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Address:	209 North Street, Rockville, Toowoomba Qld 4350	Specifier:	Denis Brown
Phone I Fax:	07 4632 0126 | 07 4639 4177	E-Mail:	denis@dessolqld.com.au
Design:	Concrete - Jun 20, 2024	Date:	20/6/2024
Fastening Point:	OUTER MOST HOLES AT TOP OF BRACKET AND LOWER MOST HOLES IN BOTTOM OF BRACKET		

Specifier's comments: tO BE CHECKED BY LAWRENCE please. SIMPSON Strong-Tie SAE250/50/2

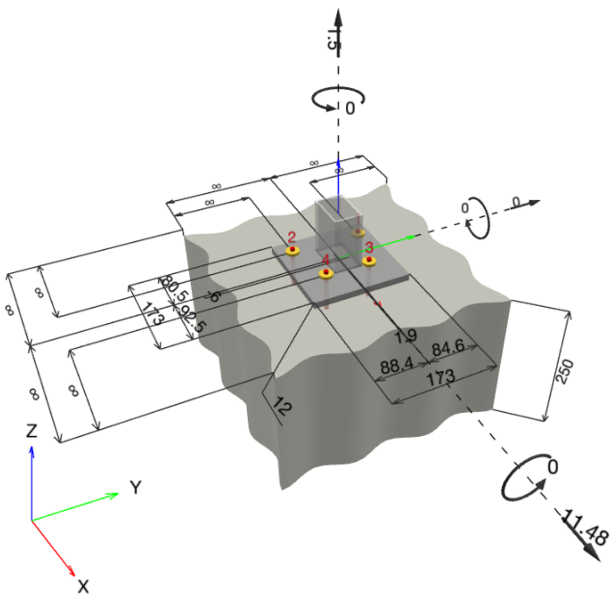
1 Anchor Design

1.1 Input data

Anchor type and size:	**HUS4-H 8 h_nom3**
Return period (service life in years):	50
Item number:	2293139 HUS4-H 8x100 60/40/30
Hilti Filling Set or any suitable annular gap filling solution	
Effective embedment depth:	h_{ef} = 56.1 mm ($h_{ef,ETA}$ = 56.1 mm), h_{nom} = 88.0 mm
Material:	Carbon Steel
Approval No.:	ETA-20/0867
Issued I Valid:	14/7/2022 | -
Proof:	SOFA based on EN 1992-4, Mechanical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 12.0 mm
Baseplate[CBFEM] :	l_x x l_y x t = 173.0 mm x 173.0 mm x 12.0 mm;
Profile:	Rectangular hollow section, 75x50x4RHS; (L x W x T) = 75.0 mm x 50.0 mm x 4.0 mm
Base material:	cracked concrete, 32MPa, $f_{c,cyl}$ = 32.00 N/mm^2; h =250.0 mm, User-defined partial material safety factor γ_c = 1.500
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	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

[CBFEM] - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

Geometry [mm] & Loading [kN, kNm]

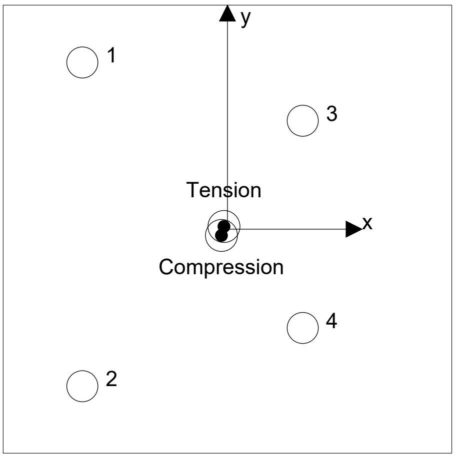


1.1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 1.500; V_x = 11.480; V_y = 0.000; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	25

1.2 Load case/Resulting anchor forces

uls SHEAR LOAD MAK 11.4 kN



Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.299	2.859	2.859	-0.006
2	0.321	2.860	2.860	0.006
3	0.556	2.881	2.881	0.006
4	0.557	2.880	2.880	-0.006

resulting tension force in (x/y)=(-1.3/1.0): 1.732 [kN]
resulting compression force in (x/y)=(-2.3/-2.4): 0.255 [kN]

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

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

Nominal 2kN

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel failure*	0.557	24.000	3	OK
Pull-out failure*	0.557	12.202	5	OK
Concrete Breakout failure**	1.732	20.509	9	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

1.3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
36.000	1.500	24.000	0.557

1.3.2 Pull-out failure

$N_{Rk,p}$ [kN]	ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
14.469	1.265	1.500	12.202	0.557

1.3.3 Concrete Breakout failure

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	$f_{c,cyl}$ [N/mm^2]
70,468	28,325	84.2	168.3	32.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
12.1	0.874	0.8	0.990	1.000	0.780

z [mm]	$\psi_{M,N}$	k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Ed} [kN]
3.6	1.000	7.700	18.302	1.500	20.509	1.732

Group anchor ID
1-4

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

11.4 kN from Clear calc

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel failure (without lever arm)*	2.881	14.016	21	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	11.480	47.384	25	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

1.4.1 Steel failure (without lever arm)

$V^0_{Rk,s}$ [kN]	k_7	$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Ed} [kN]
21.900	0.800	17.520	1.250	14.016	2.881

1.4.2 Pryout failure

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k_8	$f_{c,cyl}$ [N/mm^2]
70,468	28,325	84.2	168.3	2.000	32.00

$e_{c1,V}$ [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	1.000	0.780	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Ed} [kN]
7.700	18.302	1.500	47.384	11.480

Group anchor ID
1-4

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
0.023	0.206	2.000	5	OK

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

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.084	0.242	1.500	15	OK

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

1.6 Warnings

- The anchor design methods in PROFIS Engineering require rigid baseplates 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 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 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!
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- In general, the conditions given in ETAG 001, Annex C, section 4.2.2.1 and 4.2.2.3 b) are not fulfilled because the diameter of the clearance hole in the fixture acc. to Annex 3, Table 3 is greater than the values given in Annex C, Table 4.1 and AS5126 for the corresponding diameter of the anchor. Therefore the design resistance for anchor groups is limited to twice the steel resistance (of a single anchor) in accordance with the approval.
- Checking the transfer of loads into the base material is required in accordance with EN 1992-4, Annex A!
- 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 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.
- 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 baseplates, as per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means that the baseplate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the baseplate is considered close to rigid by engineering judgment."
- The characteristic bond resistances depend on the return period (service life in years): 50

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Specifier: Denis Brown
E-Mail: denis@dessolqld.com.au
Date: 20/6/2024

1.7 Installation data

USE 8mm Concrete Screws supplied to Site by Denis with drivers

Baseplate, steel: Grade 300; E = 200,000.00 N/mm^2; f_{yk} = 310.00 N/mm^2
Profile: Rectangular hollow section, 75x50x4RHS; (L x W x T) = 75.0 mm x 50.0 mm x 4.0 mm
Hole diameter in the fixture: d_f = 12.0 mm
Plate thickness (input): 12.0 mm

Drilling method: Hammer drilled
Cleaning: Clean the drill hole. Under the conditions - according to fastener size and drilling direction - given in the ETA and MPII (IFU), the cleaning of the drill hole may be omitted.

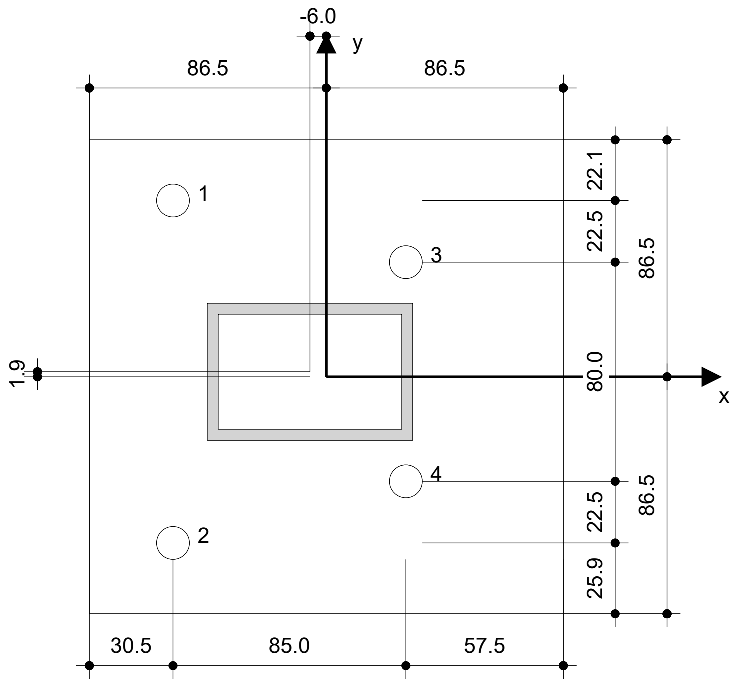
Anchor type and size: HUS4-H 8 h_nom3
Item number: 2293139 HUS4-H 8x100 60/40/30

Maximum installation torque: -
Hole diameter in the base material: 8.0 mm
Hole depth in the base material: 98.0 mm
Minimum thickness of the base material: 128.0 mm

Hilti HUS screw anchor with 70 mm embedment, 8 h_nom3, Steel galvanized, installation per ETA-20/0867, 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	• Manual blow-out pump	• SIW 6-A22 Impact Screw Driver



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-56.0	64.4	-	-	-	-
2	-56.0	-60.6	-	-	-	-
3	29.0	41.9	-	-	-	-
4	29.0	-38.1	-	-	-	-

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2 Custom pictures

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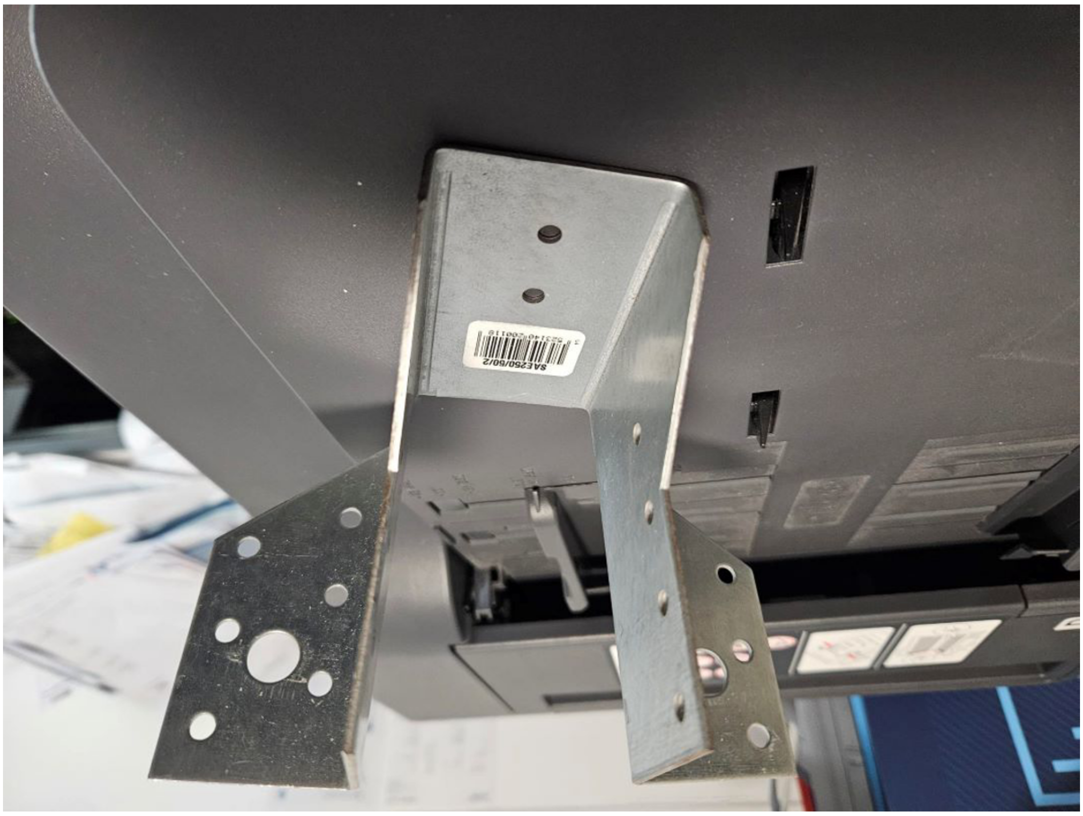

2 Baseplate design

2.1 Input data

Baseplate:	Shape: Rectangular l_x x l_y x t = 173.0 mm x 173.0 mm x 12.0 mm Calculation: CBFEM Material: Grade 300; F_y = 310.00 N/mm²; ε_{lim} = 5.00%
Anchor type and size:	HUS4-H 8 h_nom3, h_{ef} = 56.1 mm
Anchor stiffness:	The anchor is modelled 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:	AS 4100:1998 -based design using component-based FEM
Stand-off installation:	e_b = 0.0 mm (No stand-off); t = 12.0 mm
Profile:	75x50x4RHS; (L x W x T x FT) = 75.0 mm x 50.0 mm x 4.0 mm x - Material: Grade C250; F_y = 250.00 N/mm²; ε_{lim} = 5.00% Eccentricity x: -6.0 mm Eccentricity y: 1.9 mm
Base material:	Cracked concrete; 32MPa; $f_{c,cyl}$ = 32.00 N/mm²; h = 250.0 mm; E = 30,100.00 N/mm²; G = 12,541.67 N/mm²; v = 0.20
Welds (profile to baseplate):	Type of redistribution: Plastic Material: Grade B-E43XX Web weld thickness: 2.8 mm; f_{uw} = 430.00 N/mm² Flange weld thickness: 2.8 mm; f_{uw} = 430.00 N/mm²
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

Description		Profile		Baseplate			Concrete [%]
		σ_{Eq} [N/mm²]	ε_{Pl} [%]	σ_{Eq} [N/mm²]	ε_{Pl} [%]	Hole bearing [%]	
1	Combination 1	71.80	0.00	21.04	0.00	3	1

2.3 Baseplate plate classification

Results below are displayed for the decisive load combinations: Combination 1

Anchor tension forces	Equivalent rigid baseplate (CBFEM)	Component-based Finite Element Method (CBFEM) baseplate
Anchor 1	0.275 kN	0.299 kN
Anchor 2	0.275 kN	0.321 kN
Anchor 3	0.475 kN	0.556 kN
Anchor 4	0.475 kN	0.557 kN

User accepted to consider the selected baseplate 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

$\varepsilon_{Pl} \leq \varepsilon_{lim}$

Results

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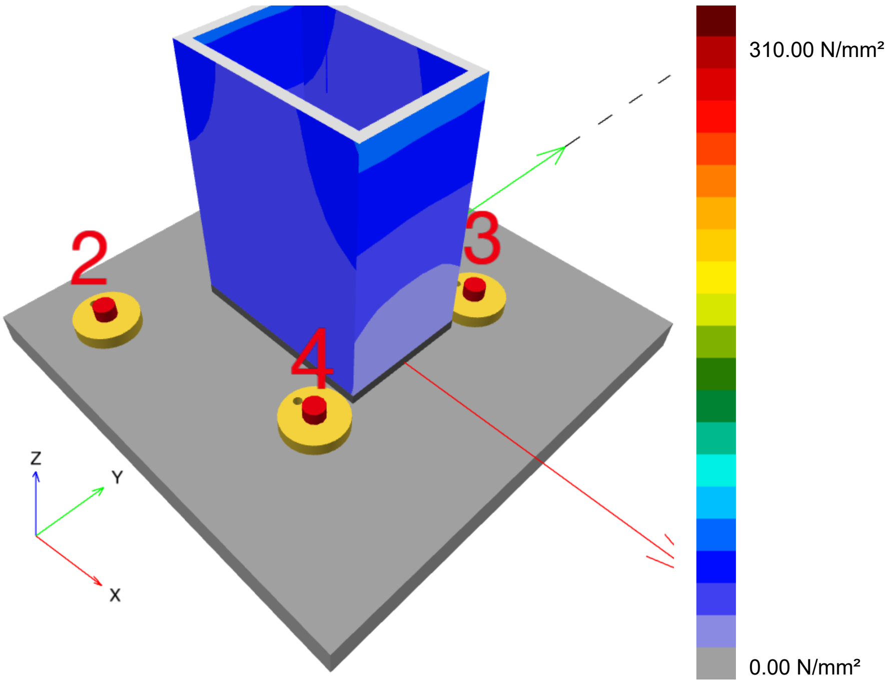
Part	Load combination	Material	σ_{Eq} [N/mm²]	ε_{Pl} [%]	f_y [N/mm²]	Φ_{steel}	$f_y\ \Phi_{steel}$ [N/mm²]	ε_{lim} [%]	Status
Plate	Combination 1	Grade 300	21.04	0.00	310.00	0.90	279.00	5.00	OK
Profile	Combination 1	Grade C250	68.62	0.00	250.00	0.90	225.00	5.00	OK
Profile	Combination 1	Grade C250	71.80	0.00	250.00	0.90	225.00	5.00	OK
Profile	Combination 1	Grade C250	63.52	0.00	250.00	0.90	225.00	5.00	OK
Profile	Combination 1	Grade C250	63.53	0.00	250.00	0.90	225.00	5.00	OK

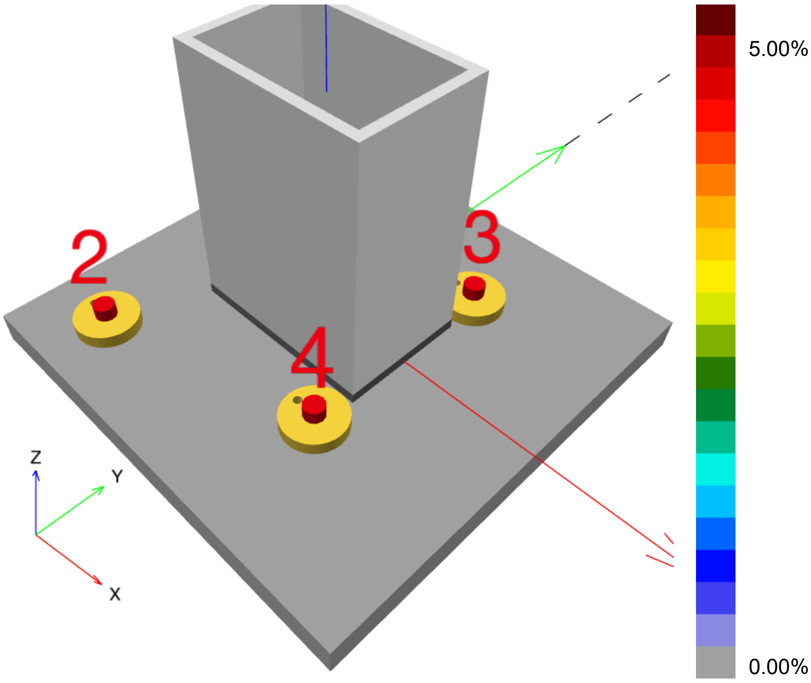
2.4.1.1 Equivalent stress

Results below are displayed for the decisive load combination: 1 - Combination 1



2.4.1.2 Plastic strain

Results below are displayed for the decisive load combination: 1 - Combination 1



2.4.2 Hole bearing

Decisive load combination: 1 - Combination 1

Plate hole bearing resistance, AS 4100:1998 section 9.3.2.4:

Results

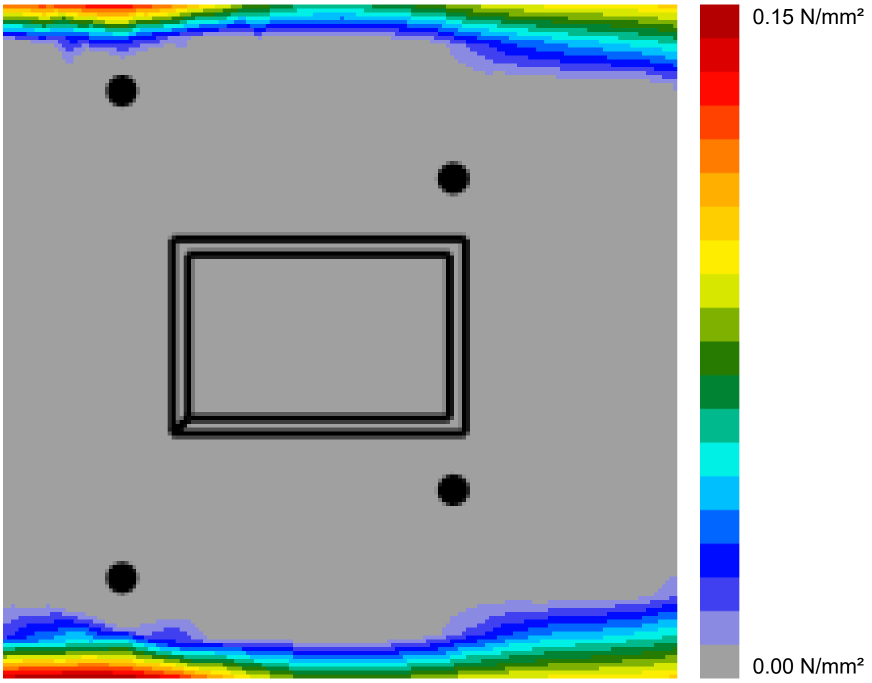
	ΦV_b [kN]	V_b^* [kN]	Utilisation [%]	Status
Anchor 1	118.886	2.859	3	OK
Anchor 2	118.886	2.860	3	OK
Anchor 3	118.886	2.881	3	OK
Anchor 4	118.886	2.880	3	OK

2.5 Concrete

Decisive load combination: 1 - Combination 1

According to AS 3600:2018 section 12.6, 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 not within the scope of PROFIS Engineering.

2.5.1 Compression in concrete under the baseplate



2.5.2 Verification of compression in concrete under the baseplate around the profile as per AS 3600:2018 12.6

Results

σ_c [N/mm²]	f_b [N/mm²]	Utilisation [%]	Status
0.04	34.56	1	OK

2.6 Symbol explanation

ε_{lim}	Limit plastic strain
ε_{Pl}	Plastic strain from CBFEM results
f_b	Concrete block bearing resistance
f_y	Yield strength
σ_c	Average stress in concrete
σ_{Eq}	Equivalent stress
Φ_{steel}	Steel capacity factor
V_b^*	Resultant of anchor shear forces Vy and Vz in shear planes

2.7 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified baseplate may not behave rigidly. Please, have the results validated by a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modelled 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.

3 Summary of results

Design of the baseplate, anchors, welds and other elements are based on CBFEM (component-based finite element method) and AS.

	Load combination	Max. utilisation	Status
Anchors	Combination 1	25%	OK
Baseplate	Combination 1	7%	OK
Concrete	Combination 1	1%	OK
Profile	Combination 1	29%	OK

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

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