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CONCEPT OF SOLVING THE STANDING TRAFFIC FOR THE CENTRAL CITY ZONE OF BANJA LUKA

Abstract:

Needs of standing traffic significantly burden the infrastructure and functioning of urban settlements. The problem is particularly acute in non-developed and developing countries whose cities are experiencing a virtually uncontrolled growth. Control of standing traffic is also an element of sustainable urban mobility. The paper presents the authors' idea to meet the needs of standing traffic through a disincentive of passenger cars in central city zone and construction of high capacity parking garages around the central zone to provide parking space as a service for the area free of motorized traffic.

Keywords: standing traffic, urban roads, central city zone, garage

КОНЦЕПТ РЈЕШАВАЊА САОБРАЋАЈА У МИРОВАЊУ ЗА ЦЕНТРАЛНУ ГРАДСКУ ЗОНУ БАЊАЛУКЕ

Сажетак:

Потребе саобраћаја у мировању значајно оптерећују инфраструктуру и функционисање урбаних насеља. Проблем је нарочито изражен у неразвијеним земљама и земљама у развоју чији градови доживљавају практично неконтролисани раст. Управљање саобраћајем у мировању је и елемент одрживе урбане мобилности. У раду је приказана идеја аутора у вези са задовољавањем потреба саобраћаја у мировању кроз дестимулацију доласка путничких аутомобила у централну зону града и изградњу капацитетних паркинга гаража по ободу уже централне зоне како би се осигурао паркинг простор као сервис за зону ослобођену моторног саобраћаја.

Кључне ријечи: саобраћај у мировању, градске саобраћајнице, централна градска зона, гаража

1. INTRODUCTION

In larger cities, the population is continuously growing, automatically provoking local increase of motorization level, i.e. number of cars. This is particularly visible in underdeveloped and developing countries, where cities, due to uneven and incoherent territorial development, represent extreme zones of attraction for the population trying to generate sufficient income for a relatively normal life (social mobility and economic prosperity). At the same time, urban development itself is often uncontrolled, in the phase of concentric expansion, which, in traffic view, causes an increase in the length of travel so that there is less and less movement that can be done on foot or by bicycle. This concept of urban content development is receptive to the use of passenger cars that are in spatial, ecological, economic, etc. conflict with the urban environment. Very often, this goes along with the fact that in most such countries the urban road network does not have sufficient capacity to consume a large amount of cars, or motor vehicles in general.

As a consequence, traffic jams and problems with standing traffic occur, posing serious issues for many cities around the globe. Due to the nature of the organization of activities in the central parts of major cities, there is a high demand for space that would meet the needs of standing traffic, and one of the main characteristics of this type of traffic is the high intensity of land use. The need for parking is relevant for individual motorization, as passenger cars spend more than 95% of their working life idle [1, 2]. For this reason, stationary traffic occupies a large part of the space intended for motorized traffic. However, in the central parts of the cities, the available space is very limited so that it also affects the possibilities of organizing any form of parking.

The main goal of standing traffic management is to align parking demand with the appropriate supply. However, the strategy of organizing standing traffic has a strong impact not only on the operation of the parking system, but also on the entire urban traffic system and the city in general. The possible responses of drivers to the organization of standing traffic (primarily parking charges and time constraints) are diverse, but also largely uniform [3]. These include changing the type of parking, parking locations, mode of transport, occupancy of the car, destination, frequency of travel, travel time (with possible consequences on the duration of parking) and route [4]. Studies have shown that the most important factor in reducing car use is the cost of parking [5].

Although a good standing traffic management strategy has many positive indications for sustainable transport, a poor strategy can have the opposite effect. For example, an analysis of 16 studies from 11 cities worldwide [6] showed that about 30% of traffic in central urban areas are vehicles that cruise in search of parking, which is the result of poor management of standing traffic. In addition, there are doubts that the implementation of a standing traffic management strategy could adversely affect the competitiveness and efficiency of operations in a particular territorial area, or in some areas of the economy [7].

Standing traffic management is also one of the elements of sustainable urban mobility, which conceptually first appeared in major cities in the world in response to the pursuit of sustainable development. Following the basic definition of sustainability, sustainable mobility should be understood as a mobility model that allows for movement with minimal impact on space and the environment, and therefore, standing traffic is an integral part of this concept as a significant consumer of spatial resources.

Like in the many countries and cities around the world, Banja Luka, as the second largest city in Bosnia and Herzegovina, experiences significant urban traffic problems manifested through congestion on major streets and intersections, as well as through lack of space to serve the needs of individual motorized traffic for short- or long-term parking. During the past period, the authorities in Banja Luka have tried to solve certain problems of standing traffic, but without major successes and/or changes in the use of traffic space in the city. The aim of this paper, in the absence of an official and serious traffic study and planning basis for organization and management of urban traffic, is to provide an initial proposal for further analysis and consideration of strategic issues in the improvement of the Banja Luka urban road network and importance of defining particular parking areas for individual motorized traffic.

2. WESTERN BALKANS - BANJA LUKA

As one of major cities in the region, Banja Luka should be observed in the context of conditions, i.e. changes that occurred over the last twenty years, and that are still happening. In this respect, a brief summary of the analysis of the basic characteristics of the Western Balkans and urban transport and traffic infrastructure in this area is presented in the few paragraphs that follow [8].

The process of demographic transition, which the population of the Western Balkans has been undergoing in recent decades, has taken place simultaneously and interacted with the process of urbanization. Uncontrolled migration has particularly stimulated the intensified demographic and spatial expansion of urban and peri-urban zones (the process of unplanned and unorganized suburbanization) of cities, which has largely caused unplanned and informal construction. Such construction most often took place in an unclear urban matrix with insufficient and/or incomplete capacities of traffic and communal infrastructure, as well as other pronounced conflict phenomena that impede quality living and working conditions of the population.

The process of urbanization of the Western Balkans shows inconsistent characteristics. Focal points of the development are larger urban settlements, dominated by larger centers (national, regional and sub-regional). They exert influence and transform the environment by the power of their functions, and urbanized and deagrarized zones are created around them. These are peri-urban rings - gravitational regions that form around stronger functional centers. The expansion of urban spatial-functional systems of cities was also followed by a change in the structure of population activity in settlements located not far from urban centers, which eventually merged with them and were subsequently administratively annexed to them. In this way, the urban tissue of all major cities (Banja Luka, Belgrade, Mostar, Niš, Novi Sad, Podgorica, Sarajevo, Skopje, Tetovo, Tirana, Tuzla, Zenica, etc.) was expanded, which by developing industrial zones, locating commercial objects, building residential areas and increasing the capacity of infrastructure facilities and the supra-structural system were transforming the surrounding rural settlements.

The mobility of the population in the Western Balkans region is many times lower than in the developed European countries (in certain countries this ratio goes up to three to four times). The majority of over 90% of all travelers are daily migrants, in urban areas. Most of trips are made by passenger cars, public urban or suburban passenger transport, while the others comprise of intercity movements. Significant unevenness of urban travel is evident, with most of the trips being made in the largest urban settlements (mainly national and certain regional centers).

The supply of traffic infrastructure, i.e. the road network in urban areas, is generally inherited and occasionally adapted to the growing demands. Some major links (primary urban roads), usually in large urban settlements have been developed and/or modernized in the last fifty years. The availability and capacity of access streets in the older urban areas remained largely unchanged. New urban settlements built according to the plans are exceptions where the primary traffic infrastructure is planned and designed according to modern principles of adaptation to the size and function of a particular settlement, i.e. urban area, but it often happens that the secondary network (access streets and parking) is missing.

In addition to the classic urban traffic infrastructure, intercity and rural infrastructure (primarily roads) very often run through central urban areas. This is especially pronounced in smaller communities, so that these zones are unnecessarily burdened with transit traffic that is not in the service of life and work of such environment. Of course, this type of infrastructure alignment provides good connectivity, but significantly interferes local traffic, life and work.

Lack of parking space for individual vehicles in large urban areas is especially visible. As a result, urban roads are often adapted to the increasing demands of standing traffic by taking away space dedicated for regular traffic flow, even in primary urban roads with mobility function rather than access function. On-street parking is dominant, while organized surface parking lots and multi-story garages (underground or above ground) exist only in urban cores and plan-built parts of larger urban settlements/cities (although not sufficient). Smaller urban settlements, on the other hand, very often do not have any capacity for standing traffic other than space within private estates, and the vehicles are mostly parked on the part of the carriageway intended for through traffic (even on intercity and rural roads passing through those settlements) creating traffic jams and significantly affecting safety.

Banja Luka, as the second largest city in Bosnia and Herzegovina and the administrative center of the Republic of Srpska, does not differ from the above mentioned basic characteristics of urban settlements in the Western Balkans region.

3. BANJA LUKA - CITY STRUCTURE AND TRAFFIC CHARACTERISTICS

The term city means an organized human settlement that is the political, economic or cultural center of the area [9]. The role of urban traffic is to integrate city amenities, direct and synchronize activities and set the pace of city life. In addition, urban roads limit the space for the development of physical

structures so that traffic is an inevitable factor in the spatial organization of the city. Therefore, the city and the traffic are unique planning and design complex with the same temporal and spatial dimensions.

As the planning and design of urban roads must be related to the land use, it is important to identify the basic units, i.e. to determine the main characteristics of the land use in the central city zone of Banja Luka. Typically (Figures 1 and 2), the inner city center is characterized mainly by business and administrative activities, although housing (single or multi-family) is also heavily represented in this part. In contrast, the rest of the central city area shows dominant housing characteristics with very few businesses.

The city center brings together various contents of higher and lower levels, imposes a high degree of social communication and connection of people into the essential community. The attractiveness of the center is a consequence of the structural elements and the services offered by the center with its contents. The basic precondition for the development of the center is its accessibility and connection with the gravity area. Significant functions of the center include the functions of supply and services, restaurants and accommodation, finance and business, communication and information, education and science, social and health care and social and political function.



Figure 1 Zoning of the central city area of Banja Luka [10]

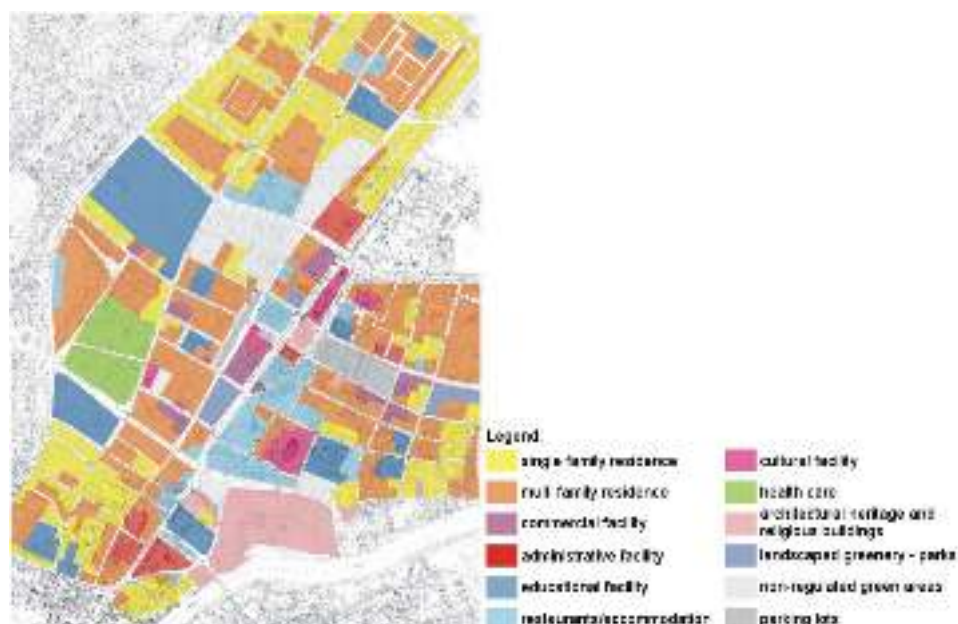


Figure 2 Land use within the central city area of Banja Luka [10]

In the last two decades, Banja Luka has witnessed a significant expansion of individual motorized traffic, accompanied by a high degree of urbanization and negligible correction of the capacity and/or organization of traffic areas. At this point, it is no longer questionable whether the city's road network will collapse, but only when it will happen. Over the last few years, it has been noticeable that morning and afternoon peak loads are being extended to more and more streets, and that in some parts of the central city area peak loads have a practically continuous duration from early morning to early evening.

Another important issue for Banja Luka is the absence of the updated urban planning documentation (currently valid is the one from 1975 [11]), as well as the outdated traffic analysis which was performed in 2007 [10]. At the moment, the only valid implementation planning documents, forming the basis for spatial planning, are regulation plans. However, they are all generally similar to one another, and the main focus is on the layout and design of structures (residential and administrative buildings), while at the same time missing to define the conditions for improvement and/or development of traffic infrastructure. Furthermore, the omission of the existing regulations (legislation, technical regulations and standards for design) in Bosnia and Herzegovina and the Republic of Srpska to address urban roads in general is also interesting - simply, such documentation does not exist. The regulatory gap is most often bridged by using certain professional literature and some experiences from outside the region that cannot be easily applied to domestic conditions.

The central city area (Figure 3) is confined with the so-called East (1) and West (2) transit (intercity roads in highly urbanized areas), on the North side with the Vuka Karadžića (3) and Aleja Svetog Save (4) streets, and on the South side with Bulevar vojvode Stepe Stepanovića (5), streets Teodora Kolokotronisa (6) and Cara Lazara (7) and Bulevar Cara Dušana (8). The aforementioned area is intersected with other urban roads, the most important being the streets of Gavre Vučkovića, Kralja Petra I Karađorđevića, Vidovdanska/Kninska, Vase Pelagića and Bulevar vojvode Živojina Mišića. There are also several significant resources and entities in the area, such as the Vrbas river, the Kastel fortress, and the old city center.

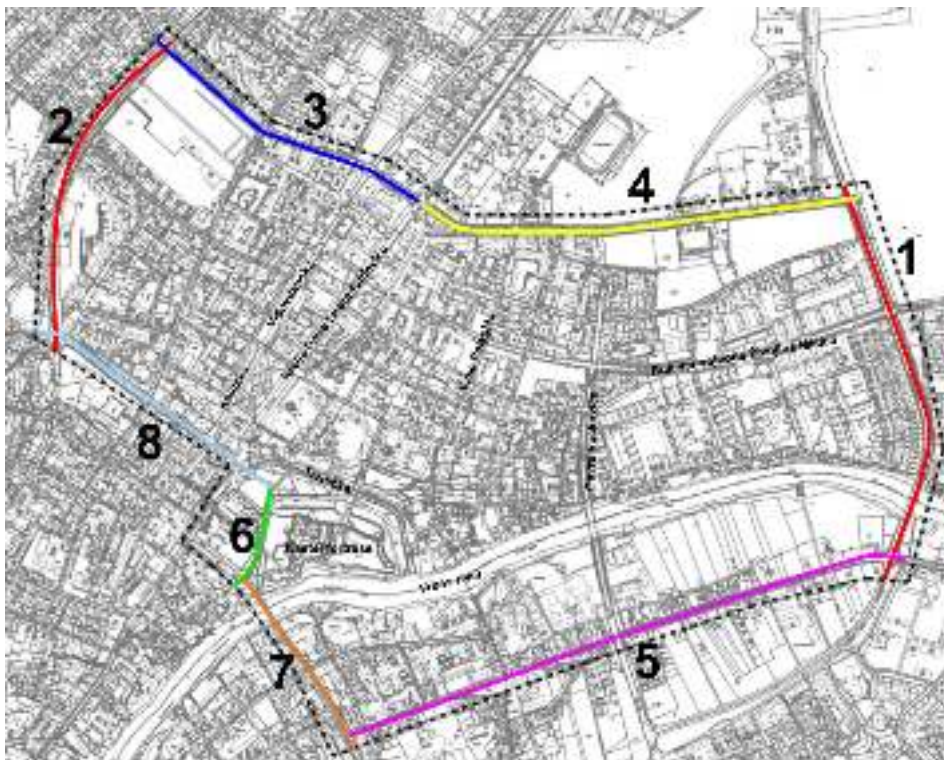


Figure 3 Coverage of the observed area [authors]

The urban street network, as dictated by theoretical basis and practical experiences, must be divided into primary (in the function of traffic connection) and secondary (in the function of supporting urban content), while the whole concept of a city as a whole is formed through intentional separation (segregation) and connection (integration) of different modes of traffic. Following these principles, the 1975 Urban Plan [11] further defined that West and East transit roads are primary urban roads - city's magistral roads interconnected into a ring by streets Ivana Gorana Kovačića in the North and

Gavrila Principa in the South (these two streets being outside the scope of the observed area in Figure 3). In the same direction, transverse connections were planned at the perimeter of the inner city center, namely Bulevar Cara Dušana - Cara Lazara Street (South) and Aleja Svetog Save - Vuka Karadžića Street (North). All other urban roads within the scope belong to the lower-level streets, i.e. to the feeder and access streets. Most of these streets were built with only two lanes and with poorly resolved space for pedestrians.

In order to improve the entire road network of the city, a great number of city streets should be reconstructed to achieve capacity expansion (i.e. final adaptation to a defined function for primary urban roads) or to carry out adaptation to a specific local conditions. In this regard, particular emphasis is placed on local network - first and second level access streets (with and without user segregation). Access streets of second level are particularly significant in relation to the possible implementation in residential areas.

The structure of the parking space in the central zone of Banja Luka reflects the specifics of current traffic relations and social attitudes about parking of passenger vehicles. In most of the central city area, passenger car parking has no time limits, but is subject to a charge system. Parking is mostly done on carriageways and sidewalks, making the conditions of movement of vehicles unbearable, while parking is also in direct conflict with urban functions. In addition, the toll system also includes several surface parking areas, with most of these areas in the city center - therefore, forcing the entry of passenger vehicles into the area limited by streets of Vidovdanska/Kninska, Bulevar cara Dušana/Tržnička, Vase Pelagića and Aleja Svetog Save.

4. STANDING TRAFFIC SOLVING CONCEPT

Since the highest densities of attractive urban contents are located in the inner central city zone, the highest concentration of parking demands occurs in this area, while at the same time this zone provides the least possibility to provide the required capacity. This should also take into account the fact that parking needs for the residents and visitors occur simultaneously in this area, without significant opportunities for combined use of the same parking facilities.

Therefore, the basic goal that should be achieved with proper movement organization and parking strategy is to discourage the use of passenger vehicles having the need for long-term parking at the city center. Only short-term parking periods that are in compliance with the operation of central urban roads can be accepted in the center. The problem of parking for city center residents should be solved by the construction of dedicated parking facilities in areas where the demands are high, as well as the possible combined use of all available parking spaces.

The street Kralja Petra I Karađorđevića is mentioned as an example of discouraging the passenger cars in the city center. As it stands, this urban road is of great capacity and runs through the center itself, generating significant motorized traffic. At the same time, significant housing and mainly service business capacities (trade, crafts, restaurants) are located around this urban road. The complete elimination of motorized traffic or the retention of public transport only on the route from Trg Krajine to the National Theatre would provide huge space for cyclists and improve the level of pedestrian service as proposed in Figure 4. A similar concept can be applied to other primary urban roads in the inner central area of the city. In case of this concept of streets, the reverse approach is applied - design decisions are not based on the parameters used in traditional design of urban roads (functional classification of the road, design speed and traffic volume), but on characteristics that more closely describe the road itself, as well as the hierarchical priority [12]. Pedestrians and cyclists come first. The aim is to provide safe access for all traffic participants. Addition to this concept of disincentives is the improvement of access street profiles through the full integration of users in common areas in order to calm traffic, raise the level of safety for "weaker" participants (pedestrians and cyclists), and prevent bypass traffic due to limited use of primary roads.

Following the previous paragraph and in order to support the complete concept of traffic organization in accordance with the postulates of sustainable urban mobility, the needs of amenities' users in this zone, from the point of view of access to passenger cars, would be addressed by the construction of high capacity parking garages around the perimeter of the zone. So far, little has been done in Banja Luka to build vehicle parking facilities, but it is a fact that parking requirements could be significantly reduced by the construction of public multi-story parking facilities. To the contrary, the construction of surface parking lots and the provision of parking in street profiles, which is still a tendency, takes up a large part of the space and cannot have significant effect on solving the problem of standing traffic in the inner city area.



Figure 4 Examples of possible solutions of cross section for Kralja Petra I Karadorđevića street [13, 14]

Figure 5 shows the once planned locations of parking garages in the inner city center, as well as their possible capacities [10]. If these proposals were implemented as planned, the demands for parking in the inner city center would be significantly lower. As can be seen, the total number of parking lots in these five planned garages is 3,306 and by their construction, the total number of lacking parking space in the city center would be reduced by almost 50%, according to analyses at the time.



Figure 5 Planning of the garages with number of parking lots [10]

However, since these proposals have not been implemented, the problem of lacking parking space still remains, although in the meantime an attempt to overcome this issue by organizing the surface parking lots and the increasing engagement of street profiles for parking purposes was made. One of the positively applied solutions is the organization of combined parking in certain residential units where tenants have the apparent status of privileged users (in terms of price, but without a guaranteed

parking space at the desired moment), while other users pay full tariff during occupancy. Currently, in this way, in the central city area, within the tariff system, about 5,000 parking lots have been provided. Considering only the minimal space required for the vehicle to stand (5.0 x 2.25 m), this represents an extremely high load for the urban road network (about 6 ha), with the stated amount increasing by at least 40-50% for communication purposes. A simple comparison with the previously planned parking garage capacities would indicate that significantly less engaged space would provide over 65% of current parking capacity, not to mention the access capacities, space freed for other purposes and the chances of adapting access streets to the concept of sustainable urban mobility.

Therefore, the only objectively possible solution for consideration is still the construction of high capacity parking garages. Bearing in mind that the acceptable length of pedestrian movements is 400-800 m [15], it is necessary to provide a motor traffic free area with a parking space. In this respect, the most rational solution is represented by the multi-story parking garages (with underground and above ground levels) in carefully selected locations around the perimeter of the central zone. Selection of the garages' locations depends, besides the acceptable length of pedestrian movement, on the available space around the perimeter of the zone without traffic. After considering the zones of attraction for the individual locations of the garages, as well as identifying the potentially available space for their location, the proposal for positioning multi-story garages is shown in Figure 6. The proposed locations are at the following positions:

- G1 - corner of Vase Pelagića and Bana Dr. Teodora Lazarevića streets;
- G2 - corner of Vuka Karadžića and Vidovdanska streets;
- G3 - Vidovdanska street (Contemporary Art Museum)
- G4 - corner of Tržnička and Đure Daničića streets;
- G5 - corner of Jovana Dučića and Bulevar cara Dušana streets;
- G6 - corner of Isaije Mitrovića, 22. aprila and Patre streets.

The quality access would be provided in this way to all amenities in the central city zone, while at the same time creating the preconditions for freeing this part of the city from the negative impact of passenger vehicles and, over time, becoming a “kingdom” of pedestrians and cyclists.

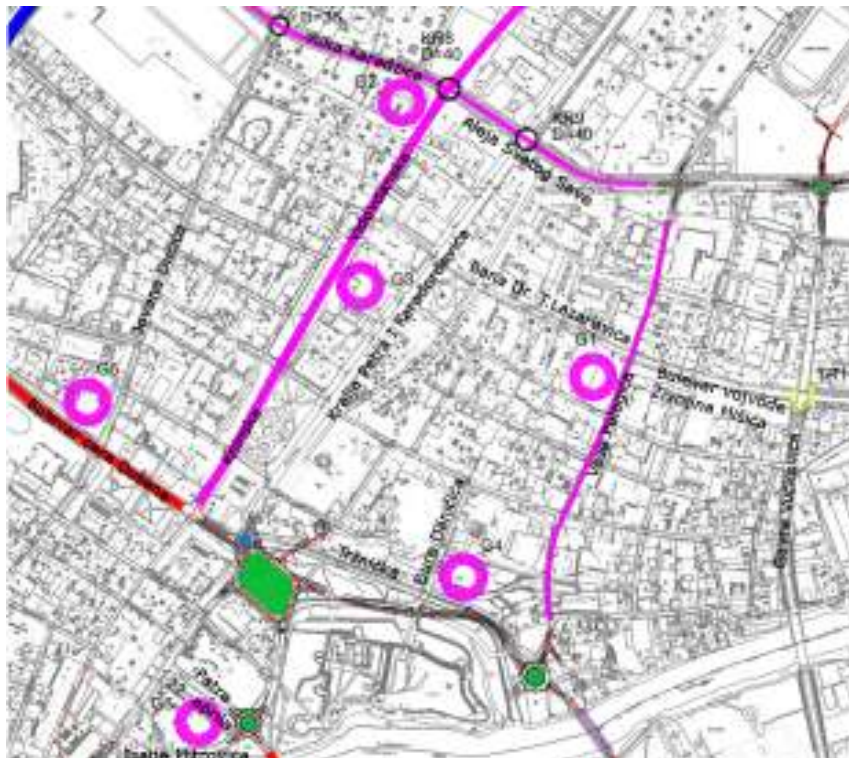


Figure 6 *Proposal of locations for parking garages [authors]*

In order to make the best use of the capacity of these sites, it is necessary to combine the proposal with appropriate solutions (corrections) on the primary network and on the network node points (intersections). For example, for good quality access to this zone, taking into account the consistency

in solving intersections, it would be desirable to reconstruct the existing classical surface intersections along the streets of Vuka Karadžića into roundabouts, at the locations of crossroads with Jovana Dučića (KR7), Vidovdanska (KR8) and Kralja Petra I Karađorđevića (KR9) streets (Figure 7). Considering that there is intensive pedestrian and bicycle traffic around the inner city center zone, and given the intensive construction in the area immediately adjacent to this zone, it is necessary to further consider and analyze pedestrian flows and the way of cross-communication through street profiles.



Figure 7 Proposal for reconstruction of intersections along the street Vuka Karadžića in order to support access to the site of the garage G2 [authors]

Also, for easier access to the parking garage in Vase Pelagića Street (which is under construction), it would be advantageous to realize the so called turbo-rotor (TR1) which would provide better access to the mentioned location for all vehicles aiming at the city center and central city contents, as well as more efficient distribution of flows towards the amenities at the edge of the central zone (Figure 7).



Figure 8 Location of the garage G1 in Vase Pelagića street and position of turbo-rotor at the crossroads of Bulevar Živojina Mišića and streets Gundulićeva, Gavre Vučkovića and Vojvode Radomira Putnika [authors]

The aforementioned discouraging and establishment of a parking garages system would also reduce the load on existing parking capacities within residential blocks, which could then be organized on the principle of restricted access, i.e. only for residents of those blocks.

On the other hand, the needs of new residents inside the central zone should be solved through the organized parking lots along the place of residence, as part of the apartment equipment. This would mean that investors, when performing new construction or reconstruction, are obliged to foresee and construct the required number of parking spaces within the facilities (underground garages or dedicating several first floors of the buildings for the purpose of parking), without planning to solve the problem within the street profile where these buildings are located. This practice should not only

be a rule for the city center, but also for the entire territory of the city. The same principle must apply to all commercial buildings in the city, and especially in the central city area, which would address the parking demands of business cars and vans, visitors and a certain (smaller) volume of employees' vehicles.

Changing the way individual streets operate and changing the use of surfaces require an analysis of the redistribution of individual motorized traffic. For the proper consideration and justification of proposed locations and measures at certain intersections, it is also necessary to further determine the number of users that will spill over into public urban transport, as well as the part of traffic that would remain present on the new form of network after the intervention. According to the data obtained by such analysis, it would be necessary to check the functionality of the network and to compare the situation before and after to determine the feasibility of the intervention and the quality of the solution.

5. CONCLUSION

Spatial demands of passenger cars are the biggest drawback of the urban traffic system. The existing Banja Luka street network is very modest in size and capacity, which leads to traffic jams on a daily basis, while it is further complicated by the enormous need for standing traffic. The capacities of the existing parking places, especially in the central city zone, are not nearly enough to meet these demands, so it is necessary to find a solution for parking vehicles in the center of Banja Luka. The need to solve the problem of standing traffic is further emphasized in the light of meeting the requirements of sustainable development, i.e. establishing sustainable urban mobility.

The solution is to discourage the motorized traffic in the inner city center and the construction of a number of multi-story garages around the perimeter of the area, which with their capacities, suitable location and well-organized system of internal movement, could lead to significant progress in improving not only vehicle parking itself, but also the complete traffic system of the city. Also, one of the normative measures, which was lost in practice in turbulent times, is the obligation of all investors to solve the problem of standing traffic within the lot where they build their facilities. All these changes must first be analyzed through appropriate models of network usage and usage of individual modes of transport in order to arrive at the correct conclusion, to the contrary of the customary in current practice to solve problems in an ad-hoc manner, without analyzing the interaction with the rest of the network. Above all, the essential premise is to finally establish a hierarchical order in urban planning and traffic base of Banja Luka.

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