Rail Baltica

RBDG-MAN-012-0109

Design guidelines

General requirements

28-03-2022

Co-financed by the European Union
Connecting Europe Facility

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1. Abbreviations

2G / 3G	2nd / 3rd Generation of Mobile communication systems
3GPP	3rd Generation Partnership Project
°C	Degree Celsius
A	Amp
AC	Alternative current
AFC	Automatic Fare Collection
AT	AutoTransformer
BHCA	Busy Hour Call Attempt
CAPEX	capital expenditure
CCS	Control Command Signalling
CCTV	Closed Circuit Television
CEDB	Compiled Energy Billing Data
CHT	Call Holding Time
CIQ	Control, Immigration, Quarantine
CT	Call Type
CWR	Continuous Welded Rail
D	Diameter
DC	Direct Current
DCS	Data Collecting system
DMO	Direct Mode
DMZ	Demilitarized Zone
DMS	Detectors Management system
DP	Danger Point
E&B	Earthing and Bonding
EIRENE	European Integrated Radio Enhanced Network
eLDA	Enhanced Location depending Addressing
EMI	Electromagnetic induction
EMC	Electromagnetic Compatibility
eMLPP	enhanced Multi-Level Precedence and Pre-emption
EN	European standard
ERA	European Railway Agency
eREC	enhanced Railway Emergency Call
ERTMS	European Railway Traffic Management System
ETCS	European Train Control System
ETCS_L2	European Train Control System - Level 2
FACP	Fire Alarm Control Panel

FN	Functional Number
FRMCS	Future Railway Mobile Communication System
FRS	Functional Requirements Specification
FBWM	flash butt welding machine
GC	Group Call
GCAREA	Group Call AREA
GMPLS	Generalized Multi-Protocol Label Switching
GPS	Global Positioning System
GSM-R	Global System for Mobile Communication
HMI	Human Machine Interface
HSL	High Speed Line
HSLM	High Speed Load Model
HSR	High Speed Rail
HO	Hand Over
HTTP	Hypertext Transfer Protocol
HV	High Voltage
HW/SW	Hardware / Software
HWL	High Water Level for 100-year return period
Hz	Hertz
IEC	International electromechanical commission
IP	Internet Protocol
IP-PABX	Internet Protocol-Private Automatic Branch exchange
IRMS	International Committee on Non-Ionizing Radiation Protection
ISO	International Standards Organization
IXL	Interlocking
Km/h	Kilometre/hour
KMC	Key Management Centre
kV	Kilovolt
LA	Los Angeles test (to measure resistance to fragmentation by shocks)
LDA	Location depending Addressing
LED	Light-Emitting Diode
Li-Fi	Light Fidelity
LOS	Level of Services
LTE	Long Term Evolution
LV	Low voltage
m	Meter
MBV	Methylene Blue Test Value
MDE	Micro-Deval test (to measure resistance to wear)
MEP	Mechanical, Electrical and Plumbing
MIMO	Multiple Input Multiple Output
MMS	Maintenance Management System
MOS	Mean Opinion Score

MTA	Mail Transfer Agent für Unix und Unix-Derivate
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
MV	Medium Voltage
NF	Negative Feeder
NMS	Network Management Systems
NSA	National Safety Assessor
NTP	Network Time Protocol
NTPS	Non Traction Power Supply
OCC	Operation Control Center
OCL	Overhead Catenary Line
OCR	Optical Character Recognition
OCS	Overhead Catenary system
OPEX	Operational expenditure
OPM	Optimum Proctor Modified
OSI- Model	Open Systems Interconnection Model
OTA	Over The Air
OWASP	Open Web Application Security Project
PAS	Public Address System
PC	Personal Computer
PIDS	Passenger Information Display System
PKI	Public Key Infrastructure
PLC	Programmable Logic Controller
PoE	Powered over Ethernet
PP	Paralleling posts
PS	Power Supply
PSD	Platform screen doors
PTT	Push To Talk
PTZ	Pan Tilt Zoom
QoS	Quality of Service
RAM	Reliability Availability Maintainability
RBC	Radio Block Centre
REC	Railway Emergency Call
RF	Radio Frequency
RFC 8	Rail Freight Corridor 8
RFC NS-B	Rail Freight Corridor North Sea - Baltic
RMS	Railway Management System
RoHS	Restriction of Hazardous Substances
ROW	Right of Way
RTU	Remote Terminal Units
SCADA	Supervisory Control and Data Acquisition
SIG	Signalling
SIM card	Subscriber Identity Module card

SMS	Short Message Service
SR	Staff Responsible
SRS	System Requirements Specification
SS	SubStation
SWP	Switching posts
t	Ton
TC	Track circuit
TES	Traction Electrification System
TMS	Traffic Management System
TN-S	Earthing system
TOR	Terms of Reference
TPS	Traction Power Supply
TSI	Technical Specification for Interoperability
TSR	Temporary Speed Restriction
TSS	Traction SubStation
TVF	Tunnel Ventilation Fans
TVD	Tunnel Ventilation Dampers
TVM	Ticket vending machine
TVO	Ticket vending office
UIC	Union Internationale des Chemins de Fer / International railway union
UMTS	Universal Mobile Telecommunications System
UPS	Uninterruptible Power Supply
USE	Upper Section of Earthworks
V	Volt
VBS	Voice Broadcast Service
VGCS	Voice Group Call Service
Wi-Fi	Technology for wireless networking
WP	Work Package

2. Standards and specifications

2.1. Specifications applicable for the Design Guidelines

Technical specifications for Interoperability applicable for the Design Guidelines are:

Title	Abbreviation	Signature date	Publication date	Application date
Commission Decision 2012/757 / EU of 14 November 2012 - Traffic Operation and Management TSI	OPE TSI	08/06/2015	30/06/2015	01/07/2015
Commission Regulation (EU) 2016/919 of 27 May 2016 - Control-Command and Signalling TSI	CCS TSI	27/05/2016	15/06/2016	05/07/2016
Commission Regulation (EU) No 1299/2014 of 18 November 2014 - Infrastructure TSI	INF TSI	18/11/2014	12/12/2014	01/01/2015
Commission Regulation (EU) No 1300/2014 of 18 November 2014 - TSI "Accessibility for disabled persons and persons with reduced mobility"	PRM TSI	18/11/2014	12/12/2014	01/01/2015
Commission Regulation (EU) No 1301/2014 of 18 November 2014 - Energy TSI	ENE TSI	18/11/2014	12/12/2014	01/01/2015
Commission Regulation (EU) No 1302/2014 of 18 November 2014 - TSI "Rolling stock - Locomotives and rolling stock for the carriage of passengers"	LOC & PAS TSI	27/05/2016	15/06/2016	05/07/2016
Commission Regulation (EU) No 1303/2014 of 18 November 2014 - TSI "Safety in railway tunnels"	SRT TSI	18/11/2014	12/12/2014	01/01/2015
Commission Regulation (EU) No 1304/2014 of 26 November 2014 - TSI "Rolling Stock - Noise"	NOI TSI	26/11/2014	12/12/2014	01/01/2015
Commission Regulation (EU) No 1305/2014 of 11 December 2014 - TSI "Telematic applications for freight"	TAF TSI	11/12/2014	12/12/2014	01/01/2015
Commission Regulation (EU) No 321/2013 of 13 March 2013 - TSI 'rolling stock - freight wagons'	WAG TSI	08/06/2015	17/06/2015	01/07/2015
Commission Regulation (EU) No 454/2011 of 5 May 2011 - TSI 'Telematic applications for passengers'	TAP TSI	25/02/2015	26/02/2015	18/03/2015

Following directives shall be considered:

2004/49/EC of April 29, 2004 on safety on the Community's railways and amending Directive 95/18/EC of the Council,	on licensing of railway enterprises
2004/50/EC of June 1, 2007 amending Annex VI to Directive 96/48/EC	of the Council, on the Interoperability of the Trans-European high-speed railway system

2007/32/EC of June 1, 2007 amending Annex VI to Directive 96/48/EC of the Council	on the Interoperability of the Trans-European high-speed railway system and amending Annex VI to Directive 2001/16/EC of the European Parliament and the Council, on the Interoperability of the Trans-European high-speed railway system;
2008/57/EC of June 17, 2008	on interoperability of the rail system within the Community, into force as of June 19, 2010 (repealing Directives 96/48/EC and 2001/16/EC from 19 July 2010). Directive (EU) 2016/797, article 58: "Article 58 – Repeal - Directive 2008/57/EC, as amended by the Directives listed in Annex V, Part A, is repealed with effect from 16 June 2020, without prejudice to the obligations of the Member States relating to the time limits for the transposition into national law of the Directives set out in Annex V, Part B. References to the repealed Directive shall be construed as references to this Directive and shall be read in accordance with the correlation table in Annex VI. "
2012/34/EU of 21 November 2012	establishing a single European railway area
REGULATION No 1371/2007	on rail passengers' rights and obligations
2016/364 of 1 July 2015	Classification of the reaction to fire performance of construction products
2016/797 of 11 May 2016	on the interoperability of the rail system within the European Union

2.2. Specific standards related to General requirements

EN Standards:

EN15273-1, EN15273-2 and EN15273-3 Railway applications - Gauges

EN1317-1 and EN1317-2 Road restraining systems

EN206 Concrete - Specification, performance, production and conformity

EN50125-2 and EN50125-3 Railway applications - Environmental conditions for equipment

IEC 60529 Degrees of protection provided by enclosures (IP Code)

EN50124-1 and EN50124-2 Railway applications - Insulation coordination

EN 12094 Fixed firefighting systems - Components for gas extinguishing systems

EN ISO9223 Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation

UIC recommendations:

UIC 777-1 R "Measures to prevent impacts by road vehicles against rail bridges and to prevent the penetration of vehicles onto the track"

3. Design standard classification

The following terms are used to classify the criteria:

- Recommended or nominal value: Standard to be achieved (must be equal or better than the stated requirement), provided that there are no major technical, cost or schedule constraints. Designers shall use 'Recommended' or 'Nominal values' to the extent practical. In case the Designer applies these values where the technical, cost or schedule constraints exist and could be arguable, the Designer shall clearly indicate such constraints and provide justification as to why the solution should be implemented.
- Minimum/Maximum or limited value: Represent limits and/or ranges of allowable values. Designers shall make every effort to avoid the use of ranges for values and to instead use specific values. Minimum/Maximum values and ranges are acceptable only in circumstances where 'Recommended' values are impractical to apply due to particular constraints.
- Exceptional values: These are extreme values, that differ from the standard design approach, and that may only be used under highly restricted conditions where 'limited values' can not be applied for the purpose of achieving an acceptable solution. Any application of 'exceptional values' in the design process requires the prior approval of RB Rail AS.
- "Shall": Indicates mandatory requirement that must be strictly implemented. Any impossibility to fulfill this requirement must be agreed through a derogation case (see change management procedure).
- "Should": Indicates preferred course of action, recommendations. No agreement of derogation is necessary, there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course - for example the same goal is reached by other solutions, which are permissible within the binding standards or documents.
- "Must": Indicates an obligation or a mandatory requirement.
- "May": Indicates a permissible course of action within the limits of the standards, but which is not mandatory to be fulfilled.

The design standard classification shall be read jointly with RBDG-MAN-011 Change management Procedure

4. General

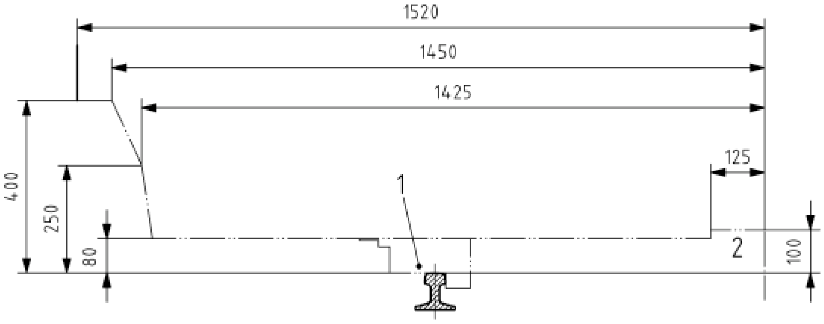
The Rail Baltica line shall accommodate passengers' trains classified as P2 traffic code and freight trains classified as F1 traffic code.

4.1. Gauge

The design shall be done considering GC gauge for all the line as defined in EN15273-1, EN15273-2 and EN15273-3.

Additionaly, for the Mixed Traffic Line sections (Refer to RBDG-MAN-013-0102_RailwayAlignment), wider and higher structure gauge shall be considered to allow overgauge exceptional transport and operation under exceptional procedures of wagons of gauge SEc (As defined in Swedish Infrastructure Manager Trafikverket document TDOK: 2015-0555).

Considering the use of low floor wagons, additional requirements for the lower part to be followed-up are defined in EN15273-3- scheme for GI3 kinematic gauge.

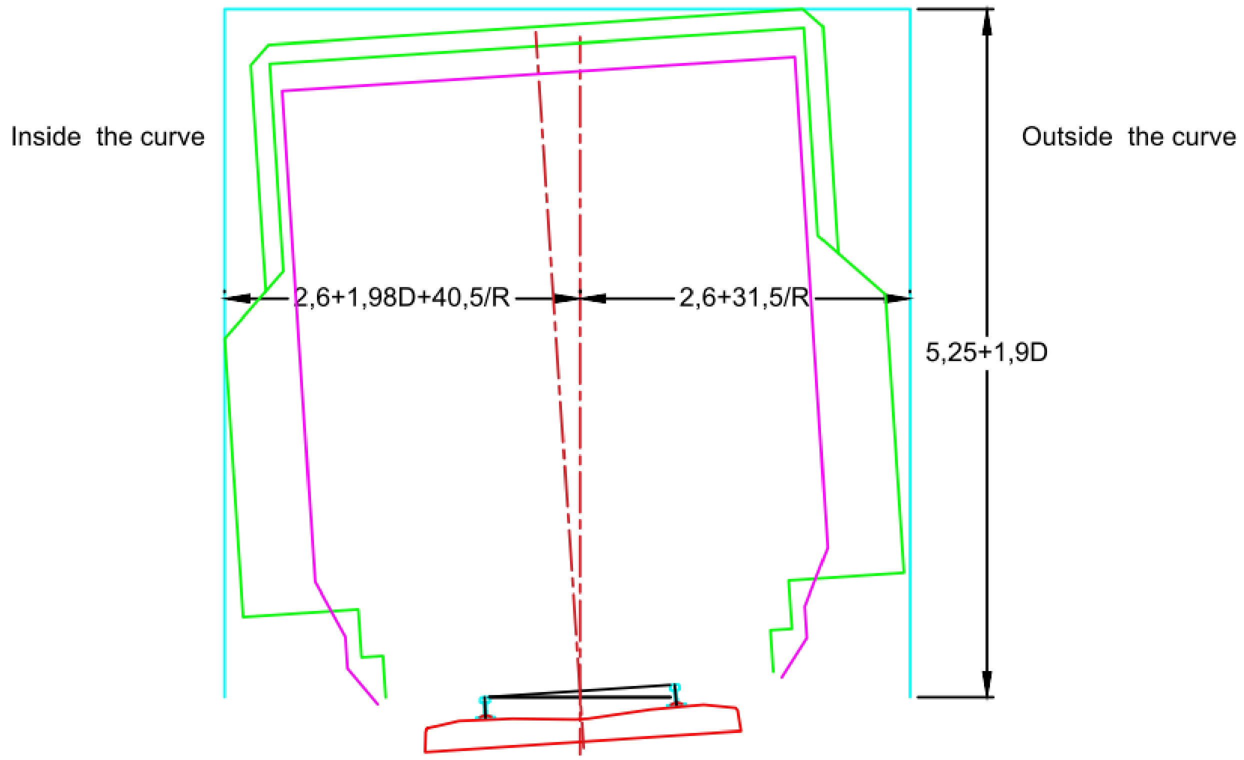


1. EXTRACT FROM EN15273-3 FOR GI3 KINEMATIC GAUGE

4.2. Structure gauge

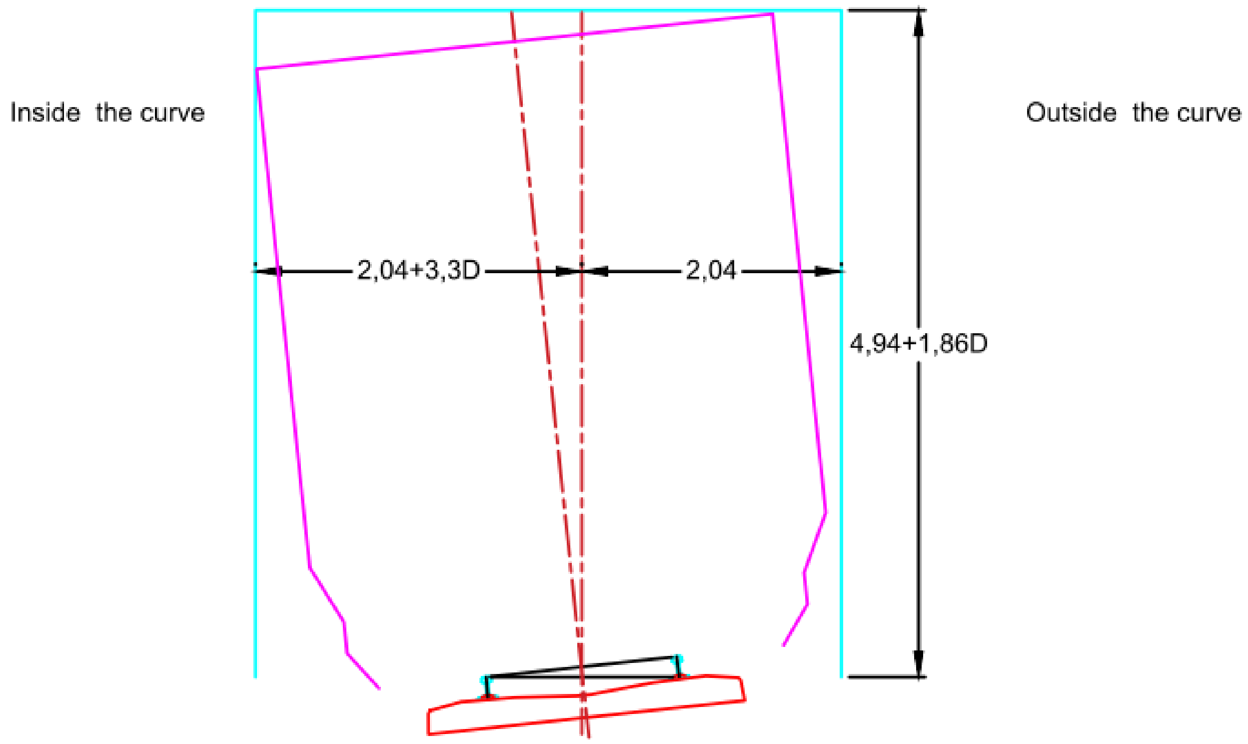
The structure gauge shall be in accordance with following requirements. The structure gauge is the area where no track-side equipment shall be located (signals, catenary masts…). The structure gauge is not dependant from the track inclination and is done in an orthonormal coordinate system. Platforms can be installed inside the structure gauge.

Mixed traffic sections:



2. MIXED TRAFFIC SECTIONS STRUCTURE GAUGE (D IS THE CANT, R IS CURVE RADIUS)

Passengers only and light freight traffic sections:



3. PASSENGERS ONLY AND LIGHT FREIGHT TRAFFIC SECTIONS STRUCTURE GAUGE (D IS THE CANT, R IS CURVE RADIUS)

4.3. Passengers train length

The design shall be done considering passenger train length of 400m for all infrastructure except the passenger platform which can be designed for 200m.

If the passengers' platform is part of an elevated structure, the designer shall provide technical and economical comparison between 200m elevated structure to be upgraded to 400m later and 400m elevated structure build since the beginning of the project for client decision.

4.4. Freight train length

The design shall be done considering freight train length of 1050m for all infrastructure.

For existing infrastructure, the designer shall provide technical and economical comparison between existing infrastructures to be upgraded to 1050m after Rail Baltica line construction completion and existing infrastructures upgraded to 1050m during Rail Baltica line construction for client decision.

4.5. Design speed for passengers' trains

The design shall be done with a design speed for passengers' trains of 249km/h maximum for the main line with mixed traffic (passengers and freight trains).

The design shall allow for sustained operating speed of 234km/h.

4.6. Design speed for freight trains

The design shall be done with a design speed for freight train of 120km/h maximum for the main line.

4.7. Axle load

The design shall be done with an axle load of 25t for all the line.

4.8. Double track

The design shall be done considering double track for all the main line.

4.9. Level crossing

No level crossing shall be designed on the Rail Baltica main line. Level crossings are allowed only in areas with no passenger traffic and low speed (40km/h maximum) such as depot, multimodal terminal.

4.10. Gauge crossing with conventional railway network

No gauge crossing with conventional railway network (1435mm and 1520mm) shall be designed on the Rail Baltica line.

Gauge crossing, or mixed gauge tracks are allowed in dedicated freight stations, with speed not exceeding 40 km/h.

4.11. Physical separation between Rail Baltica network and conventional network

A physical separation shall be visible for maintenance team between the Rail Baltica network and the conventional network. The minimum physical separation is a fence of 1.1 m height.

4.12. Maintenance path

Maintenance path of 0.8m width is required on both side of the main line. The maintenance path shall not be closer than 2.70m from the track centre on the main line (exceptional value) and shall not be interrupted by catenary masts. The nominal distance is 3.0m and this value shall be applied in all locations without right of way constraints.

In depots and multimodal terminals, the minimum distance from the track centre to the maintenance track is 2.0m.

4.13. Crosswind effect

Crosswind effect shall be checked as per INF TSI chapter 4.2.10.2 and EN 14067-6.

4.14. Control-command and Signalling

The signalling system will be based on ERTMS of level at least 2, baseline 3. No specific trains without ERTMS on-board are allowed on Rail Batica line.

4.15. Power supply and catenaries

Standard power supply shall be provided with 2x25kV – 50 Hz.
All equipment shall be monitored and controlled from national Power Supply Operation Control Centre (PSOCC) through an Overhead Control System (OCS) with a SCADA (Supervisory Remote Control and Data Acquisition System) microprocessor-based system.

4.16. Rolling stock

The Rolling stock used for the project shall be in full compliance with TSI criteria and no specific rolling stock is forecast on Rail Baltica line (no specific pantograph, full ERTMS).

The use of Eddy current brakes is not considered on Rail Baltica line.

4.17. Operations

Bi-directional signalling shall be designed on the whole line to facilitate operations. The normal train direction is the right hand-side.

5. Access

Roads design solutions shall be done in way to provide cost-effective and environmentally friendly solutions to provide the safety for road users and ensure essential road conditions throughout the design working life of the road. The consultant shall carry out all the necessary site investigations, surveys, geodetic and topography, geological, geotechnical and hydro-geology, hydrology, noise, environmental and any other investigations necessary to provide sufficient output data to develop design solutions in modern and on best examples of practice based style. The consultant is responsible to receive responsible authorities/institutions approvals in accordance with applicable national legislation, regulations and standards. In addition, designer shall follow the Operational plan, Infrastructure Maintenance Facility study, Design Guidelines, Utilities Requirements, Architecture, Landscape and Visual Identity design Guidelines.
<u>As far as possible, the designer shall consider improving existing roads instead of constructing new ones. As far as it is reasonable, the design solutions (particularly plan solutions) for access roads shall be designed to provide suitable accessibility to the adjacent railway infrastructure in way to cover functions of maintenance roads.</u>

5.1. Access and Maintenance Roads

Access roads

Access Roads are for public use and shall be foreseen to provide access to land plots, forest roads, local roads and households etc. where previous access has been cut due to the railway line. Access road technical parameters for pavement calculations and geometry shall be chosen by following criteria:

- access roads that do not lead to any maintenance road entrance shall be designed according to national legislation, standards, regulations from roads owners or governors or other institutions and traffic survey results;
- access road technical parameters for a road section prior to the entrance of a maintenance road shall be equal to or higher than the maintenance road category parameters (see Table 1).

Maintenance roads

Maintenance roads shall be designed only if it is impossible to provide access from the public roads network to railway infrastructure and/or for emergency services. Access shall be designed leading to specific infrastructure (switches, signaling cabinets, sub-stations, etc.) as close as possible. Maintenance roads shall be located inside the highspeed railway right of way. Maintenance roads shall not be open for public use. Maintenance roads shall be designed as a non-continues roads. **Detailed maintenance road layout principles shall be agreed by the Client.** If maintenance roads aren't provided on both sides of the railway line, then signaling and safety equipment shall be provided on the line to allow safe crossing of maintenance and/or emergency services teams. At the dead-end of maintenance road turnaround loop shall be foreseen. Axel loads for maintenance roads shall be chosen by Table 1 and recommended geometrical values are shown in paragraph 5.3.

Maintenance roads shall be designed to provide access to all the following railway infrastructure:

- Stations (Category I)
- Passing loops (Category I)
- Turnout areas (Category I)
- Embankment for heavy inspection equipment (Category I)
- Embankment for substations and on-line AT boxes (Category I)
- Signalling systems (Category II)
- Radio sites (Category II)
- Hot box detector embankment (Category II)
- All low voltage equipment on the embankment (Category II)
- Embankment for light inspection equipment (Category II)
- Embankment for positioning inspection catwalks or gantries for structures if maintenance is forecasted using such system (Category II)
- Each side of the high-speed line at both ends of all tunnels (Cat. II in additional to any potential Cat. I roads)
- Each side of the high-speed line adjacent to all structures (Category II).

Some sites or parts of structures may require some specific Category II roads if the roads provided for the special points above cannot serve them:

- Instrumented sites;
- Landscaped sites;
- Gravel traps for rocky embankments;
- Berms on the slope of embankment (to remove gravel from rocky slopes, maintain drainage ditches, etc.);
- Retention basins, small hydraulic structures, berm drainage, etc.

Maintenance roads are divided in two categories which differs from each other by maximum design axel load shown in Table 1. Principal schemes of access and maintenance roads are shown in paragraph 5.2..

Typical installation of maintenance road is in drawing RBDG-DWG-065-A2.

Category	Main function	Max designed axle load
I	Maintenance road	11,5 t- per axle
II	Maintenance road	3,5 t per axle
Access road	for public use	According to national regulations and legislation or maintenance road category

TABLE 1: ACCESS AND MAINTENANCE ROAD CLASSIFICATION

Green paths:

Green path is defined as a 4,0m wide area between outer edge of ditch and enclosure shown on drawing RBDG-DWG-001-A6. Green path may be used by maintenance vehicles (weight up to 3.5t, length up to 6,0m) to provide maintenance services only for culverts, noise barriers, fences and railway ditches. Usage of green path for maintenance purposes for prior mentioned structures is allowed only in exceptional cases with Client's approval and relevant National Implementig Body's approval. Designer for such situations must provide justifications and evaluate the need of green path reinforcement.
Green paths used for maintenance purpose shall not be located in flooded area. Green paths shall be located next to railway ditch. In addition, Consultant shall take into account that green paths may be used by maintenance crew only on dry seasons (june – august) or during winter time when ground is frozen. Green paths shall be levelled to provide accessibility and all necessary maintenance procedures shall be included in Maintenance manuals.

In special circumstances when CAT II maintenance road can not be designed due to land restrictions, Green path may be used. In this case the Consultant must present justification with evaluation of the need of green path reinforcement and Client's and relevant National Implementing Body's approval must be obtained.

5.2. Principal schemes of Access and Maintenance roads

Access Roads are publicly used roads that shall be designed outside of railway right of way (outside fenced territory) to provide access to land plots, forest roads, households etc. Access roads can also be used to provide access to maintenance roads. In this case maximum axle load of maintenance road shall be considered during the design of connecting access road.
Maintenance roads are not open for public use and are located inside the boundary fence. It can be used only for railway maintenance purpose or for emergency services.
Public roads shall be designed according to national legislation and regulations.

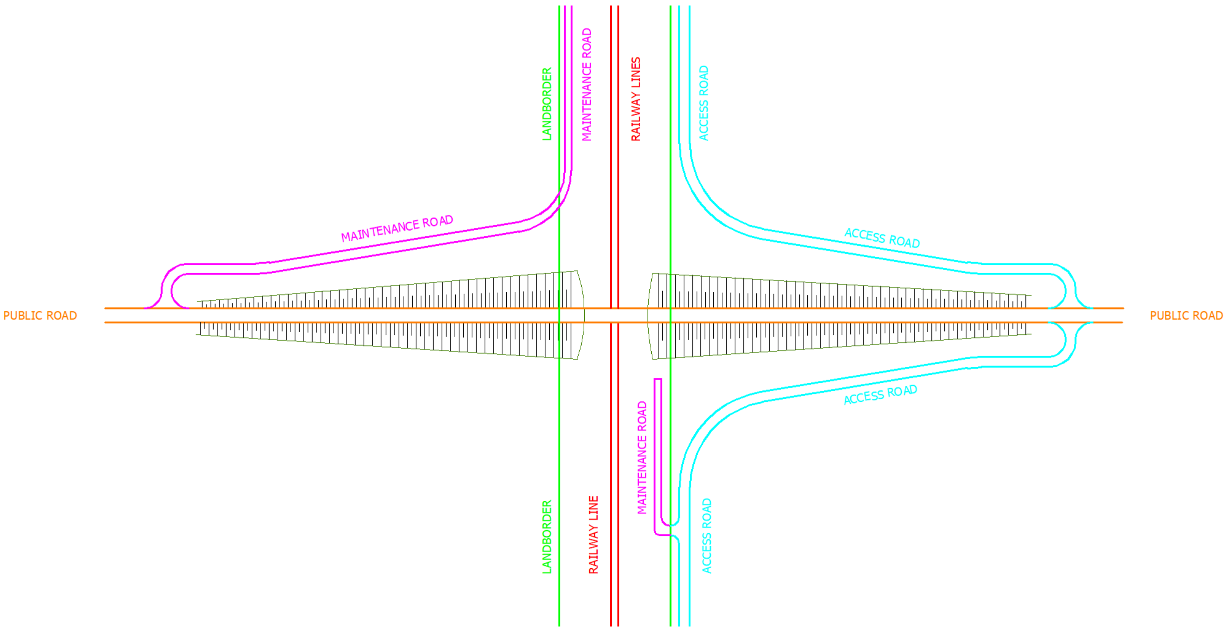


FIGURE 1 RECOMMENDED PRINCIPAL SCHEME OF ROAD CATEGORY DIVISION

Key: Land border, Maintenance road, Access road, Railway line, Public road

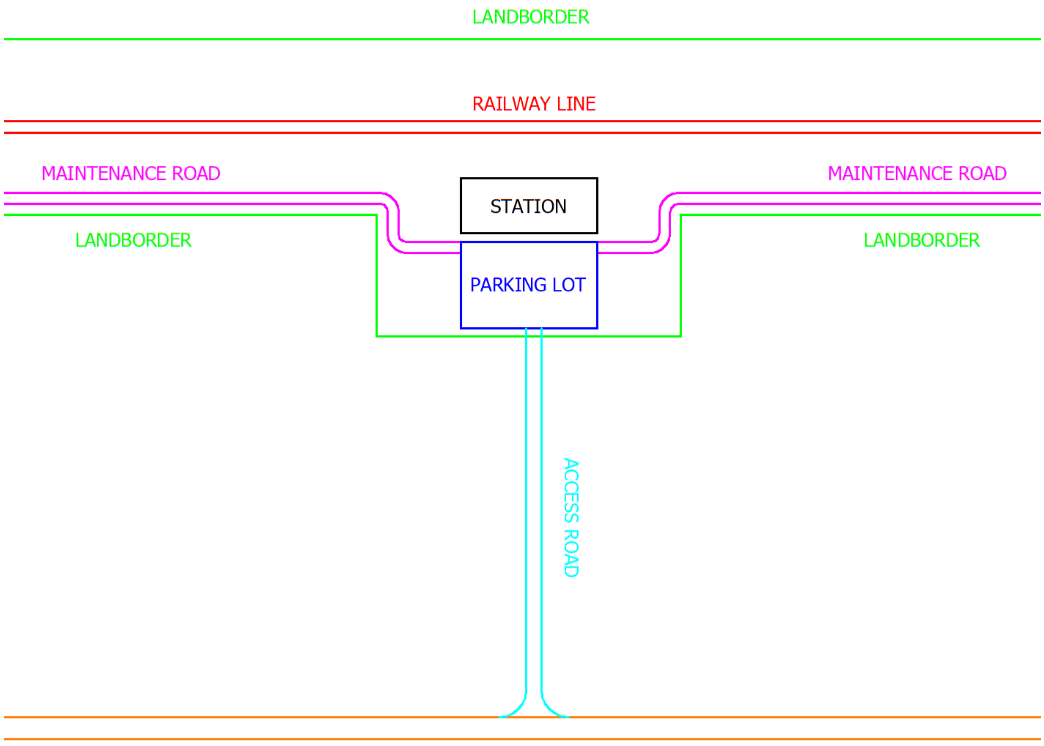


FIGURE 2 RECOMMENDED PRINCIPAL ROAD SCHEME FOR STATION AND PARKING LOT

Key: Land border, Maintenance road, Access road, Railway line, Public road

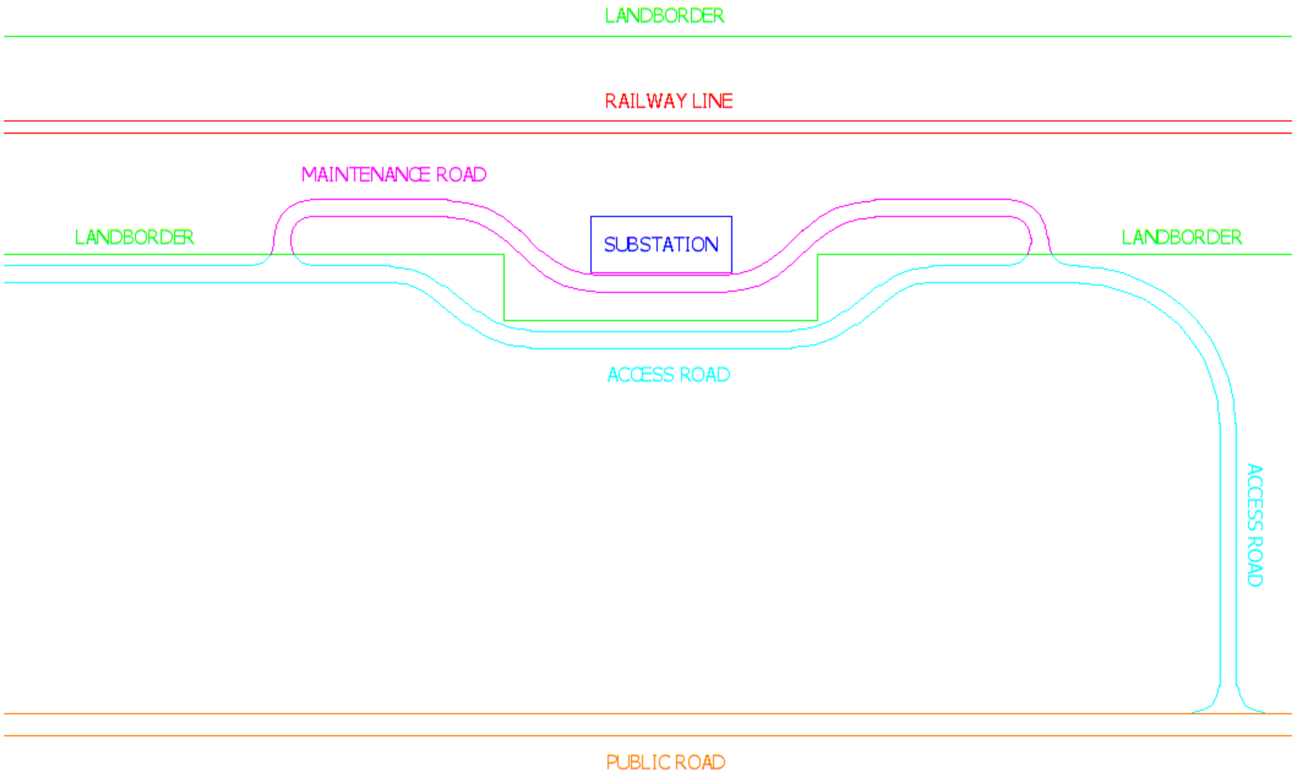


FIGURE 3 RECOMMENDED PRINCIPAL ROAD SCHEME FOR SUB-STATION

Key: Land border, Maintenance road, Access road, Railway line, Public road

In this case designed roads shall allow transporting equipment by trucks as well as handling cranes. The supposed area for operation of cranes shall be level and free from aerial cabling and other possible obstacles.

5.3. Main parameters

5.3.1. Geometrical parameters

Maintenance roads inside railway right of way shall be designed according to RBDG-DWG-065-A2 drawing.
Maintenance roads shall be designed based on swept path analysis applying design vehicles defined by chapter 5.3.3. Design speed for swept path analysis shall be 30km/h. In case 30km/h is not feasible the Consultant shall agree lower Design speed with Client. Design speed of 5km/h shall be used for section from beginning of maintenance road (entrance) till section where maintenance road is designed parallel to railway.
Geometrical values for maintenance roads designing are following:

- Maximum longitudinal slope ≤8,0%
- Minimum recommended longitudinal slope ≥0,5%.
- Minimum sag R 250m (from entrance till section where maintenance road is designed parallel to railway, Min sag Radius can be reduced)
- Minimum crest R 750m (from entrance till section where maintenance road is designed parallel to railway, Min crest Radius can be reduced)
- Cross slope for unbound aggregate mixture pavement surface road 3,5% (+/-0,5%)
- Cross slope for bound material surface pavement road 2,5%
- Cross slope for shoulder 5%
- Super elevation of 5,5% (+/-0,5%) if R≤150,0m
- Minimum super elevation transition length 6m per 1%.

5.3.2. Level of Service

Newly designed access roads intersections around (<1km radius) stations, depots, terminals shall allow to flow at Level of Service (LOS) C or better according to Highway Capacity Manual 2000 (HCM). Redesigned existing intersections shall allow to flow at LOS D or better. Evaluation of LOS shall be conducted. If necessary, traffic flow modelling survey shall be carried out.

5.3.3. Design vehicle model

Design vehicle models for maintenance roads shall be chosen by Table 2: Design vehicles
Access roads design vehicle shall be chosen by national legislation and regulations. Design solutions shall provide vehicle manoeuvrability for design vehicle and shall be economically justified.

Category	Design vehicle	Parameters

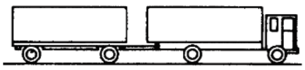
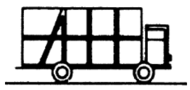
I	Truck with trailer 	Total length – 18.75m Min turning radius – 12.50m
II	2-axle garbage truck 	Total length – 8.00m Min turning radius – 7.80m
Access road	-	According to national regulations and legislation

TABLE 2: DESIGN VEHICLES

5.3.4. Width of roads

The widths for different roads categories shall be determined according to forecasted annual average daily traffic and its composition. Minimum requests are defined in table below:

Category	Min total width of road	Min total width of traffic lane
I	5.50 m	3.50m
II	4.00 m	3.00m
Access road	According to national legislation and regulations or by maintenance road category	

TABLE 3: WIDTH OF ROADS

Design solutions shall provide vehicle manoeuvrability, traffic safety, environmental requests and solutions shall be economically justified.

5.3.5. Horizontal and vertical clearance

Vertical and horizontal clearance shall meet national regulations and legislation. Additionally, minimum vertical clearance for overpass or tunnel shall meet Rail Baltica Design Guidelines requests if they are higher than national regulations and legislation.

5.3.6. Widening of curve

Pavement widening shall be foreseen for curvatures with R≤200m. Curvature shall be widened in whole length of the radius by the value shown in Table 4. Widening shall be designed on direction of carriageway's inside.

Horizontal curve radius	Widening
R=40m	1,2m

R=50m	0,9m
R=70m	0,8m
R=100m	0,7m
R=150m	0,4m
R=200m	0,25m

TABLE 4: CURVATURE WIDENING FOR MAINTENANCE ROADS

Designer shall apply swept path analysis to approve manoeuvrability for design vehicle.

5.3.7. Passing loops

For roads with total width B≤5,5m additional passing loops shall be foreseen in the sight distance or at least every 500m. If the sight distance is more than 2,0km, then additional passing loops should be foreseen after every 1,0 km. Passing loop dimensions are shown on Figure 4.

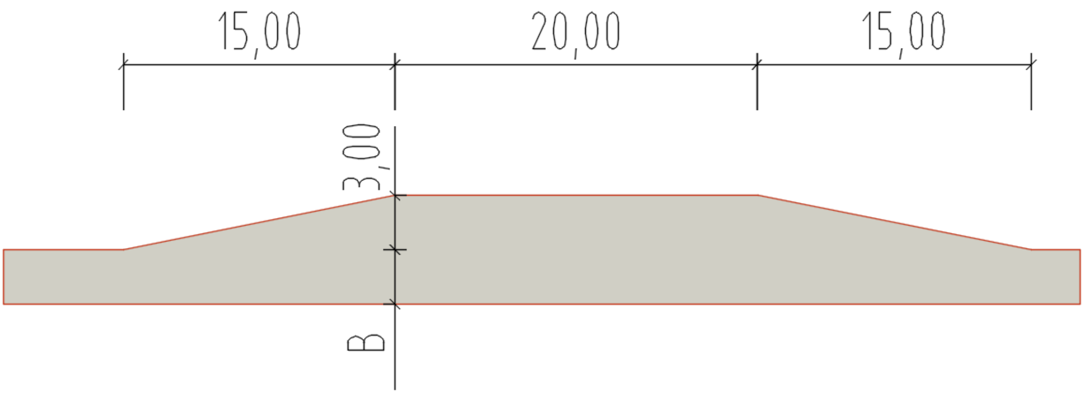


FIGURE 4 PASSING LOOP

5.3.8. Turnaround loop

For road ending with a dead end, a turnaround loop shall be foreseen. Recommended design plan layout and minimum dimensions for turnaround loop is shown on Figure 5. For cases where longest vehicle in traffic flow is foreseen truck with trailer (L=18,75m) necessity, plan solutions and dimensions of turnaround loop shall be approved by Client.

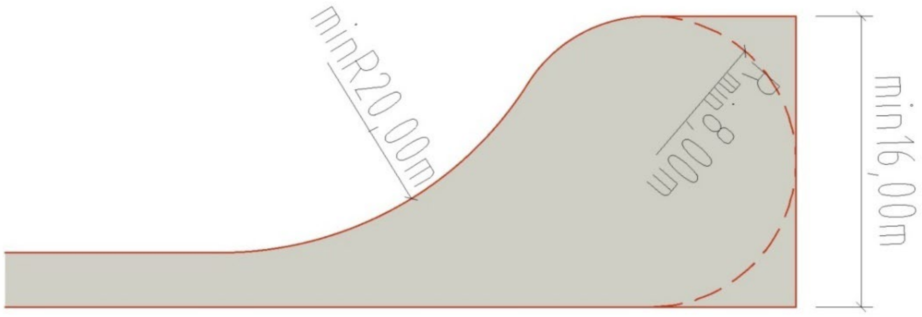


FIGURE 5 RECOMMENDED TURNAROUND LOOP

5.3.9. Exit and entrance intersections

Exit and entrance intersections shall be designed according to each national legislation. Designed intersection angle shall be 72°-108° (80-120 gon). Maximum longitudinal gradient of adjacent road shall not exceed 2,5% for at least 25m long section, measured from side of main road carriageway edge. Principles of intersections solutions are given on Figure 6. The designer shall apply swept path analysis to approve manoeuvrability for design vehicle.

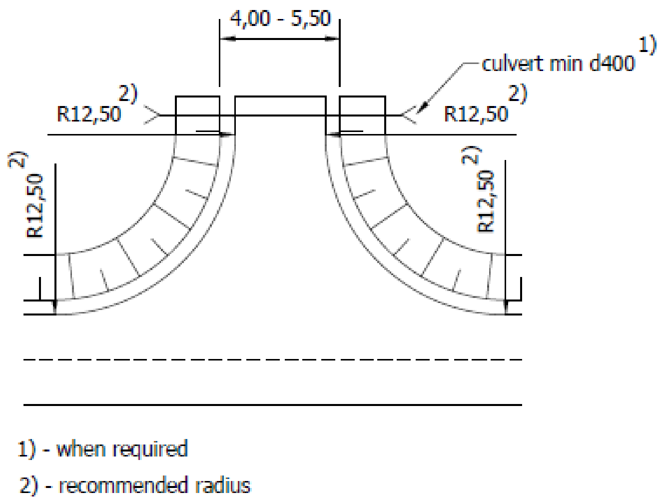


FIGURE 6 EXIT AND ENTRANCE ROAD JUNCTION FOR MAINTENANCE ROADS.

5.3.10. Road restraint systems

Road restraint systems for access roads shall be designed according to national legislation and standards (including EN 1317 "Road Restrain Systems"). For sections where, high speed railway is twinning with designed access road designer shall also observe requirements of Rail Baltica Design guidelines General requirements paragraph 7 and cross-sections RBDG-DWG-059 up to RBDG-DWG-064 depending on specific situation. Road restraint systems for maintenance roads shall be designed according to Rail Baltica Design guidelines drawing RBDG-DWG-065-A2. Technical parameters of designed safety barriers shall meet requirements of standard EN 1317. The necessity for safety barriers for maintenance roads, located inside railway right of way (inside fenced area), shall be analyzed by risk assessment from railway safety point of view.

5.4. Requirements for pavement design

Road pavement and thickness of each pavement layer shall be calculated according to national legislation and standards. Designer shall deliver detailed pavement calculation report with explanations of substantiation for used calculation parameters. For sections with low bearing capacity soils (E_{v2}<25 MPa and/or CBR<8%), including peat, thixotropic soils, high plasticity clays etc., the designer shall propose at least 3 (three) different solutions. These solutions shall be fully justified with associated cost-efficiencies and appropriate calculations/analyses.

5.4.1. Basic requirements

Axel loads and Equivalent Single Axle Load (ESAL) for road types:

- Maintenance road cat. I: 11.5t/axel (18.75m long tandem axel with single tires) ESAL 100 000 – 300 000
- Maintenance road cat. II: 3,5t/axel (single axel with single tires), ESAL<100 000
- Access roads: 11.5t/axel (18.75m long tandem axel with single tires). The ESAL shall be obtained according to traffic survey results.

Design life for the pavement is 20 years.

5.4.2. Bearing capacity

Bearing capacity on compacted surface of each layer shall be measured by static plate load test (according to DIN 18134 "Soil – Testing procedures and equipment – Plate load test"). The following strain modulus shall be met as acceptance criteria:

- Subgrade (embankment) - 45 MPa
- Subbase course (drainage layer/frost resistance layer) - 60 MPa
- Base course/surface (unbound aggregate mixture) - 120 MPa.

5.4.3. Requirements for base course

The base course shall be built using unbound aggregate mixtures. Properties for the base course aggregates shall be described based on:

a. EN 13242 "Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction"
b. EN 13285 "Unbound mixtures – Specifications".

5.4.4. Requirements for frost resistance layer

The designer shall take into account the maximum permissible frost heave values described in the table below. The need for and thickness of a special pavement layers (drainage layer or frost protection layer) shall be calculated. Frost protection and drainage functions could be combined within one pavement layer (e.g. unbound mixture with low fines content and suitable permeability). The suitability of materials to fulfil these functions shall be assessed according to national regulations and/or standards.

Category of road and type of surface	Max heave value, cm
I Category	

Unbound aggregate mixture pavement	10
Surface dressing	6
Asphalt or rigid pavement	4
II Category	
Unbound aggregate mixture pavement	12
Surface dressing	8
Asphalt or rigid pavement	4

TABLE 5: MAXIMUM PERMISSIBLE FROST HEAVE PER CATEGORY

The most traditional solution to ensure frost resistant pavement is the use of course and durable aggregate. Material is considered to act as a drainage layer if the content of fines (<0.063mm particles) is ≤5% (assessed in accordance with EN 933-1). Material properties shall be assessed according to national standards. If required, other means of tests and assessment procedures could be used to verify the draining and frost protection properties of the materials as long as adequate evidence supporting such approach is submitted for approval to Client (including calculations and cost/benefit analysis).

5.4.5. Requirements for drainage layer

The designer shall assess necessity of drainage layer and calculations to verify drainage layer thickness shall be conducted.

Drainage layers shall be designed:

- If the subgrade soil has low permeability (K_f<0,5 m/24h tested according to national standards)
- If it is necessary due to hydrogeological conditions.

Proposed pavement design solution must ensure efficient drainage from the pavement. Design solutions shall ensure that the bottom of the subbase layer is at least 30cm above highest water level (incl. capillary water level).

In the case of using unbound mixture (e.g. sand, gravel) as a drainage layer, the minimum thickness shall be 30 cm. If required, other means of effective drainage solutions may be considered as long as adequate supporting evidence is submitted for approval to Client.

Materials can be considered as drainage layer if filtration coefficient is Kf ≥1,0 m/24h (tested according to national standard), proportion of fine (<0.063mm) particles are ≤5% of total material amount and methylene blue value ≤10(test according EN 933-1 ''Tests for geometrical properties of aggregates. Determination of particle size distribution. Sieving method'' and EN 933-9 "Assessment of fines- Methylene blue test").

5.4.6. Requirements for subgrade

Only mineral materials that fulfils further mentioned requirements shall be used for subgrade.

Subgrade strain modulus (E_{V2}) in the upper part of the subgrade layer (≤ 1m from the surface of the top of subgrade) shall be at least ≥45 MPa, or CBR ≥ 20% (according to DIN 18134 "Soil – Testing procedures and equipment – Plate load test" and EN 13286-47 "Unbound and hydraulically bound mixtures - Test method for the determination of California Bearing Ratio (CBR), immediate bearing index and linear swelling"). The deformation modulus on the lower layers of subgrade (> 1 m from the surface of subgrade) shall be at least ≥25 MPa or CBR ≥ 8%. The organic content of soil shall not exceed 2% of mass in depth <1m of subgrade surface.

If existing soils are considered for subgrade construction, then during the design development stages the designer shall evaluate properties of soil to ensure all criteria is satisfied. If existing soils do not fulfil the requirements, then additional technical solutions shall be considered (replacing soil, construction of additional layers, usage of geosynthetic materials, stabilization of soil, etc.). <u>The designer shall propose at least 3 (three) different solutions and provide full justification for a cost-efficient solution supported by appropriate calculations.</u>

5.4.7. Typical cross sections

Access roads dimensions and pavement shall be designed by national legislation, standards and regulations from the road owners. Maintenance road pavement shall be designed with unbound aggregates mixture surface, if the pavement design or Client does not require otherwise. Where bound pavement is required, the designer shall ask confirmation from the Client. Embankment height and slopes shall be designed in most cost and environmentally effective way while also considering embankment stability, land usage and susceptibility to erosion. Recommended gradients for the embankment slopes are 1:2 (50%) and ditch slopes is 1:1.5 (66.7%) respectively. Material suitability should govern the suitable slope gradient according to the short-term and long-term stability calculations.

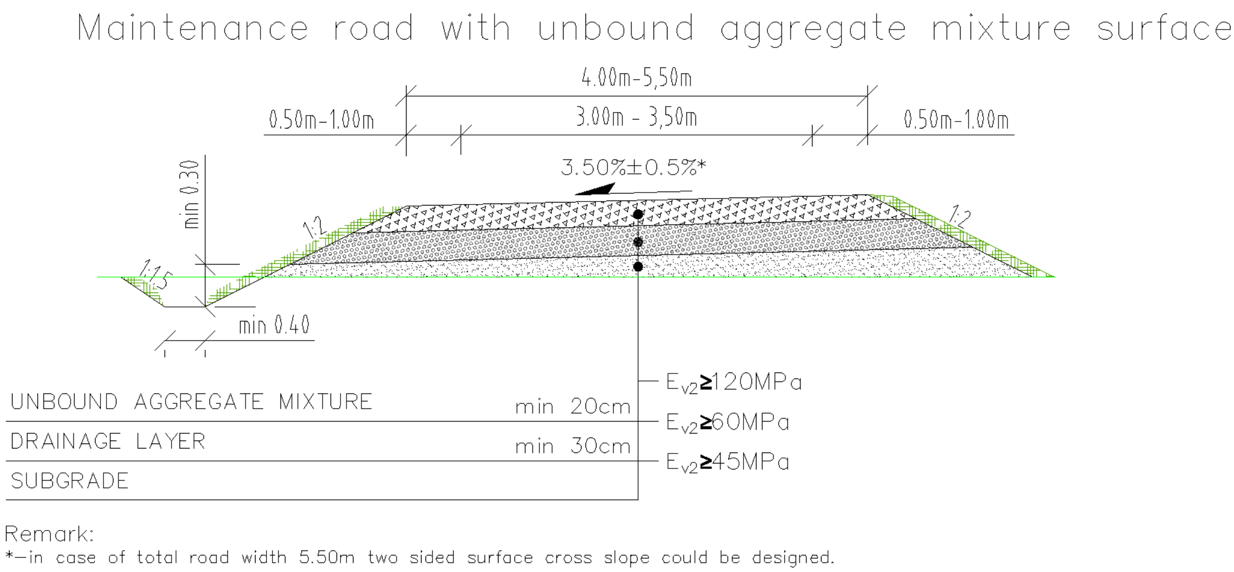


FIGURE 7 TYPICAL MAINTENANCE ROAD CROSS SECTION WITH UNBOUND AGGREGATE MIXTURE SURFACE

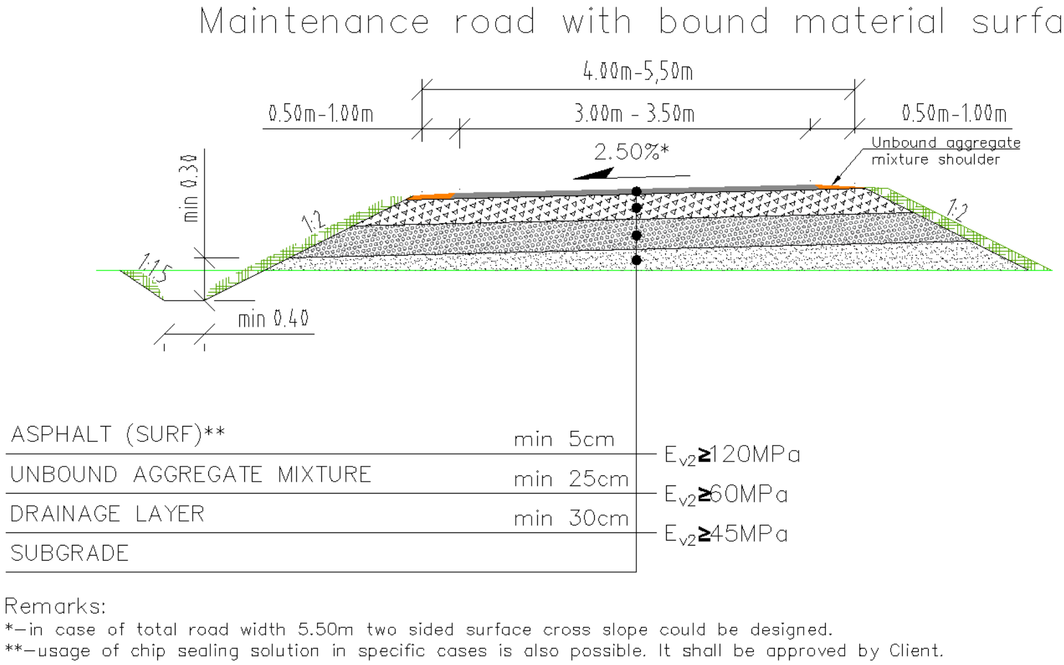


FIGURE 8 TYPICAL MAINTENANCE ROAD CROSS SECTION WITH BOUND MATERIAL SURFACE

5.5. Parking areas

Parking lots are mandatory near new objects (e.g. international railway stations, local railway stations, industrial buildings, maintenance buildings, etc..).

Minimum number of parking spaces (public and for staff) across all the Rail Baltica line shall be calculated according to national legislation and regulations.

For situations where public objects are forecasted to have a high number of users, traffic flow analysis (modelling) shall be conducted. The minimum number of parking spaces may be reduced or increased according to national legislation and standards.

The parking lots in railway stations shall be adapted for disabled people according to national legislation and standards.

Parking lots technical parameters (including pavement, lightning, drainage, etc.) shall be designed according to national legislation and standards.

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7. Constraints for highway parallel to high speed line

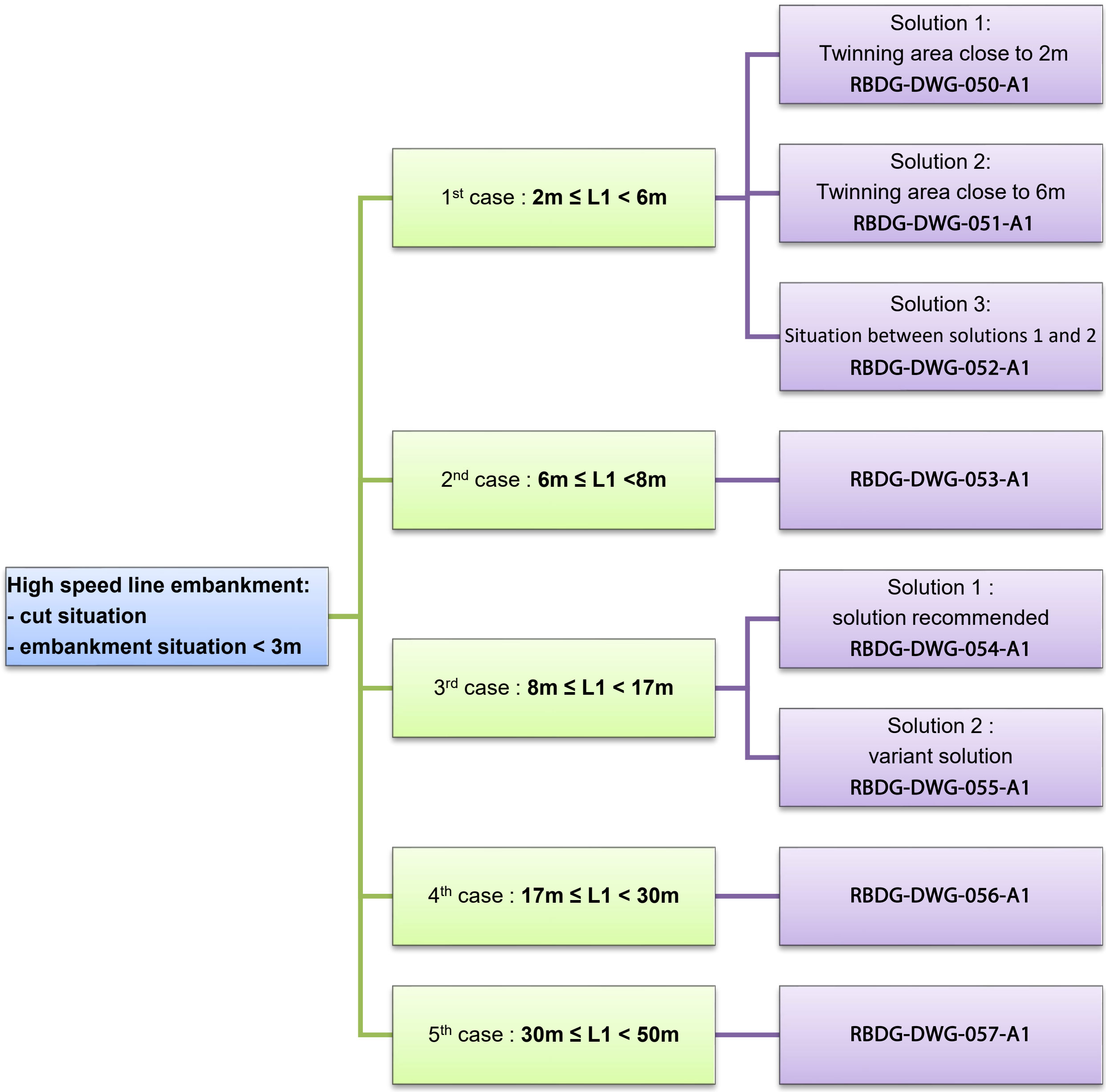
7.1.1. Twinning with high traffic routes

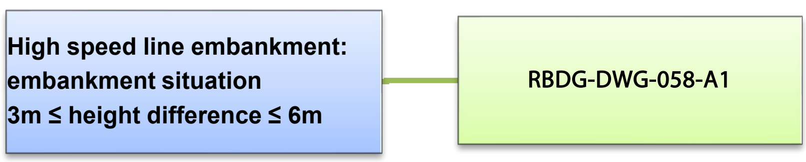
The anti-penetration protections to be implemented along the high-speed line in the case of twinning with major traffic roads (motorways, national roads, major departmental roads) is defined according to the distance between the limit of the railway installations and the limit of the roadway (identified as "L1" distance in the cross sections).

The above limits are defined as follows:

- Limits of the roadway:
  - Outer edge of the Emergency Stopping Lane
  - Outer edge of the Outer Shoulder
- Limits of the railway installations:
  - Outer edge of the railway embankment (external generator of the drainage system like ditch, outer edge of cut or the toe of the fill, outer edge of a noise barrier).

Several cases shall be applied depending on the value of the distance L1 and the difference in elevation between the high-speed line embankment and the road embankment. These cases are summarized below for application.


High speed line embankment:
- cut situation
- embankment situation < 3m
1st case : 2m ≤ L1 < 6m
2nd case : 6m ≤ L1 <8m
3rd case : 8m ≤ L1 < 17m
4th case : 17m ≤ L1 < 30m
5th case : 30m ≤ L1 < 50m
Solution 1:
Twinning area close to 2m
RBDG-DWG-050-A1
Solution 2:
Twinning area close to 6m
RBDG-DWG-051-A1
Solution 3:
Situation between solutions 1 and 2
RBDG-DWG-052-A1
RBDG-DWG-053-A1
Solution 1 :
solution recommended
RBDG-DWG-054-A1
Solution 2 :
variant solution
RBDG-DWG-055-A1
RBDG-DWG-056-A1
RBDG-DWG-057-A1


High speed line embankment:
embankment situation
3m ≤ height difference ≤ 6m
RBDG-DWG-058-A1

7.1.2. Twinning with secondary roads

In the case of twinning with secondary roads with low traffic, in particular maintenance roads built outside the rights-of-way to establish access to the high-speed line embankment, to open up isolated plots or resettle a minor roadway towards a bridge crossing the road HSR, safety devices shall be provided when the high-speed line embankment is:

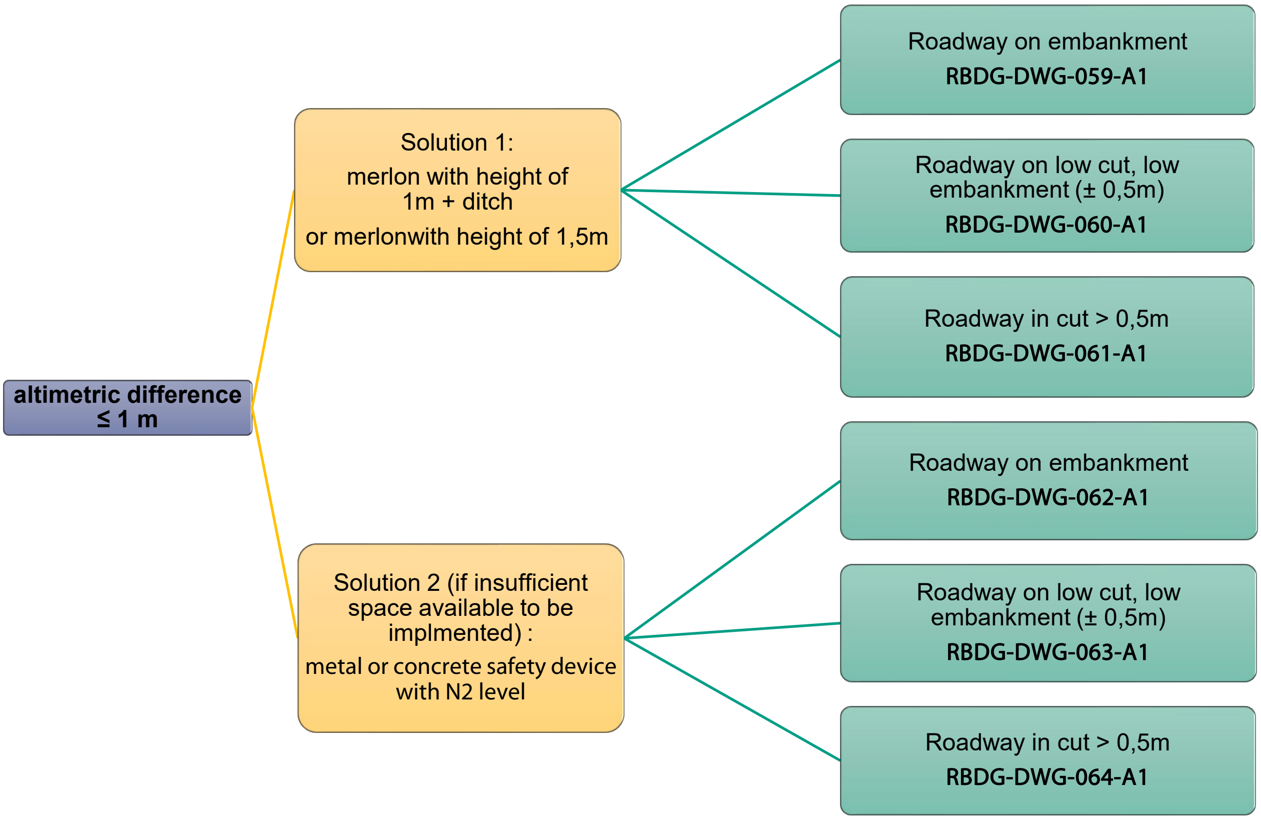
- in embankment of a height less than or equal to 1m from the secondary network,
- in cut whatever the depth is.

The safety device to be used is a merlon whose minimum height from the roadway is 1 m, associated with a ditch. The characteristics of the merlon and the ditch are shown on the standard cross - sections presented in annex.

<u>Specific case:</u>

- In the case of a single-lane lateral lane, in order not to double the drainage system, a merlon without ditch will be implemented with a height of 1.5m from the roadway level.
- If there is insufficient space to install a merlon, the installation of a metal or concrete retaining device, suitable according to the traffic and speed limit of the roadway, will be considered.

Different cases occur according to the available space and the altimetric difference between the high-speed line embankment and the road embankment (refer to typical cross sections):



8. Environmental conditions for systems

All System shall be designed and constructed in compliance with EN 50125-2 and EN 50125-3. Parameters stated in these standards and below also apply to non-electric components of the railway systems, except if other, system specific requirements are more stringent.

8.1. Atmospheric pressure / Altitude

All system shall be A1 defined as per §4.2 of EN 50125-2 and §4.2.1 of EN 50125-3.

The Signalling and Telecommunications System placed in tunnels shall withstand typical pressure variation (+/-5kPa) defined in §4.2.2 of EN 50125-3.

8.2. Temperature

All system shall be constructed to withstand temperatures equivalent Class T2 as defined in EN 50125-3, chapter 4.3.

8.3. Humidity

All system shall be constructed to withstand humidity according to class T2 in EN 50125-3, chapter 4.4.

8.4. Wind

All system shall be constructed to withstand wind according to EN 50125-3, chapter 4.5 and EN 50125-2, chapter 4.4.1 with a maximum wind flow velocity of $v_{10} = 24m/s$ (W1).

The wind velocity W1 is defined in accordance with requirements from Eurocode of the 3 countries.

8.5. Surrounding air

All system shall be constructed to withstand wind velocity according to class SW 1 (low – 0.6m/s) in EN 50125-2, chapter 4.4.

8.6. Rain

All system shall be constructed to withstand a rain intensity of 6mm/minute as stated in EN50125-2, chapter 4.5 and EN50125-3, chapter 4.6.

Signalling and Telecommunication systems shall be in line with international protection classes according to IEC 60529.

8.7. Snow, ice and hail.

All system shall be constructed to fulfil requirements as stated in EN 50125-2, chapter 4.6 and EN 50125-3, chapter 4.7. All system shall be designed for the effect of hail. The diameter of the hail stones shall be taken as 15mm.

The Signalling and Telecommunications System shall be constructed to withstand normal ice lumps that fall off moving rolling stock and fulfil requirements stated in EN 50125-3, chapter 4.8.

The Catenary System shall be designed taking into account snow and ice load to a temperature up to +5°C.
The Catenary System shall be designed for an ice load of class I3 (heavy 15N/m) on conductors.

8.8. Solar radiation

All system shall be constructed to withstand solar radiation as stated in EN 50125-3, chapter 4.9, with a maximum radiation effect from the sun of 1120 W/m2 and EN 50125-3, chapter 4.8 (category R2).

8.9. Lightning

All system shall be designed for the effects of lightning according to the Standards EN50124-1 and EN50124-2.

8.10. Pollution

All system shall be designed considering the low pollution levels 4C1, 4B1 and 4S1 if the EIA is not stating otherwise.

Where located in tunnels such as defined in the Standard EN50125-2, all system shall be designed for high pollution levels 4C3, 4B1 and 4S3.

Where located in bridges crossing highway or train network, all system shall be designed for high pollution levels 4C3, 4B1 and 4S3.
For coastal area, all system shall be designed for high pollution levels 4C3, 4B1 and 4S3.

Signalling and Telecommunication systems shall be in line with international protection classes according to IEC 60529.

8.11. Vibration and shocks

Vibrations and shocks are defined as per chapters 4.13.1, 14.13.2 and appendix C of EN 50125-3.

8.12. Fire protection

The Catenary System shall be designed for fire protection according to the Standard EN50125-2.

The Signalling and Telecommunications Systems shall be protected with a gaseous fire suppression system based on e.g. inert gas as stated in EN 12094.

All products shall be in compliance with Regulation (EU) 2016/364 of 1 July 2015 on the classification of the reaction to fire performance of construction products and the related Construction Product Regulation (CPR).

Severity	Euroclass	Classification criteria	Additional criteria	AVCP system (Assessment and Verification of Consistency of Performance)
"Non combustible" *(e.g. mineral insulated)*	A_{ca}	EN ISO 1716 Gross heat of combustion		**"1+"**, including: • initial type-testing and **continuous surveillance,** • Audit & testing of samples **by 3rd party certification body** Factory production control by manufacturer
"Low-Fire-Hazard" *cables* *(various levels)*	$B1_{ca}$	EN 50399 **Heat release** **Flame spread** EN 60332-1-2 **Flame propagation**	**Smoke production** (s1a, s1b, s2, s3) EN50399/EN61034-2 **Acidity** (a1, a2, a3) EN 50267-2-3 **Flaming droplets** (d0, d1, d2) EN 50399	
	B2ca			
	Cca			
	Dca			**"3"**, including • initial type-testing by 3rd party laboratory factory production control by manufacturer
"Standard cables"	Eca	EN 60332-1-2 Flame propagation		
No performance determined	Fca	EN 60332-1-2 Flame propagation		**"4"** : initial type-testing and factory production control by manufacturer

A risk assessment shall be carried out in the next design phases in order to establish fire protection measures. Passive fire protection measures shall be provided where the risk of fire spread is identified as too high.

Passive measures shall be adopted in preference to the provision of active systems.

The following rules shall be at least applicable:

- On the base of the fire risk assessment the designers in the next stage will define the fire class cable for each kind of use with regard to severity fire risk. The following criteria shall be taking into account:
    - B2ca s1a d1 a1 for areas with very high fire risks
    - Cca s1 d1 a1 for areas with high fire risks
    - Dca for areas with medium or high fire risks
    - Eca for areas with medium or low fire risks.
- All service penetrations including cable ducts and routes shall be fire sealed
- Electrical equipment shall present no fire risk for neighbouring materials
- Toxic gases during combustion shall be avoided by adapted equipment;
- The technical rooms, which are railway operation critical, shall be equipped by a fire safety system with an OCC's report.
- Active fire suppression systems shall only be included in the design where it has not been possible to reduce the fire risk to an acceptable level by other means.

9. Corrosion and exposure class

9.1. Corrosion class for steel parts

The steel parts and structures shall be designed considering atmospheric corrosion class C4 according to EN ISO9223. Higher requirements might be requirement for specific location as per environmental conditions.
Designer shall justify efficiency and sufficiency of the proposed solutions regarding protection measures for steel structures.

9.2. Exposure class for concrete parts

Concrete parts/Structures shall be designed considering exposure classes according to EN 206. Choice of the exposure class is dependent on the application and environmental conditions.
Design shall justify the exposure class chosen as per environmental conditions and type of structure. In case of concrete platform structure designer shall consider necessary protection measures regarding the use of de-icing agents.

Appropriate requirements for concrete must be provided depending on exposure class.
The recommended exposure class for surfaces protected by waterproofing is XC3. The recommended classes for surfaces directly affected by de-icing salts are XD3 and XF4.

10. Cableways

This chapter defines the minimum requirements on cableways on open line sections, in stations, in stopping points and in Systems Equipment Locations. Where necessary, additional cable ducts might be required based on detailed system design.

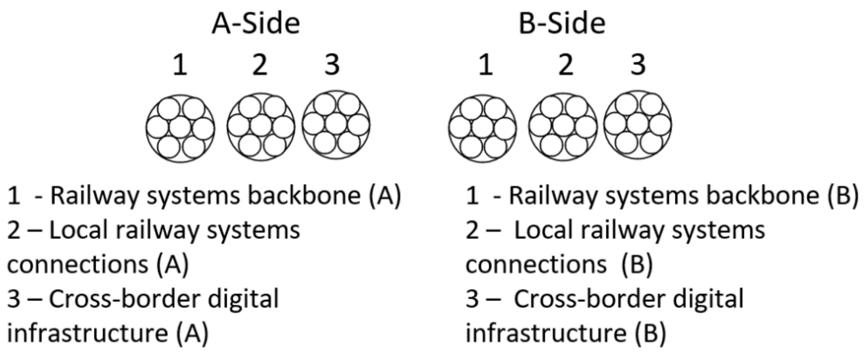
<u>Definitions:</u>

- Cableway: cable guiding and supporting system intended for cable installation including different cable path system elements: ducts, cable channels, multiducts and manholes.
- Duct: HDPE pipe used to protect all types of cables, laid directly under the ground or in cable channels.
- Cable channel: plastic or concrete U-shaped prefabricated element with cover, used for protection of ducts and cables. Cable channels are installed on surface along the track, on the earthworks or on structures.
- Multiduct: specific duct for optical cables, aggregating several microducts of inferior diameter.
- Manhole: prefabricated modular concrete chamber for pulling, connecting and dispatching of ducts, cables and cable channels.

10.1. Cableways on open line

Along the entire main line there shall be designed 3 multiducts on each side of the line (please refer to the drawing below) with maximum Outer Diameter (OD) of 70mm and not less than 7 x 16/12mm microducts for installation of fibre optic cables including:

1) one multiduct on each side of the line for railway systems backbone network needs
2) one multiduct on each side of the line for local railway systems connections
3) one multiduct on each side of the line for cross-border digital infrastructure



4. CABLEWAYS LAYOUT ON OPEN LINE

Multiducts on open line shall be directly buried or installed in cable ducts and cable channels when located in earthworks.

Distance between manholes shall not be more than 1 km and at locations defined in requirements of the Section 10.4 Concept solutions.

Multiduct connection to manholes shall be airtight.

Cableways for fibre optic cables shall be designed to provide two geo-redundant routes for cable connection to Systems Equipment Locations.

Multiducts shall be designed with minimum possible multiduct connections number between Systems Equipment Location areas with the minimal recommended length of not less than 1km and with maximum length of 1.2km between two open multiduct ends in manholes on open line and in station area.

Cableways along railway track shall be designed avoiding horizontal and vertical turns and elevations as much as possible.

10.2. Cableways in Stations, Stopping points and Systems Equipment Locations

Through stations, stopping points and Systems Equipment Locations shall be designed:

1. Main multiducts – in continuity with open line
    - one multiduct on each side of the line for railway systems backbone network needs
    - one multiduct on each side of the line for local railway systems connections
    - one multiduct on each side of the line for cross-border digital infrastructure
2. Communication, LV /MV voltage and local railway systems:
    - 3 ducts on each side of the line with OD of 110 mm
    - Maximum distance between manholes 200 m
    - Recommended minimum distance between manholes 50 m

In case if additional cables for connection of trackside equipment, return current / negative feeder for traction subsystem, etc. shall be installed, these shall be laid in additional cable channels or ducts.

10.3. General requirements

Designed cableways shall provide at least 25% spare capacity in each duct separately for future needs. Designer shall design cableways in addition to described above in chapters 10.1 and 10.2 in case if these will be required for provision of spare capacity.

Designed duct compression strength parameters shall be at least 750N and 1250N for ducts used for undertrack crossing. Duct compression force tolerance shall be selected according to IEC 61386-1. Designer shall provide static load calculations for each type of undertrack crossing solution.

10.3.1. Distance requirements

10.3.1.1. *Cable ducts*

HV/MV (with voltage higher than 1kV) and LV or copper signalling cables shall be installed in different ducts.

Cable ducts shall be designed at a horizontal distance more than 30 cm from catenary mast foundations, 1m from drainage manhole and more than 3,1 meters from railway track axis. Exceptional cable duct distance value of 2,8m from track axis and 0,5m from drainage manhole may be applied in case of limited installation space condition for cable ducts, which do not allow to implement the nominal distance of 3,1m.

Cable ducts shall be laid at the minimum depth of 0,8m from soil surface (measured from the top edge of the highest duct). Exceptional cable duct depth values may be applied in case of underground structure elements, e.g. culverts, which do not allow to implement the nominal depth of 0,8m:

- 0,5m, with a marking on site;
- 0,3m, with ducts covered by poured concrete or plate and with a marking on site.

The above-mentioned exceptional values for depth shall be coordinated and approved by RB Rail AS and are applicable only if:

- The edge of the closest cable duct is located at the distance of 3,1 m from the nearest track axis;
- On the length of maximum 10 m;

otherwise cable ducts shall be installed in surface cable channels.

Signal wire shall be designed to be installed together with cable ducts for location purposes during railway operation.

Cable ducts crossing under the tracks shall be designed at minimum depth of 1,2m below the sleeper, measured between the lower edge of the lowest sleeper and the upper edge of cable ducts.

10.3.1.2. *Cable channels*

Cable channels shall be located only in pedestrian walking areas without possibility of traffic. Designed surface load shall be not less than 10kN/m2.

Cable channel and covers shall be designed to avoid any horizontal mouvment of cover, due to its usage as walkway.

All cable channel covers shall be designed with non slippery surface.

A minimum distance of 10cm between MV (with voltage higher than 1kV) and LV or copper signalling cables shall be provided with a separator, and in compliance with EMC standards.

If cable channels aimed for cable transition from manholes to track side equipment are designed along the track, it is recommended to locate them in the center of the maintenance path and system space, except for cable channels located in structures.

For duct transition from manhole to cable channel on culverts and bridges, the transition element of the cable channel shall be designed in the centre of the manhole.

In any case, cable channels shall be designed at distance not less than 3,1m meters from railway track axis.

Where cable channels are designed to be installed in the subballast layer:

- The minimum thickness of subballast layer under the cable channels shall be 30 cm. This could be achieved by increasing the thickness of the subballast layer at the location of cable channels. In this case, the subballast layer with increased thickness shall be extended to the side of the embankment.

- Additionally, track permeability could be maintained by using special layer under the cable channels. This layer shall be made with coarse aggregate, with d ≥ 8 mm or using geosynthetics with draining function to allow rapid permeability under the cable channel. In case coarse aggregate layer is considered, the minimum thickness shall be 10 cm. In case the geosynthetics are considered, the layer thickness shall be selected depending on the product.

- The detailed properties of the coarse aggregate or geosynthetic shall be coordinated and approved by RB Rail AS and described in the material Technical Specifications.

- Designer shall specify temperature requirements for HDPE ducts to be installed in the cable channel to prevent warping due to the different temperature behaviour of HDPE pipes and cables.

10.3.1.3. *Manholes*

Manholes shall be designed at a distance more than 5m from catenary mast foundations and more than 3,1 meters from railway track axis. Exceptional cable manhole distance value of 2,9m may be applied in case of limited installation space condition for manhole, which do not allow to implement the nominal distance of 3,1m. If the distance is less than 5m from catenary pole foundation, designer shall provide calculations of static loads.

Manholes shall be located only in pedestrian walking areas without possibility of traffic. Manhole cover load class shall be not less than B125, according EN 124:2015.

All manhole covers shall have protection against unauthorized access.

All manhole covers shall be designed with non slippery surface.

Manhole covers shall be designed in a way that they cannot fall into the manhole and harm personnel or equipment.

Ladders for personnel access and shelves for cable organization purposes shall be designed inside the manhole.

Manhole and cable channel connection elements shall be designed at a distance more than 3,1m meters from railway track axis.

Described below minimal cableway system element horizontal distances shall be applied.

Element*	Element width, m	Distance from track axis, m	Distance from drainage manhole, m	Distance from catenary pole foundation, m	Distance from track axis to element axis, m
Cable ducts type (CD1, CD2, CD3)	0,39	3,1	1	0,3	3,3
Cable channel Size 1 (CC 1)	0,4	3,2	Located in the centre of maintenance and systems path		
Cable channel Size 2 (CC 2)	0,5		Located in the centre of connected manhole**		
Cable channel Size 3 (CC 3)	0,8				
Cable manhole Type IV and Type V	1,0	3,1	5	5	3,6
Cable manhole Type VII	1,4	3,1	5	5	3,8
Manhole and cable channel connection elements	0,84	3,1	-	-	3,5

* all referred element types are described in Section 10.4.1.
** used only on culverts and bridges.

10.3.2. Protection from ground and rainwater

Cableways elements shall be protected against rain and ground water overflood, which shall include:

- All manholes shall have rainwater drainage or connection to drainage system;
- If according to the results of the geotechnical survey, hydrology study and modeling HWL above bottom of manhole level has been detected in the area of the manhole installation and water may accumulate in the cable manholes, the civil design shall provide solutions.

10.4. Conceptual solutions

Conceptual cableway solutions shall be applied for all railway sections as described below. In exceptional cases such as presence of other infrastructure or spatial constraints which limit implementation of the described below concept cableway solutions, any deviations shall be coordinated with RB Rail AS.

In exceptional cases (see RBDG-MAN-012, Chapter 3) when cable ducts shall be designed in already built or designed sections as well in cases of urban constraints, parallel railway infrastructure and other limited space conditions, when the cableway requirements of Design Guidelines cannot be met, an alternative solution that ensures all originally required cableway functionality is allowed.

10.4.1. Cableways elements

Described below conceptual solutions shall be applied for cableways elements:

10.4.1.1. *Cable ducts*

Cable duct capacities shall be designed, according specific needs of the systems on every location, based of the following configuration:

- Cable Duct type 1 (CD 1) consists of 3 multiducts with an outer diameter (OD) not more than 70 mm and with not less than 7 microducts – typical arrangement of open line;
- Cable Duct type 2 (CD 2) consists of 3 multiducts with an OD not more than 70 mm with not less than 7 microducts, which are inserted in 3 ducts with an OD of 110 mm - typical arrangement for culvert and bridges;
- Cable Duct type 3 (CD 3) consists of 3 multiducts with an OD not more than 70 mm with not less than 7 microducts, which are inserted in 3 ducts with an OD of 110 mm, plus 3 ducts with an OD of 110 mm - typical arrangement for stations, in Stopping points and in Systems Equipment Locations.

It is preferable to route cable ducts alongside of siding tracks rather than main track due maintenance convenience.

10.4.1.2. *Cable channels*

Channel capacities shall be designed, according specific needs of the systems on every location, based of the following configuration:

- Cable Channel Size 1 (CC 1) consists of a precast cable channel with integrated cover with outer dimensions of 400 x 275mm and internal dimensions not less than 240 x 155mm on turnout area, Systems Equipment Locations area and ecoducts;

- Cable Channel Size 2 (CC 2) consists of a precast cable channel with top laid cover with outer dimensions of 500 x 270mm and internal dimensions not less than 370 x 155mm on culverts and bridges on open line;

- Cable Channel Size 3 (CC 3) consists of a precast cable channel with top laid cover with external dimensions of 800 x 270mm and internal dimensions not less than 700 x 155mm on culverts and bridges on station area.

HDPE pipes in the cable channel for additional protection of backbone cables shall be designed only at locations when underground duct could not be designed (e.g. on bridges and culverts).

10.4.1.3. *Cable duct crossings under the railway track:*

Under railway track crossings capacities shall be designed, according specific needs of the systems on every location, based of the following configuration:

- 5 ducts with OD of 110mm
    - Not less than every 1km;
    - At least on one side of the culvert, ecoduct and railway bridge;
    - At both sides of the railway bridge (for bridges longer than 50m) and additional 5 ducts with OD of 75mm in the middle for railway bridge with length more than 500m;
    - At Stopping point: at 100m distance from each side of the platform edge;
- 10 cable ducts with OD of 110mm
    - Not less than every 400m in area of siding tracks in a station;
    - At both sides of the turnout area, but not closer than 2m to the turnout: measuring from the turnout toes or the shunting limit;
    - At station area: at one side of culvert and railway bridge;
    - At station area: at both sides of the railway bridges (for bridges longer than 50m) and additional 5 ducts of 75min the middle for railway bridge with length more than 500m;
    - At both sides of Systems Equipment Locations;
- 15 HDPE cable ducts with OD of 110mm in the middle of platform area;

10.4.1.4. *Manholes*

Concrete prefabricated modular manholes shall be designed:

- At Systems Equipment Locations – as described in Fig 5;

- On Open line – every 1km and at each road overpass as described in Fig 6;

- At ecoducts – on one side of the structure as described in Fig 7;
- At culvert – only in exceptional case, when cable ducts cannot be designed according to exceptional values defined in Section 10.3.1.1 as described in Fig 8 and Fig 14;
- As railway bridges – as described in Fig 9 and Fig 15;
- At stations as described in Fig 10 and Fig 11;
- At stopping point as described in Fig 12;

Designer shall use the following manhole types, depending on the location and needs:

- Manholes type IV with single cover, inner dimensions of 90x80cm and outer dimensions of 110x100cm. Manholes type IV shall be designed in cases when there are no undertrack crossings or the number of ducts for undertrack crossing is 5 or less;
- Manholes type V with double cover, inner dimensions of 140x80cm and outer dimensions of 160x100cm. Manholes type V shall be designed in cases when the number of ducts for undertrack crossing is 10 or 15;
- Manholes type VII with double cover, inner dimensions of 140x120cm and outer dimensions of 165x140cm. Manholes type VII shall be designed in cases when the number of ducts for undertrack crossing is 15 and this undertrack crossing (or single manhole) is designed for entrance in equipment rooms at station, stopping point and Systems Equipment Location.

On open line sections with at least 3 km distance between two neighbouring System Equipment Locations, dimensions of the manhole located in the middle of the section (but not less than each 2 km) shall be increased to Manhole type VII in order to provide sufficient space for placing cable reserve loops.

10.4.1.5. *Manhole and cable channel connection elements*

The connection elements shall have the following dimensions:

- Precasted element with minimal inside dimensions of 40cm height, 40cm length (parallel to the track) and 70cm width (perpendicular to the track) for cable transition from manhole to precasted cable channel CC 1;
- Precasted element with minimal inside dimensions of 120cm height, 120cm length (parallel to the track) and 70cm width (perpendicular to the track) for cable duct and cable transition from manhole to precasted cable channel CC 2 and CC 3;

Designer shall increase dimensions of the cable channel and the manhole connection element shall be adjusted if it is required to meet bending radius.

10.4.1.6. *Cableways in platforms*

Connections from main cableways in platforms to the equipment and objects located on platforms or in the track, shall be implemented by means of cable channels integrated in platform surface design or ducts buried in platform structure that are connected to platform manholes.

10.4.2. Minimum cableways system configurations

Described below minimum cableways system configurations and capacities shall be applied.

Railway section	Location	
	Open line	Station area
Along track	CD 1	CD 3
Systems Equipment Locations	CD 3 + CC 1	
Bridges	CD 2 in CC 2	CD 3 in CC 3*
Culverts	CD 1 or CD 2 in CC 2*	CD 3 or CD 3 in CC 3**
Ecoducts	CD 1 + CC 1	-
Siding tracks area		CC1
Turnout area	-	CD 3 + CC 1

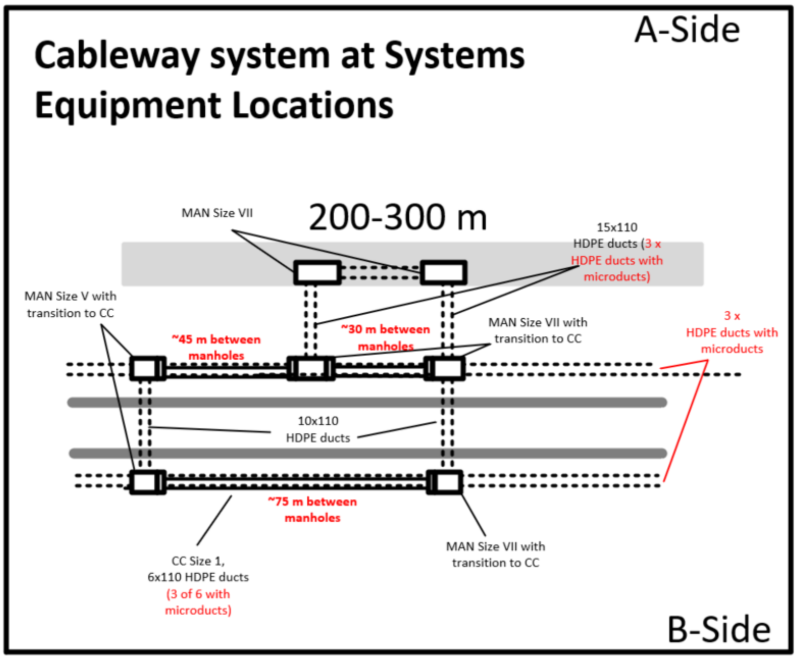
*- exact solution shall be developed depending on bridge length and exact location.

**- if duct could not be installed in at least 0,8m depth.

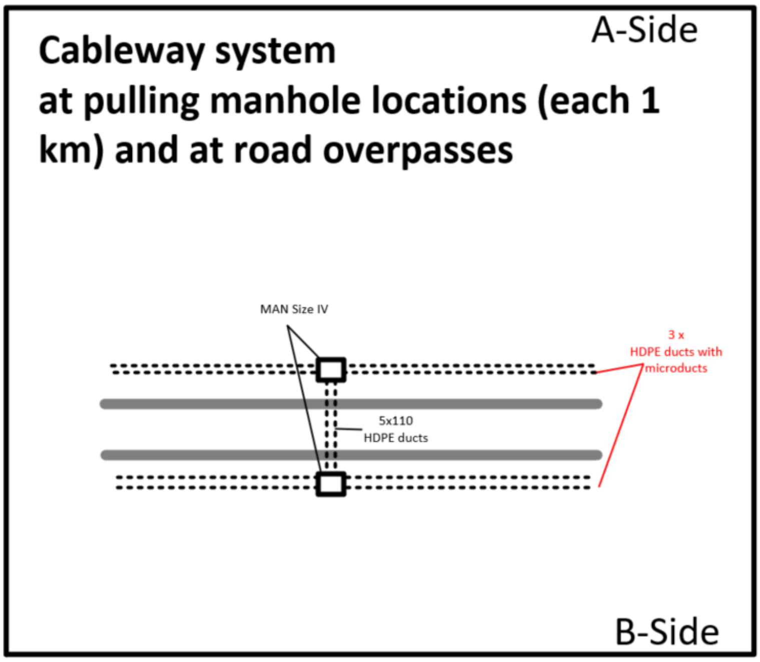
10.4.3. Conceptual solution examples

The example cableway solutions shall be applied for all railway sections as described below. In exceptional cases such as presence of other infrastructure or obstacles limiting implementation, conceptual solution deviations shall be coordinated with RB Rail AS.

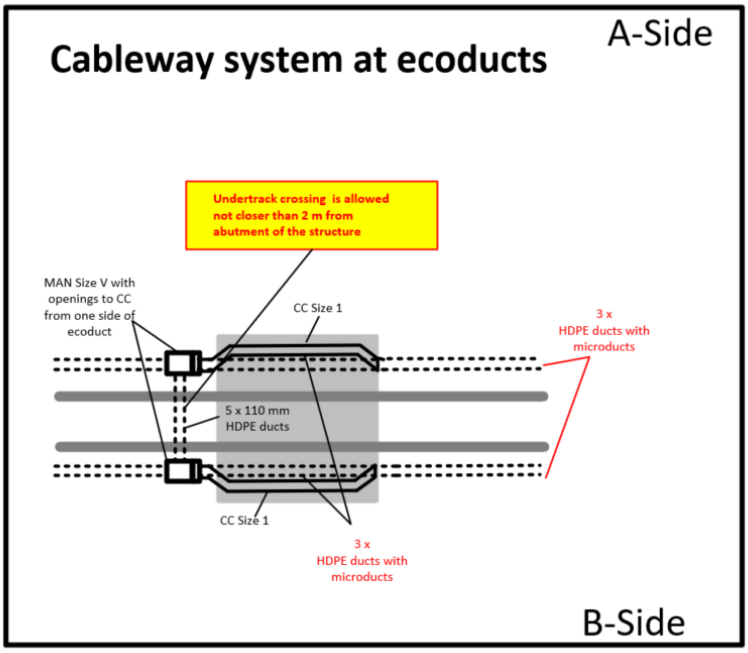
10.4.3.1. Open line location



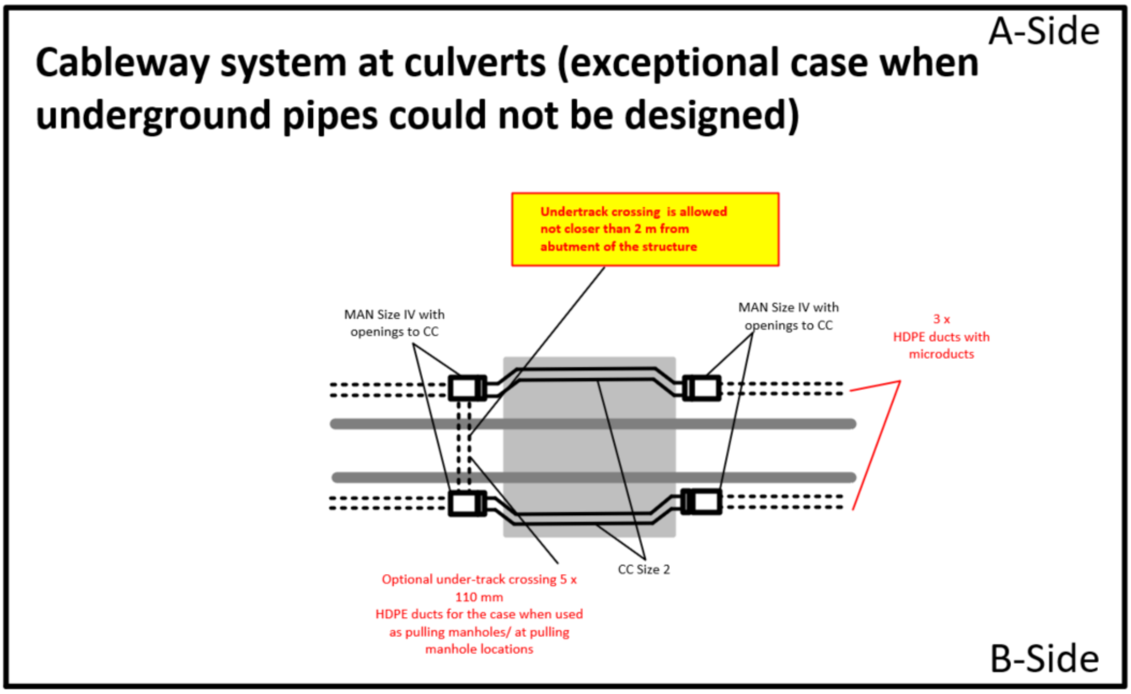
5. CABLEWAYS AT SYSTEM EQUIPMENT LOCATIONS



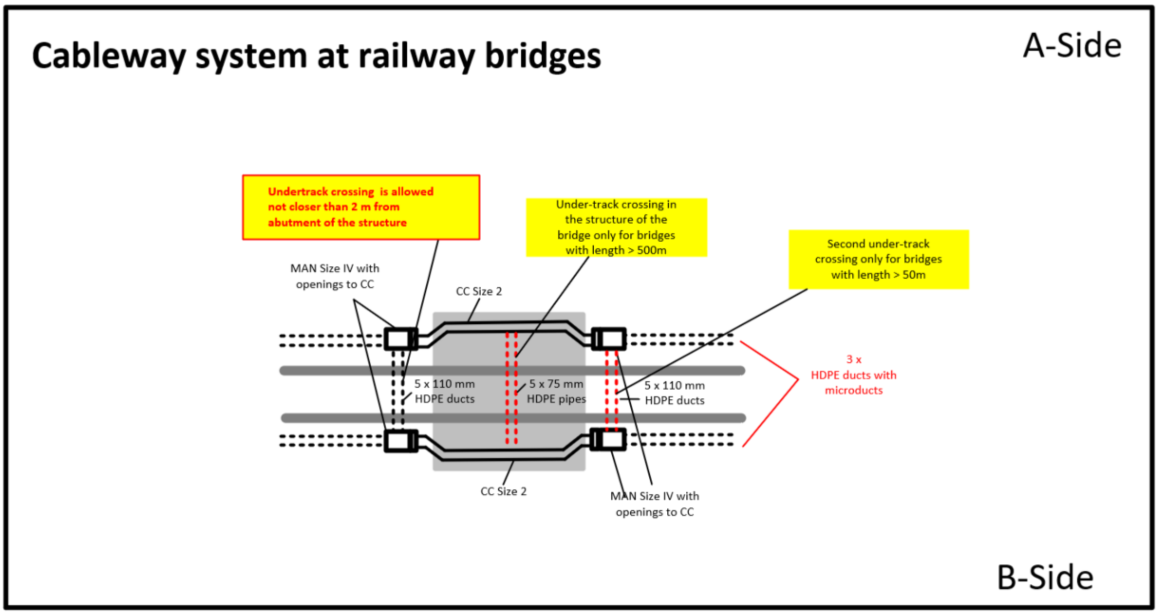
6. CABLEWAYS AT PULLING MANHOLES AND ROAD OVERPASSES



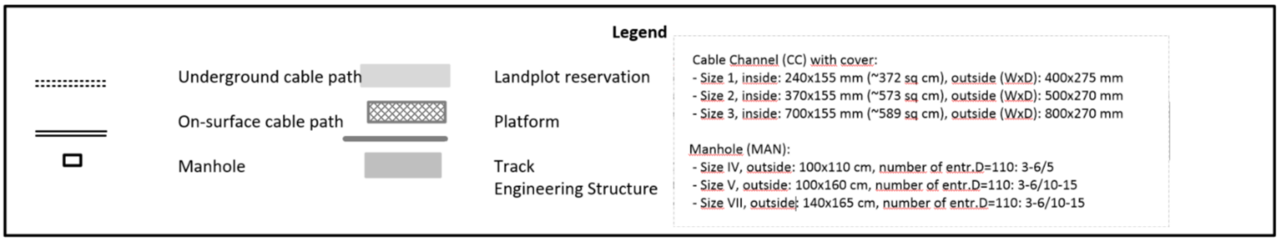
7. CABLEWAYS AT ECODUCTS



8. CABLEWAYS AT CULVERTS

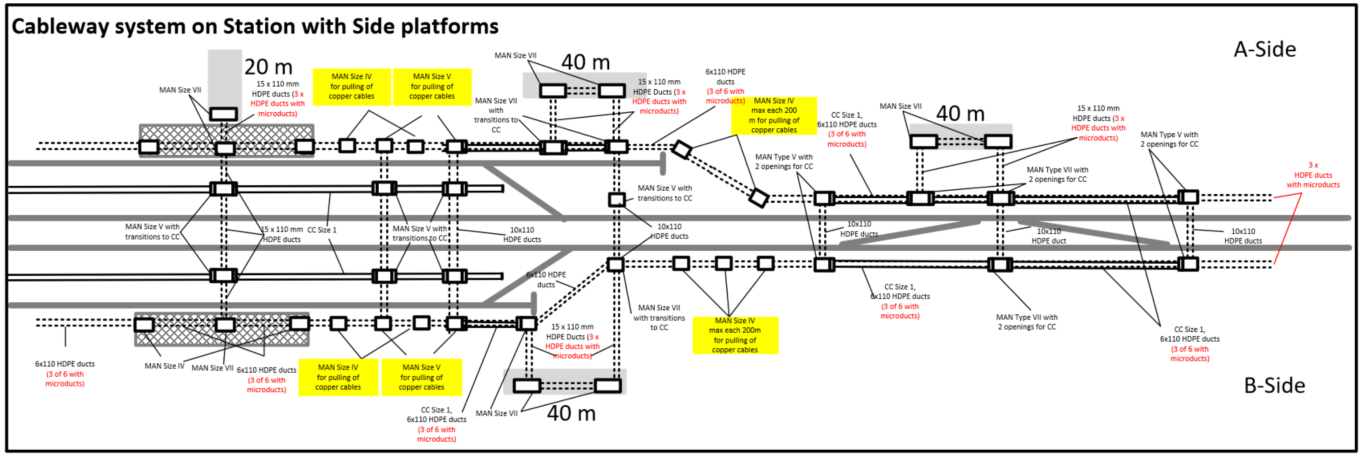


9. CABLEWAYS AT RAILWAY BRIDGES

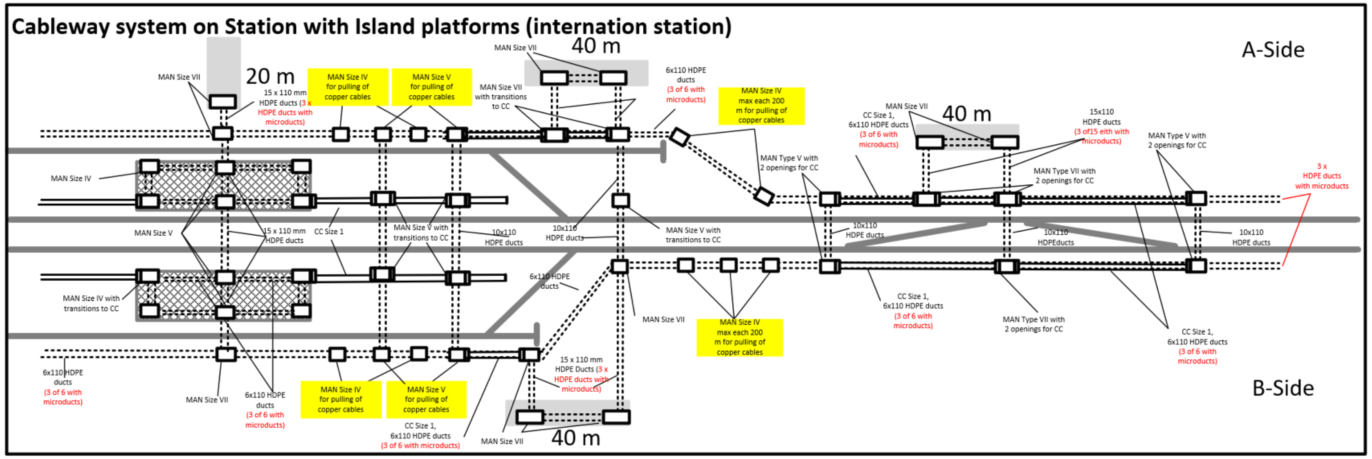

Legend
Underground cable path
On-surface cable path
Manhole
Landplot reservation
Platform
Track
Engineering Structure
Cable Channel (CC) with cover:
- Size 1, inside: 240x155 mm (~372 sq cm), outside (WxD): 400x275 mm
- Size 2, inside: 370x155 mm (~573 sq cm), outside (WxD): 500x270 mm
- Size 3, inside: 700x155 mm (~589 sq cm), outside (WxD): 800x270 mm
Manhole (MAN):
- Size IV, outside: 100x110 cm, number of entr.D=110: 3-6/5
- Size V, outside: 100x160 cm, number of entr.D=110: 3-6/10-15
- Size VII, outside: 140x165 cm, number of entr.D=110: 3-6/10-15

16. LEGEND

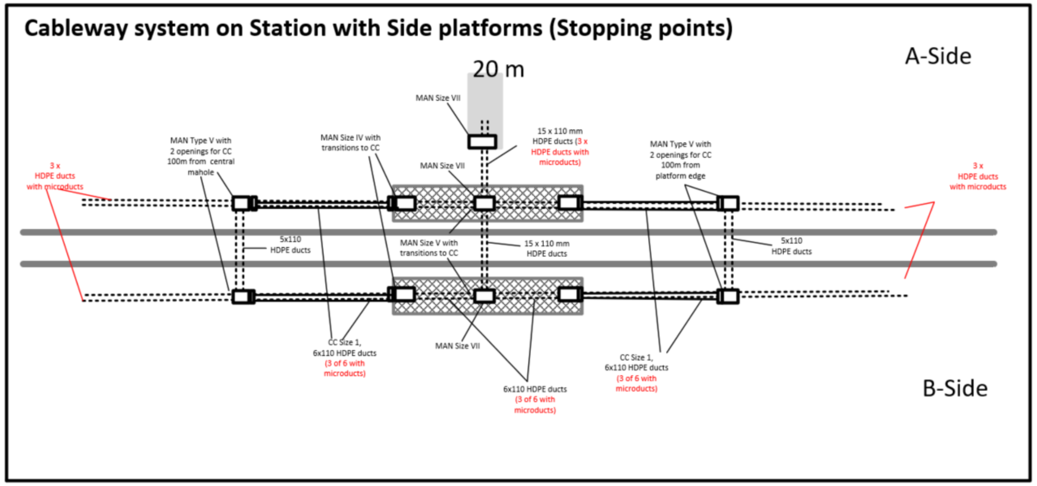
10.4.3.2. Station area location



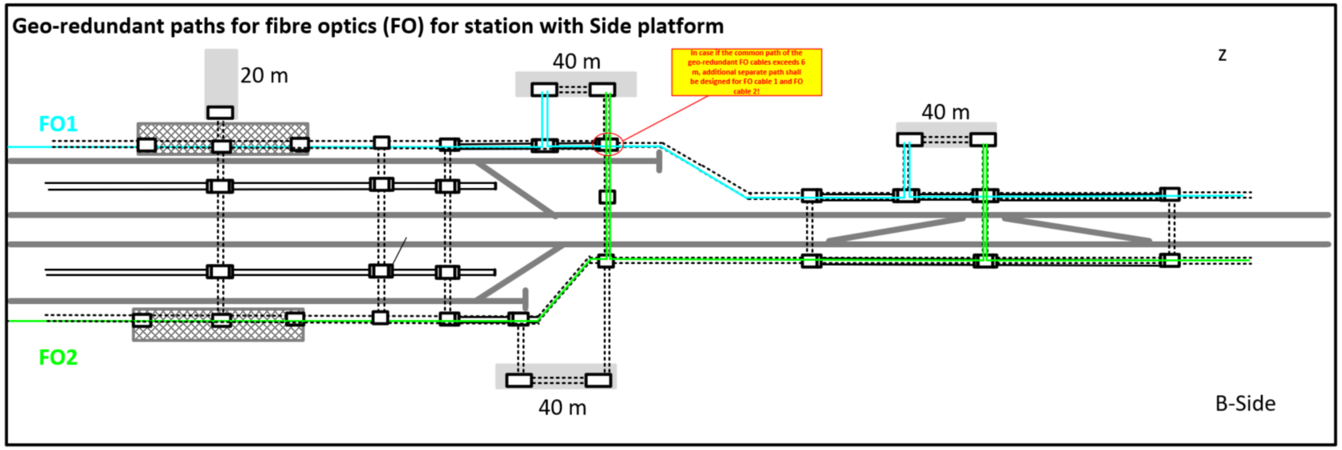
10. CABLEWAYS ON STATION WITH SIDE PLATFORMS



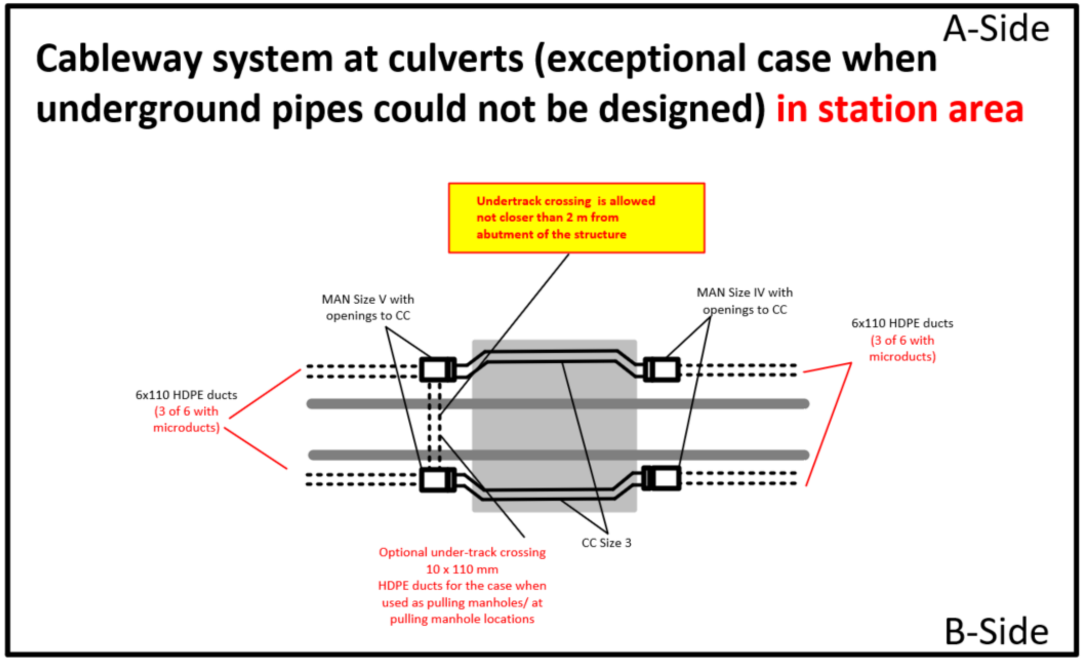
11. Cableways on station with island platforms



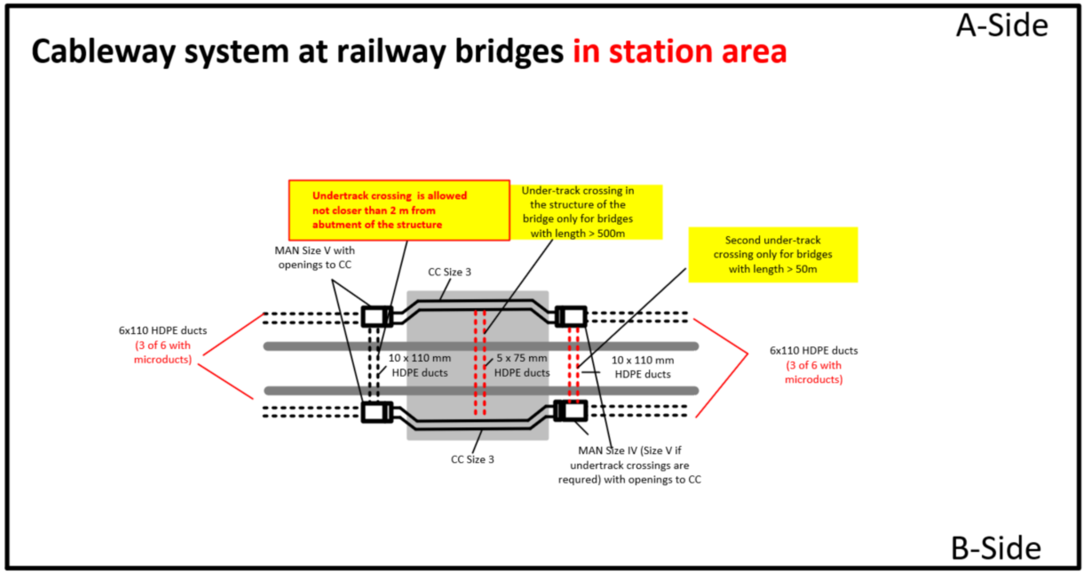
12. Cableways on stopping points



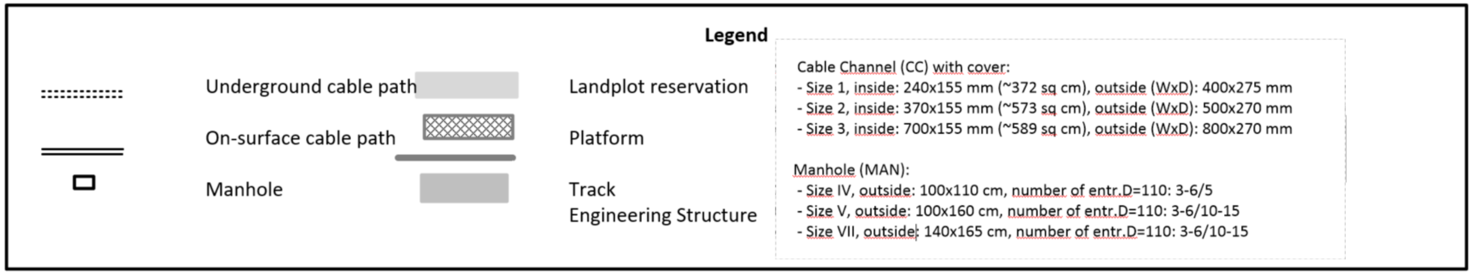
13. Geo-redundant paths for fibre optics



14. CABLEWAYS AT CULVERTS IN STATION AREA



15. CABLEWAYS AT RAILWAY BRIDGES IN STATION AREA



16. LEGEND

11. Design life

The design shall comply with following design life:

- Infrastructure
  - Earthwork, storm drainage, structure: 100 years
  - Expansion joint, bearings: 50 years
  - Track, rail, sleepers, ballast, turnouts, switches, fastening systems: 50 years
  - Components of the grounding, bonding, and lightning protection system embedded within concrete structures: 100 years
- Systems
  - Mechanical, Electrical, Plumbing, Ventilation and Fire Protection Systems: 50 years
  - Traction power supply systems and Overhead Catenary Systems: 50 years
  - Signalling, telecommunications, SCADA: 30 years
  - Grounding, bonding, and lightning protection system: 50 years
  - Battery: 20 years
  - Cable channels and manholes: 50 years

12. Typical cross sections

Main Line Earthworks	
RBDG-DWG-001	Main line embankment - Double track
RBDG-DWG-002	Main line embankment - Double track - High height (>12m)
RBDG-DWG-003	Main line cut - Double track - Dry cut (without water table)
RBDG-DWG-004	Main line cut - Double track - Wet cut (with water table)
RBDG-DWG-005	Main line cut - Double track - Dry cut with high height (>12m) without water table
RBDG-DWG-006	Main line cut in rock formation - Double track - Dry cut with high height (>12m) with pebble trap
RBDG-DWG-007	Main line - Next to actual exploited line
RBDG-DWG-008	Main line embankment - Simple Track
RBDG-DWG-009	Main line embankment - Passing loop at grade
RBDG-DWG-010	International station
RBDG-DWG-011	Depot / multimodal terminal
RBDG-DWG-012	Main line – next to an operational railway line with limited right of way
Specific cross sections	
RBDG-DWG-020	Main line embankment - Acoustic screen on embankment
RBDG-DWG-021	Main line embankment - Acoustic screen on natural ground
RBDG-DWG-022	Main line embankment - Embankment in flood plain
RBDG-DWG-023	Detail - Draining layer
RBDG-DWG-024	Detail - Protective layer
RBDG-DWG-025	Detail - Draining spur
RBDG-DWG-026	Main line embankment - Acoustic protection by merlon
Technical block	
RBDG-DWG-030	Technical block - Bridge with span
RBDG-DWG-031	Technical block - Culvert with large thickness of cover materials
RBDG-DWG-032	Technical block - Culvert with low thickness of cover materials
Drainage	
RBDG-DWG-033	Drainage - Pipe elevation and plan view
RBDG-DWG-034	Drainage - Pipe under ground level
RBDG-DWG-035	Drainage - Pipe at grade
RBDG-DWG-036	Drainage - Headwall
RBDG-DWG-037	Drainage - Pipe under ground level with lower thickness of covert materials
RBDG-DWG-038	Drainage - Pipe at grade with lower thickness of covert materials
Anti-Penetration Protection Device for highway	
RBDG-DWG-050	Railway in cut or embankment <3m) Distance to road embankment: 2m < L1 < 6m - Twinning area close to 2m
RBDG-DWG-051	Railway in cut or embankment <3m) Distance to road embankment: 2m < L1 < 6m - Twinning area close to 6m
RBDG-DWG-052	Railway in cut or embankment <3m) Distance to road embankment: 2m < L1 < 6m - Situation between 2 and 6m

RBDG-DWG-053	Railway in cut or embankment <3m) Distance to road embankment: 6m < L1 < 8m
RBDG-DWG-054	Railway in cut or embankment <3m) Distance to road embankment: 8m < L1 < 17m - Recommended situation
RBDG-DWG-055	Railway in cut or embankment <3m) Distance to road embankment: 8m < L1 < 17m - Variant solution
RBDG-DWG-056	Railway in cut or embankment <3m) Distance to road embankment: 17m < L1 < 30m
RBDG-DWG-057	Railway in cut or embankment <3m) Distance to road embankment: 30m < L1 < 50m
RBDG-DWG-058	Roadway at least 3m lower than the railway
Anti-Penetration protection device for secondary road	
RBDG-DWG-059	Altimetric difference < 1m: merlon with height of 1m + ditch or melon with height of 1,5m - RW on embankment
RBDG-DWG-060	Altimetric difference < 1m: merlon with height of 1m + ditch or melon with height of 1,5m - RW on low cut, low embankment
RBDG-DWG-061	Altimetric difference < 1m: merlon with height of 1m + ditch or melon with height of 1,5m - RW in cut > 0,5m
RBDG-DWG-062	Insufficient space available: Metal of concrete safety device with N2 level - RW on embankment
RBDG-DWG-063	Insufficient space available: Metal of concrete safety device with N2 level - RW on low cut, low embankment
RBDG-DWG-064	Insufficient space available: Metal of concrete safety device with N2 level - RW in cut > 0,5m
High speed line Railway with maintenance road	
RBDG-DWG-065	High speed line Railway with maintenance road
Structures	
RBDG-DWG-070	Viaduct – cross section
RBDG-DWG-071	Overpass – cross section
RBDG-DWG-072	Overpass - elevation
RBDG-DWG-073	Tunnel or cut and cover – cross section

13. Tolerances for the construction

The tolerances for the railway systems and subsystems construction will be defined in a separate document(s).

14. Systems Equipment Locations

This chapter defines requirements on System Equipment Locations which shall be respected by Civil Works Designers as initial land plot reservations. This initial design will be the subject of review and update by Railway Systems Designers responsible for Energy (ENE) and Control, command and signalling (CCS), including non-traction power supply and telecommunications.

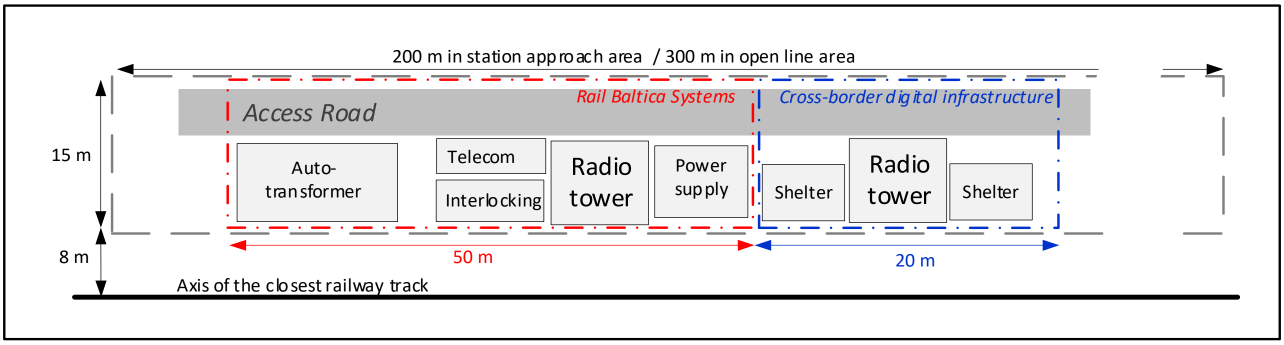
14.1. System Equipment Location outside of station and stopping point areas

For the System Equipment Location outside of stations and stopping point areas, Designer shall reserve a land plot on one side of the railway line and design a road access. The minimum width of the land plot shall be 15 m at a minimum distance of 8 meters from the axis of the closest track along the entire System Equipment Location area, in exceptional cases (such as urban areas) the area and distance to closest track axis can be reduced. RB Rail AS provides the list of required System Equipment Location chainages to Designer.

The length of the land plot reservations along the railway line shall be as follows:

- 200 m in station approach area: the distance to the closest neighbouring System Equipment Location is not more than 2 km, or
- 300 m in open line area: the distance to the closest neighbouring System Equipment Location is more than 2 km.

The diagram below provides the details on the land plot reservation area:



17. LAND PLOT RESERVATION AREA AT SYSTEM EQUIPMENT LOCATIONS

One part of the land plot reservation shall be used for location of following Rail Baltica systems:

- auto-Transformers enclosure with related protection cabinet,
- radio tower and radio-communication equipment,
- telecommunications equipment incl. fiber optic regeneration cabinet,
- interlocking equipment,
- power supply cabinet.

This reservation shall be located inside the railway fenced area (scope of Railway System Designers).

Second part of the land plot reservation shall be used for location of cross-border digital infrastructure systems:

- telecommunications equipment cabinets,
- optional radio tower.

This reservation shall be located inside the railway right-of-way, but outside the railway fenced area.

The design of the fencing system shall be according the following requirements:

- the cross-border digital infrastructure systems shall be implemented in a specific fenced area, separated from railway area;
- The cross-border digital infrastructure systems shall be directly accessible from the access road, in a manner independent from access to railway area;
- The cross-border digital infrastructure systems area shall not constitute an obstacle to the circulation along the railway tracks in the railway area, whether by car if a parallel maintenance road exists, or by foot in other case.

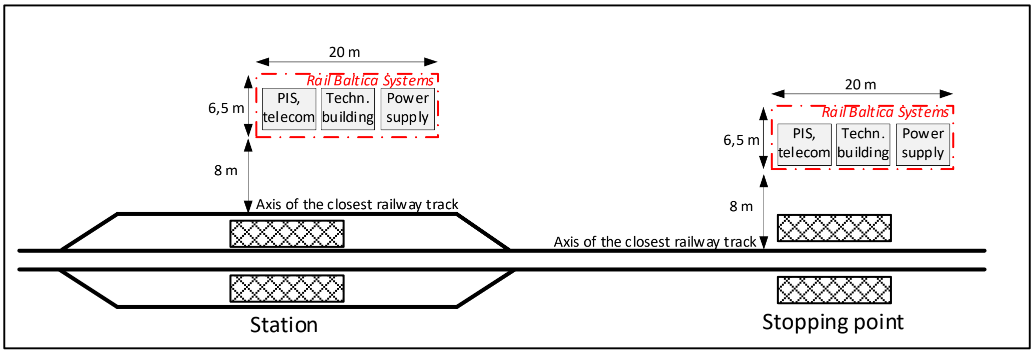
The Designer shall design no land plot reservations but only a road access for balise locations on track sections with the distance between two neighbouring System Equipment Locations more than 2 km. List of balise location chainages is provided by RB Rail AS.

14.2. System Equipment Locations in platform area

For the System Equipment Locations in platform area, Designer shall reserve a land plot of min. 130 square metres with preferred dimensions of 20 x 6,5 meters (in exceptional cases the dimensions can be adjusted to local conditions) on one side of the railway line which has a road access. Land plot reservation shall be used for location of following Rail Baltica systems:

- security system,
- Passengers Information System (PIS),
- power utilities,
- station management utilities.

The diagram below provides the details on the land plot reservation area:

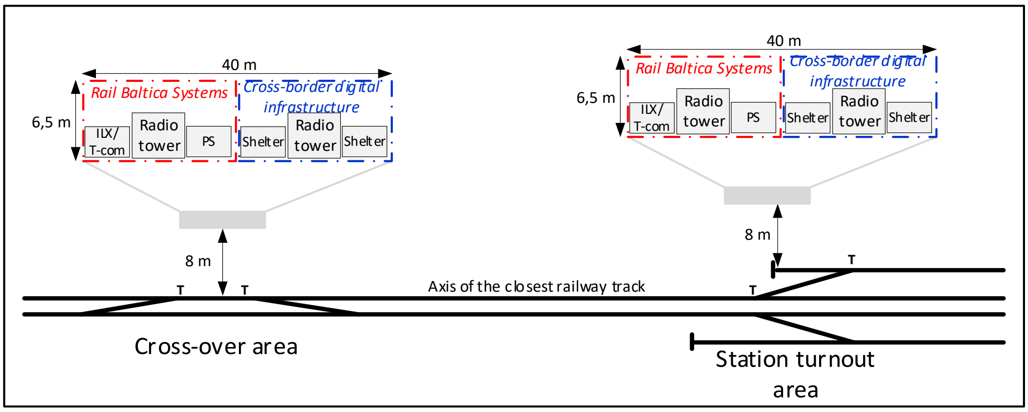


18. LAND PLOT RESERVATION AREA IN STATIONS AND STOPPING POINTS

Due to the fact that railway systems may be in future implemented inside the station building, the land plot reservation shall be made next to the planned location of the building.

14.3. System Equipment Locations in crossover and station turnout areas

For the System Equipment Locations in crossover and station turnout areas, Designer shall reserve a land plot of min. 260 square metres and the min. width of 6,5 m on any side of the railway line which has a road access. The distance to the axis of the closest track shall be not less than 8 meters, as depicted in the diagram below. The preferable location of the land plot shall be close to the turnouts marked with the sign “T”. It shall be located outside of the danger area behind the dead-end protection track.



19. LAND PLOT RESERVATION IN CROSSOVER AND STATION TURNOUT AREAS

Half of the land plot reservation shall be used for location of Rail Baltica systems:

- radio tower and radio-communication equipment,
- telecommunications equipment incl. fiber optic regeneration cabinet,
- interlocking equipment,
- power supply cabinet.

This reservation shall be located inside the railway fenced area.

Another half of the land plot reservation shall be used for location of cross-border digital infrastructure systems:

- telecommunications equipment cabinets,
- optional radio tower.

This reservation shall be located inside the railway right-of-way, but outside the railway fenced area.

The design of the fencing system shall be according the following requirements:

- the cross-border digital infrastructure systems shall be implemented in a specific fenced area, separated from railway area;
- the cross-border digital infrastructure systems shall be directly accessible from the access road, in a manner independent from access to railway area;
- the cross-border digital infrastructure systems area shall not constitute an obstacle to the circulation along the railway tracks in the railway area, whether by car if a parallel maintenance road exists, or by foot in other case.

In cases when land plots reservations required above could be designed only at the distance of more than 15 m from the axis of the closest track, Designer shall make provision for an additional area with the size of 0.4x0.6x1m at the distance of 3,8 m from the axis of the closest track for location of the one point heating cabinet for each group of 5 switches. Several areas could be located as close to each other as possible. The distance between the area and the most remote switch blades shall not exeed 300 m.