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Structural Report

U-Frame

U-Frame 60 + 75
Fixation options 1 - 5

17388

for the system by

Global Truss
Furong Industrial Area
Shajing Town

Baoan District Shenzen China

compiled by:

Aachen, 30.09.2017

INGENIEURKAMMER-BAU NORDRHEIN-WESTFALEN
BERATENDER INGENIEUR
101448

This Structural Report includes pages 1 – 12 + Annexes

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1 GENERAL REMARKS

1.1 Basics

The currently applicable regulations and standards, in particular:

DIN EN 1991-1	Loadings for buildings (Eurocode 1)
DIN EN 13814	Temporary structures
DIN EN 13782	Temporary structures – Tents
DIN EN 1993-1	Steel structures (Eurocode 3)
DIN EN 1995-1	Wooden Structures (Eurocode 5)
DIN EN 1999-1	Aluminium Structures (Eurocode 9)
DIN 4113	Aluminium Structures
DIN 4114	Stability
DIN 15920	Part 2: Stage and Studio structures
DIN 18800	Part 1: Steel Structures
DIN 2448	Steel tubes

BGV C1 und BGI 810-3

structural report 15240 U-Frame 50 + 100

1.2 Building Materials

EN AW-6082 T6	Aluminium of the Tubes U-Frame

1.3 General description

Subject of this calculation is the verification of a frame structure and the fixation of this structure.
This report is a supplement to report 15240.

Additional to the top fixation with lifting eye bolts and swivel couplers in report 15240 (options 1-3) two other options by using half couplers (options 4-5, see chap. 1.4) are taken into account. Also additional to the structural report 15240 two other sizes of U-Frames are taken into account in this calculation:

The structure consists of several stacked frames which are interconnected with fittings.
The frame structure can be connected to a ceiling structure by lifting eye bolts M12, by swivel couplers or by half couplers (manufacturer: Globaltruss).

Optionally the distance between two frames can be extended by F31 spacers. In this case the allowable loading per frame has to be reduced by the weight of the spacers (see also chapter 1.4).

In this calculation only the indoor setup is taken into account

The frame components are verified according BGI 810-3 as load lifting devices acc. EN 1999-1.

The top fixations (lifting eye bolts, swivel couplers or half coupler) are calculated acc. BGI 810-3 as lifting tackles with doubled operation coefficient.

U- Frame 60 with dimensions of 0,85 x 0,7m with tubes Ø50x3mm, material: Aluminium EN AW-6082 T6.

U- Frame 75 with dimensions of 0,90 x 0,85m with tubes Ø50x3mm, material: Aluminium EN AW-6082 T6.

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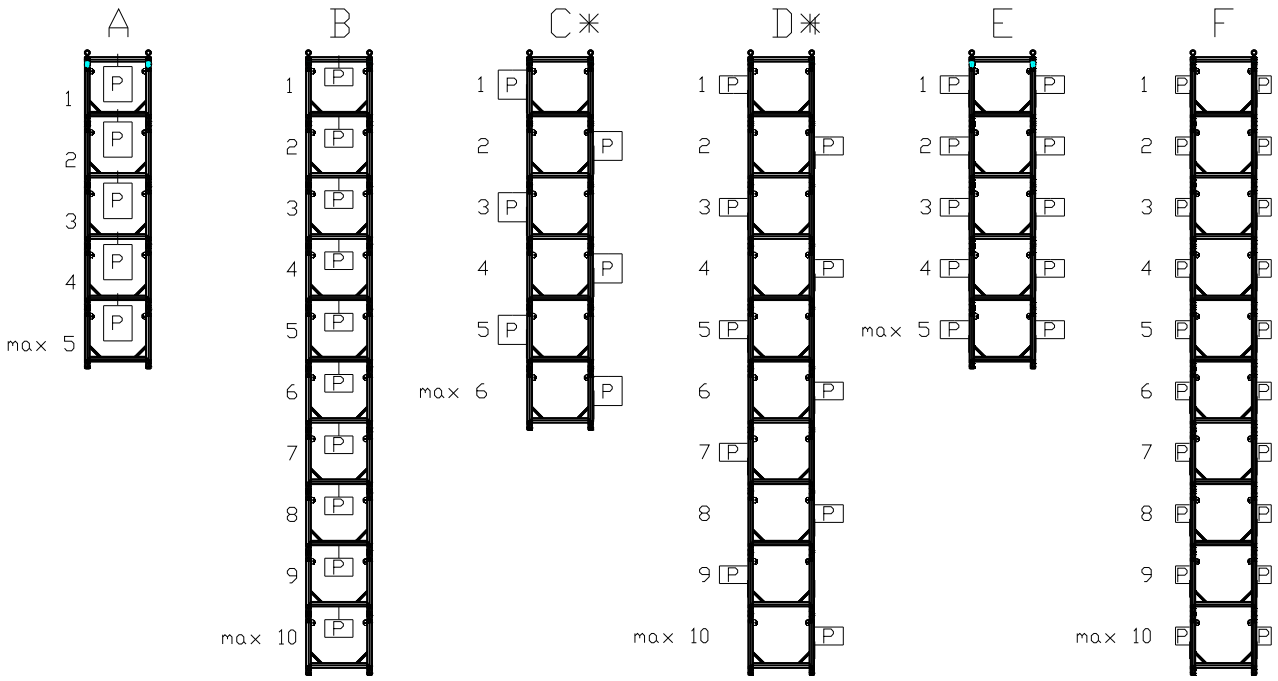
1.4 Advice on setting up and operation

There are 6 different variants (A, B, C*, D*, E, F) of frame structures. Up to 10 U-frames can be mounted together.

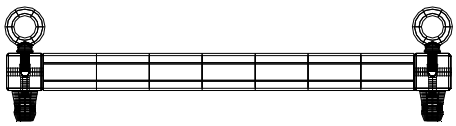
The suspended loadings are mounted centered at the horizontal tubes or at the vertical tubes:



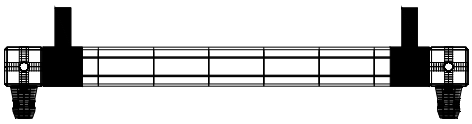
For the variants C* and D* the sum of loadings at the left and at the right side have to be equally. The number of frames has to be even.

There are 5 options fort the fixation of the U-frames at the top:

1.) Lifting eye bolt M12 acc. DIN 580 (WLL 340kg)



2.) Globaltruss Swivel Coupler (WLL 250kg) (Artikelcode: 5025/5025-B)
The couplers have to be mounted at the ends of the upper horizontal tubes.



3.) Globaltruss Swivel Coupler (WLL 500kg) (Artikelcode: 8231/8231-B)
analogue fixation no. 2.

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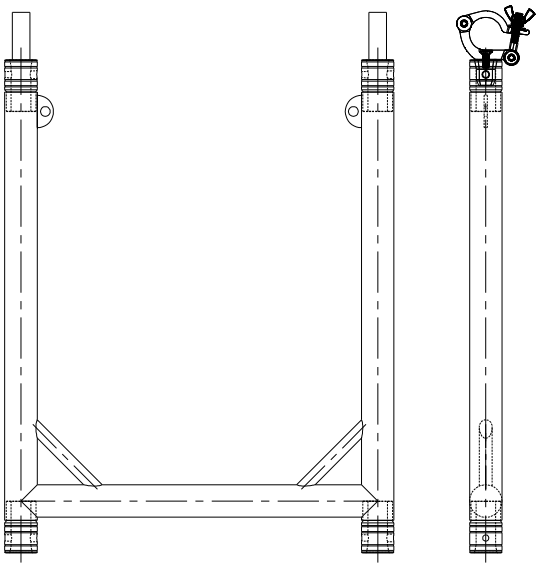
4.) Globaltruss Half Coupler (WLL 300kg) (Artikelcode: 5035-2)



5.) Globaltruss Half Coupler (WLL 500kg) (Artikelcode: 823)
Analogue fixation no. 4.

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The allowable loadings P acc. BGV C1 and BGI 810-3 per U-frame of the different variants (A,B,C*,D*,E,F) and the different options for the fixations are shown in the following tables (see also chapter 3.2).

U-Frame 50

Variante	1A
max n	5
P [kg] ≤	**63**

Variante	1B
max n	10
P [kg] ≤	**29**

Variante	1C
max n	6
P [kg] ≤	**52**

Variante	1D
max n	10
P [kg] ≤	**29**

Variante	1E
max n	5
P [kg] ≤	**31**

Variante	1F
max n	10
P [kg] ≤	**14**

Variante	2A
max n	5
P [kg] ≤	**45**

Variante	2B
max n	10
P [kg] ≤	**20**

Variante	2C
max n	6
P [kg] ≤	**37**

Variante	2D
max n	10
P [kg] ≤	**20**

Variante	2E
max n	5
P [kg] ≤	**22**

Variante	2F
max n	10
P [kg] ≤	**10**

Variante	3A
max n	5
P [kg] ≤	**95**

Variante	3B
max n	10
P [kg] ≤	**45**

Variante	3C
max n	6
P [kg] ≤	**78**

Variante	3D
max n	10
P [kg] ≤	**45**

Variante	3E
max n	5
P [kg] ≤	**47**

Variante	3F
max n	10
P [kg] ≤	**22**

Variante	4A
max n	5
P [kg] ≤	**55**

Variante	4B
max n	10
P [kg] ≤	**25**

Variante	4C
max n	6
P [kg] ≤	**45**

Variante	4D
max n	10
P [kg] ≤	**25**

Variante	4E
max n	5
P [kg] ≤	**27**

Variante	4F
max n	10
P [kg] ≤	**12**

Variante	5A
max n	5
P [kg] ≤	**95**

Variante	5B
max n	10
P [kg] ≤	**45**

Variante	5C
max n	6
P [kg] ≤	**79**

Variante	5D
max n	10
P [kg] ≤	**45**

Variante	5E
max n	5
P [kg] ≤	**47**

Variante	5F
max n	10
P [kg] ≤	**22**

U-Frame 100

Variante	1A
max n	5
P [kg] ≤	**61**

Variante	1B
max n	10
P [kg] ≤	**27**

Variante	1C
max n	6
P [kg] ≤	**50**

Variante	1D
max n	10
P [kg] ≤	**27**

Variante	1E
max n	5
P [kg] ≤	**30**

Variante	1F
max n	10
P [kg] ≤	**13**

Variante	2A
max n	5
P [kg] ≤	**43**

Variante	2B
max n	10
P [kg] ≤	**18**

Variante	2C
max n	6
P [kg] ≤	**35**

Variante	2D
max n	10
P [kg] ≤	**18**

Variante	2E
max n	5
P [kg] ≤	**21**

Variante	2F
max n	10
P [kg] ≤	**9**

Variante	3A
max n	5
P [kg] ≤	**93**

Variante	3B
max n	10
P [kg] ≤	**43**

Variante	3C
max n	6
P [kg] ≤	**76**

Variante	3D
max n	10
P [kg] ≤	**43**

Variante	3E
max n	5
P [kg] ≤	**46**

Variante	3F
max n	10
P [kg] ≤	**21**

Variante	4A
max n	5
P [kg] ≤	**53**

Variante	4B
max n	10
P [kg] ≤	**23**

Variante	4C
max n	6
P [kg] ≤	**43**

Variante	4D
max n	10
P [kg] ≤	**23**

Variante	4E
max n	5
P [kg] ≤	**26**

Variante	4F
max n	10
P [kg] ≤	**11**

Variante	5A
max n	5
P [kg] ≤	**93**

Variante	5B
max n	10
P [kg] ≤	**43**

Variante	5C
max n	6
P [kg] ≤	**77**

Variante	5D
max n	10
P [kg] ≤	**43**

Variante	5E
max n	5
P [kg] ≤	**46**

Variante	5F
max n	10
P [kg] ≤	**21**

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U-Frame 60

Variante	1A
max n	5
P [kg] ≤	**63**

Variante	1B
max n	10
P [kg] ≤	**29**

Variante	1C
max n	6
P [kg] ≤	**51**

Variante	1D
max n	10
P [kg] ≤	**29**

Variante	1E
max n	5
P [kg] ≤	**31**

Variante	1F
max n	10
P [kg] ≤	**14**

Variante	2A
max n	5
P [kg] ≤	**45**

Variante	2B
max n	10
P [kg] ≤	**20**

Variante	2C
max n	6
P [kg] ≤	**36**

Variante	2D
max n	10
P [kg] ≤	**20**

Variante	2E
max n	5
P [kg] ≤	**22**

Variante	2F
max n	10
P [kg] ≤	**10**

Variante	3A
max n	5
P [kg] ≤	**95**

Variante	3B
max n	10
P [kg] ≤	**45**

Variante	3C
max n	6
P [kg] ≤	**78**

Variante	3D
max n	10
P [kg] ≤	**45**

Variante	3E
max n	5
P [kg] ≤	**47**

Variante	3F
max n	10
P [kg] ≤	**22**

Variante	4A
max n	5
P [kg] ≤	**55**

Variante	4B
max n	10
P [kg] ≤	**25**

Variante	4C
max n	6
P [kg] ≤	**45**

Variante	4D
max n	10
P [kg] ≤	**25**

Variante	4E
max n	5
P [kg] ≤	**27**

Variante	4F
max n	10
P [kg] ≤	**12**

Variante	5A
max n	5
P [kg] ≤	**95**

Variante	5B
max n	10
P [kg] ≤	**45**

Variante	5C
max n	6
P [kg] ≤	**78**

Variante	5D
max n	10
P [kg] ≤	**45**

Variante	5E
max n	5
P [kg] ≤	**47**

Variante	5F
max n	10
P [kg] ≤	**22**

U-Frame 75

Variante	1A
max n	5
P [kg] ≤	**62**

Variante	1B
max n	10
P [kg] ≤	**29**

Variante	1C
max n	6
P [kg] ≤	**51**

Variante	1D
max n	10
P [kg] ≤	**29**

Variante	1E
max n	5
P [kg] ≤	**31**

Variante	1F
max n	10
P [kg] ≤	**14**

Variante	2A
max n	5
P [kg] ≤	**44**

Variante	2B
max n	10
P [kg] ≤	**20**

Variante	2C
max n	6
P [kg] ≤	**36**

Variante	2D
max n	10
P [kg] ≤	**20**

Variante	2E
max n	5
P [kg] ≤	**22**

Variante	2F
max n	10
P [kg] ≤	**10**

Variante	3A
max n	5
P [kg] ≤	**94**

Variante	3B
max n	10
P [kg] ≤	**45**

Variante	3C
max n	6
P [kg] ≤	**78**

Variante	3D
max n	10
P [kg] ≤	**45**

Variante	3E
max n	5
P [kg] ≤	**47**

Variante	3F
max n	10
P [kg] ≤	**22**

Variante	4A
max n	5
P [kg] ≤	**55**

Variante	4B
max n	10
P [kg] ≤	**25**

Variante	4C
max n	6
P [kg] ≤	**45**

Variante	4D
max n	10
P [kg] ≤	**25**

Variante	4E
max n	5
P [kg] ≤	**27**

Variante	4F
max n	10
P [kg] ≤	**12**

Variante	5A
max n	5
P [kg] ≤	**95**

Variante	5B
max n	10
P [kg] ≤	**45**

Variante	5C
max n	6
P [kg] ≤	**78**

Variante	5D
max n	10
P [kg] ≤	**45**

Variante	5E
max n	5
P [kg] ≤	**47**

Variante	5F
max n	10
P [kg] ≤	**22**

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Extension between two frames

Optionally the distance between two frames can be extended by F31 spacers. In this case the allowable loading per frame has to be reduced by the weight of the spacers:

Example: Extension with a 1,0m tube
Weight of extension tube 1,4 kg per side
Total weight of extension 2,8 kg
=> allowable loading has to be reduced by2,8 kg

For example variant 2 A - U-Frame50 :
now allowable P= 42,2 kg previoulsy 45 kg

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1.5 Loadings

Selfweight U-Frame 50

U-Frame	approx. 3,70 kg
U-Top	approx. 1,50 kg

Selfweight U-Frame 100

U-Frame	approx. 5,70 kg
U-Top	approx. 2,10 kg

Selfweight U-Frame 60

U-Frame	approx. 4,10 kg
U-Top	approx. 1,60 kg

Selfweight n U-Frame 75

U-Frame	approx. 4,30 kg
U-Top	approx. 1,80 kg

fitting approx. 0,25 kg

Option of fixation 1) -3): Total weight variants A – F

Variante	A in [kg]	B in [kg]	C in [kg]	D in [kg]	E in [kg]	F in [kg]
U-Frame 60	24,1	47,1	28,7	47,1	24,1	47,1
U-Frame 75	25,3	49,3	30,1	49,3	25,3	49,3
U-Frame 50	22,0	43,0	26,2	43,0	22,0	43,0
U-Frame 100	32,7	63,7	38,9	63,7	32,7	63,7

Option of fixation 4)-5): Total weight variants A - F

Variante	A in [kg]	B in [kg]	C in [kg]	D in [kg]	E in [kg]	F in [kg]
U-Frame 60	22,5	45,5	27,1	45,5	22,5	45,5
U-Frame 75	23,5	47,5	28,3	47,5	23,5	47,5
U-Frame 50	20,5	41,5	24,7	41,5	20,5	41,5
U-Frame 100	30,5	61,5	36,7	61,5	30,5	61,5

Pay loads P

Depending on the variant see chapter 1.4

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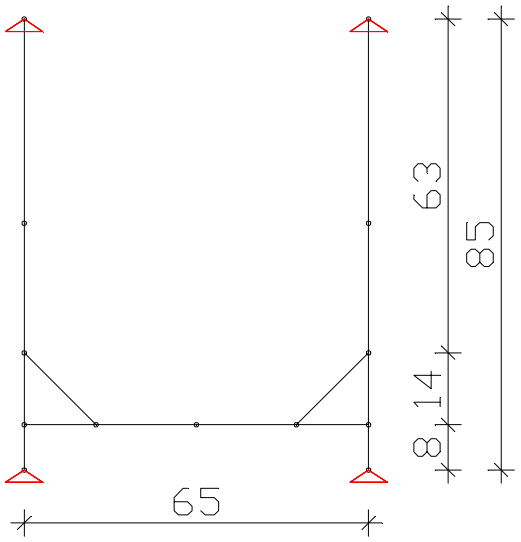
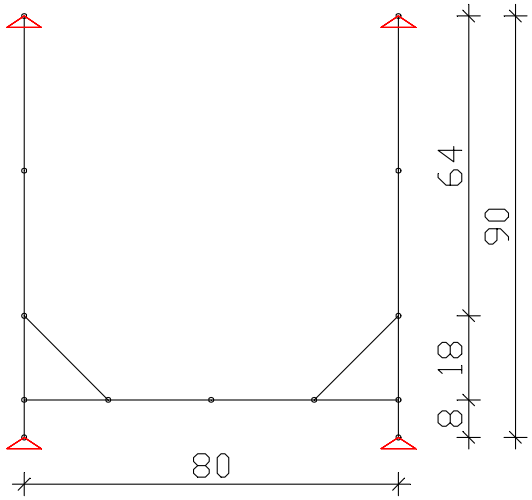
2 SYSTEM

U-Frame 60 [cm]



U-Frame 75 [m, cm]



All dimensions refer to the axes of the tubes.
(U-Frame 50 and U-Frame 100 see report 15240).

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3 STRUCTURAL INTEGRITY

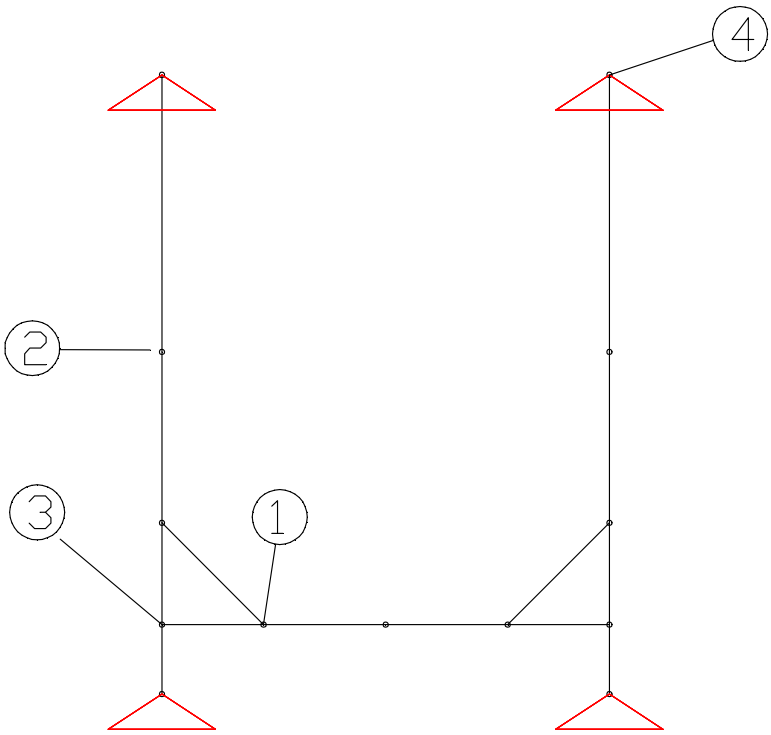
Verification of U-Frame 50 and U-frame 100 see structural report 15240.

3.1 Veriftication of the chords of the U-Frame 60 and U-Frame 75

Section- and material properties:

Chords	Material	fo [N/mm²]	fu [N/mm²]	fo,haz [N/mm²]	fu,haz [N/mm²]
50x3mm	6082 T6	250	290	125	185

The verifications are done for the variant 3A/5A, because this case includes the highest possible loadings of the U-frames.



The worst point for the verification is point 3. On the safe side it is assumed that all of the section is in the heat affected zone (HAZ).

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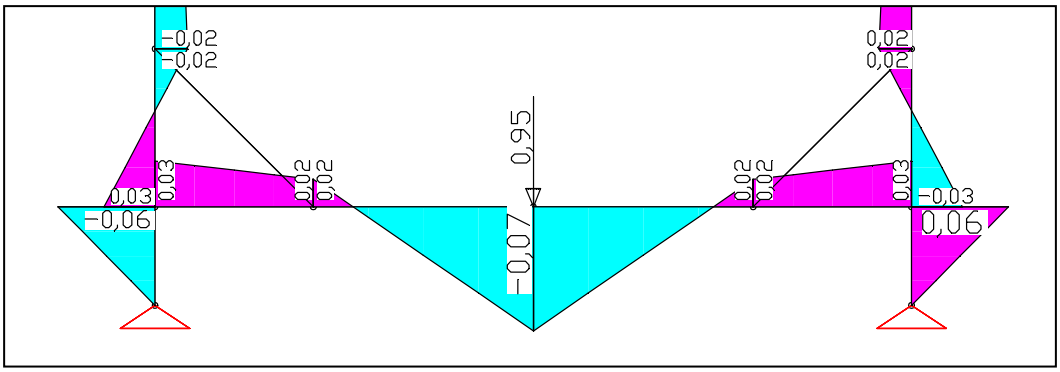
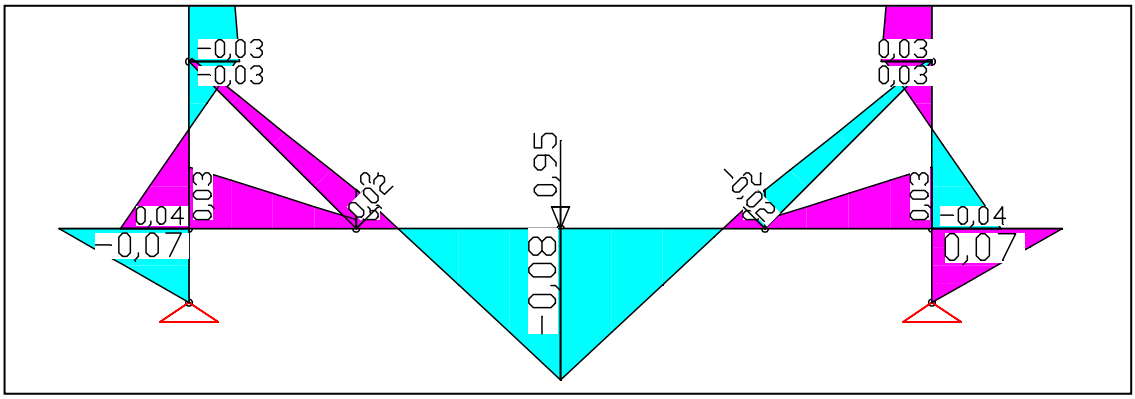
U-Frame 60: Diagram of bending moments at max. payload P of 95 kg (= 0,95 kN):



U-Frame 75: Diagram of bending moments at max. payload P of 95 kg (= 0,95 kN):



Verifications at point 3

lower bending moment comparing to Verification of U-Frame 100. (see chap. 3.1 structural report 15240)

no further proof

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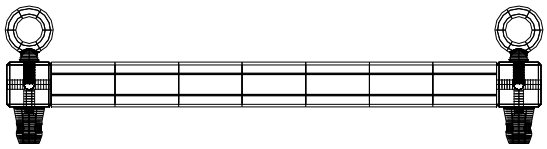
3.2 Verification of fixations:

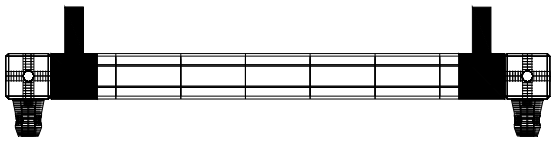
There are 3 options fort the fixation of the U-frames at the top.

Acc. BGI 810-3 only 50% of the loadcapacity given by the manufacturer can be taken into account for loadings above persons.

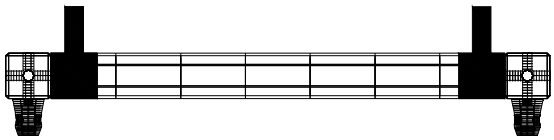
1.) Fixation with lifting eye bolts M12 Variants 1A-1F
Lifting eye bolts M12 acc. DIN 580: WLL 340 kg
allowable P_{total} = 2 · 340 / 2 = 340 kg



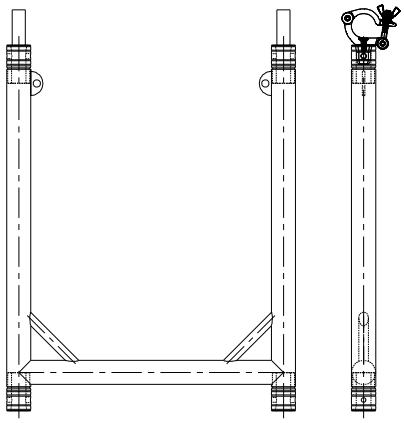
2.) Fixation with Swivel Coupler (Globaltruss) Variants 2A-2F (Artikelcode: 5025/5025-B)
WLL 250 kg
allowable P_{total} = 2 · 250 / 2 = 250 kg



3.) Fixation with Swivel Coupler (Globaltruss) Variants 2A-2F (Artikelcode: 8231/8231-B)
WLL 500 kg
allowable P_{total} = 2 · 500 / 2 = 500 kg



4.) Fixation with Half Coupler (Globaltruss) Variants 4A-4F (Artikelcode: 5035-2)
WLL 300 kg
allowable P_{total} = 2 · 300 / 2 = 300 kg



5.) Fixation with Half Coupler (Globaltruss) Variants 5A-5F (Artikelcode: 823)
WLL 500 kg
analogue fixation no. 4.
allowable P_{total} = 2 · 500 / 2 = 500 kg

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The calculation is done acc. the following principle:

$$\mathbf{P = (all\ P_{total} - G_{ges}) / k}$$

The results are shown in the tables of chapter 1.

Example for variant 5F – U-Frame 60

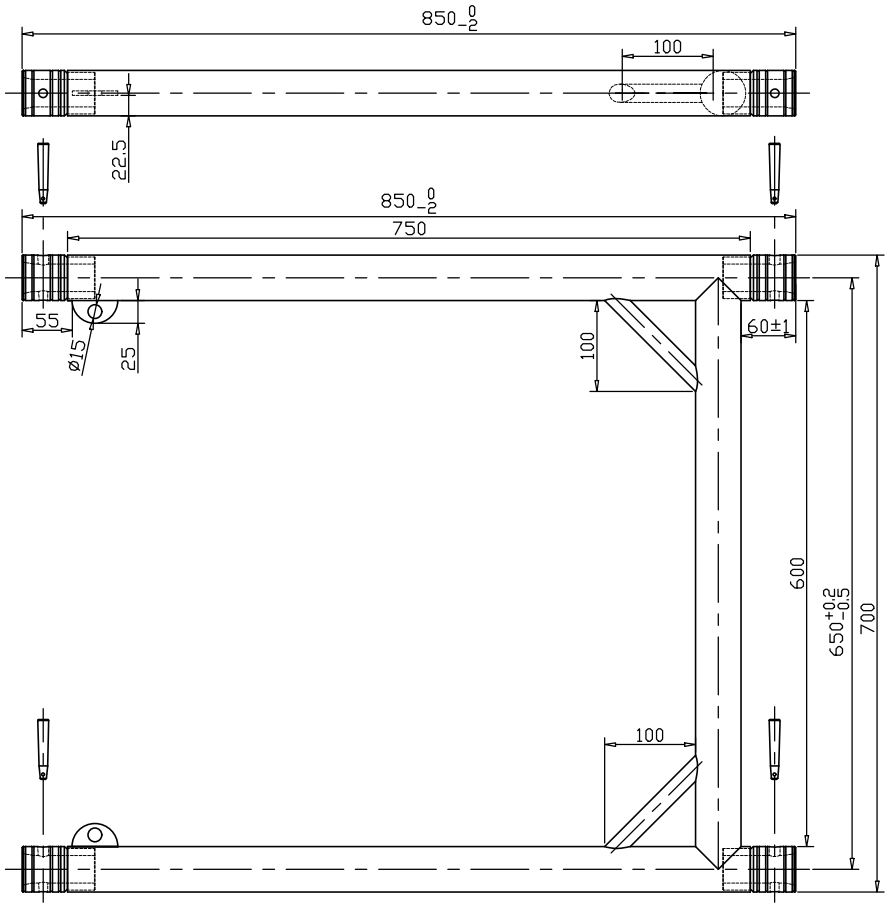
Number of frames n = 10
Number of mounted payloads k = 20

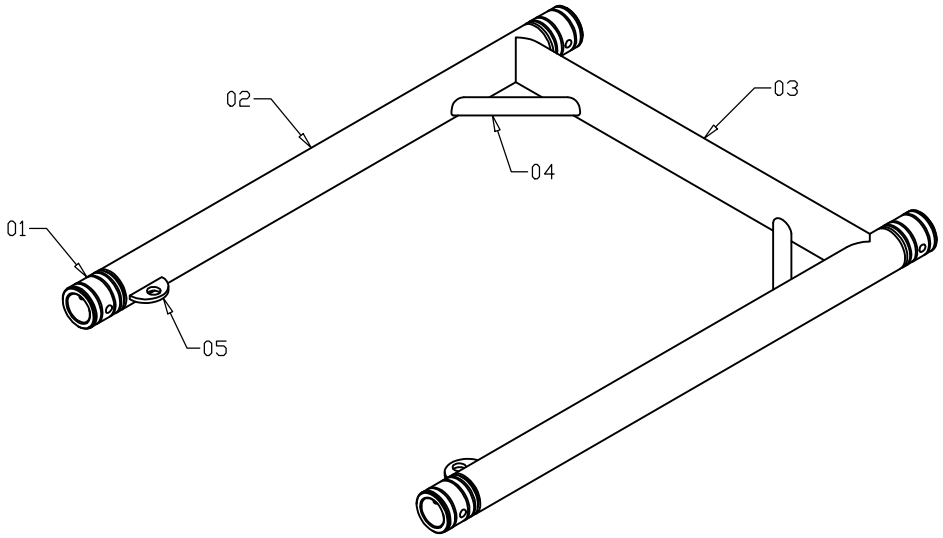
selfweight G:

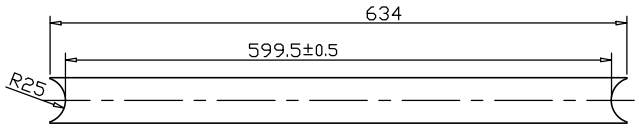
G = n x 4,1 kg + (2n-2) x 0,25
= 10 x 4,1 + 18 x 0,25 = 45,5 kg

Allowable payloads P:

P = (500 kg- 45,5 kg) / 20 = 22,7 kg = ca. 22 kg



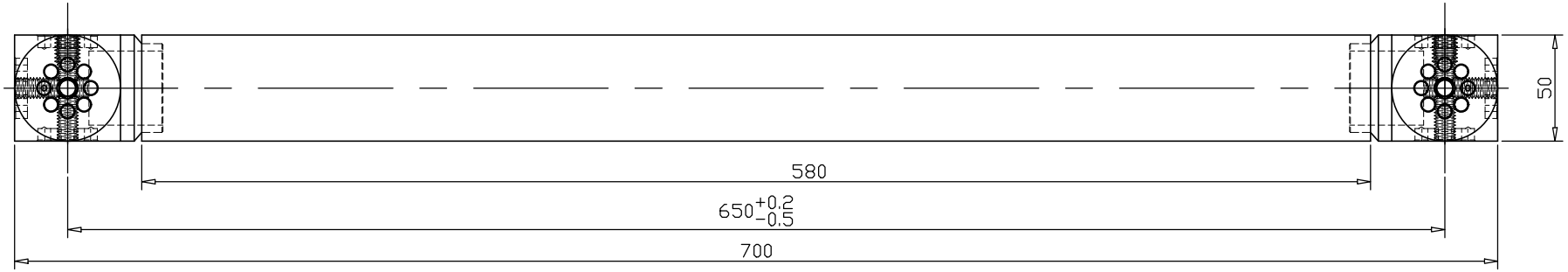


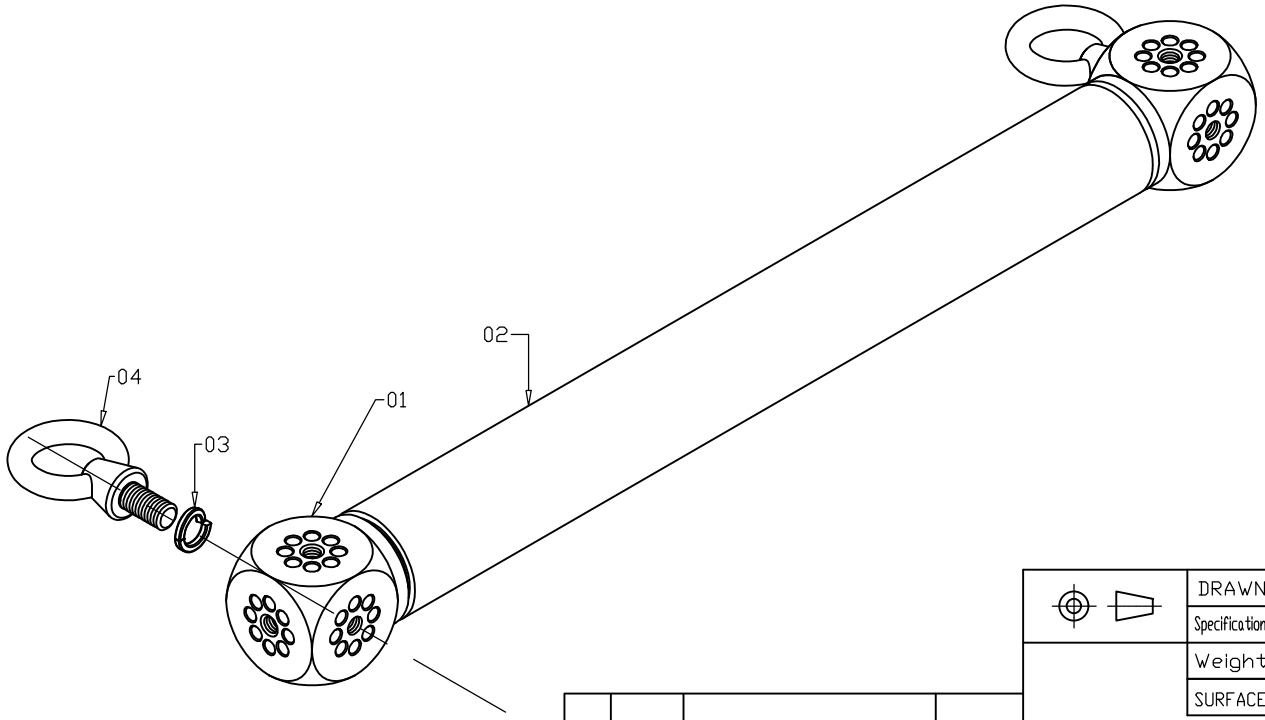


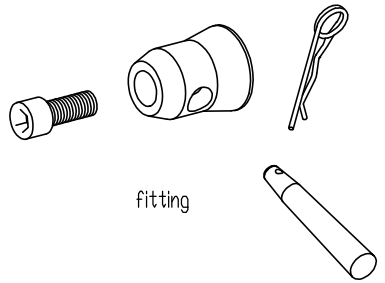
NO.	SPEC.	MATERIAL	FIN.	QTY.
fitting	DMS-01-1	Steel	ZP	4
	DMS-01-4	S45C	ZP	4
	DMS-01-3	#2011	T6	2
05	PJ-BQP117	#6061	T6	2
04	ø20*3.0t*141.4mm	#6082	T6	2
03	ø50*3.0t*634mm	#6082	T6	1
02	ø50*3.0t*750mm	#6082	T6	2
01	DMS-01-2CR	#6082	T6	4

DRAWN	F62H	DRAW NO	F62085H		2D/3D	edition	1
Specification	F62H-0.85M	DESIGN	*Iris*	DATE 17.08.14	CHECKED	APPROVED	
Weight	4.1kgs/pcs	UNITS	*mm*	Proofread			
SURFACE	RAW	SCALE	*1:8*				

MARK	NAME	RETRIEVE CONTENTS	DATE



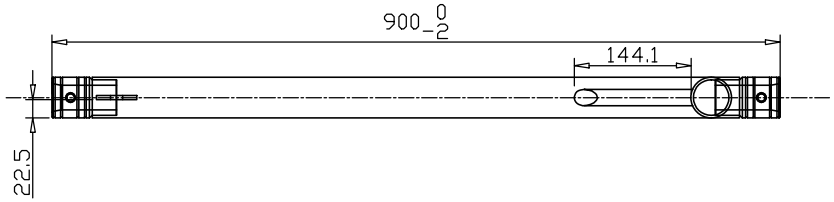


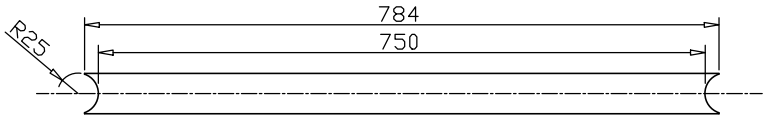


fitting	DMS-01-1	Steel	ZP	2
	DMS-01-4	S45C	ZP	2
	DMS-03-3N(M12*1.75P)	Steel	BLACK	2
	DMS-03-2N	Steel	ZP	2
04	M12*1.75P(20mm)	Steel	ZP	2
03	ø12.5*ø19*3.4t	Steel	ZP	2
02	ø50*3.0t*580mm	#6082	T6	1
01	DMS-03-1-1E	#6061	T6	2
NO.	SPEC.	MATERIAL	FIN.	QTY.

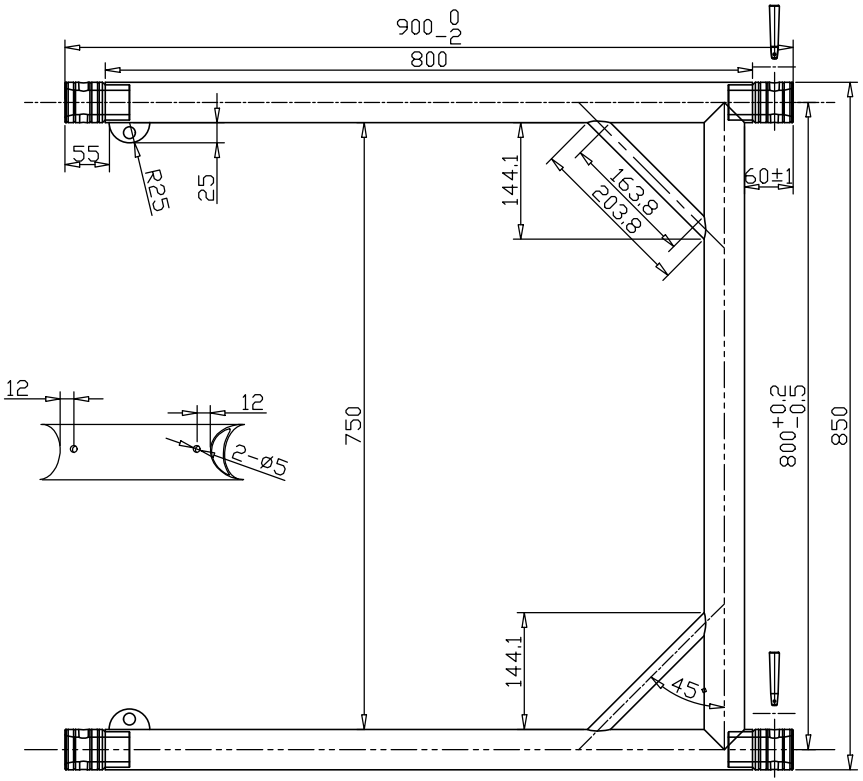
DRAWN	BOX	DRAW NO	F62H BOX		2D/3D	edition	1
Specification	F62H-0.65M BOX	DESIGN	*Iris*	DATE 17.08.14	CHECKED	APPROVED	
Weight	kgs/pcs	UNITS	*mm*	Proofread			
SURFACE	RAW	SCALE	*1:4*				

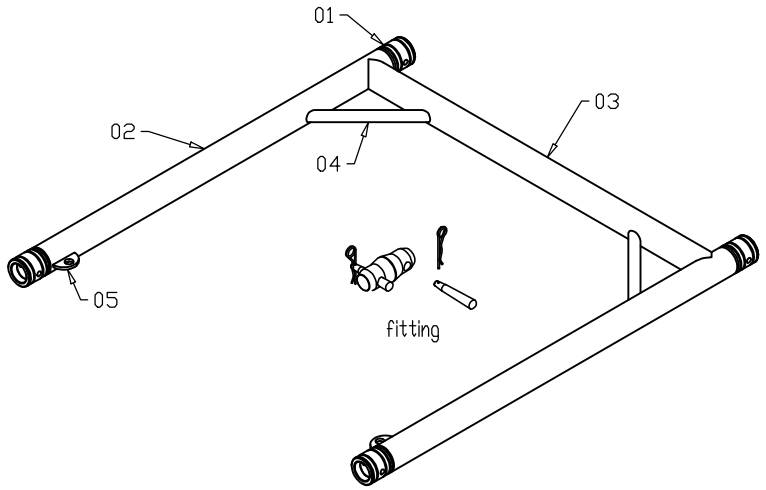
MARK	NAME	RETRIEVE CONTENTS	DATE





(03)補強管

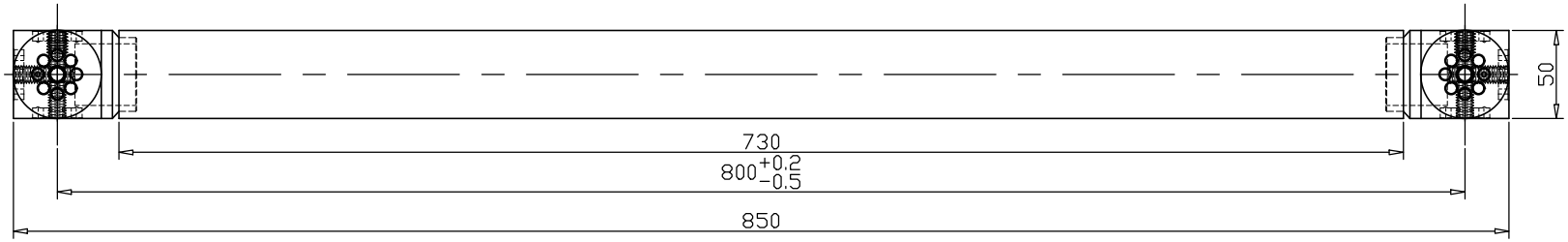


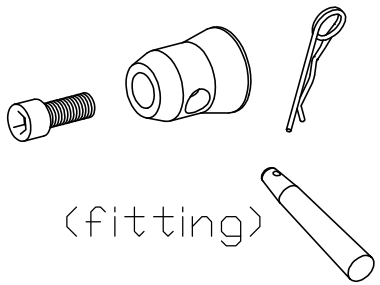


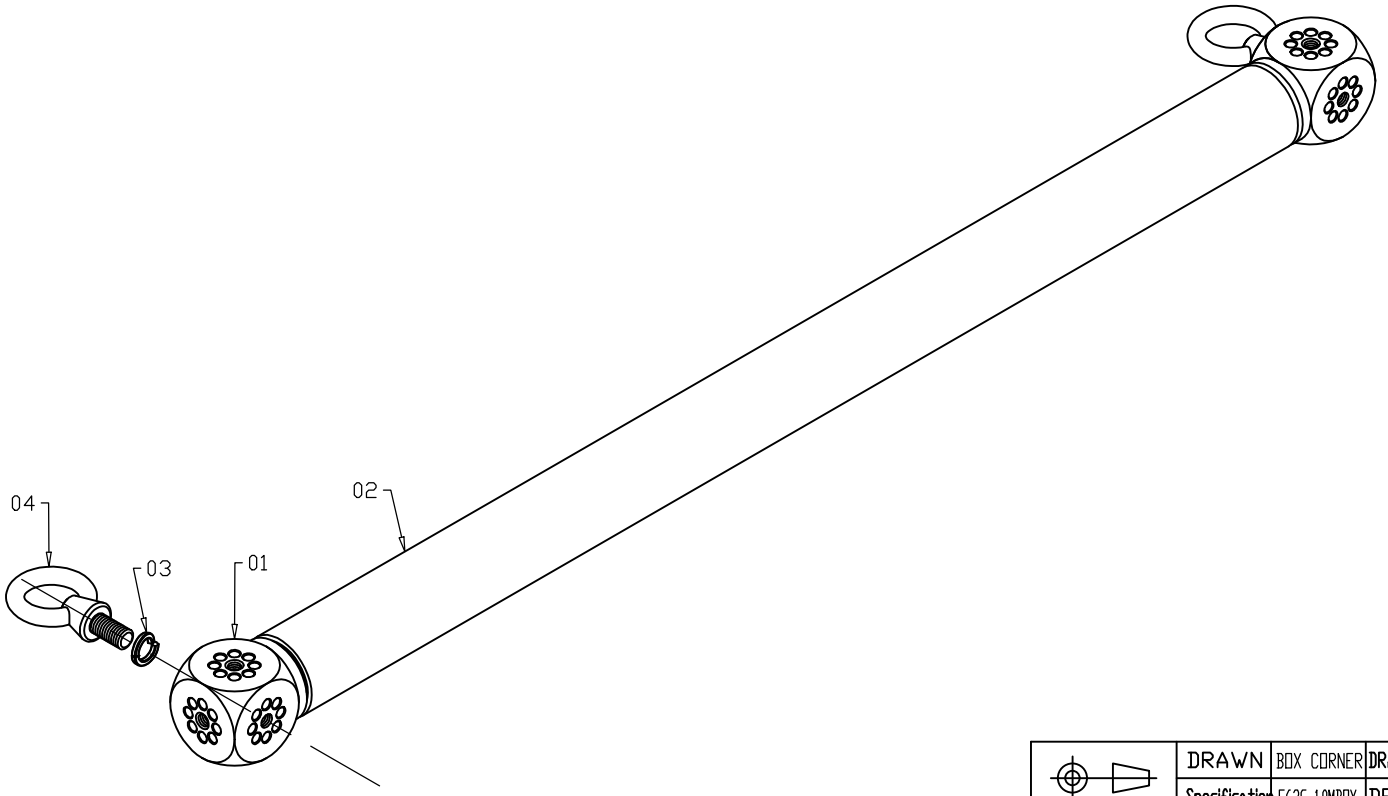
NO.	SPEC.	MATERIAL	FIN.	QTY
fitting	DMS-01-1	Steel	ZP	4
	DMS-01-4	S45C	ZP	4
	DMS-01-3	#2011	T6	2
05	PJ-BQP117	#6061	T6	2
04	ø20*3.0t*203.8mm	#6082	T6	2
03	ø50*3.0t*784mm	#6082	T6	1
02	ø50*3.0t*800mm	#6082	T6	2
01	DMS-01-2CR	#6082	T6	4

DRAWN	F62G	DRAW NO	F62900G		2D/3D	edition	1
Specification	F62G-0.9M	DESIGN	Rongwenwen	DATE 17.03.06	CHECKED	APPROVED	
Weight	3.9kgs/pcs	UNITS	mm	Proofread			
SURFACE	RAW	SCALE	1:9				

MARK	NAME	RETRIEVE CONTENTS	DATE







NO.	SPEC.	MATERIAL	FIN.	QTY
fitting	DMS-01-1	Steel	ZP	2
	DMS-01-4	S45C	ZP	2
	DMS-03-3N(M12*1.75P)	Steel	BLACK	2
	DMS-03-2N	Steel	ZP	2
04	M12*1.75P(螺紋20mm)	Steel	ZP	2
03	ø12.5*ø19*3.4t	Steel	ZP	2
02	ø50*3.0t*730mm	#6082	T6	1
01	DMS-03-1-1F	#6061	T6	2

DRAWN	BOX CORNER	DRAW NO	F62G BOX		2D/3D	edition	1
Specification	F62G-1.0MBOX	DESIGN	Rongwenwen	DATE 17.05.08	CHECKED	APPROVED	
Weight	1.52kgs/pcs	UNITS	mm	Proofread			
SURFACE	RAW	SCALE	1:4				

MARK	NAME	RETRIEVE CONTENTS	DATE