


Company:
 Address:
 Phone | Fax: |
 Design: Concrete - 8 Jul 2022 (3)
 Fastening Point:

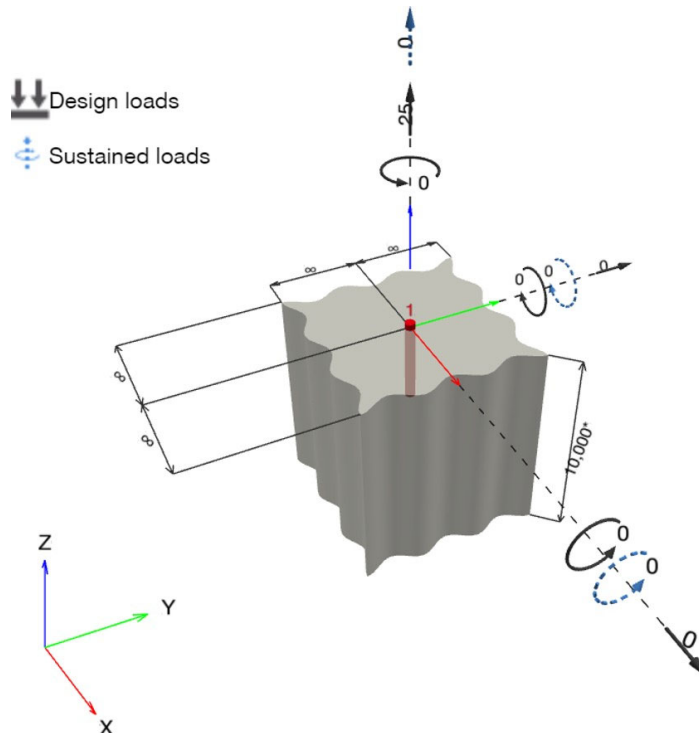
Page: 1
 Specifier:
 E-Mail:
 Date: 08/07/2022

Specifier's comments:

1 Input data

| | | |
|--|---|---|
| Anchor type and size: | HVU2 + HAS-U 5.8 M16_hef1 |  |
| Return period (service life in years): | 50 | |
| Item number: | 2223829 HAS-U 5.8 M16x165 (insert) / 2164508 HVU2 M16x125 (capsule) | |
| Effective embedment depth: | $h_{ef,act} = 125.0$ mm, $h_{nom} = 125.0$ mm | |
| Material: | 5.8 | |
| Approval No.: | ETA-16/0515 | |
| Issued Valid: | 13/11/2019 - | |
| Proof: | Design Method EN 1992-4, Chemical | |
| Stand-off installation: | | |
| Profile: | | |
| Base material: | cracked concrete, C20/25, $f_{c,cyl} = 20.00$ N/mm ² ; h = 10,000.0 mm, Temp. short/long: 0/0 °C, User-defined partial material safety factor $\psi_c = 1.500$ | |
| Installation: | hammer drilled hole, Installation condition: Dry | |
| Reinforcement: | No reinforcement or Reinforcement spacing ≥ 150 mm (any \emptyset) or ≥ 100 mm ($\emptyset \leq 10$ mm) no longitudinal edge reinforcement | |

Geometry [mm] & Loading [kN, kNm]





| | | | |
|------------------|---------------------------|------------|------------|
| Company: | | Page: | 2 |
| Address: | | Specifier: | |
| Phone Fax: | | E-Mail: | |
| Design: | Concrete - 8 Jul 2022 (3) | Date: | 08/07/2022 |
| Fastening Point: | | | |

1.1 Load combination

| Case | Description | Forces [kN] / Moments [kNm] | Seismic | Fire | Max. Util. Anchor [%] |
|------|---------------|---|---------|------|-----------------------|
| 1 | Combination 1 | N = 25.000; V _x = 0.000; V _y = 0.000; M _x = 0.000; M _y = 0.000; M _z = 0.000; N _{sus} = 0.000; M _{x,sus} = 0.000; M _{y,sus} = 0.000; | no | no | 78 |

2 Load case/Resulting anchor forces

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|--------|---------------|-------------|---------------|---------------|
| 1 | 25.000 | 0.000 | 0.000 | 0.000 |

max. concrete compressive strain: - [%]
max. concrete compressive stress: - [N/mm²]
resulting tension force in (x/y)=(0.0/0.0): 0.000 [kN]
resulting compression force in (x/y)=(0.0/0.0): 0.000 [kN]



| | | | |
|------------------|---------------------------|------------|------------|
| Company: | | Page: | 3 |
| Address: | | Specifier: | |
| Phone Fax: | | E-Mail: | |
| Design: | Concrete - 8 Jul 2022 (3) | Date: | 08/07/2022 |
| Fastening Point: | | | |

3 Tension load (EN 1992-4, Section 7.2.1)

| | Load [kN] | Capacity [kN] | Utilization b_N [%] | Status |
|--|-----------|---------------|-----------------------|--------|
| Steel failure* | 25.000 | 52.333 | 48 | OK |
| Combined pullout-concrete cone failure** | 25.000 | 35.605 | 71 | OK |
| Concrete Breakout failure** | 25.000 | 32.083 | 78 | OK |
| Splitting failure** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (anchors in tension)

3.1 Steel failure

$$N_{Ed} \leq N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}} \quad \text{EN 1992-4, Table 7.1}$$

| $N_{Rk,s}$ [kN] | $\gamma_{M,s}$ | $N_{Rd,s}$ [kN] | N_{Ed} [kN] |
|-----------------|----------------|-----------------|---------------|
| 78.500 | 1.500 | 52.333 | 25.000 |

Company:
 Address:
 Phone | Fax:
 Design: Concrete - 8 Jul 2022 (3)
 Fastening Point:

Page: 4
 Specifier:
 E-Mail:
 Date: 08/07/2022

3.2 Combined pullout-concrete cone failure

$$N_{Ed} \setminus N_{Rd,p} = \frac{N_{Rk,p}}{\psi_{M,p}} \quad \text{EN 1992-4, Table 7.1}$$

$$N_{Rk,p} = N_{Rk,p}^0 \cdot \frac{A_{p,N}}{A_{p,N}^0} \cdot \beta_{g,Np} \cdot \beta_{s,Np} \cdot \beta_{re,N} \cdot \beta_{ec1,Np} \cdot \beta_{ec2,Np} \quad \text{EN 1992-4, Eq. (7.13)}$$

$$N_{Rk,p}^0 = \beta_{sus} \cdot T_{Rk} \cdot v \cdot d \cdot h_{ef} \quad \text{EN 1992-4, Eq. (7.14)}$$

$$\beta_{sus} = 1 \quad \text{EN 1992-4, Eq. (7.14a)}$$

$$S_{cr,Np} = 7.3 \cdot d \cdot \sqrt{\beta_{sus} \cdot T_{Rk}} \cdot 3 \cdot h_{ef} \quad \text{EN 1992-4, Eq. (7.15)}$$

$$\beta_{g,Np} = \beta_{g,Np} - \left(\frac{S_{cr,Np}}{S} \right)^{0.5} \cdot (\beta_{g,Np}^0 - 1) \geq 1.00 \quad \text{EN 1992-4, Eq. (7.17)}$$

$$\beta_{g,Np}^0 = \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{T_{Rk}}{T_{Rk,c}} \right) \geq 1.00 \quad \text{EN 1992-4, Eq. (7.18)}$$

$$T_{Rk,c} = \frac{k_3 \cdot \sqrt{h_{ef}} \cdot f_{ck}}{v \cdot d} \quad \text{EN 1992-4, Eq. (7.19)}$$

$$\beta_{s,Np} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \geq 1.00 \quad \text{EN 1992-4, Eq. (7.20)}$$

$$\beta_{ec1,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{S_{cr,Np}} \right)} \geq 1.00 \quad \text{EN 1992-4, Eq. (7.21)}$$

$$\beta_{ec2,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{S_{cr,Np}} \right)} \geq 1.00 \quad \text{EN 1992-4, Eq. (7.21)}$$

| $A_{p,N}$ [mm ²] | $A_{p,N}^0$ [mm ²] | $T_{Rk,ucr,20}$ [N/mm ²] | $S_{cr,Np}$ [mm] | $c_{cr,Np}$ [mm] | c_{min} [mm] | $f_{c,cyl}$ [N/mm ²] |
|------------------------------|----------------------------------|--------------------------------------|---------------------------------|------------------|-----------------|----------------------------------|
| 140,625 | 140,625 | 16.00 | 375.0 | 187.5 | ∞ | 20.00 |
| β_c | $T_{Rk,cr}$ [N/mm ²] | k_3 | $T_{Rk,c}$ [N/mm ²] | $\beta_{g,Np}^0$ | $\beta_{g,Np}$ | |
| 1.000 | 8.50 | 7.700 | 7.66 | 1.000 | 1.000 | |
| $e_{c1,N}$ [mm] | $\beta_{ec1,Np}$ | $e_{c2,N}$ [mm] | $\beta_{ec2,Np}$ | $\beta_{s,Np}$ | $\beta_{re,Np}$ | |
| 0.0 | 1.000 | 0.0 | 1.000 | 1.000 | 1.000 | |
| β_{sus}^0 | α_{sus} | β_{sus} | | | | |
| 1.000 | 0.000 | 1.000 | | | | |
| $N_{Rk,p}^0$ [kN] | $N_{Rk,p}$ [kN] | $\psi_{M,p}$ | $N_{Rd,p}$ [kN] | N_{Ed} [kN] | | |
| 53.407 | 53.407 | 1.500 | 35.605 | 25.000 | | |

Group anchor ID

1

Company:
 Address:
 Phone | Fax:
 Design: Concrete - 8 Jul 2022 (3)
 Fastening Point:

Page: 5
 Specifier:
 E-Mail:
 Date: 08/07/2022

3.3 Concrete Breakout failure

$$N_{Ed} \leq N_{Rd,c} = \frac{N_{Rk,c}}{\psi_{M,c}} \quad \text{EN 1992-4, Table 7.1}$$

$$N_{Rk,c} = N_{Rk,c}^0 \cdot \frac{A_{c,N}^0}{A_{c,N}^0} \cdot \frac{s_{cr,N}}{s_{cr,N}} \cdot \frac{e_{c1,N}}{e_{c1,N}} \cdot \frac{e_{c2,N}}{e_{c2,N}} \cdot \frac{M,N}{M,N} \quad \text{EN 1992-4, Eq. (7.1)}$$

$$N_{Rk,c}^0 = k_1 \cdot \sqrt{f_{c,cyl}} \cdot h_{ef}^{1.5} \quad \text{EN 1992-4, Eq. (7.2)}$$

$$A_{c,N}^0 = s_{cr,N} \cdot s_{cr,N} \quad \text{EN 1992-4, Eq. (7.3)}$$

$$\frac{s_{cr,N}}{s_{cr,N}} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00 \quad \text{EN 1992-4, Eq. (7.4)}$$

$$\frac{e_{c1,N}}{e_{c1,N}} = \frac{1}{1 + \left(\frac{2 \cdot e_{N1}}{s_{cr,N}} \right)} \leq 1.00 \quad \text{EN 1992-4, Eq. (7.6)}$$

$$\frac{e_{c2,N}}{e_{c2,N}} = \frac{1}{1 + \left(\frac{2 \cdot e_{N2}}{s_{cr,N}} \right)} \leq 1.00 \quad \text{EN 1992-4, Eq. (7.6)}$$

$$\frac{M,N}{M,N} = 1 \quad \text{EN 1992-4, Eq. (7.7)}$$

| $A_{c,N}$ [mm ²] | $A_{c,N}^0$ [mm ²] | $c_{cr,N}$ [mm] | $s_{cr,N}$ [mm] | $f_{c,cyl}$ [N/mm ²] | | |
|------------------------------|--------------------------------|-----------------|-------------------|----------------------------------|-----------------|---------------|
| 140,625 | 140,625 | 187.5 | 375.0 | 20.00 | | |
| $e_{c1,N}$ [mm] | $e_{c1,N}$ | $e_{c2,N}$ [mm] | $e_{c2,N}$ | $s_{cr,N}$ | $e_{re,N}$ | |
| 0.0 | 1.000 | 0.0 | 1.000 | 1.000 | 1.000 | |
| z [mm] | M,N | k_1 | $N_{Rk,c}^0$ [kN] | $\psi_{M,c}$ | $N_{Rd,c}$ [kN] | N_{Ed} [kN] |
| 0.0 | 1.000 | 7.700 | 48.125 | 1.500 | 32.083 | 25.000 |

Group anchor ID

1

| | | | |
|------------------|---------------------------|------------|------------|
| Company: | | Page: | 6 |
| Address: | | Specifier: | |
| Phone Fax: | | E-Mail: | |
| Design: | Concrete - 8 Jul 2022 (3) | Date: | 08/07/2022 |
| Fastening Point: | | | |

4 Shear load (EN 1992-4, Section 7.2.2)

| | Load [kN] | Capacity [kN] | Utilization b_v [%] | Status |
|---------------------------------------|-----------|---------------|-----------------------|--------|
| Steel failure (without lever arm)* | N/A | N/A | N/A | N/A |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout failure* | N/A | N/A | N/A | N/A |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (relevant anchors)

5 Displacements (highest loaded anchor)

Short term loading:

$$\begin{aligned}
 N_{Sk} &= 18.519 \text{ [kN]} & \delta_N &= 0.2947 \text{ [mm]} \\
 V_{Sk} &= 0.000 \text{ [kN]} & \delta_V &= 0.0000 \text{ [mm]} \\
 & & \delta_{NV} &= 0.2947 \text{ [mm]}
 \end{aligned}$$

Long term loading:

$$\begin{aligned}
 N_{Sk} &= 18.519 \text{ [kN]} & \delta_N &= 0.4126 \text{ [mm]} \\
 V_{Sk} &= 0.000 \text{ [kN]} & \delta_V &= 0.0000 \text{ [mm]} \\
 & & \delta_{NV} &= 0.4126 \text{ [mm]}
 \end{aligned}$$

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid baseplates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the baseplate are not considered - the baseplate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required baseplate thickness with CBFEM to limit the stress of the baseplate based on the assumptions explained above. The proof if the rigid baseplate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Checking the transfer of loads into the base material is required in accordance with EN 1992-4, Annex A!
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 6.1 of EN 1992-4! For larger diameters of the clearance hole see section 6.2.2 of EN 1992-4!
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- For the determination of the $\delta_{re,v}$ (concrete edge failure) the minimum concrete cover defined in the design settings is used as the concrete cover of the edge reinforcement.
- Drilled hole cleaning must be performed according to instructions for use (blow twice with oil-free compressed air (min. 6 bar), brush twice, blow twice with oil-free compressed air (min. 6 bar)).
- Characteristic bond resistances depend on short- and long-term temperatures.
- Edge reinforcement is not required to avoid splitting failure
- The characteristic bond resistances depend on the return period (service life in years): 50



| | | | |
|------------------|---------------------------|------------|------------|
| Company: | | Page: | 7 |
| Address: | | Specifier: | |
| Phone Fax: | | E-Mail: | |
| Design: | Concrete - 8 Jul 2022 (3) | Date: | 08/07/2022 |
| Fastening Point: | | | |

Fastening meets the design criteria!



| | | | |
|------------------|---------------------------|------------|------------|
| Company: | | Page: | 8 |
| Address: | | Specifier: | |
| Phone Fax: | | E-Mail: | |
| Design: | Concrete - 8 Jul 2022 (3) | Date: | 08/07/2022 |
| Fastening Point: | | | |

7 Installation data

| | |
|---|--|
| Baseplate, steel: - | Anchor type and size: HVU2 + HAS-U 5.8 M16_hef1 |
| Profile: - | Item number: 2223829 HAS-U 5.8 M16x165 (insert) / 2164508 HVU2 M16x125 (capsule) |
| Hole diameter in the fixture: - | Maximum installation torque: 80 Nm |
| Plate thickness (input): - | Hole diameter in the base material: 18.0 mm |
| | Hole depth in the base material: 125.0 mm |
| Drilling method: Hammer drilled | Minimum thickness of the base material: 160.0 mm |
| Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required | |

Hilti HAS-U threaded rod with HVU2 capsule mortar with 125 mm embedment h_ef, M16_hef1, Steel galvanized, Hammer drilling installation per ETA-16/0515

7.1 Recommended accessories

| Drilling | Cleaning | Setting |
|--|--|--|
| <ul style="list-style-type: none"> Suitable Rotary Hammer Properly sized drill bit | <ul style="list-style-type: none"> Compressed air with required accessories to blow from the bottom of the hole Proper diameter wire brush | <ul style="list-style-type: none"> HVA square drive shafts Torque wrench |

Coordinates Anchor [mm]

| Anchor | x | y | C _{-x} | C _{+x} | C _{-y} | C _{+y} |
|--------|-----|-----|-----------------|-----------------|-----------------|-----------------|
| 1 | 0.0 | 0.0 | - | - | - | - |



| | | | |
|------------------|---------------------------|------------|------------|
| Company: | | Page: | 9 |
| Address: | | Specifier: | |
| Phone Fax: | | E-Mail: | |
| Design: | Concrete - 8 Jul 2022 (3) | Date: | 08/07/2022 |
| Fastening Point: | | | |

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.