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28–30 April 2014, Split, Croatia

Road and Rail Infrastructure III

Stjepan Lakušić – EDITOR

Organizer
University of Zagreb
Faculty of Civil Engineering
Department of Transportation



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PROBLEMS TRACING BYPASS CORRIDOR IN SMALL CITY IN THE EXAMPLE OF DRNIŠ

Ana Rigo, Željko Stepan, Igor Majstorović
*University of Zagreb, Faculty of Civil Engineering,
Department for Transportation Engineering, Croatia*

Abstract

Experience analysis in developing concept bypass of small cities shows that the implementation of new transport infrastructure projects of high rank is associated with significant problems that result in the extension of the deadlines of the projects. This paper describes the issues of regional plans as a basis for designing roads. It points to the lack of an accurate analysis of the planned corridor. Also the insufficient number of current data and information in spatial planning documents that the designer used during the execution of the project is discussed. The need to create additional solutions for corridors in order to create the optimum balance between benefits, costs and impacts based on the evaluation of the traffic model and the spatial position solutions is emphasized. This paper shows a way of finding solutions for corridor bypass in small cities enabling sustainable development of these cities in the future.

*Keywords: road design, spatial planning, transport planning, evaluation
and selection of solutions*

1 Introduction

To create design solutions tracing corridors of major infrastructure facilities, collaboration of road designers, spatial planners, environmental experts and local government, is very important from the beginning of the design. This type of collaboration in recent practice was not commonly applied.

Problems tracing corridor bypass in small towns is shown in the example of the bypass of Drniš. The position of the city of Drniš in the existing road network is shown in Figure 1. In dynamics of development and integration of the Šibensko-kninska County, in coast-hinterland relation, the need for the construction of the Drniš bypass became obvious. This need was already observed already when developing technical documentation study to build a fast road Šibenik – Drniš – Knin – BiH border (BC). The existing transport network of Drniš is made of old roads with bed technical elements, which are not suitable to support traffic that would be directed between the planned high-speed road through the intersection “Drniš” and state roads D33 and D56. The route of the planned Drniš bypass starts in the area of the village Siverić on the state road D33, before crossing the railroad Knin-Šibenik, and it finishes as an extension of the connecting road of intersection “Drniš” and highways in the intersection “Drniš” in BC.

Planned road network of Drniš bypass consists of two corridors, one of which is provided under the spatial planning documents, and the other is evaluated through “Study to determine the optimum solutions of Drniš Bypass”, and can be described as follows:

- CORRIDOR I – BC Tromilja-BH (ŽC6246) – St. John Cemetery – Badanj – D33;
- CORRIDOR II – BC Tromilja-BH (ŽC6246) – St. John Cemetery – passage under an industrial platform-planned bond D33 and D56.

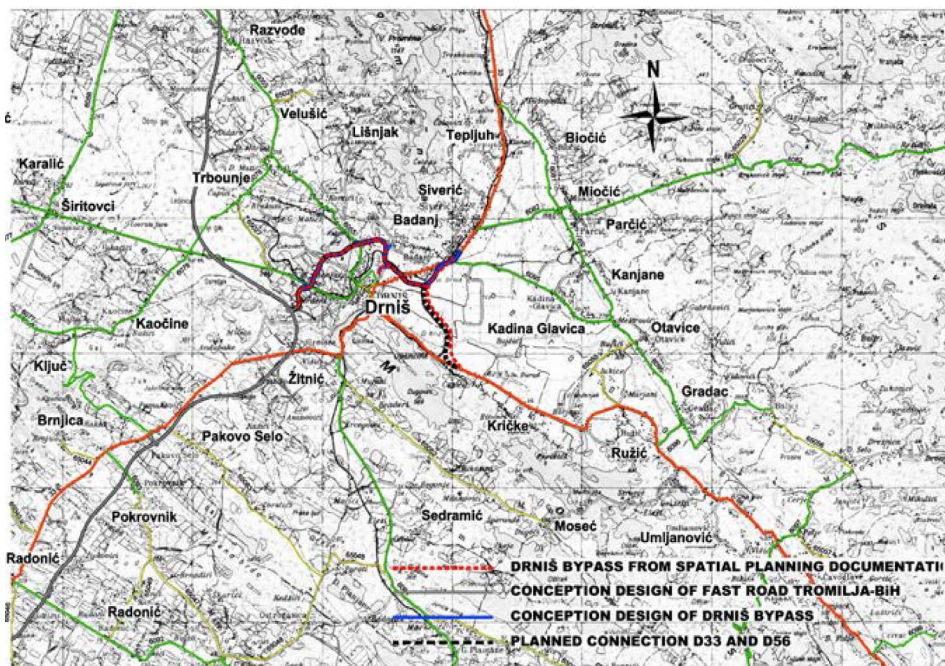


Figure 1 Position of the city of Drniš in the existing road network

2 Project background

2.1 Spatial planning documentation

Until recently, spatial plans were made without detailed analysis of their impact on the surrounding area and the environment, and taken that the planned activities are often several decades old, and that the area and its content has changed, the result is very often a need to plan a route out of the planned corridor. The result is a growing number of modifications of the route that leads to the alteration of spatial plans, which is a time-consuming process. This way of designing and collaboration requires great effort and significantly extends the deadlines given by investors, and is a common situation with facilities of line infrastructure that spatial plans wait for optimized design solutions. The project background for designing the corridor of Drniš Bypass consists of the following documentation:

- Spatial Plan of the Šibensko-kninska County, modification and addition, August 2012;
- Physical Plan Drniš- modification and addition, Urbing d.o.o., April 2006;
- Urban development plan of Drniš – modification and addition, Urbing d.o.o., 2009;
- Conceptual design of a fast road Sibenik-Knin-Drniš-BiH border, shares Tromilja-BiH border, Faculty of Civil Engineering, Zagreb, November 2009;
- A study to determine the optimum solution of building a fast road Tromilja-Drniš-Knin-Strmica, Faculty of Civil Engineering, Zagreb, in December 2010;
- A study to determine the optimum solutions Bypass Drniš, Faculty of Civil Engineering, Zagreb, December 2012.

The Conceptual design of the bypass Drniš under the current spatial planning documentation is designed in CORRIDOR I. The plan from spatial planning documentation to build the corridor was abandoned in the way so that the bypass could continue to the connecting road of inter-

section “Drniš” of fast road Šibenik-Knin-Drniš-BiH border, which prevented the construction of another bridge over the Čikola river. Modification and addition of spatial plan of Šibensko-kninska County in August 2012 have fully accepted the general design of the CORRIDOR I, on the basis that the spatial planning documents of a lower rank needs to be updated.

In the process of environmental impact of Drniš Bypass, during the public consultation the proposed Conceptual design of CORRIDOR I was rated as unacceptable by the citizens of Drniš. The citizens of Drniš expressed their disagreement with constructing the bypass route in the area of State Road D33 to St. John Cemetery, where the planned route of bypass divides the Badanj village in two parts.

Newly designed bypass route (CORRIDOR II) takes over the existing network traffic from the state road (D33) which passes through the southern part of the city and opens up new approaches to the town from the north. The northern area of the city was planned to be a commercial and residential zone. UDP Drniš is in the process of modification, and through this procedure it is necessary to implement the redevelopment of area. The bypass contributes to the development of the planned zone and allows heavy freight traffic access without loading the town (street) network. Diverting transit traffic on the bypass unloads the approach roads to the town, and in the east the road traffic no longer intersects the railway traffic. Figure 2 shows an overview of variants of the previously described corridors of Drniš bypass in one of the existing spatial planning documents.

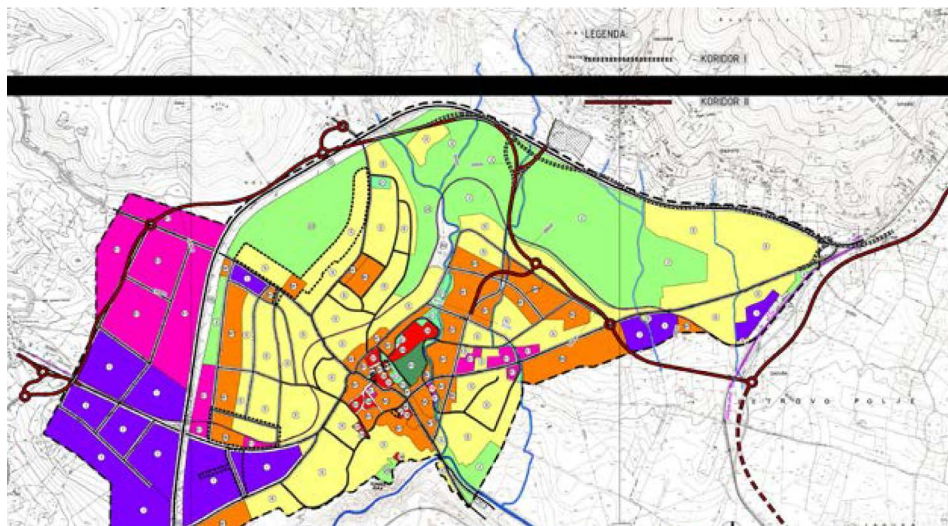


Figure 2 Urban development plan of Drniš with a preliminary ruling bypass

2.2 Geodetic background

In order to develop technical solutions of road systems a common procedure was performed by creating a digital elevation model for the project, as follows:

- scan HOK 1:5 000;
- vectorization of contour plan, height and structure characteristics;
- calculation of triangulation.

For the project the following documents were obtained: TK100, TK25 and digital orthophoto plans that were used for technical solutions and their spatial valuation.

3 The methodological approach

The methodology for selection of optimal variants consists of the following basic steps:

- analysis of spatial planning documents;
- development of technical solutions planned road network;
- development of transport models;
- definition of network scenarios;
- calculation of costs and valuation scenarios.

3.1 Traffic modelling

The traffic model is the basis for determining the traffic impacts of specific scenario which is analysed in the following section of the study. For the purposes of the preliminary design of the Drniš bypass a traffic model is made for road traffic in 2011 and in 2030, for narrower and wider areas in which the traffic impacts of road transport without investment and traffic impacts with the investment are calculated. The calculation of the effects of traffic is made for the following components:

- operating cost;
- travel times;
- accidental cost;
- pollutant volume;
- CO2 volume.

The existing transport network is shown in Figure 3. Statistical data on migration shows that the active population mostly perform their work (60%) within the settlement they live in, while 20% travel between settlements of Drniš. 20% of the active population commute to work out of town. Data obtained by counting the number of transactions that are carried out at several locations in the city, as well as data on counting traffic on national roads were used for calibration and evaluation of models. Projected traffic in the year 2030 was conducted with traffic growth of 2%. Figure 4 shows review of the planned traffic network load in 2030.



Figure 3 The existing traffic network of Drniš



Figure 4 Planned network traffic load in 2030.god.

3.2 Description of segments and presentation of technical solutions

The bypass of Drniš is intended as a road with a pavement with two traffic lanes and the design speed of 80 km/h. Drniš bypass road segments are shown in Figure 5. Road network of the Drniš Bypass is divided into seven (7) road segments:

- a – IDRJ bypass Drniš – June 2011, CORRIDOR I;
- e – BC Tromilja-BiH (ŽC6246) – connecting road for Drniš;
- f – connecting road for Drniš – D33;
- g – D33 – D33 planned bond and D56;
- h – planned connection D33 and D56;
- i – planned connection D33 and Drniš bypass;
- j – connecting road for Drniš.

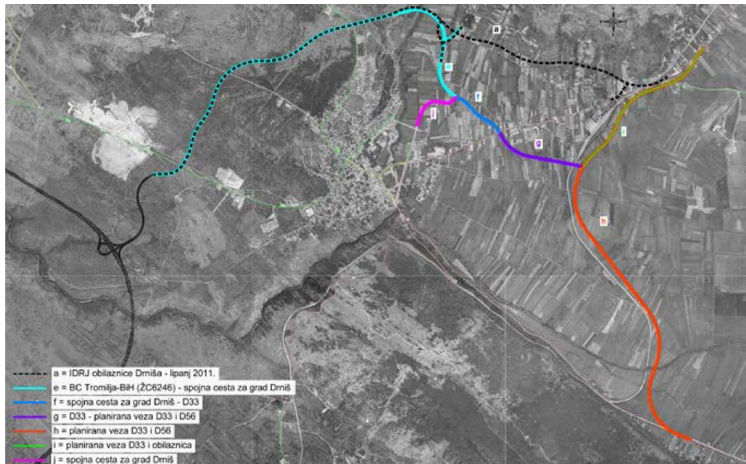


Figure 5 Overview of road segments

3.3 The calculation of costs and evaluating scenarios

By the combination of road segments for the planned network developed five (5) scenarios. For each scenario construction costs and traffic impacts are calculated. Review of scenarios, their calculated costs and economic indicators, is given in Table 1. Basic construction costs are calculated for all road segments as follows:

- route;
- objects;
- drainage.

Economic indicators are calculated for total costs (investment and maintenance) and transport effects, as follows:

- savings;
- Net Present Value – NPV;
- Benefit / cost ratio – B / C;
- Internal Rate of Return – IRR.

Net present value is calculated for the period of operation of 20 years with a discount rate of 5%.

4 Selection of optimal solutions and evaluation of variant

Economic efficiency is based on a comparison of costs and benefits (cost – benefit analysis) actions taken in the transport system (planned event – to do something) with the costs if the planned action is not taken (maintaining the status quo – do the minimum). Based on the basic parameters of the economic efficiency of the net present value (NPV), cost-benefit factor (B/C) and internal rate of return (IRR) acceptability of all proposed scenarios in road network system of Drniš is evident. Table 1 which provides an overview of the costs and economic indicators show that all scenarios offer positive values, which is an indication that all scenarios are thoroughly acceptable.

Table 1 Overview of costs and economic indicators

Name of scenario	Scenario network (segments)	New segments	Lenght	Invest. /km	Investment	Saving	NPV	B/C	IRR
			(m)	(€)	(€)	(mio. €)	(mio. €)	(mio. €)	(mio. €)
Scenario 1	a	IDRJ obilaznice Drniša - listopad 2011	5.411,00	1.758,88	9.517.319	1,282	5,14	1,447	9,01%
Scenario 2	e + j	BC Tromija-BH (ŽC6246) - spojne ceste za grad Drniš Spojna cesta za grad Drniš	5.057,00	1.461,20	7.389.299	0,854	2,10	1,234	7,24%
Scenario 3	e + f + j	BC Tromija-BH (ŽC6246) - spojne ceste za grad Drniš Spojna cesta za grad Drniš - D33 Spojna cesta za grad Drniš	5.511,56	1.432,43	7.894.901	1,026	3,67	1,382	8,51%
Scenario 4	e + f + g + h + j	BC Tromija-BH (ŽC6246) - spojne ceste za grad Drniš Spojna cesta za grad Drniš - D33 D33 - planirana veza D33 i D56 Planirana veza D33 i D56 Spojna cesta za grad Drniš	10.573,00	1.073,73	11.352.573	1,733	8,54	1,613	10,35%
Scenario 5	e + f + g + i + j	BC Tromija-BH (ŽC6246) - spojne ceste za grad Drniš Spojna cesta za grad Drniš - D33 D33 - planirana veza D33 i D56 Planirana veza D33 i obilaznica Spojna cesta za grad Drniš	7.934,00	1.172,68	9.304.053	1,309	5,64	1,498	9,44%

By comparing scenario 1, which represents Drniš Bypass in CORRIDOR I and scenario 5 representing the Drniš Bypass in CORRIDOR II, it is evident that bypass scenario in CORRIDOR II has better economic indicators.

Scenarios 2 and 3 represent parts of the Drniš Bypass, while Scenario 4 is an addition to the network in terms of defining the entire road system of the City of Drniš that makes Drniš bypass and connection of existing D33 and D56. Economic indicators of previously described scenarios also show the acceptability of these solutions, and the actual construction of the Bypass in CORRIDOR II proved to be very flexible solution.

Scenario 5 as the solution of the Bypass in CORRIDOR II according to criterion of savings, NPV, B/C and IRR is in the second place, right after the scenario 4 that represents its supplement on connection of D33 and D56. If you consider the ratio of investment per kilometre scenario 5 is the most cost-effective scenario of the Drniš Bypass. In conclusion, it is determined that scenario 5 as the solution of the bypass in CORRIDOR II, if we compare all the technical and economic indicators, is the optimal solution for the bypass.

5 Conclusion

The analysis of practice experiences shows the importance of cooperation between all stakeholders (including representatives of regional and local communities) from the start of design services. Spatial planning documentation that provides a starting point for road designing generally is not precise enough and does not contain all current data and information that designers need to consider when creating conceptual designs. This often results in smaller or larger deviations of finally designed route from the corridor outlined in the spatial planning documentations. Therefore, we can expect more frequent occurrence of the physical plans to adopt design solutions verified through the traffic, economic and spatial aspect, whose analysis should be carried out in the earlier stages of the strategic development of transport infrastructure projects. In this way the significant and increasingly frequent prolonging the period of completion of design and study activities would be avoided.

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