

	<p style="text-align: center;"> TECHNICAL STANDARDS DETAILED TECHNICAL CONDITIONS FOR THE CONSTRUCTION OF THE RAILWAY INFRASTRUCTURE OF THE SOLIDARITY TRANSPORT HUB – DESIGN GUIDELINES </p>	<p style="text-align: center;"> CENTRALNY PORT KOMUNIKACYJNY – SOLIDARITY TRANSPORT HUB POLAND </p>
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TECHNICAL STANDARDS
DETAILED TECHNICAL CONDITIONS FOR THE
CONSTRUCTION OF THE RAILWAY INFRASTRUCTURE
OF THE SOLIDARITY TRANSPORT HUB – DESIGN
GUIDELINES

VOLUME XII
RAILWAY LINE GUARD

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The list of volumes constituting the detailed technical conditions for the construction of the railway infrastructure of the Solidarity Transport Hub:

Volume A	Introduction to the STH railway standards
Volume I.1	Railway track – layout geometry
Volume I.2	Railway – design of civil structures
Volume I.3	Railway track – drainage of track layout
Volume I.4	Railway track – gauge
Volume I.5	Railway track – geotechnical investigations and design
Volume II.1	2 x 25 kV 50 Hz AC overhead catenary system and traction power supply
Volume II.2	3 kV DC overhead catenary system and traction power supply
Volume III.1	Engineering structures
Volume III.2	Tunnels
Volume IV	Non-OCL power engineering
Volume V.1	Non-public roads
Volume V.2	Public roads
Volume VI.1	Control command and signalling – basic equipment
Volume VI.2	Control command and signalling – European Train Control System (ETCS)
Volume VII.1	Fixed and wireless communication systems and data transmission
Volume VII.2	Telecommunication systems and telematics
Volume VII.3	Detection of rolling stock failure conditions (DSAT)
Volume VIII.1	Station and railway station buildings
Volume VIII.2	Technical buildings
Volume VIII.3	Structures
Volume VIII.4	Structural landscaping
Volume IX	Measures to minimise environmental impact
Volume X	Conflicts with external networks
Volume XI	Electromagnetic compatibility (EMC)
Volume XII	Railway line guard
	Describes the protective measures intended to ensure safety of passage, in particular, to prevent inadvertent entry by outsiders, animals and vehicles into the railway infrastructure area. It also includes snow curtains, noise barriers as well as fire protections.
Volume XIII	Technical support facilities
Volume XIV	Health and safety support systems for people and property
Volume XV	Survey control
Volume XVI	Railway rolling stock
Volume XVII	Automatic baggage check-in systems
Volume XVIII	Security, protection and cybersecurity integrity requirements

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Table of contents

1	Introduction.....	9
1.1	Technical scope.....	9
1.2	Relation to the complete study	9
1.3	Links to other volumes.....	9
1.4	Definitions of terms used	10
2	Essential, basic and general requirements for the STH railway infrastructure	11
2.1	Basic requirements	11
2.2	Links between the detailed technical conditions and essential requirements	11
2.3	Cybersecurity.....	12
2.4	Cybersecurity within the scope of this volume of the STH railway standards	12
3	Types of railway line guards, their application and requirements	15
3.1	General requirements concerning the location and conditions of use for fencing	15
3.2	Protection against inadvertent entry into the railway infrastructure area by outsiders.....	15
3.3	Protection against inadvertent entry into the railway infrastructure area by animals	16
3.4	Protection against inadvertent entry into the railway infrastructure area by vehicles	16
3.5	Noise barriers	16
3.6	Snow curtains	16
4	Fire protection of the railway track	19
4.1	Fire breaks.....	19
4.2	Bridges, overpasses and pedestrian overpasses.....	19
4.3	Tunnels	19
5	Related documents	21
5.1	Acts:.....	21
5.2	Regulations:.....	21
5.3	Standards, UIC leaflets:.....	21
	Appendix.....	23

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1 Introduction

- 1) This Volume XII of the “Technical standards – Detailed technical conditions for the construction of railway infrastructure of the Solidarity Transport Hub – Design guidelines” hereinafter referred to as the “Standards” is one of 30 volumes containing a description of detailed technical conditions for the construction of railway lines up to speed $V_{max} \leq 350$ km/h developed for STH by the Railway Research Institute at the request of Centralny Port Komunikacyjny spółka z o.o.
- 2) The legal basis for the design and construction of the facilities included in the Standards is the Act on Public Roads [2].
- 3) The reference documents taken into account when developing the Standards are mentioned in chapter 5.
- 4) The Standards were developed taking into account the current state of art in the scope of designing and constructing railway line guards.
- 5) In cases not regulated in the Standards, commonly applicable regulations and engineering knowledge should be used.
- 6) Whenever the Standards refer to “STH railway infrastructure”, “STH railway lines”, etc., this should be understood as new railway infrastructure, new railway lines or other civil structures constructed by STH, which may be managed by another railway infrastructure administrator in the future.

1.1 Technical scope

- 1) These Standards apply to all railway lines constructed by STH.
- 2) They include issues related to:
 - a) protective measures intended to ensure safety of passage, in particular, to prevent inadvertent entry by outsiders, animals and vehicles into the railway infrastructure area,
 - b) snow curtains,
 - c) noise barriers,
 - d) fire protections.

1.2 Relation to the complete study

The relation to the complete study is included in the table containing a list of all the volumes, given inside the title page.

1.3 Links to other volumes

The links between this volume of Standards with other volumes are presented in Table 1.
Table 1. Links to other volumes of the Standards.

Volume No	Volume title	Relation content
Volume III.1	Engineering structures	as regards: <ul style="list-style-type: none"> - railway line protection against unintentional entry of road vehicles into the railway infrastructure area, - fire protections on bridges, overpasses, and trestle bridges as well as pedestrian overpasses,
Volume III.2	Tunnels	with regard to fire protections in tunnels

Volume No	Volume title	Relation content
Volume V.1	Non-public roads	with regard to of process access roads
Volume V.2	Public roads	with regard to railway line protection against unintentional entry of road vehicles into the railway infrastructure area,
Volume VIII.3	Structures	with regard to railway line protections against access of outsiders and unauthorised persons
Volume IX	Measures to minimise environmental impact	as regards: <ul style="list-style-type: none"> - railway line protections against access of animals, - noise protections
Volume XVIII	Security, protection and cybersecurity integrity requirements	with regard to detection systems

1.4 Definitions of terms used

1) Fire access road

A paved road allowing fire service vehicles to access a civil structure at any time of the year.

[Regulation of the Minister of Interior and Administration of 24 July 2009 on fire water supply and fire roads (Journal of Laws of 2009, No. 124, item 12.1)] (Chapter 6 § 12.1)]

2) Fire break

A furrow, at least 4 m wide, parallel to a railway line, located between 2 m and 5 m from the lower edge of an embankment or the upper edge of a railway crossing cutting, and if there are side ditches – from the outer edge of these ditches.

Regulation of the Minister of Infrastructure of 7 August 2008 on required distances and conditions permitting the location of trees and shrubs, noise barrier elements and the execution of earthworks next to railway lines, as well as the method of arranging and maintaining snow fences and fire protection strips (Journal of Laws of 2020, item 1247) (§9)]

3) Railway line fencing

A physical barrier protecting the railway line area from the entry of people, animals and vehicles that could disturb the traffic of trains – [own study].

2 Essential, basic and general requirements for the STH railway infrastructure

2.1 Basic requirements

A complete list of essential requirements is included in Volume I of these Guidelines.

2.2 Links between the detailed technical conditions and essential requirements

The links between the detailed technical conditions and essential requirements are given below in tabular form (Table 2).

Table 2. The link between the detailed technical conditions and the essential, basic and general requirements for the STH infrastructure.

sub-chapter of this volume defining detailed technical conditions	essential requirements (Railway Interoperability Directive)						basic requirements	general requirements for the STH railway infrastructure			
	1.1. security	1.2. reliability and accessibility	1.3. health	1.4. environmental protection	1.5. technical compliance	1.6. accessibility	2.1. mechanical resistance and stability 2.2. fire safety 2.3. hygiene, health and the environment 2.4. safety and accessibility in use 2.5. protection against noise 2.6. energy economy and heat retention 2.7. sustainable use of natural resources	3.1. oriented towards the needs of the economy	3.2. orientation towards the needs of passengers	3.3. orientation towards the needs of carriers	3.4. compatibility with the railway infrastructure connected with the STH railway infrastructure
3.1	1.1.6 1.1.13	-	-	-	-	-	2.4.1	-	-	-	3.4.1
3.2	1.1.6	-	-	-	-	-	2.4.1	-	-	-	3.4.1
3.3	-	-	-	-	-	-	2.4.1	-	-	-	3.4.1
3.4	-	-	-	-	-	-	2.4.1	-	-	-	3.4.1
3.5	-	-	-	1.4.1 1.4.4	-	-	2.4.1 2.5.1	-	-	-	3.4.1
3.6	-	-	-	-	-	-	2.4.1	-	-	-	3.4.1
4.1	1.1.4	-	1.3.1	1.4.7	-	-	2.2.1	-	-	-	-
4.2	1.1.1 1.1.3 1.1.4 1.1.6	-	1.3.2	1.4.2 1.4.7	-	-	2.1.1, 2.2.1, 2.3.1	-	-	-	-
4.3	1.1.1 1.1.3 1.1.4 1.1.6	-	1.3.2	1.4.2	-	-	2.1.1, 2.2.1, 2.3.1	-	-	-	-

2.3 Cybersecurity

Technical solutions which collect, store, process, make available or transmit data ensuring the compliance with essential safety requirements (requirements from 1.1.1. to 1.1.11. specified in Volume A of the STH Railway Standards) and general requirements for the STH railway infrastructure concerning security (requirements 1.1.12. and 1.1.13 specified in Volume A of the STH Railway Standards) should be designed taking into account cybersecurity, i.e. “security of network and information systems”, defined in the Directive concerning measures for a high common level of security of network and information systems across the Union, as follows:

security of network and information systems” means the ability of network and information systems to resist, at a given level of confidence, any action that compromises the availability, authenticity, integrity or confidentiality of stored or transmitted or processed data or the related services offered by, or accessible via, those network and information systems;

[as defined in Article 4 of Directive 2016/1148]

Cybersecurity includes two types of threats resulting from unauthorised access to the systems/equipment/networks that collect, store, process, make available or transmit data:

1) physical security threats

It is necessary to secure systems/equipment/networks against direct access which could enable causing (intentionally or unintentionally) threats to functional safety.

2) IT security threats

It is necessary to secure systems/equipment/networks against logical access via IT systems/equipment/networks, which could enable causing (intentionally or unintentionally) threats to functional safety.

Cybersecurity defined this way applies both to information systems used for rail transport purposes and to operational systems used for rail transport purposes, but the STH railway standards do not include requirements for information systems, e.g. timetabling systems.

Physical security threats and IT security threats for operational systems for which requirements are defined in the STH railway standards should be addressed by railway operators as part of the risk assessment and by design engineers/manufacturers/contractors as part of threat control. Additionally, it is required for the applied protections to be documented and verified in accordance with the requirements included in Volume XVIII of the STH railway standards.

2.4 Cybersecurity within the scope of this volume of the STH railway standards

Currently, in the area covered by this volume of standards, there are no networks and information systems whose security could be endangered. However, it is possible that such networks and information systems or technical solutions that collect, store, process, make available or transmit data may arise. For example, a system of sensors may be used that, through wired or wireless networks, public or non-public networks or directly, will connect to, for instance, an infrastructure manager’s system. Then, they should be protected against physical security and IT security threats in a manner compliant with the requirements of the Information Safety Management System (SZBI) implemented by Centralny Port Komunikacyjny spółka z o.o.

At the same time, it should be kept in mind that the ISMS will be subject to changes because maintaining the required level of cybersecurity is not possible by one-time fulfilment of requirements of standards since cybersecurity is a process, and not a state. In order to minimise the number and size of cyber threats, the requirements (obligations) included in the Act of 5 July 2018 on the national cybersecurity system in Chapter 3 for operators of key services, in Chapter 5 for public entities should be continuously

observed in operational processes and only digital service providers fulfilling the obligations described in Chapter 4 of that Act should be used.

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3 Types of railway line guards, their application and requirements

- 1) Railway line guards are used to protect it against external hazards, e.g. access of unauthorized persons or animals, as well as to protect the environment against negative impact of the railway line, e.g. noise barriers. This applies in particular to new railway lines where intensive traffic of high-speed trains is expected.

3.1 General requirements concerning the location and conditions of use for fencing

- 1) All new STH railway lines must be fenced along their entire length.
- 2) The fencing shall be executed on both sides of the railway line along its entire length, excluding railway line crossings, sections with noise barriers, horizontal crossings with roads and pedestrian passages.
- 3) The fencing shall be designed entirely on the land owned/managed by the railway infrastructure manager. The location of the fencing is shown in the figure with the cross-section of the railway line in Volume I.1.
- 4) The distance of the fencing from the axis of the extreme electrified track should be at least 5 m. In case the distance is smaller than 5 m, the fencing should be connected to the return circuit (connected to the rail) [5].
- 5) The fencing route in the plan should be routed so that it does not collide with other circuits and equipment of the buried infrastructure.
- 6) In order to ensure access to the railway line for rescue services and maintenance units, emergency gates and wickets with a width of at least 3.6 m for gates and 1.0 m for wickets should be placed in the fencing.
- 7) Gates along the railway line should be designed with a minimum distance of 2000 m. In the case of wickets, this distance should be at least 500–750 m.
- 8) In the area of engineering structures and other civil structures, the fencing should be connected to such a structure or continued in a manner preventing access of people and animals to the fenced area of the railway line.
- 9) Locations of emergency gates of the fencing should take into account places ensuring access to water supply and fire roads.
- 10) Emergency gates should be permanently closed. Gates should be opened in justified cases by the services for which they are intended.
- 11) The description of the railway line fencing system can be found in the Appendix included at the end of this Volume.

3.2 Protection against inadvertent entry into the railway infrastructure area by outsiders

- 1) To protect railway lines against access of outsiders and unauthorised persons, except for those specified in point 3.1 of the general guidelines, fencing should be used in the space accessible to travellers (especially in the area of platforms). Details of solutions are included in Volume VIII.3 Structures, point 3.5.
- 2) Moreover, depending on the local conditions, railway line fencing should be used at stations with collision-free access to platforms in order to prevent passage through tracks in places not intended for this purpose.

3.3 Protection against inadvertent entry into the railway infrastructure area by animals

- 1) In order to protect railway lines against entry by animals, fencing adapted to species occurring in the area of the designed railway line shall be used. This applies in particular to the migration areas of wild animals or in the vicinity of animal husbandry locations.
- 2) Details concerning the solutions applied for protection of railway lines against entry of animals are presented in Volume IX – Measures to minimise environmental impact, point 3.2.

3.4 Protection against inadvertent entry into the railway infrastructure area by vehicles

- 1) In order to protect railway lines against vehicles entering the railway infrastructure area, protections in the form of reinforced safety barriers should be used in places of multi-level road crossings with railway lines in accordance with PN-EN 1317-1 [8], PN-EN 1317-2 [9], as well as with the requirements specified in the UIC Leaflet 777-1 [10]. This applies in particular to engineering structures (bridges, overpasses, trestle bridges) above the railway line and access roads to such structures.
- 2) Protection of a railway line against entry of vehicles into the railway infrastructure area in the form of (steel or concrete) safety barriers or earth structures (earth berms) should also be used in the location of parallel proximity of the railway line to roads (in particular for roads class A and S).
- 3) In the locations of public roads proximity to railway lines (in particular at sections located in the bend), the use of anti-glare screens should be taken into account for the safety of car and train drivers.
- 4) Barriers protecting against vehicles entering the railway line area are recommended to be equipped with detection systems which inform relevant services about an interruption in such a protection. The requirements for detection systems are specified in Volume XVIII – Security, protection and cybersecurity integrity requirements.
- 5) Details concerning protection solutions for engineering structures (e.g. road overpasses) passing over railway lines are included in Volume III.1 – Engineering structures, point 10.

3.5 Noise barriers

- 1) In order to protect the surroundings of the railway line against noise coming from the moving railway vehicles, it is necessary to allow for the use of noise barriers (sound screens).
- 2) Along sections of railway lines on which noise barriers have been used, it is allowed not to use additional protection against entry to the railway line area in the form of fencing, if noise barriers ensure fencing of all elements of the railway infrastructure requiring this.
- 3) Details concerning the location of noise barriers and design requirements for such barriers are included in Volume IX – Measures to minimise environmental impact, point 3.5.

3.6 Snow curtains

- 1) In order to protect the railway lines in the winter season against snow being blown in places at risk of snowdrift formation (e.g. railway line in an open space area located in an excavation with a depth of up to 2.0 m or on an embankment with a height of up to 0.5 m calculated to the rail head level) snow curtains should be designed.
- 2) Snow curtains shall be designed entirely on the land owned/managed by the railway infrastructure manager.

- 3) The distance of snow curtains from the track axis should take into account the terrain conditions in places where snowdrifts are expected to form along a given section of the designed railway line. This distance should be the product of an indicator with a value between 8 and 12 and expressed in meters of the height of the snow curtains.
- 4) The height of the snow curtains should be at least 1.5 m.
- 5) Snow curtains should be constructed as fixed. If it is not possible to construct fixed snow curtains, a space should be provided for setting portable snow curtains (e.g. wooden or plastic).
- 6) Fixed snow curtains should be made in the form of hedges or in the form of fences integrated with the permanent fencing of the railway line. It is also possible to use a permanent fencing in the form of a panel fence (see Appendix point 2b) with trailing vegetation, which may act as a hedge.
- 7) Snow curtains in the form of fences should be used in cases where due to the site conditions it is not possible to use snow curtains in the form of hedges [5]. Fences should be made of durable materials to ensure effective protection of the railway line against drifting snow.
- 8) Native species of trees and shrubs should be used to construct snow curtains in the form of hedges. Trees and bushes used for hedges should ensure:
 - a) possibly dense hedge along its entire height
 - b) fast rate of growth and reaching of the required height.
- 9) The hedges should be arranged in two rows, with the distance between rows ranging from 0.5 m to 1.0 m. The width of the strip of land under the hedge together with the strips of land on both sides of the hedge should be between 2 m and 3 m, depending on the type of plants in the hedge.
- 10) The hedges should be kept at such a height as to minimise snow drifting to railway tracks during snowstorms.
- 11) In areas where railway lines are particularly exposed to snow storms, two double-row hedges should be arranged. The distance between the hedges should range from 6 m to 10 m, counting from the outer edge of the land strips intended for their curing.
- 12) Maintenance of hedges should comply with the principles of plant protection and care.
- 13) In winter, portable snow curtains are located in places where fixed snow curtains cannot be used.
- 14) Portable snow curtains should be made of wood or plastic. Portable snow curtains should not be set up and stored under overhead power lines and within the visibility of railway crossings and passages specified in the Regulation [7].

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4 Fire protection of the railway track

- 1) An inherent risk related to railway traffic is the fire hazard of the areas adjacent to railway lines. The purpose of the railway track fire protection is to protect the adjacent area against the occurrence of uncontrolled fire spread and undesirable combustion effects as a result of the railway operation.
- 2) The source of potential fires at railway lines is:
 - a) sparks from vehicle exhaust systems,
 - b) malfunctioning braking systems,
 - c) sparks at the interface of the pantograph – contact line system of electric vehicles,
 - d) failures of the overhead contact line (defective electrical system, puncture, short-circuit),
 - e) failures of the control command and signalling systems (defective electrical components, puncture, short-circuit),
 - f) rail vehicle fire (primary or secondary — as a result of derailment, collision).
- 3) Special hazard (mainly due to specific fire development conditions and, at the same time, difficulties in conducting rescue operations) occurs when the event occurs in an area difficult to access, such as: in a tunnel, on a trestle bridge, bridge or away from access roads.

4.1 Fire breaks

- 1) Fire breaks should be arranged in the vicinity of the forests indicated in the Regulation [3] and should also cover areas directly adjacent to the forests with development susceptible to fire spreading, such as agricultural wastelands.
- 2) Information about the fire hazard category referred to in the Regulation [3] should be obtained from the competent forestry inspectorate.
- 3) Fire breaks should be designed entirely on the land owned/managed by the railway infrastructure manager.
- 4) Fire breaks should have form compliant with the Regulation [4]. It is allowed for parallel roads to fulfil the function of fire breaks, provided that the requirements referred to in the Regulation [4] are met.
- 5) The function of a fire break can also be performed by a service road.
- 6) Details concerning roads are included in Volume V.1 – Non-public roads, point 6 and Volume V.2 Public roads, point 3.

4.2 Bridges, overpasses and pedestrian overpasses

Requirements for fire protection on bridges, overpasses/trestle bridges and pedestrian overpasses are included in Volume III.1 Engineering structures, point 10.

4.3 Tunnels

Fire protection requirements for tunnels are included in Volume III.2 Tunnels, point 6 and point 8.1.

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5 Related documents

5.1 Acts:

1. Ustawa z dnia 28 marca 2003 r. o transporcie kolejowym (Dz. U. z 2019 r. poz. 710, ze zm.)
2. Ustawa z dnia 21 marca 1985 r. o drogach publicznych (Dz. U. z 2020 r. Poz. 470, z późn. zm.)

5.2 Regulations:

3. Rozporządzenie Ministra Spraw Wewnętrznych i Administracji z dnia 7 czerwca 2010 r. w sprawie ochrony przeciwpożarowej budynków, innych obiektów budowlanych i terenów (Dz. U. Nr 109, poz. 719 ze zm.)
4. Rozporządzenie Ministra Spraw Wewnętrznych i Administracji z dnia 24 lipca 2009 r. w sprawie przeciwpożarowego zaopatrzenia w wodę oraz dróg pożarowych (Dz. U. z 2009 r. Nr 124, poz. 1030)
5. Rozporządzenie Ministra Infrastruktury z dnia 7 sierpnia 2008 r. w sprawie wymagań w zakresie odległości i warunków dopuszczających usytuowanie drzew i krzewów, elementów ochrony akustycznej i wykonywania robót ziemnych w sąsiedztwie linii kolejowej, a także sposobu urządzania i utrzymywania zasłon odśnieżnych oraz pasów przeciwpożarowych (Dz. U. z 2020 r. poz. 1247)
6. Rozporządzenie Ministra Transportu i Gospodarki Morskiej z dnia 10 września 1998 r. w sprawie warunków technicznych, jakim powinny odpowiadać budowle kolejowe i ich usytuowanie (Dz.U. 1998 nr 151 poz. 987 ze zm.)
7. Rozporządzenie Ministra Infrastruktury i Rozwoju z dnia 20 października 2015 r. w sprawie warunków technicznych, jakim powinny odpowiadać skrzyżowania linii kolejowych oraz bocznic kolejowych z drogami i ich usytuowanie (Dz. U. poz. 1744 ze zm.)

5.3 Standards, UIC leaflets:

8. PN-EN 1317-1:2010 Systemy ograniczające drogę -- Część 1: Terminologia i ogólne kryteria metod badań.
9. PN-EN 1317-2:2010 Systemy ograniczające drogę -- Część 2: Klasy działania, kryteria przyjęcia badań zderzeniowych i metody badań barier ochronnych i balustrad.
10. UIC 777-1 Measures to protect railway bridges against impacts from road vehicles, and to protect rail traffic from road vehicles fouling the track. 2nd edition. 01.06.2002. UIC

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Appendix

The railway line fencing system should consist of the following elements:

- 1) Load-bearing elements of fencings:
 - a) Extreme tensioning posts (every 10 posts) and load-bearing columns for gates and wickets made of steel pipe $d = 60 \times 2.0$ mm with an anticorrosive protection (e.g. hot-dip galvanized with a 420 g/m^2 coating).
 - b) Intermediate posts made of steel pipe $d = 48 \times 2.0$ mm with an anticorrosive protection (e.g. hot-dip galvanized with a 420 g/m^2 coating).
 - c) Tensioning posts at engineering structures made of steel pipe $d = 60 \times 2.0$ mm with an anticorrosive protection (e.g. hot-dip galvanized with a 420 g/m^2 coating).
 - d) If a panel fence is used, rectangular pipes should be used.
 - e) The length of the pipes should result from the required height of the fencing and the depth of anchoring in the foundation.
 - f) Tensioning post supports made of steel pipe $d = 38 \times 1,5$ mm with an anticorrosive protection (e.g. hot-dip galvanized with a 420 g/m^2 coating), length $L = 3.0$ m.
 - Number of pieces depending on the position of the tensioning post: one piece for the post at the edge of the section and two pieces for the posts in places of sharp fencing line bends (angle of bend exceeding 15 degrees).
 - The connection of the supports with the tensioning post should be a permanent connection (e.g. welded).
 - g) The posts should be protected against rainwater penetration into their interior.
 - h) The posts should have concrete foundations (concrete class C16/20) set driven into the ground to a depth of 1.0 m and with a minimum diameter of $d = 0.3$ m.
 - i) A post should be anchored in the foundation to a depth of 0.75 m.
 - j) In case of tensioning posts at engineering structures, such posts should be fixed to concrete elements of the structures by means of dowels.
- 2) Partition:
 - a) Steel mesh partition shall be used as standard.
 - The mesh height should be 2.0 m.
 - Vertical wires should be spaced at up to 15 cm, while horizontal wires should be spaced at up to 14 cm.
 - The mesh should be made of hot-dip galvanized steel wires with a zinc layer ensuring durability for a period of at least 30 years.
 - Tensile strength of horizontal wires shall be minimum 1000 Mpa, while for vertical wires it shall be minimum 550 MP.
 - The mesh wires should be at least $d = 2.0$ mm in diameter and at least $d = 2.5$ mm in the case of extreme wires.
 - Spans should not exceed 4.0 m. Spans with a length of 3.0 m are recommended.
 - b) In places particularly exposed to outsiders (e.g. in urbanized areas), 3D extruded panel fences should be used.
 - Panels shall have a standard width of 2.5 m, minimum height of 2.0 m and a minimum 4 of horizontal extrusions.

- Panels should be made using a welding technique of steel wires with a diameter of at least 5 mm.
 - The maximum mesh size should be 50 x 200 mm.
 - The panels should be protected against corrosion in a manner ensuring their durability for at least 30 years.
 - Panels should be fastened to the posts at least at 4 heights in a manner hindering their easy disassembly, e.g. by means of breakaway nuts.
- c) In the case of fencings in places where the railway line is protected against access of animals, it is necessary to use meshes with variable wire spacing, i.e. from 5 cm at the bottom of the mesh to 10 cm at the top of the mesh.
- The height of fencing should range from 2.20 to 2.50 m, in accordance with the requirements specified in Volume IX – Measures to minimise environmental impact.
 - The fencing must adhere closely to the ground to prevent animals from entering the railway area.
- 3) Other elements of fencing:
- a) Gates and wickets of the system fencing should be made of 40 x 40 x 1.5 mm and 60 x 60 x 1.5 mm steel profiles with a mesh or panel filling.
 - b) For gates and wickets located in places where animals may be crossing, a mesh with a variable wire spacing should be used, i.e. from 5 cm at the bottom of the mesh to 10 cm at the top of the mesh.
 - c) Gates should be double-leaf with dimensions 3.6 x 2.0 m, whereas single-leaf wickets with dimensions 1.0 x 2.0 m.
 - d) Gates and wickets should be complete with load-bearing posts, hinges and closure elements.
 - e) Along the entire length of gates and wickets (between load-bearing posts), a concrete foundation driven into the ground to a depth of 1.0 m should be constructed.

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