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Structural Report

F35 (F34PN)

18444

Date 23/10/2019

SHORT VERSION

for the system by

Global Truss
Furong Industrial Area
Shajing Town

Baoan District Shenzhen China

Compiled by:

C. Fox

Aachen, 23th October 2019



This Structural Report includes pages

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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. 8.8)

1.3 General remarks

The truss system is part of a "modular construction system" with the different truss lengths

500mm, 1000mm, 1500mm, 2000mm, 2500 mm, 3000mm, 3500mm, 4000mm, 4500mm and 5000mm.

The Trusses consist of 2 upper and 3 lower main chords (round tube 50 x 4mm), which are arranged in a quadratic shape. The center chord at the bottom is connected to the outer chords by cross tubes (round tube 50 x 4mm). The trusses also consist of welded diagonal bracings (round tube 20 x 2mm). The truss type is stiffened by diagonal bracings at the top and at both vertical sides.

The distance between system lines of the mainchords is 24 cm in vertical- and 24 cm in horizontal direction.

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

The loads are applied acc. chapter 1.4. 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, $\gamma_F = 1.35$ 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 selfweight of the truss is approx. 11 kg/m

For the payloads there are 2 loadcases taken into account:

LC 1) The load can be applied as a distributed load, as multiple point loads or as single point loads on the central bottom chord.

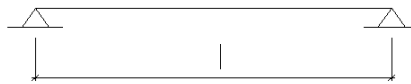
The allowable loading on the truss is limited by two conditions:

- 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:

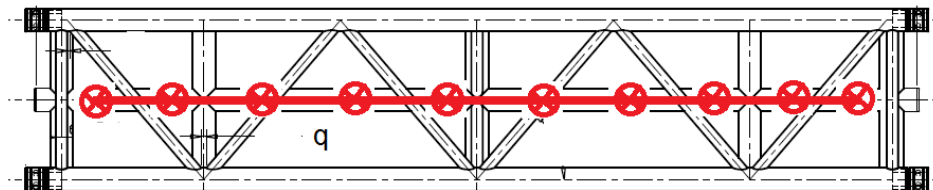
Structural system:



single span girder

Loading situations

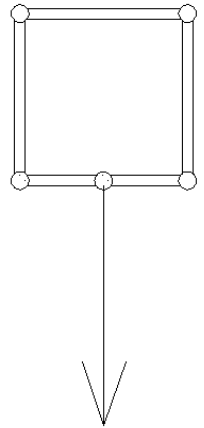
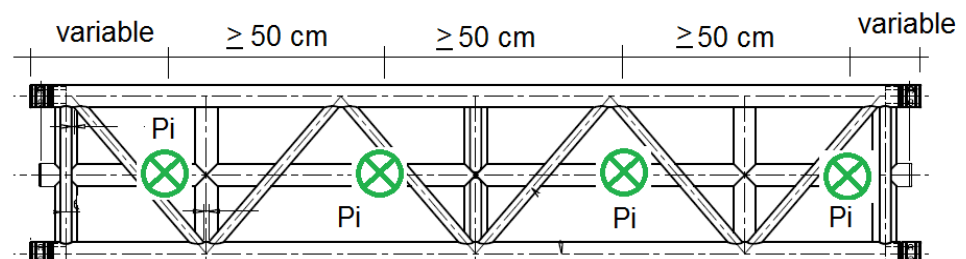
1a) uniformly distributed load (UDL) on central bottom chord



1b) multiple point load on central bottom chord at distances ≥ 50 cm

This is equivalent to a distributed load acc. 1a) $\Rightarrow P_i = \text{UDL} \cdot 0,5 \text{ m}$.

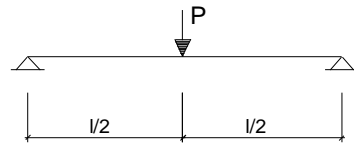
No restrictions concerning position on the central bottom chord but allowable loading in dependence of the span has to be respected, see chapter 6.



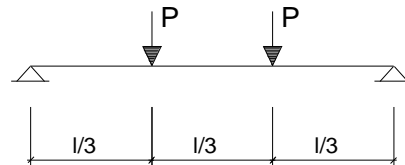


1c) Single point loads on central bottom chord

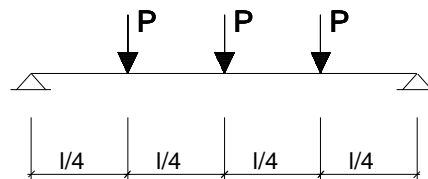
Single-load in 1/2 point



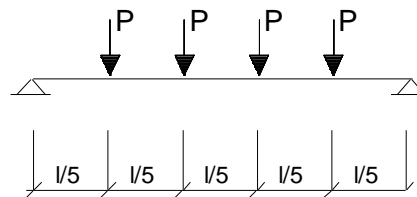
Single-load in 1/3 points



Single-load in 1/4 points



Single-load in 1/5 points

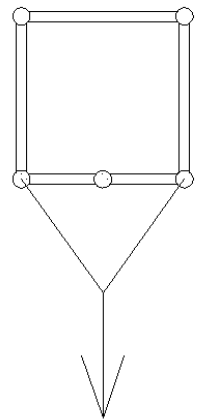
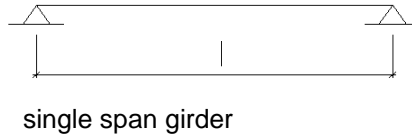




LC 2) The load can be applied as a distributed load or as single point loads on the side chords:

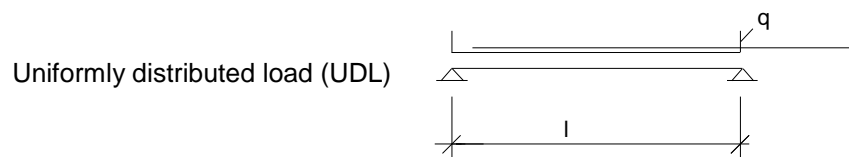
The following principle loadcases and loading situations are taken into account:

Structural system:



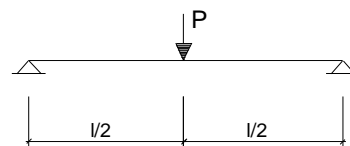
Loading situations

2a) uniformly distributed load (UDL) on side chords

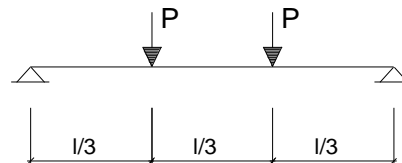


2b) Single point loads on central bottom chord

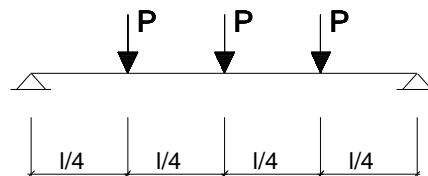
Single-load in 1/2 point



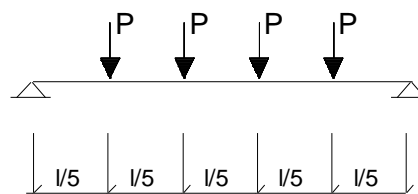
Single-load in 1/3 points



Single-load in 1/4 points

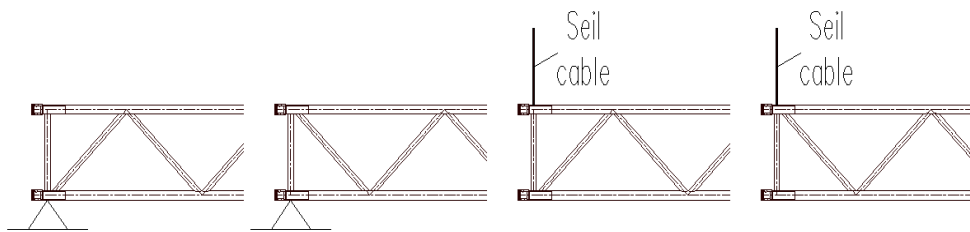


Single-load in 1/5 points

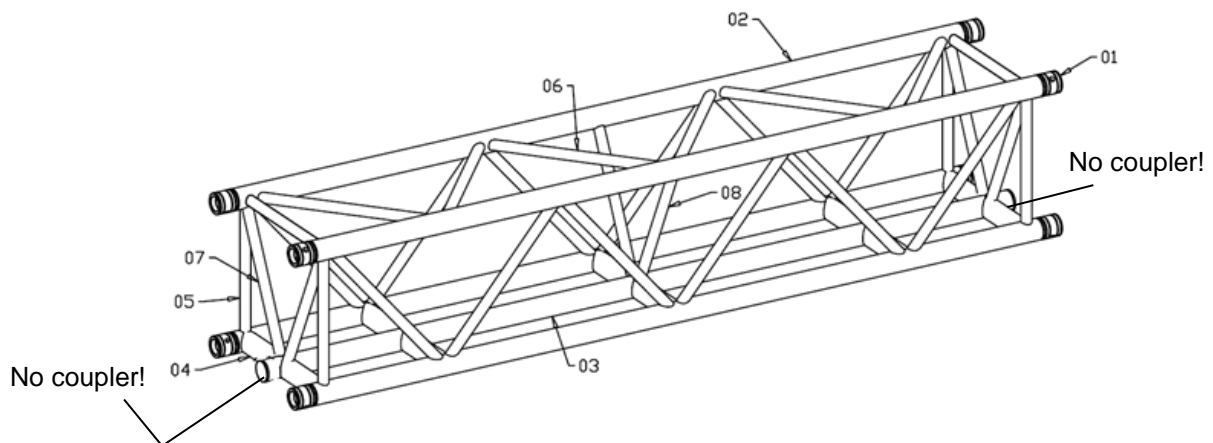




For the support or suspension there are the following possibilities:



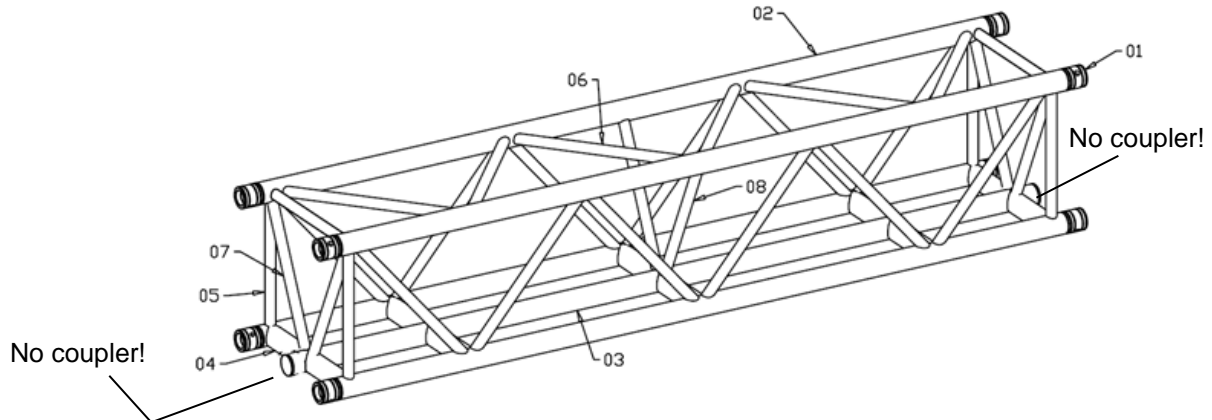
The trusses are connected at the 4 outer mainchords with couplers consisting of female fittings, connectors and bolts. The center chord of the bottom is not connected with couplers.





2 SYSTEM

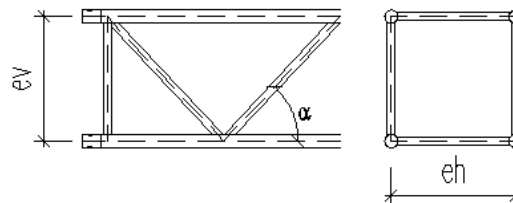
3 SECTION- AND MATERIAL PROPERTIES



Querschnittswerte Rohre / properties Tubes

	D [mm]	t [mm]	A [cm ²]	I [cm ⁴]	Wel [cm ³]	i [cm]
Gurtrohre / main chords	50,0	4	5,78	15,41	6,16	1,63
vertikal Diagonalen / Bracing	20	2	1,13	0,46	0,46	0,64
horizontal Diagonalen / Bracing	20	2	1,13	0,46	0,46	0,64

Geometrie Traverse / truss geometry



Achsabstand Gurtrohre	vertikal	ev	24	[cm]
distance axes main chords	horizontal	eh	24	[cm]
min. Neigung Diagonalen	vertikal	α	36,4	[°]
min. gradient bracing	horizontal	α	36,4	[°]

Kennwerte Gesamttraverse / properties truss-Section

A	$= 4 \times A_G$	$=$	23,12	[cm ²]
I_{yy}	$= 4 \times I_G + 4 \times A_G \times (ev/2)^2$	$=$	3391,21	[cm ⁴]
I_{zz}	$= 4 \times I_G + 4 \times A_G \times (eh/2)^2$	$=$	3391,21	[cm ⁴]
I_t	$=$ Näherung aus Erfahrungswerten	$=$	386,58	[cm ⁴]
i_y	$= (I_{yy}/A)^{1/2}$	$=$	12,11	[cm]
i_z	$= (I_{zz}/A)^{1/2}$	$=$	12,11	[cm]

Index G : Querschnittseigenschaft Gurtrohr
section properties main chord



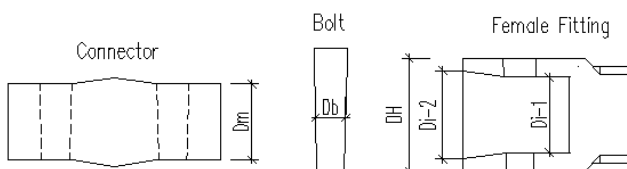
Material properties

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			
YM1=	1,10	Beulklasse / BC=	A
YM2=	1,25		
0,2%-Dehngrenze / 0,2%-Proof Strength		Zugfestigkeit / ultimate tensile strength	
fo ≤5mm=	250 [N/mm ²]	fu ≤5mm=	290 [N/mm ²]
fo >5mm=	260 [N/mm ²]	fu >5mm=	310 [N/mm ²]
fo,haz=	125 [N/mm ²]	fu,haz=	185 [N/mm ²]
Festigkeit der Schweißnaht Strength of welding seams		fw=	190 [N/mm ²]
Faktor für die WEZ-Werte beim WIG-Schweißen: Factor for HAZ-values for TIG-welding:			0,8

Bolzen / Bolt	42 CrMo (8.8)
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Verbinder / Connector	EN AW 2011 T6 (AlCuBiPb)		
0,2%-Dehngrenze / 0,2%-Proof Strength	Zugfestigkeit / ultimate tensile strength		
fo >	230 [N/mm ²]	fu >	310 [N/mm ²]

Hülse / Female fitting	EN AW 6082 T6		
zulässige Spannungen nach EN-1999-1-1 / allowable stress acc. to EN-1999-1-1			
Teilsicherheitsbeiwerte Material / partial safety factors material			
YM1=	1,10		
YM2=	1,25		
0,2%-Dehngrenze / 0,2%-Proof Strength	Zugfestigkeit / ultimate tensile strength		
fo=	250 [N/mm ²]	fu=	290 [N/mm ²]





4 ALLOWABLE LOADING SINGLE COMPONENTS

5 ALLOWABLE LOADING SINGLE SPAN GIRDER

6 SUMMARY OF RESULTS

6.1 Allowable loadings at center bottom chord (LC1):

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

The truss-elements have to be braced with diagonals.

Loads have to be applied acc. chapter 1.4.

Loads at the middle of the couplers are not allowed.

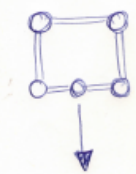
The specified values include partial safety coefficients on the loadings side acc. EN 1990 of $\gamma_F = 1.50$ for payloads and $\gamma_G = 1.35$ for selfweight of the truss.

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, $\gamma_F = 1.35$ 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.

6.1.1 Limitation of deflection = L/100

Allowable load F35 Loading applied on the central bottom chord



Span		UDL on cBC		Einzellasten / Single point loads							
Spannweite		UDL on cBC		in 1/2 Point		in 1/3 Points		in 1/4 Points		in 1/5 Points	
[m]	[ft]	[kg/m]	[lbs/ft]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]
4	13,1	511	343	800	1764	800	1764	681	1501	511	1126
5	16,4	407	273	800	1764	800	1764	678	1494	508	1121
6	19,7	337	227	800	1764	800	1764	653	1441	506	1115
7	23,0	288	193	800	1764	737	1625	562	1240	446	983
8	26,2	250	168	800	1764	656	1446	493	1086	393	866
9	29,5	202	136	800	1764	589	1298	437	963	350	771
10	32,8	162	109	745	1643	533	1174	391	862	314	693
11	36,1	126	85	674	1487	485	1069	353	777	284	627
12	39,4	94	63	614	1354	416	916	298	657	234	516
13	42,7	72	48	561	1238	343	756	246	542	193	426
14	45,9	55	37	484	1067	284	627	204	449	160	353
15	49,2	43	29	402	887	236	521	169	373	133	293
16	52,5	33	22	334	736	196	432	141	310	110	243
17	55,8	26	17	276	609	162	357	116	256	91	201
18	59,1	20	14	227	500	133	293	95	210	75	165
19	62,3	15	10	184	405	108	238	77	171	61	134
20	65,6	12	8	146	322	86	189	61	136	48	106



Load limited by allowable local loading on the Bottom chord

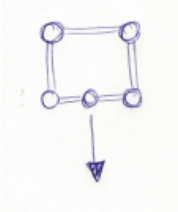


Load limited by allowable deflection of L/100



6.1.2 Limitation of deflection = L/200

Allowable load F35 Loading applied on the central bottom chord



Span Spannweite		UDL on cBC UDL on cBC		Einzellasten / Single point loads							
				in 1/2 Point in 1/2 Punkt		in 1/3 Points in 1/3 Punkten		in 1/4 Points in 1/4 Punkten		in 1/5 Points in 1/5 Punkten	
[m]	[ft]	[kg/m]	[lbs/ft]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]
4	13,1	511	343	800	1764	800	1764	681	1501	511	1126
5	16,4	407	273	800	1764	800	1764	678	1494	508	1121
6	19,7	337	227	800	1764	800	1764	649	1430	506	1115
7	23,0	255	171	800	1764	654	1442	469	1034	368	812
8	26,2	167	112	800	1764	490	1080	351	775	276	608
9	29,5	114	77	641	1413	376	829	270	595	212	467
10	32,8	80	54	500	1103	294	647	211	464	165	365
11	36,1	57	39	394	870	232	510	166	366	130	288
12	39,4	42	28	312	689	183	404	131	290	103	228
13	42,7	30	20	247	544	145	319	104	229	82	180
14	45,9	22	15	193	427	114	250	81	180	64	141
15	49,2	16	11	149	329	87	193	63	138	49	109
16	52,5	11	7	111	246	65	144	47	103	37	81
17	55,8	7	5	79	174	46	102	33	73	26	58
18	59,1	5	3	51	112	30	66	21	47	17	37



Load limited by allowable local loading on the Bottom chord

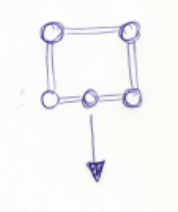


Load limited by allowable deflection of L/200



6.1.3 Limitation of deflection = L/300

Allowable load F35 Loading applied on the central bottom chord



Span Spannweite		UDL on cBC UDL on cBC		Einzellasten / Single point loads							
				in 1/2 Point in 1/2 Punkt		in 1/3 Points in 1/3 Punkten		in 1/4 Points in 1/4 Punkten		in 1/5 Points in 1/5 Punkten	
[m]	[ft]	[kg/m]	[lbs/ft]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]
4	13,1	511	343	800	1764	800	1764	681	1501	511	1126
5	16,4	407	273	800	1764	800	1764	625	1378	491	1082
6	19,7	270	182	800	1764	595	1311	427	941	335	739
7	23,0	166	112	726	1602	426	940	306	674	240	530
8	26,2	108	72	538	1186	316	696	226	499	178	392
9	29,5	72	49	406	896	239	526	171	377	134	296
10	32,8	50	33	310	684	182	402	131	288	103	226
11	36,1	35	23	237	524	139	307	100	220	79	173
12	39,4	24	16	180	398	106	233	76	167	60	132
13	42,7	17	11	134	296	79	174	57	125	44	98
14	45,9	11	7	97	213	57	125	41	90	32	70
15	49,2	7	5	65	143	38	84	27	60	21	47
16	52,5	4	3	37	82	22	48	16	35	12	27



Load limited by allowable local loading on the Bottom chord



Load limited by allowable deflection of L/300



6.2 Allowable loadings at side chord (LC2):

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

The truss-elements have to be braced with diagonals.

Loads have to be applied acc. chapter 1.4.

Loads at the middle of the couplers are not allowed.

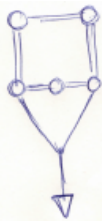
The specified values include partial safety coefficients on the loadings side acc. EN 1990 of $\gamma_F = 1.50$ for payloads and $\gamma_G = 1.35$ for selfweight of the truss.

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, $\gamma_F = 1.35$ 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.

6.2.1 Limitation of deflection = L/100

Allowable load F35 Loading applied on the side chords



Span		Einzellasten / Single point loads									
Spannweite		UDL on cBC		in 1/2 Point		in 1/3 Points		in 1/4 Points		in 1/5 Points	
[m]	[ft]	[kg/m]	[lbs/ft]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]
4	13,1	511	343	1694	3736	1021	2252	681	1501	511	1126
5	16,4	407	273	1416	3122	960	2116	678	1494	508	1121
6	19,7	337	227	1210	2668	836	1844	653	1441	506	1115
7	23,0	288	193	1053	2322	737	1625	562	1240	446	983
8	26,2	250	168	929	2048	656	1446	493	1086	393	866
9	29,5	202	136	828	1827	589	1298	437	963	350	771
10	32,8	162	109	745	1643	533	1174	391	862	314	693
11	36,1	126	85	674	1487	485	1069	353	777	284	627
12	39,4	94	63	614	1354	416	916	298	657	234	516
13	42,7	72	48	561	1238	343	756	246	542	193	426
14	45,9	55	37	484	1067	284	627	204	449	160	353
15	49,2	43	29	402	887	236	521	169	373	133	293
16	52,5	33	22	334	736	196	432	141	310	110	243
17	55,8	26	17	276	609	162	357	116	256	91	201
18	59,1	20	14	227	500	133	293	95	210	75	165
19	62,3	15	10	184	405	108	238	77	171	61	134
20	65,6	12	8	146	322	86	189	61	136	48	106

Load limited by allowable deflection of L/100



6.2.2 Limitation of deflection = L/200

Allowable load F35 Loading applied on the side chords



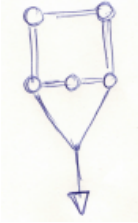
Span		Einzellasten / Single point loads									
Spannweite		UDL on cBC		in 1/2 Point		in 1/3 Points		in 1/4 Points		in 1/5 Points	
[m]	[ft]	[kg/m]	[lbs/ft]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]
4	13,1	511	343	1694	3736	1021	2252	681	1501	511	1126
5	16,4	407	273	1416	3122	960	2116	678	1494	508	1121
6	19,7	337	227	1210	2668	836	1844	649	1430	506	1115
7	23,0	255	171	1053	2322	654	1442	469	1034	368	812
8	26,2	167	112	835	1840	490	1080	351	775	276	608
9	29,5	114	77	641	1413	376	829	270	595	212	467
10	32,8	80	54	500	1103	294	647	211	464	165	365
11	36,1	57	39	394	870	232	510	166	366	130	288
12	39,4	42	28	312	689	183	404	131	290	103	228
13	42,7	30	20	247	544	145	319	104	229	82	180
14	45,9	22	15	193	427	114	250	81	180	64	141
15	49,2	16	11	149	329	87	193	63	138	49	109
16	52,5	11	7	111	246	65	144	47	103	37	81
17	55,8	7	5	79	174	46	102	33	73	26	58
18	59,1	5	3	51	112	30	66	21	47	17	37

Load limited by allowable deflection of L/200



6.2.3 Limitation of deflection = L/300

Allowable load F35 Loading applied on the side chords



Span		UDL on cBC		in 1/2 Point		in 1/3 Points		in 1/4 Points		in 1/5 Points	
Spannweite		UDL on cBC		in 1/2 Punkt		in 1/3 Punkten		in 1/4 Punkten		in 1/5 Punkten	
[m]	[ft]	[kg/m]	[lbs/ft]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]	[kg]	[lbs]
4	13,1	511	343	1694	3736	1021	2252	681	1501	511	1126
5	16,4	407	273	1416	3122	871	1921	625	1378	491	1082
6	19,7	270	182	1013	2234	595	1311	427	941	335	739
7	23,0	166	112	726	1602	426	940	306	674	240	530
8	26,2	108	72	538	1186	316	696	226	499	178	392
9	29,5	72	49	406	896	239	526	171	377	134	296
10	32,8	50	33	310	684	182	402	131	288	103	226
11	36,1	35	23	237	524	139	307	100	220	79	173
12	39,4	24	16	180	398	106	233	76	167	60	132
13	42,7	17	11	134	296	79	174	57	125	44	98
14	45,9	11	7	97	213	57	125	41	90	32	70
15	49,2	7	5	65	143	38	84	27	60	21	47
16	52,5	4	3	37	82	22	48	16	35	12	27

Load limited by allowable deflection of L/300