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

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# European Technical Assessment ETA 19/0284 of 07/05/2019

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:** | **Anchor CA-Z/X**<br>**Anchor CA-H/X**<br>**Anchor CA-Z/H** |
| **Product family to which the construction product belongs:** | Torque controlled expansion anchor made of galvanized steel or sherardized steel of sizes M8, M10, M12, M16, M20 and M24 for use in concrete. |
| **Manufacturer:** | **Marcopol Sp. z o.o. Producent Śrub**<br>ul. Oliwska 100<br>80-209 Chwaszczyno, Poland<br>Website www.marcopol.pl |
| **Manufacturing plants:** | Marcopol plant 3 |
| **This European Technical Assessment contains:** | 14 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 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This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission according to article 25 (3) of Regulation (EU) No 305/2011.

# SPECIFIC PART

## 1. Technical description of the product

The Marcopol CA-Z/X wedge anchor in the range of M8, M10, M12, M16, M20 and M24 is an anchor made of galvanised steel. The Marcopol CA-H/X wedge anchor in the range of M8, M10, M12, M16 and M20 is an anchor made of sherardized steel. The Marcopol CA-Z/H wedge anchor in the range of M8, M10, M12, M16 and M20 is an anchor made of galvanized 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 annex A.

## 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 under static or quasi static loading | See annexes C1 to C3 |
| Displacements under tension and shear loads | See annex C4 |
| Characteristic resistance under seismic loading categories C1 and C2 | See annex C5 and C6 |

### 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 C7 |

## 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.

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On behalf of the Instituto de Ciencias de la Construcción Eduardo Torroja
Madrid, 7th of May 2019

CASTILLO TALAVERA ANGEL - DNI 52507605P

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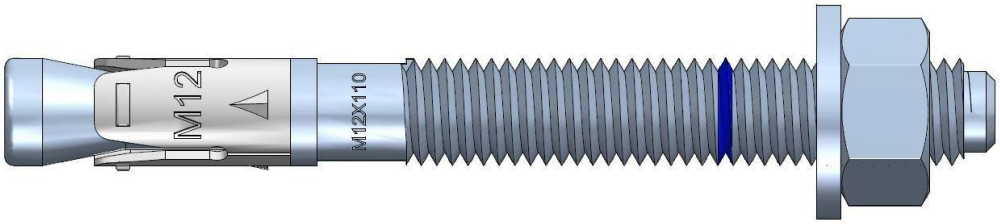
Director IETcc-CSIC

## Product and installed condition

CA-Z/X, CA-H/X, CA-Z/H anchor



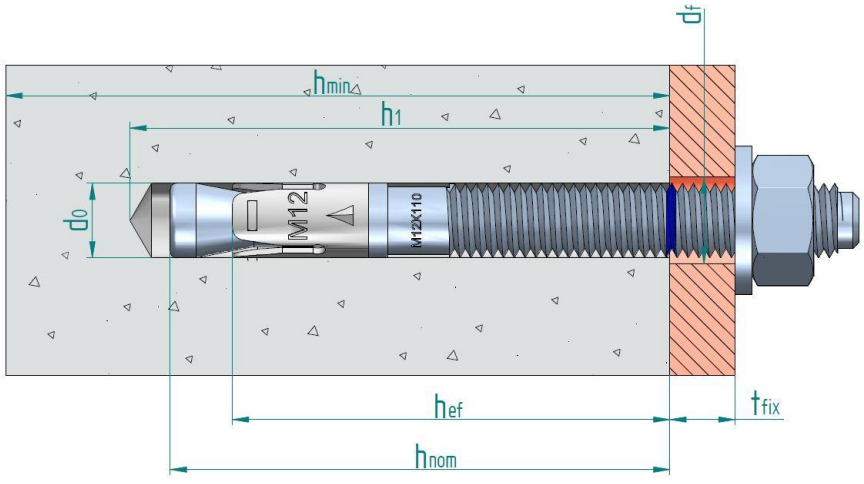

Identification on anchor:

- Expansion clip:
  - Anchor CA-Z/X: Company logo + "CA-Z/X" + Metric.
  - Anchor CA-H/X: Company logo + "CA-H/X" + Metric.
  - Anchor CA-Z/H: Company logo + "CA-Z/H" + Metric.
- Anchor body: Metric x Length
- Blue ring mark to show embedment depth
- Length letter code on head:

| Letter on head | Length [mm] |
|---|---|
| C | 68 ÷75 |
| D | 76 ÷ 88 |
| E | 89 ÷ 101 |
| F | 102 ÷ 113 |
| G | 114 ÷ 126 |
| H | 127 ÷139 |

| Letter on head | Length [mm] |
|---|---|
| I | 140 ÷ 151 |
| J | 152 ÷ 164 |
| K | 165 ÷ 177 |
| L | 178 ÷ 190 |
| M | 191 ÷ 202 |
| N | 203 ÷ 215 |

| Letter on head | Length [mm] |
|---|---|
| P | 229 ÷ 240 |
| Q | 241 ÷ 253 |
| R | 254 ÷ 266 |
| S | 267 ÷ 300 |




$d_0$: 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

| **CA-Z/X, CA-H/X, CA-Z/H anchors** | |
|---|---|
| **Product description**<br><br>Installed condition | **Annex A1** |

## Table A1: materials

| Item | Designation | Material for CA-Z/X | Material for CA-H/X | Material for CA-Z/H |
|---|---|---|---|---|
| 1 | Anchor body | M8 to M20: carbon steel wire rod, galvanized ≥ 5 µm ISO 4042 A2 with antifriction coating<br>M24: machine carbon steel, galvanized ≥ 5 µm ISO 4042 A2 with antifriction coating | Carbon steel wire rod, sherardized ≥ 40 µm EN 13811 | Carbon steel wire rod, galvanized ≥ 5 µm ISO 4042 A2 with antifriction coating |
| 2 | Washer | DIN 125, DIN 9021 galvanized ≥ 5 µm ISO 4042 A2 | DIN 125, DIN 9021 sherardized ≥ 40 µm EN 13811 | DIN 125, DIN 9021 galvanized ≥ 5 µm ISO 4042 A2 |
| 3 | Nut | DIN 934 galvanized ≥ 5 µm ISO 4042 A2, class 6 | DIN 934 sherardized ≥ 40 µm EN 13811, class 6 | DIN 934 galvanized ≥ 5 µm ISO 4042 A2, class 6 |
| 4 | Expansion clip | Stainless steel, grade A4 | Stainless steel, grade A4 | Carbon steel strip, sherardized ≥ 15 µm EN 13811 |

**Specifications of intended use**

**Anchorages subjected to:**

- Static or quasi static loads
- Seismic actions:
  - for performance category C1:
    - CA-Z/X: M10, M12 and M16
    - CA-Z/H: M10, M12, M16 and M20
  - for performance category C2:
    - CA-Z/X: M12 and M16
    - CA-Z/H: M12 and M20
- Resistance to fire exposure up to 120 minutes: all versions and sizes

**Base materials:**

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2008
- Strength classes C20/25 to C50/60 according to EN 206-1:2008
- Cracked or uncracked concrete

**Use conditions (environmental conditions):**

- Anchorages subjected to dry internal conditions.

**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:
  - EN1992-4:2018
- Anchorages under seismic actions (cracked concrete) are designed in accordance with:
  - EN1992-4:2018
  - 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.

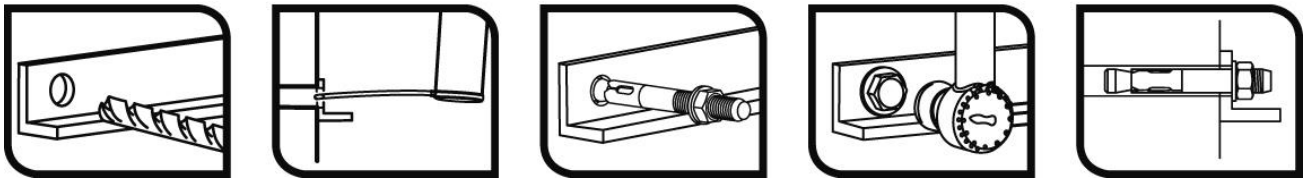
| | |
|---|---|
| **CA-Z/X, CA-H/X, CA-Z/H anchor** | **Annex B1** |
| **Intended use**<br><br>Specifications | |

## Table C1: Installation parameters for CA-Z/X, CA-H/X, CA-Z/H anchor

| Installation parameters | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| $d_0$ | Nominal diameter of drill bit: | [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| $d_f$ | Fixture clearance hole diameter: | [mm] | 9 | 12 | 14 | 18 | 22 | 26 |
| $T_{inst}$ | Nominal installation torque: | [Nm] | 20/15[1)] | 40 | 60 | 100 | 200 | 250 |
| $L_{min}$ | Total length of the bolt: | [mm] | 68 | 82 | 98 | 119 | 140 | 175 |
| $L_{max}$ | | [mm] | 200 | 200 | 250 | 250 | 300 | 400 |
| $h_{min}$ | Minimum thickness of concrete member: | [mm] | 100 | 120 | 140 | 170 | 200 | 250 |
| $h_1$ | Depth of drilled hole: | [mm] | 60 | 75 | 85 | 105 | 125 | 155 |
| $h_{nom}$ | Overall anchor embedment depth in the concrete: | [mm] | 55 | 68 | 80 | 97 | 114 | 143 |
| $h_{ef}$ | Effective anchorage depth: | [mm] | 48 | 60 | 70 | 85 | 100 | 125 |
| $t_{fix}$ | Thickness of fixture [2)]: | [mm] | L - 66 | L – 80 | L – 96 | L - 117 | L - 138 | L - 170 |
| $s_{min}$ | Minimum allowable spacing: | [mm] | 50 | 60 | 70 | 85/128[1)] | 100/150[1)] | 125 |
| $c_{min}$ | Minimum allowable distance: | [mm] | 50 | 60 | 70 | 85/128[1)] | 100/150[1)] | 125 |

[1)] Respective values for anchors CA-Z/X / CA-H/X, CA-Z/H
[2)] L = total anchor length

## Installation process



| CA-Z/X, CA-H/X, CA-Z/H anchor | Annex C1 |
|---|---|
| **Performances**<br><br>Installation parameters and installation procedure | |

## Table C2: Characteristic values to tension loads of design method A according to EN 1992-4 for CA-Z/X, CA-H/X, CA-Z/H anchor

| Characteristic values of resistance to tension loads of design according to design method A | | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Tension loads: steel failure** | | | | | | | | | |
| $N_{Rk,s}$ | Characteristic resistance: | | [kN] | 18.1 | 31.4 | 40.4 | 72.7 | 116.6 | 179.2 |
| $\gamma_{Ms}$ | Partial safety factor: | | [-] | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| **Tension loads: pull-out failure in concrete** | | | | | | | | | |
| **CA-Z/X anchor** | | | | | | | | | |
| $N_{Rk,p,ucr}$ | Characteristic resistance in C20/25 uncracked concrete: | | [kN] | 9 | 16 | 20 | 35 | 50 | 50 |
| $N_{Rk,p,cr}$ | Characteristic resistance in C20/25 cracked concrete: | | [kN] | 5 | 9 | 12 | 25 | 30 | 30 |
| **CA-H/X anchor** | | | | | | | | | |
| $N_{Rk,p,ucr}$ | Characteristic resistance in C20/25 uncracked concrete: | | [kN] | 9 | 16 | 30 | 35 | 50 | -- |
| $N_{Rk,p,cr}$ | Characteristic resistance in C20/25 cracked concrete: | | [kN] | 6 | 9 | 16 | 25 | 30 | -- |
| **CA-Z/H anchor** | | | | | | | | | |
| $N_{Rk,p,ucr}$ | Characteristic resistance in C20/25 uncracked concrete: | | [kN] | 9 | 16 | 25 | 35 | 50 | -- |
| $N_{Rk,p,cr}$ | Characteristic resistance in C20/25 cracked concrete: | | [kN] | 6 | 9 | 16 | 25 | 30 | -- |
| $\gamma_{ins}$ | Installation safety factor: | | [-] | 1.2 | 1.0 | 1.0 | 1.0 | 1.0 | 1.2 |
| $\psi_c$ | Increasing factor for $N^0_{Rk,p}$: | C30/37 | [-] | 1.22 | 1.16 | 1.22 | 1.22 | 1.16 | 1.22 |
| | | C40/50 | [-] | 1.41 | 1.31 | 1.41 | 1.41 | 1.31 | 1.41 |
| | | C50/60 | [-] | 1.55 | 1.41 | 1.55 | 1.55 | 1.41 | 1.55 |
| **Tension loads: concrete cone and splitting failure** | | | | | | | | | |
| $h_{ef}$ | Effective embedment depth: | | [mm] | 48 | 60 | 70 | 85 | 100 | 125 |
| $k_{ucr,N}$ | Factor for uncracked concrete: | | [-] | 11.0 | | | | | |
| $k_{cr,N}$ | Factor for cracked concrete: | | [-] | 7,7 | | | | | |
| $\gamma_{ins}$ | Installation safety factor: | | [-] | 1.2 | 1.0 | 1.0 | 1.0 | 1.0 | 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] | 288 | 300 | 350 | 425/510[1)] | 500/600[1)] | 560 |
| $c_{cr,sp}$ | | | [mm] | 144 | 150 | 175 | 213/255[1)] | 250/300[1)] | 280 |

[1)] Respective values for anchors CA-Z/X / CA-H/X, CA-Z/H

## Table C3: Characteristic values to shear loads of design method A according to EN1992-4 for CA-Z/X, CA-H/X, CA-Z/H anchor

| Characteristic values of resistance to shear loads of design according to design method A | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| **Shear loads: steel failure without lever arm** | | | | | | | | |
| $V_{Rk,s}$ | Characteristic resistance: | [kN] | 11.0 | 17.4 | 25.3 | 47.1 | 73.1 | 84.7 |
| $k_7$ | $k_7$ factor: | [-] | 1.0 | | | | | |
| $\gamma_{Ms}$ | Partial safety factor: | [-] | 1.25 | 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 | 673.5 |
| $\gamma_{Ms}$ | Partial safety factor: | [-] | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| **Shear loads: concrete pryout failure** | | | | | | | | |
| $k_8$ | k factor: | [-] | 1 | 2 | 2 | 2 | 2 | 2 |
| $\gamma_{ins}$ | 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 | 125 |
| $d_{nom}$ | Outside anchor diameter: | [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| $\gamma_{ins}$ | Installation safety factor: | [-] | 1.0 | | | | | |

## Table C4: Displacements under tension load for CA-Z/X, CA-H/X, CA-Z/H anchor

| Displacements under tension loads | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **CA-Z/X anchor** | | | | | | | | |
| N | Service tension load: | [kN] | 2.5 | 4.3 | 6.3 | 10.4 | 13.9 | 18.0 |
| $\delta_{N0}$ | Short term displacement: | [mm] | 1.1 | 0.7 | 1.0 | 0.4 | 1.6 | 0.4 |
| $\delta_{N\infty}$ | Long term displacement: | [mm] | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 2.0 |
| **CA-H/X anchor** | | | | | | | | |
| N | Service tension load: | [kN] | 2.5 | 4.3 | 6.3 | 10.4 | 13.9 | -- |
| $\delta_{N0}$ | 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 | -- |
| **CA-Z/H anchor** | | | | | | | | |
| N | Service tension load: | [kN] | 2.5 | 4.3 | 7.6 | 11.9 | 14.3 | -- |
| $\delta_{N0}$ | 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 | -- |

## Table C5: Displacements under shear load for CA-Z/X, CA-H/X, CA-Z/H anchor

| Displacements under shear loads | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **CA-Z/X anchor** | | | | | | | | |
| V | Service shear load: | [kN] | 4.9 | 6.8 | 8.5 | 15.1 | 24.6 | 33.6 |
| $\delta_{V0}$ | Short term displacement: | [mm] | 1.0 | 1.5 | 1.8 | 1.9 | 3.1 | 1.4 |
| $\delta_{V\infty}$ | Long term displacement: | [mm] | 1.5 | 2.3 | 2.7 | 2.9 | 4.7 | 2.1 |
| **CA-H/X anchor** | | | | | | | | |
| V | Service shear load: | [kN] | 4.9 | 6.8 | 8.5 | 15.1 | 24.6 | - |
| $\delta_{V0}$ | 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 | -- |
| **CA-Z/H anchor** | | | | | | | | |
| V | Service shear load: | [kN] | 4.9 | 6.8 | 8.5 | 15.1 | 24.6 | -- |
| $\delta_{V0}$ | 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 | -- |

## Table C6: Design information for seismic performance C1 CA-Z/X, CA-Z/H anchor

| Design information for seismic performance C1 | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Steel failure for tension and shear failure** | | | | | | | | |
| $N_{Rk,s,seis}$ | 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 | -- |
| $V_{Rk,p,seis}$ | Characteristic shear steel failure: | [kN] | -- | 12.2 | 17.8 | 33.0 | 58.5 | -- |
| $\gamma_{Ms,V}$ | Partial safety factor: | [-] | -- | 1.25 | 1.25 | 1.25 | 1.25 | -- |
| **Pull out failure** | | | | | | | | |
| **CA-Z/X anchor** | | | | | | | | |
| $N_{Rk,p,seis}$ | Characteristic pull out failure: | [kN] | -- | 5.3 | 8.4 | 17.5 | -- | -- |
| **CA-Z/H anchor** | | | | | | | | |
| $N_{Rk,p,seis}$ | Characteristic pull out failure: | [kN] | -- | 3.9 | 16.0 | 25.0 | 30.0 | -- |
| $\gamma_{ins}$ | 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 x $h_{ef}$ | | | | -- |
| $c_{cr,N}$ | Edge distance: | [mm] | -- | 1.5 x $h_{ef}$ | | | | -- |
| $\gamma_{ins}$ | Installation safety factor: | [-] | -- | 1.0 | 1.0 | 1.0 | 1.0 | -- |
| **Concrete pryout failure** | | | | | | | | |
| $k_3$ | $k_3$ 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 | -- |

## Table C7: Design information for seismic performance C2 CA-Z/X, CA-Z/H anchor

| Design information for seismic performance C2 | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Steel failure for tension and shear failure** | | | | | | | | |
| $N_{Rk,s,seis}$ | Characteristic tension steel failure: | [kN] | -- | -- | 40.4 | 72.7 | 116.6 | -- |
| $\gamma_{Ms,N}$ | Partial safety factor: | [-] | -- | -- | 1.5 | 1.5 | 1.5 | -- |
| $V_{Rk,p,seis}$ | Characteristic shear steel failure: | [kN] | -- | -- | 17.8 | 33.0 | 58.5 | -- |
| $\gamma_{Ms,V}$ | Partial safety factor: | [-] | -- | -- | 1.25 | 1.25 | 1.25 | -- |
| **Pull out failure** | | | | | | | | |
| **CA-Z/X anchor** | | | | | | | | |
| $N_{Rk,p,seis}$ | Characteristic pull out failure: | [kN] | -- | -- | 5.2 | 8.9 | -- | -- |
| **CA-Z/H anchor** | | | | | | | | |
| $N_{Rk,p,seis}$ | Characteristic pull out failure: | [kN] | -- | -- | 9.1 | -- | 21.0 | -- |
| $\gamma_{ins}$ | Installation safety factor: | [-] | -- | -- | 1.0 | 1.0 | 1.0 | -- |
| **Concrete cone failure** | | | | | | | | |
| $h_{ef}$ | Effective embedment depth: | [mm] | -- | -- | 70 | 85 | 100 | -- |
| $s_{cr,N}$ | Spacing: | [mm] | -- | -- | 3 x $h_{ef}$ | | | -- |
| $c_{cr,N}$ | Edge distance: | [mm] | -- | -- | 1.5 x $h_{ef}$ | | | -- |
| $\gamma_{ins}$ | Installation safety factor: | [-] | -- | -- | 1.0 | 1.0 | 1.0 | -- |
| **Concrete pryout failure** | | | | | | | | |
| $k_3$ | $k_3$ factor: | [-] | -- | -- | 2 | 2 | 2 | -- |
| **Concrete edge failure** | | | | | | | | |
| $l_f$ | Effective length of anchor: | [mm] | -- | -- | 70 | 85 | 100 | -- |
| $d_{nom}$ | Outside anchor diameter: | [-] | -- | -- | 12 | 16 | 20 | -- |
| **Displacements** | | | | | | | | |
| **CA-Z/X anchor** | | | | | | | | |
| $\delta_{N,seis\ (DLS)}$ | Displacement Damage Limitation State:[1) 2)] | [mm] | -- | -- | 2.34 | 3.99 | -- | -- |
| $\delta_{V\ seis\ (DLS)}$ | | [mm] | -- | -- | 5.53 | 5.96 | -- | -- |
| $\delta_{N,seis\ (ULS)}$ | Displacement Ultimate Limit State:[1)] | [mm] | -- | -- | 9.54 | 10.17 | -- | -- |
| $\delta_{V,seis\ (ULS)}$ | | [mm] | -- | -- | 9.08 | 10.66 | -- | -- |
| **CA-Z/H anchor** | | | | | | | | |
| $\delta_{N,seis\ (DLS)}$ | Displacement Damage Limitation State:[1) 2)] | [mm] | -- | -- | 5.57 | -- | 6.82 | -- |
| $\delta_{V\ seis\ (DLS)}$ | | [mm] | -- | -- | 5.53 | -- | 6.37 | -- |
| $\delta_{N,seis\ (ULS)}$ | Displacement Ultimate Limit State:[1)] | [mm] | -- | -- | 20.31 | -- | 29.12 | -- |
| $\delta_{V,seis\ (ULS)}$ | | [mm] | -- | -- | 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.

## Table C8: Characteristic values for resistance to fire CA-Z/X, CA-H/X, CA-Z/H anchor

| Characteristic values for resistance to fire | | | | | Performances | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Steel failure** | | | | | | | | | | |
| $N_{Rk,s,fi}$ | Characteristic tension resistance: | | R30 | [kN] | 0,4 | 0,9 | 1,7 | 3,1 | 4,9 | 7,1 |
| | | | R60 | [kN] | 0,3 | 0,8 | 1,3 | 2,4 | 3,7 | 5,3 |
| | | | R90 | [kN] | 0,3 | 0,6 | 1,1 | 2,0 | 3,2 | 4,6 |
| | | | R120 | [kN] | 0,2 | 0,5 | 0,8 | 1,6 | 2,5 | 3,5 |
| $V_{Rk,s,fi}$ | Characteristic shear resistance: | | R30 | [kN] | 0,4 | 0,9 | 1,7 | 3,1 | 4,9 | 7,1 |
| | | | R60 | [kN] | 0,3 | 0,8 | 1,3 | 2,4 | 3,7 | 5,3 |
| | | | R90 | [kN] | 0,3 | 0,6 | 1,1 | 2,0 | 3,2 | 4,5 |
| | | | R120 | [kN] | 0,2 | 0,5 | 0,8 | 1,6 | 2,5 | 3,5 |
| $M^0_{Rk,s,fi}$ | Characteristic bending resistance: | | R30 | [kN] | 0,4 | 1,1 | 2,6 | 6,7 | 13,0 | 22,5 |
| | | | R60 | [kN] | 0,3 | 1,0 | 2,0 | 5,0 | 9,7 | 16,8 |
| | | | R90 | [kN] | 0,3 | 0,7 | 1,7 | 4,3 | 8,4 | 14,6 |
| | | | R120 | [kN] | 0,2 | 0,6 | 1,3 | 3,3 | 6,5 | 11,2 |
| **Pull out failure** | | | | | | | | | | |
| $N_{Rk,p,fi}$ | Characteristic resistance: | | R30<br>R60<br>R90 | [kN] | 1,3/1,5[1)] | 2,3 | 3,0/4,0[1)] | 6,3 | 7,5 | 7,5 |
| | | | R120 | [kN] | 1,0/1,2[1)] | 1,8 | 2,4/3,2[1)] | 5,0 | 6,0 | 6,0 |
| **Concrete cone failure [2)]** | | | | | | | | | | |
| $N_{Rk,p,fi}$ | Characteristic resistance: | | R30<br>R60<br>R90 | [kN] | 2.9 | 5,0 | 7,4 | 12,0 | 18,0 | 31,4 |
| | | | R120 | [kN] | 2,3 | 4,0 | 5,9 | 9,6 | 14,4 | 25,2 |
| | | | | | | | | | | |
| $s_{cr,N,fi}$ | Critical spacing: | R30 to R120 | | [mm] | 4 x $h_{ef}$ | | | | | |
| $s_{min,fi}$ | Minimum spacing: | R30 to R120 | | [mm] | 50 | 60 | 70 | 85/128[1)] | 100/150[1)] | 125 |
| $c_{cr,N,fi}$ | 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** | | | | | | | | | | |
| $k_3$ | $k_3$ factor: | R30 to R120 | | [-] | 1 | 2 | 2 | 2 | 2 | 2 |

[1)] Respective values for anchors CA-Z/X / CA-H/X, CA-Z/H

[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