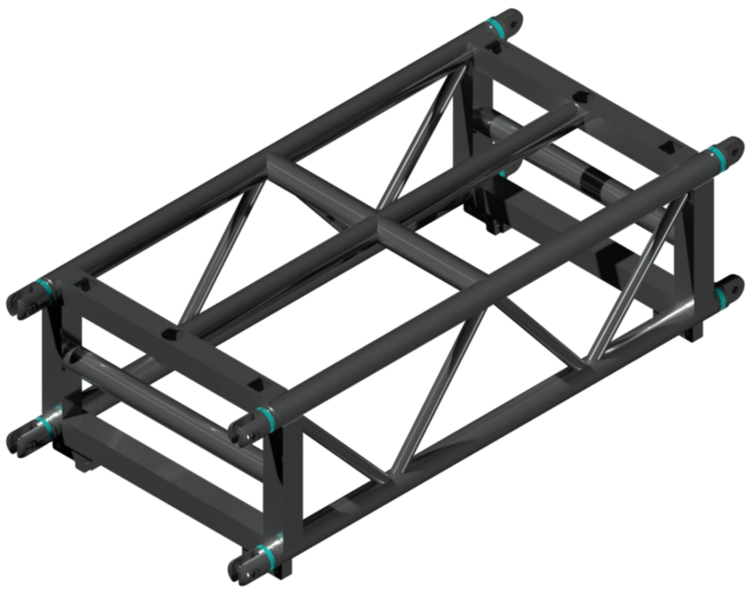
Truss Aluminium Factory a.s.

PR2T truss



CALCULATION REPORT

v. 01

Camponogara, 18/03/2024

Truss Aluminium Factory a.s., Hodolany 1226, 779 00 Olomouc, Czech Republic
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1. Premise

I signed Andrea Santello, born in Dolo (VE) – Italy - on 23/05/1986, site in Camponogara (VE) – Italy -, piazza Giuseppe Mazzini, 6/B, and registered in the Order of Engineers of Venice with the number A4927, had the commissioned to calculate the truss PR2T of the company Truss Aluminium Factory a.s., exposes the following:

2. Prescriptions

This structural report refers to rectangular truss series called "PR2T", produced from Truss Aluminium Factory a.s. in the following lengths 1220 mm and 2440 mm. The trusses must be used as beam, placed with main chords with horizontal axis. The allowed static schemes and payload are reported in the tables attached.

Payload has to be positioned near to the node points, and anyhow maximum single load must not exceed 1.00 kN (100 kg), unless the user provides suitable load distribution elements.

All connections with pins must be equipped with R-clips.

In case of excessive ovalization of the connection holes, a qualified technician is needed to check the integrity of the structure elements.

The loads have to be applied without eccentricity.

The calculation configuration and the imposed restraints have to be considered ideal conditions; therefore the user must analyze the structure according to the real load/restraint conditions.

This calculation report is considering static loads only; if dynamic actions cannot be limited, they will have to be carefully considered by assembly workers and any personnel in charge of assembly, check and certification.

If the truss would be uplifted through electric chain hoists, the personnel in charge of assembly, check and certification will have to carefully consider dynamic effects.

Present structural report is formed by 28 pages.

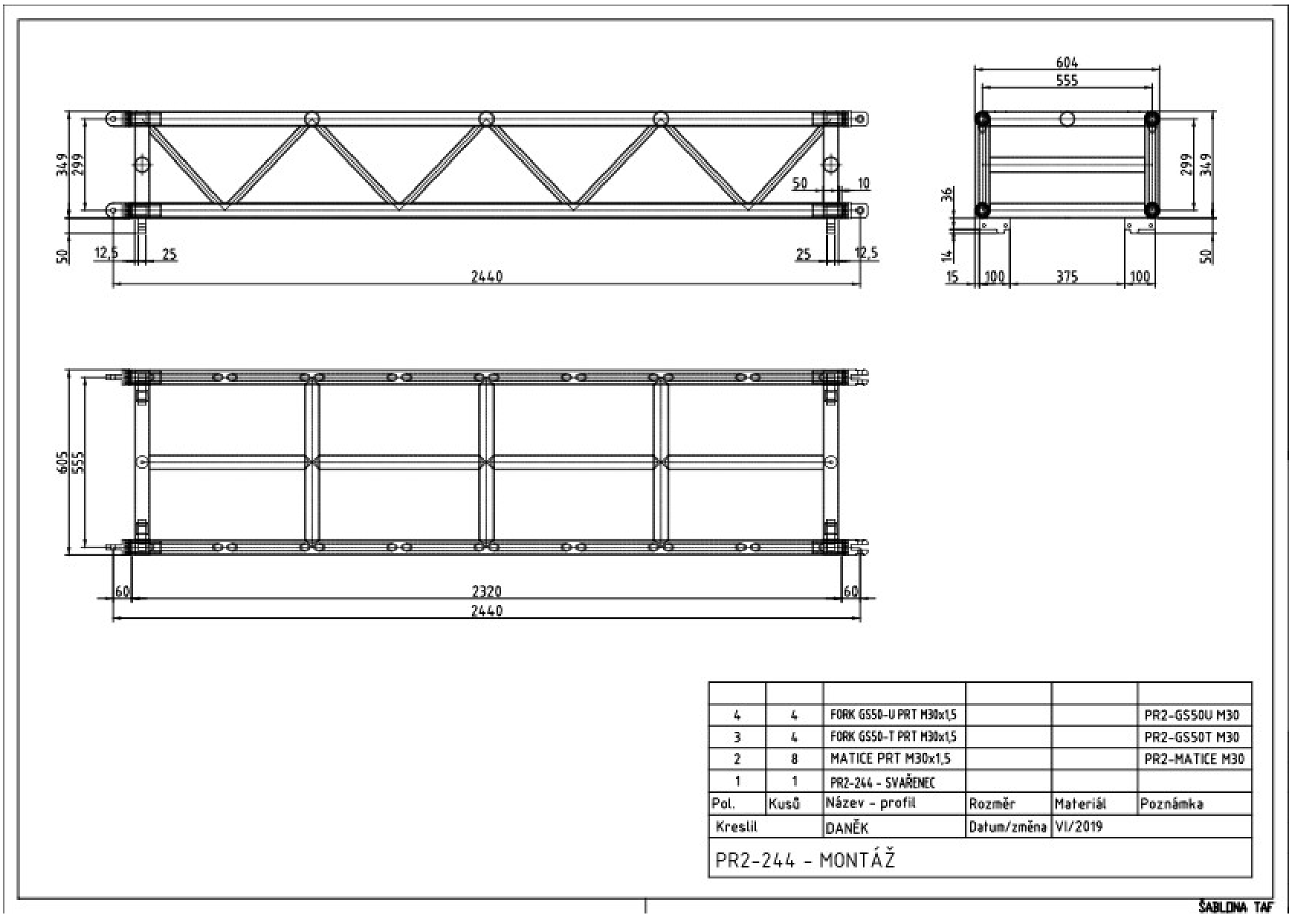
Camponogara, March 2024

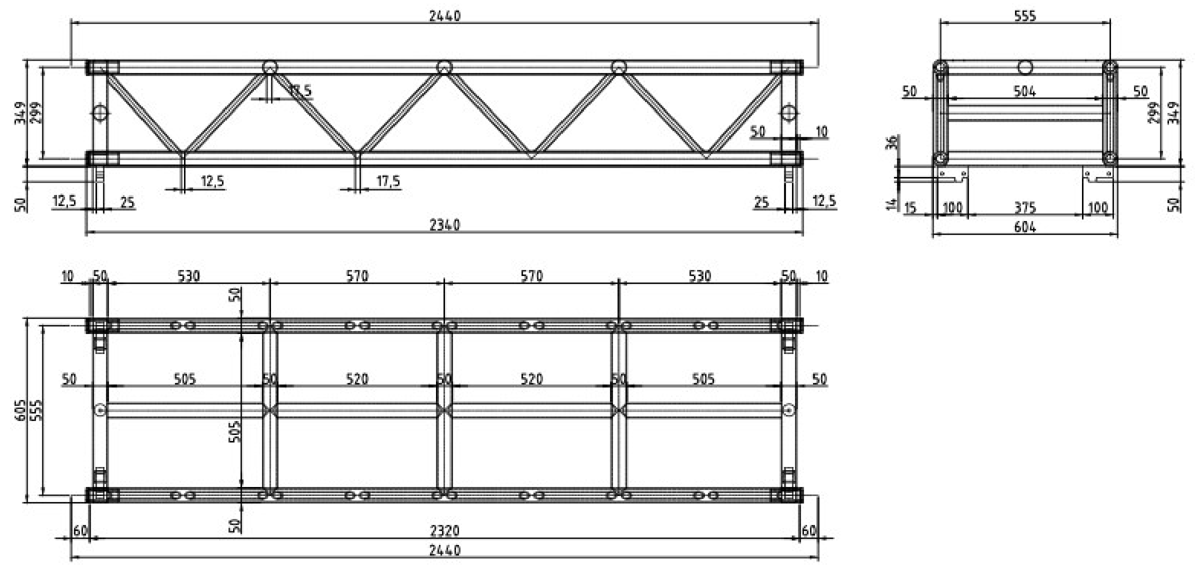
Dott. ing. Andrea Santello

Ordine degli ingegneri di Venezia

3. Structure description

Aluminum rectangular truss formed by chord (hollow section 50x4 mm) and diagonal (hollow section 25x3 mm). The connection between chords, columns and diagonals is realized by fillet welds. At the ends of the truss there are an aluminium bushing made in alloy EN AW 6082 T6, each fixed to the chord with weld. An adjustable fork is fixed inside this M30 threaded bushing. The trusses are joined together by joining the forks through a Ø16 mm pin.



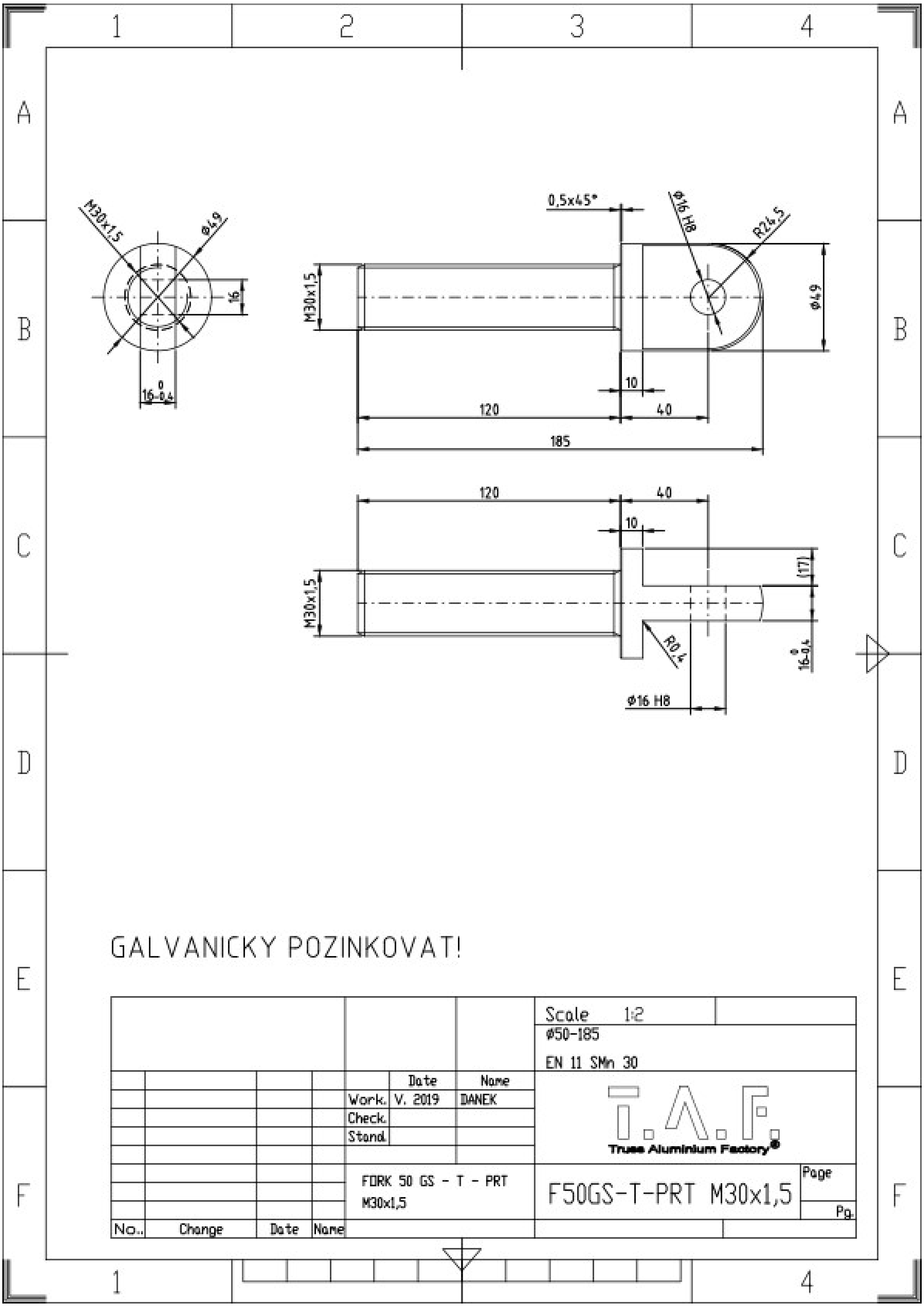


12	8	POUZDRO PRT M30x1,5			PR2-POUZDRO M30
11	4	P25	50x100	EN AW5083	
10	4	TR 25x3	359/42°	EN AW6082	
9	12	TR 25x3	368/44°	EN AW6082	
8	2	TR 4HR 50x3	527/B	EN AW6060	
7	2	TR 4HR 50x3	527/A	EN AW6060	
6	4	TR 4HR 50x3	272/2xF1	EN AW6060	

5	2	TR 50x4	504	EN AW6082	
4	2	TR 50x4	514/F1	EN AW6082	
3	2	TR 50x4	538/2xF1	EN AW6082	
2	3	TR 50x4	523/2xF1	EN AW6082	
1	4	TR 50x4	2320	EN AW6082	
Pol.	Kusů	Název - profil	Rozměr	Materiál	Poznámka
Kreslil		DANĚK	Datum/změna	VI/2019	

PR2-244 - SVAŘENEC

ŠABLONA TAF


M30x1,5
Ø49
16
16-0,4
0,5x45°
Ø16 H8
R24,5
10
120
40
185
(17)
R0,4
GALVANICKY POZINKOVAT!
Scale 1:2
Ø50-185
EN 11 SMn 30
Date
Name
Work.
V. 2019
DANEK
Check.
Stand.
T.A.F.
Truss Aluminium Factory®
FORK 50 GS - T - PRT
M30x1,5
F50GS-T-PRT M30x1,5
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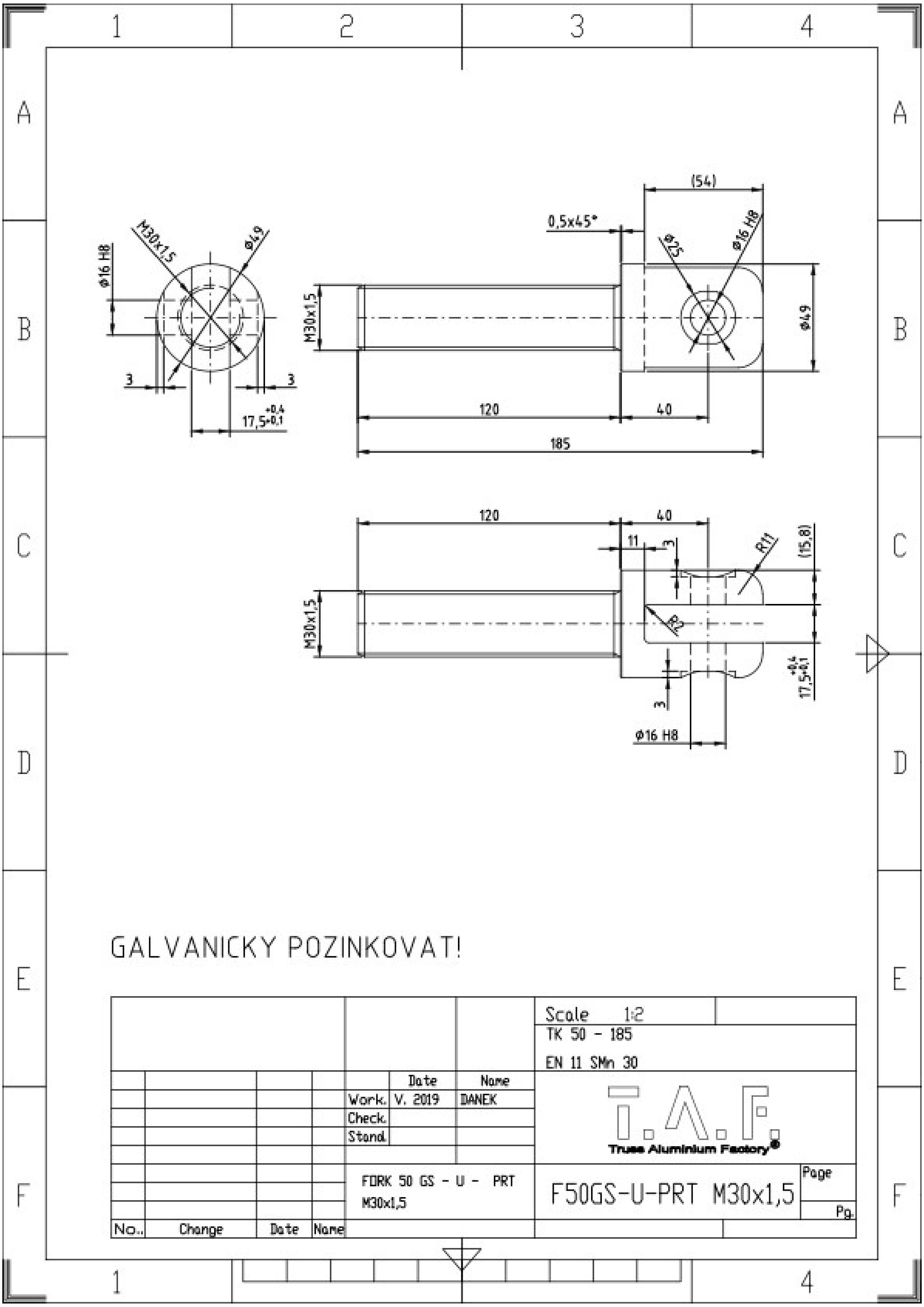
1
2
3
4
A
B
C
D
E
F
(54)
0,5x45°
Ø25
Ø16 H8
Ø49
M30x1,5
Ø16 H8
3
3
17,5+0,4 +0,1
120
40
185
11
R11
(15,8)
R2
Ø16 H8
GALVANICKY POZINKOVAT!
Scale 1:2
TK 50 - 185
EN 11 SMn 30
Date
Name
Work.
V. 2019
DANEK
Check.
Stand.
T.A.F.
Truss Aluminium Factory®
FORK 50 GS - U - PRT
M30x1,5
F50GS-U-PRT M30x1,5
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4. Reference standard

- **EN–1991-1-1-Eurocode 1:** Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings
- **EN–1993-1-1-Eurocode 3:** Design of steel structures - Part 1-1: General rules and rules for buildings
- **EN–1999-1-1-Eurocode 9**: Design of aluminium structures - Part 1-1: General structural rules
- **EN 13814** - Fairground and amusement park machinery and structures Safety

5. Introduction

The structural report is based on the limit state design. According to that method, we compare the design resistance of the structure R_d with the design load acting on the structure, according to the following relation:

$$S_d \leq R_d$$

S_d: design loadings, obtained from the design actions amplified by the factors γ_F ($\geq$1)

R_d: design resistances, corresponding to a specific failure mechanism, obtained from characteristic values of the materials resistances, reduced by the safety factors γ_m($\geq$1).

Partial safety factor used in load combination are calculated according to EN 13814, equal to 1,35 for permanent actions and 1,5 for variable actions.

Hypothesis of calculation:

This calculation assumes that the applied loads are static.

The welding is realized according to UNI EN ISO 15607.

6. Elements charateristics

General features			
Ø	50	mm	Diameter main tube
s	4	mm	Thickness main tube
A	578,05	mm^2	Area main tube
Ø	25	mm	Diameter side diagonal
s	3	mm	Thickness side diagonal
A	207,35	mm^2	Area side diagonal
α	46,00	°	Inclination side diagonal
Ø	50	mm	Diameter flat diagonal
s	3	mm	Thickness flat diagonal
A	442,96	mm^2	Area flat diagonal
α	90,00	°	Inclination flat diagonal
A_{truss}	2.312,21	mm^2	Total area
H	299,00	mm	High distance of the main tube center
W	555,00	mm	Side distance of the main tube center
I_y	52.294.725,12	mm^4	Moment of inertia on Y axis
I_z	178.670.994,74	mm^4	Moment of inertia on Z axis
S.W.	18,00	kg/m	Self-weight

6.1 Main chord

	Material		
Alloy	EN AW 6082 T6 (ET)		
f_0	250	N/mm^2	Characteristic value of 0,2 % proof strength
f_u	290	N/mm^2	Characteristic value of ultimate tensile strength
A	8	%	Elongation value
γ	0,8		Partial factor for TIG welding for alloy 6XXX and 7XXX
$f_{0,haz}$	100	N/mm^2	0,2 % proof strength in heat affected zone, HAZ
$f_{u, haz}$	148	N/mm^2	Ultimate tensile strength in heat affected zone, HAZ
$\rho_{0,haz}$	0,5		Ratio between 0,2 % proof strength in HAZ and in parent material
$\rho_{u,haz}$	0,64		Ratio between ultimate strength in HAZ and in parent material
E	70.000	Mpa	Modulus of elasticity
G	27.000	Mpa	Shear modulus
ν	0,3		Poisson factor
α	23 x 10^6	1/°C	Coefficient of linear thermal expansion
ρ	2.700	kg/m^3	Unit mass
	Geometric features		
Ø	50	mm	Diameter
s	4	mm	Thickness
A	578,05	mm^2	Area
A_{net}	578,05	mm^2	Net area of cross-section
$A_{u,eff}$	369,95	mm^2	Effective area
A_g	576,45	mm^2	Gross section
I_x	154.051,14	mm^4	X axis moment of inertia
I_y	154.051,14	mm^4	Y axis moment of inertia
W_x	6.162,05	mm^3	X axis elastic modulus
W_y	6.162,05	mm^3	Y axis elastic modulus
$I_{x,net}$	154.051,14	mm^4	X axis net moment of inertia
$I_{y,net}$	154.051,14	mm^4	Y axis net moment of inertia
$W_{x,net}$	6.162,05	mm^3	X axis net elastic modulus
$W_{y,net}$	6.162,05	mm^3	Y axis net elastic modulus
$W_{u,eff}$	4.305,83	mm^3	Effective elastic modulus

Slenderness			
β	10,17		Slenderness
Welding	X		Choice
Not welding			
β_1/ε	9,00		
β_2/ε	13,00		
β_3/ε	18,00		
ε	1,00		
C1	29,00		
C2	198,00		
β_1	9,00		
β_2	13,00		
β_3	18,00		
ρ_c	1,00		
Tensile strength			
γ_{M1}	1,1		Partial factor for resistance of cross-sections
γ_{M2}	1,25		Partial factor for resistance of cross-sections in tension to fracture
$N_{0,rd}$	131.012,06	N	Design value of resistance to general yielding of a member in tensions
$N_{u,rd}$	120.697,48	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{u,rd}$	85.829,32	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$\mathbf{N_{t,rd}}$	**85.829,32**	**N**	Design values of the resistance to tension force
Compression resistance			
$N_{u,rd}$	134.108,31	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{u,rd}$	85.829,32	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{0,rd}$	131.375,69	N	Design value of resistance to general yielding of a member in tensions
$\mathbf{N_{c,rd}}$	**85.829,32**	**N**	Design resistance to normal forces of the cross-section for uniform compression
Bending resistence			
α	1,00		Shape factor
$M_{u,rd}$	1.429.594,55	Nmm	Design resistance for bending of the net cross-section at holes

$M_{u,rd}$	998.952,17	Nmm	Design resistance for bending of the net cross-section at holes
$M_{0,rd}$	1.400.464,89	Nmm	Design resistance for bending to general yielding
M_{rd}	**998.952,17**	**Nmm**	Design resistance for bending about one principal axis of a cross-section
Shear strength			
η_v	0,6		Factor for shear area
haz	X		Welded pipe with connector
A_v	277,47	mm^2	Shear area
V_{Rd}	**36.407,90**	**N**	Design shear resistance
Buckling resistance			
κ	0,84		Factor to allow for the weakening effect of welding
χ	0,70		Reduction factor for relevant buckling mode
φ	1,03		
λ	0,94		Relative slenderness
Class A	x		Choice
Class B			
α	0,2		Imperfection factor
λ_0	0,10		Limit of the horizontal plateau of the buckling curves
N_{cr}	163.788,3	N	Elastic critical force for the relevant buckling mode based on the gross cross sectional properties
k_{inst}	2,00		Buckling length factor
l_0	570	mm	Buckling length
ω_x	1		Factors for section with localized weld
$N_{b,Rd}$	76.844,6	N	Resistance of axial compression force
$\omega_{x,haz}$	1		Factors for section with localized weld
λ_{haz}	0,81		Limit of the horizontal plateau of the buckling curves HAZ
χ_{haz}	0,60		Reduction factor for relevant buckling mode
$N_{b,Rd}$	51.885,7	N	Resistance of axial compression force
$N_{b,Rd}$	**51.885,7**	**N**	
Tensile strength welding			
L_w	157,08	mm	Welding perimeter
t_w	4	mm	Welding high
$f_{u,haz}$	148,00	MPa	Ultimate tensile strength in heat affected zone, HAZ
f_w	190,00	MPa	Characteristic values of the welding metal
γ_{Mw}	1,25		Partial factor for welding

$\sigma_{\perp,rd}$	152	MPa	Normal tension, perpendicular to the welding axis
$\sigma_{haz,rd}$	118,4	MPa	Normal force on the HAZ zone
$N_{w,rd}$	95.504,4	N	
$N_{w,haz,rd}$	74.392,9	N	
$N_{w,min,rd}$	**74.392,9**	**N**	
	Results		
N_{Rd}	**51,89**	**KN**	**Axial resistence**
M_{Rd}	**1,00**	**KNm**	**Bending resistence**
V_{Rd}	**36,41**	**KN**	**Shear resistence**

6.2 Diagonal

	Material		
Alloy	EN AW 6082 T6 (ET)		
f_0	250	N/mm^2	Characteristic value of 0,2 % proof strength
f_u	290	N/mm^2	Characteristic value of ultimate tensile strength
A	8	%	Elongation value
γ	0,8		Partial factor for TIG welding for alloy 6XXX and 7XXX
$f_{0,haz}$	100	N/mm^2	0,2 % proof strength in heat affected zone, HAZ
$f_{u, haz}$	148	N/mm^2	Ultimate tensile strength in heat affected zone, HAZ
$\rho_{0,haz}$	0,5		Ratio between 0,2 % proof strength in HAZ and in parent material
$\rho_{u,haz}$	0,64		Ratio between ultimate strength in HAZ and in parent material
E	70.000	Mpa	Modulus of elasticity
G	27.000	Mpa	Shear modulus
ν	0,3		Poisson factor
α	23 x 10^6	1/°C	Coefficient of linear thermal expansion
ρ	2.700	kg/m^3	Unit mass
	Geometric features		
Ø	25	mm	Diameter
s	3	mm	Thickness
A	207,35	mm^2	Area
A_{net}	147,35	mm^2	Net area of cross-section
$A_{u,eff}$	132,70	mm^2	Effective area
A_g	204,95	mm^2	Gross section
I_x	12.777,64	mm^4	X axis moment of inertia
I_y	12.777,64	mm^4	Y axis moment of inertia
W_x	1.022,21	mm^3	X axis elastic modulus
W_y	1.022,21	mm^3	Y axis elastic modulus
$I_{x,net}$	12.777,64	mm^4	X axis net moment of inertia
$I_{y,net}$	5.517,64	mm^4	Y axis net moment of inertia
$W_{x,net}$	1.022,21	mm^3	X axis net elastic modulus
$W_{y,net}$	441,41	mm^3	Y axis net elastic modulus
$W_{u,eff}$	746,71	mm^3	Effective elastic modulus

Slenderness			
β	8,12		Slenderness
Welding	X		Choice
Not welding			
β_1/ε	9,00		
β_2/ε	13,00		
β_3/ε	18,00		
ε	1,00		
C1	29,00		
C2	198,00		
β_1	9,00		
β_2	13,00		
β_3	18,00		
ρ_c	1,00		
Tensile strength			
γ_{M1}	1,1		Partial factor for resistance of cross-sections
γ_{M2}	1,25		Partial factor for resistance of cross-sections in tension to fracture
$N_{0,rd}$	46.578,44	N	Design value of resistance to general yielding of a member in tensions
$N_{u,rd}$	30.765,66	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{u,rd}$	30.786,60	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{t,rd}$	**30.765,66**	**N**	Design values of the resistance to tension force
Compression resistance			
$N_{u,rd}$	34.184,07	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{u,rd}$	30.786,60	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{0,rd}$	47.123,89	N	Design value of resistance to general yielding of a member in tensions
$N_{c,rd}$	**30.786,60**	**N**	Design resistance to normal forces of the cross-section for uniform compression
Buckling resistance			
κ	1,00		Factor to allow for the weakening effect of welding
χ	0,65		Reduction factor for relevant buckling mode
φ	1,10		
λ	1,01		Relative slenderness

Class A	x		Choice
Class B			
α	0,2		Imperfection factor
λ_0	0,10		Limit of the horizontal plateau of the buckling curves
N_{cr}	51.094,5	N	Elastic critical force for the relevant buckling mode based on the gross cross sectional properties
k_{inst}	1		Buckling length factor
l_0	415,7	mm	Buckling length
ω_x	1		Factors for section with localized weld
$N_{b,Rd}$	30.342,9	N	Resistance of axial compression force
$N_{b,Rd}$	**30.342,9**	**N**	
Tensile strength welding			
L_w	78,54	mm	Welding perimeter
t_w	3	mm	Welding high
$f_{u,haz}$	148,00	MPa	Ultimate tensile strength in heat affected zone, HAZ
f_w	190,00	MPa	Characteristic values of the welding metal
γ_{Mw}	1,25		Partial factor for welding
$\sigma_{\perp,rd}$	152	MPa	Normal tension, perpendicular to the welding axis
$\sigma_{haz,rd}$	118,4	MPa	Normal force on the HAZ zone
$N_{w,rd}$	35.814,2	N	
$N_{w,haz,rd}$	27.897,3	N	
$N_{w,min,rd}$	**27.897,3**	**N**	
Results			
N_{Rd}	**27,90**	**KN**	**Axial resistence**

6.3 Horizontal tube

	Material		
Alloy	EN AW 6082 T6 (ET)		
f_0	250	N/mm^2	Characteristic value of 0,2 % proof strength
f_u	290	N/mm^2	Characteristic value of ultimate tensile strength
A	8	%	Elongation value
γ	0,8		Partial factor for TIG welding for alloy 6XXX and 7XXX
$f_{0,haz}$	100	N/mm^2	0,2 % proof strength in heat affected zone, HAZ
$f_{u,\ haz}$	148	N/mm^2	Ultimate tensile strength in heat affected zone, HAZ
$\rho_{0,haz}$	0,5		Ratio between 0,2 % proof strength in HAZ and in parent material
$\rho_{u,haz}$	0,64		Ratio between ultimate strength in HAZ and in parent material
E	70.000	Mpa	Modulus of elasticity
G	27.000	Mpa	Shear modulus
ν	0,3		Poisson factor
α	23 x 10^6	1/°C	Coefficient of linear thermal expansion
ρ	2.700	kg/m^3	Unit mass
	Geometric features		
Ø	50	mm	Diameter
s	3	mm	Thickness
A	442,96	mm^2	Area
Φ_{holes}	0	mm	Elastic pins holes diameter
A_{net}	442,96	mm^2	Net area of cross-section
$A_{u,eff}$	283,50	mm^2	Effective area
A_g	440,56	mm^2	Gross section
I_x	122.811,93	mm^4	X axis moment of inertia
I_y	122.811,93	mm^4	Y axis moment of inertia
W_x	4.912,48	mm^3	X axis elastic modulus
W_y	4.912,48	mm^3	Y axis elastic modulus
$I_{x,net}$	122.811,93	mm^4	X axis net moment of inertia
$I_{y,net}$	122.811,93	mm^4	Y axis net moment of inertia
$W_{x,net}$	4.912,48	mm^3	X axis net elastic modulus
$W_{y,net}$	4.912,48	mm^3	Y axis net elastic modulus
$W_{u,eff}$	3.357,43	mm^3	Effective elastic modulus

Slenderness			
β	11,87		Slenderness
Welding	X		Choice
Not welding			
β_1/ε	9,00		
β_2/ε	13,00		
β_3/ε	18,00		
ε	1,00		
C1	29,00		
C2	198,00		
β_1	9,00		
β_2	13,00		
β_3	18,00		
ρ_c	1,00		
Tensile strength			
γ_{M1}	1,1		Partial factor for resistance of cross-sections
γ_{M2}	1,25		Partial factor for resistance of cross-sections in tension to fracture
$N_{0,rd}$	100.128,31	N	Design value of resistance to general yielding of a member in tensions
$N_{u,rd}$	79.733,62	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{u,rd}$	102.210,98	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{t,rd}$	**79.733,62**	**N**	Design values of the resistance to tension force
Compression resistance			
$N_{u,rd}$	102.767,78	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{u,rd}$	102.210,98	N	Design value of resistance to axial force of the net cross-section at holes for fasteners
$N_{0,rd}$	102.767,78	N	Design value of resistance to general yielding of a member in tensions
$N_{c,rd}$	**102.210,98**	**N**	Design resistance to normal forces of the cross-section for uniform compression
Bending resistence			
α	1,00		Shape factor
$M_{u,rd}$	1.139.694,67	Nmm	Design resistance for bending of the net cross-section at holes

$M_{u,rd}$	778.922,91	Nmm	Design resistance for bending of the net cross-section at holes
$M_{0,rd}$	1.116.472,05	Nmm	Design resistance for bending to general yielding
M_{rd}	**778.922,91**	**Nmm**	Design resistance for bending about one principal axis of a cross-section
Shear strength			
η_v	0,6		Factor for shear area
haz	X		Welded pipe with connector
A_v	1,44	mm^2	Shear area
V_{Rd}	**188,95**	**N**	Design shear resistance
Buckling resistance			
κ	1,00		Factor to allow for the weakening effect of welding
χ	1,00		Reduction factor for relevant buckling mode
φ	0,50		
λ	0,07		Relative slenderness
Class A	x		Choice
Class B			
α	0,2		Imperfection factor
λ_0	0,10		Limit of the horizontal plateau of the buckling curves
N_{cr}	137.728,0	N	Elastic critical force for the relevant buckling mode based on the gross cross sectional properties
k_{inst}	2,00		Buckling length factor
l_0	555	mm	Buckling length
ω_x	1		Factors for section with localized weld
$N_{b,Rd}$	100.128,3	N	Resistance of axial compression force
$N_{b,Rd}$	**100.128,3**	**N**	
Tensile strength welding			
L_w	157,08	mm	Welding perimeter
t_w	50	mm	Welding high
$f_{u,haz}$	100,00	MPa	Ultimate tensile strength in heat affected zone, HAZ
f_w	190,00	MPa	Characteristic values of the welding metal
γ_{Mw}	1,25		Partial factor for welding
$\sigma_{\perp,rd}$	152	MPa	Normal tension, perpendicular to the welding axis
$\sigma_{haz,rd}$	80	MPa	Normal force on the HAZ zone
$N_{w,rd}$	1.193.805,2	N	
$N_{w,haz,rd}$	628.318,5	N	

$N_{w,min,rd}$	**628.318,5**	**N**	
Results			
N_{Rd}	**79,73**	**KN**	**Axial resistence**
M_{Rd}	**0,78**	**KNm**	**Bending resistence**
V_{Rd}	**0,19**	**KN**	**Shear resistence**

6.4 Fork connection

Fork material			
Alloy	EN AW 6082 T6		
f_0	250	N/mm^2	Characteristic value of 0,2 % proof strength
f_u	310	N/mm^2	Characteristic value of ultimate tensile strength
A	8	%	Elongation value
E	70.000	Mpa	Modulus of elasticity
Pin material			
Alloy	42CrMo4		
f_0	750	N/mm^2	Characteristic value of 0,2 % proof strength
f_u	900	N/mm^2	Characteristic value of ultimate tensile strength
E	210.000	Mpa	Modulus of elasticity
Pin shear			
Φ_{pin}	15,80	mm	Pin diameter
γ_{Mp}	1,25		Partial factor
$\mathbf{F}_{v,Rd,1ST}$	**84.700,86**	**N**	Resistance on a single cutting section
$\mathbf{F}_{v,Rd}$	**169.401,71**	**N**	Pin shear resistence
Burr pin/fork			
t	16	mm	Fin thickness
γ_{M1}	1,10		Partial factor
$\mathbf{F}_{b,Rd}$	**86.181,82**	**N**	Central fin
Pin bending			
W_{el}	387,23	mm	
$\mathbf{M}_{Rd}$	**396.032,65**	**Nmm**	
Fork thread			
Threaded	M30		
A	581,00	mm^2	
$\mathbf{F}_{Rd}$	**129.679,20**	**N**	
Resistence			
$\mathbf{N}_{Rd}$	**86,18**	**KN**	**Axial resistence**
$\mathbf{M}_{Rd}$	**0,40**	**KNm**	**Bending moment resistence**

7. Truss resistance

Normal force

$\mathbf{N} = 4 \times N_c = 4 \times 51{,}9 = \mathbf{207{,}5\ kN}$

Bending moment resistance

$\mathbf{M_y} = 2 \times N_c \times h = 2 \times 51{,}9\ kN \times 0{,}299\ m = \mathbf{31{,}0\ kNm}$

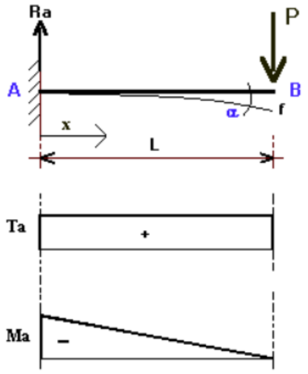
$\mathbf{M_z = 0\ kNm}$

Shear force

$\mathbf{Q_z} = 2 \times N_d \times \sin(46°) = 2 \times 27{,}9\ kN \times \sin(46°) = \mathbf{40{,}1\ kN}$

$\mathbf{Q_y = 0\ kN}$

8. Diagonal eccentricities



$Ra = P$

$Ta = Ra$

$Ma = -P\,L$

$$f = \frac{P\,L^3}{3\,E\,J}$$

$$f_x = \frac{P\,L^3}{2\,E\,J}\left(\frac{x^2}{L^2} - \frac{x^3}{3\,L^3}\right)$$

$$\left(\frac{N_{Ed}}{N_{Rd}}\right)^{\psi} + \left[\left(\frac{M_{y,Ed}}{M_{y,Rd}}\right)^{1,7} + \left(\frac{M_{z,Ed}}{M_{z,Rd}}\right)^{1,7}\right]^{0,6} \leq 1,00$$

85.829,3	Nmm	Axial resistence (no buckling)
998.952,2	N	Design resistance for bending
45,0	mm	Diagonal eccentricity
903.045,1	Nmm	Bending from maximum shear force
14.357,5	N	Residual axial resistance
8,6	**kNm**	Residual bending moment
486.646,8	Nmm	Residual bending on tube with maximum N
21,6	**kN**	Residual shear force

The axial resistance of the main chord changes according the resistance field.

9. Maximum load per meter

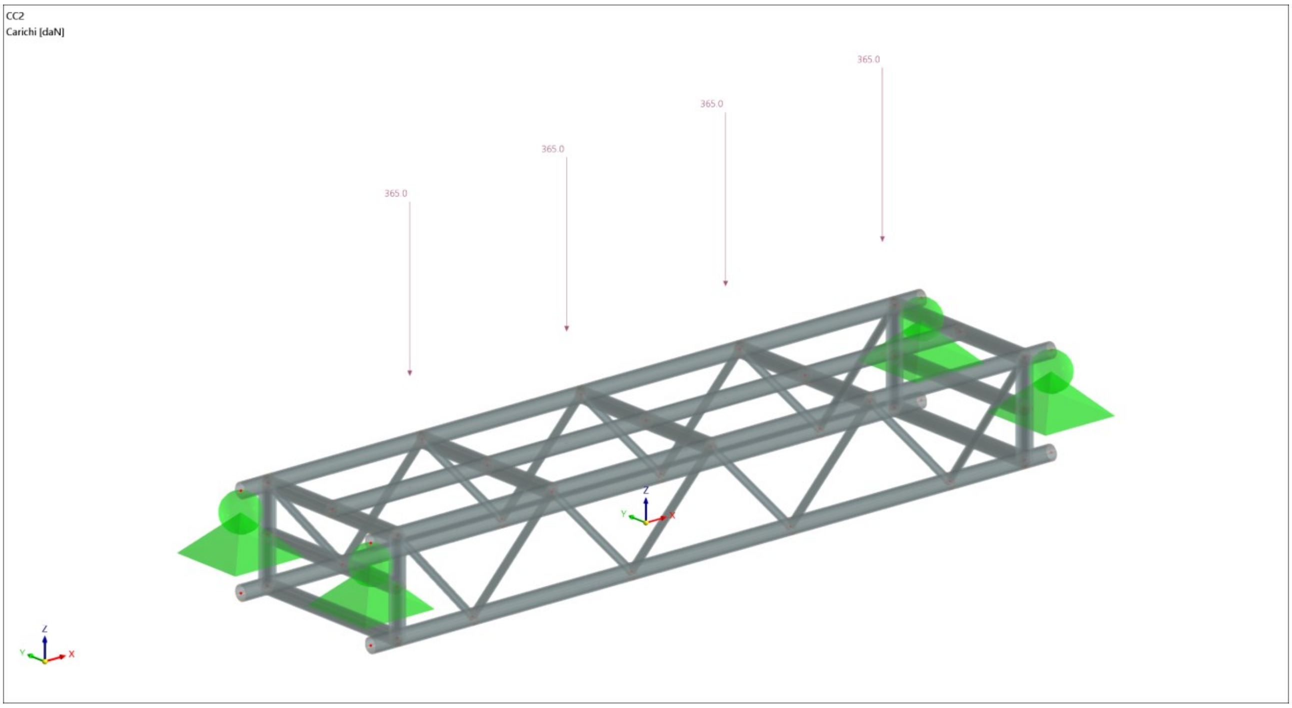
Considering the load applied to the central tube, the limit of this element is calculated:

$$F = 3,65\ kN$$

$$L = 0,57\ m$$

$$M_{Sd} = \gamma \times F \times L / 4 = 1,5 \times 3,65 \times 0,57 / 4 = 0,78\ kNm$$

$$M_{Rd\ Ø50x3} = 0,78\ kNm$$



10. Load chart

The self-weight of the truss is 18 kg/m

SPAN [m]	Uniformed distributed load			Central point load			Central three points load			Central four points load			Central five points load		
	kg/m	kg	mm	kg	kg	mm	kg	kg	mm	kg	kg	mm	kg	kg	mm
1	640	640	0	365	365	0	365	730	0	365	1.095	0	365	1.460	0
2	640	1.280	0	365	365	0	365	730	0	365	1.095	0	365	1.460	1
3	640	1.920	2	365	365	1	365	730	1	365	1.095	1	365	1.460	2
4	640	2.560	6	365	365	1	365	730	2	365	1.095	3	365	1.460	4
5	640	3.200	14	365	365	3	365	730	4	365	1.095	6	365	1.460	8
6	443	2.661	21	365	365	5	365	730	8	365	1.095	11	365	1.460	14
7	322	2.251	28	365	365	8	365	730	12	365	1.095	17	365	1.460	22
8	242	1.939	37	365	365	13	365	730	18	365	1.095	25	365	1.460	32
9	188	1.693	47	365	365	19	365	730	26	365	1.095	36	353	1.411	44
10	149	1.493	58	365	365	27	365	730	35	365	1.095	49	311	1.244	54
11	121	1.326	71	365	365	36	365	730	47	332	995	60	276	1.105	63
12	99	1.185	84	365	365	48	365	730	61	296	888	69	247	987	73
13	82	1.062	99	365	365	63	365	730	78	266	797	79	221	885	84
14	68	955	116	365	365	80	358	716	95	239	716	89	199	796	94
15	57	860	133	365	365	101	323	645	106	215	645	98	179	717	104
16	48	775	152	365	365	125	291	581	115	194	581	107	161	646	114
17	41	698	172	349	349	148	262	524	125	175	524	116	145	582	123
18	35	628	194	314	314	168	235	471	133	157	471	124	131	523	131

Cantilever load:

SPAN [m]	Uniformed distributed load			Central point load		
	kg/m	kg	mm	kg	kg	mm
0,5	640	320	0	365	365	0
1	640	640	0	365	365	0
1,5	640	960	1	365	365	1
2	594	1.188	3	365	365	3
2,5	409	1.023	6	365	365	5
3	298	894	9	365	365	9

Resistance field:

The graph must be compared with the stresses (M_{Rd} and Q_{Rd}) amplified and including the own weight. It has to be used exclusively for pre-calculation, and IT DOESN'T REPLACE the structural calculation of the truss which must be performed for any installation.