

# Flexible Chain - Sectors 11 & 15

SHARMAZANASHVILI Alexander

TSUTSKIRIDZE Niko

SHEKILADZE Davit

KEKELIA Besik

SURMAVA Archil

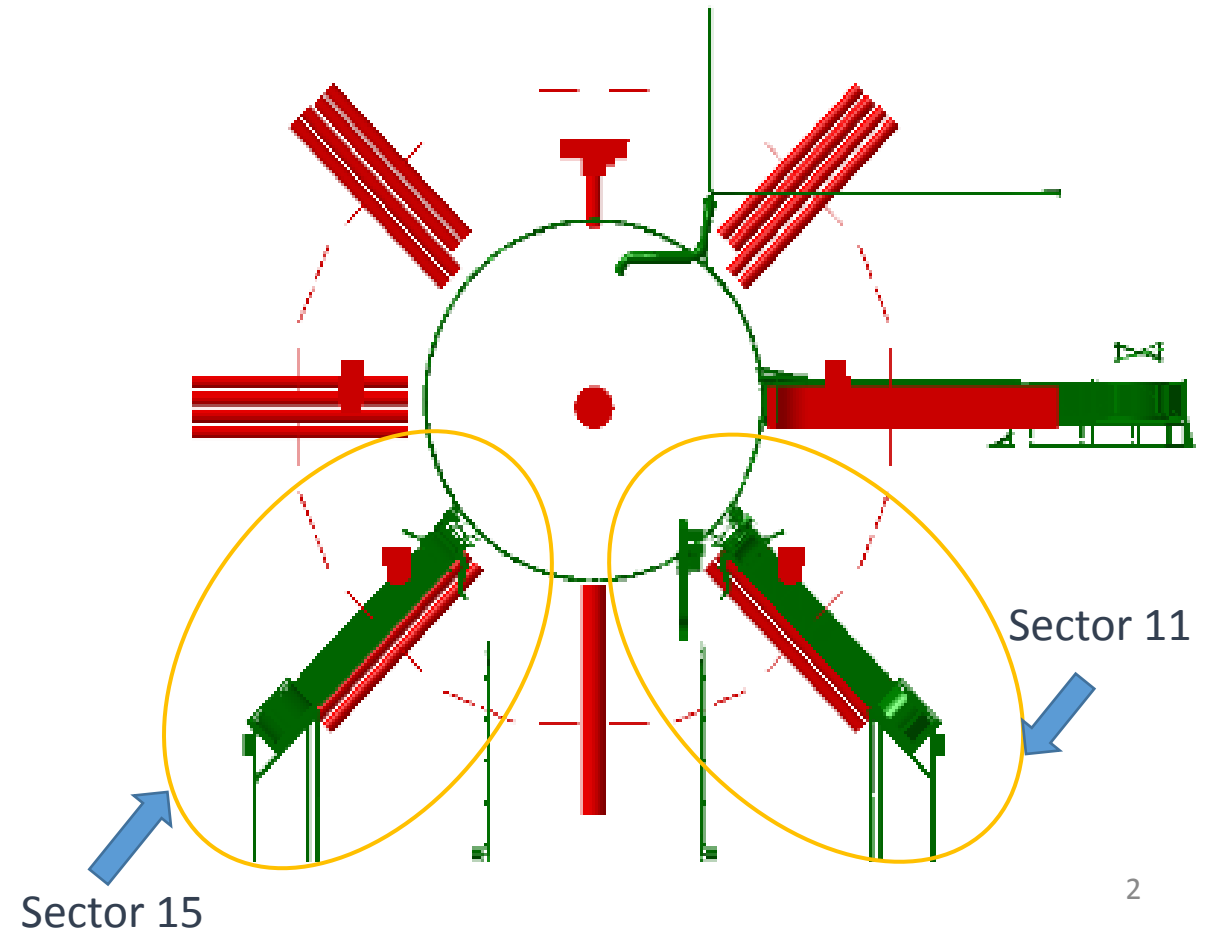
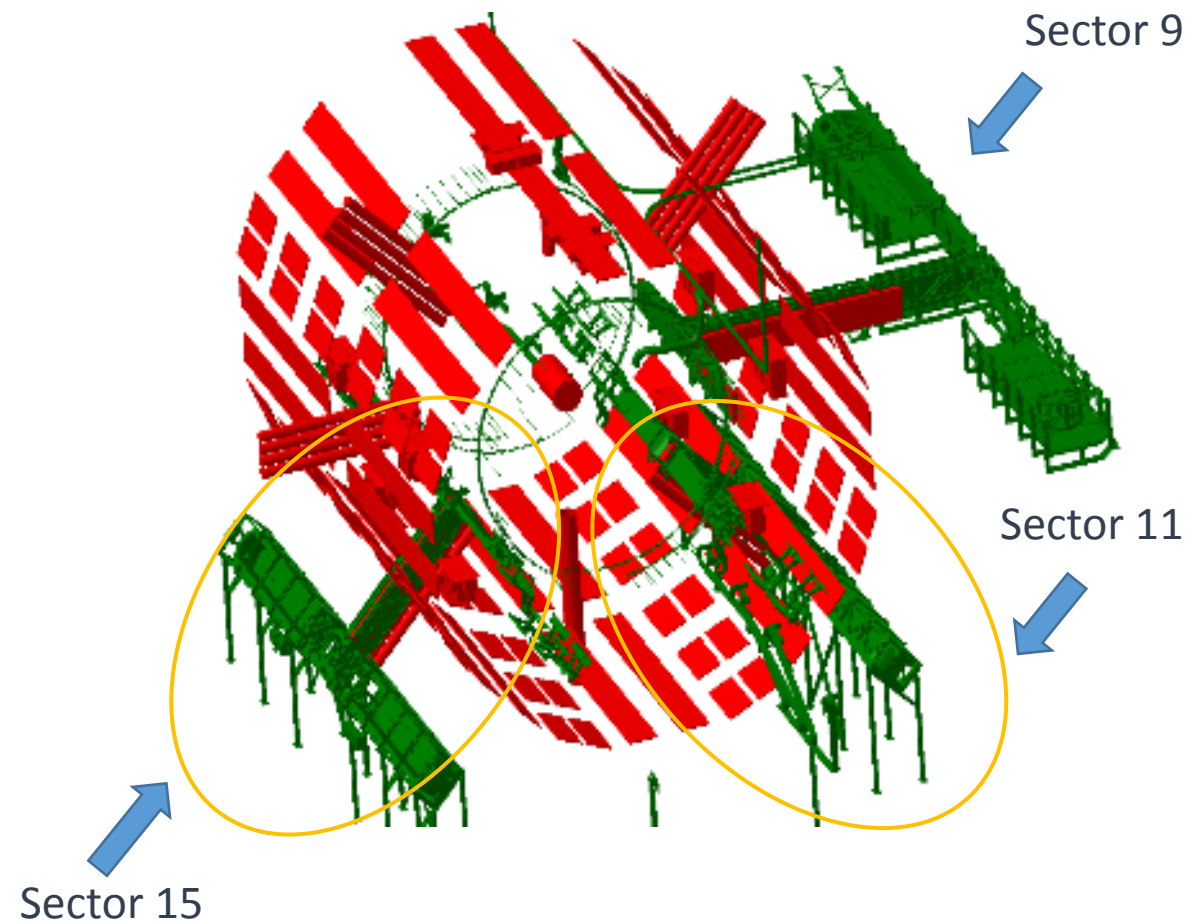
**Georgian Technical University**



# Flexible Chain in Sector 11 and 15

Flexible Chain in sector 11 and Sector 15 are symmetrical

- Flexible Chain is structure with cable bundles, pipes and flexible supports



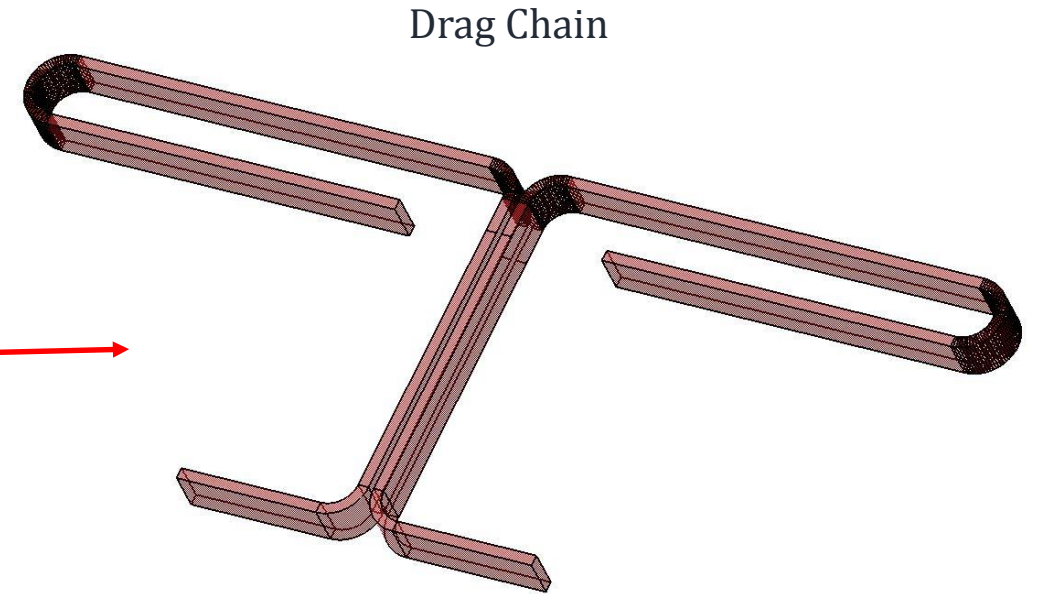
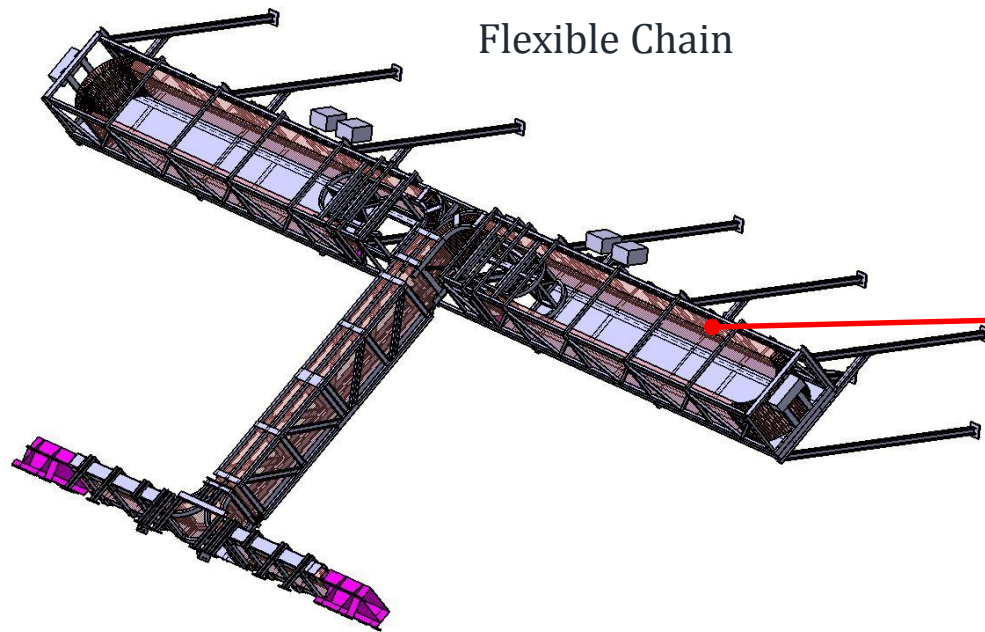
# Phase I: Reproduction of CATIA description

SmarTeam model numbers ST0160268\_01

# Phase I: Reproduction of CATIA description

## Step 1: Adding detalization

Smarteam Model

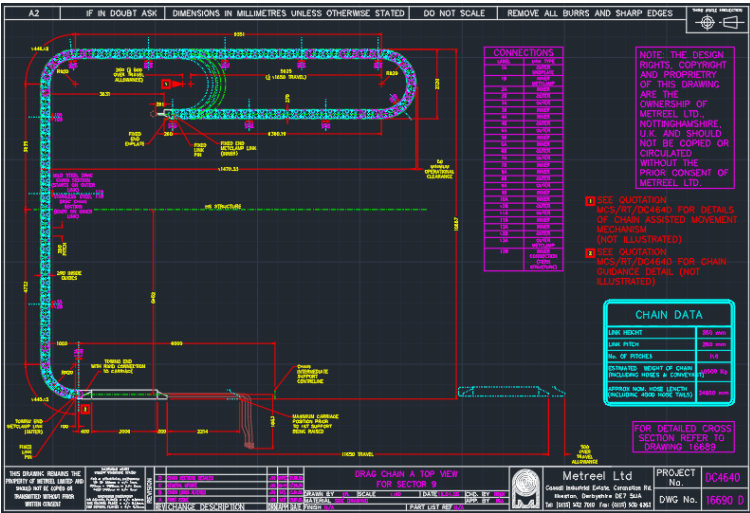


1. **Drag Chain** has no detalization
2. **Pipes** was completely missing
3. **Cables** was completely missing

# Phase I: Reproduction of CATIA description

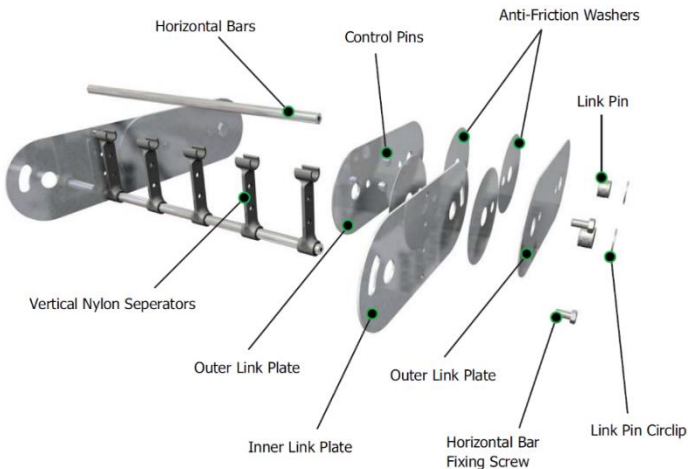
## Step 1: Adding detalization

6 Dwg files



Dwg files was provided by Marco Ciapetti

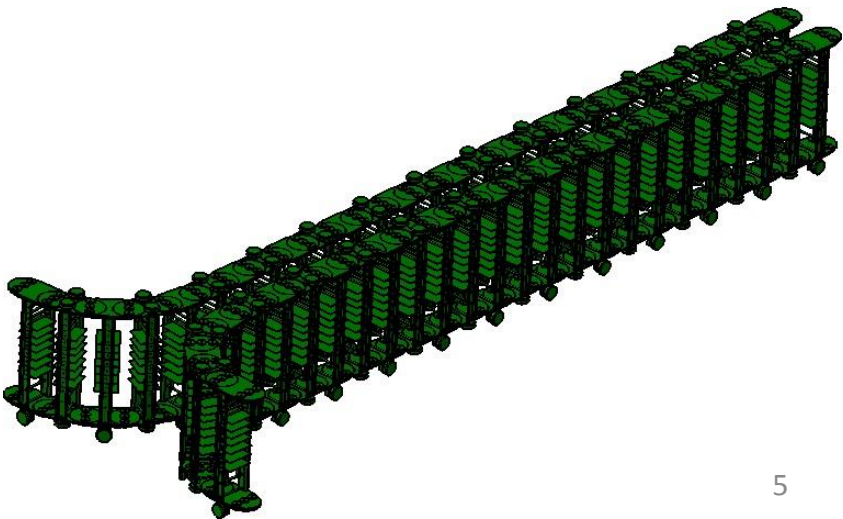
Catalog



## Drag Chain

- 1. Parts of Drag Chain were created using **Dwg files**
- 2. Drag Chain was assembled using **Catalog** and **Dwg files**

Reproduced Drag Chain



## Phase I: Reproduction of CATIA description

## Step 1: Adding detalization







## Pipes and Cables

**Pipes and Cables** was created according Excel file and drawing

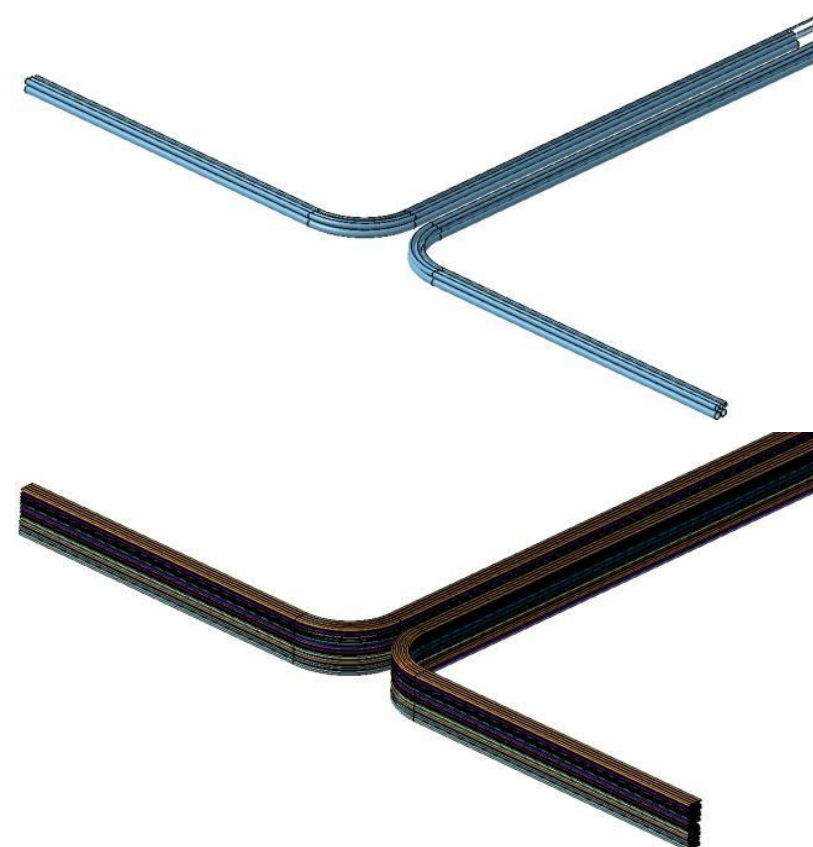
## Excel file

Calometer End Cap A. Flexible chain in sector II						STATUS FOR PHASE I		R	=	Remove (Free)
Detector	subsystem	Service	type	diameter	quantity	Section	S	Stag	Occupied	
								HP	=	Replace Occupied
1	End Cap Side A LA	DATA and SPAC optical cable	Optical	9.6	13	940.97	R			
2	End Cap Side A LB	HEC Power Supply CANBus cable	CAN	5.5	2	47.62	S			
3	End Cap Side A LC	200V Power Supply cable	LV	13	7	929.13	S			
4	End Cap Side A LD	HEC 280V	LV	8.8	2	72.63	S			
5	End Cap Side A LE	HEC PS control	Control	10.6	2	176.49	S			
6	End Cap Side A LF	CANBus (for crate and power supply)	CAN	16.5	1	210.82	RP			
7	End Cap Side A LG	Purify monitor cable	Control	6	1	28.27	S			
8	End Cap Side A LH	Interlock lines for Grounding	Control	16.5	1	196.63	S			
9	End Cap Side A LJ	Diffusion Pump system signal cable (ES vacuum-Titol)	Control	16.5	2	427.65	S			
10	End Cap Side A LL	Electrical Power Diffusion Pump cable	LV	13.5	1	143.34	S			
11	End Cap Side A LM	Filter Box (FTI) heater cable	LV	10.5	7	606.13	S			
12	End Cap Side A LN	Purifying Diffusion Pump signal cable	Control	11	3	285.18	S			
13	End Cap Side A LO	Pirani Diffusion Pump signal cable	Control	8	3	150.80	S			
14	End Cap Side A LP	TT signal cable (Anti Condenser Heater)	Control	16.5	9	1824.42	S			
15	End Cap Side A LQ	Power for anticondensation in lines	LV	14	3	461.81	S			
16	End Cap Side A LR	Cryostat Temperature Monitor cable	Control	16.5	3	644.47	S			
17	End Cap Side A LS	Filter Box (FTI) signal cable	Control	16.5	7	1496.71	S			
18	End Cap Side A LT	Detector monitor cable	Control	11	16	650.53	S			
19	End Cap Side A LV	Radiation monitor	Control	4.7	3	52.05	S			
20	End Cap Side A LZ	ECLISE	Control	7	10	384.95	S			
Total LARG cables						1952.20				
23	Ext Bunch A TA	1kV DC High Voltage Source of Drivers	HV	6	34	961.33	RP			
24	Ext Bunch A TB	200 V DC General Low Voltage Power Supply of Drivers+ES	LV	14.4	10	826.80	S			
25	Ext Bunch A TC	400V Low Voltage Power Supply	LV	14.9	16	2765.54	S			
26	Ext Bunch A TD	CAmBus (digital and HV info in one cable)	CAN	12	5	565.45	R			
27	Ext Bunch A TE	CAmBus for LV (ELMBs and LVPS steering)	CAN	12	5	565.45	S			
28	Ext Bunch A TF	CAmBus for CS from hydraulic racks	CAN	12	1	113.30	S			
29	Ext Bunch A TG	Data Readout	Optical	19.8	8	2220.73	RP			
30	Ext Bunch A TH	LASER monitoring	Control	12	1	452.28	S			
31	Ext Bunch A TJ	Water processor cooler	Control	8	7	351.96	S			
Total TLE cables						9611.51				
42	Cooling LARG	End Cap Side A LV1	Water pipes LARG	Pipe	67	1	3625.65	S		
43	Cooling LARG	End Cap Side A LV2	Water pipes LARG	Pipe	50	1	1962.50	S		
44	LARG	End Cap Side A LV3	water cooling pump	Pipe	22	2	760.27	S	????	the temperature of this is controlled by the water cooling system
45	Cooling TLECAL	End Cap Side A TV1	Water pipes TLECAL	Pipe	67	1	3625.65	S		
46	Cooling TLECAL	End Cap Side A TV2	Water pipes TLECAL	Pipe	45.4	1	2519.81	S		
47	TLECAL	End Cap Side A TV3	Cs water	Pipe	12.5	14	1786.06	S		
Total Water lines										
49		CRYOGENICS LA1	Pneumatic lines FT vacuum	Pipe	10	28	2199.11	S		
50	LARG	End Cap Side A LA2	LARG AIR cooling line	Pipe	14	6	923.63	S		
51	TLECAL	End Cap Side A TA1	CS airlines	Pipe	12	3	339.28	S		
52	TLECAL	End Cap Side A TA2	TLECAL Air cooling line	Pipe	16.5	2	427.65	S		
53	LARG+TLECAL	End Cap Side A CA2	Pneumatic lines for water cooling	Pipe	20	1	316.16	S		
54										
55										
56										
57										
58										
59										

## Drawing

1	$8 \times \phi 11,8$	
2	$10 \times \phi 12$ + BOUNSET $4 \times \phi 12,6$ + BOUNSET $4 \times \phi 12,6$	
3	? $8$ BOUNSET'S + BOUNSET $5 \times \phi 9,1$	
4	$3 \times \phi 9,1$ + $4 \times \phi 12$ + $2 \times$ concrete + $6 \times \phi 8$	
5	$13 \times \phi 9,1$ + $2 \times \phi 10,5$	
6	$13 \times \phi 11$ $4 \times \phi 16,5$ + $6 \times \phi 11$ $16 \times \phi 10$	
7	$8 \times \phi 10,5$ + $2 \times \phi 6,8$ $10 \times \phi 11$	
8	$16 \times \phi 10$ $10 \times \phi 16,4$	
9	PIPES $8 \times \phi 12$ + BOUNSET $5 \times \phi 9$	
10	$10 \times \phi 14,8$	
11	PIPES $4 \times \phi 12,5$ + $6 \times \phi 14,8$ ? PIPES $11 \times \phi 12,5$ $3 \times \phi 16,5$ $5 \times \phi 16,5$	
12	   	
13	 	

## Reproduced **Pipes** and **Cables**



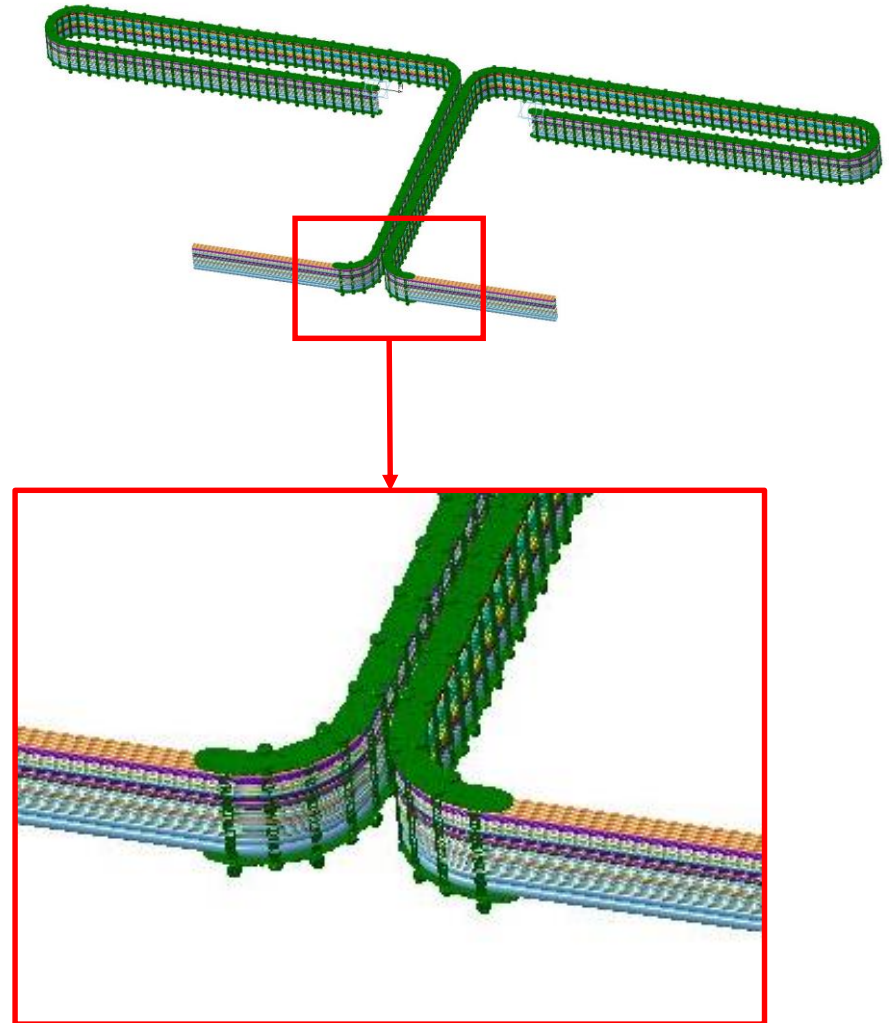
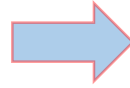
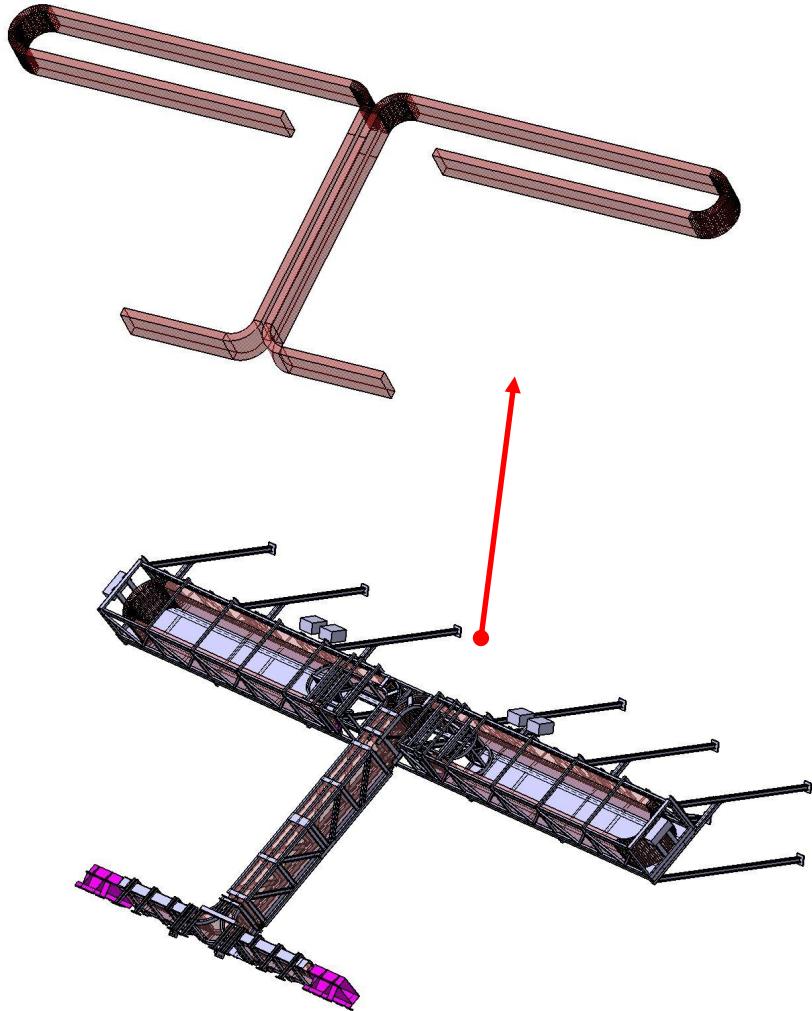
**Excel file** and **Drawing** was provided by **Marco Ciapetti**



# Phase I: Reproduction of CATIA description

## Step 1: Adding detalization

Smarteam Model

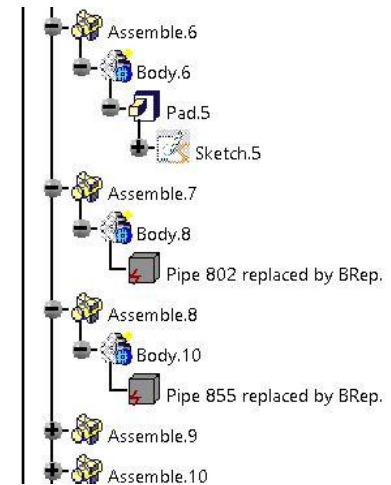
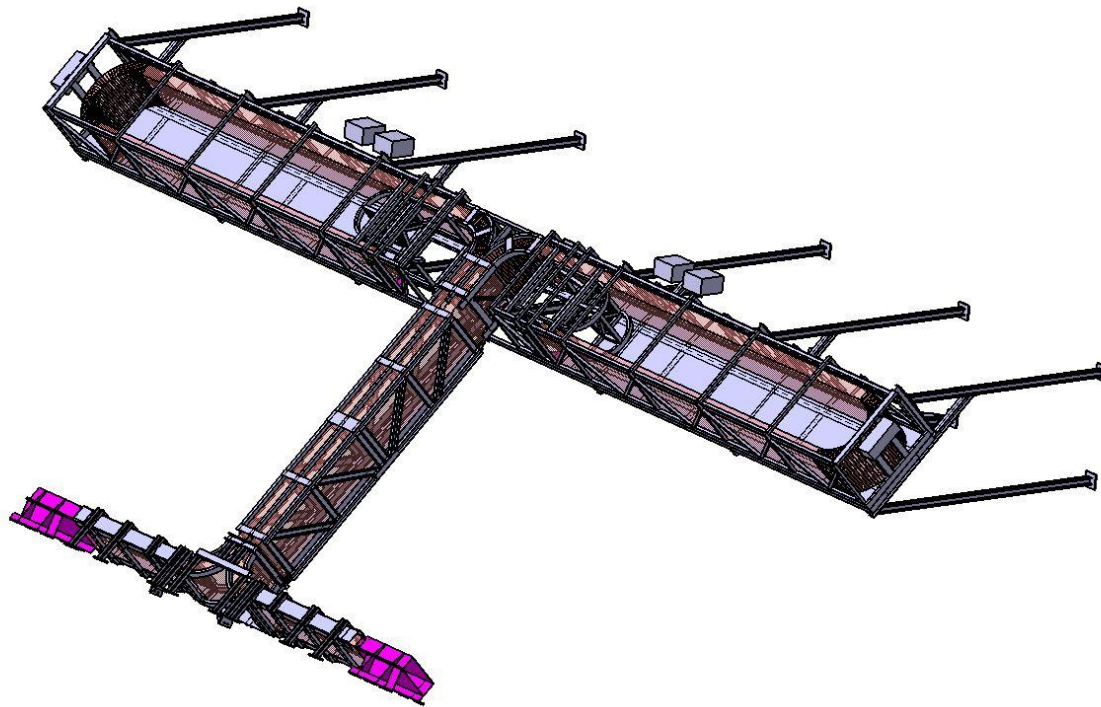


Reproduced Model

# Phase I: Reproduction of CATIA description

## Step 2: Adding history

Smarteam model

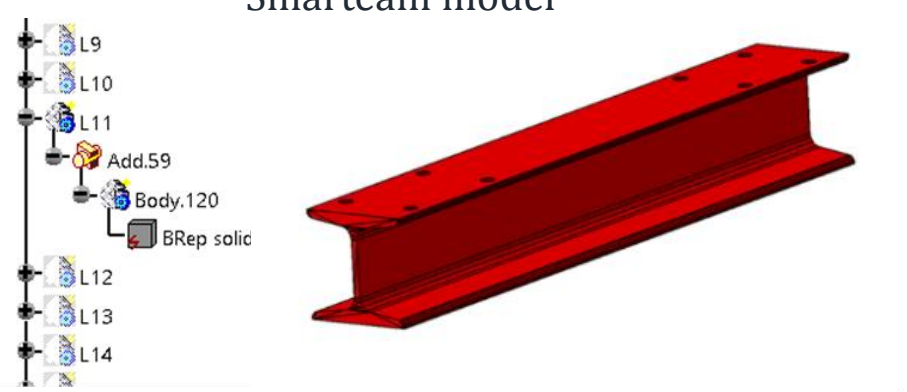




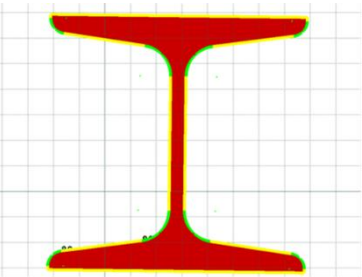
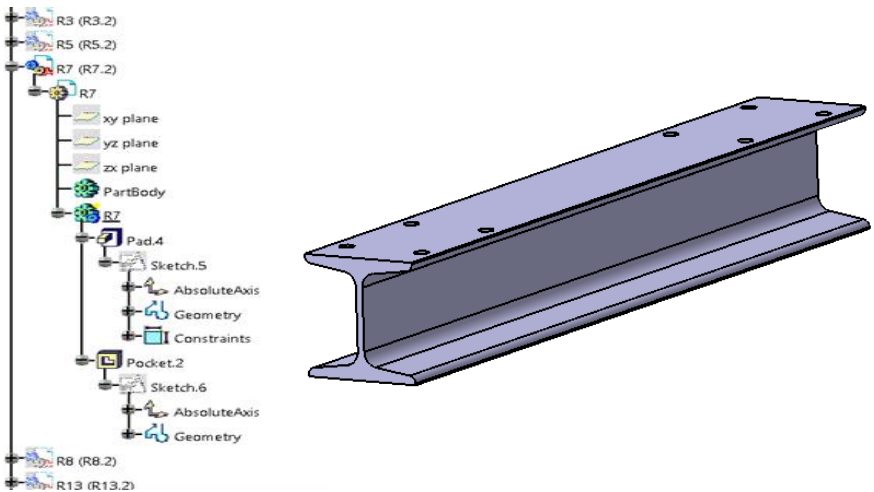
# Phase I: Reproduction of CATIA description

## Step 2: Adding history

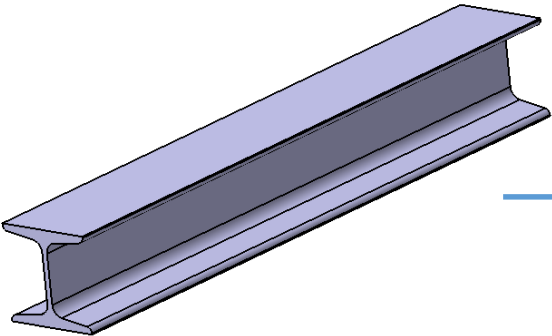
Smarteam model



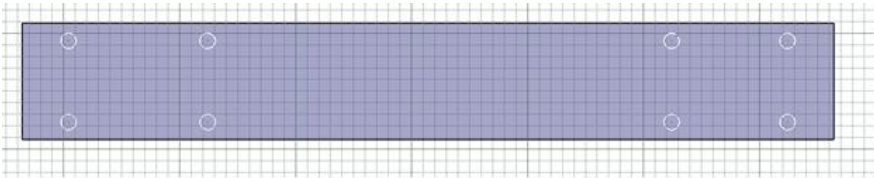
Reproduced model - Editable



Step 1. **Sketch** was created on Not Editable Model



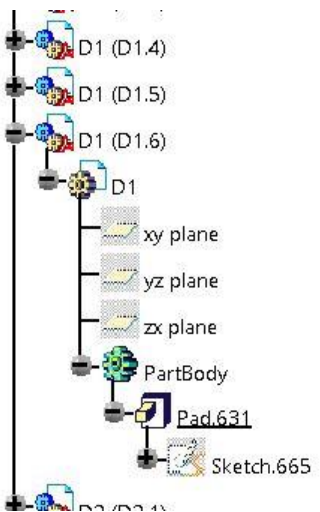
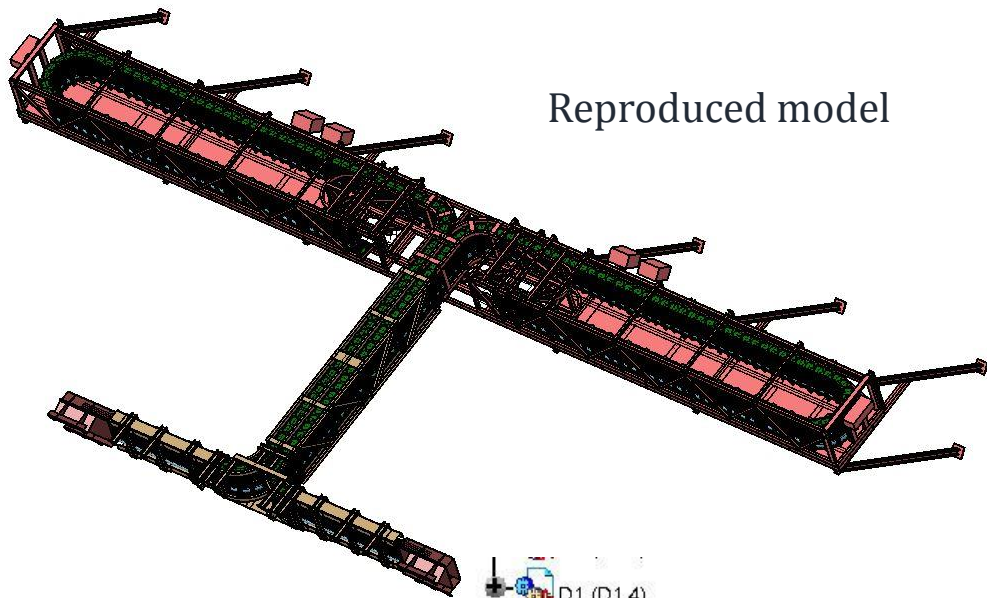
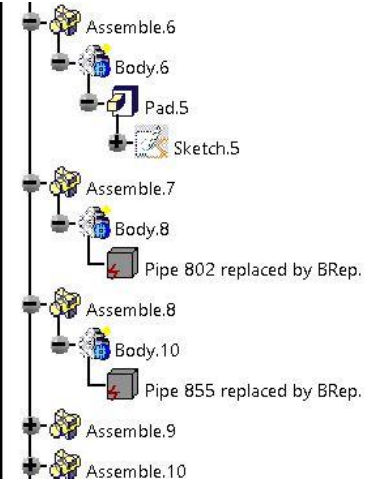
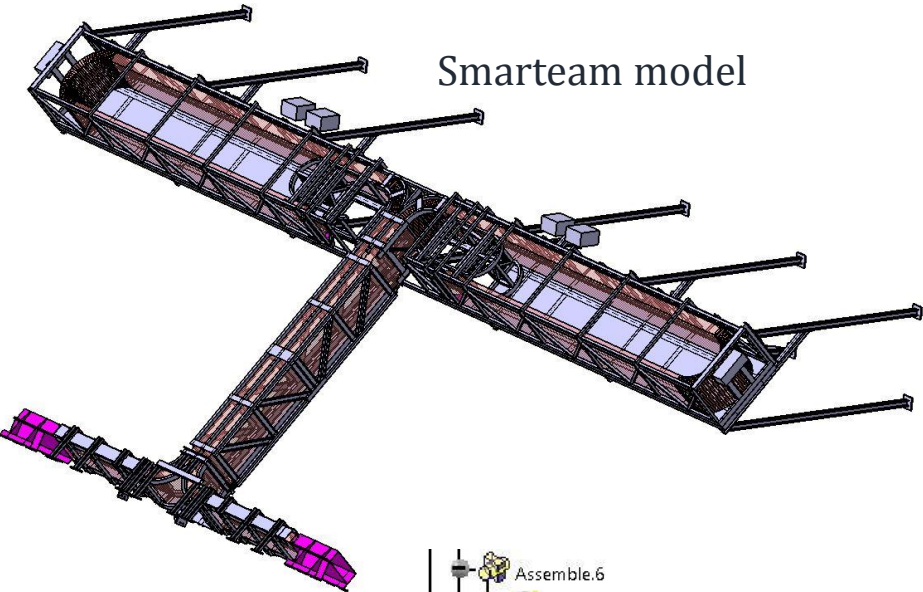
Step 2. **Part** was created using Sketch



Step 3. **Holes** was added on part

# Phase I: Reproduction of CATIA description

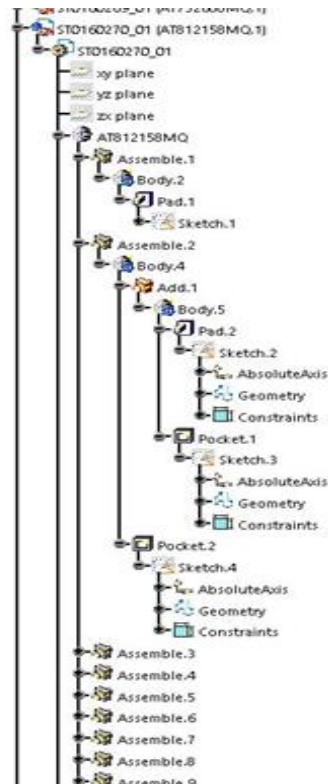
## Step 2: Adding history



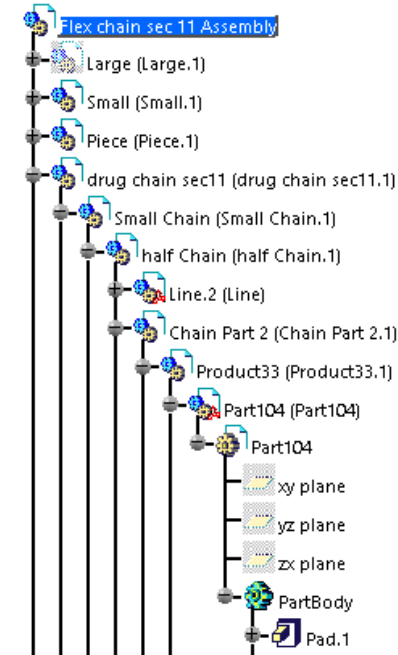
# Phase I: Reproduction of CATIA description

## Step 3: Sortation of CATIA tree

CATIA tree for Smarteam Model

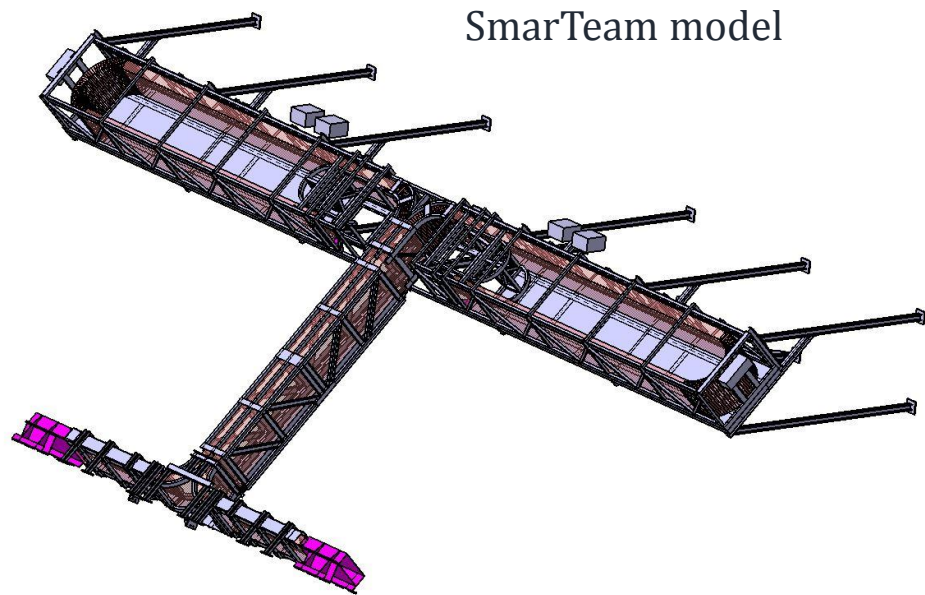


CATIA tree for Reproduced Model

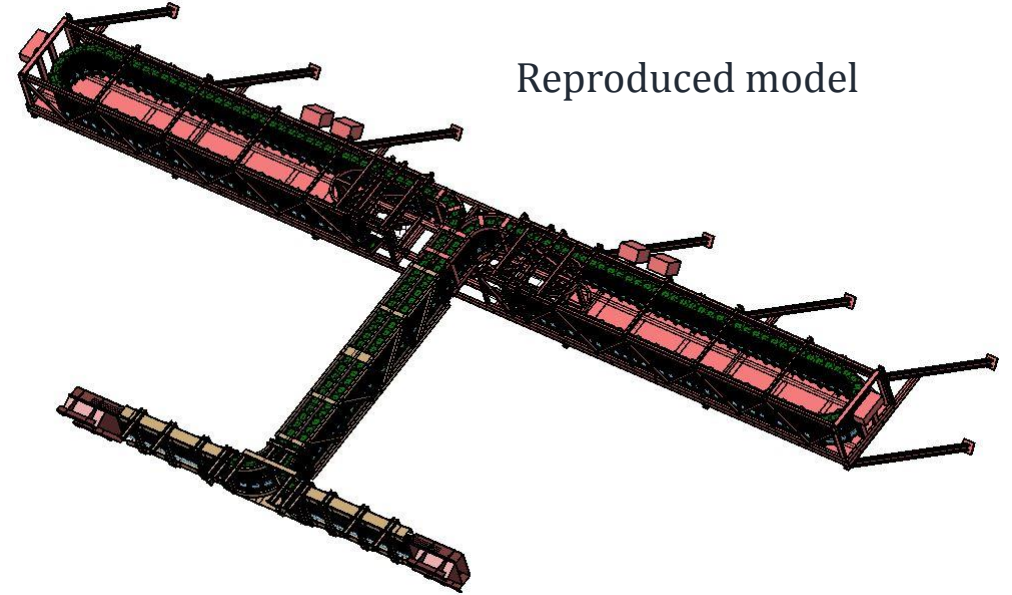
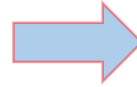


Flexible Chain was presented as 10 parts. Each part was composed about 100 models. This models were grouped in parts and than distributed in products.

# Phase I: Reproduction of CATIA description



SmarTeam model



Reproduced model

## Overall number of (SmarTeam):

- Assemblies - 7
- Parts - 60
- Bodies - 981
- Sketches - 1 252
- Geometric features - 11 131

## Overall number of (Reproduced):

- Assemblies - 2 338
  - Parts - 11 185
  - Bodies - 20 499
  - Sketches - 18 155
  - Geometric features - 87 854
- 2 331 Assemblies added
  - 11 125 Parts added
  - 487 man/hour spent
  - 8 tasks was done

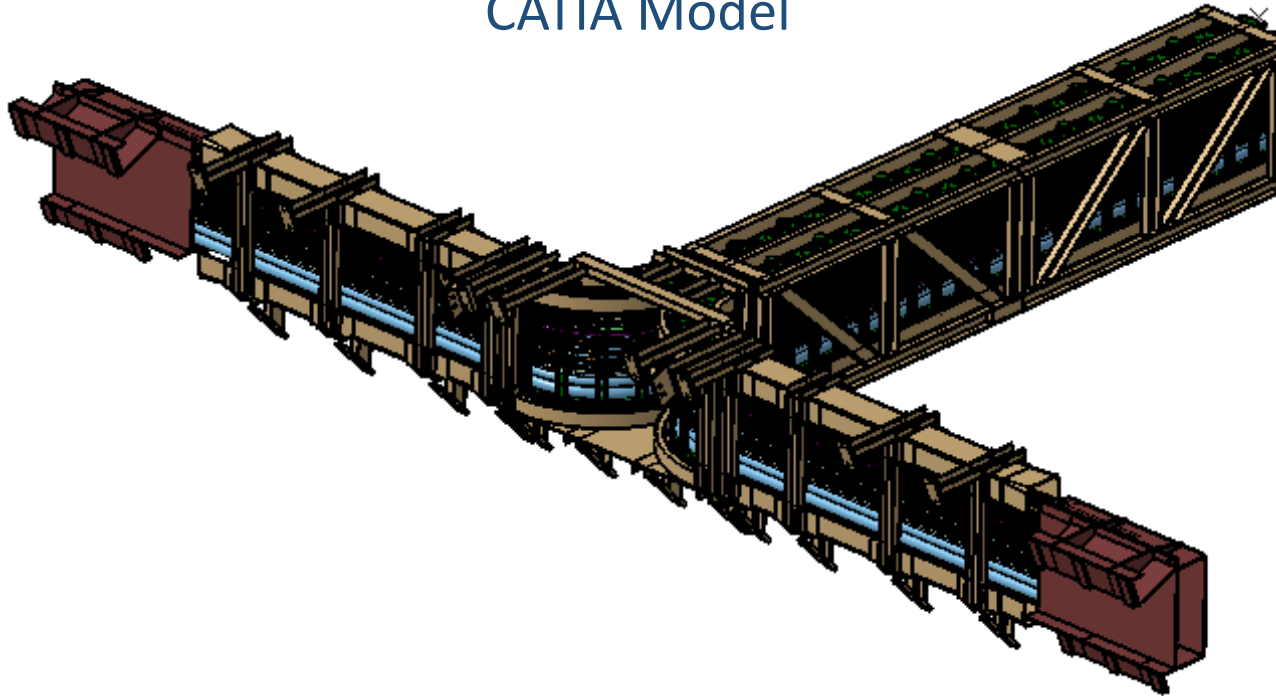
## Phase II: Simplification of CATIA model

SmarTeam model numbers ST0160268\_01



## Phase II: Simplification of CATIA model

CATIA Model

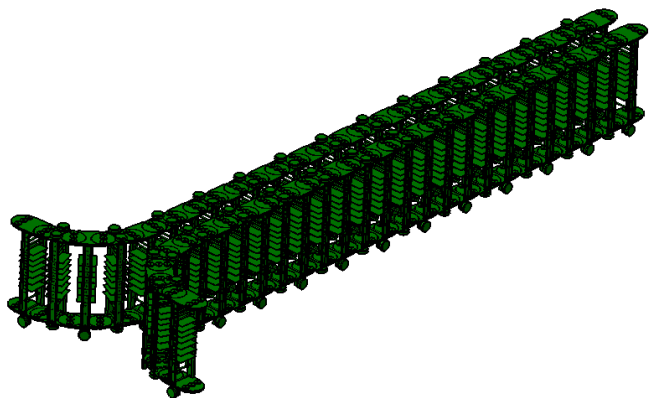


Full structure divided on 5 sub-structures:

1. Drag Chain
2. Piece
3. Pipes
4. Cables
5. Support

# Drag Chain

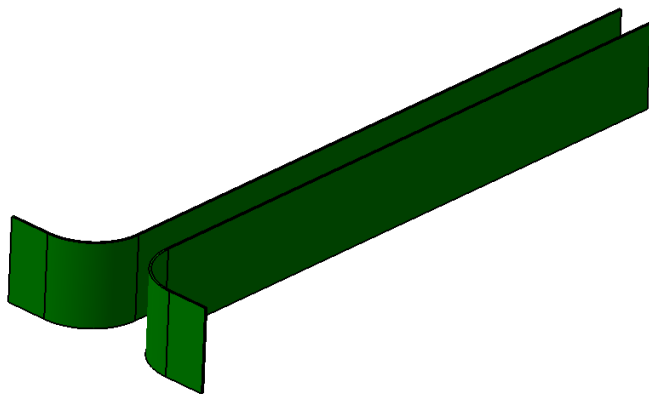
Detailed Model



Volume (m³)	0.116
Mass (kg)	928
Material	Stainless Steel
Density (kg/m³)	8'000



Simplified model



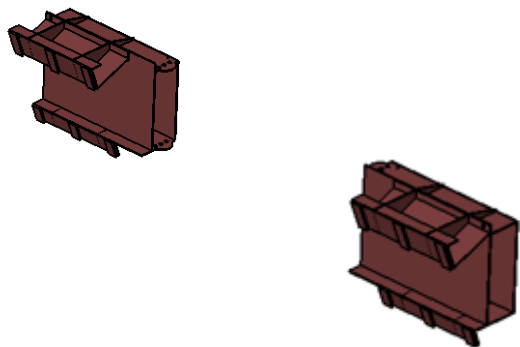
6 parts

Volume (m³)	0.116
Mass (kg)	928
Material	Stainless Steel
Density (kg/m³)	8'000

Diff: 0 Kg

# Piece

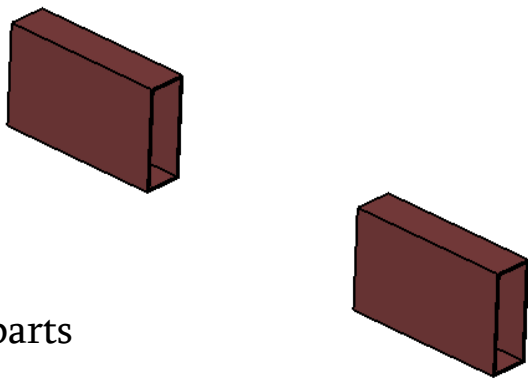
Detailed Model



Volume (m³)	0.046
Mass (kg)	368
Material	Stainless Steel
Density (kg/m³)	8'000



Simplified model

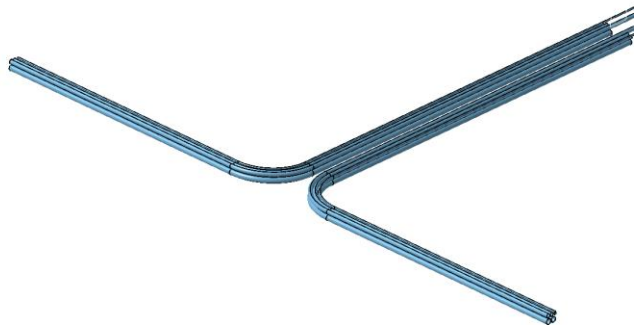


Volume (m³)	0.046
Mass (kg)	368
Material	Stainless Steel
Density (kg/m³)	8'000

Diff: 0 Kg

# Pipes

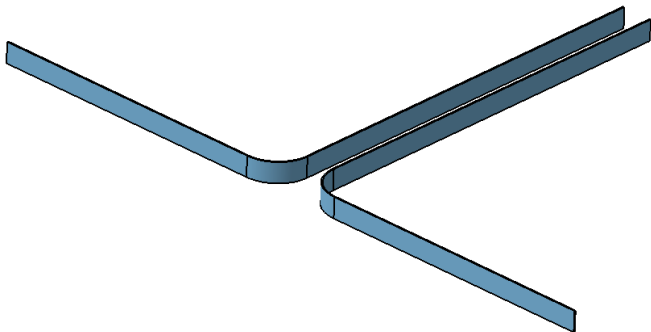
Detailed Model



Volume (m³)	0.066
Mass (kg)	528
Material	Stainless Steel
Density (kg/m³)	8'000



Simplified model



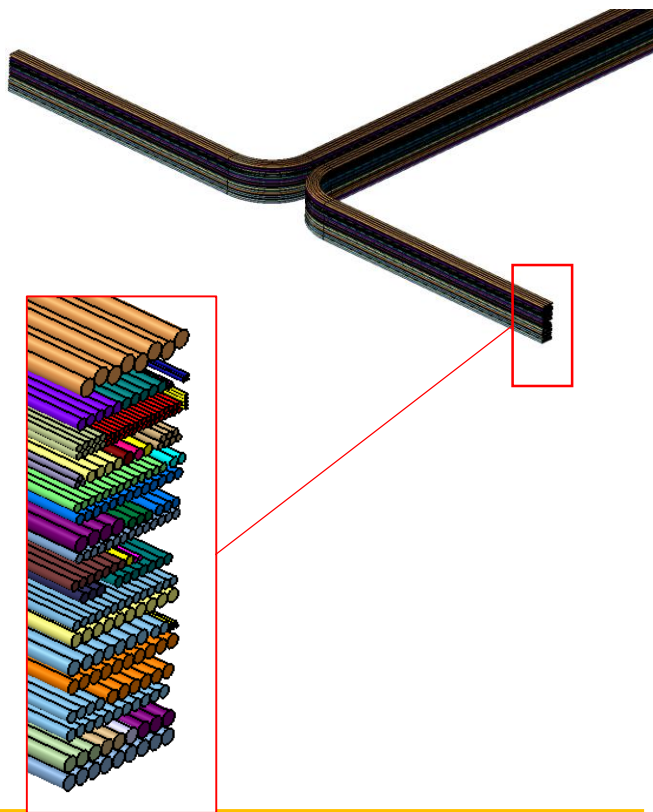
6 parts

Volume (m³)	0.066
Mass (kg)	528
Material	Stainless Steel
Density (kg/m³)	8'000

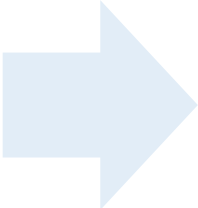
Diff: 0 Kg

# Cables

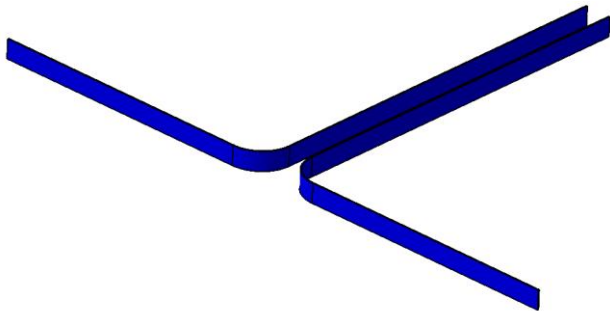
Detailed Model



Volume (m <sup>3</sup> )	0.052
Mass (kg)	465.92
Material	Cooper
Density (kg/m <sup>3</sup> )	8'960



Simplified model



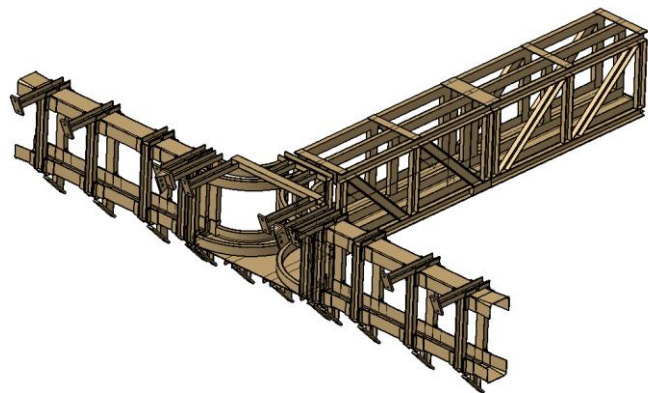
6 parts

Volume (m <sup>3</sup> )	0.052
Mass (kg)	465.92
Material	Cooper
Density (kg/m <sup>3</sup> )	8'960

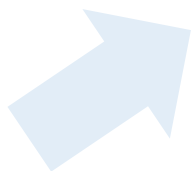
Diff: 0 Kg



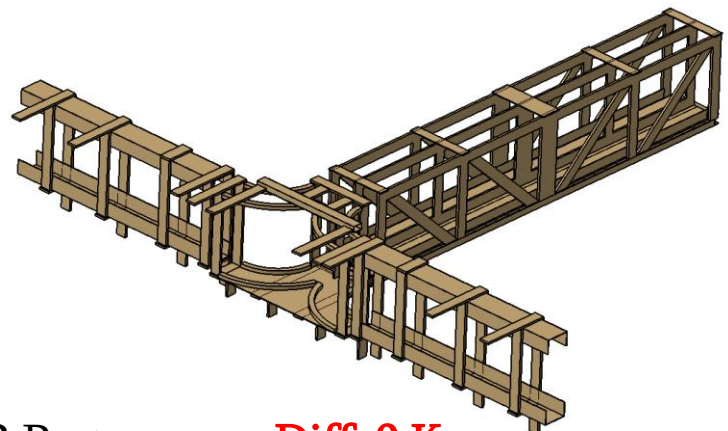
Detailed Model



Volume (m³)	0.238
Mass (kg)	1'904
Material	Stainless Steel
Density (kg/m³)	8'000
Diff: -352 Kg	



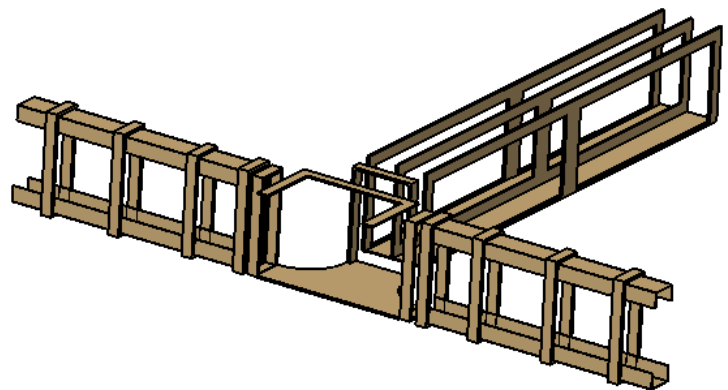
Simplified model



82 Parts:      **Diff: 0 Kg**

Volume (m³)	0.238
Mass (kg)	1'904
Material	Stainless Steel
Density (kg/m³)	8'000

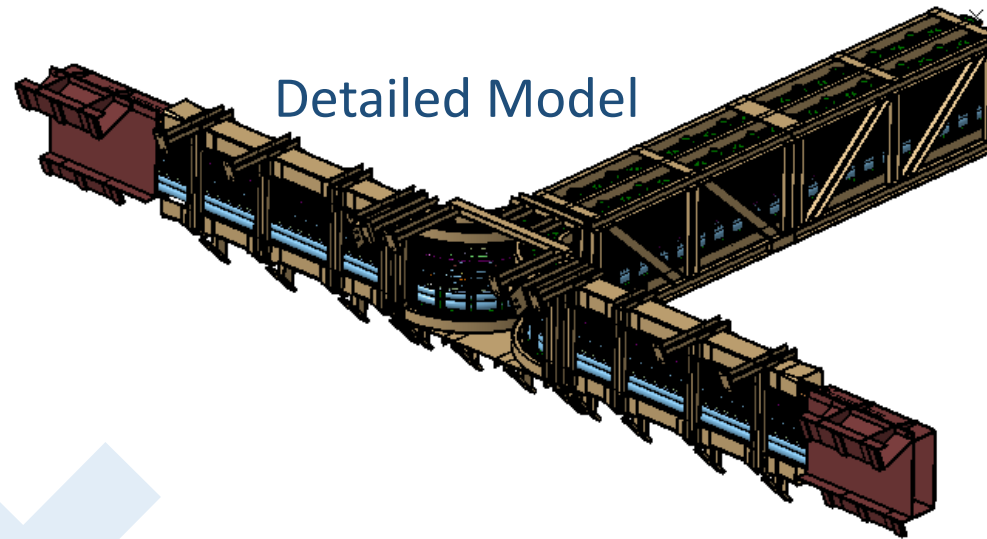
Simplified model



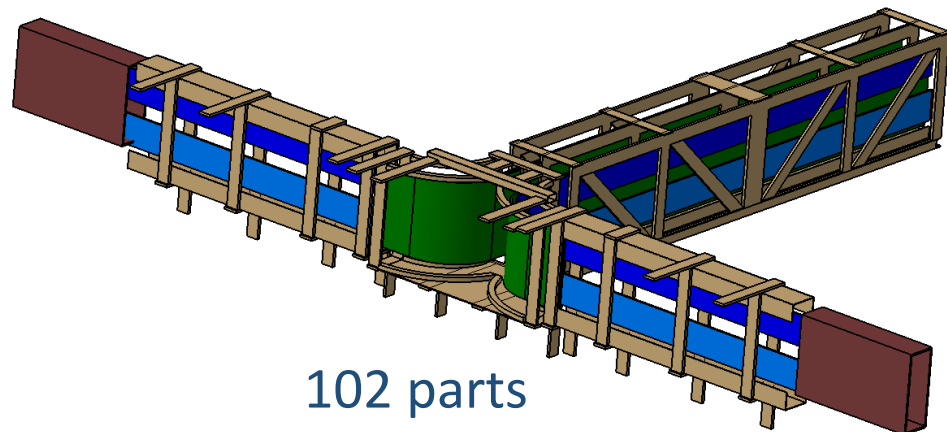
21 Parts:      **Diff: 352 Kg**

Volume (m³)	0.194
Mass (kg)	1'552
Material	Stainless Steel
Density (kg/m³)	8'000

## Phase II: Simplification of CATIA model

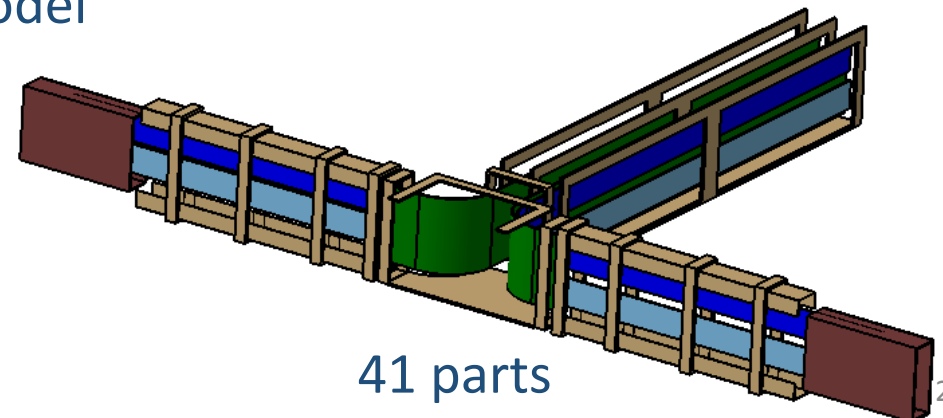


Detailed Model



102 parts

Simplified model



41 parts

## Phase III: Preparation of XML and Conflicts Checking

SmarTeam model numbers ST0160268\_01

# Preparation of XML

- We have prepared 2 XML's:

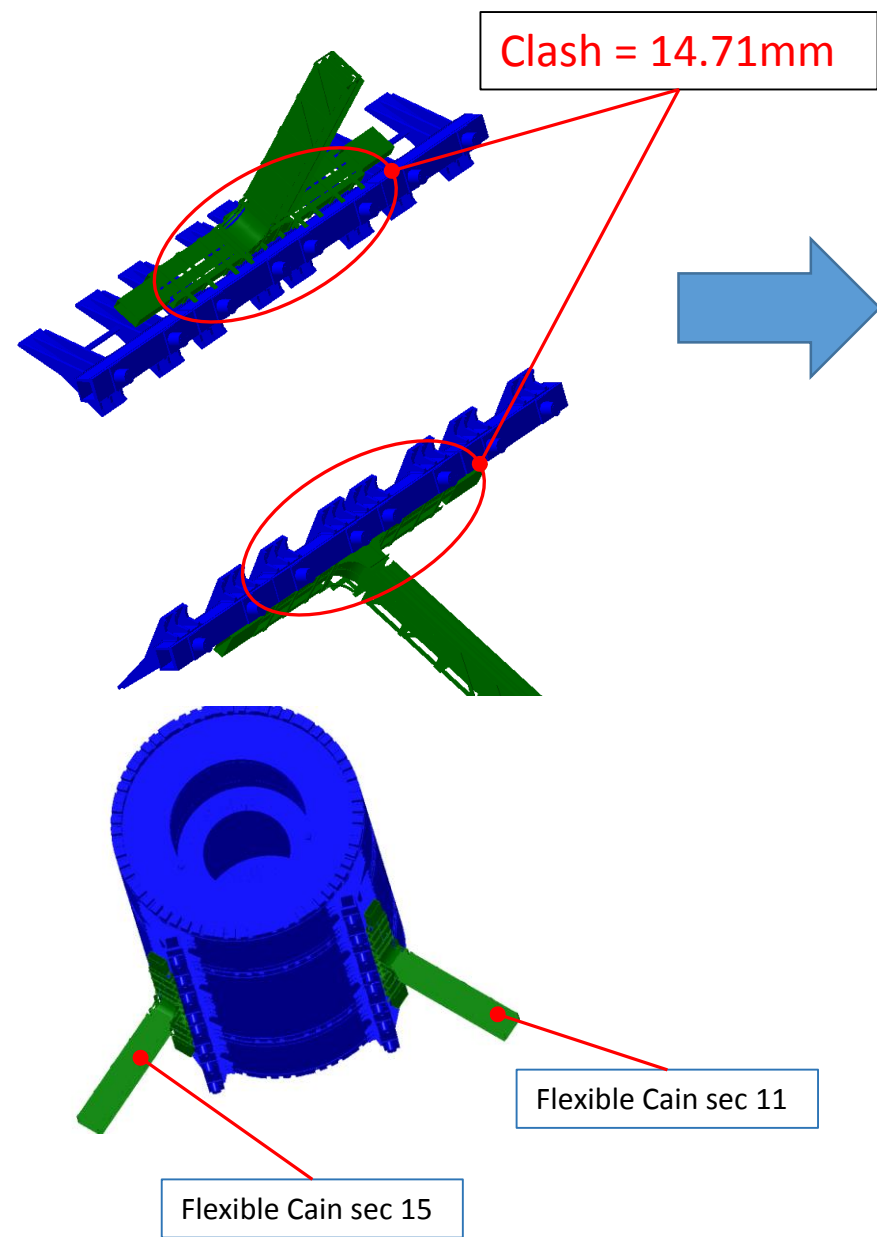
41 x 2 Vol - FlexibleChainSector11-15.xml

```
1 <!-- Support -->
2 <!-- Support -->
3 <!-- Support -->
4 <!-- Support -->
5 <!-- Support -->
6 <!-- Support -->
7 <!-- Support -->
8 <!-- Support -->
9 <!-- Support -->
10 <!-- Support -->
11 <!-- Support -->
12 <!-- Support -->
13 <!-- Support -->
14 <!-- Support -->
15 <!-- Support -->
16 <!-- Support -->
17 <!-- Support -->
18 <!-- Support -->
19 <!-- Support -->
20 <!-- Support -->
21 <!-- Support -->
22 <!-- Support -->
23 <!-- Support -->
24 <!-- Support -->
25 <!-- Support -->
26 <!-- Support -->
27 <!-- Support -->
28 <!-- Support -->
29 <!-- Support -->
30 <!-- Support -->
31 <!-- Support -->
32 <!-- Support -->
33 <!-- Support -->
34 <!-- Support -->
35 <!-- Support -->
36 <!-- Support -->
37 <!-- Support -->
38 <!-- Support -->
39 <!-- Support -->
40 <!-- Support -->
41 <!-- Support -->
42 <!-- Support -->
43 <!-- Support -->
44 <!-- Support -->
45 <!-- Support -->
46 <!-- Support -->
47 <!-- Support -->
48 <!-- Support -->
49 <!-- Support -->
50 <!-- Support -->
51 <!-- Support -->
52 <!-- Support -->
53 <!-- Support -->
54 <!-- Support -->
```

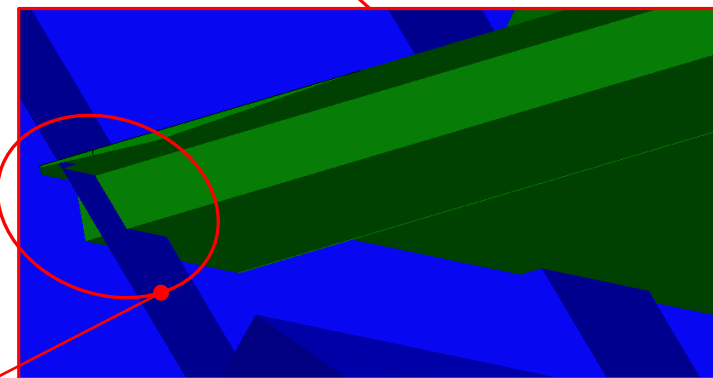
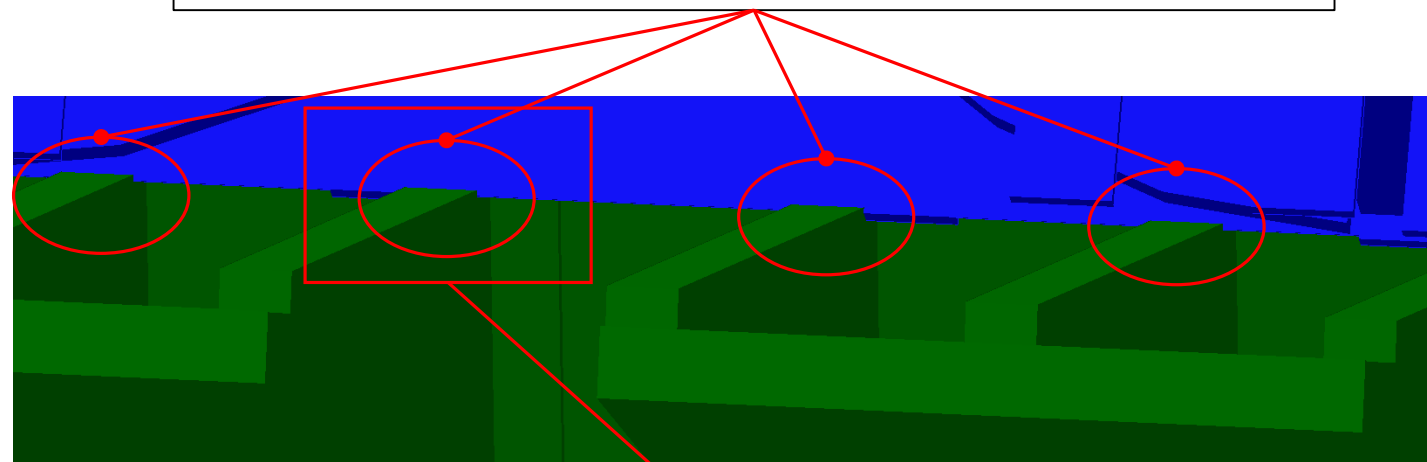
102 x 2 Vol - Flexible Chain (Sec\_11-15).xml

```
1 <!-- Support -->
2 <!-- Support -->
3 <!-- Support -->
4 <!-- Support -->
5 <!-- Support -->
6 <!-- Support -->
7 <!-- Support -->
8 <!-- Support -->
9 <!-- Support -->
10 <!-- Support -->
11 <!-- Support -->
12 <!-- Support -->
13 <!-- Support -->
14 <!-- Support -->
15 <!-- Support -->
16 <!-- Support -->
17 <!-- Support -->
18 <!-- Support -->
19 <!-- Support -->
20 <!-- Support -->
21 <!-- Support -->
22 <!-- Support -->
23 <!-- Support -->
24 <!-- Support -->
25 <!-- Support -->
26 <!-- Support -->
27 <!-- Support -->
28 <!-- Support -->
29 <!-- Support -->
30 <!-- Support -->
31 <!-- Support -->
32 <!-- Support -->
33 <!-- Support -->
34 <!-- Support -->
35 <!-- Support -->
36 <!-- Support -->
37 <!-- Support -->
38 <!-- Support -->
39 <!-- Support -->
40 <!-- Support -->
41 <!-- Support -->
42 <!-- Support -->
43 <!-- Support -->
44 <!-- Support -->
45 <!-- Support -->
46 <!-- Support -->
47 <!-- Support -->
48 <!-- Support -->
49 <!-- Support -->
50 <!-- Support -->
51 <!-- Support -->
52 <!-- Support -->
53 <!-- Support -->
54 <!-- Support -->
```

# Integration Conflicts Checking



There are Integration Conflict Between Flexible chain(sec 11) and CalorimeterSaddle **Clash = 14.71mm**

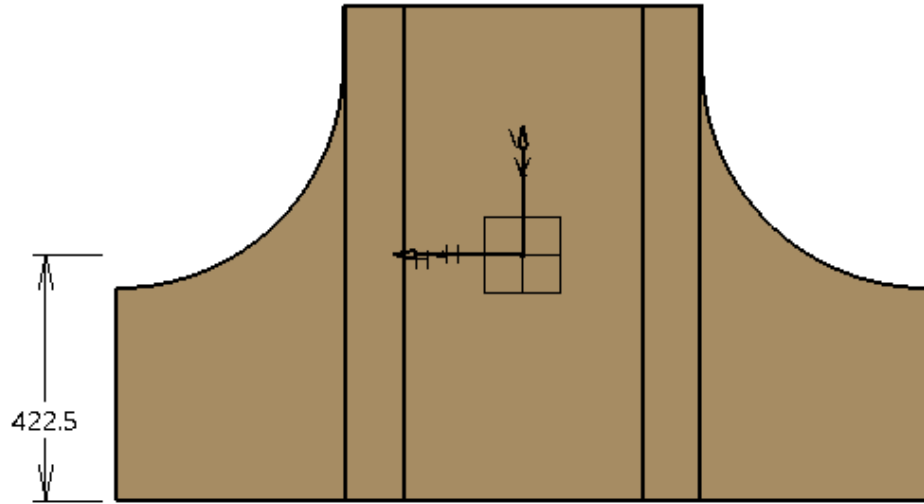


Flexible Cain sec 11 – “middle\_plate\_subtrc” before modification



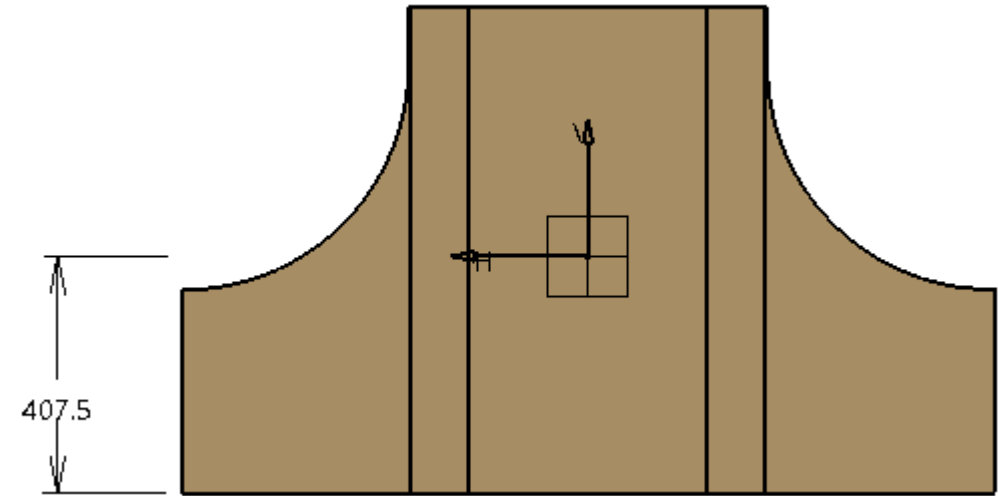
# Integration Conflicts Checking

Before modification of "middle\_plate\_subtrc"



Volume = 0.008 m<sup>3</sup>

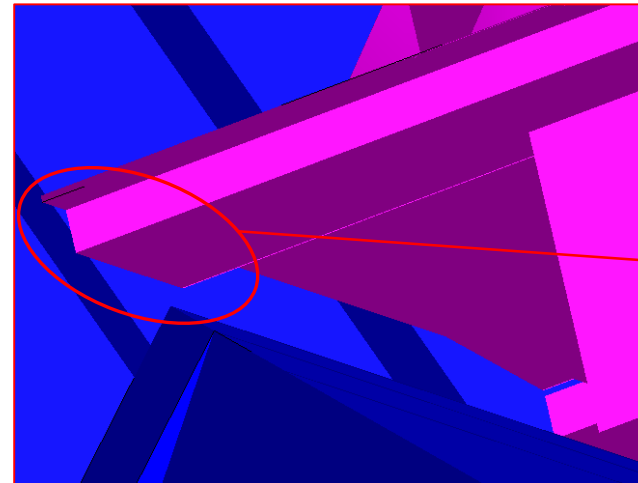
After modification of "middle\_plate\_subtrc"



Volume = 0.008 m<sup>3</sup>

"Middle\_plate\_subtrc" has been modified:

1. Height was shortened by 15mm.
2. 0.000176 m<sup>3</sup> ~ 1.4 kg was added to the modified model In order to compensate this change

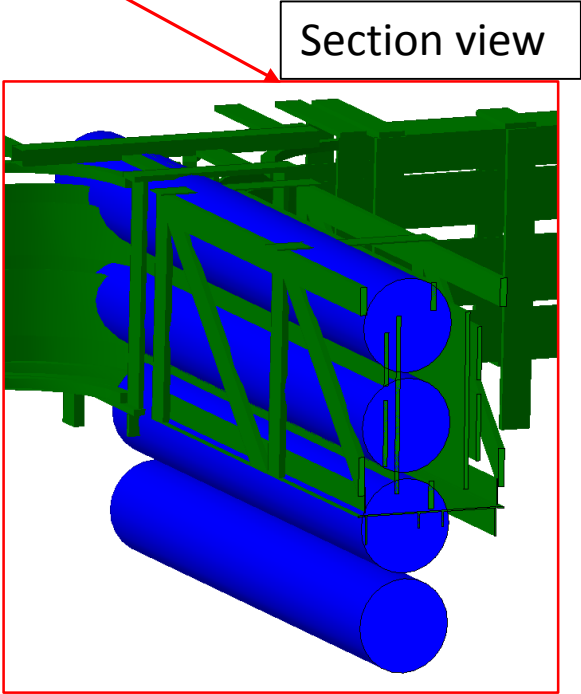
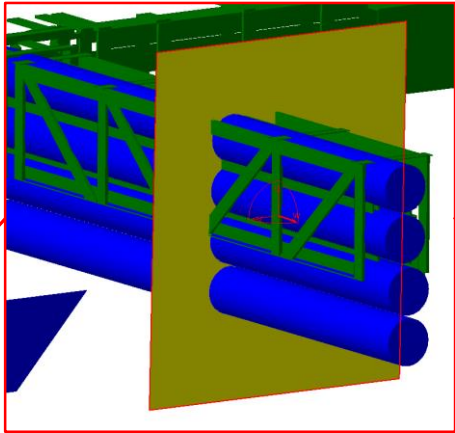
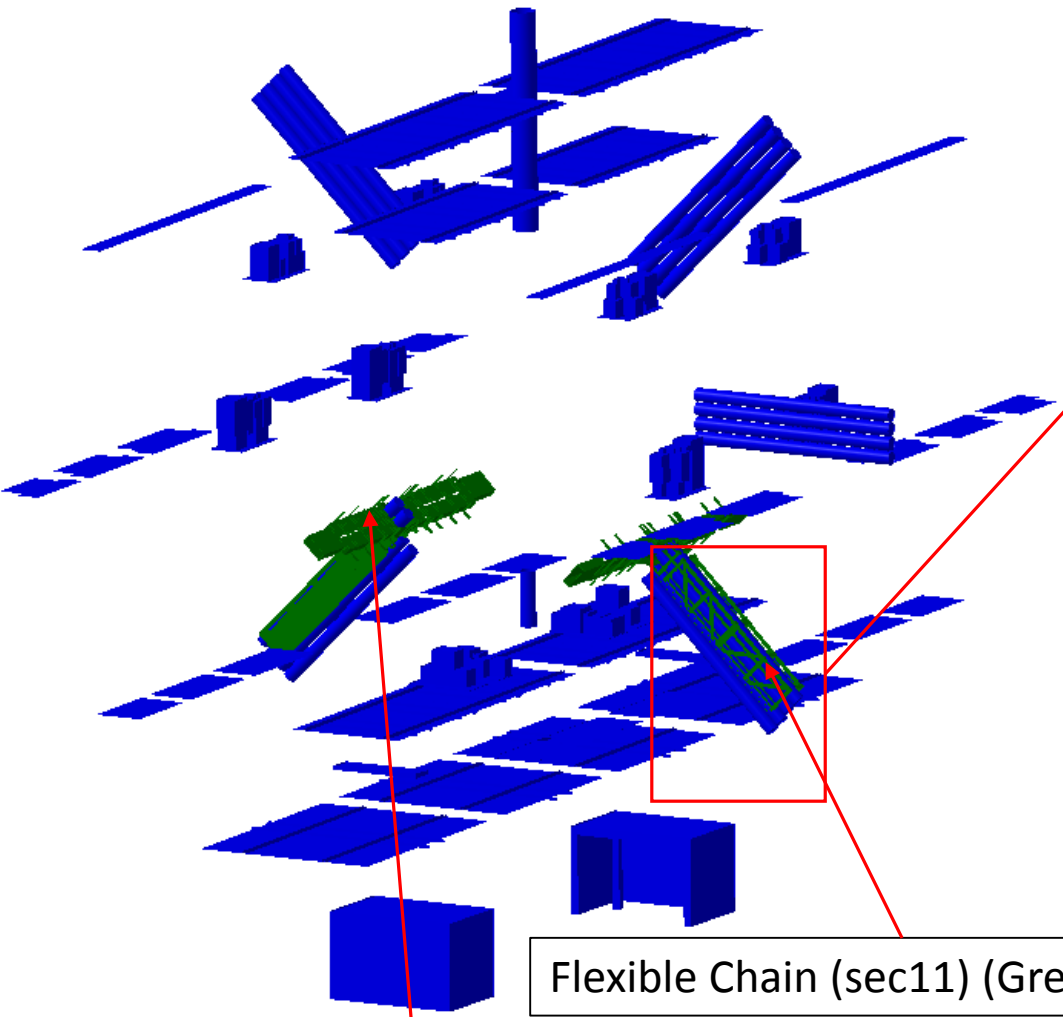


After "middle\_plate\_subtrc" modification  
**There are No Integration Conflicts**

# Integration Conflicts Checking

Services from Geant4 (Blue color)

There are Integration Conflict Between Flexible chain(sec 11-sec15) and Services



# XML on Gitlab repository

A atlas g4-xml

Project

Repository

Files

Commits

Branches

Tags

Contributors

Graph

Compare

Charts

Issues 0

Merge Requests 0

CI / CD

Operations

Registry

Members

GitLab unavailability on July 18, 22, 23 due to hypervisor security updates: <http://cern.ch/go/BP7D>

Alexander Sharmazanashvili > atlas g4-xml > Repository

2nd-push atlas-g4-xml / services / Flexible Chain (sector 11 and 15) / + History Find file Web IDE

Upload New File

Niko Tsutskiridze authored just now

12fd8232

Name	Last commit	Last update
..		
.gitkeep	Add new directory	22 minutes ago
102_Vol_-_Flexible_Chain__Sec_11-15_.xml	Upload New File	4 minutes ago
102_Vol_-_Simplification_of_Flexible_Chain_-_sec_11-15.pdf	Upload New File	just now
102_vol_-_Flexible_Chain_sec_11-15.wrl	Upload New File	4 minutes ago
41_Vol_-_FlexibleChainSector11-15.xml	Upload New File	6 minutes ago
41_Vol_-_Simplification_of_Flexible_Chain_-_sec_11-15.pdf	Upload New File	1 minute ago
41_vol_-_Flexible_Chain_sec_11-15.wrl	Upload New File	4 minutes ago
Integration_Conflict_checking-Flexible_Chain_sec11_15_.pdf	Upload New File	just now
Reproduction_-_Flexible_Chain_s11-15.pdf	Upload New File	1 minute ago

## Summary

- ❑ 2 versions of XML have been generated:
  - less detailization with 352kg. diff. and high detailization with 0kg diff.
- ❑ We found 2 clashes during Integration conflict checking:
  - First one was between Calorimeter saddle and new flexible chains (sec 11-15). These conflicts have been solved.
  - The other one between services (from geant4) and new flexible chains (sec 11-15) still exist
- ❑ The results have been uploaded on Gitlab repository

Thank you for your attention!

გმადლობთ ყურადღებისათვის!