

# Cavern geometry update

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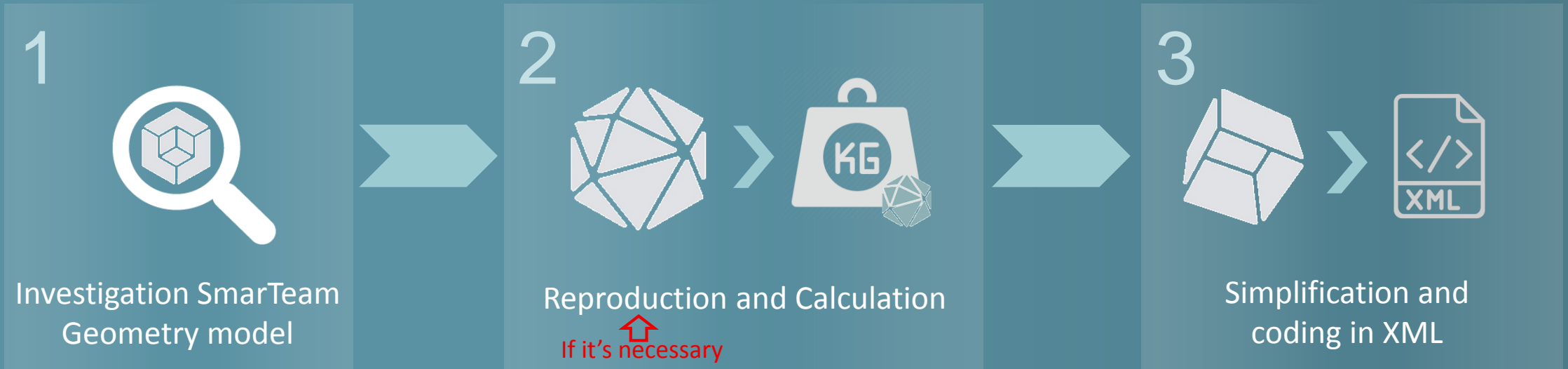
Responsible

Alexander Sharmazanashvili















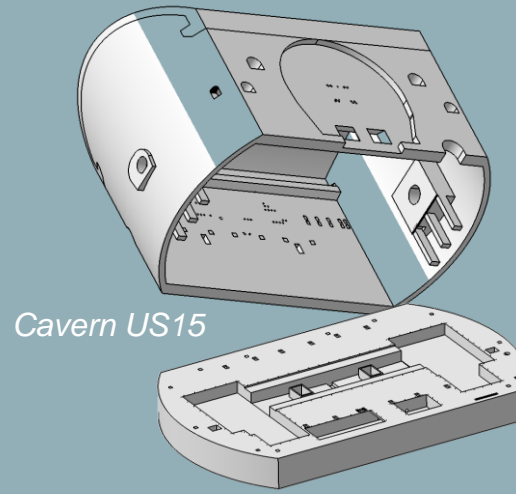
# Objective – Development of AGDD Geometry Description of the Cavern

## Steps for Cavern Geometry Description In XML

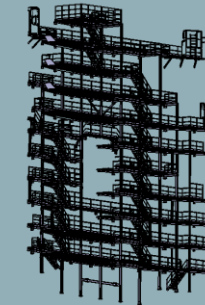
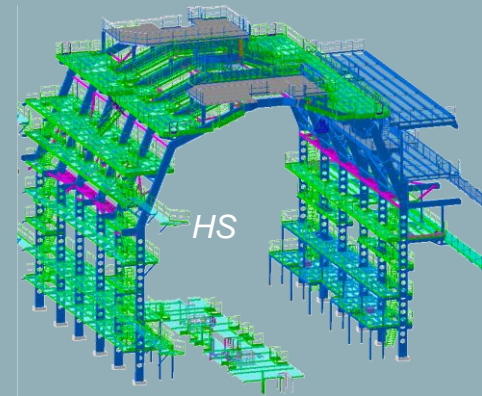
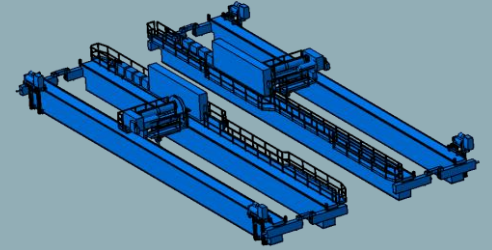


# 3 Main Groups

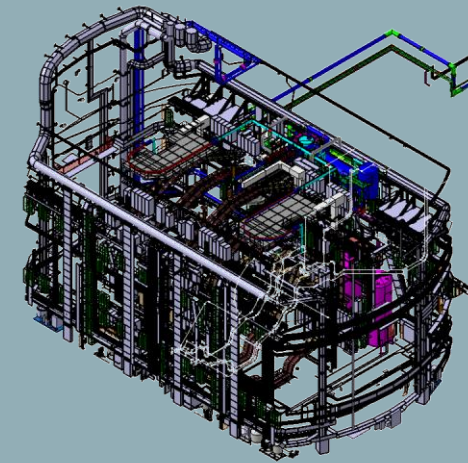
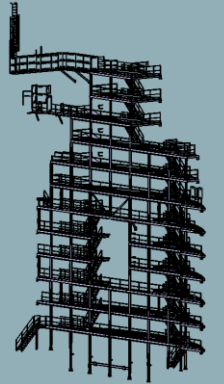
-   Cavern US15 **Done**
-   Cavern Cranes **Done**
-   HS wall Structure **Done**
-   HO wall Structure **Done**
  -  HO Side A
  -  HO Side C
-   **Services on structure** **Not done**  
(Cables, Pipes, Racks, Drug Chain, liquid tanks... etc.)



Cranes



HO



Services

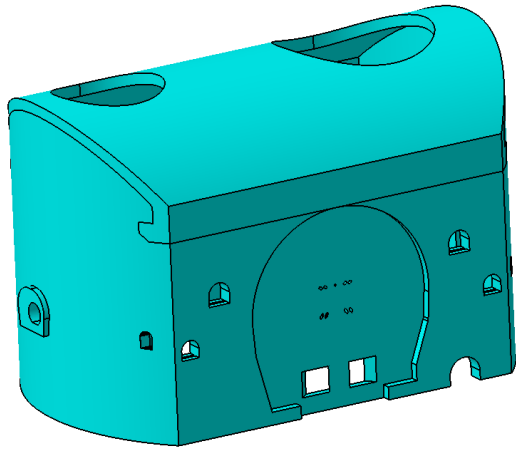
## ➤ I Group Models

# I Group models



# Cavern US15

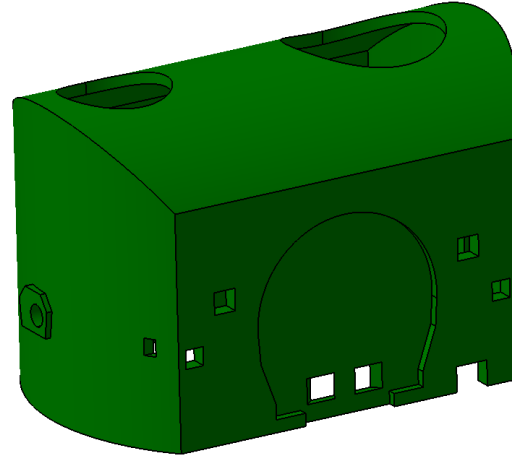
Detailed Model



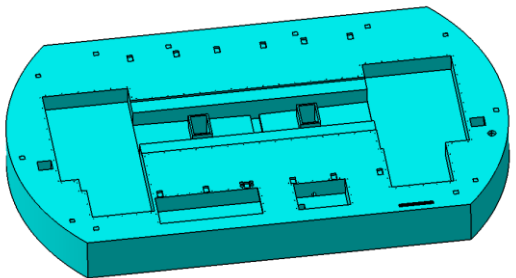
<b>Volume (m<sup>3</sup>)</b>	8817.25
<b>Mass (kg)</b>	-
<b>Material</b>	-
<b>Density (kg/m<sup>3</sup>)</b>	-



Simplified model



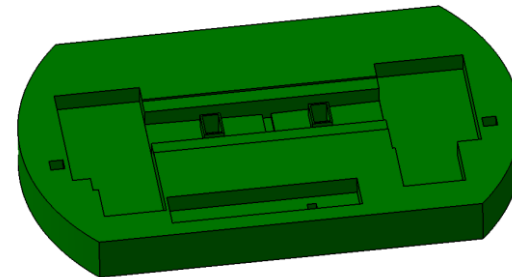
Detailed Model



<b>Volume (m<sup>3</sup>)</b>	7420.91
<b>Mass (kg)</b>	-
<b>Material</b>	-
<b>Density (kg/m<sup>3</sup>)</b>	-



Simplified model



# I Group models

# Cavern Cranes

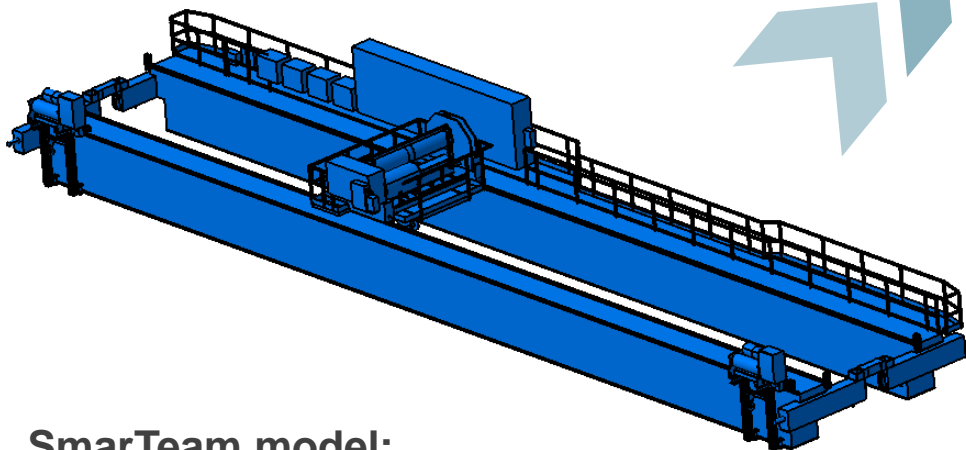
Weight both cranes – 115 T

## Calculation

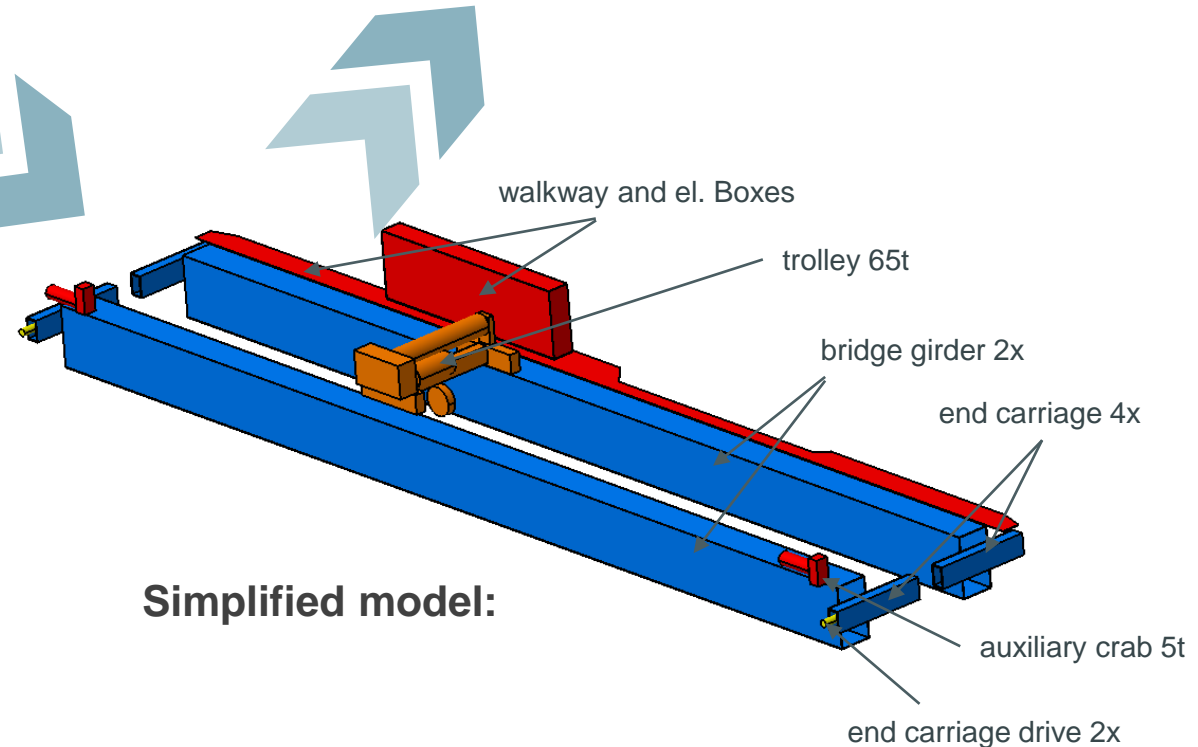
Parts of Crane	Weight 1 (kg)	Volume 1 (m³)	Weight 2 (kg)	Volume 2 (m³)	Difference (kg)
1 walkway and el. Boxes	5000	0.625	5039	0.630	-39
2 bridge girder 2x	32000	4.000	31976	3.997	24
3 end carriage drive 2x	1000	0.125	1005	0.126	-5
4 end carriage 4x	4000	0.500	3980	0.498	20
5 trolley 65t	14000	1.750	13998	1.750	2
6 auxiliary crab 5t	1500	0.188	1506	0.188	-6
<b>total</b>	<b>57500</b>	<b>7.1875</b>	<b>57505</b>	<b>7.1881</b>	<b>-4.64</b>



- Information about "Weight 1" given from Drawings
- "Volume 1" calculated as steel material (density: 8000)
- "Volume 2" and "Weight 2" are given after Simplification



**SmarTeam model:**  
ST0149444\_01 (Envelop Geometry )

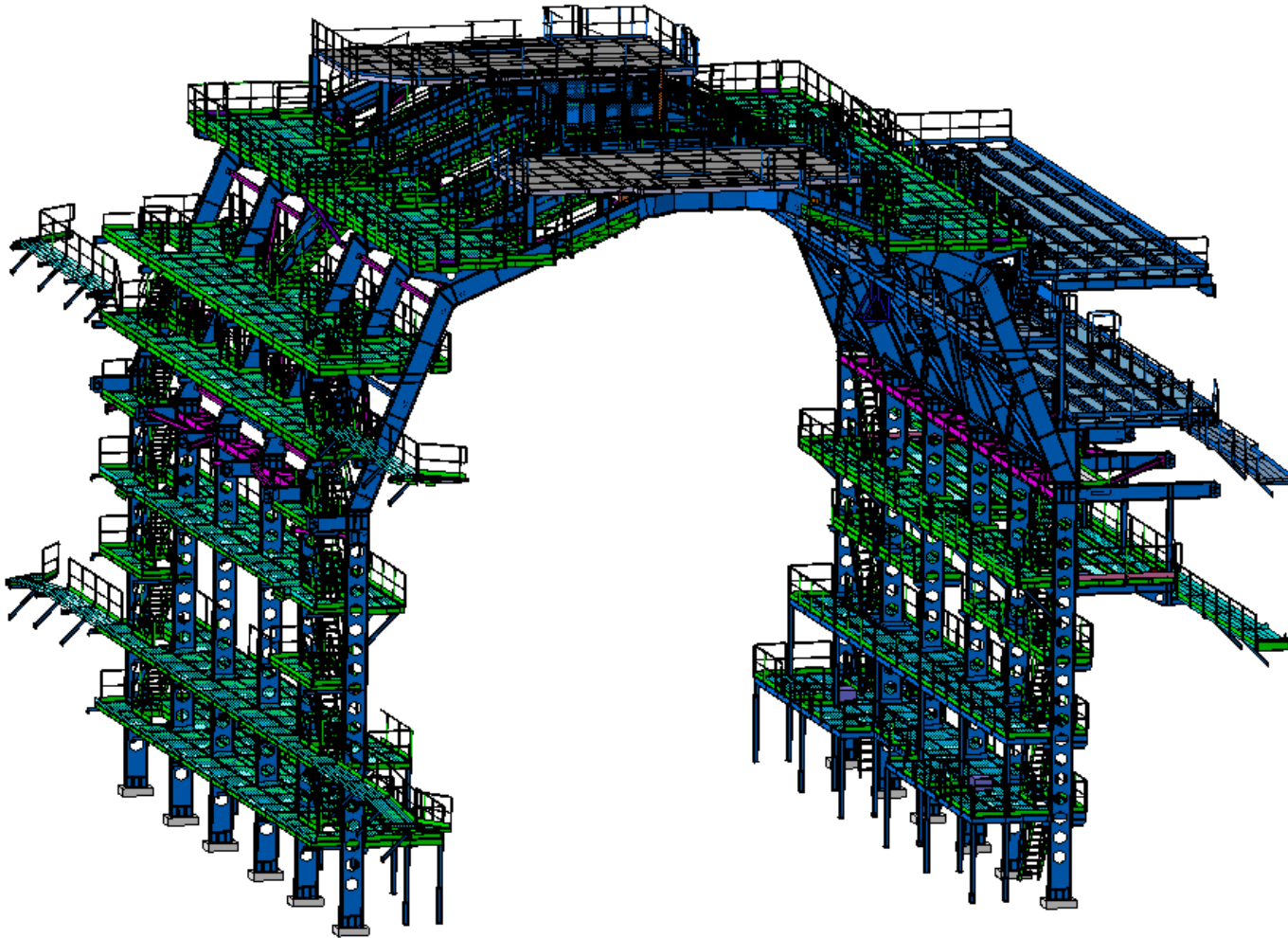


**Simplified model:**

# ➤ II Group Models

➤➤ HS wall Structure

# II Group models » HS wall Structure



Material: Steel

Density: 7850

## Steps of performed work :

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1

Investigation SmarTeam  
Geometry model

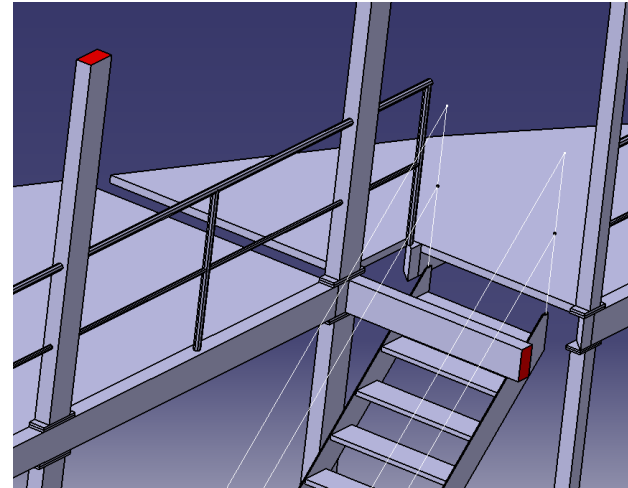
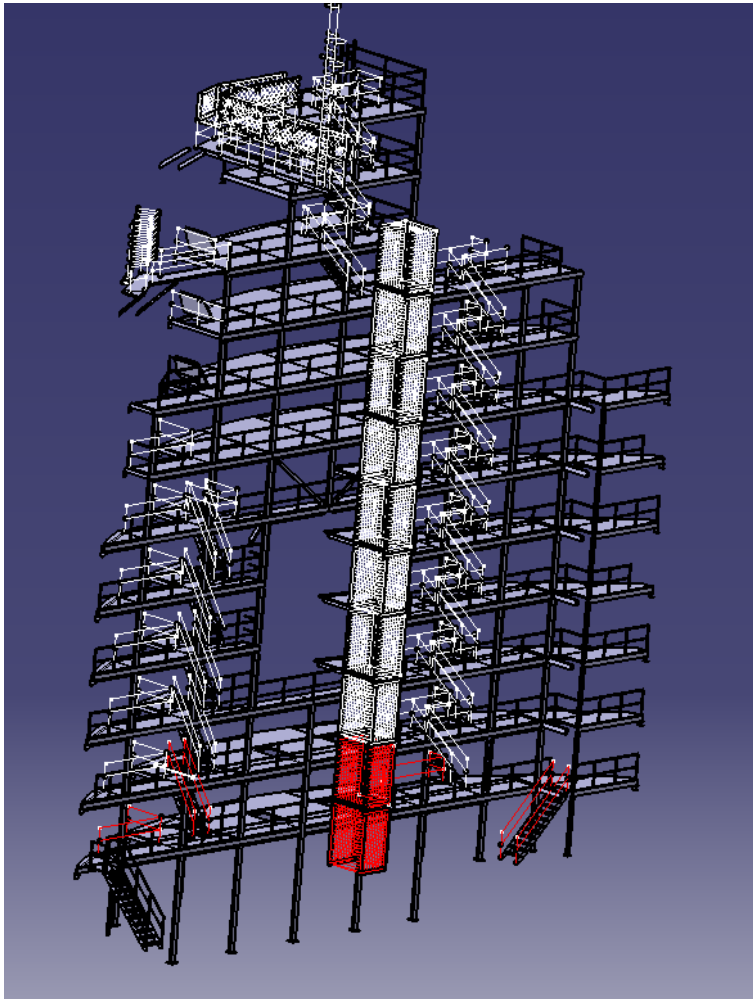
2

Reproduction and Calculation

3

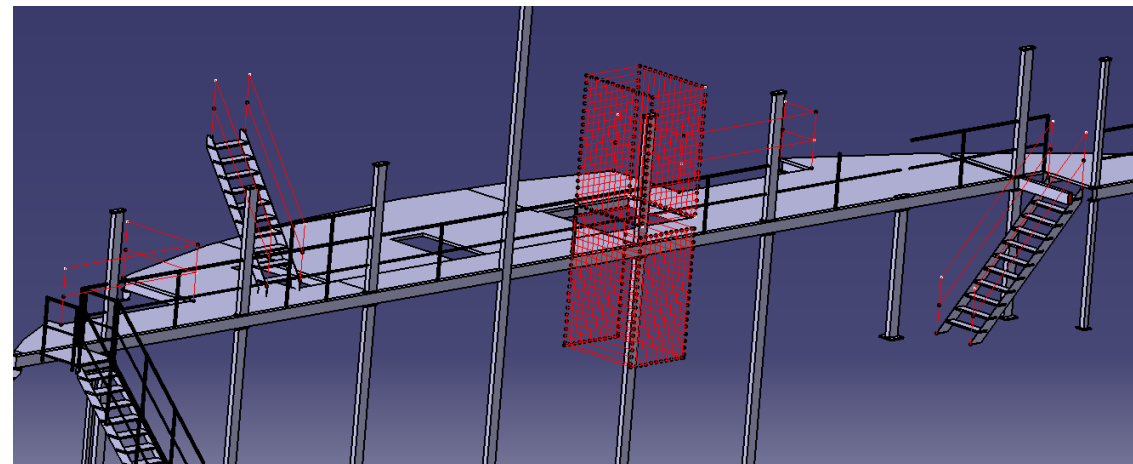
Simplification and coding in XML

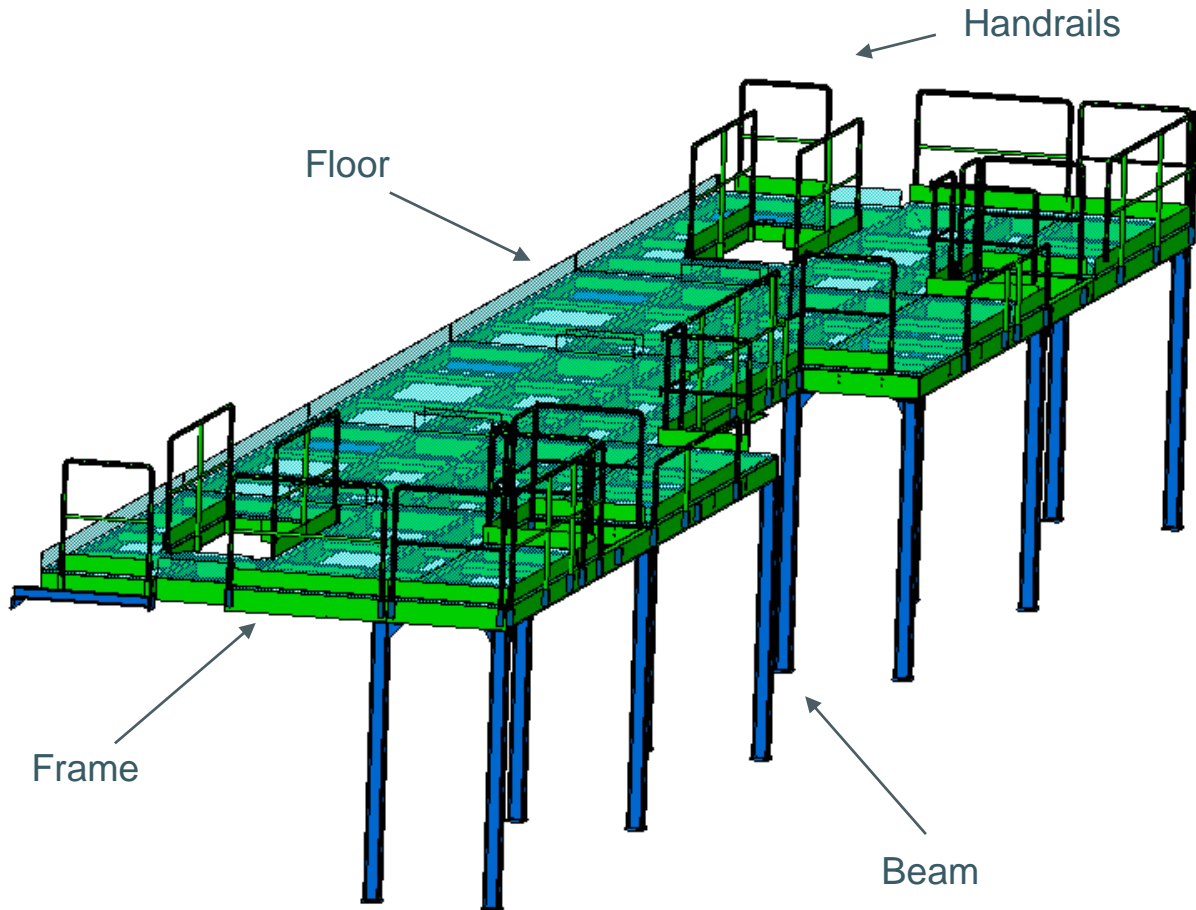




### Identified problems

- Lack of inner radius of tubes
- Some solid parts are missing
- Floor is very simplified

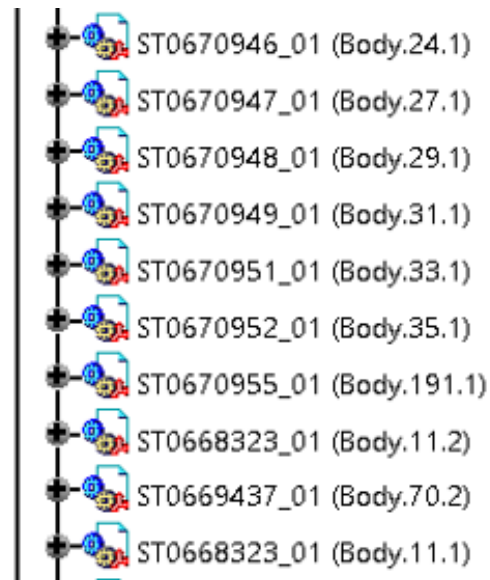




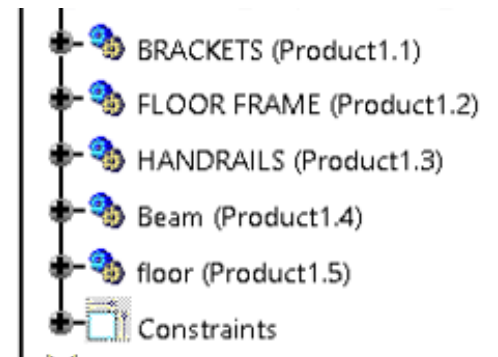
First floor of HS wall Structure

## CATIA Model Tree Correction

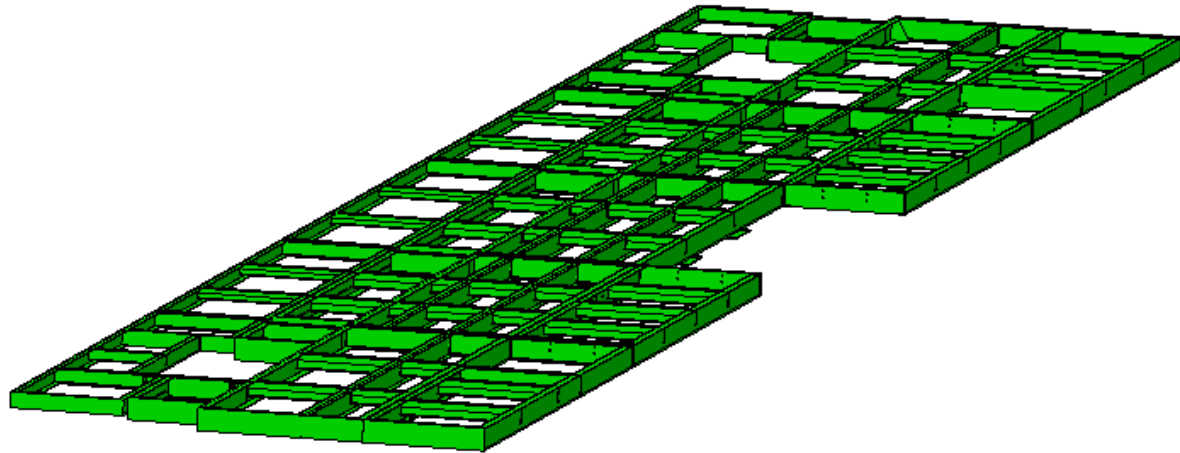
Before



After

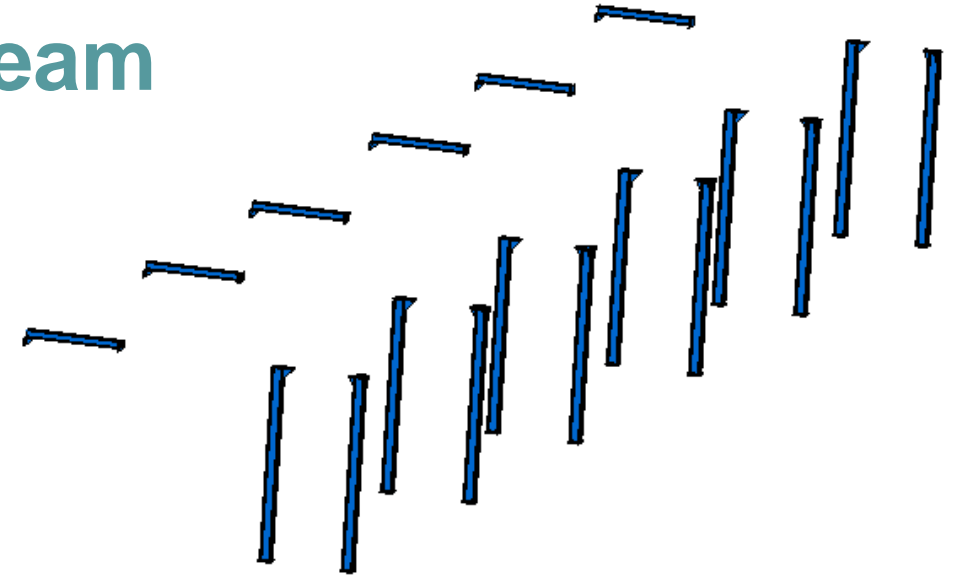


## Frame



Volume: 0.728 m<sup>3</sup>  
Weight: 5 715 kg

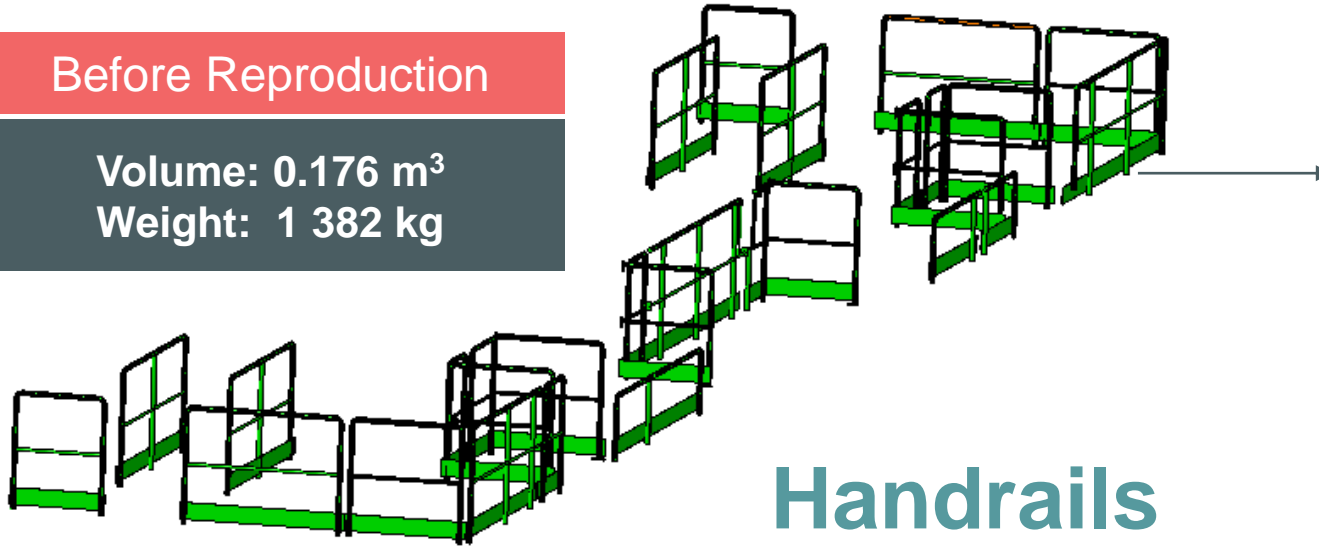
## Beam



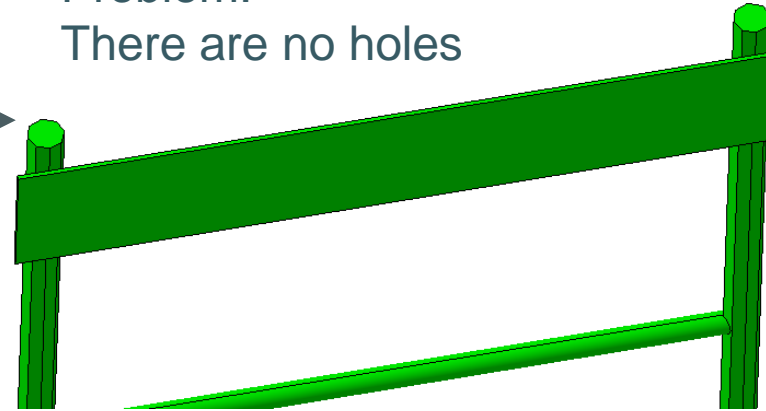
Volume: 0.122 m<sup>3</sup>  
Weight: 961 kg

Before Reproduction

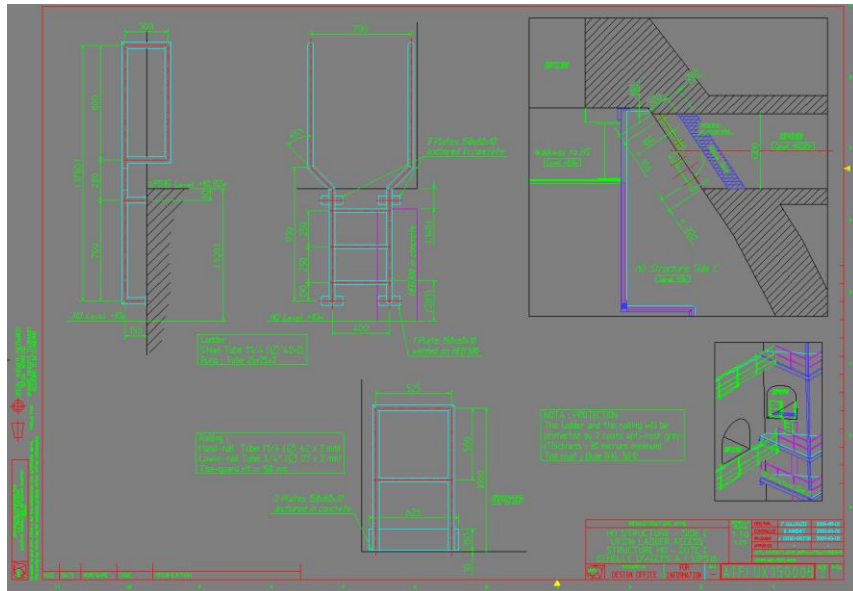
Volume: 0.176 m<sup>3</sup>  
Weight: 1 382 kg



Problem:  
There are no holes



CDD  
Drawing →



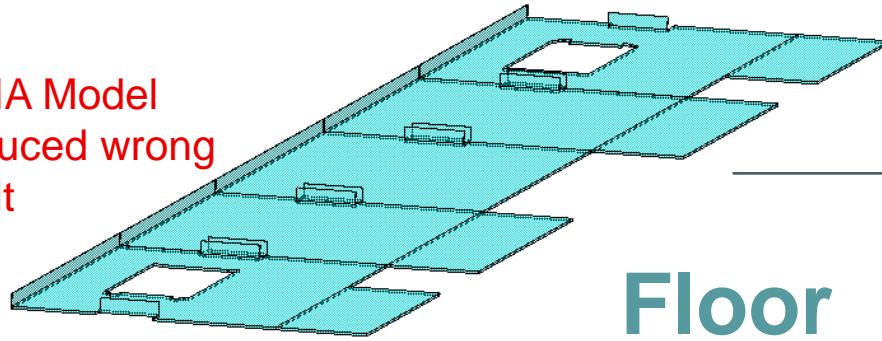
After Reproduction

Volume: 0.053 m<sup>3</sup>  
Weight: 419 kg

Before Reproduction

Volume: 2.728 m<sup>3</sup>  
Weight: 21 416 kg

← CATIA Model produced wrong result



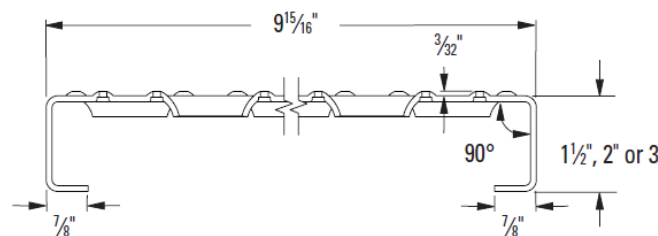
### Steel Thickness Conversion

Gauge No.	B.W.G		U.S.G	
	inch	mm	inch	mm
6	.203	5.156	.2031	5.16
7	.180	4.572	.1875	4.76
8	.165	4.191	.1719	4.37
9	.148	3.759	.1563	3.97
10	.134	3.404	.1406	3.57
11	.120	3.048	.1250	3.18
12	.109	2.769	.1094	2.78
13	.095	2.413	.0938	2.38
14	.083	2.108	.0781	1.98
15	.072	1.829	.0703	1.79
16	.065	1.651	.0625	1.59
17	.058	1.473	.0563	1.43
18	.049	1.245	.0500	1.27
19	.042	1.067	.0438	1.11
20	.035	.889	.0375	.953

Material Gauge	Channel Depth in. (mm)	Weight lb./in. ft. (kg/m)	Catalog Number	Load/Defl. Code
Steel 13 ga.	1½" (38.1)	3.5 (5.2)	P51513† A51513	U D C D
	2" (50.8)	3.9 (5.8)	P52013† A52013	U D C D
Steel 11 ga.	1½" (38.1)	4.5 (6.7)	P51511† A51511	U D C D
	2" (50.8)	5.1 (7.6)	P52011† A52011	U D C D
	3" (76.2)	5.1 (7.6)	P53011† A53011	U D C D

steel 7850

	width	length	height	kg	vol	%
Catalog	0.25	1	0.05	7.6	0.000968	7.55%
CAT.model	0.25	1	0.05	100.7	0.0128	

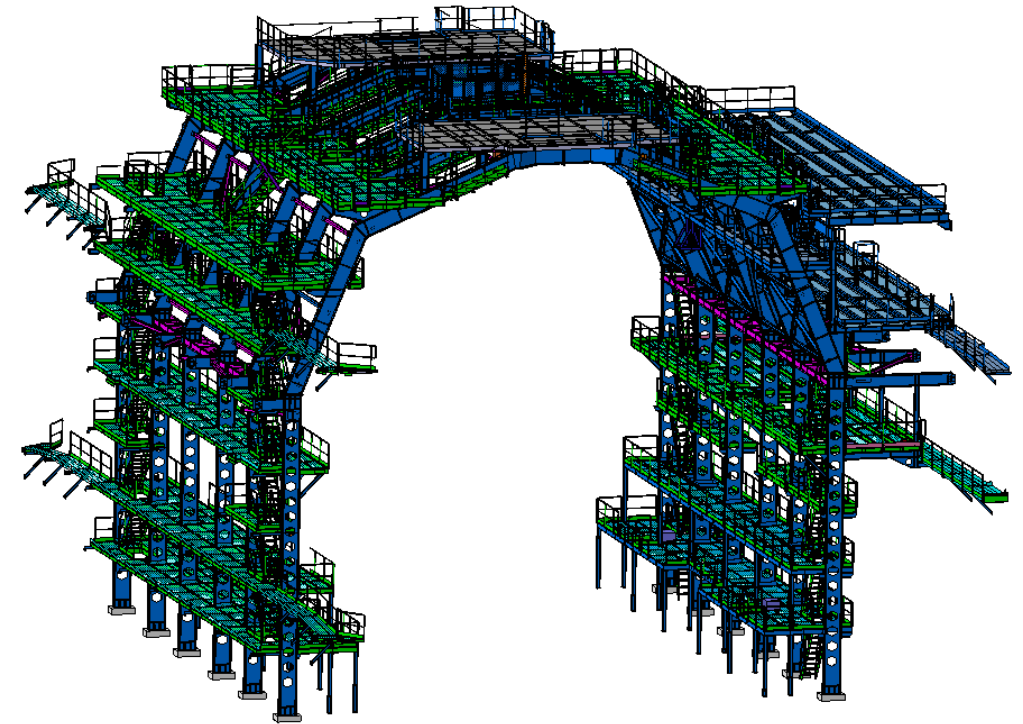


After Reproduction

Volume: 0.206 m<sup>3</sup>  
Weight: 1 617 kg

# Results of reproduction

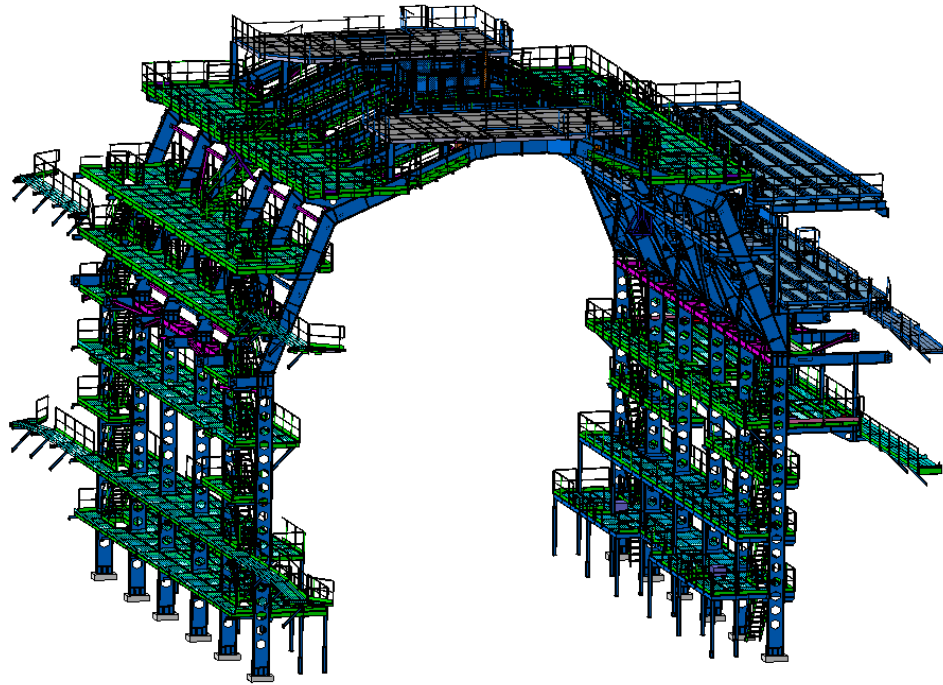
		Before Reproduction		After Reproduction	
Side	Floor	Volume m <sup>3</sup>	Weight kg	Volume m <sup>3</sup>	Weight kg
US15 Side	floor 1	3.780	29675	1.116	8758
	floor 2	4.725	37090	1.043	8190
	floor 3	0.734	5764	0.207	1627
	floor 4	2.823	22162	0.811	6368
	floor 5	1.051	8252	0.533	4185
	floor 6	3.310	25980	0.805	6322
	floor 7	3.953	31032	1.13	8869
	floor 8	3.934	30879	1.089	8548
	beams	5.357	42050	5.357	42050
USA15 Side	floor 1	4.038	31701	1.194	9374
	floor 2	2.765	21708	0.815	6399
	floor 3	1.233	9681	0.396	3105
	floor 4	9.345	73357	2.213	17374
	floor 5	2.304	18084	0.249	1954
	floor 6	8.506	66775	2.446	19205
	floor 7	2.284	17929	0.727	5708
	floor 8	5.131	40276	2.191	17199
	floor 9	4.061	31877	1.198	9407
	beams	5.534	43444	5.534	43444
Top side	str.&beam	15.578	122284	7.718	60587
	<b>Total</b>	<b>90.924 m<sup>3</sup></b>	<b>713753 kg</b>	<b>35.641m<sup>3</sup></b>	<b>279781 kg</b>



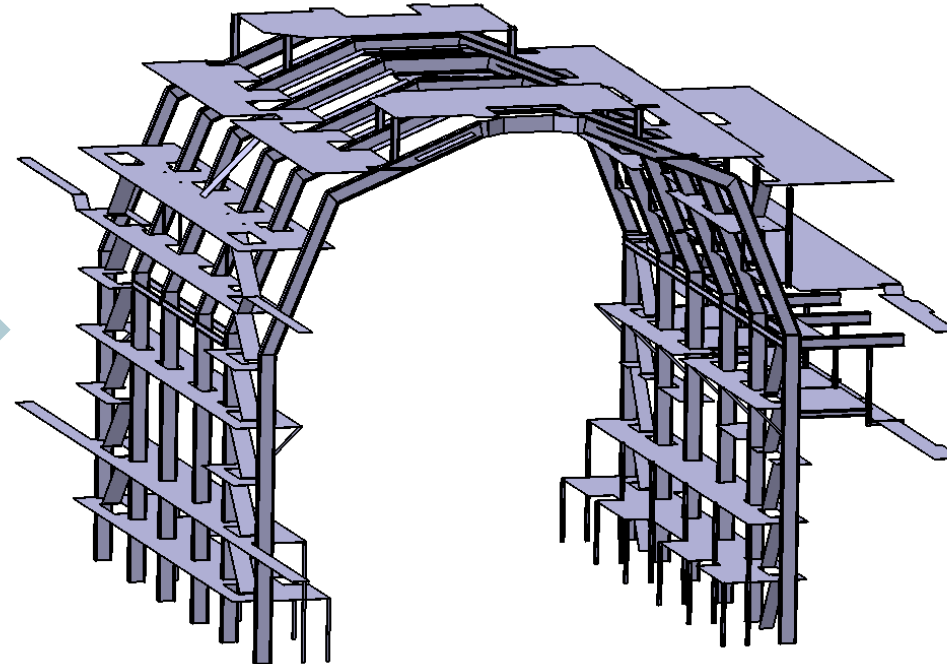
➤ Reproduced weight equals to **39.2%** of the initial weight



Detailed Model



Simplified Model



Volume: 35.641 m<sup>3</sup>  
Weight: 279'781 kg

Difference: < 0.01%

Volume: 35.642 m<sup>3</sup>  
Weight: 279'790 kg

Quantity of Simplified Model parts: 236

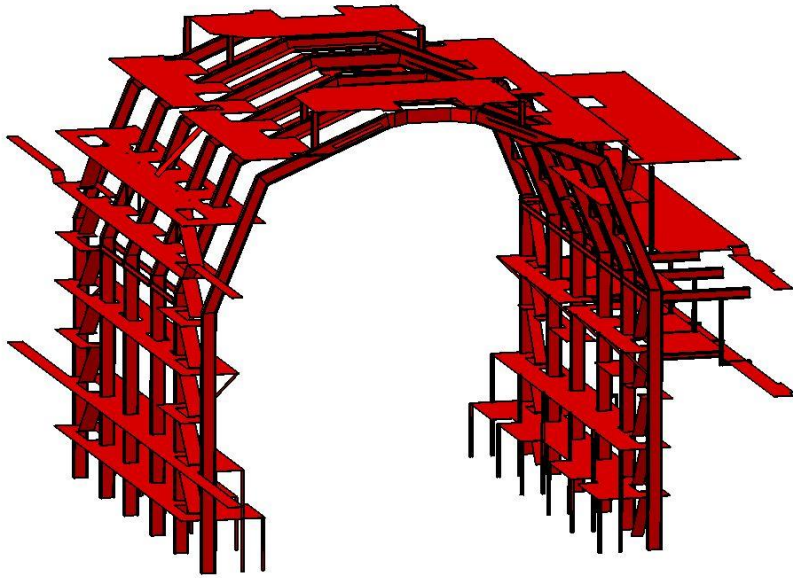
# Reproduction and Simplification of the HS wall Structure

		Before Reproduction		After Reproduction		Simplified model	
Side	Floor	Volume m3	Weight kg	Volume m3	Weight kg	Volume m3	Weight kg
US15 Side	floor 1	3.780	29675	1.116	8758	1.117	8765
	floor 2	4.725	37090	1.043	8190	1.042	8183
	floor 3	0.734	5764	0.207	1627	0.207	1627
	floor 4	2.823	22162	0.811	6368	0.811	6367
	floor 5	1.051	8252	0.533	4185	0.533	4186
	floor 6	3.310	25980	0.805	6322	0.805	6319
	floor 7	3.953	31032	1.13	8869	1.13	8868
	floor 8	3.934	30879	1.089	8548	1.089	8546
	beams	5.357	42050	5.029	39479	5.029	39480
USA15 Side	floor 1	4.038	31701	1.194	9374	1.195	9378
	floor 2	2.765	21708	0.815	6399	0.815	6396
	floor 3	1.233	9681	0.396	3105	0.395	3103
	floor 4	9.345	73357	2.213	17374	2.212	17368
	floor 5	2.304	18084	0.249	1954	0.249	1954
	floor 6	8.506	66775	2.446	19205	2.447	19206
	floor 7	2.284	17929	0.727	5708	0.727	5710
	floor 8	5.131	40276	2.191	17199	2.192	17204
	floor 9	4.061	31877	1.198	9407	1.199	9411
	beams	5.534	43444	5.534	43444	5.534	43446
Top side	str.&beam	15.578	122284	7.718	60587	7.719	60592
<b>Total</b>		<b>90.924 m<sup>3</sup></b>	<b>713753 kg</b>	<b>35.641m<sup>3</sup></b>	<b>279781 kg</b>	<b>35.642m<sup>3</sup></b>	<b>279790 kg</b>



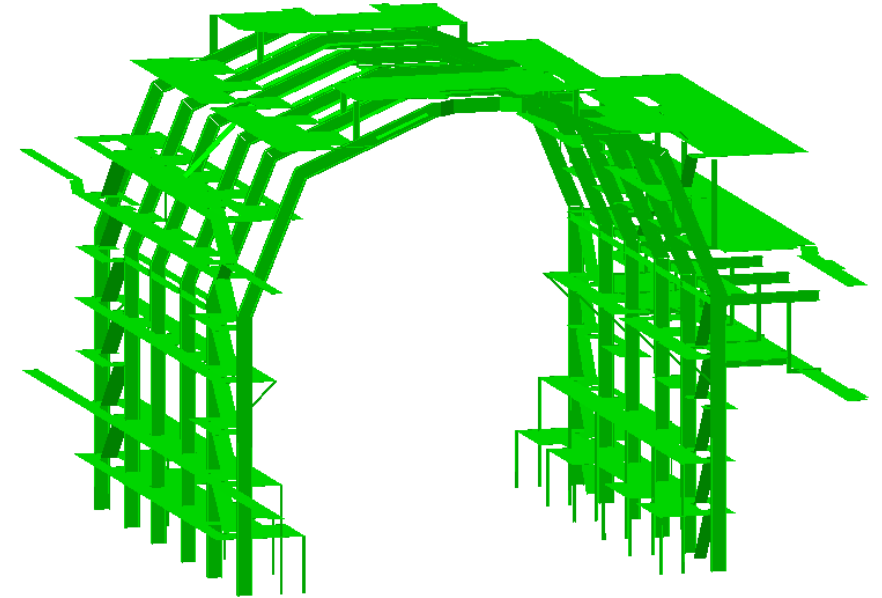
# Comparison of WRL and CATIA model volumes

Simplified CATIA Model

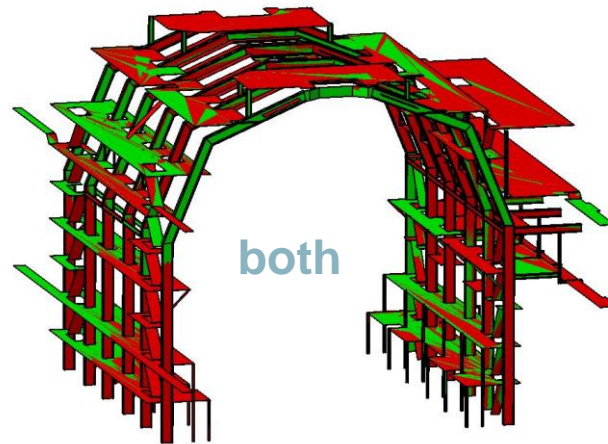


Volume: 35.642 m<sup>3</sup>

WRL Model dumped from XML



Volume: 35.648 m<sup>3</sup>



both

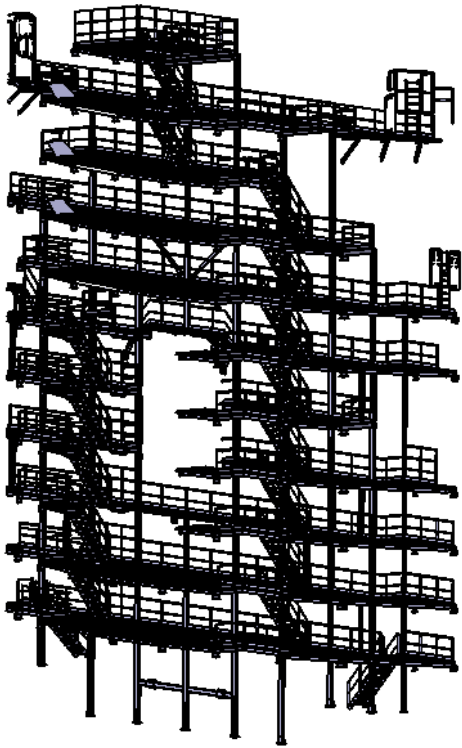
Computer inaccuracy: < 0.02%

# ➤ II Group Models

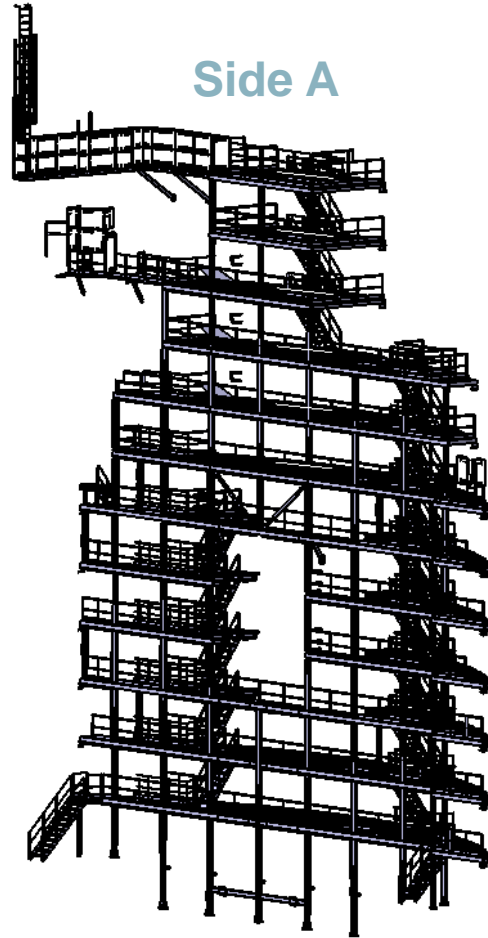
➤➤ HO wall Structure

# II Group models » HO wall Structure

Side C



Side A



## Stages of performed work :

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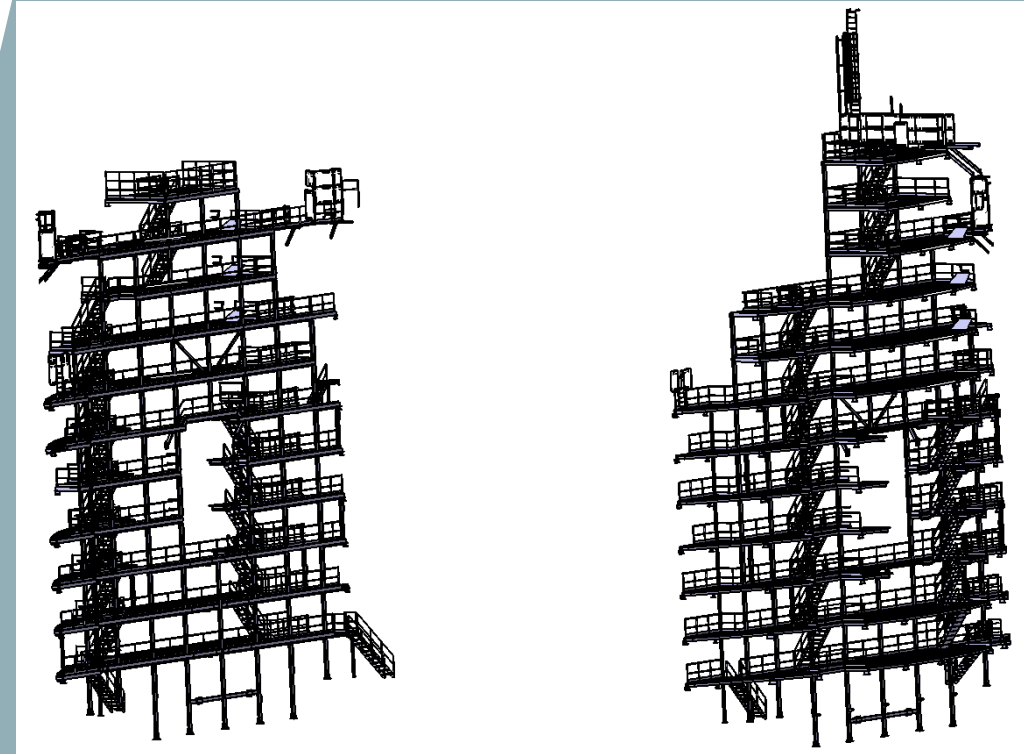
- Investigation in SmarTeam CATIA DB
- Reproduction and Calculation
- Simplification and coding in XML

Material: Steel

Density: 7850

# Results of reproduction for both sides

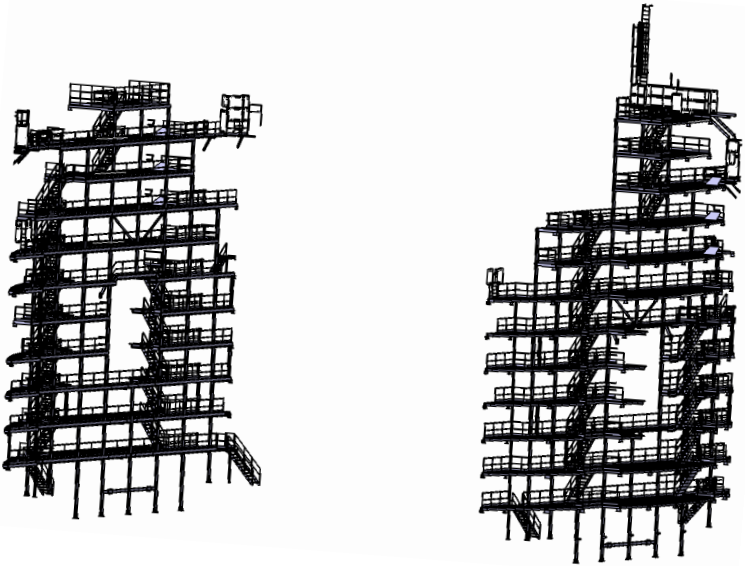
		Before Reproduction		After Reproduction	
Side	Floor	Volume m <sup>3</sup>	Weight kg	Volume m <sup>3</sup>	Weight kg
HO Side A	Floor 1	7,153	56150	1,327	10417
	Floor 2	6,09	47806	1,074	8427
	Floor 3	4,369	34294	0,84	6592
	Floor 4	3,881	30469	0,768	6029
	Floor 5	3,911	30705	0,777	6098
	Floor 6	4,56	35799	0,892	7004
	Floor 7	6,018	47241	1,048	8227
	Floor 8	5,295	41566	0,92	7220
	Floor 9	4,427	34755	0,793	6223
	Floor 10	3,307	25962	0,544	4269
	Floor 11	2,083	16352	0,36	2828
	Floor 12	2,57	20174	0,486	3813
HO Side C	Floor 1	6,9	54162	1,249	9804
	Floor 2	6,122	48055	1,075	8441
	Floor 3	4,359	34217	0,835	6554
	Floor 4	3,903	30640	0,773	6065
	Floor 5	3,322	26079	0,666	5231
	Floor 6	4,496	35292	0,872	6846
	Floor 7	6,073	47670	1,0621	8337
	Floor 8	5,538	43472	0,957	7512
	Floor 9	4,005	31437	0,666	5231
	Floor 10	4,563	35821	0,812	6374
	Floor 11	1,987	15596	0,336	2636
<i>Total</i>		104,932	823 724	19,132	150 185



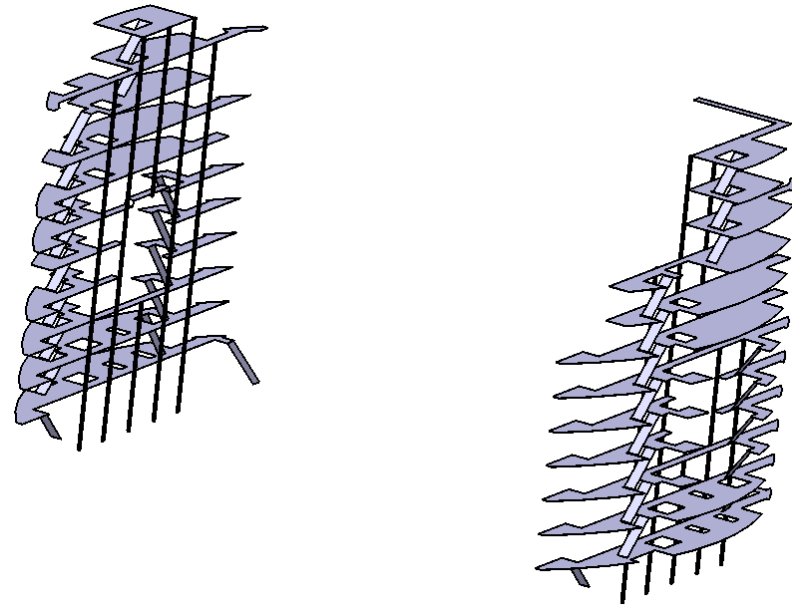
➤ Reproduced weight equals to **18,23%** of the initial weight

# HO wall Structure

Detailed Model



Simplified Model



Volume: 19,132 m<sup>3</sup>  
Weight: 150185,5 kg

Difference: < 0.05 %

Volume: 19,122 m<sup>3</sup>  
Weight: 150107,7 kg



Quantity of Simplified Model parts: 82

# Reproduction and Simplification of the HO wall Structure

## HO Side C

		Before Reproduction		After Reproduction		Simplified model	
Side	Floor	Volume m <sup>3</sup>	Weight kg	Volume m <sup>3</sup>	Weight kg	Volume m <sup>3</sup>	Weight kg
HO Side C	Floor 1	6,9	54162	1,249	9804	1,249	9801
	Floor 2	6,122	48055	1,075	8441	1,076	8443
	Floor 3	4,359	34217	0,835	6555	0,835	6558
	Floor 4	3,903	30640	0,773	6065	0,772	6060
	Floor 5	3,322	26079	0,666	5231	0,666	5227
	Floor 6	4,496	35293	0,872	6846	0,871	6838
	Floor 7	6,073	47670	1,0621	8337	1,062	8333
	Floor 8	5,538	43472	0,957	7512	0,957	7510
	Floor 9	4,005	31437	0,666	5231	0,662	5195
	Floor 10	4,563	35821	0,812	6375	0,812	6371
	Floor 11	1,987	15596	0,336	2636	0,336	2634
<i>Total</i>		<b>51,268</b>	<b>402 447</b>	<b>9,3031</b>	<b>73 034</b>	<b>9,298</b>	<b>72 989</b>

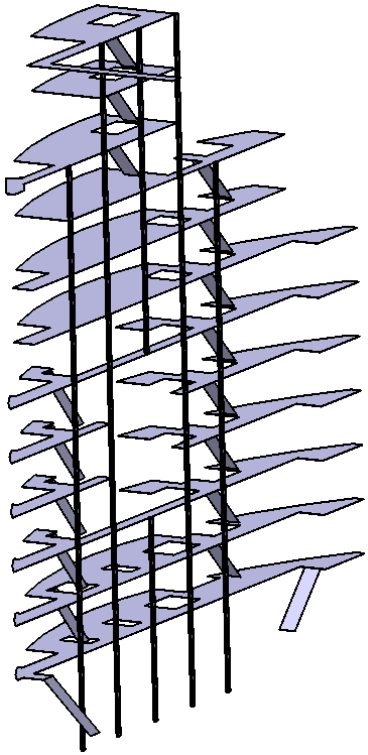
## HO Side A

		Before Reproduction		After Reproduction		Simplified model	
Side	Floor	Volume m <sup>3</sup>	Weight kg	Volume m <sup>3</sup>	Weight kg	Volume m <sup>3</sup>	Weight kg
HO Side A	Floor 1	7,153	56150	1,327	10417	1,319	10353
	Floor 2	6,09	47806	1,074	8427	1,065	8361
	Floor 3	4,369	34294	0,84	6592	0,831	6519
	Floor 4	3,881	30469	0,768	6029	0,773	6066
	Floor 5	3,911	30705	0,777	6098	0,780	6125
	Floor 6	4,56	35798	0,892	7005	0,897	7041
	Floor 7	6,018	47241	1,048	8227	1,052	8256
	Floor 8	5,295	41567	0,92	7220	0,923	7247
	Floor 9	4,427	34755	0,793	6223	0,797	6256
	Floor 10	3,307	25962	0,544	4270	0,544	4270
	Floor 11	2,083	16352	0,36	2828	0,36	2827
	Floor 12	2,57	20174	0,486	3814	0,486	3814
<i>Total</i>		<b>53,664</b>	<b>421 273</b>	<b>9,829</b>	<b>77 150</b>	<b>9,826</b>	<b>77 134</b>

# Comparison of WRL and CATIA model volumes

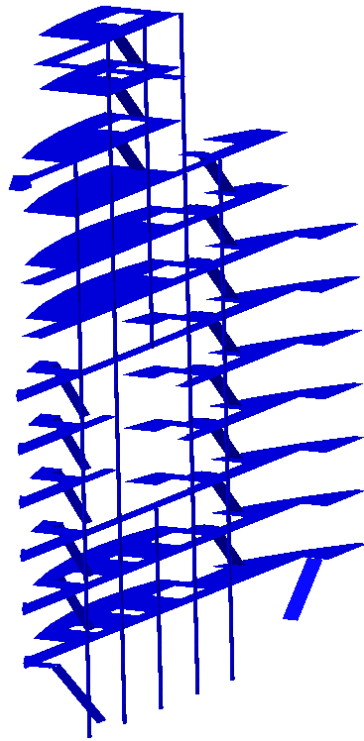
## HO wall Structure Side A

Simplified Model



Volume: 9,826 m<sup>3</sup>

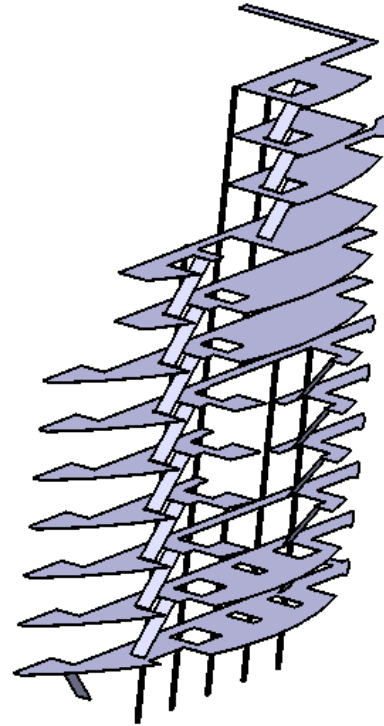
WRL Model



Volume: 9,777 m<sup>3</sup>

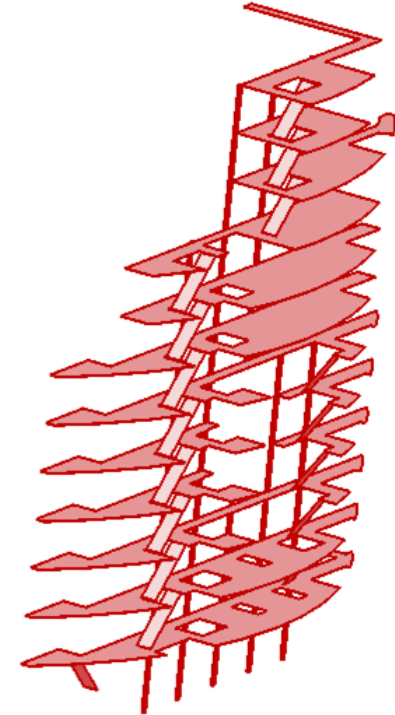
## HO wall Structure Side C

Simplified Model



Volume: 9,298 m<sup>3</sup>

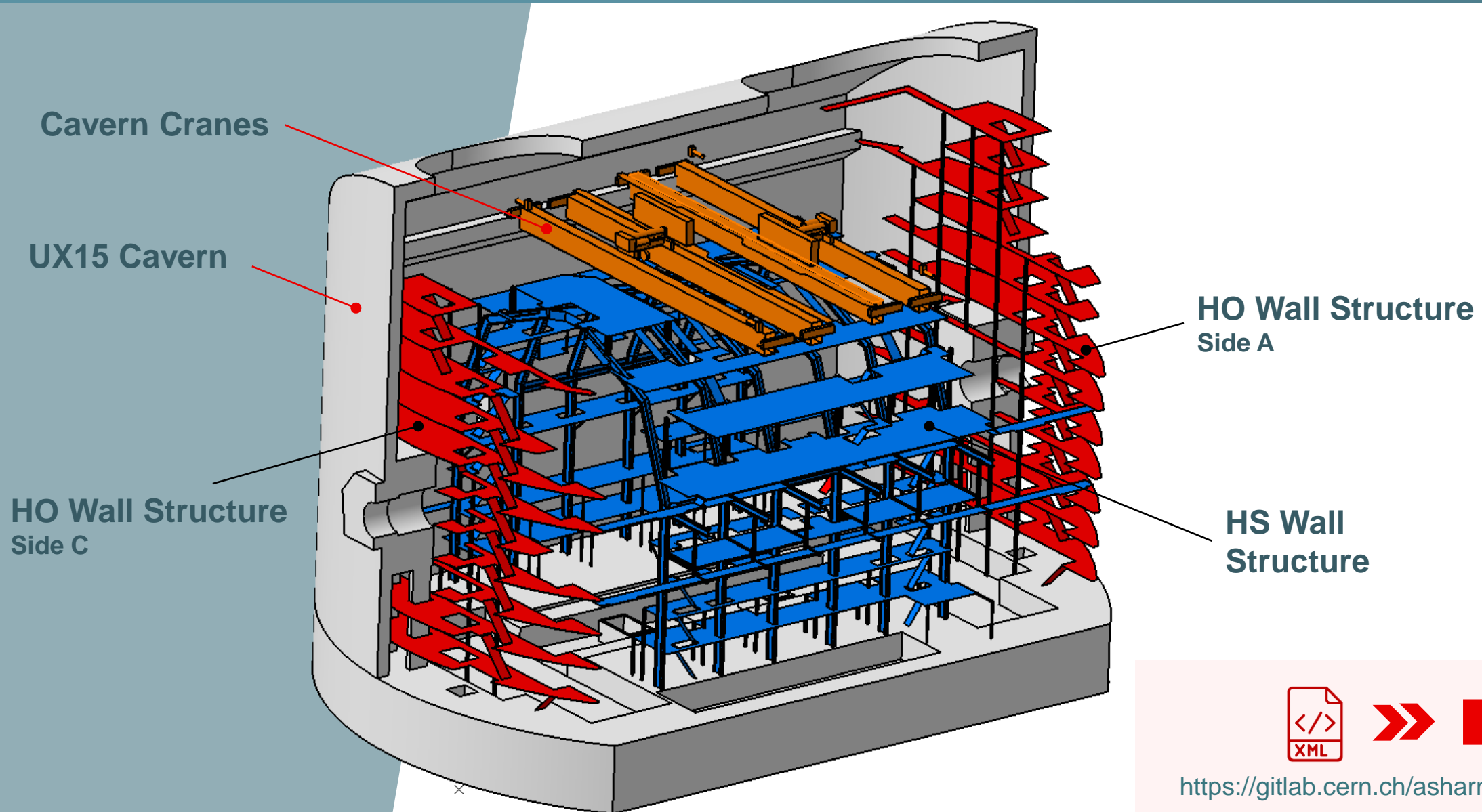
WRL Model



Volume: 9,312 m<sup>3</sup>

Computer inaccuracy : < 0.32%

# First two groups are completed



<https://gitlab.cern.ch/asharmaz/atlas-g4-xml>



# ➤ III Group Models

➤➤ Services on Structure



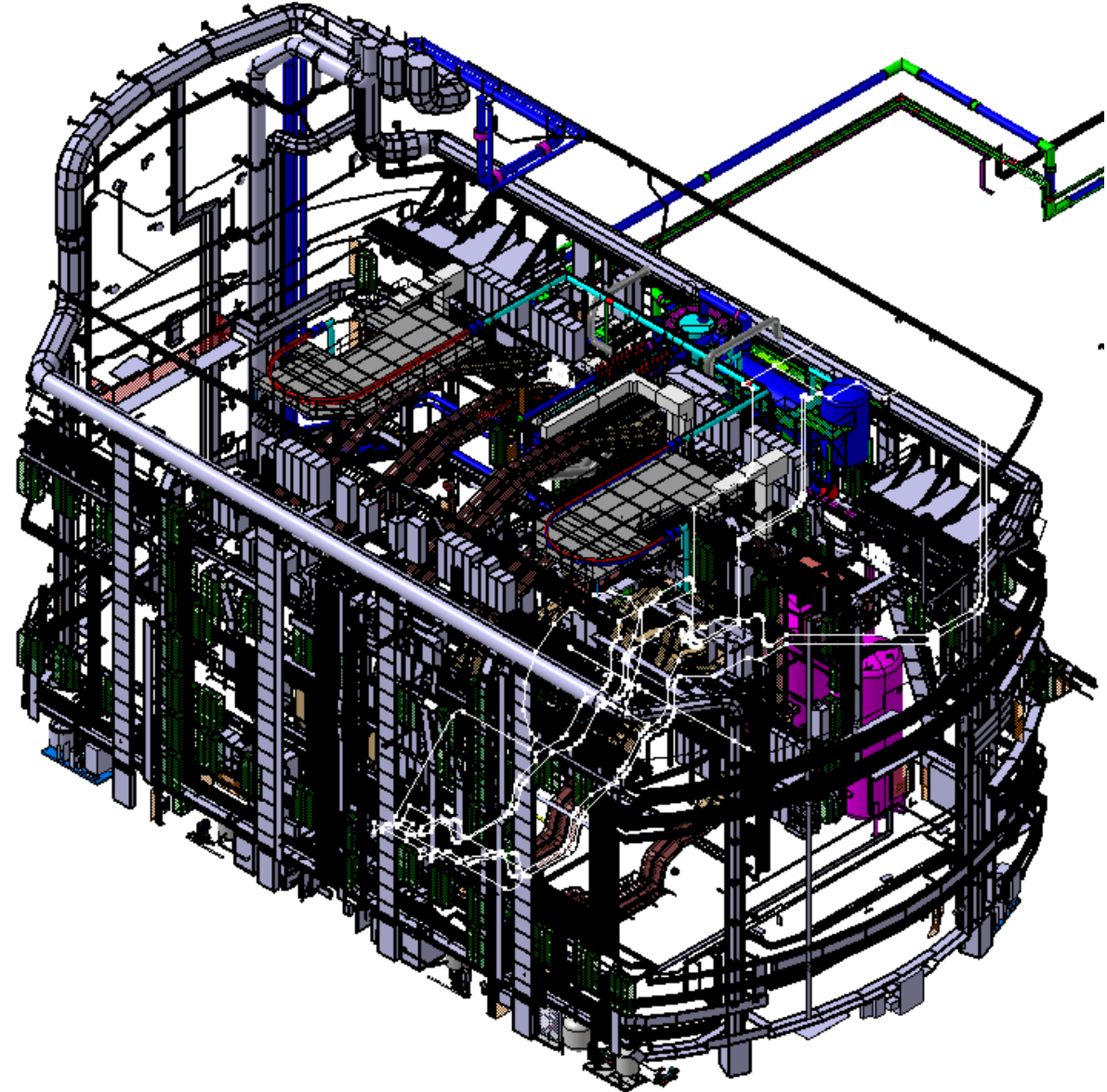
# III group - Services on Structure

## Situation in the third group

- Models have been migrated from (old cad system) Euclid and mainly are envelope geometries with no materials and the internal content of the parts (like tubes, cables and boxes)

## Next plan ?

- New list of priority models to be developed



THANK YOU