Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Veräjämäki katoksen kannakointi	Date:	22.4.2024
Fastening point:			

Specifier's comments:

1 Anchor Design

1.1 Input data

Anchor type and diameter:	**HIT-RE 500 V4 + HAS-U 5.8 M16**
Return period (service life in years):	50
Item number:	2223872 HAS-U 5.8 M16x500 (element) / 2287553 HIT-RE 500 V4 (adhesive)
Gap filling with Hilti Filling Set M16	
Effective embedment depth:	$h_{ef,opti}$ = 320.0 mm ($h_{ef,limit}$ = 320.0 mm)
Material:	5.8
Evaluation Service Report:	ETA 20/0541
Issued I Valid:	9.6.2023 | -
Proof:	Design Method EN 1992-4, Chemical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 15.0 mm
Anchor plate^{CBFEM} :	l_x x l_y x t = 300.0 mm x 160.0 mm x 15.0 mm;
Profile:	IPEa, IPEa 140; (L x W x T x FT) = 137.4 mm x 73.0 mm x 5.6 mm x 5.6 mm
Base material:	cracked concrete, C20/25, $f_{c,cyl}$ = 20.00 N/mm^2; h =5,000.0 mm, Temp. short/long: 40/24 °C, User-defined partial material safety factor γ_c = 1.500
Installation:	**automatic cleaned drilled hole, Installation condition: Dry**
Reinforcement:	no reinforcement or reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm)
	no longitudinal edge reinforcement
	Reinforcement to control splitting acc. to EN 1992-4, 7.2.1.7 (2) b) 2) present
	Supplementary reinforcement for edge y-: Closed stirrup Ø10.0 mm//150.0 mm, $f_{yk,re}$= 500.00 N/mm^2, β = 0%
	Surface reinforcement for edge y-: Ø10.0 mm, $f_{yk,re}$= 500.00 N/mm^2, β = 0%
	Direction of casting: z+
	Tolerance: 3.0 mm

^{CBFEM} - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

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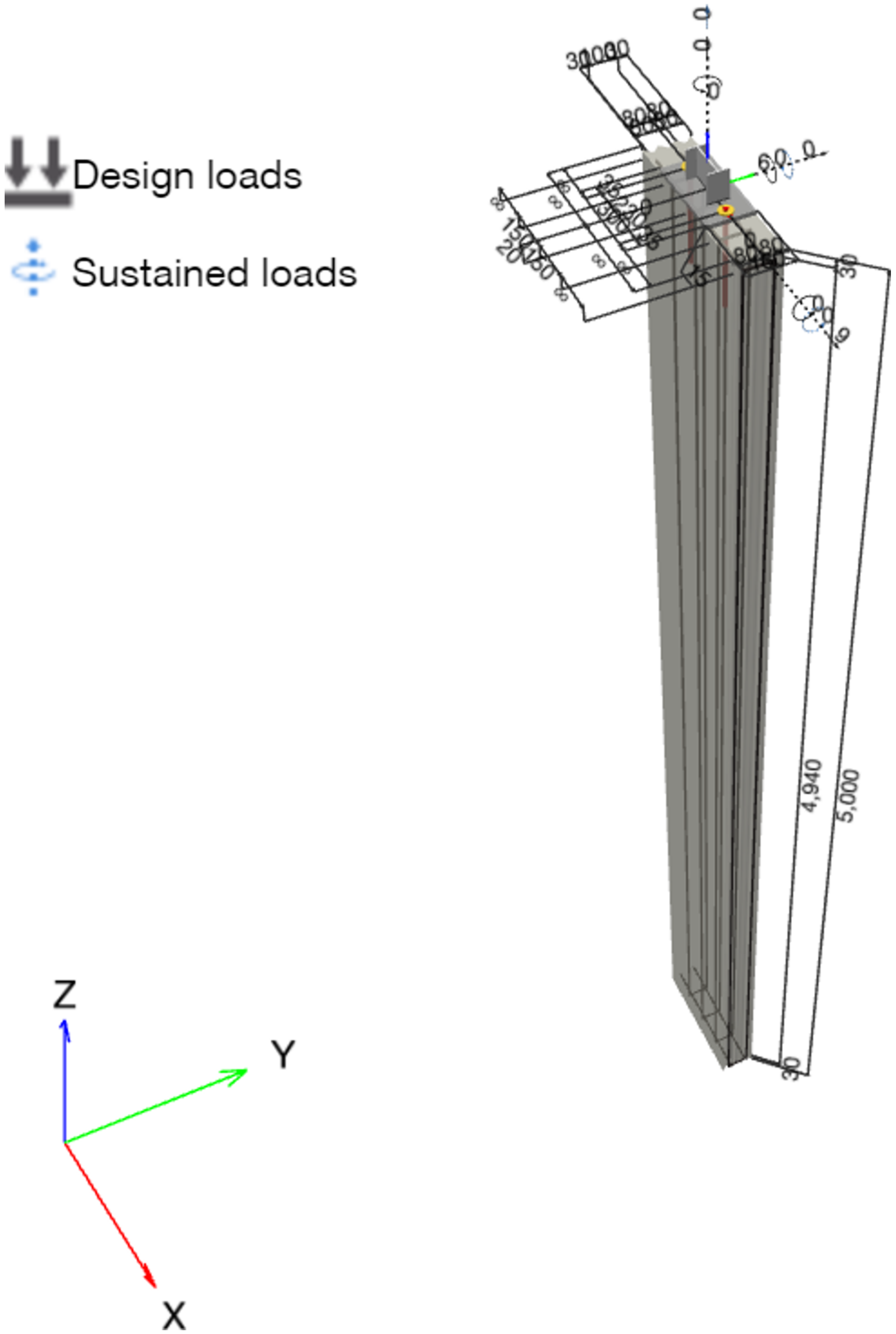
Geometry [mm] & Loading [kN, kNm]



1.1.1 Load combination

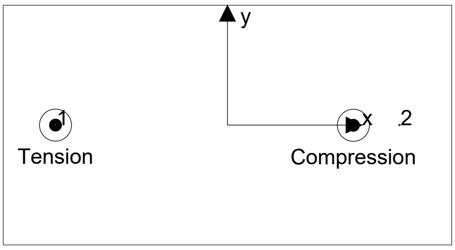
Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Load case: Design loads	$N = 0.000$; $V_x = 9.000$; $V_y = 0.000$; $M_x = 0.000$; $M_y = 6.000$; $M_z = 0.000$; $N_{sus} = 0.000$; $M_{x,sus} = 0.000$; $M_{y,sus} = 0.000$;	no	no	180

1.2 Load case/Resulting anchor forces

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	29.442	4.550	4.550	0.000
2	-0.003	4.450	4.450	-0.000



resulting tension force in (x/y)=(-115.0/0.0): 29.439 [kN]
resulting compression force in (x/y)=(84.2/-0.1): 30.889 [kN]

Anchor forces are calculated based on a component-based Finite Element Method (CBFEM)

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

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	29.442	52.333	57	OK
Combined pullout-concrete cone failure**	29.442	31.339	94	OK
Concrete Breakout Failure**	29.442	16.427	180	not recommended
Splitting failure**	N/A	N/A	N/A	N/A

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

1.3.1 Steel Strength

$N_{Ed} \leq N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$ 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	29.442

1.3.2 Combined pullout-concrete cone failure

$N_{Ed} \leq N_{Rd,p} = \frac{N_{Rk,p}}{\gamma_{M,p}}$	EN 1992-4, Table 7.1
$N_{Rk,p} = N^0_{Rk,p} \cdot \frac{A_{p,N}}{A^0_{p,N}} \cdot \psi_{g,Np} \cdot \psi_{s,Np} \cdot \psi_{re,Np} \cdot \psi_{ec1,Np} \cdot \psi_{ec2,Np}$	EN 1992-4, Eq. (7.13)
$N^0_{Rk,p} = \psi_{sus} \cdot \tau_{Rk} \cdot \pi \cdot d \cdot h_{ef}$	EN 1992-4, Eq. (7.14)
$\psi_{sus} = 1$	EN 1992-4, Eq. (7.14a)
$s_{cr,Np} = 7.3 \cdot d \cdot \sqrt{\psi_{sus} \cdot \tau_{Rk}} \leq 3 \cdot h_{ef}$	EN 1992-4, Eq. (7.15)
$\psi_{g,Np} = \psi^0_{g,Np} - \left(\frac{s}{s_{cr,Np}}\right)^{0,5} \cdot \left(\psi^0_{g,Np} - 1\right) \geq 1.00$	EN 1992-4, Eq. (7.17)
$\psi^0_{g,Np} = \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{\tau_{Rk}}{\tau_{Rk,c}}\right)^{1,5} \geq 1.00$	EN 1992-4, Eq. (7.18)
$\tau_{Rk,c} = \frac{k_3}{\pi \cdot d} \cdot \sqrt{h_{ef} \cdot f_{ck}}$	EN 1992-4, Eq. (7.19)
$\psi_{s,Np} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \leq 1.00$	EN 1992-4, Eq. (7.20)
$\psi_{ec1,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,Np}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.21)
$\psi_{ec2,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,Np}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.21)

$A_{p,N}$ [mm²]	$A^0_{p,N}$ [mm²]	$\tau_{Rk,ucr,20}$ [N/mm²]	$s_{cr,Np}$ [mm]	$c_{cr,Np}$ [mm]	c_{min} [mm]	$f_{c,cyl}$ [N/mm²]
77,053	231,918	17.00	481.6	240.8	80.0	20.00

ψ_c	$\tau_{Rk,cr}$ [N/mm²]	k_3	$\tau_{Rk,c}$ [N/mm²]	$\psi^0_{g,Np}$	$\psi_{g,Np}$
1.000	11.00	7.700	12.25	1.000	1.000

$e_{c1,N}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,N}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$
0.0	1.000	0.0	1.000	0.800	1.000

ψ^0_{sus}	α_{sus}	ψ_{sus}
0.880	0.000	1.000

$N^0_{Rk,p}$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
176.934	47.009	1.500	31.339	29.442

Group anchor ID
1

1.3.3 Concrete Breakout Failure

$N_{Ed} \leq N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{M,c}}$		EN 1992-4, Table 7.1
$N_{Rk,c}$	$= N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$	EN 1992-4, Eq. (7.1)
$N^0_{Rk,c}$	$= k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1,5}$	EN 1992-4, Eq. (7.2)
$A^0_{c,N}$	$= s_{cr,N} \cdot s_{cr,N}$	EN 1992-4, Eq. (7.3)
$\psi_{s,N}$	$= 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00$	EN 1992-4, Eq. (7.4)
$\psi_{ec1,N}$	$= \frac{1}{1 + \left(\frac{2 \cdot e_{N,1}}{s_{cr,N}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.6)
$\psi_{ec2,N}$	$= \frac{1}{1 + \left(\frac{2 \cdot e_{N,2}}{s_{cr,N}}\right)} \leq 1.00$	EN 1992-4, Eq. (7.6)
$\psi_{M,N}$	$= 1$	EN 1992-4, Eq. (7.7)

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	$f_{c,cyl}$ [N/mm^2]
153,600	921,600	480.0	960.0	20.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0.0	1.000	0.0	1.000	0.750	1.000

z [mm]	$\psi_{M,N}$	k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Ed} [kN]
199.2	1.000	7.700	197.120	1.500	16.427	29.442

Group anchor ID
1

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

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	4.550	37.728	13	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	9.000	40.724	23	OK
Concrete edge failure in direction y-**	9.000	25.559	36	OK

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

1.4.1 Steel Strength (without lever arm)

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

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

$V^0_{Rk,s}$ [kN]	k_7	$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Ed} [kN]
47.160	1.000	47.160	1.250	37.728	4.550

1.4.2 Pryout Strength (Concrete Breakout Strength controls)

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

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

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

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

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

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

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

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

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

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k_8	$f_{c,cyl}$ [N/mm²]
190,400	921,600	480.0	960.0	2.000	20.00

$e_{c1,V}$ [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	0.750	1.000	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Ed} [kN]
7.700	197.120	1.500	40.724	9.000

Group anchor ID
1, 2

1.4.3 Concrete edge failure in direction y-

$V_{Ed} \leq V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{M,c}}$	EN 1992-4, Table 7.2
$V_{Rk,c} = k_T \cdot V^0_{Rk,c} \cdot \frac{A_{c,V}}{A^0_{c,V}} \cdot \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{\alpha,V} \cdot \psi_{ec,V} \cdot \psi_{re,V}$	EN 1992-4, Eq. (7.40)
$V^0_{Rk,c} = k_9 \cdot d^{\alpha}_{nom} \cdot l^{\beta}_f \cdot \sqrt{f_{ck}} \cdot c_1^{1,5}$	EN 1992-4, Eq. (7.41)
$\alpha = 0.1 \cdot \left(\frac{l_f}{c_1}\right)^{0,5}$	EN 1992-4, Eq. (7.42)
$\beta = 0.1 \cdot \left(\frac{d_{nom}}{c_1}\right)^{0,2}$	EN 1992-4, Eq. (7.43)
$A^0_{c,V} = 4.5 \cdot c_1^2$	EN 1992-4, Eq. (7.44)
$\psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \leq 1.00$	EN 1992-4, Eq. (7.45)
$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h}\right)^{0,5} \geq 1.00$	EN 1992-4, Eq. (7.46)
$\psi_{ec,V} = \frac{1}{1 + \left(\frac{2 \cdot e_V}{3 \cdot c_1}\right)} \leq 1.00$	EN 1992-4, Eq. (7.47)
$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}} \geq 1.00$	EN 1992-4, Eq. (7.48)

l_f [mm]	d_{nom} [mm]	k_9	α	β	$f_{c,cyl}$ [N/mm^2]
192.0	16.00	1.700	0.155	0.072	20.00

c_1 [mm]	$A_{c,V}$ [mm^2]	$A^0_{c,V}$ [mm^2]
80.0	56,400	28,800

$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1.000	1.000	90.00	2.000	0.0	1.000	1.000

$V^0_{Rk,c}$ [kN]	k_T	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Ed} [kN]
12.236	0.8	1.500	25.559	9.000

1.5 Combined tension and shear loads (EN 1992-4, Section 7.2.3)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.563	0.121	2.000	34	OK

$\beta_N^{\alpha} + \beta_V^{\alpha} \leq 1.0$

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
1.792	0.352	1.000	179	not recommended

$(\beta_N + \beta_V) / 1.2 \leq 1.0$

1.6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates as per current regulations (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 base 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!
- Attention! In case of compressive anchor forces a buckling check as well as the proof of the local load transfer into and within the base material (incl. punching) has to be done separately.
- 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 anchor resistances used for this design are ONLY valid if the Hilti Filling Set will be installed on the jobsite as per IFU when the Seismic washer was selected.
- 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.
- 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
- 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 anchor design methods in PROFIS Engineering require rigid anchor plates, as per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means that the anchor plate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the anchor plate is considered close to rigid by engineering judgment."
- The characteristic bond resistances depend on the return period (service life in years): 50

1.7 Installation data

Anchor plate, steel: S 235; E = 210,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2

Profile: IPEa, IPEa 140; (L x W x T x FT) = 137.4 mm x 73.0 mm x 5.6 mm x 5.6 mm

Hole diameter in the fixture: d_f = - mm

Plate thickness (input): 15.0 mm

Drilling method: SafeSet - automatic cleaning

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 5.8 M16

Item number: 2223872 HAS-U 5.8 M16x500 (element) / 2287553 HIT-RE 500 V4 (adhesive)

Maximum installation torque: 80 Nm

Hole diameter in the base material: 18.0 mm

Hole depth in the base material: 320.0 mm

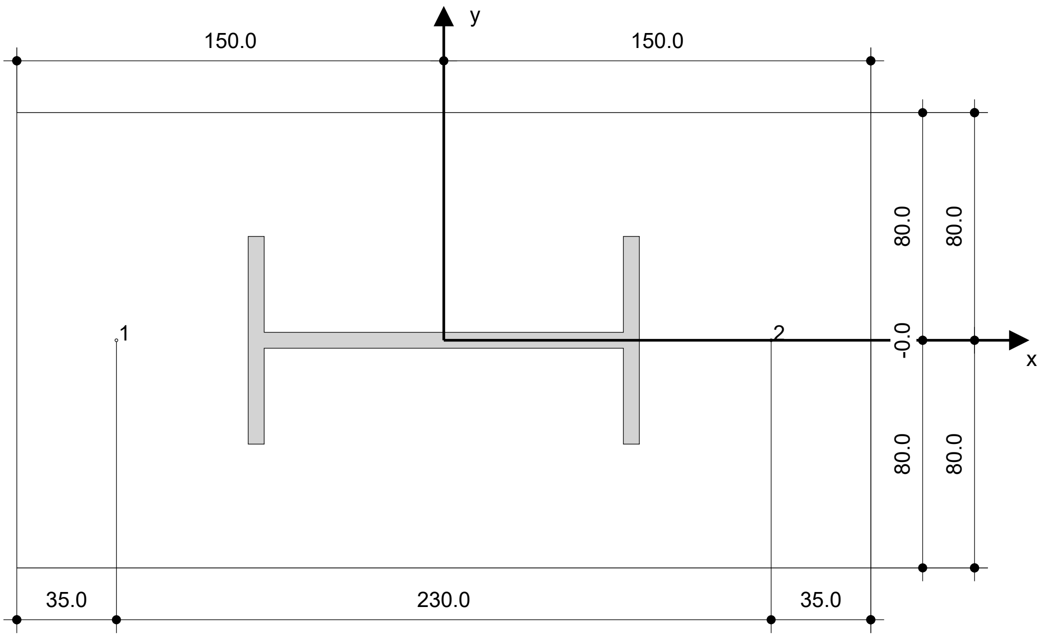
Minimum thickness of the base material: 356.0 mm

Gap filling with Hilti Filling Set M16.0 mm
http://download.hilti.biz/data/techlib/help/IFU_Seismic-Filling-Set.pdf

Hilti HAS-U threaded rod with HIT-RE 500 V4 injection mortar with 320 mm embedment h_ef, M16, Steel galvanized, SAFEset - automatic cleaning installation per ETA 20/0541, with annular gaps filled with Hilti Filling set or any suitable gap solutions

1.7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• Dispenser including cassette and mixer • Hilti filling set • Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-115.0	0.0	-	-	80.0	80.0
2	115.0	-0.0	-	-	80.0	80.0

2 Anchor plate design

2.1 Input data

Anchor plate:	Shape: Rectangular l_x x l_y x t = 300.0 mm x 160.0 mm x 15.0 mm Calculation: CBFEM Material: S 235; F_y = 235.00 N/mm²; ε_{lim} = 5.00%
Anchor type and size:	HIT-RE 500 V4 + HAS-U 5.8 M16, h_{ef} = 320.0 mm
Anchor stiffness:	The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.
Design method:	EN-based design using component-based FEM
Stand-off installation:	e_b = 0.0 mm (No stand-off); t = 15.0 mm
Profile:	IPEa 140; (L x W x T x FT) = 137.4 mm x 73.0 mm x 5.6 mm x 5.6 mm Material: S 235; F_y = 235.00 N/mm²; ε_{lim} = 5.00% Eccentricity x: 0.0 mm Eccentricity y: 0.0 mm
Base material:	Cracked concrete; C20/25; $f_{c,cyl}$ = 20.00 N/mm²; h = 5,000.0 mm; E = 30,000.00 N/mm²; G = 12,500.00 N/mm²; v = 0.20
Welds (profile to anchor plate):	Type of redistribution: Plastic Material: S 235
Mesh size:	Number of elements on edge: 8 Min. size of element: 10.0 mm Max. size of element: 50.0 mm

2.2 Summary

	Profile		Anchor plate			Concrete [%]
	σ_{Ed} [N/mm²]	ε_{Pl} [%]	σ_{Ed} [N/mm²]	ε_{Pl} [%]	Hole bearing [%]	
1	203.97	0.01	207.21	0.00	5	35

2.3 Anchor plate classification

Anchor tension forces	Equivalent rigid anchor plate (CBFEM)	Component-based Finite Element Method (CBFEM) anchor plate design
Anchor 1	25.718 kN	29.442 kN
Anchor 2	-0.003 kN	-0.003 kN

User accepted to consider the selected anchor plate as rigid by his/her engineering judgement. This means the anchor design guidelines can be applied.

2.4 Profile/Stiffeners/Plate

Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

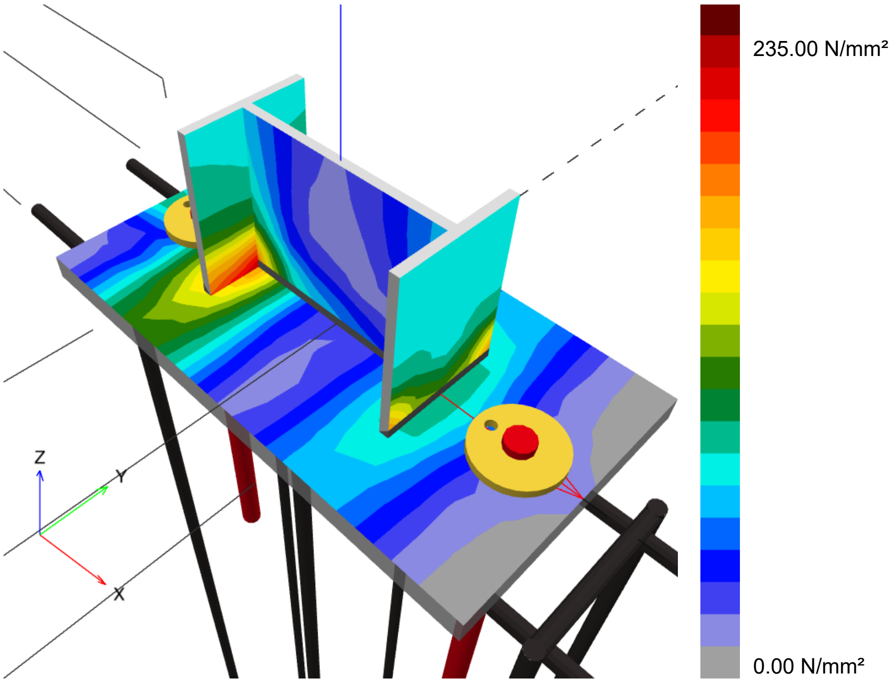
2.4.1 Equivalent stress and plastic strain

Limit state criteria as per EN1993-1-5 Annex C.8, (1) 2.

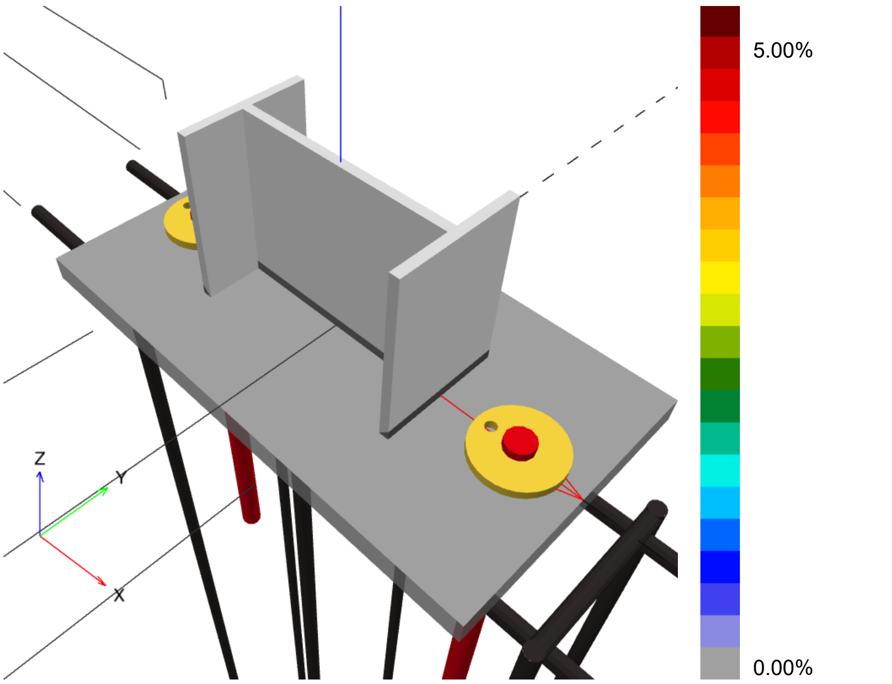
Results

Part	Material	σ_{Ed} [N/mm²]	ε_{Pl} [%]	f_y [N/mm²]	γ_{M0}	f_y/γ_{M0} [N/mm²]	ε_{lim} [%]	Status
Plate	S 235	207.21	0.00	235.00	1.00	235.00	5.00	OK
Profile	S 235	165.51	0.00	235.00	1.00	235.00	5.00	OK
Profile	S 235	222.84	0.00	235.00	1.00	235.00	5.00	OK
Profile	S 235	203.97	0.01	235.00	1.00	235.00	5.00	OK

2.4.1.1 Equivalent stress



2.4.1.2 Plastic strain



2.4.2 Hole bearing

Plate hole bearing resistance, EN1993-1 - 8 section 3.6.1:

Company:		Page:	13
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Veräjämäki katoksen kannakointi	Date:	22.4.2024
Fastening point:			

Equations

$$F_{b,Rd} = \frac{k_1\, a_b\, f_u\, d\, t}{\gamma_{M2}}$$

$$\text{Utilization} = \frac{V_{Ed}}{F_{b,Rd}}$$

Variables

	k_1	a_b	f_u [N/mm²]	d [mm]	t [mm]	γ_{M2}
Anchor 1	2.50	0.65	360.00	16.0	15.0	1.25
Anchor 2	2.50	1.00	360.00	16.0	15.0	1.25

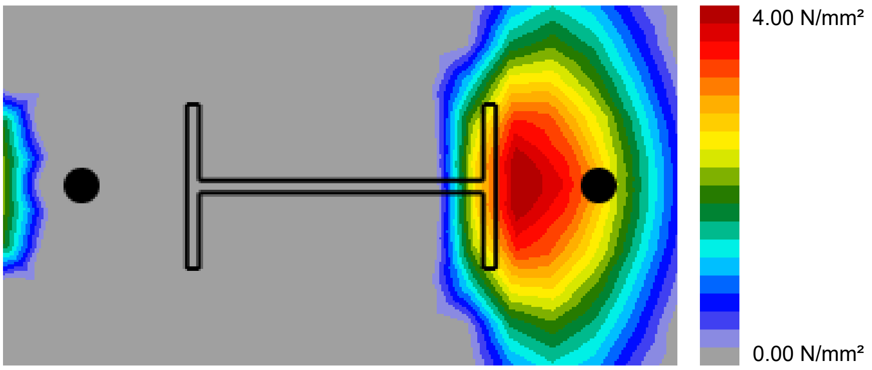
Results

	V_{Ed} [kN]	$F_{b,Rd}$ [kN]	Utilization [%]	Status
Anchor 1	4.550	112.000	5	OK
Anchor 2	4.450	172.800	3	OK

2.5 Concrete

According to EN1992-1-1 section 6.7(4), the concrete should have sufficient reinforcement to take into account the tensile forces that develop due to the fixture attachment. The definition of the reinforcement in the concrete is out of scope of PROFIS Engineering.

2.5.1 Compression in concrete under the anchor plate



2.5.2 Verification of compression in concrete under the anchor plate around the profile as per EN1992-1 section 6.7 and EN1993-1-8, section 6.2.5

Equations

$$f_{jd} = \frac{\beta_j\, k_j\, \alpha_{cc}\, f_{ck}}{\gamma_c}$$

$$\sigma = \frac{N}{A_{eff}}$$

$$\text{Utilization} = \frac{\sigma}{f_{jd}}$$

Variables

N [kN]	A_{eff} [mm²]	β_j	k_j	α_{cc}	f_{ck} [N/mm²]	γ_c
30.889	10,150	0.67	1.00	1.00	20.00	1.50

Results

σ [N/mm²]	f_{jd} [N/mm²]	Utilization [%]	Status
3.04	8.93	35	OK

2.6 Symbol explanation

a_b	Factor
α_{cc}	Long-term effects on maximum strength of concrete
A_{eff}	Effective area
β_j	Joint coefficient β_j
d	Nominal diameter of the bolt
ε_{lim}	Limit plastic strain
ε_{Pl}	Plastic strain from CBFEM results
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
f_{ck}	Characteristic compressive concrete strength
f_{jd}	The ultimate bearing strength of the concrete block
f_u	Ultimate strength
f_y	Yield strength
γ_c	Service factor - SP 16, Table 41
γ_{M0}	Steel safety factor gamma M0
γ_{M2}	Steel safety factor gamma M2
k_1	Factor for edge distance and bolt spacing perpendicular to the direction of load transfer - EN 1993-1-8 - Table 3.4
k_j	Concentration factor
N	Resulting compression force
σ	Average stress in concrete
σ_{Ed}	Equivalent stress
t	Thickness of the anchor plate
V_{Ed}	Anchor shear force

2.7 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified anchor plate may not behave rigid. Please, validate the results with a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.

Company:		Page:	15
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Veräjämäki katoksen kannakointi	Date:	22.4.2024
Fastening point:			

3 Summary of results

Design of the anchor plate, anchor, welds and other elements are based on CBFEM (component based finite element method) and Eurocode regulations.

	Max. utilization	Status
Anchors	**180%**	NOT OK
Anchor plate	89%	OK
Concrete	35%	OK
Profile	87%	OK

Fastening does not meet the design criteria!

4 Remarks; Your Cooperation Duties

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