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CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

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Designated according to Article29 of Regulation (EU) Nº 305/2011

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European Technical Assessment

ETA 20/0900 of 14/09/2022

English translation prepared by IETcc. Original version in Spanish language

General Part

Technical Assessment Body issuing the ETA designated according to Art. 29 of Regulation (EU) 305/2011:	Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc)
Trade name of the construction product:	**Thru-Bolt™ PRO** **Thru-Bolt™ PRO-G** **Thru-Bolt™ PRO-SS**
Product family to which the construction product belongs:	Torque controlled expansion anchor made of galvanized steel, sherardized steel or stainless steel of sizes M8, M10, M12, M16, and M20 for use in cracked or uncracked concrete.
Manufacturer:	**ICCONS** 383 Frankston Dandenong Road Dandenong South VIC 3175 Australia. website: www.iccons.com.au
Manufacturing plants:	ICCONS plant 2
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:	European Technical Assessment EAD 330232-00-0601 “Mechanical Fasteners for use in concrete”, ed. October 2016
This version replaces:	ETA 20/0900 issued on 13/12/2021

English translation prepared by IETcc

This European Technical Assessment is issued by the Technical Assessment Body in its official language. Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission according to article 25 (3) of Regulation (EU) No 305/2011.

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SPECIFIC PART

1. Technical description of the product

The ICCONS Thru-Bolt™ PRO-G wedge anchor in the range of M8, M10, M12, M16 and M20 is an anchor made of sherardized steel. The ICCONS Thru-Bolt™ PRO wedge anchor in the range of M8, M10, M12, M16 and M20 is an anchor made of galvanized steel. The ICCONS Thru-Bolt™ PRO-SS wedge anchor in the range of M8, M10, M12, M16 and M20 is an anchor made of stainless steel. The anchor is installed into a predrilled cylindrical hole and anchored by torque-controlled expansion. The anchorage is characterised by friction between expansion clip and concrete.

Product and installation descriptions are given in annexes A1 and A2.

2. Specification of the intended use in accordance with the applicable European Assessment Document.

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 verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 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 mean to 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 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading) Method A	See Annex C1, C3 and C4
Characteristic resistance to shear load (static and quasi-static loading).	See Annex C1 and C5
Displacements	See Annex C6
Characteristic resistance and displacements for seismic performance category C1 and C2	See Annex C7 and C8

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for class A1
Resistance to fire	See annex C9 and C10

4. Assessment and Verification of Constancy of Performances (hereinafter AVCP) system applied, with reference to its legal base

The applicable European legal act for the system of Assessment and Verification of Constancy of Performances (see annex V to Regulation (EU) No 305/2011) is 96/582/EC.

The system to be applied is 1.

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

The technical details necessary for the implementation of the AVCP system are laid down in the quality plan deposited at Instituto de Ciencias de la Construcción Eduardo Torroja.

Instituto de Ciencias de la Construcción Eduardo Torroja
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

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On behalf of the Instituto de Ciencias de la Construcción Eduardo Torroja
Madrid, 14th of September 2022

Firmado por CASTILLO TALAVERA ANGEL - DNI 52507605P
Fecha: 20/09/2022 13:10:42 CEST

Director IETcc - CSIC

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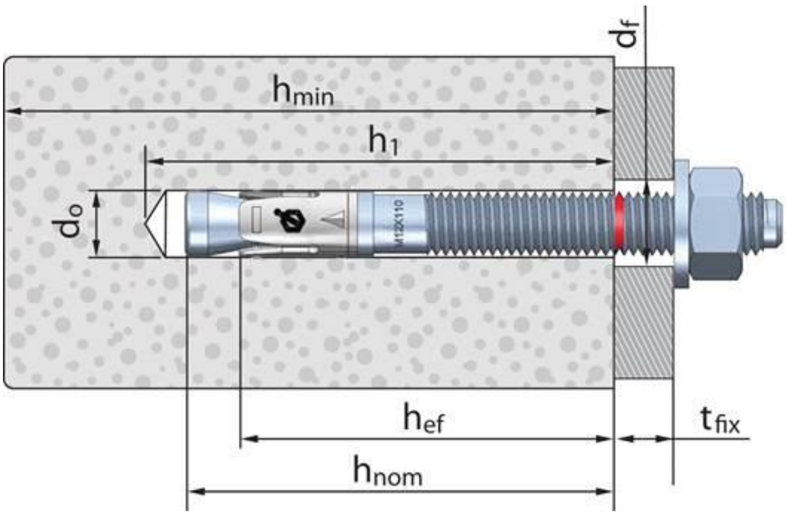
Product and installed condition

Thru-Bolt™ PRO-G, Thru-Bolt™ PRO, Thru-Bolt™ PRO-SS anchor,

Identification on anchor:

- Expansion clip:
  - Anchor Thru-Bolt™ PRO-G: Company logo + “TB” + “PRO G”
  - Anchor Thru-Bolt™ PRO: Company logo + “TB” + “PRO”
  - Thru-Bolt™ PRO™ PRO-SS Company logo + “TB” + “PRO SS”
- Bolt: Metric x Length
- Red ring mark to show embedment depth
- Length letter code on head:

Letter on head	Length [mm]	Letter on head	Length [mm]	Letter on head	Length [mm]
C	68 ÷75	I	140 ÷ 151	O	216 ÷ 228
D	76 ÷ 88	J	152 ÷ 164	P	229 ÷ 240
E	89 ÷ 101	K	165 ÷ 177	Q	241 ÷ 253
F	102 ÷ 113	L	178 ÷ 190	R	254 ÷ 266
G	114 ÷ 126	M	191 ÷ 202	S	267 ÷ 300
H	127 ÷139	N	203 ÷ 215		



d_0: Nominal diameter of drill bit
d_f: Fixture clearance hole diameter
h_{ef}: Effective anchorage depth
h_1: Depth of drilled hole
h_{nom}: Overall anchor embedment depth in the concrete
h_{min}: Minimum thickness of concrete member
t_{fix}: Fixture thickness

Thru-Bolt™ PRO-G, Thru-Bolt™ PRO, Thru-Bolt™ PRO-SS anchors	**Annex A1**
Product description Installed condition	

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Table A1: Materials

Item	Designation	Material for Thru-Bolt™ PRO-G	Material for Thru-Bolt™ PRO
1	Anchor body	Carbon steel wire rod, sherardized ≥ 40 µm EN 13811	Carbon steel wire rod, galvanized ≥ 5 µm ISO 4042 Zn5/An/T0 with antifriction coating
2	Washer	DIN 125, DIN 9021, DIN 440 sherardized ⩾ 40 µm EN 13811	DIN 125, DIN 9021, DIN 440 galvanized ≥ 5 µm ISO 4042 Zn5/An/T0
3	Nut	DIN 934 class 6, sherardized ≥ 40 µm EN 13811	DIN 934 class 6 galvanized ≥ 5 µm ISO 4042 Zn5/An/T0
4	Expansion clip	Stainless steel	Carbon steel strip, sherardized ≥ 15 µm EN 13811

Item	Designation	Material for Thru-Bolt™ PRO-SS
1	Anchor body	Stainless steel, grade A4
2	Washer	DIN 125, DIN 9021, DIN 440 stainless steel, grade A4
3	Nut	Stainless steel, grade A4 with antifriction coating
4	Expansion clip	Stainless steel, grade A4, galvanized ≥ 5 µm ISO 4042 Zn5/An/T0

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Specifications of intended use

Version	Intended use	M8	M10	M12	M16	M20
Thru-Bolt™ PRO-G	Static or quasi static loads	✓	✓	✓	✓	✓
	Seismic loads category C1	✓	✓	✓	✓	✓
	Seismic loads category C2			✓	✓	✓
	Resistance to fire exposure	✓	✓	✓	✓	✓
hru-Bolt™ PRO	Static or quasi static loads	✓	✓	✓	✓	✓
	Seismic loads category C1	✓	✓	✓	✓	✓
	Seismic loads category C2		✓	✓		✓
	Resistance to fire exposure	✓	✓	✓	✓	✓
Thru-Bolt™ PRO SS	Static or quasi static loads	✓	✓	✓	✓	✓
	Seismic loads category C1					
	Seismic loads category C2					
	Resistance to fire exposure	✓	✓	✓	✓	✓

Base materials:

- Reinforced or unreinforced normal weight concrete without fibres according to EN 206-1:2013+A1:2016
- Strength classes C20/25 to C50/60 according to EN 206-1:2013+A1:2016
- Cracked or uncracked concrete

Use conditions (environmental conditions):

- Thru-Bolt™ PRO: anchorages subjected to dry internal conditions.
- Thru-Bolt™ PRO-G:
  - Anchorages in cracked concrete: dry internal conditions
  - Anchorages in uncracked concrete: durability depending on the following environmental corrosivity categories according to ISO 9223:2012:

Corrosivity category	Corrosivity	Durability [years]
C1	Very low	50 [1)]
C2	Low	50 [1)]
C3	Medium	19
C4	High	9.5
C5	Very high	4.7
CX	Extreme	--

1) Working life of fastener limited to 50 years according to EAD 330232-01-0601 section 1.2.2

- Thru-Bolt™ PRO SS anchorages subjected to dry internal conditions, to external atmospheric exposure (including industrial and marine environment) or to permanent internal damp 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). Atmospheres under Corrosion Resistance Class CRC III according to EN 1993-1-4:2006+A1:2015 annex A.

English translation prepared by IETcc

Corrosivity category	Corrosivity	Typical environments – Examples	
		Indoor	Outdoor
C1	Very low	Heated spaces with low relative humidity and insignificant pollution; e.g., offices, schools, museums.	Dry or cold zone, atmospheric environment with very low pollution and time of wetness; e.g., certain desserts, Central Artic/Antarctic.
C2	Low	Unheated spaces with varying temperature and relative humidity. Low frequency of condensation and low pollution; e.g., storage, sport halls.	Temperate zone, atmospheric environment with low pollution (SO_2 < 5 µg/m³); e.g., rural areas, small towns. Dry or cold zone, atmospheric environment with short time or wetness, e.g., deserts, subarctic areas.
C3	Medium	Spaces with moderate frequency of condensation and moderate pollution from production process; e.g., food-processing plants, laundries, breweries, dairies.	Temperate zone, atmospheric environment with medium pollution (SO_2 5 µg/m³ to 30 µg/m³), or some effect of chlorides, e.g., urban areas, coastal areas with low deposition of chlorides. Subtropical and tropical zone, atmosphere with low pollution.
C4	High	Spaces with high frequency of condensation and high pollution from production process; e.g., industrial processing plants.	Temperate zone, atmospheric environment with high pollution(SO_2 30 µg/m³ to 90 µg/m³), or substantial effect of chlorides; e.g., polluted urban areas, industrial areas, coastal areas without spray of salt water or exposure to strong effect of de-icing salts. Subtropical and tropical zone, atmosphere with medium pollution.
C5	Very High	Spaces with very high frequency of condensation and/or high pollution from production process; e.g., mines, caverns for industrial purposes, unventilated sheds in subtropical and tropical zones	Temperate zone, atmospheric environment with very high pollution (SO_2 90 µg/m³ to 250 µg/m³), or significant effect of chlorides; e.g., industrial areas, coastal areas, sheltered positions on coastline. Subtropical and tropical zone, atmosphere with medium pollution.
CX	Extreme	Spaces with almost permanent condensation or extensive periods of exposure to extreme humidity effects and/or high pollution from production process; e.g., unventilated sheds inhumid tropical zones with penetration of outdoor pollution including airborne chlorides and corrosion-stimulating particulate matter	Subtropical and tropical zone (very high time of wetness), atmospheric environment with very high SO_2 pollution (higher than 250 µg/m³) including accompanying and production factors and/or strong effect of chlorides; e.g., extreme industrial areas, coastal and offshore areas, occasional contact with salt spray.

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete.
- Verifiable calculation rules and drawings are prepared taking into account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static actions are designed for design method A in accordance with EN 1994-4:2018
- Anchorages under seismic actions are designed in accordance with EN 1992-4:2018. Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastening in stand-off installation or with grout layer are not allowed.
- Anchorages under fire exposure are designed in accordance with EN 1992-4:2018. It must be ensured that local spalling of the concrete cover does not occur.

Installation:

- Hole drilling by rotary plus hammer mode.
- Anchor installation carried out by appropriately qualified personal and under the supervision of the person responsible for technical matters of the site.
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of aborted hole or smaller distance if the aborted hole is filled with high strength mortar and if under shear or oblique tension load it is not the direction of the load application.

English translation prepared by IETcc

Table C1: Installation parameters for Thru-Bolt™ PRO-G, Thru-Bolt™ PRO anchors

Installation parameters			Performances				
			M8	M10	M12	M16	M20
d_0	Nominal diameter of drill bit:	[mm]	8	10	12	16	20
d_f	Fixture clearance hole diameter:	[mm]	9	12	14	18	22
T_{inst}	Nominal installation torque:	[Nm]	15	40	60	100	200
L_{min}	Minimum total length of the bolt:	[mm]	68	82	98	119	140
h_{min}	Minimum thickness of concrete member:	[mm]	100	120	140	170	200
h_1	Depth of drilled hole:	[mm]	60	75	85	105	125
h_{nom}	Overall anchor embedment depth in the concrete:	[mm]	55	68	80	97	114
h_{ef}	Effective anchorage depth:	[mm]	48	60	70	85	100
t_{fix}	Thickness of fixture for washer DIN 125 ≤ [2]	[mm]	L - 66	L – 80	L – 96	L - 117	L - 138
t_{fix}	Thickness of fixture for washers DIN 9021, DIN 440 ≤ [1]	[mm]	L - 67	L – 81	L – 97	L - 118	L - 139
s_{min}	Minimum allowable spacing: for edge distance c ≥	[mm] [mm]	40 55	40 70	60 75	65 95	95 105
c_{min}	Minimum allowable distance: for spacing s ≥	[mm] [mm]	45 55	45 90	55 110	70 115	95 105

[1] L = total anchor length

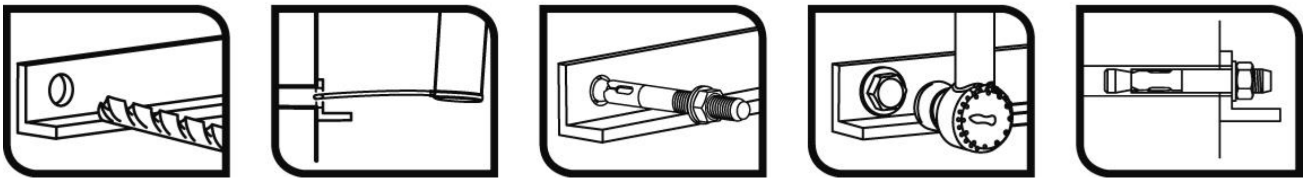
Table C2: Installation parameters for Thru-Bolt™ PRO-SS anchor

Installation parameters			Performances				
			M8	M10	M12	M16	M20
d_0	Nominal diameter of drill bit:	[mm]	8	10	12	16	20
d_f	Fixture clearance hole diameter:	[mm]	9	12	14	18	22
T_{inst}	Nominal installation torque:	[Nm]	15	30	60	100	200
L_{min}	Minimum total length of the bolt:	[mm]	68	82	98	119	140
h_{min}	Minimum thickness of concrete member:	[mm]	100	120	140	170	200
h_1	Depth of drilled hole:	[mm]	60	75	85	105	125
h_{nom}	Overall anchor embedment depth in the concrete:	[mm]	55	68	80	97	114
h_{ef}	Effective anchorage depth:	[mm]	48	60	70	85	100
t_{fix}	Thickness of fixture for washer DIN 125 ≤ [1]	[mm]	L - 66	L – 80	L – 96	L - 117	L - 138
t_{fix}	Thickness of fixture for washers DIN 9021, DIN 440 ≤ [1]	[mm]	L - 67	L – 81	L – 97	L - 118	L - 139
s_{min}	Minimum allowable spacing:	[mm]	42	47	57	75	100
c_{min}	Minimum allowable distance:	[mm]	47	52	62	75	90

[1] L = total anchor length

English translation prepared by IETcc

Installation process



English translation prepared by IETcc

Table C3: Essential characteristics under static or quasi static tension loads according to design method A of EN 1992-4 for Thru-Bolt™ PRO-G, Thru-Bolt™ PRO anchors

Essential characteristics under static or quasi-static tension loads according to design method A				Performances				
				M8	M10	M12	M16	M20
Tension loads: steel failure								
$N_{Rk,s}$	Characteristic resistance:		[kN]	18.1	31.4	40.4	72.7	116.6
γ_{Ms}	Partial safety factor:		[-]	1.5	1.5	1.5	1.5	1.5
Tension loads: pull-out failure in concrete								
Thru-Bolt™ PRO-G anchor								
$N_{Rk,p,ucr}$	Characteristic resistance in C20/25 uncracked concrete:		[kN]	10	18	--1)	36	--1)
$N_{Rk,p,cr}$	Characteristic resistance in C20/25 cracked concrete:		[kN]	6	10	16	--1)	30
Thru-Bolt™ PRO anchor								
$N_{Rk,p,ucr}$	Characteristic resistance in C20/25 uncracked concrete:		[kN]	10	18	28	34	--1)
$N_{Rk,p,cr}$	Characteristic resistance in C20/25 cracked concrete:		[kN]	7	11	15	--1)	--1)
γ_{ins}	Installation safety factor:		[-]	1.2	1.0	1.0	1.0	1.0
ψ_c	Increasing factor for $N^0_{Rk,p}$:	C30/37	[-]	1.22	1.17	1.22	1.22	1.17
		C40/50	[-]	1.41	1.31	1.41	1.41	1.31
		C50/60	[-]	1.58	1.43	1.58	1.58	1.43
Tension loads: concrete cone and splitting failure								
h_{ef}	Effective embedment depth:		[mm]	48	60	70	85	100
$k_{ucr,N}$	Factor for uncracked concrete:		[-]	11.0				
$k_{cr,N}$	Factor for cracked concrete:		[-]	7,7				
γ_{ins}	Installation safety factor:		[-]	1.2	1.0	1.0	1.0	1.0
$s_{cr,N}$	Concrete cone failure:		[mm]	3 x h_{ef}				
$c_{cr,N}$			[mm]	1.5 x h_{ef}				
$s_{cr,sp}$	Splitting failure:		[mm]	288	300	350	510	600
$c_{cr,sp}$			[mm]	144	150	175	255	300

1) Pull out failure is not decisive

English translation prepared by IETcc

Table C4: Essential characteristics under static or quasi-static tension loads according to design method A of EN 1992-4 for Thru-Bolt™ PRO-SS anchor

Essential characteristics under static or quasi-static tension loads according to design method A				Performances				
				M8	M10	M12	M16	M20
Tension loads: steel failure								
$N_{Rk,s}$	Characteristic resistance:		[kN]	18.5	30.9	45.5	71.5	122.5
γ_{Ms}	Partial safety factor:		[-]	1.4	1.4	1.4	1.4	1.4
Tension loads: pull-out failure in concrete								
$N_{Rk,p,ucr}$	Characteristic resistance in C20/25 uncracked concrete:		[kN]	12	16	22	--[1)]	--[1)]
ψ_c	Increasing factor for $N^0_{Rk,p}$:	C30/37	[-]	1.22	1.22	1.22	1.22	1.09
		C40/50	[-]	1.41	1.41	1.41	1.41	1.16
		C50/60	[-]	1.58	1.58	1.58	1.58	1.22
$N_{Rk,p,cr}$	Characteristic resistance in C20/25 cracked concrete:		[kN]	8.5	14	19	--[1)]	--[1)]
ψ_c	Increasing factor for $N^0_{Rk,p}$:	C30/37	[-]	1.01	1.00	1.09	1.09	1.17
		C40/50	[-]	1.02	1.00	1.15	1.16	1.32
		C50/60	[-]	1.02	1.00	1.20	1.22	1.44
γ_{ins}	Installation safety factor:		[-]	1.0	1.0	1.2	1.2	1.2
Tension loads: concrete cone and splitting failure								
h_{ef}	Effective embedment depth:		[mm]	48	60	70	85	100
$k_{ucr,N}$	Factor for uncracked concrete:		[-]	11.0				
$k_{cr.N}$	Factor for cracked concrete:		[-]	7,7				
γ_{ins}	Installation safety factor:		[-]	1.0	1.0	1.2	1.2	1.2
$s_{cr,N}$	Concrete cone failure:		[mm]	3 x h_{ef}				
$c_{cr,N}$			[mm]	1.5 x h_{ef}				
$s_{cr,sp}$	Splitting failure:		[mm]	164	204	238	290	380
$c_{cr,sp}$			[mm]	82	102	119	145	190

1) Pull out failure is not decisive

English translation prepared by IETcc

Table C5: Essential characteristics under static or quasi-static shear loads of design method A of EN 1992-4 for Thru-Bolt™ PRO-G, Thru-Bolt™ PRO anchors

Essential characteristics under static or quasi-static shear loads according to design method A			Performances				
			M8	M10	M12	M16	M20
Shear loads: steel failure without lever arm							
$V_{Rk,s}$	Characteristic resistance:	[kN]	11.0	17.4	25.3	47.1	73.1
k_7	Ductility factor:	[-]	1.0				
γ_{Ms}	Partial safety factor:	[-]	1.25	1.25	1.25	1.25	1.25
Shear loads: steel failure with lever arm							
$M^0_{Rk,s}$	Characteristic bending moment:	[Nm]	22.5	44.8	78.6	199.8	389.4
γ_{Ms}	Partial safety factor:	[-]	1.25	1.25	1.25	1.25	1.25
Shear loads: concrete pryout failure							
k_8	Pryout factor:	[-]	1	2	2	2	2
γ_{ins}	Installation safety factor:	[-]	1.0				
Shear loads: concrete edge failure							
ℓ_f	Effective length of anchor under shear loads:	[mm]	48	60	70	85	100
d_{nom}	Outside anchor diameter:	[mm]	8	10	12	16	20
γ_{ins}	Installation safety factor:	[-]	1.0				

Table C6 Essential characteristics under static or quasi-static shear loads of design method A of EN 1992-4 for Thru-Bolt™ PRO-SS anchor

Essential characteristics under static or quasi-static shear loads according to design method A			Performances				
			M8	M10	M12	M16	M20
Shear loads: steel failure without lever arm							
$V_{Rk,s}$	Characteristic resistance:	[kN]	11.9	18.9	27.4	55.0	85.9
k_7	Ductility factor:	[-]	1.0				
γ_{Ms}	Partial safety factor:	[-]	1.25	1.25	1.25	1.25	1.25
Shear loads: steel failure with lever arm							
$M^0_{Rk,s}$	Characteristic bending moment:	[Nm]	26.2	52.3	91.7	233.1	454.3
γ_{Ms}	Partial safety factor:	[-]	1.25	1.25	1.25	1.25	1.25
Shear loads: concrete pryout failure							
k_8	Pryout factor:	[-]	1	2	2	2	2
γ_{ins}	Installation safety factor:	[-]	1.0				
Shear loads: concrete edge failure							
ℓ_f	Effective length of anchor under shear loads:	[mm]	48	60	70	85	100
d_{nom}	Outside anchor diameter:	[mm]	8	10	12	16	20
γ_{ins}	Installation safety factor:	[-]	1.0				

English translation prepared by IETcc

Table C7: Displacements under tension load for Thru-Bolt™ PRO-G, Thru-Bolt™ PRO Thru-Bolt™ PRO-SS anchors

Displacements under tension loads			Performances				
			M8	M10	M12	M16	M20
Thru-Bolt™ PRO-G anchor							
N	Service tension load:	[kN]	2.5	4.3	6.3	10.4	13.9
δ_{N0}	Short term displacement:	[mm]	1.0	1.1	0.9	1.5	1.2
$\delta_{N\infty}$	Long term displacement:	[mm]	1.9	1.9	1.9	1.9	1.9
Thru-Bolt™ PRO anchor							
N	Service tension load:	[kN]	2.5	4.3	7.6	11.9	14.3
δ_{N0}	Short term displacement:	[mm]	1.0	1.1	0.9	1.5	1.3
$\delta_{N\infty}$	Long term displacement:	[mm]	1.6	1.6	1.6	1.6	1.6
Thru-Bolt™ PRO-SS anchor							
N	Service tension load in non cracked concrete:	[kN]	5.7	7.6	8.7	15.3	19.5
δ_{N0}	Short term displacement:	[mm]	1.4	1.4	1.4	1.8	1.8
$\delta_{N\infty}$	Long term displacement:	[mm]	1.9	1.9	1.9	1.9	1.9
Thru-Bolt™ PRO-SS anchor							
N	Service tension load in cracked cocnrete:	[kN]	4.0	6.7	7.5	10.7	13.7
δ_{N0}	Short term displacement:	[mm]	1.2	1.3	1.3	1.3	1.3
$\delta_{N\infty}$	Long term displacement:	[mm]	1.7	1.7	1.7	1.7	1.7

Table C8: Displacements under shear load for Thru-Bolt™ PRO-G, Thru-Bolt™ PRO, Thru-Bolt™ PRO-SS anchors

Displacements under shear loads			Performances				
			M8	M10	M12	M16	M20
Thru-Bolt™ PRO-G anchor							
V	Service shear load:	[kN]	4.9	6.8	8.5	15.1	24.6
δ_{V0}	Short term displacement:	[mm]	1.0	1.5	1.8	1.9	3.1
$\delta_{V\infty}$	Long term displacement:	[mm]	1.5	2.3	2.7	2.9	4.7
Thru-Bolt™ PRO anchor							
V	Service shear load:	[kN]	4.9	6.8	8.5	15.1	24.6
δ_{V0}	Short term displacement:	[mm]	1.0	1.5	1.8	1.9	3.1
$\delta_{V\infty}$	Long term displacement:	[mm]	1.5	2.3	2.7	2.9	4.7
Thru-Bolt™ PRO-SS anchor							
V	Service shear load:	[kN]	6.8	10.8	15.7	31.4	46.9
δ_{V0}	Short term displacement:	[mm]	1.9	1.6	1.6	2.2	2.2
$\delta_{V\infty}$	Long term displacement:	[mm]	2.4	2.4	2.4	3.3	3.3

English translation prepared by IETcc

Table C9: Essential characteristics for seismic performance category C1 Thru-Bolt™ PRO-G, Thru-Bolt™ PRO anchor

Essential characteristics for seismic performance category C1			Performances				
			M8	M10	M12	M16	M20
Steel tension failure							
$N_{Rk,s,C1}$	Characteristic tension steel failure:	[kN]	18.1	31.4	40.4	72.7	116.6
$\gamma_{Ms,N}$	Partial safety factor:	[-]	1.5	1.5	1.5	1.5	1.5
Steel shear failure							
Thru-Bolt™ PRO-G							
$V_{Rk,s,C1}$	Characteristic shear steel failure:	[kN]	6.6	12.5	18.9	35.4	54.8
Thru-Bolt™ PRO							
$V_{Rk,s,C1}$	Characteristic shear steel failure:	[kN]	7.7	12.2	17.8	33.0	58.5
α_{gap}	Factor for annular gap:	[-]	0.5				
$\gamma_{Ms,V}$	Partial safety factor:	[-]	1.25	1.25	1.25	1.25	1.25
Pull out failure							
Thru-Bolt™ PRO-G							
$N_{Rk,p,C1}$	Characteristic pull out failure:	[kN]	6.0	9.0	16.0	25.0	30.0
Thru-Bolt™ PRO							
$N_{Rk,p,C1}$	Characteristic pull out failure:	[kN]	5.9	8.9	16.0	25.0	30.0
γ_{ins}	Installation safety factor:	[-]	1.2	1.0	1.0	1.0	1.0
Concrete cone failure							
h_{ef}	Effective embedment depth:	[mm]	48	60	70	85	100
$s_{cr,N}$	Spacing:	[mm]	3 x h_{ef}				
$c_{cr,N}$	Edge distance:	[mm]	1.5 x h_{ef}				
γ_{ins}	Installation safety factor:	[-]	1.2	1.0	1.0	1.0	1.0
Concrete pryout failure							
k_8	Pryout factor:	[-]	1	2	2	2	2
Concrete edge failure							
ℓ_f	Effective length of anchor:	[mm]	48	60	70	85	100
d_{nom}	Outside anchor diameter:	[-]	8	10	12	16	20

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Table C10: Essential characteristics for seismic performance category C2 Thru-Bolt™ PRO-G, Thru-Bolt™ PRO anchor

Essential characteristics for seismic performance category C2			Performances				
			M8	M10	M12	M16	M20
Steel failure for tension and shear failure							
$N_{Rk,s,C2}$	Characteristic tension steel failure:	[kN]	--	31.4	40.4	72.7	116.6
$\gamma_{Ms,N}$	Partial safety factor:	[-]	--	1.5	1.5	1.5	1.5
$V_{Rk,s,C2}$	Characteristic shear steel failure:	[kN]	--	12.2	17.8	33.0	58.5
α_{gap}	Factor for annular gap:	[-]	--	0.5	0.5	0.5	0.5
$\gamma_{Ms,V}$	Partial safety factor:	[-]	--	1.25	1.25	1.25	1.25
Pull out failure							
Thru-Bolt™ PRO-G							
$N_{Rk,p,C2}$	Characteristic pull out failure:	[kN]	--	--	5.9	16.3	17.2
Thru-Bolt™ PRO							
$N_{Rk,p,C2}$	Characteristic pull out failure:	[kN]	--	3.9	9.1	--	21.0
γ_{ins}	Installation safety factor:	[-]	--	1.0	1.0	1.0	1.0
Concrete cone failure							
h_{ef}	Effective embedment depth:	[mm]	--	60	70	85	100
$s_{cr,N}$	Spacing:	[mm]	--	$3 \times h_{ef}$			
$c_{cr,N}$	Edge distance:	[mm]	--	$1.5 \times h_{ef}$			
γ_{ins}	Installation safety factor:	[-]	--	1.0	1.0	1.0	1.0
Concrete pryout failure							
k_8	Pryout factor:	[-]	--	2	2	2	2
Concrete edge failure							
ℓ_f	Effective length of anchor:	[mm]	--	60	70	85	100
d_{nom}	Outside anchor diameter:	[-]	--	10	12	16	20
Displacements							
Thru-Bolt™ PRO-G							
$\delta_{N,C2\ (DLS)}$	Displacement Damage Limitation State:1) 2)	[mm]	--	--	6.79	5.21	5.72
$\delta_{V\ C2\ (DLS)}$		[mm]	--	--	5.53	5.96	6.37
$\delta_{N,C2\ (ULS)}$	Displacement Ultimate Limit State:1)	[mm]	--	--	24.70	19.58	17,20
$\delta_{V,C2\ (ULS)}$		[mm]	--	--	9.08	10.66	12.32
Thru-Bolt™ PRO							
$\delta_{N,C2\ (DLS)}$	Displacement Damage Limitation State:1) 2)	[mm]	--	3.15	5.57	--	6.82
$\delta_{V\ C2\ (DLS)}$		[mm]	--	5.61	5.53	--	6.37
$\delta_{N,C2\ (ULS)}$	Displacement Ultimate Limit State:1)	[mm]	--	14.77	20.31	--	29.12
$\delta_{V,C2\ (ULS)}$		[mm]	--	8.68	9.08	--	12.32

1) The listed displacements represent mean values
2) A small displacement may be required in the design in the case of displacements sensitive fastening of “rigid” supports. The characteristics resistance associated with such small displacements may be determined by linear interpolation or proportional reduction.

English translation prepared by IETcc

Table C11: Essential characteristics under fire exposure Thru-Bolt™ PRO-G, Thru-Bolt™ PRO anchors

Essential characteristics under fire exposure				Performances M8	M10	M12	M16	M20
Steel failure								
$N_{Rk,s,fi}$	Characteristic tension resistance:	R30	[kN]	0,4	0,9	1,7	3,1	4,9
		R60	[kN]	0,3	0,8	1,3	2,4	3,7
		R90	[kN]	0,3	0,6	1,1	2,0	3,2
		R120	[kN]	0,2	0,5	0,8	1,6	2,5
$V_{Rk,s,fi}$	Characteristic shear resistance:	R30	[kN]	0,4	0,9	1,7	3,1	4,9
		R60	[kN]	0,3	0,8	1,3	2,4	3,7
		R90	[kN]	0,3	0,6	1,1	2,0	3,2
		R120	[kN]	0,2	0,5	0,8	1,6	2,5
$M^0_{Rk,s,fi}$	Characteristic bending resistance:	R30	[kN]	0,4	1,1	2,6	6,7	13,0
		R60	[kN]	0,3	1,0	2,0	5,0	9,7
		R90	[kN]	0,3	0,7	1,7	4,3	8,4
		R120	[kN]	0,2	0,6	1,3	3,3	6,5
Pull out failure								
$N_{Rk,p,fi}$	Characteristic resistance:	R30 R60 R90	[kN]	1,5	2,3	4,0	6,3	7,5
		R120	[kN]	1,2	1,8	3,2	5,0	6,0
Concrete cone failure [1)]								
$N_{Rk,c,fi}$	Characteristic resistance:	R30 R60 R90	[kN]	2.9	5,0	7,4	12,0	18,0
		R120	[kN]	2,3	4,0	5,9	9,6	14,4
$s_{cr.N,fi}$	Critical spacing:	R30 to R120	[mm]	4 x h_{ef}				
$s_{min,fi}$	Minimum spacing:	R30 to R120	[mm]	50	60	70	128	150
$c_{cr.N,fi}$	Critical edge distance:	R30 to R120	[mm]	2 x h_{ef}				
$c_{min,fi}$	Minimum edge distance:	R30 to R120	[mm]	c_{min} = 2 x h_{ef}; if fire attack comes from more than one side, the edge distance of the anchor has to be ≥ 300 mm and ≥ 2 x h_{ef}				
Concrete pry out failure								
k_8	Pryout factor:	R30 to R120	[-]	1	2	2	2	2

[1)] As a rule, splitting failure can be neglected since cracked concrete and reinforcement is assumed.
In absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{m,fi}$ = 1,0 is recommended

English translation prepared by IETcc

Table C12: Essential characteristics under fire exposure Thru-Bolt™ PRO-SS anchor

Essential characteristics under fire exposure				Performances				
				M8	**M10**	**M12**	**M16**	**M20**
Steel failure								
$N_{Rk,s,fi}$	Characteristic tension resistance:	R30	[kN]	0,7	1,5	2,5	4,7	7,4
		R60	[kN]	0,6	1,2	2,1	3,9	6,1
		R90	[kN]	0,4	0,9	1,7	3,1	4,9
		R120	[kN]	0,4	0,8	1,3	2,5	3,9
$V_{Rk,s,fi}$	Characteristic shear resistance:	R30	[kN]	0,7	1,5	2,5	4,7	7,4
		R60	[kN]	0,6	1,2	2,1	3,9	6,1
		R90	[kN]	0,4	0,9	1,7	3,1	4,9
		R120	[kN]	0,4	0,8	1,3	2,5	3,9
$M^0_{Rk,s,fi}$	Characteristic bending resistance:	R30	[Nm]	0,7	1,9	3,9	10,0	19,5
		R60	[Nm]	0,6	1,5	3,3	8,3	16,2
		R90	[Nm]	0,4	1,2	2,6	6,7	13,0
		R120	[Nm]	0,4	1,0	2,1	5,3	10,4
Pull out failure								
$N_{Rk,p,fi}$	Characteristic resistance:	R30 R60 R90	[kN]	2,1	3,5	4,8	--[1]	--[1]
		R120	[kN]	1,7	2,8	3,8	--[1]	--[1]
Concrete cone failure [2]								
$N_{Rk,c,fi}$	Characteristic resistance:	R30 R60 R90	[kN]	2.7	4,8	7,1	11,5	17,2
		R120	[kN]	2,2	43,8	5,6	9,2	13,8
$s_{cr.N,fi}$	Critical spacing:	R30 to R120	[mm]	$4 \times h_{ef}$				
$s_{min,fi}$	Minimum spacing:	R30 to R120	[mm]	42	47	57	75	100
$c_{cr.N,fi}$	Critical edge distance:	R30 to R120	[mm]	$2 \times h_{ef}$				
$c_{min,fi}$	Minimum edge distance:	R30 to R120	[mm]	$c_{min} = 2 \times h_{ef}$; if fire attack comes from more than one side, the edge distance of the anchor has to be ≥ 300 mm and ≥ $2 \times h_{ef}$				
Concrete pry out failure								
k_8	Pryout factor:	R30 to R120	[-]	1	2	2	2	2

[1] Pull out failure is not decisive
[2] As a rule, splitting failure can be neglected since cracked concrete and reinforcement is assumed.
In absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{m,fi} = 1,0$ is recommended