VERKEHRS TECHNIK

Wir schaffen Mobilität.

CABSYS Rail NG

The new generation

Installation instructions

Contents

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BA-RailNG 02/2022, Rev. 2.2

Foreword

Thank you for choosing the CABSYS Rail NG elevated cable duct system. These instructions are intended for all persons involved in planning and construction. It is essential that you read these instructions carefully before starting work and observe the information on route planning as well as the safety and accident prevention regulations.

Company

Domine Verkehrstechnik GmbH was founded in March 2000 as a spin-off of Techno-Composites Domine GmbH in order to focus on the special needs of customers in the rail infrastructure sector.

Since 2000, several hundred kilometres of railway lines have been equipped with the CABSYS Rail 1 & 2 GRP cable duct system. This provides reliable protection for the sensitive cable infrastructure for electrification along the tracks against weathering and unauthorised access over decades.

Over time, Deutsche Bahn AG's requirements for the cable management system have increased. This is intended to increase safety against embankment fires. The system should also be easier to install and the protection against vandalism should also be higher. In addition, the requirements for stability and strength have increased due to extreme weather conditions.

As one of Deutsche Bahn AG's partners, Domine Verkehrstechnik GmbH has significantly contributed to the development of the new generation of GRP cable duct system.

We are proud to present the new, double-walled GRP cable duct system CABSYS Rail NG.

We are happy to advise you on the possible uses of CABSYS Rail NG from our headquarters in Meppen, Lower

Saxony. Warehousing and delivery to your construction site also takes place in Meppen.

Do you need a special solution for your construction project? We can solve your problem and develop special parts for your application. Talk to us!

1. System

1.1. CABSYS Rail NG – the new generation

The new generation cable duct system – CABSYS Rail NG – is fastened with just a few screws and is thus installed significantly faster than the previous version.

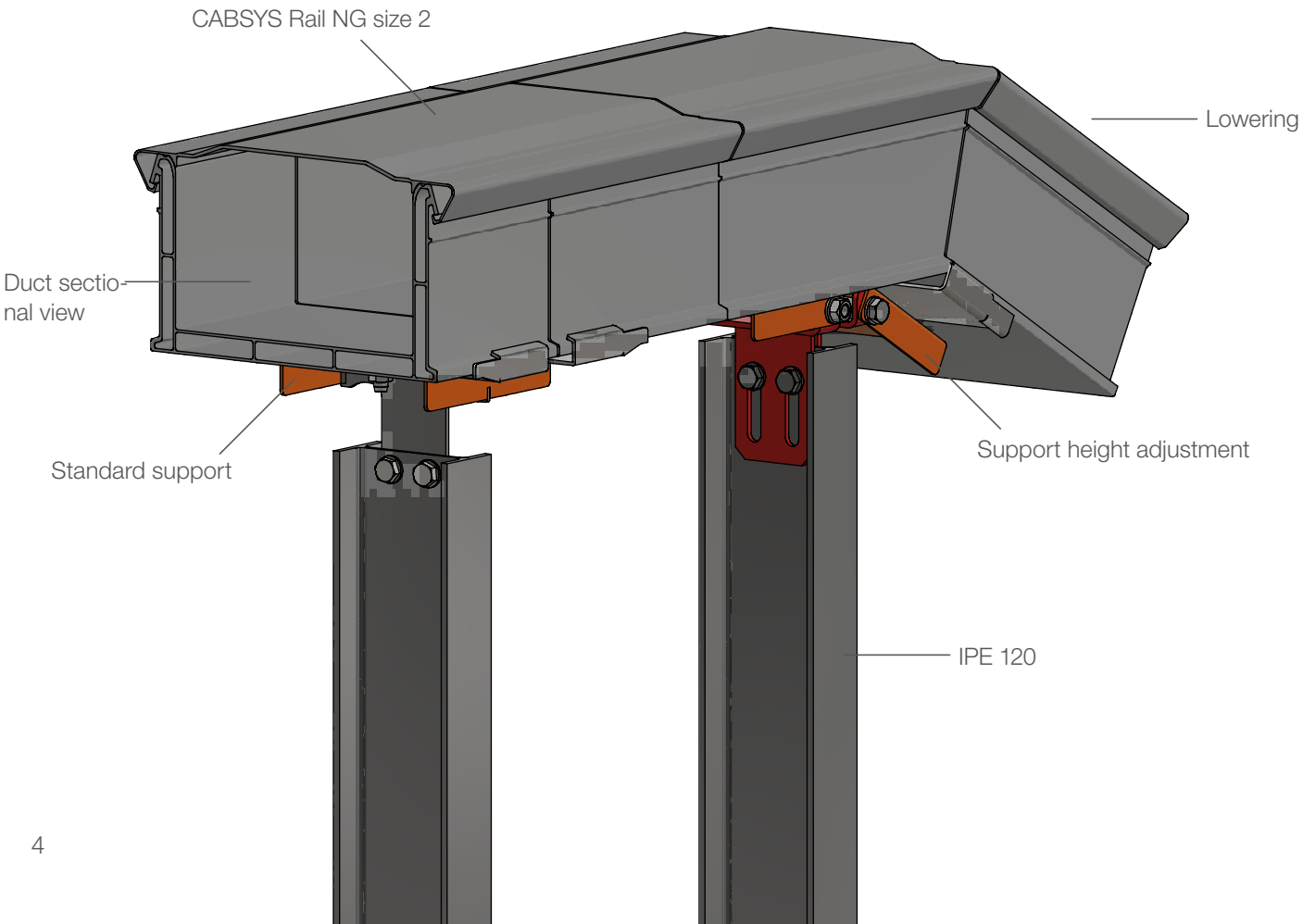
The innovative cover is very easy to lock into place – extremely time-saving, without annoying screws. The cables inside are securely protected against unauthorised access.

In coordination with Deutsche Bahn AG, the CABSYS Rail NG cable duct system was designed to protect the internal cables much more effectively against embankment fire than previously available systems.

The CABSYS Rail NG cable duct system has been tested and approved in accordance with the specifications of DB Netz AG (I.NPS 222) with the technical specifications for elevated plastic cable ducts dated 31/08/2015, Version 1.0.

Production approval DB Netz AG:

PF-2021-00347-Appendix NVO2 (October 2021)



1.2. Intended use

CABSYS Rail NG is designed exclusively for the protection of sensitive signal and power supply cables in railway and transport routes.

CABSYS Rail NG is **not** suitable for operation in the ground (burial).

The operation of CABSYS Rail NG in tunnels is **not** permitted.

1.3. Place of use and operating conditions

In the infrastructure area of railways, elevated cable duct systems may only be laid outside the safety space according to EBO. The minimum distance to the centre of the track must be determined depending on the line speed in accordance with the currently valid DB Netz AG guidelines (e.g. RIL 800.0130 etc.)

For the planning and execution of the duct route, binding information/proof is required for calculating the elevation:

- Terrain heights in metres above sea level for the course of the route
- Snow load zone in accordance with DIN EN 1991-1-3/ NA: 2010-1
- Wind loads in accordance with DIN EN 1991-1-4: 2010-12
- Ground condition in accordance with DIN 18300

In areas of snow load zone 2 with normal ground conditions, the static calculation of the elevation is considered to have been carried out. In this respect, please refer to the "CABSYS Rail NG elevation" section in these instructions and the relevant appendices of the TÜV Rheinland LGA Bautechnik GmbH report.

In some hazardous areas, significantly increased stresses can occur on the cable duct system, which must be taken into account in the planning and design, and calculated separately. These include e.g.:

- Areas in snow load zone 3
- Very high loads due to snow drift, snow slide and snow removal devices, for example on slopes, in terrain gaps
- Very high loads due to running rail traffic (pressure and suction effect)
- Very high wind loads in freestanding areas (e.g. railway embankments, etc.)

The responsible planning office and/or the person responsible for the route decides on the use and implementation of the elevated cable management system and on possible additional safety measures.

Electrical grounding of the elevated cable duct system is not necessary.

Maintenance is not generally necessary.

1.4. Product data

Cable duct and cover dimensions

	Clear width x height [mm]		Max. cable load [kN/m]
	interior	exterior	
CABSYS Rail NG I (size 1)	100 x 150	187 x 187	0.45
CABSYS Rail NG II (size 2)	250 x 150	337 x 187	0.90

Cable duct and cover – technical characteristics

Material	Glass fibre reinforced plastic (halogen-free), manufactured in accordance with EN 13706
Durability	Glass fibre rovings (longitudinal rigidity), glass fibre mats (transverse rigidity) and an additional surface nonwoven ensure decades of material resistance to weathering influences such as rain, wind and sun, as well as to common chemical substances and microorganisms. Fading of the grey GRP ducts and covers is normal and not a reason for a complaint.
Thermal elongation	3 to 5 mm in the temperature range from -30 °C to 40 °C with 6 m installation length
Dimensional stability	Durability according to ISO 75 in the temperature range from -30 °C to 80 °C
Fire protection class in accordance with DIN 53438, part 2	K1
Protection against embankment fire	Fire resistance to vegetation fire proven under defined conditions. An accredited test laboratory has proven that the temperature in the duct does not exceed 70 °C in the event of a fire. This protects the internal cables from damage.
Breakdown voltage according to VDE 303 T21 (EN 60243-1:2014-1)	30.6 kV

Elevation, attachments, screws – technical data

Steel support IPE 120	Steel S235 JR Hot-dip galvanised according to DIN 1481 Cutting edges cold-dip galvanised Standard length 180 cm Weight 19.4 kg
Support (standard, lateral adjustment, height adjustment)	Steel S700MC, galvanised
Support wall bracket and special components	Galvanised steel
Screws	Galvanised Strength class 8.8 (Tightening torque: observe specifications)

Tightening torques

	Bolted connection	Component	Torque
M12	Bolts on steel support	Standard support, lateral adjustment, height adjustment	80 Nm
M12	Flat round screw, guide plate	Standard support, lateral adjustment, height adjustment	50 Nm
M12	Clamping screw M12x170	Support height adjustment	65 Nm
M12	Screw M12x25	Expansion transition	40 Nm
M10	Panhead screw M10x45	Cable outlet expansion transition	40 Nm
M10	Panhead screw M10x25	End cap size 1 + size 2	25 Nm
M6.3	Self-tapping drilling bolt DIN 7504-K ST 6.3x19	End cap support element	Max. 8 Nm
M16	Bridge console screws	Various	Min. 80 Nm, observe specifications on drawing

Weight

Cable duct and cover	Weight [kg]
CABSYS Rail NG size 1 trough (6 m long)	32.9
CABSYS Rail NG size 1 lid (6 m long)	8.8
CABSYS Rail NG size 2 trough (6 m long)	42.2
CABSYS Rail NG size 2 lid (6 m long)	13.5

Elevation	Weight [kg]
Steel support IPE 120, 1.8 m long	19.4
Standard support for CABSYS Rail NG size 1	3.2
Standard support for CABSYS Rail NG size 2	3.3
Support lateral adjustment CABSYS Rail NG size 1	4.1
Support lateral adjustment CABSYS Rail NG size 2	4.2

1.5. Delivery and storage

Cable ducts and steel supports are packed and tied down separately on disposable pallets. GRP ducts can be easily stacked.

Supports, other accessories and fastening screws are supplied in disposable crates or cardboard packaging.

For unloading and transport on the construction site, forklift trucks or equivalent construction vehicles are required.

The ducts and supports can be easily stored outdoors. Screws and accessories should be stored in a dry place due to the nature of the packaging.

2. Safety

Before starting work, it is essential to familiarise yourself with general and local regulations for safety and accident prevention!

Observe the current version of the listed regulations as well as any other applicable regulations not mentioned here:

- DB Framework Directive 132.0118 Working in the track area
- DGUV Regulation 77, Regulation 78
- Safety measures for work on infrastructure on non-federal railways (NE) in accordance with VBG (statutory accident insurance)
- Instructions from the person responsible for the route
- Internal company and construction site specifications
- Instructions according to EU safety data sheet GRP ducts

Etc.

When carrying out any work, pay attention to your own safety and the safety of your colleagues and third parties who are not involved.

Wear personal **protective equipment**, at least in accordance with the DGUV standard: protective clothing, eye and ear protection, work shoes, gloves, and face mask as required.

Do not remove the straps when pallets are stacked on top of each other. **Falling parts** can cause **serious injury.**

When installing and processing the cable ducts, avoid **sharp-edged areas** (edges, transitions, etc.): **risk of injury**, including to persons not involved!

GRP cable ducts partly contain **residues of glass fibre and dust** (saw residue) on the surface due to the production process. These can cause **eye and skin irritation** if protective measures are not observed.

Saw the cable ducts outdoors and use **ear and eye protection** and **a mask for nose and mouth, type FFP3.** Sawdust can irritate the eyes, skin, and respiratory system.

3. Installation

3.1. Elevation

- The elevation for CABSYS Rail NG is designed for a span of 6 m. Depending on the given loads of the cable duct, the terrain shape and/or the topographical height, the span can be limited to 3 m.
- The standard length of the steel supports IPE 120 is 1.8 m
- TÜV Rheinland LGA Bautechnik GmbH provided static proof of the elevation for the most common types of terrain and ground conditions for heights up to a maximum of 700 m above sea level on level ground

The report no. 94638539/01 from TÜV Rheinland LGA Bautechnik GmbH, its appendices and applicable regulations, are decisive for the design of the elevation with steel supports IPE 120.

These appendices form part of these installation instructions and are attached to this correspondence.

- **Report no. 94638539/01 dated 12/03/2018**
- **Extended appendix_2018-03-12**
- **Layout sketch AZ 94640477**

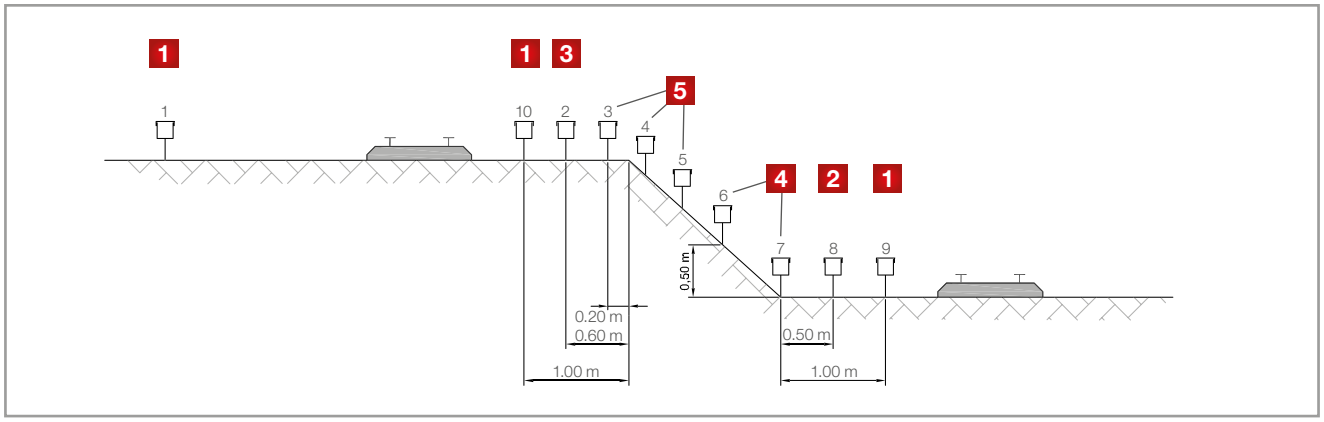
In the event of deviating values in accordance with the specifications of the report, separate evidence and calculations are necessary.

The current ATV DIN 18300 (2016) Earthworks divides the subsoil into different homogeneous areas. The classification of areas in relation to comparable soil classes can be found in the current specialist literature.

The calculation of the bedding of the steel supports is based on the worst-case constrained modulus ES = 10 MN/m² of soil class 3 in accordance with ATV DIN 18300 (2012) Earthworks.

A transfer of these results to soil classes 3 – 5 is permissible under normal conditions.

CABSYS Rail NG elevation without additional static calculation and verification



Extract of layout sketch TÜV Rheinland AZ.: 946040477

Below is a brief non-binding summary from the TÜV Rheinland LGA Bautechnik report. Binding information can only be found in the report itself.

See also Graphic 2 Extract of layout sketch TÜV Rheinland AZ.: 94640477

Taking into account the topographical height and the assumed load case combination (snow load zone, wind zone, etc.), this information applies, for which the static verification for the areas **1** **2** **3** **4** according to the layout sketch TÜV Rheinland AZ.: 946040477 is deemed to have been fulfilled.

Separate verification is required for the areas 5 (slope)

In regions with snow load zone 3, separate, reduced operating height specifications apply. See report for details.

This assumes:

- Steel stand IPE 120, length 1.80 m, integration depth 1.50 m
- Soil class 3 – 5 or comparable homogeneous areas
- Snow load zone 2
- Wind zone 3
- Terrain up to 700 m above sea level (on level ground)
- Over 700 m, separate verifications are generally required

1 Level ground

Explanation in report TÜV Rheinland paragraph 6.1

Position of steel girder 1 m or more from slope

- Support width 6 m

2 Ascending ground (trough) - slope distance from girder 0.5 m

Explanation in report paragraph 6.2

Position steel girder min. 0.5 m from an ascending slope

- Support width 6 m to 600 m above sea level
- Support width 3 m from 601 m above sea level

3 Falling terrain (dam) - slope distance 0.6 m

Explanation in report paragraph 6.3

Position steel girder min. 0.6 m to 1 m from the descending slope

- Support width 6 m

4 Duct elevation in an ascending slope 0.5 m above ground

Explanation in report paragraph 6.4

Position of steel girder max. 0.5 m above level ground in an ascending slope

- Support width 6 m to 400 m above sea level
- Support width 3 m from 401 m above sea level
- Over 600 m above sea level, additional evidence is required, taking into account the applicable ground

5 Duct elevation in slopes (position 3.4, 5 layout sketch)

Position of the steel girder greater than 0.5 m above level ground in an ascending slope. Stability calculations are generally necessary here.

3.2. Preparing for installation

Determine the cable duct route in compliance with the applicable specifications and align the horizontal course with the guide.

The position of the steel stands on the route should be selected so that the joint of the duct trough elements is centred on the support.

The installation steps for duct size 1 or 2 are identical and only differ in the selection of the corresponding components.

The following is an example description/illustration for **size 2 (CABSYS Rail NG size 2).**

Inserting the steel stands

The steel stands are inserted precisely plumb and at the correct angle. Use a suitable piling machine with positive-locking tip IPE 120 (e.g. Gayk 40). Alternatively: trench and mortar with concrete sealant.

Driven steel supports can deviate from the ideal position due to resistances in the subsurface such as rocks. Deviations of up to 3 cm from the vertical central axis, measured at the top end of the support, can be tolerated. No negative effects on stability are to be expected as a result.

Bending the steel support in the y- or z-direction, for example with an excavator arm, is not permitted! The movement puts a lot of stress on the steel support and loosens the floor, thus significantly reducing the stability. In individual cases, it is better to adapt the support to the route, for example by changing the setting or by slight mechanical alignment.

Rework corrosion protection of steel parts!

After assembly work, repair any bare metal and damaged areas over a large area with a suitable cathodic zinc dust paint. We recommend "Weicon zinc dust paint" or equivalent products that meet the requirements of DIN EN 1461. Follow the manufacturer's instructions.

3.3. Supports

There are three support types available with extensive adjustment options:

- Standard support
- Support lateral adjustment for mast bypasses, etc.
- Support height adjustment for recesses in the concrete channel or erection in a slope

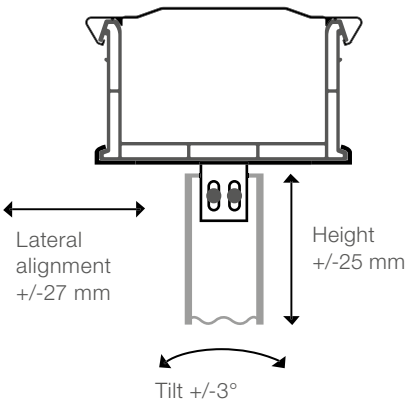
When setting up the direction change angle, it is essential to observe and not exceed the specifications according to the cable manufacturer's data sheet! The adjustment range is generally 15 – max. 30°.

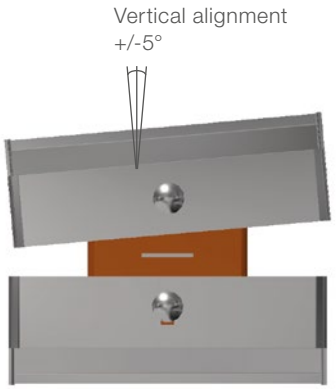
Support types

Support	Height	Lateral tilt	Lateral alignment	Vertical alignment
Standard	+/-25 mm	3°	+/-27 mm	+/-5°
Lateral adjustment	+/-25 mm	3°	+/-10 mm	+/-30°
Height adjustment	+/-25 mm	3°	+/-27 mm	+/-30°

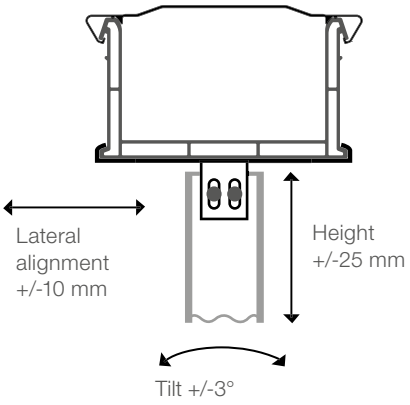
3.3.1. Adjustment and fine adjustment of the supports

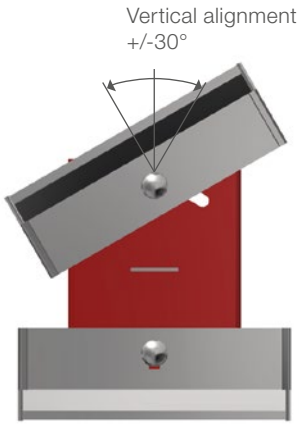
Standard support



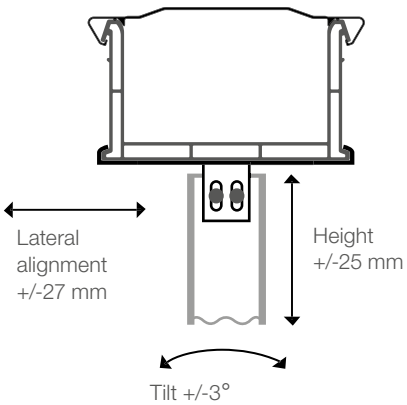


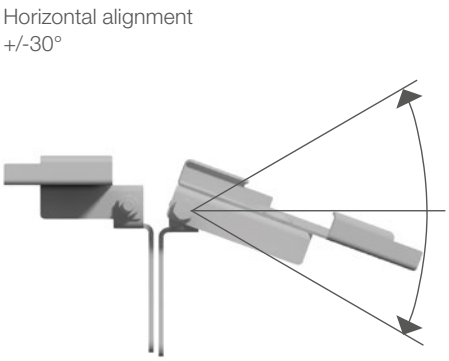
Support lateral adjustment

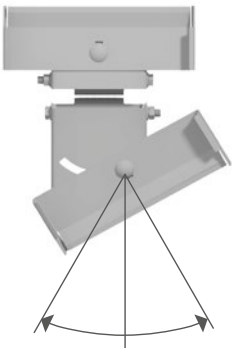




Support height adjustment



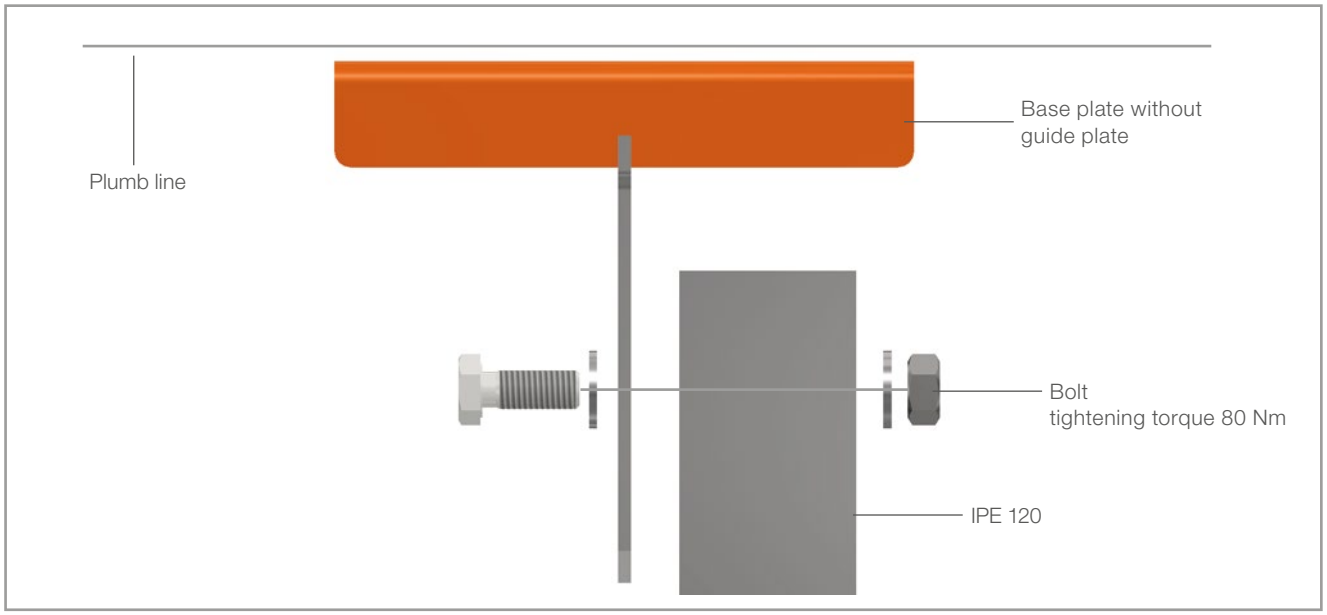




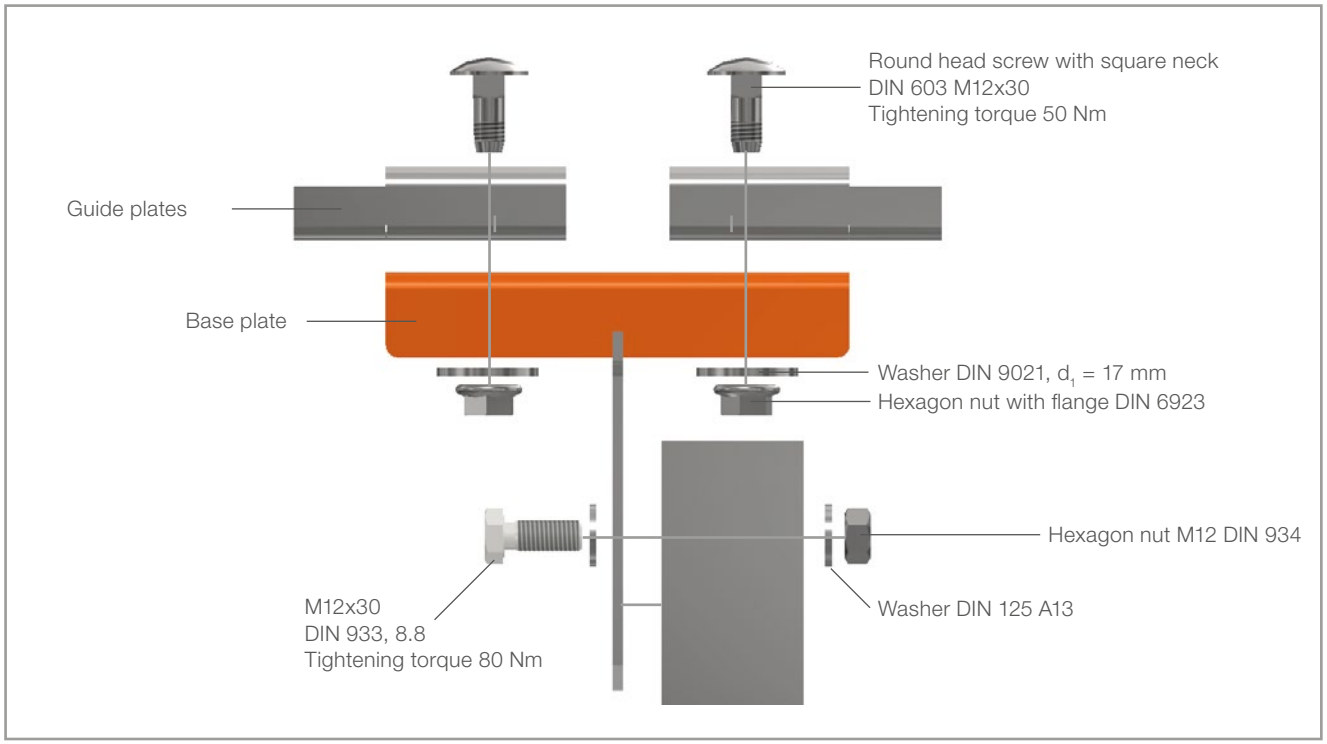
3.3.2. Assembling the supports

Required tools: Wrench width 19 mm

Mount the base plate on the steel support, align it with the plumb line and screw it tight. The guide plates are mounted together with the duct trough.



3.3.3. Assembly diagram for standard supports/support lateral adjustment



3.3.4. Support height adjustment

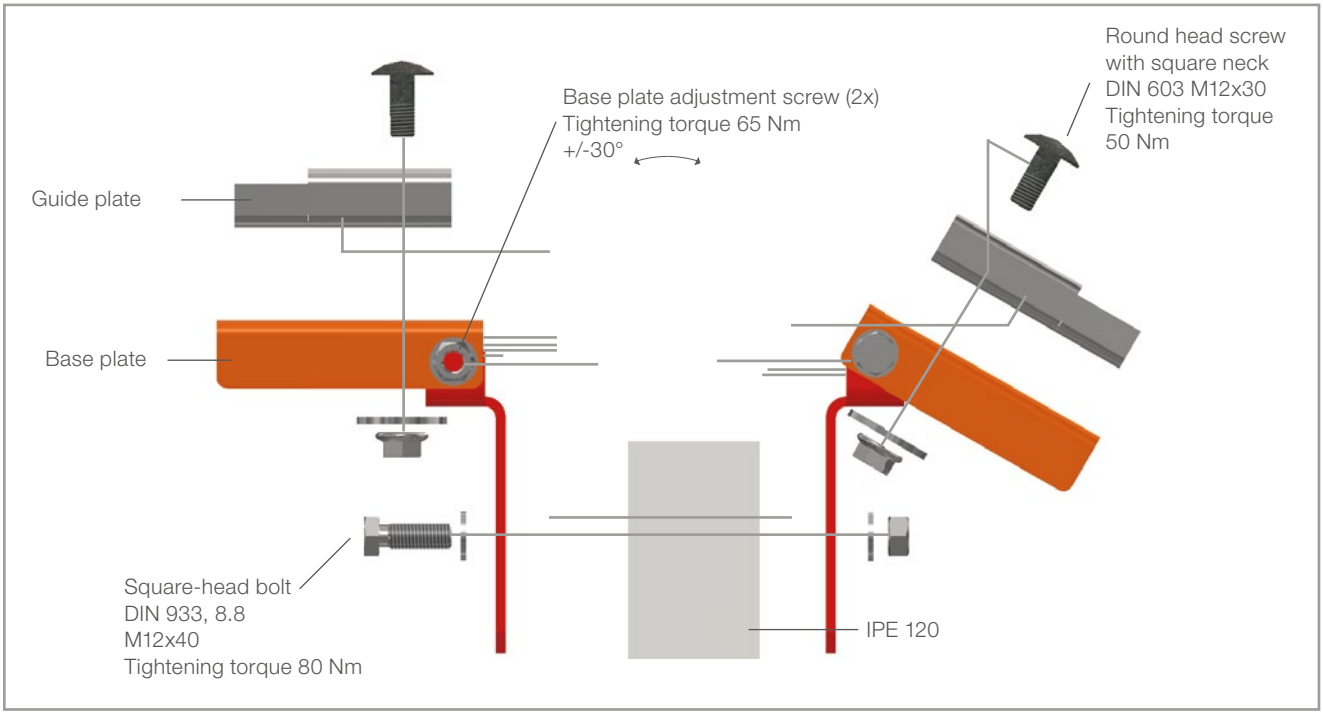
Split base plates with horizontal direction change +/-30°, such as lowering into concrete channel, ascent on slopes.

The base plates are mounted on steel supports on both sides. Due to the design, the duct extends approximately 40 mm beyond the support. This reduces the max. support spacing to 5,960 mm (standard support = 6,000 mm).

The complete component for the lowering side (on the right in the image) must be installed 5–10 mm lower due to the geometry. See drawing 121840 or 121804. Observe the tightening torque.

The lowering cable duct can then be installed with a vertical tilt of up to +/-30°. An adjustment of the mitre cut is necessary. Install the black PE support element for system stabilisation. See chapter 3.4.2.

Note the shorter support distance! (40–60 mm less)



3.4. Installing the cable duct

Required tools: Motorflex with diamond cutting disc, 19 mm wrench

Two people are required for this work.

Before installation: Make mitre cuts with a suitable angle according to the support. If necessary, cut the length of the duct trough. Use Motorflex with diamond cutting disc or equivalent.

Avoid sharp points on the inside and outside of the duct.

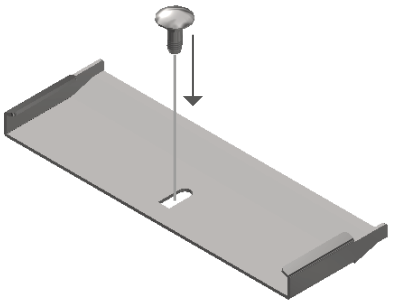
Risk of injury to persons! Cables can be damaged! Use protective gloves! Risk of crushing fingers!

3.4.1. Installing the cable duct trough

1. Insert the round-head screw into the designated hole in the guide plate.
2. Slide the guide plate with round-head screw onto the end of the duct trough of the guide plates. **For additional supports, slide further guide plates onto the duct, e.g. for a support width of 3 m.**
3. Observe the installation direction.
4. Place the duct trough with guide plate on base plate. Guide the screw thread into the elongated hole of the base plate. Align the duct trough and the guide plate. Position the joint of the duct trough elements centrally on the support, whereby a tolerance of +/- 30 mm is permitted.
5. Screw the guide plate under the base plate using a large washer and M12 flange nut. Tightening torque 50 Nm.
6. Mount the next duct trough.

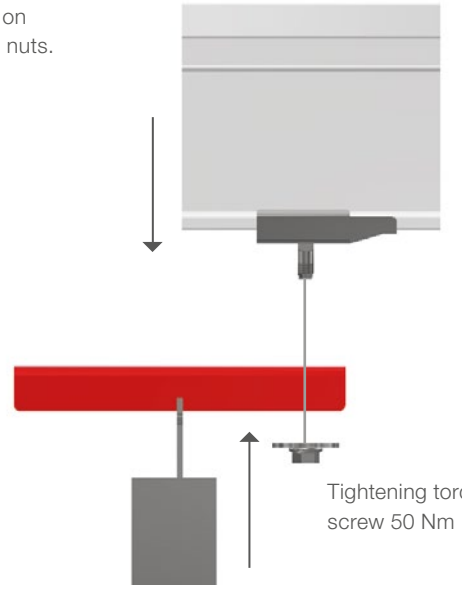
Do not install the duct elements butt-to-butt! Always leave a gap of 3–5 mm between the duct trough and cover elements to compensate for the thermal expansion of the material. Failure to do so may result in serious damage to the system during subsequent operation. Use the spacer from the accessories range.

1 Insert the round-head screw into the guide plate.



2 Slide the guide plate onto the duct.
For each additional support, slide on 2 guide plates each. Pay attention to the installation direction.

3 Position duct with guide plate on the base plate and fasten with nuts.



3.4.2. Installation of black PE support element for support lateral adjustment and support height adjustment

(Not standard support)

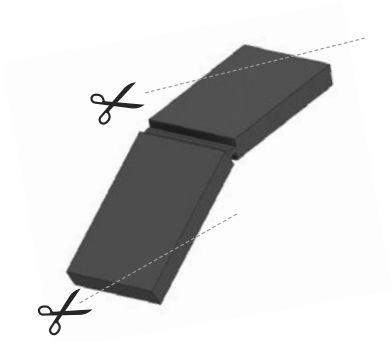
To stabilise the duct transitions, it is advisable to install a support element.

- Support element PE black width 70 mm, size 2, item no. 000631
- Support element PE black width 30 mm, size 1, item no. 000632

Fasten the first duct trough with guide plate to the base plate. Push the black PE support element halfway into the hollow chamber and secure it against slipping with a self-drilling bolt.

Slide the next trough with guide plate onto the remaining end of the support element and fasten it to the base plate. A second locking screw is not necessary. If the duct is tilted, shorten the support element (illustration shows an example).

Tightening torque for drilling bolt: 8 Nm



3.4.3. Installing the cable duct cover

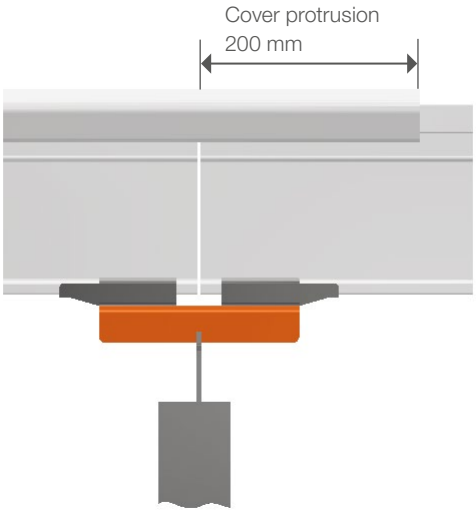
After the cover has snapped into place, the duct is a closed and protected system. Disassembly is only possible with a special lifting tool to protect against unauthorised access by third parties.

Do not use sharp-edged tools when installing the cover: Avoid damage to the duct surface.

Do not lay butt-to-butt! Leave a gap of 3–5 mm to the next cover to compensate for the thermal expansion of the material.

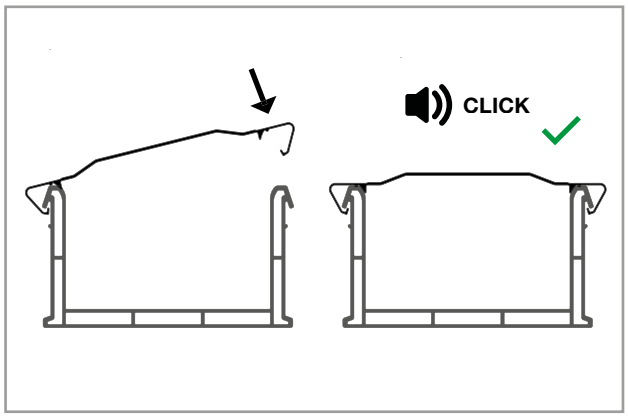
If necessary, cut the cover to length and make mitre cuts according to the duct trough. The cover should overlap the joint of the duct over a length of 200 mm.

Overlaps in mitre cuts are not possible.



Position the cover over the duct trough and hang it on one side. Audibly click into place on the other side by applying light pressure. Then check that the cover is optimally positioned and locked in place.

If necessary, use a soft rubber mallet to avoid damage to the cover.



3.4.4. Optional cover lock with clips

CABSYS Rail NG is installed in normal operation without further securing of the cover system.

In individual cases, it may be necessary to retrofit a cover securing clip:

- In areas with very short cover sections that are less than 1 m long. The strength of the cover locking mechanism may weaken under strong winds, snowbreaks or other loads. The covers must be secured with at least 2 cover securing clamps per side in these areas as a precaution. Maximum spacing of clips: 1500 mm.
- On bridges where falling parts can endanger traffic. The person responsible for the system decides on the additional protective measures.

Installation

Drill a hole of Ø 9.5 mm approximately 10 mm below the edge of the cover into the outer wall of the trough. Tip: Hold on the clip beforehand and mark the drill site using the recess in the clip.

Make sure that the internal wall is not damaged!

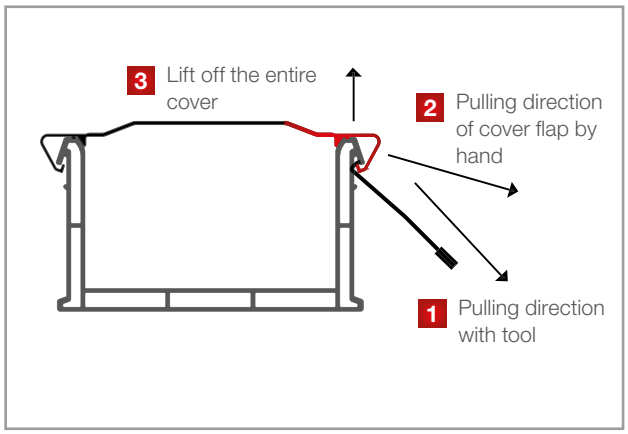
Insert the RIV-TI Flex cap nut M5x13 EPDM into the drill hole. Fasten the cover securing clip with the screw and washer. Tightening torque 2 Nm.

Retrofit kit cover securing clip (4 pcs with fixing kit), item no. 000621.

3.4.5. Opening the cable duct cover

Only use the cover opening tool with item no. 000627 from the accessories range to remove the cover.

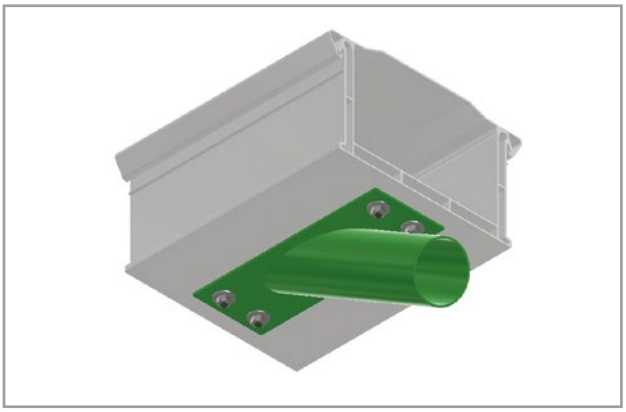
Cover opening tool



After several opening and locking operations, check the cover for damage or fatigue fracture before installation and replace if necessary.

3.4.6. Cable outlets

Cable outlet 10003133, item no. 000630



The outlet of the cables can take place downwards or to the side. The component is subsequently fastened to the duct.

Available pipe diameters (outer): 121 mm, 89 mm, 60.5 mm

For further information, see chapter 4 (Component drawings) and/or contact us.

Cut a suitable opening and four installation holes in the duct floor. For details, see the associated technical drawing, such as 10003133.

Use a jigsaw with a diamond saw blade and a drill bit with diamond setting ø 19 mm or equivalent.

Fasten the cable outlet to the duct and screw it in place.

Tightening torque screws: 40 Nm

Separable cable outlets are also available for retrofitting with existing cables.

3.5. CABSYS Rail NG on bridge rails

Due to the wide variety of bridge and bridge railing constructions, the installation situation must be assessed on an individual basis.

The solution should be found in close coordination between the client, planning office, the plant manager and Domine Verkehrstechnik GmbH as the supplier, taking into account the locally applicable regulations and guidelines.

Special components in different designs are available for connecting CABSYS Rail NG to railings and edge caps, or Domine Verkehrstechnik GmbH can develop an individual solution in close cooperation with you.

Precise measurements of the installation situation are required for the delivery of suitable parts and fasteners.

All construction work on railway structures and/or their railings must be coordinated with the responsible authority before the start.

The sole responsibility for the type of execution, stability, static calculation, etc. lies with the responsible plant manager or planning engineer.

Note the stability! Due to the loads on the structure/railings, it may be necessary to reduce the maximum cable loads.

Use the vertical railing posts to install a retaining bracket. The installation height should be as low as possible. This means that the resulting stress can be optimally absorbed.

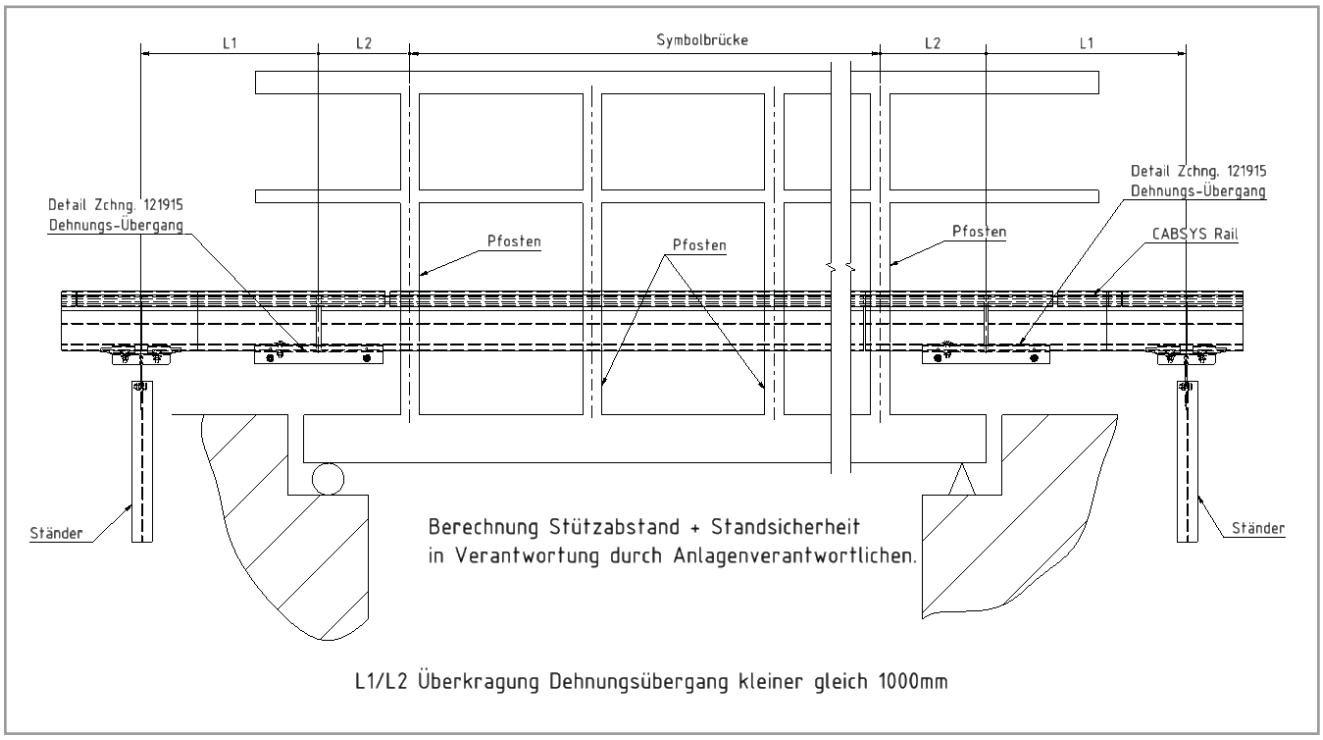
Brackets on the horizontal struts of the railing must be avoided.

Coordinate the installation positions of the brackets with the person responsible for the system!

The support distance should not exceed 3 m. For high loads, the distance may need to be reduced.

The length of the bridge extends or shortens as a result of temperature fluctuations. The structure oscillates and bends due to loads (train traffic, wind, etc.). To compensate for these forces, it is necessary to install expansion transitions at both ends of a long bridge.

Bridges and bridge railings are sometimes very old and differ in design. As a rule, the installation brackets may only be fastened to the railings, steel beams, etc. via a clamping function without damaging the bridge components. Drilling holes and machining is not permitted due to possible corrosion.

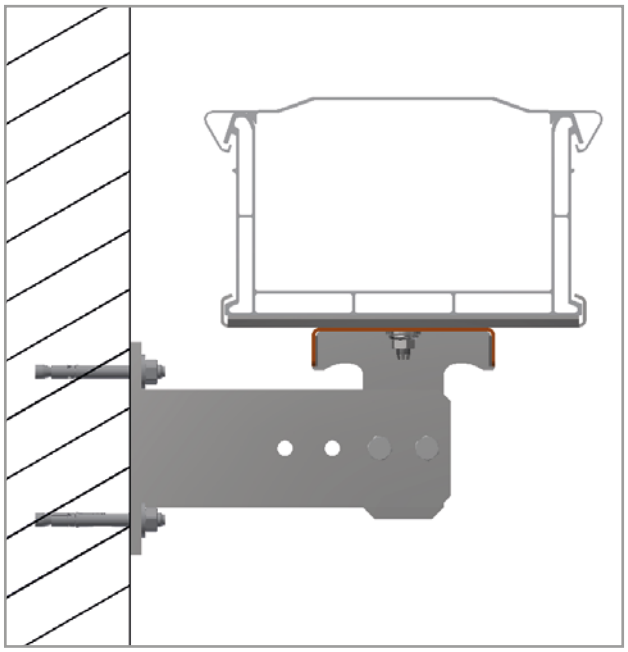


Example symbol bridge

Determine and install the position of the elongation transitions in front of and behind the bridge. See chapter Expansion transition.

Mount the base plates of the supports on the installation brackets and adjust the height and tilt.

When positioning the supports, pay attention to the total width of the cable duct with mounted cover!



Keep a sufficient distance between the duct trough and the wall/bridge railing (hand width) to enable problem-free installation/ removal of the cover.

Install the cable tray with guide plates – see previous chapter.

For optional cover securing, see chapter 3.4.4.

3.6. CABSYS Rail NG on concrete walls and buildings

Due to the wide variety of installation situations, an individual assessment must also be carried out here.

Coordination with the client, plant manager and planning office is essential. The person responsible for the system is responsible for all measures on the structure and for stability.

- Select the retaining bracket according to the installation situation and measurement

The standard version can be found in the accessories list. Other designs are produced on request. Talk to us!

- Before starting installation, determine the quality of the concrete wall and its stability
- Select and provide anchors according to the quality of the substrate. The position shall be determined by the customer in accordance with local conditions.

For concrete walls of compressive strength class C20/25 in accordance with EN 206-1/DIN 1045-2, we generally recommend the following as anchoring methods:

Fischer conical anchor rod FHB II – A L M12x100/10 with special mortar FIS 345 S or systems of the same/higher quality

- Transfer the installation height from the elevated cable duct to the structure
- Maximum support distance 3 m
- Determine hole positions and drill according to bolt type. Install and align brackets and base plate support.
- Observe the tightening torques

Install cable duct and cover – see chapter 3.4.

3.7. Expansion transition for long bridges

Since each bridge bends and oscillates under load and changes in length when the temperature changes, it is necessary to install an expansion transition at both ends of the bridge for very long bridges.

Use the expansion transition kit for this purpose.

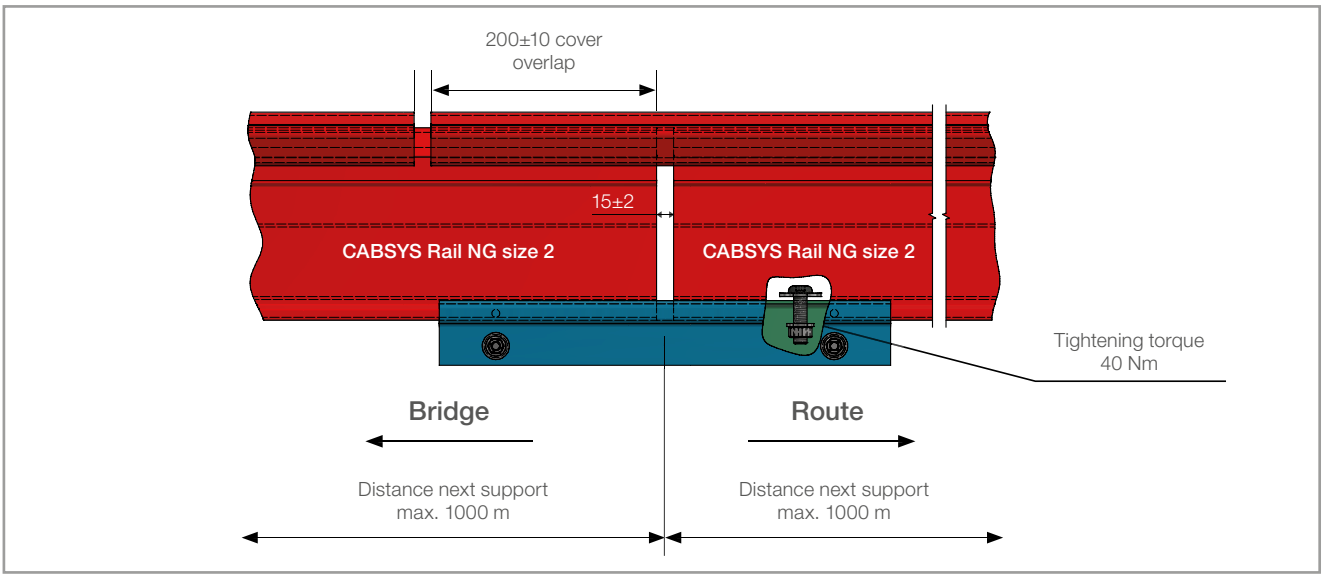
Item no. 000618 Drawing 121911, size 1

Item no. 000619 Drawing 121915, size 2

The cable duct should not end on the last support, but should protrude freestanding. Projection less than or equal to 1000 mm.

Set up expansion joint: set up 15+/-2 mm between the cable duct. Then fasten the expansion element under the trough.

Only screw the expansion element tightly to one duct trough. The other trough must remain movable.



4. Component drawings CABSYS Rail NG

No.	Description	Drawing no.	Item no. Sales unit
1	CABSYS Rail NG duct trough size 1	50458/B	000600
2	CABSYS Rail NG cover size 1	50459/B	000601
3	CABSYS Rail NG duct trough size 2	50456/B	000602
4	CABSYS Rail NG cover size 2	50457/C	000603
5	Steel support IPE 120	111917	000359
6	Standard support size 1	121757	000604
7	Support lateral adjustment size 1	121753	000605
8	Support height adjustment size 1	121804	000606
9	Standard support size 2	121698	000607
10	Support lateral adjustment size 2	119230	000608
11	Support height adjustment size 2	121840	000609
12	Standard support size 1 – Assembly	121765	
13	Standard support size 1 – Assembly – support width 3 m	121766	
14	Support lateral adjustment size 1 – Assembly	121763	
15	Standard support size 2 – Assembly	121777	
16	Support lateral adjustment size 2 – Assembly	121788	
17	Cable outlet size 1 + 2 bolted at bottom, 89 mm – Assembly	10003133	000630
18	Cable outlet size 1 + 2 bolted at bottom, 60.5 mm – Assembly	10003631	000633
19	Cable outlet size 1 – bottom, 89 mm	121790	000610
20	Cable outlet size 1 – bottom, 89 mm – Assembly	121897	
21	Cable outlet size 1 – side, 60.5 mm		000612
22	Cable outlet size 1 – bottom, 89 mm divisible		000613
23	Cable outlet size 2 bottom, 89 mm divisible	121864	000614
24	Cable outlet size 2 bottom, 89 mm divisible – Assembly	121898	
25	Duct transition size 1 – 2	121803	000615
26	End cap size 1	121770	000616
27	End cap size 2	121798	000611
28	Installation CABSYS Rail NG size 2 on bridge railings	121922	
29	Expansion transition element size 1	121911	000618
30	Expansion transition element size 2	121915	000619
31	Bracket support NG-A post profile square 80 x 80	10004815	000634
32	Bracket support side IPE 120	121909	000629
33	Bracket support on both sides + top IPE 120 – Assembly size 2	121900	000620
34	Bracket support railing posts, rectangular profile 80 x 30 mm – Assembly size 2		000624
35	Bracket support railing posts, round profile Ø 80 mm – Assembly size 2		000625
36	Bracket support railing post angle profile 80 x 80 mm – Assembly size 2	10006561	000626
37	Cover opening tool	10005141	000627
38	Support element 70 mm PE black	10003620	000631
39	Support element 30 mm PE black	10003622	000632
40	Bracket support NG-A wall installation	10005021	000635
41	Optional cover securing clip	10006219	000621

5. Applied standards

Standard	Description	Area of application	Description
DHHN2016	Deutsches Haupthöhennetzwerk	Topographical height information	Slight deviations from m above sea level in the cm range
DIN EN 206-1/ DIN 1045-2	Concrete: Definition, properties, loads	Permissible load on the subsoil	
DIN 18300 (2012)	Earthworks	Soil classes 1–7	Obsolete
DIN 18300 (2016)	General technical specifications in construction contracts (ATV) - Earthworks	Homogeneous areas	Observe issue 2019-09 and more recent
DIN 53438	Testing of combustible materials; response to ignition by a small flame		
DIN 53438 Part 2	Testing of combustible materials and components		
DIN 53461	Testing of plastics; determination of heat deflection temperature under load		
DIN 7168	General tolerances for linear and angular dimensions and geometrical tolerances		
DIN EN 10220	Seamless and welded steel tubes - Dimensions and masses per unit length	Cable outlet	Applied dimension standard pipe material cable outlet EN 10216-1 or EN 10220
DIN EN 13706 - 2	Specifications for pultruded profiles	Part 2: Methods of test and general requirements	Appendix A: Quality Appendix: Dimensional accuracy
DIN EN 1991-1-3/NA	Actions on structures	Snow loads	Zone 2/approx. 650 m NN Zone 3/approx. 500 m NN
DIN EN 1991-1-4	Actions on structures	Wind load horizontal	
DIN EN 1991-2	Actions on structures	Pressure and suction from passing trains	
DIN EN 59	Glass reinforced plastics - Determination of indentation hardness by means of a Barcol hardness tester		
DIN EN ISO 14125	Fibre-reinforced plastic composites - Determination of flexural properties		
DIN EN ISO 14126	Fibre-reinforced plastic composites - Determination of compressive properties in the in-plane direction		
DIN EN ISO 14130	Fibre reinforced plastic composites - Determination of apparent interlaminar shear strength		
DIN EN ISO 1461	Hot-dip galvanised coatings on fabricated iron and steel articles	Supports and steel supports	
DIN EN ISO 178	Plastics - Determination of flexural properties		
DIN EN ISO 527 1-4	Plastics - Determination of tensile properties		
DIN EN ISO 604	Plastics - Determination of compressive properties		
DIN EN ISO 6708	Pipework components - Definition and selection of DN (nominal size)	Cable outlet	Definition of designation DN
DIN ISO 2768-1	General tolerances	Dimensional accuracy of metal parts	
DIN VDE 303 T21/30	Test method for determining the electrical dielectric strength of solid insulating materials		
EU Directive 93/112/EC	Material Safety Data Sheet		

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BERICHT

Nr. 94638539/01 **Datum: 12.03.2018**

Auftraggeber:	DB Netz AG Kleyerstraße 25, D-60326 Frankfurt
Auftrag vom:	Bestellung 0016/708/41537511 vom 03.04.2017
Inhalt des Auftrages:	Statische Nachweise zur Aufständerung von GfK Profilen
Bauvorhaben:	GfK-Kabelkanal in aufgeständerter Bauweise
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1. Unterlagen

1.1 Prüfliste Teil A – Aufgeständerte Kabelkanäle aus Kunststoff (Technisches Lastenheft) Version 1.0 vom 31.08.2015, DB Netz AG

1.2 Merkblatt Beurteilung von Schneegleiten und Schneedruck, Verkehr und Infrastruktur Kanton Luzern vom 14.09.2015 bzw. WSL Institut für Schnee- und Lawinenforschung SLF vom November 2012

1.3 DIN EN 1991-1-3/NA: 2010-12 Allgemeine Einwirkungen Schneelasten

1.4 DIN EN 1991-2: 2010-12 Verkehrslasten auf Brücken

1.5 DIN EN 1991-1-4: 2010-12 Allgemeine Einwirkungen Windlasten

1.6 Absprachen zu Einsatzbereichen und Lastansätzen, Herr Krause DB Netz AG in verschiedenen Gesprächen und Emails

2. Baubeschreibung / Inhalt

2.1 Baubeschreibung

Neben Bahngleisen werden GfK-Kabelkanäle zur Aufnahme von Kabeln eingesetzt. Sie verlaufen oberirdisch und werden auf gerammten I-Trägern aufgeständert. Die Auflagerung der üblicherweise 6,00 m langen Profile erfolgt auf Kopfplatten über verschraubte Stahlbleche.

2.2 Inhalt

Die Abtragung der Einwirkungen auf die Gfk-Profile der Kabelkanäle in den anstehenden Baugrund wird statisch nachgewiesen. Hierfür werden die vorgesehenen Träger IPE 120 als elastisch gebettete Pfähle berechnet. Die GfK Profile einschließlich der Befestigungen auf den gerammten Trägern sind nicht Gegenstand dieses Berichtes.

Die statischen Berechnungen erfolgen in Anlehnung an die Spezifikationen in Prüfliste Teil A – Aufgeständerte Kabelkanäle aus Kunststoff (Technisches Lastenheft) Version 1.0 vom 31.08.2015 (Unterlage 1.1). Sie werden auf der Grundlage der Erfahrungen, die mittlerweile beim Einsatz der Kabelkanäle gemacht wurden, unter Berücksichtigung der Unterlagen 1.2 bis 1.5 gegenüber Unterlage 1.1 modifiziert.

Gegenüber Unterlage 1.1 wurden die Einwirkungen aus Schnee und Wind den Vorgaben der Unterlagen 1.2 bis 1.5 angepasst.

Die Bettung wird mit dem ungünstigsten Steifemodul nach 1.1 min E_s = 10 N/mm² (10 MN/m²) für die Bodenklasse 3 angesetzt. Abweichend von 1.1 wird die Bettung der obersten 30 cm dreieckförmig von 0 bis zum Endwert ansteigend angenommen.

Die Mindestnutzungsdauer beträgt 20 Jahre.

Die maximale Kopfverformung der Träger wird mit ≤ 3 cm festgelegt.

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3. Einwirkungen

Gemäß Unterlage 1.1. werden insgesamt sechs Lastkombinationen aus den acht vorgeschriebenen Lastfällen berücksichtigt. Die Lastkombinationen werden nach dem Teilsicherheitskonzept mit Lastbeiwerten aus 1.1 gebildet. Der Lastbeiwert für ständige Lasten beträgt 1,35 und der für veränderliche Lasten 1,5. Für Schneegleiten und Schneeräumung beträgt er 1,0.

Die Berechnungen werden für den Ansatz der horizontalen Lasten in die 4 Einbaufälle ebenes Gelände, neben dem Kanal nach oben ansteigende Böschung, neben dem Kanal nach unten abfallende Böschung und Aufständerung des Kanals in einer aufsteigenden Böschung untergliedert. Die maximale Böschungsneigung wird in allen Fällen mit 1:1,5 angesetzt.

Die Berechnungen werden für Geländehöhen von 300 – 700 m über NN in Schritten von 50 m geführt. Für Geländehöhen unter 300 m über NN gelten die Ergebnisse von 300 m üNN.

Alle Nachweise werden für 6,00 m Stützweite geführt. Sofern Nachweise dafür nicht erbracht werden können, wird der Einbau einer Mittelstütze angenommen. Die Stützweite für die Abtragung der Vertikal- und Horizontallasten beträgt dann 3,00 m. Als Kanalmaße werden eine Höhe von 18 cm und eine Breite von 25 cm angesetzt. Biegemomente werden für eine Aufständerung von 30 cm Höhe berechnet.

3.1 Ständige vertikale Einwirkungen

Eigengewicht Kabelkanal
Nutzlast 0,9 kN/m für Größe 2 (LF 2)

3.2 Veränderliche Einwirkungen

3.2.1 Vertikal

Mannlast von 0,75 kN (LF 3)
Schnee auf Boden gemäß Berechnung nach Unterlage 1.3; Schneelastzone 2 in Abhängigkeit von der Geländehöhe (LF 4)

3.2.2 Horizontal

Schneelast gemäß Berechnung nach Unterlage 1.2 für eine maximale Geländeneigung von 45° (LF 5)

Als Eingangswerte werden auf der sicheren Seite gewählt:

Schneewichte	3 kN/m³
Gleitfaktor N	3,2
Kriechfaktor K	0,76

Mit diesen Werten ergeben sich die Schneelasten in Abhängigkeit von der Geländehöhe gemäß Tabelle 1.

Schneelastzone 2 Höhe ü.NN m	Schneelastzone 3 Höhe ü.NN m	Seitlicher Schneedruck kN/m²
300	-	1,53
350	255	1,80
400	285	2,09
450	325	2,41
500	365	2,76
550	410	3,14
600	450	3,54
650	490	3,98
700	530	4,44

Tabelle 1 Horizontaler Schneedruck

Die horizontale Schneelast wird nur für eine angrenzende Böschung nach oben, auf der Schneegleiten auftreten kann, angesetzt.

Schneeräumung 2,5 kN/m² auf 2 x 2 m (LF 6)
Schneeräumung wird nicht berücksichtigt für 6.4, da die Räumung gegen die Böschung erfolgt.

Wind auf einer seitlichen Kanalwand für Windzone 3, Binnenland, < 10 m über Gelände
(LF 7): 0,96 kN/m²
Wind aus Zugverkehr < 250 km/h nach Unterlage 1.4 für Gleisabstand >3,25 m, glattes Material
(LF 8): +/- 0,55 kN/m²

4. Baustoffe und Bauteile

Träger und Befestigungen Stahl S235JR
Kabelkanal GfK gemäß Herstellerbeschreibung

Eingesetzter Träger IPE 120 mit einer Gesamtlänge von 180 cm
Der Träger wird 150 cm in den anstehenden Boden eingebunden.

5. Berechnung

Die Berechnungen erfolgen mit dem Programm GGU Latpile Version 5.87 als elastische gebettete Pfähle unter Berücksichtigung der Teilsicherheitsbeiwerte nach EC 7.

Lastfall-kombination	EG	Kabel	Mann-last	Schnee,v	Schnee,h	Schnee, R	Wind	Zug
1	x	x	x					
2	x	x	x				x	
3	x	x		x			x	x
4	x	x	x	x		x		
5	x	x		x	x			
6	x	x					x	x

Tabelle 2 Lastfallkombinationen nach Unterlage 1.1.

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6. Berechnungsergebnisse

Die Berechnungsergebnisse sind in den Anhängen 1 - 4 dokumentiert. Sie werden auf der jeweiligen Anlagenseite A.0 zusammengefasst. Die nachfolgenden Seiten enthalten Eingabewerte und Rechenergebnisse.

6.1 Ebenes Gelände

Der Bereich umfasst Aufständerungen, die mindestens 1,00 m von Böschungen entfernt in ebenem Gelände eingebaut werden.

In Anlage 1 sind Einwirkungen, Schnittkräfte und Verformungen in Abhängigkeit von der Geländehöhe tabellarisch dargestellt. Ausnutzungsgrade der Spannungs- und Knicknachweise sind in den einzelnen Berechnungen angegeben. Maßgebende Lastfallkombination ist LK 3 mit Wind als maßgebender Horizontalkraft, da Schneegleiten für das ebene Gelände nicht berücksichtigt wird. Maßgebender Nachweis ist für alle berechneten Geländehöhen die Kopfauslenkung des Trägers.

Als Rechenergebnisse ergeben sich Kopfverformungen der Träger von maximal 0,7 cm < zul. = 3,0 cm. Der maximale Ausnutzungsgrad bei Spannungs- und Knicknachweisen beträgt 0,29 < zul. = 1,00Die Rechenergebnisse ergeben keine Einschränkungen der angestrebten Stützenabstände von 6,00 m. Alle Nachweise werden erfüllt.

6.2 Ansteigendes Gelände (Trog) – Böschungsabstand vom Träger 0,5 m

Der Bereich umfasst Aufständerungen, die mindestens im Abstand von 0,50 m von einer aufsteigenden Böschung entfernt in ebenem Gelände eingebaut werden.

In Anlage 2 sind Einwirkungen, Schnittkräfte und Verformungen in Abhängigkeit von der Geländehöhe tabellarisch dargestellt. Ausnutzungsgrade der Spannungs- und Knicknachweise sind in den einzelnen Berechnungen angegeben. Maßgebende Lastfallkombination ist LK 3 mit Wind als maßgebender Horizontalkraft bis 400 m üNN, darüber LK 5 mit Schnee als maßgebender Horizontalkraft. Maßgebender Nachweis ist für alle berechneten Geländehöhen die Kopfauslenkung des Trägers.

Als Rechenergebnisse ergeben sich Kopfverformungen der Träger von maximal 2,9 cm < zul. = 3,0 cm. Der maximale Ausnutzungsgrad bei Spannungs- und Knicknachweisen beträgt 0,38 < zul. = 1,00

Die Rechenergebnisse ergeben keine Einschränkungen der angestrebten Stützenabstände von 6,00 m bis 600 m üNN, darüber müssen Zwischenstützen eingebaut werden (Stützweite 3,00 m). Alle Nachweise werden erfüllt.

6.3 Abfallendes Gelände (Damm) – Böschungsabstand 0,6 m

Der Bereich umfasst Aufständerungen, die mindestens im Abstand von 0,60 m von einer abfallenden Böschung entfernt in ebenem Gelände eingebaut werden.

In Anlage 3 sind Einwirkungen, Schnittkräfte und Verformungen in Abhängigkeit von der Geländehöhe tabellarisch dargestellt. Ausnutzungsgrade der Spannungs- und Knicknachweise sind in den einzelnen Berechnungen angegeben. Maßgebende Lastfallkombination ist LK 3 mit Wind als maßgebender Horizontalkraft, da Schneegleiten in Richtung auf den Kanal in abfallendem Gelände nicht berücksichtigt wird. Maßgebender Nachweis ist für alle berechneten Geländehöhen die Kopfauslenkung des Trägers.

Als Rechenergebnisse ergeben sich Kopfverformungen der Träger von 1,36 cm < zul. = 3,0 cm. Der maximale Ausnutzungsgrad bei Spannungs- und Knicknachweisen beträgt 0,3 < zul. = 1,0

Die Rechenergebnisse ergeben keine Einschränkungen der angestrebten Stützenabstände von 6,00 m. Alle Nachweise werden erfüllt.

6.4 Aufständerung des Kanals in einer aufsteigenden Böschung

Der Bereich umfasst Aufständerungen, die in maximal 0,5 m Höhe über ebenem Gelände in einer aufsteigenden Böschung eingebaut werden.

In Anlage 4 sind Einwirkungen, Schnittkräfte und Verformungen in Abhängigkeit von der Geländehöhe tabellarisch dargestellt. Ausnutzungsgrade der Spannungs- und Knicknachweise sind in den einzelnen Berechnungen angegeben. Maßgebende Lastfallkombination ist LK 3 mit Wind als maßgebender Horizontalkraft bis zu einer Geländehöhe von 400 m üNN, darüber LK 5 mit Schnee als maßgebender Horizontalkraft. Maßgebender Nachweis ist für alle berechneten Geländehöhen die Kopfauslenkung des Trägers. Die Einwirkungen aus Schneeräumung werden für die Lage in der aufsteigenden Böschung nicht berücksichtigt, da die Räumung gegen die ansteigende Böschung erfolgt.

Als Rechenergebnisse ergeben sich Kopfverformungen der Träger von maximal 3,2 cm ≤ zul. 3,0 cm (Überschreitung 10 % unseres Erachtens tolerierbar). Bei Geländehöhen über 600 m üNN treten am Pfahlkopf rechnerische Verformungen von 4,2 cm (650 m üNN) bzw. 5,9 cm (700 m üNN) auf. Der maximale Ausnutzungsgrad bei Spannungs- und Knicknachweisen beträgt 0,311 < zul. = 1,00

Die Rechenergebnisse ergeben keine Einschränkungen der angestrebten Stützenabstände von 6,00 m bis 400 m üNN, darüber müssen Zwischenstützen eingebaut werden (Stützweite 3,00 m). Die Nachweise werden mit der oben beschriebenen Einschränkung erfüllt. Für den Einbau über 600 m üNN sind zusätzliche Nachweise unter Berücksichtigung des anstehenden Bodens erforderlich.

7. Bemerkungen

Dieser Bericht gilt ausschließlich für die IPE-Profile der Aufständerungen der Kabelkanäle. Die ausreichende Dimensionierung der Kanäle und der Befestigungen wird vorausgesetzt.

Wird der für die Berechnungen angesetzte min E_S = 10 MN/m² unterschritten, sind diesen geänderten Einbaubedingungen durch eine Einbettung der Stützen in eine Betonplombe Rechnung zu tragen.

Für den Einsatz in Böschungen mit Neigungen, die steiler als 1:1,5 sind, sind zusätzliche Nachweise erforderlich.

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Sämtliche Berechnungen erfolgten mit den Schneebelastungen für Schneelastzone 2. Bei Verbau in Schneelastzone 3 ist entsprechend Tabelle 1 die Einsatzhöhe (m ü.NN) zu reduzieren/anzupassen.

8. Ergebnis

Aufgrund der Ergebnisse unserer Berechnungen bestehen gegen den Einsatz von Trägern IPE 120 mit einer Länge von 1,80 m, davon eingeerdet 1,50 m als Aufständerung für Kabelkanäle der Größen 1 und 2 gemäß technischem Lastenheft, den angepassten Schnee- und Windbelastungen sowie dem geänderten Bettungsansatz in statischer und konstruktiver Hinsicht keine Bedenken, wenn die unter Punkt 6 angegebenen Unterstützungsabstände und Geländehöhen nicht überschritten werden.

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Verteiler:	Bericht	Unterlagen
DB Netz	3-fach	3-fach

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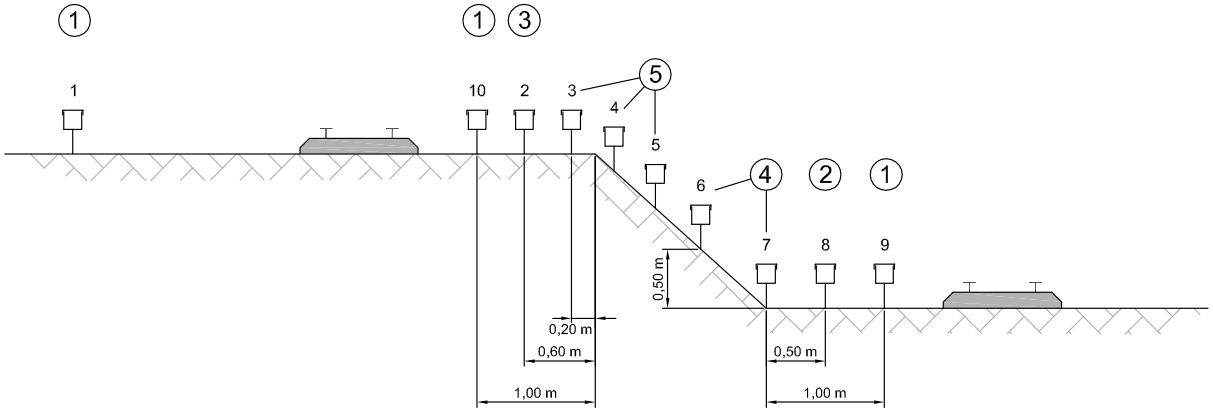
Anlagen: Berechnungsausdrucke
Lageskizze



① ebenes Gelände (Position 1, 9 und 10)

② Trog (Position 8)

③ Böschung oben (Position 2)

④ in Böschung (Position 6 und 7)

⑤ Berechnung erforderlich (Position 3, 4 und 5)

TÜV Rheinland LGA Bautechnik GmbH			
Auftraggeber: DB Netz AG			
Projekt: Aufständerung von GfK Kabelkanälen			
Anlage Lageskizze Lage der Kabelkanäle im Gleisbereich		Datum:	Name:
	gezeichnet:	13.03.18	Schrage
	geprüft:	13.03.18	Stegner
	CAD:	ST94640477_10.DWG	
	Maßstab: ./.	Az.: 94640477	
		Anlage:	

Please also note the "Extended appendix_2018-03-12" included separately with these operating instructions.

VERKEHRS TECHNIK

Wir schaffen Mobilität.

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