STUDIA MIEJSKIE
tom 31 (2018)

Andrzej ZALEWSKI*, Jan KEMPA**

TRANSPORTATION SERVICE OF SMALL TOWNS

OBSŁUGA TRANSPORTOWA MAŁYCH MIAST

NR DOI: 10.25167/sm2018.031.01 s. 11–23

ABSTRACT: The main problem connected with transport in small towns is an efficient passage of the transit route through the town. Road traffic planning is considered to be vital, which in many cases is not possible due to high costs. Another effective solution is calming the traffic along the route through towns, especially in the central areas, with lowering the speed limit to 30-40 kph (exceptionally allowing 50 kph). In this way, a consensus is achieved between the needs of traffic and town's functioning. In consequence, the status of "priority for the town" is thus given. Ample experience confirms that there is a significant improvement in traffic safety on the main road, including: decrease in the number of deaths, reduction of traffic speed, improvement in the safety of vulnerable road users, improvement in the aesthetics and appearance of public space, improving parking conditions and reducing air pollution. Effects are achieved by reducing the speed and rebuilding of street sections. In the cross-sections of streets, new solutions for pedestrian and bicycle traffic develop the public space, which in this way becomes friendly to residents. Linear infrastructure for bicycles may be limited only to a road with a high car traffic density. The planned road solution must be integrally connected with spatial development. The threshold of road nuisance perceptible on the street in a small town is lower than in medium-sized and large cities. The average annual traffic daily volume should not exceed 5000 vpd. In the aspect of protection of living environment conditions, traffic intensity on small town streets should be by half lower (<2000 vpd), which means a moderate traffic function of the street.

KEY WORDS: transportation service, small towns, traffic calming, transit roads through towns

ABSTRAKT: Głównym problemem transportowym w małych miastach jest sprawne przeprowadzenie drogi tranzytowej przez miasto. Za celowe uważa się planowanie obejść drogowych, co w wielu wypadkach nie jest możliwe ze względu na wysokie koszty. Innym i efektywnym rozwiązaniem jest uspokajanie drogi na przebiegu przez miasto, szczególnie w obszarze centralnym z ograniczeniem dozwolonej prędkości do 30–40 km/h (wyjątkowo do 50 km/h). Osiąga się w ten sposób konsensus między w ruchem drogowym a funkcjonowaniem miasta. Tym samym nadany zostaje „priorytet dla miasta". Następuje wówczas znacząca poprawa stanu bezpieczeństwa ruchu na głównym ciągu drogowym, w tym redukcja liczby ofiar śmiertelnych, a także poprawa: warunków niechronionych uczestników ruchu, warunków parkowania, stanu estetyki i wyglądu przestrzeni publicznej oraz zmniejszenie zanieczyszczeń powietrza. Efekty osiąga się przez obniżenie prędkości oraz przebudowę przekrojów ulicznych. W przekrojach ulic pojawiają się nowe

* University of Science and Technology in Bydgoszcz, The Faculty of Civil and Environmental Engineering and Architecture, Al. prof. S. Kaliskiego 7, 85-796 Bydgoszcz, e-mail: andrzej.zalewski2205@gmail.com

** University of Science and Technology in Bydgoszcz, The Faculty of Civil and Environmental Engineering and Architecture, Al. prof. S. Kaliskiego 7, 85-796 Bydgoszcz, e-mail: dzwbiis@utp.edu.pl

rozwiązania dla ruchu pieszego i rowerowego meblujące przestrzeń publiczną, która w ten sposób staje się przyjazna mieszkańcom. Infrastruktura liniowa dla rowerów może być ograniczona tylko do ciągów drogowych o dużym ruchu samochodowym. Planowane rozwiązanie drogowe musi być integralnie powiązane z zagospodarowaniem przestrzennym. Próg uciążliwości ruchu drogowego odczuwalny na ulicy w mieście małym jest niższy niż w miastach średnich i dużych. Średniodobowe roczne natężenie ruchu nie powinno być większe niż 5000 p/d. W aspekcie ochrony warunków środowiska zamieszkania natężenia ruchu na ulicach miast małych powinny być o połowę niższe (< 2000 p/d), co oznacza umiarkowaną funkcję ruchową ulicy.

SŁOWA KLUCZOWE: obsługa transportowa, miasta małe, uspokojenie ruchu, przejścia dróg tranzytowych przez miasta.

Introduction

The aim of this article is to show the scope and forms of transport services for small towns,[1] which is often neglected and underestimated in Polish conditions by urban planners and transport engineers. Transport service solutions of this type, concerning such areas are often limited to efficiently carrying the transit route through the town and restrictions, if possible, of the negative effects of road traffic. The narrow cross-sections of streets and dense buildings located next to it give rise to numerous problems both regarding the living conditions of the residents as well as the regular road traffic. This problem occurs especially in the group of small towns in which the high category road (national or provincial) is an integral element of the their spatial structure. Heavy traffic and vehicle speeds on the roadside passing through the town pose a threat to the safety of residents and result in the occurrence of a spatial barrier effect. In small towns located peripherally in relation to the external road network, problems associated with the functioning of the road-street system are far less severe and less burdensome for residents.

The limited spatial extent of small towns means that pedestrian and bicycle traffic are natural forms of transportation within their areas. Only in a few small towns has the public transport the right to exist, and when it does operate, it is primarily a form of connection of the town with its suburban areas and as a long-distance travel. Due to the historical nature of many small towns, it is also necessary to provide car parks for coaches that support their tourist attractions. This article offers a review of the problem. It was elaborated on the basis of literature review of the topic: AIPRCR/PIARC (1991), CROW (1990, 1998), Gzell (1987), Jamroz et al. (2004), VanVilet (2005), Zalewski (2012) and the authors' own experience from research and projects dealing with high class roads passing through small towns: DHV (2006), Zalewski (2002, 2011, 2012).

[1] The Central Statistical Office in Poland (GUS), according to its classification, considers a "small town" one that counts up to 20,000 residents. http://stat.gov.pl/cps/rde/xbcr/gus/oz_miasta_w_liczbach_2009_notatka_infor.pdf [accessed 17/03/2018]. From the transport's point of view, towns with a population of 35 thousand may be accepted, as well as districts in medium-sized towns with a size not exceeding 20,000 residents.

The scope of solutions in the development of transport services in towns

The scope of solutions that need to be taken account of in the transport service development of a given area includes:

– geometric and functional transformations of the street network in relation to the existing state, including zones and street sequences of the traffic calming,
– functional and technical hierarchy of the road-street network,
– spatial arrangement of routes (and possibly lines) of public transport,
– the spatial layout and classification of bicycle routes,
– parking locations and ways of using them,
– the scope and methods of car traffic restrictions,
– the spatial layout of pedestrian traffic routes, including hiking trails,
– routes and organization of delivery traffic,
– access routes for vehicles of municipal and rescue services,
– routes of transit traffic in relation to the area considered,
– routes of tourist coaches and car parks near the most attractive historic and tourist buildings,
– routes and special lines of transportation modes which constitute tourist attractions,
– railway stations, bus stops and possibly passenger inland waterways.

Among these, the most important is the designation of routes of transit traffic in relation to the area under consideration and commuting to railway stations and stops as well as bus stops. The following conditions should be taken into account when creating the concept of transport service in a given area:

– nature, density and potential of moving points (generation and absorption of traffic, the existing state of the transportation system in the scale of the town and the area,
– functions of the area and its individual parts,
– transport-related behaviours (habits, tastes, preferences, etc.) of residents and people coming to the town and the area,
– the existing and forecast level of individual motorization,
– environmental restrictions resulting from the conditions of the broadly understood protection of the natural environment,
– the possibility of using the town areas and surrounding areas for transport needs,
– technical limitations resulting from the operational parameters of transportation modes available,
– planned transformations of the general urban transportation system and predicted ways of its connection with the internal layout of the area,
– conditions resulting from strategic national, provincial, etc. documents,
– financial, material and technical-operational possibilities of implementing the intended transformations of the transport system.

In small towns, the most important activities concern shaping the road-street network, which – on the one hand – should enable road traffic and other road users such as cyclists and pedestrians to move inside the town, as well as on source-destination trips and transit journeys, which – as far as possible – should be "moved" outside the town or rationally calmed down.

In historical areas, due to their specific character, transformation of transportation systems is an investment consisting in the construction of new sections or modernization of the existing ones, whose scope is generally very limited, and this applies especially to road-street networks within these areas. Parking service, in various functional and spatial forms, can be implemented by creating strategic parking spaces (for example buffer parking) on the outskirts and parking lots (mainly underground) in the centre.

The main constraints in the discussed projects are economic and spatial aspects. Controlling the use of the small town transport system, including the historical one, requires special attention to the observance of designated or recommended routes, as well as one-off changes in the use of individual parts of the transportation space and the use of car parks in a desirable manner.[2] This requires the use of various rules and methods of traffic organization as well as organizational and legal means (such as prohibitions, orders, placing physical obstacles, etc.) and indirectly, through the impact of fiscal and information-propagandistic measures. The best results can be achieved by the simultaneous use of the set, i.e. all or some of the actions and measures described above.

Road and street system solutions in small towns

In the spatial structure of small towns, there is usually no clear division into urban planning functions, which makes the sources and objectives of the movement evenly distributed and characterized by a relatively small potential of movement. The scale of a small town, whose spatial extent does not usually exceed 2 km from the central point to the extreme places, thus making the distance travelable on foot or by bicycle, indicates a significant role of these modes of movement and the need to minimize the nuisance associated with transit traffic passing through the town.

The fewest problems of this kind occur in small towns, where road-street circuit is also an element of the nationwide system. There is no obstruction then to reaching a consensus between the conditions of transportation service and those of the area functioning. Such towns include: Wąbrzeźno, Golub-Dobrzyń and Rypin in the Kuyavian-Pomeranian Province.[3]

According to Gzell (1987), in small towns, where there was initially no segregation of traffic, and pedestrians, cyclists and vehicles shared a common surface, the natural form

[2] It takes place during various religious, state and local holidays.

[3] Through the above towns run only provincial roads, where the average daily annual traffic volumes are usually lower than on the national road network.

of organizing public space and driving traffic was its calmness in the form of woonerf.[4] Narrow streets make a natural factor that limits the speed of vehicles. At the end of the second decade of the 21st century, solutions of restricted speed zones up to 30 kph are considered more effective, with the division into roadways and pavements, due to less expensive "street furniture" and providing good conditions for bicycle traffic. At the same time, this means, unfortunately, the possibility of a significant reduction of the line infrastructure for bicycles, in the form of bicycle paths outside the roadway and lanes for bicycles on it (CROW, 2006; Zalewski, 2012).

A difficult problem to be solved, in the discussed aspect, arises in small towns and villages where the road and street system is and/or will be a part of the national and/or regional system with a high intensity transit traffic. The most popular solution is to plan a bypass of the town, which is an expensive and not always possible solution due to spatial reasons (Fig. 1B).[5] Examples of such solutions include: Skoczów (Silesian Voivodship), Kraśnik (Lubelskie Voivodeship) and Radzymin (Masovian Voivodship), in which the construction of a beltway in the series of national roads has reduced the nuisance caused by road traffic in the towns and created conditions for the transformation of public spaces in the aspect of improving the living environment (Zalewski, Pustelnik, Bryczek, 2017). In the 1990s, in Polish conditions, it was very popular to "liquefy" traffic passing through the town (Fig. 1C), while simultaneously limiting the

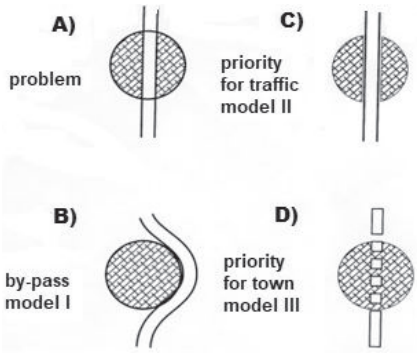

Fig. 1. Possible solutions to conducting transit traffic through small towns and villages (AIPCR/PIARC, 1991)

[4] Woonerf – functional and technical form of traffic calming involving the integration of traffic participants on one common surface, where the speed of traffic is limited to 20 kph, and pedestrians have priority over vehicles, and cars can park only in designated places. At intersections, vehicles are subject to the principle of priority on the right, i.e. intersecting roads are equivalent. This solution in Polish conditions functions under the name "residential zone".

[5] Experience of small towns, including Radzymin indicates that the construction of a bypass may have a negative impact on the economy, trade and services in the city, because before moving the traffic to a new route outside the town, drivers and travellers used to make use of the town's services and a significant part of the town's income came from handling transit traffic.

availability of areas located on both sides of the road. It was a very unfavourable solution for the town's functioning and caused numerous protests of local communities (for example crossing through Błonie – DK2[6]). In small towns, where for various reasons, there is no possibility and/or it will be hardly possible to move it out of the town area, one should strive to achieve a consensus between the traffic and the conditions of the area functioning and the living environment, and to calm the traffic on road (street) routes passing through the town (Fig. 1D).

The search for solutions in Western Europe has brought positive results by adapting means and methods for calming traffic on street and road routes passing through towns and cities (Fig. 1D).

Problems of the coexistence of buildings along rural streets and in small towns through which roads with heavy traffic, traffic safety and degradation of social conditions and life of residents are one of the most important challenges, especially in the activities of national and provincial road administrators.

High risk of accidents, constant increase in traffic on public roads and increasing limitations in introducing new road routes into existing spatial structures, with simultaneous reduction of financial resources, force the authorities to search for new solutions, which is to calm traffic on road and street routes passing through the town.

From the side of management and organization of traffic, the basic solution, in the aspect of calming traffic, is to introduce speed limits up to a maximum of 30-40 kph, and from the technical and operational point of view, adjusting the geometry and cross-section of streets to the implemented transformations. This means giving priority to living conditions and the functioning of the local community on the traffic. Traffic calming is meant to protect residents against these traffic nuisances, especially road accidents. Traffic calming gives priority to the service function of the surrounding development over the motor function. The purpose of the introduced changes is absolutely not to improve the smoothness of the passage through the given place. Importantly, the aesthetic and environmental values obtained as a result of the transformations and the speed limits implemented may also be useful after the possible circumvention of the town.

Experience to date suggests that following the implementation of traffic calming on the main road, the following effects can be expected (among others AIPCR/PIARC, 1991):

– reduction of speed by 8-20 kph,

– reducing the number of road accidents and their severity by 50-60% and the injured by 70%,

– the cost of remodelling according to the model of traffic calming by ~ 10% greater than in the case of a simple reconstruction (particularly beneficial traffic, environmental and social effects are obtained when these costs are higher by 20-30%),

– the cost of remodelling according to the model of traffic calming from 3 to 4 times smaller than in the construction of a town bypass,

[6] Currently, after the construction of the A2 motorway, it is DK92.

– higher speed drop in the daytime than at night.

Traffic calming through small towns can be used on roads, where the average daily traffic volume does not exceed 8,000 vehicles/day (vh/day), with a permissible intensity of 12,000 vh/day (CROW, 1998).

Itineraries of traffic calming against the background of spatial structure

Roads passing through towns and villages from the transport and urban point of view are very specific solutions, because – on the one hand – there is traffic aggression, and on the other one – the need to protect the street lined with buildings and provide functional connections across the street. With the passage of roads through towns, where traffic calming is implemented, there are zones with various functions and requirements from the point of view of finding compromise solutions between traffic and development. In classic shots, zones can be distinguished, referring generally to the division into urban zones, which are as follows (Fig. 2):

1. The central zone is a concentration zone of centres of social life and the destination of many journeys of residents. This part of town is characterized by compact buildings, concentration of transverse pedestrian and bicycle traffic, a significant number of transversal crossings, public facilities along public facilities and commercial facilities such as offices, schools, gastronomy outlets, churches, post offices, health centres, shops, etc. The recommended design speed for traffic calming measures is 30-40 kph, and exceptionally 50 kph.

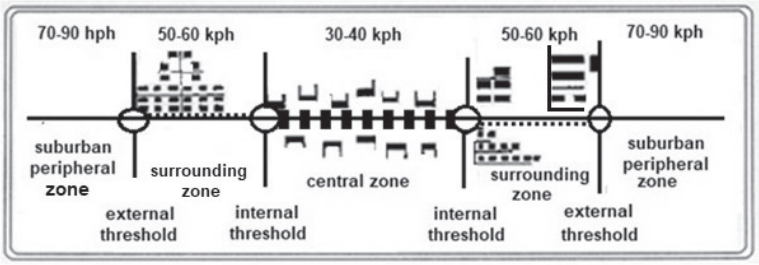

Fig. 2. Functional and traffic zones at road crossings through small towns and villages and speed zones in zones (Jamroz et al., 2004)

The development of the road lane and the environment must make drivers aware of losing their priority for the urban environment. This is achieved by such technical measures as:

– narrowing of lanes and carriageways,
– curvilinear routes,
– intersecting lanes layout,

– dividing and side islands,
– determining the parking zones along streets,
– elevation of intersection plates with ramps (the so-called plateaus),
– releasing thresholds (strip, plate, island, ramp),
– properly shaped greenery,
– lighting, including special,
– delineating zones with the priority of pedestrians, e.g. pedestrian crossings by carriageways on the pavement level.

2. Intermediate zone (surrounding) is a part of the compact settlement situated between the central zone and the outer zone. It is characterized by a significant pedestrian traffic along the road leading to the central zone (the distance to the central zone is so small that it is generally easily covered) and reduced demand for parking spaces (many parking spaces are usually located directly at the properties). The recommended design speed for traffic calming measures is 50 kph if this is a town, and the calming itinerary is longer than 1.5 km and 40 kph in shorter runs. The development of the road lane and the surroundings should aim to maintain the speed of the transit stream within the limits of 50-60 kph and satisfy the transportation needs.

3. Peripheral zone is a part of towns with a dispersed building character, characterized by low pedestrian traffic (the distance to the central zone is so large that it is rarely covered on foot) and a negligible demand for public parking spaces (each property has its own parking spaces). The recommended design speed for traffic calming measures is 60 kph or the permitted speed limit within the built-up area, i.e. 50 kph.[7] A characteristic element of these zones, located at the entrances to the zone, are the so-called "gates" informing drivers about their entering the calming stretch of the street. In the peripheral zone, it is necessary to give the driver an explicit impression of entering a section of the road of a different nature in relation to the route section he has previously moved along. This effect should be achieved in a clear and visibly recognizable way. Activities aimed at achieving this goal are usually implemented on a short road section of approx. 100-300 m and take the most common forms of:

– roadside greenery in the form of tall trees shaped into a narrowing row, parallel trees to the road, low greenery, hedges,
– constructions showing the symbol of the town or other information not directly related to road traffic,
– lighting,
– buildings for commercial use,
– conventional and unconventional vertical and horizontal signs,
– islands on the carriageway in combination with greenery.

[7] In the concept of sustainable traffic safety, it is a border zone in which there is a reduction of speed and change of drivers' behaviour from the speed allowed on a non-urban section of the road to the speed allowed in the built-up area, e.g. Van Vilet P., Schermers G., Kranenburg A.J. (2005), Zalewski A. (2000, 2001, 2002, 2011)

4. Suburban zone – part of town or village with scattered and sporadic buildings far from the road, with the speed allowed corresponding to the speed limit on undeveloped sections (on single-carriage two-lane roads: in Poland – 90 kph, in the Netherlands – 80 kph).

The extra-urban zone (also known as the warning zone) is located on the section before entering the development area at a distance of about 150-200 m before the peripheral zone and should be a preview of entry into a completely different area compared to the previous one. The most popular technical warning is the series of cross belts placed on the inlet belt to the town. Such belts should be made of a different material and in a different colour from those on the surface, which are noticeable and perceptible while driving (e.g. alternating combination of pavement and asphalt). Horizontal signs on the carriageway should be complemented with conventional vertical signs that restrict the speed limits and unconventional signs illustrating the way in which traffic is organized in the peripheral zone (narrowing, number of belts, dividing islands, etc.).

The presence of a full system of zones gives the possibility of a gradual reduction of speed so that in the central zone the recommended speed is 30-40 kph. In many situations, especially at road crossings through small towns and villages, there is a lack of one of the zones. If it is not possible to isolate the intermediate zone, the speed limit will generally be extended according to the speed limit in the central zone.

Among the analysed solutions of selected passages of transit roads through small towns and towns in Poland: Serock, Garwolin, Pułtusk, Kobylnica Słupska (inlet to Słupsk National Road No. 21), Kościerzyna and Puławy Włostowice (passage of Voivodeship road No. 824 through district of residential housing) with respect to the diversity of calming and aesthetics used, the following solutions stand out:

– passage of national road 21 through Kobylnica Słupska, implemented in 1995, which was the first solution of this type in Poland (Zalewski 2002),

– the passage of the provincial road No. 824 built in 2009 through the district of Puławy Włostowice (Zalewski 2011).

In both of the above solutions, speed restriction zones were applied on calmed sections. In the first of them, alongside the speed limit of 40 kph, carriageway geometry corrections were introduced – reduction of lane widths, traffic channel islands with pedestrian asylums, separate left-turn belts at intersections, "quasi" centre belt, chicans deviations, separation of parking spaces, pedestrian-bicycle routes located outside the road, or "gantry" elements at both ends of the calmed section. In the second solution, next to the speed limit of 40-50 kph and above these traffic calming measures were used, among others elevated and paved shields of intersections and pedestrian crossings, two-way roads for bicycles, an entry gate in the form of a traffic island that routes traffic directions from the south (Bochotnica). The implemented solutions brought positive effects: they improved road safety, reduced the risk of pedestrians and cyclists, improved functional links of spatial development situated on the both sides of calmed streets, and improved the aesthetics of public spaces in the streets.

Traffic calming in small towns is also rational in solutions when transit traffic is carried out along a road running outside the protected area, where it is desirable to prioritize environmental conditions over traffic. Fig. Fig. 3A-3C show possible connections of the road itinerary that carries out external traffic with the urban area. Speed reduction between the urban area and the transit route from 70 kph to 30 kph inside the calming zone, depending on local conditions (spatial possibilities and road-traffic conditions) should take place through the construction of a connector (3A and 3B) or/and a partial speed limit on the road serving external traffic (3B), or directly on the intersection with the entrance to the town (3C).

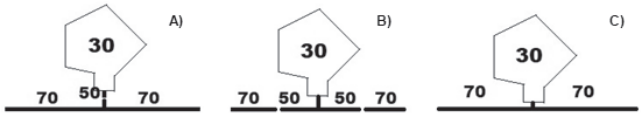

Fig. 3. Various possibilities of connecting the town – traffic calming zone (tempo 30) with a road leading transit traffic

Traffic conditioning the use of traffic calming solutions

Speed limit up to 30-40 kph does not significantly reduce the capacity of the road, because it usually occurs at a speed of 50 kph, and its changes within the bilateral 10-20-kilometre-per-hour range are small and usually do not exceed 5-10% (Amercade, 1989).

Dutch research has led to the determination of the dependence of the street traffic function, the size of the urbanized area and the permissible road traffic (Table 1). In small towns, traffic intensity lower than 500 vph means a dominant traffic function on the town street, which results from the perception of traffic nuisance in specific spatial conditions (narrow streets and neighbouring buildings), whereas in large towns the street traffic intensity amounts to 1200 vph and, exceptionally, up to 2,000 vph.

Traffic intensity not exceeding the above values can be considered acceptable when traffic calming solutions can be implemented on town streets. Streets with a moderate function in small towns are considered to be those for which the intensity does not exceed 400 vph, and in large towns – up to 1200 vph. It is believed that the limited traffic function of streets occurs when the intensity of car traffic does not exceed, regardless of the size of the urbanized area, 200 vph. It is objectively perceptible that the reception of transportation nuisances, including the size of traffic flows, depends on the size of the urbanized area.

The German experience (Table 2) leads to similar conclusions regarding the permissible traffic volumes at which traffic can be calmed down. German criteria (Mazur, Lauenstein et al., 1996) quantify traffic intensity as a function of the quality of the area of residence and safety along the road and its crossing by pedestrians.

Table 1

Characteristics of the traffic function of urban streets (CROW 1998)

Movement function	The size of the area urbanized	Acceptable in traffic – passenger cars at peak hour [vph]
dominant	small towns and towns	400-500
	medium-sized towns	600-700
	big towns	800-1200 (exceptionally 2000)
moderate	small towns and towns	200 (250) - 400
	medium-sized towns	200 (250) - 600
	big towns	200 (250) - 800
limited	all size urbanized area	< 200 (250)
sections without a movement function		There is no vehicle traffic (possibly 10 vph)

Table 2

Recommendations for calming traffic with regard to traffic volume (Mazur, Lauenstein et al., 1996)

volume traffic road	The quality of the area residence	Safety crossing the street	Safety traffic along the road
< 5000 vpd	good	possible without protection	at ≤ 40 kph, real speed satisfactory
5000-8000 vpd	satisfactory	recommended protection of pedestrian crossings	at ≤ 30 kph, real speed satisfactory
8000-12000 vpd	rather bad, at a speed of 30 km/h satisfactory depending on the architecture	necessary protection of pedestrian crossings, recommended traffic lights	it is recommended to create lanes for cyclists or roads with a "high" curb
> 12000 vpd	bad	necessary signalling and support for pedestrian crossings	it is recommended to create lanes for cyclists or roads with a "high" curb

Any traffic calming measures should not be implemented at traffic volumes above 12,000 vpd, as the quality of the residential area is described as bad. In addition, it is necessary to use traffic lights at intersections and to use segregation of horizontal bicycle traffic from the traffic flow. Good conditions in the aspect of the quality of the area of residence are considered to be when the traffic volume is less than 5,000 vpd, which corresponds to approx. 500 vph and the speed in terms of a satisfactory state of traffic safety does not exceed 40 km/h. Similar parameters of traffic intensity are recommended in Switzerland and for collective streets is 500 vph and 250 vph for local streets and 100 vph for residential streets.[8]

[8] According to Norme Suisse SN 640280.

Conclusions

The issue of transport service for small towns presented in this article indicates that the scope of solutions requiring consideration for transport services is very complex and diverse and similar to larger urban centres.

The most important issue in the transport service of small towns is the reduction of transport nuisance caused by transit traffic passing through the urban area and the reduction of traffic safety hazards. This can be achieved in different ways:

– by carrying out transit traffic outside the town area, or
– by passing through the town as a traffic road with a traffic calming, with a minimum speed limit of 50 kph and a street device to force drivers to reduce their speed accordingly.

In the case of traffic outside of the town, it is very important to link it to the road and street system of the town by grading speed limits on entries to it. Traffic calming that integrates various aspects of spatial and transportation planning of cities and urban areas is a tool for planning and urban planning and transportation very useful in solving urban problems in small towns.

Regarding the transportation services in small towns, various functional and technical forms of traffic calming apply, with a particular emphasis on restricted speed zones up to 30-40 kph and transit routes with high traffic volumes. Coherent use of methods and means of traffic calming can bring about a synergy effect, thanks to which transport will be able to coexist in a friendly manner with the residential environment.

The experience of the authors, which is also confirmed by foreign experience, indicates that the threshold of traffic nuisance perceptible on the street in a small town is less than in medium and large towns. The intensity of road traffic on a street with a dominant traffic function in a small town should not exceed 400-500 vph, which means that the average daily traffic volume should not exceed 5000 vpd. In terms of protecting the living environment, the traffic volume on a small town's streets should be half as high (< 2000 vpd), which means a moderate traffic function of the street.

References

AIPCR/PIARC, 1991, *Circulation de transit dans les Petites Agglomérations – Securité et Environnement*, Raport 04.003B Comité Technique de Routes Interurbaines et de la Route en Milieu Urbain, Route Special, Paris.

Amarcade, 1990, *La rue – un espace a mieux partager*, Paris.

CROW, 1998, *Recommendations for traffic provision in built-up areas*, ASVV, Ede.

CROW, 2006, *Urban design and traffic selection from Bach's toolbox*, ASVV Ede.

DHV Consultants, 2006, *Project Puławy Dutch Town*, Amersfoort–Warsaw (unpublished).

GAMBIT – Zintegrowany Program Poprawy Bezpieczeństwa Ruchu w Polsce. Raport Końcowy 1994–1996, Ministerstwo Transportu i Gospodarki Morskiej i Krajowa Rada Bezpieczeństwa Ruchu Drogowego, 1996, *Transport Miejski*, No. 7–8, p. 7-8.

Gzell S., 1987, *Fenomen małomiejskości*, IUPP PW, Warszawa.

Jamroz K. et al., 2004, *Zasady uspokojenia ruchu na drogach województwa pomorskiego*, Part I: *Układy ulic w miastach*, Part II: *Przejścia dróg tranzytowych przez małe miasta i miejscowości*, Gambit Pomorski, Pomorska Rada Bezpieczeństwa Ruchu Drogowego, Gdańsk www.prbrd.pl [access: November 2004].

Mazur H., Lauenstein D. et al., 1996, *Erfahrungen mit Tempo 30 Umwelt Bundes Amt*, Walter Heine, Hannover.

Norme Suisse SN 640280.

Van Vilet P., Schermers G., Kranenburg A.J., 2005, *Safer roads by applying the concept of sustainable safety*, Ministry of Transport, Public Works and Water Management, Rotterdam.

Zalewski A., 2000, "Trwałe bezpieczeństwo ruchu w projektowaniu dróg i ulic. Part I", *BRD*, No. 4, p. 10-13.

Zalewski A., 2001, "Trwałe bezpieczeństwo ruchu w projektowaniu dróg i ulic. Part II", *BRD*, No. 1, p. 9-12.

Zalewski A., 2002, "Traffic calming on the national road network to improve cycling conditions in small towns in Poland: the case of Kobylnica Slupska on National Road 21", In: H. McClintock (ed.), *Planning for cycling Principles, Practice and Solutions for Urban Planners*, CRC Press Boca Raton, Boston–New York–Washington DC, Woodhead Publishing Limited, Cambridge, England, p. 237-250.

Zalewski A., 2011, „Uspokojenie ruchu jako zagadnienie urbanistyczne", *Zeszyty Naukowe Politechniki Łódzkiej*, No 1104: *Rozprawy Naukowe*, Issue 414.

Zalewski A., 2012, „Zasady przekształceń elementów sieci drogowej w rozwiązaniach uspokojenia ruchu w aspekcie potrzeb różnych uczestników ruchu", *Zeszyty Naukowe Politechniki Rzeszowskiej. Budownictwo i Inżynieria Środowiska*, No. 283, Issue 59(3-12-4), p. 385-392.

Zalewski A., Pustelnik A., Bryczek K., 2017, „Nowe możliwości rozwoju przestrzennego miast w aspekcie budowy obwodnic na przykładzie Skoczowa i Kraśnika", In: Krych A. (ed.), *Polskie inwestycje transportowe – doświadczenia, badania i przyszłość* Stowarzyszenie Inżynierów i Techników Komunikacji Rzeczypospolitej Oddział w Poznaniu, Poznań, p. 443-456.

http://stat.gov.pl/cps/rde/xbcr/gus/oz_miasta_w_liczbach_2009_notatka_infor.pdf [access: 7.03.2018].