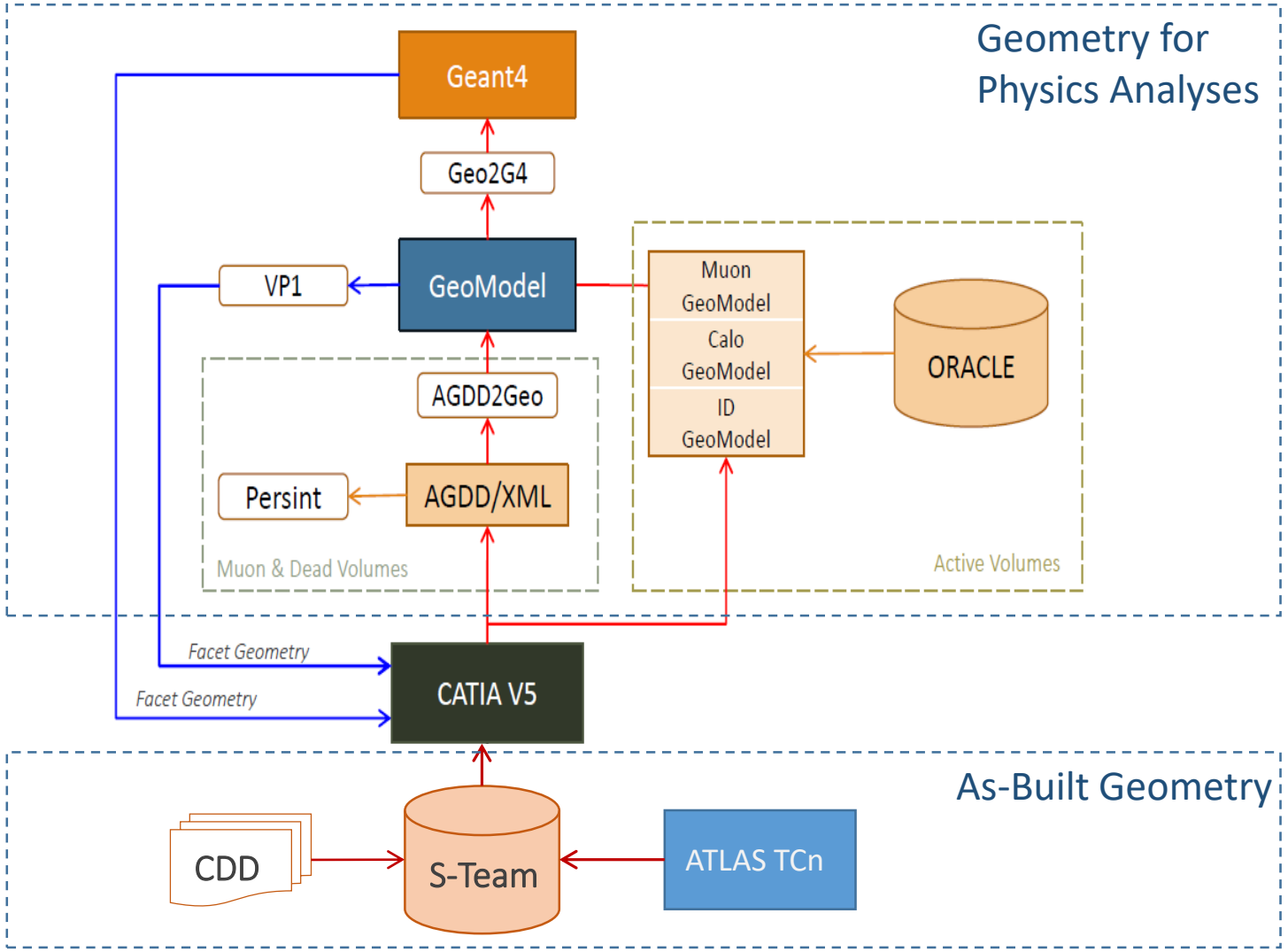
Update on Passive Materials

SHARMAZANASHVILI Alexander

Georgian Technical University
Georgian Nuclear Engineering Center

Methodology

- We are using CATIA as a hub for collection of various geometry descriptions



Details about this methodology are here: https://indico.cern.ch/event/785991/

Overall Results

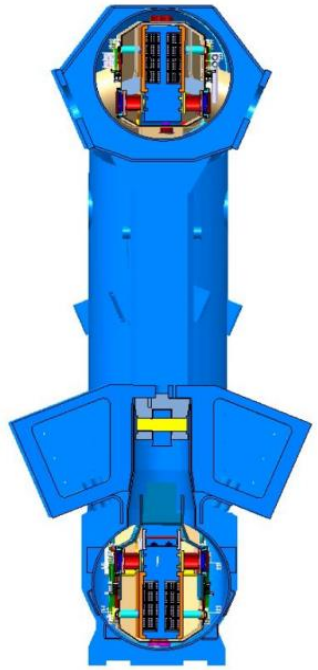
- We did 13 projects of analyses and identify differences between GEANT baseline descriptions and ‘as-built’ descriptions
- The majority of the cases (8) show necessity for reproduction of CATIA engineering descriptions. This work is most time consuming and takes about 2-3 FTE effort during the 7-8 months
- The minority of the cases (5) show no necessity for reproduction. Therefore it took about 1 FTE effort for the 1 month
- For all the projects we are providing the XML codes and technical reports of Simplification and Overlaps checking
- All results are widely accessible from the Gitlab https://gitlab.cern.ch/asharmaz/atlas-g4-xml

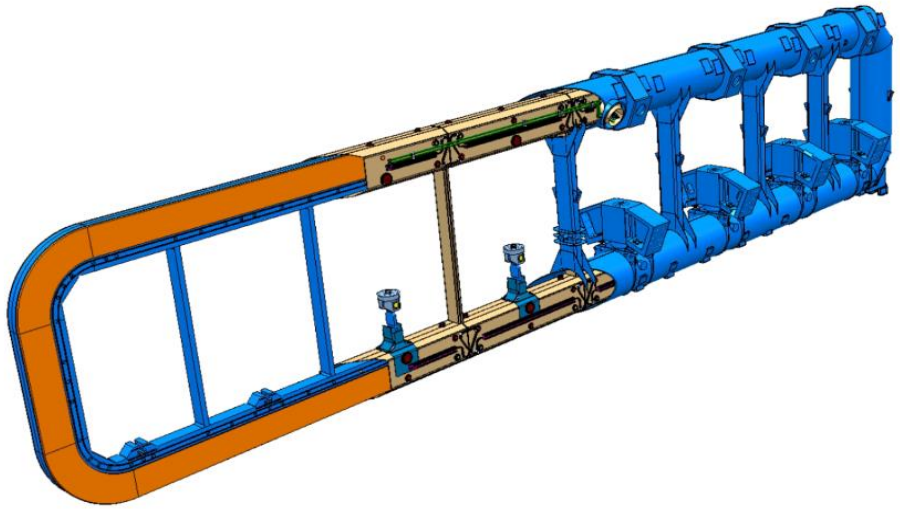
I. Description of Projects

#01: Compare Analyses of COILS

DIFF : **13 %** | **13 t** Missing
1 t Overestimated

Coil	CATIA		XML		Diff	
	Weight (kg)	*Volume (m³)*	*Weight (kg)*	*Volume (m³)*	*Weight (kg)*	
Cryostats	25'504	3.188	22'456	2.691	3'048	12%
Voussoir	12'300	4.416	13'200	4.456	-900	7%
Steffener	5'336	0.667	4'558	0.579	778	15%
Rib	4'824	0.603	3'576	0.454	1'248	26%
Inside the Coil	44'122	15.885	36'607	13.558	7'515	17%
Total:	92'086	24.759	80'397	21.738	11'700	13%





Output :
- Reproduced model in CATIA. 225 drawings added
- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 5 months

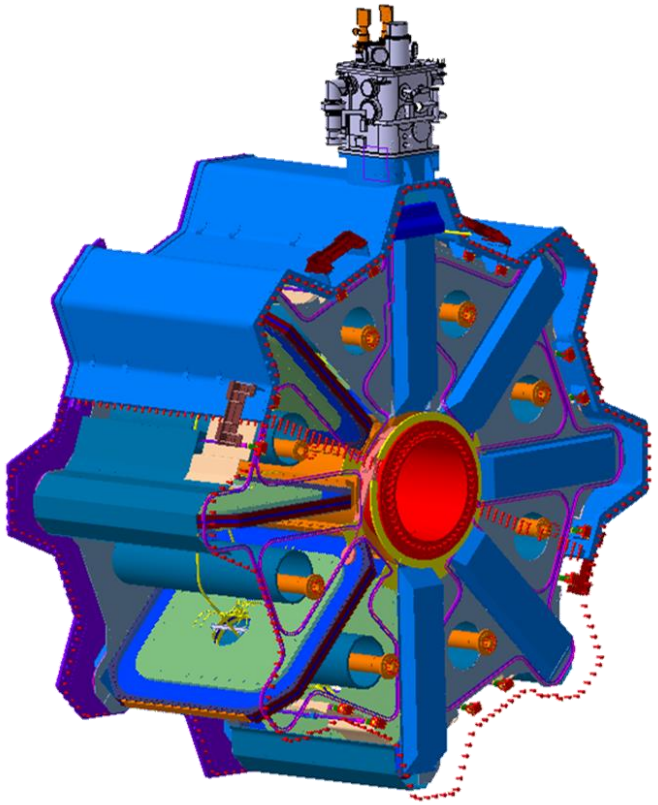
Manpower : 3 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/922635/

#02: Compare Analyses of END-CAP TOROID

DIFF : **34 %** | **10 t** Missing
7 t Overestimated

End-Cap Toroid	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
Cold Mass	116'740	43.3	123'012	45.6	-6'272	6%
Thermal Shielding	15'988	6.1	15'957	5.9	31	0.2%
Cover	57'966	20.8	57'185	20.3	781	1.3%
Bore Tube	13'433	1.68	10'208	1.28	3'225	24%
Yoke	1'820	0.23	1'338	0.17	482	27%
Stay Tube	2'028	0.75	2'214	0.82	-186	9%
JTV Shielding	4'161	1.65	4'510	1.79	-349	9%
Turret	2'476	0.73	1'512	0.56	964	39%
Tie Rod	3'077	0.39	1'268	0.2	1'809	59%
Bolts	2'965	0.37	-	-	2'965	100%
Services	869	0.2	-	-	869	100%
Total:	221'523	76.2	217'204	76.6	4'691	34%



Output :
- Reproduced model in CATIA. 902 drawings added
- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 7 months

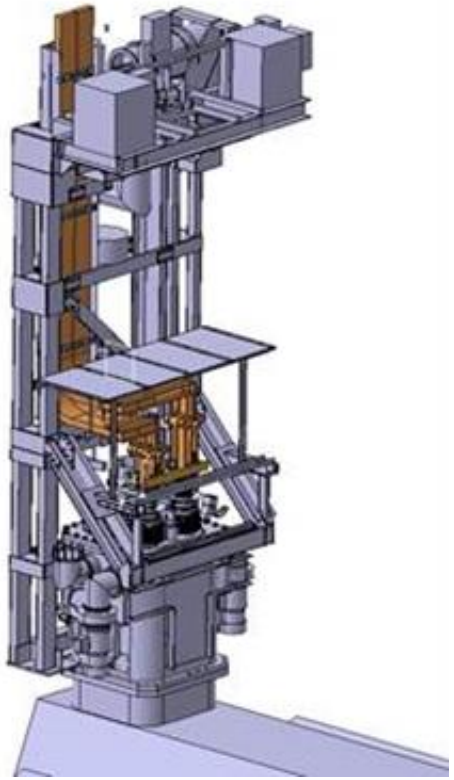
Manpower : 3 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/356850/

#03: Compare Analyses of ECT TOWER

DIFF : **70 %** | **3 t** Missing
2 t Overestimated

ECT Tower	CATIA		XML		Diff	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
ECST Left Leg Cover	130	0.048	689	0.255	-559	81%
ECST Left Leg Rod	186	0.069	648	0.24	-462	71%
ECST Right Leg	246	0.091	756	0.28	-510	68%
ECST Middle and Inclined Bars	241	0.0895	173	0.064	68	28%
ECST Front	122	0.045	168	0.062	-46	27%
ECST Front Glass	697	0.0258	342	0.157	355	51%
ECT ServTur	448	0.056	130	0.048	318	71%
ECST Cop	1'690	0.5075	-	-	1'690	100%
ECST Pipes	88	0.011	-	-	88	100%
ECST Bottom Plates	134	0.0494	-	-	134	100%
Total:	3'982	0.99	2'906	1.11	1'076	70%



Output :

- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 2 months
Manpower : 1 FTE CATIA designer/Programmer

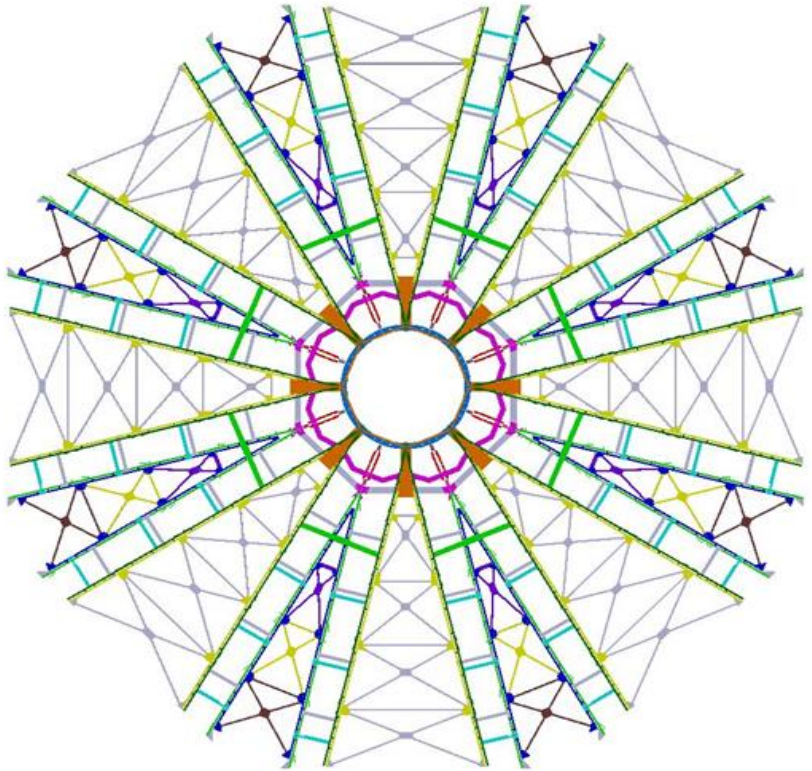
Details are here https://indico.cern.ch/event/701730/

#04: Compare Analyses of BIG WHEEL MDT

DIFF : **41 %** | **4 t** Missing

- t Overestimated

MDT Structure	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
BS External Spokes	1'419	0.53	1'005	0.400	414	29%
BS Inner Spokes	918	0.043	700	0.030	218	24%
BS Inner ring	340	0.016	-	-	340	100%
BS Bottom Girder	774	0.036	-	-	774	100%
BS Reinforcing Bar	708	0.033	648	0.030	140	9%
BS Middle Support	1'216	0.46	956	0.31	260	22%
SS External Spoke	1'439	0.533	1'025	0.420	414	29%
SS Inner Spoke	1'052	0.400	950	0.32	102	10%
SS Reinforcing Bar	398	0.147	256	0.096	142	36%
SS Cross Bracing Bay	771	0.216	640	0.187	131	17%
SS Spoke Bar1	240	0.089	-	-	240	100%
SS Spoke Bar2	162	0.06	162	0.06	-	-
SS Inner girder	125	0.047	-	-	125	100%
Bolts	972	0.122	-	-	972	100%
Total:	10'532	2.732	6'259	1.853	4'272	41%



Output :
- Reproduced model in CATIA. 75 drawings added
- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 5 months

Manpower : 2 FTE CATIA designer/Programmer

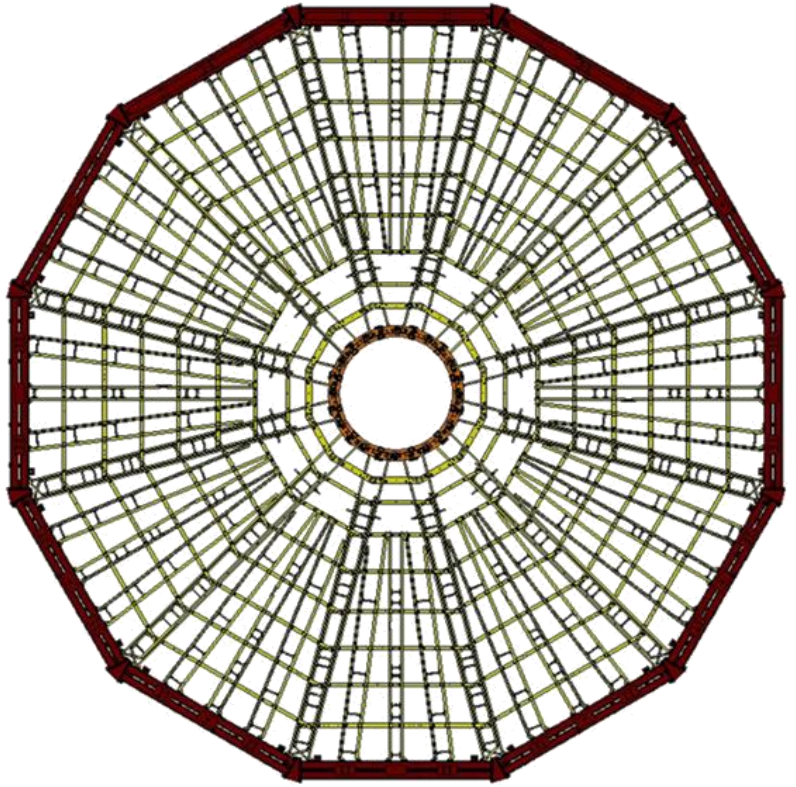
Details are here https://indico.cern.ch/event/270622/

#05: Compare Analyses of TGC1 SUPPORT

DIFF : **46 %** | **6 t** Missing

- t Overestimated

TGC1 Support	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
Outer Ring	6'230	2.31	2'470	0.91	3'760	60%
Aluminium Structure	6'830	2.53	4'720	1.75	2'110	30%
Inner Ring	534	0.20	210	0.08	324	60%
Total:	13'597	5.04	7'397	2.79	6'200	46%



Output :

- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 1 months

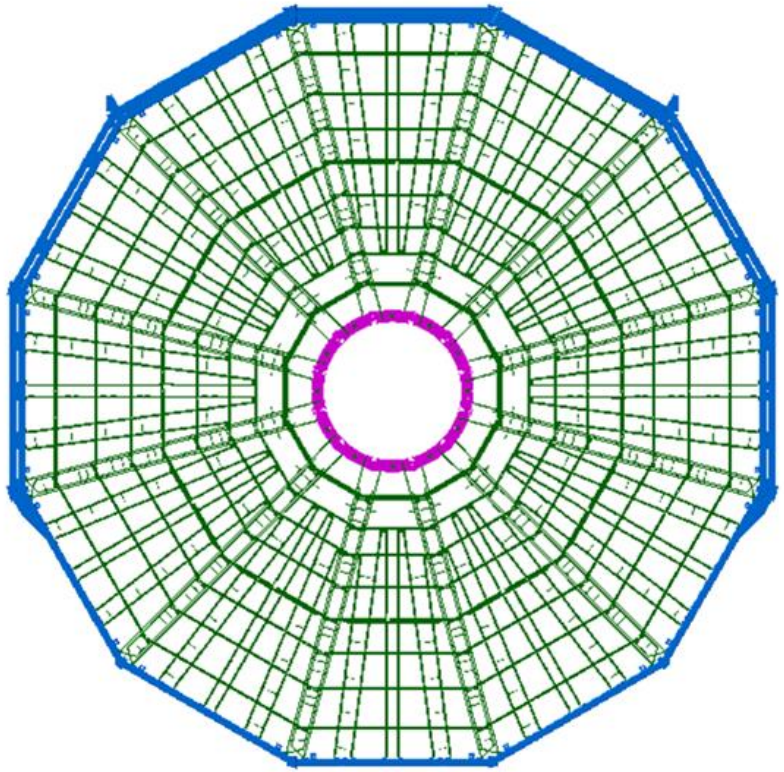
Manpower : 1 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/335418/

#06: Compare Analyses of TGC2-3 SUPPORTS

DIFF : **47 %** | **7 t** Missing
- t Overestimated

TGC2-3 Supports	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
Outer Ring	5'820	2.156	2'090	0.77	3'730	64%
Aluminium Structure	8'080	2.994	5'430	0.123	2'650	33%
Inner Ring	716	0.265	280	0.103	436	61%
Total:	14'616	5.414	7'800	2.889	6'820	47%



Output :

- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

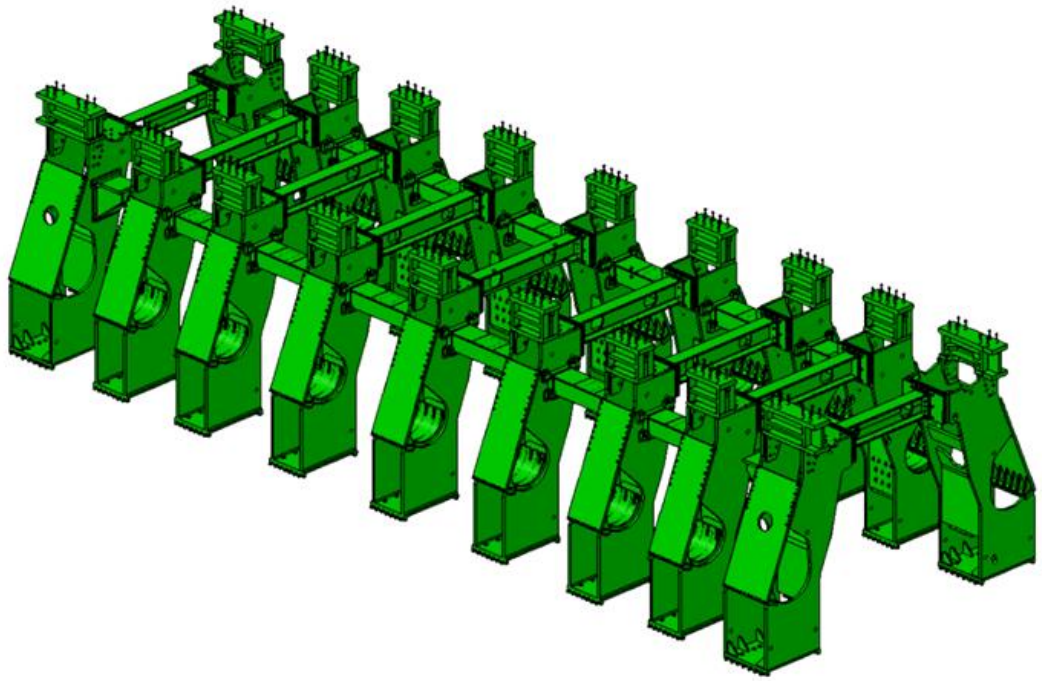
Duration : 1 months
Manpower : 1 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/335418/

#07: Compare Analyses of FEET

DIFF : **35 %** | **46 t** Missing
10 t Overestimated

FEET	CATIA		XML		Diff	
	Weight (kg)	Volume (m^3)	Weight (kg)	Volume (m^3)	Weight (kg)	
Standard Foot	213'248	26.656	186'401	23.685	26'847	13%
Extremity Foot	66'864	8.358	58'647	7.452	8'217	12%
Rail Support	31'944	3.993	31'448	3.996	496	2%
Extremity Rail Supp.	11'040	1.38	10'900	1.39	140	1%
Girder	24'096	3.012	18'305	2.326	5'791	24%
Extremity Girder	4'576	0.572	4'430	0.563	146	3%
FEET Standard strut	8'524	3.157	16'611	1.547	-8'087	49%
FEET Extremity strut	2'450	0.907	4'428	0.434	-1'978	45%
Bolts	4'320	0.50	-	-	4'320	100%
Conne Plate Bracket	-	-	138	0.051	138	100%
Total:	367'062	48.535	331'308	41.444	35'754	35%



Output :
- Reproduced model in CATIA. 902 drawings added
- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 3 months

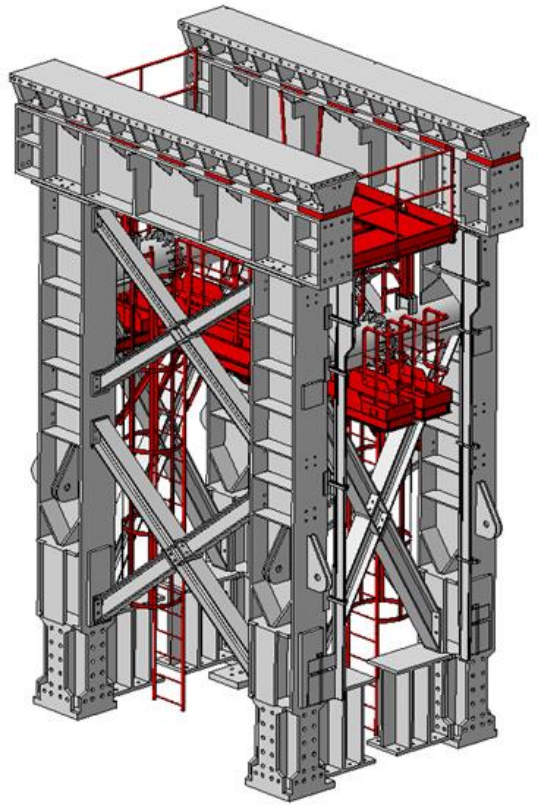
Manpower : 1.5 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/786003/

#08: Compare Analyses of HF TRUCKS

DIFF : **20 %** | **20 t** Missing
7 t Overestimated

HF Truck	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
RAILS	9'734	1.24	12'517	1.59	-2'783	22%
BEAM	10'221	1.302	14'115	1.79	-3'894	28%
COLUMN C1-L/C2-R	24'751	3.154	21'619	2.75	3'140	13%
BRACING	4'161	0.53	369	0.14	3'792	91%
JF Table	9'297	1.217	4'533	0.58	4'764	51%
SERVICES	840	0.107	-	-	840	100%
BRACKETS	3'768	0.48	-	-	3'768	100%
INFRASTRUCTURE	2'292	0.292	-	-	2'292	100%
SHIMS	1'036	0.132	-	-	1'036	100%
Total:	66'100	8.45	53'153	6.84	12'947	20%



Output :

- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

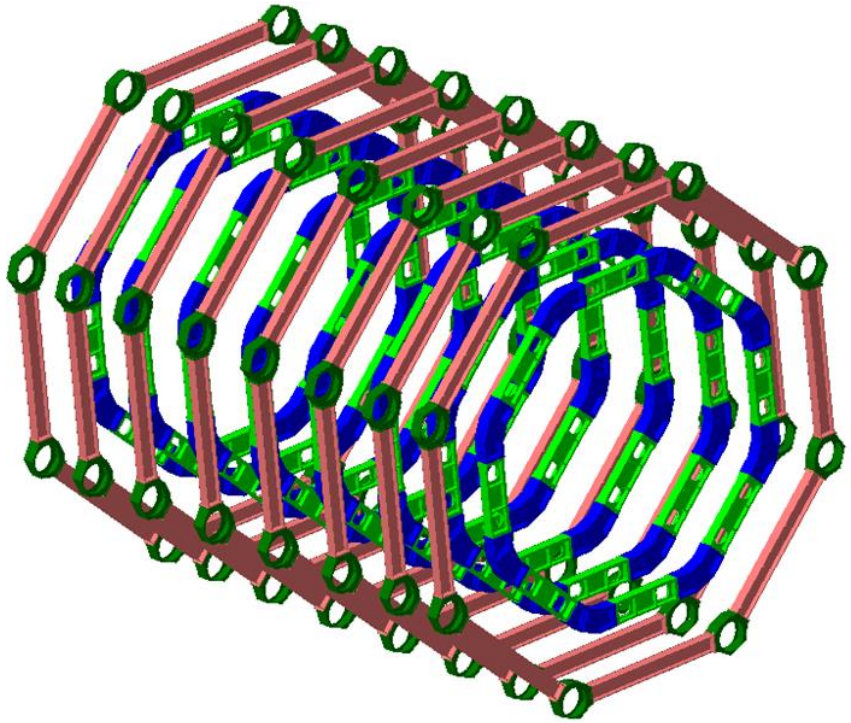
Duration : 2 months
Manpower : 1 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/645652/

#09: Compare Analyses of WARM STRUCTURE

DIFF : **39 %** | **42 t** Missing
6 t Overestimated

WARM Structure	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
StrutBar	75'384	27.92	63'909	23.67	11'475	15%
Voussoir	66'862	24.77	68'472	25.36	-1'610	3%
Connection Plate	2'228	0.83	-	-	2'228	100%
Wing Box	42'080	5.26	46'118	5.86	-4'038	10%
Connection Box	89'937	33.31	86'022	31.86	3'915	4%
Bolts	23'840	2.98	-	-	23'840	100%
ConboxShaft	1'398	0.31	853	0.32	548	39%
Total:	301'729	95.36	265'374	87.07	36'358	39%



Output :
- Reproduced model in CATIA. 5'348 bolts and 128 plates with hole were added
- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 3 months

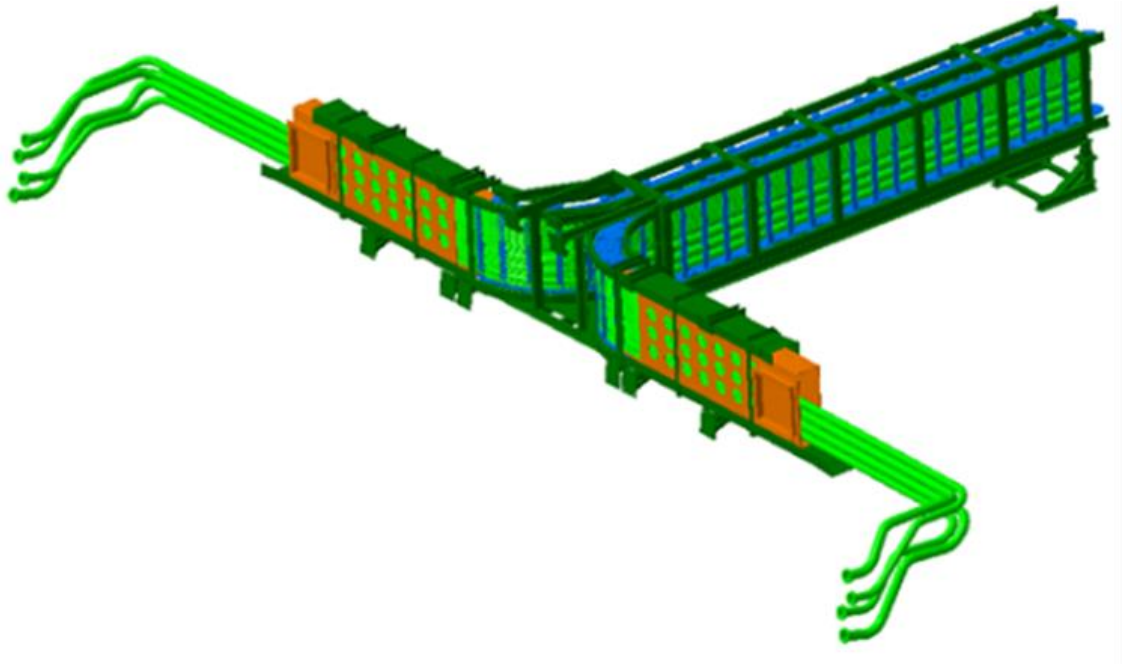
Manpower : 1 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/726014/

#10: Compare Analyses of FLEXIBLE CHAIN S9

DIFF : **97 %** | **3 t** Missing
12 t Overestimated

Flexible Chain S.9	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m³)*	*Weight (kg)*	*Volume (m³)*	*Weight (kg)*	
Support	1'968	0.25	11'877	4.399	-9'909	84%
Drag Chain	1'608	0.2	-	-	1'608	100%
Towing Arm	680	0.09	-	-	680	100%
Pipes	172	0.02	-	-	172	100%
Cables	825	0.1	-	-	825	100%
Total:	5'253	0.66	11'877	4.399	6'624	97%



Output :
- Reproduced model in CATIA. 5'348 bolts and 128 plates with hole were added
- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 3 months

Manpower : 1 FTE CATIA designer/Programmer

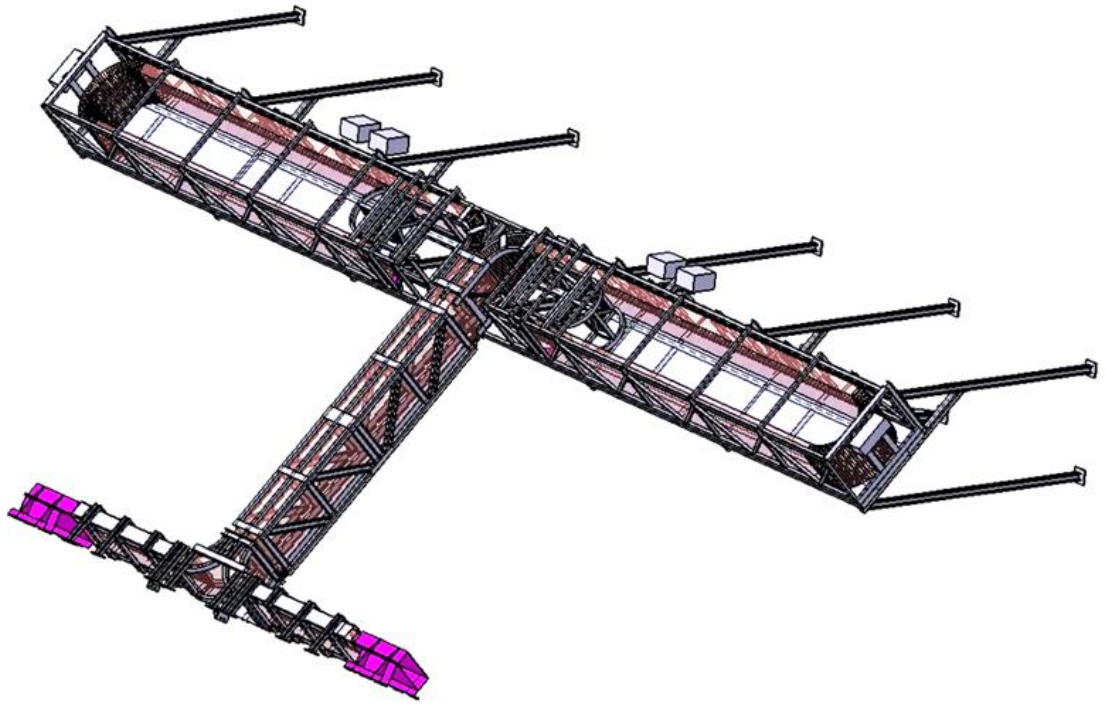
Details are here https://indico.cern.ch/event/747648/

#11: Compare Analyses of FLEXIBLE CHAIN S11/S15

DIFF : **100 %** | **4 t** Missing

- t Overestimated

Flexible Chain S.11	*CATIA*		*XML*		*Diff*	
	Weight (kg)	*Volume (m^3)*	*Weight (kg)*	*Volume (m^3)*	*Weight (kg)*	
Support	1`904	0.238	-	-	1`904	100%
Drag Chain	928	0.116	-	-	928	100%
Piece	368	0.046	-	-	368	100%
Pipes	528	0.066	-	-	528	100%
Cables	466	0.052	-	-	466	100%
Total:	4'194	0.518	-	-	4'194	100%



Output :
- Reproduced model in CATIA. 2'331 Drawings were added
- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 6 months

Manpower : 2 FTE CATIA designer/Programmer

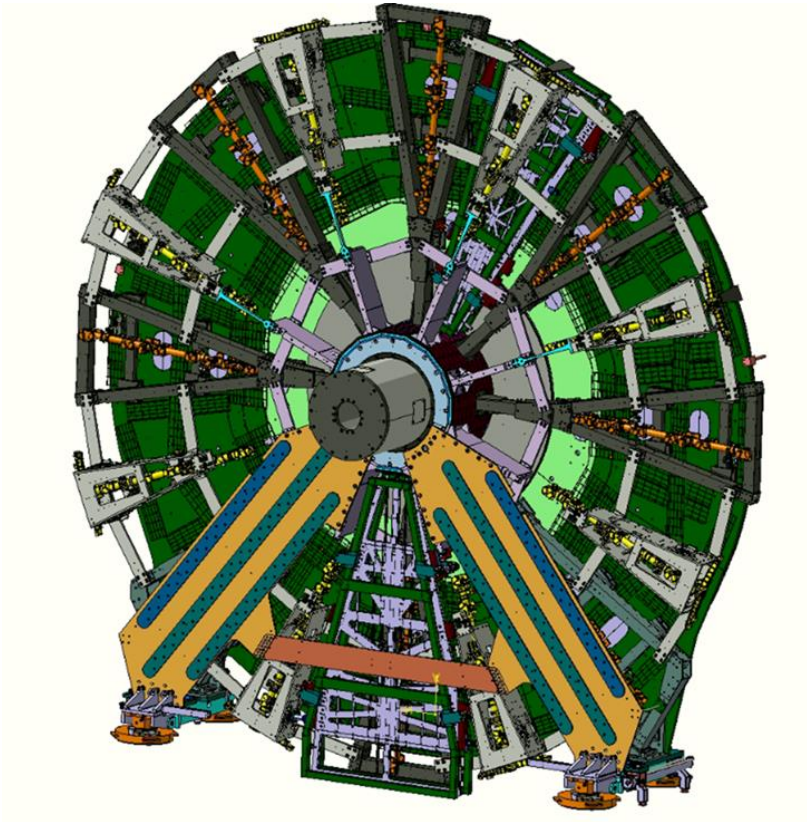
Details are here https://indico.cern.ch/event/886044/

#12: Compare Analyses of NEW SMALL WHEEL

DIFF : **13 %** | **11 t** Missing

- t Overestimated

New Small Wheel	CATIA		XML		Diff	
	Weight (kg)	Volume (m^3)	Weight (kg)	Volume (m^3)	Weight (kg)	
Aluminium Structure	7'000	2.22	7'000	7'000	0	0%
A-Plate	2'049	0.26	2'049	2'049	0	0%
NJD	38'190	4.86	38'190	38'190	0	0%
LS Spacer Frame	1'575	0.54	1'575	1'575	0	0%
SS Spacer Frame	1'189	0.41	1'189	1'189	0	0%
HUB	23'247	2.87	23'247	23'247	0	0%
Vertical Shield HO	960	0.317	-	-	960	100%
NJD Vertical Shield	1'733	0.393	-	-	1'733	100%
NSW Movement	2'721	0.347	-	-	2'721	100%
Cable Tray	113	0.014	-	-	113	100%
Rim Plates	208	0.075	-	-	208	100%
LS Spoke/Supports/	102	0.013	-	-	102	100%
Brackets	156	0.058	-	-	156	100%
EIS / SS Frame	870	0.34	-	-	870	100%
EIL / LS Frame	1'031	0.43	-	-	1'031	100%
LV crate concept	1'030	0.3	-	-	1'030	100%
Main Pipes	182	0.02	-	-	182	100%
Brackets	749	0.23	-	-	749	100%
Alignment Boxes	15	0.006	-	-	15	100%
Sec Pipes	74	0.008	-	-	74	100%
Rim Crate	256	0.05	-	-	256	100%
Hydraulic Pipes	70	0.02	-	-	70	100%
protec_V2	49	0.006	-	-	49	100%
MTP-12LC	348	0.04	-	-	348	100%
HV_MM_SPLITTER	45	0.02	-	-	45	100%
Total:	83'950	13.84	73'250	11.16	10'700	13%



Output :

- XML code
- Technical reports of – Comparison; Simplification and Integration Conflicts Checking

Duration : 6 months

Manpower : 2 FTE CATIA designer/Programmer

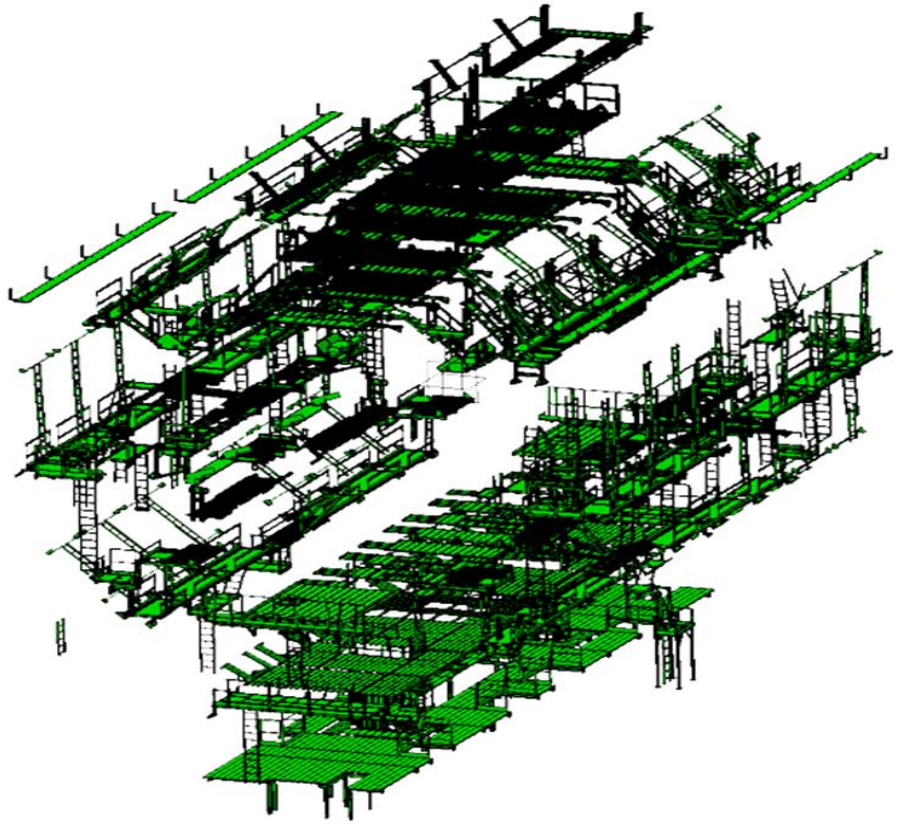
Details are here https://indico.cern.ch/event/881125/

#13: Compare Analyses of ACCESS PLATFORMS

DIFF : **88 %** | **21 t** Missing

- t Overestimated

Access Platforms	CATIA		XML		Diff	
	Weight (kg)	Volume (m^3)	Weight (kg)	Volume (m^3)	Weight (kg)	
Sector 1	1'735	0.643	71	0.026	1'664	96%
Sector 3	2'506	0.928	38	0.014	2'468	98%
Sector 5 (1st Floor)	1'790	0.663	408	0.151	1'382	77%
Sector 5 (2nd Floor)	1'444	0.535	544	0.202	900	62%
Sector 5 (3rd Floor)	810	0.3	-	-	810	100%
Sector 7	2'478	0.897	38	0.014	2'440	98%
Sector 9	1'760	0.652	71	0.026	1'689	96%
Sector 11	1'682	0.6	79	0.029	1'603	95%
Sector 13 (1st Floor)	3'674	0.739	-	-	3'674	100%
Sector 13 (2nd Floor)	2'238	0.829	748	0.277	1'490	66%
Sector 13 (3rd Floor)	1'511	0.560	544	0.202	967	64%
Sector 15	1'658	0.614	78	0.029	1580	95%
Total:	23'287	7.96	2'618	0.97	20'670	88%



Output : Technical reports of –
- Comparison
- Simplification
- Integration Conflicts Checking

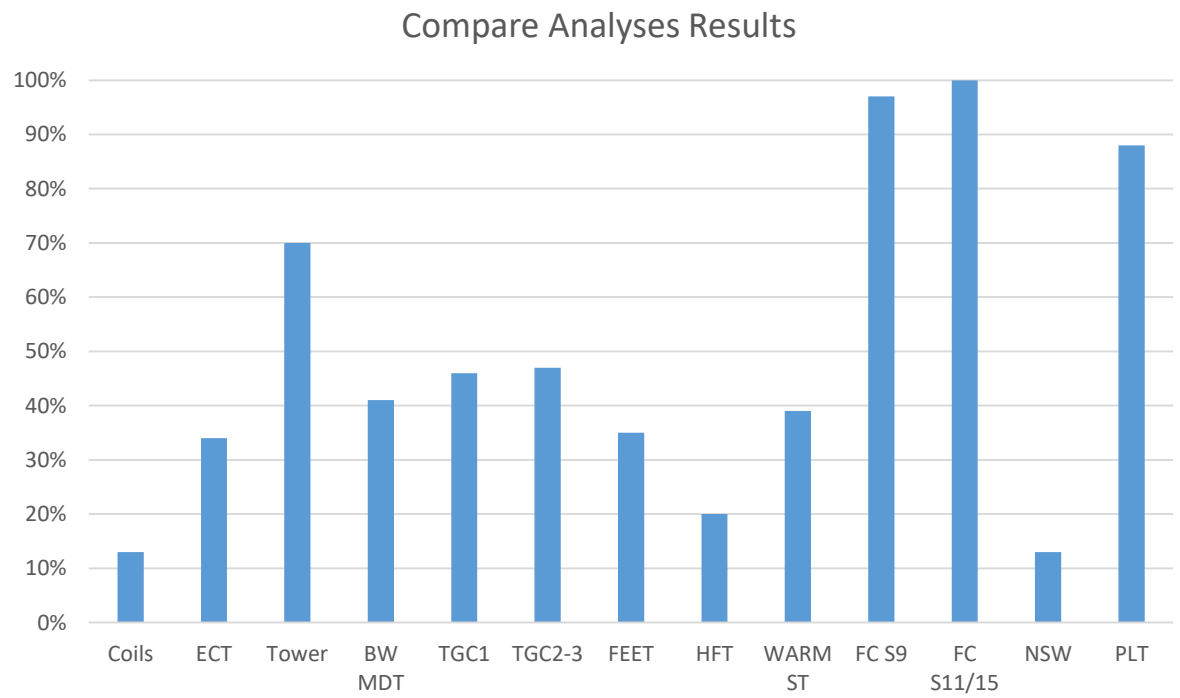
Duration : 3 months

Manpower : 1 FTE CATIA designer/Programmer

Details are here https://indico.cern.ch/event/934886/

Conclusions

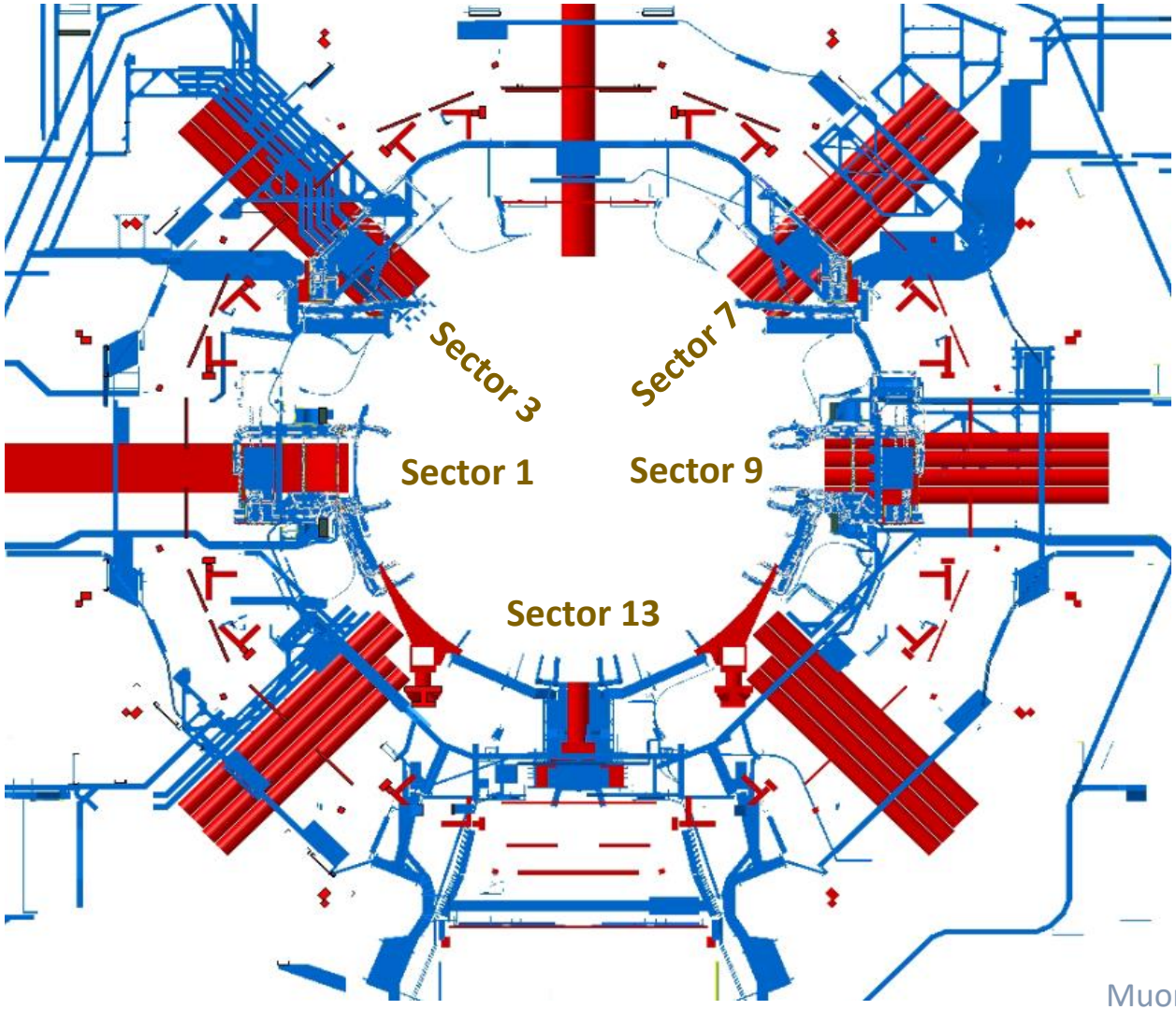
- Passive materials descriptions of Muon are far away from the detector ‘as-built’ geometry
- The difference is varying from 13% to 98%
- The differences can cause the Data-MC discrepancies



II. Next Passive Materials to be Considered

Services – Racks, Cable Trays (Inner)

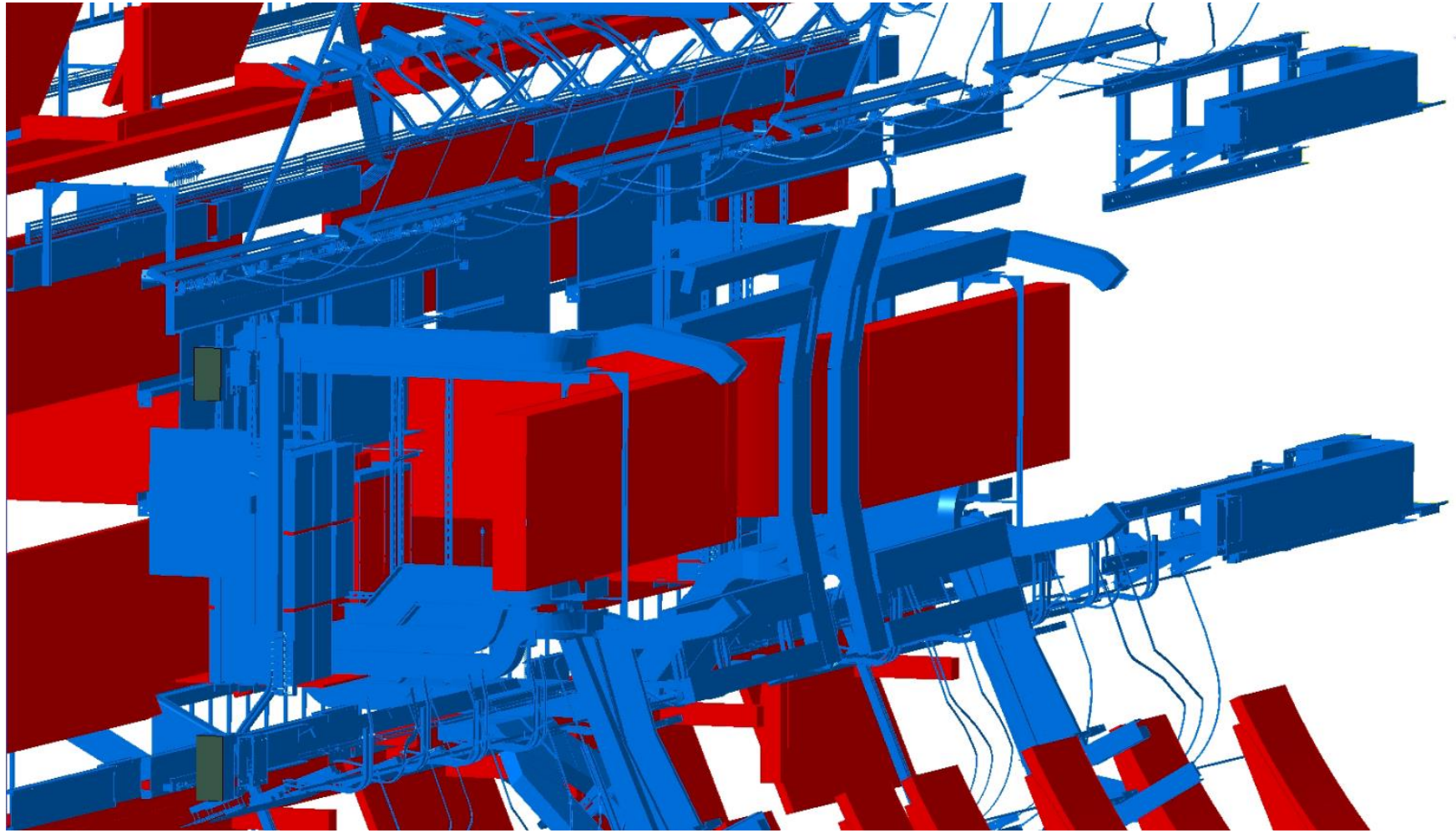
- Problematic Sectors with massive distribution of materials are
  - Sector 1
  - Sector 3
  - Sector 7
  - Sector 9
  - Sector 13



Services – Racks, Cable Trays (Inner)

- Sector 1

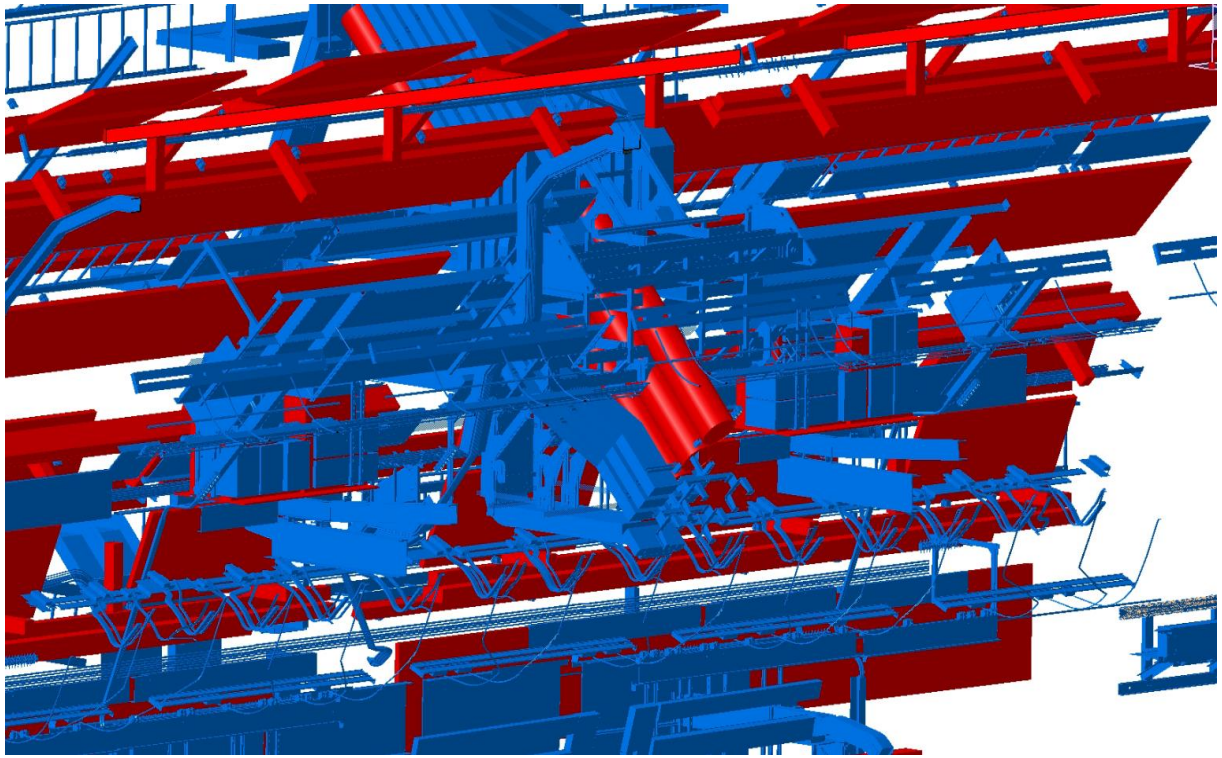
GEANT + CATIA



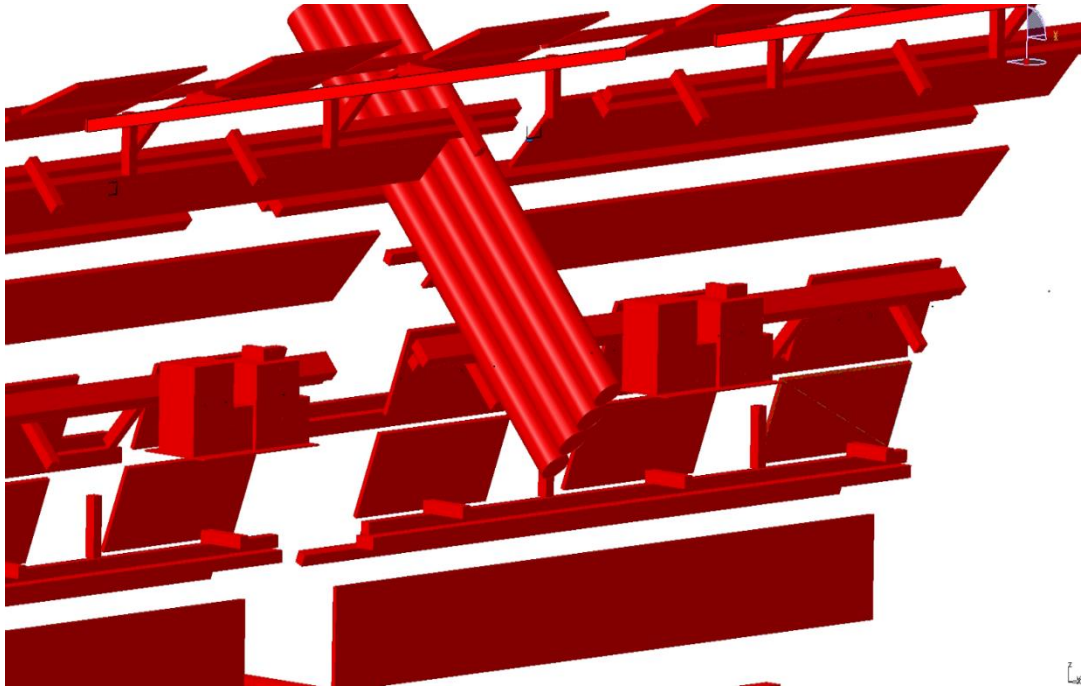
Services – Racks, Cable Trays (Inner)

- Sector 3

GEANT + CATIA



GEANT

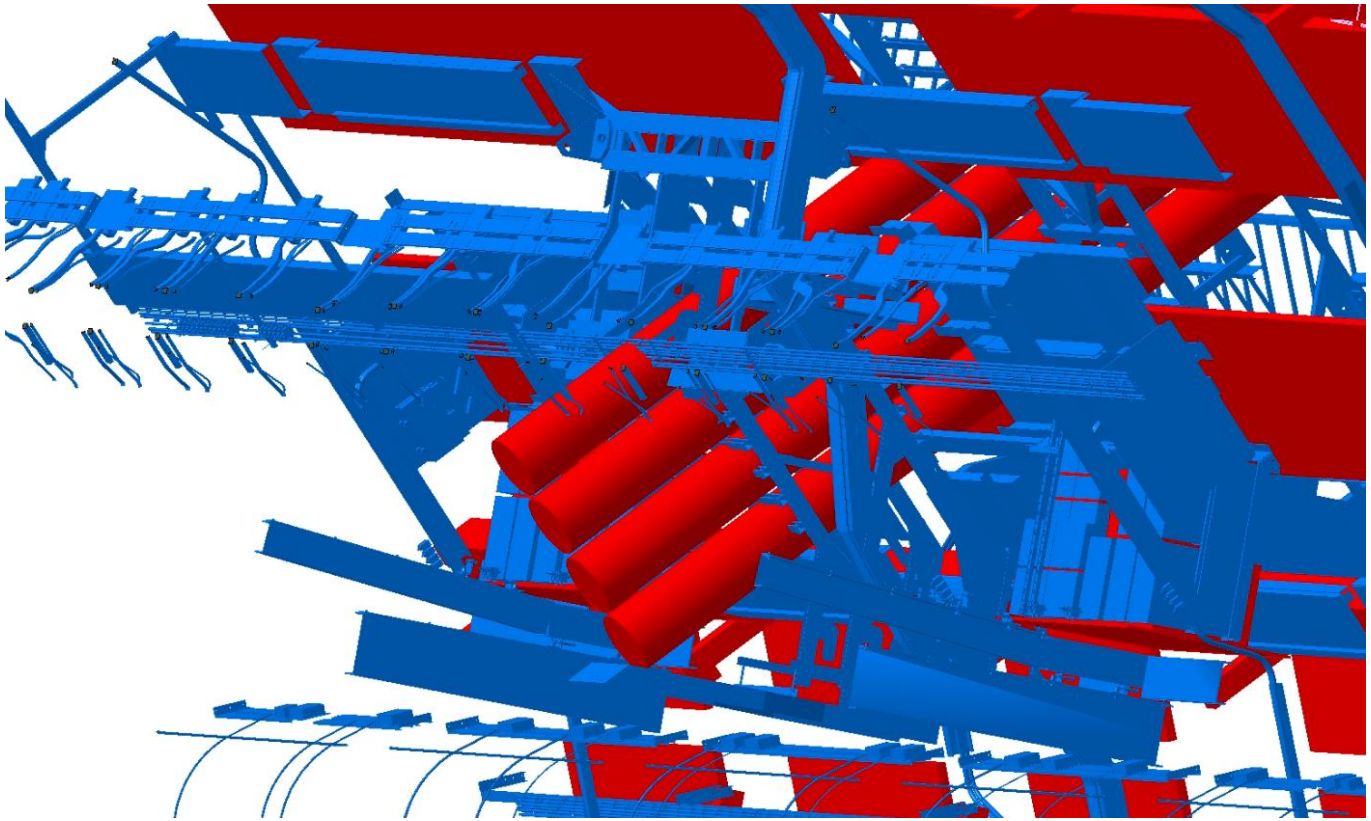


- GEANT
- CATIA

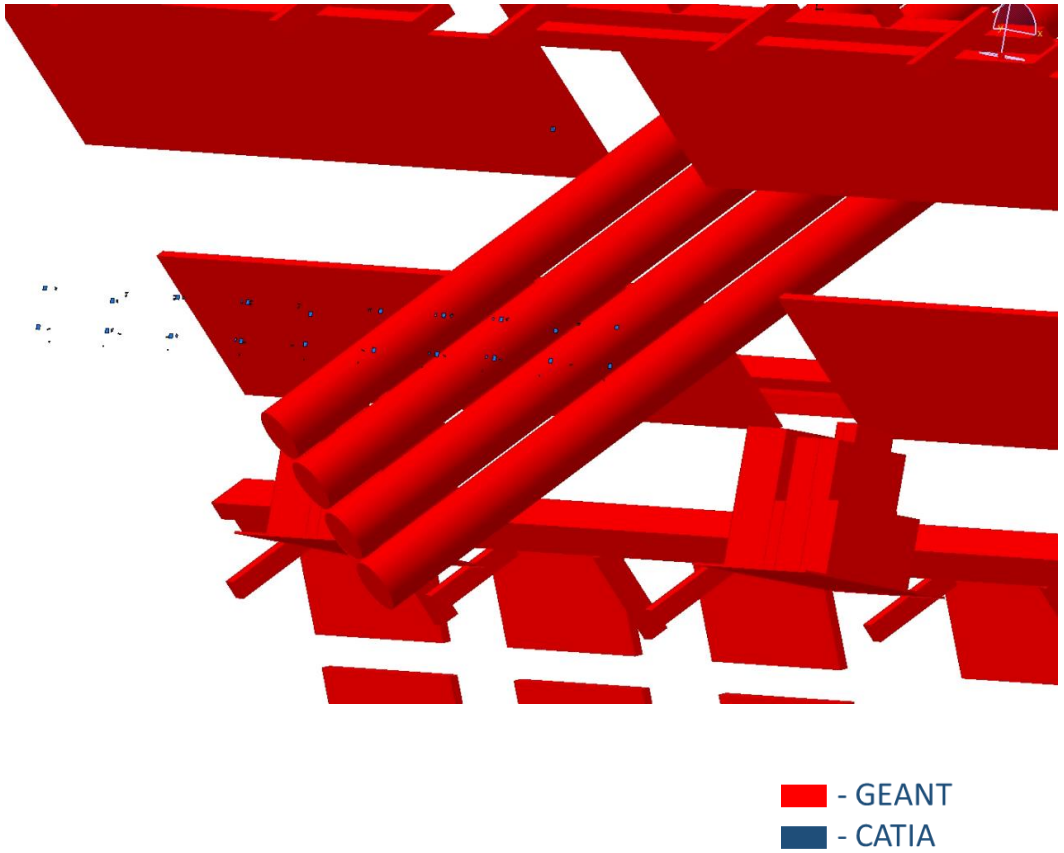
Services – Racks, Cable Trays (Inner)

- Sector 7

GEANT + CATIA



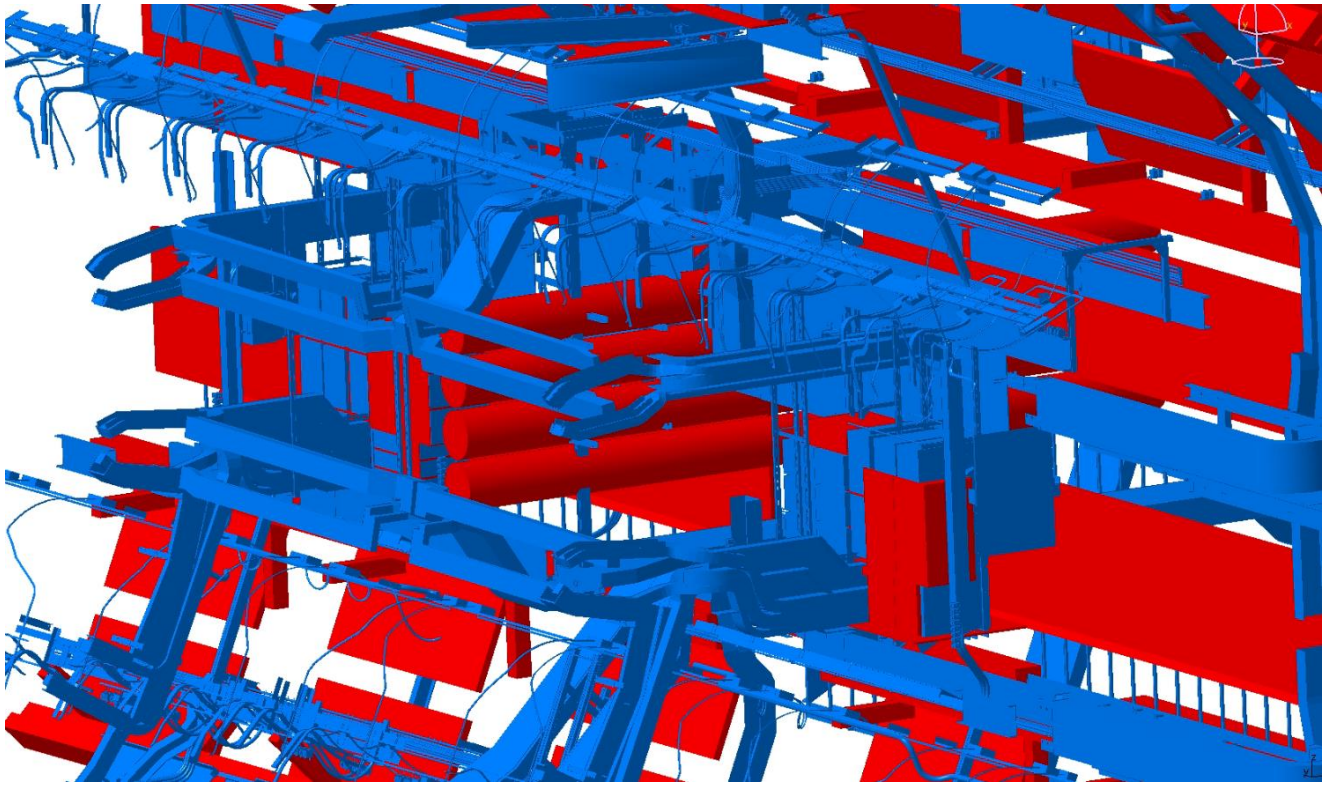
GEANT



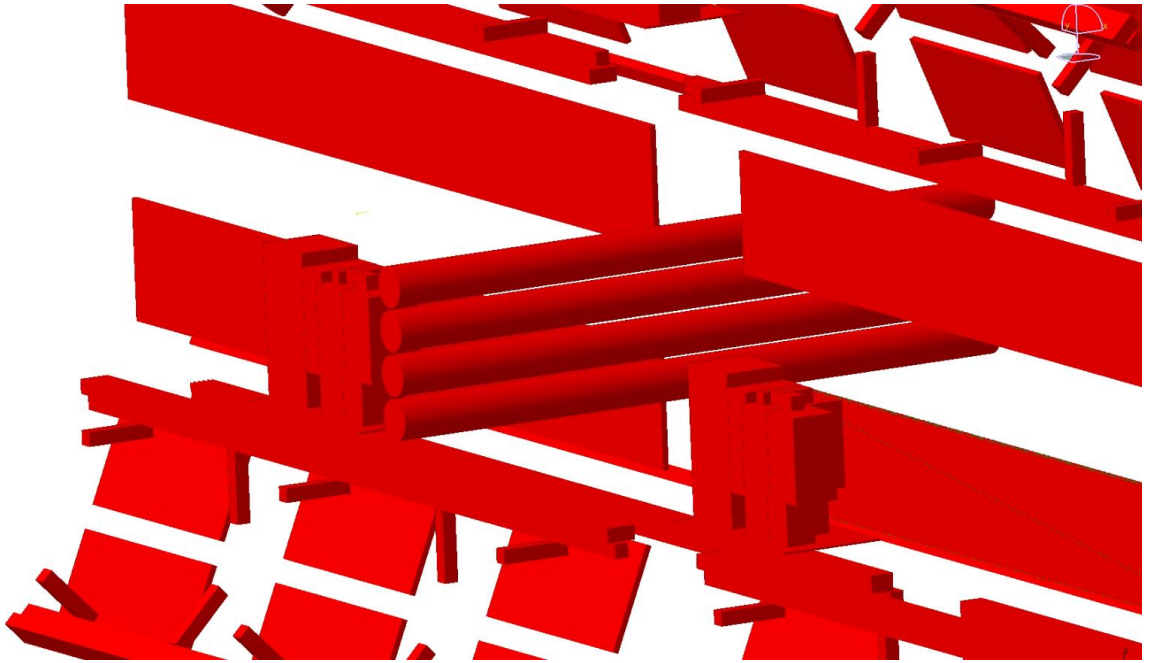
Services – Racks, Cable Trays (Inner)

- Sector 9

GEANT + CATIA



GEANT

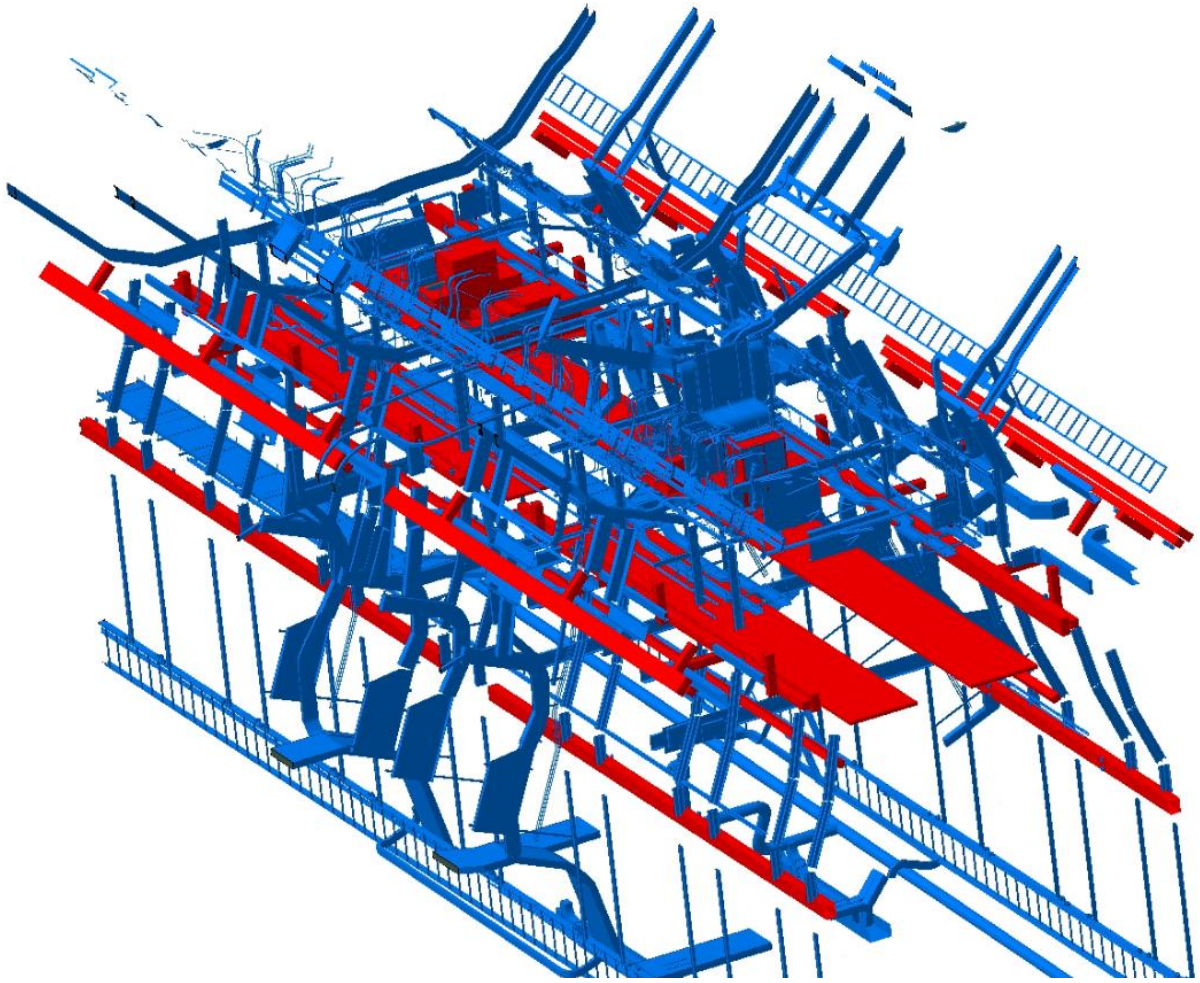


- GEANT
- CATIA

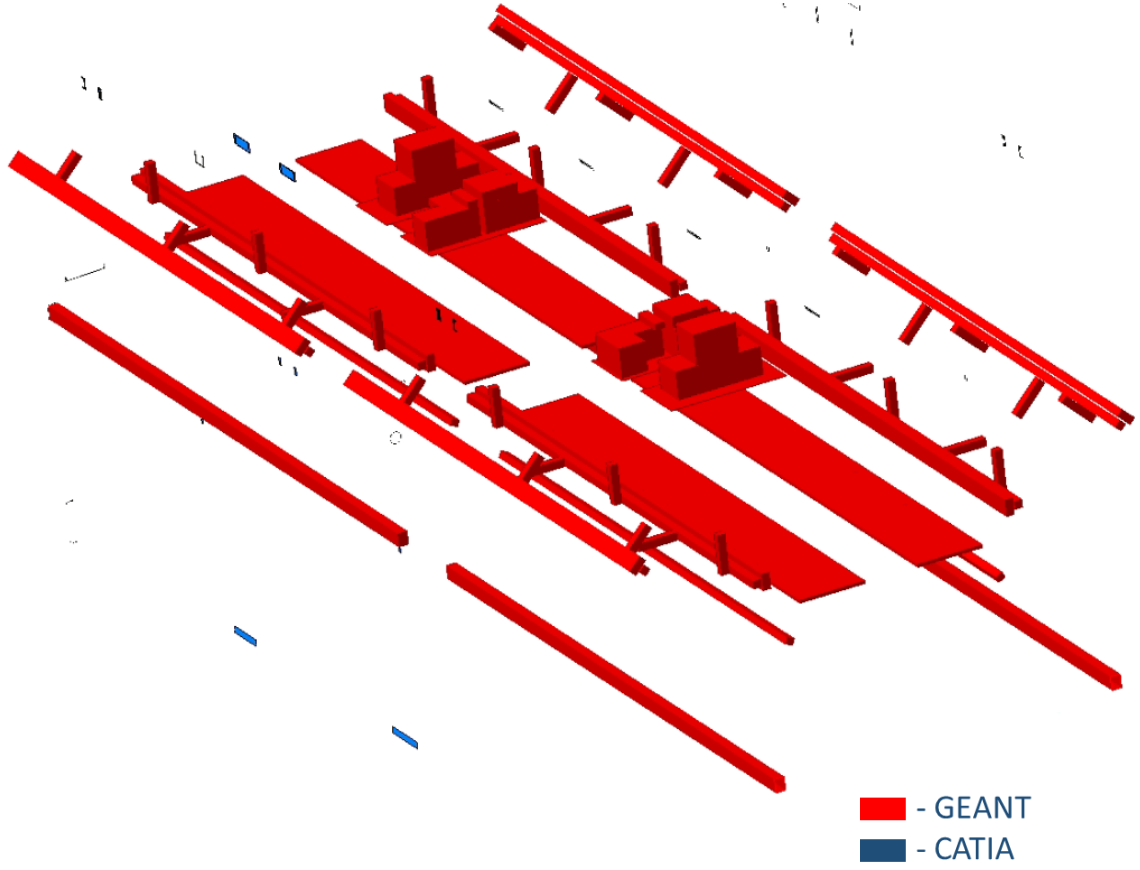
Services – Racks, Cable Trays (Inner)

- Sector 13

GEANT + CATIA

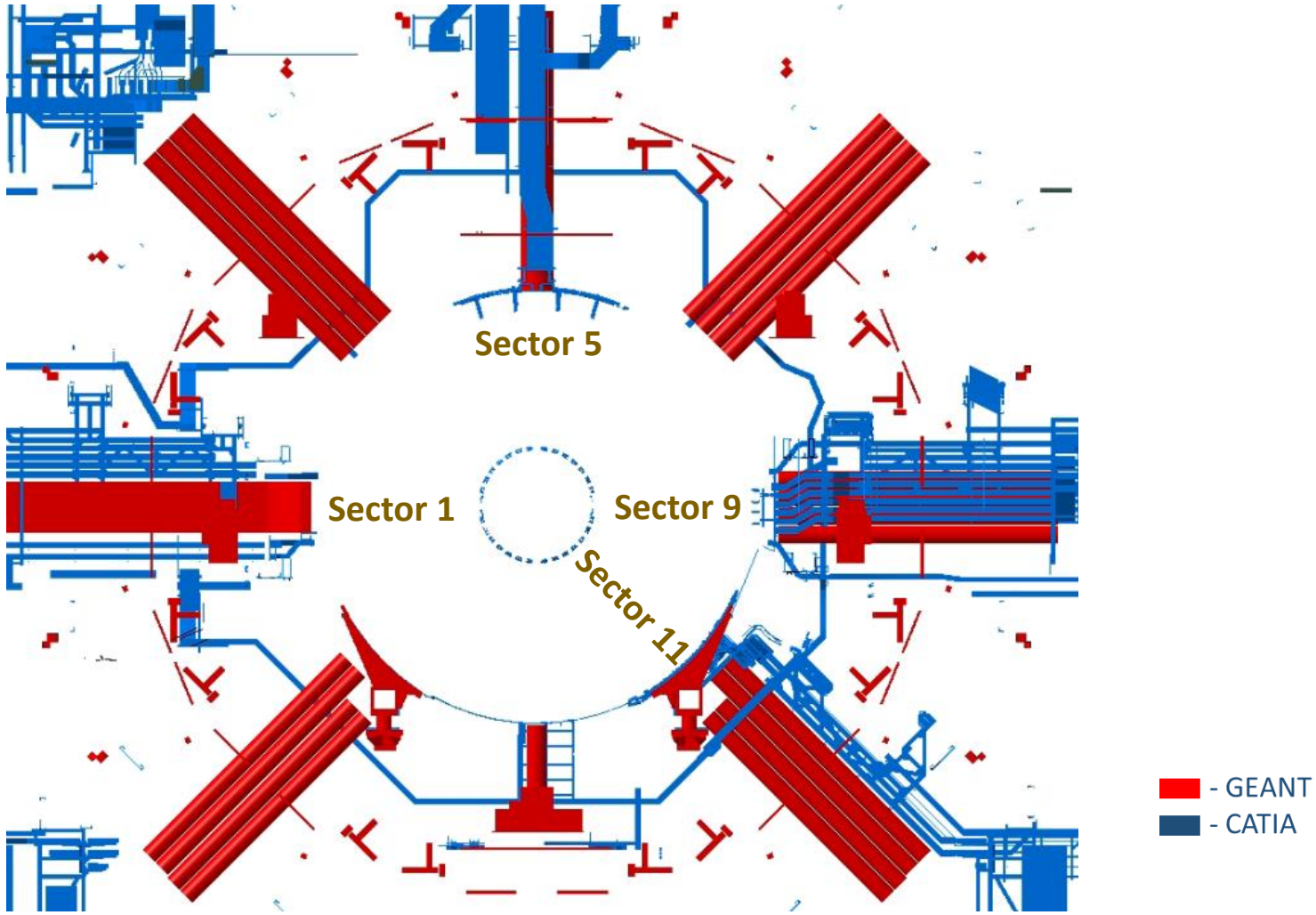


GEANT



Services – Racks, Cable Trays (Outer)

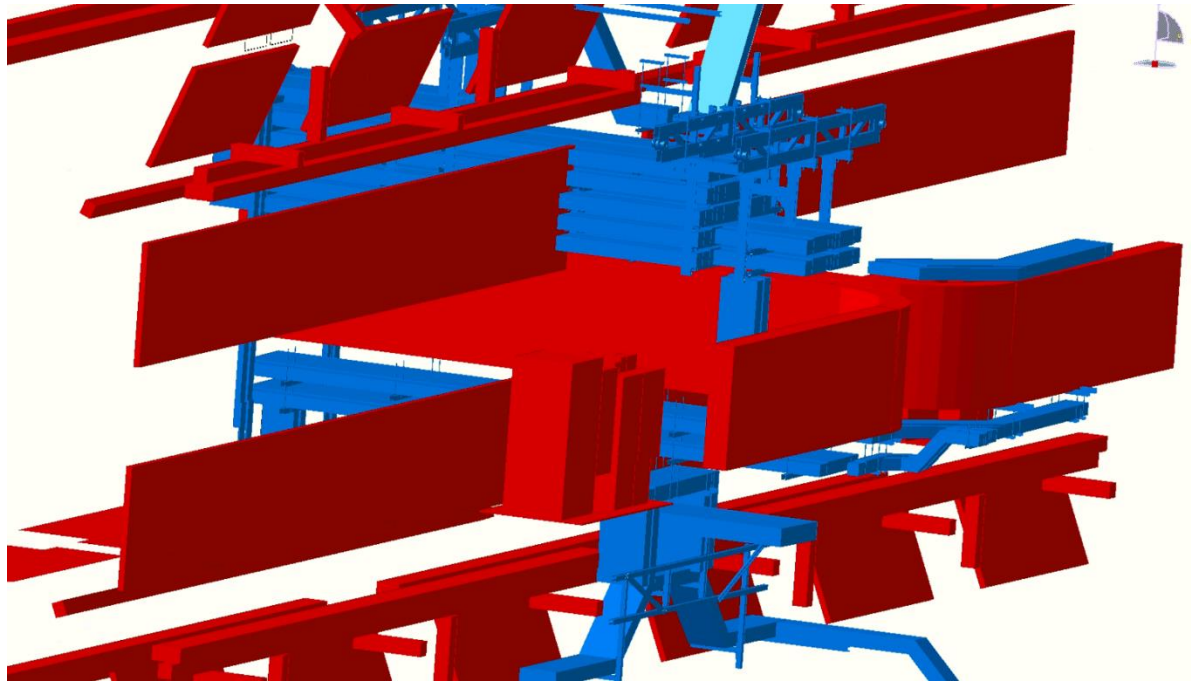
- Problematic Sectors with massive distribution of materials are
  - Sector 1
  - Sector 5
  - Sector 9
  - Sector 11



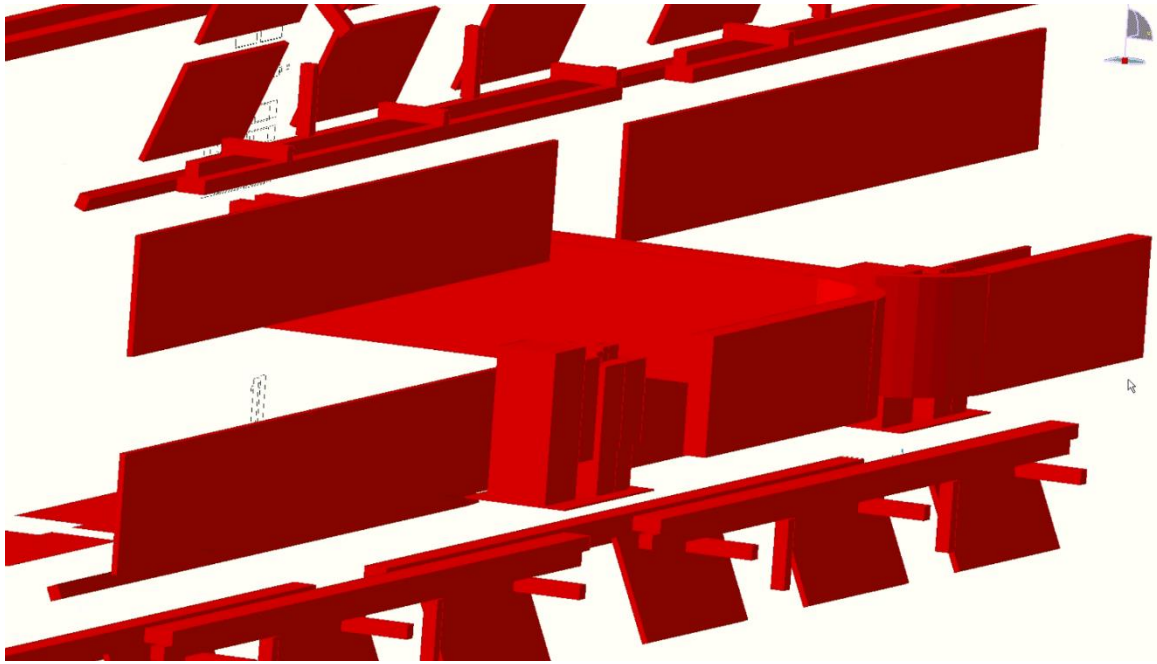
Services – Racks, Cable Trays (Outer)

- Sector 1

GEANT + CATIA



GEANT

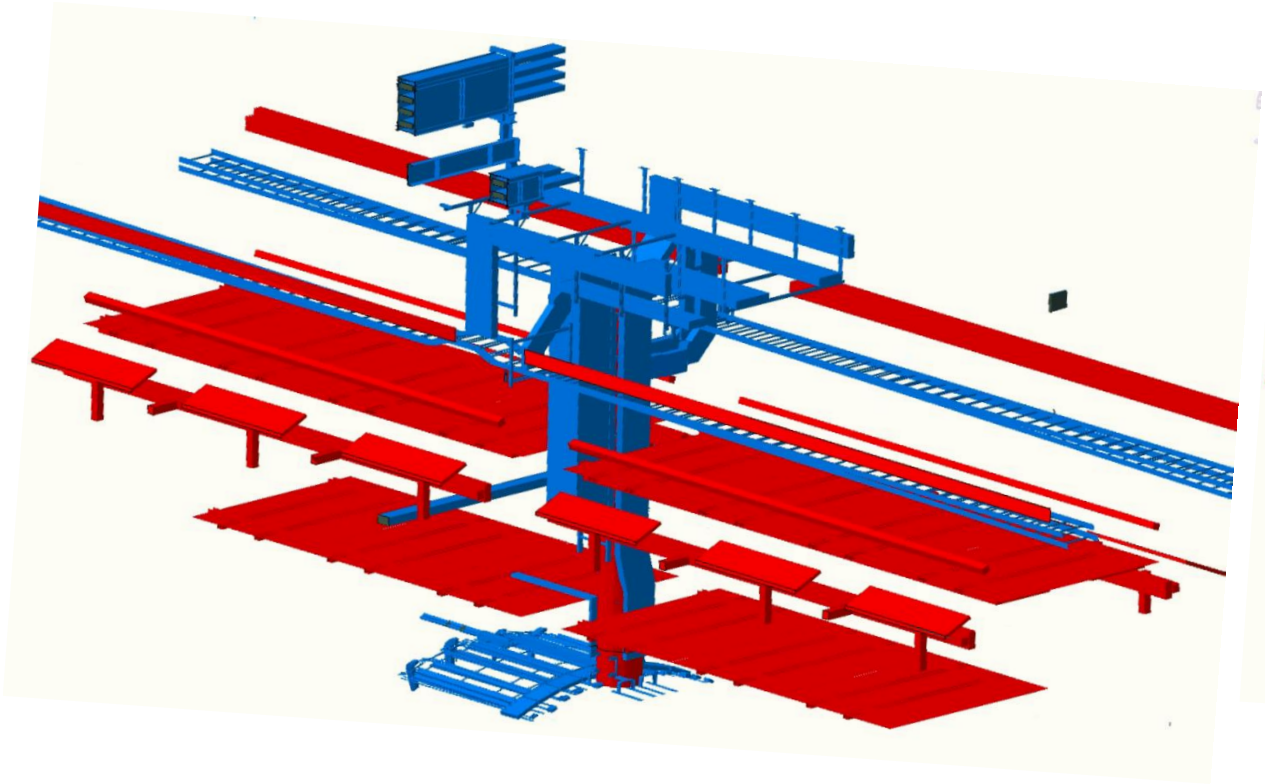


- GEANT
- CATIA

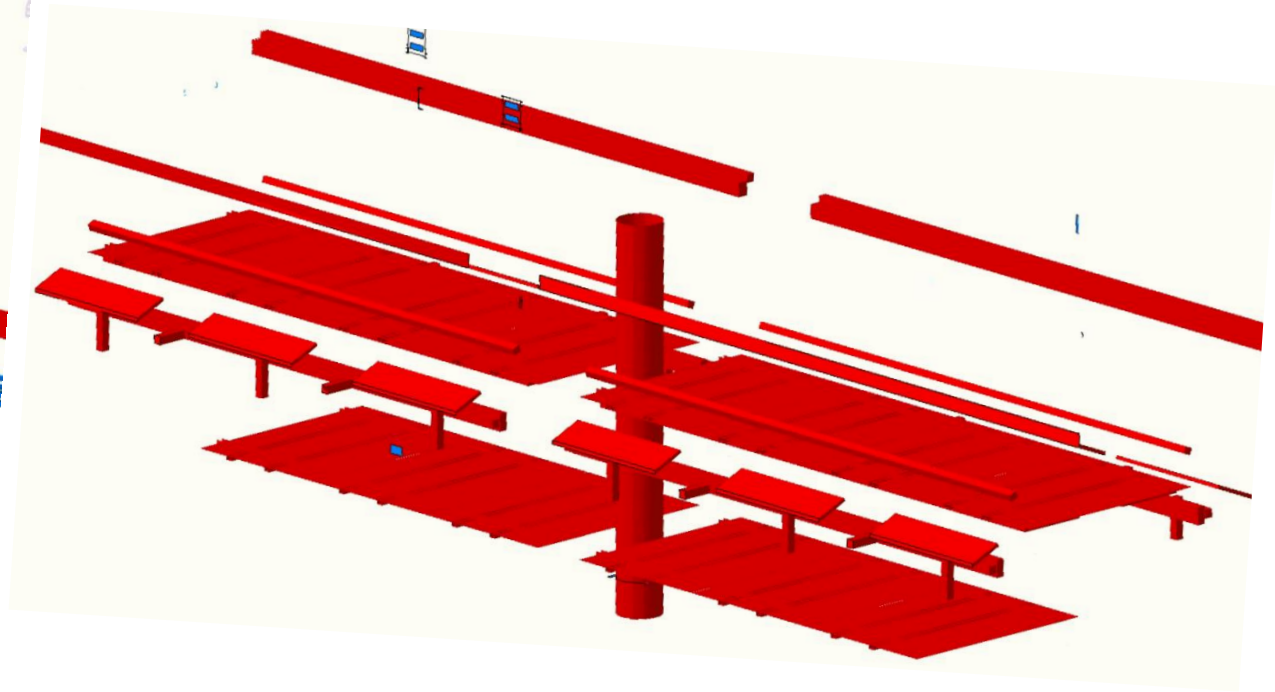
Services – Racks, Cable Trays (Outer)

- Sector 5

GEANT + CATIA



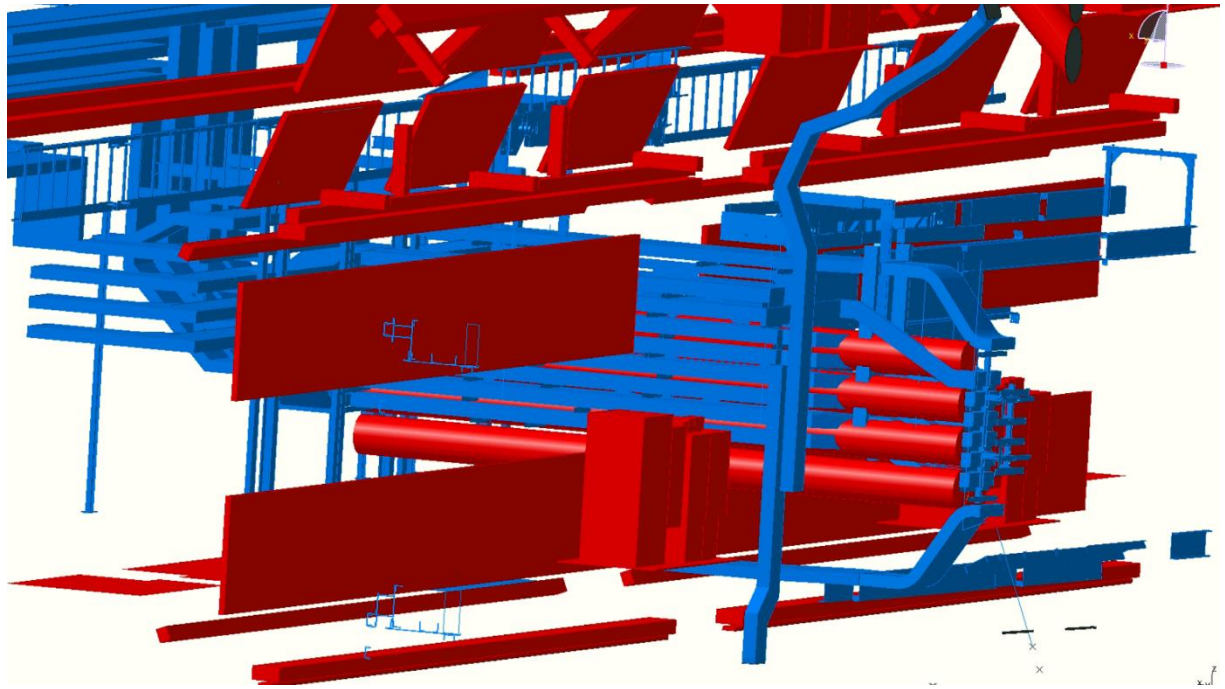
GEANT



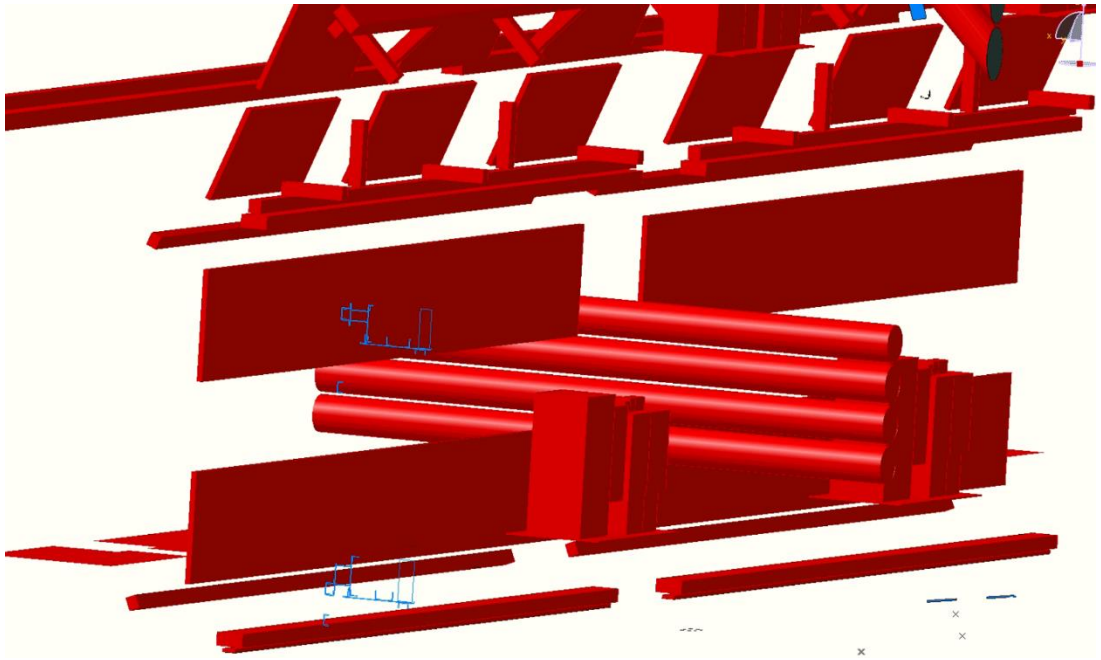
Services – Racks, Cable Trays (Outer)

- Sector 9

GEANT + CATIA



GEANT



- GEANT
- CATIA

Thanks for your attention,