

GEOTECHNICAL SYSTEMS

SUSPA Rock Anchors

Approval Number Z-20.1-53

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Deutsches Institut für Bautechnik DIBt
(German Institute for Building Technology)

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Applicant:

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Subject of approval:

SUSPA-Rock Anchors

The above-mentioned subject of approval is hereby granted a general construction supervisory authority approval.

This general construction supervisory authority approval comprises 16 pages and 6 annexes.

Important Notice

This general construction supervisory authority approval is the translation of a document originally prepared in the German language which has not been verified and officially authorized by the "Deutsches Institut für Bautechnik" (German Institute for Civil Engineering). In case of doubt in respect to the wording and interpretation of this approval, the original German version of this document shall prevail exclusively. Therefore, no liability is assumed for translation errors or inaccuracies.

I. GENERAL PROVISIONS

1. This general construction supervisory authority approval verifies the suitability (fitness for the intended purpose) of the subject of approval in keeping with the regional building codes.
2. This general construction supervisory authority approval does not replace any permissions, consents, and certifications required by law for the construction projects to be carried out.
3. This general construction supervisory authority approval is granted without prejudice to the rights of third parties, especially private property rights.
4. Notwithstanding any further regulations in the "Special Provisions" section, the manufacturer and distributor of the subject of approval must provide the user of the subject of approval with copies of the general construction supervisory authority approval; furthermore, they have to inform the user that the general construction supervisory authority approval must be available at the place of use. Copies of this general construction supervisory authority approval must be made available to the involved authorities on request.
5. This general construction supervisory authority approval may only be reproduced in its entirety. The publication of extracts is subject to the approval by the DIBt. Texts and drawings of advertising material may not contradict this general construction supervisory authority approval. Translations of the general construction supervisory authority approval must contain the note "Translation of the German original which has not been verified by the DIBt".
6. This general construction supervisory authority approval is granted subject to revocation. The provisions of this general construction supervisory authority approval can be subsequently amended or changed, especially if the latest technical findings give reason for this.
7. This communication refers to the statements and documents submitted by the applicant. A change in these principles is not made by this decision and must be disclosed to the DIBt without delay.
8. This decision also includes a general type approval. The general type approval covered by this decision also applies as a general construction supervisory approval for the type of construction.

II. SPECIAL PROVISIONS**1 Subject of approval and application**

(1) Subject of this general construction supervisory authority approval are "SUSPA Rock Anchors" by company DYWIDAG-Systems International GmbH with steel tendons made of prestressing strands according to Table 1:

Table 1: Steel tendon

Prestressing strand type	Steel grade	Diameter	Nominal cross-section
0.6" prestressing strands	St 1570/1770	15.3mm	140mm ²
	St 1660/1860		
0.62" prestressing strands	St 1570/1770	15.7mm	150mm ²
	St 1660/1860		

(2) The following design variants according to Table 2 are distinguished:

Table 2: Design variants

Design variant	No. of strands	Corrosion protection system in the area of the	
		free steel length L_{fs}	bond length L_{tb}
Type G (see Annex 1)	1 - 22	Plastic sheathing around each individual strand, filled with corrosion protection compound at the factory; overall strand bundle within a smooth plastic duct to be injected with inner cement grout in the borehole	Corrugated plastic sheathing, filled with inner cement grout either at the factory or in the borehole
Type R (see Annex 2)	1 - 22	Plastic sheathing around each individual strand, filled with corrosion protection compound at the factory; overall strand bundle within a corrugated plastic duct to be injected with inner cement grout in the borehole	Corrugated plastic sheathing, filled with inner cement grout either at the factory or in the borehole (only in the case of descending anchors)

(3) Ground anchors may be used as permanent anchors with predominantly static load.

(4) Use is limited to those cases where the entire load transfer length of the anchor is located either in non-cohesive or cohesive soil or in rock (cf. DIN EN 1997-1¹ in conjunction with DIN EN 1997-1/NA² and DIN 1054³, Section 3.1). Deviating cases may only be carried out subject to the consent of an expert in geotechnical engineering.

(5) DIN EN 1537⁴, Section 5, applies to the soil investigation requirements.

2 Regulations covering the construction product

2.1 Properties and composition

2.1.1 Steel tendon

(1) Only general construction supervisory authority approved prestressing steel according to Table 1 consisting of seven cold-drawn, smooth individual wires may be used as material for the steel tendon. The supplementary provisions from the construction supervisory authority approved no. Z-13.8-152, section 2.1.2, must be observed.

(2) Within a steel tension part (strand bundle) only tension wire strands of the same nominal diameter and steel grade may be used.

(3) Only general construction supervisory authority approved strands provided with a corrosion protection system may be used. The corrosion protection system consisting of a corrosion protection compound and PE sheathing will be applied at the factory where the prestressing steel is produced.

(4) Alternatively, prestressing strands may be used which are to be provided with PE sheathings in the area of the free steel length at the applicant's factory, with the void between the strand and the sheathing being completely filled with Nontribos MP-2 corrosion inhibitor. The amount of corrosion protection compound inserted, related to a length of 1m, should on average be a minimum of 42g/m and may not fall short of 25g/m.

2.1.2 Anchor head

(1) The prestressing strands must be anchored with wedges in the wedge plate according to the general construction supervisory authority approval No. Z-13.8-152 "Anchor Heads for Ground Anchors for 2 up to 22 Strands" belonging to the company DYWIDAG-Systems International GmbH.

(2) The wedge plate must show a thread for verification purposes and/or regulation of load, by which the whole wedge plate can be lifted off without releasing the wedges. In addition, the wedge plate is to be marked on the surface located on the top with the inscription "St 1860" when using the strands with a steel grade St 1660/1860. Wedge plates in which strands with a steel grade St 1570/1770 are anchored, have no inscription.

(3) Alternatively when making use of strands with a steel grade 1570/1770, wedge plates and wedges according to the general construction supervisory authority approval Z-13.1-21 "SUSPA-Strand Post-Tensioning System 140 mm²" and Z-13.1-82 "SUSPA-Strand Post

¹ DIN EN 1997-1:2009-09	Eurocode 7: Geotechnical design - Part 1: General rules; German version EN 1997-1:2004 + AC:2009
² DIN EN 1997-1/NA:2010-12	National Annex - Nationally determined parameters - Eurocode 7: Geotechnical design - Part 1: General rules
³ DIN 1054:2010-12	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1
DIN 1054/A1:2012-08	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1:2010; amendment A1:2012
DIN 1054/A2:2015-11	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1:2010; amendment 2
⁴ DIN EN 1537:2001-01	Execution of special geotechnical works - Ground anchors
DIN EN 1537 Ber. 1:2011-12	Correction to DIN EN 1537:2001-01

Tensioning System 150 mm² can be used, with the exception that the wedge plates must show an external thread. The additional regulations in section 3.1 (3) must be observed.

2.1.3 Protection caps, anchor plate, steel transition tube (steel tube)

(1) The inner protection cap (Annexes 3 and 4) which is screwed onto the wedge plate and the void of which must be filled with "Cox GX" petroleum jelly, Nontribos MP-2, UNIGEL 128 F-1, or with FC 284 TP 70 petroleum jelly, must consist of polyethylene. The inner protection cap must be sealed against the anchor plate by means of a sealing consisting of Denso tape.

(2) As an additional protection, an outer protection cap (Annexes 3 and 4) made of steel (S235JR) or stainless steel (material Nos. 1.4301, 1.4541, or 1.4571) with an inserted sealing washer made of perbunan is screwed onto the anchor plate. If the anchor head is covered by concrete, the outer protection cap may be omitted.

(3) Anchor plates which are cast in concrete must fulfill the provisions of the general construction supervisory authority approval Z-13.1-21 and Z-13.1-82, respectively. In the case of anchor plates with direct support on concrete or on steel transition structures, the anchor plates must be verified in accordance with applicable technical building regulations.

(4) The pipe socket must consist of steel (S235JR) and have dimensions conforming to the number of strands according to Annex 4 and Annex 5, respectively. The trumpets are connected to the anchor plate on the air-side end, and on the earth-side end they overlap the smooth or corrugated plastic duct. With regard to the design variant type G, a lip seal (perbunan) which is glued into the pipe socket must be arranged within the overlapping length, while for design variants type R, the sealing is effected by means of roll rings arranged in pairs (closed-cell chloroprene rubber).

2.1.4 Plastic ducts

(1) For the sheathing of the free steel length or of the bond length, only such plastic pipes may be used which consist of PVC-U as specified by DIN EN ISO 1163-1⁵, of polyethylene with a molding compound pursuant to DIN EN ISO 1872-1⁶ - PE, E, 45 T 022 - or of polypropylene with a molding compound as defined by DIN EN ISO 1873-1⁷ -PP- B, EAGC, 10-16-003 or by DIN EN ISO 1873-1 - PP - H, E, 06-35-012/022. Only pipes without trapped bubbles and with uniform pigmentation may be used.

(2) If required, the individual segments of the PVC-U sheathings must be screwed together and glued with PVC glue. Unspliced tubes must be used as the PE or PP sheathings.

(3) It is necessary to ensure that only straight pipes are used.

(4) The basic dimensions of the smooth and corrugated ducts must comply with the specifications in Annexes 1 to 4.

(5) For an alternative sheathing of the individual strands in the free steel length L_{fs} at the applicant's factory, sheathings made of polyethylene with the aforementioned molding compound 19.2x1.25mm diameter (for strands 15.3mm diameter / 0.6"), or 19.7x1.25mm diameter (for strands 15.7mm diameter / 0.62") must be used.

⁵ DIN EN ISO 1163-1:1999-10

Plastics - Unplasticized poly(vinyl chloride) (PVC-U) molding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1163-1:1995) - German version EN ISO 1163-1:1999

DIN EN ISO 1872-1:1999-10

Plastics - Polyethylene (PE) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1872-1:1993) - German version EN ISO 1872-1:1999

DIN EN ISO 1873-1:1995-12

Plastics - Polypropylene (PP) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1873-1:1995) - German version EN ISO 1873-1:1995

2.1.5 Corrosion protection compound

(1) Corrosion protection compounds are used in the area of the free steel length, of the steel tube (steel transition tube), and of the anchor head.

(2) Nontribos MP-2 or "Cox GX" petroleum jelly must be used as a corrosion protection compound in the area of the pipe socket (steel transition tube). If the smooth (type G) or corrugated (types R) plastic sheathing has been filled with inner cement grout in the free steel length L_{fs} and Nontribos MP-2 is used as the corrosion protection compound, then the contact surfaces with cement grout must be sealed with Icosit 277.

(3) The void of the inner PE protection cap screwed onto the wedge plate must be filled with "Cox GX" petroleum jelly, Nontribos MP-2, UNIGEL 128 F-1, or with FC 284 TP 70 petroleum jelly.

(4) Where the PE sheathings are applied at the applicant's factory, the void between the strands and the PE sheathings must be filled with Nontribos MP-2 in the area of the free steel length.

2.1.6 Anti-corrosion coating

(1) If not cast in concrete completely, the anchor plate must be provided with a corrosion protection system as defined by DIN EN ISO 12944-5⁸ in dependency of the determined corrosivity category of the environment and with the protection period "high (H)". The surface must be prepared as specified by DIN EN ISO 12944-4⁹. DIN EN ISO 12944-7¹⁰ must be observed for the execution of the coating work.

(2) The exposed surfaces of the pipe socket and of the outer steel protection cap must also be provided with one of the aforementioned corrosion protection systems. Corrosion protection for these parts may be omitted if they have a wall thickness of $\geq 6.0\text{mm}$ or are cast in concrete.

(3) Alternatively, the anchor plate and exposed surfaces or surfaces of steel parts not sufficiently covered with concrete, given a corrosivity category of the environment from C1 to C4 inclusive, must be provided with corrosion protection using hot-dip zinc coating according to DIN EN 14713-1¹¹ in dependency of the determined corrosivity category of the environment with the protection period "very high (VH)". The surfaces must be prepared and treated as prescribed by DIN EN ISO 1461¹². DASt Guideline 022¹³ must be observed.

DIN EN ISO 12944-5:2008-01	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems (ISO 12944-5:2007); German version EN ISO 12944-5:2007
DIN EN ISO 12944-4:1998-07	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 4: Types of surface and surface preparation (ISO 12944-4:1998); German version EN ISO 12944-4:1998
DIN EN ISO 12944-7:1998-07	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 7: Execution and supervision of paint work (ISO 12944-7:1998) - German version EN ISO 12944-7:1998
DIN EN ISO 14713-1:2010-05	Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 1: General principles of design and corrosion resistance (ISO 14713-1:2009); German version EN ISO 14713-1:2009
DIN EN ISO 1461:2009-10	Zinc coatings applied on steel by hot-dip galvanizing (galvanization of pieces) – requirements and tests (ISO 1461:2009); German version EN ISO 1461:2009
DASt Guideline 022:2016-06	Guideline for hot-dip-zinc-coating of prefabricated structural steel components, Deutscher Ausschuss für Stahlbau DASt, Sohnstr. 65, 40237 Düsseldorf

2.1.7 Inner cement grout

Inner cement grout in accordance with DIN EN 447¹⁴ must be used. In addition, DIN EN 445¹⁵ and DIN EN 446¹⁶ must be observed.

2.1.8 Cement grout

(1) The basic materials to be used for the cement grout are cements with particular properties in accordance with DIN 1164-10¹⁷ and cements in line with DIN EN 197-1¹⁸ - taking into consideration the valid exposure class as defined by DIN EN 206-1¹⁹ in conjunction with DIN 1045-2²⁰ (Tables 1, F.3.1, and F.3.2) -, water as stipulated by DIN EN 1008²¹ and, where required, additives in accordance with DIN EN 934-2²² in conjunction with DIN EN 206-1/DIN 1045-2 or subject to a general construction supervisory authority approval, and natural aggregates for concrete with a maximum grain diameter of 4mm in compliance with DIN EN 12620,²³ taking DIN EN 206-1/DIN 1045-2 into consideration.

(2) The water/cement ratio must range between 0.35 and 0.7 and should be chosen as low as possible. The cement grout must be mixed mechanically, and may not segregate and lump before its injection. In the case of an alternative use of inner cement grout, the water/cement ratio must be limited to a maximum of 0.44 pursuant to DIN EN 447.

2.1.9 Additional components

(1) Spacers must correspond to the specifications of Appendices 1 to 2 and to the specifications deposited at DIBt. In the area of the bond length L_{tb} the strands must be bundled by steel straps and spread with inner spacers every 80 cm. The bundles of strands must be centered by means of a continuous PE round cord (6 mm minimum diameter for anchors with 1 to 12 strands or 7 mm minimum diameter for anchors with 13 to 22 strands) at a pitch of 0.25m in such a manner that a distance of ≥ 5 mm between the overall strand bundle and the corrugated duct is ensured.

(2) Corrosion protection heat shrink sleeves (CPSM or SATM) or fix heat shrink sleeves (CFM, MSTM, MWTM, or MOK) must be used as heat shrink sleeves. These consist of

DIN EN 447:1996-07	Grout for prestressing tendons - Specification for common grout - German version EN 447:1996
¹⁵ DIN EN 445:1996-07	Grout for prestressing tendons - Test methods - German version EN 445:1996
¹⁶ DIN EN 446:1996-07	Grout for prestressing tendons - Grouting procedures; German version EN 446:1996
¹⁷ DIN 1164-10:2013-03	Special cement - Part 10: Composition, requirements and conformity evaluation for cement with low effective alkali content
DIN EN 197-1:2011-11	Cement - Part 1: Composition, specifications and conformity criteria of common cements; German version EN 197-1:2011
¹⁹ DIN EN 206-1:2001-07	Concrete - Part 1: Specification, performance, production and conformity
DIN EN 206-1/A1:2004-10	Concrete - Part 1: Specification, performance, production and conformity; German version EN 206-1/A1:2004
DIN EN 206-1/A2:2005-09	Concrete - Part 1: Specification, performance, production and conformity; German version EN 206-1:2000/A2:2005
DIN 1045-2:2008-08	Concrete, reinforced and prestressed concrete structures - Part 2: Concrete - Specification, properties, production and conformity - Application rules for DIN EN 206-1
DIN EN 1008:2002-10	Mixing water for concrete - Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete; German version EN 1008:2002
DIN EN 934-2:2009-09	Admixtures for concrete, mortar and grout - Part 2: Concrete admixtures - Definitions, requirements, conformity, marking and labelling; German version EN 934-2:2009
²³ DIN EN 12620:2008-07	Aggregates for concrete; German version EN 12620:2002+A1:2008

polyethylene; the sealing adhesive compound within the heat shrink sleeve must be a hot-melt-type adhesive. The heat shrinkable sleeves must be shrunk on with hot air, infrared radiation, or the soft flame of a gas burner; the wall thickness in shrunk condition must be $\geq 1.5\text{mm}$.

2.2 Manufacture, storage, transport, and marking

2.2.1 Manufacture of prefabricated anchors for installation and grouting purposes

2.2.1.1 General

(1) Prior to its installation, the prestressing steel must be treated in accordance with the approval provisions of the prestressing steel. The prestressing steel must be clean and free of damaging rust.

(2) Prestressing steels with a slight rust film may be used. The term "slight rust film" is defined as the uniform beginning of rust formation which has not yet led to the formation of corrosion pits visible with the naked eye and which in general may be removed by wiping with a dry rag.

(3) Corrosion protection and manufacture must be carried out at the factory in accordance with the work instructions deposited at DIBt.

2.2.1.2 Prefabricated anchors

(1) The strand bundle is encased by a plastic pipe in the area of the free steel length. The individual strand must be provided either with a PE sheathing or an individual PE sheathing and some plastic corrosion protection compound (cf. Annexes 1 to 4). Alternatively, the following methods may be used:

- Only general construction supervision authority approved prestressing strands according to section 2.1.1 having a corrosion protection system consisting of a corrosion protection compound and PE sheathing applied at the manufacturing plant of the prestressing steel may be used.
- The strands are encased with PE sheathings in the area of the free steel length at the applicant's factory, with the void between the strand and the sheathing being completely filled with Nontribos MP-2 corrosion inhibitor.

(2) When using general construction supervision authority approved prestressing strands having a corrosion protection system, the PE sheathing of the strands extruded in the steel mill must be removed in the area of the planned bond length; the corrosion protection compound must be washed off with water at approx. 90°C and at 70 to 80bar.

(3) The strands must be routed through a corrugated plastic sheathing within the designated bond length for anchors type G and over the whole anchor length for anchors type R; the corrugated plastic sheathing must have a uniform wall thickness of $\geq 1\text{mm}$. The diameters of the sheathings depend on the number of strands in the tendon (see Annexes 1 and 2). The sheathing must be closed with a PE end cap having a wall thickness of $\geq 1\text{mm}$ to the soil or rock side, with the PE end cap being connected to the sheathing via a corrosion protection heat shrink sleeve (CPSM or SATM). The overlap on the sheathing must be a minimum of 85mm. The heat shrink sleeve overlaps the end cap and the sheathing by the same length in each case.

(4) Where anchors type G are used, the strand bundle in the area of the free steel length L_{fs} must be routed through a smooth plastic sheathing with a minimum wall thickness of $\geq 3\text{mm}$. The diameters of the sheathings depend on the number of strands within the sheathing (Annex 3).

(5) With regard to anchors type G, a steel coupler must be arranged at the transition point from the bond length to the free steel length to connect the corrugated and smooth sheathings; both sheathings must each be pushed onto the steel coupler to one third of the steel coupler length (Annex 1). The transitions of both sheathings onto the steel

coupler must be sealed off with a common seamless corrosion protection heat shrink sleeve (CPSM or SATM) that is at least 300mm long.

(6) The void in the area of the bond length between the corrugated plastic sheathing and the steel tendon must be filled with inner cement grout either at the factory or in the borehole. In both cases, the inner cement grout must be injected with an injection speed of no more than 5m/min.

(7) If factory injected, the anchors in the area of the bond length must be stored in an inclined manner for this purpose and injected with inner cement grout from the bottom end cap in upward direction. Where anchors type G (Annex 1) and anchors type R (Annex 2) are used, they must be injected until the inner cement grout exits from a ventilation opening arranged in the smooth pipe (for anchors type G) or in the corrugated pipe (for anchors type R). The ventilation opening must be arranged in such a manner that the ends of the PE sheathings of the monostrands are located approx. 300mm in the area of the bond length.

(8) In the case of injection in the borehole, an inner grouting tube must already be installed at the factory.

For anchors of the type G which are to be installed upwardly inclined, an inner vent line and a cement grout or bitumen plug must be additionally installed within the steel coupler at the factory (Annex 1).

2.2.1.3 Design and corrosion protection of the anchor head

(1) The design of the anchor head is depicted in Annexes 3 and 4. The assembly of the anchor head on the construction site must be carried out in accordance with the work instructions deposited at DIBt. The following prefabrication measures of the anchor head construction must be taken at the factory:

A pipe socket to be welded to the anchor plate must be disposed in the area between the anchor plate and the upper end of the sheathing. The welding work to seal the pipe socket to the anchor plate must be carried out at the factory. Companies which carry out the welding operations on the anchor plates, must have a welding certificate for the execution class EXC 1 as required by DIN EN 1090-1²⁴.

After their connection, the pipe socket (inside and outside) and exposed anchor plates must be provided with a coating according to DIN EN ISO 12944-5 or a zinc coating in line with DIN EN ISO 14713-1 applied at the factory which offers permanent corrosion protection, taking into account the actual ambient conditions, see Section 2.1.6.

For anchors type G, the lip seal must be glued into the earth-side end of the pipe socket with the aid of a water-insoluble contact adhesive subsequent to the aforementioned activities.

If the outer steel protection cap consists of stainless steel with the material numbers 1.4301, 1.4541 or 1.4571 (see also Annex 5) in accordance with the general construction supervisory authority approval for "Products, Connection Elements and Components made of Stainless Steel", approval No. Z-30.3-6, it need not be provided with a corrosion protection system. With regard to corrosion, the steels specified in approval No. Z-30.3-6 are assigned either to resistance class II (material numbers 1.4301 and 1.4541) or III (material number 1.4571). The specifications provided in Tables 1 and 1.1 and Section 2.1.6 therein must be adhered by.

(2) If considered necessary by the external surveillance agency, samples must be deposited with such agency. DIN EN ISO 12944-7, Section 6, applies to coating materials according to DIN EN ISO 12944-5.

²⁴ DIN EN 1090-1:2012-02

Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components; German version EN 1090-1:2009+A1:2011

2.2.2 Transport and storage

(1) The integrity of the corrosion protection components must be ensured. Special care must be taken during storage, transport and installation of the readily assembled permanent anchors so that sheathings will not be damaged as a result of improper handling.

(2) Depending on the temperatures, the anchors may not be removed from the assembly bench for 24 hours after injection of the inner cement grout has taken place at the factory.

(3) Further transportation and installation may only be carried out 3 days after injection of the inner cement grout has taken place at the factory. The anchors may be installed at a time when the inner cement grout has not yet fully hardened.

(4) The anchors may not be stored on the ground; contamination and soiling of most notably the corrugated pipes must be avoided. If the anchors are supported at intervals only, the support points may not be sharp-edged, but must be flat.

(5) If anchors are piled up, they must lie on top of each other in a parallel manner. If supported in intervals by square timbers or adequate spacers, then the weight of the anchors on top may only be carried via the timbers or spacers.

(6) In no case may the anchors be thrown or dropped. They must be transported in such a manner (e.g. by hand on the shoulders or by means of carrying straps) that in particular the corrugated sheathings will not be damaged.

(7) If transported by a crane hook, the anchor must be carried at its stressing end or with carrying straps or placed in ducts.

(8) The anchors may also be transported wound up in coils and inserted into the borehole from the coil, with the factory grouted bond length tangentially protruding from the coil. The work instructions deposited at DIBt must be observed.

(9) During installation and transport of the anchors, the following minimum bending radii R must be observed:

min R = 0.90m (permanent anchors consisting of 1 to 9 strands),

min R = 1.00m (permanent anchors consisting of 10 to 12 strands).

min R = 1.25m (permanent anchors consisting of 13 to 22 strands).

2.2.3 Marking

(1) The delivery note for the prefabricated anchor must be marked by the manufacturer with the mark of conformity (Ü-Zeichen) in accordance with the conformity mark regulations issued by the German Länder. The marking may only be performed if the requirements pursuant to Section 2.3 have been met.

(2) The delivery note must, among other things, state for which ground anchors the components are designated and in which plant they have been manufactured. Only components for one design variant to be specified may be delivered on a delivery note.

2.3 Certificate of conformity

2.3.1 General

(1) Each manufacturing factory must confirm that the anchor components and the prefabricated anchors for installation and grouting comply with the provisions of this general construction supervisory authority approval by means of a certificate of conformity based on the factory's own production control and regular external surveillance, including initial testing, in accordance with the following provisions.

(2) The manufacturer of the anchor components and of the prefabricated anchors must commission a notified product certification body and a recognized external surveillance authority to issue the certificate of conformity and carry out external surveillance, including product testing.

(3) The declaration that a certificate of conformity has been issued must be made by the manufacturer by marking the building products with the mark of conformity (Ü-Zeichen),

indicating the intended purpose.

(4) The notified product certification body must send a copy of the certificate of conformity issued to the DIBt for information purposes.

(5) In addition, a copy of the initial test report must be forwarded to the DIBt for information.

2.3.2 Factory production control

(1) Each factory must set up and carry out its own factory production control. A factory production control is understood to be the continuous monitoring of the production to be conducted by the manufacturer, who thus ensures that the building products manufactured meet the requirements of this general construction supervisory authority approval.

(2) The factory production control system must include at least the measures listed in Annex 6 regarding the incoming goods inspection and the control during the production.

(3) The results of the factory production control must be recorded and evaluated. The records must contain at least the following information:

- Description of the building product or of the basic material and its components,
- Type of control or inspection,
- Date of manufacture and date of inspection of the building product or of the basic material or of the components,
- Results of the controls and inspections and, if applicable, comparison with the relevant requirements,
- The signature by the person responsible for the factory production control.

(4) The records must be kept for a minimum of five years and submitted to the notified product certification body involved in continuous surveillance. They must be submitted to DIBt and to the competent highest construction supervisory authority on request.

(5) If the test results are unsatisfactory, the manufacturer must immediately take the measures necessary to eliminate the identified deficiency. Construction products which do not meet the requirements must be handled in such a manner that they cannot be mistaken for conforming products. Once the deficiency has been eliminated, the test in question must be immediately repeated, provided that this is technically feasible and also required to verify the elimination of the deficiency.

2.3.3 External surveillance

(1) The facilities and the internal factory production control system in all manufacturing plants must be reviewed by a notified product certification body on a regular basis, but at least twice a year.

(2) Within the scope of external surveillance, an initial testing in accordance with Annex 7 must be carried out. As part of the external surveillance, samples are to be taken for sample checks, and the testing tools are to be checked. Both sampling and testing are incumbent on the notified product certification body involved in continuous surveillance.

(3) The results of the certification and of the external surveillance must be kept for a minimum of five years. They must be presented to DIBt and to the competent highest construction supervisory authority by the notified product certification body on request.

3 Provisions covering design and dimensions

3.1 Planning and design

(1) Unless stated otherwise in the text below, DIN EN 1997-1 in conjunction with DIN EN 1997-1/NA and DIN 1054 apply to the design and calculation of structures using ground anchors.

(2) When anchoring, the anchor plate as well as the steel or concrete reinforced construction on which the anchor plate lies must be verified separately and according to the applicable technical construction provisions.

(3) In the case of anchorage with an anchor plate cast in concrete, the general construction supervisory authority approval of the "SUSPA Strand Post-Tensioning System 140mm²" (No. Z-13.1-21) and "SUSPA Strand Post-Tensioning System 150mm²" (No. Z-13.1-82), respectively, applies. The additional reinforcement mentioned therein must be taken into account. If the anchor plate is supported on steel or reinforced concrete structures, the static behavior of the anchor plates and of the transition structures must be verified in each individual case. Both are not subject matter of this general construction supervisory authority approval.

(4) The transfer of loads in the structure (e.g. splitting forces) must be verified on a case-to-case basis.

(5) It must be verified that the change of load (characteristic value) in the steel tendon due to frequently repetitive live loads (including wind) is not greater than 20% of the characteristic load E_k .

(6) The overall safety of the anchored rock mass is the subject of rock mechanical verification of stability; the anchor forces required for stability must be determined by an expert²⁵. For rock anchorages, the design values of the rock pressure (resistance) must be established on a case-to-case basis by an expert, taking into consideration a possible structural fault in the immediate vicinity of the borehole. Any necessary adapters must be designed pursuant to the relevant standards, taking into account the design values of the rock pressure (resistance).

3.2 Installation

3.2.1 General

(1) The requirements of DIN EN 1537 in conjunction with DIN SPEC 18537²⁶ and DIN EN 1997-1 in conjunction with DIN EN 1997-1/NA and DIN 1054 must be observed, provided nothing to the contrary is stated in the text below.

(2) Assembly and installation of the ground anchors may only be carried out under the technical direction of the applicant.

(3) Work must be carried out in accordance with the work instructions deposited at DIBt. The work instructions regarding the production of anchors on the construction site and the assembly of the anchor head must be available on the construction site. A copy of the instructions must be made available to the surveillance agency (Section 4.7); the same applies to the construction drawings of the anchor head.

(4) The applicant must keep a list of structures secured with permanent anchors, indicating the structure anchored, the type of anchor (model), and the number of anchors.

²⁵ Experts in geotechnical engineering must be consulted for the determination of static and structural requirements and characteristic loads.

²⁶ DIN SPEC 18537:2012-02 Supplementary provisions to DIN EN 1537:2001-01, Execution of special geotechnical works - Ground anchors

3.2.2 Drilling the boreholes

3.2.2.1 Borehole diameter

The borehole diameter must be chosen in such a manner that the anchor including spacers can be inserted without any problems. The minimum borehole diameters are stated in Appendices 1 to 2. DIN EN 1537 in conjunction with DIN SPEC 18537, Section 8.1, applies.

3.2.2.2 Boreholes in rock

(1) The drilling method must be matched with the specific rock properties.

(2) It must be verified that in the area of the free anchor length perpendicular to the borehole axis

no joint movements are anticipated if the annular space between the borehole wall and the sheathing is grouted with cement mortar (e.g. if the load transfer length is not limited as per Section 4.4.2), or

the expected joint movements are smaller than the difference between the sheathing and the borehole diameter if the annular space between the borehole wall and the sheathing is not grouted with cement mortar (e.g. if the load transfer length has been limited as per Section 4.4.2).

(3) It is recommended to check the free passage of the boreholes by means of a gauge, for example.

3.2.3 Installation into the borehole

(1) Spacers must be arranged in the area of the bond length as stipulated by Annexes 1 to 2.

(2) If in the case of a cased borehole, the projecting end of the drill set has an edged internal thread or rather a sharp-edged tube end, the anchors prepared in accordance with Section 2.2.1 may only be inserted into the borehole if an edge-free inserting trumpet or a tube nipple fully covering the internal thread of the casing has been placed onto the projecting end of the drill set. Attention must be paid that the corrosion protection is not damaged when inserting the anchor.

3.2.4 Produktion of the ground anchor

3.2.4.1 Production of the grout body

3.2.4.1.1 General, manufacture of the grout body

(1) In the instance of a cased borehole, the pipes will be drawn slowly and step by step after filling the borehole with cement grout, installing the anchor and, where required, placing the grout cap, while maintaining the necessary grouting pressure. Grouting must at least be effected until the transition point from the bond length L_{tb} of the tendon to the free steel length L_{fs} .

(2) The injection for the production of the grout body must always be carried out from the deepest point of the grout body, while venting, if required, must always be effected from the highest point. For ascending anchors, the packer mounted outside on the sheathing at the transition point from the bond length L_{tb} of the tendon to the free steel length L_{fs} must be activated prior to the beginning of the grouting operations.

(3) In the case of ground anchors where the void within the corrugated plastic duct has not already been filled with inner cement grout at the factory (see Table 2), grouting may be carried out after installation of the anchor into the borehole in the course of producing the grout body. In addition, Section 4.5, second paragraph, must be observed.

3.2.4.1.2 Production of the grout body in rock

(1) The rock must be so compact that perfect production of the grout body is ensured. This must be verified by special examinations (e.g. visual borehole inspection, gauge measurement of the grout level, geohydraulic test) to the extent required.

(2) The mortar formula, the grouting pressure, and the grouting operation must be determined on a case-by-case basis by the field engineer in consultation with an expert and the designing engineer based on the results of the rock explorations and water injection tests as well as the findings after the drilling of the boreholes. The designated grouting method must be explored within the scope of a suitability test. The quantity of inner cement grout required for one anchor, its composition, and the grouting pressure must be measured and recorded. It is recommended to use the production record according to Annex H.1 of DIN SPEC 18537.

3.2.4.2 Limitation of the load transfer length

(1) In general, the load transfer length must be limited by one of the following methods:

a) by flushing out excess cement grout (e.g. with water or bentonite suspension) by means of a flushing hose permanently mounted on the sheathing. The flushing hose must be arranged in such a manner that the first lateral discharge openings lie 50cm above the transition point between the free steel length and the bond length of the tendon. Verification of this value must be confirmed in the record. The flushing pressure applied must amount to approx. 4bar.

b) by flushing out excess cement grout by means of a flushing lance. The flushing lance closed at the bottom and provided with lateral openings must be inserted up to approx. 1.0m above the transition point L_{tb}/L_{fs} . The flushing pressure applied must amount to approx. 4bar.

c) by blocking the load transfer length by means of a packer. The suitability of the packer must be verified within the scope of a suitability test.

(2) In the case of downwardly inclined (descending) ground anchors, methods a), b), or c) may be applied. For upwardly inclined (ascending) ground anchors, method c) must be applied.

(3) Limitation of the load transfer length may be omitted if the respective conditions stated in DIN EN 1537 in conjunction with DIN SPEC 18537, Section 8.3.6, are fulfilled.

3.2.4.3 Post-grouting

(1) Post-grouting operations with cement suspension may be carried out in accordance with DIN EN 1537 in conjunction with DIN SPEC 18537, Section 8.3.6.

(2) Subsequently, if the load transfer length must be limited, the free anchor length must be flushed free, e.g. with water or bentonite suspension.

3.2.8 Corrosion protection measures on the construction site

(1) The individual steps of the assembly of the anchor head on the construction site including corrosion protection measures must be carried out in accordance with the work instructions deposited at DIBt.

(2) The design variants according to Table 2 are differentiated. The void between the strand bundle and the corrugated plastic duct not filled at the factory must be filled with inner cement grout according to DIN EN 447 in the borehole via the grouting tube placed above the strand bundle, beginning from the low point of the area to be injected. In addition, DIN EN 445 and DIN EN 446 must be observed. The grouting operation may not be stopped before inner cement grout of the same texture emerges, without any bubbles, from the corrugated duct in the case of downwardly inclined (descending) anchors and from the vent tube in the case of upwardly inclined (ascending) anchors as has been added

on the grouting side. In the case of ascending anchors, grouting of the free steel length L_{fs} may be omitted.

(3) The area between the anchor plate and the upper end of the smooth plastic sheathing (anchor type G) or of the corrugated plastic sheathing (anchor types R) must be protected by means of the steel tube welded to the anchor plate. For this purpose, the transition to the smooth plastic sheathing must be sealed with a lip seal in the case of anchors type G (see Annex 3), and the transition to the corrugated plastic sheathing by means of two roll rings in the case of anchors types R (Annex 4). The void between the steel tendon and the anchor plate/pipe socket must be filled with Nontribos MP-2 or with "Cox GX" petroleum jelly.

(4) If the smooth or corrugated plastic sheathing has been filled with cement grout and Nontribos MP-2 is used as the corrosion protection compound, then the cement grout surface within the plastic sheathing must be sealed with Icosit 277 beforehand.

(5) After the anchor has been stressed, the wedge plate and the excess protruding prestressing steel must be protected with the inner PE protection cap to be screwed onto the wedge plate and the void of which must be filled with "Cox GX" petroleum jelly, Nontribos MP-2, UNIGEL 128 F-1, or with FC 284 TP 70 petroleum jelly. The inner protection cap must be sealed against the anchor plate by means of a sealing consisting of Denso tape.

(6) An outer steel protection cap including an inserted seal washer made of perbunan is screwed onto the anchor plate as an additional protection measure. If the anchor head is set in concrete, the outer protection cap may be omitted.

(7) Where anchors must be restressed, it must be ensured that their corrosion protection is properly executed after restressing, e.g. through subsequent injection of "Cox GX" petroleum jelly.

3.2.6 Stressing operation

(1) After sufficient hardening of the grout body, the anchors can be stressed. To do so, a hollow piston jack is pushed onto the excess protruding strand. This jack is seated on the wedge plate of the anchor head.

(2) The tendon must be anchored perpendicular, in each direction, to its axis.

(3) To ensure that the anchor head is positioned rectangular to the steel tendon, angular deviations must be compensated (e.g. pipe wedges, mortar bed, or similar).

(4) When anchored, the wedges are embedded 6mm in the anchor head; the effect of such embedding must be taken into account as slip when the extension is determined. For free steel lengths of ≤ 5 m such slip must be compensated in that the wedge plate is lifted off the anchor plate after the wedges have been embedded, and subsequently washers with an overall height of 6mm are placed between the wedge plate and the anchor plate.

(5) If, after the anchors have been installed and the stressing jack has been dismantled, no precise information regarding the strand protrusion is available, the strands are severed approx. 20-50mm outside of the wedge plate.

3.2.7 Suitability and acceptance tests, supervision of installation

(1) Suitability and acceptance tests must be carried out on every construction site pursuant to DIN EN 1537 in conjunction with DIN SPEC 18537.

(2) The suitability tests must be supervised by a surveillance agency for monitoring the installation of ground anchors which is included in the list of inspection, surveillance and

certification agencies in keeping with the regional building codes, Part V, as amended from time to time²⁷.

(3) The surveillance agency employed, within the scope of monitoring activities related to suitability and acceptance tests, must supervise at least randomly the assembly of permanent anchors on the construction site, especially the corrosion protection measures to be carried out on site, e.g. the complete grouting of the anchor head area with a corrosion protection compound.

(4) If the entire void between the strand bundle and the corrugated pipe is filled with inner cement grout in the borehole only, the basic functioning must be monitored by the surveillance agency. In addition, the proper installation must be monitored by random checks. This must be noted in the test report.

(5) The surveillance agency must report to the competent building supervision authority if facilities and personnel on the construction site do not warrant proper installation. The beginning of these activities must be reported to the building supervision authority in charge.

3.2.8 Declaration of compliance regarding execution

The executing company must submit a declaration that the ground anchors manufactured comply with the provisions of this general construction supervisory authority approval.

3.3 Provisions for usage, maintenance, and service

3.3.1 Verification

(1) DIN EN 1537 in conjunction with DIN SPEC 18537, Section 9.11, applies.

(2) If required, verification should be assumed by the surveillance agency which has already been involved with the suitability tests.

Bettina Hemme
Section Head

Certified

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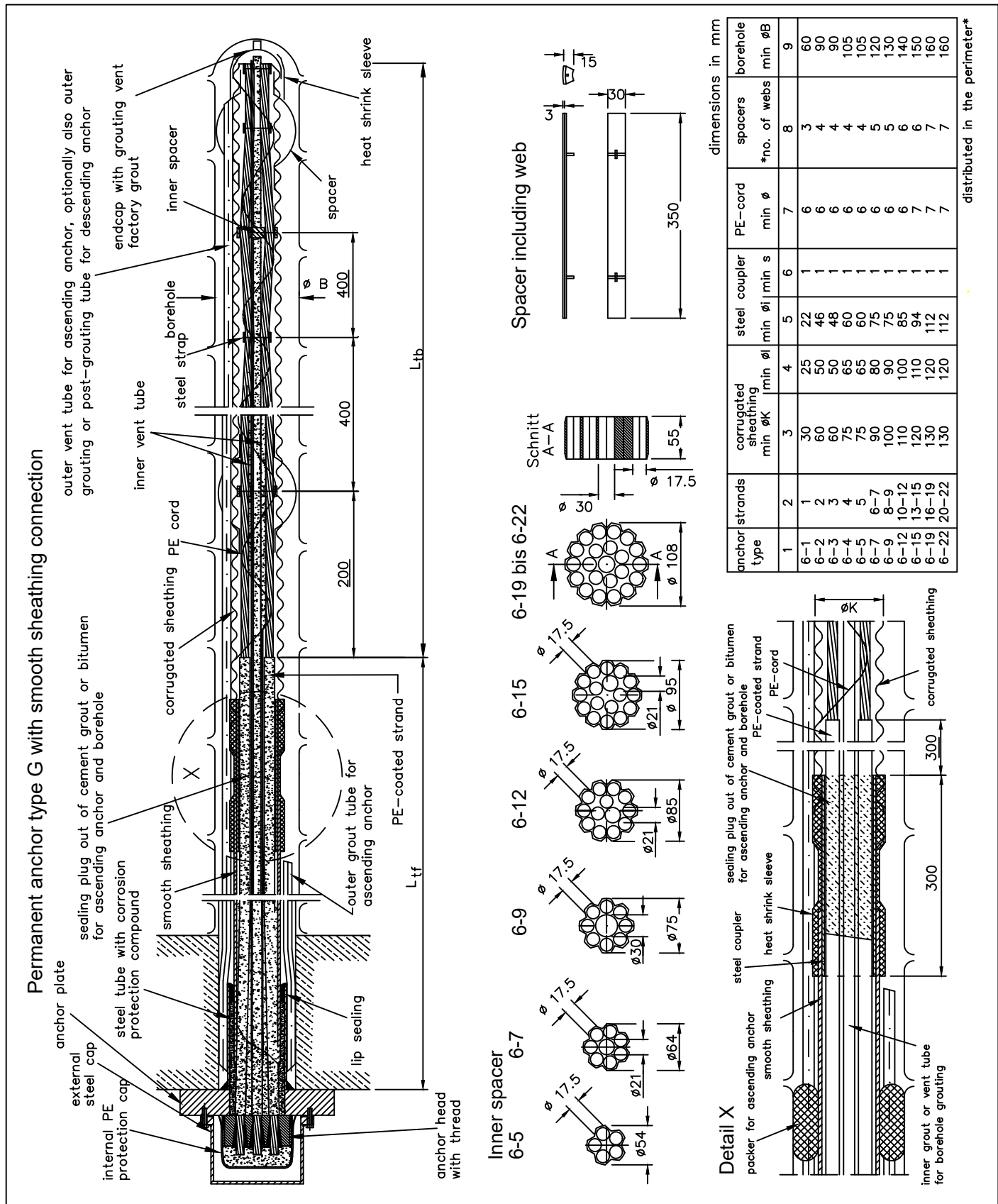
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Deutsches Institut
für Bautechnik

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²⁷ Most recent: List of inspection, surveillance and certification agencies based on the regional building codes as of May 2014 - DIBt - Mitteilungen, Deutsches Institut für Bautechnik, 2014 edition of June 19, 2014



anchor strands type	corrugated sheathing min ØK	steel coupler min Ø	PE-cord min Ø	spacers		dimensions in mm	
				*no. of webs	#no. of webs	min	max
1	2	3	4	5	6	7	9
6-1	25	22	25	25	1	6	60
6-2	50	46	50	46	1	6	90
6-3	60	48	60	48	1	6	90
6-4	75	60	65	60	1	6	105
6-5	75	60	65	60	1	6	105
6-7	90	75	80	75	1	6	120
6-9	100	75	90	75	1	6	130
6-12	110	85	100	85	1	6	140
6-15	120	94	110	94	1	7	150
6-19	130	112	120	112	1	7	160
6-22	130	112	120	112	1	7	160

* distributed in the perimeter

SUSPA-Rock anchors

Permanent anchor overview
Type G 6-1 to 6-22

Annex 1

Permanent anchor type R with continuous corrugated sheathing

outer vent tube for ascending anchor
optionally also outer grouting or
post-grouting tube for descending anchor

dimensions in mm

anchor strands	corrugated sheathing min ØK	PE-cord min Ø	spacers *no. of webs	borehole min ØB
type 1	3	5	6	7
6-1	30	5	3	60
6-2	60	6	4	90
6-3	60	6	4	90
6-4	75	6	4	105
6-5	75	6	4	105
6-7	90	6	5	120
6-9	100	6	5	130
6-12	110	6	6	150
6-15	120	7	6	140
6-19	130	7	7	160
6-22	130	7	7	160

distributed in the perimeter*

Inner spacer

Spacer including web

Detail X

ØK

300

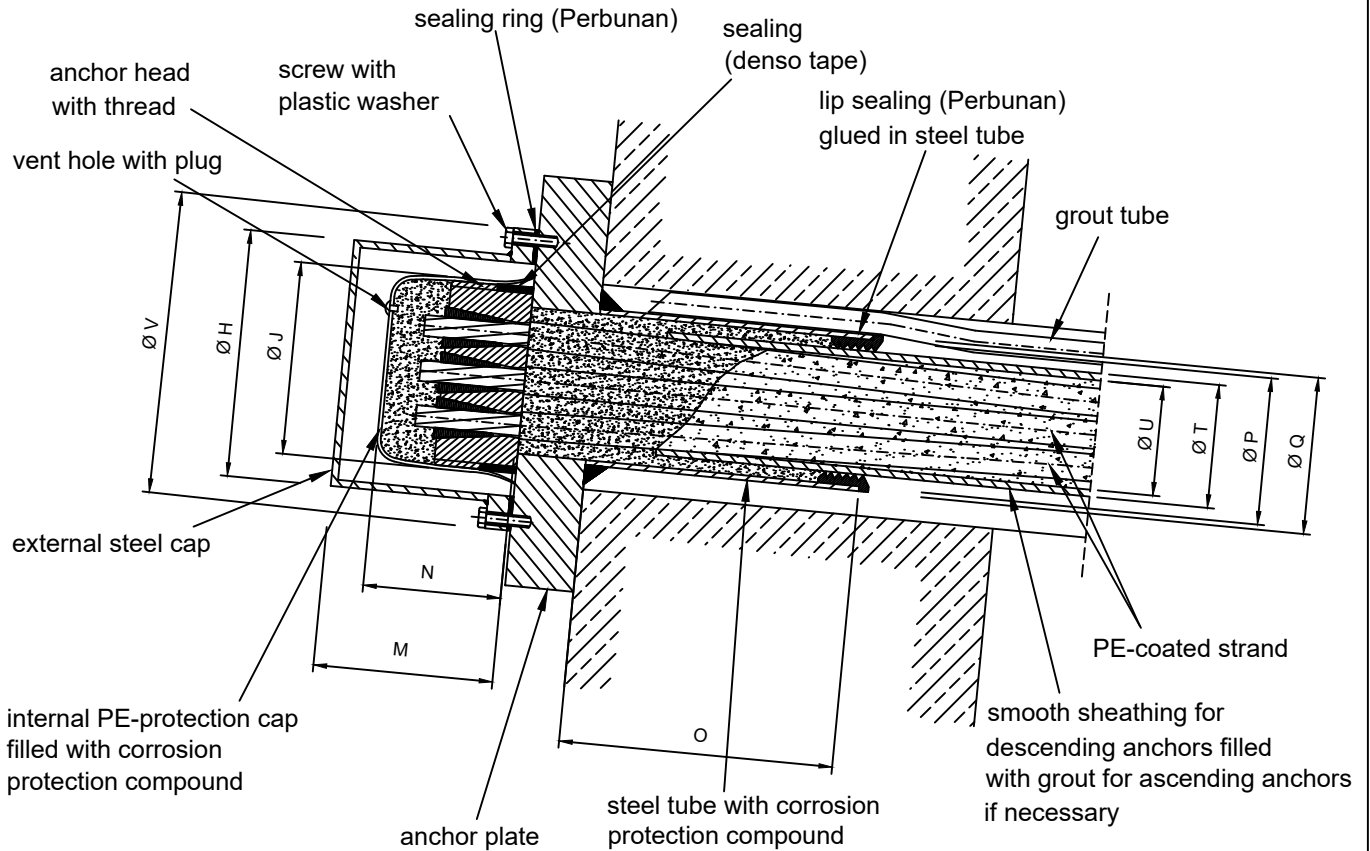
SUSPA-Rock anchors

Permanent anchor (corrugated) overview

Type R 6-1 to 6-22

Annex 2

Anchor head with smooth sheathing in free length



For types 6-15 to 6-22 the steel tube has a reduction piece (steel) for the sealing

anchor type	strands	external protection cap (steel)			internal protection cap (PE)		steel tube			smooth sheathing	
		Ø V	Ø H	M	Ø J	N	Ø Q	Ø P	O	Ø T	Ø U
1	2	3	4	5	6	7	8	9	10	11	12
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
6-1	1	140	89	110	64	95	51,0	45,2	160	32	26,0
6-2	2	178	133	110	98	95	82,5	75,3	160	63	55,8
6-3	3	178	133	110	103	95	82,5	75,3	160	63	55,8
6-4	4	219	178	125	122	100	101,6	93,6	170	75	66,4
6-5	5	219	178	125	144	110	101,6	93,6	170	75	66,4
6-7	6-7	229	178	125	144	110	114,3	106,3	290	90	79,8
6-9	8-9	267	216	140	163	110	114,3	106,3	290	90	79,8
6-12	10-12	267	216	140	182	120	146,0	136,0	460	100	90,0
6-15	13-15	305	254	160	209	130	159,0	149,0	650	110	97,4
6-19	16-19	305	254	160	219	140	191,0	178,4	650	125	115,0
6-22	20-22	324	273	170	239	150	191,0	178,4	750	125	115,0

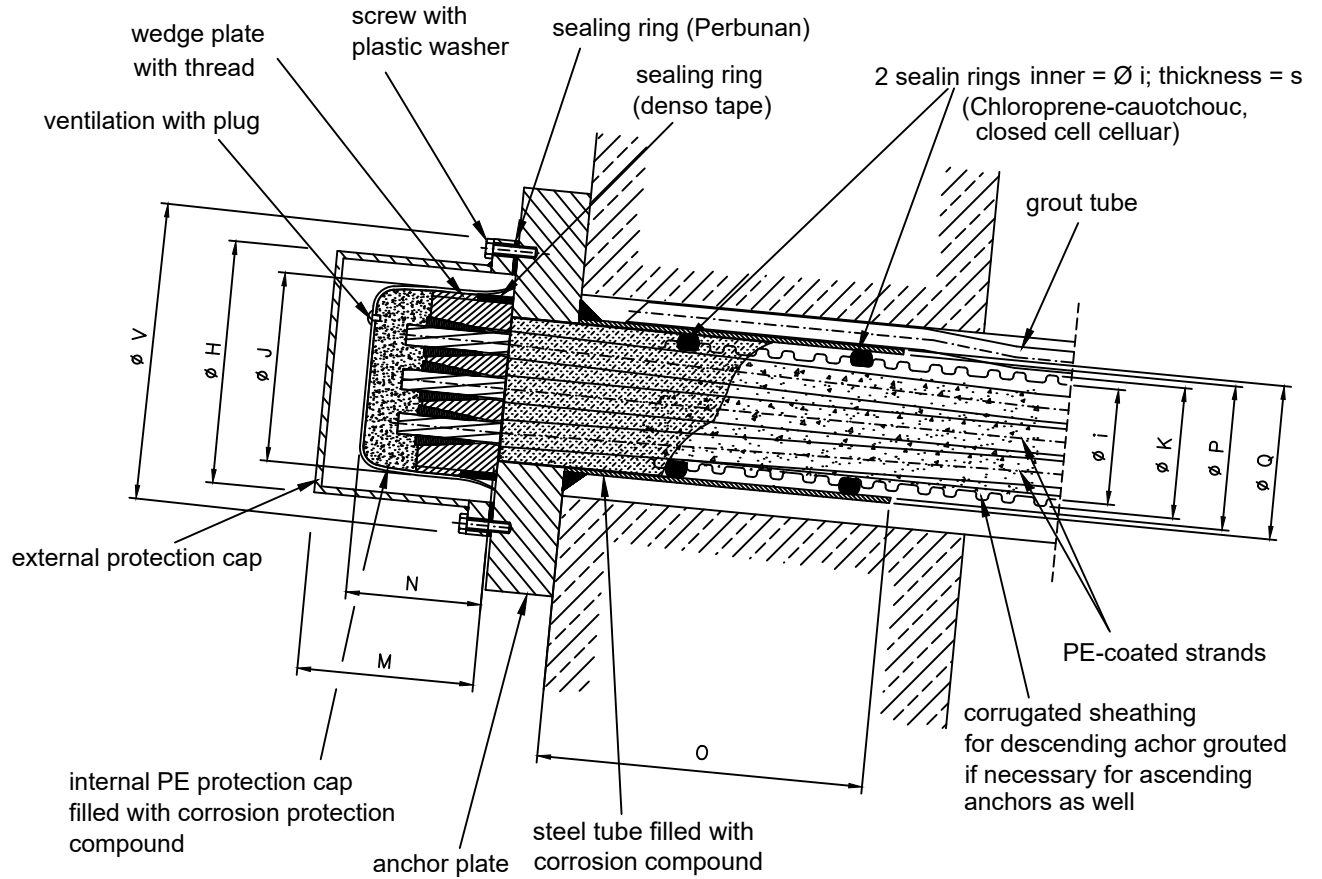
SUSPA-Rock anchors

Annex 3

Permanent anchor. Anchor head detail
Type G 6-1 to 6-22

Anchor type R with continuous corrugated sheathing

anchor head & sheathing of free length



anchor type	strands	external cap (steel)			intercal cap (PE)		steel tube			corrugated sheathing		sealing rings s
		$\varnothing V$	$\varnothing H$	M	$\varnothing J$	N	$\varnothing Q$	$\varnothing P$	O	$\varnothing K$	$\varnothing i$	
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
6-1	1	140	89	110	64	95	51,0	45,2	160	32	26,0	15
6-2	2	178	133	110	98	95	82,5	75,3	160	63	55,8	15
6-3	3	178	133	110	103	95	82,5	75,3	160	63	55,8	15
6-4	4	219	178	125	122	100	101,6	93,6	170	75	66,4	20
6-5	5	219	178	125	144	110	101,6	93,6	170	75	66,4	20
6-7	6-7	229	178	125	144	110	114,3	106,3	290	90	79,8	20
6-9	8-9	267	216	140	163	110	114,3	106,3	290	90	79,8	20
6-12	10-12	267	216	140	182	120	139,7	128,5	460	100	90,0	25
6-15	13-15	305	254	160	209	130	159,0	149,0	650	110	97,4	30
6-19	16-19	305	254	160	219	140	191,0	178,4	650	125	115,0	40
6-22	20-22	324	273	170	239	150	191,0	178,4	750	125	115,0	40

SUSPA-Rock anchors

Annex 4

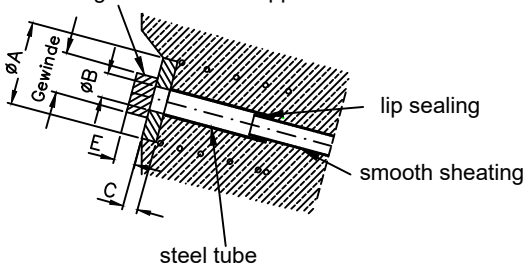
Permanent anchor. Anchor head detail (corrugated)
Type R 6-1 to 6-22

Anchor plate embedded in concrete
according to Approval Z-13.1-21 or Y-13.1-82

Alternative 1
anchor plate embedded

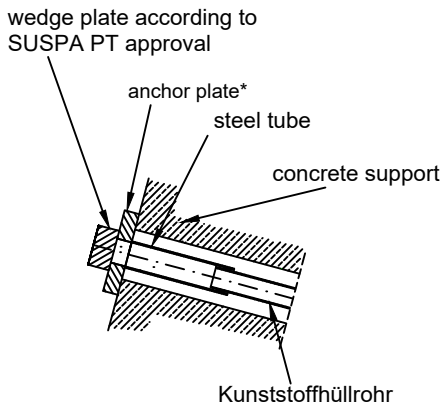
anchor type	strands	wedge plate SUSPA		ØB	concrete ≥ C20/25 anchor plate		concrete ≥ C30/37 anchor plate	
		thread	E		min ØA	min C	min ØA	min C
1	2	Tr	mm	mm	mm	mm	mm	mm
6-1	1	56x3	50	20	80	15	80	15
6-2	2	90x6	50	52	130	20	110	15
6-3	3	95x6	50	58	150	25	130	20
6-4	4	110x6	55	72	170	25	150	25
6-5	5	135x6	60	86	200	30	170	25
6-7	6-7	135x6	60	86	230	35	200	30
6-9	8-9	155x6	65	112	260	40	230	35
6-12	10-12	170x6	75	120	290	45	260	40
6-15	13-15	200x6	85	150	330	50	290	45
6-19	16-19	210x6	95	152	380	55	330	50
6-22	20-22	230x8	100	174	420	60	360	50

wedge plate & anchor plate according to SUSPA-PT approval



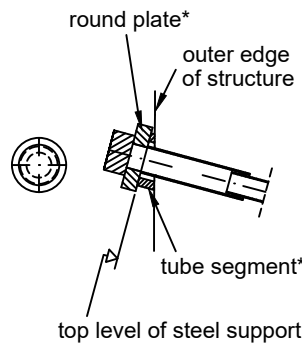
Anchor plate placed on concrete or steel construction

Anchor plate directly placed on concrete

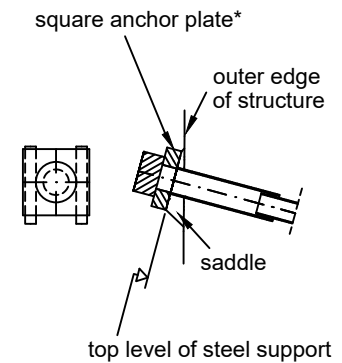


Anchor plate placed on piece of steel tube

tube segment as steel support example:



saddle as steel support example:



* Dimensions of the anchor plate must be obtained with appropriate calculation.

SUSPA-Rock anchors

Permanent anchor. Support of anchor head
Type 6-1 to 6-22

Annex 5

General Construction Supervisory Authority Approval/
No. Z-20.1-53 from February 21, 2018

Test		Inspection method	Factory control	II/FS	Value
1. Inspection of incoming products					
1.1	Presstressing steel	Delivery note	Every delivery	X	Compliance mark according to approval
1.2	Wedges	Delivery note	Every delivery	X	Compliance mark according to approval Z-13.1-21 and Z-17.1-82
1.3	Wedge plates with thread				
	Wedge plate	Delivery note	Every delivery		Compliance mark according to approval Z-13.1-21 and Z-17.1-82
	Nominal diameter and thread depth	Measurement	Every delivery		Working drawings
1.4	Plastic tubes (smooth and corrugated), end cap				
	Compound	DIN EN 10204	Every delivery	X	Certificate of compliance 2.1
	Wall thickness	Measurement	1 every 100 pieces	X*	DIN EN 1537 and drawings
	Inner and outer diameter	Measurement	1 every 100 pieces	X*	Minimum value according to annexes 1 to 5
1.5	Lip sealing and sealing rings				
	Diameter (inner and outer in sealing rings)	Measurement	1 % of the produced amount	X*	Working drawings
1.6	Steel tube				
	Type of steel	DIN EN 10204	Every delivery	X	Certificate of compliance 2.1
	Inner and outer diameter	Measurement	1 every 100 pieces	X*	Working drawings
	Wall thickness	Measurement	1 every 100 pieces	X*	Working drawings
1.7	Shrinking tube				
	Compound	DIN EN 10204	Every delivery	X	Certificate of compliance 2.1
1.8	Anticorrosion coating, materials and anticorrosion systems				
	Material properties and coating thickness	DIN EN 10204	5 % of the produced amount	X	Acceptance test certificate 3.1
SUSPA-Rock anchors					Annex 6 Page 1 of 2
Factory prefabrication – control plan for the factory prefabrication and external supervision					

Test		Inspection method	Factory control	II/FS	Value
2.Control during production					
2.1	Single strands – amount of anticorrosion compound applied	Weighing	Daily; at least every 20 anchors	X	Mean value > 42 g/m Individual value
	Single strands – distribution of anticorrosion compound	Visual	Daily; at least every 20 anchors	X	Penetrated in every groove, all surfaces connected
2.2	Strands in bond length – free from anticorrosion compound	Visual	Daily	X	Yes
2.3	O-Rings – test on the function assumed	Visual, proof	5 % of the produced amount	X	Yes
2.4	Steel tube with deflector and O-Ring – test on the function assumed	Visual, proof	5 % of the produced amount	X	Yes
2.5	Shrinking tube – wall thickness in shrunk state	Proof and measurement	1 on each type of anchor and production	X*	>1,5 mm
2.6	Grouting mortar	DIN EN 445	DIEN EN \$\$&	X	DIN EN 447

- Test plan:

If each individual measured value is equal to or greater than the required minimum value, L_{os} shall be assumed. Other samples may be taken. In these samples the same measurements from the first sample are to be carried out. The measurement results shall be summarized with the previous measurements. The mean value \bar{x} and the standard deviation s must be formed from all measured values. If the test parameter (numerical value)

$$z = \bar{x} - 1,64 s$$

to be formed therefrom is equal to or greater than the required minimum value, the value L is to be rejected.

SUSPA-Rock anchors

Factory prefabrication – control plan for the factory prefabrication and external supervision

Annex 6
Page 2 of 2



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