



REVIEW OF STATE OF RAILWAY INFRASTRUCTURE IN BOSNIA AND HERZEGOVINA – POSSIBILITIES FOR INCREASING SPEED AND EFFECTS OF INTRODUCTION OF TRAINS WITH TILTING TECHNOLOGY

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Abstract

At the beginning of 2010th BiH came first composition-tilt technology trains (Talgo), while the end of the 2011th remain of the total contracted nine compositions for the Federation of Bosnia and Herzegovina Railways (ŽFBiH), and even five composition of the Republic of Serbian Railways (ŽRS). During the late 2011th and the beginning of 2012th these trains should be fully involved in the traffic and so will meet the prerequisites for the restoration of international traffic. However, the question remains the kind of line they will be let in traffic, i.e. the kind of situation is existing infrastructure and the effects of which will be the introduction of these trains. This paper will give a brief overview of the current state of the railway infrastructure in the FBiH (in its main corridor - Vc), and the possibility of increasing the speed and safety of driving in order to achieve the best possible effects of the introduction of trains-tilt technology and fulfill the given conditions in the agreement for the development of transport services (AGTC Agreement).

Keywords: tilt technology trains, railway infrastructure, urban areas, environmen

1 Introduction

After the war in Bosnia as a result of the destruction of war remained serious damage to railway infrastructure, as well as impoverished vehicle park.

In this period, many activities have been launched with the aim of training the railway infrastructure and the establishment of railway traffic. Priority was the restoration of destroyed bridges and rehabilitation center break the train network, with the aim to quickly establish local (within the state of traffic). So, the goal was to establish the continuity of the railway network in Bosnia, in which successful, but unfortunately have not created the conditions for the normal flow of traffic.

This is because most lines are in poor mechanical condition and high degree of technical worn out.

There is the establishment of international traffic, first to neighboring states Croatian R (Ploce – Sarajevo, later Sarajevo – Zagreb), then with Hungary (Sarajevo – Budapest) and Serbia (Sarajevo – Belgrade).

However, the current situation in terms of passenger traffic is very bad and the existing volume of passenger traffic in BiH is slight, or symbolic in relation to the pre-war.

In order to improve the situation it was decided to start the reconstruction Railways of Bosnia and Herzegovina (here and later: ŽBiH) rolling stock, or acquisition of the latest technology, pan-tilt trains.

In preliminary contacts companies Patentes Talgo SA of Madrid has expressed interest in the delivery of its products, trains-tilt technology “Talgo Pendular. Activities around procurement Talgo trains going since 2001. I have a contract signed 2005th. With this contract, the Federation of BiH acquire nine passenger set of nine cars, the value of 67.7 million euros, and the Republic of Serbian acquire five such compositions value of about 40 million euros.



Figure 1 Train “Talgo Pendular”

In accordance with the agreement, the company Patentes “Talgo” SA from Madrid Railways of FBiH will deliver the first two sets of trains in 2010. year, and the other seven in 2011. ŽFBH plan included in the timetable five daily and four sets of night, which is planned to transport to Zagreb, Ljubljana and Belgrade.

“Supply these trains will be established the most modern passenger service and to restore international rail passenger traffic, and planned routes to Vienna Budapest and Belgrade, “announced the ŽBiH.

Although the acquisition of these trains is a major step forward in improving the quality of passenger traffic is still not expecting any spectacular results.

In fact, the procurement of trains with tilt technology will come to increase the comfort of travel, but will remain a problem the length of travel, or will not reach significant increase in speed.

The main reasons for this are: the current state of the railway infrastructure, as well as territorial division route of the railway between different railway administrations (the company) (ŽFBiH, ŽRS, Croatian Railways, Railways of Serbia) and what are the words below.

2 Current condition of railway infrastructure

I start the development of railways in Bosnia and Herzegovina, tied for the period of the rule of the Turkish empire (Ottoman Empire) was built when the 2 500km long railway Istanbul – Vienna, within which was built 101km long section of normal gauge railway Dobrljin – Banja Luka (1869.).

Since 1878th until 1918th BiH is located within the Austro-Hungarian Monarchy, and Railway in BiH (via Sisak) associated with the rest of the railway network in Europe. What is characteristic of this period of intensive construction narrow-gauge (760mm) lines over the country (about 1617km) and to a lesser extent the normal gauge line (Brcko, Bosanski Šamac and Bos.Brod).

Since 1878th until 1918. Bosnia is located in part of the period since 1918. until 1941. Bosnia and Herzegovina was not so pronounced development of the railway network. At that time, Bosnia was in the part of the Kingdom of Serbs, Croats and Slovenes and the Kingdom of Yugoslavia, and was built about 66km railway track and around the normal 115km narrow-gauge railway.

The period since 1945. to 1978. Was the period of intensive construction of railroad tracks in the normal then the Socialist Republic of BiH (within the Socialist Federal Republic of Yugoslavia). Built 855km normal gauge line (of which 87km two-gauge, and replacement or elimination many narrow-gauge railway.

After this period of intensive construction, since 1978. to 1991. (even today) has not built any new mile track, but were introduced at the time of modern technology, such as automatic railway block - APB, remote traffic control etc.

Development of Railways in Bosnia and Herzegovina was abruptly stopped, and after the aggression and war (1992–1995) rail infrastructure is significantly damaged (partly destroyed large contact network, plant electric pull, signal-security and telecommunications equipment, super structure, and totally destroyed 14 bridges.

The total loss suffered by the railway infrastructure is estimated at about 1,000 million U.S. \$. (The study on the Transport Master Plan in Bosnia and Herzegovina 2000 ”)

In the postwar period through the emergency reconstruction program is carried out repairs to the basic capacity of the railway infrastructure in order to quickly establish training and railway traffic. This goal is achieved, however, not achieved any improvement on the existing railway infrastructure which is built on the rough terrain in the period 1946 -1966, with the technical parameters (Table 1) that allowed the maximum speed to 100km/h.

In Bosnia today, we have a network of railroads normal track width (1435mm) of the total length of approximately 1030 kilometers.

About 75% of the railway is electrified and is powered by the AC voltage nominal 25kW, 50Hz. This network of railway infrastructure managed by two companies that have established the entity of the government:

Federation of Bosnia and Herzegovina (FBiH) in 2001. The railway company founded Public FBiH Railways (ŽFBiH) the same year the Republic of Serbian (RS) founded the Republic of Serbian Railways (ŽRS). Government entities are majority owners of these companies (FBiH-92% stake in ŽBiH, RS - 80% of ŽRS). Both companies provide services to transport goods and passengers by rail, and both managers and infrastructure. (Ownership of the infrastructure is related to the territory of which the entity is located).

At the state level, entities are 1998th established a public corporation ВНЖК, whose task is to ensure inter-entity institutional cooperation and to act as a supervisory and regulatory organizations with certain powers.

Table 1 Parameters of the railroads in BiH.

Parameter	Sarajevo –Capljina	Bos.Šamac –Sarajevo	Doboj –Bos.Novi
Length of line (km)	170,39	236,154	179,63
Number of tracks	1	1 on 148,949km 2 on 87,205km	1
Type of pull	electric	electric	electric
Max. grade level (‰)	24	8,8	20
Min. curve radius (m)	250	300	295
Category railway	D4	D4	D4
Gabarit	UIC -506		

Table 2 Parameters of the railroads in BiH.

Parameter	Bos.Novi- Martin Brod	Doboj –Tuzla	Brčko –Banovići
Length of line (km)	137,178	57,369	90,226
Number of tracks	1	1	1
Type of pull	Elektric/diesel	diesel	diesel
Max. grade level (‰)	19,5	8	24
Min. curve radius (m)	240	225	200
Category railway	D4	D4	C4
Limit gauge	UIC -506		

As seen from the table on most lines are applied border (allowed) values of the parameters of geometric features stripes (minimum radius of curvature and the maximum grade level). The reason the adverse field conditions (disadvantage railway route), and avoiding the high cost of construction.

It is precisely these parameters represent the biggest problem with the aspect of a possible rate increase, which will be shown in a somewhat more detailed analysis of the stripe should communicate Talgo trains.

Another big problem is the age line. As already mentioned in the last line of BiH is built 1978th, but the building have not made any serious reconstructive works.



Figure 2 Age of the superstructure since the last overhaul on the lines ŽBiH

Figure 3 Maximum allowed speed on the lines ŽBiH.

Consequently we have limited the speed of movement, so that the maximum speed is 70 kilometers / h for passenger and 50km/h for freight trains.

Only in the last start time of the big reconstruction of line Sarajevo – Capljina, so that the section of track Bradina – Konjic has been completed, and start the repairs on the section Konjic – Capljina. What is needed is to be noted that with this big reconstruction not change the geometrical parameters of tracks, but is based solely on the replacement of superstructure. Effects like made big reconstruction is reflected primarily in increased traffic safety at the existing speed, however, significantly increase the speed can't be achieved without fixing the critical parameters of track geometry.

3 Parameter line Sarajevo – Capljina and Bosanski Samac – Sarajevo

Talgo trains are among the high class - comfortable trains and they are mainly used on medium and long distances at which demands a high level of service.

As previously mentioned, the objective of the procurement of these trains by ŽFBiH i žRS to establish or improve the quality of traffic on international lines.

From the aspect of BiH as a priority railway lines can enumerate:

- Ploče – Sarajevo - Zagreb
- Sarajevo – Beograd
- Banja Luka – Beograd.

These lines are the two most important transport route, the first Pan-European Corridor Vc, while the other Corridor X.

Below, we focus on the first mentioned line, or lines of the Corridor Vc passing through Bosnia and Herzegovina line: Sarajevo – Capljina (line 11), and Bosanski Samac – Sarajevo (line 12).

3.1 Railway Sarajevo – Capljina – state border (Metković) (line 11)

Total length of track on this section is 171,756 km.

Since this is 80,541 km (about 47%) route of the railway was laid in the direction, while he 91,215 km curves (about 53%). The minimum horizontal curve radius applied is 250 m, while the maximum is 10,000 m.

On Figure 4 and 5 representation of curves is shown a certain radius, and the percentage participation of a certain radius of curvature of the total route length of railways in the curves.

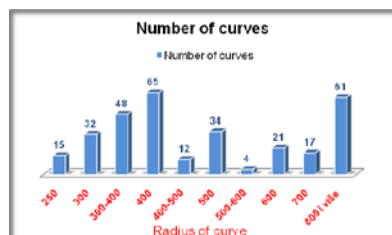


Figure 4 Number of curves

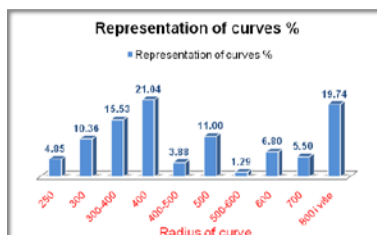


Figure 5 Representation of curves

With the figure can be seen that the share is the total curve 309, of which even 210 (68%) radius < 600 m (according to the regulations for the speed of less than 100 km/h).

Respectively 76.27% (69,859.44 m) length of railways in the curves (ie 40% of the total length of the shares) is in the radius curves < 600 m.

3.2 Railway Bos.Šamac – Sarajevo (line 12)

Total length of track on this section is 234,179 km.

Since it is 108.555 kilometers (about 46.35%) route of the railway was laid in the direction, while the curves, 125.624 kilometers (about 53.65%). The minimum horizontal curve radius applied is 250 m, while the maximum is 50,000 m.

On Figure 6 and 7 representation of curves is shown a certain radius, and the percentage participation of a certain radius of curvature of the total route length of railways in the curves.

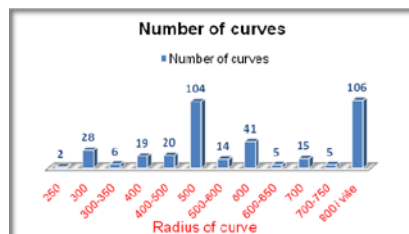


Figure 6 Number of curves

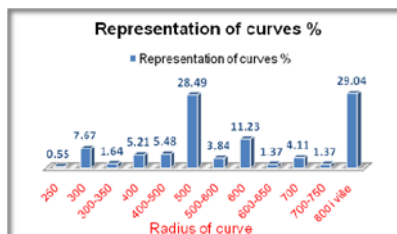


Figure 7 Representation of curves

With the figure can be seen that the share is the total razmatranj curve 365, of which even 193 (53%) radius < 600 m (according to the regulations for the speed of less than 100 km/h).

Respectively 60% (74.81 km) length of railways in the curves (ie 32% of the total length of the shares) is in the radius curves < 600 m According to the timetables for 1991/92, 2009/10 year's drive to the treated routes and achieved the best travel time data in Table 3:

Table 3 Travel time.

Relation	Travel time		
	1991/92	2009/10	best
Sarajevo – Zagreb (via Banja Luka)	6 ^h 35 ^{min}	9 ^h 23 ^{min}	6 ^h 35 ^{min}
Sarajevo – Ploče	2 ^h 44 ^{min}	4 ^h 02 ^{min}	
Ploče – Sarajevo – Zagreb	10 ^h 52 ^{min}		
Sarajevo – Beograd (via Vrpolje)	6 ^h 00 ^{min}	8 ^h 43 ^{min}	5 ^h 00 ^{min}
Banja Luka – Beograd (via Vrpolje)	5 ^h 33 ^{min}		

Of data from these can be seen that while driving a train in 2010. between Sarajevo – Zagreb for almost 3 hours more than 1991-1992. Between Sarajevo – Ploče travel time is longer for 1 hour and 18 minutes.

On the part of the line (which passes through BiH), which is 171.76 kilometers long we (the border) 15 cells in which it is dealing with an average of 1 per minute, or driving time is 2 s. 44m, while the time to practice 13 minutes. Therefore, the total travel time is 2s.57m., Which is larger than the travel time between Sarajevo – Ploče from 1991.

Also we have two border crossings with the retention of the 18 minutes, or a total retention of the border is about 36 minutes. If we divide the time travels the length relations we get an average speed of travel, which is about 67km/h.

Means that we make up for loss time (one hour) and made time travel from 1991. Had to increase the speed of travel at about 120km/h, which is due to the line parameters in these conditions it is impossible to do without major reconstruction.

A similar situation is between Sarajevo – Zagreb, where we have something better route parameters and greater time losses. From foreign experience is known to be possible to increase the speed in curves with pan-tilt technology trains moving in the limit of 10%.

This increase is possible only if the use of complete trains, however, our railways have been told only passenger seating (without locomotive) to pull classic locomotives, so this speed increase can not be achieved.

4 Conclusion

Talgo trains acquisition represents a major step forward from the viewpoint of improving the quality of rail travel, however, that the railway has become competitive to other forms of passenger transport in this region (especially road) you need to do much more.

In the first place necessary to reduce the length (time) travel in value since 1991. that the approximate time that achieve aspects of road transport, while air sitem the untouchable, but he Railways was indeed competitive with regard to the cost of transportation.

It is therefore very important to try to reduce travel time to get through traffic organization measures (to reduce the number of cells in the inter-state lines, the waiting time for inter-state and entity boundaries, etc.) and thus try to make rail competitive and attract travelers with whom it will come to return investment.

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