

CETRA²⁰¹⁴

3rd International Conference on Road and Rail Infrastructure
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



CETRA²⁰¹⁴

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

TITLE

Road and Rail Infrastructure III, Proceedings of the Conference CETRA 2014

EDITED BY

Stjepan Lakušić

ISSN

1848-9850

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.

Marko Uremović · Matej Korlaet

PRINTED IN ZAGREB, CROATIA BY

“Tiskara Zelina”, April 2014

COPIES

400

Zagreb, April 2014.

Although all care was taken to ensure the integrity and quality of the publication and the information herein, no responsibility is assumed by the publisher, the editor and authors for any damages to property or persons as a result of operation or use of this publication or use the information's, instructions or ideas contained in the material herein.

The papers published in the Proceedings express the opinion of the authors, who also are responsible for their content. Reproduction or transmission of full papers is allowed only with written permission of the Publisher. Short parts may be reproduced only with proper quotation of the source.

Proceedings of the
3rd International Conference on Road and Rail Infrastructures – CETRA 2014
28–30 April 2014, Split, Croatia

Road and Rail Infrastructure III

EDITOR

Stjepan Lakušić

Department of Transportation

Faculty of Civil Engineering

University of Zagreb

Zagreb, Croatia

CETRA²⁰¹⁴

3rd International Conference on Road and Rail Infrastructure

28–30 April 2014, Split, Croatia

ORGANISATION

CHAIRMEN

Prof. Stjepan Lakušić, University of Zagreb, Faculty of Civil Engineering

Prof. Željko Korlaet, University of Zagreb, Faculty of Civil Engineering

ORGANIZING COMMITTEE

Prof. Stjepan Lakušić

Prof. Željko Korlaet

Prof. Vesna Dragčević

Prof. Tatjana Rukavina

Assist. Prof. Ivica Stančerić

dr. Maja Ahac

Ivo Haladin

dr. Saša Ahac

Josipa Domitrović

Tamara Džambas

All members of CETRA 2014 Conference Organizing Committee are professors and assistants of the Department of Transportation, Faculty of Civil Engineering at University of Zagreb.

INTERNATIONAL ACADEMIC SCIENTIFIC COMMITTEE

Prof. Vesna Dragčević, University of Zagreb

Prof. Isfendiyar Egeli, Izmir Institute of Technology

Prof. Rudolf Eger, RheinMain University

Prof. Ešref Gačanin, University of Sarajevo

Prof. Nenad Gucunski, Rutgers University

Prof. Libor Izvolt, University of Zilina

Prof. Lajos Kisgyörgy, Budapest University of Technology and Economics

Prof. Željko Korlaet, University of Zagreb

Prof. Zoran Krakutovski, University of Skopje

Prof. Stjepan Lakušić, University of Zagreb

Prof. Dirk Lauwers, Ghent University

Prof. Zili Li, Delft University of Technology

Prof. Janusz Madejski, Silesian University of Technology

Prof. Goran Mladenović, University of Belgrade

Prof. Otto Plašek, Brno University of Technology

Prof. Vassilios A. Profillidis, Democritus University of Thrace

Prof. Carmen Racanel, Technical University of Civil Engineering Bucharest

Prof. Tatjana Rukavina, University of Zagreb

Prof. Andreas Schoebel, Vienna University of Technology

Prof. Mirjana Tomičić-Torlaković, University of Belgrade

Prof. Audrius Vaitkus, Vilnius Gediminas Technical University

Prof. Nencho Nenov, University of Transport in Sofia

Prof. Marijan Žura, University of Ljubljana



IMPORTANCE OF TEMPORARY TRAFFIC REGULATION DURING CONSTRUCTION OR RECONSTRUCTION OF ROADS

Sanja Dimter¹, Hrvoje Dragovan², Dalibor Opačak², Vladimir Moser¹

1 University of Osijek, Faculty of Civil Engineering Osijek, Croatia

2 Institute IGH, Department of designing roads in Osijek, Croatia

Abstract

During construction work on individual road network sections it is necessary, for shorter or longer period of time, to close for traffic some small part or even the entire length of the section. At the same time, unobstructed traffic should be ensured redirecting to the nearby road routes or, if no such routes exist, constructing temporary (or permanent) road sections and intersections is needed. Traffic redirection during the construction or reconstruction of high priority roads, with heavy traffic volume, is a problem which is additionally enhanced in cases of main city routes.

An example of such problem is the South Osijek Bypass, a part of the D2 Croatian state road. With traffic load of 18,500 vehicles/day AADT (Average Annual Daily Traffic), this is one of the busiest roads in Croatia. The role of South Osijek Bypass is traffic redirection outside the city and connection of major roads to Našice (D2) and Valpovo (D36) to the west, Vukovar (D2) and Erdut (D213) to the east, Beli Manastir (D7) in the north and Đakovo (D7) and Vinkovci (D518) to the south. Northern pavement of South Osijek Bypass was built between 1973 and 1989 year with two traffic lanes intended for two-way traffic while the southern pavement extension was postponed because of, at that point, insufficient traffic volume. Southern pavement construction started in year 2011, during which extension of four intersections and building of a whole one new intersection was needed. Given that the old, northern pavement was constantly under heavy traffic, the solution of temporary traffic regulation during the works was a particular challenge for the designer.

The paper describes traffic solutions for unobstructed traffic flow during construction works on the southern pavement extension of South Osijek Bypass with special emphasis on the importance of quality traffic flows diverting.

Keywords: temporary traffic regulation, reconstruction of road, South Osijek Bypass, heavy traffic volume, traffic flow regulation

1 Introduction

During construction or reconstruction of roads, special attention should be paid on uninterrupted traffic flow throughout the whole construction period. The uninterrupted flow of traffic can be secured by placing the appropriate traffic signs (a simpler way, in normal traffic conditions) or special, particular regulation of traffic (more complex manner, in particular traffic conditions) [1].

Particular traffic regulations, by their definition, represents all the measures to ensure the uninterrupted traffic flow at some stretch of the road. Particular traffic regulation is necessary in cases of complex construction; such as work at intersections, construction of the half-width of the road, in the course of alternating one-way traffic, etc.

Sometimes is necessary, for shorter or longer period of time, to close for transport small stretch of road or even the entire length of the road. With simultaneous progress of the construction, road users should allow an uninterrupted ride on nearby roads or, if no such directions, performing a temporary (or permanent) road sections and intersections. About all the measures for traffic regulation, it is necessary to inform promptly all road users about the new traffic regulation in a given period.

1.1 Legal and technical regulations

The obligations of investors and contractors before and during the execution of works and the mode of organisation of temporary traffic regulation during the construction or reconstruction of roads are determined by the legal and technical regulations [2-6].

Act of Roads [2], defines the obligations of the legal entity that manages roads during construction works. According to Art.62, Act requires establishment of appropriate temporary traffic regulation during construction. Traffic regulation must be established for ensures safe traffic flow and unhindered performance of work or other activities.

Act of Road Traffic Safety [3] defines a mode of marking construction works and obstacles on the road. Art.10 requires visible marking of road (or part of road) where works are carried out. Marking must ensure road users safety. Part of the road is marked by setting the appropriate traffic signs [4], and the safety of traffic participants is provided by placing bumpers.

According to the General Technical Requirements for Road Works, Volume I, [5], the contractor is required to set up and maintain traffic signs on construction site and in all prescribed places in the required number, form and technical characteristics in accordance with the work progress and the requirements of legally relevant institutions. The Contractor shall procure and maintain temporary lighting for the road, which must provide the same level of light as public lighting, which it replaces.

Temporary traffic diversion, according to GTR [5], will be performed in areas where buildings or construction site intersects existing roads, intersections, pedestrian and bicycle paths, or parts thereof, and because of the safety or scope of work it is not possible to establish a satisfactory traffic flow.

In the case of buildings affecting the traffic flow in the wider region and a number of associated existing roads, as well as in the case of national roads, the investor is required to ensure project development of temporary traffic regulations and to obtain all necessary approvals from the relevant institutions.

The contractor is required for quality solution of roads for temporarily traffic. Solution has to be in accordance with the category of roads and with the application of relevant standards. The contractor has to ensure safe traffic during the construction works. Upon completion of the works the contractor shall remove the temporary roads [5].

Regulation of justified cases and the procedure of closing a public road [6] prescribes the events in which public road can be closed and the closing procedure. Under the public road closure, it is considered the establishment of banning or restricting traffic for all or certain types of vehicles on certain public road or part of a public road on certain days or for a specified period.

Reasonable cases for the closure of a public road, according to the Regulation [6], is performing of routine and periodic maintenance works and reconstruction of public roads, as well as other works or activities on a public road that affect traffic safety or can not be done without closing the public road.

It is necessary to establish the conditions under which a public road will be closed, such as determining the optimal time of closure of public roads, determining of a public road on which traffic can be redirect, determining the conditions for the establishment of temporary traffic regulation; determining the time at which the road must be opened and brought to the original state and determining the mode of informing the public.

2 Temporary traffic regulation during construction of South Osijek Bypass

2.1 Importance of South Osijek Bypass for City of Osijek and the surrounding region

Traffic redirection during the construction or reconstruction of high priority roads with heavy traffic volume is a problem which is additionally enhanced in cases of main city routes. An example of such problem is the South Osijek Bypass, a part of the D2 Croatian state road. With traffic load of 18,500 vehicles/day AADT (Average Annual Daily Traffic), this is one of the busiest roads in Croatia. The role of South Osijek Bypass is traffic redirection outside the city and connection of major roads to Našice (D2) and Valpovo (D36) to the west, Vukovar (D2) and Erdut (D213) to the east, Beli Manastir (D7) to the north and Đakovo (D7) and Vinkovci (D518) to the south.

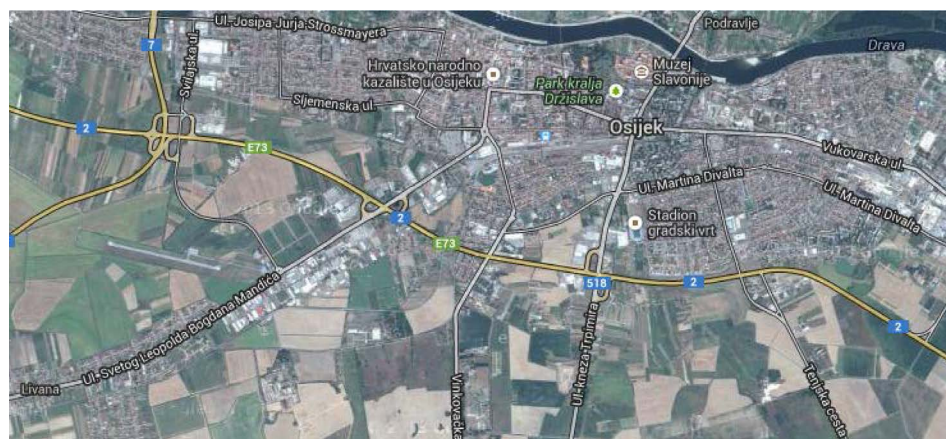


Figure 1 South Osijek Bypass, a part of the D2 Croatian state road [7]

Northern pavement of South Osijek Bypass was built between 1973 and 1989 year with two traffic lanes intended for two-way traffic while the southern pavement extension was postponed because of, at that point, insufficient traffic volume. Southern pavement construction started in year 2011, during which extension of four intersections and build of a whole one new intersection was needed. Considering that the old, northern pavement was constantly under heavy traffic, the solution of temporary traffic regulation during the works was a particular challenge for design engineers.

2.2 Description of project solution: road section between intersections Vinkovačka and Čepinska

The length of the four-lane section Southern bypass of Osijek city is 12.1 km long. It was planned to upgrade five existing intersections and the construction of a new intersection – “Vinkovačka”. The task of the new intersection “Vinkovačka” was to relieve traffic between intersections “Čepinska” and “Trpimirova” also between streets Drinska and Divaltova. Project solution of road section between streets Vinkovačka and Čepinska (Figure 2), including the new project solution intersection “Vinkovačka” were represented the very challenging task on the route of the Southern Bypass. On the mentioned road section there are three structures:

- 1 Underpass “Filipovica”, length $L=41,6$ m (new object (two objects) demolition of the existing embankment below the northern pavement);
- 2 Overpass “Bosutsko” over railroads, length $L=127,50$ m (a new object with the existing);
- 3 Underpass “Vinkovačka”, length $L=44,20$ m (four-lane city roads, demolition of existing)

and construction of new structure, partial demolition of the existing embankment below the northern pavement, construction of two objects).

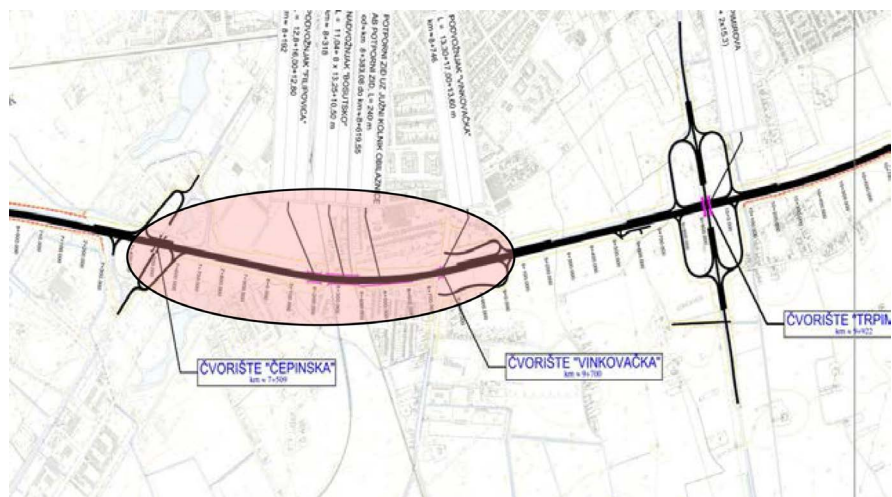


Figure 2 Part of layout drawing Southern bypass of Osijek: road section between intersections Vinkovačka and Čepinska [8]

2.3 Different variants selection of traffic regulation

Works on the embankment below the south pavement have led to problems with the uninterrupted flow of traffic. It was necessary to make a decision: will traffic on the north pavement during the constructions be stopped? Investor (Croatian Roads) and the Designer analyzed two variants:

- 1 Traffic to the northern pavement will not be interrupted during construction works. The existing embankment below the northern pavement would ensure with the planks in the length of 600 meters, installation of cement-gravel-clay piles (jet grouting), and with construction of AB diaphragm behind objects with a length of about 100 m. Estimated cost of this variant was 16.5 million HRK (2.1 million euros).
- 2 Traffic to the northern pavement will be stopped during the construction work and redirect to the bypass line of the existing road nearby to the agricultural economy “Ankin Dvor” (Fig.3.). Estimated cost of this variant, redirected traffic to the bypass line, amounted to about 6 million HRK (0.78 million euros).

Decision about the traffic conduction was analyzed as follows:

- costs of both variants;
- any unforeseen circumstances and constructions work that can further occur during the execution of works;
- possible traffic accidents and casualties passengers on the northern pavement due to open site.

Investor (company “Croatian Roads”), team of design engineers and representatives of the City of Osijek, made the decision to accept variant II as cost effective and safer traffic variant. With this variant all work on road section will be uninterrupted, without any potential traffic accidents, traffic jams, delays in operation at the site and without unforeseen works (and without additional financial resources) for the implementation of the most demanding part of the route South bypass of Osijek.

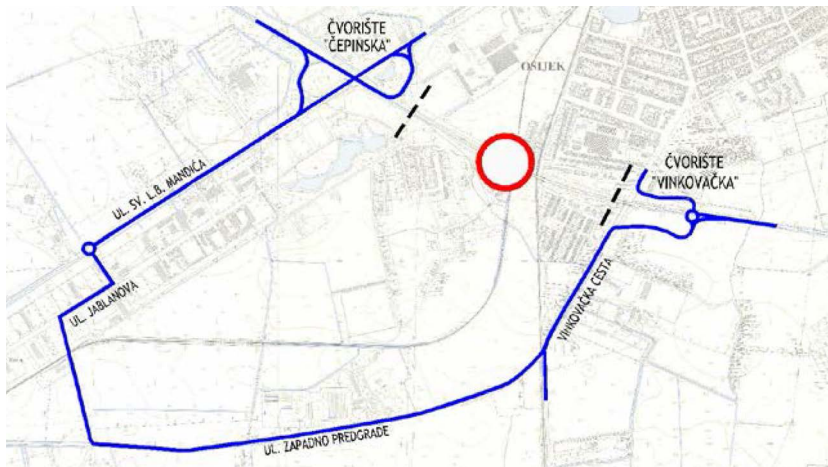


Figure 3 Final variant (II) of traffic regulation: bypass route of existing road [8]

In the main design [8] was planned closure of traffic on the northern pavement between intersections “Čepinska” and “Vinkovačka” with the traffic possibility by branches of the intersections loop. Diverting traffic from the north pavement between mentioned intersections was defined by the alternate route: bypass line of the existing road near by agricultural economy “Ankin dvor”.

The bypass route (Fig. 3). is 4.5 km length and passes through the existing transport infrastructure of the city of Osijek. The route begins at the intersection “Čepinska” using ramp of intersection. After that, the traffic diverted to city road street St. L. B. Mandić in the direction of the roundabout at the entrance to the industrial zone. Further traffic passing industrial zone (Jablanova street) and cross the railroad tracks in the level and connects to the street Zapadno predgrade. Then bypass route passes economy “Ankin dvor” and after crossing the railroad tracks at the level connects to Vinkovačka street to Vinkovačka intersection. Node “Vinkovačka” provides a connection of bypass traffic flow to the existing pavement of southern bypass and represents the end of the bypass route.

End of bypass route represented the biggest problem because it had to provide a crossing of two relatively strong traffic flow direction: one way the direction of the bypass route, and another direction from the city center. This is the busiest intersection during rush hour and, realistically, at this intersection was expected increase in traffic congestion.

Proposed problem solution and finally accepted, was roundabout (Fig.4). This solution, as the most rational and the safest, ultimately was derived. Traffic equipment and signaling on the road was organized to allow uninterrupted traffic on the bypass route. Velocity of traffic is regulated at 50 km/h.



Figure 4 Roundabout as solution for good connection of few traffic flows [9]

2.4 Traffic regulation in phased

Complete traffic regulation during construction works is made through two phases:

- Phase I – included upgrade of the existing road near by “Ankin dvor” in a length of 1.22 km. The existing road was 5-6 meters width, with surface of crashed stone, thickness of 50cm, in very poor condition. The existing road was upgraded from crushed stone material and a asphalt pavement.
- Phase II – included the construction of the northern and southern branches of nodes “Vinkovačka “ (in accordance with existing project documentation [8]), the preparation of project documentation for the bypass route [9], and construction of controlled railway crossing with semi-barriers, light and sound.

The performance of first phase of bypass construction started end of January 2012 and during 2013. started final, second phase.

3 Conclusion

Before making the final decision about stopping and traffic diversion due to road construction should be analyzed the overall picture of traffic flow in the city and surroundings. The final solution can not be an overnight solution and should be approached from several directions, taking into considering all users in traffic flow. The contribution of the described traffic regulation, specially for community that lives along the road, is manifold: this solution is provided a safe traffic flow without congestion, construction works on the South bypass route will be unobstructed, according to the timetable, the local community got a new road as an alternative road and this solution is created the basic conditions for further development of the observed part of the city of Osijek. Finally, the leading idea, with selection of technical characteristic or economic optimization of road route, should be traffic safety. From the date of opening for traffic on the bypass direction weren't no major traffic accidents or delayed traffic flow.



Figure 5 The construction site on Southern bypass of Osijek: overpass “Bosutsko”

References

- [1] Divić, A.: Cestovna signalizacija i sigurnost prometa, Priručnik za građenje, održavanje i rekonstrukciju cesta, Savez društava za ceste Hrvatske, Zagreb, 1976, 139-190.
- [2] Zakon o cestama, Narodne novine br.84/11, 22/13, 54/13 i 148/13
- [3] Zakona o sigurnosti prometa na cestama, Narodne novine, br.67/08, 48/10, 74/11 i 80/13
- [4] Pravilnik o prometnim znakovima, signalizaciji i opremi na cestama, Narodne novine br. 33/05, 64/05, 155/05,14/11
- [5] Opći tehnički uvjeti za radove na cestama, knjiga I, Hrvatske ceste i Hrvatske autoceste, Zagreb, 2001.
- [6] Pravilnik o opravdanim slučajevima i postupku zatvaranja javne ceste, Narodne novine 119/2007
- [7] www.google.com/maps/place/Osijek/ 10.02.2014
- [8] Glavni građevinski projekt trase ceste; Južna obilaznica grada Osijeka, Dogradnja južnog kolnika, dionica „Koridor Vc-čvorište Tenjska“, Institut IGH d.d, svibanj 2011.
- [9] Izvedbeni projekt obilaznog pravca za potrebe izgradnje državne ceste D2, dogradnja južnog kolnika južne obilaznice grada Osijeka, Institut IGH d.d., srpanj 2013.