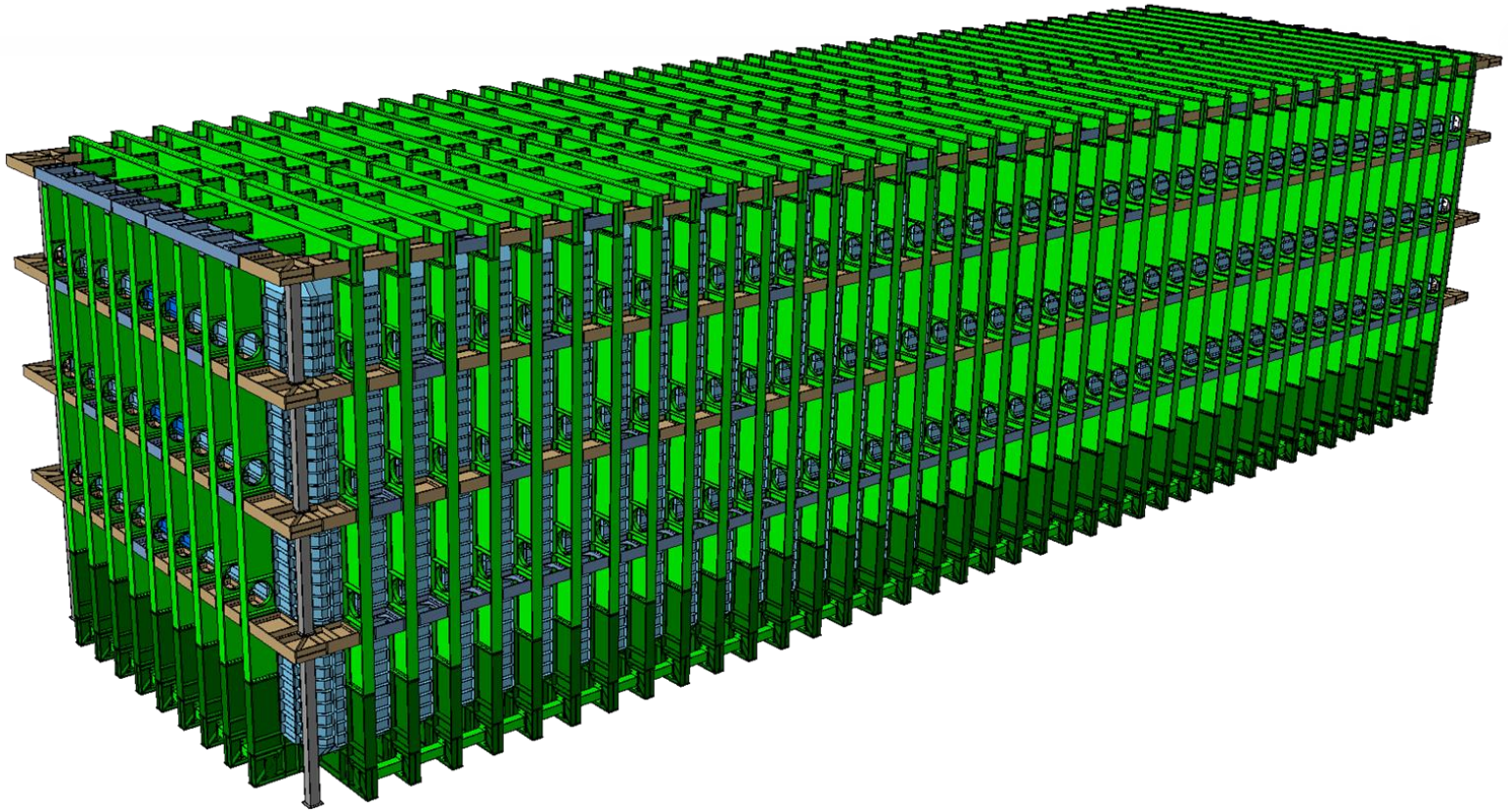


LBNF CAD models, Drawings and Component list

Christophe Bault

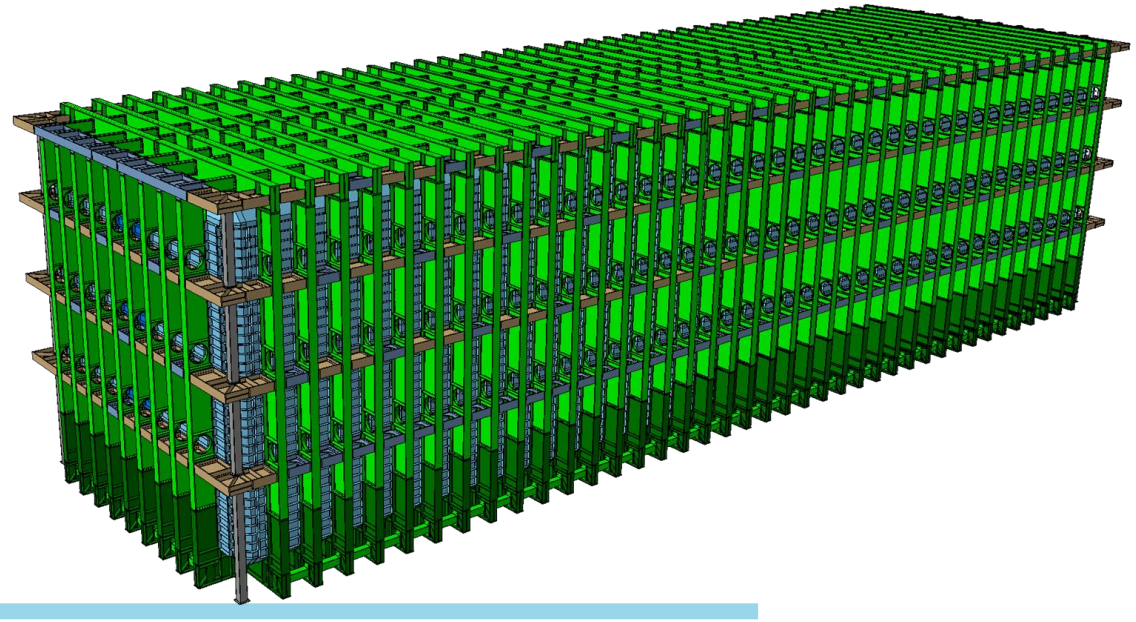
LBNF Cryostat, final design review

SURF, 21-22 August 2017

CERN Fermilab Sanford Underground Research Facility

Table of content

- Who Am I and Where Have I Been?
- Introduction to CAD model of the outer structure
- Design modification implemented since last review (end of 2016)
- Assembly process to be prototyped
- Further design optimization
- List of outer structure components



Who Am I and Where Have I Been?

Senior Mechanical designer
CERN, Experimental Physics Department

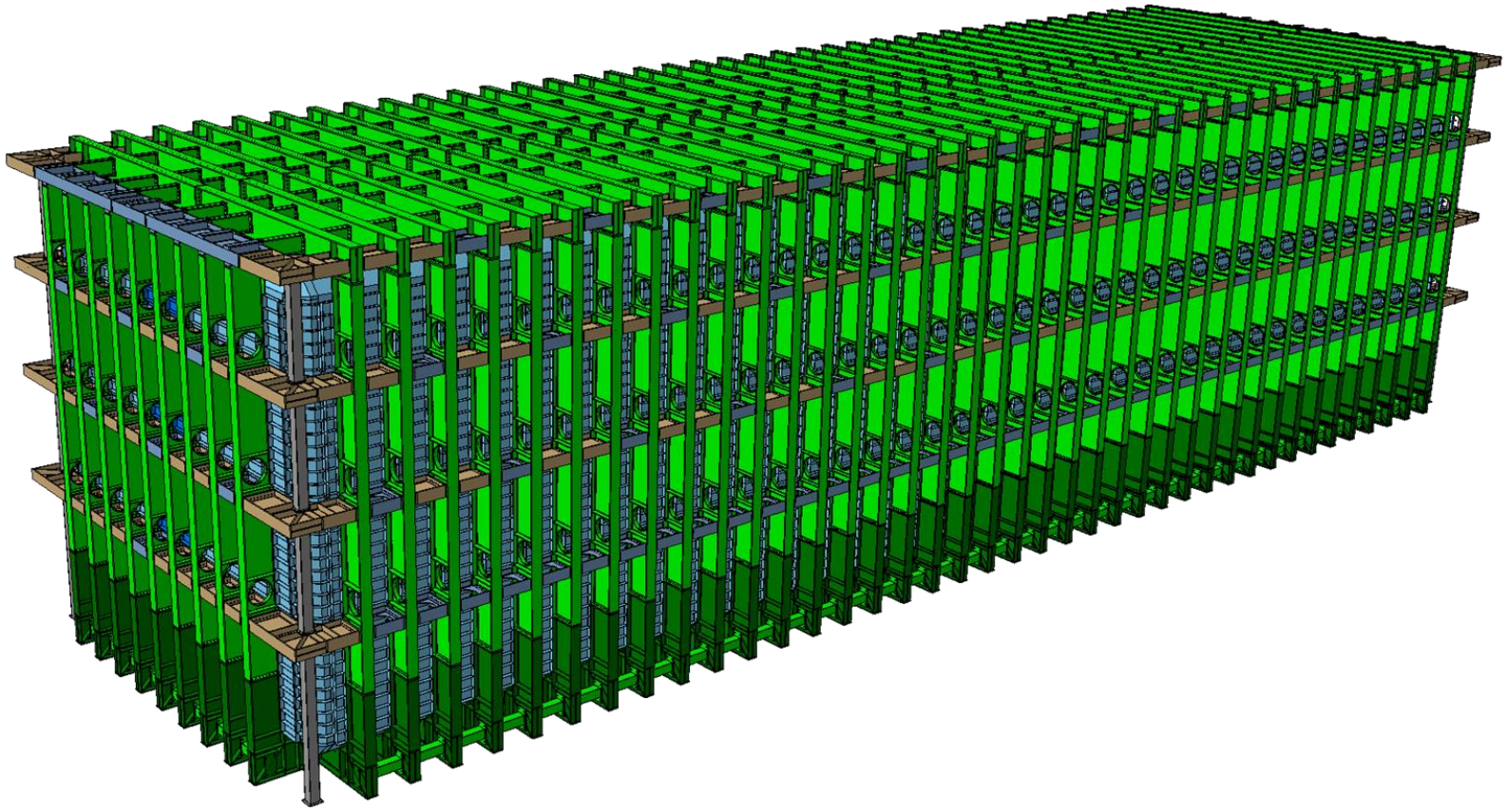
In charge of LBNF/DUNE Warm cryostat CAD models, in accordance with structural analysis made within EP-DT. Use of CATIA V5 (Dassault systems) CAD system.
In charge of proposing a conceptual LBNF/DUNE Warm cryostat assembly process.

30 years of professional experience in mechanical engineering design, 24 years of professional experience in 3d CAD modeling.
At CERN since 2001, experience includes 11 years as mechanical designer for various experiment and detector design such as ATLAS LHC Inner Detector project (current and upgrades), NA62 straw chamber, Roman Pot for LHC, etc…, 3d design, manufacturing drawings, follow-up construction, and installation.

Cad model of the outer structure

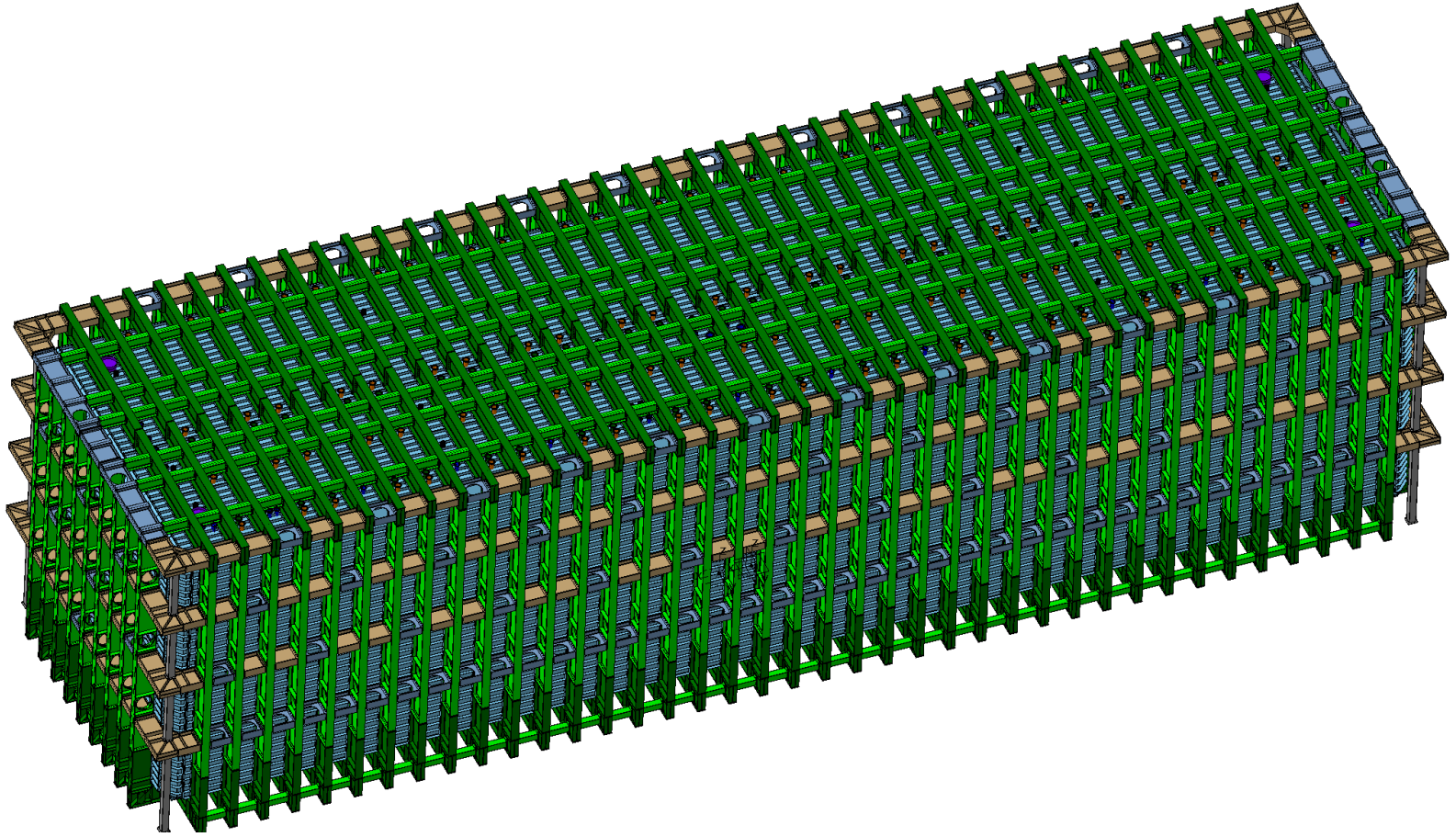
In accordance with the different structural analysis models made by EP/DT-EO

- Stp file available: https://edms.cern.ch/document/1828121/1



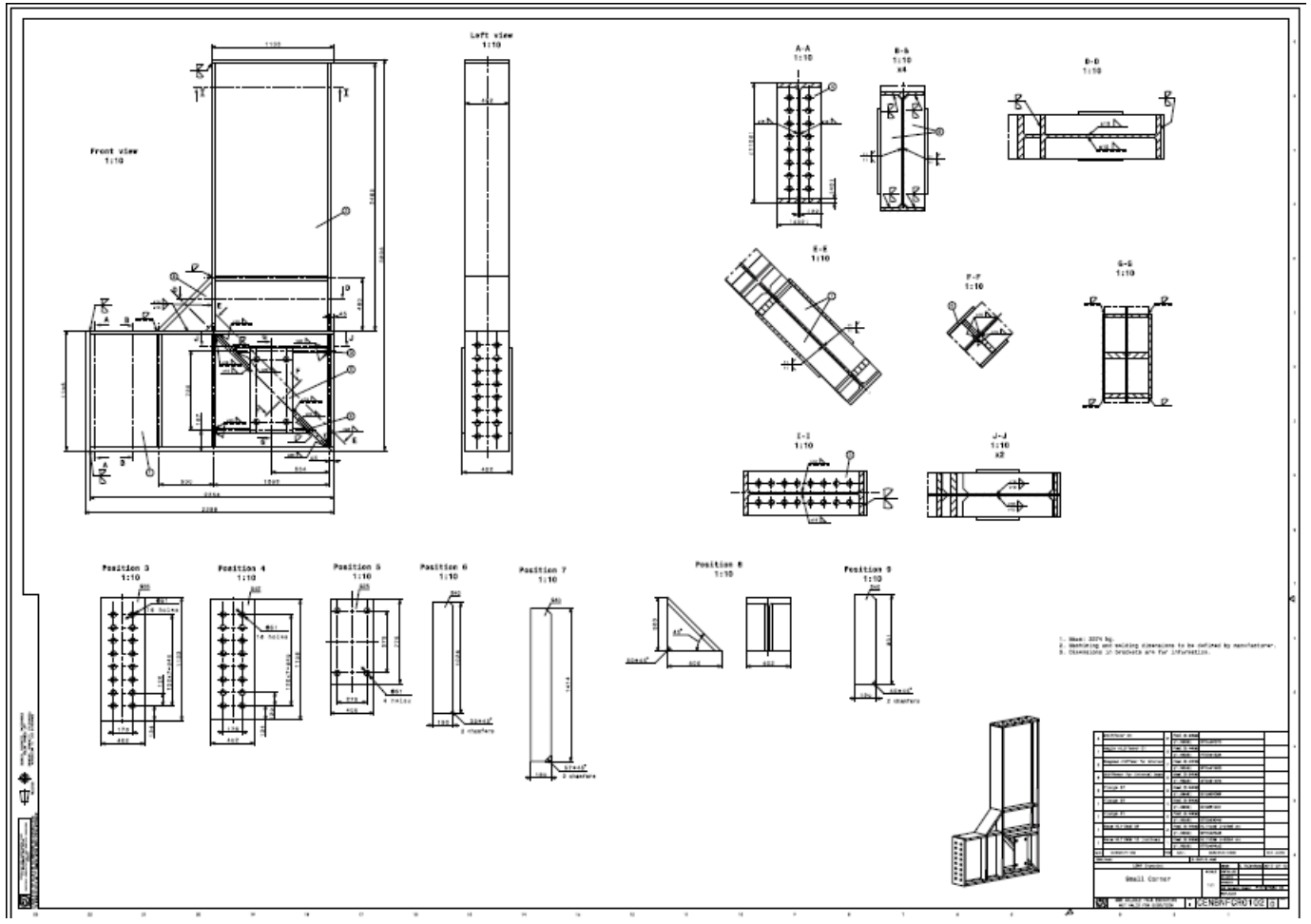
Cad model of the outer structure

– This model has been used by Dimitar to create the 3d model with roof penetration: https://edms.cern.ch/document/1834560/1



Cad model of the outer structure

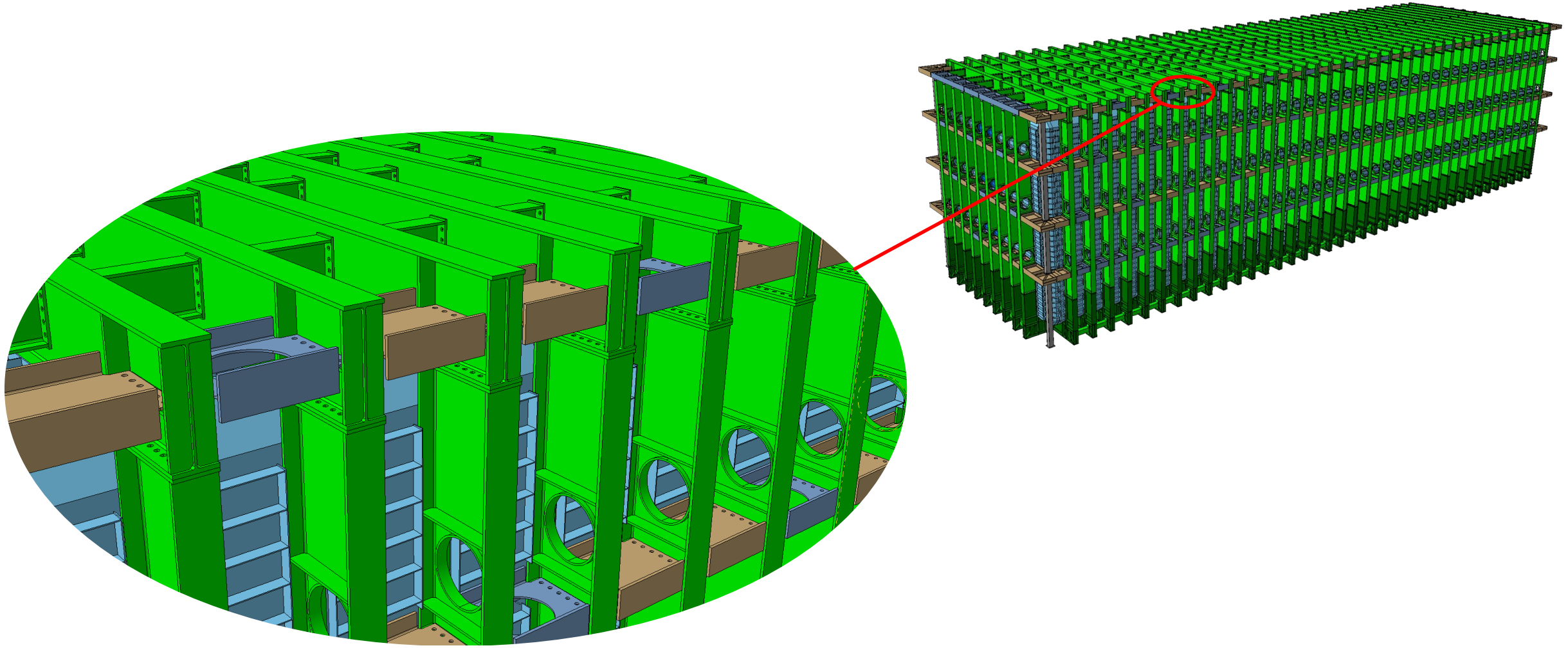
– Dimitar created a set of production drawings: https://edms.cern.ch/document/1834559/1



Design modification

implemented since last review (end of 2016)

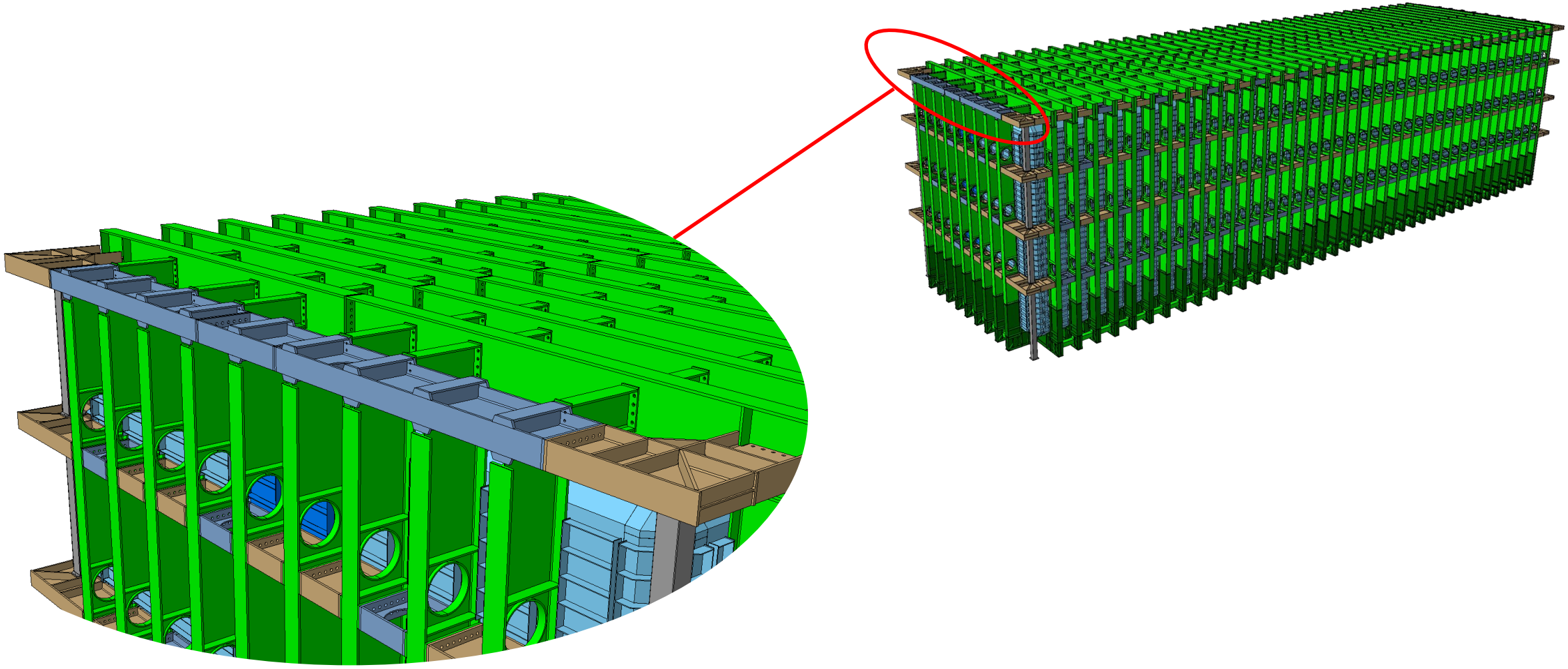
Connection between vertical beam and roof beam re-designed for structural reason



Design modification

implemented since last review (end of 2016)

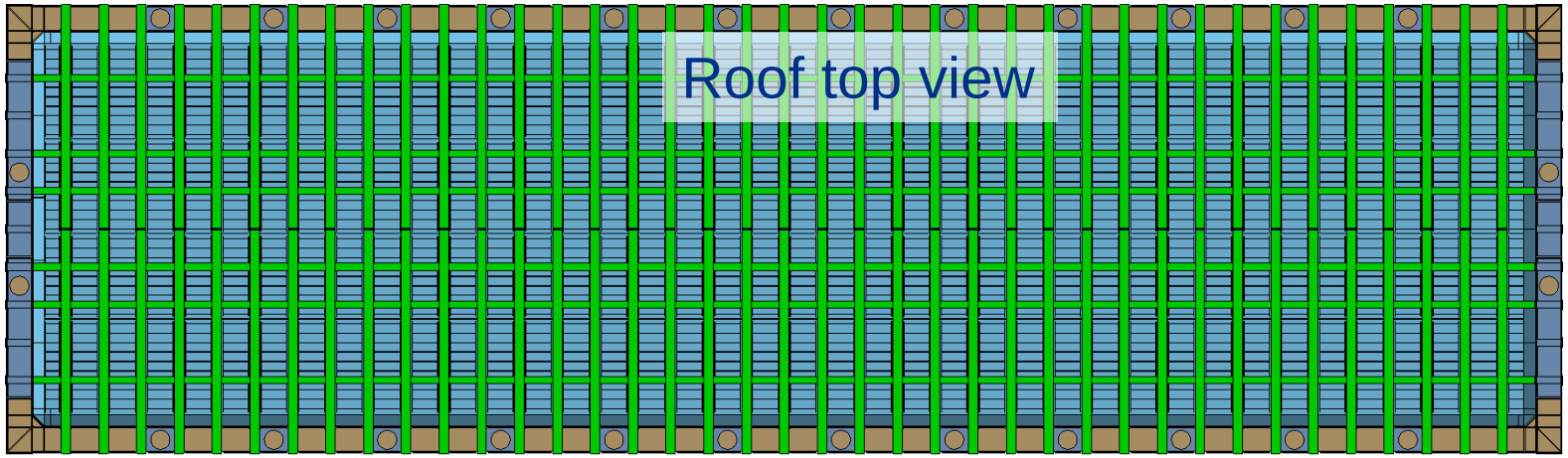
Connection between roof and short wall

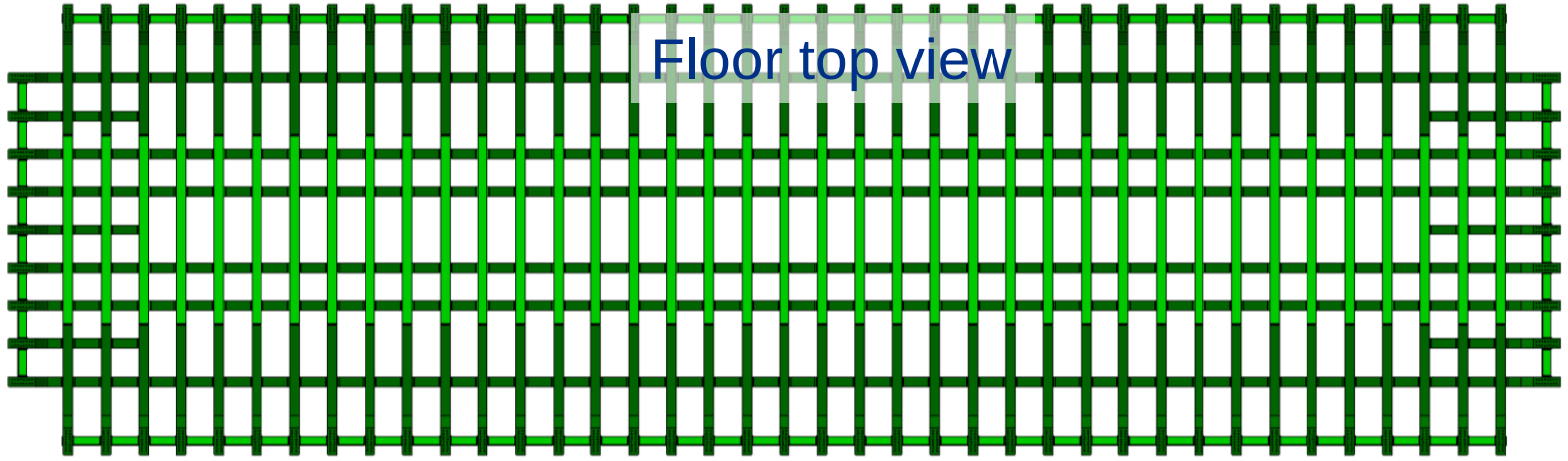


Design modification

implemented since last review (end of 2016)

Replacement of central row of beams in the roof, for penetration reasons. For structural coherence. same modification has been made on the floor

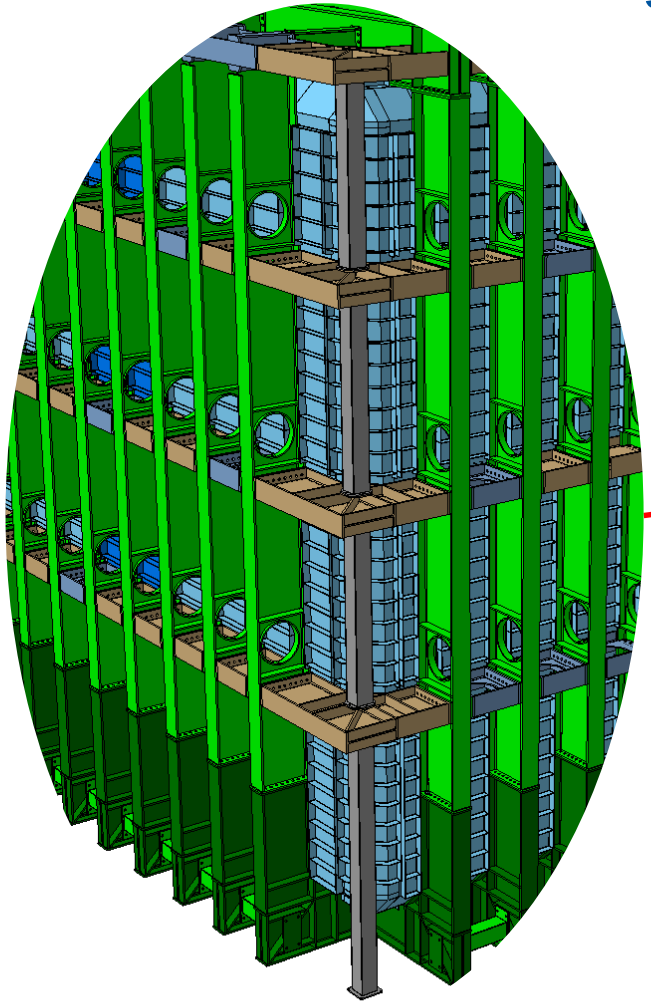


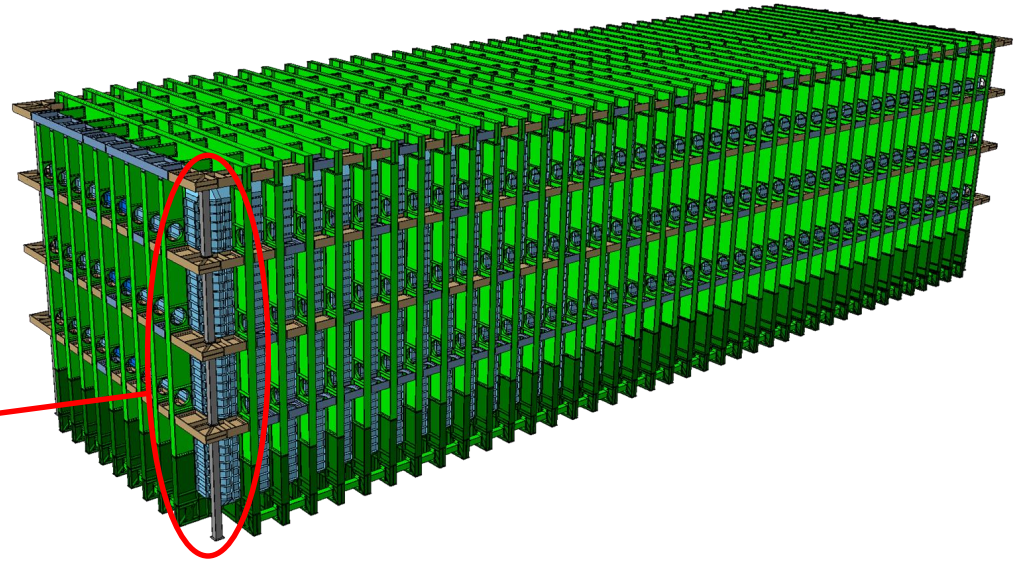


Design modification

implemented since last review (end of 2016)

Corner beams to link small wall and long wall. Add pillars to support corner beams

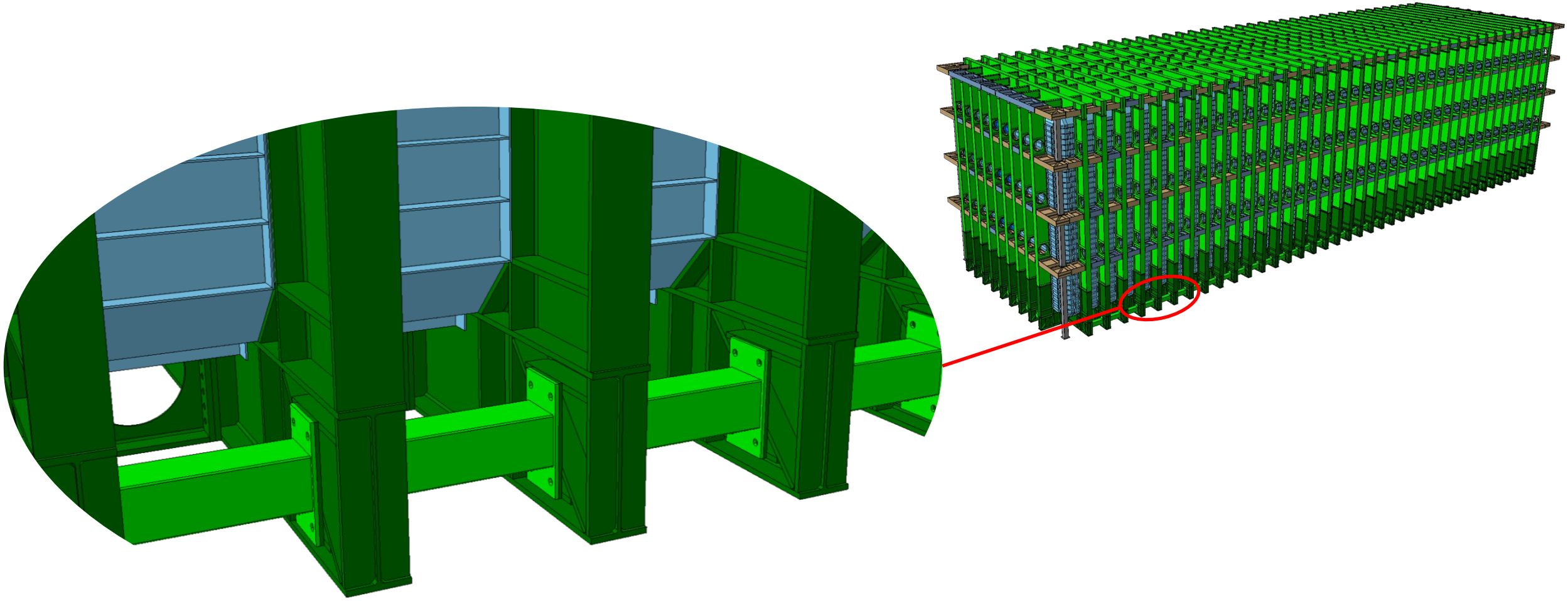




Design modification

implemented since last review (end of 2016)

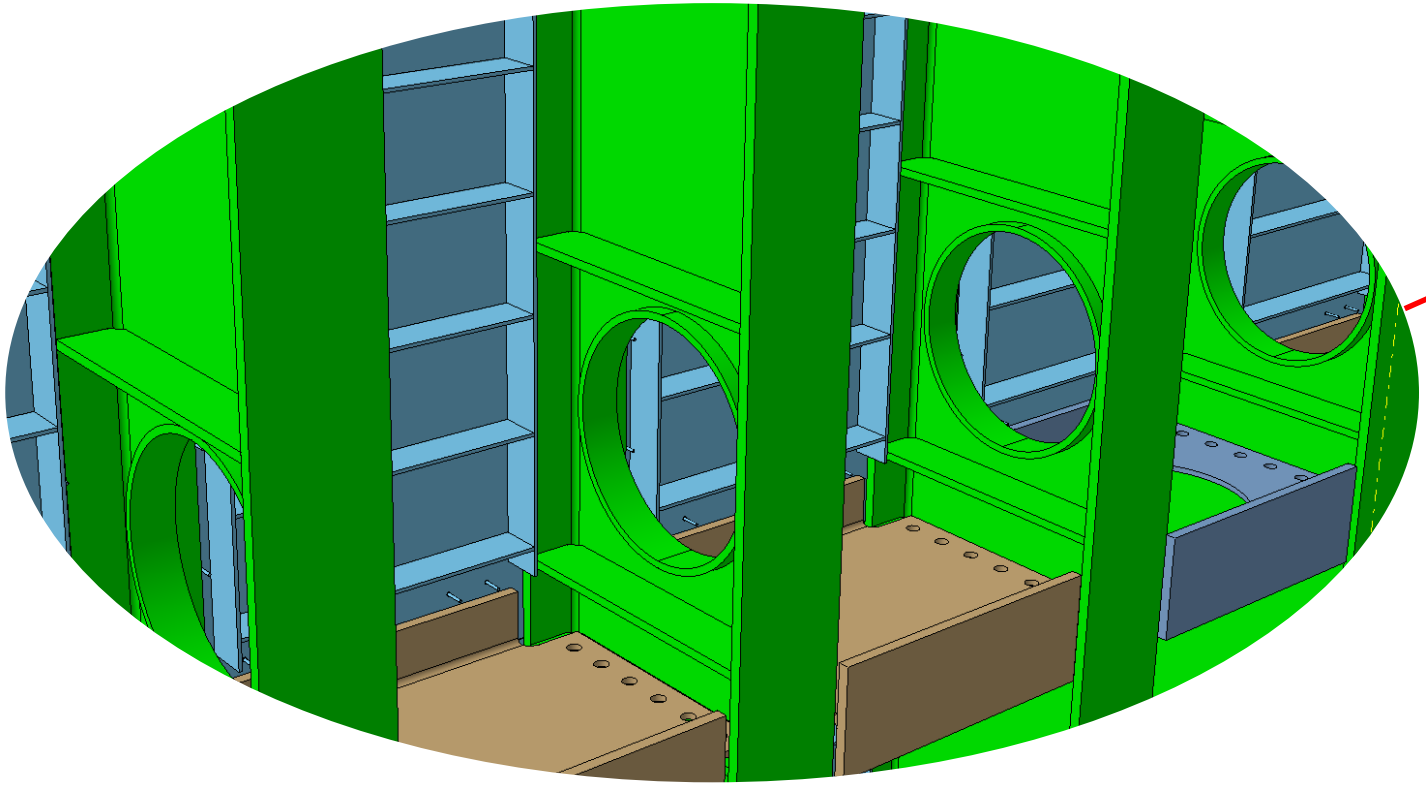
Re-design of ground belts

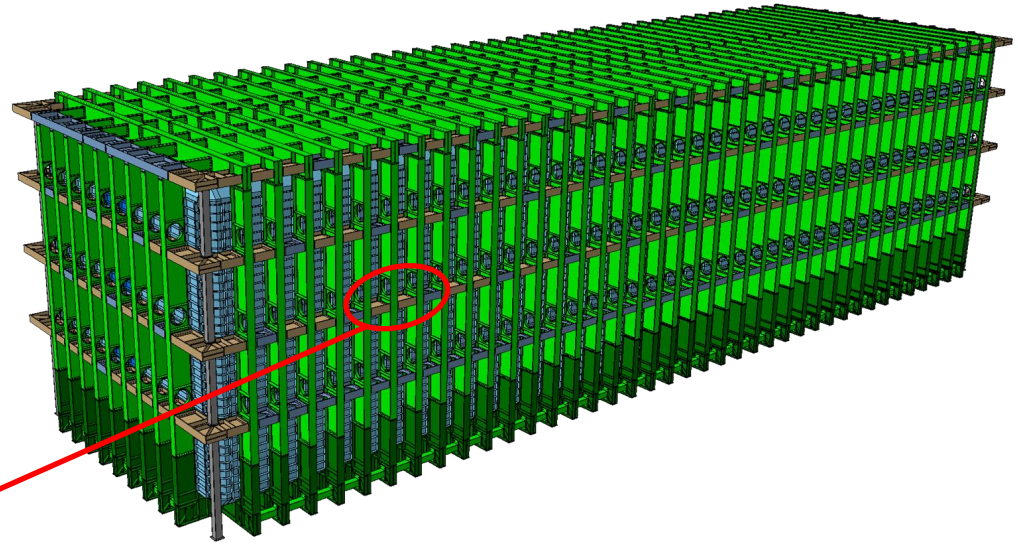


Design modification

implemented since last review (end of 2016)

Access hole region reinforced by adding stiffeners



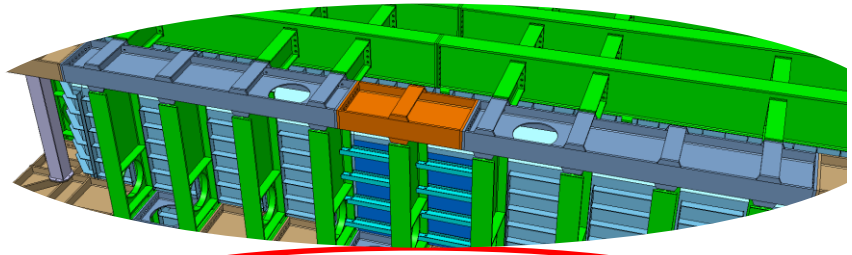


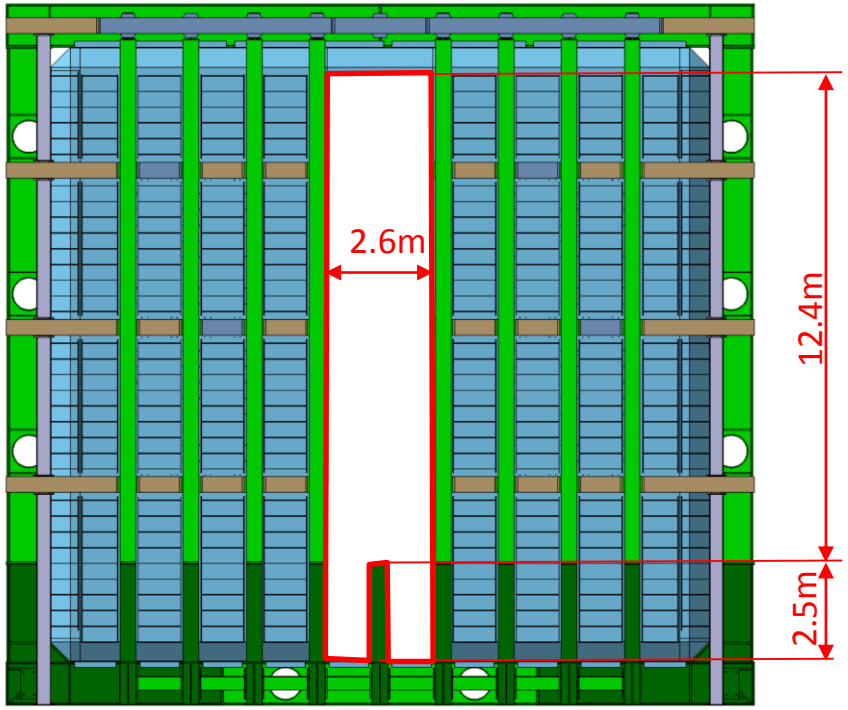
Design modification

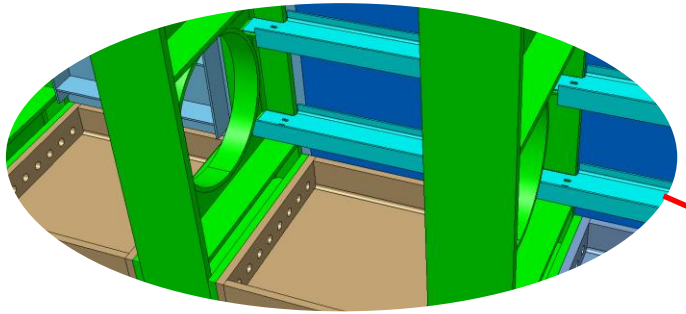
implemented since last review (end of 2016)

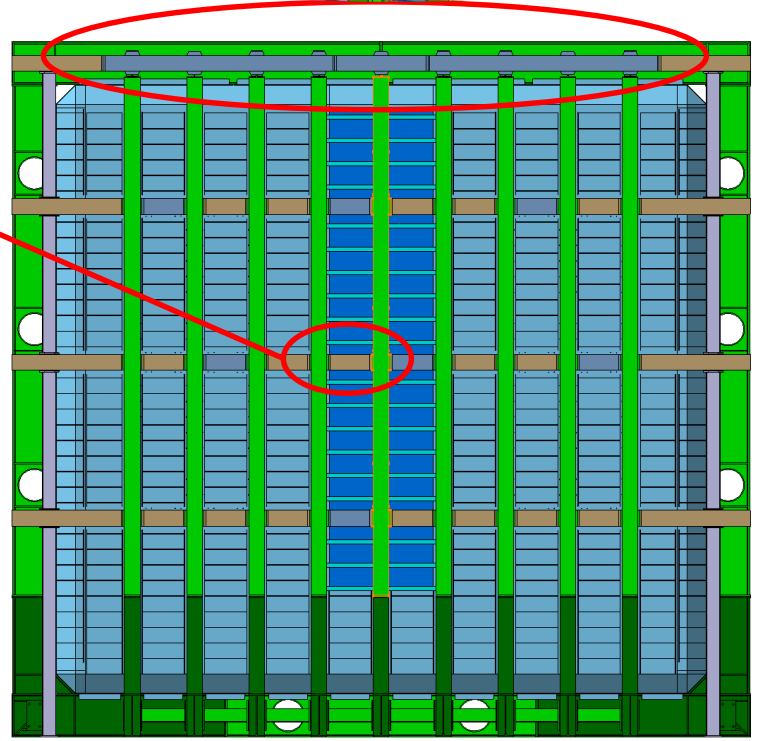
Opening for detector insertion: closure process defined (will be shown in installation sequence on August, 22nd) , and design adapted:

- Top horizontal beam sliced in 3 pieces,
- Warm membrane with specific reinforcement



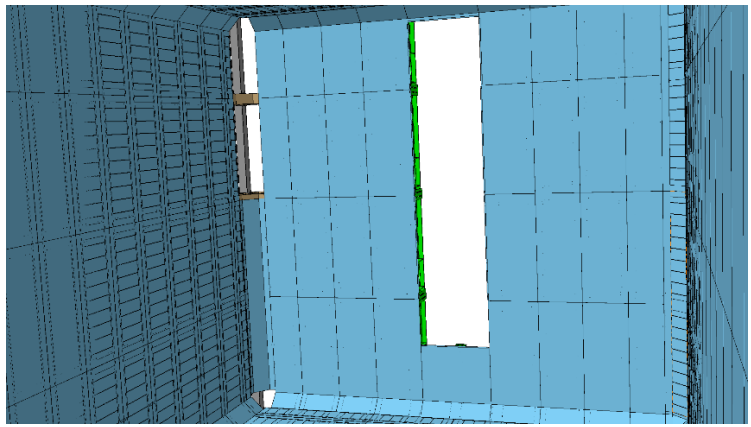


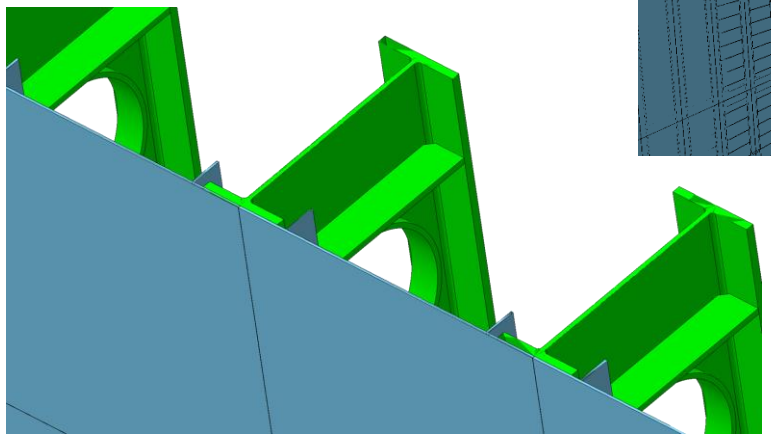




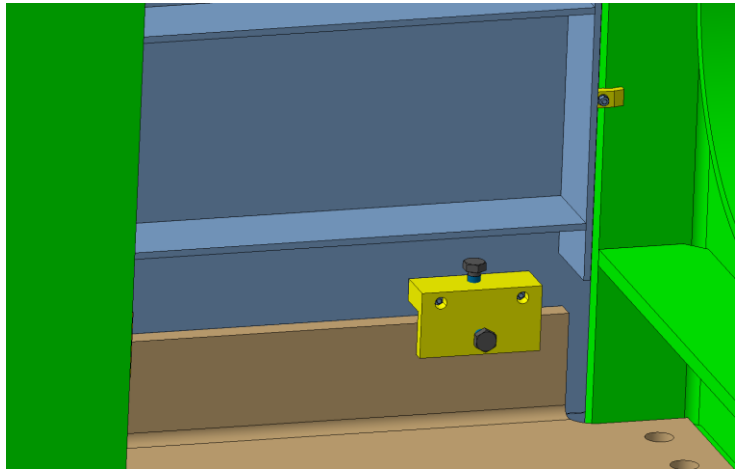
Assembly process to be prototyped

- Warm membrane:
  - How to slice and connect each side (long wall/short wall/roof/floor). Corners to be defined



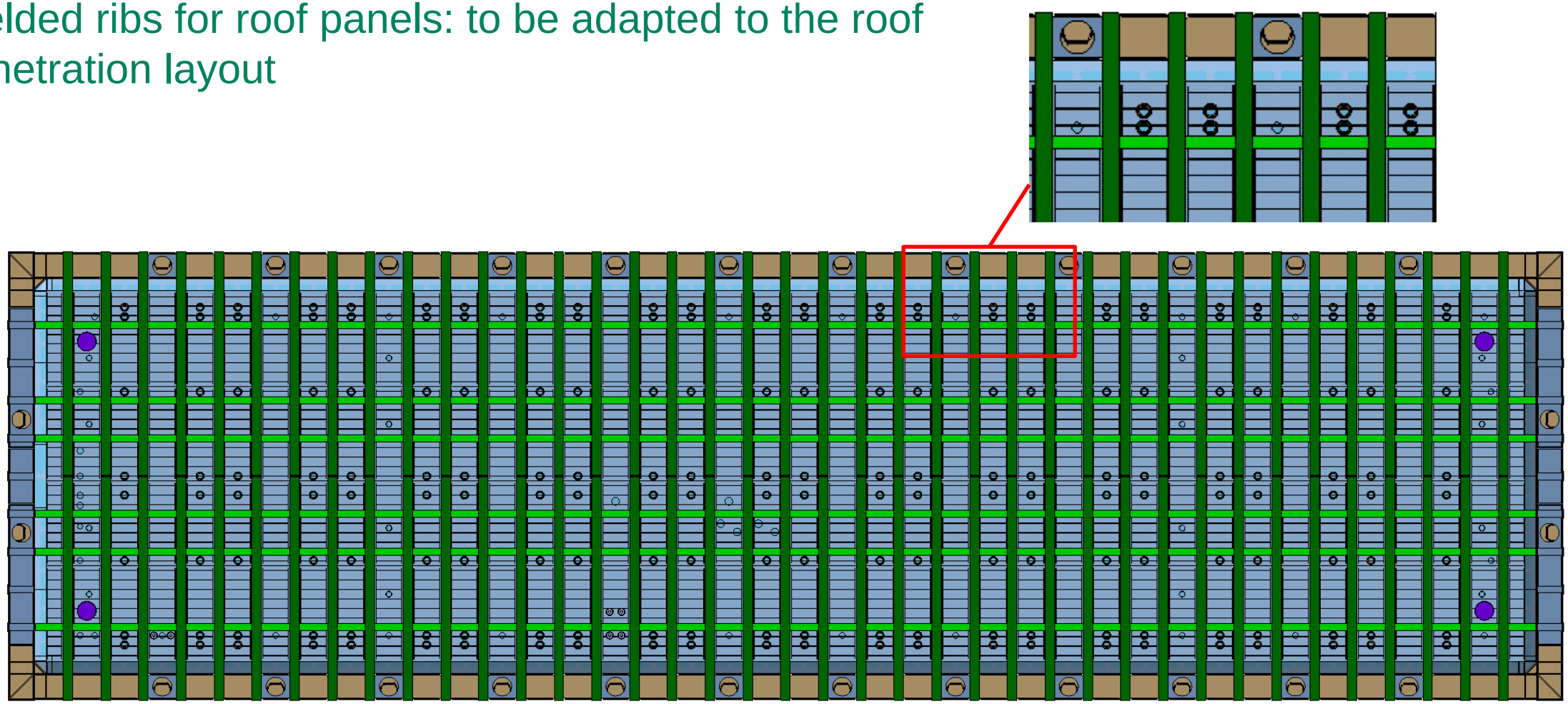


  - Design of panel interface for welding
  - Clamps for supporting panels before full membrane is welded



Further design optimization

- Warm membrane:
  - Welded ribs for roof panels: to be adapted to the roof penetration layout

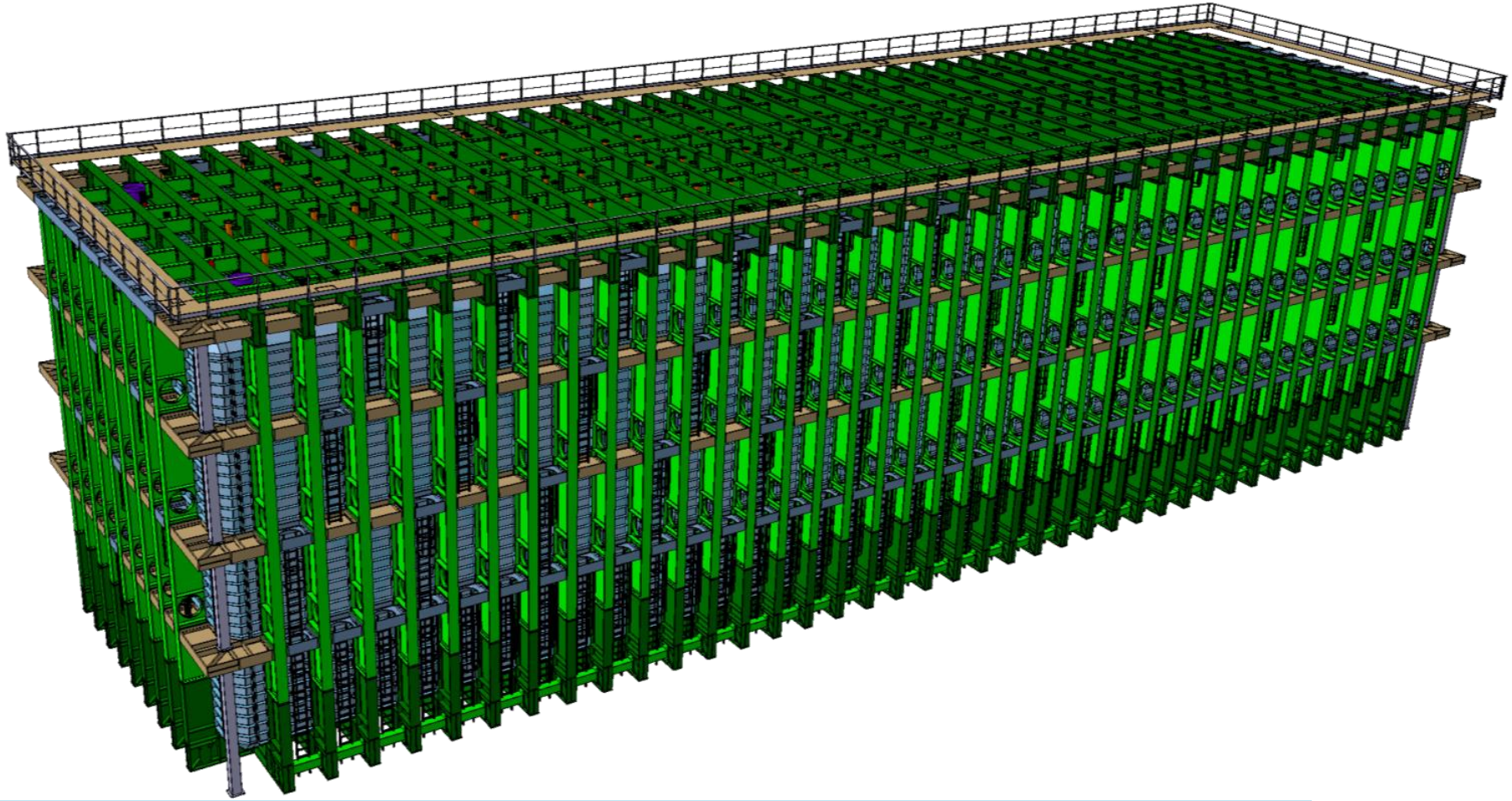


Further design optimization

- 800mm diameter holes for human access:
  - Proposal made on the current design. Could be adapted following safety request, and the ease of access during the assembly process

Further design optimization

- Platforms and ladders:
  - To be adapted to the chosen access layout, and all other services integrated in the cavern



List of outer structure components

- To validate the access shaft use
- To define the material needed for handling along the tunnels
- To validate the cranes capacity,

Document available: https://edms.cern.ch/document/1739475/4

CERN
CH-1211 Geneva 23
Switzerland

EDMS Document No.
1739475 v.4
CERN Div./Group or Supplier/Contractor Document No.
EP/DT/EO

Specification

DUNE OUTER VESSEL – WEIGHT AND DIMENSION OF ALL COMPONENTS

Abstract

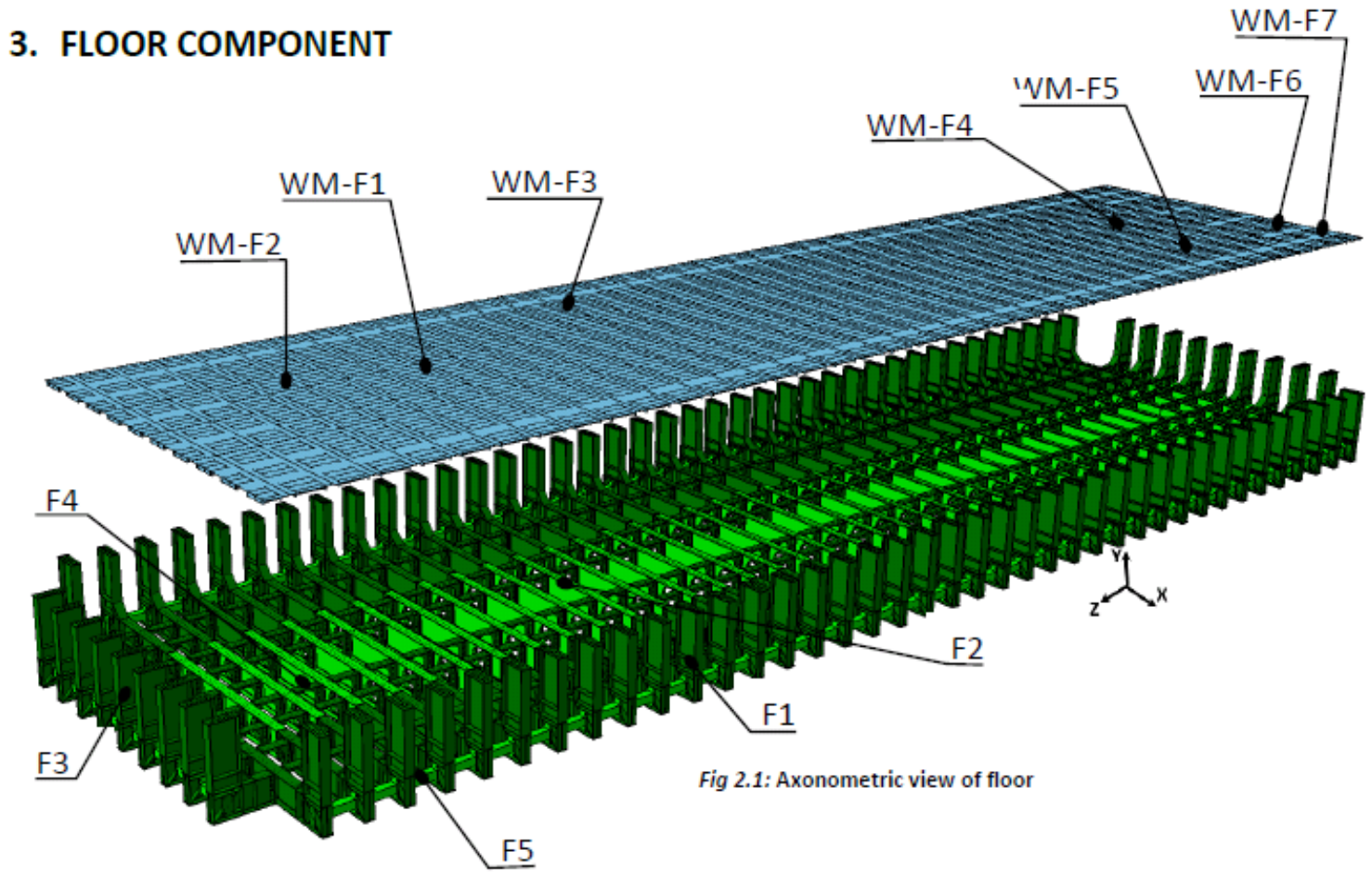
This report lists the components of 1 DUNE outer vessel. Each component should be lowered from the surface to the cavern by the dedicated pit elevator

Prepared by:	*Verified by:*	*Approved by:*
Christophe Bault	Andrea Catinaccio	Click here to enter text.
Date : 28 July 2017	Date : 14 August 2017	Date : Click here to enter a date.

List of outer structure components

Document composed of:

- CAD model picture with naming



List of outer structure components

Document composed of:

- A list of components with weight of each, and total weight

	Neutrino Lar tank - Structural warm skin concept			*Date: August 16th 201*
	composed of:			
		Quantity	Weight (kg)/unit	Total weight (kg)
LW1	Vertical beam , HL1100M (13.124x1.158x0.492)	39	8250	321750
LW/SW2	Horizontal spacer beam with access hole (moment connection), HL1100M (1.108x1.108x0.402)	8	710	5676
LW/SW3	Horizontal spacer beam without access hole (moment connection), HL1100M (1.518x1.108x0.402)	4	805	3221
LW4	Horizontal spacer beam with access hole (pinned connection), HL1100M (1.518x1.108x0.402)	68	497	33810
LW5	Horizontal spacer beam without access hole (pinned connection), HL1100M (1.518x1.108x0.402)	72	593	42689
WM-LW/SW1	12mm Warm membrane with welded ribs - central module ground to level 1 (4.5x1.6x0.658)	38	1062	40337
WM-LW/SW2	12mm Warm membrane with welded ribs - central module intermediate level (4x1.6x0.162)	76	919	69806
WM-LW/SW3	12mm Warm membrane with welded ribs - central module top level (3.12x1.6x0.658)	38	717	27254
WM-LW4	12mm Warm membrane with welded ribs - extremity module ground to level 1 (4.5x0.66x0.658)	2	488	977
WM-LW5	12mm Warm membrane with welded ribs - extremity module intermediate level (4x0.66x0.162)	4	426	1703
WM-LW6	12mm Warm membrane with welded ribs - extremity module top level (3.12x0.66x0.658)	2	325	649
LW	**Long wall**	**2**	**547870**	**1095741**
	Metallic structure			***3187317***

Extract

List of outer structure components

Document composed of:

- A list of components with weight of each, and total weight

Most critical:

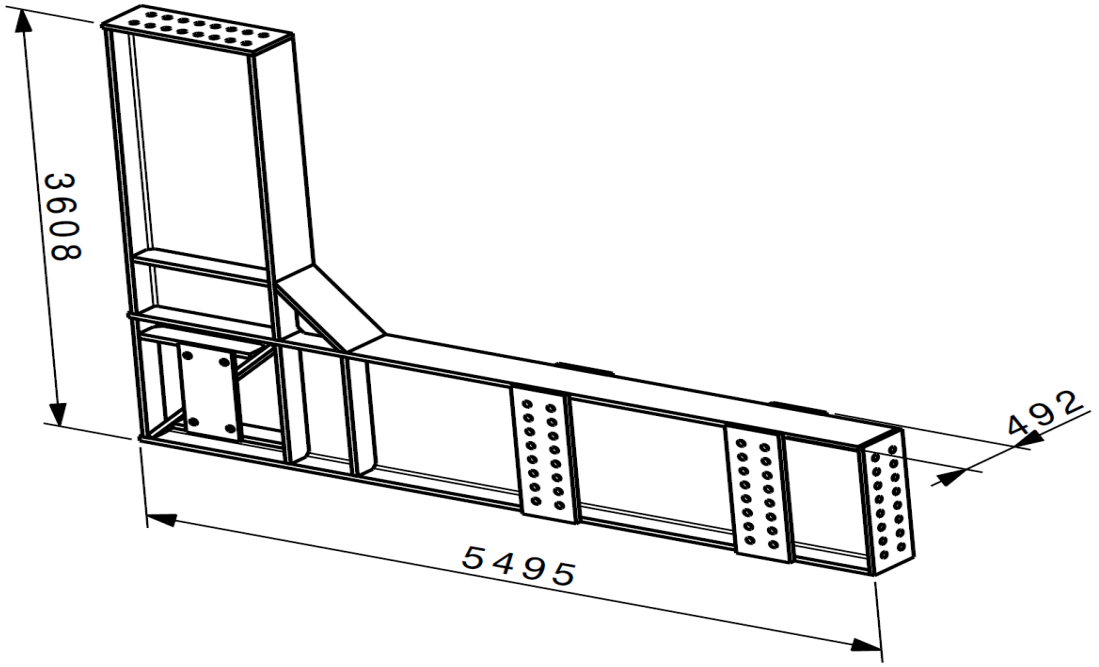
Extract

		Quantity	Weight (kg)/unit
F1	Long side Corner beam , HL1100M (5.495x3.608x0.492)	78	6045
F2	Central beam , HL100M (8x1.108x0.492)	39	6071
F	**Floor**	**1**	**1106870**
R1	Main roof beam , HL1100M (9.46x1.108x0.402)	78	4969
R	**Roof**	**1**	**640312**
SW1	Vertical beam , HL1100M (13.637x1.133x0.492)	9	8384
SW	**Short wall without opening**	**1**	**172171**
SW1	Vertical beam , HL1100M (13.637x1.133x0.492)	9	8384
WM-SW11	12mm Warm membrane with welded ribs - larger module ground to level 1 (4.5x1.86x0.658)	2	1129
WM-SW14	12mm Warm membrane with welded ribs - under removable,floor to top L beam (2.72x3,08x0.658)	1	1268
SW	**Short wall with opening**	**1**	**172224**
LW1	Vertical beam , HL1100M (13.124x1.158x0.492)	39	8250
LW	**Long wall**	**2**	**547870**

List of outer structure components

Document composed of:

- For each component, a 3d view with outer dimensions, weight and quantities:



		Quantity	Weight (kg)/unit
F1	Long side Corner beam , HL1100M (5.495x3.608x0.492)	78	6045

Thank you for your attention