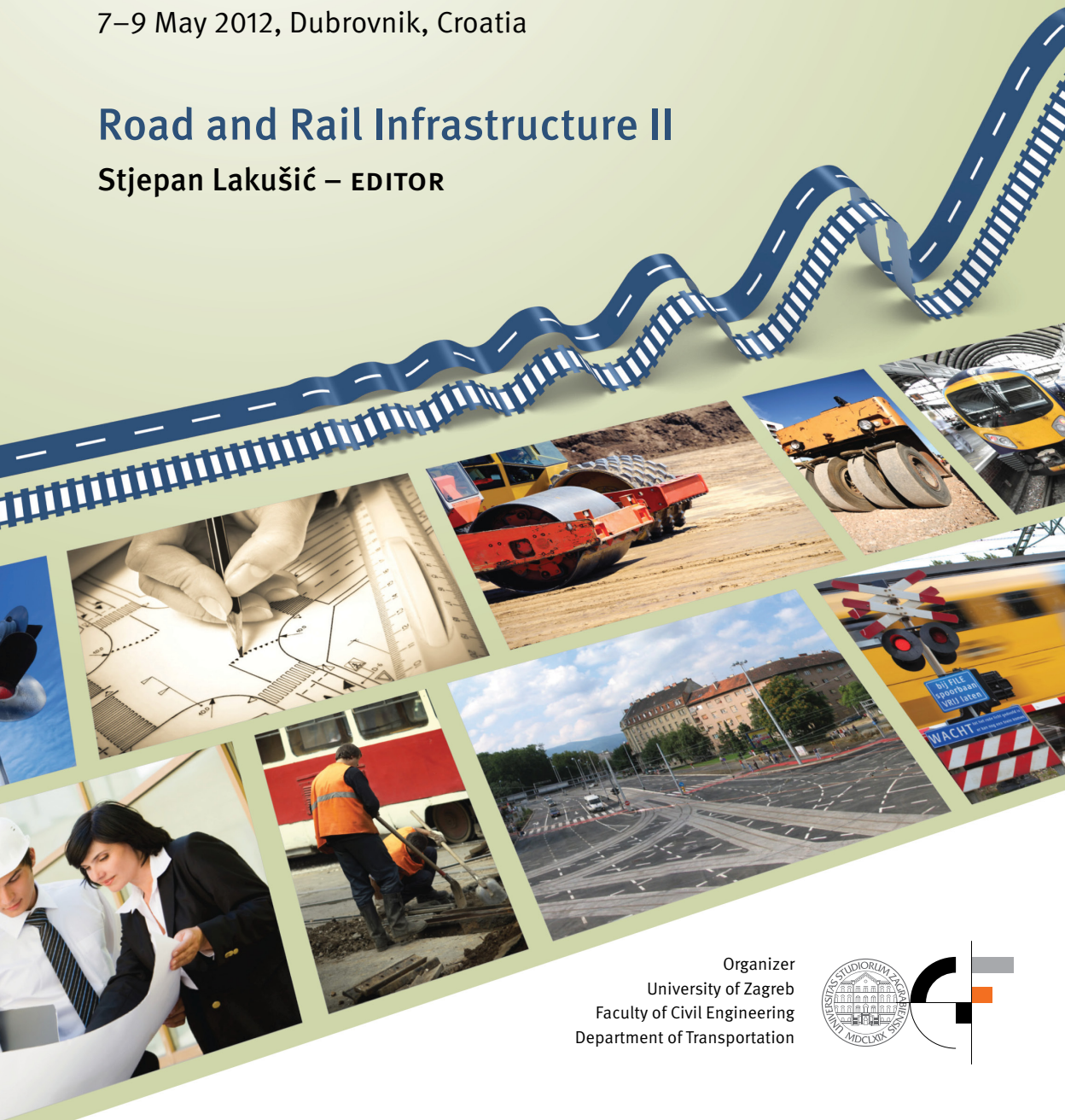
CETRA 2012

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

Road and Rail Infrastructure II

Stjepan Lakušić – EDITOR



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INTEGRATED PERIODIC TIMETABLE IN HUNGARY – EXPERIENCES, HELP FOR VISION

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Abstract

This paper describes the integrated periodic timetable (ITF – abbreviation from German term Intergrierter Takt Fahrplan) on Hungarian railway networks within its introduction and future. The project for a new timetable began in 2004 with a pilot project on suburban lines around Budapest. Income increased by approximately 12 percent in the first months, wherefore it was decided for the extension of the system to cover the majority of the railway network. The main step started in 2006, in the eastern part of the country. The backbone of the system is a new InterCity network, with hourly services between all major cities in the eastern and northern part of the country. In the following years the implementation of the system for the entire network has slowed down, but now we have ITF on all important lines of the network. On lines where the ITF was implemented, it has stopped the previous constant 10–12 percent yearly decrease in ridership, moreover on all hourly system ITF lines passenger numbers further increased a few percent.

Keywords: ITF, Hungary, integrated periodic timetable, results

1 Introduction of ITF in Hungary

1.1 Pilot project

In 2004 according to the strategy of the Hungarian State Railways (MÁV Rt.) a project called 'Suburban Railway Development Project' was started. The aim of this project was to determine the passenger demands, provide better services with a basically new timetable structure, new vehicles and infrastructure developments.
As a pilot project, a new ITF system timetable was introduced on two suburban lines carrying heavy commuter traffic. Budapest–Vác–Szob line running along the river Danube is not just a suburban line but an international link to Slovakia, Czech Republic, Poland and Germany as well. It is double track, electrified, equipped with multi–direction automatic block control and the allowed speed is 100–120 kph. Budapest–Veresegyház–Vác line is a secondary line by terms of infrastructure, it is single track, electrified and equipped with centralized traffic control. The allowed speed is about 60 kph.
The structure of the new timetable: Budapest–Vác–Szob line is divided into two zones, the inner circle ranges from Budapest to Vác, and the outer circle from Vác to Szob. The inner circle is served by stopping trains in every 30 minutes. The outer circle has trains in every 60 minutes which skip all stops in the inner circle. For this structure we use the 'zoning system' term, and the trains skipping stops in the inner circle are called 'zoning trains'.

On Budapest–Veresegyház–Vác line, due to the infrastructural conditions (single track), just a simple, symmetric and periodic timetable was introduced with additional fast trains running in the peak hours.
The suburban lines together with the connecting railway lines, the regional buses and the ferry on the Danube construct a complete transport system based on intermodal relations. The application of the zoning system resulted in a significant journey time decrease for about 30 percent of the passengers. The new system did not cause unfavourable changes in service frequency or journey time for any of the passengers. Despite the fact that there is a new highway between Budapest and Vác, the 25 minutes journey time of the zoning trains running at 120 kph is absolutely competitive. Travelling by train from the suburbs directly into the city centre became by far the fastest way.
In the new timetable there are 43 percent more trains, but the total costs increased only very slightly by about 0.4 percent, mainly caused by the higher traction energy consumption. This is due to the fact that the percentage of variable costs in the cost structure of the suburban railway traffic is quite low. [1]

1.2 ITF–East

As a result of the success of the pilot project in the Budapest area, a further extension of the ITF principle was decided in 2005. Due to the size of the project and considering the available resources, the timetable reform was planned to take place in two steps. In the first step the ITF system was planned for the eastern part of the country and the Budapest–Vienna line. The significant structural change of the 'ITF–lines' required to modify the timetable of the connecting branch lines and bus routes as well, so the periodic timetable simply spread through the eastern part of the country.
The backbone of the timetable is the new InterCity network, which connects all major cities of Eastern Hungary. InterCity trains are the flagships, they stand for higher comfort and less stops, shorter journey times. The new system is based on two core–routes:

- The two hourly circle InterCity trains from Budapest, via Miskolc, Nyíregyháza, Debrecen and Cegléd, back to Budapest, with hourly frequency between Budapest and Miskolc as well as between Nyíregyháza and Budapest.
- The hourly InterCity trains from Budapest to Szeged.

The two routes are connected at Cegléd, which became the most important network hub (node used as the connection points of the integrated periodic timetable) in the system. This way the cities of the Hungarian Great Plain have periodic connections hourly.
On the ITF lines, the overall increase of train–km output was 22 percent, mainly caused by the new commuter services and long–distance trains. The new timetable was heavily based on better utilisation of the existing resources, especially the rolling stock. This was achieved with optimised (and sometimes shorter) turn rounds and reorganization of maintenance works.
Similarly to the successful periodic timetable pilot project, the extension of the ITF system to the eastern part of country also proved to be successful. Although the start–up was not free of problems, the railway staff and the passengers quickly got used to the new system. [2]

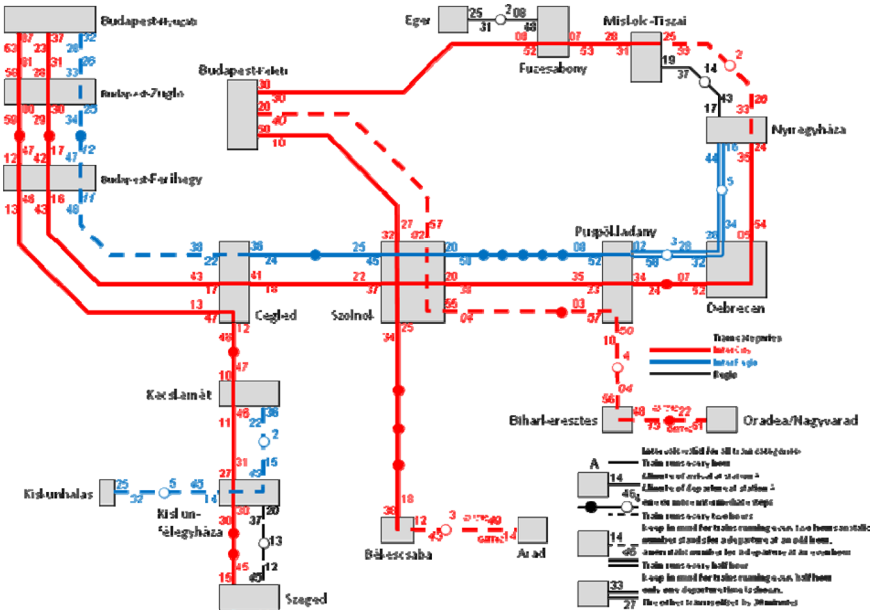

Figure 1 Timetable–map of the current interregional ITF system of Eastern Hungary

1.3 ITF–West

The development of ITF was much slower on the rest of the lines, but now we have ITF system timetable on all the main lines, only a few regional and interregional lines in Transdanubia are still missing. The ITF–West was introduced step by step, first on the suburb lines, then on the Budapest–Pécs line and at the south shore of the Lake Balaton, and finally on a few interregional lines like Sárbogárd–Szekszárd. The development was slow, because the railways lost its competitiveness already in the 80's, the major cities were served mainly by buses, and the state didn't want to have a new competitor of the as well state financed bus companies. But since the ITF started to work in Transdanubia too, in every year there are more and more lines, where the trains take more passengers and the buses loose. In 2012, there is two hourly frequency ITF on all the main lines and on most of the interregional lines, and there are plans to develop hourly service on all the main lines.

2 Results of Hungarian ITF adaptation

The pilot project was the most successful timetable development in Hungary; it has increased the passenger numbers about 40 percent since its introduction. This massive success was also because of the zoning system, and the much shorter journey times. There were no vehicle or infrastructure deve lopments, the lines are still working under the same conditions, as it was before the introduction of ITF.

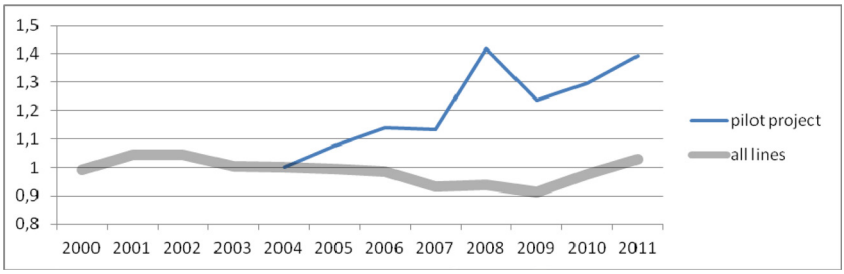

Figure 2 Changes in number of passengers on the lines of the pilot project compared to the same index on the network. 1 (100 percent) means the number of passengers in 2000 [3]

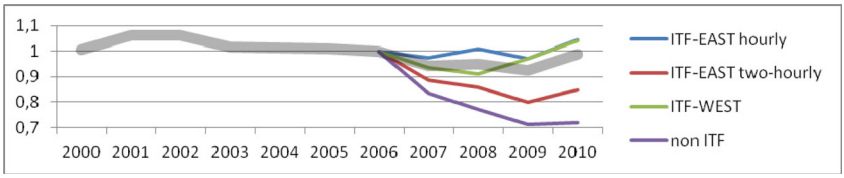

Figure 3 Changes in number of passengers on the lines of ITF–East project compared to the same index on the network. 1 (100 percent) means the number of passengers in 2000 [3]

During the first two years following the introduction of ITF–East the railway ticket prices have been raised by altogether more than 30 percent, which has had dramatic effects on passenger numbers: On the non ITF lines the passenger numbers have come down with a run, but the ITF lines were able to retain the number of the passengers. On the hourly frequency ITF–East lines the passenger numbers haven't come down between 2006 and 2008, while the rest of the network has lost more than 15 percent of the passengers, and in 2010 the ITF–East lines had 5 percent more than before the introduction of ITF. The greatest development was on the ITF–West lines because in these lines the trains started to be competitors of the buses again, the passenger numbers have increased about 15 percentage points in two years after the introduction of ITF–West. In 2011 the MÁV–Start has changed its statistic system, therefore sadly the 2011 data is not comparable with the previous ones, but in 2011 the passenger numbers increased on the whole network mostly because of the increasing fuel prices, and the gap between ITF and non ITF lines got even bigger.

3 Future timetable developments

Since the introduction of the ITF the first time we will need to modify the structure will be in December of 2012, because the infrastructure development of the line between Budapest and Székesfehérvár and between Boba and Hodoš will be ready, and the parameters of the lines will be different, the journey time will be much shorter and the capacity of the lines will increase.

The line between Budapest and Székesfehérvár is one of the most important lines of Hungary, because it connects Budapest and three important lines which serve two regions of Transdanubia. The journey time of nonstop trains between Budapest and Székesfehérvár will cut about 20 minutes, and the capacity will increase in the most busy suburb part, because one more track will be built.

The line between Boba and Hodoš was reconstructed already few years ago, but because of the limited capacity of the Budapest–Székesfehérvár line, we couldn't modify the timetable structure, we couldn't use the new rail triangle, which can cut the journey time of the fast trains by another 15 minutes.

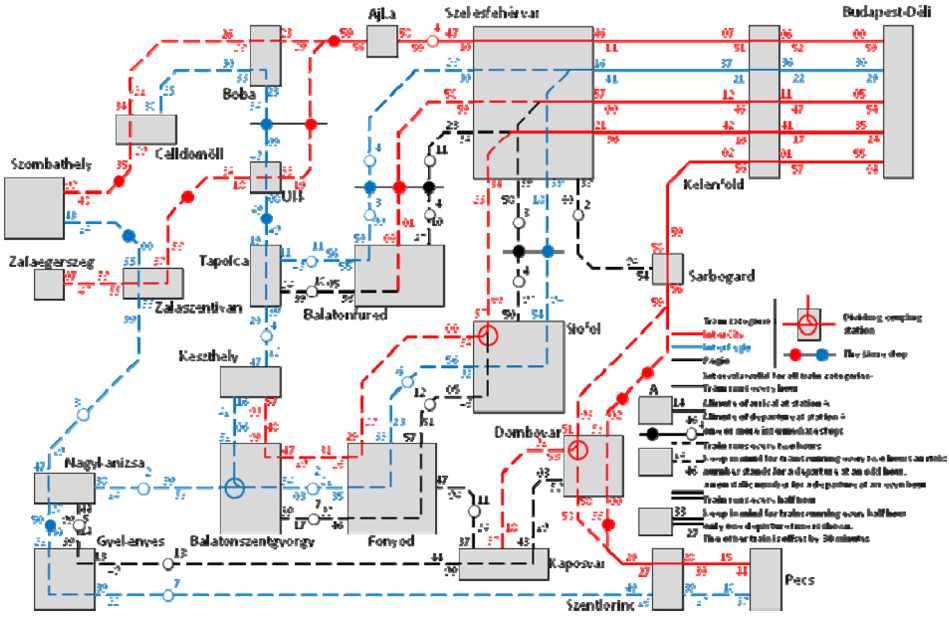

Figure 4 Timetable–map for the mid–term planned interregional ITF system at the area of Lake Balaton

3.1 Budapest–Székesfehérvár–Veszpém–Zalaegerszeg / Szombathely line

Since the introduction of ITF–west, there is a two hourly frequency between Budapest and Boba. The trains divide there, one of the parts drives to Zalaegerszeg and the other part to Szombathely. Dividing and coupling the trains takes about 15 minutes. According to the new structure we are planning to introduce hourly frequency between Budapest and Devecser. One of the trains will go to Zalaegerszeg by using the new railway triangle at Boba, and the other to Szombathely.

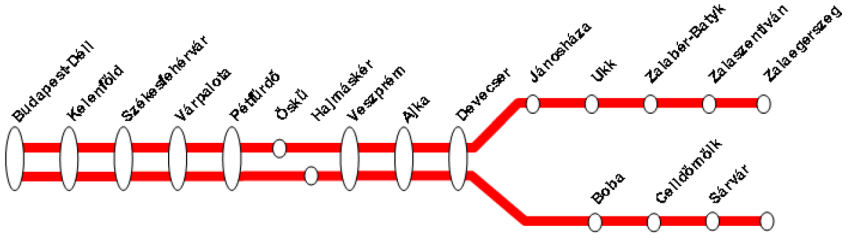

Figure 5 Stops of the planned Budapest–Szombathely and Budapest–Zalaegerszeg interregional trains

Between Budapest and Devecser the headway will be halved, and the journey time will be cut by 20 minutes from Budapest. Between Devecser and Zalaegerszeg as well as between Boba and Szombathely, the frequency stays two hourly, but the journey time is cut by more than 40 minutes.

The new structure also has hubs in Veszprém which is one the most important cities of middle Transdanubia, and in Zalaszentiván, Celldömölk and Szombathely, but the Veszprém and Celldömölk hubs will shift by 30 minutes. For the new structure we don't need more vehicles, even though the trains will run double as often, because the running and the turnaround times will be much shorter. So we will use our fleet much more efficient.

3.2 The northern coast of Lake Balaton

Because of the development of the Budapest–Székesfehérvár line and because of its increasing capacity we can make a new timetable structure on the northern coast of Lake Balaton, with more trains on the section that is closer to Budapest. In the current timetable there are fast trains in two hourly frequency, but not to all of the stations there are direct trains from Budapest, and since this is a typical coast line, the passengers are mostly holiday travellers from Budapest, they strongly prefer the direct connection. The other problem is that the journey time from Budapest is too long, because the fast trains stop in all the most important stations, trying to give direct connection to more people. The current timetable is basically a wrong compromise between offering direct connections and offering short travelling time. From 2013 summer, we are planning to introduce a zoning timetable, which will solve both of the problems.
It will be much more efficient, it will significantly decrease the needed capacity of train sets. The travelling time will be cut by 20–40 minutes from Budapest, the train sets will be shorter, the running and the turnaround times will be much shorter, and we will offer more capacity in the section where there are more passengers and less, where there are less. Just a number to describe what it means in business results: for the new timetable we need 33 passenger cars less, the maintenance of 33 old passenger cars is about 1 million euro for a year, so that's what we save yearly.

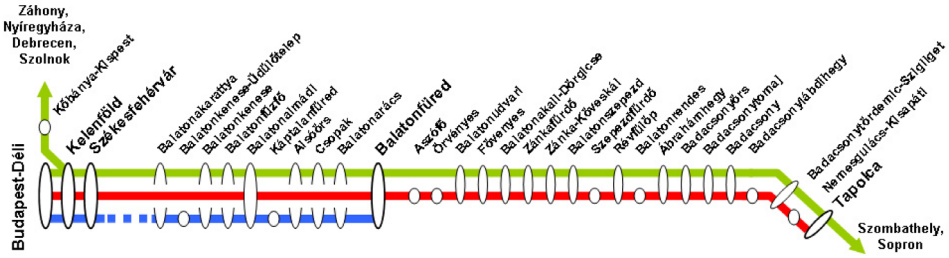

Figure 6 Stops of the trains of the planned Balaton–northern–coast zoning system

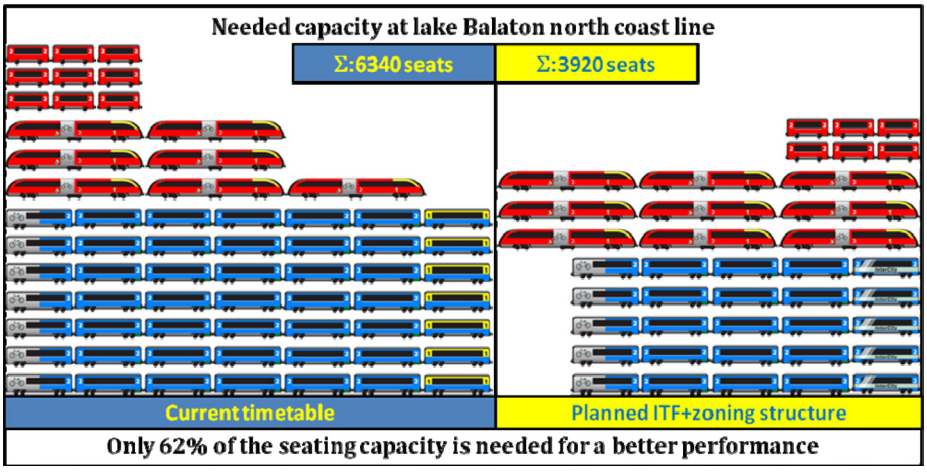

Figure 7 The needed rolling stock for the current and the planned Balaton–northern–coast zoning timetable

3.3 Other impacts of the infrastructure developments

On the line Budapest–Nagykanizsa–Gyékényes the journey time will be cut by 20 minutes, but the structure remains the same, the trains will depart 20 minutes later and arrive 20 minutes earlier at Budapest. Because of that the turnaround times will change, and we need one train set less.

4 Examples for timetable based infrastructure developments

The ITF is the most effective way to stop and reverse the characteristic loss of passengers in the railway sector, but its main advantage is manifested as huge cost savings in infrastructure development processes. Knowing the exact required technical details for building a competitive public transport system significantly reduces the construction costs. Development of railway infrastructure is one of the most cost–intensive investments, mainly funded by taxpayers. These circumstances make it very important that the concept of creation must be always preceded by the construction. The more detailed your concept is, the less you pay on development. Experience has shown that the most detailed plans for the future are based on the philosophy of the ITF.

4.1 Plans for reconstruction of suburban line Budapest–Veresegyház–Vác

The line is a quite important part of Budapest's suburb network, it was part of the ITF pilot project, as we mentioned. It has ITF timetable since more than seven years now. Since then the passenger numbers are increasing. For now it has became a quite busy line transporting 2 million passengers yearly, but its infrastructure is still very poor: it is a one track line, the trains run about 60 kph The journey time for 49 km is 1:25 minutes. For developing the line, the original plan was to renew the tracks for 80 kph, (higher speed is just partially possible due to the alignment) and renew all the stations. After making the plans for the tracks, the designers tried to make an ITF timetable for the reconstructed infrastructure, but the journey time had become just 6 minutes shorter, because the meetings of the trains couldn't move, so the trains would have to wait for each other in middle stations, as much as the journey time got shorter before. Because of this the MÁV–Start didn't accept the plans, therefore the designers had to remake them. In this case first they made a timetable structure, and after that they checked what infrastructure parameters it requires. By that the journey time will be cut by 18 minutes, the 30 minutes frequency will be possible for both directions in the same time. For that they needed to plan two short sections, which are usable for 100 kph, and a new station where the trains could meet, but the system requires fewer tracks in two other stations.

4.2 Plans for reconstruction of south Balaton line

That was the first example, when due to the perfectly working ITF system timetable, the first step of the infrastructure development was designing the timetable. The south Balaton line between Székesfehérvár and Nagykanizsa is an electrified line, with one track and automatic block signal, as well as centralized traffic control. The original speed of the line was 100 kph, but nowadays trains run only about 60 kph, because of the poor condition of the rails. Since the introduction of ITF–West, there are two hourly frequency fast trains between Budapest and Balatonszentgyörgy. The trains divide there, one of the parts goes to Keszthely and the other part to Nagykanizsa. The fast trains stop at every settlement at the lake, so on that part they also provide the regional service, with relatively high passenger numbers all year long. But due to the low speed and the many stops between Budapest and Nagykanizsa, the travelling time is not even comparable with the highway, for this the trains are not competitive. During summertime the Lake Balaton is the most important holiday destination in Hungary, and due to the really good location of the stations, the trains are very popular. Apart from the regular periodic fast trains there are plenty of holiday semi–fast trains which provide direct service for the vacationers to all the stops from Budapest

and from Eastern–Hungary as well (at lake Balaton there are plenty of stops typically for recreation areas without any resident population). There are two major problems with the current timetable, the journey time is not competitive, and the direct trains are even much slower, and they are not part of the periodic system. Finding solutions for these problems was the core of designing the timetable which will be the base of infrastructure development: In the new structure the two hourly fast trains with the current stops have remained, there are periodic trains for vacationers providing direct connections and a faster express train for the most important cities like Keszthely and Fonyód. The periodic fast trains will meet each other in hubs in Siófok, which is the most important city of the south shore, and in Balatonszentgyörgy, where the lines to Nagykanizsa and Kesztely connect. This structure requires 100 kph and partially 120 kph available speed, and two short sections with double tracks, where the periodic trains can meet each other. The result will be a competitive railway line, with hubs on the right stations, providing direct services for vacationers with good journey time in all the relations.

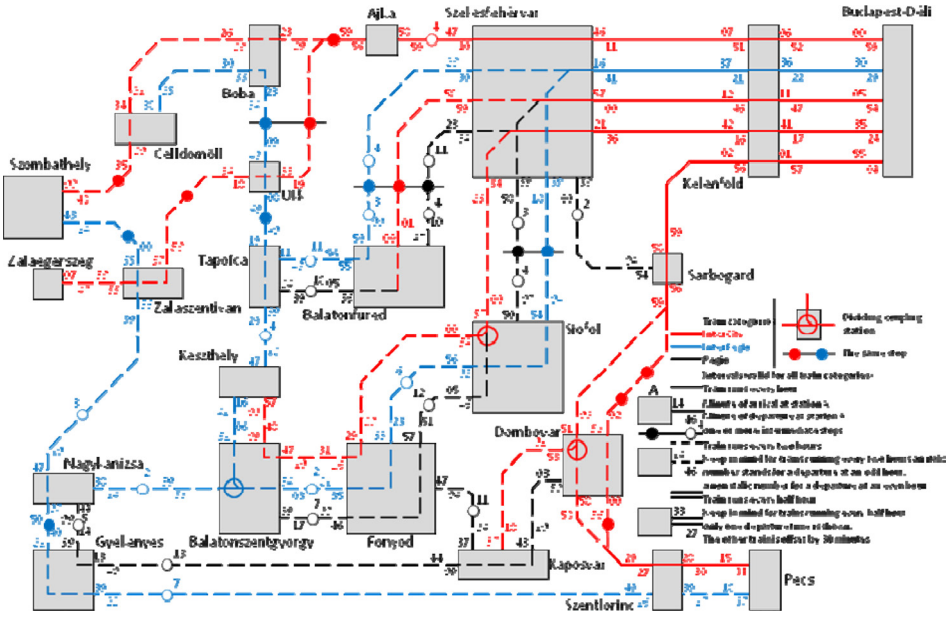

Figure 8 Timetable–map for the mid–term planned interregional ITF system at the area of Lake Balaton

4.3 Plans for reconstruction of Miskolc-Tiszai station

The core component of ITF is the transfer between trains especially in the hubs. To organise transfer the most comfortable way, we need to reconfigure hub stations in a transfer–friendly way on the occasion of their infrastructure development. It is very important to know exactly what the transfer time will be between any two trains and how many passengers are expected to change from one to the other. Knowing this information makes it possible to design platforms to their most proper place.

To determine the most serviceable topography of a station, we need to know the pinpoint timetable–plans for all lines leading there. If we know this we have to prepare the infrastructure according to these timetable–plans in the best possible way, but don't have to prepare the infrastructure for all possible traffic situations. This specification results in a considerable cost reduction of the infrastructure development.

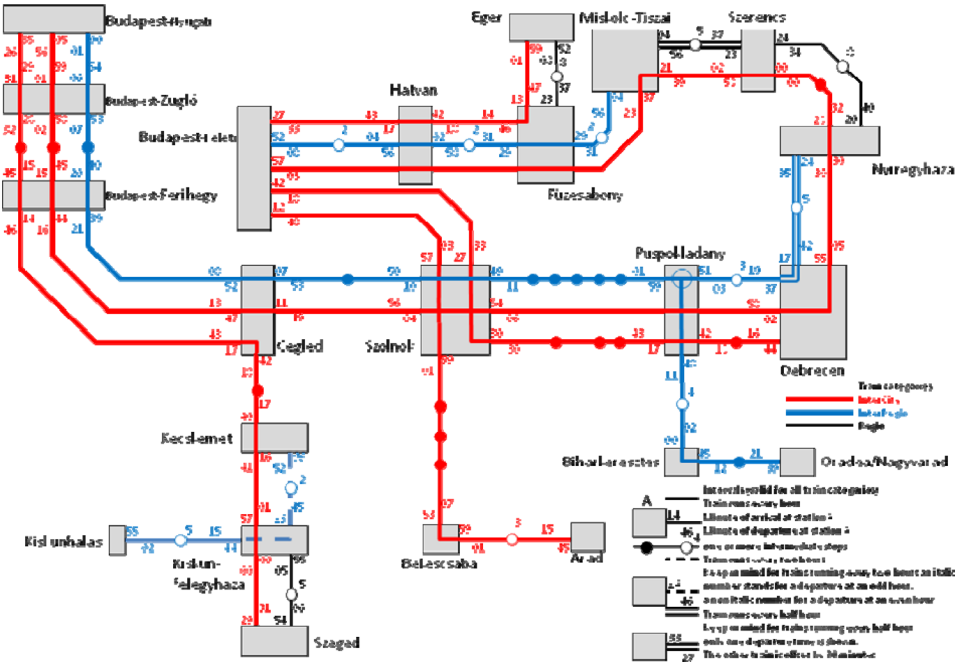

Figure 9 Timetable–map for the mid–term planned interregional ITF system of Eastern Hungary

One of the most important hubs attending the (previously introduced ITF–East) core network is Miskolc, which is the third biggest city in Hungary. This hub is planned to join 2 long–distance (hourly), 4 suburban (hourly), 3 so called tram–train – combined tram and suburban train service, which uses the railway outside, and the tram network inside the city – (half hourly) and 3 (high frequency) city–tram connections. In a conventional approach, altogether these 12 destinations would need 24 (arrival & departure) tracks to make connection between all of them. With this high number of platforms it is simply impossible to be able to guarantee acceptable transfer conditions. Furthermore, there are now only 4 platforms on the station, and in the middle of a living city it would be a desperate endeavour to expand it so much. But if we have an elaborated timetable structure, we can allocate our hub–trains not only in space but time as well.

For the new Miskolc–Tiszai station a non–conventional setting of the tracks has been planned, with through tracks on the two sides, and a specified turnaround area for the connecting trains between them. The fastest and the most comfortable way of transferring between two trains is when both of them are on the same platform. One platform has only two sides, but this topology (Fig. 9) guarantees the same platform for three trains in the same time including a through track. With an easy access to a turnaround area, it is possible for all the connecting trains to replace each other, one after the other.

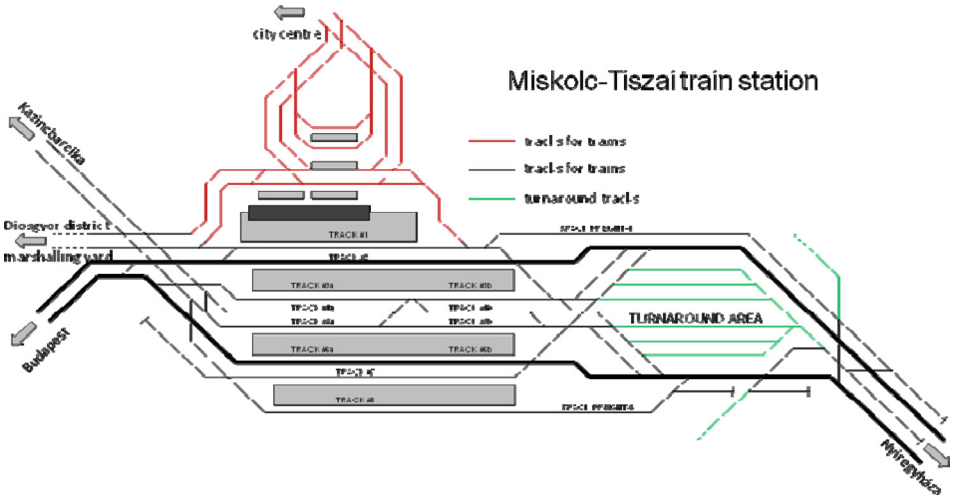

Figure 10 Topology of the planned new Miskolc train station

5 Conclusion

In Hungary ITF system timetables first managed to stop the loss of railway passengers, then they have become being the base of infrastructure developments, and now they are defaults in politics and in public as well. Trains running in periodic schedule is just like gravitation, it's normal. There are many examples when schools, workplaces or private attractions started to go by the periodic timetable. But maybe the most important advantage of ITF are the huge cost savings in infrastructure development processes, which means that an economy can use its sources much more efficiently.

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