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1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	$N = 0.000; V_x = 0.000; V_y = -40.000;$ $M_x = 0.000; M_y = 0.000; M_z = 0.000;$	no	no	96
2	Combination 2	$N = 0.000; V_x = 0.000; V_y = 40.000;$ $M_x = 0.000; M_y = 0.000; M_z = 0.000;$	no	no	24

2 Load case/Resulting anchor forces

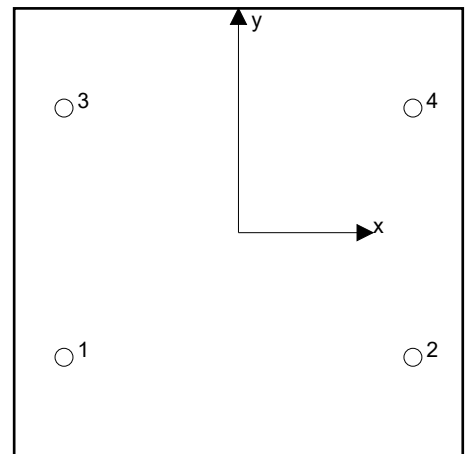
Controlling load case: 1 Combination 1

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	9.917	-0.060	-9.917
2	0.000	10.084	-0.060	-10.083
3	0.000	9.917	0.060	-9.917
4	0.000	10.084	0.060	-10.083

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]



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



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

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel failure*	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 β_v [%]	Status
Steel failure (without lever arm)*	10.084	43.600	24	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	10.084	50.244	21	OK
Concrete edge failure in direction y-**	40.000	41.712	96	OK

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

4.1 Steel failure (without lever arm)

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

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

$V_{Rk,s}^0$ [kN]	k_7	$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Ed} [kN]
54.500	1.000	54.500	1.250	43.600	10.084

4.2 Pryout failure

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

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

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

$$N_{Rk,c}^0 = k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1,5} \quad \text{EN 1992-4, Eq. (7.2)}$$

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

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

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

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

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

$A_{c,N}$ [mm ²]	$A_{c,N}^0$ [mm ²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k_8	$f_{c,cyl}$ [N/mm ²]	
38,025	38,025	97.5	195.0	3.410	30.00	
$e_{c1,v}$ [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	1.000	1.000	1.000
k_1	$N_{Rk,c}^0$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Ed} [kN]		
7.700	22.101	1.500	50.244	10.084		

Group anchor ID

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4.3 Concrete edge failure in direction y-

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

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

$$V_{Rk,c}^0 = k_9 \cdot d_{nom}^\alpha \cdot l_f^\beta \cdot \sqrt{f_{ck}} \cdot c_1^{1,5} \quad \text{EN 1992-4, Eq. (7.41)}$$

$$\alpha = 0.1 \cdot \left(\frac{l_f}{c_1} \right)^{0,5} \quad \text{EN 1992-4, Eq. (7.42)}$$

$$\beta = 0.1 \cdot \left(\frac{d_{nom}}{c_1} \right)^{0,2} \quad \text{EN 1992-4, Eq. (7.43)}$$

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

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

$$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h} \right)^{0,5} \geq 1.00 \quad \text{EN 1992-4, Eq. (7.46)}$$

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

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

l_f [mm]	d_{nom} [mm]	k_9	α	β	$f_{c,cyl}$ [N/mm ²]		
65.0	16.00	1.700	0.046	0.056	30.00		
c_1 [mm]	$A_{c,V}$ [mm ²]	$A_{c,V}^0$ [mm ²]					
300.8	237,956	407,163					
$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$	
1.000	1.541	0.17	1.000	1.5	0.997	1.000	
$V_{Rk,c}^0$ [kN]	k_T	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Ed} [kN]			
69.698	1.0	1.500	41.712	40.000			

5 Displacements (highest loaded anchor)

Short term loading:

$$N_{Sk} = 0.000 \text{ [kN]} \quad \delta_N = 0.0000 \text{ [mm]}$$

$$V_{Sk} = 7.469 \text{ [kN]} \quad \delta_V = 1.0567 \text{ [mm]}$$

$$\delta_{NV} = 1.0567 \text{ [mm]}$$

Long term loading:

$$N_{Sk} = 0.000 \text{ [kN]} \quad \delta_N = 0.0000 \text{ [mm]}$$

$$V_{Sk} = 7.469 \text{ [kN]} \quad \delta_V = 1.5851 \text{ [mm]}$$

$$\delta_{NV} = 1.5851 \text{ [mm]}$$

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 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!

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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 $\psi_{re,v}$ (concrete edge failure) the minimum concrete cover defined in the design settings is used as the concrete cover of the edge reinforcement.
- Load transfer from supplementary reinforcement to the structural member shall be verified by the responsible structural engineer.
- With supplementary reinforcement and post-installed anchors, please ensure that in the jobsite the rebars are not drilled through.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

7 Installation data

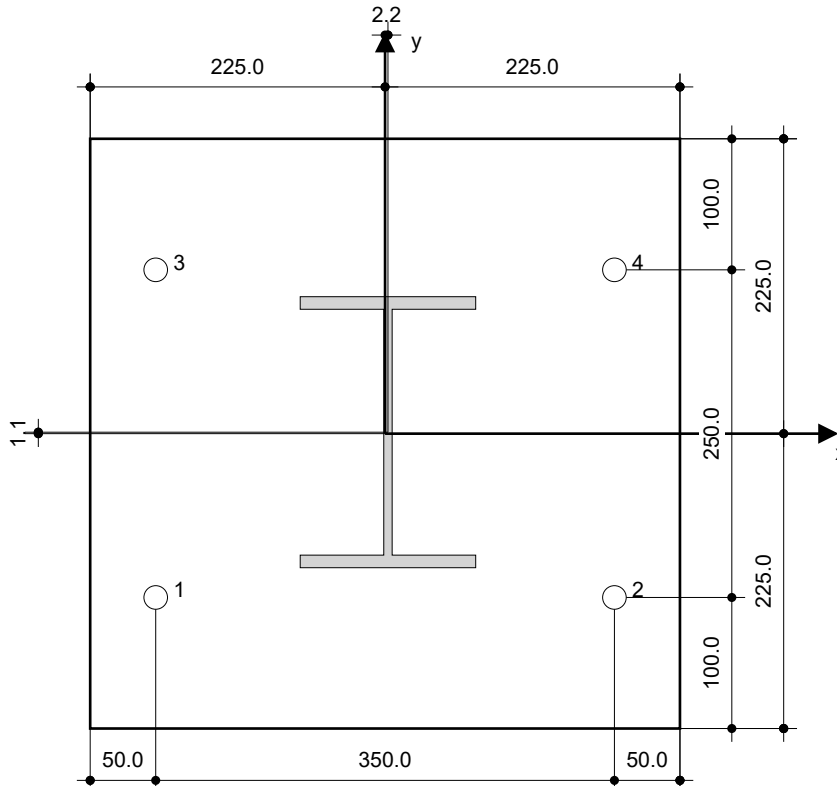
Baseplate, steel: S 235; $E = 210,000.00 \text{ N/mm}^2$; $f_{yk} = 235.00 \text{ N/mm}^2$
 Profile: Advance UKB, 203 x 133 x 30; (L x W x T x FT) = 206.8 mm x 133.9 mm x 6.4 mm x 9.6 mm
 Hole diameter in the fixture: $d_f = 18.0 \text{ mm}$
 Plate thickness (input): 15.0 mm
 Recommended plate thickness: not calculated
 Drilling method: Hammer drilled
 Cleaning: No cleaning of the drilled hole is required

Anchor type and size: HST3 M16 hef1
 Item number: 2114053 HST3 M16x115 15/-
 Maximum installation torque: 110 Nm
 Hole diameter in the base material: 16.0 mm
 Hole depth in the base material: 98.0 mm
 Minimum thickness of the base material: 120.0 mm

Hilti HST3 stud anchor with 65 mm embedment, M16 hef1, Steel galvanized, installation per ETA 98/0001

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"> No accessory required 	<ul style="list-style-type: none"> Hilti SIW 6AT-A22 + SI AT-A22 Torque wrench Hammer



Coordinates Anchor [mm]

Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	-175.0	-125.0	-	-	300.8	-
2	175.0	-125.0	-	-	300.8	-
3	-175.0	125.0	-	-	550.8	-
4	175.0	125.0	-	-	550.8	-







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8 Drilling and installation

HST3 (-R) subject to:

Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling* 	TE2(-A) – TE30(-A)			TE40 – TE70		
Diamond core drilling* 	DD-30W, DD-EC1					
Setting tool* 	Setting tool HS-SC				-	
Hollow drill bit drilling* 	-		TE-CD, TE-YD			
Seismic Set/ Filling Set** 	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-
Impact Wrench and Adaptive Torque Module 	Impact Wrench SIW 6AT-A22 and adaptive torque module SI-AT-A22					-

*Installation methods provided in ETA-98/0001
 **Seismic set needed to fill the annular gap between anchor and fixture:
 No annular gap, double design resistance (agap=1)



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9 Remarks; Your Cooperation Duties

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