

CETRA²⁰¹⁴

3rd International Conference on Road and Rail Infrastructure
28–30 April 2014, Split, Croatia

Road and Rail Infrastructure III

Stjepan Lakušić – EDITOR

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ANĐELI INTERCHANGE ON MATULJI – UČKA SECTION OF ADRIATIC HIGHWAY (B8)

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Abstract

Matulji – Lupoglav section of the Adriatic highway was opened in 1981. and after 30 years it is in dire need of upgrade. Currently, construction of the second carriageway on this section is in design stage, but there were also upgrades on the existing section done, especially in the last couple of years. This was necessary because of the increase of traffic, but also because of large increase in residential construction on the outskirts of the highway corridor, and sometimes even in the corridor. In 2006, BINA Istra as the concessionaire of the Istrian Y, which Matulji-Učka is a part of, decided on three main points of upgrade on the existing section. These were construction of the merging lanes on the existing Veprinac interchange (Phase 1), construction of the new Anđeli interchange (Phase 2) and construction of the 2km long slow vehicles lane from Frančići viaduct to Anđeli viaduct (Phase 3). After conceptual design of the proposed upgrades, which explored multiple variants and options, final decision was made by the concessionaire that on Veprinac interchange merging lanes for vehicles connecting onto the highway in both Učka and Matulji direction should be designed, new Anđeli intersection will be designed to increase traffic safety and slow vehicles lane will be designed on the mountain side of the existing carriageway to allow for retaining of traffic throughout the construction period. This paper will focus on the design and construction of the new Anđeli interchange, from the conceptual design that included multiple variant options in 2006 to finalization of the project and opening of the interchange for use in the summer of 2012.

Keywords: infrastructure, road design, highway, interchange design, upgrade

1 Introduction

Even after construction of slow vehicles lane on the 1.5 km stretch of B8 in front of “Učka” tunnel entrance at the Kvarner side, there were still issues with traffic congestion, especially in the summer months. Also, existing emergency stop areas near “Anđeli” viaduct were used by the locals as an illegal road entry point, and existing Veprinac interchange was built with direct exits from county road 5048 towards Učka and Matulji, without any merge lanes. Because of that, this part of the B8 was considered lacking in traffic safety, and it was decided to improve the existing state even before the construction of the second carriageway.

Conceptual design of existing section improvements along with solutions for construction of additional 1.8km long slow vehicles lane and merge lanes in Veprinac interchange, produced multiple variants of the future “Anđeli” interchange. Finally, 5 different variants were proposed to the Investor, which differed in layout disposition of the interchange, and in type (semi-interchange with only turn-out lane from Matulji and merge lane towards Matulji, or a full interchange). After revising the proposed variants, the Investor decided that a full interchange should be designed, with two design constraints. First was that the existing frame structure that served as a road passage under the B8 highway must be kept, so traffic can be

maintained throughout the construction period, and the second was keeping of the existing water reservoir in the future interchange.

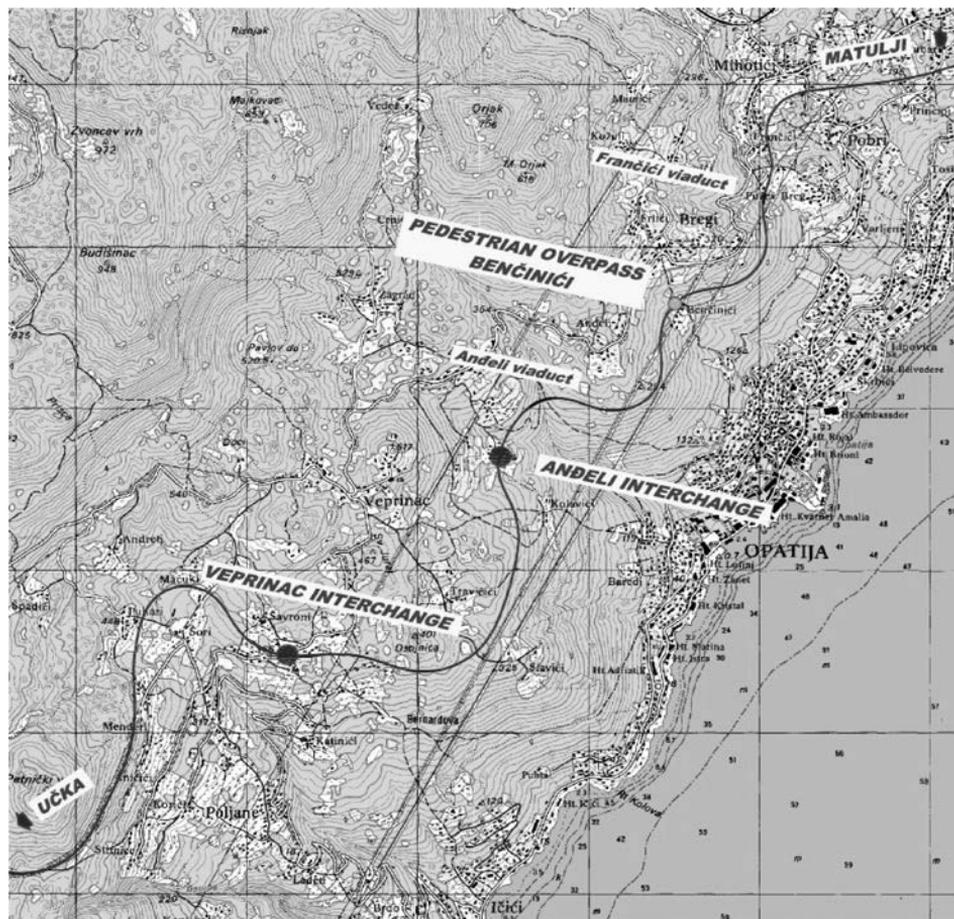


Figure 1 Matulji-Učka section of Adriatic highway (B8)

2 Design stage

2.1 Interchange

Andeli junction is serving primarily as a connection to settlements of Kolavići and Zatka, but in the future, city of Opatija plans to build a local road network that it is an essential part of. Given the terrain configuration, the interchange was designed as a half-clover stretched over a long section of main road, but in a narrow corridor, to minimize the earthworks. Steep terrain slopes also imposed usage of minimum design elements.

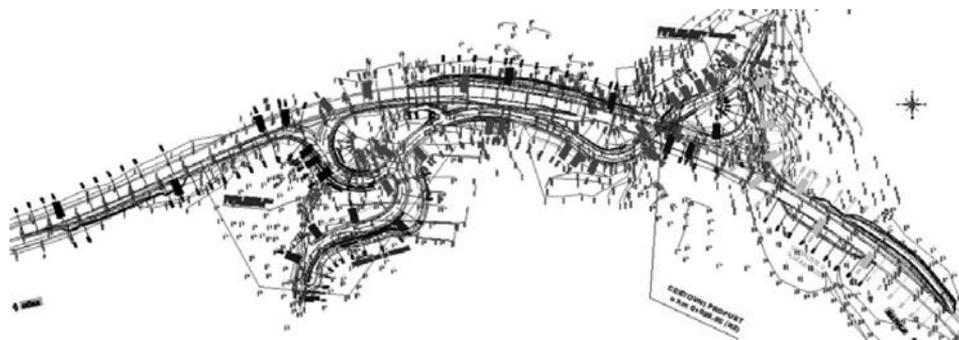


Figure 2 "Andeli" interchange

Technical elements of the interchange allow for design vehicle speed of 30 km/h on ramps, while the speed on the main road is limited to 80 km/h. Also, because the existing road underpass has inadequate width of only 4 meters, alternate traffic will be kept until the construction of second highway carriageway.

Table 1 Technical elements used for interchange design

minimum horizontal radius	25 m
maximum slope level (ramps)	10 %
maximum slope level (other)	12 %
lane width (traffic/emergency)	3.25/2.5 m
shoulder width	2.0/1.5 m
crossfall (straight/curve)	2.5/max. 7.0 %
minimum vertical radius (crest/sag)	250/200 m

Connection to the existing road to Kolavići was reconstructed and moved to surpass the level difference in excess of 12m at an acceptable longitudinal slope of 10.8%. Also, because of the level differences, design of retaining walls was necessary. Total of 5 retaining walls were designed, 2 on the northern side to protect the Slatina flood stream, and 3 on the southern side for protection of the existing water reservoir / cutoff chamber "Kolavići". Since the geotechnical investigation works showed that terrain consists mostly of rock, cuts were designed with slopes between 1:1 and 2:1, with maintenance shoulders on cuts higher than 8m. Fill embankment slopes were designed at 1:1.5. Since the merge lane towards Matulji required the demolition of existing emergency stop area, it was moved app. 240m in direction of Matulji. Because of this, emergency phones installation and optic fibre cables in highway shoulders were also moved.

2.2 Viaduct

Since the existing road underpass, which is a concrete frame structure, couldn't be reconstructed, the new structure that serves the merge lane in Učka direction was designed separate from it in every way. To accomplish this, the new structure has pile foundations, to also minimize influence on existing B8 embankments. In constructive sense, viaduct is a single span slab propped on head beams with variable height – a monolithic structure.

Table 2 Viaduct technical elements

span	12.8 m
width	7.10 m
beam height	1.50-4.65 m
pile diameter	0.8 m

Structure was calculated in SOFiSTiK software, with finite elements method, as a spatial construction elastically propped on the ground. Dimensioning was carried out for Ultimate limit state (ULS), and checked for Serviceability limit state (SLS).

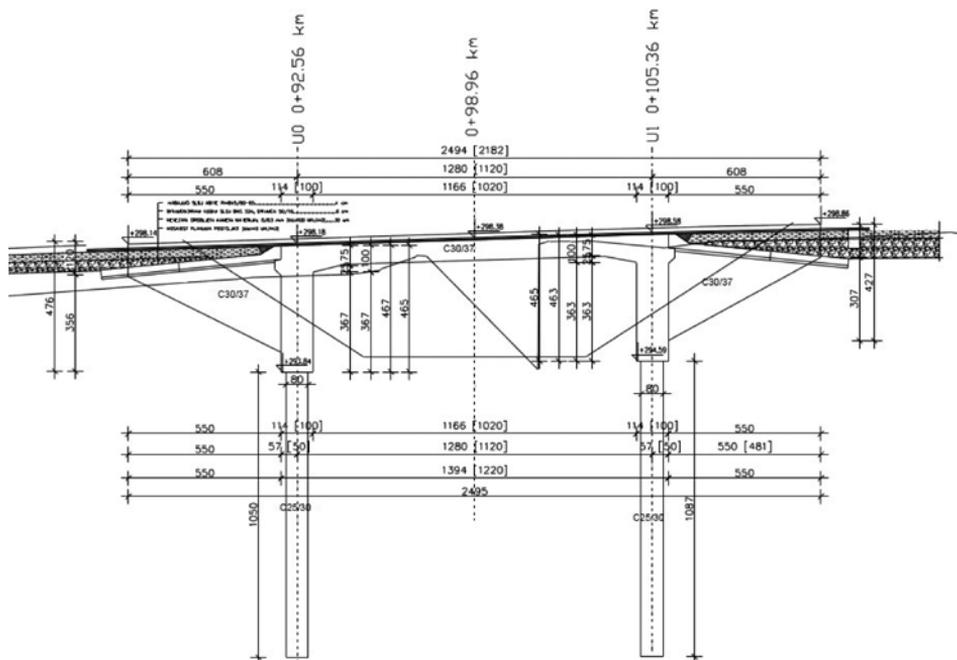


Figure 3 “Andeli” viaduct longitudinal profile

2.3 Permits obtaining procedure

Long period of time needed for finalization of this project was in no small part a direct consequence of prolonged legal procedures. Preliminary design was started in October of 2008, and in July of 2009 the request for Location permit was submitted. It wasn't until May of 2011 that the Location permit became valid. In the 2 years that passed, procedure was delayed by many factors, including transfer of jurisdiction, land owner appeals and bureaucracy issues. This was cause for subsequent postponing of slow vehicles lane construction since financing for that part of the project was terminated because of the delays.

Fortunately, construction permit obtaining procedure was much faster and without big problems. This meant that construction permit was issued in November of 2011, which allowed the construction to start in early 2012.

3 Construction

Construction of the interchange started in February of 2012, as soon as weather conditions allowed. Deadline for opening of the new interchange was set for the beginning of the tourist season. It was carried out by Bouygues TP as a main contractor, and Cesta Pula and other local companies as subcontractors. The new road viaduct construction works were carried out by Viadukt.

3.1 Changes in original design during construction

In the process of construction preparation, it became obvious that the company that manages local water and drainage has no need for the existing water reservoir / cutoff chamber “Kolavići”. This information didn’t emerge in the design stage because of jurisdiction issues. Since it became clear that the reservoir can be demolished, two of the five designed retaining walls lost their purpose and were substituted with embankments. Instead of the existing reservoir, pressure reduction station was built along with a new pipeline. Also, after negotiations with Croatian waters agency, which is responsible for all waterways in Croatia, two retaining walls designed to protect the Slatina flood stream were substituted with a series of concrete culverts. This meant that only the retaining wall on the connection road to Kolavići was constructed, and main and construction designs were updated accordingly.



Figure 4 Slatina flood stream bed and culvert entrance

During the construction, design of cuts was changed to accommodate wider maintenance paths with access on both beginning and end of the cut. This required changes in the plot division reports, which was done according to as built documentation and survey.

3.2 Construction finalization and interchange opening

Construction of the interchange was finished in a predicted timetable, with only mild obstructions to ongoing traffic. Beginning of July 2012, internal technical audit was performed by the Ministry of Internal Affairs and Ministry of Maritime Affairs, Transport and Infrastructure. This allowed for opening of the interchange even before the official technical audit. The official audit was performed in late July, and with it, construction of the new Anđeli interchange was officially over after six years of design and construction.

In 18 months after the interchange opening, there was only one significant accident, caused by a driver who performed an illegal U-turn at the emergency stop area position. Fortunately, there were no fatalities, only material damages. This proves that the reasons for construction of “Anđeli” interchange were valid.

Currently, local population is requesting that City of Opatija continues with improvements to road network that are a part of the local spatial plans. Construction of the “Anđeli” interchange allowed the planned connections to Benčinići and Slavići to move from wishful thinking into possible projects. Time will show if this is just the beginning of improvements or a lonely exception.

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