safety concerns, improving the general conditions of signs have positive impacts on accidents reduction. The signs have a critical role in terms of speed control, adapting its maximum limit on the road characteristics and on the interaction with other modes such as pedestrians and cyclists; restriction and prohibition of certain types of maneuvers, and indication of the existence of dangerous conditions. The proper placement of road signs is especially important in some particularly sensitive issues from the point of view of safety, either because of their dangerousness, or due to the requirement of taking complex decisions by the driver. The most significant examples are intersections, curves, bumps and the edge of urban areas (Gomes, 2004). In an urban context, pedestrian and cyclist crossings, the control of movements at intersections and between lanes and the regulation of certain maneuvers (such as parking) have a particular relevance.

The traffic sign system may contribute to the improvement of mobility, ensuring the legibility of the road by the users and the adaptation of the driving task to road conditions. Therefore, road signs play a significant role on speed regulation and avoiding flow constraints, separating

different types of traffic and minimizing the points of conflict. The placement of signs must be the strictly necessary, avoiding a disproportionate restriction of traffic movement.

In what mobility concerns, direction signs are especially important to allow decision-making and to improve driving efficiency. It is therefore essential, especially in urban areas, the existence of clearly visible and homogeneous direction signs (CERTU, 2007b).

In general, and to fulfil the requirements that ensure an adequate mobility and an appropriate safety, it is essential that traffic signs remain clearly visible, easily understandable, enough, simple, coherent and correctly positioned (CERTU, 2007b).

3. International experience

In the last several decades, a number of innovative solutions on the use of road signs in urban areas have been shaped, thereby improving the safety and mobility of road users. Among them two types of approaches have been selected, corresponding to two divergent views of the traffic signs role in the regulation of traffic: the Zone 30 and the Shared Space.

The Zone 30 model, which was created in France in the early 1990s, aims to provide all urban road users a harmonious coexistence in the best safety conditions possible. Thus, this approach involves the application of various principles related to traffic calming in order to limit the speed (maximum limit of 30 kph) and to promote cycling and pedestrian circulation. Other key objectives of this concept are the regulation of street parking and the encouragement of public transport use (Renesson, 2006). Zones 30 are applicable in most of the urban areas, although its implementation is more common in residential areas, close to school buildings, in historic city centres, in shopping streets or in cycle lanes. The intervention area can range from a section of a street to the entire district, although it normally includes a small number of streets (CERTU, 1995a).

In these zones, the road is shared by both motor vehicles and cyclists, generally without any kind of segregation between these two circulations. However, this does not happen in what pedestrian circulation concerns, since sidewalks remain perfectly individualized from the rest of the road, with the prevalence of the customary rules of priority of motorized traffic over the pedestrian one on the carriageway, although the pedestrian freedom to cross is guaranteed in any point of the road (pedestrian crossings are not necessary) (CERTU, 2008). More recently, pedestrian priority zones (*zones de rencontre*) have been experienced, allowing pedestrians to have priority over vehicles.

Although there is not a single model, this type of intervention includes the implementation of a set of speed reduction measures such as narrowing lanes and chicanes (associated to alternating parking spaces each side of the road), raised pavements, bumps, changes in trajectory, among others (CERTU, 2004). Differentiated treatment of walks and pavements of the road, parking organization and street furniture, street lighting and vegetation placement also

assure that driving is made under the recommended conditions. Zone 30 entries are subject to special attention in order to clearly and readily show drivers the change in the speed regime (Figure 1).



Figure 1 – A Zone 30 street, in Bourg-en-Bresse, France (CERTU, 2008).

The signs placed within the Zone 30 should be the less dense as possible. In general, longitudinal, axial and lateral road markings shall be avoided as well as pedestrian crossings (only allowed in special cases, to be used by disabled persons) (CERTU, 2008). Intersections should not be regulated by traffic signs or traffic lights in order to prevail the right priority rule. In some intersections, the installation of mini-roundabouts or compact roundabouts can prevent the practice of high speeds and the marginalization of cyclists (CERTU, 2004). In the other cases, the signs used are those of the general regime.

The implementation of this concept has produced satisfactory results, particularly in France. The speed limitation to a relatively low level and its implementation on the road has produced positive effects on safety, particularly to pedestrians. In some places, it has been achieved reductions of the average speed of around 10 kph (CERTU, 2000) or even 30 to 50 percent (CERTU, 1995b), with significant reduction in accident rate (CERTU, 1995c). However, motorized traffic mobility is severely restricted, unlike what happens in cycling and pedestrian flows (especially in road crossing flows).

Another approach considers road signs as part of the problem by limiting users' risk perception and by promoting a culture of segregation over the various traffic categories, preventing their free movement and the natural adaptation of human behaviour to the specific situations and to the surrounding environment. As such, this model known as Shared Space aims the complete elimination of road signs.

The concept of shared space is a new philosophy for planning and organizing the urban public space, whose main aim is to encourage improvements in the quality and safety of public space and environment in a pedestrian and cyclist point of view, but without forbidding or restricting the movement of motorized traffic (Fryslân Province, 2005). Central to this concept is the integration of different functions and different users in a common space. This approach is in

sharp contrast with the current situation of the streets, in which prevails the idea of segregating the different types of traffic and the various urban functions (Hamilton-Baillie, 2006).

The integrator option is based on the principle that risk perception by users depends on the surrounding environment. The implementation of strict standards and traffic management common instruments inculcate in users an excessive sense of safety, leading them to abandon the use of their intelligence and their analytical and decision-making abilities, breaking their link with the environment (Monderman et al., 2006). In fact, as soon as common instruments are removed from the road, allowing some uncertainty in the circulation and interaction between the different traffic flows, users lose any kind of intermediary between them and the road and become more attentive and naturally focused on surroundings and in direct visual contact with other actors, regaining power of decision. This leads drivers to reduce speed and to drive in a more defensive and safer way. Likewise, pedestrians and cyclists reassume some control in their interaction with the motorized traffic (Monderman et al., 2006).

Shared Space requires the complete removal of all instruments that normally regulate traffic, namely vertical signs, light signals and road markings. Thus, vehicles movement at intersections obeys to the rule of priority to the right. The equipment traditionally used by the conventional traffic calming approach is also removed (Fryslân Province, 2005). The individualized sidewalks are eliminated and the entire road surface is now at the same level. The pavement of the road usually has specific characteristics (such as colour, surface type, configuration) that emphasizes certain important aspects of the circulation, leading to the desired behaviour. The road pavement allows an efficient reading of the road environment, without the need to intervene through signs, delineating the area where the principles of Shared Space are in force (Fryslân Province, 2005). Figure 2 shows, for the same Dutch street, the situation before and after its adaptation to Shared Space.



Figure 2 – A street in Haren, Netherlands, before (left) and after (right) its suitability to Shared Space (Fryslân Province, 2005).

The effects on road safety are quite consistent. In Oudehaske, Netherlands, reductions were achieved in speed by 40%, while the application of conventional traffic calming measures can usually reach values close to 10% (Hamilton-Baillie, 2008). In Drachten, also in the Netherlands, the almost complete removal of all traffic lights, road markings and vertical signs,

as well as the elimination of turning segregated lanes, bus lanes, cycle lanes and pedestrian crossings at an intersection used daily by pedestrians, cyclists and more than 20,000 vehicles led to a significant reduction in accidents (Monderman et al., 2006). In what mobility concerns, the implementation of these measures usually has very positive effects too, helping to decrease traffic congestion and reducing the travel time of a given route (reduction by 50% in the case of Drachten), despite the lower maximum speed practiced (by limiting downtime at intersections, achieved by eliminating traffic lights) (Monderman et al., 2006).

Makkinga's case is an extreme example of the application of these principles, given the fact that this small Dutch town totally removed road signs, traffic lights and road markings. The initial objective of this intervention was to achieve a reduction of the maximum speed limit to 30 kph, a goal that was fully achieved and even exceeded. The absence of priority signs and marks at intersections caused no harm to the safety of the various users (Hamilton-Baillie, 2008).

After all, it has to be noted that the effective implementation of such an approach is strongly related to the cultural context, particularly with regard to human behaviour, so this model may prove to be inadequate in certain cases where the users' acceptance and their willingness to change ingrained habits and practices are more difficult.

4. Case studies

For the analysis of the case studies, a set of indicators related to mobility and safety were defined and used. These indicators assess the current situation of road environment and its main characteristics in these places, paying particular attention to traffic signs situation. Later, through the information obtained with each indicator, the main constraints for the proper functioning of the intersection were detected, establishing its connection with the traffic signs present at the site. Later, a number of recommendations to the traffic sign system were proposed in order to solve these problems.

The indicators used are the following:

- *Traffic*, which expresses the quantification of traffic volumes of vehicles, cyclists and pedestrians. Moreover, the respective sub-flows are also taken into account, including public transport vehicles and trucks;
- *Waiting time*, which quantifies the average waiting time in each of the flows, which happens usually due to traffic congestion;
- *Conflicts*, which identifies the conflict places between flows;
- *Geometry*, which identifies the main geometric characteristics of the road that may harm the road proper functioning (for example, the evaluation of visibility for different users in an intersection);

- *Casualties*, which quantifies the occurrence of accidents, described in terms of number of cases involving deaths, serious injuries and minor injuries;
- *Speed*, which evaluates the speed of vehicles on the approach to the analyzed place, in a purely qualitative form, through the use of a sliding scale from A to C, with A-level to an average speed exceeding 50 kph, the C level to less than 30 kph and the level B to a speed level between these two values;
- *Traffic signs*, which evaluates all the signs, of all categories (road signs, road markings, traffic lights, etc.), particularly regarding their visibility, placement, redundancy, interference between signs and the conservation status of signs and markings.

The analyzed case studies correspond to two distinct situations, which represent two types of space that despite their differences are unequivocally part of the urban environment: Campo de Ourique, a Lisbon district, and Venda do Pinheiro, a town in the municipality of Mafra, in Lisbon Metropolitan Region. The district of Campo de Ourique is a consolidated urban area, located in the centre of a large conurbation. The traffic has a distinctly residential and commercial origin, despite the existence of an important crossing flow. Venda do Pinheiro, by contrast, is a suburban area and as such, with a lower population density and a relatively sparse and irregular shape. The traffic that flows on its main street is primarily a crossing flow. The choice of these two cases allowed the evaluation of road signs influence in two different contexts, enabling the analysis of a greater number of situations present in urban areas.

The results given by the indicators application in each of the two contexts allowed the identification of several problems, related to the local traffic signs in a greater or lesser extent. From those results, the most relevant were the conflicts between motorized and pedestrian circulation and the regulation of parking, in the case of the consolidated urban area; as well as excessive speed and congestion driven by the crossing flow in the case of the suburban space.

Applying this approach to the case studies allowed the detection of some problems, but revealed some difficulties in terms of diagnosis and of the proposed mitigation to the identified problems. In fact, some of the indicators used, such as *geometry* and *traffic signs*, proved to be too broad and generic, involving the collection of a comprehensive data set. It was the case of *traffic signs* that raised more problems, since it involved the assessment of many characteristics of all signs and marks in all categories. *Geometry* suffered from the same weakness, in that it covers a wide range of subjects, since visibility to parking places disposition.

Moreover, the lack of available information was problematic to collect some data, conditioning the subsequent analysis. This difficulty is reflected in casualties, especially when applied to the case studies in Venda do Pinheiro. On the other hand, the inclusion of indicators of different nature, whether qualitative or quantitative, has also proved to be problematic, as it introduced a degree of some dispersion in the analysis of each case, preventing further aggregation of the overall results. Addressing this problem could pass for an intermediate

solution, with the expression of the result obtained in each of these indicators in a qualitative grading scale, similar to what already happens in *speed*.

Finally, the analysis of the results revealed that a significant part of the problems detected depends on factors unrelated to the action of the traffic sign system, most of them being inherent to the configuration and disposition of the road and of the analyzed intersections. In fact, the inclusion of *geometry* aimed to unravel the problematic situations directly related to traffic signs action from other problems caused by other factors. In any case, the impossibility to implement the prescribed recommendations prevents the verification of their effectiveness, and is itself a limitation of this analysis.

5. Conclusion

This work intended to relate the road signs use with the mobility and security, addressing in particular the importance of this relationship in the urban context. Despite these two areas tend to be antagonistic, in a sense that a higher level of safety involves some restriction of the vehicles movement (and the opposite is also true), it is the result of reconciling these two domains that decides the degree of success of the traffic sign system.

Thus, two different examples of practices implemented at international level were introduced. It was found that both approaches have produced positive results, but its transposition into the Portuguese reality would have to take into consideration other factors, in particular regarding the cultural context and the prevailing habits and behavior of road users. However, in both cases there are valid options to consider. The case study presented was illustrative of this fact and its description intended to establish a methodology for analyzing and proposing solutions, which should be validated in many other contexts, to contribute to the effective regulation of signage in urban areas.

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