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Design:	Concrete - Jan 8, 2022	Date:	8/1/2022
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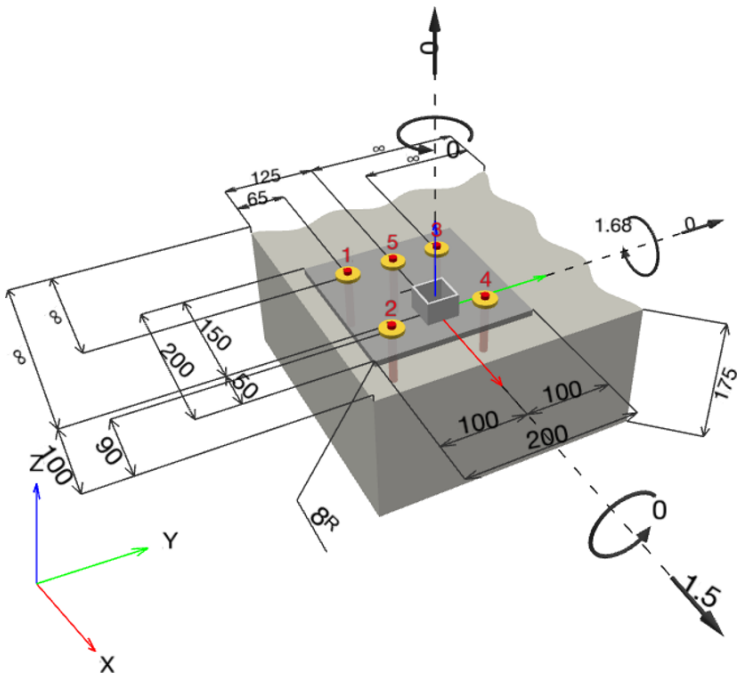
Specifier's comments:

1 Input data

Anchor type and diameter:	**HST3-R M10 hef2**
Return period (service life in years):	50
Item number:	2105865 HST3-R M10x100 40/20
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,opti}$ = 64.0 mm ($h_{ef,limit}$ = 100.0 mm), h_{nom} = 72.0 mm
Material:	A4
Evaluation Service Report:	ETA 98/0001
Issued I Valid:	4/5/2021 | -
Proof:	Based on Engineering judgement SOFA - based on ETAG testing with a load factor 2 and global safety factor 3
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 8.0 mm
Anchor plate[R]:	l_x x l_y x t = 200.0 mm x 200.0 mm x 8.0 mm; (Recommended plate thickness: not calculated)
Profile:	Square hollow, 40 x 40 x 2,9; (L x W x T) = 40.0 mm x 40.0 mm x 2.9 mm
Base material:	cracked concrete, C35/45, $f_{c,cube}$ = 45.00 N/mm^2; h = 175.0 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	no reinforcement or reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm) no longitudinal edge reinforcement

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [mm] & Loading [kN, kNm]



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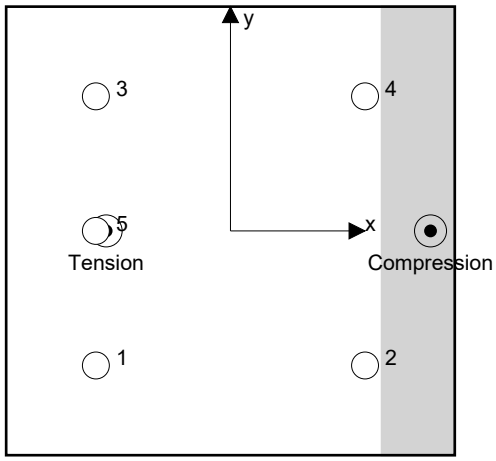
1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 0.000; V_x = 1.500; V_y = 0.000; M_x = 0.000; M_y = 1.680; M_z = 0.000;	no	no	100

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	3.725	0.300	0.300	0.000
2	0.222	0.300	0.300	0.000
3	3.725	0.300	0.300	0.000
4	0.222	0.300	0.300	0.000
5	3.725	0.300	0.300	0.000

max. concrete compressive strain:	0.12 [‰]
max. concrete compressive stress:	3.58 [N/mm^2]
resulting tension force in (x/y)=(-55.4/0.0):	11.617 [kN]
resulting compression force in (x/y)=(89.2/0.0):	11.617 [kN]

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

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3 Tension load (Based on ETAG, Annex C, Section 5.2.2 FOS = 3)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	3.725	9.567	39	OK
Pullout Strength*	3.725	6.708	56	OK
Combined pullout-concrete cone failure*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	11.617	12.787	91	OK
Splitting failure**	11.617	15.955	73	OK

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

3.1 Steel Strength

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
28.700	3.000	9.567	3.725

3.2 Pullout Strength

$N_{Rk,p}$ [kN]	ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
15.000	1.342	3.000	6.708	3.725

3.3 Concrete Breakout Failure

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
85,986	36,864	96.0	192.0

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
43.4	0.689	0.0	1.000	0.903	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.700	26.446	3.000	12.787	11.617

Group anchor ID
1-5

3.4 Splitting failure

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,sp}$ [mm]	$s_{cr,sp}$ [mm]	$\psi_{h,sp}$
85,986	36,864	96.0	192.0	1.500

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	k_1
43.4	0.689	0.0	1.000	0.903	1.000	7.700

$N^0_{Rk,c}$ [kN]	$\gamma_{M,sp}$	$N_{Rd,sp}$ [kN]	N_{Sd} [kN]
22.000	3.000	15.955	11.617

Group anchor ID
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4 Shear load (Based on ETAG, Annex C, Section 5.2.3 FOS = 3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	0.300	8.433	4	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	N/A	N/A	N/A	N/A
Concrete edge failure in direction x+**	1.500	5.157	30	OK

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

4.1 Steel Strength (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
25.300	3.000	8.433	0.300

4.2 Concrete edge failure in direction x+

l_f [mm]	d_{nom} [mm]	k_1	α	β
64.0	10.00	1.700	0.084	0.064

c_1 [mm]	$A_{c,V}$ [mm^2]	$A^0_{c,V}$ [mm^2]
90.0	43,200	36,450

$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
0.844	1.000	1.000	0.0	1.000	1.000

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
15.457	3.000	5.157	1.500

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5 Combined tension and shear loads (Based on ETAG, Annex C, Section 5.2.4 FOS = 3)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.909	0.291	1.000	100	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 2.759 [kN] $\quad \delta_N$ = 0.2904 [mm]

V_{Sk} = 0.222 [kN] $\quad \delta_V$ = 0.0352 [mm]

δ_{NV} = 0.2925 [mm]

Long term loading:

N_{Sk} = 2.759 [kN] $\quad \delta_N$ = 0.6292 [mm]

V_{Sk} = 0.222 [kN] $\quad \delta_V$ = 0.0521 [mm]

δ_{NV} = 0.6314 [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!

7 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 ETAG 001, Annex C(2010)Section 7! The software considers that the grout is installed under the anchor plate 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 design method SOFA assumes that no hole clearance between the anchors and the fixture is present. This can be achieved by filling the gap with mortar of sufficient compressive strength (e.g. by using the Hilti Filling set) or by other suitable means
- The compliance with current standards (e.g. EN 1993, AS 4100:1998, etc.) is the responsibility of the user
- An SLS-check is not performed for SOFA and has to be provided by the user!
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

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8 Installation data

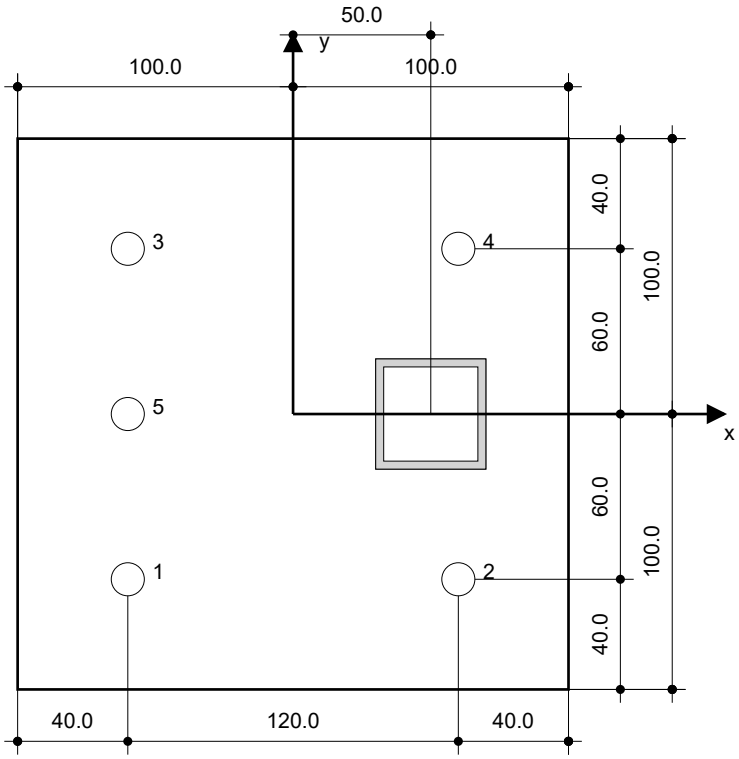
Anchor plate, steel: EN S235; E = 205,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2
Profile: Square hollow, 40 x 40 x 2,9; (L x W x T) = 40.0 mm x 40.0 mm x 2.9 mm
Hole diameter in the fixture: d_f = 12.0 mm
Plate thickness (input): 8.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: HST3-R M10 hef2
Item number: 2105865 HST3-R M10x100 40/20
Maximum installation torque: 45 Nm
Hole diameter in the base material: 10.0 mm
Hole depth in the base material: 89.0 mm
Minimum thickness of the base material: 84.0 mm

Hilti HST3 stud anchor with 64 mm embedment, M10 hef2, Stainless steel, installation per ETA 98/0001, with annular gaps filled with Hilti Filling set or any suitable gap solutions

8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• No accessory required	• Hilti SIW 6AT-A22 + SI AT-A22 • Filling set • Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-60.0	-60.0	-	210.0	65.0	-
2	60.0	-60.0	-	90.0	65.0	-
3	-60.0	60.0	-	210.0	185.0	-
4	60.0	60.0	-	90.0	185.0	-
5	-60.0	0.0	-	210.0	125.0	-

9 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)

10 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.
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