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Company:
 Address:
 Phone | Fax:
 Design: Concrete - Aug 11, 2022
 Fastening point:

Page: 1
 Specifier:
 E-Mail:
 Date: 2022-08-12

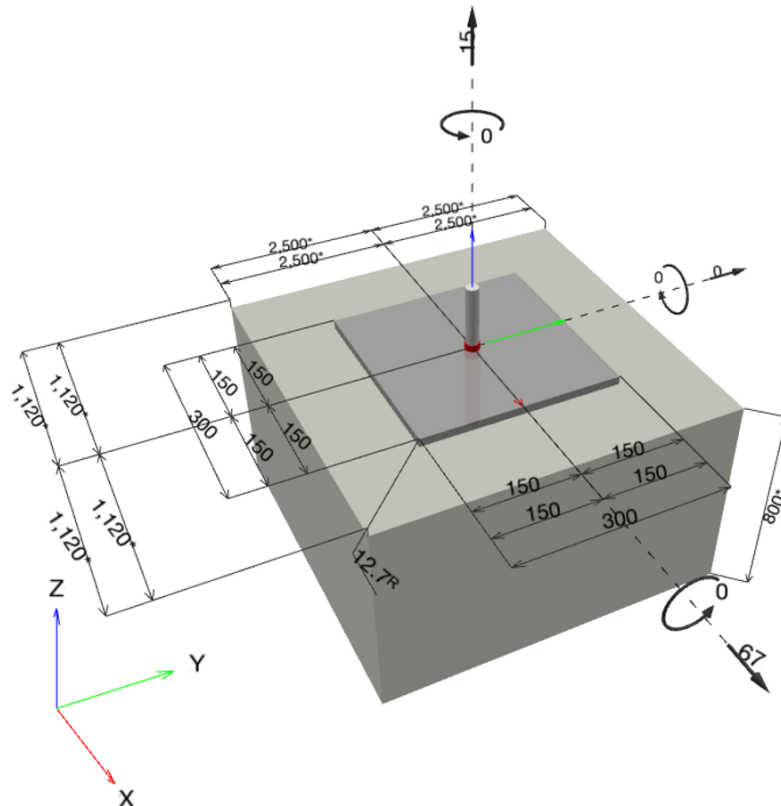
Specifier's comments:

1 Input data

Anchor type and diameter:	Hex Head ASTM F 1554 GR. 36 7/8	
Item number:	not available	
Effective embedment depth:	$h_{ef} = 120.0$ mm	
Material:	ASTM F 1554	
Evaluation Service Report:	Hilti Technical Data	
Issued Valid:	- -	
Proof:	Design Method CSA A23.3-14 / CIP.	
Stand-off installation:	$e_b = 0.0$ mm (no stand-off); $t = 12.7$ mm	
Anchor plate ^R :	$l_x \times l_y \times t = 300.0$ mm x 300.0 mm x 12.7 mm; (Recommended plate thickness: not calculated)	
Profile:	Round bars (AISC), 3/4; (L x W x T) = 19.1 mm x 19.1 mm	
Base material:	cracked concrete, $f'_c = 34.47$ N/mm ² ; $h = 800.0$ mm	
Reinforcement:	tension: condition B, shear: condition B; edge reinforcement: none or < 15M bar	

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

Geometry [mm] & Loading [kN, kNm]



www.hilti.ca

Company:		Page:	2
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	Concrete - Aug 11, 2022	Date:	2022-08-12
Fastening point:			

1.1 Design results

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 15.000; V _x = 67.000; V _y = 0.000; M _x = 0.000; M _y = 0.000; M _z = 0.000;	no	148

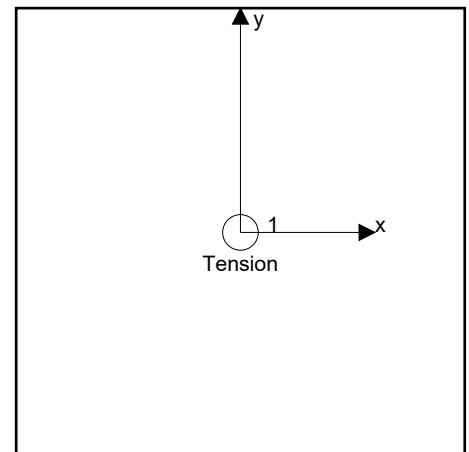
2 Load case/Resulting anchor forces
Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	15.000	67.000	67.000	0.000

max. concrete compressive strain: - [%]
 max. concrete compressive stress: - [N/mm²]
 resulting tension force in (x/y)=(0.0/0.0): 15.000 [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 anchor plate.


3 Tension load

	Load N _f [kN]	Capacity N _r [kN]	Utilization β _N = N _f /N _r	Status
Steel Strength*	15.000	81.052	19	OK
Pullout Strength*	15.000	103.048	15	OK
Concrete Breakout Failure**	15.000	50.168	30	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$$N_{s,uta} = A_{se} f_{uta}$$

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

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

Variables

n	A _{se,N} [mm ²]	f _{uta} [N/mm ²]
1	298	399.90

Calculations

$$\frac{N_{s,uta} \text{ [kN]}}{119.195}$$

Results

N _{s,uta} [kN]	φ _s	R	N _{sar} [kN]	N _{fa} [kN]
119.195	0.850	0.800	81.052	15.000

www.hilti.ca

 Company:
 Address:
 Phone | Fax: |
 Design: Concrete - Aug 11, 2022
 Fastening point:

 Page: 3
 Specifier:
 E-Mail:
 Date: 2022-08-12

3.2 Pullout Strength

$$N_{cpr} = \psi_{c,p} N_{pr}$$

$$N_{pr} = 8 \cdot A_{brg} \phi_c f'_c R \quad \text{CSA A23.3-14 Eq. D.16}$$

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

Variables

f'_c [N/mm ²]	$\psi_{c,p}$	A_{brg} [mm ²]
34.47	1.000	575

Calculations

$$\frac{8 A_{brg} f'_c \text{ [kN]}}{158.535}$$

Results

$8 A_{brg} f'_c$ [kN]	ϕ_c	R	N_{pr} [kN]	N_{cpr} [kN]	N_{fa} [kN]
158.535	0.650	1.000	103.048	103.048	15.000

3.3 Concrete Breakout Failure

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

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

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

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

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

$$\psi_{cp,N} = 1.0 \quad \text{CSA A23.3-14 D.6.2.7}$$

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

Variables

h_{ef} [mm]	$c_{a,min}$ [mm]	$\psi_{c,N}$	c_{ac} [mm]	k_c	λ_a	f'_c [N/mm ²]
120.0	1,120.0	1.000	-	10.0	1.000	34.47

Calculations

A_{Nc} [mm ²]	A_{Nc0} [mm ²]	$\psi_{ed,N}$	$\psi_{c,N}$	$\psi_{cp,N}$
129,600	129,600	1.000	1.000	1.000

Results

ϕ_c	R	N_{br} [kN]	N_{cbr} [kN]	N_{fa} [kN]
0.650	1.000	50.168	50.168	15.000

www.hilti.ca

Company:	Page: 4
Address:	Specifier:
Phone Fax:	E-Mail:
Design: Concrete - Aug 11, 2022	Date: 2022-08-12
Fastening point:	

4 Shear load

	Load V_f [kN]	Capacity V_r [kN]	Utilization $\beta_V = V_f/V_r$	Status
Steel Strength*	67.000	45.592	147	not recommended
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	67.000	100.337	67	OK
Concrete edge failure in direction x+**	67.000	370.175	19	OK

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

4.1 Steel Strength

$$V_{sar} = 0.6 A_{se,V} \phi_s f_{uta} R \quad \text{CSA A23.3-14 Eq. D.31}$$

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

Variables

n	A _{se,V} [mm ²]	f _{uta} [N/mm ²]
1	298	399.90

Calculations

Results

φ _s	R	V _{sar} [kN]	V _{fa} [kN]
0.850	0.750	45.592	67.000

www.hilti.ca

Company:
 Address:
 Phone | Fax: |
 Design: Concrete - Aug 11, 2022
 Fastening point:

Page: 5
 Specifier:
 E-Mail:
 Date: 2022-08-12

4.2 Pryout Strength

$$V_{cpr} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_{br} \right] R \quad \text{CSA A23.3-14 Eq. D.44}$$

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

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

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

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

$$\Psi_{cp,N} = 1.0 \quad \text{CSA A23.3-14 D.6.2.7}$$

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

Variables

k_{cp}	h_{ef} [mm]	$c_{a,min}$ [mm]	$\Psi_{c,N}$
2	120.0	1,120.0	1.000
c_{ac} [mm]	k_c	λ_a	f'_c [N/mm ²]
-	10.0	1.000	34.47

Calculations

A_{Nc} [mm ²]	A_{Nc0} [mm ²]	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$
129,600	129,600	1.000	1.000	1.000

Results

ϕ_c	N_{br} [kN]	V_{cp} [kN]	R	V_{cpr} [kN]	V_{fa} [kN]
0.650	50.168	100.337	1.000	100.337	67.000

www.hilti.ca

 Company:
 Address:
 Phone | Fax: |
 Design: Concrete - Aug 11, 2022
 Fastening point:

 Page: 6
 Specifier:
 E-Mail:
 Date: 2022-08-12

4.3 Concrete edge failure in direction x+

$$V_{cbr} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{\alpha,V(D.7.2.1(c))} V_{br} \quad \text{CSA A23.3-14 Eq. D.32}$$

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

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

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

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

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

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

Variables

c_{a1} [mm]	c_{a2} [mm]	$\Psi_{c,V}$	h_a [mm]	l_e [mm]
1,120.0	2,500.0	1.000	800.0	120.0
λ_a	d_a [mm]	f_c [N/mm ²]	$\Psi_{\alpha,V(D.7.2.1(c))}$	
1.000	22.2	34.47	1.000	

Calculations

A_{Vc} [mm ²]	A_{Vc0} [mm ²]	$\Psi_{ed,V}$	$\Psi_{h,V}$
2,688,000	5,644,800	1.000	1.449

Results

ϕ_c	R	V_{br} [kN]	V_{cbr} [kN]	V_{fa} [kN]
0.650	1.000	536.434	370.175	67.000

5 Combined tension and shear loads

$\beta_N = N_r/N_r$	$\beta_V = V_r/V_r$	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.299	1.470	1.000	148	not recommended

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

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!

Fastening does not meet the design criteria!

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Company:
 Address:
 Phone | Fax:
 Design: Concrete - Aug 11, 2022
 Fastening point:

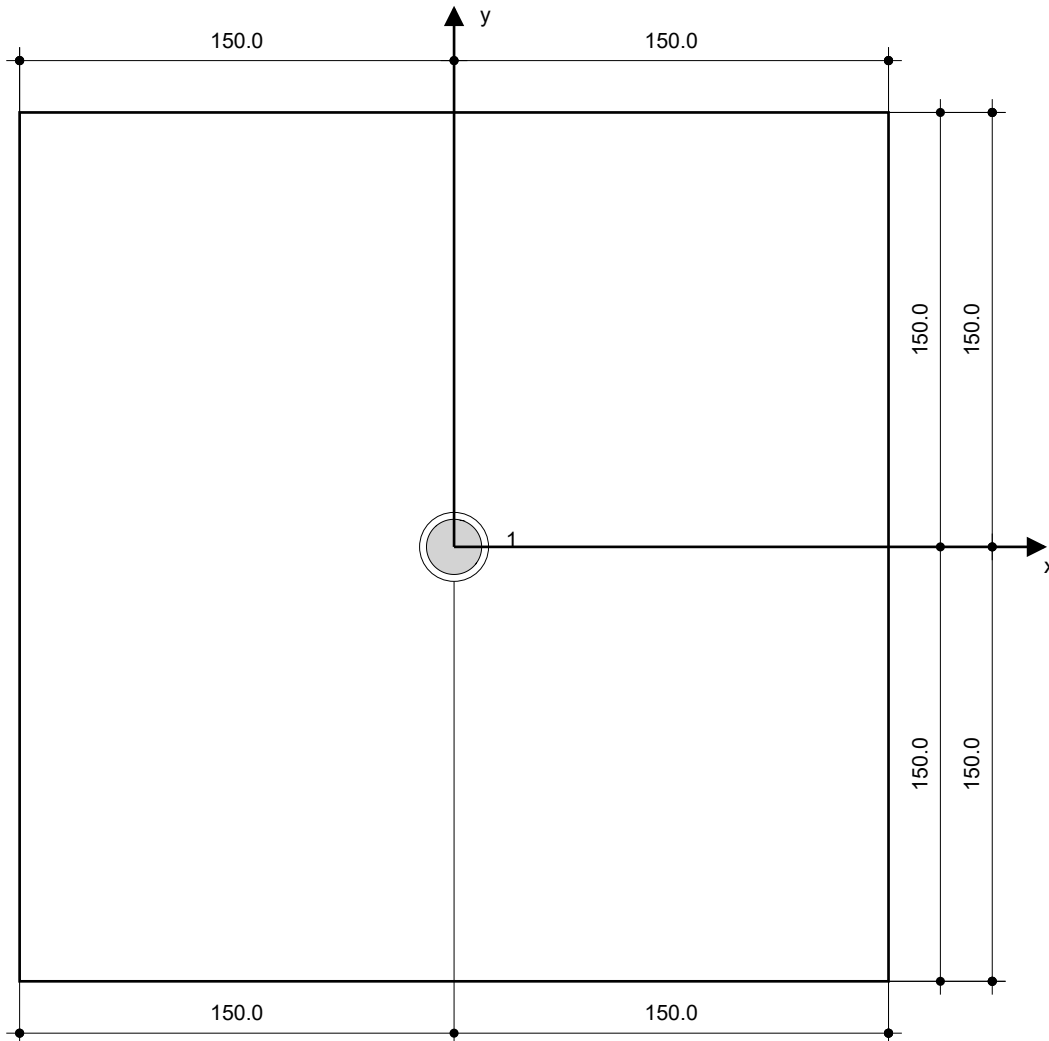
Page: 7
 Specifier:
 E-Mail:
 Date: 2022-08-12

7 Installation data

Profile: Round bars (AISC), 3/4; (L x W x T) = 19.1 mm x 19.1 mm
 Hole diameter in the fixture: $d_f = 23.8$ mm
 Plate thickness (input): 12.7 mm
 Recommended plate thickness: not calculated

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 7/8
 Item number: not available
 Maximum installation torque: -
 Hole diameter in the base material: -
 Hole depth in the base material: 120.0 mm
 Minimum thickness of the base material: 146.7 mm

Hilti Hex Head headed stud anchor with 120 mm embedment, 7/8, Steel galvanized, installation per instruction for use



Coordinates Anchor [mm]

Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	0.0	0.0	1,120.0	1,120.0	2,500.0	2,500.0



www.hilti.ca

Company:		Page:	8
Address:		Specifier:	
Phone Fax:		E-Mail:	
Design:	Concrete - Aug 11, 2022	Date:	2022-08-12
Fastening point:			

8 Remarks; Your Cooperation Duties

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