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# European Technical Assessment

# ETA-18/0870 of 28/12/2018

*English translation prepared by CSTB - Original version in French language*

**General Part**

| | |
|---|---|
| Nom commercial :<br>*Trade name* | **WBAT-PF WALRAVEN UNDERCUT ANCHOR** |
| Famille de produit :<br>*Product family* | **Cheville métallique à verrouillage de forme, en acier galvanisé à chaud, pour fixation en béton fissuré et non fissuré diamètres M12 et M16**<br>***Undercut anchor, made of hot dip galvanized steel for use in cracked and uncracked concrete: sizes M12 and M16*** |
| Titulaire :<br>*Manufacturer* | J. Van Walraven Holding<br>Industrieweg 5<br>NL-3641RK Mijdrecht<br>The Netherlands |
| Usine de fabrication :<br>*Manufacturing plants* | **Walraven factory A7** |
| Cette évaluation contient :<br>*This assessment contains* | 13 pages incluant 10 pages d'annexes qui font partie intégrante de cette évaluation<br>13 *pages including 10 pages of annexes which form an integral part of this assessment* |
| Base de l'ETE :<br>*Basis of ETA* | EAD 330232-00-0601, "Ancrages mécaniques dans le béton"<br>*EAD 330232-00-0601, "Mechanical fasteners for use in concrete"* |
| Cette évaluation remplace:<br>*This Assessment replaces* | Corrigendum |

## Specific Part

### 1 Technical description of the product

WBAT-PF WALRAVEN UNDERCUT ANCHOR is an anchor made of zinc electroplated steel which is placed into a drilled hole and anchored by torque-controlled expansion.

The illustration and the description of the product are given in Annexes A.

### 2 Specification of the intended use

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

The provisions made in this European technical assessment are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

### 3 Performance of the product

#### 3.1 Mechanical resistance and stability (BWR 1)

| Essential characteristic | Performance |
|---|---|
| Characteristic tension resistance acc. EN 1992-4 | See Annex C 1 |
| Characteristic shear resistance acc. EN 1992-4 | See Annex C 2 |
| Characteristic under seismic actions, seismic category C1 | See Annex C 5 |
| Displacements | See Annex C 6 |

#### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Anchorages satisfy requirements for Class A1 |
| Characteristic tension resistance under fire acc. EN 1992-4 | See Annex C 3 |
| Characteristic shear resistance under fire acc. EN 1992-4 | See Annex C 4 |

#### 3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances contained in this European technical approval, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

#### 3.4 Safety in use (BWR 4)

For Basic requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

#### 3.5 Protection against noise (BWR 5)

Not relevant.

### 3.6 Energy economy and heat retention (BWR 6)

Not relevant.

### 3.7 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

### 3.8 General aspects relating to fitness for use

Durability and Serviceability are only ensured if the specifications of intended use according to Annex B1 are kept.

## 4 Assessment and verification of constancy of performance (AVCP)

According to the Decision 96/582/EC of the European Commission[1], as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

| Product | Intended use | Level or class | System |
|---|---|---|---|
| Metal anchors for use in concrete | For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units | — | 1 |

## 5 Technical details necessary for the implementation of the AVCP system

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Centre Scientifique et Technique du Bâtiment.

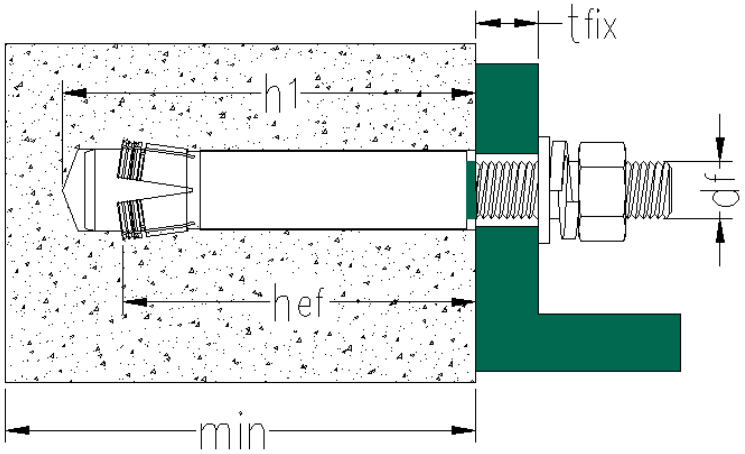
The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of anchors for issuing the certificate of conformity CE based on the control plan.

**The original French version is signed by**

Charles Baloche
Technical Director

[1] Official Journal of the European Communities L 254 of 08.10.1996

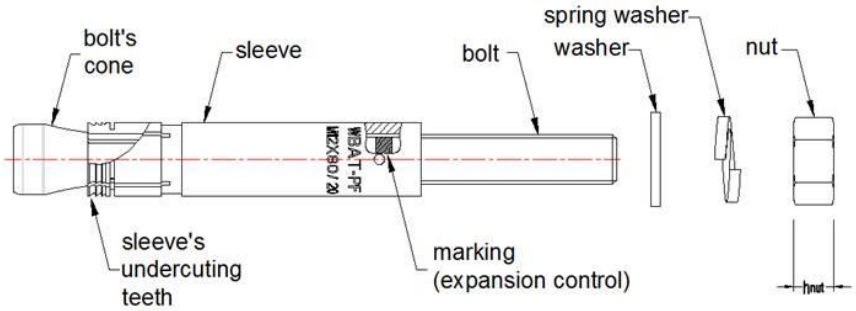
## Installed condition




## Marking on the bolt

WBAT-PF
followed by MX x Y where
MX = thread diameter
Y = effective anchorage depth
e.g. WBAT-PF-M16x100

## Different parts of the anchor




## Materials

| Part | Designation | Material | Protection |
|---|---|---|---|
| **1** | Threaded bolt with cone | cold formed heat treated steel, elongation at break≥12%<br>40Cr | all steel items are hot dip galvanized ≥ 50 micron |
| **2** | Sleeve | steel tube GB/T 20 | |
| **3** | Washer | acc. DIN 125-1 140HV March 1990 Q235B | |
| **4** | Spring washer | DIN 127 | |
| **5** | Nut | Hexagon nut acc. DIN 934 grade 8 | |

## Specifications of intended use

**Anchorages subject to:**

- Static, quasi-static and fire.
- Seismic actions performances C1.

**Base materials:**

- Cracked concrete and uncracked concrete
- Reinforced or unreinforced normal weight concrete of strength classes C20/25 to C50/60 according to EN 206.

**Use conditions (Environmental conditions):**

- Structures subjected to dry internal conditions.

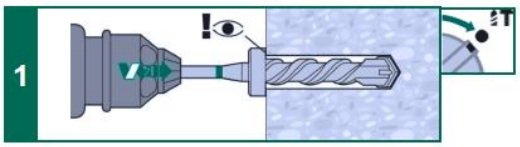
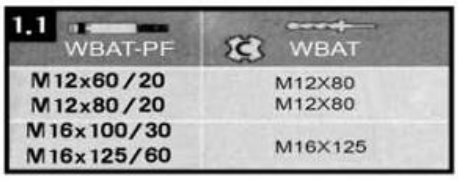
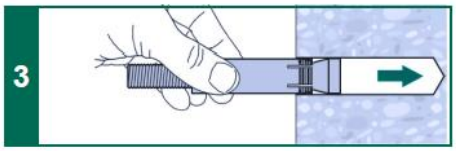
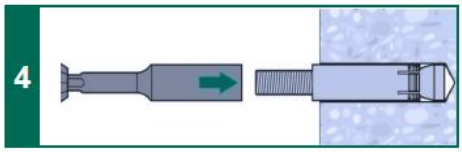
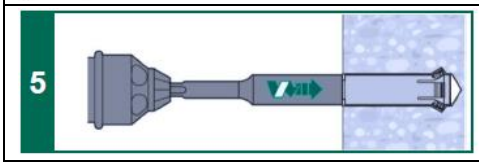
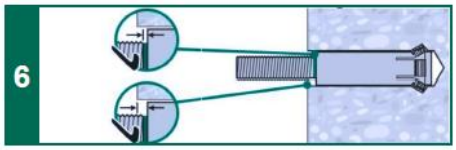
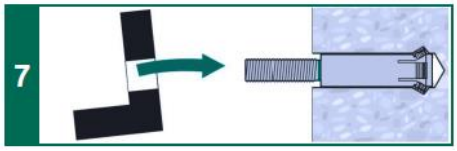
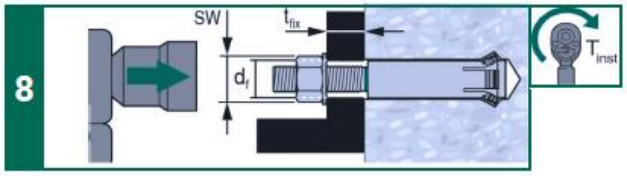
**Design:**

- The anchorages are designed in accordance with the EN 1992-4" Design of fastenings for use in concrete" under the responsibility of an engineer experienced in anchorages and concrete work.
- For application with resistance under fire exposure the anchorages are designed in accordance with method given in EN 1992-4" Design of fastenings for use in concrete.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings.

**Installation:**

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor.
- Anchor installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools.
- Effective anchorage depth, edge distances and spacing not less than the specified values without minus tolerances.
- Hole drilling by hammer drill with conventional bit.
- Cleaning of the hole of drilling dust.
- Application of specified torque moment using a calibrated torque wrench.
- In case of aborted hole, drilling of new hole at a minimum distance of twice the depth of the aborted hole, or smaller distance provided the aborted drill hole is filled with high strength mortar and no shear or oblique tension loads in the direction of aborted hole

## Installation of WBAT-PF

| | |
|---|---|
|  <br>  | Drill borehole using WBAT drill bit.<br>Apply hammerdrill mode. |
|  | Clean the borehole of dust and debris. |
|  | Insert the anchor by hand. |
|  <br>  | Use setting tool a hammer drill.<br>Apply hammerdrill mode and create undercut by sleeve expansion. |
|  | |
|  | Check that setting mark is visible otherwise repeat step 5.<br>Check that sleeve is underneath the concrete surface<br>Sleeve must not protrude concrete surface. |
|  | Attach the fixture. |
|  | Attach the belonging washer and nut and apply installation torque using a torque wrench (Tables 2 and 3). |

**WBAT-PF WALRAVEN UNDERCUT ANCHOR**

**Intended Use**
Installation parameters

**Annex B2**

**Table 1: Anchor dimensions**

| | | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|---|
| **Length of the anchor** | **Min.** | $h_{nom}$ | **[mm]** | 110,8 | 130,8 | 164,0 | 218,5 |
| | **Max.** | | **[mm]** | 113,2 | 133,2 | 167,0 | 221,5 |
| **Fixture thickness** | | $t_{fix}$ | **[mm]** | 20 | 20 | 30 | 60 |
| **Length expansion sleeve** | | $l_{clip}$ | **[mm]** | 60.0 | 80,3 | 100,2 | 125,3 |
| **Width torque wrench** | | **SW** | **[mm]** | 19 | 19 | 24 | 24 |

**Table 2: Installation data**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| **Drill hole diameter** | $d_0$ | **[mm]** | ≤ 18,5 | ≤ 18,5 | ≤ 23,0 | ≤ 23,0 |
| **Drill hole depth** | $h_1$ | **[mm]** | 73 | 92 | 108 | 132 |
| **Embedment depth** | $h_{ef}$ | **[mm]** | 60 | 80 | 100 | 125 |
| **Installation torque** | $T_{inst}$ | **[Nm]** | 45 | 45 | 180 | 180 |
| **Diameter of clearance hole in the fixture** | $d_f$ | **[mm]** | 14 | 14 | 18 | 18 |
| | | | | | | |
| **Min. member thickness** | $h_{min}$ | **[mm]** | 140 | 160 | 200 | 250 |
| | | | | | | |
| **Minimum edge distance** | $c_{min}$ | **[mm]** | 350 | 120 | 150 | 200 |
| **Minimum spacing** | $s_{min}$ | **[mm]** | 400 | 120 | 300 | 200 |

**Table 3: Characteristic values for tension loads in case of static and quasi static loading**

| | | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | |
| Char. resistance | | $N_{Rk,s}$ | [kN] | 53,9 | | 100,5 | |
| Partial factor for steel failure | | $\gamma_{Ms}$ [1)] | [-] | 1,25 | | | |
| **Pullout failure** $N_{Rk,p} = \Psi_c \times N^0_{Rk,p}$ | | | | | | | |
| Char. resistance in concrete C20/25 | cracked | $N^0_{Rk,p}$ | [kN] | Pull-Out not decisive | | | |
| | uncracked | $N^0_{Rk,p}$ | [kN] | Pull-Out not decisive | | 46,0 | |
| Partial safety factor for cracked or uncracked concrete | | $\gamma_{inst}$ | [-] | 1,2 | | 1,0 | |
| Increasing factor for $N^0_{Rk,p}$ | concrete C30/37 | $\Psi_c$ | [-] | 1,17 | | | |
| | concrete C40/50 | | [-] | 1,30 | | | |
| | concrete C50/60 | | [-] | 1,41 | | | |
| **Concrete cone failure and splitting failure** | | | | | | | |
| Effective embedment depth | | $h_{ef}$ | [mm] | 60 | 80 | 100 | 125 |
| Factor for cracked concrete | | $k_{cr}$ | [-] | 7,7 | | | |
| Factor for uncracked concrete | | $k_{ucr}$ | [-] | 11,0 | | | |
| Partial safety factor for cracked or uncracked concrete | | $\gamma_{inst}$ | [-] | 1,2 | | 1,0 | |
| Char. spacing | concrete cone failure | $s_{cr,N}$ | [mm] | 3 $h_{ef}$ | | | |
| | splitting failure | $s_{cr,sp}$ | [mm] | 420 | 400 | 350 | 340 |
| Char. edge distance | concrete cone failure | $c_{cr,N}$ | [mm] | 1,5 $h_{ef}$ | | | |
| | splitting failure | $c_{cr,sp}$ | [mm] | 210 | 200 | 175 | 170 |

[1)] In absence of other national regulations

**WBAT-PF WALRAVEN UNDERCUT ANCHOR**

**Design according to EN 1992-4**
Characteristic resistance under tension loads

**Annex C1**

**Table 4: Characteristic values for shear loads in case of static and quasi static loading**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | |
| Char. resistance | $V_{Rk,s}$ | [kN] | 28,6 | | 69,0 | |
| Factor considering ductility | $k_7$ | [-] | 0,8 | | | |
| Partial factor for steel failure | $\gamma_{Ms}$ [1)] | [-] | 1,25 | | | |
| **Steel failure with lever arm** | | | | | | |
| Char. bending moment | $M^0_{Rk,s}$ | [N.m] | 104,8 | | 266,4 | |
| Partial factor for steel failure | $\gamma_{Ms}$ [1)] | [-] | 1,25 | | | |
| **Concrete pry-out failure** | | | | | | |
| Factor in Eq. 7.39 of EN 1992-4 | $k_8$ | [-] | 2,0 | 2,0 | 2,0 | 2,0 |
| Factor installation of post-installed fastener | $\gamma_{inst}$ | [-] | 1,2 | | 1,0 | |
| **Concrete edge failure** | | | | | | |
| Effective length of anchor under shear loading | $l_f$ | [mm] | 60 | 80 | 100 | 125 |
| Outside diameter of anchor | $d_{nom}$ | [mm] | 17,5 | 17,5 | 21,5 | 21,5 |
| Factor installation of post-installed fastener | $\gamma_{inst}$ | [-] | 1,2 | | | |

[1)] In absence of other national regulations

**Table 5: Characteristic tension resistance in cracked and uncracked concrete under fire exposure**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | |
| Characteristic resistance[1)] | R30 $N_{Rk,s,fi}$ | [kN] | 1,7 | 1,7 | 3,1 | 3,1 |
| | R60 $N_{Rk,s,fi}$ | [kN] | 1,3 | 1,3 | 2,4 | 2,4 |
| | R90 $N_{Rk,s,fi}$ | [kN] | 1,1 | 1,1 | 2,0 | 2,0 |
| | R120 $N_{Rk,s,fi}$ | [kN] | 0,8 | 0,8 | 1,6 | 1,6 |
| **Pullout failure (cracked and uncracked concrete)** | | | | | | |
| Char. resistance in concrete ≥ C20/25[1)] | $N_{Rk,p,fi(90)}$ | [kN] | 6,0 | 9,2 | 14,7 | 12,2 |
| | $N_{Rk,p,fi(120)}$ | [kN] | 4,8 | 7,4 | 11,8 | 9,8 |
| **Concrete cone and splitting failure[2)] (cracked and uncracked concrete)** | | | | | | |
| Char. resistance in concrete ≥ C20/25 | $N^0_{Rk,c,fi(90)}$ | [kN] | 7,2 | 14,2 | 27,1 | 39,4 |
| | $N^0_{Rk,c,fi(120)}$ | [kN] | 5,8 | 11,3 | 21,7 | 31,5 |
| Characteristic spacing | $s_{cr,N}$ | [mm] | 240 | 320 | 400 | 500 |
| Characteristic edge distance | $c_{cr,N}$ | [mm] | 120 | 160 | 200 | 250 |

1) Design under fire exposure is performed according to the design method given in EN 1992-4. Under fire exposure usually cracked concrete is assumed. The design equations are given in EN 1992-4, Anexe D.

2) As a rule, splitting failure can be neglected when cracked concrete and reinforcement is assumed.

EN 1992-4 covers design for fire exposure from one side. For fire attack from more than one side the edge distance must be increased to $c_{min} \geq 300$ mm and $\geq 2 \cdot h_{ef}$.

**Table 6: Characteristic shear resistance in cracked and uncracked concrete under fire exposure**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | |
| Characteristic resistance[1)] | R30 $V_{Rk,s,fi}$ | [kN] | 1,69 | 1,69 | 3,14 | 3,14 |
| | R60 $V_{Rk,s,fi}$ | [kN] | 1,26 | 1,26 | 2,36 | 2,36 |
| | R90 $V_{Rk,s,fi}$ | [kN] | 1,10 | 1,10 | 2,04 | 2,04 |
| | R120 $V_{Rk,s,fi}$ | [kN] | 0,84 | 0,84 | 1,57 | 1,57 |
| **Steel failure with lever arm** | | | | | | |
| Characteristic bending moment[1)] | R30 $M^0_{Rk,s,fi}$ | [Nm] | 2,6 | 2,6 | 6,7 | 6,7 |
| | R60 $M^0_{Rk,s,fi}$ | [Nm] | 1,9 | 1,9 | 5,0 | 5,0 |
| | R90 $M^0_{Rk,s,fi}$ | [Nm] | 1,7 | 1,7 | 4,3 | 4,3 |
| | R120 $M^0_{Rk,s,fi}$ | [Nm] | 1,3 | 1,3 | 3,3 | 3,3 |
| **Concrete pry-out failure** | | | | | | |
| Factor in Eq. 7.39 of EN 1992-4 | $k_8$ | [-] | 2,0 | 2,0 | 2,0 | 2,0 |
| Characteristic resistance | R90 $V_{Rk,\,cp,fi}$ | [kN] | 1,4 | 28,3 | 54,2 | 78,7 |
| | R120 $V_{Rk,\,cp,fi}$ | [kN] | 11,5 | 22,7 | 43,4 | 63,1 |
| **Concrete edge failure** | | | | | | |
| Eff. length of anchor under shear loading | $l_f$ | [mm] | 60 | 80 | 100 | 125 |
| Outside diameter of anchor | $d_{nom}$ | [mm] | 17,5 | 17,5 | 21,5 | 21,5 |

[1)] Design under fire exposure is performed according to the design method given in EN 1992-4. Under fire exposure usually cracked concrete is assumed. The design equations are given in EN 1992-4, Anexe D.

EN 1992-4 covers design for fire exposure from one side. For fire attack from more than one side the edge distance must be increased to $c_{min} \geq 300$ mm and $\geq 2 \cdot h_{ef}$.

**Table 7: Characteristic values of resistance under tension load in case os seismic category C1**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| Effective embedment depth | $h_{ef}$ | [mm] | 60 | 80 | 100 | 125 |
| **Steel failure** | | | | | | |
| Characteristic resistance | $N_{Rk,s,\ seis}$ | [kN] | 53,9 | | 100,5 | |
| Partial safety factor | $\gamma_{Ms,seis}$ [1)] | [-] | 1,25 | | | |
| **Pullout failure** | | | | | | |
| Characteristic resistance | $N_{Rk,p,\ seis}$ | [kN] | 16,0 | | 46,0 | |
| Installation safety factor | $\gamma_{inst}$ | [-] | 1,2 | | 1,0 | |

[1)] In absence of other national regulations

**Table 8: Characteristic values of resistance under shear load in case os seismic category C1**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| Effective embedment depth | $h_{ef}$ | [mm] | 60 | 80 | 100 | 125 |
| **Steel failure without lever arm** | | | | | | |
| Characteristic resistance | $V_{Rk,s,\ seis}$ | [kN] | 26,62 | | 63,73 | |
| Partial safety factor | $\gamma_{Ms,seis}$ [1)] | [-] | 1,25 | | | |

[1)] In absence of other national regulations

**Table 9: Displacements under tension loading**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| **Tension load in uncracked concrete C20/25 to C50/60** | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,1 | 0,1 | 0,1 | 0,2 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,4 | 0,4 | 1,1 | 1,1 |
| **Tension load in cracked concrete C20/25 to C50/60** | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,3 | 0,5 | 0,5 | 0,8 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 1,2 | 1,2 | 1,1 | 1,1 |

**Table 10: Displacements under shear loads**

| | | | WBAT-PF-M12x60 | WBAT-PF-M12x80 | WBAT-PF-M16x100 | WBAT-PF-M16x125 |
|---|---|---|---|---|---|---|
| **Shear load in cracked and uncracked concrete C20/25 to C50/60** | | | | | | |
| Displacement | $\delta_{V0}$ | [mm/(N/mm²)] | 4,7 | | 7,1 | |
| | $\delta_{V\infty}$ | [mm/(N/mm²)] | 5,1 | | 7,6 | |