Construction of the Belgrade bypass – section C

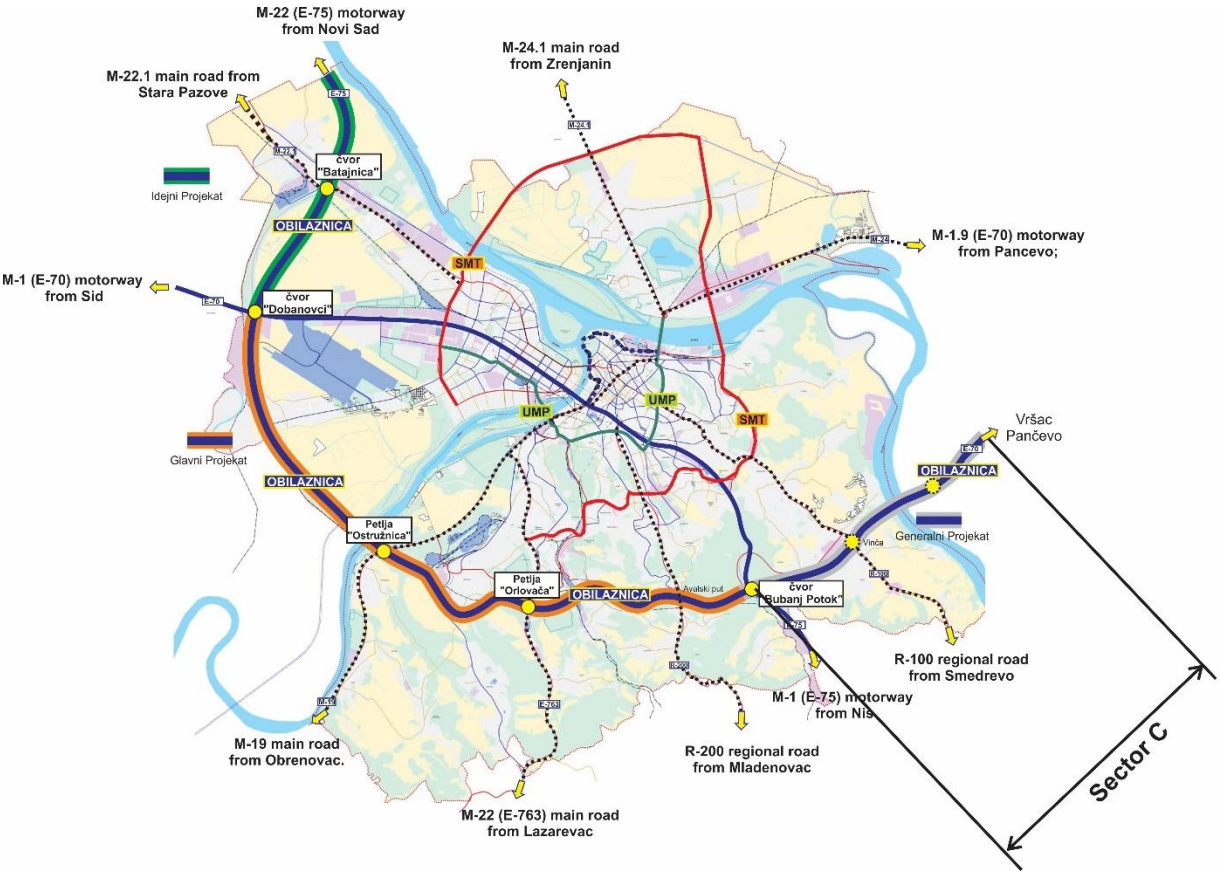
General information

This project regards the construction of a new stretch of **Belgrade bypass motorway (i.e., Section C)**. The Belgrade bypass is a ring motorway linking important roads around the city[1] (see Figure 6-1 and Figure 6-2).

The proposed project will extend the Belgrade bypass providing a link between Pan-European transport Corridor X and Corridor IV and will allow an uninterrupted transit for traffic travelling between the E-75 and the E-70. It will also divert the majority of transit traffic out of the Belgrade urban area. This section is 31 km long and includes a 600-meter-long combined road and rail bridge over the Danube River.

As regards the **relevance of the project**, the construction of Section C of the Belgrade bypass has been identified as a priority project in the Spatial Plan of the Republic of Serbia 2010-2014-2020[2]. This project is also linked with the feasibility study of the motorway section Belgrade-Pančevo-Vršac to Romania border (see section **Napaka! Vira sklicevanja ni bilo mogoče najti.**).

Figure 6-1: Belgrade Bypass with links to road network of Serbia - Overview of section C

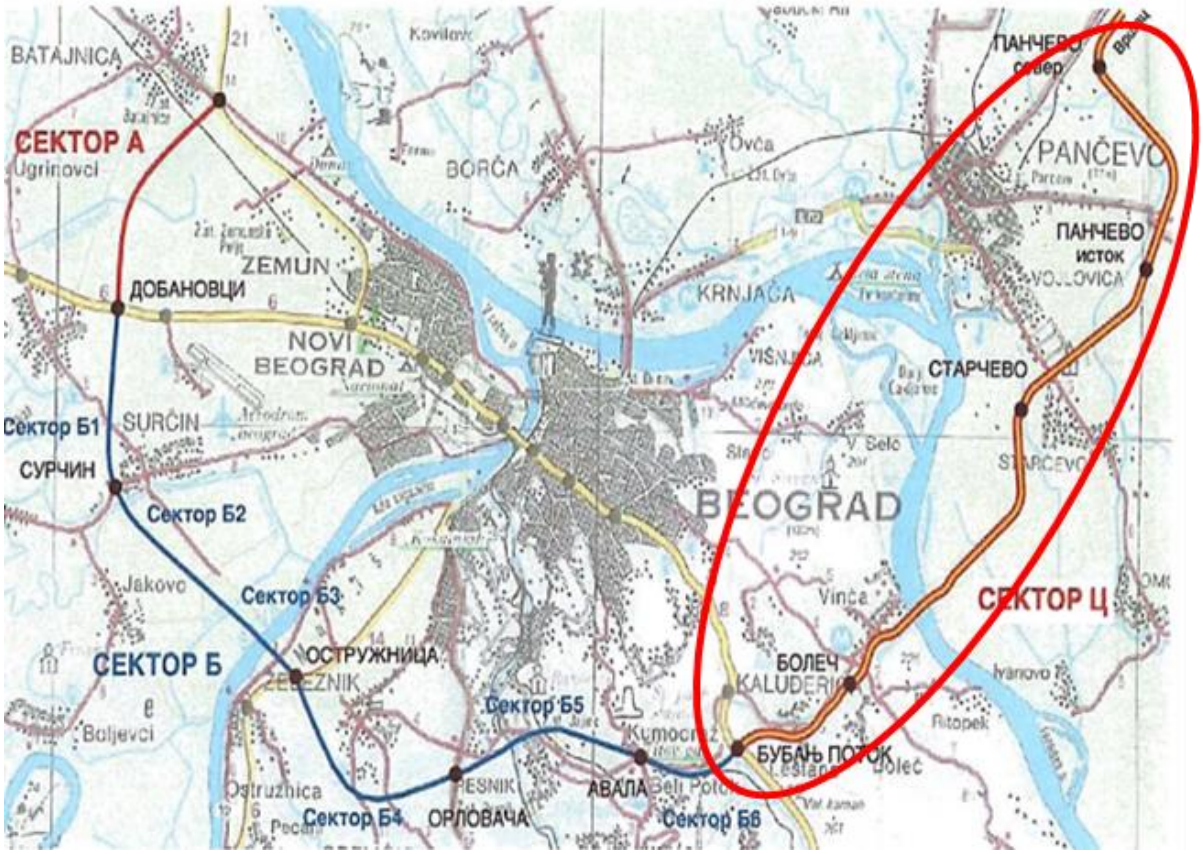


Source: TRT elaboration on Belgrade core road network

[1] M-1 (E-70) motorway from Sid, M-22.1 main road from Stara Pazova; M-22 (E-75) motorway from Novi Sad; M-24.1 main road from Zrenjanin; M-1.9 (E-70) motorway from Pancevo; R-100 regional road from Smedrevo; M-1 (E-75) motorway from Nis; R-200 regional road from Mladenovac; M-22 (E-763) main road from Lazarevac; M-19 main road from Obrenovac.

[2] Ministry of Environment and Spatial Planning of the Republic of Serbia (2010).

Figure 6-2: Belgrade Bypass - Detail of Section C (Bubanj Potok-Boleč-Starčevo-Pančevo East-Pančevo North)



Source: Ministry of Environment and Spatial Planning of the Republic of Serbia (2010)

The construction of Section C of the Belgrade bypass has the following key points of importance:

- multimodality, as this corridor is meant to serve both road and railway transport (i.e., the bridge over Danube river will serve both modes);
- transport of dangerous goods will be removed from city area;
- Section C of the Belgrade bypass is also the bypass of the city of Pančevo;
- it will enable significant load relief for the existing road network in the city centre.

Regarding the other sections, Section A is in operation and Section B is under finalisation.

Technical description

The project is meant to extend the bypass of Belgrade from the intersection with the E-75 (i.e., Corridor X) at Bubanj Potok to Pančevo. This section is 31 km long and will be constructed according to a 4-lane motorway standards with a design speed of 120km/h.

The alignment of Section C was analysed and developed in **3 sub-sections**:

- Bubanj Potok-Marijino polje (i.e., from km 596 +670 to km 607 +600);
- Marijino polje-Đurđevac (i.e., from km 607 +600 to km 618 +800);
- Đurđevac-link to state road the order I M-1.9 (i.e., from km 618 +800 to km 627 +650).

Specifically, the project envisages the construction of:

- a 600-meter-long road and rail bridge over the Danube River, connecting Boleč to Starčevo;

- two tunnels with a combined length of 6 km (approximately in the section between Bubanj Potok and Boleč);
- five grade-separated interchanges;
- Several bridges and culvert structures.

According to the relevant regulations and the predetermined design speed, the technical elements are shown in the Table 6-1.

Table 6-1: Designed characteristics of the project of the Belgrade bypass - section C

Characteristic	Assumed value
Cross section profile	
Traffic lane 4 x 3,75 m	15,00 m
Emergency lane 2 x 2,50 m	5,00 m
Marginal strips 2 x (0,5 m + 0,20 m)	1,40 m
Shoulder 2 x 1,50 m	3,00 m
Layout plan	
Maximum length in direction	2.400 m
Minimum radius of horizontal curve	750 m
Minimum radius horizontal curve	3.000 m
Min. length of the stop in sight at i_n = 0%	260 m
Maximum width of the zone of visibility	11,3 m
Longitudinal profile	
Maximum longitudinal slope	4%
Maximum slope of warping ramp	0,75%
Minimum radius of curvature of the concave	12.000 m
Minimum radius of curvature of the convex	17.000 m

Source: CIP (2008)

The **estimated construction costs** reported in the pre-feasibility study are presented in Table 6-2. The costs breakdown is presented in the Table 6-3. The operating and maintenance costs are mentioned in study, but calculation and values are not available.

Table 6-2: Estimated construction costs per sub-section of the Belgrade bypass - section C

Section	Estimated cost [€, 2008]
Bubanj Potok-Marijino polje (km 596 +670 to km 607 +600)	181.336.884
Marijino polje-Đurđevac (km 607 +600 to km 618 +800)	44.171.497
Đurđevac-link to state road the order I M-1.9 (km 618 +800 to km 627 +650)	56.374.493
TOTAL	**281.882.874**

Source: CIP (2008)

Table 6-3: Breakdown of estimated construction costs per subsection of the Belgrade bypass - section C [€]

Item	Bubanj Potok-Marijino polje	Marijino polje-Đurđevac	Đurđevac-link to state road the order I M-1.9
Preliminary works	7.578.166	386.888	213.110
Road substructure	5.961.898	7.390.908	7.158.484
Drainage	537.815	766.876	726.435
Culverts for water	159.756	59.020	57.264
Carriageway edge	237.710	399.901	347.846
Pavement structure	237.710	8.288.479	6.340.038
Roadside arrangement	488.267	453.099	318.609
Environmental protection	422.550	0	0
Interchanges	380.915	412.934	2.197.306
Interchange Bolec	942.962	1.769.024	6.228.786
Bridges	93.869.146	18.229.703	26.108.910
Water regulation[3]	12.158.926	394.821	257.680
Engineering structures	498.282	0	0
Tunnels	50.772.107	0	0
Telecommunications	551.578	347.166	276.543
Relocation Pipeline (estimated investment value)	0	0	49.017
Electro installation	1.153.739	632.076	726.361
Traffic signs and equipment	1.809.119	1.854.270	2.251.898
Landscaping of road area	697.561	682.927	431.707
Total investments on road:	172.701.794	42.068.092	53.689.993
Contingencies-5%	8.635.090	2.103.405	2.684.500
Total investment value +extras	**181.336.884**	**44.171.497**	**56.374.493**
Total investment value per km	**16.590.749**	**3.943.884**	**6.369.999**

Source: CIP (2008)

Project implementation

The period of implementation of the project is **not yet scheduled**, since the Government of Serbia, through the Ministry of Construction, Transport and Infrastructure, is still looking for financing options. Loan or PPP scheme (in form of Design-Build and other infrastructure delivery models) are options considered for project implementation. The project management and supervision is not yet defined as well as the procurement plan.

Transport demand

Transport demand analysis was carried out in the period 2007-2008. **Two scenarios** were developed covering the period 2011-2025, namely:

- optimistic scenario based on the accelerated dynamic of Association and joining the EU;
- pessimistic scenario based on the prolongation of the Association Agreement with the EU.

Table 6-4 summarises on the assumed values of the socio-economic variables.

[3] Equipment for water removal process.

Table 6-4: Assumed values of the socio-economic variables of the Belgrade bypass - section C

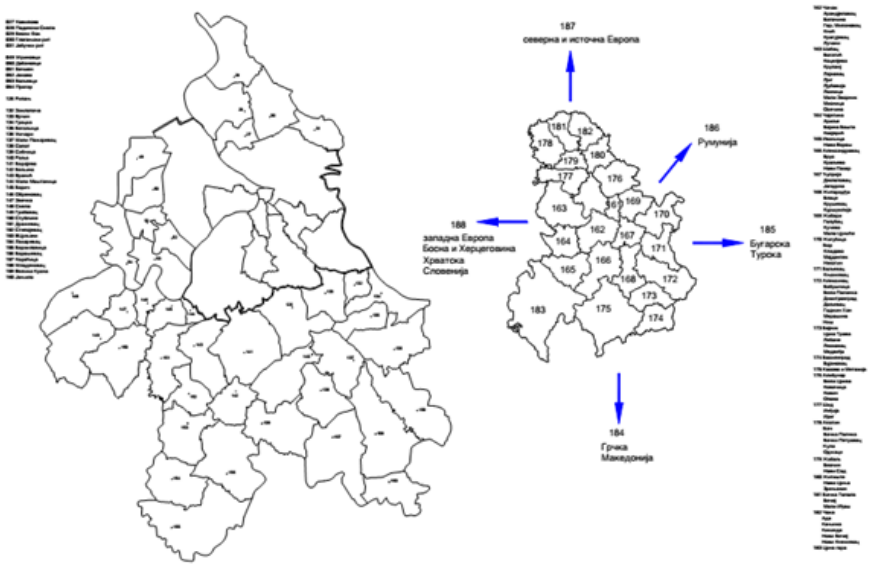
Socio-economic variable	Optimistic scenario		Pessimistic scenario	
	2011	2025	2011	2025
National income per capita	€ 4.365	€ 8.290	€ 3.230	€ 6.090
Annual growth rate of national income	7,0 %	5,0 %	3,8 %	4,5 %
Annual growth rate of the industry	7,5 %	6,0 %	4,5 %	5,0 %
Annual growth rate of the agriculture	5,5 %	4,0 %	3,5 %	4,0 %
Annual growth rate of the services	3,0 %	5,0 %	2,0 %	3,0 %

Source: CIP (2008)

Specific field investigations were conducted for this project. Data relied on estimations of the Highway Institute and investigations of the Faculty of Traffic and Transport Engineering of 2003. The Highway Institute conducted a survey and traffic counting on the outer ring road of Belgrade, at 10 locations of the main entrance routes to Belgrade. The aim was to collect data about the journeys of passengers and goods and elaborate the information to obtain an **origin-destination matrix**.

The origin and destination survey was used to produce future traffic flows for network modelling and distribution on the traffic flows on road network. Figure 6-3 shows the zoning distribution employed to elaborate the origin-destination matrix.

Figure 6-3: Belgrade zoning to elaborate the origin-destination matrix



Source: CIP (2008)

Regarding modelling assumptions, it is worth remarking that: (i) diverted traffic was analysed only from other road directions, but not from other transport modes and (ii) generated traffic was not analysed.

With respect to the **forecasted trends of the economy**, the process of political accession to the EU, the forecasted demographic patterns in the area and the traffic growth factors are summarised in Table 6-5. According to IBRD (2015), the annual GDP growth rates are equal to 1,11% and 1,83% for the low/moderate and moderate/high scenarios, for the period 2020-2030. The estimated growth of transport demand on the long term is fairly in line with the assumed trend of the economy.

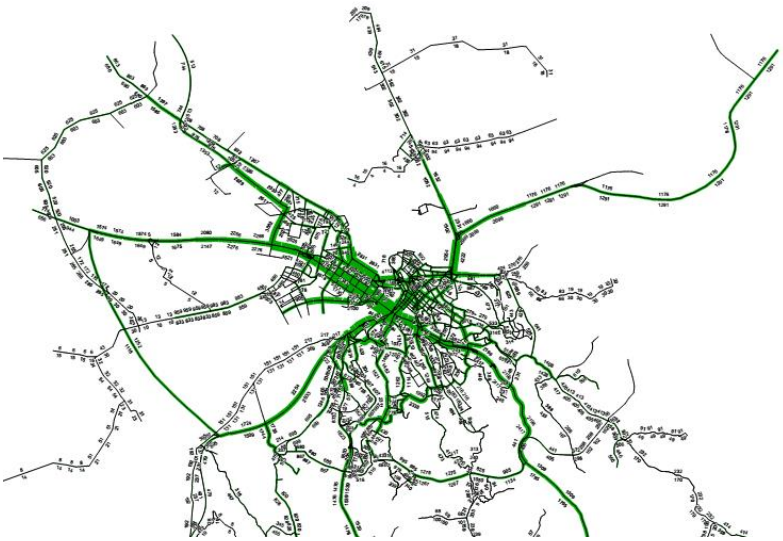
Table 6-5: Traffic growth factors for the period 2005-2030 [%]

Year	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030
Total rate	23,32	21,58	15,04	9,71	7,84
Annual rate	4,66	4,32	3,01	1,94	1,57

Source: CIP (2008)

Figure 6-4 and Figure 6-5 display the forecasted traffic of 2030 with and without Section C.

Figure 6-4: Forecasted traffic in 2030 without Section C of the Belgrade bypass



Source: CIP (2008)

Figure 6-5: Forecasted traffic in 2030 with Section C of the Belgrade bypass

Source: CIP (2008)

Financial analysis

The transit on the bypass of Belgrade is free of charge. The financial analysis was not carried out.

Economic analysis

The information regarding the economic analysis is not complete. The planned construction period is not presented in the prefeasibility study. The forecasted period extends until 2030, but there is not an indication of the starting point in time. The benefits from the project implementation have been calculated with respect to the variations of:

- vehicle operating costs;
- travel time costs;
- accident costs;

- bypass maintenance costs.

A precise description of the elaborations is not reported in the study. The economic analysis provides only some unit prices and the final results of a so-called "realistic scenario" in terms of economic performance indicators, assuming a discount rate equal to 10% (see Table 6-6).

Table 6-6: Summary of economic performance indicators

Scenario of growth	EIRR (%)	ENPV [€ million]	B/C
Realistic	14,4	88,0	2,3

Source: CIP (2008)

A **sensitivity analysis** was carried out to determine the variation of the performance indicators. Limited information is provided with respect to the sensitivity analysis. On not clarified pessimistic assumptions, the EIRR is equal to zero, the ENPV reduces to € -220,3 million and the B/C ratio is -2,2.

Environmental analysis

In order to comply with environmental requirements, the analysis was carried out in a separate study within the preliminary design.

Impacts on the environment for both construction and operations stages were analysed regarding the following aspects: air, soil and water pollution, impact on landscape, flora and fauna, noise, vibrations, borrow pits and archaeological locations during construction and exploitation.

The assessment of the current quality of environmental elements was made using available data provided by relevant institutions who conduct systematic monitoring of the quality of air, surface waters and soil. According to data from the Institute for the Protection of Cultural Monuments, the protected **natural and cultural goods** were identified.

During the construction phase, a certain number of civil and engineering activities were envisaged as having an impact to the environment components. The level of impact depends on the type of activity and sensitivity of the environment. Temporary **air pollution** was expected on specific sections and for a short time, the longest up to the end of construction works. The **soil can be contaminated** by spillages and can be controlled by proper handling and manipulation with the equipment and vehicles, good site organization and by respecting the manuals defined in the Environmental Management Plan (i.e., EMP). Borrow pits and deposit areas will be defined and proposed in the design documentation. The re-cultivation of the excavated areas will be defined by EMP.

Surface watercourses and irrigation channels stretch along the future highway corridor. During the construction phase, excavations in the river beds, crossing and spillages have to be avoided and prevented. Temporary crossings should be planned and strictly controlled. On the specific locations, watercourses need to be regulated according to designs.

Identified **archaeological sites** are out of the site of the future corridor. Nevertheless, excavation works will be done with great care and all newly identified archaeological locations will be recorded and treated according to regulations. The Institute for Monument Protection should be present on the site during excavation works.

The **calculation of noise and air pollution** was carried out. The obtained relevant noise levels at cross sections showed that the average equivalent level of noise will exceed permitted values on certain locations. Technical measures of protection from noise are envisaged on some sections of the future motorway and will be defined in the design documentation.

The analyses of all of the relevant impacts brought about a general conclusion that the corridors defined in the design will bear certain **negative environmental impacts** in the form of increased noise level, air pollution and contamination of soil, surface and ground waters. In the following design stage,

it will be necessary to carry out a detailed analysis and propose mitigation measures for minimisation of the negative impacts.

Safety levels

Information on the analysis of safety levels is not available in the consulted documentation.