



Structural assessment of contamination protection structure and bioshield roof

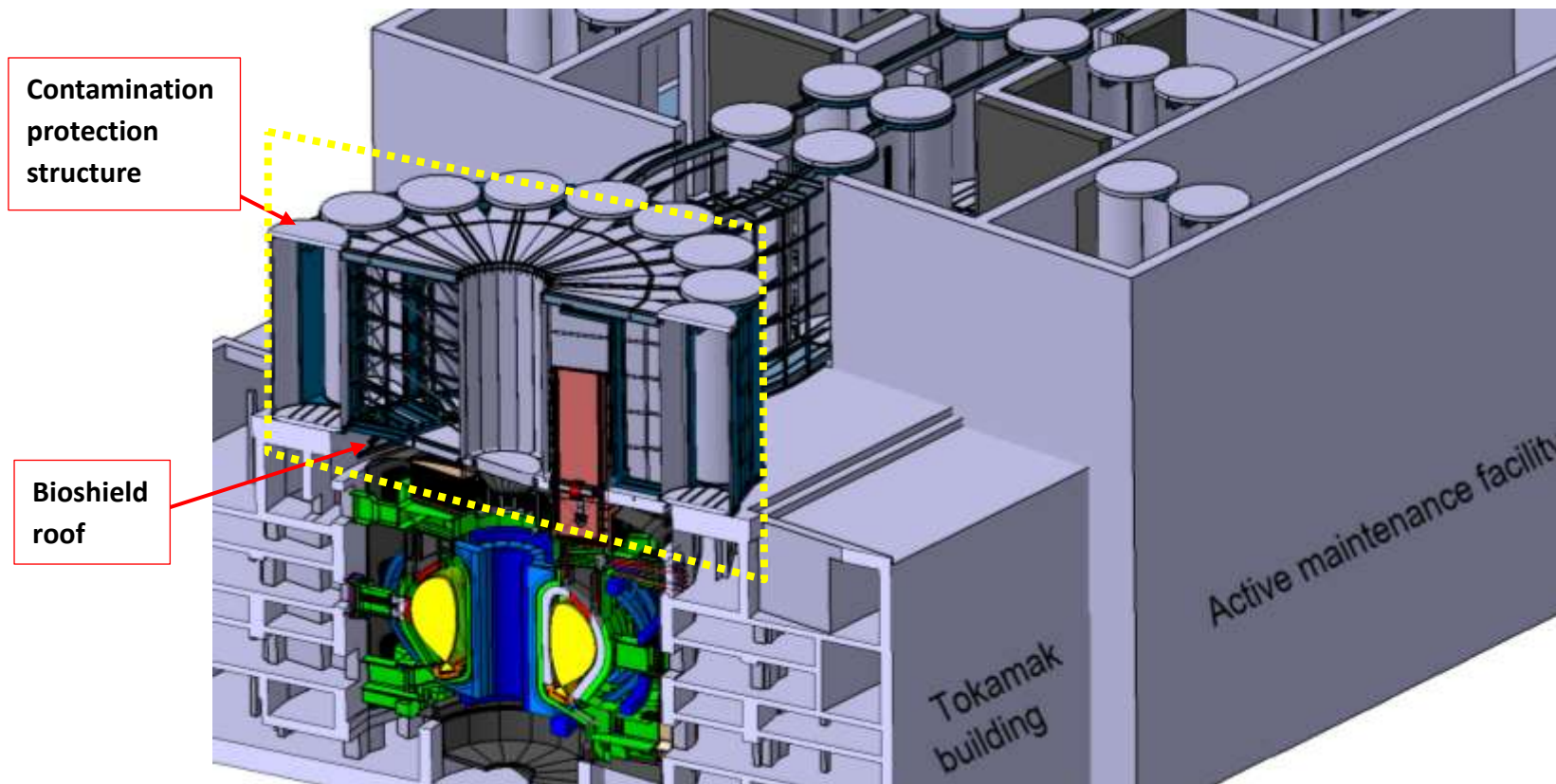
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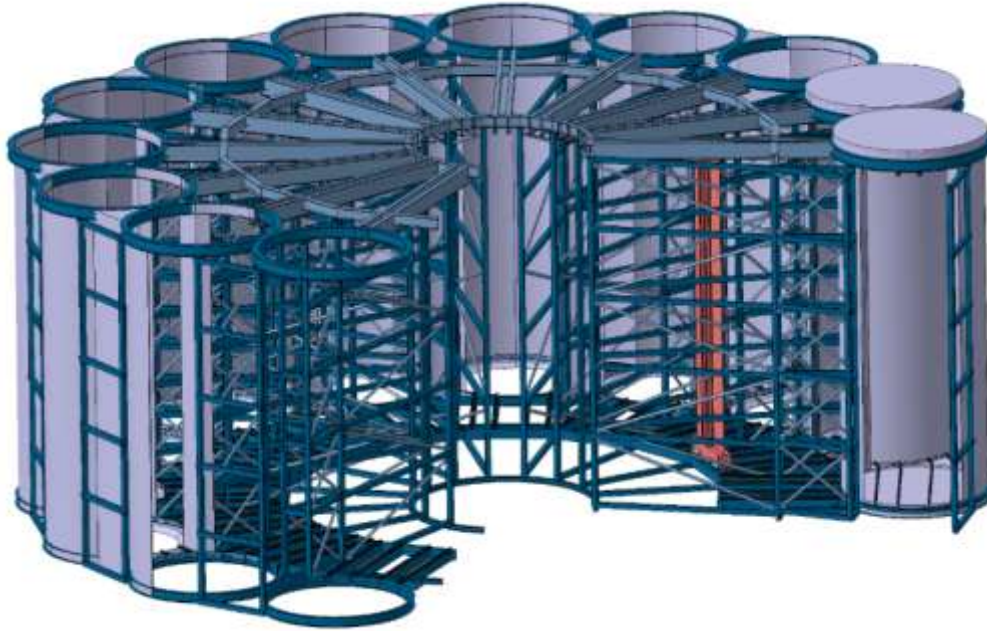


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Section of tokamak complex

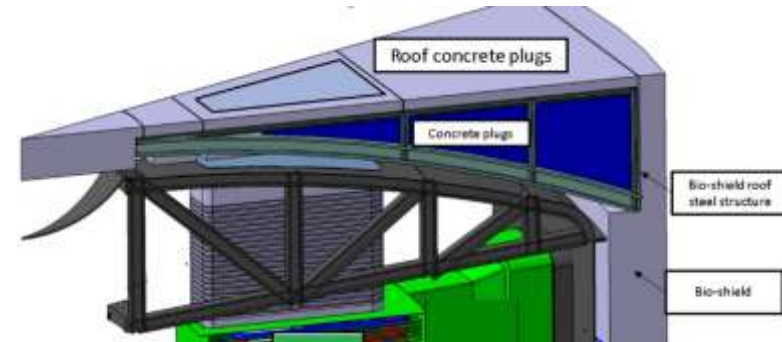


Contamination Protection Structure and Bioshield roof



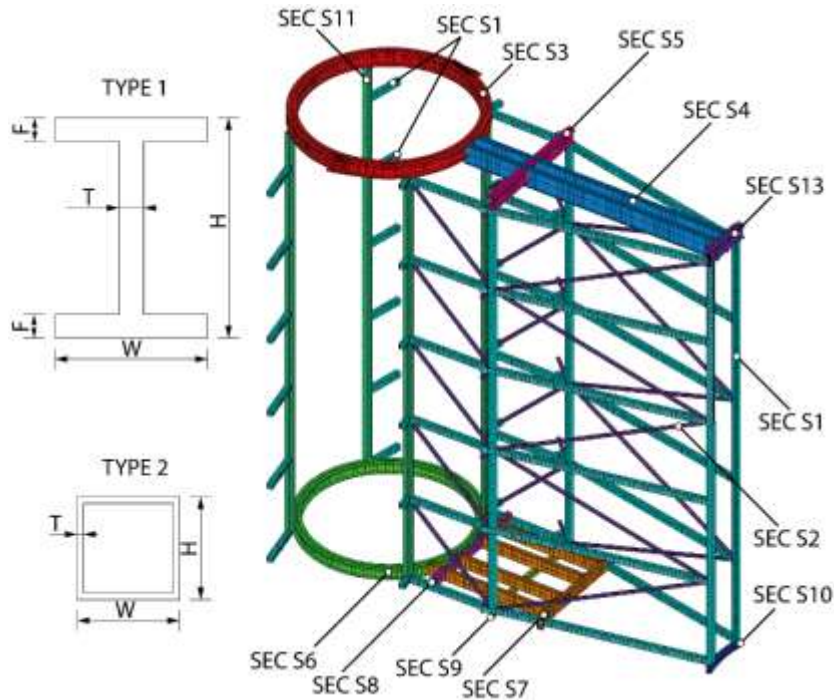
Aims of the task: 1) verify the structural integrity
2) propose necessary design improvements.

Design criteria: Eurocode 3 (EC3) for steel structures.

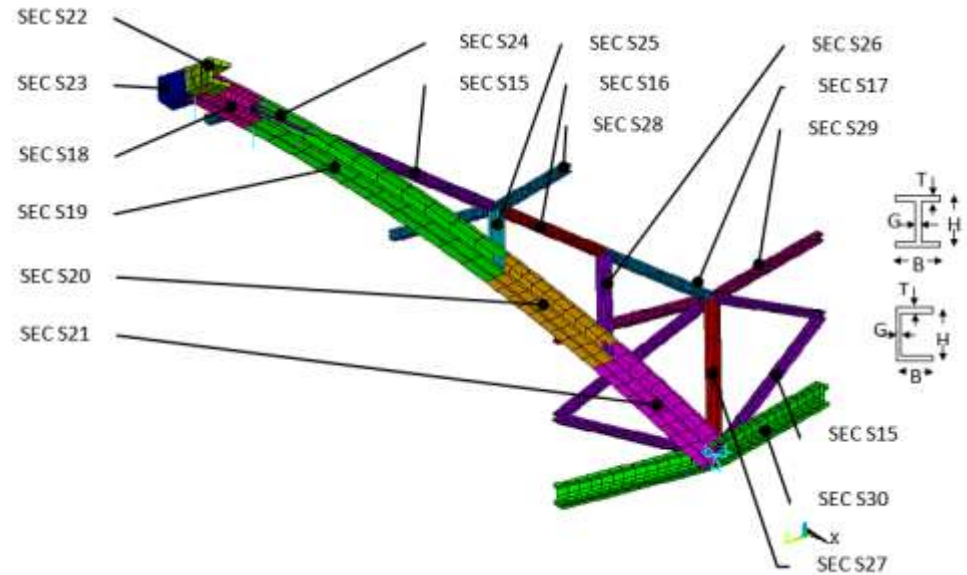


(Analysed in 2019)

FE parameterized model of the structure (beam elements)

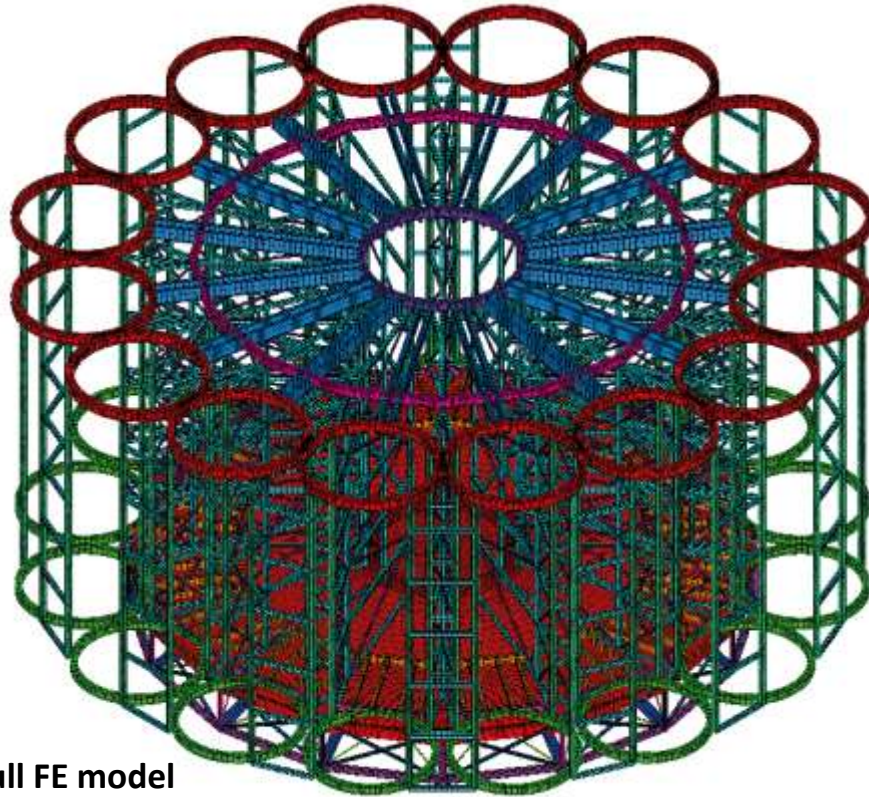


1/16 of the Contamination Protection Structure FE model

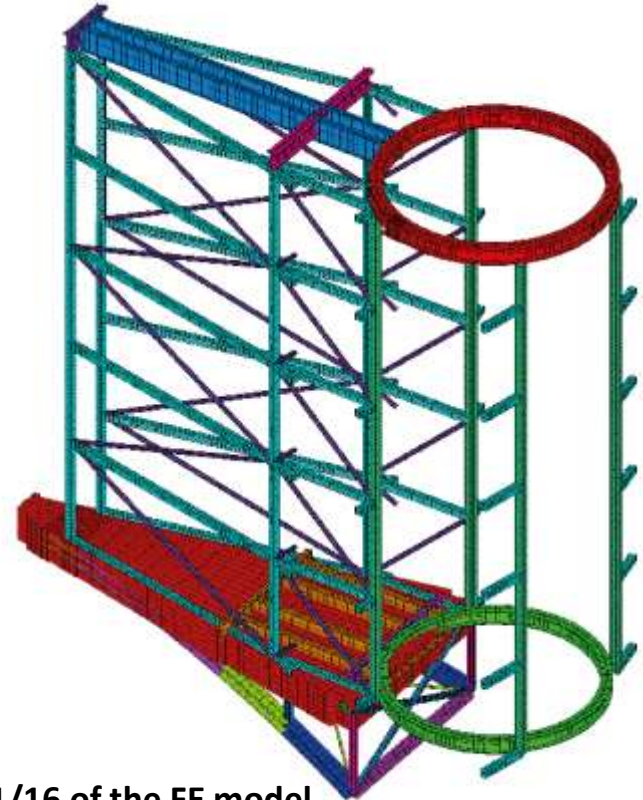


1/16 of the Bioshield roof FE model

FE model of entire structure (containment structure + bioshield roof)

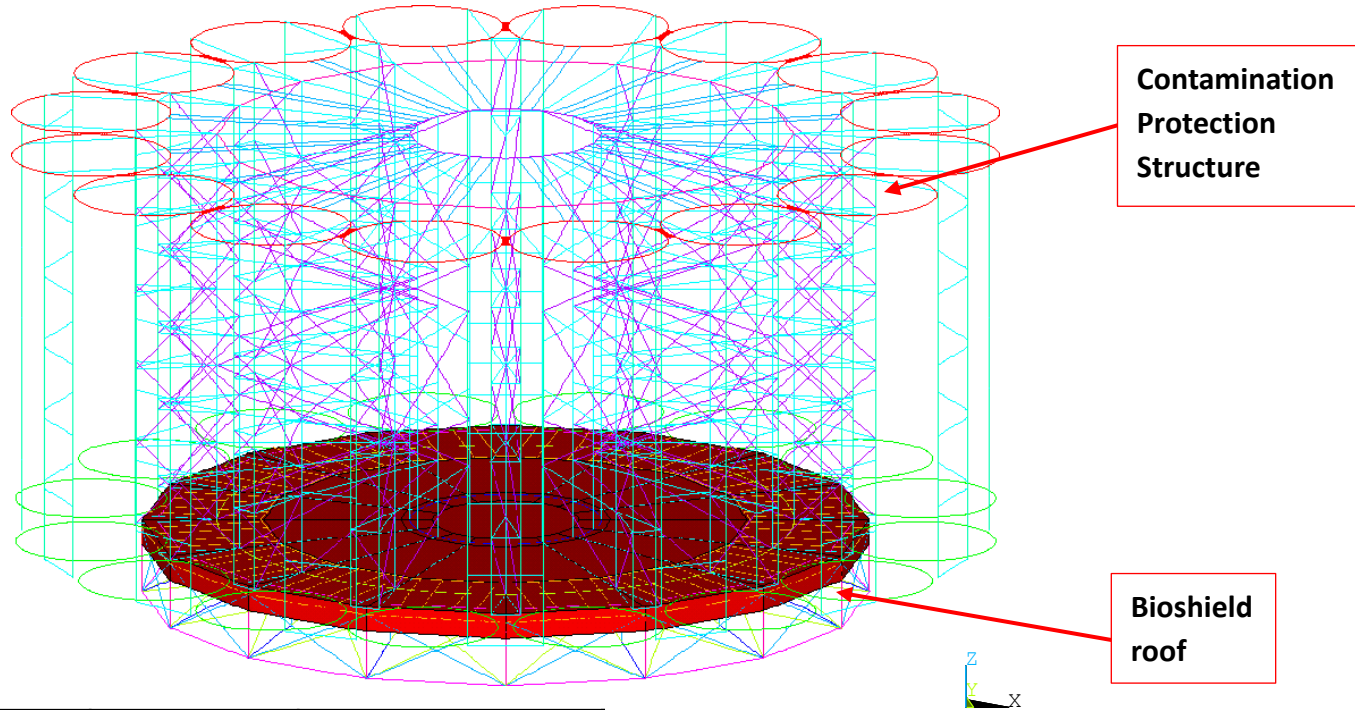


Full FE model



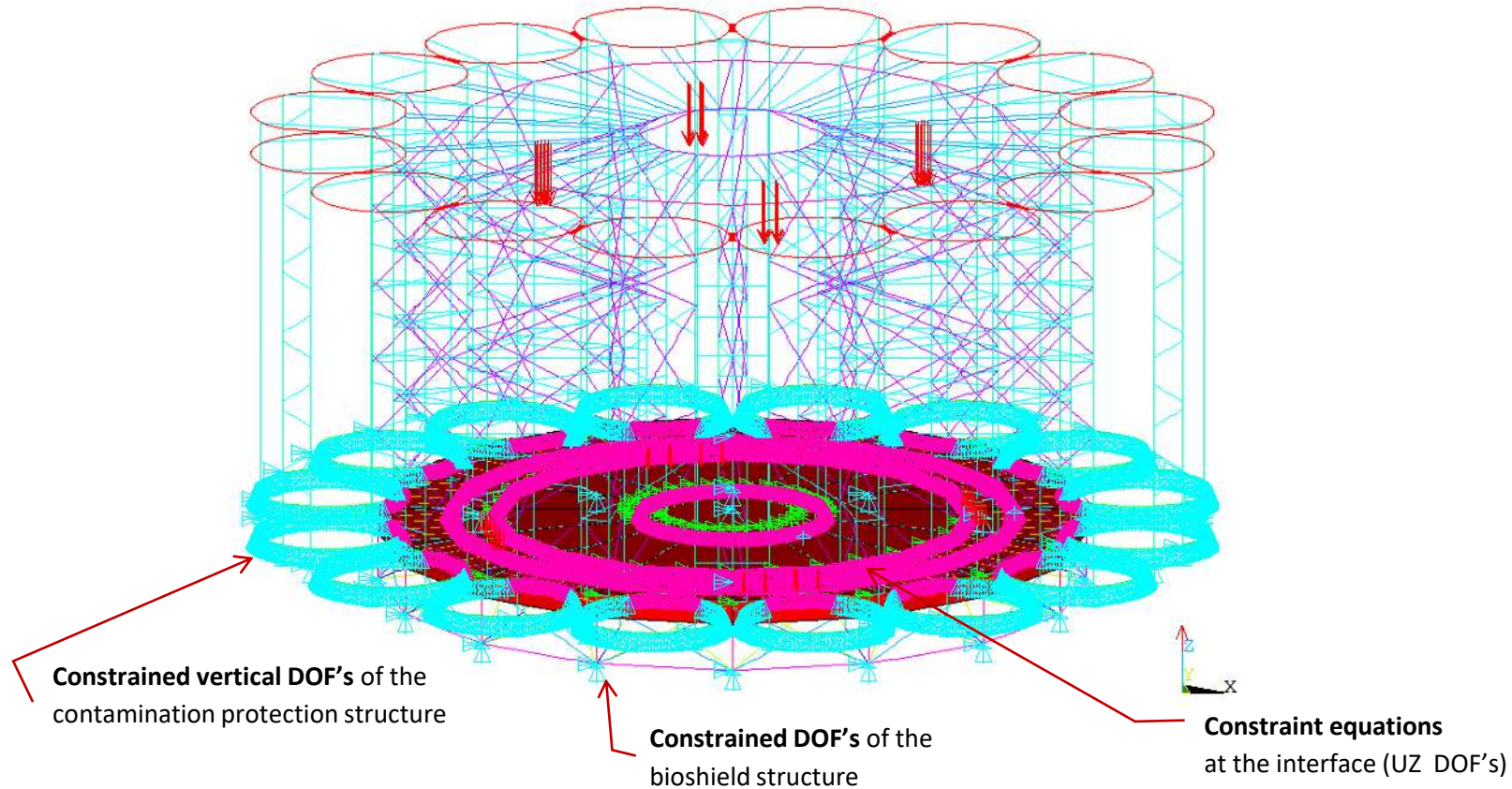
1/16 of the FE model

FE model of entire structure (containment structure + bioshield roof)

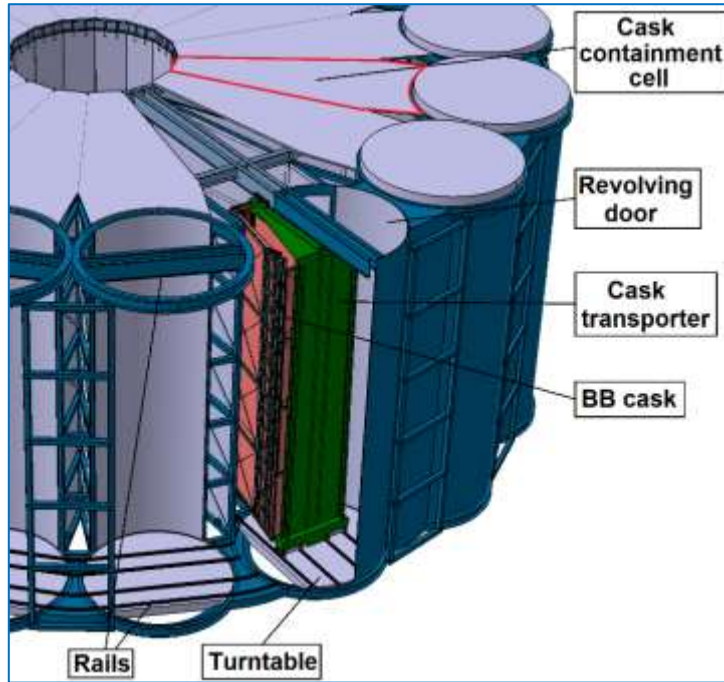


Element Type	Nodes	Name	Used in the mesh of
3D Structural Solid	8	SOLID185	All Solid components
3D Linear Beam	2	BEAM188	All Beam elements
Constraint element	2	MPC184	

FEM model of entire structure (Boundary conditions and constraints)



Load conditions and cask transporter configurations

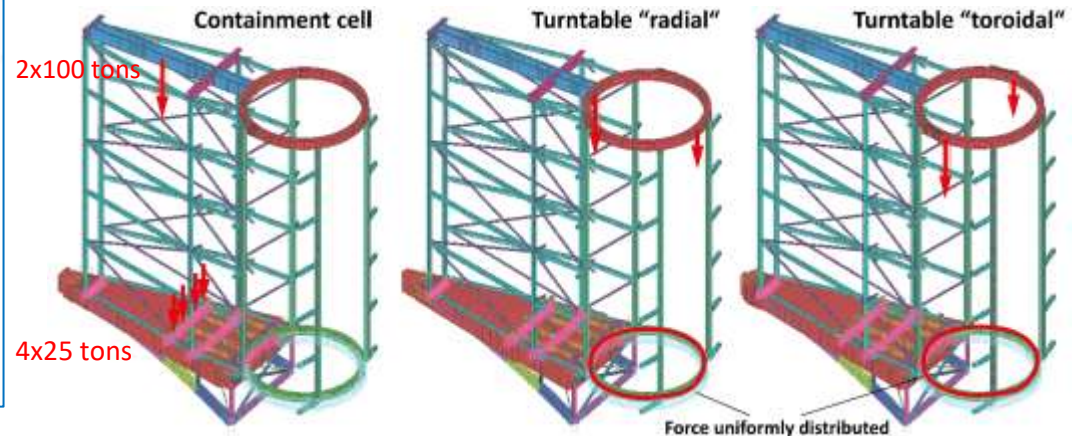


Load conditions:

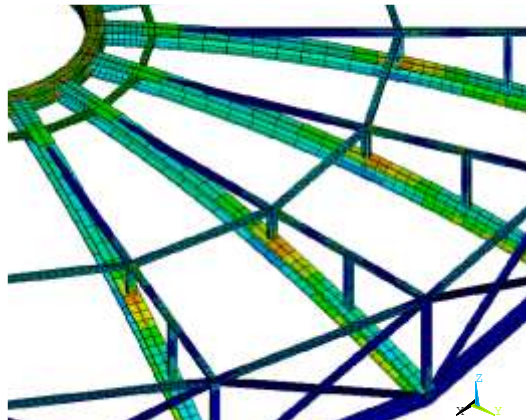
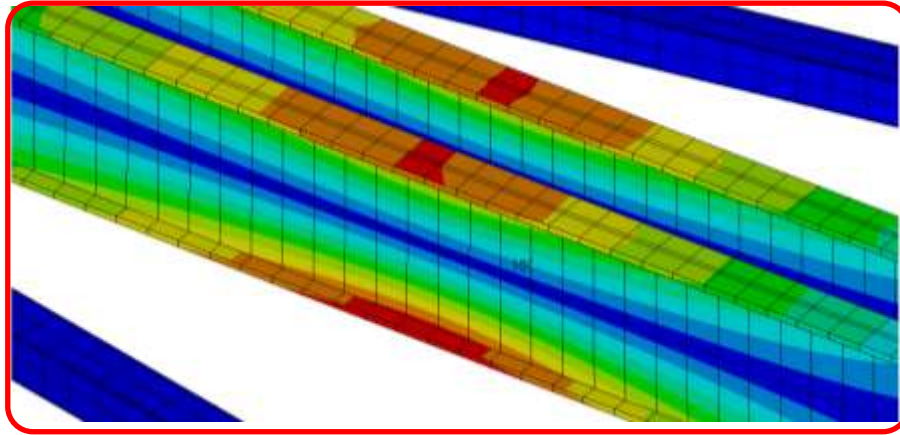
LC1 - $1.35 \cdot \text{gravity} + 1.5 \cdot \text{equipment}$

LC2 - $1.0 \cdot \text{gravity} + 1.0 \cdot \text{equipment} + 1.0 \cdot \text{SL-1}$

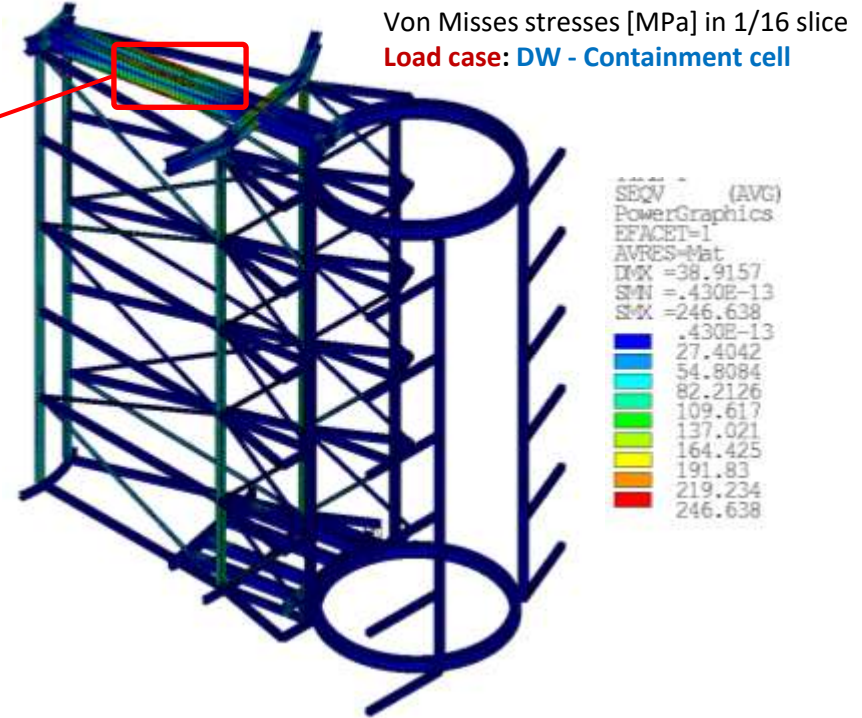
Cask transporter configurations:



Results of linear static analysis

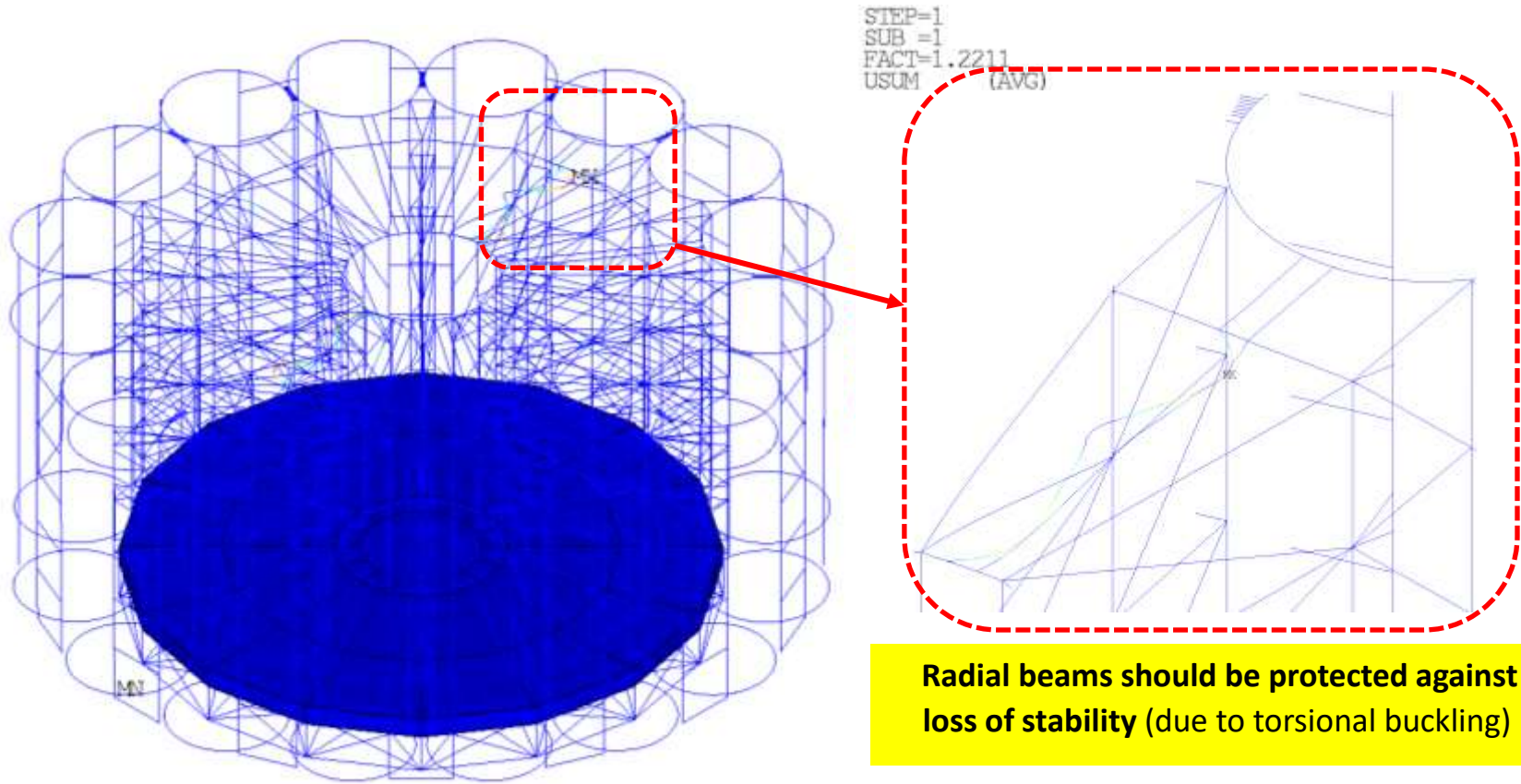


SEQV (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =31.8059
SMN =.143E-03
SMX =167.728
167.728
149.092
130.455
111.819
93.1824
74.5459
55.9095
37.273
18.6366
.143E-03



Stresses are in allowable limit

Results of linear buckling analysis





1. Structural integrity has been verified using parametrized FE models (*Ansys APDL*)
2. Stress level is in an acceptable range (*below $f_{yk}/1.1 = 323\text{MPa}$*)
3. The structure is strong and rigid enough to withstand considered loads provided that the stability of the radial beams is improved
4. Loads acting on the bioshield roof structure turned out to be lower than those assumed during its preliminary design (2019)

Mass estimation:

- Containment structure – **1849** tons
- Bioshield roof structure – **633** tons
- Concrete blocks – **5047** tons



Thank you for your attention