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Phone   Fax:		E-Mail:	
Design:	ST103 Dia. Strut to Capping Beam Connection Detail	Date:	10/12/2024
Fastening point:			

**Specifier's comments:**

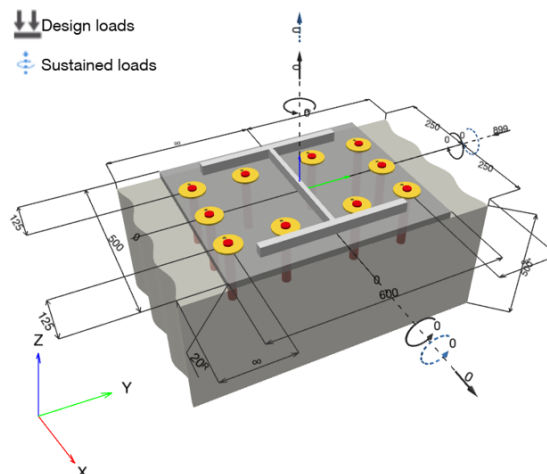
**1 Input data**



<b>Anchor type and diameter:</b>	<b>HIT-RE 500 V4 + HAS-U 8.8 M24</b>
Return period (service life in years):	50
Item number:	2223889 HAS-U 8.8 M24x300 (element) / 2287553 HIT-RE 500 V4 (adhesive)
<b>Filling set or any suitable annular gap filling solution</b>	
Specification text:	Hilti HAS-U 8.8 threaded rod with HIT-RE 500 V4 injection mortar with 150 mm embedment hef, M24, Steel galvanized, Hammer drilled installation per ETA 20/0541, with annular gaps filled with Hilti Filling set or any suitable gap solutions
Effective embedment depth:	$h_{ef,act} = 150.0$ mm ( $h_{ef,limit} = -$ mm)
Material:	8.8
Evaluation Service Report:	ETA 20/0541
Issued   Valid:	09/06/2023   -
Proof:	SOFA based on EN 1992-4, Chemical
Stand-off installation:	$e_b = 0.0$ mm (no stand-off); $t = 20.0$ mm
Anchor plate <sup>R</sup> :	$l_x \times l_y \times t = 500.0$ mm x $600.0$ mm x $20.0$ mm; (Recommended plate thickness: not calculated)
Profile:	HD, ; (L x W x T x FT) = $400.0$ mm x $400.0$ mm x $13.0$ mm x $21.0$ mm
Base material:	cracked concrete, C32/40, $f_{c,cyl} = 32.00$ N/mm <sup>2</sup> ; $h = 500.0$ mm, Temp. short/long: 30/30 °C, User-defined partial material safety factor $\gamma_c = 1.500$
<b>Installation:</b>	<b>Hammer drilled hole, Installation condition: Dry</b>
Reinforcement:	no reinforcement or reinforcement spacing $\geq 150$ mm (any $\emptyset$ ) or $\geq 100$ mm ( $\emptyset \leq 10$ mm) no longitudinal edge reinforcement

<sup>R</sup> - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [mm] & Loading [kN, kNm]**



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**1.1 Load combination**

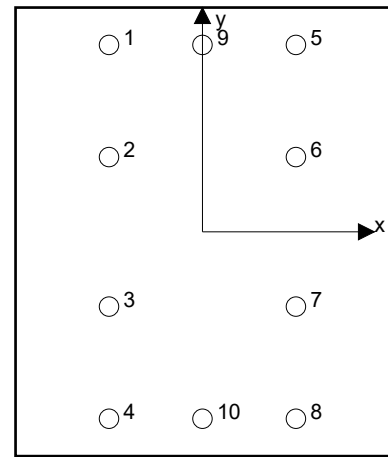
Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Strut Force	N = 0.000; V <sub>x</sub> = 0.000; V <sub>y</sub> = -899.000; M <sub>x</sub> = 0.000; M <sub>y</sub> = 0.000; M <sub>z</sub> = 0.000; N <sub>sus</sub> = 0.000; M <sub>x,sus</sub> = 0.000; M <sub>y,sus</sub> = 0.000;	no	no	424

**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	0.000	89.900	0.000	-89.900
2	0.000	89.900	0.000	-89.900
3	0.000	89.900	0.000	-89.900
4	0.000	89.900	0.000	-89.900
5	0.000	89.900	0.000	-89.900
6	0.000	89.900	0.000	-89.900
7	0.000	89.900	0.000	-89.900
8	0.000	89.900	0.000	-89.900
9	0.000	89.900	0.000	-89.900
10	0.000	89.900	0.000	-89.900



Max. concrete compressive strain: - [%]  
 Max. concrete compressive stress: - [N/mm<sup>2</sup>]  
 Resulting tension force in (x/y)=(-/-): 0.000 [kN]  
 Resulting compression force in (x/y)=(-/-): 0.000 [kN]

Anchor forces are calculated based on the assumption of a rigid anchor plate.



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### 3 Tension load EN 1992-4, Section 7.2.1

	Load [kN]	Capacity [kN]	Utilization $\beta_N$ [%]	Status
Steel Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A
Splitting failure**	N/A	N/A	N/A	N/A

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

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## 4 Shear load EN 1992-4, Section 7.2.2

	Load [kN]	Capacity [kN]	Utilization $\beta_V$ [%]	Status
Steel Strength (without lever arm)*	89.900	112.960	80	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	899.000	216.901	415	not recommended
Concrete edge failure in direction x-**	359.600	84.905	424	not recommended

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

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

### 4.1 Steel Strength (without lever arm)

$$V_{Ed} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{Ms}} \quad \text{EN 1992-4, Table 7.2}$$

$$V_{Rk,s} = k_7 \cdot V_{Rk,s}^0 \quad \text{EN 1992-4, Eq. (7.35)}$$

$V_{Rk,s}^0$ [kN]	$k_7$	$V_{Rk,s}$ [kN]	$\gamma_{Ms}$	$V_{Rd,s}$ [kN]	$V_{Ed}$ [kN]
141.200	1.000	141.200	1.250	112.960	89.900

### 4.2 Pryout Strength (Concrete Breakout Strength controls)

$$V_{Ed} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{Mc,p}} \quad \text{EN 1992-4, Table 7.2}$$

$$V_{Rk,cp} = k_8 \cdot \min \{N_{Rk,c}; N_{Rk,p}\} \quad \text{EN 1992-4, Eq. (7.39c)}$$

$$N_{Rk,c} = N_{Rk,c}^0 \cdot \frac{A_{c,N}}{A_{c,N}^0} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N} \quad \text{EN 1992-4, Eq. (7.1)}$$

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

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

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

$$\psi_{ec1,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{v,1}}{s_{cr,N}}\right)} \leq 1.00 \quad \text{EN 1992-4, Eq. (7.6)}$$

$$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{v,2}}{s_{cr,N}}\right)} \leq 1.00 \quad \text{EN 1992-4, Eq. (7.6)}$$

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

$A_{c,N}$ [mm <sup>2</sup> ]	$A_{c,N}^0$ [mm <sup>2</sup> ]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	$k_8$	$f_{c,cyl}$ [N/mm <sup>2</sup> ]	
475,000	202,500	225.0	450.0	2.000	32.00	
$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	$\psi_{M,N}$
0.0	1.000	0.0	1.000	0.867	1.000	1.000
$k_1$	$N_{Rk,c}^0$ [kN]	$\gamma_{Mc,p}$	$V_{Rd,cp}$ [kN]	$V_{Ed}$ [kN]		
7.700	80.021	1.500	216.901	899.000		
Group anchor ID						
1-10						

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**4.3 Concrete edge failure in direction x-**

$$V_{Ed} \leq V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{Mc}} \quad \text{EN 1992-4, Table 7.2}$$

$$V_{Rk,c} = k_T \cdot V_{Rk,c}^0 \cdot \frac{A_{c,V}}{A_{c,V}^0} \cdot \Psi_{s,V} \cdot \Psi_{h,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{ec,V} \cdot \Psi_{re,V} \quad \text{EN 1992-4, Eq. (7.40)}$$

$$V_{Rk,c}^0 = k_9 \cdot d_{nom}^\alpha \cdot l_f^\beta \cdot \sqrt{f_{ck}} \cdot c_1^{1.5} \quad \text{EN 1992-4, Eq. (7.41)}$$

$$\alpha = 0.1 \cdot \left( \frac{l_f}{c_1} \right)^{0.5} \quad \text{EN 1992-4, Eq. (7.42)}$$

$$\beta = 0.1 \cdot \left( \frac{d_{nom}}{c_1} \right)^{0.2} \quad \text{EN 1992-4, Eq. (7.43)}$$

$$A_{c,V}^0 = 4.5 \cdot c_1^2 \quad \text{EN 1992-4, Eq. (7.44)}$$

$$\Psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \leq 1.00 \quad \text{EN 1992-4, Eq. (7.45)}$$

$$\Psi_{h,V} = \left( \frac{1.5 \cdot c_1}{h} \right)^{0.5} \geq 1.00 \quad \text{EN 1992-4, Eq. (7.46)}$$

$$\Psi_{ec,V} = \frac{1}{1 + \left( \frac{2 \cdot e_V}{3 \cdot c_1} \right)} \leq 1.00 \quad \text{EN 1992-4, Eq. (7.47)}$$

$$\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}} \geq 1.00 \quad \text{EN 1992-4, Eq. (7.48)}$$

$l_f$ [mm]	$d_{nom}$ [mm]	$k_9$	$\alpha$	$\beta$	$f_{c,cyl}$ [N/mm <sup>2</sup> ]	$c_1$ [mm]
150.0	24.00	1.700	0.110	0.072	32.00	125.0
$A_{c,V}$ [mm <sup>2</sup> ]	$A_{c,V}^0$ [mm <sup>2</sup> ]	$\Psi_{s,V}$	$\Psi_{h,V}$	$e_{c,V}$ [mm]	$\Psi_{ec,V}$	
164,062	70,312	1.000	1.000	0.0	1.000	
$\alpha_V$ [°]	$\Psi_{\alpha,V}$	$\Psi_{re,V}$				
90.00	2.000	1.000				
$V_{Rk,c}^0$ [kN]	$k_T$	$\gamma_{Mc}$	$V_{Rd,c}$ [kN]	$V_{Ed}$ [kN]		
27.291	1.0	1.500	84.905	359.600		

Group anchor ID

1-4

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

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## 5 Displacements (highest loaded anchor)

Short term loading:

$N_{Sk}$	=	0.000 [kN]	$\delta_N$	=	0.0000 [mm]
$V_{Sk}$	=	66.593 [kN]	$\delta_V$	=	1.9978 [mm]
			$\delta_{NV}$	=	1.9978 [mm]

Long term loading:

$N_{Sk}$	=	0.000 [kN]	$\delta_N$	=	0.0000 [mm]
$V_{Sk}$	=	66.593 [kN]	$\delta_V$	=	3.3296 [mm]
			$\delta_{NV}$	=	3.3296 [mm]

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 anchor plate! 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 anchor plates 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 anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate 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  $\psi_{re,v}$  (concrete edge failure) the minimum concrete cover defined in the design settings is used as the concrete cover of the edge reinforcement.
- Please note that this design utilizes user defined material safety factor values that differ from the default values recommended in EN1992-4. Partial Safety factor value:  $\gamma_c = 1.500$
- Characteristic bond resistances depend on short- and long-term temperatures.
- Edge reinforcement is not required to avoid splitting failure
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- The characteristic bond resistances depend on the return period (service life in years): 50

**Fastening does not meet the design criteria!**

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### 7 Installation data

Anchor plate, steel: S 355; E = 210,000.00 N/mm<sup>2</sup>; f<sub>yk</sub> = 355.00 N/mm<sup>2</sup>

Profile: HD, ; (L x W x T x FT) = 400.0 mm x 400.0 mm x 13.0 mm x 21.0 mm

Hole diameter in the fixture: d<sub>f</sub> = 26.0 mm

Plate thickness (input): 20.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-RE 500 V4 + HAS-U 8.8 M24

Item number: 2223889 HAS-U 8.8 M24x300 (element) / 2287553 HIT-RE 500 V4 (adhesive)

Maximum installation torque: 200 Nm

Hole diameter in the base material: 28.0 mm

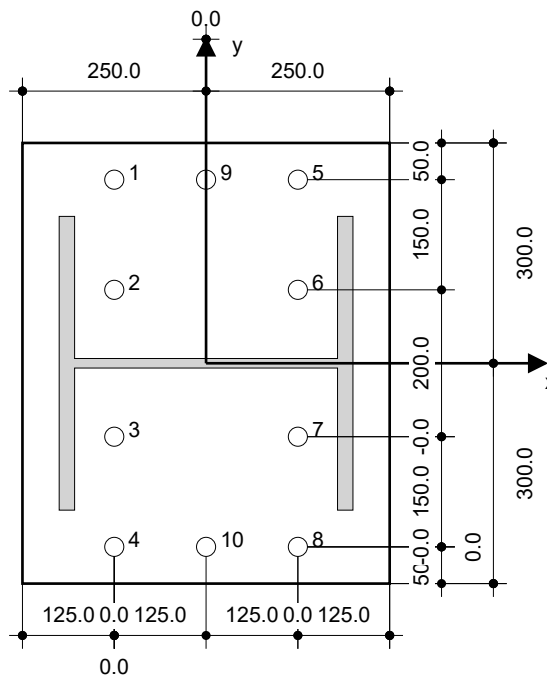
Hole depth in the base material: 150.0 mm

Minimum thickness of the base material: 206.0 mm

Hilti HAS-U 8.8 threaded rod with HIT-RE 500 V4 injection mortar with 150 mm embedment hef, M24, Steel galvanized, Hammer drilled installation per ETA 20/0541, with annular gaps filled with Hilti Filling set or any suitable gap solutions

#### 7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> <li>• Suitable Rotary Hammer</li> <li>• Properly sized drill bit</li> </ul>	<ul style="list-style-type: none"> <li>• Compressed air with required accessories to blow from the bottom of the hole</li> <li>• Proper diameter wire brush</li> </ul>	<ul style="list-style-type: none"> <li>• Dispenser including cassette and mixer</li> <li>• Torque wrench</li> </ul>



Coordinates Anchor [mm]

Anchor	x	y	c <sub>x</sub>	c <sub>+x</sub>	c <sub>-y</sub>	c <sub>+y</sub>	Anchor	x	y	c <sub>x</sub>	c <sub>+x</sub>	c <sub>-y</sub>	c <sub>+y</sub>
1	-125.0	250.0	125.0	375.0	-	-	6	125.0	100.0	375.0	125.0	-	-
2	-125.0	100.0	125.0	375.0	-	-	7	125.0	-100.0	375.0	125.0	-	-
3	-125.0	-100.0	125.0	375.0	-	-	8	125.0	-250.0	375.0	125.0	-	-
4	-125.0	-250.0	125.0	375.0	-	-	9	0.0	250.0	250.0	250.0	-	-
5	125.0	250.0	375.0	125.0	-	-	10	0.0	-250.0	250.0	250.0	-	-

Input data and results must be checked for conformity with the existing conditions and for plausibility!  
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## 8 Remarks; Your Cooperation Duties

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