ANALYSIS OF STANDARDISED PLATFORM CONFIGURATION SOLUTIONS IN THE CONTEXT OF EUROPEAN AND NATIONAL LEGISLATION

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Abstract

This paper focuses on variant configurations of platforms in railway stations on lines of regional importance. An overview of the solutions used in selected European countries is presented. Then, for each standardised solution, its compliance with both European and national legislation is examined. This compliance is compared between the countries examined, and selected solutions are recommended for further investigation of their characteristics.

Keywords

Railway platform, Passenger movement, Platform access, Pedestrian level crossing, Technical Specifications for Interoperability

1 INTRODUCTION

Increasing interest in comfortable, safe and accessible passenger rail transport has motivated designers to find innovative solutions in platform design for several decades. Different national legislative frameworks have led to significantly different approaches to platform design concepts across European countries. It was not until the publication of the Technical Specifications for Interoperability (referred to as TSI) in 2014 that the basic legislative framework for the design and operation of railway lines across European countries was established. Naturally, the new rules also apply to station platforms and their access routes.

Since then, individual EU Member States have been working to adapt their rail infrastructure to comply with the new overarching legislation and enable the creation of a single European railway area. For stations and platform configurations, the pressure for harmonisation of conditions is not so significant, as vehicle movement is not restricted if the structure gauge is respected. For this reason, significant differences in national rules on this issue remain and, although the impact on functionality is not substantial, these differences can have a major impact on the usability of certain technical solutions and the overall approach to railway modernisation.

The differences between national rules are already visible in the overall concept of station layout. This is particularly evident on lines and in stations of regional importance, where the pressure to implement interoperability is not as strong. While in some European countries it is possible to provide access to platforms at track level, in others this is not permitted. Similarly, there are significant differences in the speed at which some design features can still be used. At a greater level of technical detail, the differences are even more pronounced: there is no uniform standard for platform and access widths, permitted ramp gradients differ, and the conditions for granting exemptions vary from country to country. For these reasons, a situation arises in which what is common practice in one European country is legally impossible in another.

This paper will assess the consistency between the TSI and national legislation on station configurations and platform parameters in Germany, the Czech Republic, Poland, Slovakia, and Hungary. Furthermore, the compliance of three selected stations with the TSI and their own national legislation, as well as with the legislation of other countries, will be examined. Finally, the national rules will be evaluated for their compatibility with other countries and, if necessary, modifications will be proposed.

2 LEGISLATION BACKGROUND

At the European level, the key documents are the Technical Specifications for Interoperability (TSI), supplemented by the corresponding EN standards. This is a set of documents enforced through a regulation of the European

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Parliament and the Council, which makes them mandatory for EU member states. They are divided into subsystems, of which the most relevant for station, platform, and access-related issues are TSI INF (Infrastructure) and TSI PRM (Persons with Disabilities and Persons with Reduced Mobility). In addition to the regulations themselves, which govern aspects such as the period of validity or the method of implementation, these documents contain annexes with technical specifications. TSI INF defines the basic technical characteristics of platforms, e.g. their length, height above the top of the rail, geometric parameters of the adjacent track, and the distance between the track centreline and the platform edge [1]. TSI PRM focuses on the general movement of people – the key data for this issue include the minimum platform width, the permitted dimensions of obstacles and passages around them, the minimum width of track crossings, ramps, and other parameters [2].

In Germany, the issue is regulated by the "Richtlinie 813" group of directives. These form part of the regulations issued by the DB AG Group, with the responsible authority being the infrastructure manager DB InfraGO AG. It is divided into several modules; the data concerning platforms and their access are contained in module 81302 Bahnsteige und ihre Zugänge (Platforms and Their Accesses) [3].

The Czech Republic and Slovakia have a similar legislative approach. The design of railway stations is regulated by the standards ČSN 73 6310 – Navrhování železničních stanic (currently barely used, replaced by other documents) and STN 73 6310 Navrhovanie železničných staníc (both translated as Design of Railway Stations). Due to their common history, both regulations even have the same numerical designation. In the Czech Republic, platform design is regulated by the standard ČSN 73 4959 - Nástupiště a nástupištní přístřešky na drahách celostátních, regionálních a vlečkách (Platforms and Platform Shelters on National, Regional and Sidings Railways) [4]. This document is currently being updated. In Slovakia, a very similar regulation applies: STN 73 6359 – Nástupištia na železničných dráhach (Platforms on Railways). All these documents are issued by the relevant national Institute of Technical Standardisation [5].

Polish legislation consists of three groups. The first is Directive 987: Rozporządzenie ministra transportu i gospodarki morskiej z dnia 10 września 1998 r. w sprawie warunków technicznych, jakim powinny odpowiadać budowle kolejowe i ich usytuowanie (Regulation of the Minister of Transport and Maritime Economy of 10 September 1998 on Technical Conditions for Railway Structures and Their Location). This document has been amended in 2014, 2018, and 2024. The second group comprises the technical standards of the infrastructure manager PKP PLK S.A. The final group consists of internal regulations of PKP PLK S.A.: Warunki techniczne (Technical Conditions) [5].

In Hungary, the main document regulating this area is Regulation 103/2003 (XII.27.) GKM rendelet a hagyományos vasúti rendszerek kölcsönös átjárhatóságáról (Regulation of the Minister of Economy and Transport on the Mutual Interoperability of Conventional Railway Systems), particularly Annex 4: Országos vasúti szabályzat, I. Kötet, Országos közforgalmú és saját használatú vasutak (National Railway Regulations, Volume I, Public National and Private Railways). This document is further supplemented by the publication Országos Közforgalmú Vasutak Pályatervezési Szabályzata (Design Rules for National Public Railways), published by the Budapest University of Technology and Economics [5].

3 EXAMINED PARAMETERS

Along with the diversity of legislative solutions, the form of regulations also varies considerably at the national level. The technical parameters that affect the design of a railway station are stated in a different way in each national regulation, have different boundary conditions for their use, and their values are related to different reference levels, and so on. For this reason, it has not always been possible to compare some data, while others are only provided for certain countries. Tab. 1 gives an overview of the monitored parameters and their values depending on the specific legislation.

Additional explanation to Tab. 1: Data in brackets indicate values that are applicable only in case of limiting spatial conditions or require special approval. If a slash is used, this means the values can be used in specific cases, for example, if the value depends on the speed in the adjacent track or its character. Values in bold do not exactly correspond to TSI requirements. “V” represents the highest possible speed trains can pass through the described point.

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Tab. 1 Overview of monitored platform design parameters in countries selected [1], [2], [3], [5].

Parameter	TSI	DE	CZ	SK	PL	HU
Minimal radius of the track adjacent to platform in m	300	300	500 (300/ **190**)	600 (300)	300	300
Minimal track spacing in stations in m	-	4.50	4.75	5.00	4.50	4.75
Width of danger area (160 km/h or less) in mm	-	850	800	800/ 1000	775/ 1275	750/ 1000
Standardised platform height in mm	760/550/less for curves with small radius	760/550 (380)	550 (380)	550 (300)	760/ 550 (300)	500–600 (300)
Platform edge – track centre distance in mm	depending on structure gauge	1650–1680 (for 550 mm)	1670–1680	1725–1750	1640–1690	1725–1750
Platform lateral slope in %	-	ca. 2.0	0.5–2.0	1.0–2.0	2.0	1.0–3.0
Maximal longitudinal slope of track adjacent to platform in ‰	2.5	2.5	1.0	1.0 (2.5)	0.5 (2.5)	1.5 (2.5)
Minimal width of side platform/one-side level-access island platform in m	-	2.75 (2.45)	3.00 (2.50)	3.00	2.50	3.30
Minimal width of level-access island platform in m	-	3.30	4.30	-	3.30	-
Minimal width of narrowed end of a platform in m	-	2.80	3.20	3.50	3.30	3.55
Minimal width of island platform accessible via overpass/underpass in m	-	6.10	6.10	6.70/ 6.55 (6.05)	3.30	5.55
Access via level crossing possible	Yes	Yes, for $V \leq 160$ km/h	Yes, tracks with $V \leq 50$ km/h	No	Light traffic only	Yes, for $V \leq 120$ km/h
Minimal one-way path width in mm	800	800/**600**	800	**600**	800	800
Minimal danger zone – obstacle distance in mm	1200/800	1200/900	1600/ 1200	1200/ **1000**	**800**	**1000**
Minimal staircase width in mm	1600	2400 (1800)	1600	2250	2400	2250
Maximal ramp longitudinal slope in %	moderate, steep for short distances	6.00	8.33 (12.50)	8.33 (12.50)	6.00	5.00 (8.00)
Minimal ramp width in mm	1600 (1200)	2400	**1300**	**1300**	**1100**	**1200**

At first sight, there is virtually no absolute agreement between the parameters observed across countries. Some parameters, such as the minimum radius of the track adjacent to the platform, agree on a single value of 300 m, but in the Czech Republic and Slovakia this value is an exception, and the standardised value is stricter. Similarly, all countries use a platform height of 550 mm above the top of the rail. In Poland and Germany, this value applies only to predominantly regional and suburban traffic; the standardised height level is 760 mm above the top of the rail, which corresponds to the TSI. Hungary is the only country where platform height is defined by a range. All countries allow for lower platforms, but only under constrained spatial conditions, and the height of such platforms is also not uniform.

The key parameter for interoperability is the distance between the platform edge and the centre of the track. In this case, the TSIs specify a tolerance for the distance from the structure gauge, so the distance can vary by more than 100 mm in national regulations due to variations (values for platforms with 550 mm height were examined).

Parameters not regulated by the TSIs, e.g. track spacing in stations, danger zone widths, or required platform widths, vary significantly across countries. For the safety belt width, all countries define multiple values depending on the speed of passing trains. For the Czech Republic and Germany, this is not evident in the table, as the increased values apply only for speeds above 160 km/h, which were not considered due to the character of the stations examined.

A special case is access to the platform at track level via a pedestrian crossing. Depending on the country, such a solution may be considered a standard level crossing or have special rules. TSIs allow this without additional conditions. Slovak regulations prohibit this solution completely. The remaining countries allow it under marginal conditions. In Germany, crossings can be designed for speeds up to 160 km/h; in the Czech Republic, this is only allowed on single-track lines with a maximum speed of 50 km/h (or 80 km/h if a warning device is used),); Hungarian regulations set this limit at 120 km/h. In Poland, crossings are permitted only at stations with light traffic, and if the speed exceeds 15 km/h, an audible warning device and a physical barrier must be installed.

The parameters relating to pedestrian movement are relatively consistent across countries, with the most common value for a single-person corridor width being 800 mm (Slovakia being the only exception), which corresponds to the standardised dimension [6]. Other parameters differ more but are not essential for the final functionality of the solution and only affect user comfort.

4 LEGISLATION COMPLIANCE DURING MODERNISATION

This section presents a comparison of the technical parameters described above with the implementation of railway stations that were recently modernised. The functional characteristics and practical experience with these solutions will be further examined by the author.

The tables (Tab. 2, Tab. 3, Tab. 4) show the consistency between the solution used in the examined stations and the legislation at both TSI and national level. If an "!" is used, it means that an exceptional value is used, but this is not considered as non-compliant. The symbol "**!!**" indicates an apparent non-compliance with the value set by the legislation. This is not necessarily a violation of the regulations; for example, the solution may be treated with an exception, or it may be a historical solution that has not yet been modified to comply with current legislation. Nevertheless, the author calls for such inconsistencies to be evaluated and considered for modification.

Piliscsaba (Hungary)

The Piliscsaba station is located on the Budapest - Esztergom line in Hungary. The trains run at a maximum speed of 60 km/h and the traffic is of a suburban character. Modernisation took place in 2013; since then, the station has one double-sided island and one side platform with level crossing access. The station scheme can be seen on Fig. 1.

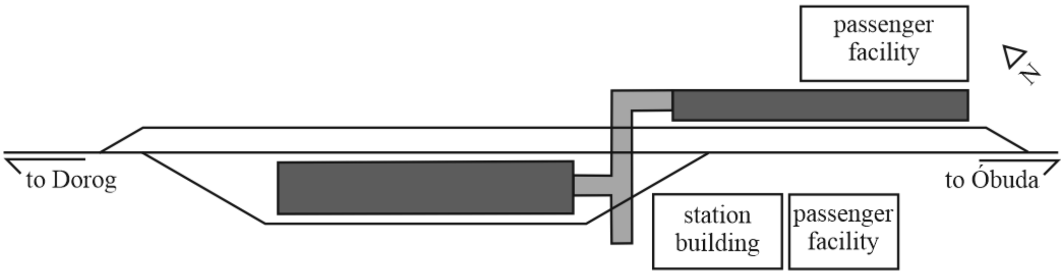

Fig. 1 Piliscsaba station scheme.

Tab. 2 Compliance of the Piliscsaba station design with legislation.

Parameter	Station	TSI	DE	CZ	SK	PL	HU
Minimal radius of the track adjacent to platform in m	300			!	!		
Track spacing in m	4.75				!!		
Width of danger area in mm	775		!!				
Platform height in mm	550						
Width of side platform in m	3.3						
Width of level-access island platform in m	6.75						
Width of narrowed end of a platform in m	4.75						
Access via level crossing	Yes			!!	!!	!!	
Minimal danger zone – obstacle distance in mm	1800						
Maximal ramp longitudinal slope [%]	3						
Minimal ramp width in mm	3000						

The most significant inconsistency with other countries' legislation is the level crossing approach. Given the speed of 60 km/h and the absence of warning devices, such a solution would not be permitted in the Czech Republic and Poland. Slovak national rules completely exclude such a solution. Furthermore, there are inadequate values of the width of the danger area in relation to German legislation and track spacing in relation to Slovak legislation.

Raspenava (Czech Republic)

This station is located on the Liberec – Zawidów line in the Czech Republic, modernised in 2016–2017. It is also a branch station for the line Raspenava – Bílý Potok pod Smrkem. Traffic is mostly regional, with trains coupling and decoupling at this station, as some of them continue to the branch line. There is one side platform and two single-sided island platforms accessible by a pedestrian crossing. The station scheme can be seen in Fig. 2.

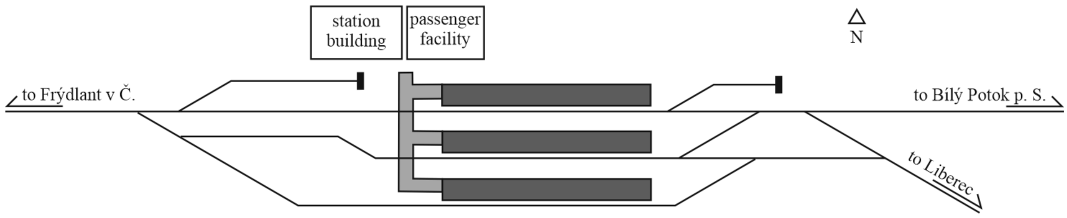

Fig. 2 Raspenava station scheme.

Tab. 3 Compliance of the Raspenava station design with legislation.

Parameter	Station	TSI	DE	CZ	SK	PL	HU
Minimal radius of the track adjacent to platform in m	straight track						
Track spacing in m	4.75				!!		
Width of danger area in mm	800		!!				
Platform height in mm	550						
Width of side platform/one-side level-access island platform in m	3.3						
Access via level crossing	Yes				!!	!!	
Minimal danger zone – obstacle dist. in mm	1000			!!			
Maximal ramp longitudinal slope in %	8		!!			!!	!
Minimal ramp width in mm	2000		!!				

The station has a mismatch in track spacing with Slovak and in danger zone width with German legislation. Also, according to Slovak regulations, it would not be possible to set up a pedestrian crossing at all. According to Polish regulations, a warning device would have to be added.

There is also non-compliance with domestic regulations – gravel bins are placed on the platforms, which do not leave sufficient clearance for pedestrians. Here the Czech legislation is the strictest; in all the other countries concerned, this implementation would be satisfactory.

The ramp between the crossing and the platform also does not comply with the German and Polish legislation in terms of its slope and, in relation to German legislation, also in terms of its width.

Szklarska Poręba Górna (Poland)

This station is located in southern Poland on the line from Jelenia Góra to the Czech border. It has mixed passenger traffic, with long-distance trains from central Poland, suburban trains from Jelenia Góra, and regional trains to the Czech Republic. All trains start or end here. As a result, the station has a rather complex layout, with one bay platform, one side platform, and one single-sided island platform accessible by a pedestrian crossing with a warning device. The maximum allowed train speed at the station is 50 km/h. Reconstruction was carried out in two phases, in 2013 and 2016. The station scheme can be seen in Fig. 3.

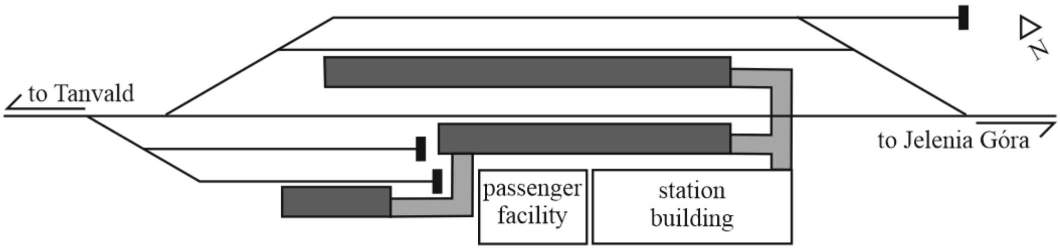

Fig. 3 Szklarska Poręba Górna station scheme.

Tab. 4 Compliance of the Szklarska Poręba Górna station design with legislation.

Parameter	Station	TSI	DE	CZ	SK	PL	HU
Minimal radius of the track adjacent to platform in m	190	!!	!!	!	!!	!!	!!
Track spacing in m	4.5			!!	!!		!!
Width of danger area in mm	750/1000		!!	!!	!!		!!
Platform height in mm	550						
Width of side platform/one-side level-access island platform in m	4.5/3.0/2.5		!	!	!!		!!
Access via level crossing	Yes				!!		
Minimal danger zone – obstacle distance in mm	800		!!	!!	!!		!!
Maximal ramp longitudinal slope in %	6						!
Minimal ramp width in mm	1600		!!				

Since this station is in mountainous terrain with very limited space, the minimum values possible according to the national regulations are often used here, which are quite lenient. As a result, this station has many inconsistencies with the legislation of other countries, especially Slovakia and Hungary.

The single-sided island platform is adjacent to a turnout with a curve radius of 190 m, which is not only contrary to TSI but also to all national regulations except the Czech ones (where this value is allowed only as an exception). The author assumes that passenger boarding does not take place regularly at this location, as it is located close to the end of the platform, and it is used for stabling locomotives. As an additional measure, the platform is separated from the track at the point of the switch to avoid collisions between vehicles and the platform. The author does not know the historical context of this solution but assumes that it is an exception granted due to space limitations.

5 DISCUSSION

The following Tab. 5 shows the number of non-compliances with national and European legislation that were found in the examined examples of railway stations.

Tab. 5 Numbers of non-consistent values in the given examples.

Parameter	TSI	DE	CZ	SK	PL	HU
Minimal radius of the track adjacent to platform	1	1		1	1	1
Minimal track spacing in stations			1	3		1
Width of danger area (for 160 km/h or less)		3	1	1		1
Standardised platform height						
Width of side platform / one-side level-access island platform				1		1
Minimal width of level-access island platform						
Minimal width of narrowed end of a platform						
Access via level crossing			1	3	2	
Minimal danger zone – obstacle distance		1	2	1		1
Maximal ramp longitudinal slope		1			1	
Minimal ramp width		2				
TOTAL	***1***	***8***	***5***	***10***	***4***	***5***

From the total number of inconsistencies, we can clearly see that Slovak legislation is the most stringent by European standards. In general, strict requirements are imposed on the dimensions of the components, and the inability to implement platforms with pedestrian access also contributes significantly to the result.

German legislation is also relatively strict, but here most of the inconsistencies concern pedestrian access routes. In terms of track design, the differences are minimal.

Czech and Hungarian legislation show the same number of non-conformities; they also agree on several parameters. In general, these approaches can be considered as a compromise, which is also reflected in their values.

Polish legislation is the most neutral in terms of the values set but has relatively strict conditions for establishing pedestrian crossings of tracks.

The TSI standards are the most benign. These do not specify some values at all or present them in a rather general way. They also contain several exceptions that can be applied during design.

6 CONCLUSION

As is clear from these examples, the differences between the national regulations differ not only in their administrative treatment but also in the values they provide. There is a considerable difference in their benevolence, which in practice has a significant impact on the financial and time requirements for investment in railway infrastructure.

As far as compliance between national rules and TSIs is concerned, there is relatively little difference. This is helped by the relative benevolence of TSIs and the fact that some parameters are not regulated by TSIs at all. The author considers this approach to be correct and believes that in the future we can expect a reduction in requirements at the national level rather than a tightening of European legislation. In case of a TSI standards revision, national experience must be considered. The exchange of experience between infrastructure managers could also help to minimise inconsistencies. On the other hand, in certain circumstances, it is possible to allow Member States partial variability in the standards they develop.

The relative benevolence of TSI standards must be used in a reasonable way, and when designing railway stations, it is necessary not only to pay attention to the minimum requirements of the legislation, but also to meet the requirements of passengers in the best possible way while maintaining safety. Finding an optimum between these contradictory requirements is the subject of the author's next work.

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