SPRÁVA ŽELEZNIC

Manuál pro projektování VRT ve stupni DÚR

High-Speed Railways Design Guide for the Planning Permit Level

31st July 2020

Confidential document

Full wording of Appendix A to Guideline SŽ PO-16/2020-GŘ

Contents

Sources of images and schemes:

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List of abbreviations

AC	Alternating Current
AoE	Automatic Train Operation over ETCS
ASHS	Autonomous Automatic Extinguishing System
ATAF	Automatic Track Ahead Free
ATO	Automatic Train Operation
ATS	Automatic Transfer Switch
B+R	system, space or area for safe bike storage at a public transportation terminal Bike and Ride
BTS	Base Transceiver Station
CCS	Control Command and Signalling
CK MD	Central Commission of the Czech Ministry of Transport
CTD	Telematics and Diagnostics Unit of Správa železnic, státní organizace (since April 1, 2020) Technical Command Centre of Správa železnic, State Organisation (TÚDC; until March 31, 2020)
ČD	České dráhy, akciová společnost Czech Railways, joint stock company
ČSN	Czech Technical Standard
DC	Direct Current
DDTS	Remote Diagnostics of Railway Systems and Equipment
DOZ	Signalling Equipment Remote Control
DŘT	Dispatching Control System
DSP	Building Permit Design
DÚR	Planning Permit Design (Zoning Permit Design)
DWDM	Dense Wavelength-Division Multiplexing
ED	Power Supply Dispatching
EIA	Environmental Impact Assessment
EIRENE	international standard for GSM-R European Integrated Railway Radio Enhanced Network
EN	European Norm
ENE	Energy supply/power supply
EOV	Electric Turnout Heating
EPS	Fire Alarm System
ERA	European Union Agency for Railways
ERTMS	European Rail Traffic Management System
ERÚ	Energy Regulatory Office
ETCS	European Train Control System
EU	European Union
FRMCS	Future Railway Mobile Communication System

FS	Full Supervision (ETCS mode)
GPK	Track Geometry
GSM-R	Global System for Mobile Communications – Railway
GŘ	Generální ředitelství Správy železnic, státní organizace Directorate General of Railway Administration, state organisation
GVD	Train Traffic Diagram
HDPE	High density polyethylene
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
INF	Infrastructure
IZS	Integrated Rescue System
K+R	Place for stopping and dropping or taking on travellers by a public transportation terminal Kiss and Ride
KDZ	Expansion and Shrinking Device
LGV	Ligne à Grande Vitesse
LOC&PAS	Locomotives and Passenger Rolling Stock
MD ČR	Ministry of Transport of the Czech Republic
MPLS	Multiprotocol Label Switching
MN	Small Voltage
NN	Low Voltage
OS	On-Sight (ETCS mode)
P+R	long-term parking for passenger cars by a public transportation terminal Park and Ride
PHS	Noise Protection Wall
PJD	Ballastless Track
PK	Road
PNE	Corporate Electric Power Standard
PVRT	Samostatné oddělení přípravy vysokorychlostních tratí Správy železnic High-Speed Railways Planning Unit of Správa železnic
RAMS	Reliability, Availability, Maintainability, Safety
RBC	Radio Block Centre
RV	Reversing (ETCS mode)
SFDI	Státní fond dopravní infrastruktury State Transport Infrastructure Fund
SH	Shunting (ETCS mode)
SIF	Schema des installations ferroviaires
SNCF	Société Nationale des Chemins de fer Français
SpS	Sectioning Point
SR	Staff Responsible (ETCS mode)

SŽDC	Správa železniční dopravní cesty, státní organizace (until 31st December 2019) Správa železnic, státní organizace (since 1st January 2020)
SZZ	Station Signalling System
TEN-T	Trans-European Transport Network pursuant to Regulation of the European Parliament and Council Regulation (EU) No. 1315/2013 on Union guidelines for the development of trans-European transport network
TGV	Train à Grande Vitesse
TK	Top of the Rail Head
TNS	Contact Substation
TNŽ	Technical Norm for Railways
TS	Transformer Station
TSI	Technical Specifications for Interoperability
TCI	Technical Command Centre of Správa železnic, State Organisation (until March 31, 2020) Telematics and Diagnostics Unit of Správa železnic, státní organizace (CTD; since April 1, 2020)
TV	Contact Lines
TZZ	Track Safety System
UIC	International Union of Railways Union Internationale des Chemins de fer
UN	Unfitted (ETCS mode)
UPS	Uninterruptible Power Supply/Source
ÚP	Zoning Plan
ÚTS	Due Diligence Study
VPVRK	Free Space of High-Speed Track
VR	High-Speed
VRT	High-Speed Rail Line
VN	High Voltage
VVN	Extra High Voltage
ZPDP	Train Detection Systems
ŽST	Railway Station
ZÚR	Regional Zoning Plan
ZVN	Extremely High Voltage
ZZEE	Power Back-Up Unit

1 Introduction

Based on **Regulation (EU) No. 1315/2013 of the European Parliament and of the Council on Union guidelines for the development of the trans-European transport network,** the Czech Republic committed to support the development of railway infrastructure by building new rail lines in the main directions of the TEN-T trans-European network corridors.

In 2017 **the Czech government issued decree No. 389 on the fast connections development scheme in the Czech Republic** for the construction of new high-speed rail lines, modernisation of significant existing lines, procurement of corresponding rolling stock and creation of a new operating concept, particularly for long-distance passenger railway transport.

SŽ, as the railway infrastructure manager, was authorised – based on the documents mentioned above – with the construction of new high-speed rail lines. One of the steps in this task is to adopt the regulations and standards for the design, construction and operation of railways with speeds over 200 km/h. This adaptation is however a long process, so this document shall bridge the transition period, defining the technical and operating requirements for high-speed rail lines in the Fast railway connections system and allowing continuous preparations of different projects on the level of Due Diligence, Feasibility Study and the Planning Permit.

This Guide for the design of high-speed rail lines for the planning permit level (hereafter only the "Guide") is the result of cooperation between SŽ and SNCF International that started in April 2019 and lasted until March 2020 based on the Services Agreement (and an amendment thereto) signed by the top management of these two organisations. As part of this cooperation, SŽ made work trips, organised numerous workshops, held continuous consultations and accessed documents of this most experienced high-speed infrastructure manager in Europe, to obtain high-speed railways know-how. Their concept (the TGV connections and LGV lines) is very close to that of the Fast connections and/or high-speed network in the Czech Republic.

This Guide was then written by SŽ experts who adopted the proven French solutions to the conditions of the Czech railways and the local legal environment.

SNCF International and any other part of the SNCF group are not responsible for any further use, implementation or development based on the Guide.

The aim of this Guide is to introduce the comprehensive requirements of the investor (i.e. SŽ) to planning permit design contractors for HS pilot sections in the Czech Republic. These requirements involve the design, scope and principles of different solutions to HS systems and sub-systems based on proven French solutions arising from more than 40 years of experience of SNCF with and shall be applied in the Czech environment. This Guide shall therefore allow civil engineers and designers prepare the planning permit design in accordance with the requirements of act No. 183/2006 Coll. on zoning and the building code (the Building Act), as amended, its implementing decrees and other regulations that are binding on the national and European level (particularly TSI) and give them the chance of designing a system that will be optimised in terms of design, economical execution, operating costs and maintenance options and that will be environmentally friendly and negotiable with the state administration, self-governments and the public.

The concept and scope of this Guide correspond with the requirements of Appendix No. 3 "Planning permit design scope and contents" to decree. No. 499/2006 Coll. on civil design documentation, as amended.

Given the importance and the European reach of the project, this document is also available in the English language with the title High-Speed Railways Design Guide for the Planning Permit

Level and can be used by foreign designers expected to participate in public tenders for the contractor for the planning permit design.

1.1 Sources and inputs for this Guide

This Guide was prepared by the High-Speed Railways Planning Unit (PVRT) of the Track Modernisation Unit of SŽ General Direction, which is the author of this regulation, and is based on these inputs:

- **Cooperation between Správa železnic (SŽ) and SNCF** from April 2019 until March 2020 based on the Services Agreement (including the appendix thereto) made between SŽ and SNCF International, the aim of which was to create this Guide based on excursions, lectures, expert workshops (see below), inputs and consultations with experts from SNCF that has been developing, preparing, designing, operating, maintaining and servicing its own high-speed railways system for more than 40 years.
  All rights granted by SNCF under this cooperation are expressly intended for use by Správa železnic for the preparation, implementation and promotion of high-speed rail lines in the Czech Republic.
- **Référentiel Infrastructure – Référentiel Technique pour la réalisation des LGV** (and related regulations), which is an internal technical manual in the exclusive ownership of SNCF containing the basic concept, requirements and civil and technical solutions of the French HS system.
- **Requirements and remarks of SŽ expert units** – mostly of the strategy unit, different track operability units of the general direction and technical railways maintenance.
- **Technical Operations Studies – Technical HS solutions** prepared between 2015 and 2017 and approved by the Central Commission of the Ministry of Transport in Oct. 2017.

1.1.1 Expert workshops of SŽ and SNCF

Below you can find the time line and a brief outline of expert workshops that took place between May 2019 and January 2020 mostly in Prague. The inputs for and outputs of these events are available (mostly in the French language).

- Study trip (13th to 24th May 2019; France)
  - Making the widest possible circle of stakeholders in SŽ familiar with how to operate HS railways in everyday practice (lectures, excursions).
- The Czech railway and legal environment (4th June 2019; France)
  - Making SNCF experts familiar with the Czech economic, railway and legal environment, with the current state of works on the preparation of the different HS routes and with the required detail level of this Guide.
- Bridges (25th June 2019; Prague)
- Alignment (26th and 27th June 2019; Prague)
- Railway sub-structure (11th July 2019; Prague)
- HS lines and the surroundings – SIF railway systems scheme (17th July 2019; Prague)
- Tunnels (18th July 2019; Prague)
- Railway super-structure (30th and 31st July 2019; Prague)
- Contact and power supply (23rd Aug. 2019; Prague)
- Maintenance (27th to 29th Aug. 2019; France)
  - A workshop in France focused on the provision of operability and maintenance technology, held directly in SNCF maintenance sites and on sites where major work is under way on HS rail lines (done always during a regular night closure).
  - A link between the design of a new rail line designed for 100 years and its effective maintenance is considered to be the core issue in France.
- Communication systems (3rd Sep. 2019; Prague)
- Safety systems (4th Sep. 2019; Prague)
- HS lines preparation and construction management + rolling stock interoperability (5th Sep. 2019; Prague)
- HS lines and the surroundings – noise, the environment, parallel placement with roads, etc. (10th Sep. 2019; Prague)
- Project management of HS liness projects in SNCF (16th Jan. 2020; Prague)
- Public consultations in France (17th Jan. 2020; Prague)

1.2 Requirements for high-speed railways

1.2.1 General requirements

Certain restrictions to the HS railways system are laid down in related regulations (national or international), which brings corresponding design and sizing of certain civil structures that are dependent on them.

Other restrictions arising from the experience with the design, construction and operation of HS lines however often lead to more specific requirements regarding civil and technical solutions that are not defined in any regulations yet. Such specific requirements for the design of high-speed rail lines are described in more detail in this Guide and are mostly based on the experience of SNCF experts and their units SNCF Réseau and SNCF Voyageurs (SNCF Mobilités until 31st December 2019).

These initial requirements include:

- contact between train wheels and rails must be preserved under all circumstances;
- the route shall be designed as a comfortable route due to static and dynamic load on the structure and for high convenience of passengers;
- operation on the HS rail line must meet the highest reliability, quality and safety requirements and distances between trains must be correctly defined, so that required precision of the timetable can be reached.

1.2.2 Operating requirements

The HS rail line must meet very strict Reliability, Availability, Maintainability and Safety (RAMS) requirements.

Combination of the high travel speeds, the stopping distance of the train and the vertical curvature of the track do not give the driver the possibility to stop the train within the visibility range. On top of this, the train speed must be independent of weather (fog, snowfall, etc.). For these reasons, the signal system used on the conventional network cannot be used and rail lines and trains operated at speeds over 160 km/h must be equipped with the **ETCS Level 2 safety system** (according to the TSI requirements).

The driver cannot generally stop his/her train if an obstacle, reaching into the driving profile (falling rock or boulder, land slide, random object, vehicle, etc.), appears or if there is a defect on the railway super-structure (rail misalignment, rail fracture, etc.). These restrictions commit the designer to take all known risks that may affect the operating safety into account and take all necessary measures against such risks. These measures primarily involve the use of the ETCS Level 2 safety system, use of wind speed and snow sensors, or retaining systems against the fall of a vehicle onto the track. Given the nature of operation on HS rail lines, train stopping or a major speed reduction are only possible in very exceptional situations. These cases seriously compromise reliability in the HS timetable.

Regular and accurate connections on HS rail lines are extremely important for passengers. Any delay in HS operation has an immediate impact on connecting means of transport, on the turning of trains and causes major delays of connecting trains, with serious consequences particularly during the morning and afternoon peaks. This also translates into financial compensation claims from passengers and train operators.

Small operating reserves in travel times of trains, particularly during peaks, do not allow almost any operation disruptions. When calculating the travel time, penalties for trains slowing down on very short sections (due to maintenance) must be added. The speeds in such sections still remain relatively high (230 km/h, 160 km/h or 100 km/h).

Availability and reliability of the reference speed on HS lines is the essential prerequisite for ensuring regular connections. Given the high attractiveness of HS trains and with work restrictions in the immediate vicinity of the tracks, maintenance work on HS lines are

performed at night during a night closure. Minor day closures (closing of a part of the track) are intended for the most urgent repairs and inspections only. All this leads to measures addressing the possibility of staff movement in the HSL area, the frequency and the location of differently sized approaches to the tracks and defining the amount, and thus the noise, of the night maintenance required.

Regular connections on HS lines must be ensured under all circumstances, mostly in terms of the climate and weather (frost, very wet or very dry periods, rain, snowfall, wind, etc.), Restrictions (lower speed, detour) may be adopted only in very short periods of time if an exceptional phenomenon arises (very strong wind, heavy snowfall, earthquake, etc.).

1.2.3 Quality of civil works

All civil structures must be made in high quality to ensure safe operations, regular connections and high convenience for passengers on HS rail lines. As track maintenance and repairs can only be done at night during the night break, any long-term intervention into the HS track is very challenging and costly. Therefore, the following principles must be followed:

- technical solutions enabling diagnostics, inspection and maintenance work without the need for operation restrictions on the HS rail line;
- **reliability and durability of all civil structures during their whole service life of 100 years**, i.e. the structures must be in operation for this period of time without any expected changes to safety coefficients and without any interventions except for routine maintenance (rails replacement, slope maintenance, drainage maintenance, coatings on metal structures, possible replacement of bridge bearings, etc.).

1.3 Objectives

This Guide shall optimise and technical and financial solution in all relevant areas. It defines the requirements for the design of HS civil structures, reflects the restrictions of the HS railway system for every type of civil structure and brings details about:

- the criteria to be fulfilled;
- the sizing principles meeting the above-mentioned general and operation requirements;
- typical and/or recommended solutions;
- exceptional solutions;
- forbidden solutions;
- special requirements connected with civil design and construction.

1.4 Area of application

The requirements of this Guide apply on the territory of the Czech Republic for HS rail lines designated only for passenger trains with maximum loading 22.5 tonnes per axle (for speeds 200 < V ≤ 230 km/h) and 18.0 tonnes per axle (for speeds V > 230 km/h).

All vehicles operated on the HS rail lines must be meet the TSI requirements.

Design speeds of less than and including 200 km/h (e.g. connecting rail lines) are speeds for conventional lines designed according to current applicable ČSN standards and SŽ regulations.

1.5 Exemptions from recommended values and solutions

The application of values that are exceptionally allowed in the Guide and the application of exemptions from the solutions described herein must be approved by the investor, i.e. SŽ and the author of this regulation, the High-Speed Railways Planning Unit (PVRT) of the Track Modernisation Unit of SŽ General Direction in cooperation with the respective departments of the track operability unit of the General Direction and/or operations control unit of the General Direction.

However, the principle is to limit their use to the lowest possible level.

1.6 Design values

The proposed values stated in this document comply with the EU interoperability directive and TSI. Specific values, which may be more stringent than those given in the TSI, are contained in the individual chapters of the Manual.

The intervals and values stated below are used in this Guide depending on the importance of the different parameters (particularly in chapter 2 Alignment). Different areas, intervals and levels can be merged or not used on a case-to-case basis. If no limit value is used for a parameter, then a value identical with the maximum or minimum value is intended.

1.6.1 Recommended values

These values represent a value range which the designer must comply with unless local or other restrictions prevent the designer from this. The application of recommended values guarantees a comfortable ride and adequate costs of track maintenance.

1.6.1.1 Limit value

This value defines the range of recommended design values from the top or from the bottom. If limit values are exceeded, the high travel convenience for passengers is compromised and line maintenance costs rise. Therefore, this value should not be exceeded.

1.6.2 Exceptional values

These values represent a value range that is very rare and must be limited only to specific, limited places where the relevant solution does not allow such values.

1.6.2.1 Maximum and minimum value

This value defines from the top of from the bottom the range of exceptional design values, lying outside the range of recommended values. This value must not be exceeded.

1.6.2.2 Application of exceptional values and solutions

The application of exceptional values that may compromise travel convenience or maintenance conditions must be justified with serious reasons (not systematic issues). As a result, the following general restriction applies: an exceptional value regarding the horizontal or vertical proposal is permitted every 20 km provided these exceptional proposals do not overlap and the distance between such places where these values were used is at least 300 m.

The use of exceptional values and solutions is governed by **chapter 1.5 Exemptions from recommended values and solutions**. The possibility of keeping the solution open for changes in the more detailed design phases, particularly on the Building Permit Design level, is an essential pre-condition of the use of exceptional values and solutions.