Cubism - Braque's Bottle and Fishes, Paris c.1910-12

Module Structure and LAr Circulation

ArgonCube Engineering call
Feb 12th 2021
James Sinclair, LHEP

What is new with module structures?

…nothing! The baseline design remains unchanged since December.

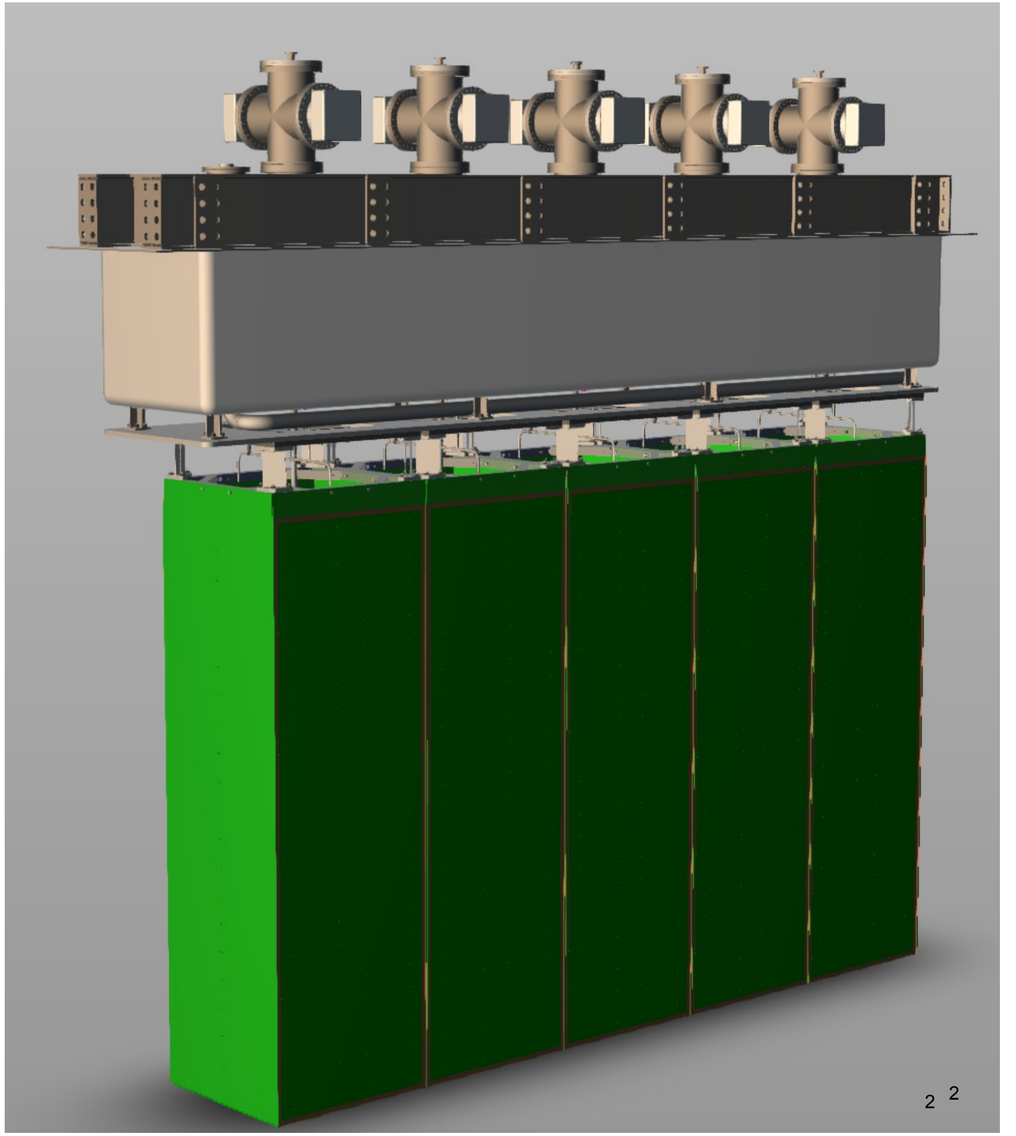
Reviews by Andrew & Knut have identified items that need reworking:

1 – connections between modules
2 – spacer between modules
3 – connection to support frame
4 – reduce fixing depth

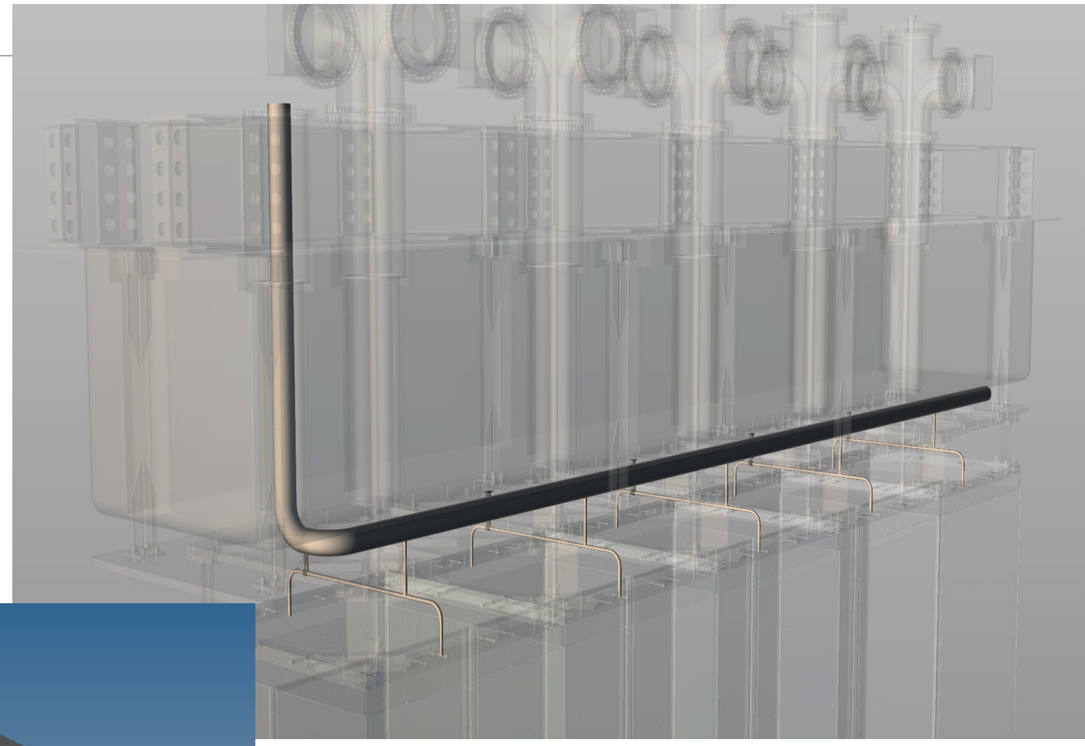
CFD has show we need to update the LAr injection points

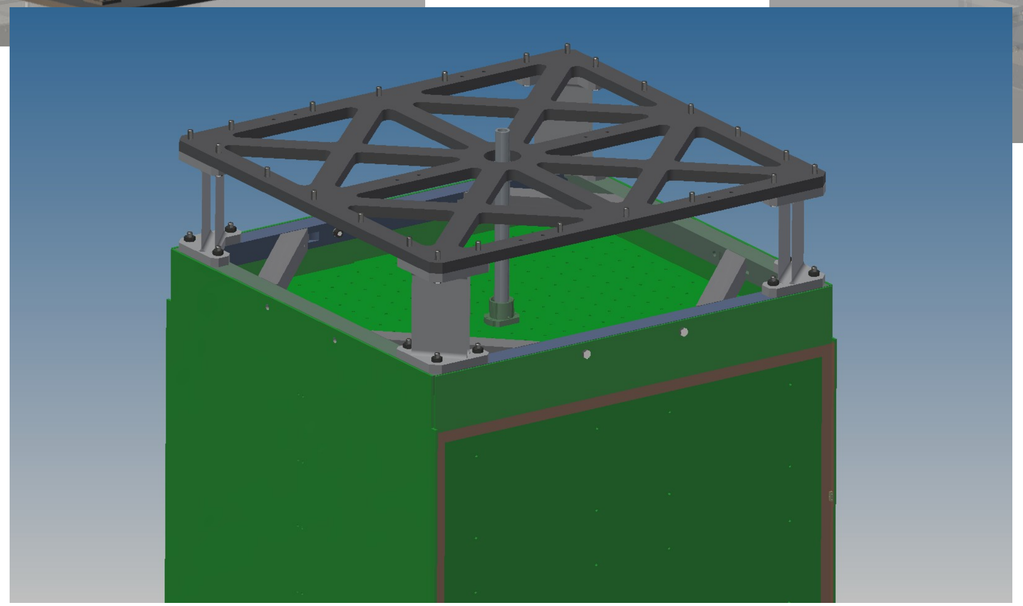
Thermal FEA has shown flexures can be simplified.

LBNF-Cryo requested LAr distribution test (piston purge)



Structures overview





LAr distribution changes

E. Voirin's CFD of the ND modules suggest changing from singe injection point above each TPC to two will help mitigate hot spot at Light preamps.

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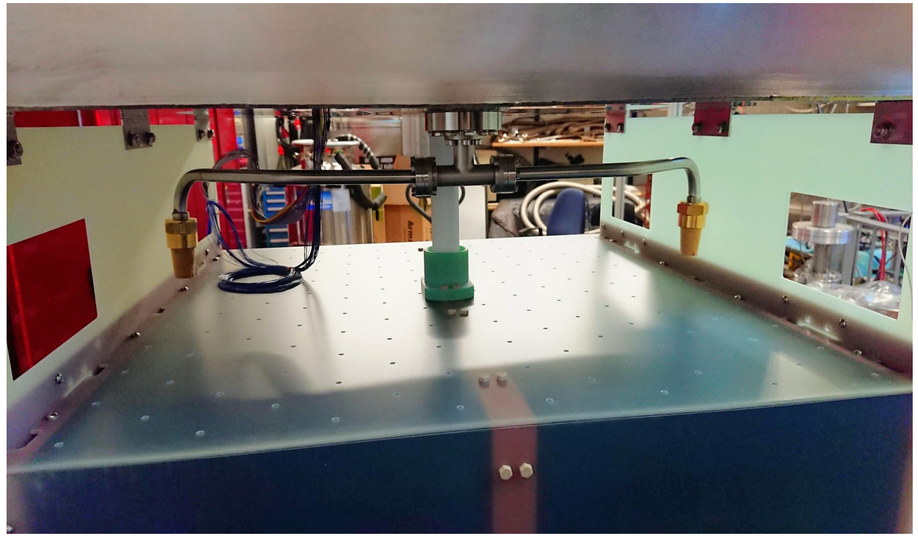
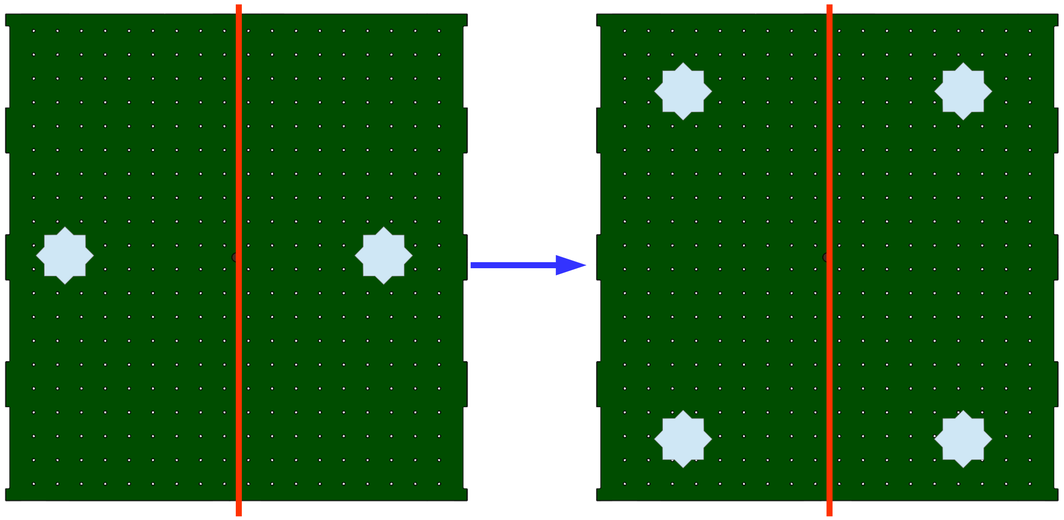
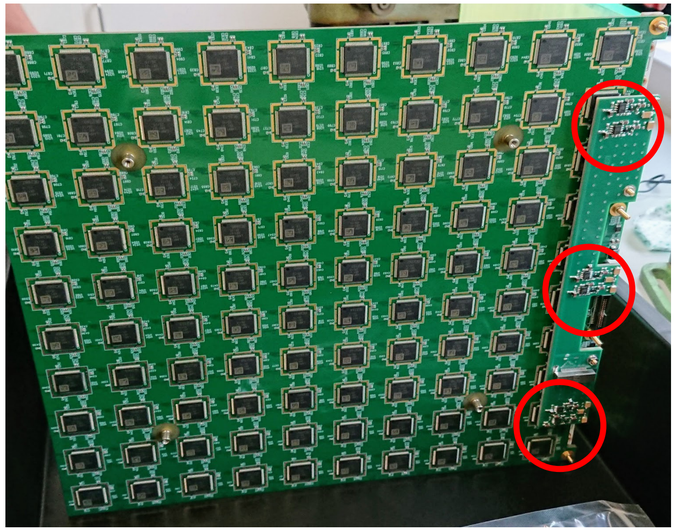
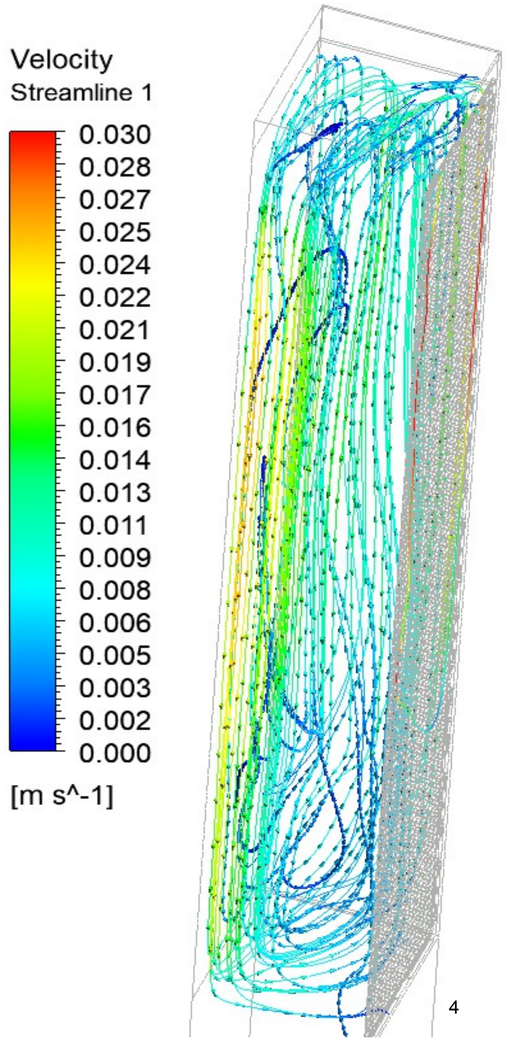








LAr distribution test

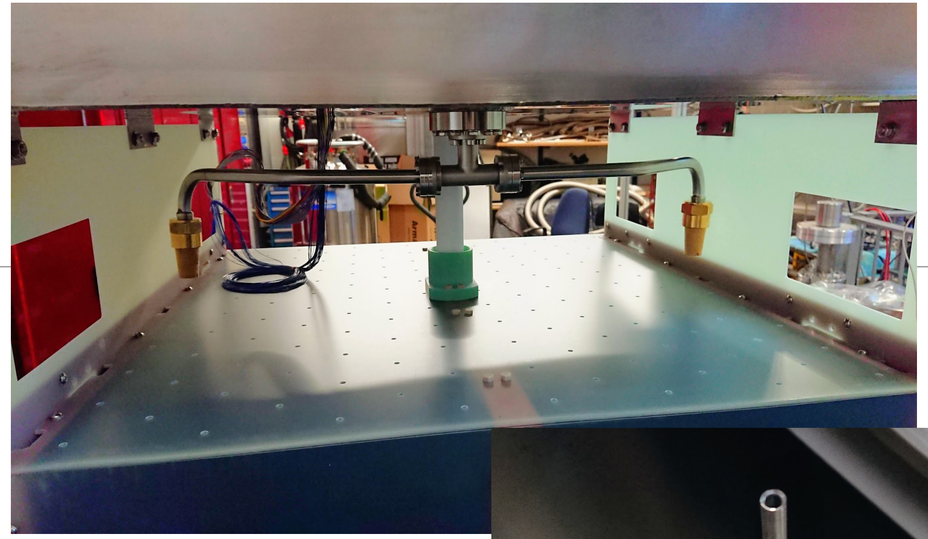
0 velocity of the injected LAr is important for reaching purity. Therefore, a diffuser or baffle is needed at injection point.

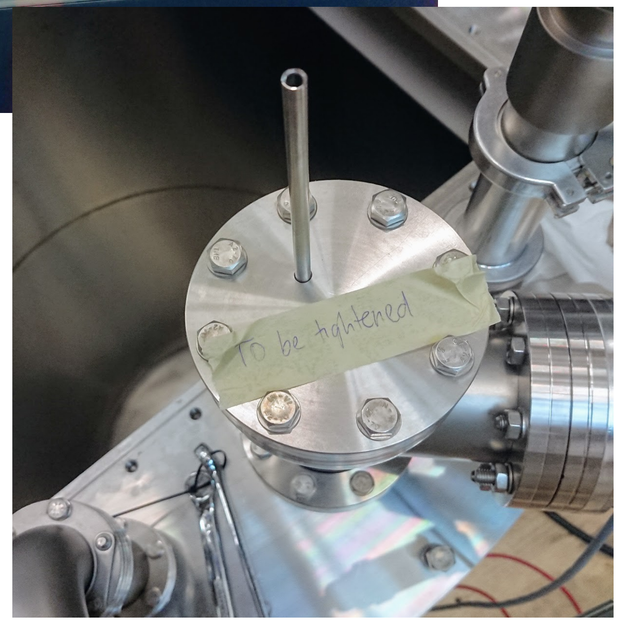
LBNF-Cryo are concerned about trapped volumes during piston purge.

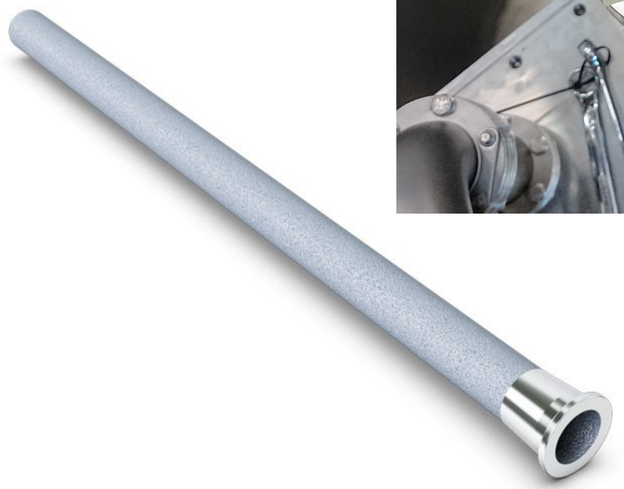
We have to include gas return lines at all feedthroughs, but we must also be able to exhaust through filling line during piston purge.

It is also important to minimize dP of the diffuser as supply pressure is limited to ~2 bar absolute sans additional pump.

Will reach out to GKN for appropriate product.







Propose modification to Mod0 run

Add a gas return line to LAr inlet that feeds gas chromatograph.

After vacuum leak check, return to atmosphere, and begin piston purge.

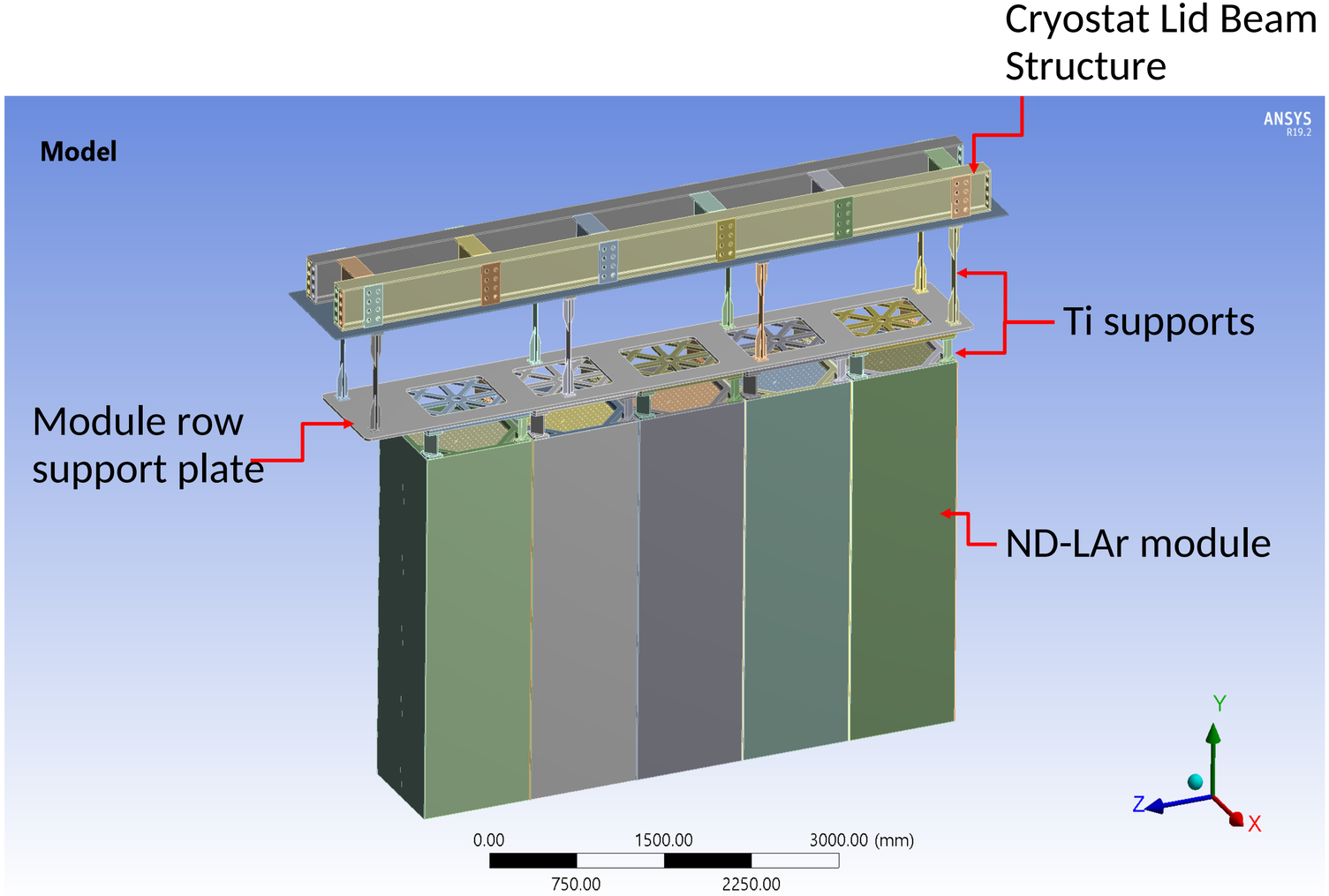
If desired O2/H20 level is reached after suggested 5x volume change, begin fill and run.

If desired O2/H20 level is not reached after suggested 5x volume change, return to vacuum then begin fill and run.

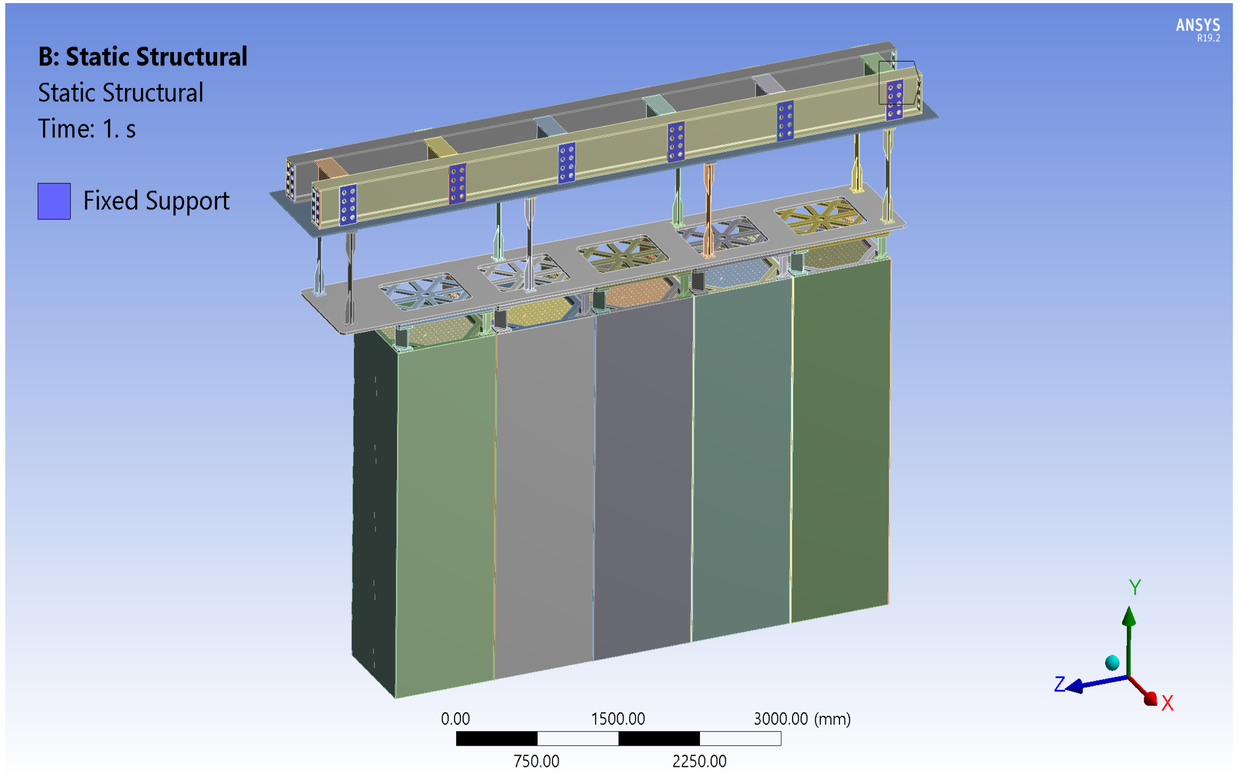
Additional time ~ 10 days.

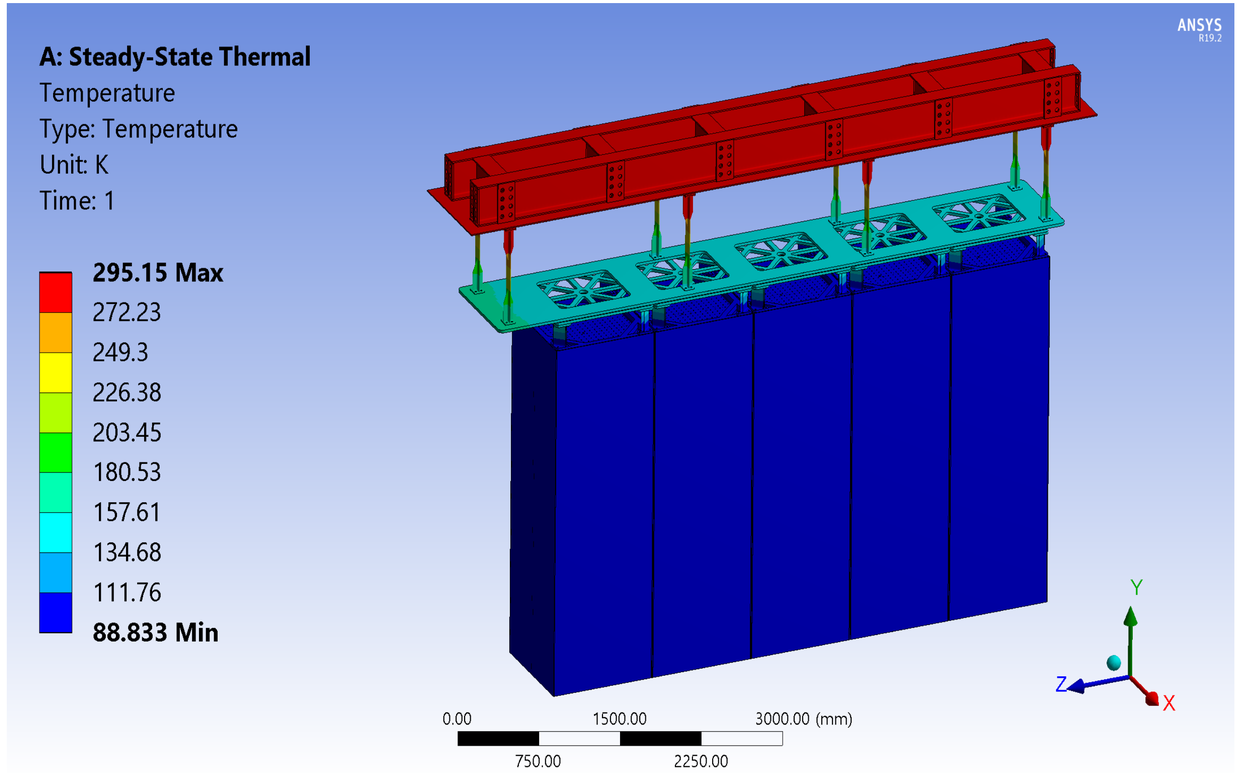
Thermal FEA

Andrew performed an analysis using a simplified geometry

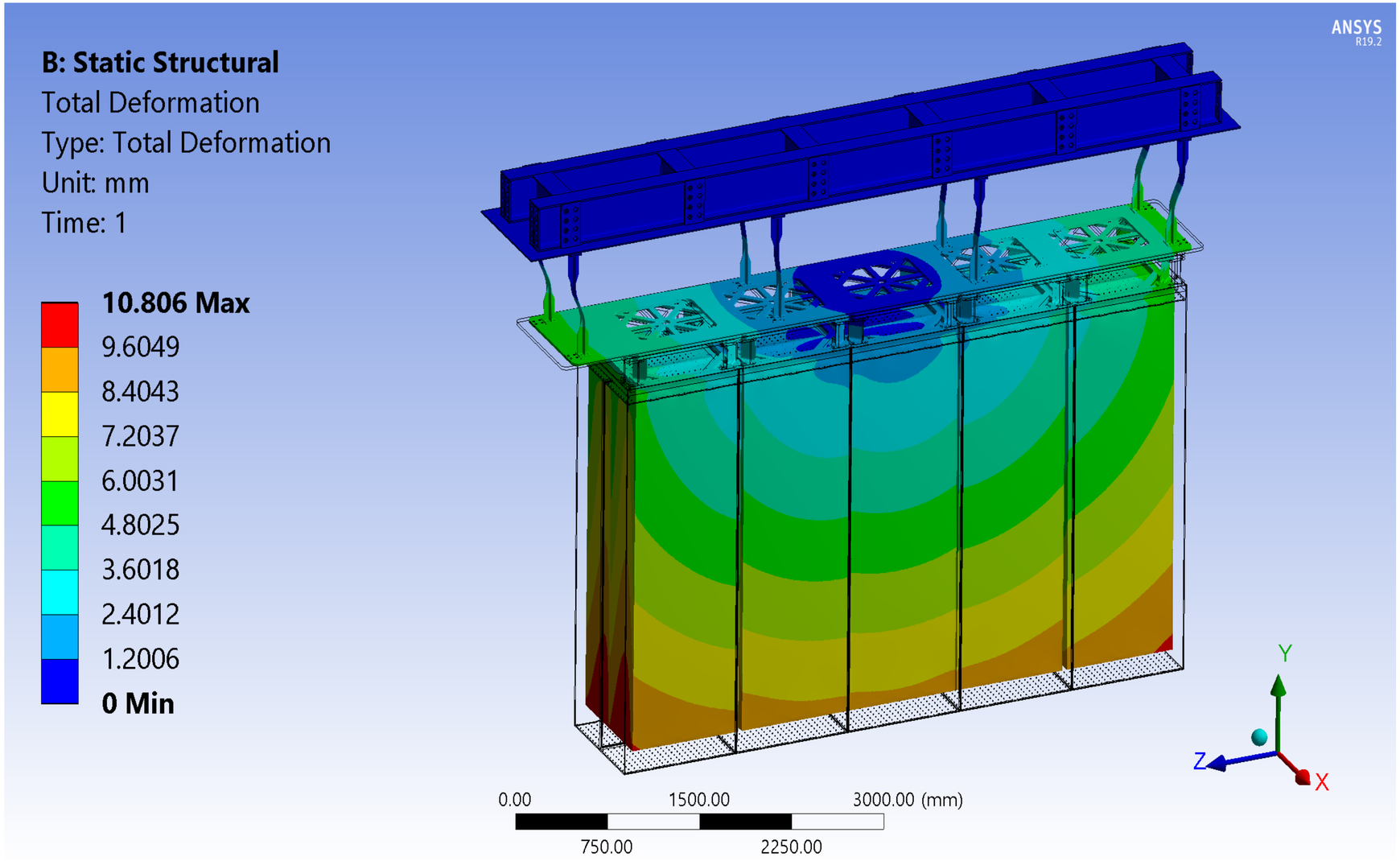


Thermal FEA

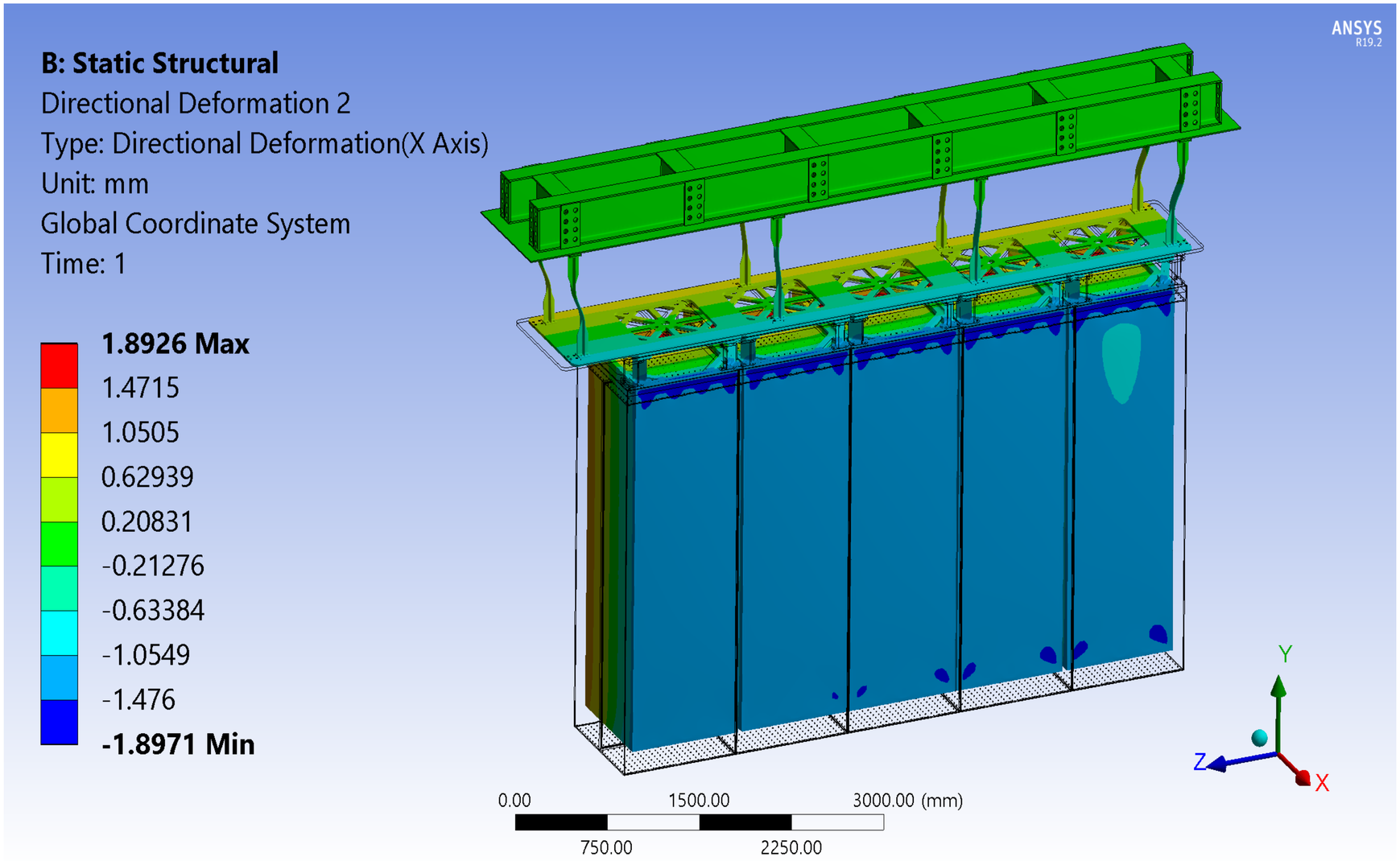

ANSYS
R19.2
B: Static Structural
Static Structural
Time: 1. s
Fixed Support
0.00
1500.00
3000.00 (mm)
750.00
2250.00
Y
Z
X


ANSYS
R19.2
A: Steady-State Thermal
Temperature
Type: Temperature
Unit: K
Time: 1
295.15 Max
272.23
249.3
226.38
203.45
180.53
157.61
134.68
111.76
88.833 Min
0.00
1500.00
3000.00 (mm)
750.00
2250.00
Y
Z
X

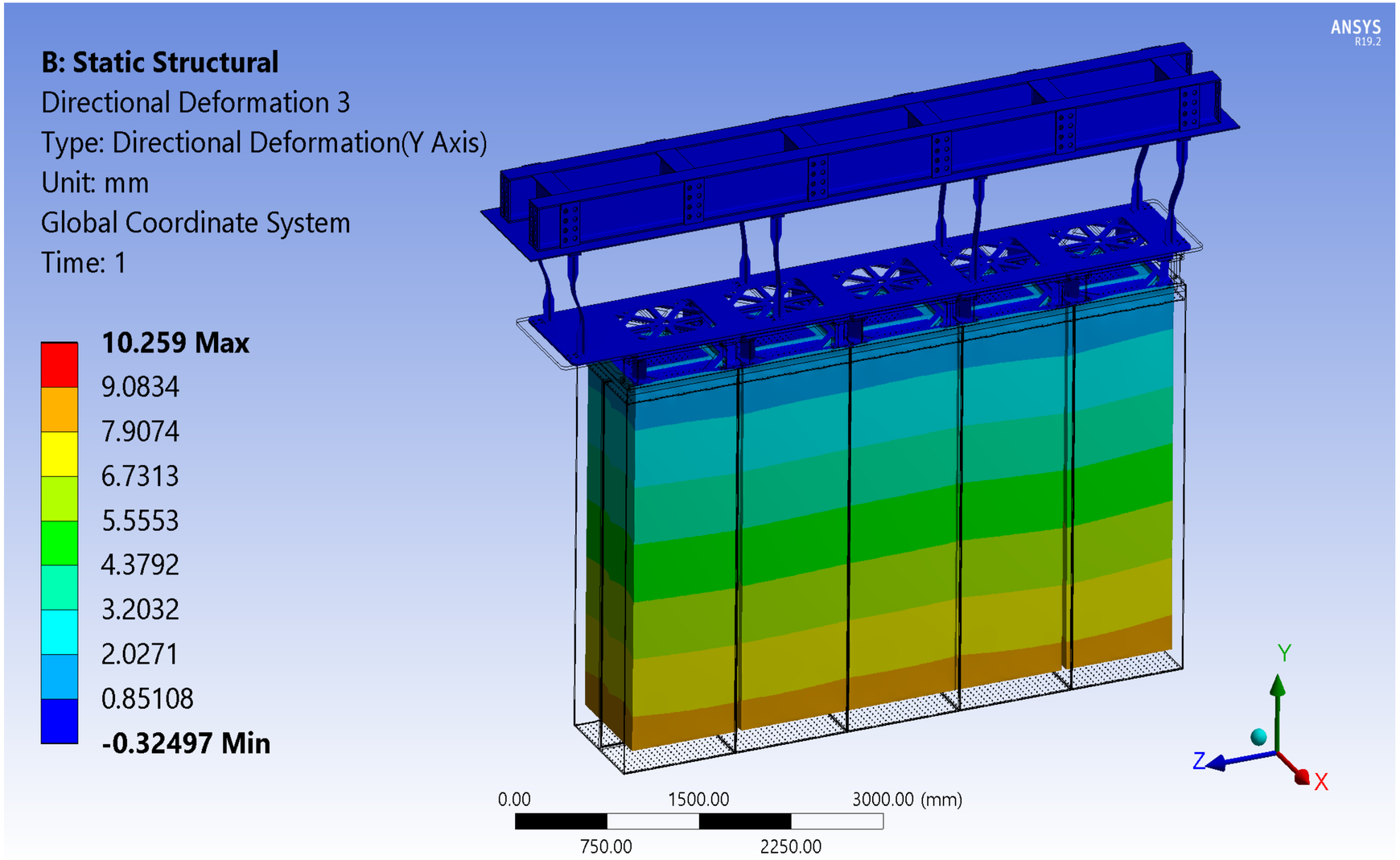
Thermal FEA – Total deflection



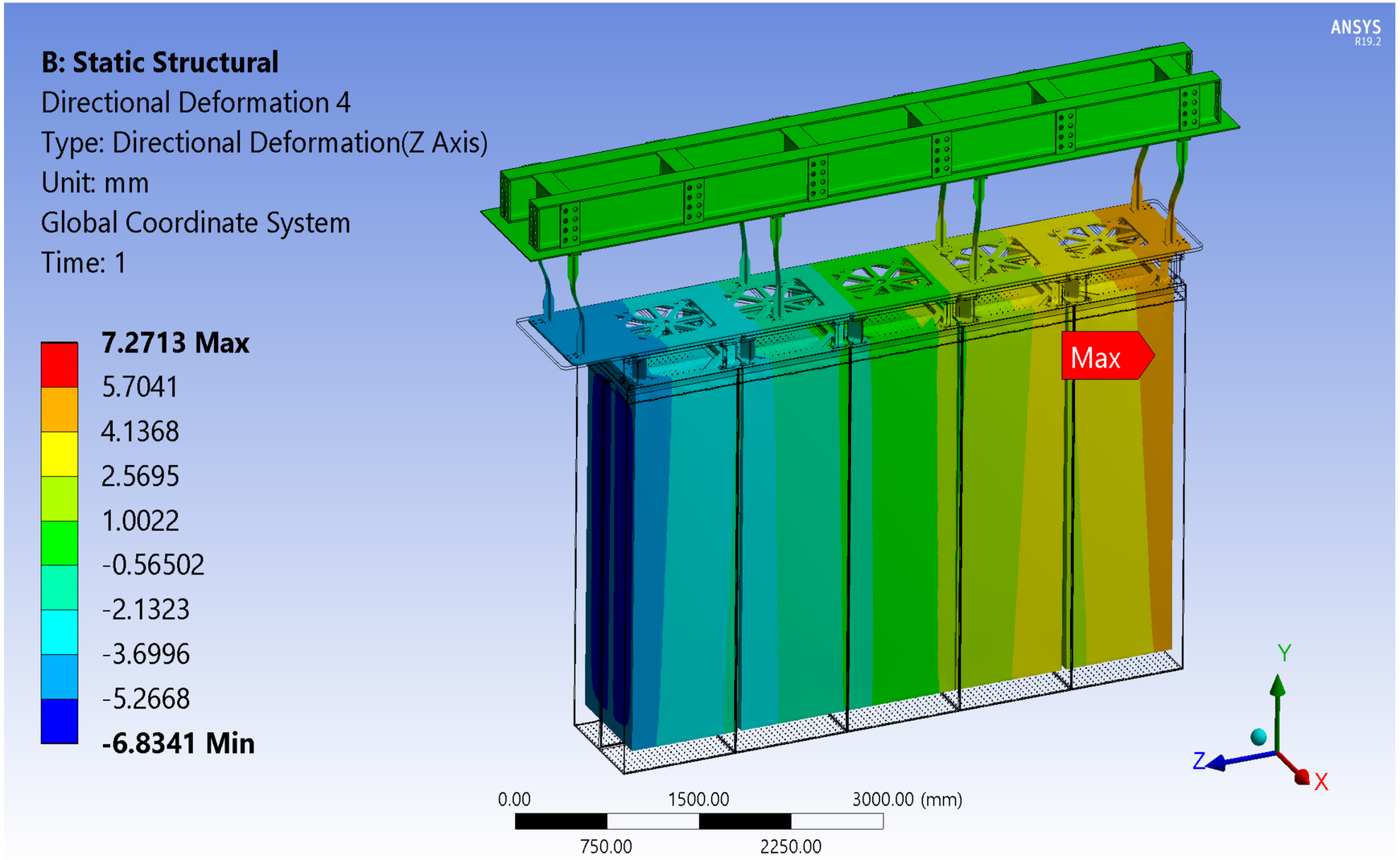
Thermal FEA – x-axis deflection



Thermal FEA – y-axis deflection

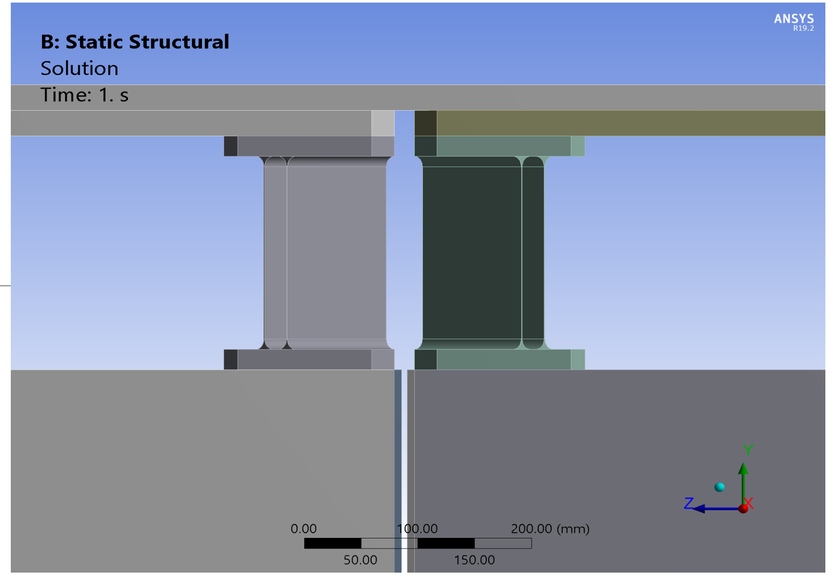
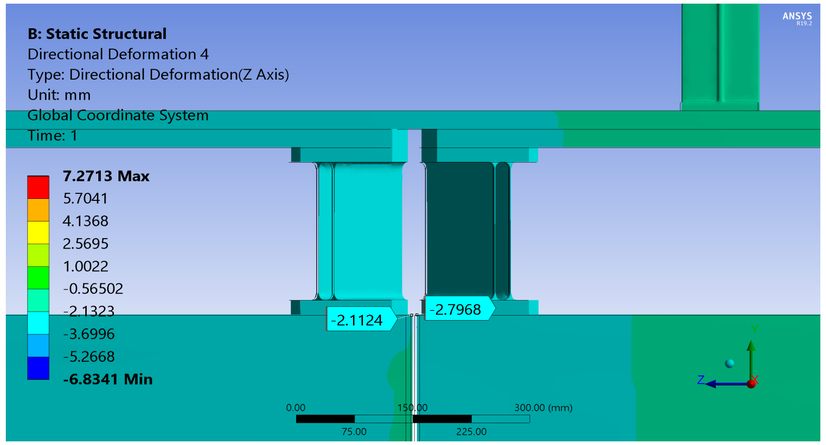
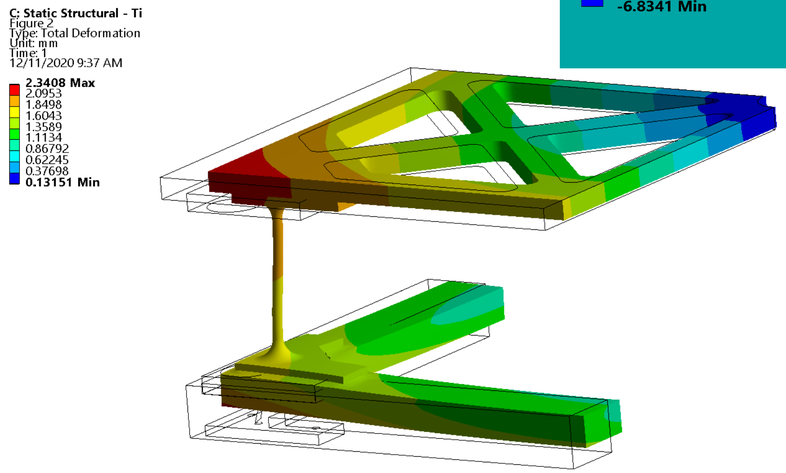


Thermal FEA – z-axis deflection



Simplifying flexures

Minimal change in module separation indicates that thermal driven deflections not main consideration for potential module interferences at cold temperature.

Stainless steel plate contacts enough to match the G10 well. Some uncertainty on G10 properties in LAr, overall though the G10 will shrink so interference is unlikely.

A simpler flexure design can be adopted.