

TECHNOLOGICAL ASPECTS OF EXTENSION OF TRANSPORT OPERATION ON RAIL-LINES IN RECONSTRUCTION

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Abstract: High quality of operational concepts in railway transport represents one of the basic premises of functional public transport system and public transport services. In this area the systematic timetable engineering plays an important role. Advanced timetable engineering brings a strong contribution for an effective use of infrastructure capacity. This systematic approach is very important, especially when the new railway service is being introduced on such railway line, which is in the state of reconstruction with numerous restrictions. The article demonstrates this approach on the example of the introduction of new express trains Prague - Linz in the timetable 2016/17.

KEYWORDS: RAILWAY TRANSPORT, PUBLIC TRAFFIC, RAILWAY TECHNOLOGY, TIMETABLING, FBS

1 Introduction

In the Czech Republic, over a period of more than 20 years, intensive renewal of railway infrastructure, primarily transit railway corridors, has taken place. One of these cases is IV. transit corridor leading from Děčín via Prague to the border with Austria in the direction of Linz. Between Prague and České Budějovice, the corridor is already completed at 75% of its length. The Ministry of Transport, as the orderer of long-distance trains, decided to order new express trains between Prague and České Budějovice in the Timetable 2016/17, which will be a new additional passenger service to the current fast trains. Between Prague and České Budějovice, there is motorway D3 in construction, so it is also not yet completed and the new express trains have a travel time comparable to that of individual transport.

The task was to prepare such an operational concept on the railway line, to make the most of the modernized infrastructure for the new trains, the trains of existing trains did not deteriorate and the technological impacts on the sections in the reconstruction (eg cruising in single track sections or sections under the construction) were minimal.

2 Prerequisites for solving the rail capacity and timetable problem

The timetable is a basic instrument for organizing railway transport. Though, it represents supply of connections in network for passengers. Generally, timetables can be divided into fixed-interval (periodic) and commercial (non-periodic).

The way from the basic idea of transport concept to final daily operation is long and complicated – from the transport planning with regards to present infrastructure parameters through timetable planning to the simulation of the transport concept. Within the stage of transport planning the transport relations (OD-Matrix) and estimated Modal-Split of railway passenger transport have to be determined followed by the line network scheme defining the lines, period of services and capacity of operating vehicles. These two phases generate the background for a rough draft of operational concept. Finally, this proposal of operational concept has to be verified by tool for timetable planning.

The problems of the new operational concept on the corridor line Prague - České Budějovice can be defined by three topics.

The first was the capacity of the line itself - line sections before the reconstruction are in many places only single-track with limited possibilities of train crossing. There are also some

double-track sections under reconstruction, which have to be operated as only single-track. The capacity of the line is further limited by the fact, that in the Czech Republic the speed of the trains by working places on the tracks is reduced to 50 km/h and for stations to 40 km/h (with regard to the provisional state of the signalling equipment).

The second problematic topic was defined by the constraints of the transport concept. Classical long-distance fast trains (train category R) are operated in a basic interval of 120 minutes, and for most of the working day it is completed for 60 minutes interval. The long distance trains R are reaching the complete IPT (interval periodic timetable) node in Tábor in the minute 00, the wider IPT node in Veselí nad Lužnicí at minute 30 and the wider IPT node in České Budějovice in the minute 00. The suburban regional transport service at Prague is operated in a basic interval 30 minutes between Prague and Benešov. At the nearest agglomeration section between Prague and Strančice the interval is concentrated in peak hours of working days to 15 minutes. The paths for long-distance fast trains are in the timetable so designed, to avoid overtaking regional trains in the section between Prague and Benešov, i.e. to avoid the loss of time for passengers in suburban transport. From this constraint it follows logically, that for the new express trains (train category Ex), the only path which could be used between Prague and Benešov is shifted exactly 30 minutes to the current fast trains. Thus, the entire timetable interval scheme of the Ex and R trains with regional trains had only such a time-manipulation space, to avoid disturbing current IPT nodes while avoiding overtaking regional trains. The conditions for the timetable construction of the path for new express trains were such, that a path with the smallest technological conflicts had to be found, which at the same time fulfilled the time conditions for passing trains on the border with Austria (for reaching transfer connections in station Linz). Although only 8 pairs of new express trains per day were introduced, a virtually periodical timetable scheme with Ex path in every hour must be found. This is due to the fact, that the Ex trains were introduced on the principle of a 4-hour period Prague - České Budějovice - Linz, supplemented by one express connection Prague - České Budějovice - Český Krumlov (UNESCO city with a tourist attendance of more than 1.3 mil persons per year) and 3 pairs of express trains Prague - České Budějovice in peak hours of working days.

The third problematic topic concerns to the vehicles, which are necessary for newly established express trains. The new operational concept was based on using of new passenger seating cars with modern locomotives type 380 ČD (Czech Railways)

From the point of view of reached travel times, the straightening looks as follows:

- travel time of fast trains (R) in periodic path Prague - České Budějovice in timetable 2015/16: 2 hour 23 min

- travel time of fast trains (R) in periodic path Prague - České Budějovice in timetable 2016/17 (by solved timetable conflicts with Ex trains): 2 hour 20-25 min

- travel time of new introduced express trains (Ex) in periodic path Prague - České Budějovice in timetable 2016/17: 1 hour 58 min

Even more interesting is the result achieved in the relation Prague - Linz.

In the timetable 2015/16, the Prague - Linz connection was made with fast trains (R) which continued to Linz from train Prague - České Budějovice, in the amount of 2.5 pairs a day (in one direction were 3 connections, the other 2 and the one ending in České Budějovice). Travel time Prague - Linz was 4 hours 50 min.

In the timetable 2016/17 the connection between Prague and Linz is provided by express trains, where between České Budějovice - Linz the already existing fast train paths were used. At the Austrian side, the Pregarten - Linz service was modified to two-segment operational concept and the express train use the higher segment path. The total balance of time savings is 25 minutes on the Czech territory between Prague - České Budějovice (Ex path), 8 minutes on the Czech territory (removal of the locomotive overpass in České Budějovice) and 12 minutes on the Austrian territory (influence of two-segment service Pregarten - Linz). The total time savings achieved 45 minutes and the resulting travel time of the Prague - Linz train is currently 4 hours 5 minutes.

5 Conclusion

This paper has presented, what timetable solutions could be achieved by appropriate technological combinations on the railway infrastructure, that is undergoing reconstruction, but it already enables higher transport attractiveness. All technological processes and variants have been reviewed in FBS. The state of construction of the 4th railway corridor between Prague - České Budějovice allowed, in conjunction with other follow-up measures of operational and technological nature, the introduction of a new express train segment, which led to shorter travel times not only in the relation itself, but also in the international relation Prague - Linz.

From the point of view of travel times, there was found such solution, which by introducing new express trains (Ex) did not damage existing fast train segment (R), including its transfer links. The average travel speed of fast trains (R) Prague - České Budějovice is 73.7 km/h. The average travel speed of the newly established express trains (Ex) Prague - České Budějovice is 87.5 km/h. Between Prague and České Budějovice, there is not yet a motorway D3 completed. The current travel time by individual transport is so comparable with the travel time of the newly introduced Express trains. This is the reason, why newly introduced trains have become a very attractive and sought after connection.

With further construction works, the constraints for train paths will also change and the technological solution founded for timetable 2016/17 is only temporary. However, we believe, that applying the same procedures a methods will result in a further

shortening of travel times of long distance trains (both categories Ex and R) as soon as infrastructure capabilities allow it, naturally without impacting on existing interconnections and IPT nodes of lower service segments.

Advanced timetable engineering brings a strong contribution for an effective use of infrastructure capacity – it's possible to say, where the current limits and bottlenecks of the infrastructure are – using these support tools is possible to enumerate, what the most important precautions in operation and investment in relation to capacity, reliability and safety are. This effectiveness is particularly fundamental by investment-consuming railway infrastructure. Practical application of these tools makes necessary link between theory and praxis.

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