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European Technical Assessment

ETA-11/0002 of 16/12/2016

General Part

Technical Assessment Body issuing the European Technical Assessment	Instytut Techniki Budowlanej
Trade name of the construction product	R-HAC-V
Product family to which the construction product belongs	Bonded anchor with threaded rod of sizes M8 to M30 or rebars Ø8 do Ø25 mm for use in non-cracked concrete
Manufacturer	RAWLPLUG S.A. ul. Kwidzyńska 6 51-416 Wrocław Poland
Manufacturing plant	Manufacturing Plant no. 3
This European Technical Assessment contains	19 pages including 3 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	Guideline for European Technical Approval ETAG 001, Edition April 2013 “Metal anchors for use in concrete – Part 1: Anchors in general and Part 5: Bonded anchors”, used as European Assessment Document (EAD)
This version replaces	ETA-11/0002 issued on 28/06/2013

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Specific Part

1 Technical description of the product

The R-HAC-V is a bonded anchor (capsule type) consisting of chemical mortar glass capsules and steel element (anchor rod).

The steel elements are the threaded anchor rods of sizes M8 to M30 or the reinforcing bars (rebars) with diameters from 8 to 25 mm.

The glass capsule is placed into a drilled hole previously cleaned and anchor rod is driven by machine with simultaneous hammering and turning. The steel element is anchored by the bond between steel part, chemical mortar and concrete.

An illustration and description of the products are given in Annexes A.

2 Specification of the intended use in accordance with the applicable European Assessment Document (EAD)

The performances given in Section 3 are only valid if the anchors are used in compliance with the specifications and conditions given in Annexes B.

The performances given 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 or the Technical Assessment Body, but are to be regarded only as a means for choosing the right 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 Performance of the product

3.1.1 Mechanical resistance and stability (BWR 1)

The essential characteristic is detailed in the Annexes C.

3.1.2 Safety in case of fire (BWR 2)

Essential characteristics	Performances
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance assessed

3.1.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances 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 Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

3.1.4 Safety and accessibility in use (BWR 4)

For Basic Requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability (BWR 1).

3.1.5 Sustainable use of natural resources (BWR 7)

No performance assessed.

3.2 Methods used for the assessment

The assessment of fitness of the anchors for declared intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements 1 and 4 has been made in accordance with the ETAG 001 *"Metal anchors for use in concrete*", Part 1: "*Anchors in general*" and Part 5: "*Bonded anchors*", on the basis of Option 7.

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

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

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 for in the applicable European Assessment Document (EAD)

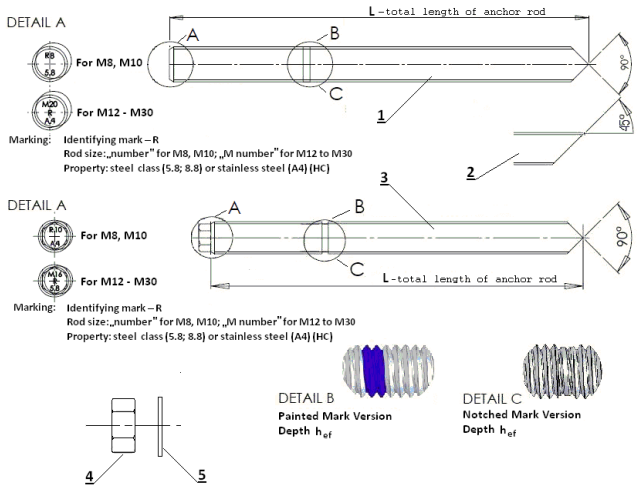
Technical details necessary for the implementation of the AVCP system are laid down in the control plan which is deposited at Instytut Techniki Budowlanej.

For type testing the results of the tests performed as part of the assessment for the European Technical Assessment shall be used unless there are changes in the production line or plant. In such cases the necessary type testing has to be agreed between Instytut Techniki Budowlanej and the notified body.

Issued in Warsaw on 16/12/2016 by Instytut Techniki Budowlanej

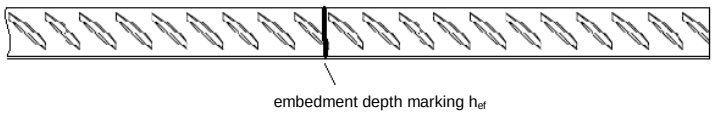
Anna Panek, MSc
Deputy Director of ITB

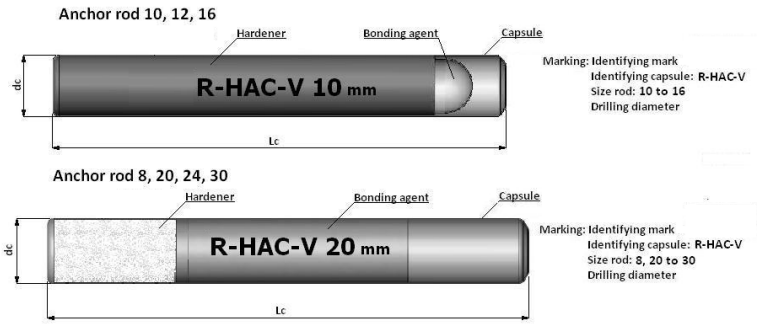
Threaded rods M8 to M30 with washer and hexagon nut



1. **Anchor rod R-STUDS - (5.8, 8.8,..) (A4),(HC) – FL**
2. **45°shape with anchor rod**
3. **Anchor rod R-Studs - (5.8, 8.8,..) (A4),(HC) – with Hex-drive**
4. **Hexagonal nut**
5. **Washer**

Reinforcing bars (rebars) Ø8 to Ø25 according to Annex 6, Table 6





R-HAC-V (glass capsules)	8 mm	10 mm	12 mm	16 mm	20 mm	24 mm	30 mm
L_c [mm]	85 ± 3%	85 ± 3%	95 ± 2%	95 ± 2%	180 ± 2%	215 ± 1%	270 ± 1%
d_c [mm]	9,25	10,75	12,65	16,75	21,55	23,75	33,20
R-STUDS (threaded rods)	M8	M10	M12	M16	M20	M24	M30
L [mm]	110; 160; 250	130, 170, 190, 220, 250	160, 190, 220, 260, 300	190, 220, 260, 300, 310, 380	260, 350	300, 400	380
Rebars	-	Ø8	Ø10	Ø12 and Ø14	Ø16	Ø20	Ø25

R-HAC-V

Annex A1

of European Technical Assessment ETA-11/0002

Product description
Characteristic of the product

Table A1: Metal components – threaded rods

Part	Designation		
	Steel, zinc plated	**Stainless steel**	**High corrosion resistance stainless steel (HCR)**
Threaded rod	Steel, property class 5.8 to 12.9 acc. to EN ISO 898-1 electroplated ≥ 5 µm acc. to EN ISO 4042 or hot-dip galvanized ≥ 45 µm acc. to EN ISO 10684	Material 1.4401, 1.4404, 1.4571 acc. to EN 10088; property class 70 and 80 (A4-70 and A4-80) acc. to EN ISO 3506	Material 1.4529, 1.4565, 1.4547 acc. to EN 10088; property class 70 acc. to EN ISO 3506
Hexagon nut	Steel, property class 5 to 12, acc. to EN ISO 898-2; electroplated ≥ 5 µm acc. to EN ISO 4042 or hot-dip galvanized ≥ 45 µm acc. to EN ISO 10684	Material 1.4401, 1.4404, 1.4571 acc. to EN 10088; property class 70 and 80 (A4-70 and A4-80) acc. to EN ISO 3506	Material 1.4529, 1.4565, 1.4547 acc. to EN 10088; property class 70 acc. to EN ISO 3506
Washer	Steel, acc. to EN ISO 7089; electroplated ≥ 5 µm acc. to EN ISO 4042 or hot-dip galvanized ≥ 45 µm acc. to EN ISO 10684	Material 1.4401, 1.4404, 1.4571 acc. to EN 10088	Material 1.4529, 1.4565, 1.4547 acc. to EN 10088

Table A2: Metal components – reinforcing bars according to EN 1992-1-1, Annex C

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ [N/mm^2]		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	

Rib height h: The maximum rib height h_{rib} shall be: $h_{rib} \leq 0,07 \cdot Ø$

Table A3: Chemical mortar

Product	**Composition**
R-HAC-V	Bonding agent: Vinylester styrene free resin Hardener: Dibenzoyl peroxide Additive: Quartz sand (filler)

R-HAC-V	**Annex A2** of European Technical Assessment ETA-11/0002
Product description Materials	

SPECIFICATION OF INTENDED USE

Use:

The anchors are intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled and failure of anchorages made with these products would compromise the stability of the works, cause risk to human life and/or lead to considerable economic consequences.

Anchors subject to:

Static and quasi-static loads:

- Threaded rods: M8 to M30.
- Reinforcing bars: 8 to 25 mm.

Base material:

- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum to C50/60 at maximum according to EN 206.
- Non cracked concrete.

Temperature range:

The anchors may be used in the following temperature range:

- -40°C to +40°C (max. short term temperature +40°C and max. long term temperature +24°C).
- -40°C to +80°C (max. short term temperature +80°C and max. long term temperature +50°C).

Use conditions (environmental conditions):

- Elements made of galvanized steel may be used in structures subject to dry internal conditions.
- Elements made of stainless steel may be used in structures subject to dry internal conditions and also in concrete subject to external atmospheric exposure (including industrial and marine environment) or exposure in permanently damp internal conditions if no particular aggressive conditions exist. Such 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).
- Elements made of high corrosion resistant stainless steel may be used in structures subject to dry internal conditions and also in concrete subject to external atmospheric exposure or exposure in permanently damp internal conditions or in other particular aggressive conditions. Such 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 chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Installation:

- Installation temperature ≥ -5°C.
- Dry or wet concrete (use category 1).
- Flooded holes with the exception of seawater (use category 2).
- All anchor sizes are suitable for rotary hammer drilled holes.

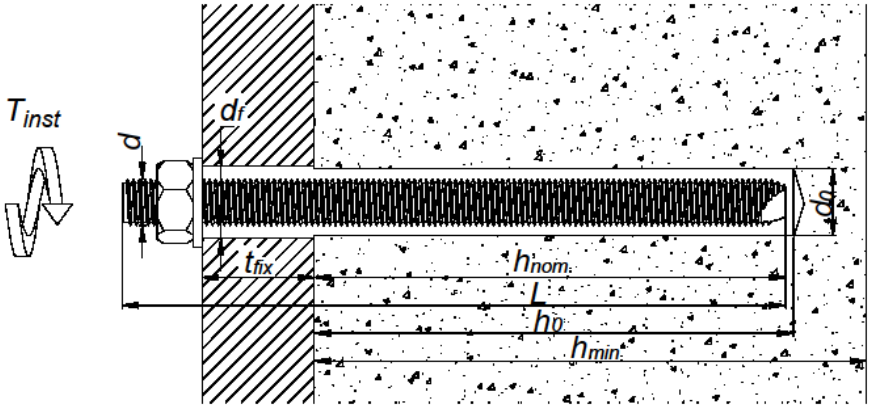
Design methods:

- Elements made of threaded rods - EOTA Technical Report TR 029 (September 2010) or CEN/TS 1992-4:2009.
- Elements made of reinforcing bars (rebars) may be used as anchors designed in accordance with the EOTA Technical Report TR 029 only. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the reinforcing bars act as dowels to take up shear forces. Connections with the post-installed reinforcing bars in concrete structures designed in accordance with EN 1992-1-1 (Eurocode 2) are not covered by this European Technical Assessment.

R-HAC-V	**Annex B1** of European Technical Assessment ETA-11/0002
Intended use Intended use	

Table B1: Installation data – threaded rods

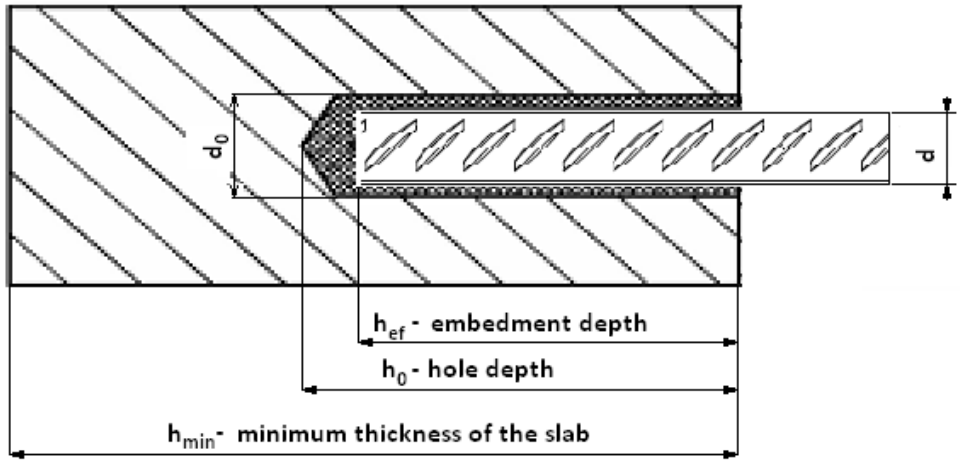
Size		M8	M10	M12	M16	M20	M24	M30
Diameter of anchor rod	d [mm]	8	10	12	16	20	24	30
Nominal drilling diameter	d_0 [mm]	10	12	14	18	24	28	35
Maximum diameter hole in the fixture	d_f [mm]	9	12	14	18	22	26	33
Effective embedment depth	$h_{ef} = h_{nom}$ [mm]	80	90	110	125	170	210	270
Depth of the drilling hole	h_0 [mm]	h_{ef} + 5 mm						
Minimum thickness of concrete member	h_{min} [mm]	120	130	140	180	230	270	340
Torque moment	T_{inst} [Nm]	10	20	40	80	120	180	300
Minimum spacing	s_{min} [mm]	$0,5 \cdot h_{ef}$						
Minimum edge distance	c_{min} [mm]	$0,5 \cdot h_{ef}$						



R-HAC-V	**Annex B2** of European Technical Assessment ETA-11/0002
Intended use Installation data– threaded rods	

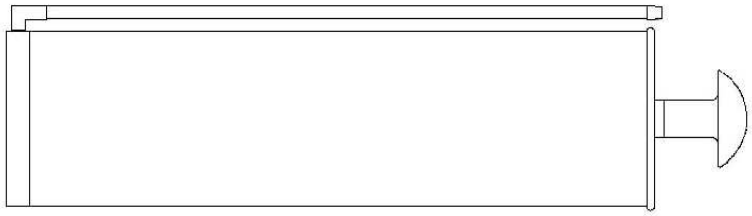
Table B1: Installation data – threaded rods

Rebar size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Nominal diameter of rebar	d	[mm]	8	10	12	16	20	24	30
Drilling diameter	d_0	[mm]	12	14	18	18	22	26	35
Depth of the drilling hole	h_0	[mm]	h_{ef} + 5						
Embedment depth	h_{ef}	[mm]	80	90	110	125	170	210	270
Minimum thickness of the concrete member	h_{min}	[mm]	120	130	140	180	230	270	340
Minimum spacing and edge distance									
Minimum spacing	s_{min}	[mm]	0,5 · h_{ef}						
Minimum edge distance	c_{min}	[mm]	0,5 · h_{ef}						

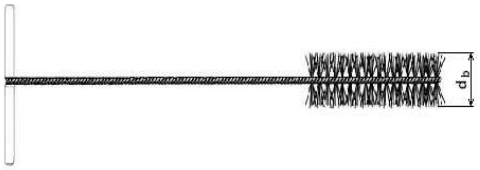


R-HAC-V	**Annex B3** of European Technical Assessment ETA-11/0002
Intended use Installation data – reinforcing bars	

Manual blower pump



Steel brush



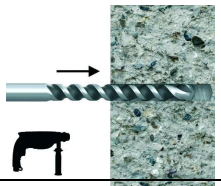
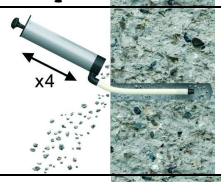
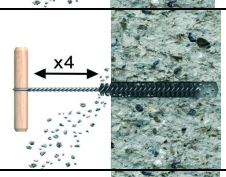
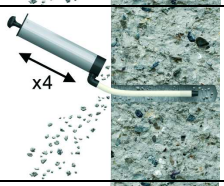
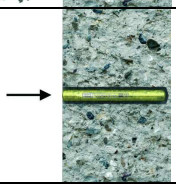
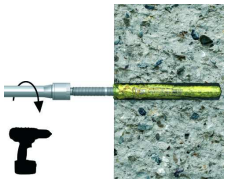
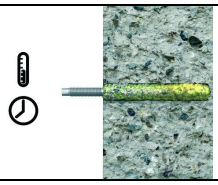
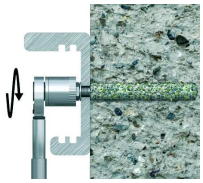
Brush diameter

Size rod	M8	M10	M12	M16	M20	M24	M30
Brushes diameter d_b (mm)	12	14	16	20	26	30	37

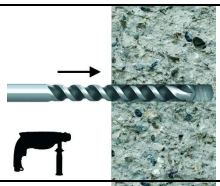
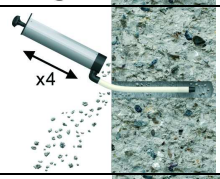
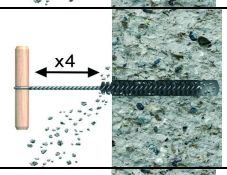
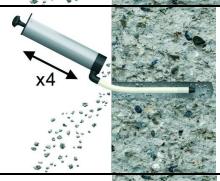
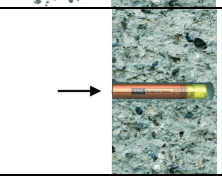
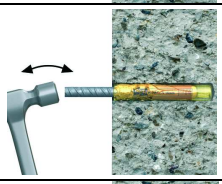
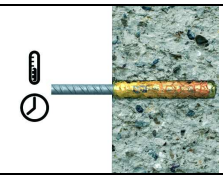
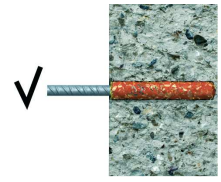
Table B2: Minimum curing time

Concrete temperature	Minimum curing time[1)]
-5°C	24 h
0°C	14 h
5°C	4 h
10°C	3 h
15°C	1,5 h
20°C	45 min
30°C	20 min
40°C	10 min

[1)] Curing time shall be doubled for wet concrete

	Drill a hole to the required diameter and depth using a rotary hammer drilling machine.
	4x blowing starting from the bottom of the drilled hole using the hand pump.
	4x brushing (at least) using the specified steel brush.
	4x blowing starting from the bottom of the drilled hole using the hand pump.
	Insert the glass capsule into the cleaned hole.
	Positioning the stud into the drilled hole. Switch on the drilling machine (simultaneous hammering and turning) and drive the stud into the drilled hole until the embedment depth is reached. Setting control: Mortar excess flows out at the top of the drilled hole.
	Leave the fixing undisturbed until the cure time elapses.
	Attach the fixture and tighten the nut to the required torque.

R-HAC-V	**Annex B5** of European Technical Assessment ETA-11/0002
Intended use Installation instruction – threaded rods	

	Drill a hole to the required diameter and depth using a rotary hammer drilling machine.
	4x blowing starting from the bottom of the drilled hole using the hand pump.
	4x brushing (at least) using the specified steel brush.
	4x blowing starting from the bottom of the drilled hole using the hand pump.
	Insert the glass capsule into the cleaned hole.
	Position the rebar into the glass capsule then switch on the drilling machine and drive the stud into the capsule. Switch off the drilling machine as soon as the anchoring depth is achieved.
	Leave the fixing undisturbed until the cure time elapses.
	

R-HAC-V	**Annex B6** of European Technical Assessment ETA-11/0002
Intended use Installation instruction – reinforcing bars	

Table C1a: Characteristic values of resistance under tension loads – threaded rods

Size				M8	M10	M12	M16	M20	M24	M30
Steel failure										
Steel failure with threaded rod grade 5.8										
Characteristic resistance		$N_{Rk,s}$	[kN]	18	29	42	78	122	176	280
Partial safety factor		γ_{Ms} [1)]	[-]	1,50						
Steel failure with threaded rod grade 8.8										
Characteristic resistance		$N_{Rk,s}$	[kN]	29	46	67	126	196	282	449
Partial safety factor		γ_{Ms} [1)]	[-]	1,50						
Steel failure with threaded rod grade 10.9										
Characteristic resistance		$N_{Rk,s}$	[kN]	37	58	84	157	245	353	561
Partial safety factor		γ_{Ms} [1)]	[-]	1,40						
Steel failure with threaded rod grade 12.9										
Characteristic resistance		$N_{Rk,s}$	[kN]	44	70	101	188	294	424	673
Partial safety factor		γ_{Ms} [1)]	[-]	1,40						
Steel failure with stainless steel threaded rod grade A4-70										
Characteristic resistance		$N_{Rk,s}$	[kN]	26	41	59	110	171	247	393
Partial safety factor		γ_{Ms} [1)]	[-]	1,87						
Steel failure with stainless steel threaded rod grade A4-80										
Characteristic resistance		$N_{Rk,s}$	[kN]	29	46	67	126	196	282	449
Partial safety factor		γ_{Ms} [1)]	[-]	1,60						
Steel failure with high corrosion threaded rod grade 70										
Characteristic resistance		$N_{Rk,s}$	[kN]	26	41	59	110	171	247	393
Partial safety factor		γ_{Ms} [1)]	[-]	1,87						
Combined pull-out and concrete cone failure										
Characteristic bond resistance in non-cracked concrete C20/25	Temp. range I: 40ºC/24ºC	$\tau_{Rk,ucr}$	[N/mm²]	11	11	10	10	9	9	7
	Temp. range II: 80ºC/50ºC			9,5	9	8,5	8	7	7	6
Increasing factor for $\tau_{Rk,ucr}$ in non-cracked concrete		ψ_c	C30/37	1,04					1,0	
			C40/50	1,07						
			C50/60	1,09						
Installation safety factor for use category 1		γ_2 [2)] = γ_{inst} [3)]	[-]	1,4		1,2	1,4			
Installation safety factor for use category 2		γ_2 [2)] = γ_{inst} [3)]	[-]	1,4						
Factor acc. CEN/TS 1992-4-5:2009, § 6.2.2.3 and § 6.2.3.1		$k_8 = k_{ucr}$ [3)]	[-]	10,1						
Effective anchorage depth		h_{ef}	[mm]	80	90	110	125	170	210	270
Edge distance and spacing		$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$						
		$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$						

1) In the absence of other national regulations
2) Parameter for design according to EOTA Technical Report TR 029
3) Parameter for design according to CEN/TS 1992-4-5:2009

Table C1b: Characteristic values of resistance under tension loads – threaded rods

Size			M8	M10	M12	M16	M20	M24	M30
Splitting failure									
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210	270
Edge distance and spacing	$c_{cr,sp}$ [4)5)]	[mm]	$c_{cr,sp} = hef * \left(\frac{\tau_{k,ucr}}{8}\right)^{0,4} * \left(3,1 - 0,7\frac{h}{h_{ef}}\right)$						
	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$						
Installation safety factor for use category 1	γ_2 [2)] = γ_{inst} [3)]	[-]	1,4		1,2	1,4			
Installation safety factor for use category 2	γ_2 [2)] = γ_{inst} [3)]	[-]	1,4						

1) h = concrete member thickness
2) Parameter for design according to EOTA Technical Report TR 029
3) Parameter for design according to CEN/TS 1992-4-5:2009
4) For $h/h_{ef} \leq 2,4$; if $h/h_{ef} > 2,4$ $c_{cr,sp} = 1,5 \times hef$
5) $\tau_{k,ucr}$ from Table C1a

Table C2: Characteristic values of resistance under shear loads - steel failure without lever arm [1)] – threaded rods

Size			M8	M10	M12	M16	M20	M24	M30
Steel failure with threaded rod grade 5.8									
Characteristic resistance	$V_{Rk,s}$	[kN]	9	14	21	39	61	88	140
Partial safety factor	γ_{Ms} [2)]	[-]	1,25						
Steel failure with threaded rod grade 8.8									
Characteristic resistance	$V_{Rk,s}$	[kN]	15	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [2)]	[-]	1,25						
Steel failure with threaded rod grade 10.9									
Characteristic resistance	$V_{Rk,s}$	[kN]	18	29	42	78	122	176	280
Partial safety factor	γ_{Ms} [2)]	[-]	1,50						
Steel failure with threaded rod grade 12.9									
Characteristic resistance	$V_{Rk,s}$	[kN]	22	35	51	94	147	212	337
Partial safety factor	γ_{Ms} [2)]	[-]	1,50						
Steel failure with stainless steel threaded rod grade A4-70									
Characteristic resistance	$V_{Rk,s}$	[kN]	13	20	29	55	86	124	196
Partial safety factor	γ_{Ms} [2)]	[-]	1,56						
Steel failure with stainless steel threaded rod grade A4-80									
Characteristic resistance	$V_{Rk,s}$	[kN]	15	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [2)]	[-]	1,33						
Steel failure with high corrosion stainless steel threaded rod grade 70									
Characteristic resistance	$V_{Rk,s}$	[kN]	13	20	29	55	86	124	196
Partial safety factor	γ_{Ms} [2)]	[-]	1,56						

1) Ductility factor acc. CEN/TS 1992-4-5:2009, § 6.3.2.1: $k_2 = 1,0$
2) In the absence of national regulations

Table C3: Characteristic values of resistance under shear loads - steel failure with lever arm – threaded rods

Size			M8	M10	M12	M16	M20	M24	M30
Steel failure with threaded rod grade 5.8									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	19	37	65	166	324	561	1124
Partial safety factor	γ_{Ms} 1)	[-]	1,25						
Steel failure with threaded rod grade 8.8									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} 1)	[-]	1,25						
Steel failure with threaded rod grade 10.9									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	37	75	131	333	649	1123	2249
Partial safety factor	γ_{Ms} 1)	[-]	1,50						
Steel failure with threaded rod grade 12.9									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	45	90	157	400	779	1347	2699
Partial safety factor	γ_{Ms} 1)	[-]	1,50						
Steel failure with stainless steel threaded rod grade A4-70									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	26	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} 1)	[-]	1,56						
Steel failure with stainless steel threaded rod grade A4-80									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} 1)	[-]	1,33						
Steel failure with high corrosion stainless steel threaded rod grade 70									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	26	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} 1)	[-]	1,56						

1) In the absence of national regulations

Table C4: Characteristic values of resistance under shear loads – pry-out and concrete edge failure – threaded rods

Size			M8	M10	M12	M16	M20	M24	M30
Pry-out failure									
Factor acc. to equation (5.7) of TR 029 or acc. to equation (27) of CEN/TS 1992-4-5:2009	k [1] = k_3 [2]	[-]	2						
Concrete edge failure: see clause 5.2.3.4 of Technical Report TR 029									
Effective anchor length	l_f	[mm]	80	90	110	125	170	210	270
Diameter of the anchor	d [1] = d_{nom} [2]	[mm]	8	10	12	16	20	24	30

[1] Parameter for design according to EOTA Technical Report TR 029

[2] Parameter for design according to CEN/TS 1992-4-5:2009

Table C5: Displacements under tension loads – threaded rods

Size			M8	M10	M12	M16	M20	M24	M30
Characteristic displacement under tension loads in non-cracked concrete C20/25 to C50/60									
Admissible service load	N	[kN]	7,5	10,8	18,2	25,7	42,7	58,2	82,5
Displacement	δ_{N0}	[mm]	0,20	0,20	0,30	0,35	0,35	0,40	0,45
	$\delta_{N\infty}$	[mm]	0,70	0,70	0,70	0,70	0,70	0,70	0,70

These values are suitable for each temperature range and categories specified in Annex B1

Table C6: Displacements under shear loads– threaded rods

Size			M8	M10	M12	M16	M20	M24	M30
Characteristic displacement under shear loads in non-cracked concrete C20/25 to C50/60									
Admissible service load	V	[kN]	3,7	5,8	8,4	15,7	24,5	35,3	55,6
Displacement	δ_{V0}	[mm]	2,5	2,5	2,5	2,5	2,5	2,5	2,5
	$\delta_{V\infty}$	[mm]	3,7	3,7	3,7	3,7	3,7	3,7	3,7

These values are suitable for each temperature range and categories specified in Annex B1

Table C7: Characteristic values of resistance under tension loads – reinforcing bars

Size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Steel failure									
Steel failure with reinforcing bar B500B									
Characteristic resistance	$N_{Rk,s}$	[kN]	27,6	43,2	62,2	84,7	110,6	172,8	270,0
Partial safety factor	γ_{Ms} 1)	[-]	1,4						
Combined pull-out and concrete cone failure									
Characteristic bond resistance in non-cracked concrete C20/25									
Temperature range I: 40ºC/24ºC	$\tau_{Rk,ucr}$	[N/mm²]	8	8	8	8,5	9	7	6,5
Temperature range II: 80ºC/50ºC	$\tau_{Rk,ucr}$	[N/mm²]	7	7	7	7	7,5	6	5,5
Increasing factor C30/37	ψ_c	[-]	1,04						1,00
Increasing factor C40/50			1,07						
Increasing factor C50/60			1,09						
Installation safety factor for use category 1	γ_2 2) = γ_{inst} 3)	[-]	1,2						
Installation safety factor for use category 2	γ_2 2) = γ_{inst} 3)	[-]	1,2					1,4	1,4
Factor acc. CEN/TS 1992-4-5:2009, § 6.2.2.3 and § 6.2.3.1	$k_8 = k_{ucr}$ 3)	[-]	10,1						
Effective anchorage depth	h_{ef}	[mm]	80	90	110	110	125	170	210
Edge distance	$c_{cr,N} = c_{cr,Np}$	[mm]	$1,5 \cdot h_{ef}$						
	$c_{cr,sp}$	[mm]	$c_{cr,sp} = hef * \left(\frac{\tau_{k,ucr}}{8}\right)^{0,4} * \left(3,1 - 0,7\frac{h}{h_{ef}}\right)$						
Spacing	$s_{cr,N} = s_{cr,Np}$	[mm]	$3,0 \cdot h_{ef}$						
	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$						

h = concrete member thickness

1) in the absence of national regulations
2) Parameter for design according to EOTA Technical Report TR 029
3) Parameter for design according to CEN/TS 1992-4-5:2009
4) For $h/h_{ef} \leq 2,4$; if $h/h_{ef} > 2,4$ $c_{cr,sp} = 1,5 \times h_{ef}$
5) $\tau_{Rk,ucr}$ from Table C1a

Table C8: Characteristic values of resistance to shear loads for steel failure without lever arm – reinforcing bars

Size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Steel failure - reinforcing bars (f_{uk} ≥ 550 MPa) [1)]									
Characteristic resistance	$V_{Rk,s}$	[kN]	13,8	21,6	31,1	42,3	55,3	86,4	135,0
Partial safety factor	γ_{Ms}	[-]	1,5						

1) The characteristic resistance $V_{Rk,s}$ shall be determined acc. to Technical Report TR 029, equation (5.5)

Table C9: Characteristic values of resistance to shear loads for steel failure with lever arm – reinforcing bars

Size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Steel failure - reinforcing bars (f_{uk} ≥ 550 MPa) [1)]									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	33	65	112	178	265	518	1012
Partial safety factor	γ_{Ms}	[-]	1,5						

1) The characteristic resistance $M^0_{Rk,s}$ shall be determined acc. to Technical Report TR 029, equation (5.6b.)

Table C10: Characteristic values of resistance under shear loads – pry-out and concrete edge failure – reinforcing bars

Size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Pry out failure									
Factor acc. to equation (5.7) of TR 029 or acc. to equation (27) of CEN/TS 1992-4-5:2009	k [1] = k_3 [2]	[-]	2	2	2	2	2	2	2
Concrete edge failure: see clause 5.2.3.4 of Technical Report TR 029									
Effective anchor length	l_f	[mm]	80	90	110	110	125	170	210
Diameter of the anchor	d [1] = d_{nom} [2]	[mm]	8	10	12	14	16	20	25

[1] Parameter for design according to EOTA Technical Report TR 029

[2] Parameter for design according to CEN/TS 1992-4-5:2009

Table C11: Displacement under tension loads – reinforcing bars

Size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Characteristic displacement in non-cracked concrete C20/25 to C50/60 under tension loads									
Admissible service load[1)]	N	[kN]	6,7	8,8	13,8	17,6	23,5	29,6	47,0
Displacement	δ_{N0}	[mm]	0,20	0,20	0,35	0,35	0,40	0,45	0,45
	$\delta_{N\infty}$	[mm]	0,70	0,70	0,70	0,70	0,70	0,70	0,70

These values are suitable for each temperature range and categories specified in Annex B1

Table C12: Displacement under shear loads – reinforcing bars

Size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Characteristic displacement in non-cracked concrete C20/25 to C50/60 under shear loads									
Admissible service load[1)]	V	[kN]	3,7	5,8	8,4	15,7	24,5	35,3	55,6
Displacement	δ_{V0}	[mm]	2,5	2,5	2,5	2,5	2,5	2,5	2,5
	$\delta_{V\infty}$	[mm]	3,7	3,7	3,7	3,7	3,7	3,7	3,7

These values are suitable for each temperature range and categories specified in Annex B1