

## The role of greenery and traffic calming measures in road infrastructure planning

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**Abstract.** *The role of greenery and traffic calming measures in road infrastructure planning.* The “life” of a town is connected with its infrastructure. So it is that, apart from serving their principal function, motorways, roads, airports and other facilities which make transport possible largely determine contemporary urban design. To achieve balanced forms of urban infrastructure that ensure comfort, safety and spatial order, it is necessary when designing new solutions to adopt a multi-faceted approach that combines everything local residents need and maintains harmony with the existing cultural landscape. Development of this kind should be guaranteed by the town’s authorities and infrastructure administrators. It is therefore necessary to coordinate a number of complex undertakings when planning and developing urban space. The coherent and comprehensive implementation of planned road safety improvements should not only reduce the number and seriousness of accidents but should also lead to an improved quality of urban life and living conditions, more efficient division of urban space, better traffic flow for pedestrians and cyclists, changes in the behaviour of all road users, changes in the structure of the cargoes transported and greater use of safer means of transport. This paper deals with a concept for planning transport infrastructure based on the principle of establishing zones and shared spaces and presents examples of how roads and their environs can be planned in a town.

*Key words:* traffic calming measures, road safety, transportation, greenery

## INTRODUCTION

Creating a cultural landscape connected with communication routes in Europe began in the sixteenth century when development of the economy and civilisation required the construction of new and better roads. Communication routes with lines of trees on both sides have mostly retained their former routes, which have for centuries been incorporated in the diverse topography of the areas they have served.

The neighbourhoods of open, urbanised areas are, therefore, reflected in the long history of road planning and design. In the majority of European regions from the Middle Ages to the nineteenth century, strong physical, psychological and visual borders [Lörzin, 2010] have been implicit in the typical development of settlement structures. The transportation infrastructure has been a significant component of these settlement structures and planning its development is one of the major tasks of spatial planning both in urbanised areas and elsewhere.

The experience of Western countries indicates that the issue of road safety lies deep in planning solutions and that

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it is necessary to consider it as part of an integrated approach that also includes quality of life, the spatial and functional composition of towns and social considerations. An interdisciplinary and coherent approach to transportation, architectural and social problems brings about an effect of synergy whose consequence is to make a contribution to improving the quality of inhabitants' lives. Apart from issues directly related to communication and safety, it is important to base the proper planning of a road and its surroundings on principles of sustainable development and to take into account not only the measurable economic or social benefits but also environmental protection as broadly understood. As a consequence, it is important to shape the surroundings of roads in such a manner as to allow for an increase in areas of greenery. Not only does greenery increase the ecological values of the communication space but, in its form, shape or selection of material, it can also improve road safety.

## MATERIAL AND METHODS

This paper deals with an idea of planning for transport infrastructure based on the principle of establishing zones and shared spaces. Examples of how roads and their environs can be planned in a town are presented. This paper attempts to answer an important and by no means rhetorical question: how can a compromise be reached between eco-friendly landscape management, including that of urban green areas, and the considerations essential to planning for transport infrastructure and improving road safety? The monographic method was applied for the

analysis. An introductory analysis of data was performed, which covered the available documents, monographs, historical materials and maps. This made it possible to select the research area and to establish the aims of the study.

## RESULTS AND DISCUSSION

### The means of shaping transportation spaces

Road safety within the spatial structures of towns, cities and agglomerations may be achieved through urban planning that reduces the need to travel using vehicles by, for example, making it possible to transact the daily business of life and work by bicycle or on foot. From the point of view of model spatial solutions for towns, the highest level of traffic safety is offered by the theoretical model of a linear town based on the zoning of urban functions, public transport services and on concentrating buildings around the hub. The zoning of functions in urban areas means clearly specifying the role of vehicle transport and its permitted speed in a given zone [Gunnarsson 1995].

In its simplest terms, the space where movements are performed may be divided into space for vehicle transport, space for pedestrians and space for calmed traffic, which is intended both for vehicle and pedestrian traffic. Zoning understood in this way proves highly effective – particularly in terms of improving the safety of the youngest road traffic participants (Fig. 1).

As a component of the spatial structure of a town or city, the street network is the most permanent element of an ur-



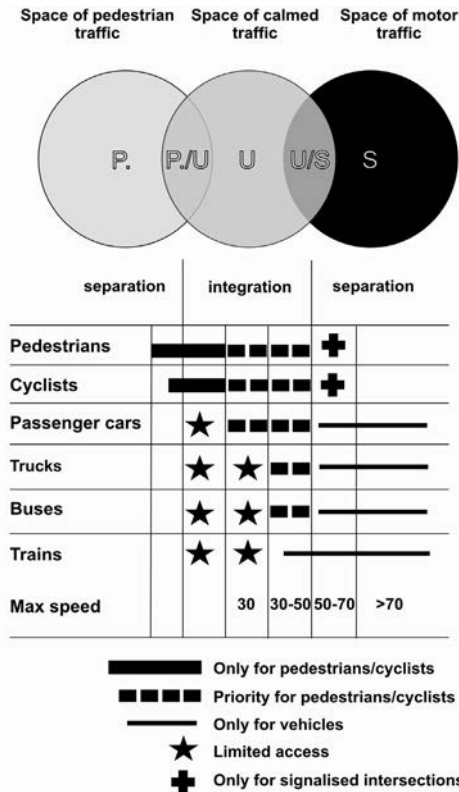


FIGURE 1. Classification of transport spaces in urban areas [Gunnarsson, 1995]

banised area and, at the same time, the most difficult to transform: if this is to be done it should be undertaken with the utmost care. There have been numerous space-shaping concepts that have striven to both integrate and segregate traffic. In the 1960s, the complete segregation of vehicle traffic from pedestrian traffic was preferred, which was exemplified in the planning and design of numerous multi-level pedestrian crossings, which are now treated by their users as a necessary evil [Jaszczak and Żukowska, 2012].

If the best effects are to be achieved, however, planning measures for ensuring safety need to be comprehensively

employed along with other groups of measures which improve the comfort and quality of life in urban spaces. One of them is shaping the landscape, including areas of greenery. In the Polish case, the planning measures most in need of implementation in the towns and cities are as follows: developing a road network with a clear hierarchy, controlling availability, zoning speed limits in the street-and-road systems, developing calmed traffic zones and routes and developing systems of bicycle paths.

This paper describes the means for shaping transportation space in towns and cities by designing calmed traffic zones incorporating vehicle, pedestrian and bicycle traffic. The relevant literature provides a range of definitions of traffic calming. In its simplest terms, this means shaping the public space, the road system and their surroundings in such a manner as to limit the speed of vehicles and, at the same time, reduce transit traffic, achieve spatial order and improve the quality of the inhabitants' lives [Jamrozik, 2009]. Greenery plays an extremely important role in such solutions. Drivers commonly associate traffic calming with difficulties in the form of elements limiting speed on the road, of which the most widely known is the speed control hump. And yet the idea of traffic calming involves a set of comprehensive actions which include the whole hierarchy of a road network, with the diverse functions of roads and the areas they serve taken into consideration. This involves the control of road availability (which reduces *inter alia* heavy vehicle traffic in pedestrian traffic zones) and establishing speed limit zones. Practice in the Netherlands has shown that an impor-

tant aspect of availability management is for streets with a minimum speed of 30 km per hour to have as few junctions as possible. The point is to eliminate collisions, that is, situations which pose a threat of accidents when approaching junctions at higher speeds. Only on such a basis is it possible to locate and design physical traffic calming measures. These measures should definitely be applied as a supportive action in a situation where, having introduced functional hierarchization and availability control, and having established speed zones, there is a need to persuade drivers to maintain the required speed and to make it physically impossible to drive faster [Jamrozik, 2009].

Since the concept of calmed traffic means introducing solutions which would render driving at excessive speeds impossible, various types of components are employed that prevent driving too fast and discourage burdensome transit traffic from moving through particular areas. These solutions include carriage-way narrowing, elevated junction surfaces and small roundabouts. The hierarchical division of roads with regard to

the actual functions they fulfil in a given area involves the introduction of speed zones: a 50 km per hour zone, a 30 km per hour zone, and residential zones and pedestrian traffic zones with availability control (Fig. 2).

The traffic calming in question is performed mainly in central and residential zones where there is mixed vehicle, pedestrian and bicycle traffic, which results in speed limits of up to 30–40 km per hour. The traffic calming measures are introduced together with greenery areas and landscaping components that enhance the aesthetic value and spatial order of the surroundings, which in turn improves the comfort and quality of the inhabitants' lives. Moreover, introducing various vegetation formations in the case of diverse types of traffic requires prior spatial analyses and depends on the specificity of a town or city and on its character (arrangements of old town/city areas, new buildings). In the case of vehicle traffic in the town or in city centres, the usual suggestion is, wherever possible, to employ low vegetation due to the limited space available for green cover or to introduce small avenues of

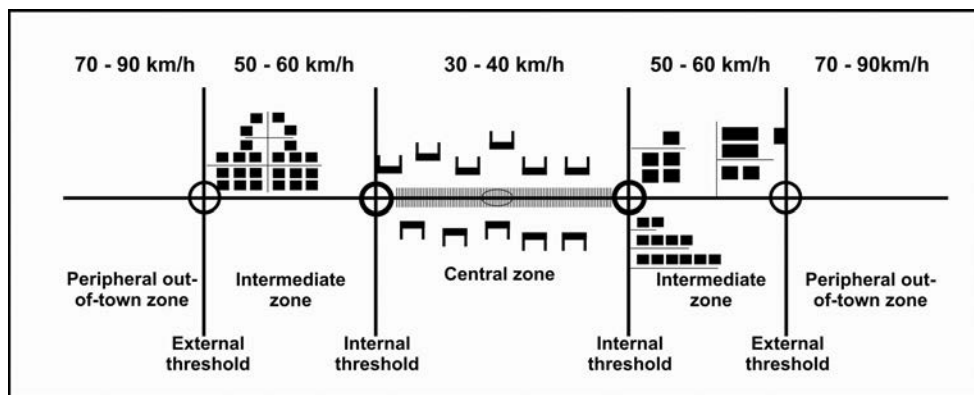


FIGURE 2. Division into zones with speed differentiation [Gunnarsson, 1995]

trees interspersed with trimmed shrubs or perennials. Linear/strip lawn areas are preferred along bicycle paths, whereas in pedestrian zones it is possible to use plants in boxes and pots as well as vertical forms, such as creepers.

### **Greenery and road infrastructure in towns and cities**

Greenery has been employed for centuries for communication systems in the open landscape in the form of linear roadside tree cover and tree or shrub clusters which highlight the entrance to, or the exit from, a town or a local residential complex. Shaped greenery was established in towns and cities inside the urban fabric, but it also served to emphasise and highlight entrances either in the form of an avenue or of a gate with various formations of vegetation nearby. Nowadays, due to the extensive development of suburbs, in many European regions we are witnessing the disappearance of clear points which differentiate between the urban area and the open landscape. The noticeable “sprawl” of the suburban zone, particularly in the Polish case, also generates a range of problems connected with communication, road safety and whether or not it is possible to drive smoothly through these zones – especially in periods of heavy traffic. There are also now more and more buildings with diverse uses in the roadside belt, such as housing developments, and retail and service centres. What is more, the roadsides have been “trashed” with all manner of advertisements and promotional signboards of various sizes and forms.

The over-concentration of billboards and advertisements may also be seen in

the centres of towns and cities, although in a slightly different spatial structure. From the point of view of road communication, this results in reduced driving safety and also lowers the town or city’s aesthetic value. However, it is not only the introduction of inappropriate buildings or landscaping, the poor solutions related to journeys to town, to city centres or to driving in residential areas or the limited space for car parks that contribute to the hazards of driving a car or a single-track vehicle: sometimes similar adverse effects may be caused by faulty arrangement of vegetation formations. This is a consequence of selecting species which, due to their size or morphology, do not fit into small roadside zones, roundabout areas or car parks. There are instances of introducing plantings that are too high or too low, whose parts (sprouts, inflorescences or fruit) pose a threat to people and cause vehicle damage (especially in car parks, or along the streets). At the initial stage of plant growth the problems are not that visible. However, once maturity is reached damage begins to be done. Yet at the same time the mature vegetation presents a powerful case for environmental protection as there will be a tendency to think that green areas that already exist should be preserved. In this way an inappropriate arrangement of greenery frequently leads to conflict, since it comes to be perceived by the public as “a good thing” (which is quite justified). At this stage, of course, it is much more difficult to change its character than at the initial design stage.

Town and city centres are among the areas with the greatest traffic loads. As regards historical systems, and in the old



town fabric in particular, such traffic is in many cases limited to pedestrian traffic with the possible addition of cycling lanes. These solutions require planning access zones that enable access for cars and also parking zones. Ultimately, the main spatial complexes in town and city centres are usually squares and green squares and this is precisely where a great number of renewal projects have been implemented in Europe and in Poland in recent years. The factors of particular importance in the case of town or city squares are the revitalisation programmes and how far the communication system is available and meets the needs of inhabitants and tourists. It is also important not to overlook the introduction of greenery and certain historical considerations – especially in places with heritage structures. For these reasons plans and designs should balance existing and historical needs and values. Nonetheless, the means of new development of roads, streets and paths, as well as the materials employed, often reveal a certain ignorance on the part of planners as well as a unidirectional way of proceeding, which results in the loss of cultural values or, conversely, in a failure to adapt the systems to the current needs of users.

New trends imply an increase in the role of green areas in the utility and production functions in towns and cities. The “urban agriculture” which has been developing more and more rapidly in large agglomerations in the world is a step in the right direction, but its effects in areas with increased traffic, and especially in places where the pollution caused by transport is high, seem doubtful. Ideas for balancing the unfavourable changes in towns and cities by introduc-

ing various forms of greenery to housing estates and utility functions have been presented by Jäggi [2011] using the example of Toronto. In this context, a new approach to tree cover in streets along with what is known as “streetscape agriculture” emerges, where the space between communication routes in a town or city is treated as a production space with high participation of fruit tree cover and low vegetation with consumption value [Lehrer and Rombouts, 2011]. In this case, however, prior analyses are necessary concerning the purposefulness of introducing such greenery, which should account for, among other matters, the safety of those using the tree-covered lanes, including potential fruit pickers.

### **The role of greenery in the planning of traffic calming measures**

People who live in close proximity to crowded arteries not only complain about the fear of being hit by a motor vehicle but also about a range of daily transport inconveniences, such as noise, air pollution or difficulties crossing the road. In many areas these could be remedied by introducing calmed traffic zones.

It is important when introducing limited speed zones that a street’s decoration, design features and traffic management all comply with the speed applicable in that area. On the other hand, drivers would appreciate precise information that they are on a route leading to a zone in which the speed limit is different. Greenery can definitely enhance information about speed reduction and the way this is received by drivers. What is more, if it is properly arranged along the streets it helps focus drivers’ attention. The very same characteristics of



greenery that pose threats along sections of inter-urban roads due to reduced visibility may – if skilfully arranged along the roads – produce the desired traffic-calming effect in specific places on urban roads.

A driver will reduce speed when expecting an obstacle. It is therefore a good idea to introduce an optical narrowing of the road at the entrance to a town or city or at boundaries between zones with different speed limits. One of the ways to achieve this narrowing effect is to establish a gate with posts near the carriageway. A natural gate formed with the use of roadside greenery is, however, more visually attractive. It enhances a calmed traffic zone and emphasises the urban character of the street. A similar effect can be achieved by properly arranged dwarf greenery, for example on a pedestrian island in the median strip. Apart from the proper arrangement of roadside greenery, it is also necessary to select the appropriate tree and shrub species, as well as to carry out frequent care treatments to keep the greenery in good condition. Only then will it properly serve to improve traffic safety.

Traffic calming measures may be divided into three simple categories: horizontal and vertical carriageway diversions, narrowings, and central pedestrian islands [FRIL, 2005]. These may be constructed using various technologies and diverse materials but, if the effect of synergy described above (to improve inhabitants' safety and the aesthetics of the landscape) is to be achieved it is desirable to introduce greenery not only as a complementary component but also as one which enhances engineering solutions. In numerous cases the green-

ery itself may constitute an engineering measure which reduces speed, such as in the form of an entrance gate to a town (Fig. 3).



FIGURE 3. Natural gates to a town in Uelzen, Germany (A. Jaszczak)

The best solution which takes safety principles into consideration is communicating speed changes to the driver with the use of vertical accents, such as trees of appropriate sizes bedded with low, trimmed shrubs. Depending on the category (see above), the relevant literature provides multiple examples of engineering measures for traffic calming, some of which have been briefly introduced and described above. In principle, it is both possible and desirable to apply greenery in all instances. Doing so enhances the speed-reduction effect through the frequent use of the natural elements of the surroundings (Fig. 4).

If greenery is employed properly, the streets in small and big towns may be both safe and aesthetically pleasing. With the use of greenery it is possible to greatly reduce the adverse effects of vehicle traffic in the form of road traffic hazards, excessive exhaust fumes, noise emissions and transport-related vibra-



FIGURE 4. An example of a comprehensive set of traffic-calming measures installed along national road 20 in Kościerzyna, Poland (J. Żukowska)

tions. Moreover, if appropriate arrangements are made greenery can be applied as a natural component of traffic calming and in creating aesthetic and permanent zones of calmed traffic. This is how safe public spaces that are friendly towards local communities and provide them with excellent conditions for a neighbourly and social life are established [Jamrozik, 2009]. The paper presents an example of a comprehensive solution in the next chapter.

### The “Dutch Town” in Puławy

The impact of these measures on speed may be further reinforced through the application of a broad spectrum of supplementary measures, including not only a green system but also special road surfaces, street furniture or a combination of these resources. The best effects are achieved by comprehensively equipping roads with traffic-calming measures over extended road segments and throughout large residential areas.

In Poland, the “Dutch Town” in Puławy has become a model solution in this respect. It has made the town known for acting dynamically to enhance qual-

ity of life and for pursuing harmonious development. Part of the reason for this is that the town was selected to implement a joint project of the Polish Ministry of Infrastructure and the Ministry of Transport of the Kingdom of the Netherlands. Puławy’s was not a random selection, since it has a varied geometrical system of streets and different road categories, which means that a variety of traffic-calming solutions can be applied. The project’s approval by the town authorities and their experience in cooperating with the Netherlands were influential factors. The aim of the project was to disseminate practical knowledge and modern ideas on how road engineering and traffic calming can be combined to the benefit of the environment and to promote traffic calming as an effective instrument that can permanently improve the inhabitants’ safety and quality of life. This aim was achieved through the reconstruction of a part of Puławy’s street system using model solutions previously adopted in the Netherlands.

The project covered a section of provincial road 824 and an adjacent area of the Włostowice district (Fig. 5), where a range of road-engineering solutions ensured that the speed of motor-vehicle traffic would be safe and comply with regulations, improved the quality of life and safety of the district’s inhabitants by providing safe routes to school, work and public utilities, took care of the aesthetics of the surroundings, created a safe and friendly road environment and regulated the flow of motor-vehicle traffic. The Figures 6 and 7 present several example solutions that use vegetation as an integral component to comple-





FIGURE 5. Traffic-calming programme in Puławy (K. Jamrozik, 2009)

ment engineering solutions. The project also introduced the following additional engineering solutions: entrance gates to the 30 km per hour zone, bus stops, mini roundabouts, elevated junctions, speed control humps, pedestrian paths and shared bicycle and pedestrian paths (Figs. 6, 7).

The “Dutch Town” project in Puławy was enthusiastically accepted by both the citizens and local authorities. Even though it meant radical speed reductions, which are perceived by many as limiting their freedom and are therefore controversial, there were no objections raised. This proves that a comprehensive approach to quality of life for inhabitants, which not only introduces restrictions, but also offers more aesthetic surroundings and a more comfortable life for inhabitants in the direct vicinity, ensures the success of an undertaking.



FIGURES 6 and 7. Natural barrier and entry to the 30 km per hour zone (K. Jamrozik, 2009)

## CONCLUSIONS

The appropriate shaping of public space, including the road system and its surroundings, makes it possible to achieve spatial order, improve the aesthetic value of the surroundings and enhance the inhabitants’ quality of life and safety. The comprehensive solution of traffic calming in residential zones presented in this paper is a way to successfully prevent accidents and other nuisances related to road traffic by preventing driving with excessive speed and by eliminating undesired transit traffic from calmed zones. In undertaking to shape space in these ways the application of a range of engineering measures and the deployment of

vegetation compositions based on species resistant to unfavourable conditions are both irreplaceable complementary elements. The solutions set out in this paper have been employed for many years in western European countries, including in the Netherlands, Sweden and Germany, and they are now being introduced in Poland on an increasingly large scale. A model solution in this respect is the first comprehensive traffic calming programme, which was implemented in Puławy thanks to cooperation between Poland and the Netherlands.

### Acknowledgements

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**Streszczenie:** *Rola zieleni i środków uspokojenia ruchu w planowaniu infrastruktury drogowej. „Życie” miasta związane jest z jego infrastrukturą. Autostrady, drogi, lotniska i inne obiekty oprócz głównej funkcji transportowej w dużej mierze determinują współczesne kierunki projektowe w miastach. W celu osiągnięcia zrównoważonych form infrastruktury miejskiej, które zapewniają komfort, bezpieczeństwo i ład przestrzenny, przy projektowaniu nowych rozwiązań, konieczne jest przyjęcie wielu założeń. Powinny one łączyć potrzeby mieszkańców, bezpieczeństwo i charakterystykę istniejącego krajobrazu kulturowego. Duże znaczenie ma udział w procesie projektowym władz miasta i instytucji związanych z infrastrukturą. Ważne jest zatem wypracowanie kompleksowych przedsięwzięć w planowaniu i rozwoju przestrzeni miejskiej. Spójne i kompleksowe wdrożenie planowanych rozwiązań w zakresie bezpieczeństwa ruchu drogowego nie tylko*



zmniejszy liczbę wypadków, ale powinno także przyczynić się do poprawy jakości i warunków życia w mieście, bardziej efektywnego podziału przestrzeni miejskiej i lepszego przepływu ruchu pieszych i rowerzystów. Wywoła ono również zmiany w zachowaniu wszystkich użytkowników dróg i zwróci uwagę na konieczność powszech-

nego używania bezpieczniejszych środków transportu. Artykuł dotyczy koncepcji planowania infrastruktury transportowej na podstawie zasad oddzielnych i wspólnych przestrzeni. Podano w nim przykłady planowania przestrzeni dróg i ich otoczenia w mieście.