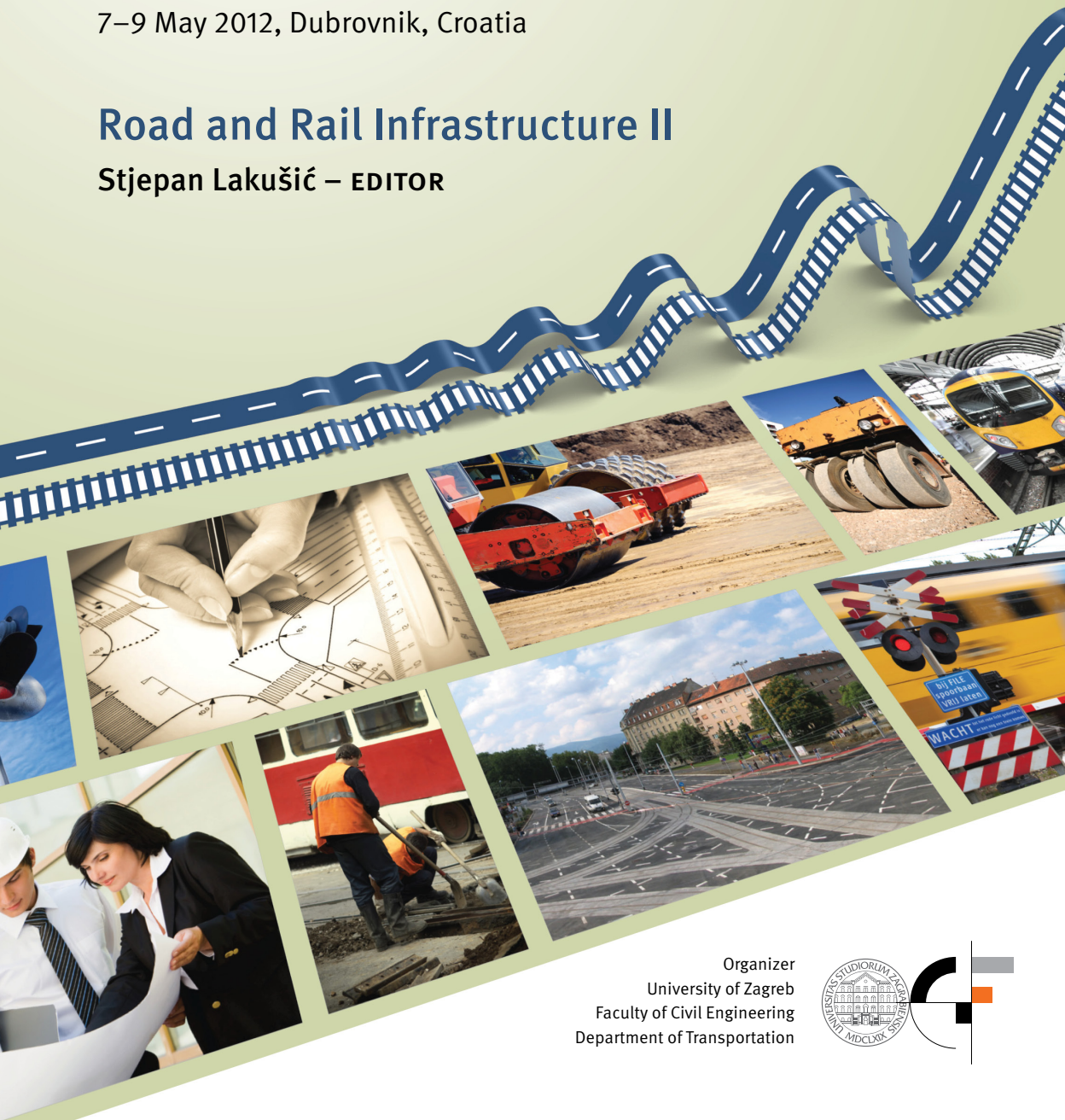
CETRA 2012

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

Road and Rail Infrastructure II

Stjepan Lakušić – EDITOR



Organizer
University of Zagreb
Faculty of Civil Engineering
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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
Stjepan Lakušić

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

Proceedings of the
2nd International Conference on Road and Rail Infrastructures – CETRA 2012
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TECHNICAL AND TECHNOLOGICAL PRECONDITIONS FOR IMPLEMENTATION OF THE INTEGRATED TIMETABLE IN REGIONAL PASSENGER TRANSPORT IN THE REPUBLIC OF HUNGARY

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Abstract

The technological aspect of introducing regional passenger transport refers primarily to the implementation of integrated timetable. This problem had been tackled both in the Republic of Croatia and in her immediate surroundings (Hungary, Slovenia, etc.) until now only within the frames of individual networks. Soon, when the Republic of Croatia joins the European Union the organization of passenger transport in the border region in regional passenger transport will become a joint issue as well as the possibility that needs to be taken advantage of as soon as possible in a high–quality manner. The objective of this paper is to indicate the possibility of integrating the regional passenger transport in the Republic of Hungary and the Republic of Croatia at minimal expenditure of financial and material means. For this segment of common transport market to be used in the best way, it is necessary to determine the crucial technical and technological parameters of rail transport, which would be used to implement such a concept in a proper manner.

Keywords: regional passenger transport; integrated timetable; technological parameters

1 Introduction

One of the basic activities of the rail system is to provide the transport service in passenger traffic. This service is public, which means that it is intended for all the citizens under the same conditions. This means that anyone who wants to use it, can acquire an adequate transport document and thus become a potential user of the service. Public passenger transport, apart from being accessible to anyone who needs transport, features also some advantages over the transport by passenger car, i.e. over the personal transport such as e.g.: public transport generates much less pollution per carried passenger; public transport consumes much less propelling energy per carried passenger; public transport is several times safer than personal transport; public transport occupies much less space than personal transport (long queues of cars, parking lots, etc.); public transport increases the mobility of citizens who gravitate to this transport system, i.e. assures a higher standard of living. The mentioned advantages are the main reason why the railway transport will have in the near future an even greater significance than before, and especially after the accession of the Republic of Croatia into the European Union. This is precisely the incentive for the carried out research presented in this paper. The accession of the Republic of Croatia in the European Union, namely, means elimination of the border traffic on some sections of the railway network (of the Croatian Railways), and practically the creation of new regional sections. This paper will briefly present the idea of how and under which conditions, first of all the technical and technological ones, is possible to establish a high–quality regional passenger transport on some sections. This

refers primarily to the region along the border of the Republic of Croatia and the Republic of Hungary, and the idea of the organization of regional transport on the Zagreb–Koprivnica–Kaposvar section will be presented.

2 Study on transport demand

In regional passenger transport on the HŽ railway network the average travel route ranged from 32km in 2001 to 48.2km in 2010. In interurban passenger traffic on the network of HŽ railway lines the average travel route for the same period ranged from 47km to 55km. This leads to the conclusion that the total average transport route in the system of the Croatian Railways is unacceptably low, regardless of whether it refers to internal both interurban and urban–suburban transport of passengers. Such level of service is seen in the number of carried passengers in regional transport on the network of railway lines of the Croatian Railways system (Table 1).

Table 1 Realization of transport and revenues in regional transport system of HŽ

YEAR	2005	2006	2007	2008	2009	2010
PASSENGERS	14,362	14,485	14,351	14,176	14,690	14,537
PKM	619,000	629,000	603,000	675,000	690,000	657,000
REVENUE	157,300	167,000	174,400	186,100	178,100	175,000

The reasons for such low level of service in regional passenger transport on the mentioned network, i.e. obvious stagnation of the total number of carried passengers lies in the following facts:

1 insufficient (technologically inefficient) investments in rail infrastructure in the function of target network;
2 insufficient investments in repair and modernisation of the rolling stock for the passenger transport requirements, and
3 technologically unsustainable model of organization of passenger transport service providers which requires radical structural changes and a good restructuring program.

If high–quality reforms and a sustainable investment cycle in this sector of passenger transport fail to be realized in the coming period, a certain growing trend of the carried passengers can be expected, but with a very low rate of growth. The part of regional transport that refers to the topic of this paper is related to the railway stations Križevci, Koprivnica and Vrbovec for which the traffic forecast is presented in Table 2.

Table 2 Forecast of regional transport per railway stations

RAILWAY STATIONS	2006	2010	2015	2020	2025	2028
Križevci	189,877	209,132	229,767	247,524	286,948	295,643
Koprivnica	364,517	367,227	405,448	436,783	506,351	521,694
Vrbovec	226,201	272,572	300,942	324,199	375,836	387,224
TOTAL	780,595	848,931	936,157	1,008,506	1,169,135	1,204,561

The expected increase in the number of passengers according to the obtained results, if the necessary investments into infrastructure fail to be realized, according to the obtained results in the period from 2010 to 2015 per rate of 2%, from 2015 – 2020 it is 1.5%, from 2020 – 2025 it is 3%, and further it would be at a rate of 1% with somewhat lower expectations, if the necessary investment into infrastructure fail to be realized.

3 Integrated public passenger transport

Integration means organization of parts (elements) into a whole (structure) which acts harmoniously in the existence of common goals i.e. that which features harmony between single and common goals.
Integration in passenger transport plays a very significant role since its definition means organization of certain elements into a whole which acts towards achieving common goals. In other words, integration connects all the elements that participate in the transport process (all the transport subsystems) into a unique system (integrated public passenger transport) which leads towards a better, more efficient, faster and safer passenger transport from origin to destination. In this way every traffic subsystem can make maximum use of its advantages but in integration with others who participate in transport realization.
It is precisely for this reason that eight railway stations have been selected in traffic that would be organized on the Zagreb–Koprivnica–Kaposvar section (four on the railway lines of the Croatian Railways and four stations on the railway lines of the Hungarian Railways). These are the stations in which another new line forks so that the passengers have a direct connection towards their destinations or they can change to another transport subsystem in order to arrive to their destinations.

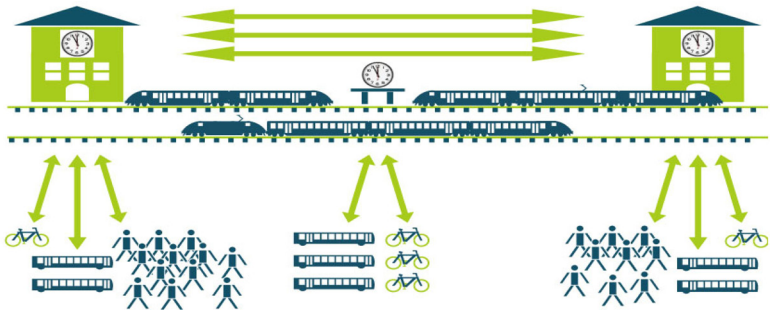

Figure 1 Scheme of integrated passenger transport

3.1 Introduction of a clock–face timetable

Since passenger transport has the advantage in railway transport over cargo, more attention should be paid to its performance, i.e. more care should be taken of its organization in order to make it maximally punctual and efficient, and so that it meets the passenger transport demands. In order to achieve this it is necessary to design such a timetable in which trains from the starting stations (Zagreb, Koprivnica, Kaposvar) depart and arrive into them in regular time intervals, and this type of timetable is called a clock–face timetable, since the trains depart and arrive in equal time intervals (of 10, 15, 20, 30, 60 or more minutes). On this section of the railway line a clock–face timetable will be introduced with time intervals of 90 minutes (Figure 2), where four electric multiple unit compositions will be used for the total organization of passenger transport, and the time of departure of the first train will be determined after a market survey, i.e. when it is established at which time the passengers require trains.

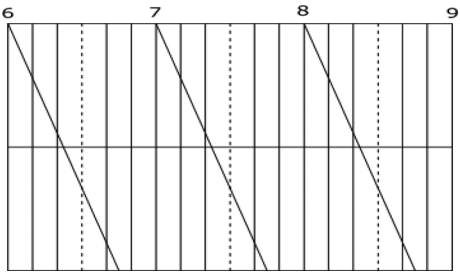

Figure 2 Clock–face timetable graph

Such integrated timetable features mainly two significant advantages and these are: passengers' satisfaction due to easier coping with the timetable, efficiency of the clock–face timetable.

Table 3 A forecast of travel times

Section	Current travel time	Target travel time
Zagreb – Dugo Selo	25 min	15 min
Dugo Selo – Križevci	26 min	15 min
Križevci – Koprivnica	44 min	30 min
Σ	95 min	60 min

Regarding the planned capacity of the compositions in the clock–face timetable the maximum passenger capacity would amount to 62,208 passengers daily, under the condition that all the seats and all the standing places are occupied.

4 Rolling stock and transport capacities

One of the basic elements for the realization of the determined traffic demand and organization of regional transport are the multiple unit vehicles that have to be interoperable, i.e. usable on both rail networks. Therefore, one of the proposed possibilities are the electric multiple units for regional transport that have been developed for the HŽ system requirements by the companies Končar and TŽV–Gredelj. This is a four–unit composition which is intended for regional passenger transport, with two motor units and two central modules. The end modules are the driving modules with driver's cabs. On one end the driving module rests on a bogie, and the other end rests on the supporting inter–bogie at the joint of two modules. The driving equipment of the driving module is located in a case outside the driving bogie. The rest of the space in the case is the low–floor passenger space (floor height at 600mm above rails, and maximally 850mm above free frames, allowing entry from a platform of 200, 350 or 500mm height).
The driving module is equipped with electromotive drive of 1,050kW installed power with two traction electric motors. The module is fitted with a pair of double doors 1,300mm wide, and seats of higher comfort adapted to regional transport. The central modules are exclusively passenger modules. They are set between the end modules with driver's cabs, and each relies on two inter–bogies on the joints of two modules. The modules are completely low–floor (floor height at 600mm above rails and maximally 850mm above free frames). Each module is equipped with a pair of double doors, and seats of higher comfort adapted to regional transport. The passenger cabins of the modules are connected by connecting tunnels and thus form a unique space without partitions. The floor in the connecting tunnels is at a height of maximally 850mm, and transitions from one level to another are designed with slightly inclined ramps (of 1:8 gradient). The passenger cabin is fitted with partly transparent partitions that visually close the space,

and protect the passengers against cold air when the doors are opened. The seats are mostly designed as double–seats, except in the part which is intended for disabled passengers in wheelchairs, and parents with children in baby carriages, where single seats and folding seats are installed. Part of the space is equipped with bicycle hangers. EMU operates so that it allows connecting of three EMUs in one set by means of automatic couplings.

5 Possibilities of organizing passenger transport in regional traffic on the observed Zagreb–Koprivnica–Kaposvar line

By analyzing the condition of the railway lines that encompasses the existing organization of operation on the mentioned section of the network the most important thing is to determine the conditions of traffic reorganization. The concept of the proposed line reorganization is based on the following assumptions: new categorization of local passenger trains and the network, and the travelling method of single train category; minimization of turnaround interval by determining the railway station of composition turnaround; integration of such organization of regional passenger transport into the organization of suburban trains of the major cities of RH in a unique technological system.
The realization of this concept has to show, in relation to the existing condition, that it is possible without any investments into the existing infrastructure to increase the available transport capacity and to ensure the users' service of higher quality. The concept of new passenger transport organization in this part of the network means different activity measures on each line section, and as the criterion for the proposed concept in Figure 3 the target structure of the railway station, turnaround and the respective travel times is presented. Because of the new method of participation in the method and costs of passenger transport, the RPP trains participate only in RPP traffic with emphasis on stopping at all the planned stops, and for them the tickets for the combined passenger transport are valid. Also, due to the integration of GPP rail transport other trains would disturb the integrated timetables and the integrated technological process of passenger transport in general.
Another criterion is the distance between turnaround stations and the travel time, which should never exceed the maximally planned ones (according to Figure 5).

Figure 3 Time intervals as condition of terminal stations

At the same time the proposed concept of organizing the lines or regional trains is based on two basic assumptions: new categorization of regional passenger trains and network and the operation method of single train category; minimization of turnaround interval by determining the composition turnaround stations.

Figure 4 Graphic presentation of a section of regional passenger transport network

5.1 Modification of the bus timetable

In previous analyses it has been determined that the bus transport is not sufficiently harmonized with rail transport, and interventions are necessary to solve this issue. The bus timetable should be designed so that bus arrivals are adapted to the rail timetable, so that the buses arrive 10 or maximally 15 minutes earlier to the integration point, to allow passengers fast and easy change of the transport subsystem and trip continuation, and leave to end destinations 10 or maximally 15 minutes after train departure so that the passengers would not lose too much time on waiting and travelling.
First those bus lines which are used by the largest number of passengers should be adapted, since these are precisely the lines that are the basis of integration. In order to achieve fastest possible passenger exchange, apart from harmonization of lines, timetables and integration points, it is very important that the passengers have the possibility of using all the transport modes during their trips with only one ticket that would be valid in all the transport means used on their trips, from the origin to destination. One of the simple solutions is a card with a microchip containing user's data, and special devices that the attendants i.e. the staff or the vehicles of a certain transport mode would be fitted with. In this way the data would be read in a fast and simple way, and the tickets would be charged and controlled. If all the aforementioned is realized, the regional passenger trains will perform their basic functions: integrated passenger transport with other regional transport modes, operating from start to terminal regional railway stations in time intervals of 90' – 120' (Figure 5 and Figure 6).

6 Conclusion

Until now, the railway traffic in the Republic of Croatia had not considered the possible integration of regional passenger transport with the Republic of Hungary in those regions where there is a certain need for that. Soon, when the Republic of Croatia joins the European Union the organization of passenger transport (regional) in the border region will become a joint possibility for all the railways whose networks are in the region.
It is certainly necessary to consider the transport capacities that would make such a service possible. In this sense, HŽ has already undertaken certain steps. Since the current HŽ – Passenger Transport rolling stock does not satisfy present transport requirements, and regarding the expected growth of this segment of rail transport, in cooperation with the companies Končar and TŽV Gredelj a serial production of electric multiple units has been started, which have technical characteristics that are interoperable for the Croatian and for the Hungarian railway network.
Apart from the issue of the rolling stock on the observed network sections there is also the issue of the usage condition of the railway infrastructure, which affects especially the neatness and comfort of passenger transport. In this sense both countries, and first of all the Republic of Croatia should make additional efforts, the more so, since the train running velocities (commercial and technical) on the main railway lines of the Croatian Railways are getting lower every year.
Finally, taking into consideration all that has been said, it may be concluded that the modifications in this sector of railway traffic are inevitable as well, and that they will have to take place really soon. The technological solutions that have been provided in this paper will soon have to be implemented on the entire railway network of the Republic of Croatia. The offered solutions are very practical and very easy to implemented due to great similarities in the method of traffic flows in the earlier mentioned countries and it is already now necessary to make the preparations so that the changes could be implemented with as few problems as possible and in order to achieve maximum efficiency in operation.

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