

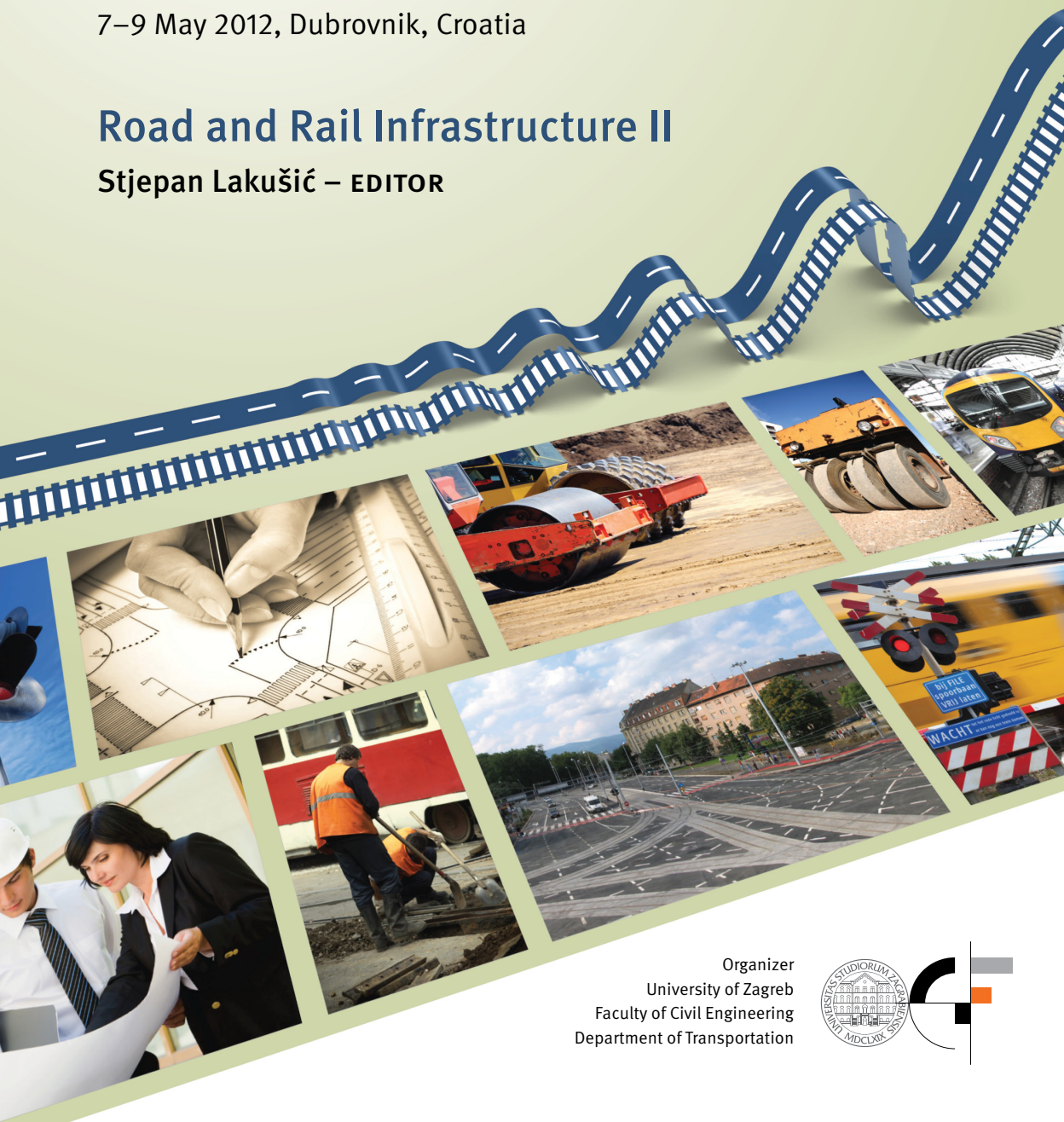


CETRA²⁰¹²

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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IMPLEMENTATION OF PERIODIC TIMETABLE IN REGIONAL PASSENGER TRANSPORT OF REPUBLIC OF CROATIA

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Abstract

Periodic timetable is designed as a new, more accessible and efficient system for organization of passenger rail transport that does not require a large investment interventions. It offers possibility for much needed regularity in Croatian public railway transport supply. Considering the current condition of Croatian railway system and its environment this approach appears to be the most efficient. Primary features of periodic timetable are its readability for the final user and symmetry as it thus seems more attractive and efficient. The principle of periodic time table itself ensures systematization of operations in stations and therefore provides improvements to the safety standards. With its transparency this type of timetable also greatly contributes to the quality of services and thereby increases the chance among competitors in a growing market of railway operators.

The paper refers to the identification of technical and technological parameters of the track infrastructure as a function of periodic timetable for the regional passenger transport system of Croatian Railways. The outcome of the research aims to possibilities of gaining productivity through more rational use of resources, namely rolling stock, but also through cohesion of the network. The further benefits will be setting grounds for implementing timed connections to other modes of urban transport, thus, integrating time tables [3]. This will propose the much higher level of service which will have the railway passenger transport in its core structure.

Keywords: regional passenger transport; periodic timetable, integrated timetable

1 Introduction

Transportation of people and goods between regions has never been more challenging task. There are so many demands to meet in attempt to stay in competition. Some important issues are speed, time accuracy, accessibility and affordability. All these parameters must be taken into account when constructing regional passenger transport.

Road transport in Croatia, although overloaded, seems to have more effective answers. In 2007 the same number of passengers was transported by rail and road [6]. This number increased in 2010 and the difference went in favour of railway by some 19%, but that is still not enough from the ecological point of view, not to mention road traffic congestions.

This paper proposes some solutions for so much needed rapid railway transport between major regions in Croatia. Introducing Periodic Timetable, or originally Taktfahrplan, can offer regularity and cohesion of the service that will attract passengers even from competition. This kind of service must offer speed that will compete with other modes, but stay affordable at the same time. Another aspect is comfortability which is not a priority but it can attract certain percentage of more demanding passengers. Here will come in handy new diesel and electric motor units that HŽ will invest in. These investments are based on prognosis that in

the period from 2010 to 2015 the rate of increase in passenger number just in regional transport will be 3.5% [4].

There is more often another term in use when it comes to marketing: 'user friendly'. In timetable planning it means recognisable service, looking simple and easy to remember. Also, all services of a kind must be identical to each other.

It is proposed to implement periodic timetable in central part of HŽ network as a first step in the research of implementing integrated periodic timetable on a much wider scale.

2 Periodic timetable

2.1 The history

'Integraler Taktfahrplan' or 'Integrated Fixed-Interval Timetable' was introduced for the first time on Dutch Railways, the Rotterdam–Schevening line. After successful introduction the Dutch started implementation of the Periodic Timetable throughout the whole network in 1932. Similar idea was implemented afterwards on distant service lines of the British Railways.

The real value of the Integrated Periodic Timetable was recognized in the 1970's by the two Swiss engineers Samuel Staehli and Hans Meiner. In that period Swiss Railways were facing a real threat – expansion of highways throughout the Switzerland what could mean losing a big portion of the market. After several failed projects, taking into account all prior deficiencies, they managed to construct an integrated timetable for the whole network, connecting all major and some smaller cities. The plan was presented in 1982 and in 1987 was adopted at national level as 'Project Rail 2000'. Basic feature of the new model was emphasizing the importance of the actual timetable [1]. The main characteristic of the Periodic Timetable is that all trains arrive at stations (nodes) approximately at the same time and at the same time depart in different directions. Integrated Periodic Timetable is an innovative public transport system that ensures periodic, better connected and reliable service. The implementation on Swiss Railways was carried out in stages on individual sections which were afterwards interconnected. First results showed a 20% increase in the number of trains and only a 4% increase in costs which has resulted in long-term success in rail passenger transport (Figure 1). This success encouraged and inspired other rail operators, and this type of service spread throughout Europe. The system was successfully implemented in Germany (Bayern-Takt), Austria (Austrotakt NAT, Plan912), France, Hungary, etc.

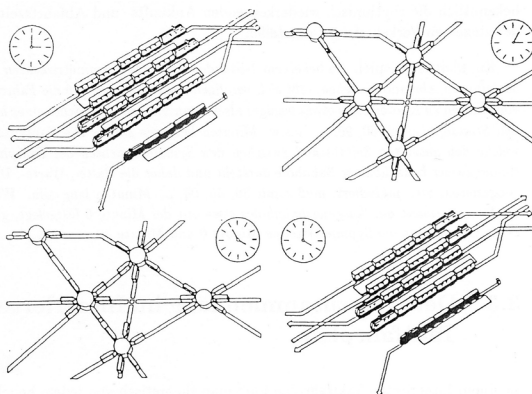


Figure 1 Knotensystem Bahn 2000 – 2 hour 'takt' [1]

2.2 Advantages

Basic features of an Integrated Periodic Timetable are its periodicity, symmetry and 'everywhere to everywhere' connections in nodes which maximize the coherence of the region. These basic features make this timetable memorable and accessible to end users and therefore market oriented. It makes changing connecting trains quite easy and waiting times are minimal. From the technical aspect, the construction of the Periodic Timetable is being done on 24 hour basis and as such is applicable on the whole week (except modifications for the weekend and holidays). Benefits for the passengers are reduced travelling time, drastically reduced waiting times and increased traffic density. The whole timetable is more transparent and increases mobility.

2.3 Disadvantages

The Periodic Timetable system does not tolerate any interference. In case of delay the defect ripples through the network and resuming normal operational condition requires great efforts. All likely possible delays must be taken into account so that all possible damage can be kept to a minimum. This is considered the main disadvantage of this kind of service. Another possible problem for the network is the fact that a large number of trains must be simultaneously present at the station which could point to lack of infrastructure and result in forming of bottlenecks.

3 Technical and technological parameters

3.1 Regional network setup

For implementing periodic time table dedicated specifically to regional passenger transport, some guidelines need to be set. Taken into account the Croatian topography and present train running times, it is proposed that technological delimitation between urban/suburban and regional transport is being set on a base of amount of travelling time. Accordingly, approximate travelling time for the urban/suburban services is proposed to be 60 minutes to or from given regional centre. Such determined areas are shown in Figure 2 for the towns of Zagreb and Varaždin.

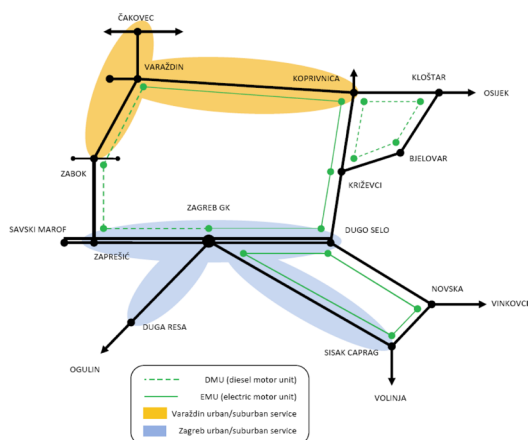


Figure 2 Urban/suburban service and proposal of regional service

Respectively, travelling times for the regional services would be 60–120 minutes between regional centers. Regional services are not meant to stop for passengers in the area of urban/suburban service trains except in final destinations on double line track. On single line tracks regional service trains would stop in stations with higher fluctuation of passengers. Considering the partial electrification of HŽ network and the extent of the investment needed for the full coverage of the central part of network, theoretical model was proposed as shown in Figure 2, using electric and diesel units. Diesel units are used westbound connecting Varaždin and Zagreb Main Station as a main hub. At least one stopping will occur, preferably in Zabok as the outskirts of the Varaždin–gravitating zone. That way it will offer quality and fast connection to Zagreb and at the same time provide trains passing. Eastbound main line offers electric haul, so it is proposed to use electric units for connections between Zagreb–hub and Sisak, Novska and Koprivnica. Considering the significance of the segment Varaždin–Koprivnica not just for regional, but also urban/suburban transport, electrification of the segment is inevitable and that fact is taken into account. The secondary eastern loop Koprivnica–Križevci via Bjelovar is designed also using DMUs.

3.2 Optimizing regional service for periodic timetable

The selected central region is connected in two main and one secondary loops (Figure 3). Figures near the sections represent travelling times between nodes. First loop connects Zagreb Main Station and Varaždin through east and west connection. The eastern node planned for passing trains is Križevci.

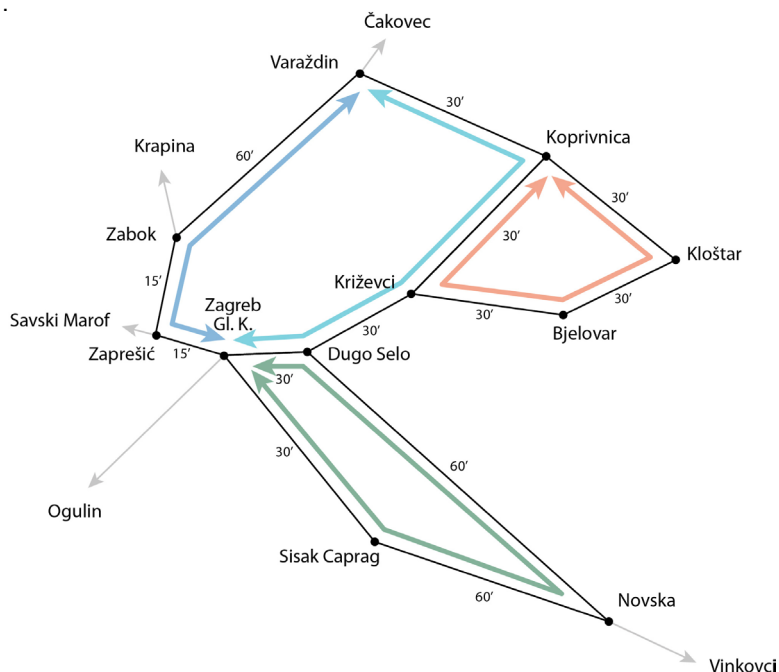


Figure 3 Implementation of Periodic Timetable

Križevci is also connecting node along with Koprivnica with the secondary loop and Kloštar is selected node for passing trains. Zabok is already mentioned as passing point for the western line. Second main loop is Zagreb – Novska and symmetric point for passing is Novska.

Below are tables containing travelling times (t_v) and traveling speeds (v_v) enlisted in the HŽ Annual Network Report. There are also planned travelling times (t_p) and travelling speeds (v_p) for the same sections calculated for the Periodic Timetable. There are also shown differences in actual and planned travelling times with noticeable time savings in most sections. Current traveling time for section Zagreb G.K.–Varaždin via Zabok is 130 minutes and planned travelling time with needed reconstructions is 90 minutes. 40 minutes saved is excellent contribution to competitiveness on this section (Table 1).

Table 1 Zagreb G. K. – Zabok – Varaždin [5]

| Section | t_v [min] | v_v [km/h] | t_p [min] | v_p [km/h] | Δt [min] |
|-------------------------|-------------|--------------|-------------|--------------|------------------|
| Zagreb Gl.K. – Zaprešić | 19 | 60–70 | 15 | 110 | -4 |
| Zaprešić – Zabok | 29 | 60–80 | 15 | 140 | -14 |
| Zabok – Varaždin | 79 | 40–80 | 60 | 90 | -19 |

Current traveling time for section Zagreb G.K. – Varaždin via Križevci is 128 minutes and planned travelling time with needed reconstructions is 105 minutes (Table 2).

Table 2 Zagreb Gl. K. – Križevci – Varaždin [5]

| Section | t_v [min] | v_v [km/h] | t_p [min] | v_p [km/h] | Δt [min] |
|--------------------------|-------------|--------------|-------------|--------------|------------------|
| Zagreb Gl.K. – Dugo Selo | 19 | 80 | 30 | 90 | +11 |
| Dugo Selo – Križevci | 23 | 50–140 | 30 | 90 | -7 |
| Križevci – Koprivnica | 37 | 50–140 | 30 | 110 | -7 |
| Koprivnica – Varaždin | 37 | 80–100 | 30 | 100 | -7 |

Current shortest traveling time for section Koprivnica – Bjelovar is 128 minutes and planned travelling time with needed reconstructions is 105 minutes. It is also planned a 60 minutes service Koprivnica – Kloštar – Bjelovar that does not exist in current timetable (Table 3).

Table 3 Koprivnica – Bjelovar – Križevci [5]

| Section | t_v [min] | v_v [km/h] | t_p [min] | v_p [km/h] | Δt [min] |
|-----------------------|-------------|--------------|-------------|--------------|------------------|
| Koprivnica – Kloštar | 33 | 80–100 | 30 | 90 | -3 |
| Kloštar – Bjelovar | 32 | 65–80 | 30 | 90 | -2 |
| Bjelovar – Križevci | 34 | 65–80 | 30 | 90 | -4 |
| Križevci – Koprivnica | 37 | 50–140 | 30 | 120 | -7 |

Time savings in loop Zagreb G.K. – Novska are significant (Table 4.). Current shortest travelling time for section Zagreb G.K. – Sisak Caprag is 99 minutes, and planned travelling time for the Periodic Timetable is 30 minutes. For section Zagreb G. K. – Novska via Sisak Caprag is planned 90 minutes, and current timetable does not offer this connection. With some necessary reconstruction on section Zagreb G.K. – Novska via Dugo Selo instead of current 104 minutes, planned travelling time is 75 minutes and travelling would be shortened for 29 minutes. This model offers for instance, practical connection for passengers coming from Koprivnica or Kloštar via Križevci to Novska. They wouldn't need to go all the way to Zagreb to catch good connection, they could just transfer in the same 'takt' in Dugo Selo and save significant amount of time.

Table 4 Zagreb G.K. – Novska [5]

| Section | t_i [min] | v_i [km/h] | t_p [min] | v_p [km/h] | Δt [min] |
|-------------------------|-------------|--------------|-------------|--------------|------------------|
| Zagreb G.K.–Sisak C. | 60 | 50–140 | 30 | 120 | -30 |
| Sisak C. – Novska | 99 | 60–80 | 60 | 90 | -39 |
| Novska – Dugo Selo | 84 | 60–80 | 90 | 110 | -24 |
| Dugo Selo – Zagreb G.K. | 19 | 80 | 30 | 90 | +11 |

Time savings in loop Zagreb G.K. – Novska are significant (Table 4.). Current shortest travelling time for section Zagreb G.K. – Sisak Caprag is 99 minutes, and planned travelling time for the Periodic Timetable is 30 minutes. For section Zagreb G. K. – Novska via Sisak Caprag is planned 90 minutes, and current timetable does not offer this connection. With some necessary reconstruction on section Zagreb G.K. – Novska via Dugo Selo instead of current 104 minutes, planned travelling time is 75 minutes and travelling would be shortened for 29 minutes. This model offers for instance, practical connection for passengers coming from Koprivnica or Kloštar via Križevci to Novska. They wouldn't need to go all the way to Zagreb to catch good connection, they could just transfer in the same 'takt' in Dugo Selo and save significant amount of time.

4 Conclusion

Infrastructural network of HŽ is characterized by specific technical and technological parameters for exploitation and maintenance. This is of course reflected directly on level of service in passenger transport. Taking into account the mentioned fact, the opinion of the authors is that the only acceptable concept of the improvement of service level is complete separation of urban/suburban, regional and long distance systems in technical and technological aspect. The only technologically acceptable way of realization of this concept is high quality integration of passenger transport subsystems by means of Integrated Periodic Timetable. For that purpose a simulation of Periodic Timetable was conducted on a specific section of HŽ network and it derived several conclusions:

- key connecting nodes for the regional passenger transport;
- level of availability of track infrastructure;
- level of availability of station infrastructure.

Proposed conception showed sustainability of this approach in regional passenger transport and urban/suburban passenger transport on one section of the network and it's applicability on the rest of the network.

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