Büro für Tragwerksplanung und Ingenieurbau
vom Felde + Keppler GmbH & Co. KG

Lütticher Straße 10-12
52064 Aachen
www.vom-felde.de

Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

Structural Report U-Frame 15240

for the system by

B & K Braun GmbH
Industriestraße 2

76307 Karlsbad

compiled by:

Aachen, 30.06.2015

INGENIEURKAMMER-BAU NORDRHEIN-WESTFALEN
BERATENDER INGENIEUR
101448

This Structural Report includes pages 1 – 8 + Annexes

Büro für Tragwerksplanung und Ingenieurbau
vom Felde + Keppler GmbH & Co.KG
Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

TABLE OF CONTENTS

Annex: drawings

Büro für Tragwerksplanung und Ingenieurbau
vom Felde + Keppler GmbH & Co. KG
Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

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

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.

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 or by swivel 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 or by swivel couplers) are calculated acc. BGI 810-3 as lifting tackles with doubled operation coefficient.

Two sizes of U-frames are taken into account:

U- Frame 50 with dimensions of 0,76 x 0,6m with tubes Ø50x3mm, material: Aluminium EN AW-6082 T6.

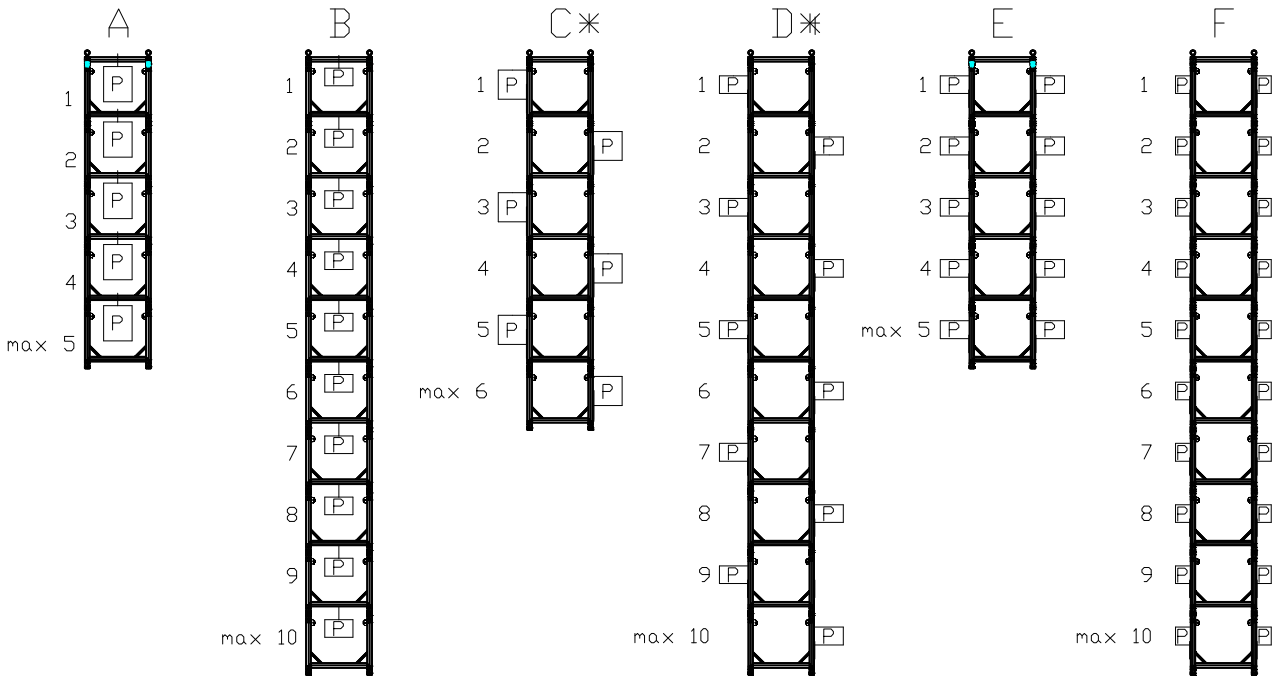
U- Frame 100 with dimensions of 1,1 x 1,25m with tubes Ø50x3mm, material: Aluminium EN AW-6082 T6.

Büro für Tragwerksplanung und Ingenieurbau
vom Felde + Keppler GmbH & Co. KG
Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

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.

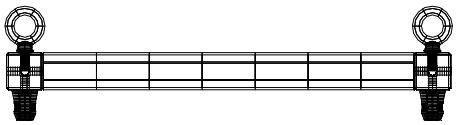
The suspended loadings are mounted centered at the horizontal tubes or at ther vertical tubes:



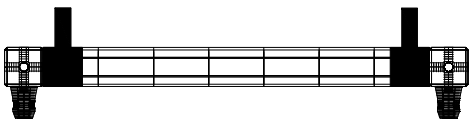
For the variants C* and D* the sum of loadings at the left and at the right side have tob e equally. The number of frames has to be even.

There are 3 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.

Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

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**

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**

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

Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

1.5 Loadings

Selfweight U-Frame 50

U-Frame	approx. 3,70 kg
U-Top	approx. 1,50 kg
Verbinder	approx. 0,25 kg

Selfweight n U-Frame 100

U-Frame	approx. 5,70 kg
U-Top	approx. 2,10 kg
Verbinder	approx. 0,25 kg

Total wieght variants A – F

Variante	A in [kg]	B in [kg]	C in [kg]	D in [kg]	E in [kg]	F in [kg]
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

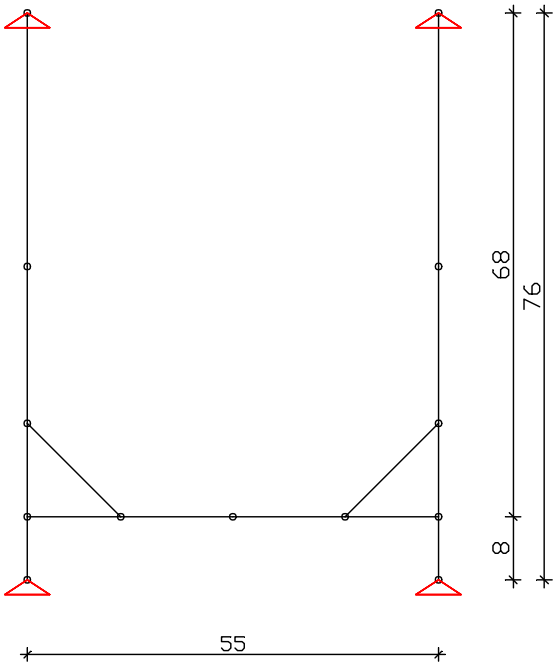
Pay loads P

Depending on the variant see chapter 1.4

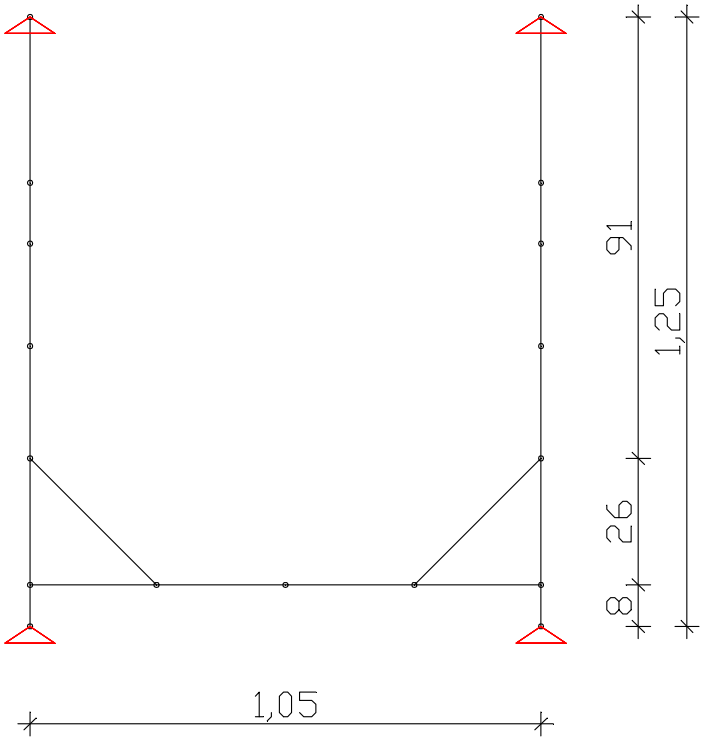
Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

2 SYSTEM

U-Frame 50 [cm]



U-Frame 100 [m, cm]



All dimensions refer to the axes of the tubes.

Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

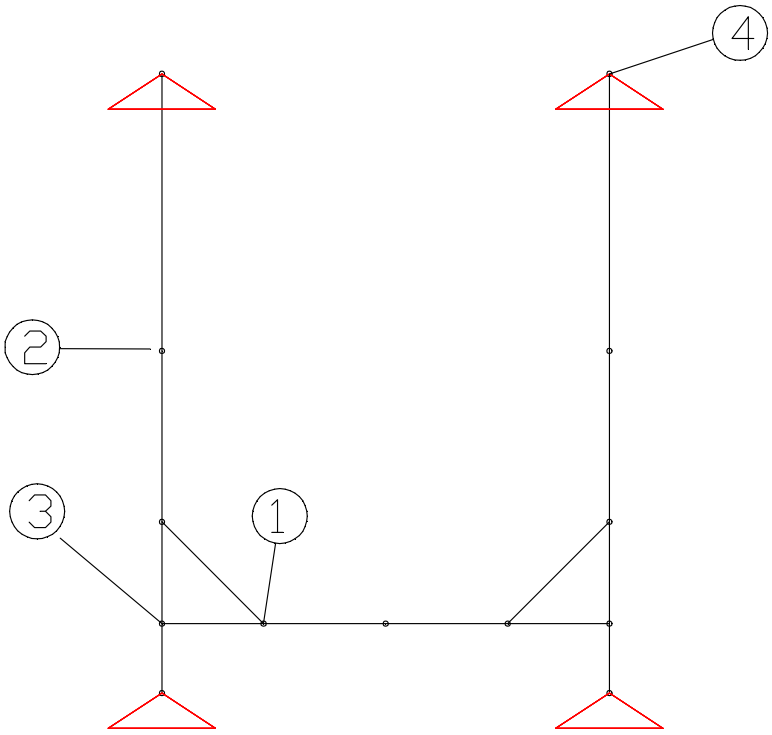
3 STRUCTURAL INTEGRITY

3.1 Veriftication of the chords of the U-Frame

Section- and material properties:

U-Frame	Chords	Material	fo [N/mm²]	fu [N/mm²]	fo,haz [N/mm²]	fu,haz [N/mm²]
50 / 100	50x3mm	6082 T6	250	290	125	185

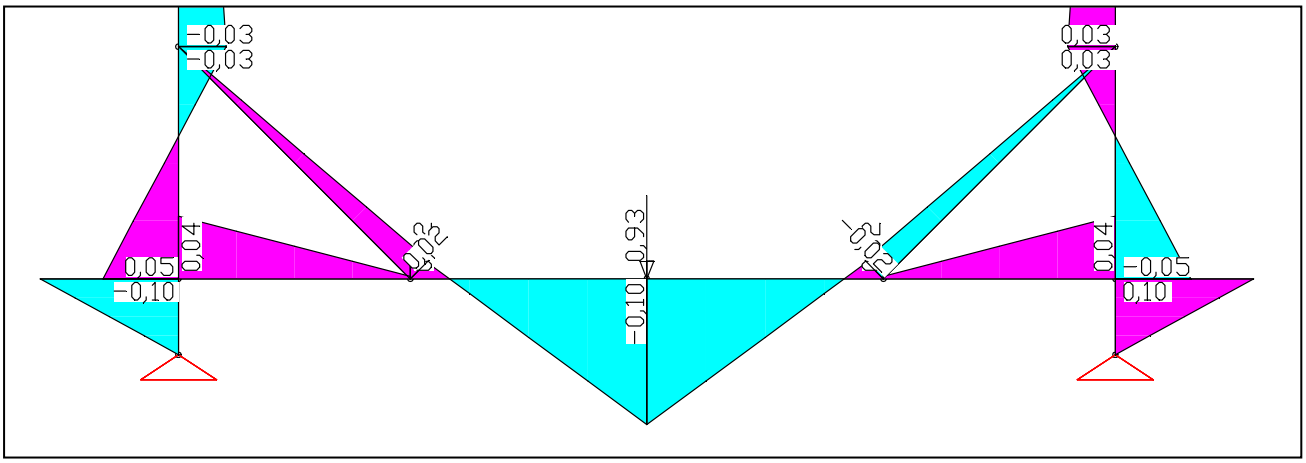
The verifications are done for the variant 3A, because this case includes the highest possible loadings of the U-frames



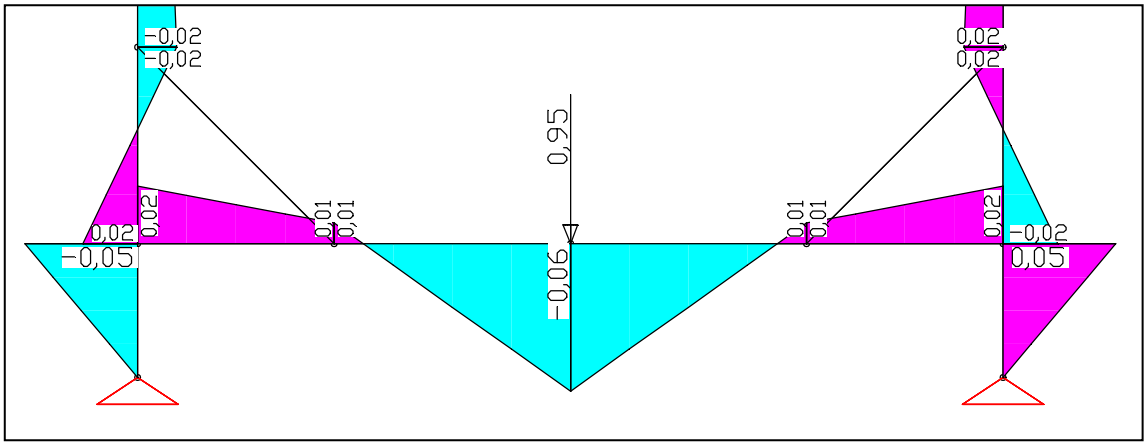
The worst point for the verification is point 3. On the safe side it is assumed that all of the section is in the heat affected zone (HAZ).

Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

U-Frame 100: Diagram of bending moments at max. payload P of 93 kg (= 0,93 kN):



U-Frame 50: Diagram of bending moments at max. payload P of 95 kg (= 0,95 kN):



Verifications at point 3

Interaction of bedning moment and normal force in the chord:

Maximum loading	max M_{Ed} = 10 kNcm max N_{Ed} = 5,0 / 2 = 2,5 kN (from max. loadcapacity oft he fixations, see chapter. 3.2)
Resistance	min fu,haz = 18,5 kN/cm² (EN AW 6082 T6) A = 4,43 cm²
	Reduction factor 0,8 acc. EN 1999-1
	NRd = 0,8 · 18,5 / 1,25 · 4,43 cm² = 52,45 kN
	ρu,haz = 185 / 290 = 0,64 teff = 0,8 · 0,64 · 3 = 1,53 mm => W,net = π · 2,35² · 0,153 = 2,65cm³ min fu = 29 kN/cm² (EN AW 6082 T6) MRd = 2,65 · 29 / 1,25 = 61,48 kNcm
Verification:	Interaction acc. EN 1999-1: $(2,5 / 52,45)^{1,3} + 10 / 61,48 = 0,18 < 1,0$

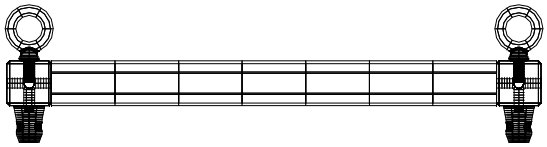
Lütticher Straße 10-12
52064 Aachen
Telefon: 0241 / 70 96 96
Telefax: 0241 / 70 96 46
buero@vom-felde.de

3.2 Verification of fixations:

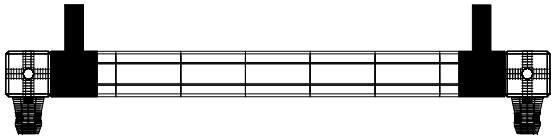
There are 3 options fort the fixation of the U-frames at the top.

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

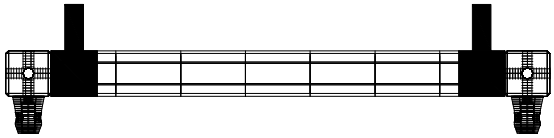
1.) Fixation with lifting eye bolts M12 Variants 1A-1F
Lifting eye bolts M12 acc. DIN 580: WLL 340 kg
allowable P_{total} = 2 · 340 / 2 = 340 kg



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



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 1F – U-Frame 50

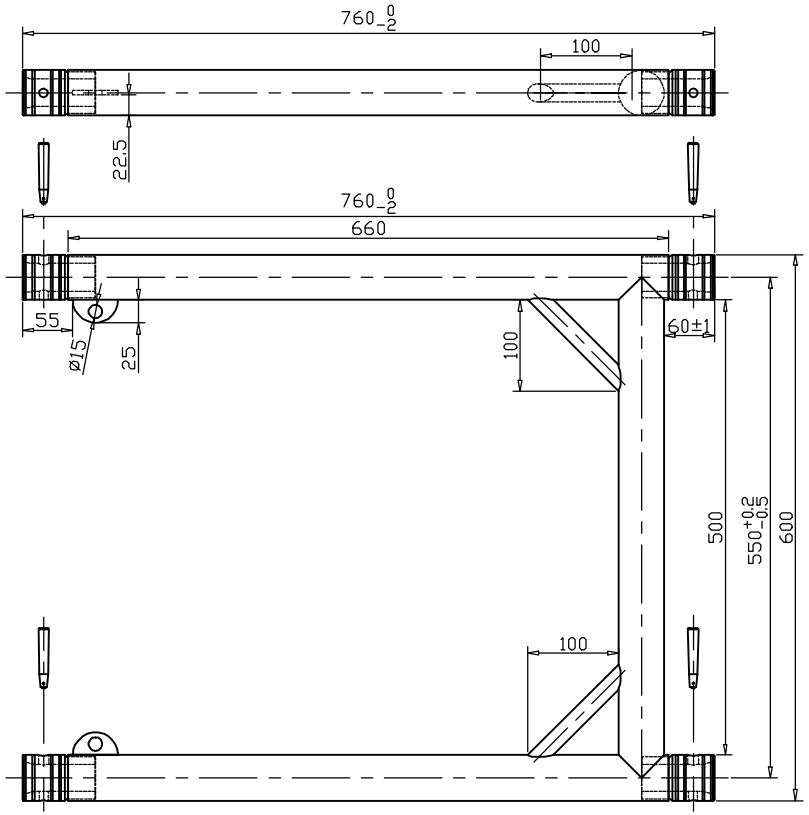
Number of frames n = 10
Number of mounted payloads k = 20

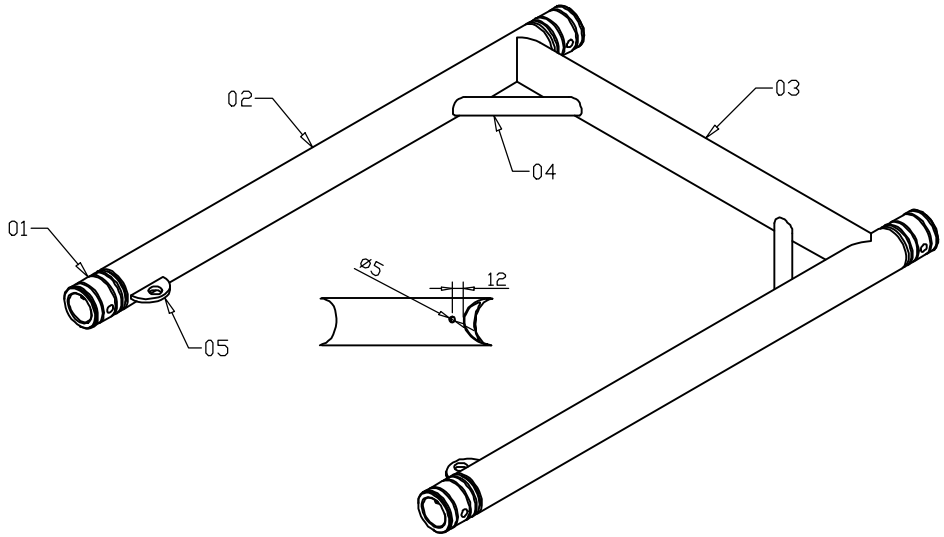
selfweight G:

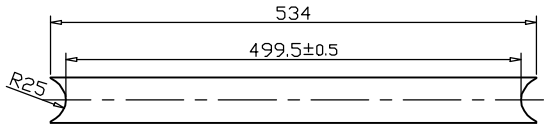
G = n x 3,7 kg + 1,5 kg + (2n-2) x 0,25
= 10 x 3,7 + 1,5 + 18 x 0,25 = 43 kg

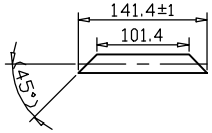
Allowable payloads P:

P = (340 kg- 43,5 kg) / 20 = 14,85 kg = ca. 14 kg





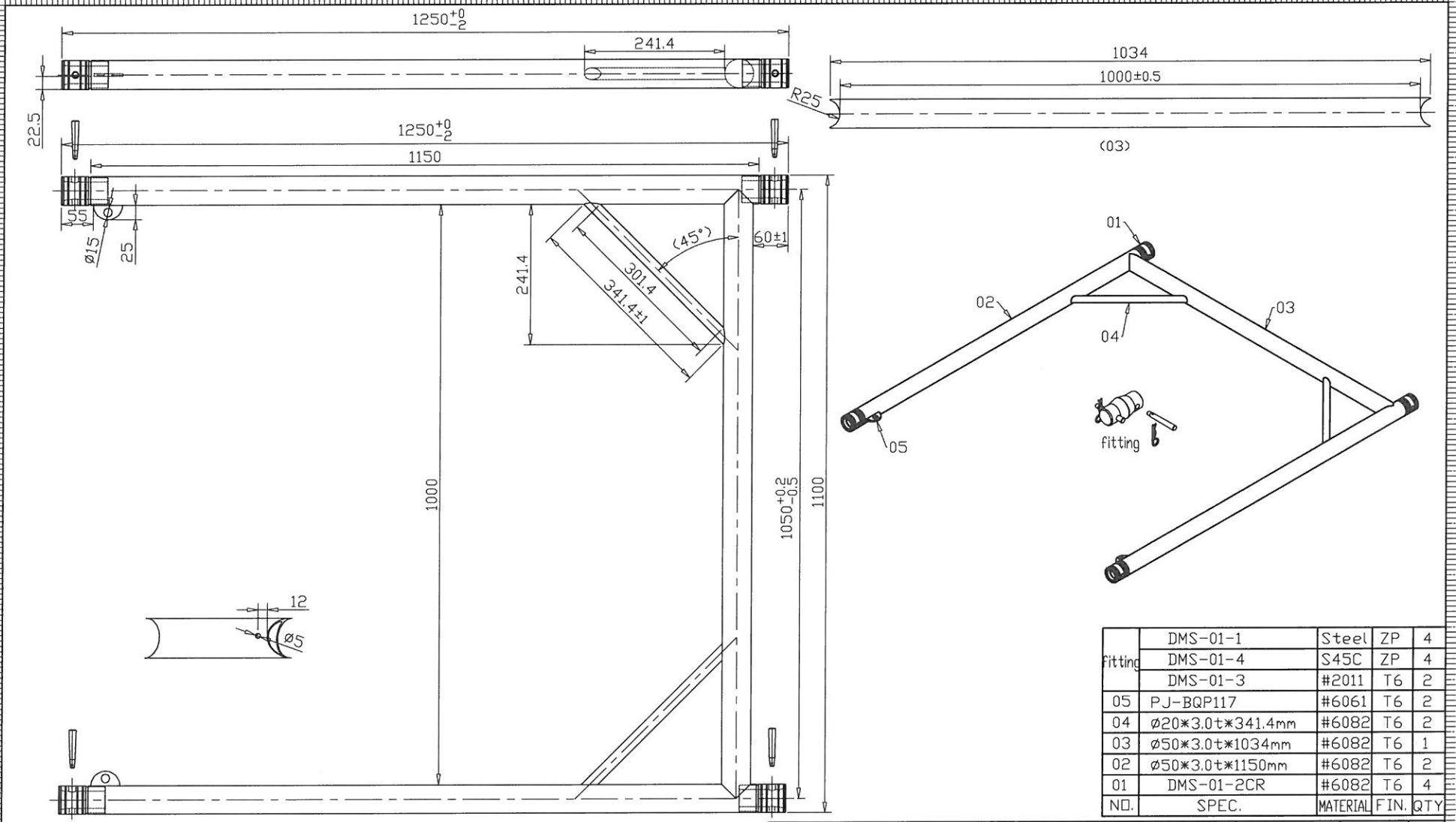




fitting	DMS-01-1	Steel	ZP	4
	DMS-01-4	S45C	ZP	4
	DMS-01-3	#2011	T6	2
05	PJ-BQP117	#6061	T6	2
04	ø20*3.0t*141.4mm	#6082	T6	2
03	ø50*3.0t*534mm	#6082	T6	1
02	ø50*3.0t*660mm	#6082	T6	2
01	DMS-01-2CR	#6082	T6	4
NO.	SPEC.	MATERIAL	FIN.	QTY.

DRAWN	F62E	DRAW NO	F62076E		2D/3D	edition	1
Specification	F62E-0.76M	DESIGN	OJM	DATE 15.03.24	CHECKED	APPROVED	
Weight	3.7kgs/pcs	UNITS	mm	Proofread			
SURFACE	RAW	SCALE	1:8				

MARK	NAME	RETRIEVE CONTENTS	DATE

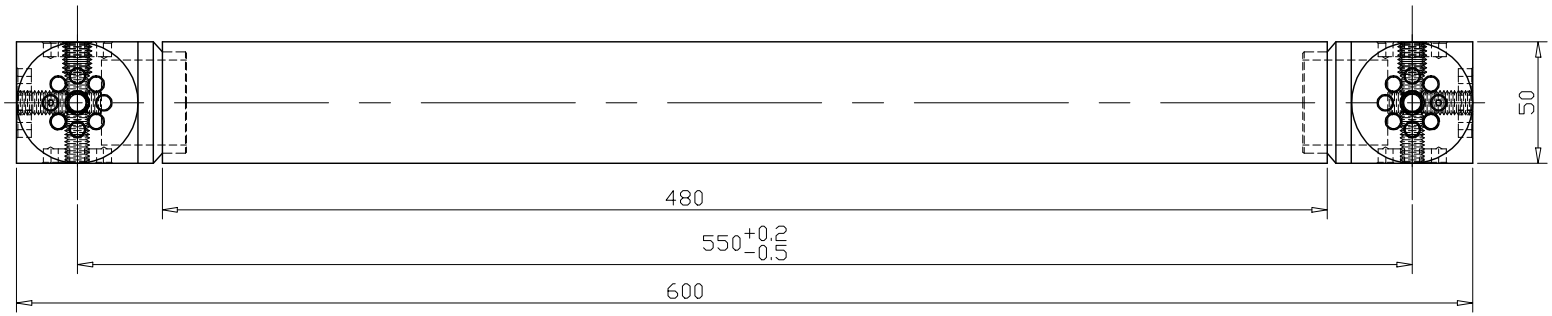


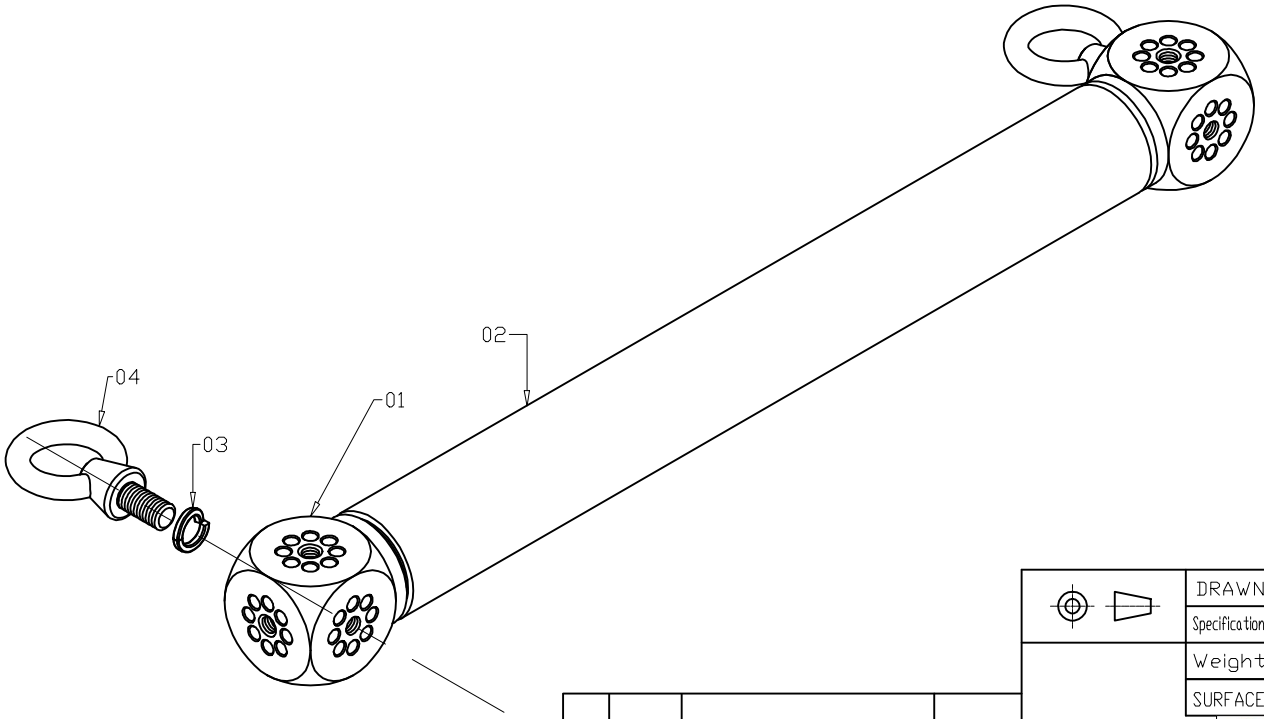
fitting	DMS-01-1	Steel	ZP	4
	DMS-01-4	S45C	ZP	4
	DMS-01-3	#2011	T6	2
05	PJ-BQP117	#6061	T6	2
04	ø20*3.0t*341.4mm	#6082	T6	2
03	ø50*3.0t*1034mm	#6082	T6	1
02	ø50*3.0t*1150mm	#6082	T6	2
01	DMS-01-2CR	#6082	T6	4
NO.	SPEC.	MATERIAL	FIN.	QTY

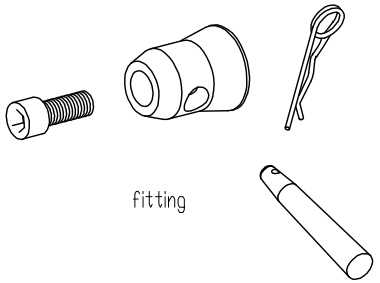
DRAWN	F62D	DRAW NO	F62125D		2D/3D	edition	2
Specification	F62D-1.25M	DESIGN	Erong	DATE 15.03.23	CHECKED	APPROVED	
Weight	5.71kgs/pcs	UNITS	mm	Proofread			
SURFACE	RAW	SCALE	1:9				

MARK	NAME	RETRIEVE CONTENTS	DATE

Cosmic Truss





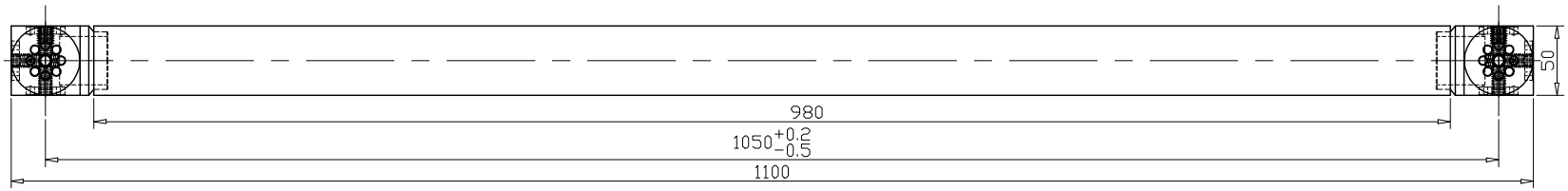


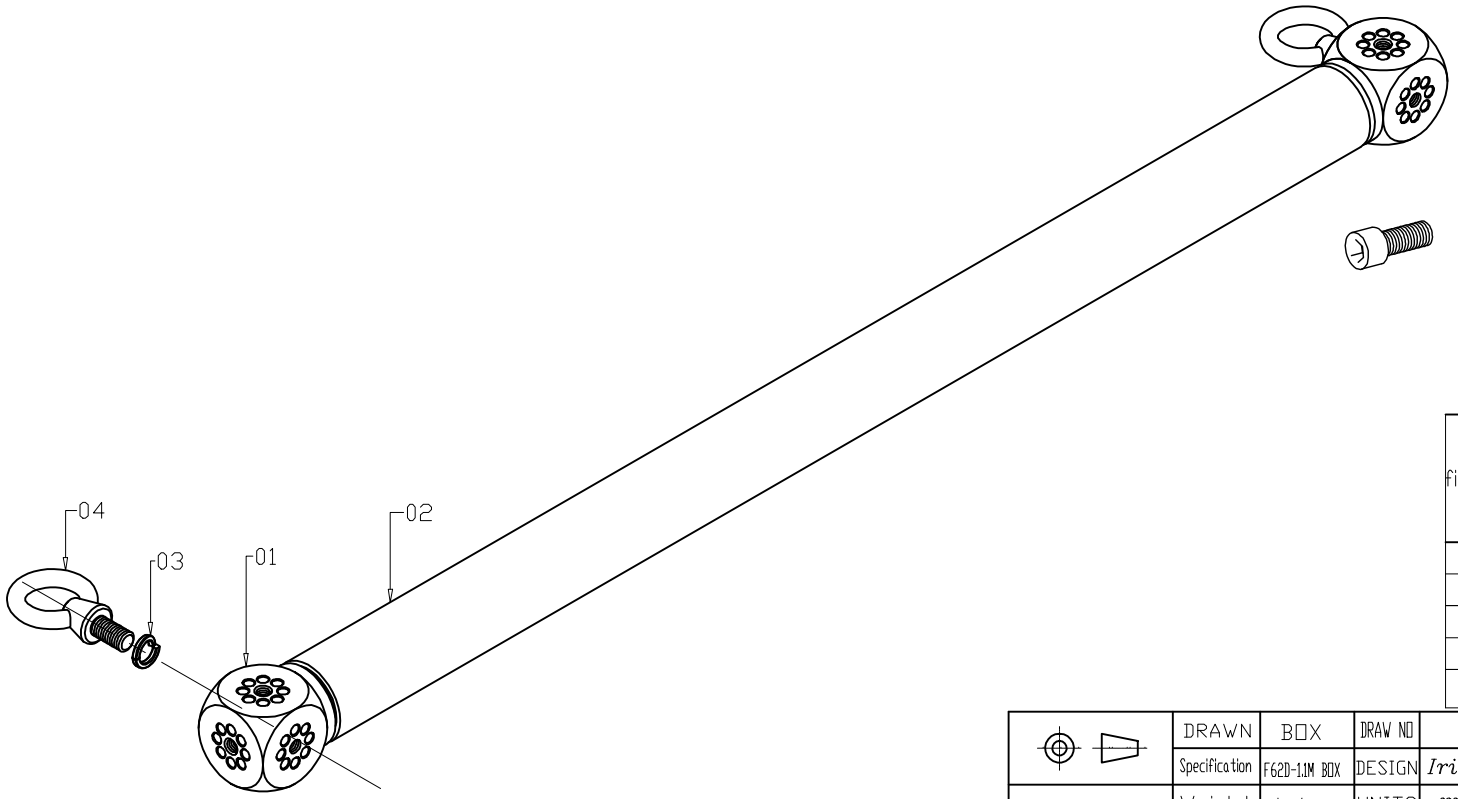
fitting	DMS-01-1	Steel	ZP	4
	DMS-01-4	S45C	ZP	4
	DMS-03-3N(M12*1.75P)	Steel	BLACK	4
	DMS-03-2N	Steel	ZP	4
04	M12*1.75P(20mm)	Steel	ZP	2
03	ø12.5*ø19*3.4t	Steel	ZP	2
02	ø50*3.0t*480mm	#6082	T6	1
01	DMS-03-1-1E	#6061	T6	2
NO.	SPEC.	MATERIAL	FIN.	QTY.

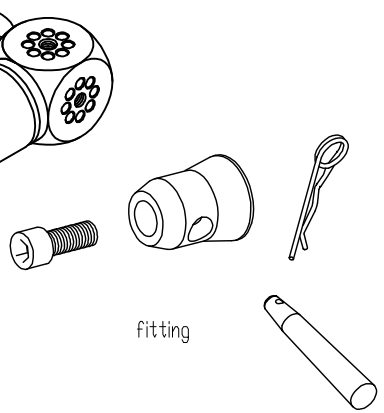
DRAWN	BOX	DRAW NO	F62E BOX		2D/3D	edition	1
Specification	F62e-0.5M BOX	DESIGN	lol	DATE 15.01.19	CHECKED	APPROVED	
Weight	kgs/pcs	UNITS	mm	Proofread			
SURFACE	RAW	SCALE	1:4				

MARK	NAME	RETRIEVE CONTENTS	DATE

Cosmic Truss®







NO.	SPEC.	MATERIAL	FIN.	QTY.
fitting	DMS-01-1	Steel	ZP	4
	DMS-01-4	S45C	ZP	4
	DMS-03-3N(M12*1.75P)	Steel	BLACK	4
	DMS-03-2N	Steel	ZP	4
04	M12*1.75P(20mm)	Steel	ZP	2
03	ø12.5*ø19*3.4t	Steel	ZP	2
02	ø50*3.0t*980mm	#6082	T6	1
01	DMS-03-1-1E	#6061	T6	2

DRAWN	BOX	DRAW NO	F62D BOX		2D/3D	edition	2
Specification	F62D-1.1M BOX	DESIGN	Iris	DATE 15.01.16	CHECKED	APPROVED	
Weight	kgs/pcs	UNITS	mm	Proofread			
SURFACE	RAW	SCALE	1:4				

MARK	NAME	RETRIEVE CONTENTS	DATE

Cosmic Truss