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Member of EOTA
www.eota.eu

European Technical Assessment

ETA 10/0430 of 26/04/2017

Technical Assessment Body issuing the ETA: Technical and Test Institute for Construction Prague	
Trade name of the construction product	LUSAN VINILESTER PLUS SIN ESTIRENO
Product family to which the construction product belongs	Product area code: 33 Bonded injection type anchor for use in cracked and non-cracked concrete
Manufacturer	Lusan Fijaciones y Anclajes S.L. Pol. Plà de la Bruguera C/ Solsonès, 66, 08211 Castellar del Vallès Barcelona Spain
Manufacturing plant	PLANT 1
This European Technical Assessment contains	23 pages including 19 Annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	ETAG 001-Part 1 and Part 5, edition 2013, used as European Assessment Document (EAD)
This version replaces	ETA 10/0430 issued on 28/05/2013

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

1. Technical description of the product

The LUSAN VINILESTER PLUS SIN ESTIRENO with steel elements is bonded anchor (injection type).

Steel elements can be galvanized or stainless steel threaded rod or rebar.

Steel element is placed into a drilled hole filled with injection mortar. The steel element is anchored via the bond between metal part, injection mortar and concrete. The anchor is intended to be used with embedment depth from 8 diameters to 12 diameters.

The illustration and the description of the product are given in Annex A.

2. Specification of the intended use in accordance with the applicable EAD

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The provisions made in this European Technical Assessment are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the products in relation to the expected economically reasonable working life of the works.

3. Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance for tension loads - threaded rod	See Annex C 1
Characteristic resistance for tension loads - rebar	See Annex C 2
Characteristic resistance for shear loads - threaded rod	See Annex C 3
Characteristic resistance for shear loads - rebar	See Annex C 4
Characteristic resistance for tension loads - threaded rod	See Annex C 5
Characteristic resistance for tension loads - rebar	See Annex C 6
Characteristic resistance for shear loads - threaded rod	See Annex C 7
Characteristic resistance for shear loads - rebar	See Annex C 8
Displacement for threaded rod	See Annex C 9
Displacement for rebar	See Annex C 10
Characteristic resistance for tension and shear loads for seismic design - threaded rod	See Annex C 11

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance assessed

3.3 Hygiene, health and environment (BWR 3)

Regarding dangerous substances contained in this European Technical Assessment, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

For basic requirement safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

3.5 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

3.6 General aspects relating to fitness for use

Durability and serviceability are only ensured if the specifications of intended use according to Annex B 1 are kept.

4. Assessment and verification of constancy of performance (AVCP) system applied with reference to its legal base

According to the Decision 96/582/EC of the European Commission[1] the system of assessment verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units	-	1

5. Technical details necessary for the implementation of the AVCP system, as provided in the applicable EAD

5.1 Tasks of the manufacturer

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European Technical Assessment.

The manufacturer may only use raw materials stated in the technical documentation of this European Technical Assessment.

The factory production control shall be in accordance with the control plan which is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Technical and Test Institute for Construction Prague.[2] The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

The manufacturer shall, on the basis of a contract, involve a body which is notified for the tasks referred to in section 4 in the field of anchors in order to undertake the actions laid down in section 5.2. For this purpose, the control plan referred to in this section and section 5.2 shall be handed over by the manufacturer to the notified body involved.

The manufacturer shall make a declaration of performance, stating that the construction product is in conformity with the provisions of this European Technical Assessment.

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1 Official Journal of the European Communities L 254 of 08.10.1996

2 The control plan is a confidential part of the documentation of the European Technical Assessment, but not published together with the ETA and only handed over to the approved body involved in the procedure of AVCP.

5.2 Tasks of the notified bodies

The notified body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The notified certification body involved by the manufacturer shall issue a certificate of constancy of performance of the product stating the conformity with the provisions of this European Technical Assessment.

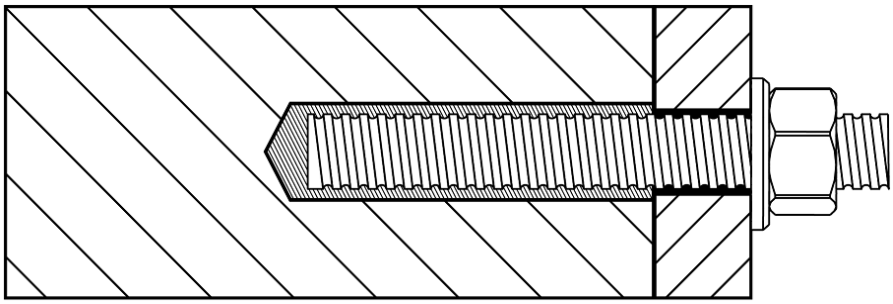
In cases where the provisions of the European Technical Assessment and its control plan are no longer fulfilled the notified body shall withdraw the certificate of constancy of performance and inform Technical and Test Institute for Construction Prague without delay.

Issued in Prague on 26.04.2017

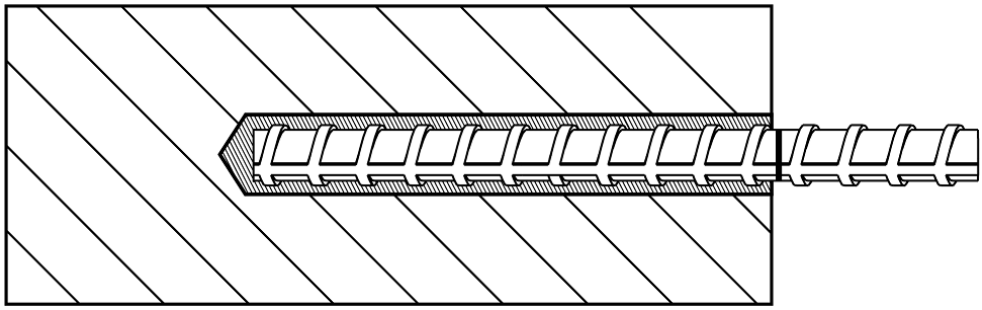
By

Ing. Mária Schaan
Head of the Technical Assessment Body

Threaded rod



Reinforcing bar



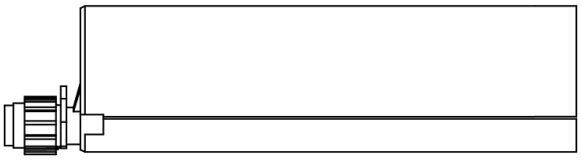
LUSAN VINILESTER PLUS SIN ESTIRENO	**Annex A 1**
Product description Installed conditions	

Coaxial cartridge

LUSAN VINILESTER PLUS SIN ESTIRENO
150 ml
380 ml
400 ml
410 ml

Side by side cartridge

LUSAN VINILESTER PLUS SIN ESTIRENO
350 ml
825 ml



Two part foil in a single piston component cartridge

LUSAN VINILESTER PLUS SIN ESTIRENO
150 ml
170 ml
300 ml
550 ml
850 ml

Peeler cartridge

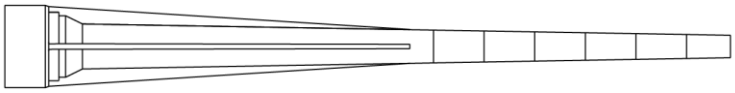
LUSAN VINILESTER PLUS SIN ESTIRENO
280 ml

Marking of the mortar cartridges

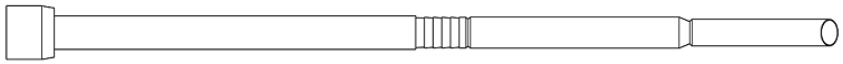
Identifying mark of the producer, Trade name, Charge code number, Storage life, Curing and processing time

Mixing nozzle

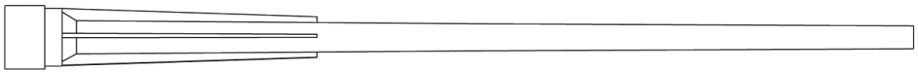
CMN



CMLR

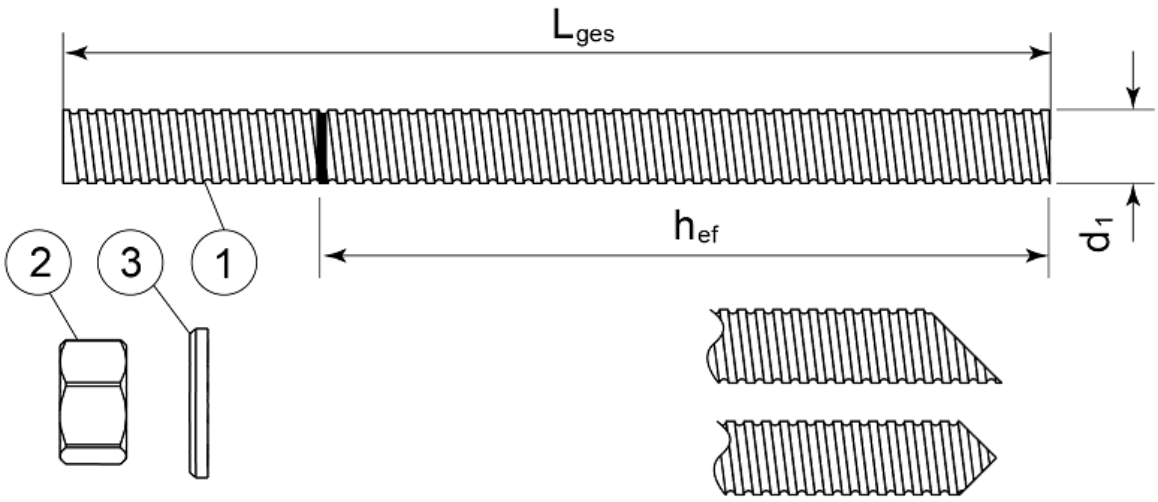


KR for use with 850



LUSAN VINILESTER PLUS SIN ESTIRENO	**Annex A 2**
Product description Injection system	

Threaded rod M8, M10, M12, M16, M20, M24



Standard commercial threaded rod with marked embedment depth

Part	Designation	Material
Steel, zinc plated ≥ 5 µm acc. to EN ISO 4042 or Steel, Hot-dip galvanized ≥ 40 µm acc. to EN ISO 1461 and EN ISO 10684 or Steel, zinc diffusion coating ≥ 15 µm acc. to EN 13811		
1	Anchor rod	Steel, EN 10087 or EN 10263 Property class 4.6, 5.8, 8.8, 10.9* EN ISO 898-1
2	Hexagon nut EN ISO 4032	According to threaded rod, EN 20898-2
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod
Stainless steel		
1	Anchor rod	Material: A2-70, A4-70, A4-80, EN ISO 3506
2	Hexagon nut EN ISO 4032	According to threaded rod
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod
High corrosion resistant steel		
1	Anchor rod	Material: 1.4529, 1.4565, EN 10088-1
2	Hexagon nut EN ISO 4032	According to threaded rod
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod

*Galvanized rod of high strength are sensitive to hydrogen induced brittle failure

LUSAN VINILESTER PLUS SIN ESTIRENO	**Annex A 3**
Product description Threaded rod and materials	

Rebar Ø8, Ø10, Ø12, Ø16, Ø20, Ø25

Standard commercial reinforcing bar with marked embedment depth

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of $k = (f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend/Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	 ±6,0 ±4,5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

LUSAN VINILESTER PLUS SIN ESTIRENO	**Annex A 4**
Product description Rebars and materials	

Specifications of intended use

Anchorages subject to:
- Static and quasi-static load.
- Seismic performance category C1: threaded rod size M10, M12, M16, M20, M24

Base materials
- Non-cracked concrete.
- Cracked and non-cracked concrete for threaded rod size M10, M12, M16, M20, M24
- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum and C50/60 at maximum according EN 206-1:2000-12.

Temperature range:
- -40°C to +80°C (max. short. term temperature +80°C and max. long term temperature +50°C)

Use conditions (Environmental conditions)
- Structures subject to dry internal conditions (zinc coated steel, stainless steel, high corrosion resistance steel).
- Structures subject to external atmospheric exposure including industrial and marine environment, if no particular aggressive conditions exist (stainless steel, high corrosion resistance steel).
- Structures subject to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel, high corrosion resistance steel).
- Structures subject to permanently damp internal condition, with particular aggressive conditions exist (high corrosion resistance steel).

Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Use categories:
- Category 1 – installation in dry or wet concrete.

Design:
- The anchorages are designed in accordance with the EOTA Technical Report TR 029 “Design of bonded anchors” under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings.
- Anchorages under seismic actions (cracked concrete) have to be designed in accordance with EOTA Technical Report TR 045 "Design of Metal Anchors under Seismic Action”.

Installation:
- Dry or wet concrete.
- Hole drilling by hammer drill mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

LUSAN VINILESTER PLUS SIN ESTIRENO	**Annex B 1**
Intended use Specifications	

Applicator gun

A

B

C

D

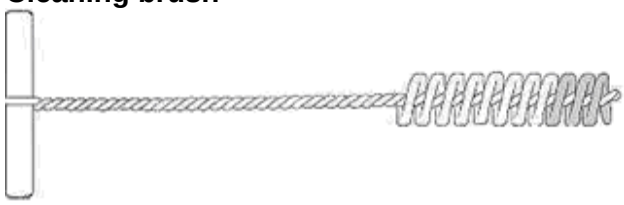
E

F

G

Applicator gun	A	B	C	D	E	F	G
Cartridge	Coaxial 380ml 400ml 410ml	Side by side 350ml	Foil capsule 150ml 300ml 550ml	Foil capsule 150ml 300ml Peeler 280ml	Coaxial 150ml	Side by side 825ml	Foil capsule 850ml

Cleaning brush



LUSAN VINILESTER PLUS SIN ESTIRENO	**Annex B 2**
Intended use Applicator guns Cleaning brush	

Installation instructions

1. Drill the hole to the correct diameter and depth using a rotary percussion drilling machine.

2. Thoroughly clean the hole in the following sequence using the brush with the required extensions and a blow pump:

   Blow Clean x2.
   Brush Clean x2.
   Blow Clean x2.
   Brush Clean x2.
   Blow Clean x2.

   Remove standing water from the hole prior to cleaning to achieve maximum performance.

3. Select the appropriate static mixer nozzle for the installation, open the cartridge/cut foil pack and screw nozzle onto the mouth of the cartridge. Insert the cartridge into a good quality applicator (gun).

4. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in the resin.

5. If necessary, cut the extension tube to the depth of the hole and push onto the end of the mixer nozzle, and fit the correct resin stopper to the other end.

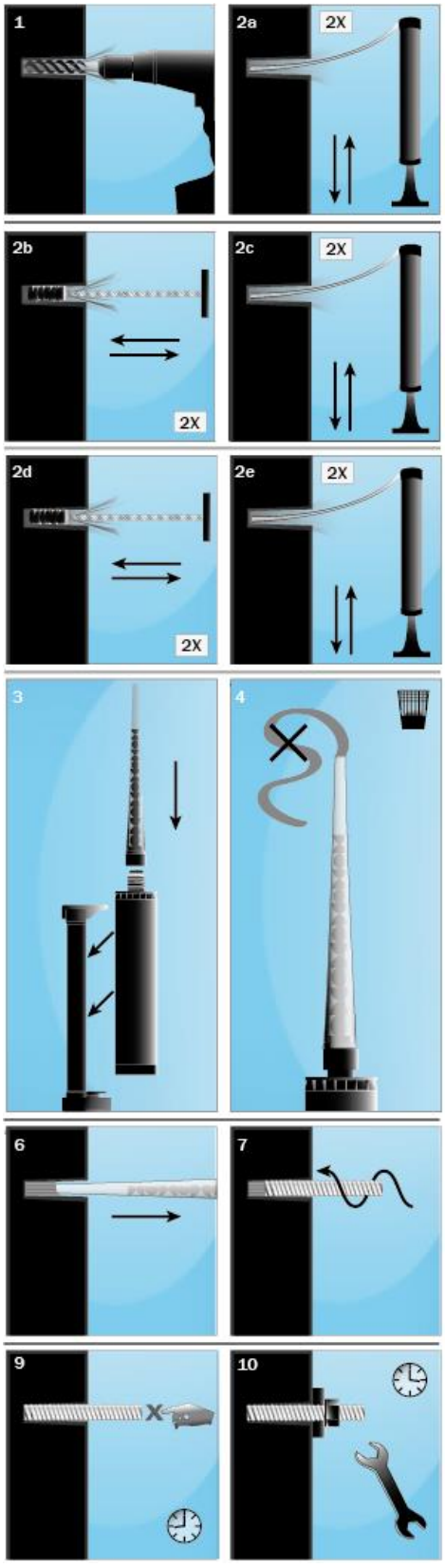
6. Insert the mixer nozzle (or the extension tube with resin stopper when necessary) to the bottom of the hole. Begin to extrude the resin and slowly withdraw the mixer nozzle from the hole ensuring that there are no air voids as the mixer nozzle is withdrawn. Fill the hole to approximately ½ to ¾ full and withdraw the nozzle completely.

7. Insert the clean threaded bar, free from oil or other release agents, to the bottom of the hole using a back and forth twisting motion ensuring all the threads are thoroughly coated. Adjust to the correct position within the stated working time.

8. Excess resin will be expelled from the hole evenly around the steel element showing that the hole is full.
   This excess resin should be removed from around the mouth of the hole before it sets.

9. Leave the anchor to cure.
   Do not disturb the anchor until the appropriate loading time has elapsed depending on the substrate conditions and ambient temperature.

10. Attach the fixture and tighten the nut to the recommended torque.
    Do not overtighten.



LUSAN VINILESTER PLUS SIN ESTIRENO

Intended use
Installation procedure

Annex B 3

Table B1: Installation parameters of threaded rod

Size			M8	M10	M12	M16	M20	M24
Nominal drill hole diameter	$Ød_0$	[mm]	10	12	14	18	22	26
Diameter of nylon cleaning brush	d_b	[mm]	14	14	20	20	29	29
Torque moment	T_{inst}	[Nm]	10	20	40	80	150	200
$h_{ef,min}$ = 8d								
Depth of drill hole	h_0	[mm]	64	80	96	128	160	192
Minimum edge distance	c_{min}	[mm]	35	40	50	65	80	96
Minimum spacing	s_{min}	[mm]	35	40	50	65	80	96
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm				h_{ef} + $2d_0$	
$h_{ef,max}$ = 12d								
Depth of drill hole	h_0	[mm]	96	120	144	192	240	288
Minimum edge distance	c_{min}	[mm]	48	60	72	96	120	144
Minimum spacing	s_{min}	[mm]	48	60	72	96	120	144
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm				h_{ef} + $2d_0$	

Table B2: Installation parameters of rebar

Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Nominal drill hole diameter	$Ød_0$	[mm]	12	14	16	20	25	32
Diameter of nylon cleaning brush	d_b	[mm]	14	14	19	22	29	40
$h_{ef,min}$ = 8d								
Depth of drill hole	h_0	[mm]	64	80	96	128	160	200
Minimum edge distance	c_{min}	[mm]	35	40	50	65	80	100
Minimum spacing	s_{min}	[mm]	35	40	50	65	80	100
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm				h_{ef} + $2d_0$	
$h_{ef,max}$ = 12d								
Depth of drill hole	h_0	[mm]	96	120	144	192	240	300
Minimum edge distance	c_{min}	[mm]	48	60	72	96	120	150
Minimum spacing	s_{min}	[mm]	48	60	72	96	120	150
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm				h_{ef} + $2d_0$	

Table B3: Cleaning

All diameters
- 2 x blowing
- 2 x brushing
- 2 x blowing
- 2 x brushing
- 2 x blowing

Table B4: Minimum curing time

Application temperature	Processing time	Load time
+5 to +10°C	10 mins	145 mins
+10 to +15°C	8 mins	85 mins
+15 to +20°C	6 mins	75 mins
+20 to +25°C	5 mins	50 mins
+25 to +30°C	4 mins	40 mins

Processing time refers to the highest temperature in the range.
Load time refers to the lowest temperature in the range.
Cartridge must be conditioned to a minimum +5°C.

LUSAN VINILESTER PLUS SIN ESTIRENO

Intended use
Installation parameters
Curing time

Annex B 4

Table C1: Design method TR 029
Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$N_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms} 1)	[-]	2,00					
Steel grade **5.8**	$N_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms} 1)	[-]	1,50					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	γ_{Ms} 1)	[-]	1,50					
Steel grade **10.9**	$N_{Rk,s}$	[kN]	37	58	84	157	245	353
Partial safety factor	γ_{Ms} 1)	[-]	1,33					
Stainless steel grade **A2-70, A4-70**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms} 1)	[-]	1,87					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	γ_{Ms} 1)	[-]	1,60					
Stainless steel grade **1.4529**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms} 1)	[-]	1,50					
Stainless steel grade **1.4565**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms} 1)	[-]	1,87					

Combined pullout and concrete cone failure in non-cracked concrete C20/25								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Characteristic bond resistance in non-cracked concrete								
Dry and wet concrete	τ_{Rk}	[N/mm²]	10	9	8,5	8	7,5	7,5
Partial safety factor	γ_{Mc} 1)	[-]	1,8 2)					
Factor for concrete C50/60	ψ_c	[-]	1					

Combined pullout and concrete cone failure in cracked concrete C20/25							
Size			**M10**	**M12**	**M16**	**M20**	**M24**
Characteristic bond resistance in cracked concrete							
Dry and wet concrete	τ_{Rk}	[N/mm²]	4	4	4	4	4
Partial safety factor	γ_{Mc} 1)	[-]	1,8 2)				
Factor for cracked concrete C30/37	ψ_c	[-]	1,12				
Factor for cracked concrete C40/50	ψ_c	[-]	1,23				
Factor for cracked concrete C50/60	ψ_c	[-]	1,30				

Splitting failure								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Edge distance	$c_{cr,sp}$	[mm]	$1,5h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$3,0h_{ef}$					
Partial safety factor	γ_{Msp} 1)	[-]	1,8					

1) In absence of national regulations
2) The partial safety factor γ_2=1,2 is included

LUSAN VINILESTER PLUS SIN ESTIRENO

Performances
Design according to TR 029
Characteristic resistance for tension loads - threaded rod

Annex C 1

Table C2: Design method TR 029
Characteristic values of resistance to tension load of rebar

Steel failure – Characteristic resistance								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	28	43	62	111	173	270
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					

Combined pullout and concrete cone failure in non-cracked concrete C20/25								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Characteristic bond resistance in non-cracked concrete								
Dry and wet concrete	τ_{Rk}	[N/mm²]	10	9	9	8,5	8	8
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]					
Factor for concrete C50/60	ψ_c	[-]	1					

Splitting failure								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Edge distance	$c_{cr,sp}$	[mm]	$1{,}5h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$3{,}0h_{ef}$					
Partial safety factor	γ_{Msp} [1)]	[-]	1,8					

[1)] In absence of national regulations
[2)] The partial safety factor γ_2=1,2 is included

LUSAN VINILESTER PLUS SIN ESTIRENO

Performances
Design according to TR 029
Characteristic resistance for tension loads - rebar

Annex C 2

Table C3: Design method TR 029
Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$V_{Rk,s}$	[kN]	7	12	17	31	49	71
Partial safety factor	γ_{Ms} [1)]	[-]	1,67					
Steel grade **5.8**	$V_{Rk,s}$	[kN]	9	15	21	39	61	88
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9**	$V_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Stainless steel grade **A2-70, A4-70**	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Stainless steel grade **1.4565**	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					

Steel failure with lever arm								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$M^0_{Rk,s}$	[N.m]	15	30	52	133	260	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,67					
Steel grade **5.8**	$M^0_{Rk,s}$	[N.m]	19	37	66	166	325	561
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$M^0_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9**	$M^0_{Rk,s}$	[N.m]	37	75	131	333	649	1123
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Stainless steel grade **A2-70, A4-70**	$M^0_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$M^0_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$M^0_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Stainless steel grade **1.4565**	$M^0_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Concrete pryout failure								
Factor *k* from TR 029 Design of bonded anchors, Part 5.2.3.3			2					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					

Concrete edge failure								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
See section 5.2.3.4 of Technical Report TR 029 for the Design of Bonded Anchors								
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

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Performances
Design according to TR 029
Characteristic resistance for shear loads - threaded rod

Annex C 3

Table C4: Design method TR 029
Characteristic values of resistance to shear load of rebar

Steel failure without lever arm								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	14	22	31	55	86	135
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					

Steel failure with lever arm								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$M^{o}_{Rk,s}$	[N.m]	33	65	112	265	518	1013
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Concrete pryout failure								
Factor *k* from TR 029 Design of bonded anchors, Part 5.2.3.3			2					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					

Concrete edge failure								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
See section 5.2.3.4 of Technical Report TR 029 for the Design of Bonded Anchors								
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

Table C5: Design method CEN/TS 1992-4
Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$N_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms} [1)]	[-]	2,00					
Steel grade **5.8**	$N_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Steel grade **10.9**	$N_{Rk,s}$	[kN]	37	58	84	157	245	353
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **A2-70, A4-70**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms} [1)]	[-]	1,87					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	γ_{Ms} [1)]	[-]	1,60					
Stainless steel grade **1.4529**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Stainless steel grade **1.4565**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms} [1)]	[-]	1,87					
Combined pullout and concrete cone failure in non-cracked concrete C20/25								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Characteristic bond resistance in non-cracked concrete								
Dry and wet concrete	τ_{Rk}	[N/mm²]	10	9	8,5	8	7,5	7,5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]					
Factor for concrete C50/60	ψ_c	[-]	1					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		10,1					
Combined pullout and concrete cone failure in cracked concrete C20/25								
Size				**M10**	**M12**	**M16**	**M20**	**M24**
Characteristic bond resistance in cracked concrete								
Dry and wet concrete	τ_{Rk}	[N/mm²]		4	4	4	4	4
Partial safety factor	γ_{Mc} [1)]	[-]		1,8 [2)]				
Factor for cracked concrete C30/37	ψ_c	[-]		1,12				
Factor for cracked concrete C40/50	ψ_c	[-]		1,23				
Factor for cracked concrete C50/60	ψ_c	[-]		1,30				
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8			7,2				
Concrete cone failure								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Factor according to CEN/TS 1992-4-5 Section 6.2.3	k_{ucr}			10,1				
	k_{cr}			7,2				
Edge distance	$c_{cr,N}$	[mm]		$1,5h_{ef}$				
Spacing	$s_{cr,N}$	[mm]		$3,0h_{ef}$				
Splitting failure								
Edge distance	$c_{cr,sp}$	[mm]		$1,5h_{ef}$				
Spacing	$s_{cr,sp}$	[mm]		$3,0h_{ef}$				
Partial safety factor	γ_{Msp} [1)]	[-]		1,8				

[1)] In absence of national regulations
[2)] The partial safety factor γ_2=1,2 is included

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Performances
Design according to CEN/TS 1992-4
Characteristic resistance for tension loads - threaded rod

Annex C 5

Table C6: Design method CEN/TS 1992-4
Characteristic values of resistance to tension load of rebar

Steel failure – Characteristic resistance								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	28	43	62	111	173	270
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					

Combined pullout and concrete cone failure in non-cracked concrete C20/25								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Characteristic bond resistance in non-cracked concrete								
Dry and wet concrete	τ_{Rk}	[N/mm²]	10	9	9	8,5	8	8
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]					
Factor for concrete C50/60	ψ_c	[-]	1					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		10,1					

Concrete cone failure								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Factor according to CEN/TS 1992-4-5 Section 6.2.3	k_{ucr}		10,1					
Edge distance	$c_{cr,N}$	[mm]	$1,5h_{ef}$					
Spacing	$s_{cr,N}$	[mm]	$3,0h_{ef}$					
Splitting failure								
Edge distance	$c_{cr,sp}$	[mm]	$1,5h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$3,0h_{ef}$					
Partial safety factor	γ_{Msp} [1)]	[-]	1,8					

[1)] In absence of national regulations
[2)] The partial safety factor γ_2=1,2 is included

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Performances
Design according to CEN/TS 1992-4
Characteristic resistance for tension loads - rebar

Annex C 6

Table C7: Design method CEN/TS 1992-4
Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$V_{Rk,s}$	[kN]	7	12	17	31	49	71
Partial safety factor	γ_{Ms} [1)]	[-]	1,67					
Steel grade **5.8**	$V_{Rk,s}$	[kN]	9	15	21	39	61	88
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9**	$V_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Stainless steel grade **A2-70, A4-70**	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Stainless steel grade **1.4565**	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1		k_2	0,8					
Steel failure with lever arm								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$M^0_{Rk,s}$	[N.m]	15	30	52	133	260	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,67					
Steel grade **5.8**	$M^0_{Rk,s}$	[N.m]	19	37	66	166	325	561
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$M^0_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9**	$M^0_{Rk,s}$	[N.m]	37	75	131	333	649	1123
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Stainless steel grade **A2-70, A4-70**	$M^0_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$M^0_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$M^0_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Stainless steel grade **1.4565**	$M^0_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Concrete pryout failure								
Factor according to CEN/TS 1992-4-5 Section 6.3.3		k_3	2,0					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					
Concrete edge failure								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
See section 6.3.4 of CEN/TS 1992-4-5								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

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Performances
Design according to CEN/TS 1992-4
Characteristic resistance for shear loads - threaded rod

Annex C 7

Table C8: Design method CEN/TS 1992-4
Characteristic values of resistance to shear load of rebar

Steel failure without lever arm								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	14	22	31	55	86	135
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1	k_2		0,8					

Steel failure with lever arm								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$M^0_{Rk,s}$	[N.m]	33	65	112	265	518	1013
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Concrete pryout failure								
Factor according to CEN/TS 1992-4-5 Section 6.3.3	k_3		2,0					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					

Concrete edge failure								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
See section 6.3.4 of CEN/TS 1992-4-5								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

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Performances
Design according to CEN/TS 1992-4
Characteristic resistance for shear loads - rebar

Annex C 8

Table C9: Displacement of threaded rod under tension and shear load

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Non-cracked concrete								
Tension load	F	[kN]	6,3	7,9	11,9	15,9	23,8	29,8
Displacement	δ_{N0}	[mm]	0,3	0,3	0,3	0,3	0,4	0,5
	$\delta_{N\infty}$	[mm]	0,5	0,5	0,5	0,5	0,5	0,5
Shear load	F	[kN]	3,1	5,0	7,2	13,5	21,0	30,3
Displacement	δ_{V0}	[mm]	1,5	1,5	1,5	1,5	2,0	2,5
	$\delta_{V\infty}$	[mm]	2,3	2,3	2,3	2,3	3,0	3,8
Cracked concrete								
Tension load	F	[kN]		5,1	7,4	13,1	20,5	24,6
Displacement	δ_{N0}	[mm]		0,4	0,7	0,7	0,7	0,6

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Performances
Displacement for threaded rod

Annex C 9

Table C10: Displacement of rebar under tension and shear load

Rebar size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Non-cracked concrete								
Tension load	F	[kN]	7,9	9,9	13,9	23,8	29,8	55,6
Displacement	δ_{N0}	[mm]	0,3	0,3	0,3	0,4	0,4	0,5
	$\delta_{N\infty}$	[mm]	0,5	0,5	0,5	0,5	0,5	0,5
Shear load	F	[kN]	5,9	9,3	13,3	23,7	37,0	57,9
Displacement	δ_{V0}	[mm]	0,3	0,4	0,4	0,4	0,4	0,5
	$\delta_{V\infty}$	[mm]	0,5	0,6	0,6	0,6	0,6	0,8

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Performances
Displacement for rebar

Annex C 10

Table C11: Characteristic values of resistance under seismic action category C1 for threaded rods

Size			**M10**	**M12**	**M16**	**M20**	**M24**
Tension load							
Steel failure							
Characteristic resistance grade **4.6**	$N_{Rk,s,seis}$	[kN]	23	34	63	98	141
Partial safety factor	γ_{Ms} [1)]	[-]			2,00		
Characteristic resistance grade **5.8**	$N_{Rk,s,seis}$	[kN]	29	42	79	123	177
Partial safety factor	γ_{Ms} [1)]	[-]			1,50		
Characteristic resistance grade **8.8**	$N_{Rk,s,seis}$	[kN]	46	67	126	196	282
Partial safety factor	γ_{Ms} [1)]	[-]			1,50		
Characteristic resistance grade **10.9**	$N_{Rk,s,seis}$	[kN]	58	84	157	245	353
Partial safety factor	γ_{Ms} [1)]	[-]			1,33		
Characteristic resistance **A2-70, A4-70**	$N_{Rk,s,seis}$	[kN]	41	59	110	172	247
Partial safety factor	γ_{Ms} [1)]	[-]			1,87		
Characteristic resistance **A4-80**	$N_{Rk,s,seis}$	[kN]	46	67	126	196	282
Partial safety factor	γ_{Ms} [1)]	[-]			1,60		
Characteristic resistance **1.4529**	$N_{Rk,s,seis}$	[kN]	41	59	110	172	247
Partial safety factor	γ_{Ms} [1)]	[-]			1,50		
Characteristic resistance **1.4565**	$N_{Rk,s,seis}$	[kN]	41	59	110	172	247
Partial safety factor	γ_{Ms} [1)]	[-]			1,87		
Combined pull-out and concrete cone failure							
Dry and wet concrete	$\tau_{Rk,seis,C1}$	[N/mm²]	3,2	3,2	3,2	3,2	3,2
Partial safety factor	γ_{Mc} [1)]	[-]			1,8 [2)]		

Shear load							
Steel failure without lever arm							
Characteristic resistance grade **4.6**	$V_{Rk,s,seis}$	[kN]	7	10	23	30	40
Partial safety factor	γ_{Ms} [1)]	[-]			1,67		
Characteristic resistance grade **5.8**	$V_{Rk,s,seis}$	[kN]	9	13	28	38	51
Partial safety factor	γ_{Ms} [1)]	[-]			1,25		
Characteristic resistance grade **8.8**	$V_{Rk,s,seis}$	[kN]	14	21	45	61	81
Partial safety factor	γ_{Ms} [1)]	[-]			1,25		
Characteristic resistance grade **10.9**	$V_{Rk,s,seis}$	[kN]	18	26	56	76	101
Partial safety factor	γ_{Ms} [1)]	[-]			1,50		
Characteristic resistance **A2-70**, **A4-70**	$V_{Rk,s,seis}$	[kN]	12	18	39	53	71
Partial safety factor	γ_{Ms} [1)]	[-]			1,56		
Characteristic resistance **A4-80**	$V_{Rk,s,seis}$	[kN]	14	21	45	61	81
Partial safety factor	γ_{Ms} [1)]	[-]			1,33		
Characteristic resistance **1.4529**	$V_{Rk,s,seis}$	[kN]	12	18	39	53	71
Partial safety factor	γ_{Ms} [1)]	[-]			1,25		
Characteristic resistance **1.4565**	$V_{Rk,s,seis}$	[kN]	12	18	39	53	71
Partial safety factor	γ_{Ms} [1)]	[-]			1,56		

[1)] In absence of national regulations
[2)] The partial safety factor γ_2=1,2 is included

Note: Rebars are not qualified for seismic design

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Performances
Reduction factors for seismic design

Annex C 11