



CETRA²⁰¹²

2nd International Conference on Road and Rail Infrastructure
7–9 May 2012, Dubrovnik, Croatia

Road and Rail Infrastructure II

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CETRA²⁰¹²
2nd International Conference on Road and Rail Infrastructure
7–9 May 2012, Dubrovnik, Croatia

TITLE

Road and Rail Infrastructure II, Proceedings of the Conference CETRA 2012

EDITED BY

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ISBN

978-953-6272-50-1

PUBLISHED BY

Department of Transportation
Faculty of Civil Engineering
University of Zagreb
Kačićeva 26, 10000 Zagreb, Croatia

DESIGN, LAYOUT & COVER PAGE

minimum d.o.o.
Katarina Zlatec · Matej Korlaet

COPIES

600

A CIP catalogue record for this e–book is available from the National and University Library in Zagreb under 805372

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SPECIFIC FEATURES OF A5 HIGHWAY–BRIDGE OVER RIVER DRAVA

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Abstract

Slavonija and Baranya County, which occupies almost 20% of the total Croatian area have a very auspicious traffic position due to the main European transport routes. Construction of highways in this area that has so far been relatively isolated to other parts of Croatia have many positive effects both locally and globally through economic and social development. Beli Manastir–Osijek–Svilaj highway is a part of the International Pan–European Corridor Vc that connects North Europe with the Adriatic Sea. This part of that corridor is passing through two parts of eastern Croatia very different in macro–relief and climate: east–Croatian lowland and Slavonian Posavina with Požega valley. The specific feature of this section is its transverse position due to which it intersects a number of state, county and local roads, two routes of existing railway lines (one main railway line and one Clas I) and it also intersects two rivers, Sava and Drava with the existing waterway routes. To demonstrate that even within design and building of roads through the lowland part of Croatia there are challenges, details of the bridge across river Drava project and constructions so as the basic Corridor Vc features on its section through Slavonija and Baranya County will be presented in this paper.

Keywords: A5 highway, bridge, Drava, Corridor Vc

1 Introduction

One of the main prerequisites for the development of each country is developed and modernized motorway network integrated into global transportation system. The great advantage of Croatia is its position in Central European, Mediterranean and Danube region thus it is located at the crossroads of globally significant transport corridors.

Development of motorway in Croatia started in 1950s when building of single–carriageway road (Brotherhood and Unity Motorway), first between Zagreb and Belgrade, and Zagreb and Ljubljana has started. This road was designated as the first phase of motorway construction and, it is interesting that it was built with concrete pavement [1]. Construction of the first kilometers of motorway, as the result of need for connection between the northern continental and southern coastal areas started in the mid–1960s when motorway Zagreb–Karlovac (45 km long) as the first toll collection motorway in the region and the exiting section from Rijeka towards Zagreb (10 km long Orehovica–Grobnik section) were built [1].

Until 1990th the Slavonski Brod section was completed, some of the larger cities bypass (Rijeka, Split, Osijek) were built, tunnel Učka and Krk Bridge were open to traffic so Croatia had 305 km long motorway network.

During the war and postwar period, motorway construction was weaker in intensity, but even within this period of time continuation of studies and designs of future motorway sections were ensured. Since 1991 to 2000, construction of 230 km long motorway sections were completed and Croatian national motorway network was 541 km long [2].

During the next ten years, intensive motorway construction is recorded in Croatia. Within this period of time, over 700 km of newly constructed motorways has been open to traffic, which

means average of 80 km newly constructed motorway per year. Figure 1a shows state of national motorway network in 1999 and figure 1b state on national motorway network in 2011 [2].

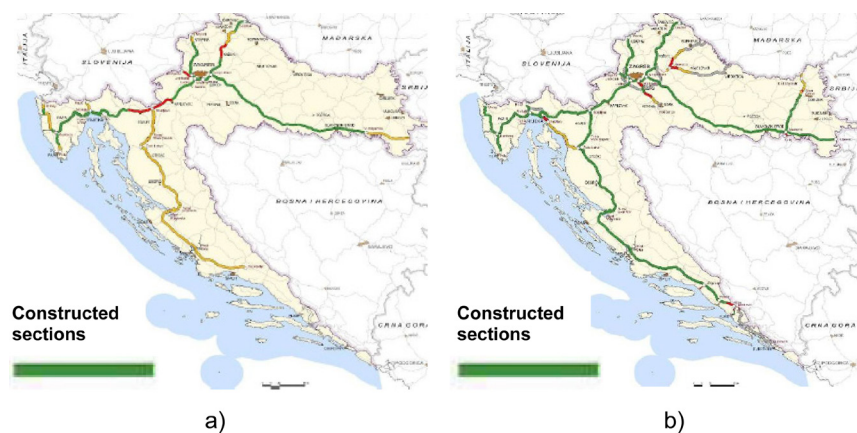


Figure 1 State of Croatian motorway network during 1999. (a) and 2011. (b) [2]

Today, Croatian motorway network is 1260.5 km long and 294 km of motorway per million inhabitants puts Croatia at very top of motorway network developed countries in Europe [2].

2 Corridor Vc and A5 motorway

Due to its auspicious traffic position to the main European transport routes, Croatia is divided by the pan-European multi-modal corridors: Corridor v (its Vb and Vc routes) and Corridor x (its main and Xa route). Figure 2 shows European traffic routes passing Croatian territory defined in Helsinki in 1997.



Figure 2 Routes of European traffic corridors passing Croatian territory [1]

Beli Manastir–Osijek–Svilaj motorway, designated as route A5 is a part of the International Pan-European Corridor Vc that connects North Europe with the Adriatic Sea. This part of corridor is passing through two parts of eastern Croatia very different in macro-relief and climate:

east–Croatian lowland and Slavonian Posavina with Požega valley. The specific feature of this section is its transverse position due to which it intersects a number of state, county and local roads, two routes of existing railway lines (the main railway line Savski Marof–Zagreb–Tovarnik and Clas I railway line Varaždin–Koprivnica–Osijek–Dalj) and it also intersects two rivers, Sava and Drava with the existing waterway routes. Another specific feature of the area route A5 is passing is its extremely rich archeological, cultural and historical heritage. Namely, Baranya region has a huge tourist potential and offers many facilities such as pure, intact nature and ethnic richness regarding the specific impact of the multi–ethnic nations who lived in this area and whose customs and values are cherished for centuries. In this area, there are also protected natural values such as Nature Park Kopački rit. This world famous wetland reserve formed at the confluence of Drava and Danube, with flood area of about 17 000 ha is a true ornithological paradise with over 270 birds species and it is added in the list of internationally important wetlands.

A route of the Corridor Vc passing through the Republic of Croatia is divided into 6 sections. Five of them passes through Slavonia and Baranya and are designated as route A5 while sixth section passes through south Dalmatia and is designated as route A10.

First section of route A5, Đakovo–Sredanci was opened to traffic in November 2007 in total length of 23.0 km. The second section, Osijek–Đakovo was opened to traffic in April 2009 in total length of 32.5 km. Building of the Drava Bridge represents construction beginning of longest unfinished section Osijek–Beli Manastir in length of 24.6 km. After complete of that section, the shortest section Beli Manastir–Hungarian border in length of only 5 km is to be built. In September of 2011, works on the section Sredanci–B&H border started and the end of the works is planned in 2013th. This section in total length of only 3 km is one of the most expensive ones because of 6 facilities, including complete construction of Svilaj border crossing which must be constructed according to Schengen conditions and bridge over river Sava which is to be financed jointly by Croatia and B&H [4]. Figure 3 presents motorway A5 divided into sections according to the time of opening to traffic [3].



Figure 3 Sections of A5 motorway [3]

To achieve its full potential, route A5 needs to be connected with sections of Corridor Vc in Hungary and Bosnia and Herzegovina. On the Hungarian side, motorway has come to town of Bóly and the rest of 19 km long section to Croatian border is planned to be finished until the end of 2013 [5]. Through Bosnia and Herzegovina, around 40 km of motorway has been finished and until the end of 2013 it is planned for new 80 km of motorway to be opened to traffic [5]. Even though route A5 passing over lowland part of Croatia, it is designed with significant number of facilities: 23 overpasses, 3 game crossings, 1 viaduct, a number of culverts and 17 bridges [1] among which it is worth mentioning the Sava River Bridge and the Drava River Bridge which main characteristics will be described.

3 The Drava River Bridge

Bridge over river Drava is located between two suburban communities, Josipovac and Petrijevci so the number of factors influenced on its disposition [6]:

- navigation and navigation clearance conditions (waterway width of 50 m and height of 5.25 m);
- river Drava inundation width (3100 m at the bridge location);
- Vučica riverbed;
- flood embankment;
- location of the future hydroelectric power plant which partition profile need to be built downstream of the bridge so the bridge will be crossing over dam lake;
- nature preservation conditions.

Designing this bridge, few conceptual designs have been made [3]. First solution represented simple, customary design of a bridge in lowland while the other represented more attractive design, visually more impressive. Figure 4 presents first, ordinary bridge design and figure 5 presents future the Drava River Bridge.

Bridge is designed as a cable-stayed bridge with composite steel structure. Riparian bridge width is 2×13.2 m due to which left and right roadways are on separated facilities and on the main span they are on the same facility, width of 28 m [6].

Plan view of the bridge starts with curve radius of 4000 m which continues into the transition curve length of $L=200$ m ($A=894.43$ m), straight line length of 1055.68 m, another transition curve with length of $L=200$ m and it ends with curve of 4500 m radius [6]. Bridges vertical alignment is conditioned by navigation clearance so it is designed with vertical convex curve, tangents grade of 0.61%.



Figure 4 One of the bridge conceptual design solutions [3]

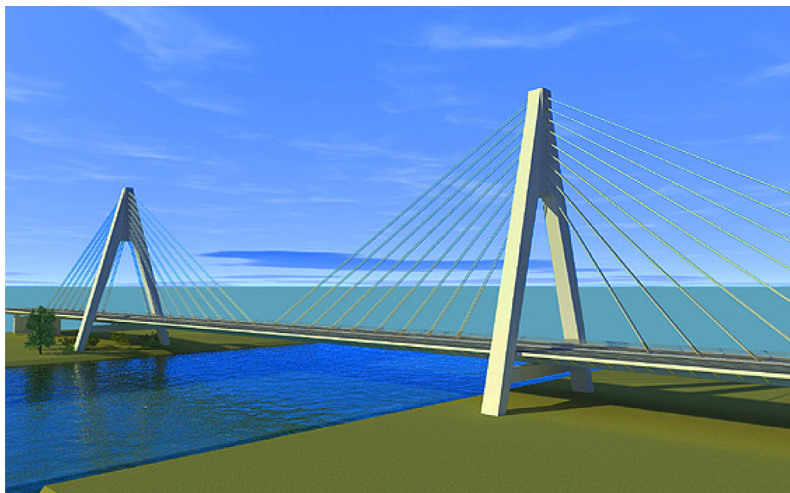


Figure 5 Appearance of the future Drava River Bridge [7]

One motorway roadway is consisted of 0.5 m marginal strip, two traffic lanes width of 3.75 m with marginal strip of 0.2 m and stop lane of 2.5 m width. Traffic bridge surface is extended for a further 0.5 m for each side, concrete path of 0.25 m and protective steel fence of 0.4 m width and height of 1 m [6]. Pavement transverse gradient is 2.5%, double sloping and constant.

The main bridge span is consisted of steel beam, reinforced concrete pylon and tie rods. Bearing steel beam is composited with reinforced concrete deck slab. Two reinforced concrete pylons are later A shaped, rectangular cross sections structures which are slightly widens towards the top and based on two groups of bored piles, 25 piles in each group, diameter of 150 cm and length of 19, 22 and 25 m. On each side of the pylons, there are two rows of 10 tie rods consisted of 20–60 cables [6]. Bridge has a total of 45 groups of concrete columns (2 or 3 columns in a group, different in cross section shapes) and columns which are positioned along the river bed are designed with granite stone facing for the protection of floating objects such as ice, branches and nozzle sandblasting [6].

Over the concrete deck slab, asphalt pavement construction is designed with 4.5 cm thick Splittmastixasphalt SMA 16, 5 cm thick binding course vs 16 and one-layer bituminous strip waterproofing [6].

Surface water reception and drainage is designed with two-part gully with the ability of collecting seepage water. Water from the gully goes by connecting pipes to the drain pipes, which are connected to the manhole nearest to the bridge.

Construction of this 2485 m long bridge started in July, 2011 and currently construction of piles are in progress (figures 6 and 7). The beginning of a construction works on this almost 950 million kn worth bridge, with a contract time of 30 months marked the beginning of construction works on a longest (24.6 km long) unfinished section of A5 motorway, Beli Manastir–Osijek.



Figure 6 Construction works on the Drava River Bridge



Figure 7 Construction site on the Drava River Bridge

4 Significance of motorway A5 and the Drava River Bridge

Motorway construction has both, positive and some negative effects for a society.

First of all, modern road network is one of the main prerequisites for the sustainable economic development. Beside the facts of faster, safer and more comfortable travel between countries and regions, during motorway construction increased demand for the construction materials and services are great impulse to the construction sector, locally and nationally and it has a great economic contribution to a region where the motorway passes along.

Motorway A5 is designed as traffic 'spine' of eastern Croatia which connects it with the rest of the country, as with a Europe. It represents precondition for of economic, tourist and cultural development of this region as for the whole country.

The main negative impact is increased need for financial resources, first for its construction and then for its management, maintenance and rehabilitation which in this times of crisis is a huge burden to society. Another negative impact is its influence on the environment since the construction of a motorway may drastically affect the landscape and disrupt the natural balance between animal and plant life. But despite that, there are much more positive influences on the society of motorway construction and modern technologies of road construction are making huge contribution in reducing earlier mentioned negative impacts.

Since the first section of A5 motorway has been open to traffic, the number of vehicles is in constant increase. In the first seven months of 2011, 371 400 vehicles has passed A5 motorway [8] and in the first six months of the same year the increase of 3.36% in toll collection has been recorded in reference to the same period of 2010 [4]. During the whole 2011, total of 655 410 vehicles has passed A5 motorway [4]. To full fill its full potential, A5 motorway need to be finished; it needs to be connected with the Hungarian and Bosnia and Herzegovina border and construction of the Drava River Bridge is a next step.

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