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Design:	Drafts_VAN.037085.0174-CALC-20241029-ARM-NE	Date:	10/31/2024
Fastening point:			

Specifier's comments:

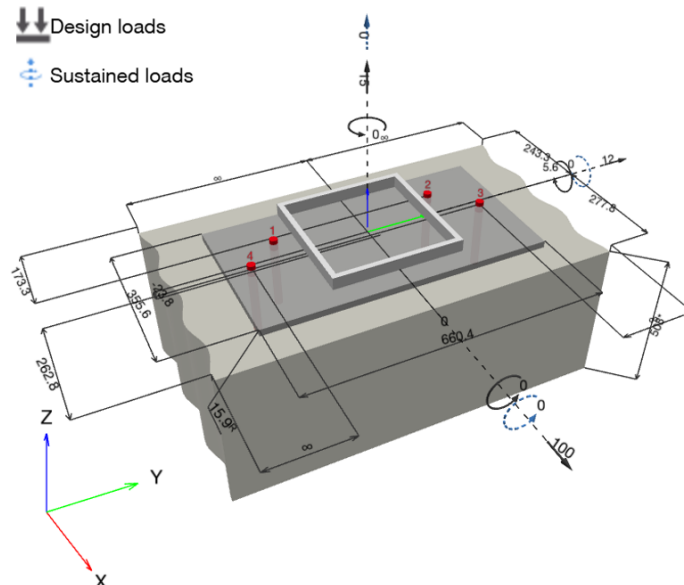
1 Input data



Anchor type and diameter:	HIT-HY 200 V3 + HAS-V-36 (ASTM F1554 Gr.36) 3/4
Item number:	2198029 HAS-V-36 3/4"x8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Specification text:	Hilti HAS threaded rod with HIT-HY 200 V3 ASTM F1554 Grade 36 injection mortar with 150 mm embedment hef, 3/4, Carbon steel, Safe Set System, Hammer drilled installation per ESR-4868
Effective embedment depth:	$h_{ef,act} = 150.0 \text{ mm}$ ($h_{ef,limit} = - \text{ mm}$)
Material:	ASTM F1554 Grade 36
Evaluation Service Report:	ESR-4868
Issued Valid:	- -
Proof:	Design Method CSA A23.3-14 / Chem.
Stand-off installation:	$e_b = 0.0 \text{ mm}$ (no stand-off); $t = 15.9 \text{ mm}$
Anchor plate ^R :	$l_x \times l_y \times t = 355.6 \text{ mm} \times 660.4 \text{ mm} \times 15.9 \text{ mm}$; (Recommended plate thickness: not calculated)
Profile:	Square HSS (AISC), HSS12X12X.500; (L x W x T) = 304.8 mm x 304.8 mm x 12.7 mm
Base material:	cracked concrete, $f'_c = 30.00 \text{ N/mm}^2$; $h = 508.0 \text{ mm}$, Temp. short/long: 20/20 °C
Installation:	Hammer drilled hole, Installation condition: Dry
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: > 15M bar with stirrups ($s \leq 100 \text{ mm}$)

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

Geometry [mm] & Loading [kN, kNm]



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1.1 Design results

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 15.000; V _x = 100.000; V _y = 12.000; M _x = 0.000; M _y = 5.600; M _z = 0.000; N _{sus} = 0.000; M _{x,sus} = 0.000; M _{y,sus} = 0.000;	no	143

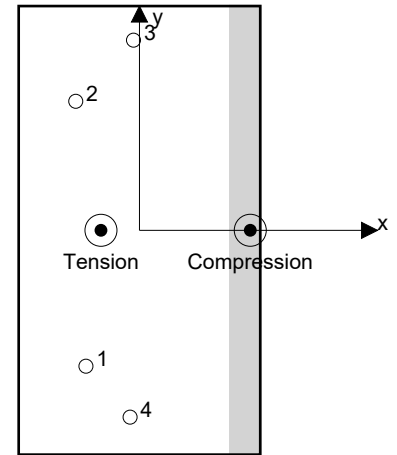
2 Load case/Resulting anchor forces

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	11.129	25.323	25.147	2.978
2	11.913	25.034	24.858	2.967
3	7.464	24.976	24.791	3.030
4	7.727	25.384	25.203	3.026

Max. concrete compressive strain: 0.05 [‰]
 Max. concrete compressive stress: 1.60 [N/mm²]
 Resulting tension force in (x/y)=(-56.7/0.1): 38.233 [kN]
 Resulting compression force in (x/y)=(163.1/0.1): 23.233 [kN]



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

3 Tension load

	Load N _f [kN]	Capacity N _r [kN]	Utilization β _N = N _f /N _r	Status
Steel Strength*	11.913	58.681	21	OK
Bond Strength**	38.233	86.177	45	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	38.233	96.508	40	OK

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

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3.1 Steel Strength

$$N_{s,uta} = A_{se} f_{uta} = \text{ESR value} \quad \text{refer to ICC-ES ESR-4868}$$

$$N_{sar} = A_{se} \phi_s f_{uta} R \quad \text{CSA A23.3-14 Eq. D.2}$$

$$N_{sar} \geq N_{fa} \quad \text{CSA A23.3-14 Table D.1}$$

Variables

n	$A_{se,N}$ [mm ²]	f_{uta} [N/mm ²]
1	216	399.90

Calculations

$N_{s,uta}$ [kN]
86.296

Results

$N_{s,uta}$ [kN]	ϕ_s	R	N_{sar} [kN]	N_{fa} [kN]
86.296	0.850	0.800	58.681	11.913

3.2 Bond Strength

$$N_{agr} = \left(\frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec1,Na} \Psi_{ec2,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{bar} \quad \text{CSA A23.3-14 Eq. D.21}$$

$$N_{agr} \geq N_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

$$A_{Na} = \text{see CSA A23.3-14, Part D.6.5.1, Fig. D.11}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{CSA A23.3-14 Eq. D.22}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{7.60}} \quad \text{CSA A23.3-14 Eq. D.23}$$

$$\Psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.25}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.27}$$

$$\Psi_{cp,Na} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.29}$$

$$N_{bar} = \lambda_a \phi_c \tau_r \pi d_a h_{ef} R \quad \text{CSA A23.3-14 Eq. D.24}$$

Variables

τ_{uncr} [N/mm ²]	d_a [mm]	h_{ef} [mm]	$c_{a,min}$ [mm]	$\alpha_{overhead}$	τ_{cr} [N/mm ²]
16.18	19.1	150.0	173.3	1.000	9.18
$e_{1,N}$ [mm]	$e_{2,N}$ [mm]	c_{ac} [mm]	λ_a		
7.9	1.3	240.3	1.000		

Calculations

c_{Na} [mm]	A_{Na} [mm ²]	A_{Na0} [mm ²]	$\Psi_{ed,Na}$
277.9	578,884	309,012	0.887

$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$
0.972	0.995	1.000

Results

ϕ_c	R	N_{bar} [kN]	N_{agr} [kN]	$N_{fa,g}$ [kN]
0.650	1.000	53.580	86.177	38.233

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3.3 Concrete Breakout Failure

$$N_{cbgr} = \left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_{br} \quad \text{CSA A23.3-14 Eq. D.4}$$

$$N_{cbgr} \geq N_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

$$A_{Nc} \text{ see CSA A23.3-14, Part D.6.2.1, Fig. D.7}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{CSA A23.3-14 Eq. D.5}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_{1,N}}{3 h_{ef}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.8}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.11}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.13}$$

$$N_{br} = k_c \phi_c \lambda_a \sqrt{f_c} h_{ef}^{1.5} R \quad \text{CSA A23.3-14 Eq. D.6}$$

Variables

h_{ef} [mm]	$e'_{1,N}$ [mm]	$e'_{2,N}$ [mm]	$c_{a,min}$ [mm]	$\psi_{c,N}$
150.0	7.9	1.3	173.3	1.000
c_{ac} [mm]	k_c	λ_a	f_c [N/mm ²]	
240.3	7.1	1.000	30.00	

Calculations

A_{Nc} [mm ²]	A_{Nc0} [mm ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$
470,547	202,500	0.966	0.994	0.931	1.000

Results

ϕ_c	R	N_{br} [kN]	N_{cbgr} [kN]	$N_{fa,g}$ [kN]
0.650	1.000	46.438	96.508	38.233



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4 Shear load

	Load V_f [kN]	Capacity V_r [kN]	Utilization $\beta_V = V_f/V_r$	Status
Steel Strength*	25.384	33.008	77	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	100.717	176.844	57	OK
Concrete edge failure in direction x+**	100.717	79.629	127	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

$V_{s,uta}$ = ESR value refer to ICC-ES ESR-4868
 $V_{sar} = 0.6 A_{se,V} \phi_s f_{uta} R$ CSA A23.3-14 Eq. D.31
 $V_{sar} \geq V_{fa}$ CSA A23.3-14 Table D.1

Variables

n	$A_{se,V}$ [mm ²]	f_{uta} [N/mm ²]
1	216	399.90

Calculations

$$\frac{V_{s,uta} \text{ [kN]}}{51.777}$$

Results

$V_{s,uta}$ [kN]	ϕ_s	R	V_{sar} [kN]	V_{fa} [kN]
51.777	0.850	0.750	33.008	25.384

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4.2 Pryout Strength (Bond Strength controls)

$$V_{cpgr} = k_{cp} \left[\left(\frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} \right] R \quad \text{CSA A23.3-14 Eq. D.45}$$

$$V_{cpgr} \geq V_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

$$A_{Na} \text{ see CSA A23.3-14, Part D.6.5.1, Fig. D.11}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{CSA A23.3-14 Eq. D.22}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{7.60}} \quad \text{CSA A23.3-14 Eq. D.23}$$

$$\Psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.25}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.27}$$

$$\Psi_{cp,Na} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.29}$$

$$N_{ba} = \lambda_a \phi_c \tau_r \pi d_a h_{ef} \quad \text{CSA A23.3-14 Eq. D.24}$$

Variables

k_{cp}	$\alpha_{overhead}$	$\tau_{uncr} \text{ [N/mm}^2\text{]}$	$d_a \text{ [mm]}$	$h_{ef} \text{ [mm]}$	$c_{a,min} \text{ [mm]}$
2.000	1.000	16.18	19.1	150.0	173.3
$\tau_{cr} \text{ [N/mm}^2\text{]}$	$e_{1,N} \text{ [mm]}$	$e_{2,N} \text{ [mm]}$	$c_{ac} \text{ [mm]}$	λ_a	
9.18	0.2	1.7	240.3	1.000	

Calculations

$c_{Na} \text{ [mm]}$	$A_{Na} \text{ [mm}^2\text{]}$	$A_{Na0} \text{ [mm}^2\text{]}$	
277.9	578,884	309,012	
$\Psi_{ed,Na}$	$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$
0.887	0.999	0.994	1.000

Results

ϕ_c	$N_{ba} \text{ [kN]}$	$V_{cpgr} \text{ [kN]}$	R	$V_{cpgr} \text{ [kN]}$	$V_{fa,g} \text{ [kN]}$
0.650	53.580	176.844	1.000	176.844	100.717

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4.3 Concrete edge failure in direction x+

$$V_{cbgr} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{\alpha,V(D.7.2.1(c))} V_{br} \quad \text{CSA A23.3-14 Eq. D.33}$$

$$V_{cbgr} \geq V_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

 A_{Vc} see CSA A23.3-14, Part D.7.2.1, Fig. D.13

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{CSA A23.3-14 Eq. D.34}$$

$$\Psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v}{3c_{a1}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.38}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.41}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{CSA A23.3-14 Eq. D.42}$$

$$V_{br} = 3.75 \lambda_a \phi_c \sqrt{f_c} c_{a1}^{1.5} R \quad \text{CSA A23.3-14 Eq. D.36}$$

Variables

c_{a1} [mm]	c_{a2} [mm]	e_v [mm]	$\Psi_{c,V}$	h_a [mm]
262.8	-	0.0	1.400	508.0
l_e [mm]	λ_a	d_a [mm]	f_c [N/mm ²]	$\Psi_{\alpha,V(D.7.2.1(c))}$
150.0	1.000	19.1	30.00	1.000

Calculations

A_{Vc} [mm ²]	A_{Vc0} [mm ²]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$
310,787	310,787	1.000	1.000	1.000

Results

ϕ_c	R	V_{br} [kN]	V_{cbgr} [kN]	$V_{fa,g}$ [kN]
0.650	1.000	56.878	79.629	100.717

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

5 Combined tension and shear loads

$\beta_N = N_r/N_r$	$\beta_V = V_r/V_r$	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.444	1.265	1.000	143	not recommended

$$\beta_{N,V} = (\beta_N + \beta_V) / 1.2 \leq 1$$



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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!
- Condition A applies when supplementary reinforcement is used. The R factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Checking the transfer of loads into the base material is required in accordance with CSA A23.3!
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. CSA A23.3-14 Annex D, Clause D.10.1

Fastening does not meet the design criteria!

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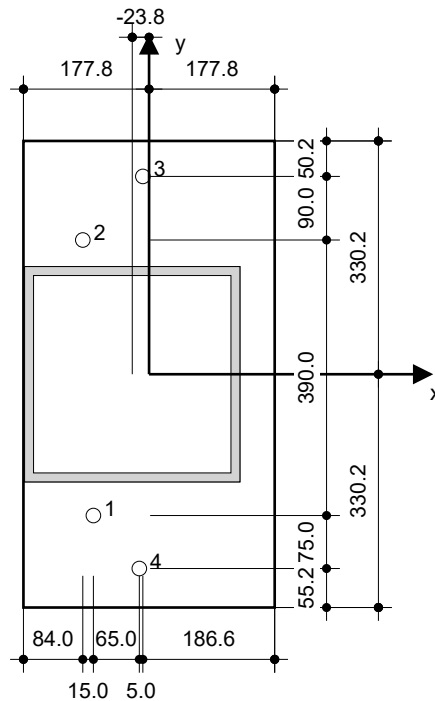
7 Installation data

Profile: Square HSS (AISC), HSS12X12X.500; (L x W x T) = 304.8 mm x 304.8 mm x 12.7 mm	Anchor type and diameter: HIT-HY 200 V3 + HAS-V-36 (ASTM F1554 Gr.36) 3/4
Hole diameter in the fixture: $d_f = 20.6$ mm	Item number: 2198029 HAS-V-36 3/4"x8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Plate thickness (input): 15.9 mm	Maximum installation torque: 136 Nm
Recommended plate thickness: not calculated	Hole diameter in the base material: 22.2 mm
Drilling method: Hammer drilled	Hole depth in the base material: 150.0 mm
Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required	Minimum thickness of the base material: 194.4 mm

Hilti HAS threaded rod with HIT-HY 200 V3 ASTM F1554 Grade 36 injection mortar with 150 mm embedment hef, 3/4, Carbon steel, Safe Set System, Hammer drilled installation per ESR-4868

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"> • Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush 	<ul style="list-style-type: none"> • Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}
1	-78.8	-200.0	188.3	332.8	-	-
2	-93.8	190.0	173.3	347.8	-	-
3	-8.8	280.0	258.3	262.8	-	-
4	-13.8	-275.0	253.3	267.8	-	-



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8 Remarks; Your Cooperation Duties

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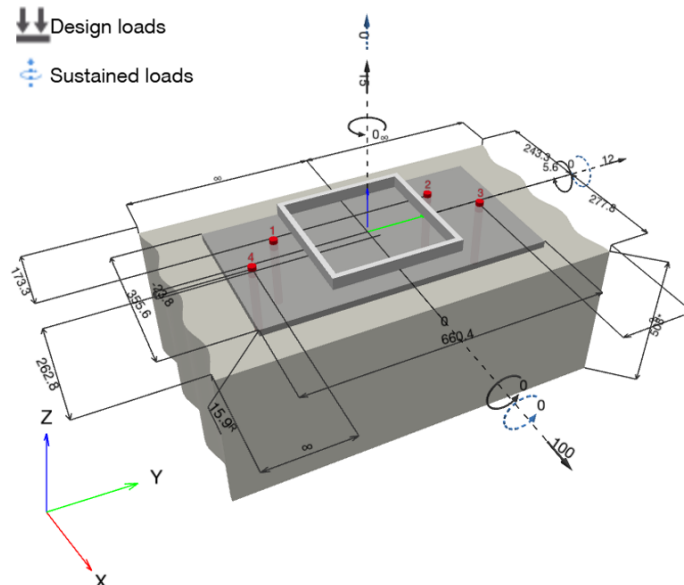
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Effective embedment depth:	$h_{ef,act} = 150.0 \text{ mm}$ ($h_{ef,limit} = - \text{ mm}$)
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Proof:	Design Method CSA A23.3-14 / Chem.
Stand-off installation:	$e_b = 0.0 \text{ mm}$ (no stand-off); $t = 15.9 \text{ mm}$
Anchor plate ^R :	$l_x \times l_y \times t = 355.6 \text{ mm} \times 660.4 \text{ mm} \times 15.9 \text{ mm}$; (Recommended plate thickness: not calculated)
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Base material:	cracked concrete, $f'_c = 30.00 \text{ N/mm}^2$; $h = 508.0 \text{ mm}$, Temp. short/long: 20/20 °C
Installation:	Hammer drilled hole, Installation condition: Dry
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: > 15M bar with stirrups ($s \leq 100 \text{ mm}$)

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

Geometry [mm] & Loading [kN, kNm]



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1.1 Design results

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 15.000; V _x = 100.000; V _y = 12.000; M _x = 0.000; M _y = 5.600; M _z = 0.000; N _{sus} = 0.000; M _{x,sus} = 0.000; M _{y,sus} = 0.000;	no	91

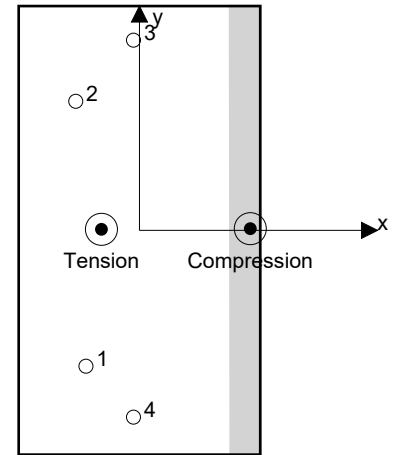
2 Load case/Resulting anchor forces

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	11.255	25.311	25.135	2.979
2	12.016	25.047	24.870	2.969
3	7.518	24.993	24.810	3.026
4	7.562	25.367	25.185	3.026

Max. concrete compressive strain: 0.05 [‰]
 Max. concrete compressive stress: 1.63 [N/mm²]
 Resulting tension force in (x/y)=(-56.0/1.5): 38.351 [kN]
 Resulting compression force in (x/y)=(163.2/2.5): 23.351 [kN]



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

3 Tension load

	Load N _f [kN]	Capacity N _r [kN]	Utilization β _N = N _f /N _r	Status
Steel Strength*	12.016	58.681	21	OK
Bond Strength**	38.351	85.569	45	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	38.351	96.052	40	OK

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

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3.1 Steel Strength

$$N_{s,uta} = A_{se} f_{uta} = \text{ESR value} \quad \text{refer to ICC-ES ESR-4868}$$

$$N_{sar} = A_{se} \phi_s f_{uta} R \quad \text{CSA A23.3-14 Eq. D.2}$$

$$N_{sar} \geq N_{fa} \quad \text{CSA A23.3-14 Table D.1}$$

Variables

n	$A_{se,N}$ [mm ²]	f_{uta} [N/mm ²]
1	216	399.90

Calculations

$N_{s,uta}$ [kN]
86.296

Results

$N_{s,uta}$ [kN]	ϕ_s	R	N_{sar} [kN]	N_{fa} [kN]
86.296	0.850	0.800	58.681	12.016

3.2 Bond Strength

$$N_{agr} = \left(\frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec1,Na} \Psi_{ec2,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{bar} \quad \text{CSA A23.3-14 Eq. D.21}$$

$$N_{agr} \geq N_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

$$A_{Na} = \text{see CSA A23.3-14, Part D.6.5.1, Fig. D.11}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{CSA A23.3-14 Eq. D.22}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{7.60}} \quad \text{CSA A23.3-14 Eq. D.23}$$

$$\Psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.25}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.27}$$

$$\Psi_{cp,Na} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.29}$$

$$N_{bar} = \lambda_a \phi_c \tau_r \pi d_a h_{ef} R \quad \text{CSA A23.3-14 Eq. D.24}$$

Variables

τ_{uncr} [N/mm ²]	d_a [mm]	h_{ef} [mm]	$c_{a,min}$ [mm]	$\alpha_{overhead}$	τ_{cr} [N/mm ²]
16.18	19.1	150.0	173.3	1.000	9.18
$e_{1,N}$ [mm]	$e_{2,N}$ [mm]	c_{ac} [mm]	λ_a		
8.4	2.8	240.3	1.000		

Calculations

c_{Na} [mm]	A_{Na} [mm ²]	A_{Na0} [mm ²]	$\Psi_{ed,Na}$
277.9	578,884	309,012	0.887

$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$
0.971	0.990	1.000

Results

ϕ_c	R	N_{bar} [kN]	N_{agr} [kN]	$N_{fa,g}$ [kN]
0.650	1.000	53.580	85.569	38.351

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3.3 Concrete Breakout Failure

$$N_{cbgr} = \left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_{br} \quad \text{CSA A23.3-14 Eq. D.4}$$

$$N_{cbgr} \geq N_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

$$A_{Nc} \text{ see CSA A23.3-14, Part D.6.2.1, Fig. D.7}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{CSA A23.3-14 Eq. D.5}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_{1,N}}{3 h_{ef}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.8}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.11}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.13}$$

$$N_{br} = k_c \phi_c \lambda_a \sqrt{f_c} h_{ef}^{1.5} R \quad \text{CSA A23.3-14 Eq. D.6}$$

Variables

h_{ef} [mm]	$e'_{1,N}$ [mm]	$e'_{2,N}$ [mm]	$c_{a,min}$ [mm]	$\psi_{c,N}$
150.0	8.4	2.8	173.3	1.000
c_{ac} [mm]	k_c	λ_a	f_c [N/mm ²]	
240.3	7.1	1.000	30.00	

Calculations

A_{Nc} [mm ²]	A_{Nc0} [mm ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$
472,422	202,500	0.964	0.988	0.931	1.000

Results

ϕ_c	R	N_{br} [kN]	N_{cbgr} [kN]	$N_{fa,g}$ [kN]
0.650	1.000	46.438	96.052	38.351

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4 Shear load

	Load V_f [kN]	Capacity V_r [kN]	Utilization $\beta_V = V_f/V_r$	Status
Steel Strength*	25.367	33.008	77	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	100.717	176.949	57	OK
Concrete edge failure in direction x+**	100.717	133.894	76	OK

* 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

$V_{s,uta}$ = ESR value refer to ICC-ES ESR-4868
 $V_{sar} = 0.6 A_{se,V} \phi_s f_{uta} R$ CSA A23.3-14 Eq. D.31
 $V_{sar} \geq V_{fa}$ CSA A23.3-14 Table D.1

Variables

n	A _{se,V} [mm ²]	f _{uta} [N/mm ²]
1	216	399.90

Calculations

$V_{s,uta}$ [kN]
51.777

Results

V _{s,uta} [kN]	φ _s	R	V _{sar} [kN]	V _{fa} [kN]
51.777	0.850	0.750	33.008	25.367

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4.2 Pryout Strength (Bond Strength controls)

$$V_{cpgr} = k_{cp} \left[\left(\frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} \right] R \quad \text{CSA A23.3-14 Eq. D.45}$$

$$V_{cpgr} \geq V_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

$$A_{Na} \text{ see CSA A23.3-14, Part D.6.5.1, Fig. D.11}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{CSA A23.3-14 Eq. D.22}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{7.60}} \quad \text{CSA A23.3-14 Eq. D.23}$$

$$\Psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.25}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.27}$$

$$\Psi_{cp,Na} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.29}$$

$$N_{ba} = \lambda_a \phi_c \tau_r \pi d_a h_{ef} \quad \text{CSA A23.3-14 Eq. D.24}$$

Variables

k_{cp}	$\alpha_{overhead}$	$\tau_{uncr} \text{ [N/mm}^2\text{]}$	$d_a \text{ [mm]}$	$h_{ef} \text{ [mm]}$	$c_{a,min} \text{ [mm]}$
2.000	1.000	16.18	19.1	150.0	173.3
$\tau_{cr} \text{ [N/mm}^2\text{]}$	$e_{1,N} \text{ [mm]}$	$e_{2,N} \text{ [mm]}$	$c_{ac} \text{ [mm]}$	λ_a	
9.18	0.2	1.6	240.3	1.000	

Calculations

$c_{Na} \text{ [mm]}$	$A_{Na} \text{ [mm}^2\text{]}$	$A_{Na0} \text{ [mm}^2\text{]}$		
277.9	578,884	309,012		
$\Psi_{ed,Na}$	$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$	
0.887	0.999	0.994	1.000	

Results

ϕ_c	$N_{ba} \text{ [kN]}$	$V_{cpgr} \text{ [kN]}$	R	$V_{cpgr} \text{ [kN]}$	$V_{fa,g} \text{ [kN]}$
0.650	53.580	176.949	1.000	176.949	100.717

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4.3 Concrete edge failure in direction x+

$$V_{cbgr} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{\alpha,V(D.7.2.1(c))} V_{br} \quad \text{CSA A23.3-14 Eq. D.33}$$

$$V_{cbgr} \geq V_{fa,g} \quad \text{CSA A23.3-14 Table D.1}$$

$$A_{Vc} \text{ see CSA A23.3-14, Part D.7.2.1, Fig. D.13}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{CSA A23.3-14 Eq. D.34}$$

$$\Psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v}{3c_{a1}}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.38}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{CSA A23.3-14 Eq. D.41}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{CSA A23.3-14 Eq. D.42}$$

$$V_{br} = 3.75 \lambda_a \phi_c \sqrt{f_c} c_{a1}^{1.5} R \quad \text{CSA A23.3-14 Eq. D.36}$$

Variables

c_{a1} [mm]	c_{a2} [mm]	e_v [mm]	$\Psi_{c,V}$	h_a [mm]
262.8	-	5.3	1.400	508.0
l_e [mm]	λ_a	d_a [mm]	f_c [N/mm ²]	$\Psi_{\alpha,V(D.7.2.1(c))}$
150.0	1.000	19.1	30.00	1.000

Calculations

A_{Vc} [mm ²]	A_{Vc0} [mm ²]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$
529,568	310,787	0.987	1.000	1.000

Results

ϕ_c	R	V_{br} [kN]	V_{cbgr} [kN]	$V_{fa,g}$ [kN]
0.650	1.000	56.878	133.894	100.717

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

5 Combined tension and shear loads

$\beta_N = N_r/N_r$	$\beta_V = V_r/V_r$	ζ	Utilization β_{NV} [%]	Status
0.448	0.768	5/3	91	OK

$$\beta_{NV} = \beta_N^\zeta + \beta_V^\zeta \leq 1$$



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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!
- Condition A applies when supplementary reinforcement is used. The R factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Checking the transfer of loads into the base material is required in accordance with CSA A23.3!
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. CSA A23.3-14 Annex D, Clause D.10.1

Fastening meets the design criteria!

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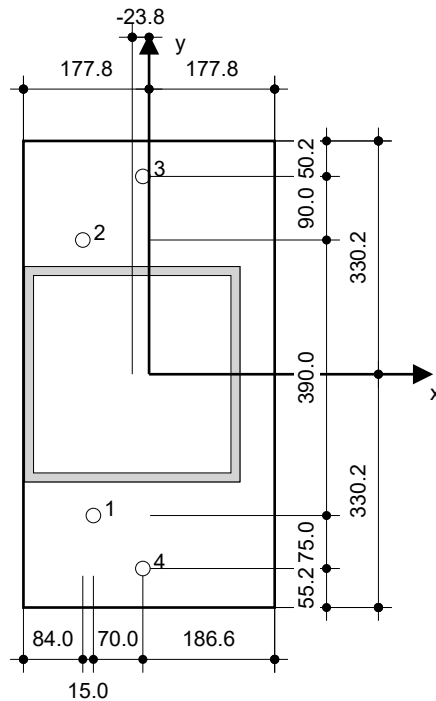
7 Installation data

Profile: Square HSS (AISC), HSS12X12X.500; (L x W x T) = 304.8 mm x 304.8 mm x 12.7 mm	Anchor type and diameter: HIT-HY 200 V3 + HAS-V-36 (ASTM F1554 Gr.36) 3/4
Hole diameter in the fixture: $d_f = 20.6$ mm	Item number: 2198029 HAS-V-36 3/4"x8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Plate thickness (input): 15.9 mm	Maximum installation torque: 136 Nm
Recommended plate thickness: not calculated	Hole diameter in the base material: 22.2 mm
Drilling method: Hammer drilled	Hole depth in the base material: 150.0 mm
Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required	Minimum thickness of the base material: 194.4 mm

Hilti HAS threaded rod with HIT-HY 200 V3 ASTM F1554 Grade 36 injection mortar with 150 mm embedment hef, 3/4, Carbon steel, Safe Set System, Hammer drilled installation per ESR-4868

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"> • Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush 	<ul style="list-style-type: none"> • Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}
1	-78.8	-200.0	188.3	332.8	-	-
2	-93.8	190.0	173.3	347.8	-	-
3	-8.8	280.0	258.3	262.8	-	-
4	-8.8	-275.0	258.3	262.8	-	-



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8 Remarks; Your Cooperation Duties

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