XXIII R-S-P seminar, Theoretical Foundation of Civil Engineering (23RSP) (TFoCE 2014)

Possibilities of Increasing Territorial Coverage and Operational Performance of the Tatra Electric Railways

Libor Ižvölta, Michal Šmaloa*

* Department of Railway Engineering and Track Management, FCE, University of Žilina, Univerzitná 8215/1, 010 26 Žilina, Slovak Republic

Abstract

In the context of requirement of environmental protection in the Tatra National Park (TANAP) and the territorial coverage solution primarily with ecological railway transport becomes current demand of extending the current network of Tatra Electric Railways (TER) and possibly to connect Slovak and Polish side of the mountains. The basic prerequisite for a functional, safe and attractive operation of the Tatra Electric Railways is modernization of existing lines, because current state causes not only high maintenance costs, but also significantly reduces the speed, safety, reliability and operational efficiency. The paper suggests ways to reconstruct the existing network and upgrade it to achieve the required technical parameters in case of attractiveness of rail transport in the High Tatras.

Keywords: infrastructure; railway; territorial coverage; narrow-gauge lines; operational performance.

1. Introduction

Infrastructure in the region of High Tatras represents a unique transport system, where in addition to shipping, exists or existed perhaps all that it was possible to transport. There was a electrobus over 100 years ago running in the High Tatras, there are tracks of normal and narrow gauge, narrow gauge adhesive cog track, cableways and funicular railway. There is located the highest situated airport near Poprad for airliners in Central Europe providing mainly charter flights in the winter and summer season.

High Tatras welcomed the first visitors already in the 16th century and the first foreign explorers and scientists began to be interested in the mountains in the 18th century. They found paths in the forest from the Tatra villages used by hunters, herbalists, shepherds, and treasure hunters. The first log cabin was built in acid springs under the Slavkovský Peak up in 1793 [1].

* Corresponding author. Tel.: +421-041-513 5849.
E-mail address: michal.smalo@fstav.uniza.sk
Nearly one hundred years later – in 1871 there was opened a 139 km long section of Košice-Bohumín Railway (hereinafter referred to as “KBR”) from Poprad to Žilina, which resulted in a breakthrough in the development of tourism. The connection of the highest station of KBR – Štrba and Štrbské Pleso with cog railway was established in 1876.

In spite of the rapid development of settlements, the construction of the luxury grand hotels and bathhouses, adequate connection was still missing. Tatra settlements were connected with each other by narrow paths, roadways led only to "parent" villages in Poprad basin. Due to competitive reasons, some of them even resisted the road connection with neighbouring settlements. Also for these reasons, the first motorists from Poprad arrived in Starý Smokovec in 1900. Electric buses – pioneering three-axle vehicles on wooden wheels - were running on this route from 1904. They proved to be unreliable and slow on the steep road with uneven surface – they overcame 12 km long route in 75 minutes. For these reasons, the operation was inflexible, but still an attractive tourist line, completed in 1906, and there started the preparatory work for the construction of electric railway connecting Tatra settlement with Poprad.

Already in 1906 there were initiated measuring works and a year later the actual construction of narrow gauge railway track. Transport at the first, 12.8 km long section of electric railway from Poprad to Starý Smokovec, was launched on 20th December 1908. Number of defects in a newly installed railway claimed to take radical measures to build a network of electric railways by the construction of a railway connection Starý Smokovec – Tatranská Lomnica and Starý Smokovec – Štrbské Pleso, and the realization of extensive reconstruction of existing electric railway (comprising mainly replacement of the superstructure, route changes of some sections, modernization of power facilities, construction of a new depot in Poprad and later the station building in Starý Smokovec). The reconstruction work was initiated in March 1910 and the most important building structures were put into use three months later. The construction of other track sections ran together with the reconstruction of the first section. Public operation in the section Starý Smokovec – Tatranska Lomnica (section length of 6.0 km) was initiated on 16th December, 1911 and the first train visited from Starý Smokovec to Štrbské Pleso on 13th December, 1912 (section length of 16.6 km) [1]. The Tatra railway network should have expanded even further and although the section from Štrbské Pleso to Podbanské, with a possible extension to Liptovský Háj, branching-off to Popradské Pleso and railway from Tatranská Lomnica to Tatranská Basin and Levoča. However, all of these bold plans at that time were frustrated by the beginning of World War I and the railway tracks remained at approximately the extent that we know them today [2].

In the mid-50 years of the last century, narrow gauge tracks in the High Tatras were threatened by extinction. Accumulating problems in keeping the operation of unsafe vehicles on the tracks with poor maintenance, which led to many emergency situations, resulted in the need to find a definitive solution to the future of the Tatra railway. Government Transport Design Institute (Státní ústav dopravního projektování – SUDOP) in Prague and Košice subsequently developed extensive reconstruction studies for standard gauge railway from Poprad to Tatranská Lomnica and its extension through Starý Smokovec to Nižné Hágy and its connection to the main track in Štrba [3].

The decision to hold the FIS Nordic World Ski Championships in 1970 opened consideration of reconstruction of Tatra transport system, with a number of solutions proposed. One of them was even complete cancellation of TER and its replacement by road transport. However, the proposals to rebuild the "Cesta slobody" (Road of Freedom) on four-lane road did not meet with understanding of Tatra National Park Administration (TANAP). The environmentalists’ requirements were heard and the invasion of cars, at least for some time, was averted [4].

Another design should be the realization of monorail of ALWEG type, which should replace the existing narrow gauge railways and connect Poprad with Štrbské Pleso. Monorail sparked controversy among experts in the field of transport, but perhaps the whole Republic discussed about the pros and cons of this overhead railway. Bold plans then counted with the extension of the track to Ždiar, Lysá Poľana, but also its connection with the Polish side of mountains. After careful consideration of the advantages and disadvantages of the possible alternatives of transport service of the High Tatras, there were eventually proposed to continue the reconstruction of TER, modernize funicular Starý Smokovec – Hrebeniok and restore earlier cancelled cog railway Štrba – Štrbské Pleso [1].

Narrow gauge railway is the central transport system in the High Tatras for over 100 years. During this long development, many parameters of tracks gradually changed due to reconstructions, relocation and other modifications. The biggest building interventions during the existence of tracks include relocation bypassing the urban part of Poprad-Veľká with a new entry site in Poprad-Tatry railway station, construction of a new depot in Poprad and Štrbské Pleso railway station in a new location – close to the existing station of cog railway to Štrba.
2. Possibilities for TER extension and interconnection

As it was already mentioned in the introduction, narrow gauge railways are verified transport system on the Slovak side of the High Tatras over a century. However, technical progress is unstoppable and increasing demands for the speed, safety, environmental protection and attractiveness of railway operations put on the TER tracks new targets that can only be achieved by reconstructing and modernizing of their tracks or their double-tracking, extending or even connecting with the Polish part of the High Tatras. A reliable operating railway transport in the High Tatras on both sides of national borders of Slovak Republic and Poland (hereinafter referred to as "SR", "PL") is not only a good option to increase the attractiveness of this location for its visitors, but also the only possible competition-capable alternative of still expanding individual car transport. The issue of future of the TER tracks and attractiveness of the transport system in the High Tatras region by increasing the speed, compacting interval between trains and better connections to rail service on the main line Bratislava – Žilina – Košice, or creating a connection of Poprad Airport, is a current problem in relation to the requirement of environmental protection in TANAP and solutions of serviceability of the area for the ecological railway transport.

There were already efforts to extend the current network of TER in the territory of the High Tatras, or its connection with the Polish side in the past, and this idea is not new at all. However, its implementation is more current not only for the above reasons, but also because of the increased mobility of the population resulting of the existence of the borders of the Schengen area and promoting the ideas of the necessary cross-border cooperation in order to create new jobs and increase tourism in the area of the Slovak-Polish border. From the rest of the period there is known more than one study, where dealt with the possibility of extension of the TER network, or connection of two neighbouring State territories. There were prepared two variants of informative proposal of a new route in [5] considering the connection of the existing TER platform in railway station in Poprad-Tatry with Poprad Airport and the subsequent conduction of the route through the village Batizovce and Gerlachov to existing passing loop Tatranská Polianka. The first variant assumes the connection of a new section of the connecting track to RD Poprad-Tatry TER and subsequent routing to the main railway line Žilina – Košice. The second variant is considering with the beginning of the section approximately km 3.000 (right-hand directional curve with a radius of 300 m) of the existing track, and parallel direction with the motorway section D1 Mengusovce – Jánovce to Poprad Airport. The remaining section of the new railway track is identical to the first variant. The connection of TER network with Poprad Airport would significantly attract the connection of a significant railway intersection and the highest airport for transport aircraft in Central Europe, which, during the winter, but also the summer tourist season accepts a number of Charter flights.

Other bold plans include connection of TER track system with the Polish side of the High Tatras. The connection of both border territories of mountains is the current issue from the fifties of the last century and they did not come into focus only before the FIS Nordic World Ski Championships (1970), but also in relation to the candidacy of Poprad for the Olympic Winter Games (2006) and this chance has opened again in connection with the candidacy of Poland to the Winter Olympics in 2022. The extension of TER network through the villages of Ždiar and Tatranská Javorina should connect the centers of tourism of Slovak side of mountains with the Polish, especially with Zakopané, or Nowy Targ and Krynica. Preliminary study of the possible extension of the TER network to the Polish side of the High Tatras is shown in Fig 1. It may be seen that the new railway would connect to the existing route in Tatranska Lomnica railway station and continue through the settlements of Vysoké Tatry – Tatranské Matliare and Tatranská Kotlina to the village Ždiar, where this route follows the horizontal and vertical alignment of existing roads II/537 and I/67 to the extent possible. In section Ždiar – Podspády – Lysá Poľana (state border SR/PL), the railway track continues to copy morphologically difficult terrain of Belianské Tatry and is parallel with state road I/67. On the Polish side of the High Tatras, the railway track would follow again the roads no. 960 (section Łysa Polana – Bukowina Tatrzańska) and no. 961 (section Bukowina Tatrzańska - Poronin) to the extent possible. There is proposed a route in parallel with the railway track no. 135 Kraków Główny – Chabówka – Zakopane in the section Poronin - Zakopane.

With the support of EU funds, there were already developed two conceptual proposals in 2003 related to rail transport solutions not only in the High, but also Low Tatras:

• Tatra transport system and nature protection,
• Study on the tourist route around the Western Tatras from Zakopané to Liptovský Mikuláš.
The project "Tatra transport system and nature protection" was prepared by a group of experts led by the representatives of the Municipal authorities in Zakopané and Poprad. The project pointed out to deficiencies and non-systemic connection of transport systems on both sides of the Tatras. There was developed a proposal of transport system within the project in accordance with the principles of equal development following the principles of the protection of the environment. In the same period, there was prepared Study on the tourist route around the Western Tatras from Zakopané to Liptovský Mikuláš. This project included cooperation of company Belasá planéta, MO Zakopané and DO Žilina. There is a proposal of transport system in the area of Tatras in Fig. 2 resulting from both of the projects, where an important element of this proposal, which are tracks, is obvious. It is assumed that urban development axis allows spatial integration of at least 40 municipalities and 2 cities with targeted development of tourism.

In this context, it is certainly an interesting idea that PKP PLK S.A. has been planning reconstruction of canceled track section Nowy Targ – Podczerské – Trstená since 2006, which is part of the track connecting Kraków and Vienna. The reconstruction of this route is of a great importance in freight transport. Informative term of implementation of reconstruction section Nowy Targ – Podczerské – Suchá Hora is scheduled for 2020. The railway superstructure in the section Nowy Targ – Podczerské was dismantled in 1991 and 1992 and the lands were handed over to the local government administration. At present, the property fell into ruins, and unfortunately, most of the railway structures on the track were damaged. Given that there is intense truck traffic in this area, many Members of the Polish Parliament support the reconstruction of the track in question. Before the interconnection of the track network TER to interesting locations of the Polish side of the High Tatras is necessary to reconstruct and modernize the existing sections.
Given the hard horizontal and vertical alignment of the TER tracks, sudden changes in routing parameters, difficult geomorphological and climatic conditions, it is necessary to approach the design of reconstruction or modernization of these tracks particularly sensitively and professionally. The infrastructure manager identified for the most serious weaknesses in the structure of railway superstructure and substructure the following [7]:

- failures in track geometry, which have origin in freezing subgrade structure, respectively in inadequate drainage,
- directional shifts in curves (especially during winter and summer), suggesting a lack of rigidity of track skeleton,
- wear of the check rail Kn 60,
- rail corrugations and spreading of the rail head,
- weathered rocks falling,
- inconvenient condition of culverts, supporting and retaining walls,
- incomplete recovery of platforms for new power units,
- inconvenient structural elements of railway level crossings.

There has not yet been applied the structure of continuously welded rail track (hereinafter referred to as "CWR track") on the TER tracks, now established element in the structure of railway superstructure around the world, providing several benefits. The structure of CWR track does not only reduce the maintenance cost of tracks and rail vehicles, but also contributes to increasing the safety and reliability of rail transport, comfort for passengers, where it is possible to characterize the operation as more environmental [8]. The objectives of a possible modernisation of the TER tracks are to increase the speed, comfort and safety of traveling. In addition to providing the necessary reconstruction, the basic requirement is, therefore, change of some parameters of the tracks in order to meet these objectives. Considering the modernisation it is necessary and appropriate to increase track speed of today's 60 km.h\(^{-1}\) to 80 km.h\(^{-1}\) in the selected sections depending on parameters of track geometry (hereinafter referred to as "TG").

It is possible to increase the radius of directional curves R in some directional curves (in particular in sections passing through Poprad basin) and adjust the TG parameters so these curves can be used for higher track speed. The track parameters adjusted are then necessary to adapt security and communication device for the future increase of the total track permeability and the introduction of attractive time-keeping transport for passengers. It is possible to
double-tracking the selected sections (eg. Veľký Slavkov – Pod lesom) in the future as well, thereby increasing capacity of the track [9].

In terms of construction of railway substructure it is necessary to reconstruct (or modernize) in particular drainage structures. Culverts are necessary to purify and reconstruct, some of them substitute for new to ensure their full functionality again. Particular attention should be paid to supporting and retaining walls, and especially in areas of potential landslides. There should be even considered the modification of bridges – for example in conjunction with the construction of CWR track. From the railway substructure devices, it is necessary to pay attention in particular to platforms. Platforms topped with a solid edge are needed to rebuild so to have the solid surface and strong edge to ensure barrier-free access for passengers to low-floor electrical units. Access roads are also necessary to adjust for barrier-free access. Attention must also be paid to the level crossings with roads – state roads of 2nd and 3rd class, special-purpose and local roads, country and forest roads and foot paths.

3. Conclusions

It is clear from the above activities that the issue of attractiveness and approach of the territory of Tatras on both sides to their better and more ecological use in recent years is alive not only in Slovakia, but also in Poland. A considerable undersize of road transport between regions gives evidence in the benefit of construction of railway connection between Slovak and Polish part of the Tatras, when the number of vehicles is above the acceptable limit and motorists must overcome great distances or often use problematic drive-through mountain passages in winter. In addition, road transport loads significantly down the environmentally valuable region. An extension of the original TER network, or railway connection of both sides of the State border SR/PL would assess both regions and open new possibilities for mutual cooperation not only in the field of tourism. It is clear, however, that achieving this goal will not be easy. The problem of the implementation of the extension of the TER, connection of the Slovak and Polish part of the High Tatras, or even more generous connections, and therefore economic use of mountain and submontane regions of Orava and Liptov, following the area of Zakopané in Poland is not only costly, but it is difficult to create conditions for the extension of the TER infrastructure, which lies in overcoming legal and conservation measures in relation to the construction on the territory of the National Park. It is understood that the implementation of these ideas must precede development of transport and economic studies, documenting problems, proposals and solution phases, but mainly a way of achieving the necessary transport capacities with the proposal of financing the operation of the rail system, with the support of the business community, region and state.

Acknowledgements

The contribution originated within the framework of OP Education for the project "Promoting quality education and research in the field of transport, as the engine of the economy" (ITMS: 26110230076), which is co-financed from the resources of the European Social Fund.

References