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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.



European Technical Approval ETA-13/0131

*Amended**

Trade name:

Profix PBZ-DP Bolzenanker

Holder of approval:

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Generic type and use of construction product:

Carbon steel with Zinc/Aluminium coating torque-controlled expansion anchors in sizes of M8, M10, M12, M16 and M20 for use in cracked and non-cracked concrete

Valid from: to:

27 June 2013
10 August 2017

Manufacturing plant:

Manufacturing Plant No 2

This European Technical Approval contains:

11 pages including three Annexes which form an integral part of the document.



European Organisation for Technical Approvals

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 Profix PBZ-DP Bolzenanker are through-fixing torque-controlled expansion anchors in sizes of M8, M10, M12, M16 and M20 (see Annex 1, Figure 1). Each type comprises special bolt with a taper, an expansion sleeve, a hexagonal nut and a washer. The anchors are made from carbon steel finished in zinc/aluminium coating (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, Figures 1 and 2 and Tables 1 and 2).

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 for use only in structures of reinforced or unreinforced, cracked or non-cracked concrete with a strength class in the range of C 20/25 to C 50/60 (in accordance with ENV 206 : 1990 *Concrete — Performance, production, placing and compliance criteria*) in dry, internal conditions, and for anchorages subject to static or quasi-static loading.

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 characteristics of the product given in Annex 3, Tables 1 and 2 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 characteristics values given in Annex 3, Tables 5 and 6 have been derived in accordance to 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.

(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.

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 inspections 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
- 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.

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

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 calculation, 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, Figures 1 and 2 and Tables 1 and 2).

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 appropriately qualified for 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
- minimum effective anchorage depth
- minimum hole depth
- torque moment
- information on the installation procedure, including cleaning of the hole, preferably by illustration
- reference to any special installation equipment needed
- identification of the manufacturing batch.

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



On behalf of the British Board of Agrément

B C Chamberlain

Brian Chamberlain
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Claire

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Date of First issue: 27 June 2013

ANNEX 1 PRODUCT DETAILS

Figure 1 Profix PBZ-DP Throughbolt Anchor

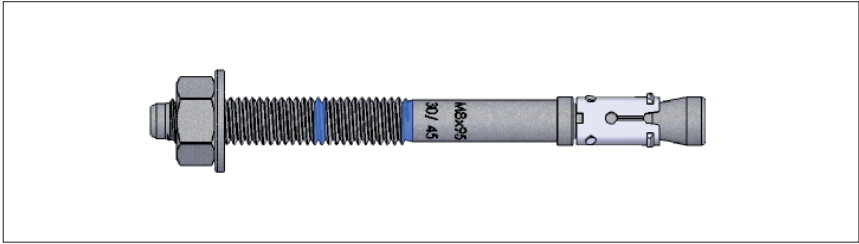
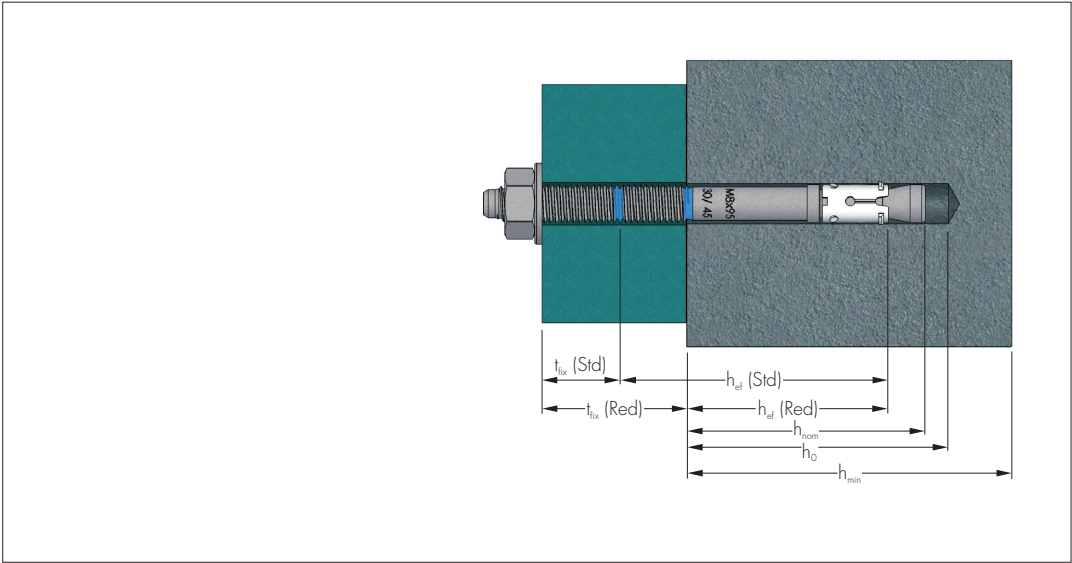


Table 1 Dimensions and material details

Part	Raw material	Characteristic
Anchor body	Steel Rod on Coil Cold Forged Bolts BS 3111-1 : 1987 Grade O/3 M8-M16 Condition B M20 Condition C	Chemical Analysis, Ultimate Tensile Strength and Details of Drawn Condition <ul style="list-style-type: none"> C 0.13/0.18 Si -/0.4 Mn 0.5/1.0 P-/0.05 S -/0.05 % Ultimate Tensile Strength: <ul style="list-style-type: none"> drawn, spheroidize annealed and light drawn: 430-480 N·mm⁻² spheroidize annealed and light drawn 480-530 N·mm⁻²
	EN 10263-2 : 2001 Grade C17C M8-M16 +U+C+AC+LC M20 +AC+C	Chemical Analysis, Ultimate Tensile Strength and Details of Drawn Condition <ul style="list-style-type: none"> C 0.15/0.19 Si -/0.1 Mn 0.65/0.85 P-/0.025 S -/0.025 % Ultimate Tensile Strength: <ul style="list-style-type: none"> cold drawn, spheroidize annealed and skin passed: 430-480 N·mm⁻² spheroidize annealed and cold drawn – 480-530 N·mm⁻²
Expansion sleeve	Steel Strip EN 10139-2 DC03 M8-M12 C590 M16-M20 C490	Chemical Analysis and Hardness <ul style="list-style-type: none"> C -/0.10 Mn -/0.45 P -/0.035 S -/0.035 % Hardness: <ul style="list-style-type: none"> M8-M12 – 185-215 HV M16-M20 – 155-185 HV
Nut	Hexagonal nuts	Certificate of Conformity <ul style="list-style-type: none"> BS 3692 or DIN 934
Washer	Flat washers	Certificate of Conformity <ul style="list-style-type: none"> BS4320 or DIN 125A

ANNEX 2 INSTALLATION DETAILS

Figure 1 Pre-torque installation



ANNEX 2 INSTALLATION DETAILS (continued)

Figure 2 Post-torque installation

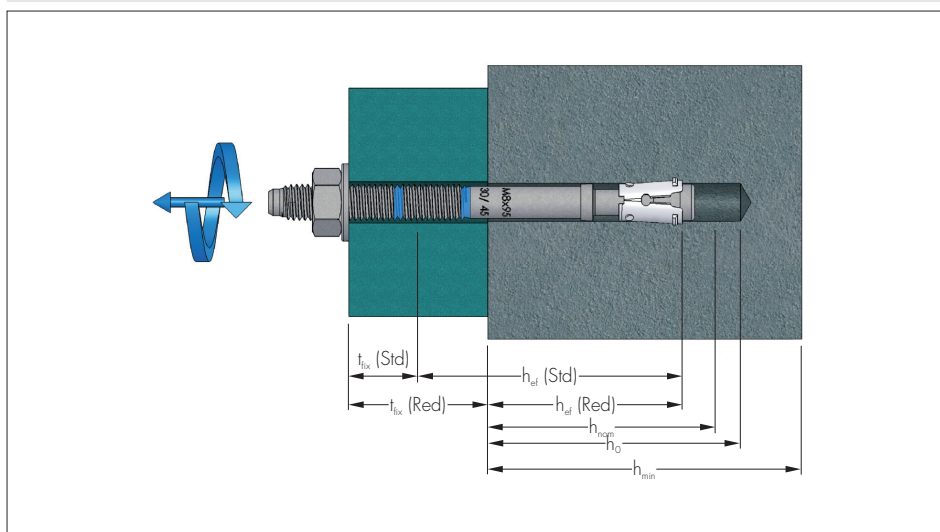


Table 1 Installation dimensions

Characteristic	Anchor size									
	M8		M10		M12		M16		M20	
	Red ⁽¹⁾	Std	Red ⁽¹⁾	Std	Red	Std	Red	Std	Red	Std
Bolt Length (l_{min}) (mm)	55		65		80		105		125	
Bolt Length (l_{max}) (mm)	180		180		180		180		180	
Minimum thickness of concrete member (h_{min}) (mm)	100	100	100	120	100	140	130	170	160	200
Minimum spacing and edge distance in cracked concrete										
Minimum spacing (s_{min}) (mm)	55	50	75	70	150	90	190	160	300	180
Where $c \geq$ (mm)	45	50	60	65	100	80	125	130	200	150
Minimum edge distance (c_{min}) (mm)	40	40	50	45	80	65	110	90	120	100
Where $s \geq$ (mm)	80	80	100	100	180	150	280	240	260	220
Minimum spacing and edge distance in non-cracked concrete										
Minimum spacing (s_{min}) (mm)	55	50	75	70	150	90	190	160	300	180
Where $c \geq$ (mm)	45	50	60	65	100	80	125	130	200	150
Minimum edge distance (c_{min}) (mm)	45	40	60	50	100	65	125	100	200	120
Where $s \geq$ (mm)	55	100	75	110	150	180	190	240	300	225

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

ANNEX 2 INSTALLATION DETAILS (continued)*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_0 (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} (Nm)	
M8 8 mm	65	b	M8x65/15	30	9	–	–	–	40	32	15	10	PBZ-DP-08065/15
	80	d	M8x80 15/30	40	9	55	47	15	40	32	30	10	PBZ-DP-08080/15
	85	D	M8x85 20/35	45	9	55	47	20	40	32	35	10	PBZ-DP-08085/20
	100	F	M8x100 35/50	60	9	55	47	35	40	32	50	10	PBZ-DP-08100/35
	115	G	M8x115 50/65	75	9	55	47	50	40	32	65	10	PBZ-DP-08115/50
M10 10 mm	65	B	M10x65/5	21	11	–	–	–	49	39	5	20	PBZ-DP-10065/5
	80	D	M10x80/20	31	11	–	–	–	49	39	20	20	PBZ-DP-10080/20
	95	E	M10x95 15/35	46	11	69	59	15	49	39	35	20	PBZ-DP-10095/15
	115	G	M10x115 35/55	66	11	69	59	35	49	39	55	20	PBZ-DP-10115/35
	130	J	M10x130 50/70	81	11	69	59	50	49	39	70	20	PBZ-DP-10130/50
M12 12 mm	80	D	M12x80/5	30	13	–	–	–	60	48	5	40	PBZ-DP-12080/5
	100	F	M12x100 5/25	40	13	80	68	5	60	48	25	40	PBZ-DP-12100/5
	120	h	M12x120 25/45	60	13	80	68	25	60	48	45	40	PBZ-DP-12120/25
	135	J	M12x135 40/60	75	13	80	68	40	60	48	60	40	PBZ-DP-12135/40
	150	L	M12x150 55/75	90	13	80	68	55	60	48	75	40	PBZ-DP-12150/55
M16 16 mm	100	F	M16x100/5	30	18	–	–	–	80	65	5	100	PBZ-DP-16100/5
	105	f	M16x105/10	35	18	–	–	–	80	65	10	100	PBZ-DP-16105/10
	140	K	M16x140 20/40	60	18	100	85	20	80	65	40	100	PBZ-DP-16140/20
	160	M	M16x160 40/60	80	18	100	85	40	80	65	60	100	PBZ-DP-16160/40
	180	P	M16x180 60/80	80	18	100	85	60	80	65	80	100	PBZ-DP-16180/60
M20 20 mm	125	H	M20x125/5	50	22	–	–	–	100	80	5	180	PBZ-DP-20125/5
	160	M	M20x160 20/40	61	22	119	99	20	100	80	40	180	PBZ-DP-20160/20

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		M20	
	Red ⁽¹⁾	Std	Red ⁽¹⁾	Std	Red	Std	Red	Std	Red	Std
Steel failure										
Characteristic resistance ($N_{Rk,s}$) (kN)	15.8		25.2		37.3		66.1		101.0	
Design resistance ($N_{Rd,s}$) (kN)	11.3		18.0		26.6		47.2		72.1	
Partial safety factor (γ_{Ms})	1.4		1.4		1.4		1.4		1.4	
Pull-out failure C20/25 concrete										
Characteristic resistance in cracked concrete ($N_{Rk,p}$) (kN)	3.0	5.0	6.0	9.0	9.0	12.0	16.0	20.0	–	30.0
Design resistance in cracked concrete ($N_{Rd,p}$) (kN)	1.7	2.8	3.3	6.0	6.0	8.0	10.7	13.3	–	20.0
Characteristic resistance in non-cracked concrete ($N_{Rk,p}$) (kN)	7.5	9.0	9.0	12.0	12.0	20.0	–	35.0	–	–
Design resistance in non-cracked concrete ($N_{Rd,p}$) (kN)	4.2	5.0	5.0	8.0	8.0	13.3	–	23.3	–	–
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⁾	1.5 ⁽³⁾	1.5 ⁽³⁾
Concrete cone failure C20/25 concrete										
Characteristic resistance in cracked concrete ($N_{Rk,c}$) (kN)	–	–	–	–	–	–	–	–	25.8	–
Design resistance in cracked concrete ($N_{Rd,c}$) (kN)	–	–	–	–	–	–	–	–	17.2	–
Characteristic resistance in non-cracked concrete ($N_{Rk,c}$) (kN)	–	–	–	–	–	–	26.4	–	36.1	49.6
Design resistance in non-cracked concrete ($N_{Rd,c}$) (kN)	–	–	–	–	–	–	17.6	–	24.1	33.1
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⁾	1.5 ⁽³⁾	1.5 ⁽³⁾
Effective anchorage depth (h_{ef}) (mm)	32	47	39	59	48	68	65	85	80	99
Spacing ($s_{cr,N}$) (mm)	96	141	117	177	144	204	195	255	240	297
Edge distance ($c_{cr,N}$) (mm)	48	71	59	89	72	102	98	128	120	149
Splitting failure										
Spacing ($s_{cr,sp}$) (mm)	170	220	200	300	250	340	320	430	410	530
Edge distance ($c_{cr,sp}$) (mm)	85	110	100	150	125	170	160	215	205	265
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⁾	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	1.20	1.12	1.16	1.22	1.22	1.00	1.11	1.14	1.12
	C40/50	1.40	1.22	1.33	1.44	1.44	1.00	1.22	1.28	1.26
	C50/60	1.60	1.33	1.50	1.67	1.67	1.00	1.33	1.43	1.39

(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		M20	
	Red ⁽¹⁾	Std	Red ⁽¹⁾	Std	Red	Std	Red	Std	Red	Std
Steel failure without lever arm										
Characteristic resistance ($V_{Rk,s}$) (kN)	10.1		16.0		23.3		43.0		67.4	
Design resistance ($V_{Rd,s}$) (kN)	8.1		12.8		18.6		34.4		53.9	
Partial safety factor (γ_{Ms})	1.25		1.25		1.25		1.25		1.25	
Steel failure with lever arm										
Characteristic resistance ($M_{Rk,s}$) (Nm)	19		38		67		167		328	
Partial safety factor (γ_{Ms})	1.25		1.25		1.25		1.25		1.25	
Concrete pry-out failure										
Factor for Equation (5.6), ETAG, Annex C, 5.2.3.3 (k)	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0
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⁾	1.5 ⁽³⁾	1.5 ⁽³⁾
Concrete edge failure										
Effective length of anchor (l_i) (mm)	32	47	39	59	48	68	65	85	80	99
Anchor diameter (d_{nom}) (mm)	8	8	10	10	12	12	16	16	20	20
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⁾	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		M20	
			Red	Std	Red	Std	Red	Std	Red	Std	Red	Std
Tension Load in cracked concrete	(N)	(kN)	1.2	2.0	2.4	4.3	4.3	5.7	7.6	9.5	12.3	14.3
Corresponding Displacement	(δ_{N0})	(mm)	0.6	0.8	0.3	1.0	0.5	0.7	0.3	0.4	0.4	0.4
	($\delta_{N\infty}$)	(mm)	1.0	0.9	1.1	1.4	1.0	0.9	0.8	1.1	1.3	0.7
Tension Load in non-cracked concrete	(N)	(kN)	3.0	3.6	3.6	5.7	5.7	9.5	12.6	16.7	17.2	23.6
Corresponding Displacement	(δ_{N0})	(mm)	0.1	0.3	0.3	0.3	0.1	0.6	0.5	0.2	0.1	0.6
	($\delta_{N\infty}$)	(mm)	1.0	0.9	1.1	1.4	1.0	0.9	0.8	1.1	1.3	0.7

Table 4 Displacements under shear loading

			M8		M10		M12		M16		M20	
			Red	Std	Red	Std	Red	Std	Red	Std	Red	Std
Tension Load in cracked and non-cracked concrete	(V)	(kN)	5.8	5.8	9.2	9.2	13.3	13.3	24.5	24.5	38.5	38.5
Corresponding Displacement	(δ_{V0})	(mm)	1.2	1.2	1.5	1.5	2.0	2.0	2.4	2.4	2.6	2.6
	($\delta_{V\infty}$)	(mm)	1.8	1.8	2.3	2.3	3.0	3.0	3.6	3.6	3.9	3.9

ANNEX 3 CHARACTERISTICS (continued)*Table 5 Characteristic values of resistance to tension loads under fire exposure*

	Anchor size									
	M8		M10		M12		M16		M20	
	Red	Std	Red ¹	Std	Red	Std	Red	Std	Red	Std
Fire resistance duration at 30 minutes										
Steel failure										
Characteristic resistance ($N_{Rk,s,fi(30)}$) (kN)	0.4		0.9		1.7		3.1		4.9	
Pull-out failure										
Characteristic resistance ($N_{Rk,p,fi(30)}$) (kN)	0.8	1.3	1.5	2.3	2.3	3.0	4.0	5.0	–	–
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	10.3	17.6
Fire resistance duration at 60 minutes										
Steel failure										
Characteristic resistance ($N_{Rk,s,fi(60)}$) (kN)	0.3		0.8		1.3		2.4		3.7	
Pull-out failure										
Characteristic resistance ($N_{Rk,p,fi(60)}$) (kN)	0.8	1.3	1.5	2.3	2.3	3.0	4.0	5.0	–	–
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	10.3	17.6
Fire resistance duration at 90 minutes										
Steel failure										
Characteristic resistance ($N_{Rk,s,fi(90)}$) (kN)	0.3		0.6		1.1		2.0		3.2	
Pull-out failure										
Characteristic resistance ($N_{Rk,p,fi(90)}$) (kN)	0.8	1.3	1.5	2.3	2.3	3.0	4.0	5.0	–	–
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	10.3	17.6
Fire resistance duration at 120 minutes										
Steel failure										
Characteristic resistance ($N_{Rk,s,fi(120)}$) (kN)	0.2		0.5		0.8		1.6		2.5	
Pull-out failure										
Characteristic resistance ($N_{Rk,p,fi(120)}$) (kN)	0.6	1.0	1.2	1.8	1.8	2.4	3.2	4.0	–	–
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	8.2	14.0
Spacing ($s_{cr,N}$) (mm)	$4 \times h_{ef}$		$4 \times h_{ef}$		$4 \times h_{ef}$		$4 \times h_{ef}$		$4 \times h_{ef}$	
Spacing (s_{min}) (mm)	55	50	75	70	150	90	190	160	300	180
Edge distance ($c_{cr,N}$) (mm)	$2 \times h_{ef}$		$2 \times h_{ef}$		$2 \times h_{ef}$		$2 \times h_{ef}$		$2 \times h_{ef}$	
Edge distance (c_{min}) (mm)	$c_{min} = 2 \times h_{ef}$, however, if the fire attack is from more than one side, the edge distance of the anchor has to be ≥ 300 mm and $2 \times h_{ef}$									

Note:

In the absence of other national regulations the partial safety factor for resistance under Fire Exposure

 $\gamma_{M,fi} = 1.0$ is recommended.

ANNEX 3 CHARACTERISTICS (continued)

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

	Anchor size									
	M8		M10		M12		M16		M20	
	Red	Std	Red	Std	Red	Std	Red	Std	Red	Std
Fire resistance duration at 30 minutes										
Steel failure without lever arm										
Characteristic resistance ($V_{Rk,s,fi(30)}$) (kN)	0.4		0.9		1.7		3.1		4.9	
Steel failure with lever arm										
Characteristic resistance ($M_{Rk,s,fi(30)}$) (Nm)	0.4		1.1		2.6		6.7		13.0	
Fire resistance duration at 60 minutes										
Steel failure without lever arm										
Characteristic resistance ($V_{Rk,s,fi(60)}$) (kN)	0.3		0.8		1.3		2.4		3.7	
Steel failure with lever arm										
Characteristic resistance ($M_{Rk,s,fi(60)}$) (Nm)	0.3		1.0		2.0		5.0		9.7	
Fire resistance duration at 90 minutes										
Steel failure without lever arm										
Characteristic resistance ($V_{Rk,s,fi(90)}$) (kN)	0.3		0.6		1.1		2.0		3.2	
Steel failure with lever arm										
Characteristic resistance ($M_{Rk,s,fi(90)}$) (Nm)	0.3		0.7		1.7		4.3		8.4	
Fire resistance duration at 120 minutes										
Steel failure without lever arm										
Characteristic resistance ($V_{Rk,s,fi(120)}$) (kN)	0.2		0.5		0.8		1.6		2.5	
Steel failure with lever arm										
Characteristic resistance ($M_{Rk,s,fi(120)}$) (Nm)	0.2		0.6		1.3		3.3		6.5	
	M8		M10		M12		M16		M20	
	Red	Std	Red	Std	Red	Std	Red	Std	Red	Std
Concrete pry-out failure										
k factor ($k^{(1)}$)	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0