Deutsches Institut für Bautechnik

Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts

Zulassungs- und Genehmigungsstelle für Bauprodukte und Bauarten

Allgemeine bauaufsichtliche Zulassung / Allgemeine Bauartgenehmigung

Datum:	Geschäftszeichen:
16.12.2022	I 12-1.12.3-6/22

Nummer:
Z-12.3-152

Geltungsdauer
vom: **December 16, 2022**
bis: **December 16, 2027**

Antragsteller:
The Siam Industrial Wire Co., ltd.
555 Rasa Tower 14th Floors, Phaholyothin road
CHATUCHAK, BANGKOK 10900 THAILAND

Gegenstand dieses Bescheides:
Prestressing steel strands St 1570/1770 made from seven cold-drawn, smooth individual wires with Nominal diameter: 9.3-12.5-15.3-15.7 mm with application regulations for prestressed concrete and Felsanker

The above-mentioned object of the regulation is hereby generally approved/approved by the building authorities.
This notice comprises ten pages and three annexes.

I GENERAL PROVISIONS

1 With this decision, the usability or applicability of the subject matter of the regulation in the sense of the state building regulations is proven.

2 This notice does not replace the permits, approvals and certificates required by law for the implementation of construction projects.

3 This notice is issued without prejudice to the rights of third parties, in particular private property rights.

4 Copies of this decision are to be made available to the user of the subject of the regulation, irrespective of further regulations in the "Special Provisions". In addition, the user or user of the subject matter of the regulation must be informed that this notification must be available at the point of use or application. Copies must also be made available to the authorities involved on request.

5 This decision may only be reproduced in its entirety. A publication of excerpts requires the approval of the German Institute for Building Technology. Texts and drawings of advertising literature must not contradict this decision, translations must contain the note "Translation of the German original version not checked by the Deutsches Institut für Bautechnik".

6 This decision is revocable. The provisions can be supplemented and changed later, especially if new technical knowledge requires this.

7 This decision relates to the information and documents submitted by the applicant. A change to these basics is not covered by this notification and must be disclosed to the Deutsches Institut für Bautechnik without delay.

II SPECIAL PROVISIONS

1 Subject of the regulation and area of use or application

(1) The subject of approval is the cold-drawn prestressing steel strand St 1570/1770 consisting of seven cold-drawn individual wires with a circular cross-section. The nominal diameters of the prestressing steel strands are 9.3-12.5-15.3 and 15.7 mm (see Annex 1). The prestressing steel strand has very low relaxation.

(2) The prestressing steel strand

may: ÿ be used for prestressing prestressed concrete components according to DIN EN 1992-1-1:2011-01# in connection with DIN EN 1992-1-1/NA:2013-04,

ÿ for the prestressing of concrete bridges according to DIN EN 1992-2:2010-12 in connection with DIN EN 1992-2/NA:2013-04, whereby section 2.1.4 is analogous to DIN EN 1992-1-1 in connection with DIN EN 1992-1-1/NA is to be observed,

ÿ for the production of rock anchors according to DIN EN 1537:2014-07 in connection with DIN SPEC 18537:2017-11. be used.

(3) The object of approval may be used for the straight prestressing of finished parts in the prestressing bed (immediate bond) according to Section 1.(2) for the nominal diameters 9.3 and 12.5 mm; the use of nominal diameters of 15.3 and 15.7 mm is not definitively regulated.

(4) DIN EN 1992-1-1 in connection with DIN EN 1992-1-1/NA does not conclusively regulate the use as a tension member in prestressing methods without bond or in subsequent bond.

(5) The subject of the approval are the application provisions for the planning, design and execution of prestressed concrete components made of normal concrete according to DIN EN 206-1 in conjunction with DIN 1045-2 and rock anchors according to DIN EN 1537 in conjunction with DIN SPEC 18537 with the prestressing steel strand. In addition, the technical building regulations apply, provided they do not contradict this decision.

DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA applies to prestressed concrete components: or DIN EN 1992-2 in conjunction with DIN EN 1992-2/NA.

DIN EN 1537 in conjunction with DIN SPEC 18537 applies to the manufacture of rock anchors.

2 Provisions for the construction product

2.1 properties and composition

2.1.1 Dimensions and weight per meter (1) The

nominal diameters, cross-sections, weights per running meter (running meter) and the respective tolerances are given in Appendix 1, Table 1. The basic appearance of the prestressing steel strand cross-section is shown in Appendix 1, Figure 1.

(2) The values resulting from the tolerances are defined as 5% quantiles of the total population. The production is to be adjusted in such a way that the mean cross-sectional area Ap considered diameter-by-diameter is not smaller than the nominal cross-section.

(3) The cross-sectional area Ap is to be determined by weighing, whereby the bulk density of the cold-drawn prestressing steel strand is assumed to be 7.81 g/cm³ and the surface design is assumed to be evenly distributed over the surface.

Detailed information on all standard references is listed below after Section 3.

2.1.2 Mechanical properties (1) The requirements for the mechanical properties are given in Annex 2, Table 2 and the stress-strain curve in Annex 3, Figure 2.

(2) The values in Annex 2, Table 2 are defined as 5% quantiles of the population; in addition, these values may not exceed 5 in individual cases for the properties yield strength Rp0.1 or Rp0.2, tensile strength Rm and total elongation at maximum force Agt % are fallen below.

(3) The 95% quantile of the tensile strength of a production quantity (melt or batch) may exceed the nominal strength of Rm = 1570 N/mm² by a maximum of 12%.

(4) For cross -sections Ap ÿ 93 mm² (strand diameter ÿ 12.5 mm), the transverse pressure sensitivity must be verified by means of the deflection pull test in accordance with DIN EN ISO 15630-3, Section 12. The drop in load-bearing capacity must not be more than 28%.

(5) The relaxation test values at a test temperature of 20 °C may exceed the values specified in Appendix 2, Table 3 by a maximum of 10%.

(6) The test results on which the confirmation of the Wöhler curve is based according to DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA are deposited with the Deutsches Institut für Bautechnik.

2.1.3 Composition

(1) The prestressing steel strand has the following basic chemical composition in Mass % (melting analysis):

C	And	Mn	P max.	S max.
0.72 to 0.83	0.15 to 0.30	0.60 to 0.90	0,035	0,025

(2) The detailed composition of the prestressing steel strand must be complied with as it is deposited with the German Institute for Building Technology and the external monitoring body.

2.1.4 Mechanical properties for verification of stability 2.1.4.1 Elongation DIN EN 1992-1-1, Section 3.3.2 (2) applies with the following specifications: The characteristic elongation of the prestressing steel at maximum load is ÿuk = 3.5% (corresponds to Agt) to assume.

2.1.4.2 Relaxation

DIN EN 1992-1-1/NA, section NCI to 3.3.2 (4)P applies with the following stipulations: (1) The calculated values for the relaxation of the prestressing steel strand can be found in Annex 2, Table 3. These voltage losses apply to temperatures that occur in components due to climate. For other temperatures, with the exception of the application regulated in Section 2.1.4.2 (2), the relaxation values must be determined separately.

(2) If prestressed concrete elements are heat treated (~ 8 h) under a prestressed bed of 0.8 ÿ Rp0.1 or 0.65 ÿ Rm (the lower value is decisive) and at temperatures up to +80 °C, the relaxation loss ÿRz,t can be set at 4%. In this case it can be assumed that all the relaxation loss occurs during the heat treatment and all later relaxation losses under normal temperature are anticipated.

2.1.4.3 Strength DIN EN 1992-1-1, Section 3.3.3 applies with the following specifications: (1) The characteristic value of the 0.1% proof stress is fp0.1k = 1500 N/mm² (corresponds to Rp0.1) to accept.

(2) The characteristic value of the tensile strength of the prestressing steel is assumed to be fpk = 1770 N/mm² (corresponds to Rm) .

2.1.4.4 Modulus of elasticity

DIN EN 1992-1-1, Section 3.3.6 (2) applies with the following specification: Ep = 197,000 N/

mm² is to be assumed as the calculated value for the modulus of elasticity.

2.1.4.5 Fatigue properties DIN EN 1992-1-1,

Section 6.8 applies in conjunction with DIN EN 1992-1-1/NA with the following stipulations: (1) For verification of fatigue of the prestressing steel strand, the Wöhler curve is used

DIN EN 1992-1-1, Section 6.8.4, Figure 6.30 with the relevant parameters N*, k1, k2 and ÿÿRsk according to Table 1.

(2) In the immediate bond, the Wöhler curve described with the parameters from Table 1, Line 1 only applies outside the anchorage area.

(3) For verification within the anchorage area, the stress range ÿÿRsk of the prestressing steel strand in the immediate bond at the end of the transfer length shall be limited to 50 N/mm². This regulation applies without restriction for up to a maximum of 10 million.
load cycles.

Table 1: Wöhler curve parameters

prestressing steel	**N***	**voltage exponent**		D_{Rs} **at N* cyclesb)** N/mm²
		k1	**k2**	**class** 1
in immediate connection (even) a) **in**	106	5	9	185
subsequent connection c)				
ÿ single strands in plastic ducts	106	5	9	185
ÿ straight tendons, curved Tendons in plastic ducts	106	5	9	150
ÿ curved tendons in steel ducts a) In the immediate	106	3	7	120
bond, the Wöhler curve described only applies outside of the anchor area. b) Values in the installed condition c) For proof of the anchorage and coupling of tendons, the provisions of the proof of usability and type approval of the respective prestressing system must be observed.				

2.2 **Manufacture, packaging, transport, storage and labeling Manufacture** (1) The starting

2.2.1 material for the prestressing steel strands is melted as oxygen steel or electric steel. The individual wires produced by cold drawing are twisted into strands. The finished prestressing steel strand undergoes a heat treatment with the aim of achieving low relaxation. The manufacturing conditions must be observed as they are deposited with the Deutsches Institut für Bautechnik.

(2) Welds caused by the manufacturing process must be removed. If the welding of individual wires is unavoidable for the production of particularly long prestressing steel strands, this must be done before the entire drawing process. In the finished prestressing steel strand, welds must be at least ten times the lay length apart.

2.2.2 Packaging, transport, storage

(1) The subject of approval may be delivered wound in coils. In doing so, 0.9 times the yield strength Rp0.1 or the elasticity limit Rp0.01 (the lower value is decisive) of the individual wire must not be exceeded.

(2) Prestressing steel strands wound in rings must be able to be unwound straight.

(3) Prestressing steel strands must be protected from moisture in closed transport containers (e.g. containers, trucks with tarpaulins) or by suitable packaging.

(4) Transport containers and storage rooms must be dry and free from corrosive substances (e.g. chlorides, nitrates, acids).

(5) Care must be taken during transport and storage to ensure that the prestressing steel strand is neither mechanically damaged nor soiled.

(6) Subsequent straightening of the prestressing steel strand is not permitted.

2.2.3 Labeling and delivery note (1) The prestressing steel strand, which is wound into a ring or already cut and bundled into ready-made lengths, must be provided with a tag measuring around 60 x 120 mm² that is weather-resistant and insensitive to mechanical injuries with the Ü symbol and the following inscription:

Repairs: ... Prestressing steel strand St 1570/1770 - cold-drawn, round, smooth individual wires - according to approval no. Z-12.3-152 Relaxation class: very low Wöhler line class 1 Nominal diameter: mm Melt no.: Batch no.: Order no.: Date of delivery: Recipient:	**Caution sensitive prestressing steel!** Store dry and protected from corrosion! Do not damage, do not pollute! Please keep it and send it in if you have a complaint!

(2) The delivery note must contain the same information as the tag according to 2.2.3 (1) as well as the stress-strain curves based on the manufacturing data according to DIN EN 1992-1-1, Section 3.3.4 (4) inclusive of the modulus of elasticity and must be marked by the manufacturer with the mark of conformity (Ü mark) in accordance with the national mark of conformity regulations. Labeling may only take place if the requirements according to Section 2.3 are met. Confirmation of **conformity General** (1) The confirmation of the conformity of the construction product with the provisions of the general building inspectorate approval covered by the notification must be submitted for each

2.3 manufacturing plant with a declaration of conformity from the manufacturer based on in-house production control and

2.3.1 a certificate of conformity from a certification body recognized for this purpose, as well as regular external monitoring by a recognized monitoring body in accordance with the following provisions.

(2) For the issuance of the certificate of conformity and the external monitoring including the product tests to be carried out, the manufacturer of the construction product must involve a recognized certification body and a recognized monitoring body.

(3) The manufacturer must issue the declaration of conformity by labeling the construction products with the conformity mark (Ü mark) with reference to the intended use.

(4) The certification body shall provide the Deutsches Institut für Bautechnik with a copy of the certificate of conformity it has issued.

(5) The Deutsches Institut für Bautechnik must also be given a copy of the initial test report for information.

2.3.2 Factory Production Control

(1) A factory production control must be set up and carried out in each manufacturing plant. Factory production control means the continuous monitoring of production to be carried out by the manufacturer, with which he ensures that the building products he manufactures comply with the provisions of the general building inspectorate approval covered by this decision.

(2) The factory production control should be at least the ones listed in the "Test and control plan for surveillance" deposited by the Deutsches Institut für Bautechnik include measures.

(3) The results of the factory production control must be recorded and evaluated in accordance with the criteria specified in the "test and control plan for surveillance". The records must contain at least the following information: - designation of the construction product or the starting material,

- type of control or test, - date of manufacture and testing of the construction product or the

starting material, - result of the controls and tests and, if applicable, comparison with the

Requirements,

ÿ Signature of the person responsible for the factory production control.

(4) The records are to be kept for at least five years and submitted to the monitoring body responsible for external monitoring. They are to be presented to the German Institute for Building Technology and the competent supreme building control authority on request.

(5) If the test result is unsatisfactory, the manufacturer must immediately take the necessary measures to rectify the defect. Construction products that do not meet the requirements are to be handled in such a way that confusion with conforming ones is ruled out. Once the defect has been remedied, the test in question must be repeated immediately - insofar as this is technically possible and necessary to prove that the defect has been rectified.

2.3.3 External monitoring

(1) In each manufacturing plant, the plant and the factory production control must be checked regularly by external surveillance, but at least twice a year.

(2) As part of the external monitoring, an initial test of the construction product must be carried out, samples must be taken and tested in accordance with the “test and control plan for monitoring” provided by the German Institute for Building Technology and samples can also be taken for spot checks. The sampling and testing are the responsibility of the recognized monitoring body.

(3) The results of the certification and external monitoring must be kept for at least five years. They must be submitted by the certification body or the monitoring body to the Deutsches Institut für Bautechnik and the competent supreme building control authority on request.

3 Provisions for planning, dimensioning and execution

3.1 Planning and design DIN EN

1992-1-1 applies in conjunction with DIN EN 1992-1-1/NA unless otherwise specified below. The following sections are also to be considered analogously for the application according to DIN EN 1992-2 in connection with DIN 1992-2/NA.

3.1.1 Design 3.1.1.1

Anchorage in immediate bond

(1) For prestressing steel strands with Ap > 100 mm² (nominal diameter 15.3 and 15.7 mm) an application for immediate connection is not possible according to this decision.

(2) When using DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA, the bond stress fbpt according to Equation (8.15) with ÿp1 = 2.85 and the bond strength fbpd according to Equation (8.20) with to determine ÿp2 = 1.4. ÿct = 0.85 and ÿc = 1.5 are to be used for fctd(t) and fctd .

(3) Uncracked concrete is required to introduce the prestressing force. The formation of explosive cracks on the front side of the component during or after the introduction of the clamping force must be ruled out. DAfStb booklet 600, Section 8.10.2 must be observed.

3.1.1.2 Additional application rules for cyclic loading in the immediate bond

(1) To determine the anchorage length lbpd of the prestressing steel strand in the immediate bond under cyclic loading, equation (8.21) according to DIN EN 1992-1-1 in connection with DIN EN 1992-1-1/NA is replaced as follows:

$$lbpd=lpt2+ÿ2ÿÿÿÿpd-ÿpmÿ/\ fbpdÿÿdyn \quad (1)$$

there is

lpt2 the upper rated value of the transmission length according to DIN EN 1992-1-1, Section 8.10.2.2(3) in conjunction with DIN EN 1992-1-1/NA and Section 3.1.1.1(2) of this decision, if ÿ1 = 1.0, then nominal diameter according to DIN EN 1992-1-1, Section 8.10.2.3(1) in connection with DIN EN 1992-1-1/NA, NCI to

a2 8.10.2.3 (1) is equivalent to; the preload minus all losses in clamping force; according to Section 3.1.1.1(2)

ÿ of this notice;

ÿpd

ÿpmÿ

fbpd

ÿdyn = 2/3.

Crack formation within the anchorage area lbpd according to equation (1) is not permitted. For this purpose, it must be verified that the concrete tensile stress does not exceed the following values within the anchorage length lbpd :

ÿ for the upper load of the cyclic loading the value 0.85 ÿ fctk;0.05; ÿ under static maximum loading in the serviceability limit state (under rare (characteristic) combination of actions with the assumption of ÿ0,i = 1.0) the value fctk;0.05.

(2) If according to DIN EN 1992-1-1, section 8.10.2.3, equation (8.21) in connection with DIN EN 1992-1-1/NA, to 8.10.2.3 and NCI to 8.10.2.3 (NA.7) results in a greater anchorage length lbpd for than according to Section 3.1.1.2 (1), Equation (1), this is decisive.

3.2 **Execution** (1)

When used according to DIN EN 1992-1-1 in connection with DIN EN 1992-1-1/NA, the provisions of DIN EN 13670 in connection with DIN 1045-3 and DIN 1045-4 apply.

The provisions of DIN EN 1537 in conjunction with DIN SPEC 18537 apply to the manufacture of rock anchors.

(2) With regard to the treatment and protection of the prestressing steel strand at the point of application, the relevant provisions (e.g. standards, guidelines) must be observed. The prestressing steel strand must also be protected against corrosion, mechanical damage, etc. during processing until the final protection (e.g. grouting with cement mortar) is produced.

(3) A damaged prestressing steel strand may neither be processed nor installed.

(4) The prestressing steel strands may not be welded.

(5) Subsequent straightening of the prestressing steel strand is not permitted.

If no other information is given in the present decision, the following Provisions referred to:

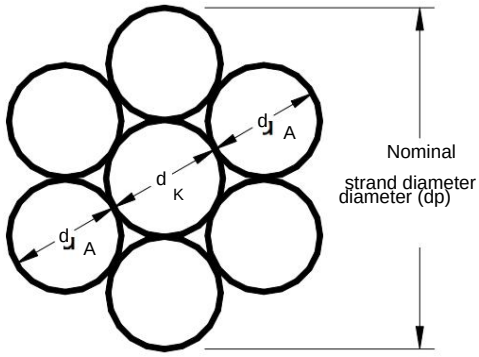
DIN EN 206-1:2001-07	Concrete Part 1: Specification, characteristics, manufacture and conformity German version EN 206-1:2000 **in** **connection with:** ## DIN EN 206-1/A1:2004-10 Concrete - Part 1: Specification, properties, production and Conformity; German version EN 206-1:2000/A1:2004 ## DIN EN 206-1/A2:2005-09 Concrete - Part 1: Specification, properties, production and Conformity; German version EN 206-1:2000/A2:2005
DAfStb-Heft 600:2012	Explanation of DIN EN 1992-1-1 and DIN EN 1992-1-1/NA (Eurocode 2)
DIN 1045-2:2008-08	Structures made of concrete, reinforced concrete and prestressed concrete - Part 2: Concrete - Definition, properties, production and conformity - Application rules for DIN EN 206-1
DIN 1045-3:2012-03	Structures made of concrete, reinforced concrete and prestressed concrete - Part 3: Construction - application rules for DIN EN 13670 **in connection with:** ## DIN 1045-3 correction 1:2013-07: Structures made of concrete, reinforced concrete and prestressed concrete - Part 3: Construction - application rules for DIN EN 13670, Correction to DIN 1045-3:2012-03
DIN 1045-4:2012-02	Structures made of concrete, reinforced concrete and prestressed concrete - Part 4: Supplementary rules for the production and the Conformity of finished parts
DIN EN 1537:2014-07	Execution of work in special civil engineering - grouted anchors German version EN 1537:2013

DIN EN 1992-1-1:2011-01	Eurocode 2: Design and construction of reinforced concrete and Prestressed concrete structures - Part 1-1: General design rules and rules for building construction; German version EN 1992-1-1:2004 + AC:2010
	combined with: ## DIN EN 1992-1-1/A1:2015-03
	Eurocode 2: Design and construction of reinforced concrete and Prestressed concrete structures - Part 1-1: General design rules and rules for building construction; German version EN 1992-1-1:2004/A1:2014
DIN EN 1992-1-1/NA:2013-04	National Annex - Nationally determined parameters - Eurocode 2: Design of Reinforced and prestressed concrete structures - Part 1-1: General Design rules and rules for building construction **in**
	connection with: ## DIN EN 1992-1-1/NA/A1:2015-12
	National Annex - Nationally determined Parameters - Eurocode 2: Design and construction of Reinforced and prestressed concrete structures - Part 11: General design rules and rules for building construction; Change A1
DIN EN 1992-2:2010-12	Eurocode 2: Design and construction of reinforced concrete and Prestressed concrete structures - Part 2: Concrete bridges - Design and construction rules; German version EN 1992-2:2005+AC:2008
DIN EN 1992-2/NA:2013-04	National Annex - Nationally determined parameters - Eurocode 2: Design of Reinforced concrete and prestressed concrete structures - Part 2: Concrete bridges - design and construction rules
DIN EN 13670:2011-03	Execution of structures made of concrete, German version of IN 13670:2009
DIN EN ISO 15630-3:2020-02	Steels for reinforcement and prestressing of concrete - Test methods - Part 3: Prestressing steels (ISO 15630-3:2019, corrected version 2019-10); German version EN ISO 15630-3:2019
FROM SPEC 18537:2017-11	Supplementary specifications to DIN EN 1537:2014-07, Execution of work in special civil engineering - ground anchors

Dr.-Ing. Lars Eckfeldt
head of department

Notarized
German man

Image 1: Representation of the prestressing steel strand cross-section



dA = outer wire diameter dK = core wire diameter

Lay length: 14 to 18 times the strand diameter (dp)

Table 1: Dimensions, weight and tolerances

strand					single wires
nominal diameter dp = ÿ ÿ 3 dA		**nominal cross-section** Ap	tolerance	**nominal weight** a)	**diameter ratio core wire/outer wires** min / dA
mm	Customs	mm²	%	g/m	---
9,3	3/8"	52	±2	406,0	ÿ 1,03
12,5	1/2"	93		726,0	
15,3	0,6"	140		1093,0	
15,7	0,62"	150		1172,0	
a) Rohdichte = 7,81 [g/cm³]					

Prestressing steel strands St 1570/1770 made from seven cold-drawn, smooth individual wires with ND: 9.3 to 15.7 mm with instructions for use for prestressed concrete and rock anchors

Representation of the prestressing steel strand cross-section, dimensions, weights and tolerances

Attachment 1

Table 2: **Strength and deformation properties**

relaxation class	**strength class**		**St 1570/1770** **very low**	**Quantile** a) [%]
elastic limit	Rp0,01 MPa		1350	5
0.1 % strain limits	Rp0,1	MPa	1500	5
0.2 % strain limits	Rp0,2	MPa	1570	5
tensile strenght	Rm	MPa	1770	5
total elongation at maximum force	Eight	%	3,5	5
bend counts back and forth bending test DIN EN ISO 15630-3:2020-02, Section 7	Nb	--	3	5
a) Quantiles for a statistical probability of w=1-ÿ = 0.95 (one-sided)				

Table 3: Calculated values for stress losses ÿ **Rz,t in [%] of the initial stress Ri**

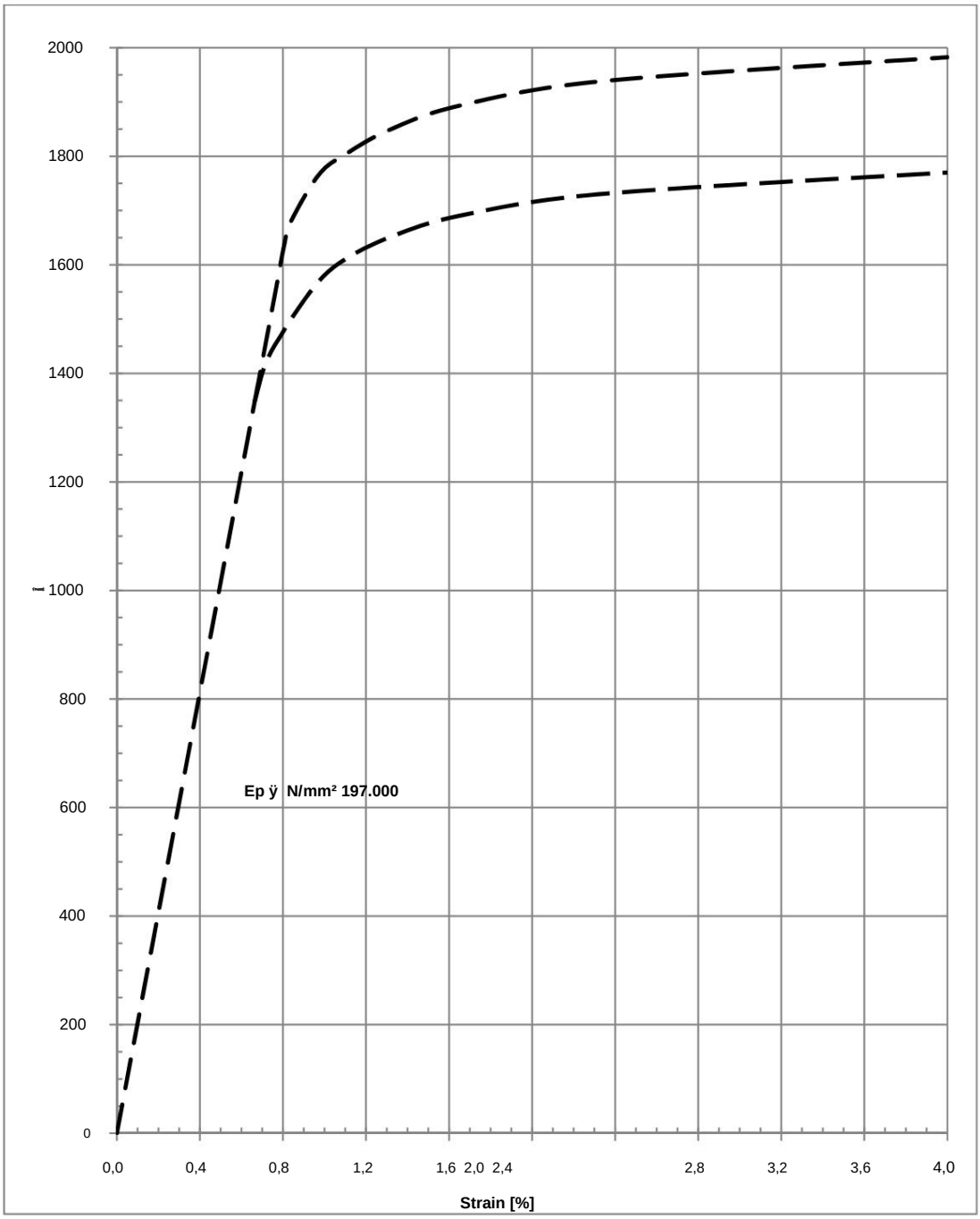
	very low relaxation						
	Time after tempering in hours						
Ri/Rm	1	10	200	1000	5000	5 ÿ 105	106
0,45	below 1%						
0,50							
0,55						1,0	1,2
0,60					1,2	2,5	2,8
0,65				1,3	2,0	4,5	5,0
0,70			1,0	2,0	3,0	6,5	7,0
0,75		1,2	2,5	3,0	4,5	9,0	10,0
0,80	1,0	2,0	4,0	5,0	6,5	13,0	14,0

Prestressing steel strands St 1570/1770 made from seven cold-drawn, smooth individual wires with ND: 9.3 to 15.7 mm with instructions for use for prestressed concrete and rock anchors

Mechanical properties, relaxation values

Attachment 2

Picture 2: Basic stress-strain curve



The lines give an orientation for the basic stress-strain curve assuming the calculated value of the modulus of elasticity (Ep) of 197,000 N/mm².

Prestressing steel strands St 1570/1770 made from seven cold-drawn, smooth individual wires with ND: 9.3 to 15.7 mm with instructions for use for prestressed concrete and rock anchors	Attachment 3
Basic stress-strain curve	