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Authorised and notified according to Article 10 of the Council Directive (89/106/EEC) of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products.

BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

Designated by Government to issue European Technical Approvals

Member of EOTA

European Technical Approval ETA-12/0021

*Second issue**
Amendment*

Trade name:	Rawl R-HPTII-A4 Anchor
Holder of approval:	Rawlplug S.A. ul. Kwidzyńska 6 PL 51-416 Wrocław Poland Tel: + 44 (0)141-638 7961 Fax: + 44 (0)141-638 7397 e-mail: technical@rawlplug.co.uk website: www.rawlplug.com
Generic type and use of construction product:	Stainless steel torque-controlled expansion anchors in sizes of M8, M10, M12 and M16 for use in cracked and non-cracked concrete
Valid from: to:	14 November 2012 13 November 2017
This version replaces:	ETA-12/0021 valid from 13 March 2012 to 12 March 2017
Manufacturing plant:	Manufacturing Plant No 2
This European Technical Approval contains:	10 pages including three Annexes which form an integral part of the document.

I LEGAL BASES AND GENERAL CONDITIONS

1 This European Technical Approval is issued by the British Board of Agrément in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 [Construction Products Directive (CPD)] on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by the Council Directive 93/68/EEC of 22 July 1993[2]
- UK implementation of CPD Statutory Instruments 1991, No 1620. The Building and Building Construction Products Regulations 1991 — made 15 July 1991, laid before Parliament 22 July 1991, coming into force 27 December 1991, and amended by the Construction Products (Amendment) Regulations 1994 (Statutory Instruments 1994, No 3051)
- Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC[3]
- Manufacturers and importers may use European Technical Approvals issued in accordance with Article 9 of Directive 89/106/EEC before 1 July 2013 as European Technical Assessments throughout the period of validity of those approvals[4]
- EOTA Guideline for European Technical Approval ETAG 001 (Edition 1997, as amended) *Metal Anchors for Use in Concrete*, Part 1 *Anchors in general* and Part 2 *Torque-controlled expansion anchors*.

2 The British Board of Agrément is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3 This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

4 This European Technical Approval may be withdrawn by the British Board of Agrément, in particular after information by the Commission on the basis of Article 5[1] of Council Directive 89/106/EEC.

5 Reproduction of this European Technical Approval, including transmission by electronic means, shall be in full. However, partial reproduction can be made with the written consent of the British Board of Agrément. In this case, partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.

(1) Official Journal of the European Communities No L40, 11.2.1989, p12.
(2) Official Journal of the European Communities No L220, 30.8.1993, p1.
(3) Official Journal of the European Communities No L17, 20.1.1994, p34.
(4) Official Journal of the European Communities No L88, 4.4.2011, p32.

6 The European Technical Approval is issued by the approval body in its official language. This version should correspond to the version circulated within EOTA. Translations into other languages have to be designated as such.

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

The Rawl R-HPTII-A4 Anchors are through-fixing torque-controlled expansion anchors in sizes of M8, M10, M12 and M16 (see Annex 1, Figure 1). Each type comprises a special bolt with a taper, an expansion sleeve, a hexagonal nut and a washer. The anchors are made from A4 grade stainless steel (see Annex 1, Table 1).

The anchor is installed in a drilled hole; tightening the nut draws the cone into the sleeve. The expansion of this sleeve applies the anchorage (see Annex 2, Figure 1 and Table 1).

The product is intended for use in making structural fixings to normal-weight concrete where Essential Requirements 1 and 4 *Mechanical resistance and stability* and *Safety in use*, respectively (CPD, Annex 1), apply.

The product is to be used for anchorages subject to static or quasi-static loading in structures of reinforced or unreinforced normal-weight concrete of strength classes C20/25 at minimum and C50/60 at maximum in accordance with EN 206-1 : 2000 *Concrete — Specification, performance, production and conformity*.

The product may be anchored in cracked or non-cracked concrete.

The anchor may be used in structures subjected to dry internal conditions and also in structures subjected to external atmospheric exposure (including industrial and coastal environments), or exposure in permanently damp internal conditions, providing particularly aggressive conditions do not exist. Such aggressive conditions include; permanent and alternating immersion in seawater or the splash zone of seawater, atmospheric chloride of indoor swimming pools, and atmospheres with extreme chemical pollution (eg desulfurisation plants or road tunnels where de-icing chemicals are used).

The provisions made in this ETA are based on an assumed intended working life for 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 used as a means for selecting the appropriate product in relation to the expected economically reasonable working life of the works.

2 Characteristics of product and methods of verification

The product is available in the range given in part II, section 1, and has the characteristics listed in Annex 3, Tables 1 to 6.

Each anchor is marked with the anchor type, size and thread diameter.

The assessment of fitness for the intended use (see part II, section 1, third and fourth paragraphs) has been made in accordance with EOTA ETAG 001 : 1997, Part 1 *Anchors in general* and Part 2 *Torque-controlled expansion anchors*.

The characteristic resistances and displacements of the product given in Annex 3, Tables 1 to 4 have been derived from ETAG 001 : 1997, Annex C, Option 1, and should be used for designs in accordance with the same ETAG, Annex C, Method A.

The characteristic values for fire resistance given in Annex 3, Tables 5 and 6 have been derived in accordance with the Technical Report TR020.

The anchors shall only be packaged and supplied as complete units.

3 Evaluation of Conformity and CE Marking

3.1 Attestation of Conformity system

The system of attestation of conformity applied to this product shall be that laid down in the CPD, Annex III, 2(i) (referred to as System 1).

3.2 Responsibilities

3.2.1 Tasks for the manufacturer, factory production control

The manufacturer continues to operate a factory production control system. All elements, requirements and provisions adopted by the manufacturer are documented to ensure that the product conforms with this ETA.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the prescribed test plan[5]. The raw materials shall be subject to controls and tests by the manufacturer before acceptance. Checks on incoming materials shall include control of the certificates of conformity presented by suppliers (comparison with nominal values) by verifying dimensions and determining material properties.

The manufactured components are checked for:

all components

- dimensions (eg diameter, length, thickness)
- material properties (eg hardness, yield and ultimate tensile strengths)

anchor body

- thread
- surface finish

expansion sleeve

- surface finish

assembled anchor

- assembly (visual)
- completeness.

The frequency of controls and tests conducted during production and on the assembled anchor is laid down in the prescribed test plan, taking account of the manufacturing process of the anchor.

The results of factory production control are recorded and evaluated. The records include at least:

- designation of the product, basic material and components
- type of control or testing
- date of manufacture of the product and date of testing of the product or basic material and components
- result of control and testing and, if appropriate, comparison with requirements
- signature of person responsible for factory production control.

The records shall be presented to the inspection body involved in the continuous surveillance. Details of the extent, nature and frequency of testing[5] and controls to be performed within the factory production control shall correspond to the prescribed test plan included in the manufacturer's technical documentation relating to this European Technical Approval.

3.2.2 Tasks for approved bodies

3.2.2.1 Initial type-testing of the product

For initial type-testing, the results of the tests performed as part of the assessment for the European Technical Approval 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 the British Board of Agrément and the approved body involved.

3.2.2.2 Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the prescribed test plan, the factory, in particular the staff and equipment, and the factory production control, are suitable to ensure a continuous and orderly manufacturing of the anchors with the specifications given in part II, section 1.

3.2.2.3 Continuous surveillance

It is recommended that routine surveillance inspection be conducted at least twice per year by the approved body. However, for factories which are the subject of a certificated quality assurance system, surveillance visits may be carried out at less frequent intervals.

It shall be verified that the system of factory production control and the specified manufacturing processes are maintained, taking account of the prescribed test plan.

The results of product certification and continuous surveillance shall be made available on demand by the certification body to the British Board of Agrément. Where the provisions of the European Technical Approval and the prescribed test plan are no longer fulfilled, the certificate of conformity shall be withdrawn by the certification body.

3.3 CE marking

The CE marking[6] shall be affixed to each package of anchors. The CE symbol shall be accompanied by the following information:

- identification number of the certification body

(5) The prescribed test plan has been deposited with the British Board of Agrément and is only made available to the approved bodies involved in the conformity attestation procedure.

(6) See EU commission Guidance Paper D *CE Marking under the Construction Products Directive*.

- identification of the product
- name or identification mark of producer and the registered address of the producer
- the last two digits of the year in which the CE marking was affixed
- number of the EC certificate of conformity
- use category (ETAG 001, Option 1).

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The anchor is manufactured in accordance with the provisions of the European Technical Approval using the manufacturing processes as identified in the inspection of the plant by the British Board of Agrément and the approved body and laid down in the technical documentation.

4.2 Installation

4.2.1 Design of anchorages

An anchor is deemed fit for its intended use provided:

- anchorages are designed in accordance with ETAG 001 : 1997, Annex C, Design Method A, for torque-controlled expansion anchors, under the responsibility of an engineer experienced in anchorages and concrete structures
- verifiable calculations, notes and drawings are prepared taking account of the loads to be resisted
- it is positioned in accordance with the design drawings (eg it is correctly positioned relative to reinforcement or supports)
- it is installed correctly (see Annex 2, Figure 1 and Table 1).

4.2.2 Installation of anchors

The fitness for use of the anchorage can be assumed if the anchor is installed correctly in accordance with the following requirements:

- installation is carried out by personnel under the direction of supervisors, all of whom are competent to undertake this work
- the anchor is that supplied by the manufacturer (ie components must not be exchanged)
- installation is in accordance with the manufacturer's specifications and drawings prepared for that purpose, and the appropriate tools are used
- before placing the anchor, checks are made to ensure that the strength class of concrete is in the range given, and is not lower than that of the concrete to which the characteristic loads apply
- checks are made to ensure the concrete has been well compacted, eg significant voids are not present
- the hole is cleared of drilling dust
- the effective anchorage depth is achieved (ie the approximate embedment mark on the anchor is below the concrete surface)
- the edge distance and spacing are within the specified values, without minus tolerances
- the drill holes are positioned without damaging the reinforcement
- if a hole is aborted, the new hole is located a minimum distance away of twice the depth of the aborted hole or, if the aborted drill hole is filled with high-strength mortar and if shear or oblique tension loads are not in the direction of load application, a smaller distance may be used
- the specified torque moment is applied using a calibrated torque wrench.

4.2.3 Responsibility of the manufacturer

It is the responsibility of the manufacturer to ensure that the information on the specific conditions given in part II, sections 1, 2, 4.2.1 and 4.2.2, is given to those concerned. This information may be made by replicating the respective parts of the European Technical Approval. In addition, all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum information(7) required is:

- drill bit diameter
- thread diameter
- maximum thickness of the fixture

(7) All data shall be presented in a clear and explicit form.

BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

On behalf of the British Board of Agrément

Brian Chamberlain
Head of Approvals — Engineering

Greg Cooper
Chief Executive

Date of Second issue: 14 November 2012

**Original ETA issued 13 March 2012.*

**ETA amended on 19 June 2013 to update the Legal Bases and General Conditions and Evaluation of Conformity and CE Marking sections, update the approval holder details and make minor editorial changes.*

ANNEX 1 PRODUCT DETAILS

Figure 1 Rawl R-HPTII-A4 Throughbolt Anchor

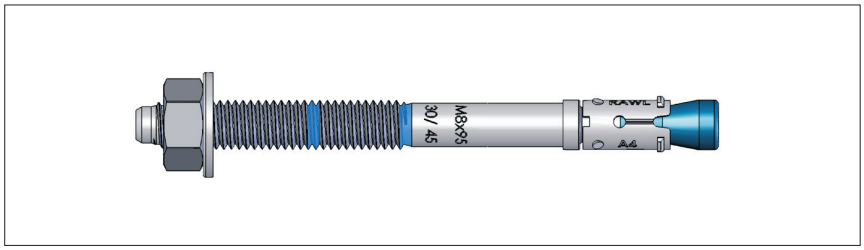


Table 1 Dimensions and material details

Part	Raw material	Characteristic
Anchor body	Steel Rod on Coil Cold Forged Bolts EN 10263-5 X3CrNiCuMo17-11-3-2 (1.4578) or BS 3111-2 Grade 396S17	Chemical Analysis, Ultimate Tensile Strength and Details of Drawn Condition • C -/0.04 Si -/1.00 Mn -/2.00 P-/0.045 S -/0.015 • Cr 16.5/17.5 Mo 2.0/2.5 Ni 10.0/11.0 Cu 3.0/3.5 % Ultimate Tensile Strength: • M8–M10 = 600–700 N·mm^{-2} • M12–M16 = 550–650 N·mm^{-2} +AT+C (Solution Annealed and Cold Drawn) • C -/0.07 Si -/1.00 Mn -/2.00 P-/0.045 S -/0.030 • Cr 16.0/18.5 Mo 2.0/3.0 Ni 10.0/14.0 Cu 3.0/4.0 % Ultimate Tensile Strength: • M8–M10 = 600–700 N·mm^{-2} • M12–M16 = 550–650 N·mm^{-2}
Expansion sleeve	Steel Strip EN 10088-2 X5CrNiMo17-12-2 (1.4401)	Chemical Analysis and Hardness • C -/0.07 Si -/1.00 Mn -/2.00 P -/0.045 S -/0.015 • Cr 16.5/18.5 Mo 2.0/2.5 Ni 10.0/13.0 % Ultimate Tensile Strength: • 530–680 N·mm^{-2}
Nut	Hexagonal nuts	Certificate of Conformity Dimensions: • ISO 4759-1, Tolerance Grade A or DIN 934 Mechanical Properties: • ISO 3506-2, Steel Grade A4, Class 70 or 80
Washer	Flat washers	Certificate of Conformity • BS 4320 or DIN 125A

ANNEX 2 INSTALLATION DETAILS

Figure 1 Pre-torque installation

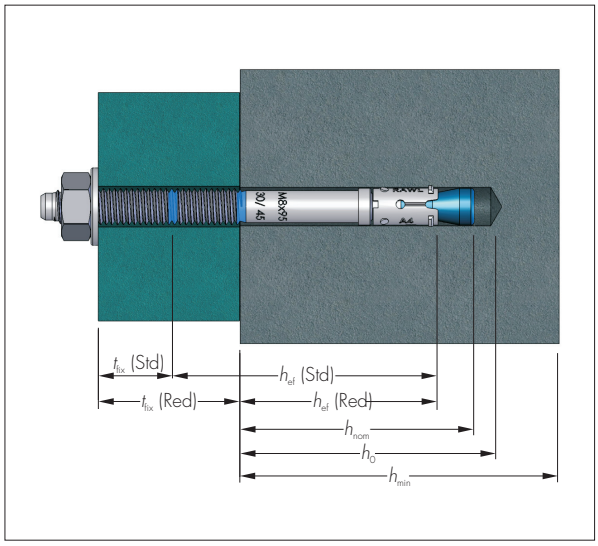
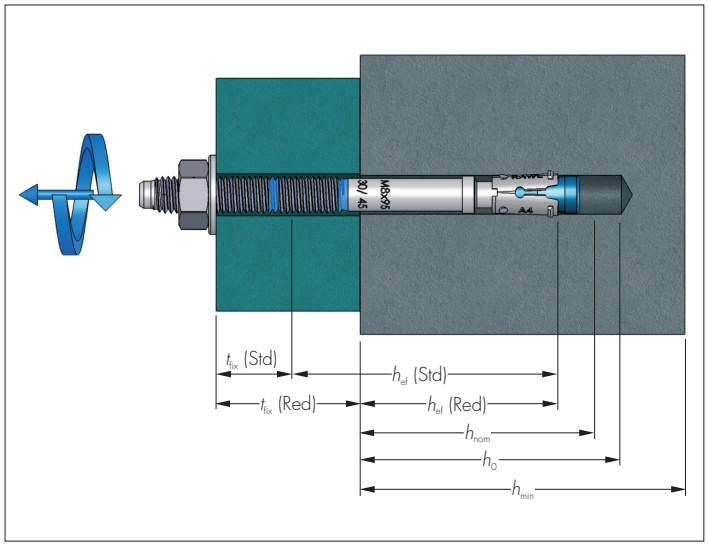


Figure 2 Post-torque installation



ANNEX 2 INSTALLATION DETAILS (continued)

Table 1 Installation dimensions

Characteristic		Anchor size							
		M8		M10		M12		M16	
		Red[1]	Std	Red[1]	Std	Red	Std	Red	Std
Bolt Length	(l_{min}) (mm)	55		65		80		105	
	(l_{max}) (mm)	180		180		180		180	
Minimum thickness of concrete member (h_{min}) (mm)		100	100	100	120	100	140	130	170
Minimum spacing and edge distance in Cracked Concrete									
Minimum spacing	(s_{min}) (mm)	50	55	70	70	120	90	150	135
	(for $c \geq$) (mm)	50	55	70	70	95	75	100	105
Minimum edge distance	(c_{min}) (mm)	40	40	50	45	70	55	85	70
	(for $s \geq$) (mm)	80	70	120	90	150	140	200	200
Minimum spacing and edge distance in Non-Cracked Concrete									
Minimum spacing	(s_{min}) (mm)	50	55	70	70	120	90	150	135
	(for $c \geq$) (mm)	50	55	70	70	95	75	100	105
Minimum edge distance	(c_{min}) (mm)	50	40	70	50	95	55	100	80
	(for $s \geq$) (mm)	50	100	70	115	120	125	150	200

(1) Use restricted to anchoring statically indeterminate structural components.

Table 2 Installation details

Thread size/hole diameter in concrete	Bolt length	Head marking	Bolt marking	Thread length	Hole diameter in fixture	Standard embedment			Reduced embedment			Recommended torque	Product code
						Minimum hole depth	Effective embedment depth	Maximum fixture thickness	Minimum hole depth	Effective embedment depth	Maximum fixture thickness		
d/d_o (mm)	l (mm)			l_G (mm)	d_f (mm)	h_0 (mm)	h_{ef} (mm)	t_{fix} (mm)	h_0 (mm)	h_{ef} (mm)	t_{fix} (mm)	T_{inst} (N·m)	
M8 8 mm	60	B	M8x60/10	25	9	–	–	–	40	32	10	15	R-HPTII-A4-08060/10
	75	C	M8x75 10/25	35	9	55	47	10	40	32	25	15	R-HPTII-A4-08075/10
	85	D	M8x85 20/35	45	9	55	47	20	40	32	35	15	R-HPTII-A4-08085/20
	95	E	M8x95 30/45	55	9	55	47	30	40	32	45	15	R-HPTII-A4-08095/30
	105	f	M8x105 40/55	75	9	55	47	40	40	32	55	15	R-HPTII-A4-08105/40
	115	G	M8x115 50/65	75	9	55	47	50	40	32	65	15	R-HPTII-A4-08115/50
M10 10 mm	65	B	M10x65/5	21	11	–	–	–	49	39	5	30	R-HPTII-A4-10065/5
	80	D	M10x80/20	31	11	–	–	–	49	39	20	30	R-HPTII-A4-10080/20
	95	E	M10x95 15/35	46	11	69	59	15	49	39	35	30	R-HPTII-A4-10095/15
	115	G	M10x115 35/55	66	11	69	59	35	49	39	55	30	R-HPTII-A4-10115/35
	130	J	M10x130 50/70	81	11	69	59	50	49	39	70	30	R-HPTII-A4-10130/50
	140	K	M10x140 60/80	91	11	69	59	60	49	39	80	30	R-HPTII-A4-10140/60
M12 12 mm	80	D	M12x80/5	30	13	–	–	–	60	48	5	50	R-HPTII-A4-12080/5
	100	F	M12x100 5/25	40	13	80	68	5	60	48	25	50	R-HPTII-A4-12100/5
	125	H	M12x125 30/50	65	13	80	68	30	60	48	50	50	R-HPTII-A4-12125/30
	150	L	M12x150 55/75	90	13	80	68	55	60	48	75	50	R-HPTII-A4-12150/55
	180	P	M12x180 85/105	100	13	80	68	85	60	48	105	50	R-HPTII-A4-12180/85
M16 16 mm	125	H	M16x125 5/25	45	18	100	85	5	80	65	25	100	R-HPTII-A4-16125/5
	140	K	M16x140 20/40	60	18	100	85	20	80	65	40	100	R-HPTII-A4-16140/20
	150	L	M16x150 30/50	70	18	100	85	30	80	65	50	100	R-HPTII-A4-16150/30
	180	P	M16x180 60/80	100	18	100	85	60	80	65	80	100	R-HPTII-A4-16180/60

ANNEX 3 CHARACTERISTICS

Table 1 Characteristic resistances under tension loads without the influence of spacing or edge distances

Characteristic		Anchor size							
		M8		M10		M12		M16	
		Red[1]	Std	Red[1]	Std	Red	Std	Red	Std
Steel failure									
Characteristic resistance ($N_{Rk,s}$) (kN)		21.2		33.6		44.8		82.6	
Design resistance ($N_{Rd,s}$) (kN)		14.1		22.4		29.9		55.1	
Partial safety factor (γ_{Ms})		1.5		1.5		1.5		1.5	
Pull-out failure									
Characteristic resistance in cracked concrete ($N_{Rk,p}$) (C20/25)		3.0	6.0	7.5	9.0	9.0	12.0	16.0	25.0
Design resistance in cracked concrete ($N_{Rd,p}$) (C20/25)		1.7	3.3	4.2	6.0	6.0	8.0	10.7	16.7
Characteristic resistance in non-cracked concrete ($N_{Rk,p}$) (C20/25)		7.5	9.0	12.0	16.0	–	25.0	–	–
Design resistance in non-cracked concrete ($N_{Rd,p}$) (C20/25)		4.2	5.0	6.7	10.7	–	16.7	–	–
Partial safety factor (γ_{Mp})		1.8[2]	1.8[2]	1.8[2]	1.5[3]	1.5[3]	1.5[3]	1.5[3]	1.5[3]
Concrete cone failure									
Characteristic resistance in non-cracked concrete ($N_{Rk,c}$) (C20/25)		–	–	–	–	16.8	–	26.4	39.5
Design resistance in non-cracked concrete ($N_{Rd,c}$) (C20/25)		–	–	–	–	11.2	–	17.6	26.3
Partial safety factor (γ_{Mc})		1.8[2]	1.8[2]	1.8[2]	1.5[3]	1.5[3]	1.5[3]	1.5[3]	1.5[3]
Effective anchorage depth (h_{ef}) (mm)		32	47	39	59	48	68	65	85
Spacing ($s_{cr,N}$) (mm)		96	141	117	177	144	204	195	255
Edge distance ($c_{cr,N}$) (mm)		48	71	59	89	72	102	98	128
Splitting failure									
Spacing ($s_{cr,sp}$) (mm)		160	240	200	300	250	340	320	430
Edge distance ($c_{cr,sp}$) (mm)		80	120	100	150	125	170	160	215
Partial safety factor (γ_{Msp})		1.8[2]	1.8[2]	1.8[2]	1.5[3]	1.5[3]	1.5[3]	1.5[3]	1.5[3]
Increasing factors for $N_{Rk,p}$ and $N_{Rk,c}$									
Cracked and non-cracked concrete (ψ_c)	C30/37	1.07	1.16	1.07	1.26	1.16	1.23	1.18	1.18
	C40/50	1.13	1.33	1.13	1.52	1.32	1.45	1.37	1.37
	C50/60	1.20	1.50	1.20	1.78	1.49	1.67	1.55	1.55

(1) Use restricted to anchoring statically indeterminate structural components.

(2) Includes γ_2 factor 1.2.

(3) Includes γ_2 factor 1.0.

ANNEX 3 CHARACTERISTICS (continued)

Table 2 Characteristic resistances under shear loads without the influence of spacing or edge distances

Characteristic	Anchor size							
	M8		M10		M12		M16	
	Red[1]	Std	Red[1]	Std	Red	Std	Red	Std
Steel failure without lever arm								
Characteristic resistance ($V_{Rk,s}$) (kN)	11.7		18.5		24.6		45.4	
Design resistance ($V_{Rd,s}$) (kN)	9.4		14.8		19.7		36.3	
Partial safety factor (γ_{Ms})	1.25		1.25		1.25		1.25	
Steel failure with lever arm								
Characteristic resistance ($M_{Rk,s}$) (N·m)	22		45		72		180	
Partial safety factor (γ_{Ms})	1.25		1.25		1.25		1.25	
Concrete pry-out failure								
Characteristic resistance ($V_{Rk,cp}$) (C20/25) (kN)	–	–	14.7	–	–	–	–	–
Design resistance ($V_{Rd,cp}$) (C20/25) (kN)	–	–	8.2	–	–	–	–	–
Factor for Equation (5.6), ETAG 001, Annex C, 5.2.3.3 (k)	–	–	1.2	–	–	–	–	–
Partial safety factor (γ_{Mc})	–	–	1.8[2]	–	–	–	–	–
Concrete edge failure								
Effective length of anchor (l_f) (mm)	32	47	39	59	48	68	65	85
Anchor diameter (d_{nom}) (mm)	8		10		12		16	
Partial safety factor (γ_{Mc})	1.8[2]	1.8[3]	1.8[2]	1.5[3]	1.5[3]	1.5[3]	1.5[3]	1.5[3]

(1) Use restricted to anchoring statically indeterminate structural components.
(2) Includes γ_2 factor 1.2.
(3) Includes γ_2 factor 1.0.

Table 3 Displacements under tension loading

			M8		M10		M12		M16	
			Red	Std	Red	Std	Red	Std	Red	Std
Tension load in cracked concrete	(N)	(kN)	1.2	2.4	3.0	4.3	4.3	5.7	7.6	11.9
Corresponding displacement	(δ_{N0})	(mm)	1.1	0..5	0.5	1.2	0.8	1.0	0.2	1.0
	($\delta_{N\infty}$)	(mm)	1.8	1.3	0.8	1.2	1.0	1.3	0.6	1.1
Tension load in non-cracked concrete	(N)	(kN)	3.0	3.6	4.8	7.6	8.0	11.9	12.6	18.8
Corresponding displacement	(δ_{N0})	(mm)	0.1	0.3	0.2	0.2	0.1	0.5	0.3	0.5
	($\delta_{N\infty}$)	(mm)	0.8	1.3	0.8	1.2	1.0	1.3	0.6	1.1

Table 4 Displacements under shear loading

			M8		M10		M12		M16	
			Red	Std	Red	Std	Red	Std	Red	Std
Shear load in cracked concrete and non-cracked concrete	(V)	(kN)	6.7	6.7	5.8	10.6	14.1	14.1	25.9	25.9
Corresponding displacement	(δ_{V0})	(mm)	3.0	3.0	1.5	2.7	2.5	2.5	2.2	2.2
	($\delta_{V\infty}$)	(mm)	4.5	4.5	2.2	4.1	3.8	3.8	3.8	3.3

ANNEX 3 CHARACTERISTICS (continued)

Table 5 Characteristic values of resistance to tension loads under fire exposure[1]

Characteristic		M8		M10		M12		M16	
		Red	Std	Red	Std	Red	Std	Red	Std
Fire resistance duration at 30 minutes									
Steel failure:									
Characteristic resistance ($N_{Rk,s,fi(30)}$) (kN)		0.7	0.7	1.5	1.5	2.5	2.5	4.7	4.7
Pull-out failure:									
Characteristic resistance ($N_{Rk,p,fi(30)}$) (kN)		0.8	1.5	1.9	2.3	2.3	3.0	4.0	6.3
Concrete cone failure:									
Characteristic resistance ($N_{Rk,c,fi(30)}$) (kN)		1.0	2.7	1.7	4.8	2.9	6.9	6.1	12.0
Fire resistance duration at 60 minutes									
Steel failure:									
Characteristic resistance ($N_{Rk,s,fi(60)}$) (kN)		0.6	0.6	1.2	1.2	2.1	2.1	3.9	3.9
Pull-out failure:									
Characteristic resistance ($N_{Rk,p,fi(60)}$) (kN)		0.8	1.5	1.9	2.3	2.3	3.0	4.0	6.3
Concrete cone failure:									
Characteristic resistance ($N_{Rk,c,fi(60)}$) (kN)		1.0	2.7	1.7	4.8	2.9	6.9	6.1	12.0
Fire resistance duration at 90 minutes									
Steel failure:									
Characteristic resistance ($N_{Rk,s,fi(90)}$) (kN)		0.4	0.4	0.9	0.9	1.7	1.7	3.1	3.1
Pull-out failure:									
Characteristic resistance ($N_{Rk,p,fi(90)}$) (kN)		0.8	1.5	1.9	2.3	2.3	3.0	4.0	6.3
Concrete cone failure:									
Characteristic resistance ($N_{Rk,c,fi(90)}$) (kN)		1.0	2.7	1.7	4.8	2.9	6.9	6.1	12.0
Fire resistance duration at 120 minutes									
Steel failure:									
Characteristic resistance ($N_{Rk,s,fi(120)}$) (kN)		0.4	0.4	0.8	0.8	1.3	1.3	2.5	2.5
Pull-out failure:									
Characteristic resistance ($N_{Rk,p,fi(120)}$) (kN)		0.6	1.2	1.5	1.8	1.8	2.4	3.2	5.0
Concrete cone failure:									
Characteristic resistance ($N_{Rk,c,fi(120)}$) (kN)		0.8	2.2	1.4	3.9	2.3	5.5	4.9	9.6
Spacing (mm)	$s_{cr,N}$	$4 \times h_{ef}$							
	s_{min}	50	55	70	70	120	90	150	135
Edge distance (mm)	$c_{cr,N}$	$2 \times h_{ef}$							
	c_{min}	$c_{min} = 2 \times h_{ef}$ however if the fire attack is from more than one side. the edge distance of the anchor has to be ≥300 mm and ≥$2 \times h_{ef}$							

(1) In the absence of other national regulations. the recommended partial safety factor for resistance under fire resistance ($\gamma_{M,fi}$) is 1.0.

ANNEX 3 CHARACTERISTICS (continued)

Table 6 Characteristic values of resistance to shear loads under fire exposure

Characteristic	M8		M10		M12		M16	
	Red	Std	Red	Std	Red	Std	Red	Std
Fire resistance duration at 30 minutes								
Steel without lever arm:								
Characteristic resistance ($V_{Rk,s,fi(30)}$) (kN)	0.7		1.5		2.5		4.7	
Steel failure with lever arm:								
Characteristic resistance ($M_{Rk,s,fi(30)}$) (N·m)	0.7		1.9		3.9		10.0	
Fire resistance duration at 60 minutes								
Steel without lever arm:								
Characteristic resistance ($V_{Rk,s,fi(60)}$) (kN)	0.6		1.2		2.1		3.9	
Steel failure with lever arm:								
Characteristic resistance ($M_{Rk,s,fi(60)}$) (N·m)	0.6		1.5		3.3		8.3	
Fire resistance duration at 90 minutes								
Steel without lever arm:								
Characteristic resistance ($V_{Rk,s,fi(90)}$) (kN)	0.4		0.9		1.7		3.1	
Steel failure with lever arm:								
Characteristic resistance ($M_{Rk,s,fi(90)}$) (N·m)	0.4		1.2		2.6		6.7	
Fire resistance duration at 120 minutes								
Steel without lever arm:								
Characteristic resistance ($V_{Rk,s,fi(120)}$) (kN)	0.4		0.8		1.3		2.5	
Steel failure with lever arm:								
Characteristic resistance ($M_{Rk,s,fi(120)}$) (N·m)	0.4		1.0		2.1		5.3	
Concrete pry-out failure								
k factor[1] (k)	–	–	1.2	–	–	–	–	–
Concrete edge failure	The Characteristic Resistance ($V^0_{Rk,c,fi}$) in C20/25 to C50/60 concrete is determined by: $V^0_{Rk,c,fi} = 0.25 \times V^0_{Rk,c[\leq 90]}$ and, $V^0_{Rk,c,fi} = 0.20 \times V^0_{Rk,c[120]}$ With the initial value of the Characteristic Resistance ($V^0_{Rk,c}$) in cracked concrete C20/25 under normal temperature according to ETAG 001, Annex C, 5.2.3.4.							

(1) According to Equation (5.6) of ETAG 001 Annex C, the values of *k* factor (*k*) and the relevant values of $N_{Rk,c,fi}$ given in Table 5 have to be considered in the design.

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