Comparison of the Deflection and Stresses Between CRP and CRU Installation

October 30th, 2024

CRP Model

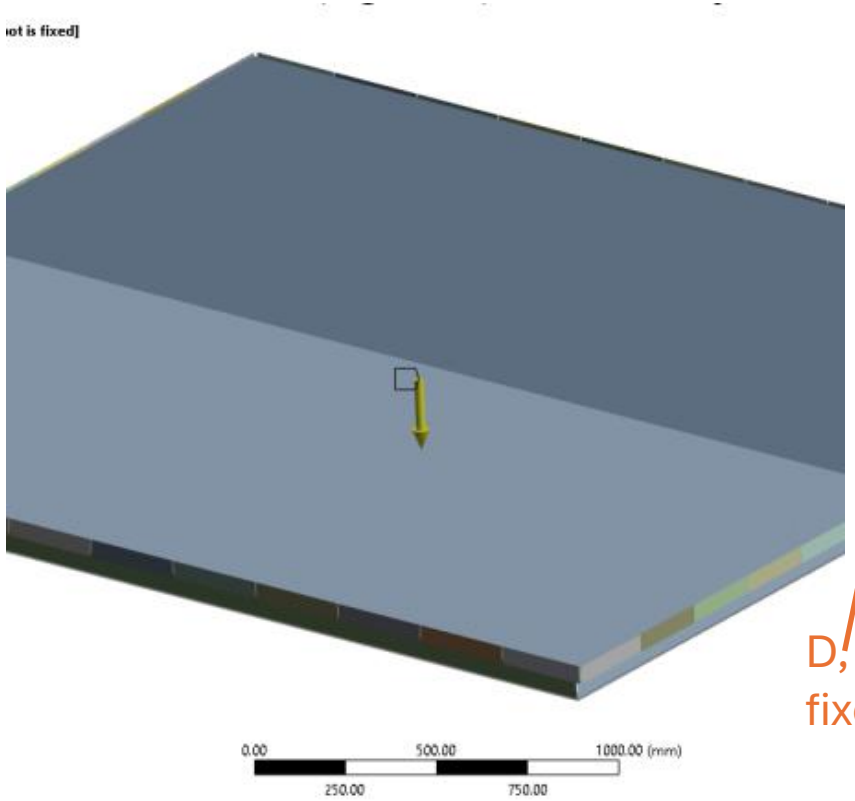


Figure 62 : Loading condition - Gravity

Standard Earth Gravity

D, fixed

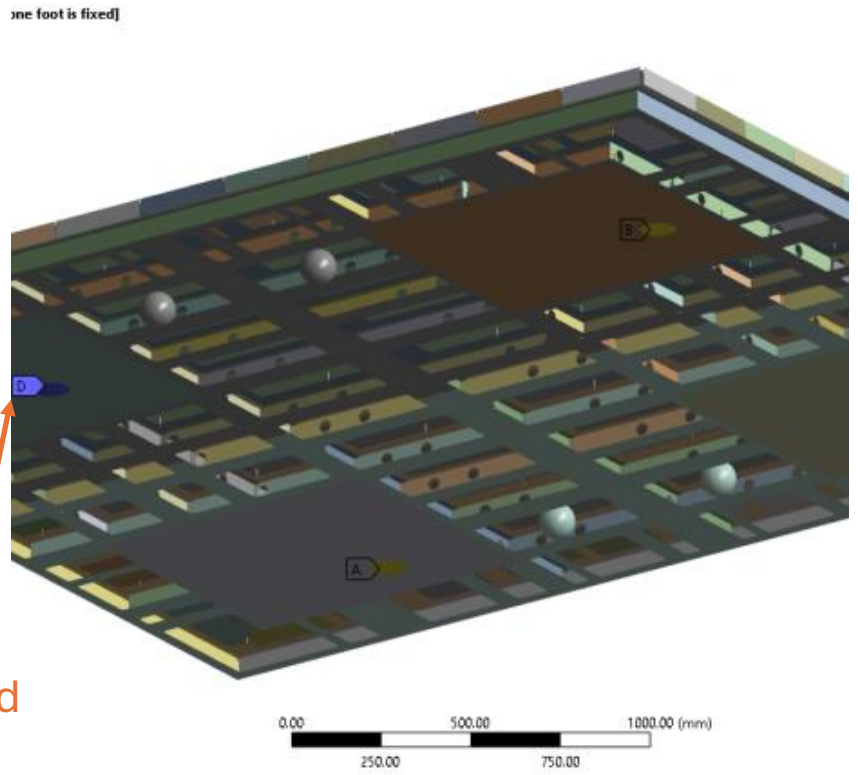


Figure 63 : Boundary condition - Bottom CRP standing on 4

D is treated as fixed, with A B C free to slide.

CRP Anode Deformation

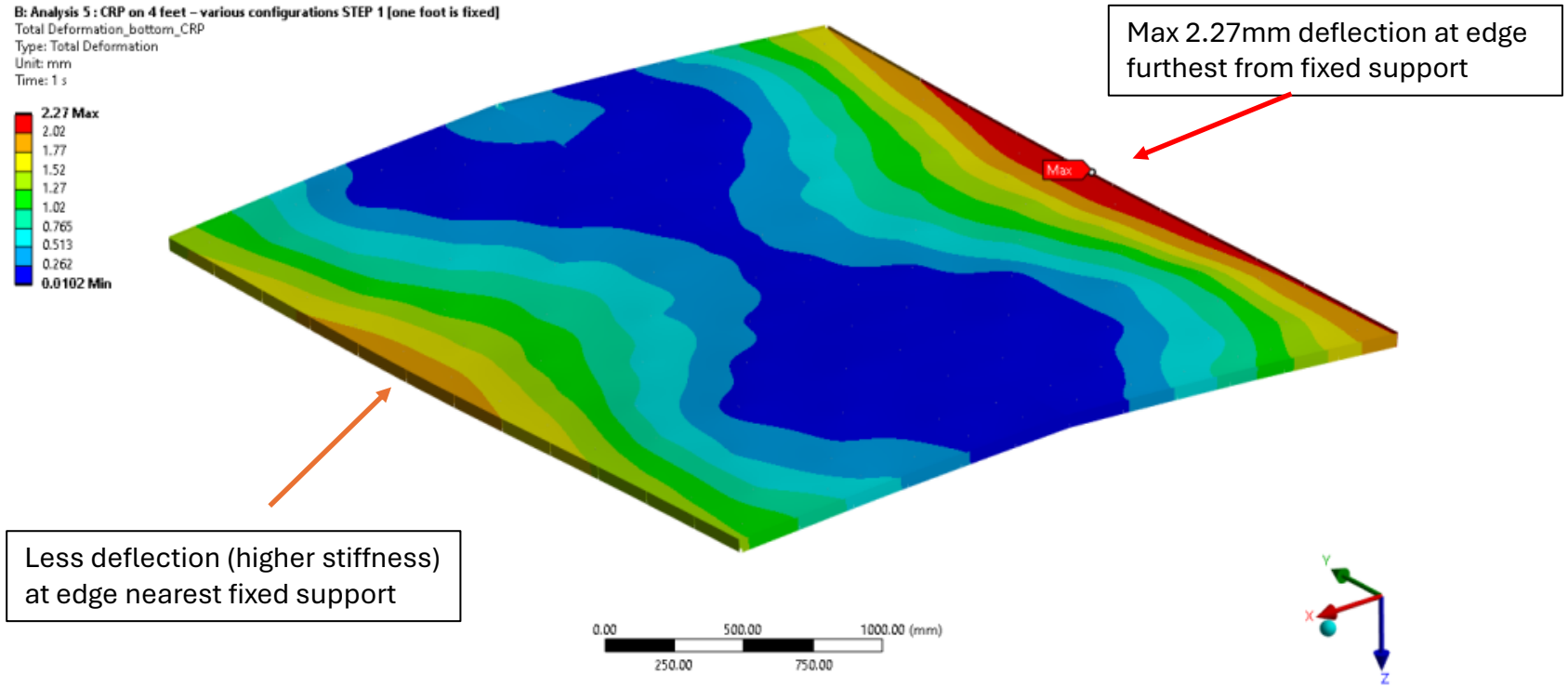
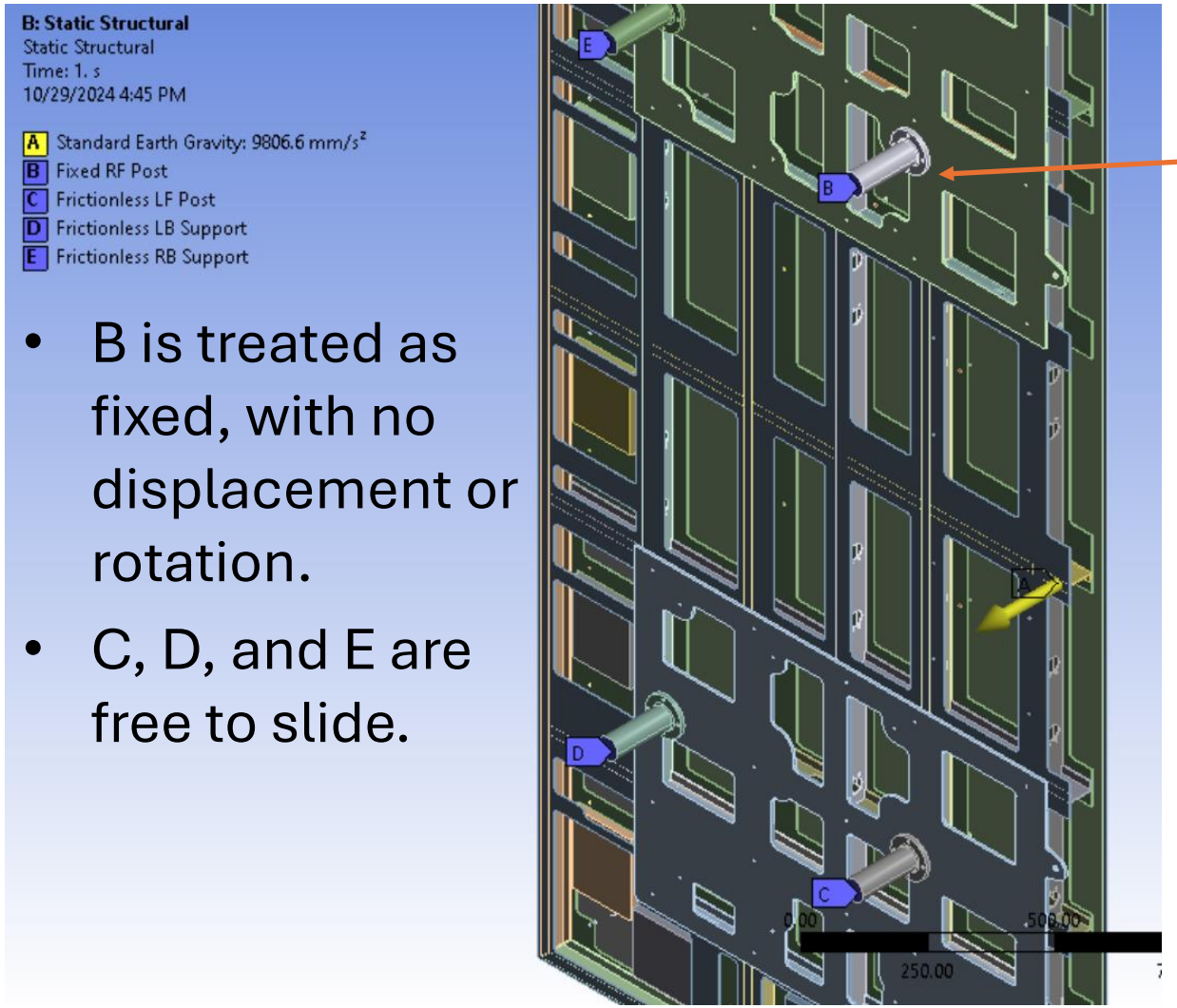


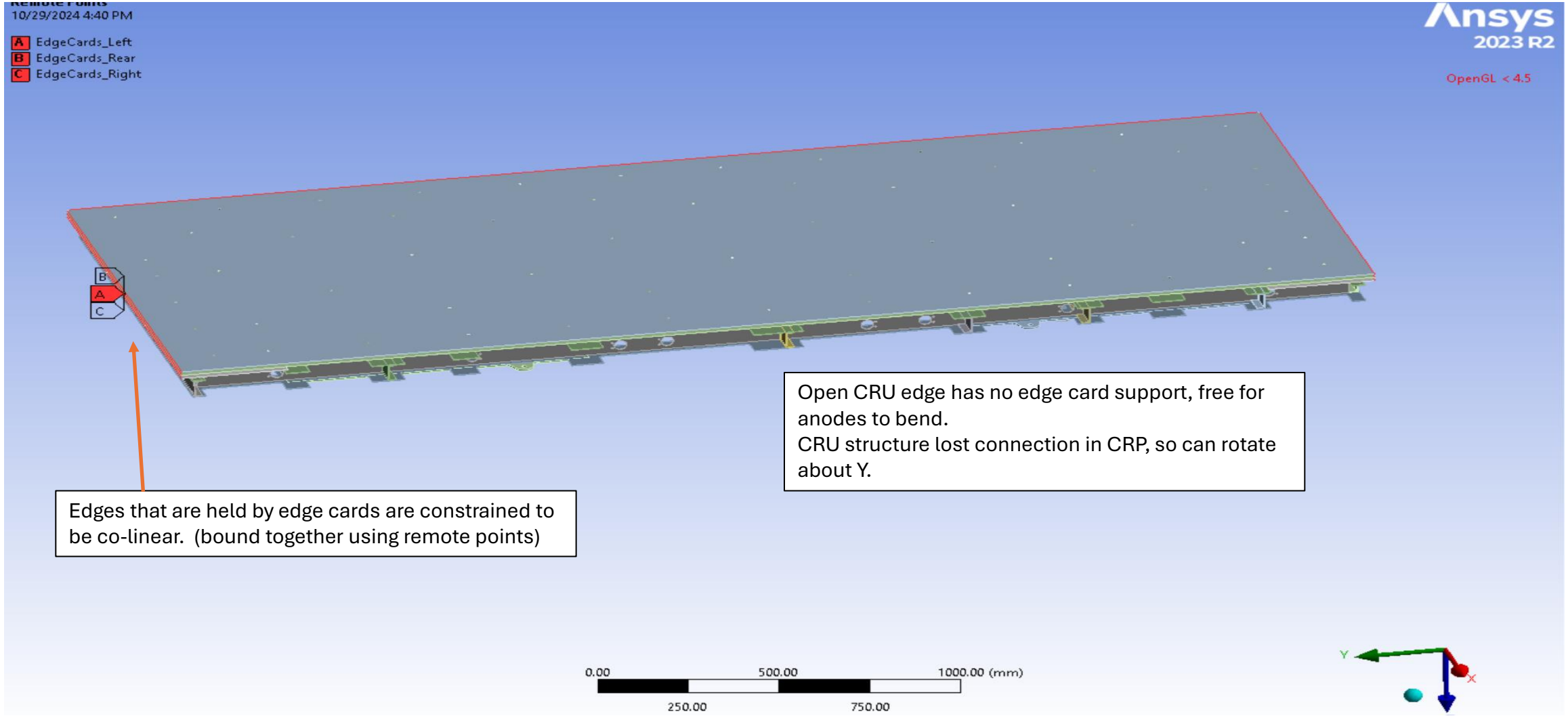
Figure 132: Analysis 6 step 1 - Anode - Total deformation

CRU Model Boundary Conditions



- B is treated as fixed, with no displacement or rotation.
- C, D, and E are free to slide.

CRU Model


10/29/2024 4:40 PM
A EdgeCards_Left
B EdgeCards_Rear
C EdgeCards_Right
Ansys
2023 R2
OpenGL < 4.5
B
A
C
Edges that are held by edge cards are constrained to be co-linear. (bound together using remote points)
Open CRU edge has no edge card support, free for anodes to bend.
CRU structure lost connection in CRP, so can rotate about Y.
0.00
500.00
1000.00 (mm)
250.00
750.00
Y
X

Would a Stainless-Steel Adapter Plate Work?

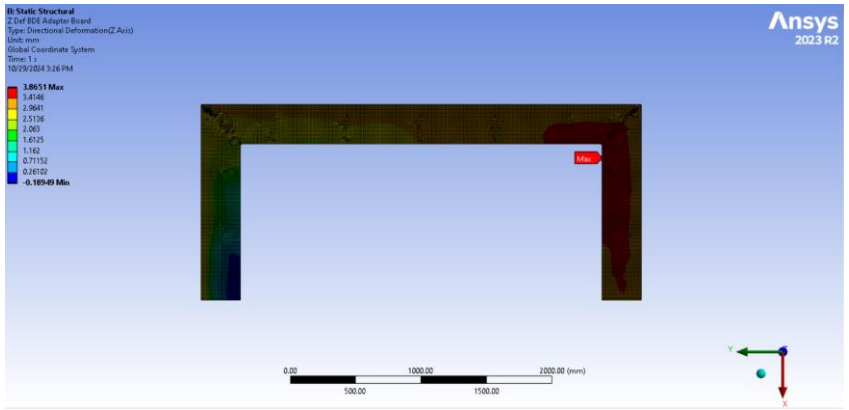
Last time we discussed the possibility of making the adapter plates from stainless steel.

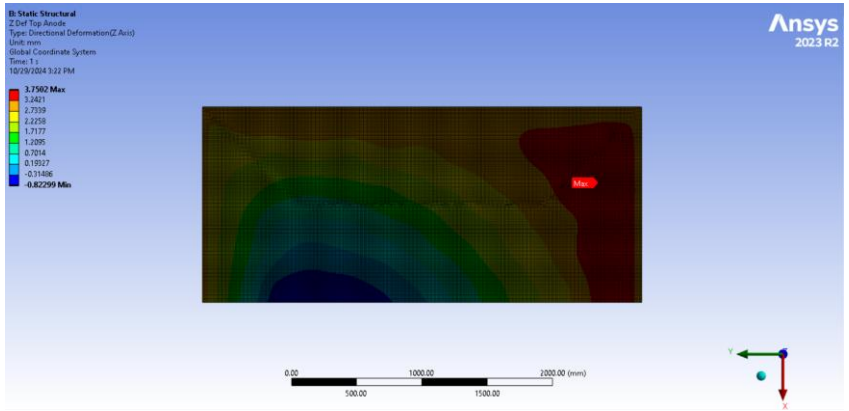
The questions we need to answer to determine if it is suitable are:

1. Are the deformations in the PCB planes acceptable?
2. Are the stresses in the PCB spacers acceptable?
3. Are the stresses in the structure acceptable?

Let's compare the answers to these questions for both G10 and Stainless-Steel Adapter Plates.

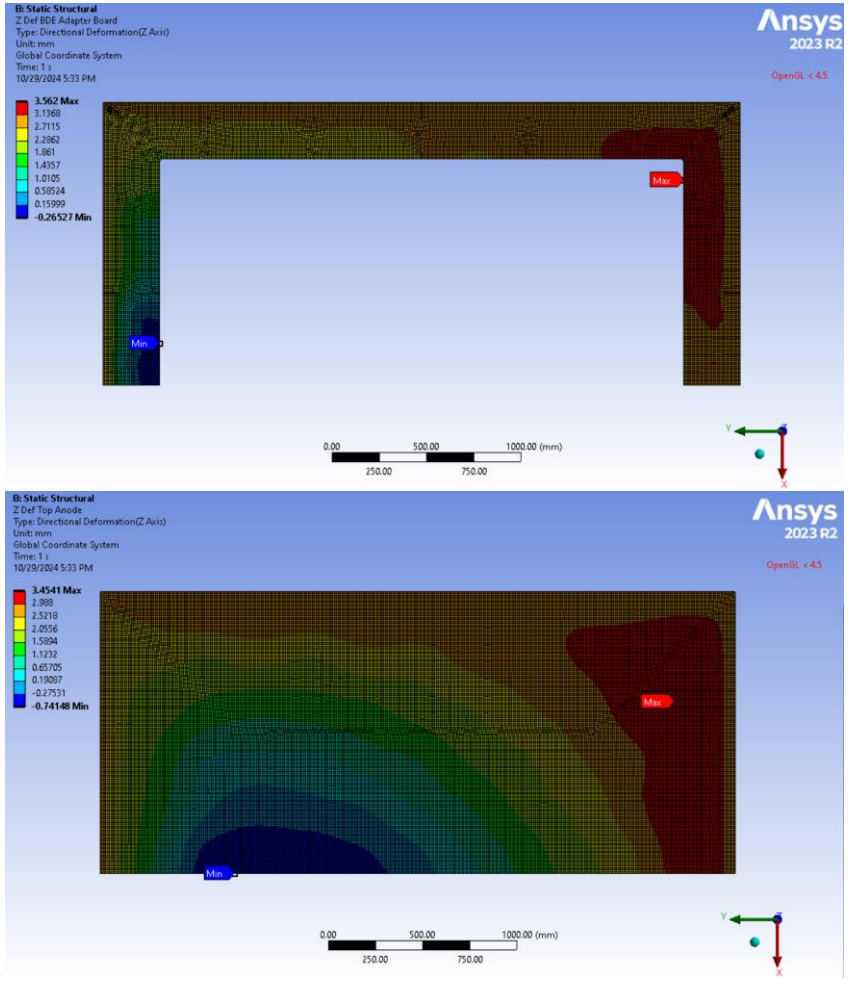
G10 PCB Plane Deflections





- Maximum deflection of 3.87mm in the BDE adapter boards.
- This is greater than that of the CRP, but this is expected due to the lack of edge cards and stiffness added by the bolted connection of the two CRU together.
- Asymmetry is an artifact of the singular perfectly fixed foot, but this is the same as the original CRP model.

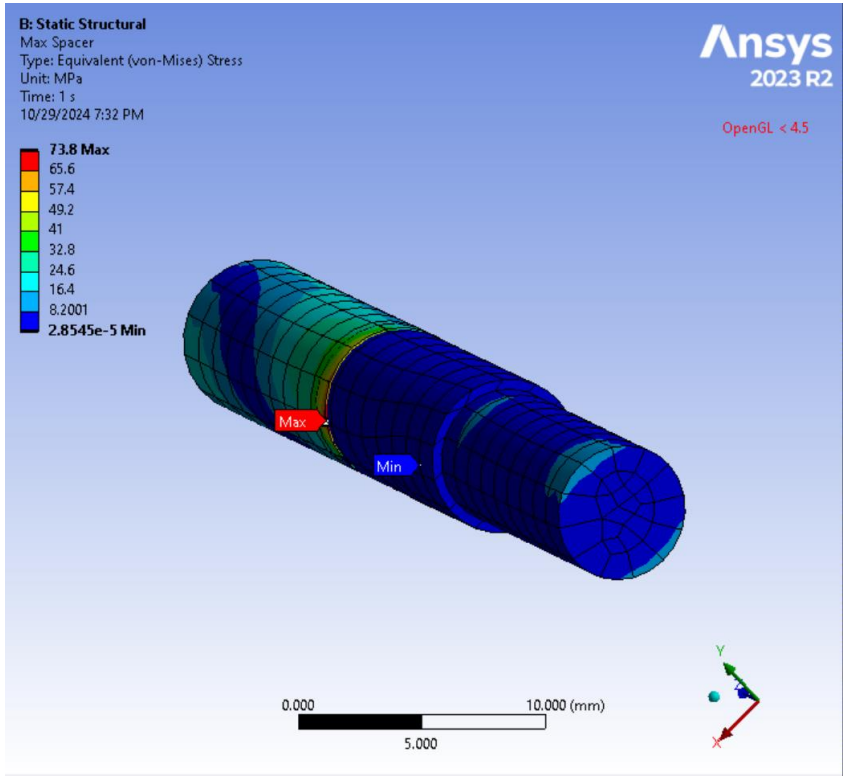
Stainless-Steel PCB Deflection



- Less deformation than the G10 CRU but more than the original CRP design.

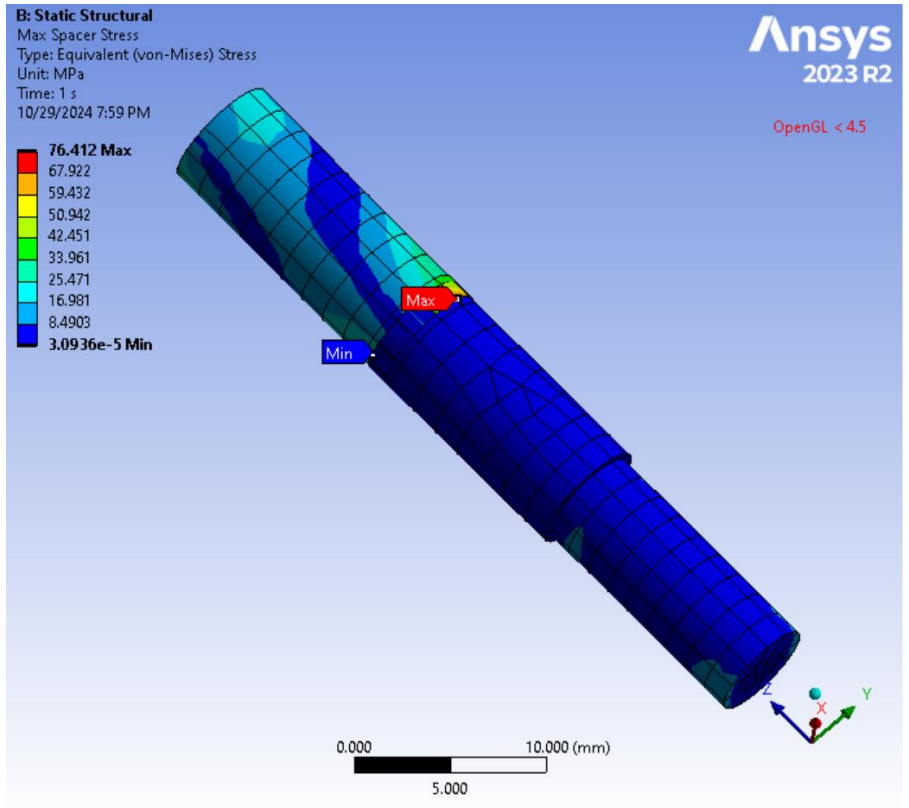
Stainless Steel adapter plate: max load on Anode Spacer

- The reported maximum is an artifact of the bonded contact at that face to the PCB.
- The integral average of von Mises stress in this spacer is 5.7MPa.
- This is the spacer with the worst stress.



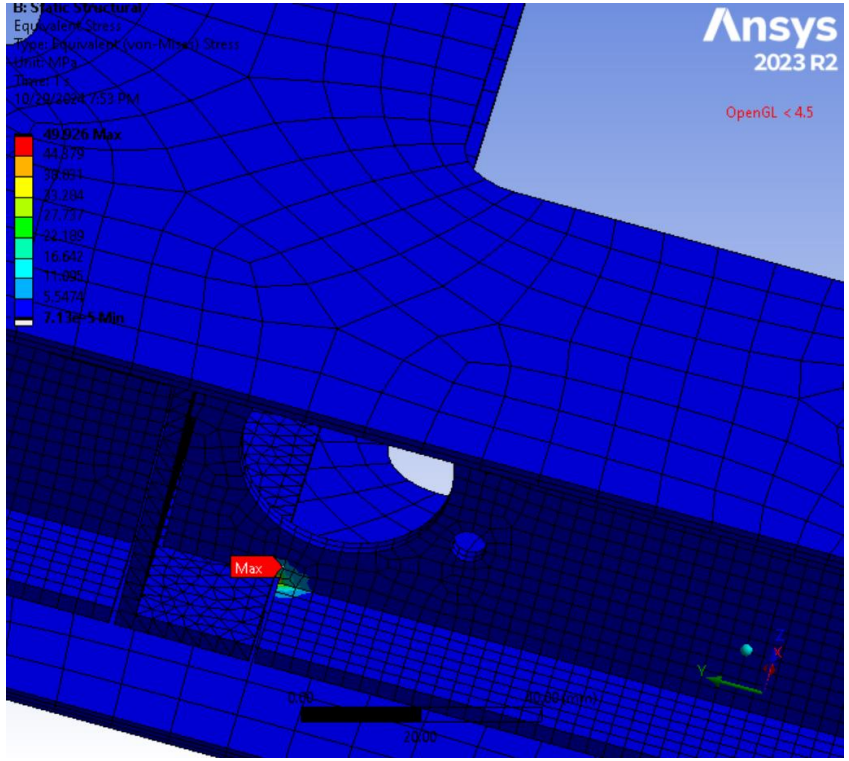
G10 adapter plate: max load on Anode Spacer

- The reported maximum is an artifact of the bonded contact at that face to the PCB.
- The integral average of von Mises stress in this spacer is 10MPa.
- This is the spacer with the worst stress.



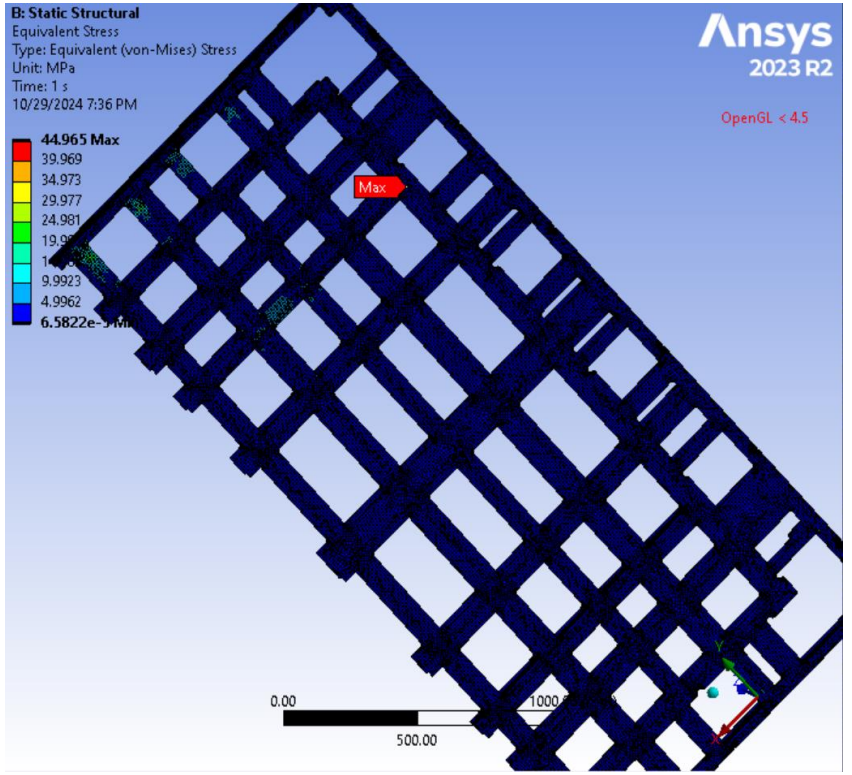
G10 Adapter Plate Stress: max stress in CRU structure

- Maximum of 50MPa located within a channel beam member. Occurs at a point where two beams intersect and there is a cable hole.
- Integral average over the structure is 0.625 MPa.



Stainless Steel Adapter plate: max stress in CRU Structure

- Maximum von Mises stress of 44.65, located within a channel beam member.
- The integral average is 0.63 MPa.



Conclusions

- Separating the CRP and removing material from the adapter plates have significant negative impacts on the stiffness of the structure. This is not surprising, but worth noting.
- Making the adapter plates from stainless has better outcomes than G10, and we predict will be cheaper.
- The deformations shown here will be less extreme after LAr fill due to buoyant forces. It would be equivalent to approximately 0.3g.

Next Time

- Model the Unistrut frame approach in this condition.
- Model all three configurations as they are installed in liquid argon.
- Further model development.

Question About FEMB Mounting

- The model shows that the only connection to the FEMB is the spacers to the BDE Board.
- Effectively, the FEMBs are hung by the BDE board.
- Is this how the FEMBs are mounted?
- The deflection predicted by the model considering the FEMBs hung under the BDE board is larger than anticipated (> 1mm) in the dry install position.