



## UTILIZATION OF RAILWAY CAPACITIES FOR SOLVING TRAFFIC PROBLEMS IN CITY AREAS

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### Abstract

Development of transport in the cities, but still faced with great difficulties, and in the future period, the problem will be even more complex (congestion roads, impacts on the environment, traffic accidents). The reason for this is “chronic” lack of space in urban centers as well as the massive use of passenger vehicles, which have a very unfavorable ratio effect - space. These problems can not be effectively resolved in the big cities or areas without the use of rail system. In our conditions in the areas of Sarajevo, Tuzla, Mostar, Banja Luka, there is unused capacity of rail infrastructure. Their use for the development of light rail and suburban binding with existing rail systems might contribute to solving the traffic problems in these areas. This report deals with the possibilities of optimal utilization of railway capacity and created effects that appear on the roads of the area.

*Keywords: light rail, traffic accidents, urban areas, environmental protection*

### 1 Introduction

Traffic, in the broadest sense, is an integral part of the functioning of society, and is directly connected with the manner and quality of life. He not only has to follow the development of the city, but also causes changes and encourages his overall development. At the same time, a number of traffic demands consumption of resources such as land, energy, construction materials, ekspolattation and maintenance of traffic systems, etc., and makes a series of negative impacts on space, environment, etc.

With the rapid pace of urban development, as well as the complexity of this development comes to the numerous conflict situations in the city, and for the normal functioning of the city (urban) system shall be placed increasing demands in front of traffic.

Transportation is the backbone of the system and the many examples of the world, even our cities, it is evident that the rapid development of urban transport often leads to aggregation (delay) in the functioning of the city.

The biggest problem is the fact that contemporary motorization required too much space, which can not always provide, without consequences for other urban facilities and urban economics. This particularly applies to passenger cars which transport the disproportionate effect of taking the city land.

Therefore, the extreme demands of urban land and to question the legitimacy and even its physical feasibility of large-scale use in cities with a high level of motorization.

Another very important issue in solving the urban traffic is stationary traffic, because modern transportation means, especially means of individual transportation (cars), because of its constructive and exploitation characteristics, require very large areas.

Passenger (personal) car most of the day at rest and just this fact represents a growing problem for cities is coming to a lack of space for parking of personal vehicles.

High investments in traffic infrastructure can significantly reduce or delay the bar sometimes, more efficient use of existing transport infrastructure.

Many major cities have implemented the EU and implement comprehensive projects to increase the attractiveness of public transport passengers without major investments, to achieve greater security and reliability, less power consumption and reduction of noise and air pollution. This is especially true in congested urban centers, where kapacitetna fast and comfortable vehicles to electric drive, with the maximum priority in traffic and centrally controlled (ITS) redirected users of private vehicles in the JGP series of positive effects for the city, and city transport companies.

This work will be shown in the example of Sarajevo features optimal utilization of existing rail system and the effects would be reflected in the city network of roads and the city itself.

## 2 Traffic load in the area of Canton Sarajevo

The Traffic Study of the Sarajevo Canton, which is for the investor - Canton Sarajevo, as the bearer of development done in Sarajevo, Faculty of Civil Engineering, carried out a study of traffic related to the Canton area.

Research is characterized by division of the six municipalities of the urban inner part (Stari Grad, Centar, Novo Sarajevo, Novi Grad, Ilidza, Vogosca) and four external community (Hadzici, Ilijas, Trnovo and Pale). This area is very similar to the city of Sarajevo from 1991. and enables comparison of research results with the results of previous.

Only research is divided into 175 zones, and has done aggregation these zones in 74 districts, respectively.

In this area was conducted and the household survey whose results showed that the area of Canton Sarajevo, 449 895 achieved a total population of 960 565 movements per day, of which about 648,089 Mechanized movement a day, which is approximately the number of trends from 1981. (approx 703 000)

I have a relationship in the structure of Mechanized movement between public transport passengers (JGPP) and the passenger cars (PC) is different from the community and are moving within 55 to 65% in favor JGPP, with the exception of the most remote communities in the Canton (Trnovo) in which the ratio 70:30 in favor of PC .

In addition to the survey of households, was carried out in parallel and record traffic on 18 urban crossroads, at 9 locations in sections of primary networks, and on the screen line (4 locations).

Based on the results of this recording was made average annual daily traffic (AADT) primary network of roads in the city of Sarajevo, which is shown in Figure 1

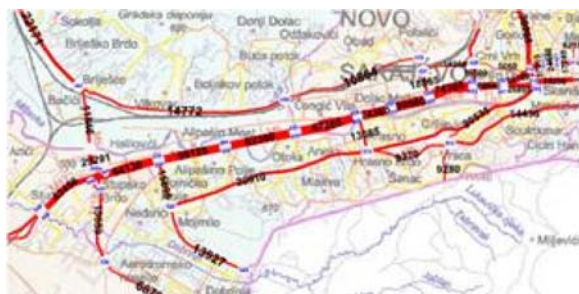


Figure 1 Derived AADT network roads for 2005.

The figure 1 is seen that the maximum traffic load on the central area of the city and the city's arteries.

Consequently have low speed and very low levels of services in certain crossroads in peak hour (level of service E and F).

The study was conducted on traffic forecast for the area of Sarajevo Canton, which is made with two rates of growth (pessimistic and optimistic) and from the forecast shows that the planning period is expected a substantial increase in traffic and that only with a number of interventions on the existing network, or construction of new roads, we can reach a satisfactory speed of travel and levels of service.

### **3 Possibility of introducing suburban Lake Railway (Light metro) on existing railway infrastructure**

As seen from the forecast of future trends, the future is expected to significantly increase traffic to under-developed road infrastructure in the area of Canton can not accept. If the existing traffic system remained unchanged, this is a total increase of individual transport would have a disastrous effect on the functioning of the urban transportation system and the city itself. Many world cities are faced with this problem and they applied different solutions that were appropriate to their specific situations and problems. What is characteristic of all these solutions is that it is related to favoring public transport and transport destimulation individual use various measures such as subsidizing JGP, a more expensive parking, restriction of traffic in the narrow city center and giving absolute priority vehicles public transport passengers. Also, we have tried to means of mass transportation center to connect people with narrow and around the periphery with a reliable, fast and comfortable transport, which was basic but even the most solvable problem.

Thus solved traffic system enables smooth development of the rope and beyond the periphery of cities and the formation of the so-called. metropolitan areas with highly represented environmental criteria which are all prerequisites for comfortable living and smooth economic development.

It is in this direction should go and develop the city of Sarajevo, which has quite a disadvantage, because it is located in a valley that prevents the smooth expansion of the city and also create negative environmental impacts.

This is primarily related to air quality, especially in winter, very bad, and what contributes to a very large use of personal vehicles and are one of the most significant sources of air pollution. From the previously mentioned analysis we can conclude that on the one hand, but now we have preoterečenu urban roads network on the other hand, we have enough (almost certainly) used the railway capacity, which has a very favorable position relative to the direction of development and major traffic flows.

In Figure 2 shows the position of the railway in the area of Sarajevo Canton in relation to the position of the lines of urban transportation companies, as well as in relation to a network of primary roads.

With picture 2 shows that the position of the railway very affordable and it is at the direction of the main corridor, and that can be used to retrieve parts from external developments (suburban) community of Canton.

Based on data from the study of traffic (IR matrix Trends) shows that in 2010 the year in the nine municipalities of Canton, we can expect approximately 112 000 Mechanized movement. If the matrix of the IC exclude local (municipal) movement and movement between the municipalities of inner city areas will get the size of the movement from suburban areas to the central city municipalities - which amounts to a total of 19 550 movements per day.

Also be aware will take the number of passengers on the lines of public transport passengers in the area under consideration which is about 36 500 per day.

The choice of particular methods or forms of transport following parameters define the travel length of travel, length of trip, purpose of travel, income, level of motorization, the speed, the cost of transportation, accessibility, comfort, etc.



**Figure 2** Position of the railway line in Canton

In order to estimate future users of the new system of passenger should carry out detailed analysis and collect much data.

For the purposes of this paper as an example will be taken to this new form of transportation decided to move in the first case 10%, in another 20% and third 30% of individual transport users (PA), and will observe the effects that appeared to network of roads.

Expected number of movements (passenger car) for 2010 and 2020. is given in Table 1.

**Table 1** Expected number of movements passenger car.

Year	10%	20%	30%
2010	1955	3909	5864
2020	2266	4532	6798

As seen from Table 9 In the event that a new type of transportation decided to cross 20% of users in the passenger car 2010 to have a reduction of about 3900 vehicles per day in one direction, and 7800 in both directions. If we take the average availability of 1.5 passengers per vehicle, we get 11,700 passengers and if we take the same percentage of users crossing JGPP which is 7300 passengers get on the suburban railway lines, a total of 19 000 passengers a day.

Effects that would appear on the network roads (and in the city) are:

- 1 traffic,
- 2 space,
- 3 environmental,
- 4 economical.

ad.1) These effects are reflected in the reduction of traffic jams on the existing network of roads due to reduction in the number of vehicles. Hence there would be a reduction in the number of accidents, or increase traffic safety.

ad.2) It is known that passenger cars most of the day are at rest (approximately 90%) and the fact that they should provide the space. These requirements range from 1.3 to 1.8 parking spaces per passenger vehicle, or 25–40m<sup>2</sup>. Na Based on these data we can conclude that the passenger car cover large areas and in this sense completely non rational. With the reduction in number and came up big savings in space (which is very expensive and limited), which can be used for other purposes, particularly in central urban areas.

ad.3) Road motor transport is one of the most important sources of air pollution because it contributes the most carbon monoxide CO, NO<sub>x</sub> nitric oxides and organic compounds NMVOC no methane In addition to the emissions of toxic pollutants, a significant share of traffic in emissions of carbon dioxide emissions of CO<sub>2</sub> and nitrogen monoxide N<sub>2</sub>O.

Increased number of motor vehicles imported in BiH in the post-war period, has significantly influenced the increase in the age structure of vehicles (average over 12 years.) Exacerbated the technical accuracy and increased noise and emission of pollutants. All this is accompanied by a weak improvement of road network, inadequate traffic management system and poor conditions for the development of stationary traffic.

Particularly big problem is the excessive use of personal vehicles which have, with respect to their capacity and availability, very unfavorable ratio (20 – 70 times) harmful ingredient of combustion per passenger than buses, and rail systems are environmentally favorable. Noise, caused by the movement of vehicles in the city, also leads to psychological and physiological disorders population. As the case of emission of pollutants, personal vehicles and in terms of noise emission per passenger, far less favorable.

ad.4) For the introduction of suburban light railway would need to make some investments on the other hand, the introduction of this system would lead to a reduction in the need of investment in the construction of new roads and parking spaces. Would also reduce the costs incurred due to accidents

Economic effects would be reflected through the improvement of rail operations, and to which would come as a result of increasing the number of passengers.

As seen with the introduction of this system and attract traffic to come to the many positive effects on both the urban network of roads and at their own city.

However, in order to achieve this or that “forced” people to opt for this form of transport they need to offer high-quality, fast and reliable transport system. For this purpose, is made and investments in railway infrastructure through the construction station, located near the suburbs, provision of adequate vehicle for the transportation of passengers and possible construction of new railway section.

As for the geometric elements of the route, the existing railway to fully meet the conditions for the introduction of this system. It is necessary to build a new stop to accept passengers. To provide fast and reliable passenger must do adequate supply of vehicles, and for this purpose from experience, as they proved to be most effective low-floor vehicles that enable rapid exchange of passengers, and they are to their construction characteristics closer to trams than the classic railway.

Under the construction of new shares thoughts primarily on the construction of the railway section from Station Sarajevo travel through villages and Vogošća circuit on line Sarajevo - B. Samac, for which there is a conceptual project done. In this way, to carry out the transformation of the cells from the front to pass the station, which would come up to improve its efficiency, because it would reduce the switching operation of the station. Also to connect the central city and part of the settlement Vogošća where we have much traffic load.



Figure 3 Railroad Sarajevo - Vogosca

## 4 Conclusion

City development and growth of motorization leads to a permanent decline in the level of service and quality of urban transport which is reflected in the high congestion and delays of public transport vehicles and passenger cars. To resolve this problem, often snatch for the construction of new infrastructure facilities, especially roads, and that doing so did not fully utilize existing capacity. Construction of transport infrastructure is very expensive, especially in urban conditions, which are spatially limited. Based on all this, the question is whether the act rationally, or if we need capital investment in new road infrastructure if we have reserves in other existing traffic systems?

There are primarily thinking of the train unused capacity of infrastructure that the much smaller investment could be used for solving traffic problems in large urban areas. In many developed countries, using various combinations rail system (rail and rail infrastructure for the efficient binding of the wider urban area, and its other forms (subways and light rail systems) in the narrow urban area. The advantages of this combined system of transportation is reflected in reduced traffic jams, as well as capturing the surface (stationary traffic) in the narrow area of the city. and thus opens the possibility for the formation of residential and commercial zones in suburban areas in this way have a quick and secure connection with the smaller urban areas. The planned development of the Canton of Sarajevo, Bosna river valley in the direction of the Ilijas Kiseljak, and the direction Hadžići - Pazarić - Tarcin, imposes the need to solve the mass and rapid transport of passengers and connect the future with the narrower part of the periphery of the city. Connecting in suburban areas with the city efficiently and can achieve the fastest suburban rail. The suburban railway can use the existing infrastructure that passes through the area and the shortest connection of the future town center with the area. This enables many positive effects on the existing network of roads (discharge, increase security, increase the speed and level of services). Also, the realization of positive effects from the aspect of environmental protection (reduction of air pollution, noise, vibration) and thus improve the quality of life in the metropolitan area.

Of course, I can not immediately expect the positive effects and financial gain, they will need a certain period of time that users of existing systems realize the benefits of the new system and start to use it. The biggest advantage of this system is the travel time to the consideration shares is less than travel time road transportation system, especially in peak hours, which is enabled with a high degree of isolation route in relation to other forms of transport.

With aspects of railway infrastructure capacity there are no obstacles to the introduction of this system of transport that would use the "holes" in the schedule. Such a model to solve problems of traffic, which has been long present in the world, could be applied to all major cities of Bosnia and Herzegovina that have unused capacity of the railway infrastructure.

For this purpose it is necessary to make detailed analysis and studies on the basis of which will be seen that the possibilities for the introduction of these systems, and what the effects and benefits we have of it.

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