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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	SW - SS PFC column-groundbeam connection	Date:	28/08/2023
Fastening Point:			

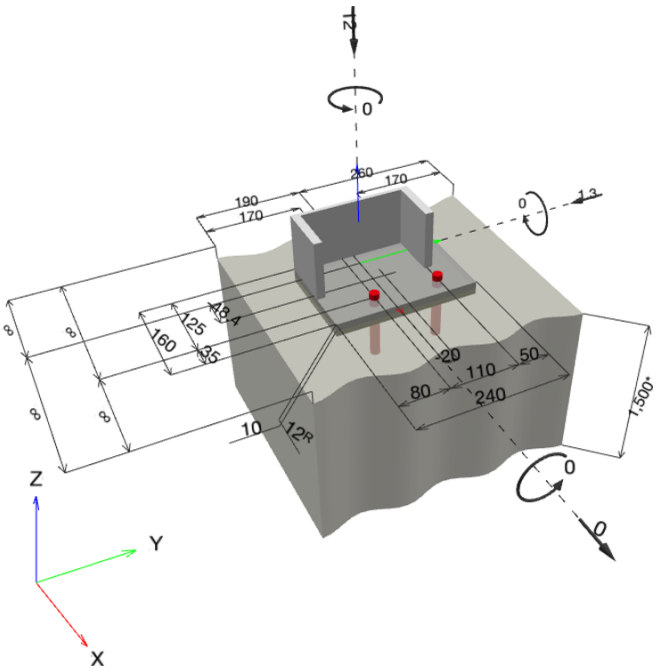
Specifier's comments:

1 Input data

Anchor type and size:	**HST3 M16 hef2**
Return period (service life in years):	50
Item number:	2105859 HST3 M16x145 45/25
Effective embedment depth:	h_{ef} = 85.0 mm, h_{nom} = 98.0 mm
Material:	
Approval No.:	ETA-98/0001
Issued I Valid:	13/07/2020 | -
Proof:	Design Method ETAG-FIRE; fire resistance duration: 120 [min], fire from 1 side
Stand-off installation:	without clamping (anchor); restraint level (baseplate): 2.00; e_b = 10.0 mm; t = 12.0 mm
	Hilti Grout: CB-G EG, epoxy, $f_{c,Grout}$ = 120.00 N/mm^2
Baseplate^R :	l_x x l_y x t = 160.0 mm x 240.0 mm x 12.0 mm; (Recommended plate thickness: not calculated)
Profile:	U profile, ; (L x W x T x FT) = 200.0 mm x 90.0 mm x 7.0 mm x 14.0 mm
Base material:	cracked concrete, C30/37, $f_{c,cube}$ = 37.00 N/mm^2; h = 1,500.0 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	No reinforcement or Reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm)
	with longitudinal edge reinforcement d >= 12.0 [mm] + close mesh (stirrups, hangers) s <= 100.0 [mm]

^{R} - The anchor calculation is based on a rigid baseplate assumption.

Geometry [mm] & Loading [kN, kNm]



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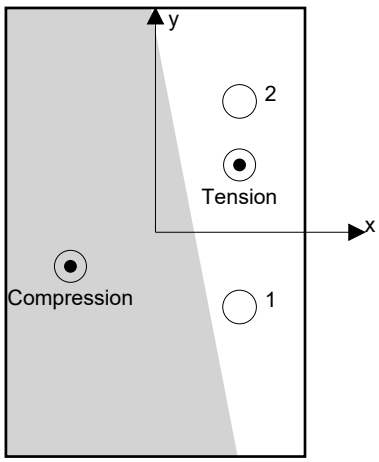
1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 0.000; V_x = 0.000; V_y = 10.000; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	62
2	Combination 2	N = 0.000; V_x = 0.000; V_y = -10.000; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	62
3	Combination 3	N = -17.000; V_x = 0.000; V_y = 10.000; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	63
4	Combination 4	N = -17.000; V_x = 0.000; V_y = -10.000; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	63
5	Combination 5	N = 0.000; V_x = 0.000; V_y = 1.300; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	yes	302
6	Combination 6	N = 0.000; V_x = 0.000; V_y = -1.300; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	yes	302
7	Combination 7	N = -12.000; V_x = 0.000; V_y = 1.300; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	yes	1,155
8	Combination 8	N = -12.000; V_x = 0.000; V_y = -1.300; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	yes	1,155

2 Load case/Resulting anchor forces

Controlling load case: 8 Combination 8



Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.121	1.281	1.104	-0.650
2	0.270	1.281	-1.104	-0.650

max. concrete compressive strain:	0.04 [‰]
max. concrete compressive stress:	1.25 [N/mm^2]
resulting tension force in (x/y)=(45.0/36.0):	0.391 [kN]
resulting compression force in (x/y)=(-45.5/-18.2):	12.391 [kN]

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

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3 Tension load (EOTA TR 020, section 2.2.1)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel failure*	0.270	2.400	12	OK
Pull-out failure*	0.270	5.600	5	OK
Concrete Breakout failure**	0.391	11.299	4	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
2.400	1.000	2.400	0.270

3.2 Pull-out failure

$N_{Rk,p}$ [kN]	Ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
5.600	1.000	1.000	5.600	0.270

3.3 Concrete Breakout failure

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
153,000	115,600	170.0	340.0

$e_{c1,N}$ [mm]	$\Psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\Psi_{ec2,N}$	$\Psi_{s,N}$	$\Psi_{re,N}$
0.0	1.000	21.0	0.890	1.000	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.200	9.592	1.000	11.299	0.391

Group anchor ID
1, 2

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4 Shear load (EOTA TR 020, section 2.2.2)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel failure (without lever arm)*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	1.281	0.377	340	not recommended
Pryout failure*	1.281	21.646	6	OK
Concrete edge failure in direction y-**	1.706	10.516	17	OK

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

4.1 Steel failure (with lever arm)

l [mm]	α_M
24.0	2.00

N_{Sd} / $N_{Rd,s}$	1 - N_{Sd} / $N_{Rd,s}$	$M^0_{Rk,s}$ [kNm]	$M_{Rk,s} = M^0_{Rk,s}$ (1 - N_{Sd}/ $N_{Rd,s}$) [kNm]
0.112	0.888	0.005	0.005

$V^M_{Rk,s} = \alpha_M * M_{Rk,s} / l$ [kN]	$\gamma_{Ms,b,V}$	$V^M_{Rd,s}$ [kN]	V_{Sd} [kN]
0.377	1.000	0.377	1.281

4.2 Pryout failure

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor
76,500	115,600	170.0	340.0	3.410

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

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
9.592	1.000	21.646	1.281

Group anchor ID
2

4.3 Concrete edge failure in direction y-

l_f [mm]	d_{nom} [mm]	k_1	α	β
85.0	16.00	1.700	0.071	0.062

c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
170.0	130,050	130,050

$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1.000	1.000	40.34	1.242	0.0	1.000	1.400

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
6.047	1.000	10.516	1.706

5 Combined tension and shear loads (EOTA TR 020, section 2.2.3)

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.112	3.396	2.000	1,155	not recommended

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

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 ETAG 001, Annex C(2010)Section 7! The software considers that the grout is installed under the baseplate without creating air voids and before application of the loads.
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of ETAG 001, Annex C! For larger diameters of the clearance hole see Chapter 1.1. of ETAG 001, Annex C!
- 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.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening does not meet the design criteria!

7 Installation data

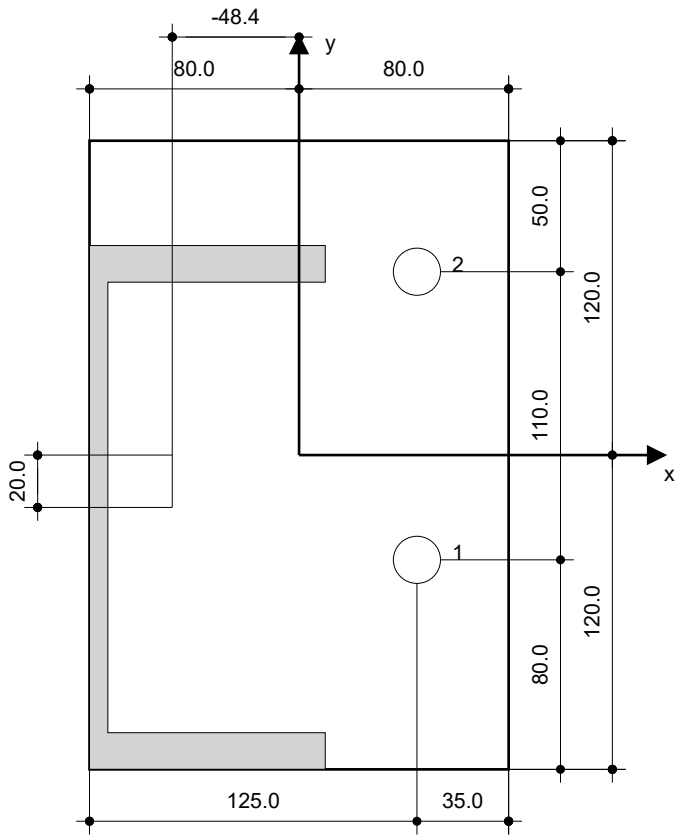
Baseplate, steel: S 355; E = 210,000.00 N/mm^2; f_{yk} = 355.00 N/mm^2
Profile: U profile, ; (L x W x T x FT) = 200.0 mm x 90.0 mm x 7.0 mm x 14.0 mm
Hole diameter in the fixture: d_f = 18.0 mm
Plate thickness (input): 12.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and size: HST3 M16 hef2
Item number: 2105859 HST3 M16x145 45/25
Maximum installation torque: 110 Nm
Hole diameter in the base material: 16.0 mm
Hole depth in the base material: 106.0 mm
Minimum thickness of the base material: 160.0 mm

Hilti HST3 stud anchor with 98 mm embedment, M16 hef2, Steel galvanized, installation per ETA-98/0001

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	45.0	-40.0	-	-	170.0	280.0
2	45.0	70.0	-	-	280.0	170.0

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)

9 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.