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Preliminary Structural Report Prerigg-Truss

18228

Date 08/03/2018

for the system by

Global Truss
Furong Industrial Area
Shajing Town

Baoan District Shenzen China

Compiled by:

Aachen, 08.03.2018

INGENIEURKAMMER-BAU NORDRHEIN-WESTFALEN
BERATENDER INGENIEUR
101448

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1 PRELIMINARY NOTES

1.1 Basics

The currently applicable regulations and standards, in particular:

DIN EN 1991-1	Actions on structures (Eurocode 1)
DIN EN 13814	Fairground and amusement park machinery and structures
DIN EN 13782	Temporary Structures – Tents
DIN EN 1993-1	Design of steel structures
DIN EN 1999-1	Design of aluminium structures

1.2 Materials

Tubes	Aluminium EN AW-6082 T6
Bolts	Güte mid. 8.8 (grade min. 10.9)

1.3 General remarks

The truss system is part of a "modular construction system". In this preliminary report only the truss length 3000 mm is regarded.

The Trusses consist of 3 upper and 2 lower main chords (round tube 50 x 4mm), which are arranged in a rectangular shape. The center chord at the top is connected to the outer chords by cross tubes (round tube 50 x 4mm). The trusses also consist of welded diagonal bracings (round tube 25 x 3mm). The truss is stiffened by bracings at both vertical sides.

The distance between system lines of the mainchords is 30,5 cm in vertical- and 54 cm in horizontal direction.

The trusses are connected at the 4 outer mainchords with couplers consisting of male and female fittings, connectors and bolts. The center chord of the top is not connected with couplers.

The loads are applied at the center chord of the top. The allowable loads are listed in tables (see chapter 6).

The verification of the single parts is done according the safety concept of EN 1990 with a partial safety factor of the loading side of 1.50 for payloads.

For applications which can be calculated on the basis of other codes, the partial safety factors can be adjusted (for example temporary structures acc. EN 13814, yF = 1.35 for payloads).

To use the resulting allowable loads with British Standard (BS) and ANSI, the allowable loads listed in tables have to be multiplied by 0.85.

1.4 Geometry and loadings

The load can be applied as a distributed load or as multiple point loads on the central bottom chord.

The allowable loading on the Prerigg-truss is limited by two conditions:

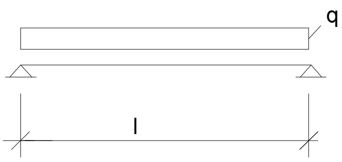
1) First condition is the local load transfer from the central bottom chord to the bracing node.

2) Second condition is the global load transfer to the truss supports.

Resulting allowable loading, see chapter 6

The following principle loadcases and loading situations are taken into account:

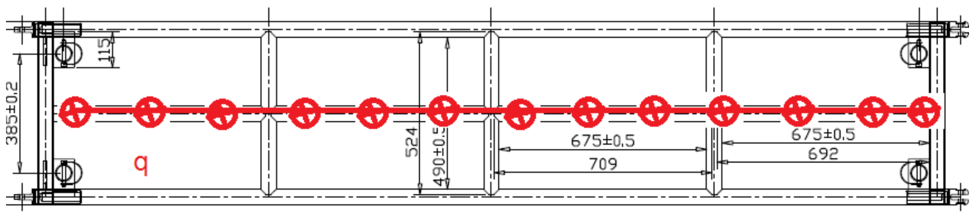
Structural system:



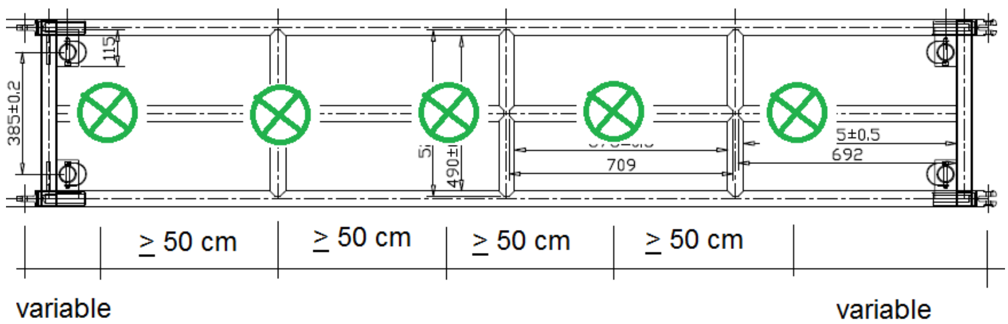
single span girder

Loading situation

a) uniformly distributed load (UDL) on central top chord

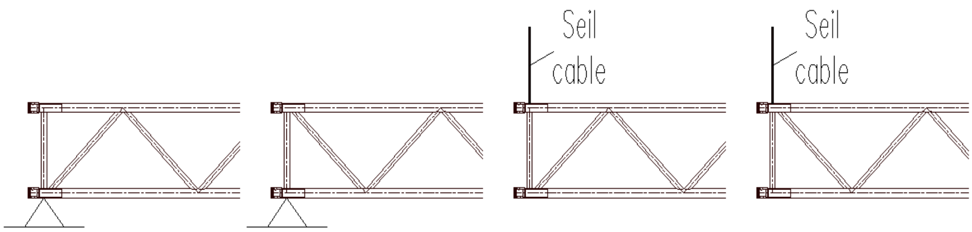


b) multiple point load on central top chord with maximum point load of Pi ≤ 200 kg and distances ≥ 50 cm (equivalent to a distributed load of ≤ 400 kg/m) . No restrictions concerning position on the central top chord but allowable loading in dependence of the span has to be respected , see chapter 6.

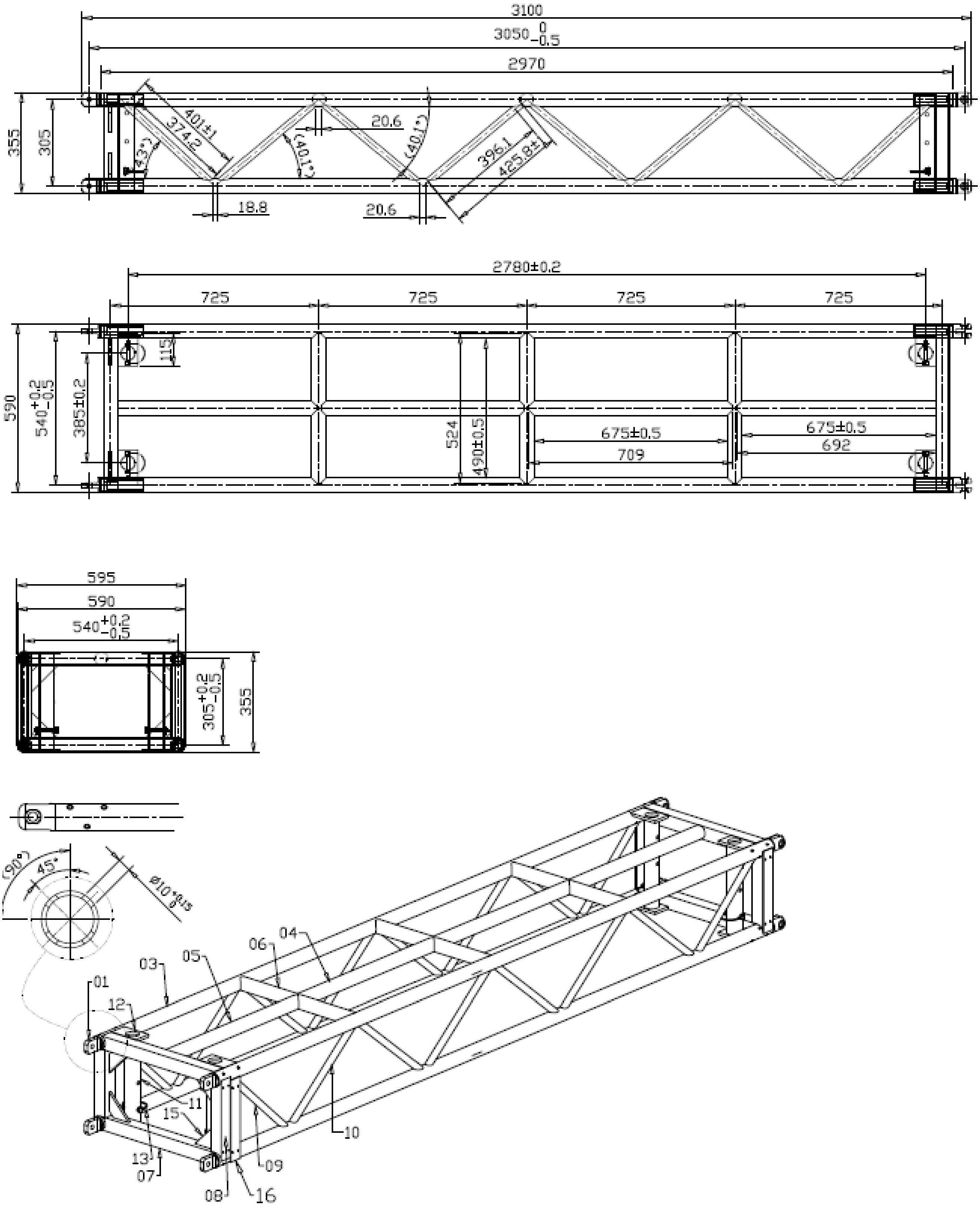


The selfweight of the truss is approx. 16 kg/m

For the support or suspension there are the following possibilities:



2 SYSTEM

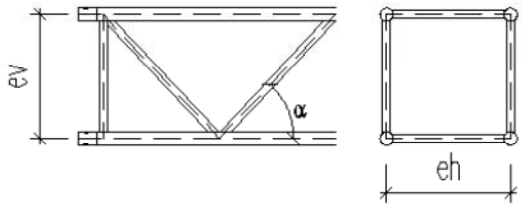

3100
3050 0 -0.5
2970
355
305
401±1
374.2
(43°)
20.6
(40.1°)
(40.1°)
396.1
425.8±
18.8
20.6
2780±0.2
725
725
725
725
590
540 +0.2 -0.5
385±0.2
115
524
490±0.5
675±0.5
709
675±0.5
692
595
590
540 +0.2 -0.5
305 +0.2 -0.5
355
(90°)
45°
Ø10 +0.15 0
01
12
03
05
06
04
11
15
13
07
08
16
09
10

3 SECTION- AND MATERIAL PROPERTIES

Querschnittswerte Rohre / properties Tubes

	D	t	A	I	Wel	i
	[mm]	[mm]	[cm²]	[cm⁴]	[cm³]	[cm]
Gurtrohre / main chords	50,0	4	5,78	15,41	6,16	1,63
vertikal Diagonalen / Bracing	25	3	2,07	1,28	1,02	0,79
horizontal Rohre / Lateral tubes	50	4	5,78	15,41	6,16	1,63

Geometrie Traverse / truss geometry



Achsabstand Gurtrohre	vertical	ev	30,5	[cm]
distance axes main chords	horizontal	eh	54	[cm]
min. Neigung Diagonalen	vertikal	α	40,1	[°]
min. gradient bracing	horizontal	α	90	[°]

Kennwerte Gesamttraverse / properties truss-Section

A	$= 4 \times A_G$	=	23,12	[cm²]
Iyy	$= 4 \times I_G + 4 \times A_G \times (ev/2)^2$	=	5438,96	[cm⁴]
Izz	$= 4 \times I_G + 4 \times A_G \times (eh/2)^2$	=	16917,65	[cm⁴]
It	= Näherung aus Erfahrungswerten	=	9049,22	[cm⁴]
iy	$= (Iyy/A)^{1/2}$	=	15,34	[cm]
iz	$= (Izz/A)^{1/2}$	=	27,05	[cm]

Index G : Querschnittseigenschaft Gurtrohr
section properties main chord

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Material properties

Gurtrohre + Diagonalen EN AW 6082 T6 (AlMgSi1)
chords and bracing

zulässige Spannungen nach EN-1999-1-1 / allowable stress acc. to EN-1999-1-1

Teilsicherheitsbeiwerte Material / partial safety factors material

γ_{M1}	1,10	Beulklasse / BC	A
γ_{M2}	1,25		

0,2%-Dehngrenze / 0,2%-Proof Strength			Zugfestigkeit / ultimate tensile strength		
fo t≤5mm	250	[N/mm²]	fu t≤5mm	290	[N/mm²]
fo t>5mm	260	[N/mm²]	fu t>5mm	310	[N/mm²]
fo,haz	125	[N/mm²]	fu,haz	185	[N/mm²]

Festigkeit der Schweißnaht — fw 190 [N/mm²]
Strength of welding seams

Faktor für die WEZ-Werte beim WIG-Schweißen: 0,8
Factor for HAZ-values for TIG-welding:

Verbinder-Male / Female EN AW 6082 T6 (AlMgSi1)

0,2%-Dehngrenze / 0,2%-Proof Strength			Zugfestigkeit / ultimate tensile strength		
fo	255	[N/mm²]	fu	300	[N/mm²]

Verbinder Bolzen 10.9

fyb	900	[N/mm²]	fub	1000	[N/mm²]

Teilsicherheitsbeiwerte Material / partial safety factors material

γ_{M0}	1,00
γ_{M2}	1,25

Spannstifte nach EN ISO 8752

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Querschnitts- und Materialeigenschaften der Gurtrohre / Section- and material properties of the chord tubes

Material	E =	70000	[N/mm²]	
	fo =	250,00	[N/mm²]	
	fo/γM1 =	227,27	[N/mm²]	
	fo,haz =	125,00	[N/mm²]	
	fu =	290,00	[N/mm²]	
	fu/γM2 =	232,00	[N/mm²]	
	fu,haz =	185,00	[N/mm²]	
	fu,haz/γM2 =	148,00	[N/mm²]	
Querschnitt	D0 =	50,00	[mm]	
cross section	A =	5,78	[cm²]	
	I =	15,41	[cm⁴]	
	i =	1,63	[cm]	
Bestimmung der QS-Klasse	β =	10,61	[-]	$3 \cdot (D0 / t)^{0,5}$ nach 6.10
Determination of section-class	ε =	1,00	[-]	$(250 / fo)^{0,5}$
	QS-Klasse =	1		nach Kap. 6.1.4.4 acc. chapter 6.1.4.4
Beiwerte Biegeknicken	BC =	A	[-]	
Coefficients for buckling	α =	0,20	[-]	
	λo =	0,10	[-]	
teff im Bereich der WEZ teff in heat affected zone	red Faktor =	0,8	[-]	(WIG $_{TIG}$)

Knotenpunkt mit 1 Diagonalen / node with 1 bracing

D1	=	25,00	[mm]	
U_{WEZ}	=	85,00	[mm]	$D1 + 2 \cdot 30$
U_{Total}	=	157,08	[mm]	
teff,o/t	=	0,68	[-]	$[1 - (1 - \text{red-Faktor} \cdot fo,haz / fo) \cdot U_{WEZ} / U_{Total}]$
teff,u/t	=	0,74	[-]	$[1 - (1 - \text{red-Faktor} \cdot fu,haz / fu) \cdot U_{WEZ} / U_{Total}]$

Knotenpunkt mit 2 Diagonalen / node with 2 bracing

D1	=	25,00	[mm]	
D2	=	50,00	[mm]	
U_{WEZ}	=	151,04	[mm]	$\pi / \mathbf{2} \cdot D0 + D1 / 2 + 2 \cdot 30$
U_{Total}	=	157,08	[mm]	
teff,o / t	=	0,42	[-]	$[1 - (1 - \text{red-Faktor} \cdot fo,haz / fo) \cdot U_{WEZ} / U_{Total}]$
teff,u / t	=	0,53	[-]	$[1 - (1 - \text{red-Faktor} \cdot fu,haz / fu) \cdot U_{WEZ} / U_{Total}]$

Querschnitts- und Materialeigenschaften der vert. Diagonalen / Section- and material properties of the vert. bracing

Material	E =	70000	[N/mm²]
	fo =	250,00	[N/mm²]
	fo/γM1 =	227,27	[N/mm²]
	BC =	A	[-]
	α =	0,20	[-]
	λo =	0,1	[-]
Querschnitt / cross section	Do =	25	[mm]
	A =	2,07	[cm²]
	I =	1,28	[cm⁴]
	i =	0,79	[cm]

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4 ALLOWABLE LOADING SINGLE COMPONENTS

Gurtrohr im Bereich der WEZ an der Kupplung
main chord in heat affected zone at coupler

N_{Rd} = A x 0,8* x $f_{u,haz}$ / γ_{M2}	=	**68,44**	[kN]	*(WIG $_{TIG}$) örtliche Schweißnaht nach Kap. 6.2.9.3 (1) local welding seam acc. chapter 6.2.9.3 (1)

Gurtrohr auf Druck an der Kupplung im Bereich der Spannstifte in der WEZ
main chord at coupler under pressure at pins at HAZ

d,pins	=	10	[mm]	
A,net	=	4,98	[cm²]	
N_{Rd} = A,net x 0,8* x $f_{u,haz}$ / γ_{M2}	=	**58,97**	[kN]	nach Gl. 6.21a acc. equation 6.21a

Gurtrohr auf Zug an der Kupplung im Bereich der Spannstifte in der WEZ mit 2 Diagonalen
main chord at coupler under tension at pins at HAZ with 2 bracings

d,pins	=	10	[mm]	
A,net	=	4,98	[cm²]	
N_{Rd} = A,net x 0,8* x $f_{u,haz}$ / γ_{M2}	=	**58,97**	[kN]	nach Gl. 6.19a Faktor 0,9 nicht angesetzt wg. Verstärkung durch Diagonale acc. equation 6.19a factor 0,9 not taken into acc. due to strengthening by bracing

Gurtrohr im Bereich der WEZ ohne Spannstifte
main chord in heat affected zone without pins

Knotenpunkt mit 1 Diagonalen / node with 1 bracing

N_{Rd} = $A_{u,eff}$ x f_u / γ_{M2} (mit $A_{u,eff}$ = $t_{eff,u}$ / t x A)	=	**98,57**	[kN]	nach Gl. 6.19b acc. equation 6.19b

Knotenpunkt mit 2 Diagonalen / node with 2 bracing

N_{Rd} = $A_{u,eff}$ x f_u / γ_{M2} (mit $A_{u,eff}$ = $t_{eff,u}$ / t x A)	=	**70,97**	[kN]	nach Gl. 6.19b acc. equation 6.19b

Knicken Gurtrohr zw. Knoten ohne Diagonale in der Mitte
buckling main chord bewteen nodes without bracing in the middle

sk	=	72,50	[cm]	
Ncr	=	202,48	[kN]	
λ^*	=	0,84	[-]	
ϕ	=	0,93	[-]	
X	=	0,76	[-]	
κ	=	1,00	[-]	
N_{Rd} = κ x X x A x f_o / γ_{M1}	=	**99,27**	[kN]	nach Gl. 6.49a acc. equation 6.49a

relevant for main chord tubes: **NRd_G = 58,97 kN**

Bending of the center 50x4 mm tubes:

Lokale Biegung Gurtrohr Knotenpunkt vollst. in WEZ
Local bending of chord

örtliche Schweißnaht nach Kap. 6.2.9.3 (1)
local welding seam acc. Chapter 6.2.9.3 (1)

D =	50	[mm]	
red Faktor =	0,8	[-]	(WIG $_{TIG}$)
ρu,haz =	0,64	[-]	fu,haz / fu
tu,eff =	2,04	[mm]	red-Faktor · ρu,haz · t
Wnet= π x R² x tu,eff =	3,39	[cm³]	mit R = D / 2 - t / 2
MuRd = Wnet · fu / yM2 =	**78,71**	[kNcm]	nach Gl. 6.24 acc. equation 6.24

Lokale Biegung Gurtrohr Knotenpunkt vollst. in WEZ
Local bending of chord

örtliche Schweißnaht nach Kap. 6.2.9.3 (2)
local welding seam acc. Chapter 6.2.9.3 (2)

	α =	0,55	[-]	nach Tab. 6.4
Nebenrechnung QS-Kl. 3	D =	50,0	[mm]	
Auxiliary calculation for class 3	red Faktor =	0,8	[-]	(WIG $_{TIG}$)
	ρo,haz =	0,5	[-]	fo,haz / fo
	to,eff =	1,60	[mm]	teff,o / t · t
	Wel,haz= π x R² x to,eff =	2,66	[cm³]	mit R = D / 2 - t / 2
	Wel =	6,16	[cm³]	
	Wpl,haz= 4 x R² x to,eff =	3,39	[cm³]	mit R = D / 2 - t / 2
	β3 =	18	nach Ka	nach Kap. 6.1.4.4
	β2 =	13	nach Ka	nach Kap. 6.1.4.4
	α,3w =	0,64	[-]	
MoRd = α · Wel · fo / yM1	=	**76,95**	[kNcm]	nach Gl. 6.24 acc. equation 6.24

Bracing

Diagonale im Bereich der WEZ
bracing in heat affected zone

NRd = A x 0,8* x fu,haz / YM2 =	**24,55**	[kN]	*(WIG $_{TIG}$) Querschweißnaht nach Kap. 6.2.9.3 (1) local welding seam acc. chapter 6.2.9.3 (1)

Knicken Diagonale
buckling bracing

sk =	43,00	[cm]	
Ncr =	47,74	[kN]	
λ* =	1,04	[-]	
ϕ =	1,14	[-]	
X =	0,63	[-]	
NRd = X x AG x fo / YM1 =	**29,60**	[kN]	nach Gl. 6.49a acc. equation 6.49a

Schweißnaht zwischen Diagonale und Gurtrohr
welding seam between chord and female conical coupler

fw =	190,00	[N/mm²]	
Ymw =	1,25	[-]	
NRd = A x fw / YM1 =	**31,52**	[kN]	nach Gl. 8.29 acc. equation 8.29

relevant for bracing tubes: **NRd$_D$ = 24,55 kN**

Allowable normal force at coupler:

Bolzen / Bolt					
Material	10.9	f_{yb}	=	90,00	[kN/cm²]
		f_{ub}	=	100,00	[kN/cm²]
Geometrie geometry		D_b	=	1,59	[cm]
		A_b	=	1,98	[cm²]
zul. Normalkraft aus Abscheren n. EN 1993-1-8: allowable loading due to shearing acc. to EN 1993-1-8:	$N_{Rd} = 2 \times 0{,}60 \times A_b \times f_{ub} / \gamma_{M2}$		=	190,14	[kN]
Biegung des Bolzens in Anlehnung an EN 1993-1-8 Kap. 3.13.2 bending of the bolt acc. to EN 1993-1-8 chapter 3.13.2	$M_{Rd} = 1{,}5 \times W_{el} \times f_{yb} / \gamma_{M0}$		=	53,07	[kNcm]
Kombination Biegung und Abscheren n. EN 1993-1-8 combination of bending and shearing acc. to EN 1993-1-8		a	=	1,23	[cm]
		b	=	1,59	[cm]
		c	=	0,08	[cm]
	$M_{Ed} = N/8 \times (b + 4c + 2a)$ (Ansatz Med auf der sicheren Seite liegend) $(M_{Ed}/M_{Rd})^2 + (F_{Ed}/F_{Rd})^2 \leq 1$		=	0,54	x N [kNcm]
	→	N_{Rd}	=	**86,71**	**[kN]**
Verbinder / male fitting					
Material		EN AW 6082 T6 (AlMgSi1)			
Geometrie geometry		Dm	=	15,88	[mm]
Lochleibung in Anlehnung an EN 1999-1-1 Kap. 8.5.5 Bearing Stress acc. to EN 1999-1-1 Chapter 8.5.5		f_u / γ_{M2}	=	240,00	[N/mm²]
		d_o	=	15,88	[mm]
		t	=	15,88	[mm]
		e_1	=	25	[mm]
		α_b	=	0,525	[-]
		e_2	=	24	[mm]
		k_1	=	2,5	[-]
	$N_{rd} = k_1 \times \alpha_b \times f_u \times d \times t / \gamma_{M2}$		=	**79,40**	[kN]

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Anschluss Verbinder-Gurtrohr mit 3 Spannstiften
Connection fitting - main chord with 3 spring pins

3 Spannstifte Ø 10 mm nach EN ISO 8752 bzw. DIN 7346 und DIN 1481: Mindestabscherkraft (2-schnittig):					
3 spring pins Ø 10 mm acc. to EN ISO 8752				40	[kN]
respectively DIN 7346 und DIN 1481:		γ_{M2}	=	1,25	[-]
minimal shear load (double shear):					
		3xNrd	=	**96**	**[kN]**
Lochleibung in Anlehnung an EN 1991-1-1 Kap. 8.5.5					
Bearing Stress acc. to EN 1991-1-1		do	=	10	[mm]
chapter 8.5.3		teff, u	=	2,04	[mm]
		p2	=	37	[mm]
		k1	=	2,5	[-]
	f_u=		=	290	
1. Spannstift	e_1 [mm] = 20	$\alpha b1$	=	0,67	[-]
1. spring pin	$N_{rd1} = 2 \times k1 \times \alpha b \times fu \times d \times t / \gamma_{M2}$		=	15,79	[kN]
2. Spannstift	e_1 [mm] >= 35	$\alpha b1$	=	1,00	[-]
2. spring pin	$N_{rd1} = 2 \times k1 \times \alpha b \times fu \times d \times t / \gamma_{M2}$		=	23,68	[kN]
3. Spannstift	p_1 [mm] = 30	$\alpha b2$	=	0,75	[-]
3. spring pin	$N_{rd2} = 2 \times k1 \times \alpha b \times fu \times d \times t / \gamma_{M2}$		=	17,76	[kN]
$N_{rd,ges}$ =	$N_{rd1} + N_{rd2} + N_{rd3}$		=	**57,23**	**[kN]**

The allowable normal force of the coupler is relevant compared to the allowable normal force of the tube (NRd_G = 57,23 kN > 58,97 kN).

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Interaction bending and normal force at coupler of the outer chords

Verification of interaction bending and normal force at coupler

=> $\mathbf{(Nsd_G / NRd_G)^{1,3} + (Msd_G / MRd_G) < 1{,}0}$

mit $Nsd_G = Nsd / 4 + Msd / (2 \cdot 0{,}35\ m)$
und $Msd_G = 0{,}25 \cdot Qsd \cdot 8{,}0\ cm = 2{,}0\ cm \cdot Qsd$
=> a = factor for cantilever at the coupler = 2,0 cm

Nsd, Msd und Qsd: global internal forces in the truss (in kN resp. kNm)

The global internal forces include the following safety factors acc. Eurocode:

selfweight of the truss: yF = 1,35

Net load on the truss: yF = 1,50

NRd_G = allowable loading of the chord in the heat affected zone (see following table):

Gurtrohr auf Druck an der Kupplung im Bereich der Spannstifte in der WEZ
main chord at coupler under pressure at pins at HAZ

d,pins	=	10	[mm]	
A,net	=	4,98	[cm²]	
N_{Rd} = A,net x 0,8* x fu,haz / γ_{M2}	**=**	**58,97**	[kN]	nach Gl. 6.21a acc. equation 6.21a

MRd_G = MuRd (see following table):

Lokale Biegung Gurtrohr Knotenpunkt vollst. in WEZ
Local bending of chord

örtliche Schweißnaht nach Kap. 6.2.9.3 (1)
local welding seam acc. Chapter 6.2.9.3 (1)

D=	50	[mm]	
red-Faktor=	0,8	[-]	(WIG $_{TIG}$)
ρo,haz=	0,64	[-]	fu,haz / fu
tu,eff=	2,04	[mm]	red-Faktor · ρu,haz · t
$W_{net} = \pi \times R^2 \times t_{u,eff}$=	3,39	[cm³]	mit R = D / 2 - t / 2
MuRd = Wnet · fu / yM2=	**78,71**	[kNcm]	nach Gl. 6.24 acc. equation 6.24

The following 2 cases are taken into account.

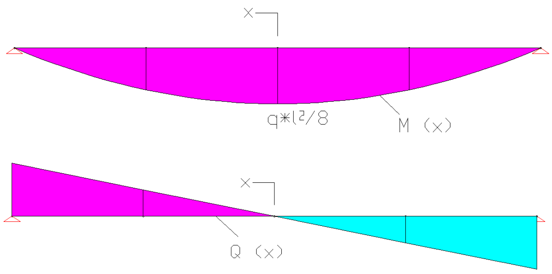
1. Verification of the center chords at the bottom at UDL-loads or multiple single point loads

The center chord at the botto are loaded at the worst points with multiple single point loads at a distance of 50 cm between each load.

2. Verification of the outer chords with uniformly distributed load (UDL)

The coupler is always located at the theoretically worst point. This results from the following extremum-calculation:

Note: For the determination of the worst position of the coupler, the exponent 1,3, for the relation of actual load to the allowable load is not taken into account with sufficient accuracy.



$Msd\ (x) = qsd \cdot L^2 / 8 - qsd \cdot x^2 / 2$
$Qsd\ (x) = qsd \cdot x$

$NRd_G = 58{,}97$ kN
$MRd_G = 78{,}71$ kNcm

M-Q Interaction $Msd(x) / (2 \cdot 0{,}305 \cdot 58{,}97) + Qsd(x) \cdot 2{,}0 / 78{,}71$

Extreme value: $d/dx\ \sigma\ (x) = 0$

$\Rightarrow x = 2 \cdot 0{,}305 \cdot 58{,}97 \cdot 2{,}0 / 78{,}71 = 0{,}914$ m
(from middle of span)

Summary

Following points are relevant for the determination of the allowable loads:

1. Allowable bending moment of the center chord at the top and the cross tubes (MRd_G) => MRd_G = 76,95 kNcm

2. Allowable normal force in main chord (NRd_G)

   Main chord in heat affected zone at coupler is relevant => NRd_G = 57,23 kN

3. Global shear force in truss (Q)

   Allowable normal force in diagonals at nodes is relevant => NRd_D = 24,55 kN

   zul shear force from $QRd / (2 \cdot \sin 41°) < 0{,}9 \cdot NRd_D$
   * 10% reduction because of minor stresses

   => allow. $QRd = 0{,}9 \cdot 24{,}55 \cdot 2 \cdot \sin 40{,}1°$ => QRd = 28,46 kN

4. Interaction bending and normal force at coupler see page 12

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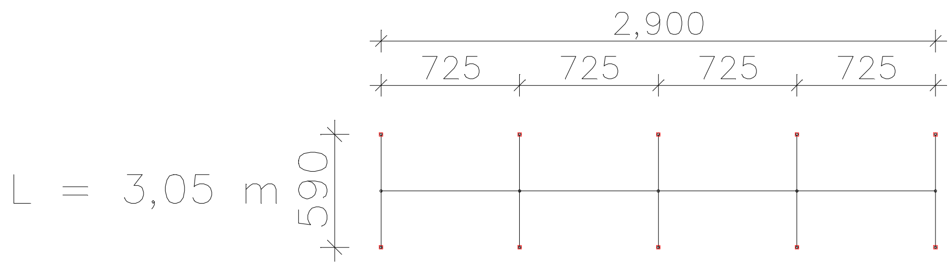
5 ALLOWABLE LOADING SINGLE SPAN GIRDER

5.1 Center chords at bottom

Systems [cm]:



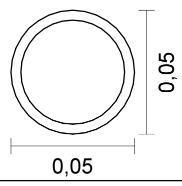
Loadings:	Multiple point loads at a distance of 50 cm	Pi = 2,0 kN see following pages
Calculation		see following pages
Verification:	max M_{Ed} = 1,5 · 51 kNcm = 76,5 kNcm	< MRd = 76,95 kNcm

M 1 :

System characteristics

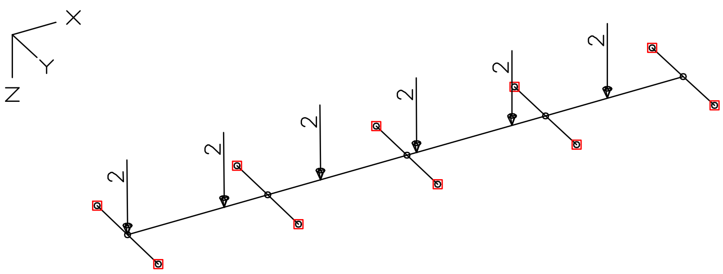
15 Nodes
14 Beams
10 Supports
0 Link elements
1 Material properties
1 Section properties
5 Load cases
1 Load case combinations
7 Result locations in beam elements

Section properties

1	Polygon 	Centroid [m]	ys = 0,000	zs = 0,000
		Area [m²]	A = 5,7435e-04	
		Moments of inertia [m4]	Ix = 1,0000e-06	
			Iy = 1,5208e-07	I1 = 1,5208e-07
			Iz = 1,5208e-07	I2 = 1,5208e-07
		Main axis angle [Grad]	Phi = 0,000	Iyz = 0,0000e+00
		Averaging of the lateral force shear stress over section width		

Material Properties

	No.	Type	E-Modu. [MN/m²]	GModule [MN/m²]	alpha.t [1/K]	gamma [kN/m³]	Miscellaneous
1	1	Frei	70000	27000	1,0e-05	27,000	fc = 1e+06 [MN/m²] ft = 1e+06



LC 60: Load, 3,0 m

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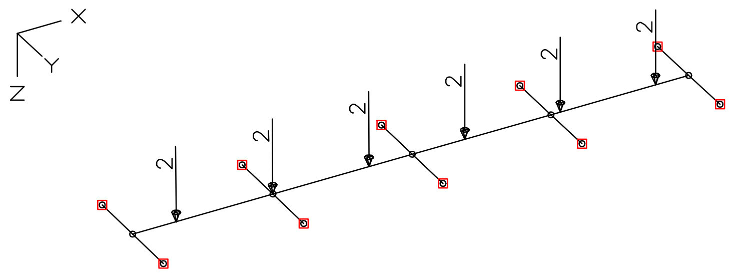
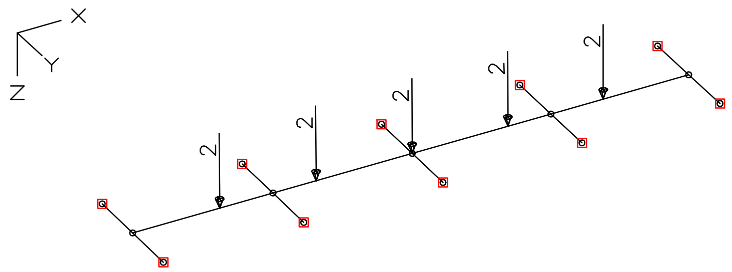
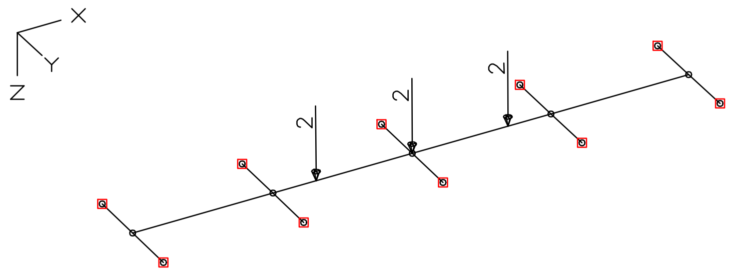
M 1 :



LC 61: Load, 3,0 m

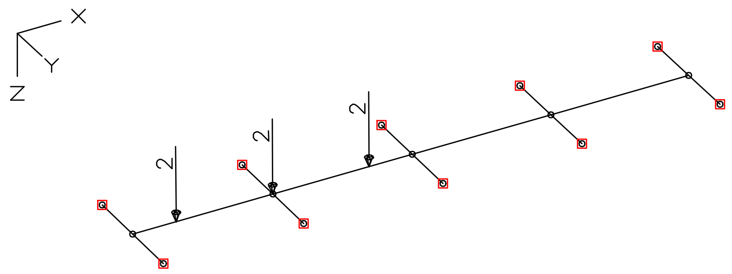


LC 62: Load, 3,0 m



LC 63: Load, 3,0 m

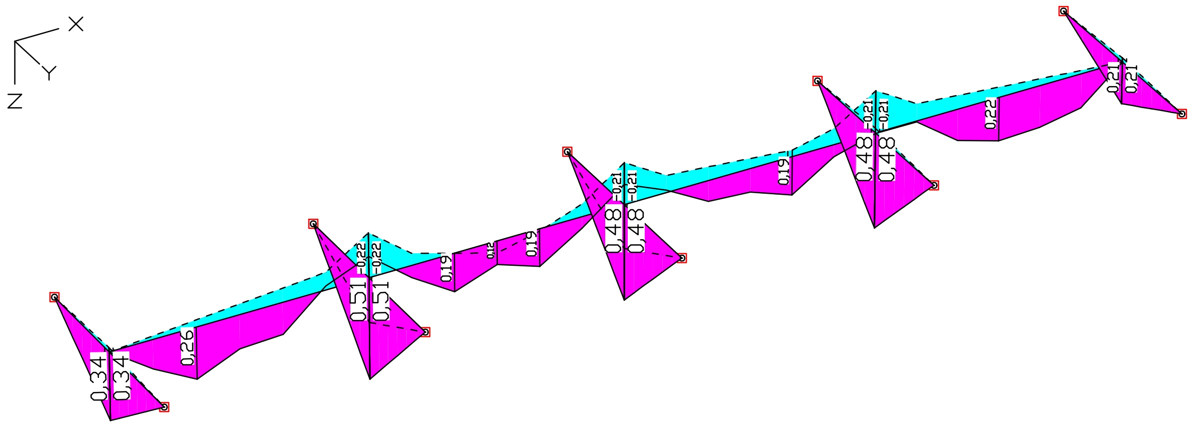
M 1 :



LC 64: Load, 3,0 m

Load case combination 1

Exclusive selection		Factor
60	3,0 m	1,000
61	3,0 m	1,000
62	3,0 m	1,000
63	3,0 m	1,000
64	3,0 m	1,000



Internal forces My min, max; LFK K1

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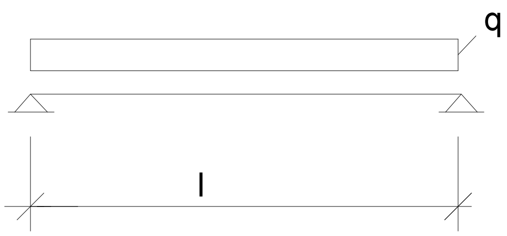
5.2 Outer chords + bracing uniformly distributed load (UDL)

System:



Loading

qsd = psd + gsd (Net load + selfweight, incl. safety factors)

Normal for4ce in chords:
NRd $\geq$ qsd · L² / 8 / (n · b) => qsd $\leq$ NRd · (n · b) · 8 / L²
=> zul p = (NRd · (n · b) · 8 / L² - gsd) / yF

Normal force in bracing:
QRd $\geq$ qsd · L / 2 => qsd $\leq$ QRd · 2 / L
=> zul p = (QRd · 2 / L - gsd) / yF

Interaction at coupler:
Verification of interaction bending and normal force at coupler by an iterative method.

=> $(Nsd_G / NRd_G)^{1,3} + (Msd_G / MRd_G) < 1,0$

applied: The coupler is located at e = 1,217 m from the middle of the span (theoretically worst point, see extremum-calculation in chapter 4)

Loading table:

Gleichstreckenlast
Uniformly distributed load UDL

	zulässige Belastung in Abhängigkeit von / allowable load as a function of			
	NRd	QRd	Interaction at coupler	Center chord at bottom
L [m]	**zul q [kN/m]**	**zul q [kN/m]**	**zul q [kN/m]**	**zul q [kN/m]**
4,00	11,48	9,34	10,45	4,00
5,00	7,30	7,44	6,95	4,00
6,00	5,02	6,18	4,91	4,00
7,00	3,65	5,28	3,62	4,00
8,00	2,76	4,60	2,76	4,00
9,00	2,15	4,07	2,17	4,00
10,00	1,71	3,65	1,74	4,00
11,00	1,39	3,30	1,41	4,00
12,00	1,15	3,02	1,17	4,00
13,00	0,95	2,77	0,98	4,00
14,00	0,80	2,56	0,82	4,00
15,00	0,68	2,38	0,70	4,00
16,00	0,58	2,23	0,60	4,00
17,00	0,50	2,09	0,51	4,00
18,00	0,43	1,96	0,44	4,00
19,00	0,37	1,85	0,38	4,00
20,00	0,32	1,75	0,33	4,00
21,00	0,28	1,66	0,29	4,00
22,00	0,24	1,58	0,25	4,00
23,00	0,21	1,50	0,21	4,00
24,00	0,18	1,43	0,19	4,00

Loadings > 4 kN/m are not allowed acc. chapter 5.1!

6 SUMMARY OF RESULTS

6.1 Allowable loadings:

Spannweite Span [m]	UDL UDL [kN/m]	
4	4,00	*
5	4,00	*
6	4,00	*
7	3,62	
8	2,76	
9	2,15	
10	1,71	
11	1,39	
12	1,15	
13	0,95	
14	0,80	
15	0,68	
16	0,58	
17	0,50	
18	0,43	
19	0,37	
20	0,32	
21	0,28	
22	0,24	
23	0,21	
24	0,18	

***The allowable loading is limited by the local load transfer on central bottom chord (Chapter 1.4 - First condition)**

The values of the table are only valid for single-span girder.

The truss-elements have to be braced with diagonals.

Loads have to be applied at the center chords of the bottom.

Loads at the middle of the couplers are not allowed.

The specified values include partial safety coefficients on the loadings side acc. EN 1990 of yF = 1.50 for payloads and yG = 1.35 for selfweight of the truss.

For applications which can be calculated on the basis of other codes, the partial safety factors can be adjusted (for example temporary structures acc. EN 13814, yF = 1.35 for payloads).

To use the resulting allowable loads with British Standard (BS) and ANSI, allowable loads listed in tables have to be multiplied by 0.85.

6.2 Deflections at max. allowable loadings:

Vorhandene Durchbiegung [cm] Prerigg-Truss unter max. zul. Lasten

Deflections [cm] for Prerigg-Truss at max. allowable loads

Spannweiten	UDL
Span	UDL
[m]	[cm]
4	0,36
5	0,89
6	1,85
7	3,11
8	4,10
9	5,19
10	6,42
11	7,78
12	9,28
13	10,91
14	12,69
15	14,60
16	16,66
17	18,86
18	21,21
19	23,70
20	26,35
21	29,15
22	32,11
23	35,23
24	38,51

(grey) = deflection $\geq$ L/100