

COORDINATION LINES DESIGN OF PUBLIC TRANSPORT ON THE ROUTE KOSICE AND CITY OF MOLDAVA NAD BODVOU

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Abstract

Public transport provides basic transportation needs of the residents of towns and villages. The increase of individual transport affects the division of transport between public transport and individual automobile transport. A solution is offered by a new integrated transport system that better exploits the potential of vehicles. The condition is an appropriate arrangement of the transport system, which allows reaching an agreement in the required quantity and adequate quality among the needs of the population and economical and technical disposition of the company. The paper deals with the coordination of rail lines and bus services between Kosice and city of Moldava nad Bodvou. The compilation of a new timetable for the route is based on needs of the population, conversion of passed kilometres and passenger kilometres. The dissertation research on Hutníky stop in integrated transport systems on the railway trait Kosice - Moldava nad Bodvou town also serves as base. The result is a design of a new timetable for the selected route.

Keywords: Košice, Moldava nad Bodvou, integrated transport system, public transport

1. INTRODUCTION

The main role of public transport is to preserve the development of urban agglomerations and a balanced development of regions. It shall ensure the basic transport needs of the population. However, the steady increase in individual motoring reduces the quality and quantity of public transport and burdens road transport infrastructure. Nevertheless, it has a negative impact on the environment.

The indirect division of transport labour in passenger transport can be influenced by a number of arrangements such as the introduction of an integrated transport system (ITS), which includes several benefits for passengers. Coordination of transport lines and preparation of timetables for the transport needs of the population of the region is needed for the ITS to work. The launch of a new integrated terminal in Moldava nad Bodvou brings also a launch of seven new pairs of trains. The final timing of the connections is not resolved yet, and based on previous experience with that section, we divided the individual connections according to the calculations of passenger-kilometers and transport performance.

The primary benefit of this article is to analyze the public transport on the route Košice - Moldava nad Bodvou town. Coordination and setting up of the timetable as a division of transport work in passenger public transport on this given route is elaborated in the secondary part.

2. ESSENTIAL THEORETICAL ASPECTS OF THE INTEGRATED TRANSPORT SYSTEM IN THE KOŠICE SELF-GOVERNING REGION

The aim of ITS lies in the provision of efficient and economic transport services in the area of interest, in terms of systems of the economic and non-economic needs of individuals and organizations. The strategy, which aim is a functional ITS system builds on the decision of constructing the integrated transport system including constructions in the respective region or the area of interest. The system is currently being built simultaneously

in the area of transport infrastructure and in the area of organizational arrangements. The activities of the expert group for the promotion of "The Region of Eastern Slovakia" and solving of studies addressing transport-tariff system proceed in accordance with the strategic documents of the EU and SR [1].

2.1. Terminal of the integrated passenger transport (TIPT) Moldava nad Bodvou

Terminal in Moldava nad Bodvou is part of the Integrated Transport System (ITS) of Košice Self-governing Region (KSR). ITS is based on long-term efforts of the Department of Transport KSR to create the conditions for sustainable regional and urban mobility. "Region of Eastern Slovakia" is planned to be formed by mutual coordination of timetables in line with the Strategic development plan for public passenger transport of the Slovak republic (SR) until 2020. It represents the integration of public passenger transport in the regions of Košice and Prešov [2].

Essential data:

- | | |
|--|-----------------------------------|
| - Constructor: | Železnice Slovenskej republiky |
| - Price for work according to the contract for work: | 5 604 592.52 € (VAT not included) |
| - Beginning of construction work: | 1.10.2014 |
| - End of construction work: | 30.9.2015 [3]. |

2.2. Coordination of public passenger transport system

The coordinated system of passenger transport is characterized by:

- the application of the criteria of the most viable alternative in the creation of lines of public transport, paying attention to the time and place elimination of duplicate lines,
- promoting maximum spatial continuation of public transport lines in order to minimize time delays resulting from the need for changes, and thus reduce the exhaustion of passengers [4],
- application of economic principles in the investment policy, the most appropriate use of the technical bases, select the most viable alternative to build common devices taking into account the amount of investment costs [5],
- creating equal information and operational systems for the needs of passengers (eg. information on delays),
- applying the principles of the time continuation of the connections of all lines during the preparation of timetables and in compliance checking [6,7].

3. ANALYSIS OF PASSENGER TRANSPORT ON LINES KOŠICE - MOLDAVA NAD BODVOU TOWN

Before proposing the division of lines of public transport on the route Košice - Moldava nad Bodvou town, we conducted an analysis of travel opportunities in the public bus and rail transport. The routes of bus lines is mainly performed by first class road no. 50 / E571 and the expressway R2. The route of railway lines is carried over the track section no. 160. Illustrations of stops and infrastructure of road and rail network of the given route is shown in **Fig.1**.

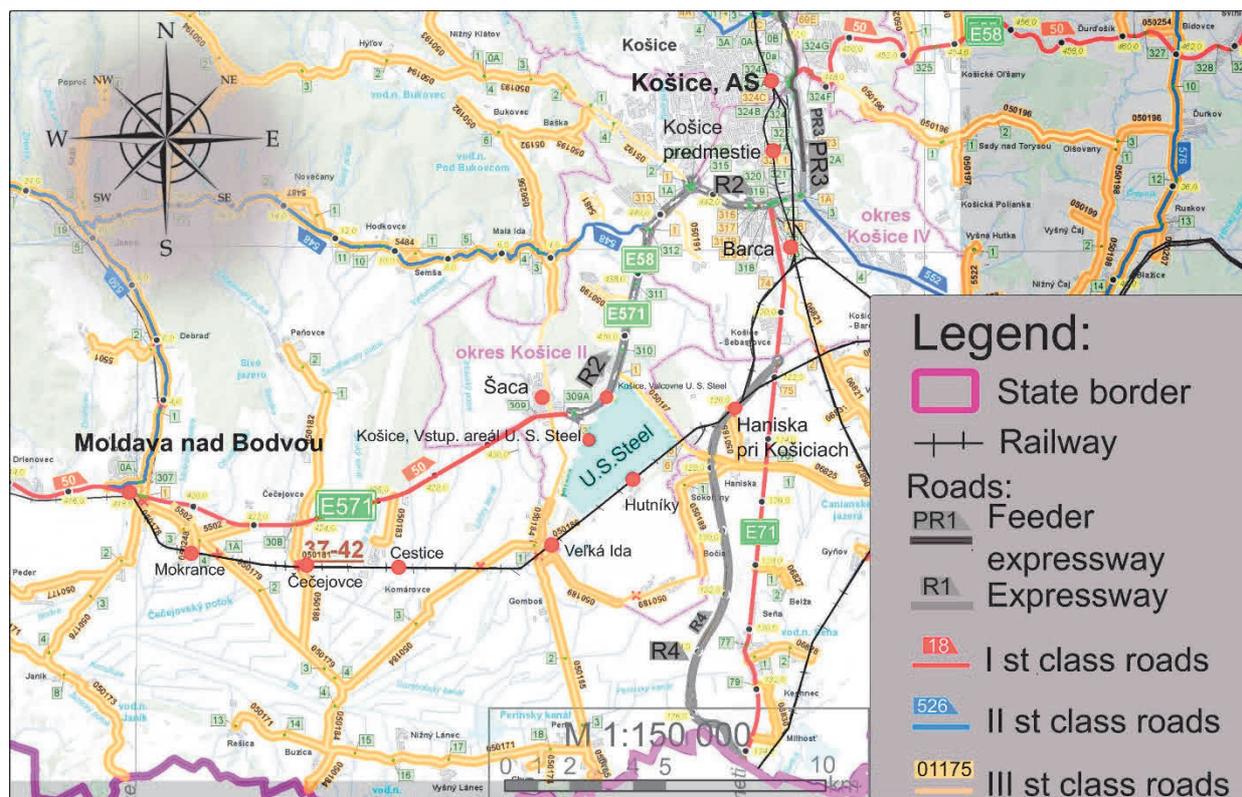


Fig. 1 Road and rail networks infrastructure

3.1. Analysis of the current state of passenger rail transport

Currently, the work on TIPT Moldava nad Bodvou is being completed. By the end of 2015, a new timetable will be created, in which seven pairs of passenger trains will run between the town Moldava nad Bodvou and Košice. For the coordination of these connections and bus connections, it is necessary to know the essential data of the given railway network, which is outlined in **Table 1**.

Table 1 The essential line characteristics of the route Košice - Moldava nad Bodvou [8]

Track stage		Length [km]	Number of rails	Electrification	Travel speed of passenger trains [km.hod ⁻¹]	Track speed [km.hod ⁻¹]
Košice	Barca	5	2	1	50	100
Barca	Haniska pri Košiciach	7	2	1	93.3	100
Haniska pri Košiciach	Moldava nad Bodvou	21	2/1	0	84	100

Analysis of passenger train services for the year 2015 on the route Moldava nad Bodvou - Košice is in **Table 2**.

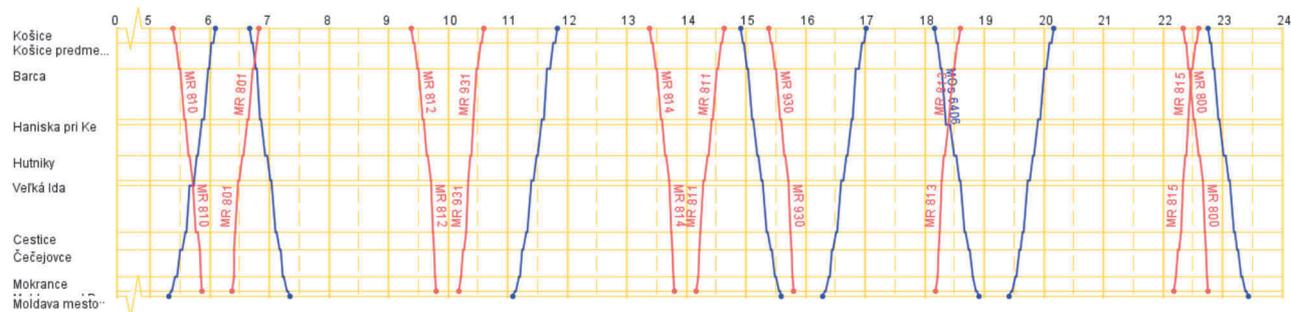
Table 2 Analysis of passenger train services for the year 2015 [9]

Route	Number of connections	Average travel time [min.]	Number of stops	Distance [km]
Moldava nad Bodvou - Košice	[4Pt, 5E] = 9	33.4	Pt-9/E-1	31
Košice - Moldava nad Bodvou	[4Pt, 5E] = 9	31.9	Pt-9/E-1	31

Pt - Passenger train

E - Express train

The current state of the train transport graph (TTG) on the route Košice - Moldava nad Bodvou from the 2015 timetable is shown in **Fig. 2**.


Fig. 2 TTG of the route Košice -Moldava nad Bodvou [9]

3.2. Analysis of the current state of passenger bus transport

The analysis of passenger bus transport for the year 2015 on the route Moldava nad Bodvou - Košice is developed in **Table 3**.

Table 3 Analysis of passenger bus transport for the year 2015 [10]

Route	Number of direct connections	Average travel time [min.]	Average distance [km]	Average number of stops	The shortest travel time	The longest travel time
Moldava nad Bodvou - Košice	37	41.9	30.4	10	32	58
Košice - Moldava nad Bodvou	40	43.9	30.4	8	30	60

The design of the transport service is based on the coordination of the individual bus and train services and the distribution of transport work. The calculation of the new timetable is based on the permeability of the railway line and the needs of students, employees of the company US Steel and other residents. All transport capacity will remain the same while we have the opportunity in the need for increased transport capacity at a lower cost than the current state. Grafikon program was used to check the permeability of the railway route.

The number of transported passengers will be divided by the increase of connections in train transport. This will allow them to take advantage of rail transport.

4. DESIGN OF COORDINATION OF LINES OF PASSENGER SERVICES ON ROUTES KOSICE AND MOLDAVA NAD BODVOU - TOWN

Table 4 includes the designed simplified timetable for seven pairs of lines of passenger train service and the required number of remaining lines of bus transport to meet the transport needs of the population to commute to work, school and civic amenities. Considering the large amount of links on the route we provide only a simplified version of the timetable.

Table 4 The simplified design of the timetable on the route Košice - Moldava nad Bodvou town

Route Košice - Moldava nad Bodvou town						Route Moldava nad Bodvou town - Košice					
Mode of transport	Departure	Arrival	Travel time	Distance	Number of stops	Mode of transport	Departure	Arrival	Travel time	Distance	Number of stops
Train	5:29	6:12	43	31	10	Bus	4:45	5:25	40	31	13
Bus	5:45	6:20	35	31	6	Bus	4:47	5:30	43	31	12
Bus	6:00	6:43	43	29	12	Bus	5:05	5:45	40	31	1
Bus	6:35	7:35	60	35	12	Train	5:19	6:06	47	31	10
Train	6:38	7:20	42	31	10	Bus	5:17	6:15	58	30	14
Bus	6:50	7:29	39	31	4	Bus	5:21	5:55	34	31	5
Bus	7:00	7:45	45	29	12	Bus	5:30	6:15	45	30	12
Bus	8:00	8:45	45	29	10	Bus	5:41	6:21	40	31	5
Bus	8:35	9:05	35	31	3	Bus	6:01	6:45	44	29	13
Bus	9:15	10:02	47	29	11	Bus	6:20	7:00	40	31	5
Bus	10:10	11:00	50	29	11	Bus	6:15	7:00	45	29	12
Bus	10:20	10:50	30	31	1	Bus	6:34	7:12	38	31	4
Bus	11:15	12:00	45	29	11	Bus	6:45	7:30	45	31	12
Bus	11:30	12:11	41	31	4	Train	7:14	8:02	48	31	10
Bus	12:10	12:55	45	29	12	Bus	7:11	7:45	34	35	3
Bus	12:30	13:12	42	31	5	Bus	7:21	7:55	34	35	3
Bus	12:30	13:22	52	31	6	Bus	7:34	8:10	36	31	5
Bus	12:45	13:26	41	31	5	Bus	7:42	8:25	43	29	12
Bus	13:10	14:00	50	31	15	Bus	8:05	8:50	45	29	12
Bus	13:45	14:36	51	29	11	Bus	8:32	9:08	36	31	4
Bus	14:05	14:45	40	31	3	Bus	9:10	9:55	45	29	14
Bus	14:15	14:53	38	35	3	Bus	10:15	11:00	45	29	12
Train	14:20	15:01	41	31	10	Bus	10:55	11:40	45	29	13
Bus	14:40	15:20	40	31	3	Train	11:05	11:50	45	31	10
Bus	14:50	15:34	44	29	11	Bus	11:50	12:30	40	29	14
Bus	14:50	15:42	52	29	12	Bus	12:43	13:15	32	31	4
Train	14:55	15:36	41	31	10	Bus	12:50	13:35	45	29	14

Bus	15:05	15:40	35	35	3	Bus	12:59	13:35	36	31	14
Bus	15:10	16:01	51	29	11	Train	13:12	14:01	49	31	10
Train	15:30	16:12	42	31	10	Bus	14:10	14:55	45	29	14
Bus	15:40	16:30	50	31	12	Bus	15:04	15:45	41	31	5
Bus	16:20	17:10	50	29	12	Bus	15:05	15:55	50	33	15
Bus	16:25	17:04	39	31	3	Bus	15:50	16:35	45	29	13
Bus	16:50	17:35	45	29	3	Train	16:17	17:01	44	31	10
Bus	17:25	18:05	40	29	10	Bus	16:20	17:00	40	29	12
Bus	17:45	18:25	40	31	4	Train	17:05	17:50	45	31	10
Train	18:10	18:55	45	31	10	Bus	17:02	17:40	38	31	5
Bus	18:15	19:00	45	29	12	Bus	17:10	17:50	40	31	3
Bus	18:15	19:00	45	29	12	Bus	18:20	19:00	40	29	13
Bus	18:50	19:31	41	29	6	Bus	19:10	19:50	40	29	12
Bus	19:25	20:10	45	29	10	Train	19:25	20:10	45	31	10
Bus	20:40	21:20	40	29	10						
Train	22:45	23:26	41	31	10						
Bus	23:00	23:35	35	31	1						

5. CONCLUSION

The role of the study was to analyze the current state of public passenger transport on the given route and the introduction of ITS, which includes the construction of the Terminal of the Integrated Passenger Transport (TIPT) in Moldava nad Bodvou. The construction of a new system may increase the usage and attractiveness of passenger train traffic on the route Košice - Moldava nad Bodvou town and the quality of provided transport services, frequency of connections and uniform fares, which will facilitate travelling. The second part includes a new design of a harmonized timetable of passenger train and bus services. In passenger train transport the number of connections has increased to cater for the population needs of the given region more readily. The advantage of this solution is the option of more flexibly increasing the number of passengers transported without much expenditure by the addition of train waggon in case of demand. For the proper functioning of the new system, it is necessary to coordinate also the lines of the surrounding municipalities of the given region and the establishment of a single uniform transport and tariff conditions of the region.

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