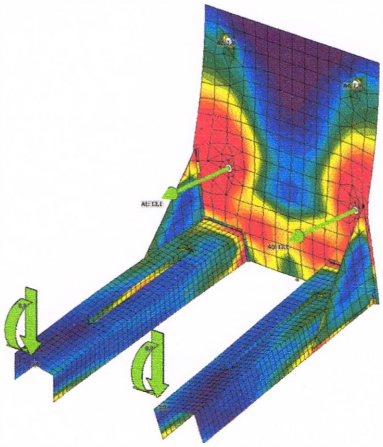
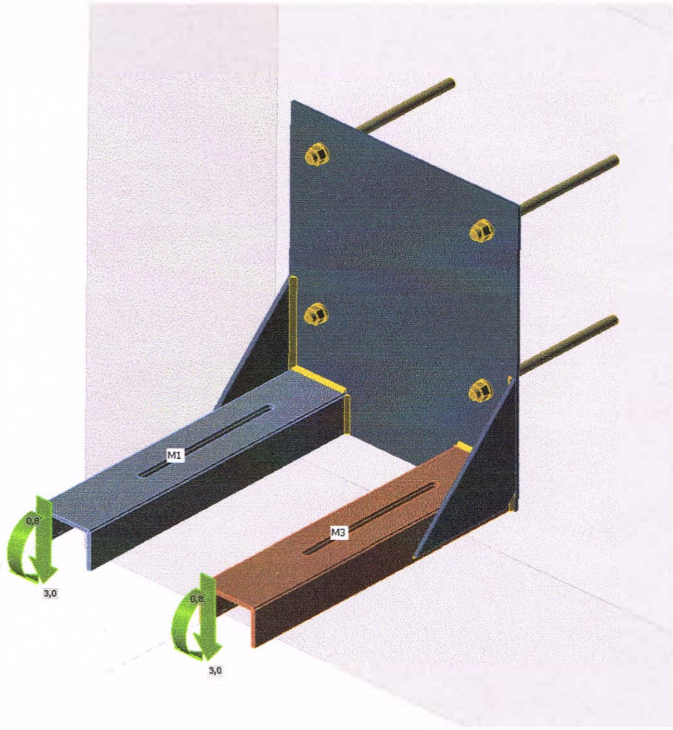
project: **console for DT33-34** (anchor bracket, wall mount)

ID number: **O – 03 / 2020**





subject:

static calculation report

contract number: **20_043**

date: **12 - 2020**

client (order): **Duratruss B.V.**

Junostraat 2

6468 EW Kerkrade

investor/project:

contrator: **LOstade CZ s.r.o.**

Na Burni 1497/39, 710 00 Ostrava

www.lostade.cz

worked out: **Ing. Jan Lukáš**

jan.lukas@lostade.cz

+420 724 791 227

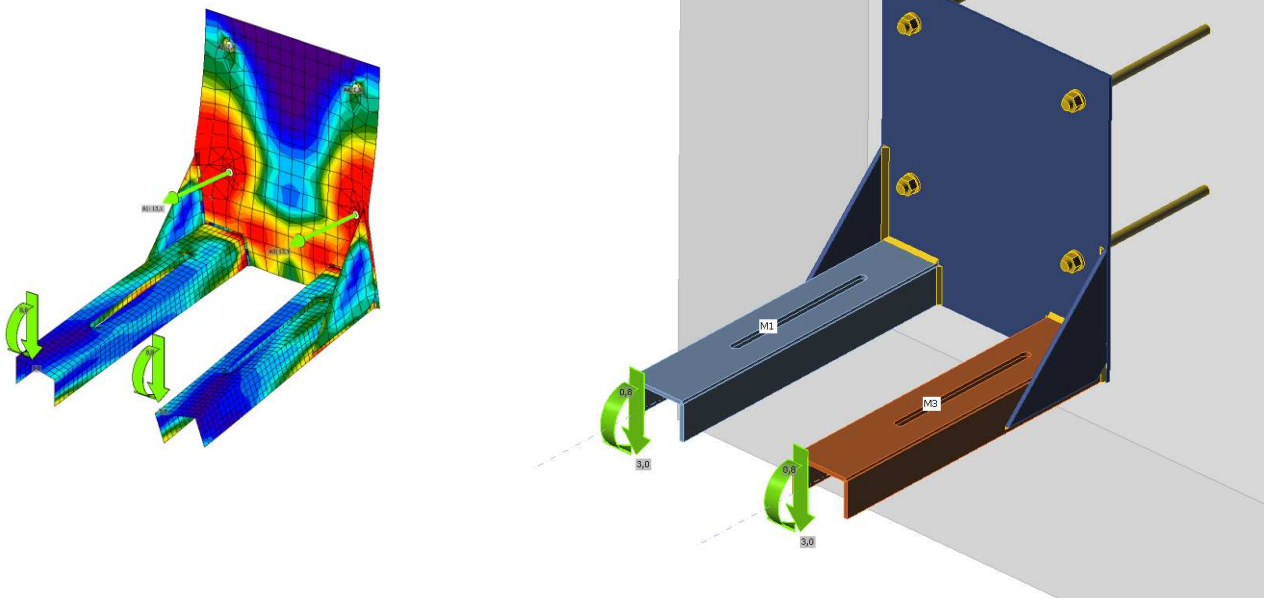
signature:

authorization:

Ing. JAN LUKÁŠ inženýr pro statiku a dynamiku staveb autorizovaný ČKAIT 1103419

project: **console for DT33-34** (anchor bracket, wall mount)

ID number: **O – 03 / 2020**



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signature:

index:

total number of pages: **-12-**

1 description of the structure

brief assignment - inputs

type of structure:	accessories of DT truss system
basic dimensions:	contour 330 x 305 / 380 mm
location:	indoor installation
purpose:	special segment – anchor bracket for wall mounting square/
primary truss sys.:	triangular truss _DT 34 / DT 33 | chords T. Ø 50 mm

Static calculation of the DT truss accessories – **console (anchor bracket)** – for **wall mounting** of truss system DT33 and DT34 with chord tubes Ø50mm and with a spacing of 240 mm.

This wall mount element is consisted from two 300 mm length U-profile with clamps that can be moved in the longitudinal groove. The spacing of the U-profiles is the same, ie 240 mm. The longitudinal groove allows adjustment of the clamps (truss support) in the range of 200 mm. The U-profiles are welded at the front to a sheet metal plate P5 measuring 330 x 380 mm. There are triangular stiffeners welded on the outer sides. In the anchor plate there are 4 holes with an inner Ø 13 mm, prepared for M12 anchor bolts.

Main parametrs/specifications:
U-profile … U 80 x 50 x 5.0 (mm), groove Ø12-212
Clamps … 2x sys. clamp d=50mm, gar. capacity 500 kg
anchor plate … P5 – 330/380
triangular stiffeners … made from P5-100

2 design fundamental

2.1 standards

ČSN EN 1990	Basis of structural design
ČSN EN 1991-1-1	Eurocode 1: Actions on structures *Part 1-1: General actions – Densities, self-weight, imposed loads for buildings*
ČSN EN 1993-1-1	Eurocode 3: Design of steel structures *Part 1-1: General rules and rules for buildings*
ČSN EN 1993-1-8	Eurocode 3: Design of steel structures *Part 1-8: design of joints*
ČSN EN 1999-1-1	Eurocode 9: Design of aluminium structures *Part 1-1: General structural rules*

2.2 materials

truss – all tubes:	EN-AW 6082 (alloy – Al Si1MgMn), T6
U-profile, P5-100:	EN-AW 6060 (alloy – Al MgSi), T6
sheet metal plate:	EN-AW 5083 (alloy – Al Mg4,5Mn0,7), O/H111
bolts:	8.8 … steel, f_{yb} = 640 Nmm^{-2}
welding metod:	TIG
filler metal for welds:	6060 + 5083 -> welding type 5; calc. group of filler metal – 5356

2.3 structure classification

Execution class: **EXC 2 …**
… in accordance with - ČSN EN 1090-1+A1; **ČSN EN 1090-3+A1**; (ČSN EN 1090-2+A1)
Manufacture of all structure components fall in EXC 2 or higher class.
Consequences class for the structure application: CC2

2.4 *loads*

Permanent actions: self-weight of structure (g_0)

Imposed load: Q…point load – in both clamps

Safe factors: SC work with safe factors according EC standards for structure design.
- Self-weight, type of the permanent actions: γ_f **= 1,35**
- imposed loads/actions: γ_f **= 1,50**

The total load determines the **limit load capacity of the bracket with safety according to EU standards.** Only the vertical load on the console is taken into account (without horizontal actions)!

➔ **the MAX design load capacity** at full extension is **400 kg** (4,0 kN) with a safety factor of **1.5** / 600 kg is a characteristic load witout safety _s.f. = 1,0

The load is applied to the elemet in the form of a pair of vertical forces _2x 2,0 kN (200 kg) * 1,5 = 3,0 kN; acting at the ends of the longitudinal groove -> this eccentricity causes an additional moment effect.

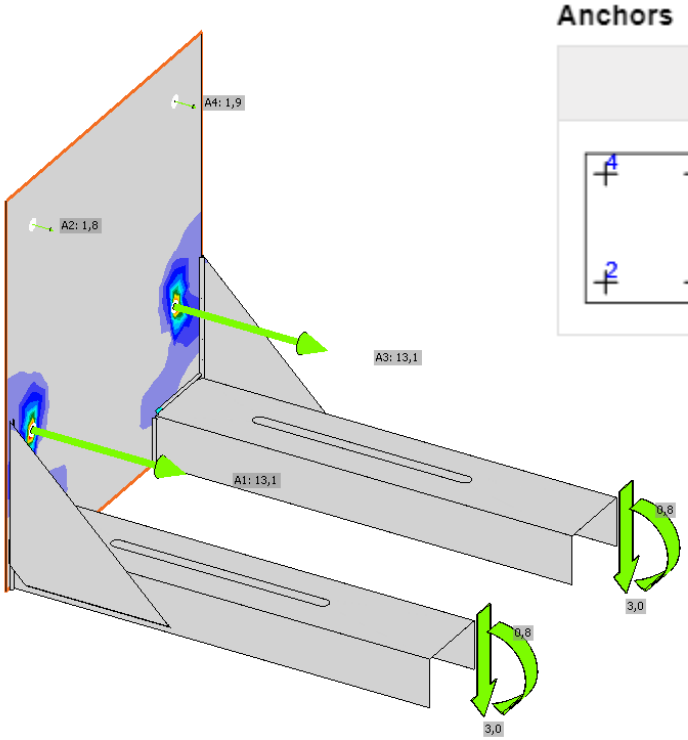
*calculation of 1 design force: 2,0 kN * 1,5 = 3,0 kN [Fz]*

*calculation of corresponding moment: 3,0 kN * 0,28 m (max. excentr.) = 0,84 kNm [My]*

2.5 *anchoring*

The maximum design load described above derives the following set of force effects (reactions) on the anchoring elements by which the bracket is held on the wall. -> $F_{t,Ed}$ / V of the anchors.

Resulting anchor forces (=design load case for each anchor):



Anchors

	Name	Loads	$F_{t,Ed}$ [kN]	V [kN]
	A1	LE1	13,1	1,5
	A2	LE1	1,8	1,5
	A3	LE1	13,1	1,5
	A4	LE1	1,9	1,5

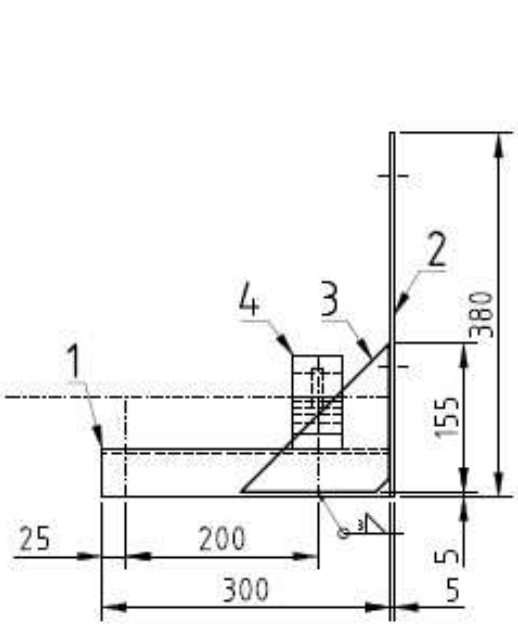
Reactions results - designed forces (actions) in 1 anchor:
- tension force **= 13,1 kN** (= 1310 kg)
- Vertical, shear force **= 1,5 kN** (= 150 kg)

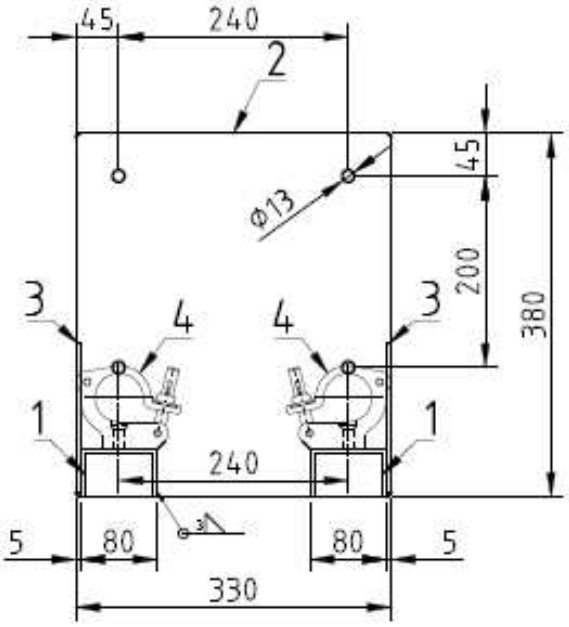
➔ the anchorage mainly depends on the basic material of the wall, on its condition and parameters (concrete, brick, thickness, reinforcement, edge distances, etc.) All 4 anchor have to be fixed against this set of forces!

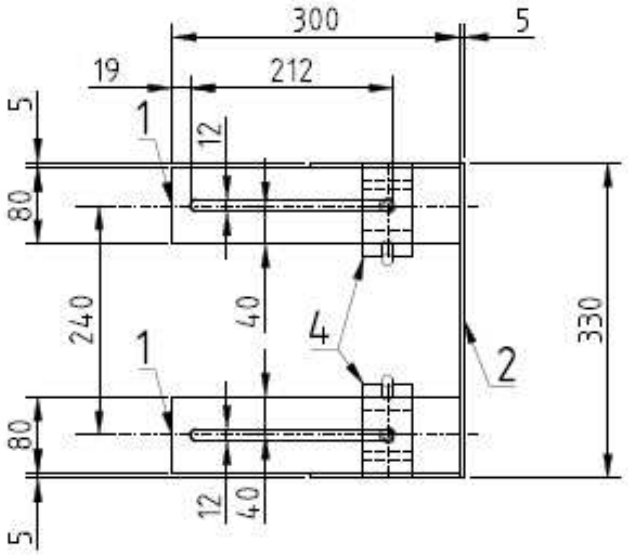
➔ **Type and way of the anchoring/fixing is fully up to local authority of structure user.**

2.6 geometry – segment drawing

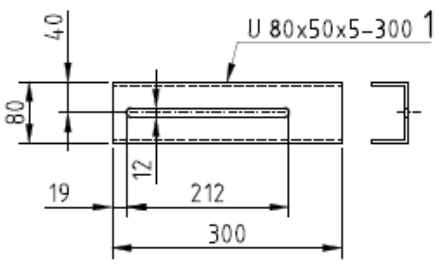
assembly drawing of the bracket (console) - wall mount segment
according the files from DRT: [Konsole for DT34.pdf]

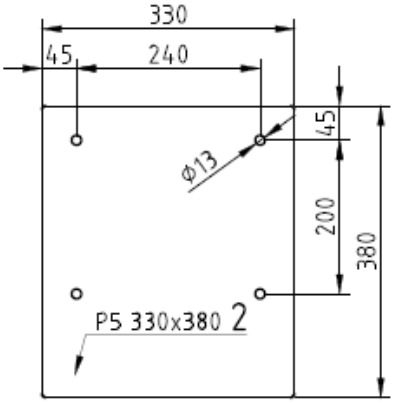


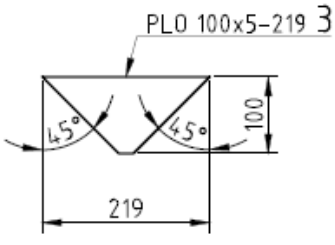




4	2	SIDE CLAMP			#8020
3	2	PLO 10x5	145	AW 6060	
2	1	P5	330x380	AW 5083	
1	2	U 80x50x5	300	AW 6060	
Pol.	Kusů	Název - profil	Rozměr	Materiál	Poznámka
KONSOLE FOR DT34					







3 static calculation and analysis

3.1 SA of the detail - segment

software info: Application _IDEA StatiCa Connection, version 10.1.99.54266, developed by Idea StatiCa

static analysis: CBFEM method _ replaces specific analysis of internal forces in joint with general FEA.

author: Jan Lukáš

3.1.1 inputs data, geometry

Beams

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
M1	2 - U 80x50 / 5(U80)	0,0	0,0	-90,0	0	0	0	Node
M3	2 - U 80x50 / 5(U80)	0,0	0,0	-90,0	0	0	240	Node

cross-sections

Name	Material
2 - U 80x50 / 5(U80)	AW 6060 T6

Anchors

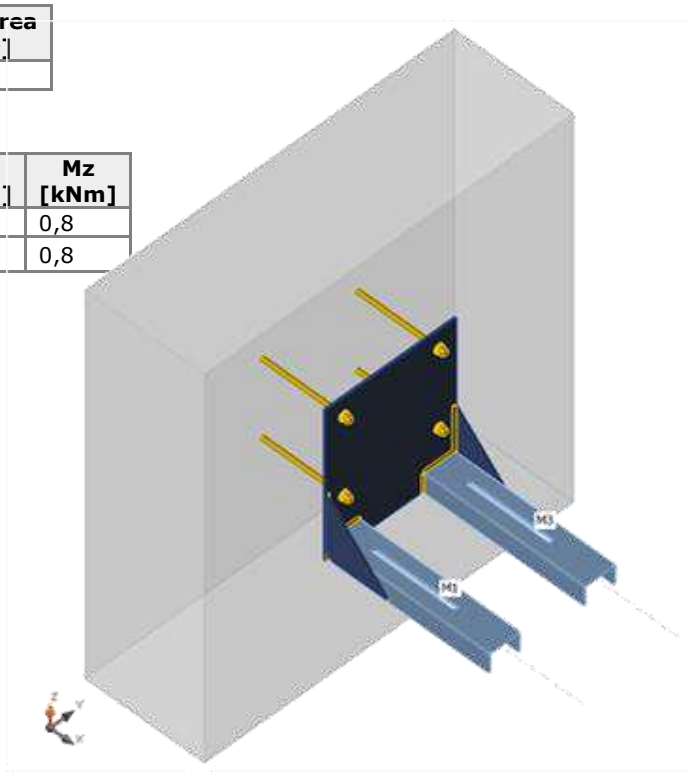
Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm²]
M12 8.8	M12 8.8	12	800,0	113

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	M1	0,0	3,0	0,0	0,0	0,0	0,8
	M3	0,0	3,0	0,0	0,0	0,0	0,8

Foundation block

Item	Value	Unit
CB 1		
Dimensions	980 x 930	mm
Depth	300	mm
Anchor	M12 8.8	
Anchoring length	200	mm
Shear force transfer	Anchors	



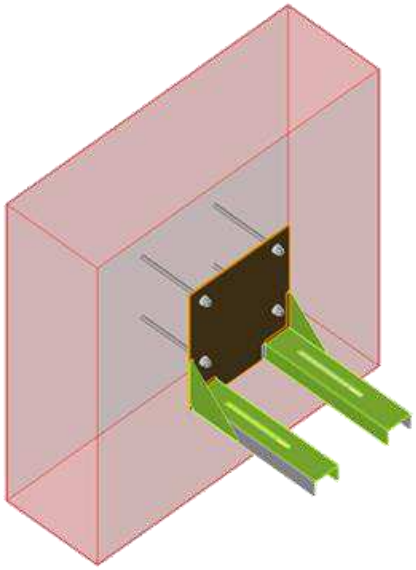
3.1.2 Checks

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	**3,7 < 5%**	**OK**
Anchors	**45,3 < 100%**	**OK**
Welds	**98,7 < 100%**	**OK**
Concrete block	Not calculated	
Buckling	Not calculated	

Plates

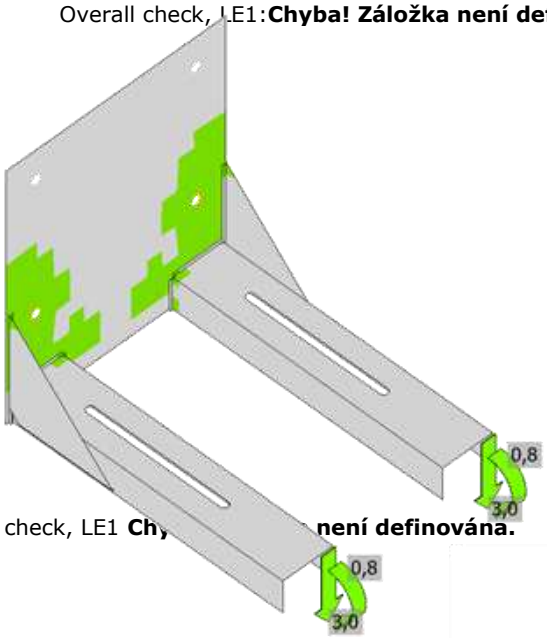
Name	Material	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Status
M1-bfl 1	AW 6060 T6	5,0	LE1	112,8	0,0	OK
M1-tfl 1	AW 6060 T6	5,0	LE1	138,2	0,0	OK
M1-w 1	AW 6060 T6	5,0	LE1	140,0	0,0	OK
M3-bfl 1	AW 6060 T6	5,0	LE1	136,8	0,0	OK
M3-tfl 1	AW 6060 T6	5,0	LE1	112,9	0,0	OK
M3-w 1	AW 6060 T6	5,0	LE1	139,5	0,0	OK
SP1	AW 5083 o/h111	5,0	LE1	127,6	3,7	OK
SP2	AW 6060 T6	5,0	LE1	140,1	0,2	OK
SP3	AW 6060 T6	5,0	LE1	140,1	0,2	OK

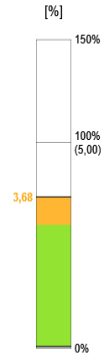


Design data

Material	f_y [MPa]	ε_{lim} [%]
AW 6060 T6	140,0	5,0
AW 5083 o/h111	125,0	5,0

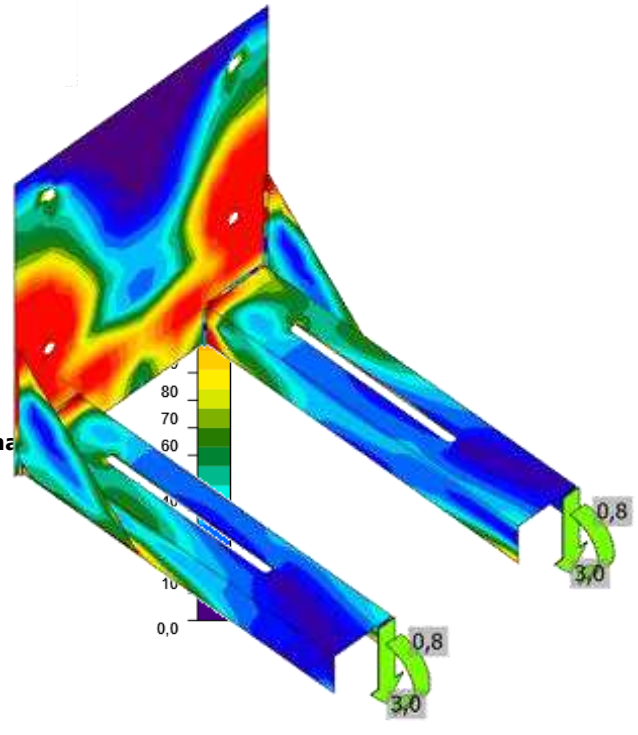
Overall check, LE1:**Chyba! Záložka není definována.**



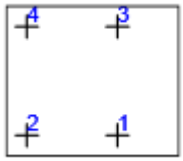


Strain check, LE1 **Chy není definována.**

Equivalent stress, LE1 **Chyba! Záložka není definována.**



Anchors

	Name	Loads	$F_{t,Ed}$ [kN]	V [kN]	N_{rdc} [kN]	N_{rdp} [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	$V_{Rd,cp}$ [kN]	$V_{Rd,c}$ [kN]	Status
	A1	LE1	13,1	1,5	28,9	0,0	45,3	33,0	5,7	31,8	69,4	42,5	OK
	A2	LE1	1,8	1,5	28,9	0,0	6,3	33,0	5,5	2,9	69,4	53,1	OK
	A3	LE1	13,1	1,5	28,9	0,0	45,2	33,0	5,7	31,8	69,4	42,5	OK
	A4	LE1	1,9	1,5	28,9	0,0	6,5	33,0	5,5	3,0	69,4	53,1	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]	V_{rds} [kN]	S_{tf} [MN/m]
M12 8.8 - 1	41,1	41,5	26,9	26,9	247

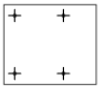
Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	Ut [%]	Ut_c [%]	Status
SP1	M1-bfl 1	◢3,0◣	48	LE1	58,6	0,0	-16,7	-7,3	-31,6	34,4	22,9	OK
		◢3,0◣	48	LE1	94,6	0,0	-55,6	17,3	40,7	55,6	31,6	OK
SP1	M1-tfl 1	◢3,0◣	48	LE1	74,4	0,0	70,1	13,2	5,9	57,2	25,2	OK
		◢3,0◣	48	LE1	93,5	0,0	-41,5	-10,4	47,3	55,0	44,7	OK
SP1	M1-w 1	◢3,0◣	75	LE1	167,6	1,5	17,0	-54,5	79,4	98,6	42,3	OK
		◢3,0◣	75	LE1	167,7	1,2	119,8	21,0	-64,4	98,7	46,7	OK
SP1	M3-bfl 1	◢3,0◣	48	LE1	93,2	0,0	-41,3	9,5	-47,3	54,8	44,0	OK
		◢3,0◣	48	LE1	75,8	0,0	70,8	-13,1	-8,7	57,8	25,8	OK
SP1	M3-tfl 1	◢3,0◣	48	LE1	94,5	0,0	-55,6	-17,4	-40,6	55,6	31,9	OK
		◢3,0◣	48	LE1	58,5	0,0	-16,5	7,3	31,5	34,4	22,8	OK
SP1	M3-w 1	◢3,0◣	75	LE1	167,5	1,4	15,5	54,8	79,2	98,6	41,8	OK
		◢3,0◣	75	LE1	166,4	1,1	119,8	-20,8	-63,4	97,9	46,1	OK
M1-bfl 1	SP2	◢3,0	140	LE1	43,7	0,0	19,0	-4,8	22,2	25,7	13,4	OK
M1-bfl 1	SP2	◢3,0	0	LE1						0,0	0,0	OK
M1-bfl 1	SP2	◢3,0	23	LE1	34,2	0,0	-12,3	-4,9	17,7	20,1	17,5	OK
M3-tfl 1	SP3	◢3,0	140	LE1	43,9	0,0	19,1	-4,8	-22,3	25,8	13,3	OK
SP1	SP2	◢4,0	140	LE1	166,7	0,1	77,3	0,0	-85,3	98,0	44,8	OK
M3-tfl 1	SP3	◢3,0	0	LE1						0,0	0,0	OK
M3-tfl 1	SP3	◢3,0	23	LE1	35,0	0,0	-12,3	-5,0	-18,3	20,6	18,4	OK
SP1	SP3	◢4,0	140	LE1	166,7	0,1	77,1	0,0	85,3	98,0	45,0	OK

Design data

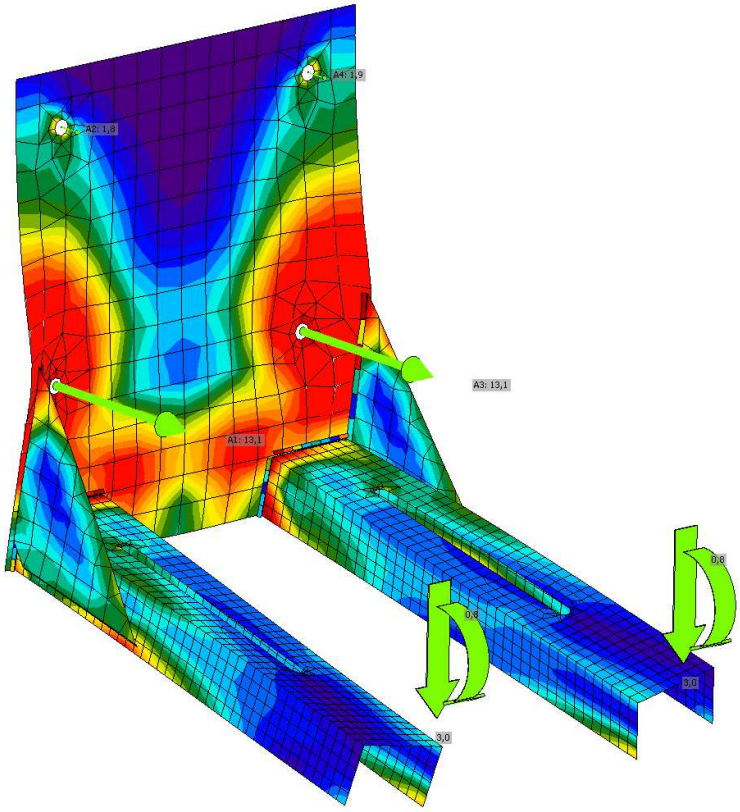
	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
AW 6060 T6	0,80	170,0	122,4

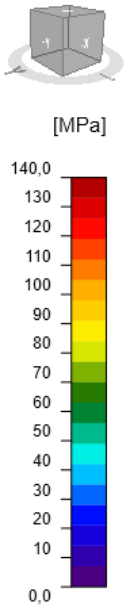
3.1.3 bill of material – manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
SP1	P5,0x380,0-330,0 (AW 5083 o/h111)		1			M12 8.8	4
OTV1/2	P5,0x406,0-75,0 (AW 6060 T6)		2				
SP2/3	P5,0x155,0-155,0 (AW 6060 T6)		2	Fillet: a = 3,0	163,2		

3.1.4 FE analysis – equivalent stress

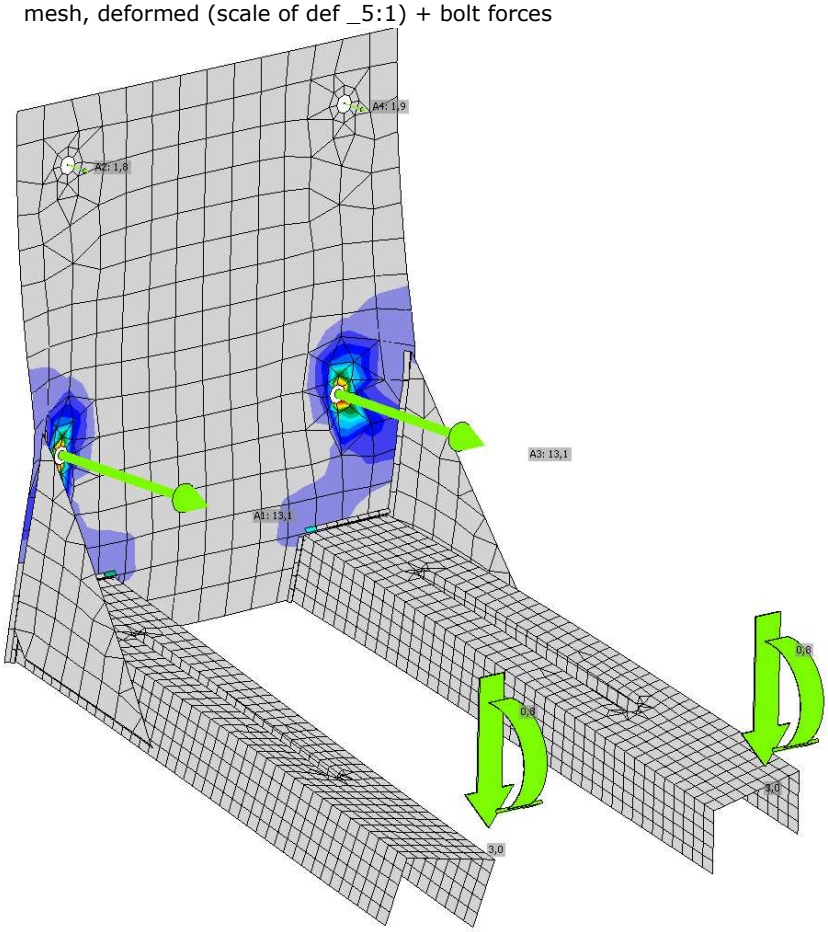
mesh, deformed (scale of def _5:1) + bolt forces

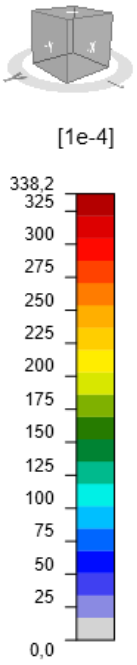




3.1.5 FE analysis – plastic strain

mesh, deformed (scale of def _5:1) + bolt forces

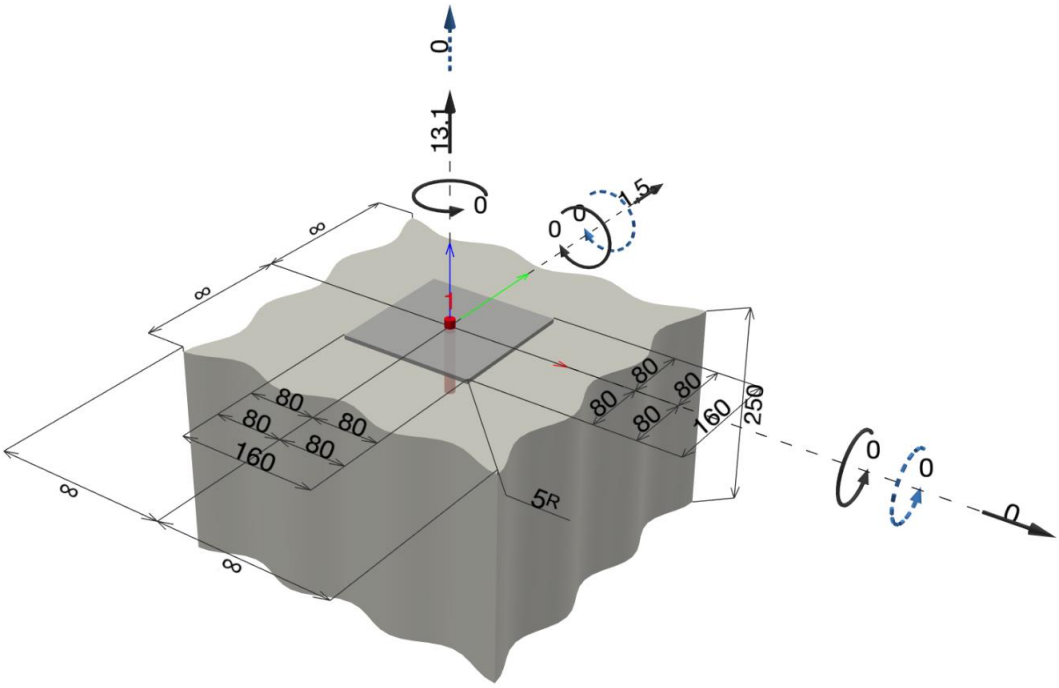




4 anchoring - example

example of chemical anchor assessment

- code checks acc. EC 2 _ Design Method EN 1992-4, Chemical
- used software: **Hilti** PROFIS Engineering 3.0.66



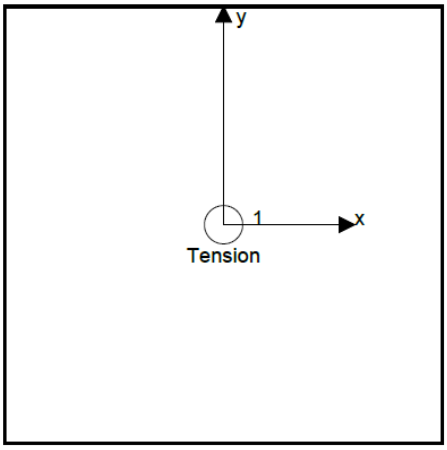
1 Input data

Anchor type and diameter:	**HIT-HY 200-A + HAS-U 5.8 M12**
Return period (service life in years):	50
Item number:	2223821 HAS-U 5.8 M12x110 (element) / 2022696 HIT-HY 200-A (adhesive)
Effective embedment depth:	$h_{ef,opti}$ = 75.0 mm ($h_{ef,limit}$ = 220.0 mm)
Material:	5.8
Evaluation Service Report:	Hilti Technical Data
Issued I Valid:	- | -
Proof:	Design Method EN 1992-4, Chemical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 5.0 mm
Anchor plate^R :	l_x x l_y x t = 160.0 mm x 160.0 mm x 5.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C16/20, $f_{c,cyl}$ = 16.00 N/mm^2; h = 250.0 mm, Temp. short/long: 40/24 °C, partial material safety factor γ_c = 1.500
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

1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Kombinace 1	N = 13.100; V_x = 0.000; V_y = 1.500; M_x = 0.000; M_y = 0.000; M_z = 0.000; N_{sus} = 0.000; $M_{x,sus}$ = 0.000; $M_{y,sus}$ = 0.000;	no	no	99

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	13.100	1.500	0.000	1.500

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0.0/0.0): 13.100 [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 (EN 1992-4, Section 7.2.1)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	13.100	28.133	47	OK
Combined pullout-concrete cone failure**	13.100	15.634	84	OK
Concrete Breakout Failure**	13.100	13.337	99	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

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

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	1.500	16.880	9	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	1.500	26.674	6	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

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
0.466	0.089	2.000	23	OK

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

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.982	0.056	1.000	87	OK

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

5 conclusion

Static calculation proved load capacities of the special segment – anchor bracket for wall mount (console) truss holder elemets.

Element is safe, because it has sufficient bearing capacity … resume:
>> Console capacity is **400 kg** <<

Structure can be used only according to defined terms and conditions with designed loads.

The structure requires careful assembly and inspection of all connections, including its anchoring. The anchoring mainly depends on the basic material of the wall, on its condition and parameters. Type and way of the fixing is fully up to local authority of structure user.

In Ostrava (Czech republic), 22-01-2021

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