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17–19 May 2018, Zadar, Croatia

# Road and Rail Infrastructure V

Stjepan Lakušić – EDITOR



Organizer  
University of Zagreb  
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Department of Transportation



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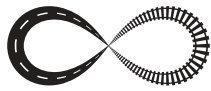
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## TRAFFIC MODEL FOR THE TRAMWAY LINES IN NEW CITY CENTRE OF BRATISLAVA

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### Abstract

The goal of this contribution is to describe the development of the public transport services in the new city centre of Bratislava, Capital of Slovak Republic. The real solution is to realize the set of three tramway lines around the new down town of the Bratislava. A huge development boom from the Danube river bank and on the edge of the Old City, where is risen up a new down town of the city. The territory specified will have around 20 high-rises with different function and there will be more than 17 500 new parking spaces (see Fig. 1). O quarter of the area is built a one third is under construction and all the tall buildings will be finished in 2025. At present, the operation of the territory is at the border of the saturation flows. The article shows a systematic traffic engineering and planning work starting with a set of traffic surveys and results for the next creating of traffic model which will be used not only for the prognosis scenarios of dynamic traffic flows but for changing the modal split for the public transport. There will be a new bus station and begins to reflect on the new tram routes. The results of extensive travel survey and the methodology of traffic modelling for improving the operation of the territory with designing the new tramway lines as a form of sustainable mobility will be shown.

*Keywords: pubic transport, tramway lines, traffic modelling, urban areas*

### 1 New city centre development in Bratislava

The city position in this issue must consist of systematic regulation of build-out in order to reach contemporary modern conception of forming so called “smart cities” – sustainable living and sustainable mobility. Each new investment, large or small, should have the people’s mobility system solved. Illogical delocalisation of the employment, services and free time functions beyond the residential area causes huge transportation demand, especially for the personal car usage. Especially the problem is in a centre of the city. The first level of solution is correct saturation of various functions in given area. Nowadays, the reality is that we have saturated flows on the street network around the contact area of the new city centre. The second level is traffic planning as a whole, not just to design the connection of an object to the road system, but to integrate the site into the supply – demand system of city, for the area to “breathe” and sustainably develop.

Every city’s development is subjected to the urban planning documentation. Bratislava has a valid Land use master plan (LMP) and Transport master plan (TMP) according to the Building act. What is a truth, the city was not able to direct systematically its own development over the period of last 2 decades. Such undirected expansion was caused unrestrained build-out without a vision, without continual traffic service solution in relation with the region within the agglomeration. Today the problem of every new investment is, that the investor wants to

multiply the value of his real estate with minimal expenses, regardless new people – city residents – once living, working or spending their time in his investment. Furthermore each new investment affects the existing urban area, where other people live for even decades and they think of their environment very conservatively. The city should stand on the inhabitants side and direct the development so that it would be pleasant for the people to remain, eventually to constantly return for work, services and amusement, because the city is worth living in. The answer should be the measurability of the sustainable development/transport together with clear rule what the smart deal in the city is really.



Figure 1 Visualization of the southern part of New City centre in Bratislava (Source: © J&T Real Estate)

Nowadays the big impact of the developers creates a complex evaluation of the urban area of the new city centre of Bratislava. Couple of architectural and urban studies exists, depending of the investors, who develop this area. Finally, they cooperation among them allowed to realize a big traffic survey and creating a complex traffic model. For this new city centre area exist a traffic model of present situation and a base new matrix of 42 investments [2]. The aim is to change and re-define the current traffic behaviour and create for the new area new functional interest and certainly the new quality of relationships of the territory. The system solution is the new public transport service for this area with which will be created by a capacitive new tramway network (Figure 1).

The traffic service proposal deals with the existing traffic infrastructure on given future and realised app. more than 2 mil. m<sup>2</sup> functional areas. These ones generate input for the traffic planning, which will define new traffic volumes in many scenarios to find a functional solution of traffic organization and control. Particular variants of the tramway lines in given area are proposed to be the primary tool for future “sustainable mobility”. Around the main streets the issue is the urban tram with narrow gauge of 1000 mm defined in urban planning documentation. Still open is the possibility to develop the area tram service in Bratislava with double gauge which is considered by the introduced added standard gauge (1435 mm) tram-train track connected to the existing railway network in Bratislava. On the area of Bratislava is 80 km of classical railway infrastructure but not used for urban public transport. This track than could be a part of the integrated suburban public transport system aiming to access the agglomeration of Bratislava. The technical solutions still open. Only the bureaucratic and administration responsibility of relevant authorities have. Technically is solved all details in operational parameters. Bratislava last years realized the new tramway line form the Old City toward the southern part of Bratislava – Petržalka across the Danube river a nucleus of this sustainable modern tramway line for operation of tramway with 1 000 mm and for tram-train with 1 435 mmm gauge. The first financial support was covered by EU funds.

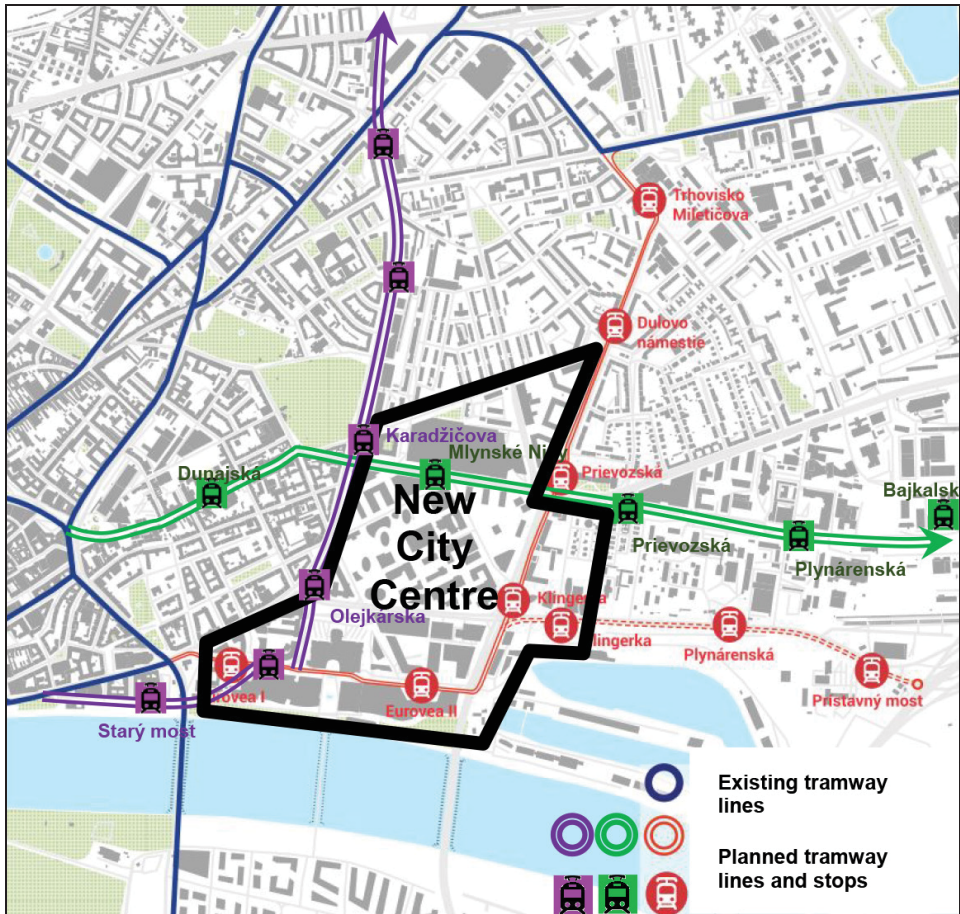


Figure 2 Scheme of new tramway lines for new City Centre in Bratislava

## 2 Technical solution of new tramlines

For the new City centre were studied three tramway lines. According to the complex public transport services we had define these base items:

- 1) The operation of existing public transport lines using buses and trolleybuses in the area in and around the new centre will be in operation to keep the modal split;
- 2) Tramway lines will be the new carrying system of public transport in the solved area created by 4 tangential tracks (see the Fig. 2);
- 3) Tramway tracks will be led in the main traffic area of the streets but horizontally separated from road lanes. The sections in pedestrian zones will be in the middle of the street, and the other, where the tram tracks are designed on the side (left or right) from the dynamic traffic. Special section will be on the northern part of the City centre where the tram track will be both side in the PT lanes.



Figure 3 Scheme of the new tramway line Dunajská – Mlynské nivy

## 2.1 Tramway line Dunajská street – Mlynské nivy

This tramway line is defined by the Transport Master Plan of the City of Bratislava (see the Fig 3). This is a big advance for systematic work for preparing the design work. The city of Bratislava must consider a solution to the capacity system of urban public transport (UPT) in order to service the new modern city centre. In this place is under construction Terminal Mlynské nivy (MN) Bus Station which will be served by the tramway line. In Certain double-track solutions as shown in Figure 4 were sought in search of a system transport solution to tram lines according to the interests of key developers in this area. The proposed routes, however, must be primarily assessed by traffic flows of passengers through a comprehensive transport model, and then it is necessary to look for an engineering design of lines placement in the area under intense development in terms of architectural and construction designs with individual investments in this area, which can be subject to restrictive conditions.

A design in technical study level according to [3] is a partial result. However, the proposed technical design has not been assessed in terms of traffic flows of passengers travelling by UPT, and it can be assumed that only a double-track solution to service in the area will be meaningful from the south from Petržalka borough cross the river Danube (see Fig. 3, left side the bridge), as well as a two-way solution in relation to the city centre (Dunajská Street) towards Mlynské nivy. The proposed solution to the location of stops will very likely be suitable for service in the area as well as for the operation of MN Bus Station.

## 2.2 Tramway line Danube riverbank – Pribinova – Karadžičova street

The tramway route layout according to [4] (Figure 4) starts at Ľ.Štúr square at the current rail intersection from Rázusovo waterfront to Vajanského waterfront and continues towards Slovak National Museum, where it turns to Fajnorovo waterfront, using two contra directional curves. The problem of the longitudinal alignment is at the interchange with the Old Bridge, mainly because of the need to keep the clearing cross-section of the double track tram route under the Old Bridge.



Figure 4 Designed tram track (red line) in the riverbank area

From the Old Bridge goes the track along Eurovea, up the streets Pribinova and Olejkárska back to Dostojevsky rad. The track at Pribinova street, is designed on the boulevard along the street edges because of the entrance/exit of Eurovea parking garage. The crossing of tram track direction on Krupkova street is designed outside the junction in the direction towards the Slovak National Theatre. The track continues through the signal controlled junction Landererova where the principle of design along the street edges ends. A two-way stop is designed in front of the ZSE building. The tram track is placed to the right side of the street along Karadžičova street to the intersection with Mlynské nivy, where it intersects with proposed tram track Kamenné sq. – Dunajská – Mlynské nivy – intersection of Bajkalská street and Mlynské nivy (chapter 2.2).



### 2.3 Tramway line Pribinova – Košická street

This tramway line was designed by the developer according to [5]. Interesting deal is that the idea comes from private sector and they would like to finance this project. On the figure 1 with red line is the complete new line which will be connected near the Old Bridge and will be in the back side of the new Promenade Eurovea shopping mall on Pribinova street. The line will continue on the right side of the Apollo Bridge on Košická street and will continue on the all length of this street. On the northern part will be connected to the existing tramway axis in Ružinov borough. Optional added track is an arm along the Prístavna street to the Port Bridge.

### 3 Traffic model for the new City Centre of Bratislava

Creating a model for a new territorial development with new tram lines is a complex work of traffic engineers and planners according the definitions of the City of Bratislava it were a requirement to use the model from TMP. The original



Figure 5 Scenario of present situation for the morning peak from MTP (© CDV Brno, 2014 [2])



Figure 6 Scenario of present situation for the morning peak from MTP (© DOTIS Consult, Ltd., 2016 [7])

model was developed by another company. The system work of the traffic-engineering deal included from the performance of long term surveys, up to creation of a traffic model for the territory of the new city centre of Bratislava. The analysed area was set out through the streets: Mlynské nivy – Košická – Landererova – Dostojevského rad – Karadžičova (Figure 1). A detailed analysis of the issue of transport surveys published in [1] and results are presented in [6] The result of the traffic model published in this article is based on the extensive urban area analysis, which will serve for the progressive loading of defined transport network investments prepared on the territory. It will be fulfilled with the development of the tram network at the borders of the territory (Figure 1). This is almost 2 million m<sup>2</sup> of new administrative and residential areas, which produce more than 22 000 new parking spaces. In the model was added 72 now zones which represents all entry/exit of the garages.

The largest problem was the setting of the scenario of the transport model to the present state with the application of the model from MTP [7]. Professional works have exceeded the amount of time that would be used if it would create an entirely new model for a specified territory as defined by the scope of the accepted background. The condition of the city of Bratislava, however, was to use the existing transport model, which is part of the strategic land-use planning tools. The transport model from MTP had too many trivial and substantive errors. For comparison, Figure 5 and 6, is a cut-out from a model of the city – above is the output from the MTP, below the new model created on new traffic survey. The simple comparison of the data from both scenarios is clear.

Nowadays each investment is tested in the traffic model (42 new buildings). The aim is to show the high of the new traffic volumes from each investment and to know the partial percentage from all amounts of traffic flows on the street network. The scenarios gradually put a strain on the trail of the individual investments on which is considered the critical way of traffic saturation on junctions. To this situation will be implemented the individual sections of tramway tracks on the territory for a new down town. Their technical solution were verified in advance and published in [4-6].

## 4 Conclusion

The complex studies of tramway lines together with traffic planning tools clearly show that the immense developing activities change completely the whole current traffic relations around the area of new City Centre. The planned new administrative-residential-leisure zone in centre of Bratislava will be significantly changing the modal split of this area and its traffic volume. Only the UPT can afford a higher quality of service for this new area of interest by city rail-track transport with adequate capacity. Following traffic-engineering, traffic-urban and traffic-planning steps have to be carried out which are the main attributes of the new tramway lines solution in details as follows:

- a comprehensive transport survey of the entire area was a necessary tool, whose realization has already shown the disproportion of area's current service and could define the quality of the new traffic model,
- new functional traffic model based on the model of MTP has shown the possibility of making several scenarios for handling the variability of the area in terms of the creation of new stops of public transport for all the PT kinds operating in Bratislava,
- analysis of modal split in favour of the tramway system demonstrates a sufficient volume of passengers in the design a network of 3 tracks,
- it is recommended that the whole territory should be addressed by the transport model by gradually loading the individual investments within a sufficient time horizon representing the complex development of the territory,
- in case of collapse of current traffic organization system on junctions to reconsider all controlled junctions by traffic lights with testing of scenarios for several time gaps in years,

- to gradually assess each junctions in solved territory and to propose gradual changes in the transport infrastructure in line with the development of the network structure of the tramway transport system,
- to keep the smart solutions or sustainable mobility for this new created area to resolve the basic relations of pedestrian flows and its routings with sufficient capacity in urban traffic patterns,
- to solve completely the modal split in the whole area of the new down town, mainly cycling infrastructure with main public traffic stops connections outside of main traffic streams which are followed by a high dynamic traffic volume.

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