

DUNE APA shipping packing update

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1-Mar-2021

Outline

- Reminders and progress since the collaboration meeting's update
- Step-by-step install
- Shipping update
- Next steps

Key players?

- APA shipping core team
 - Peter Sutcliffe (Liverpool)
 - George Stavrakis (Liverpool)
 - Jeff Nelson (William & Mary)
- Broader APA contributors
 - Dan Wenman (PSL/Wisc)
 - Ang Lee (Fermilab)
 - Giuseppe Gallo (Fermilab)
 - Alberto, Justin, Brian
- CERN team
 - Olga Beltramello, CERN
 - M. Carlini, CERN
 - Jean-Louis Grenard, CERN
 - Jan Hrivnak, CERN
 - Benoit Lacarelle, CERN
 - Dimiter Mladenov, CERN
 - Alberto Rigamonti, CERN
 - Mariana Zimbru, CERN

Reminder

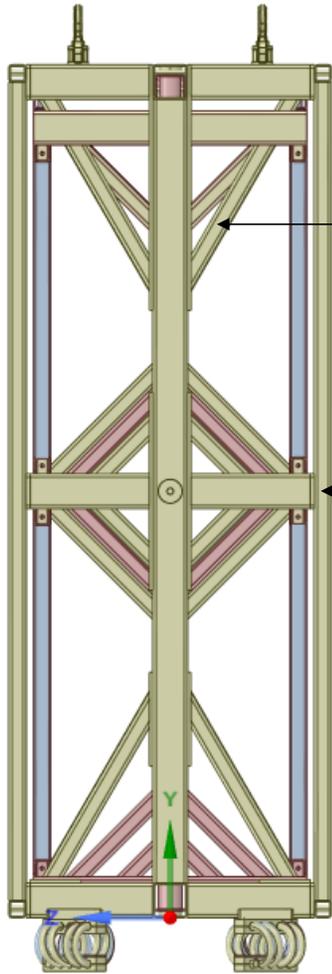
- After the review last summer CERN helped with a simplified “beam model” that allowed for an integrated analysis of the entire frame+isolators+APA system
 - The design was found not to be stiff enough and coupled to vibrations during shipping
- CERN iterated a design in their model until they found a good response – they delivered that design to the APA team for integration/finish late last year
- At the [collaboration meeting we presented the updated design](#)
- On 2/1 we also sent this revised design back to the CERN group to verify that the (mostly incremental) design updates would not impact the dynamic analysis

CERN's 2/9 summary of the revisions

“Minor changes were brought to the ASF design of December 2020. These changes are necessary for operational activities and/or improved fabrication and are deemed acceptable as they do not significantly impact the dynamic response of the structural assembly. The changes include:

1. Height
2. Inclination of the diagonal bars at both end sides of the SF was increased to allow for access
3. The cross section of the Longitudinal central-top bar was increased.
4. The attachment of the lateral frame was changed.
5. Parts of the structure were made removable
6. Plates were added between orthogonally welded sections.”

They also shared a set of model overlays for comparison



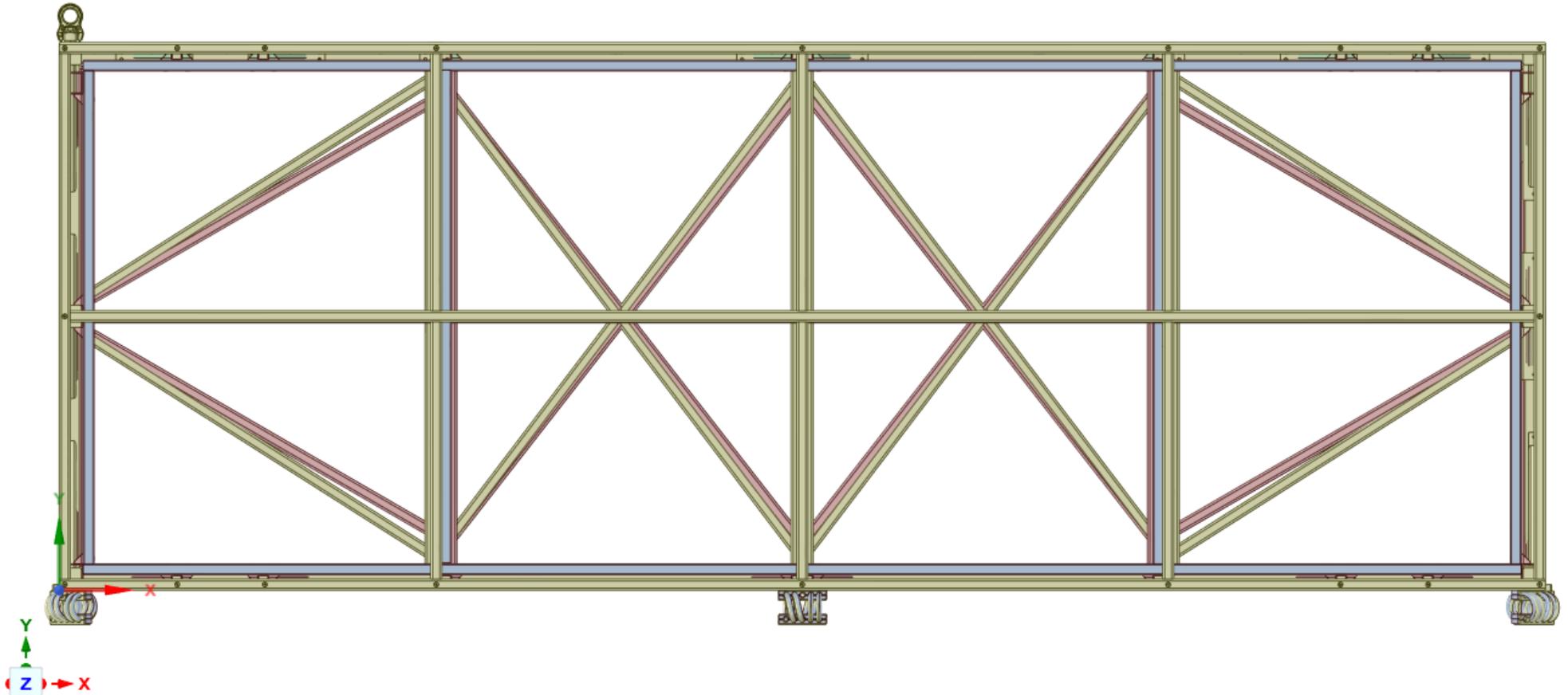
Height

Inclination of end side braces

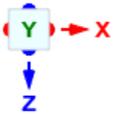
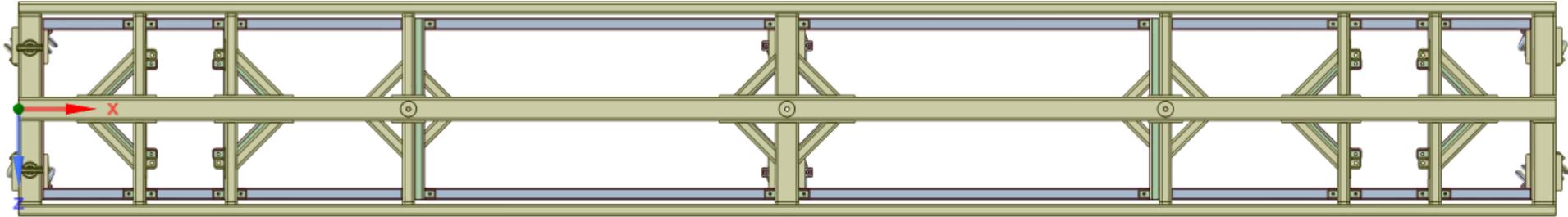
Lateral frame attached on the edge of central frame tubing

Yellow – new design
Red&Blue – CERN design

*Yellow – new design
Red&Blue – CERN design*

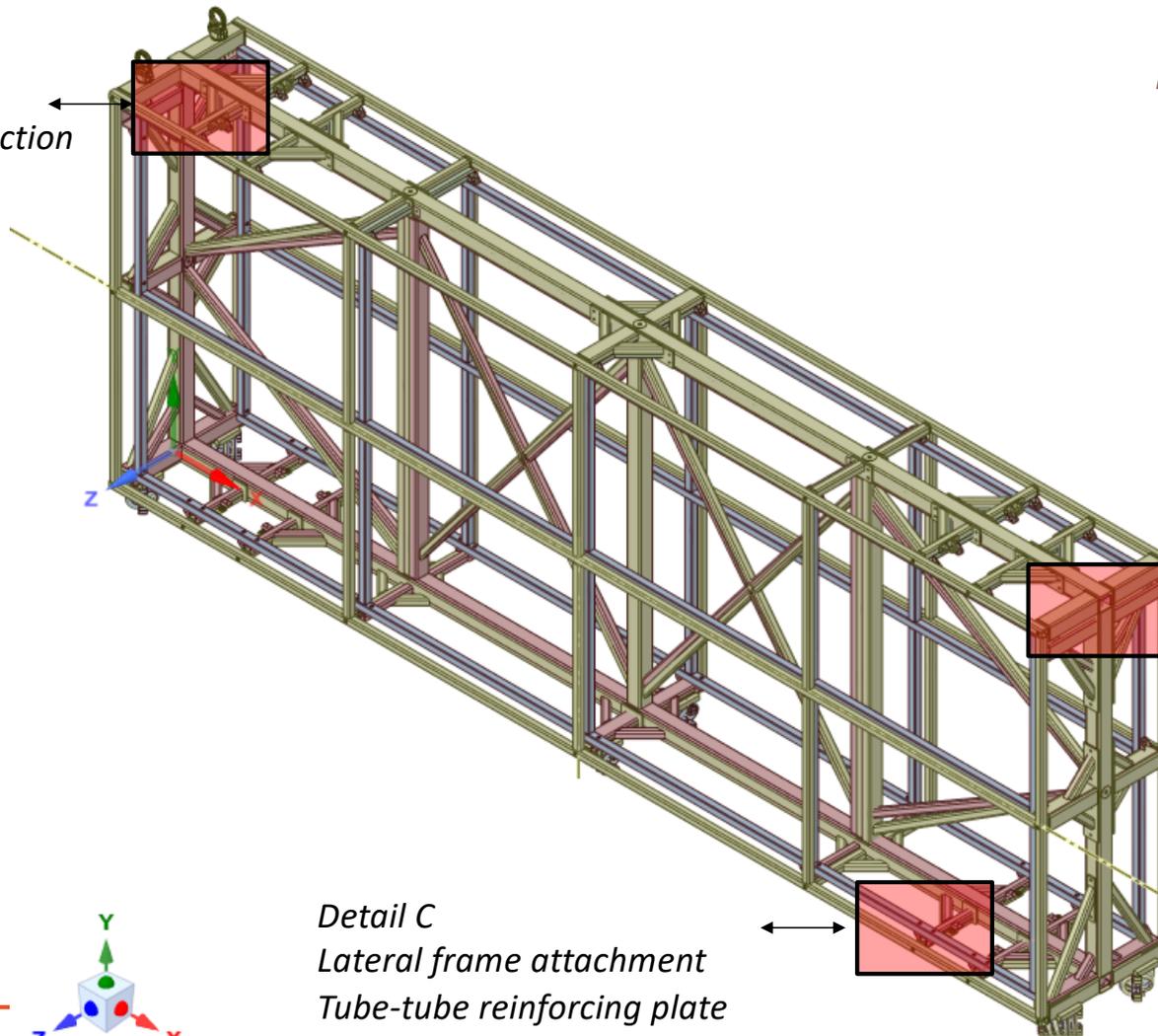


Yellow – new design
Red&Blue – CERN design



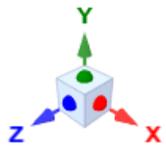
Detail A
ASF to APA connection

Yellow – new design
Red&Blue – CERN design

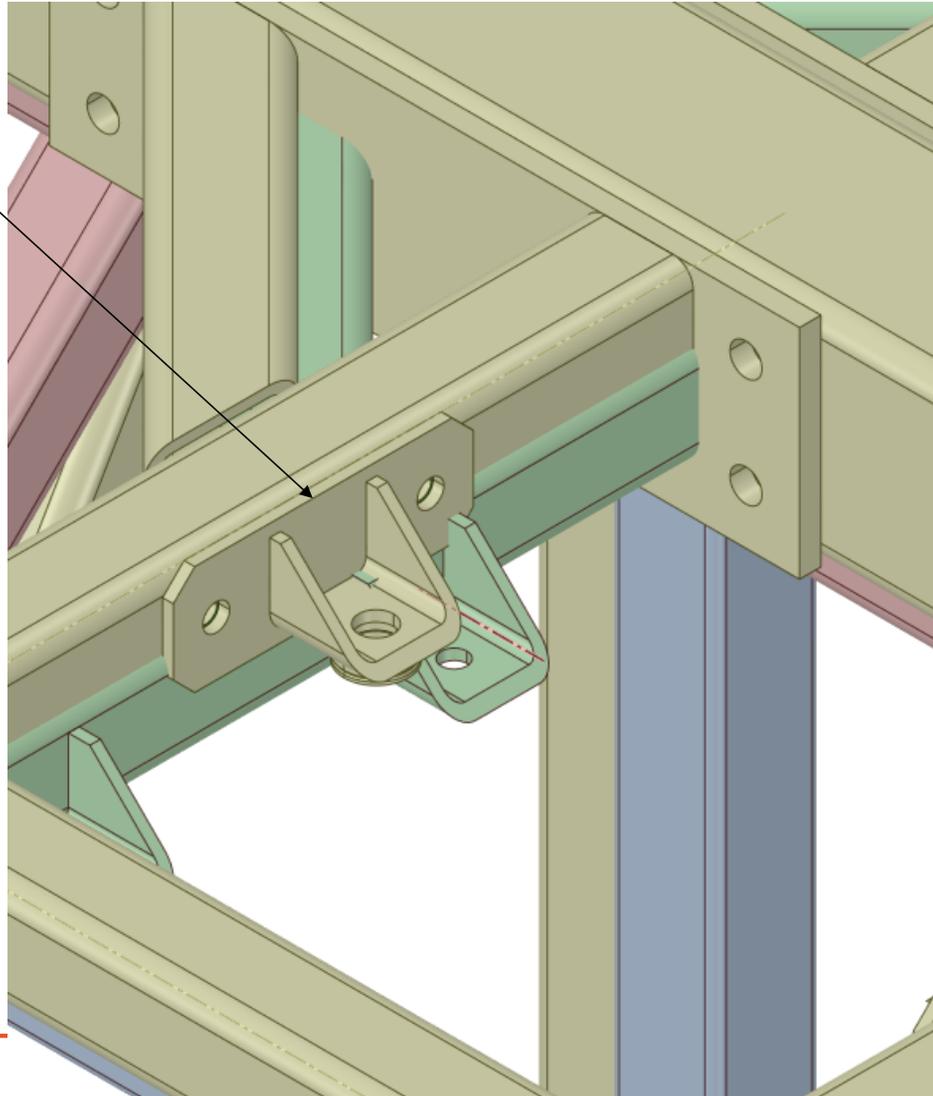


Detail B
Top central tube section

Detail C
Lateral frame attachment
Tube-tube reinforcing plate



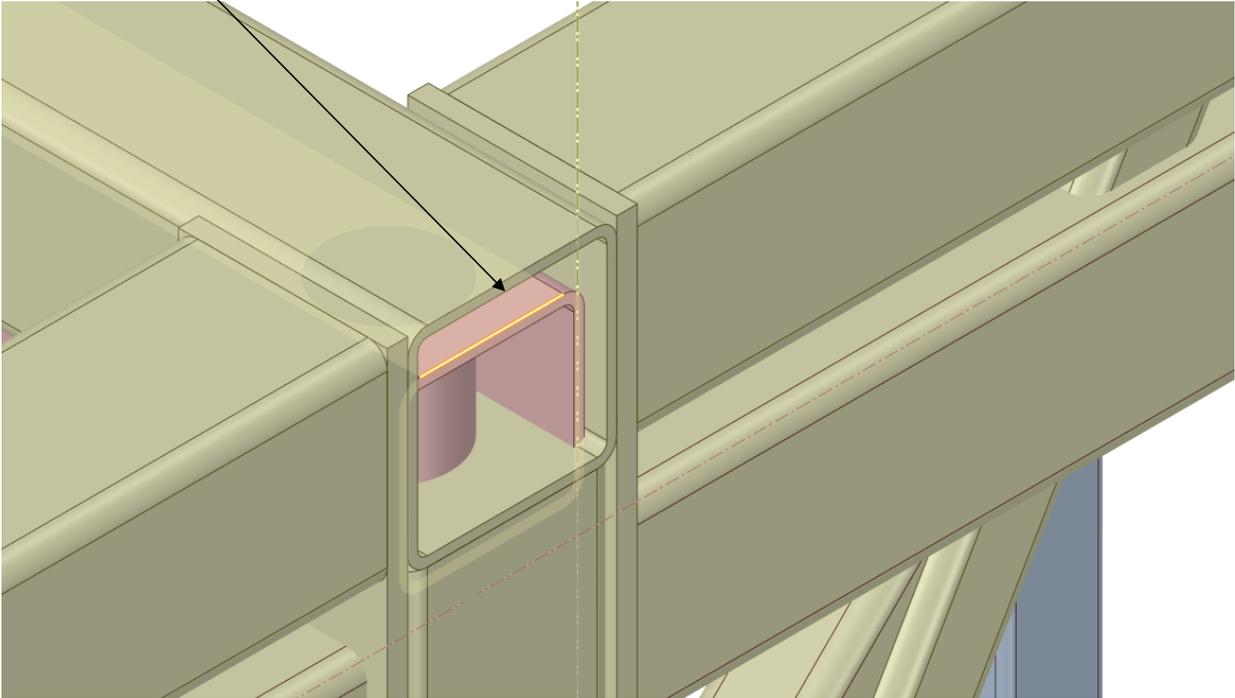
Detail A
ASF to APA connection
Bolted plate connection
was added



Yellow – new design
Red&Blue&Green – CERN design

*Yellow – new design
Red&Blue – old design*

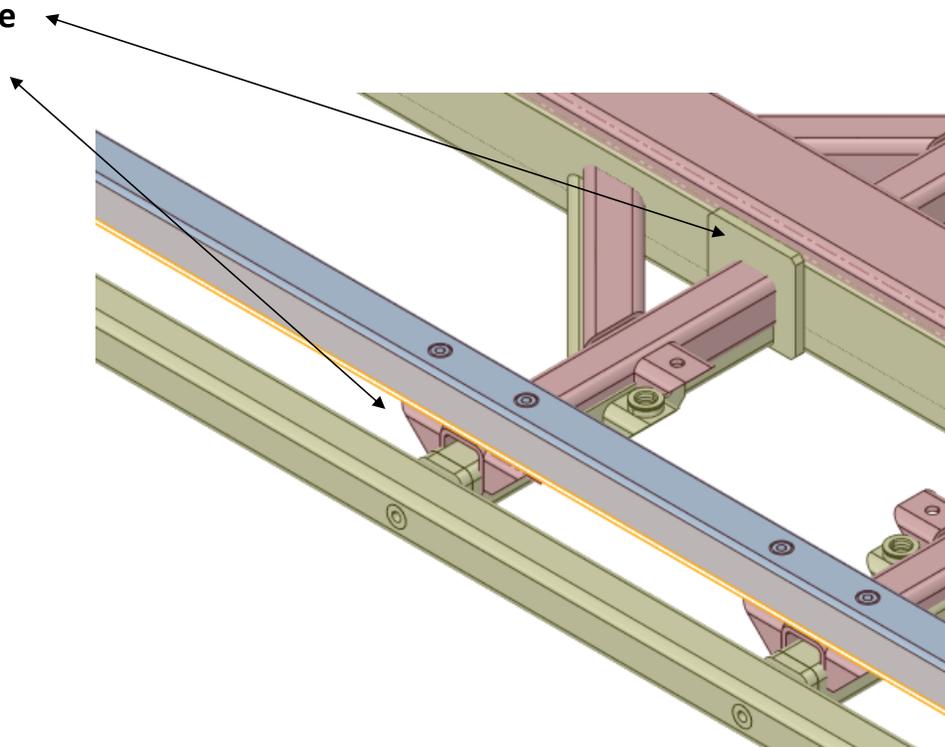
Detail B
Top central tube section
Increased from 90x90 to
100x100



Detail C

Tube-tube reinforcing plate

Lateral frame attachment

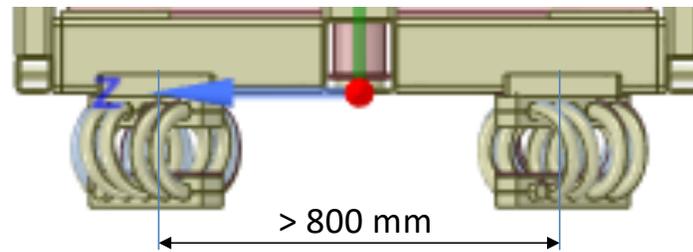


*Yellow – new design
Red&Blue – old design*

CERN's conclusion (2/9)

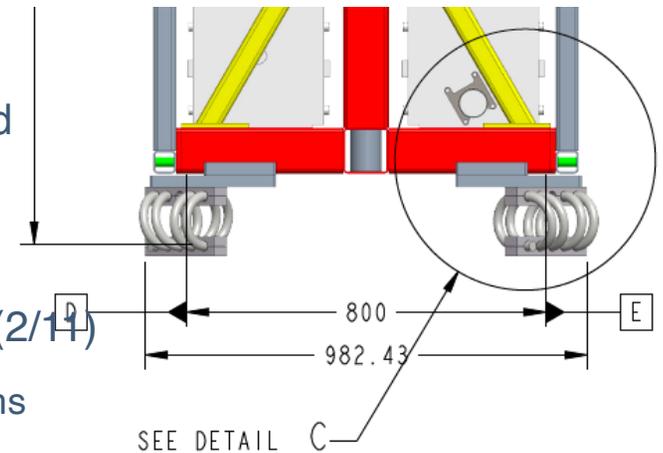
The following changes are necessary:

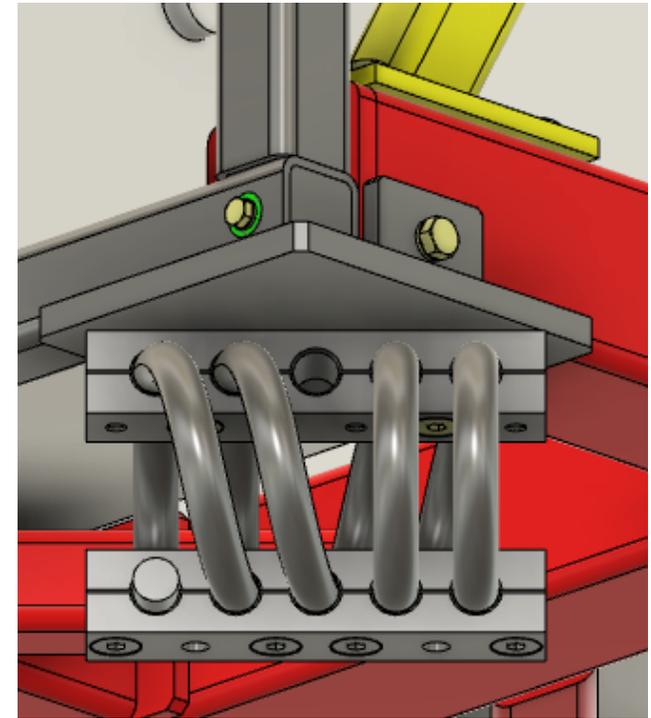
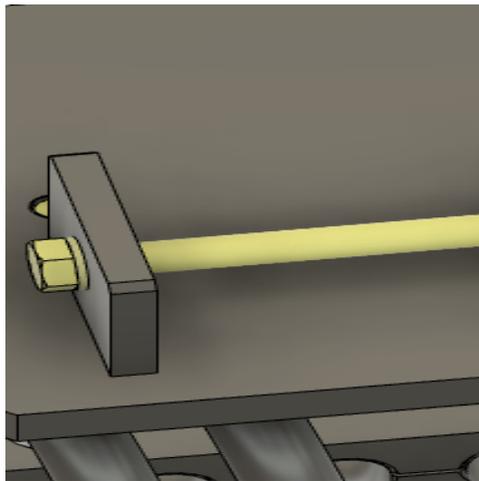
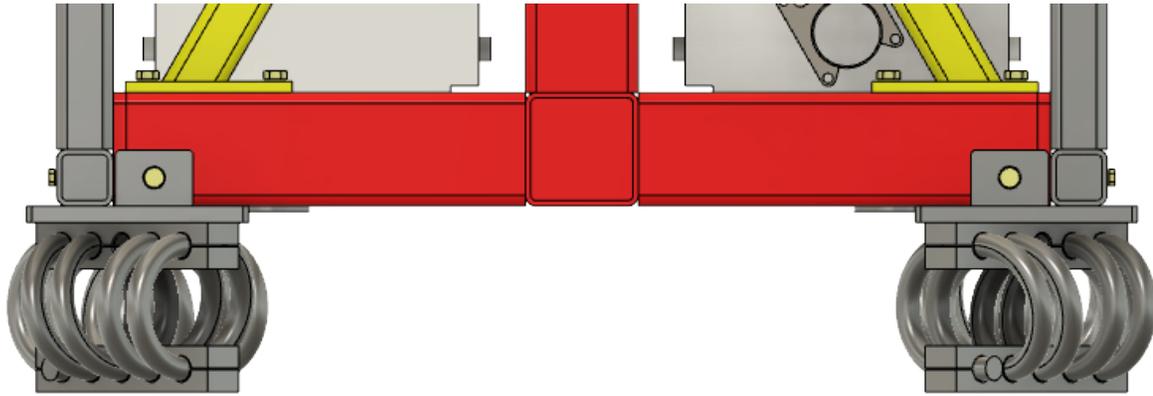
1. Lateral spacing of the WRAs must be 800mm inter-axis. Thus, the position of each WRA must be shifted 120 mm towards the exterior. This is necessary in order to limit the dynamic lateral displacements.

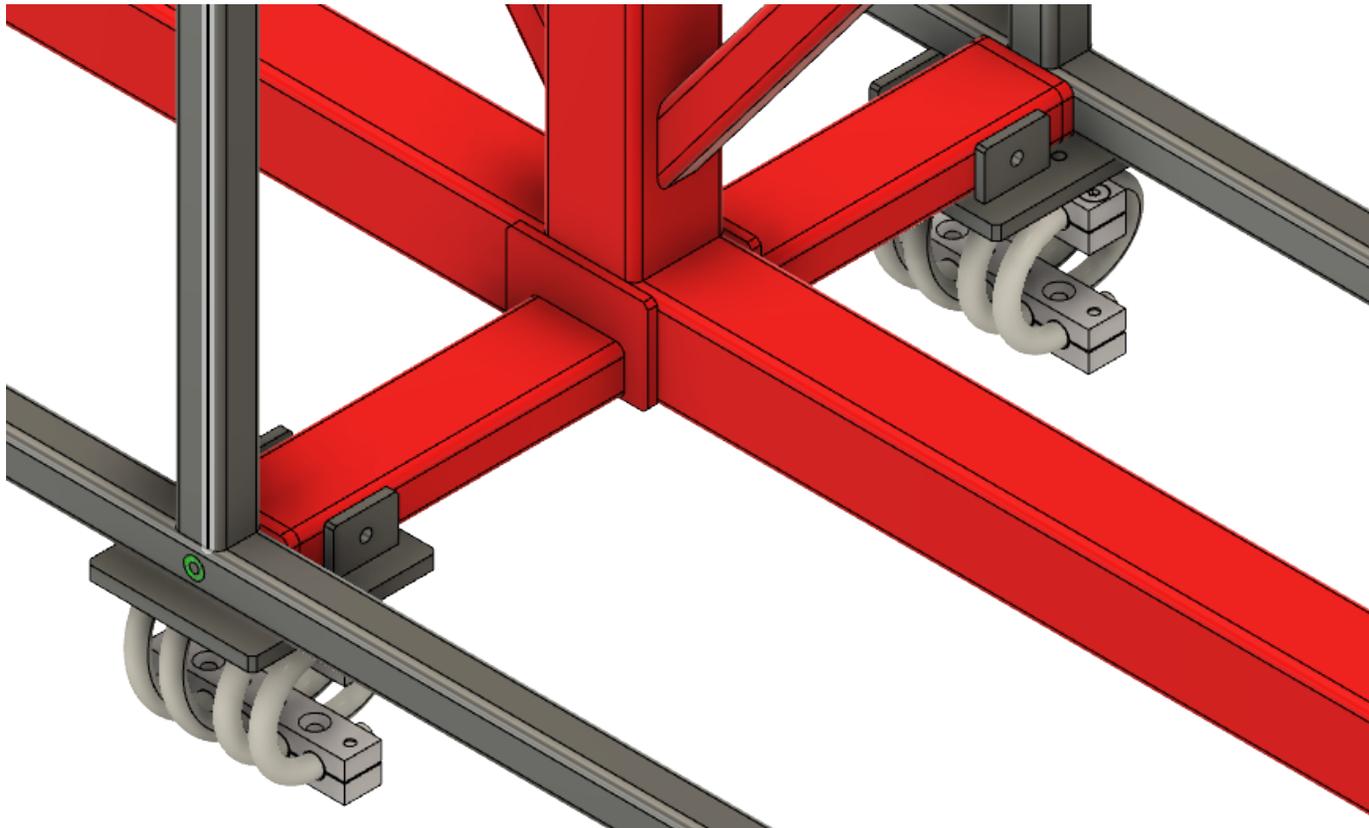


The shift from 560 to 800 mm c2c spacing

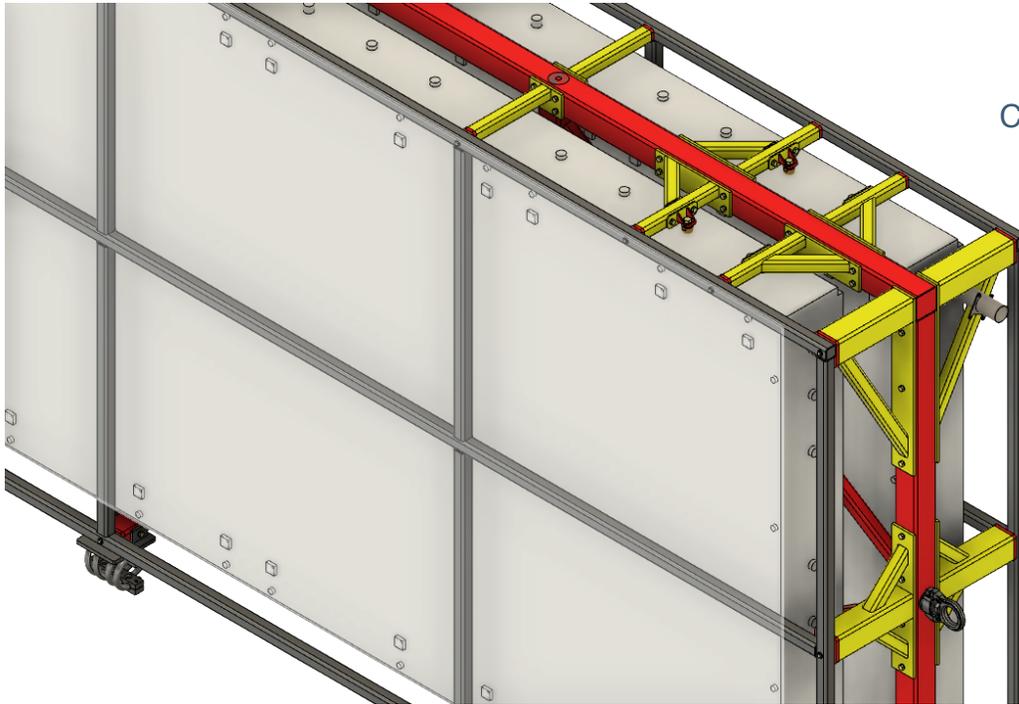
- Clearly an important aspect of the design
 - Note that the CERN frame was 800mm wide – and delivered without placed isolators
- This ended up not being straightforward
 - George made a “scenario drawing” to show that placement (2/14)
 - Necessitates plates that cantilever the isolators beyond the arms
- By 2/19 George and Benoit converge on a revised isolator mounting scheme







Since then...



- 2/24 version with fasteners released
- 2/25 meeting with TSG marine and engineering team(s)
 - Asking them for their own analysis report

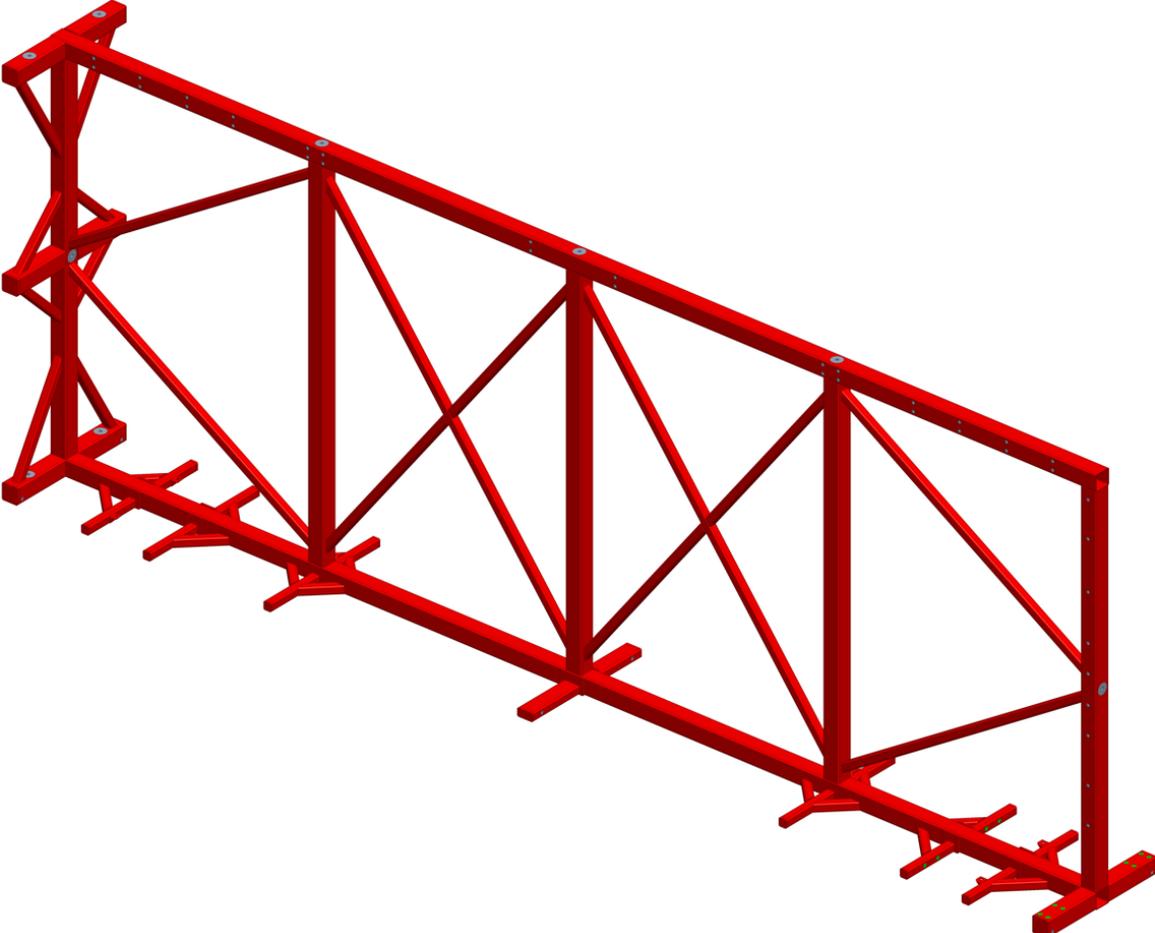
Current efforts

- Drawing set – for TSG analysis and US-based quotes [George]
- Outer skins - envisioned to be sheet steel [George]
- Documentation of mount and unmount steps by stage of operations [Jeff/George]
- Final APA consortium sign off on Analysis Plan
 - JKN has – others?
 - With that sign off, we think we are ready to start
- CERN will lead the new engineering analysis campaign
- Work on logistics model with SURF/Consortium
- Updated
- Update the cart design (Peter/Alan)

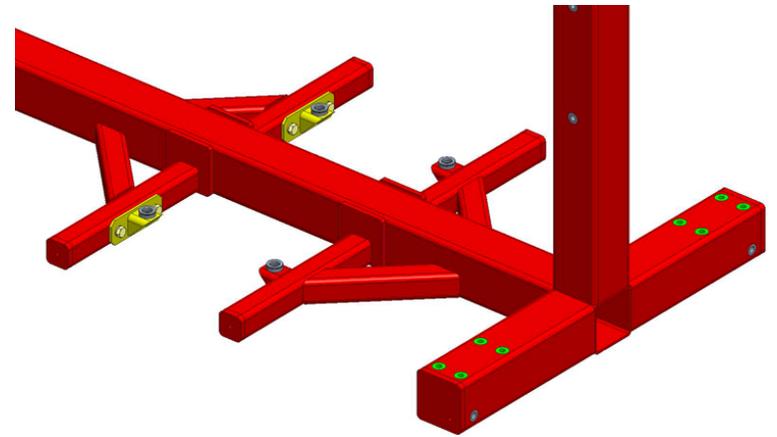
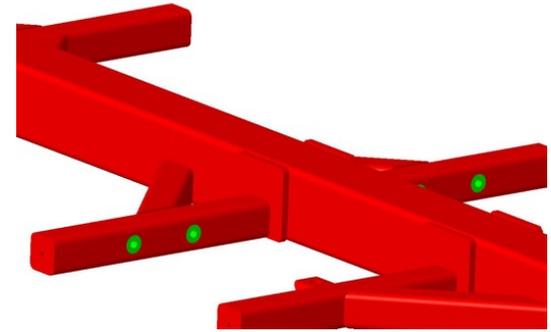
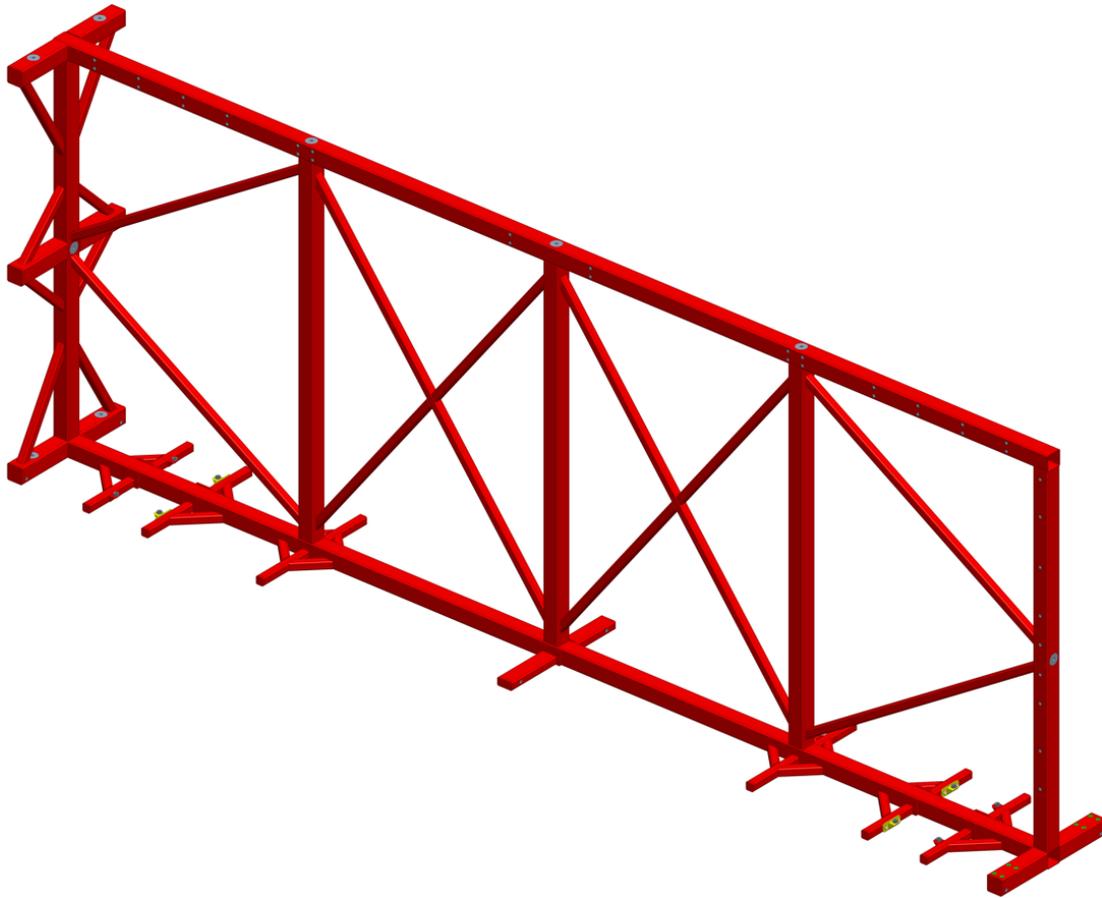
Installation of APAs



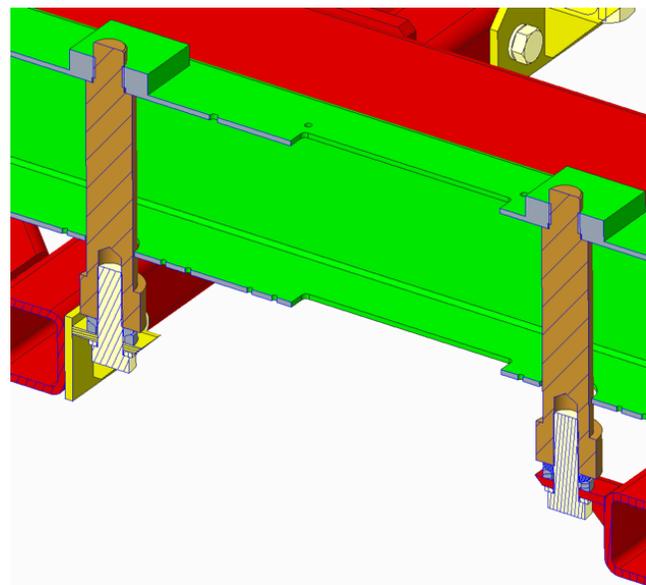
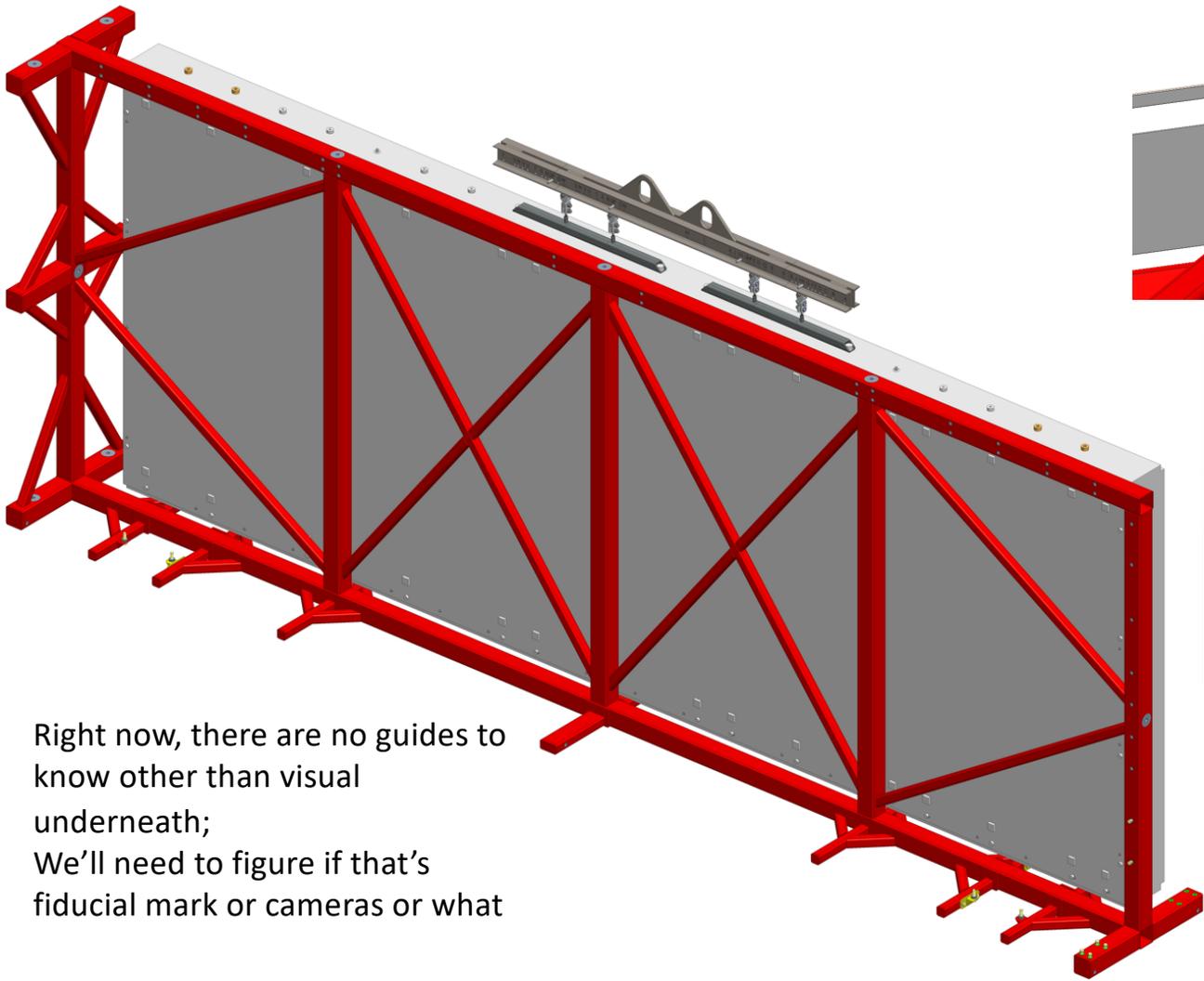
Start with an empty frame, mount on cart – not shown yet



Loose-bolt the lower mounts (yellow)

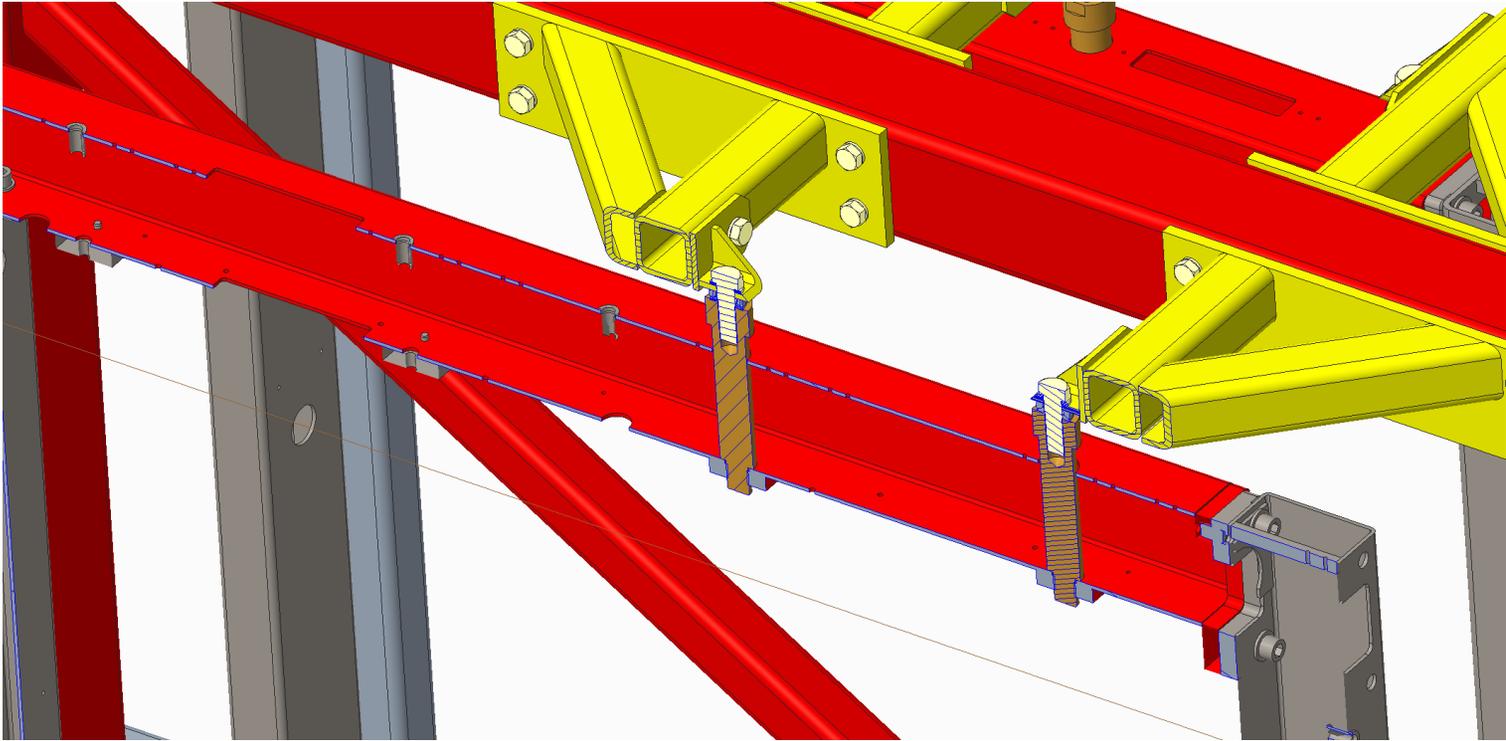


Right the first APA into place; connect lower mounts

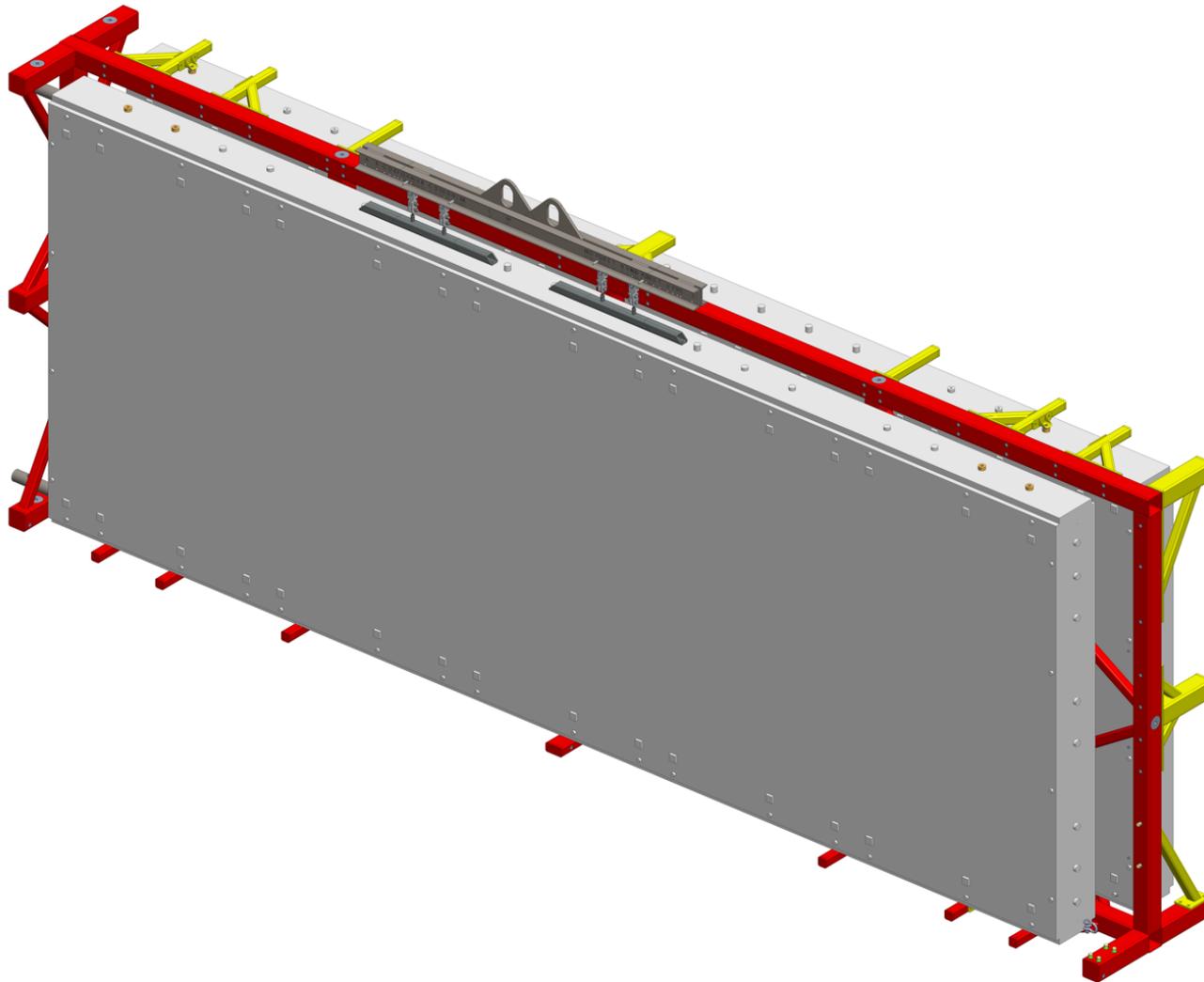


Right now, there are no guides to know other than visual underneath; We'll need to figure if that's fiducial mark or cameras or what

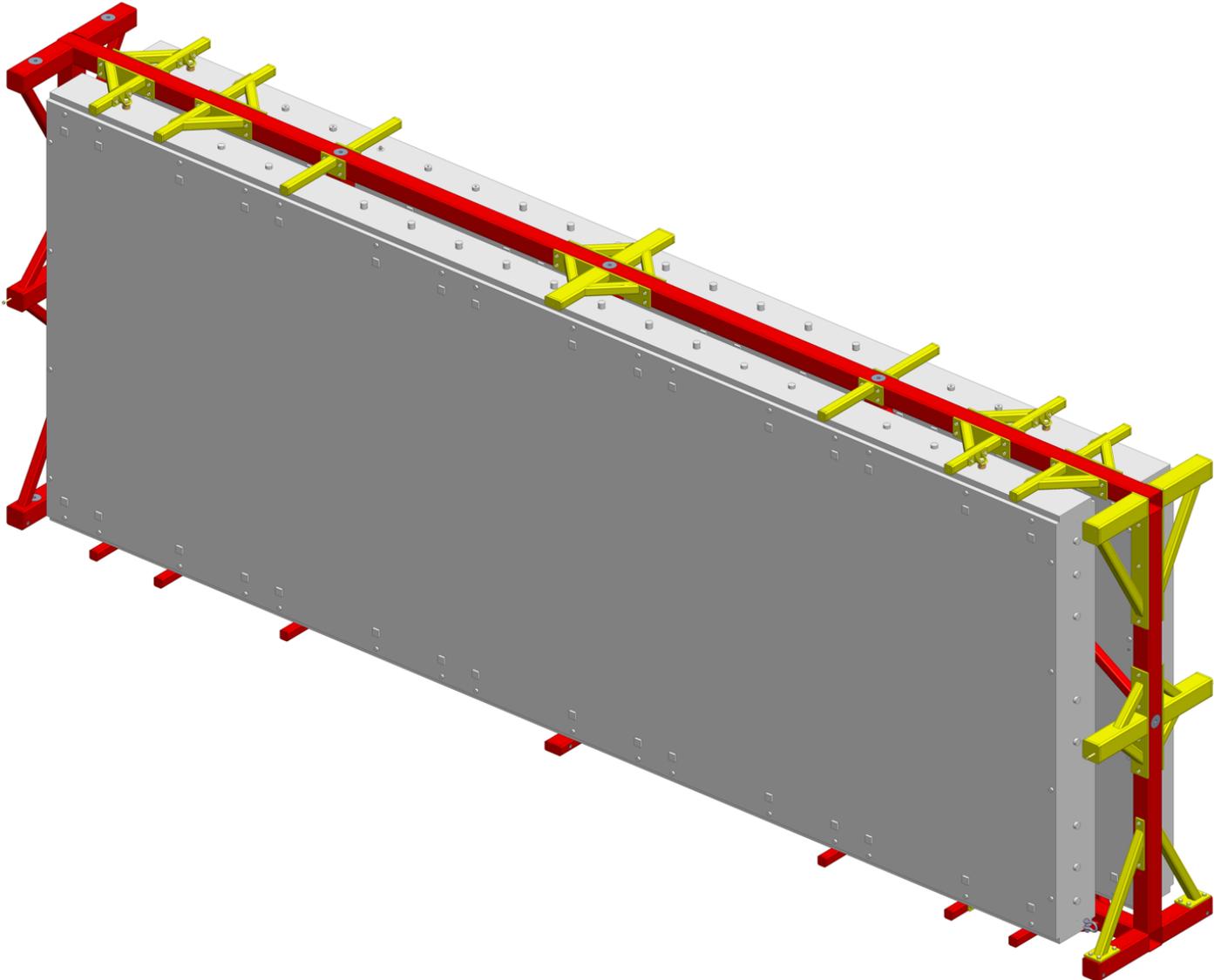
Mount the upper arms; Connect upper mounts to the APA



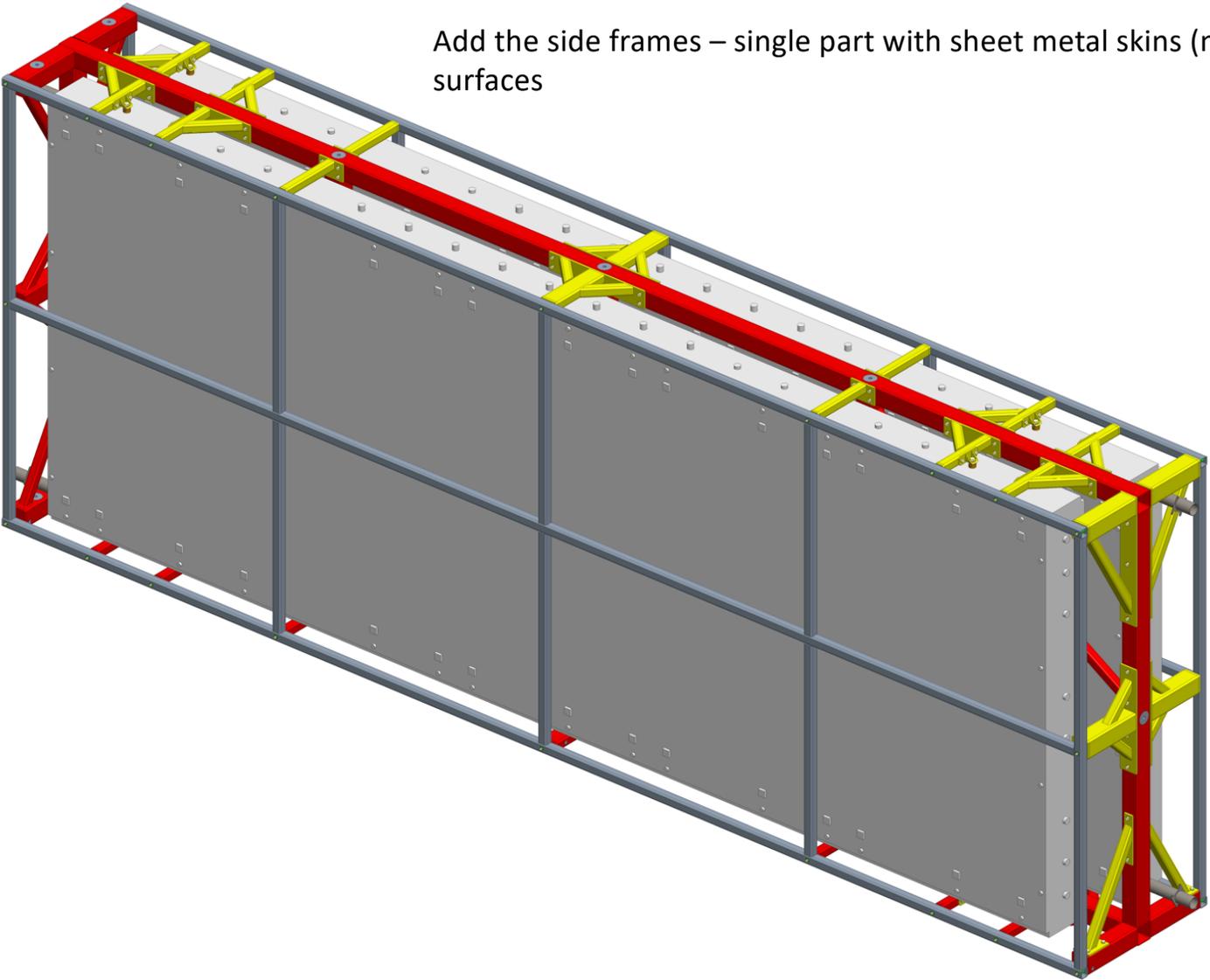
Add other arms to the first side of the frame; Mount 2nd APA in the same way



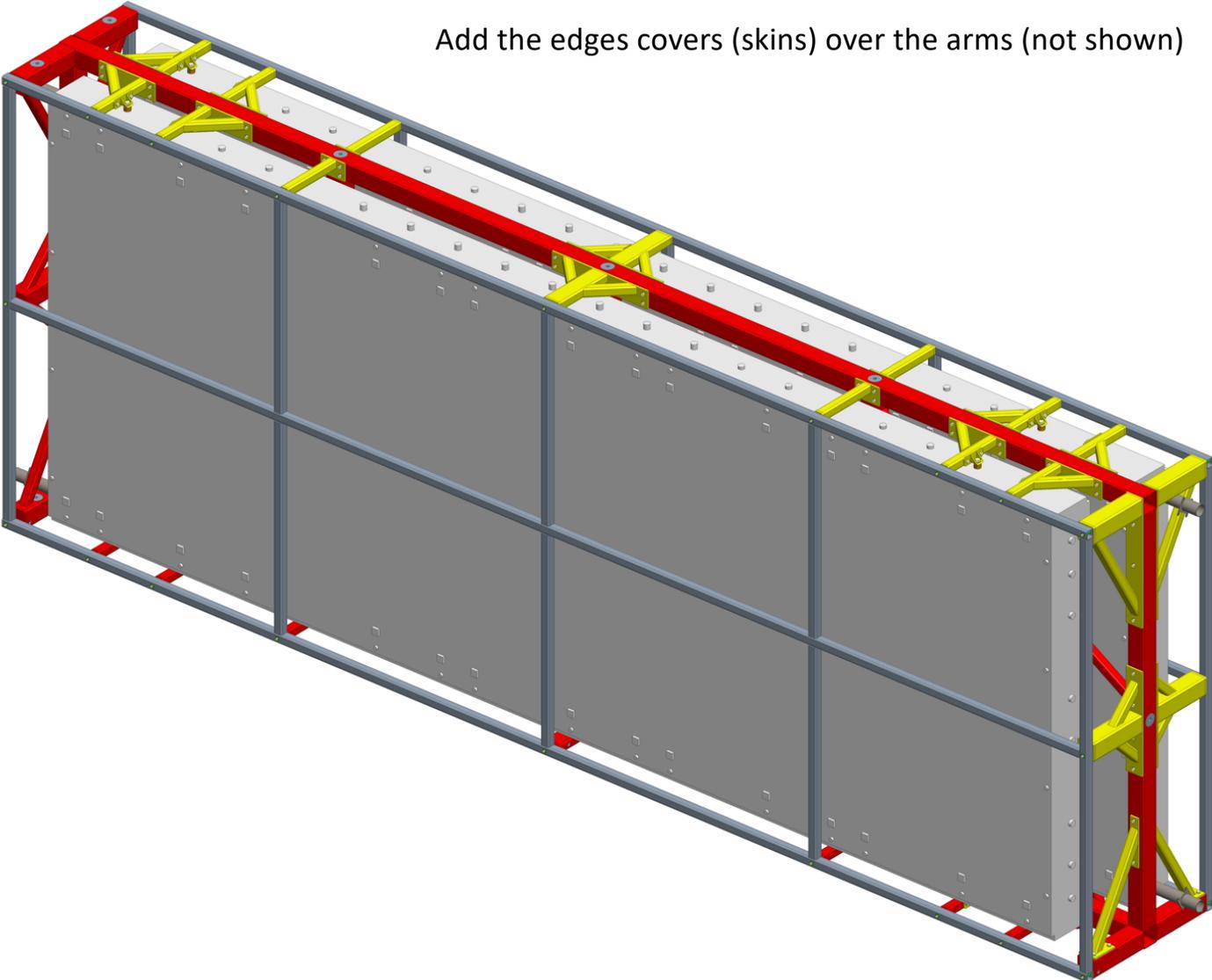
Add arms on 2nd side



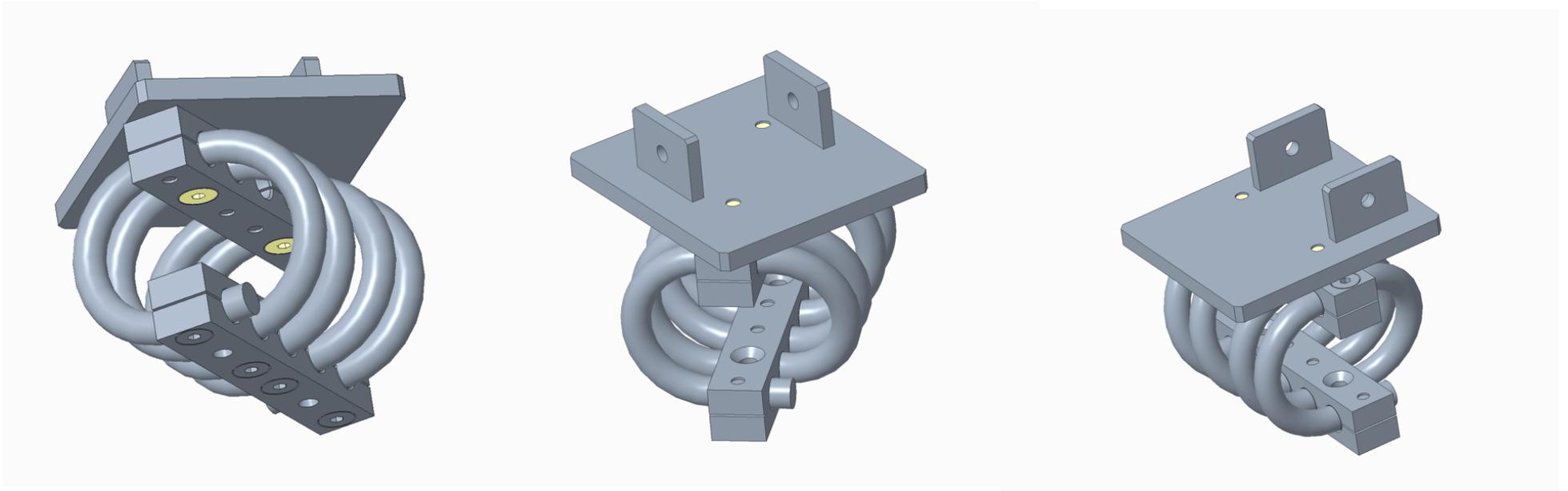
Add the side frames – single part with sheet metal skins (not shown) on the large side surfaces



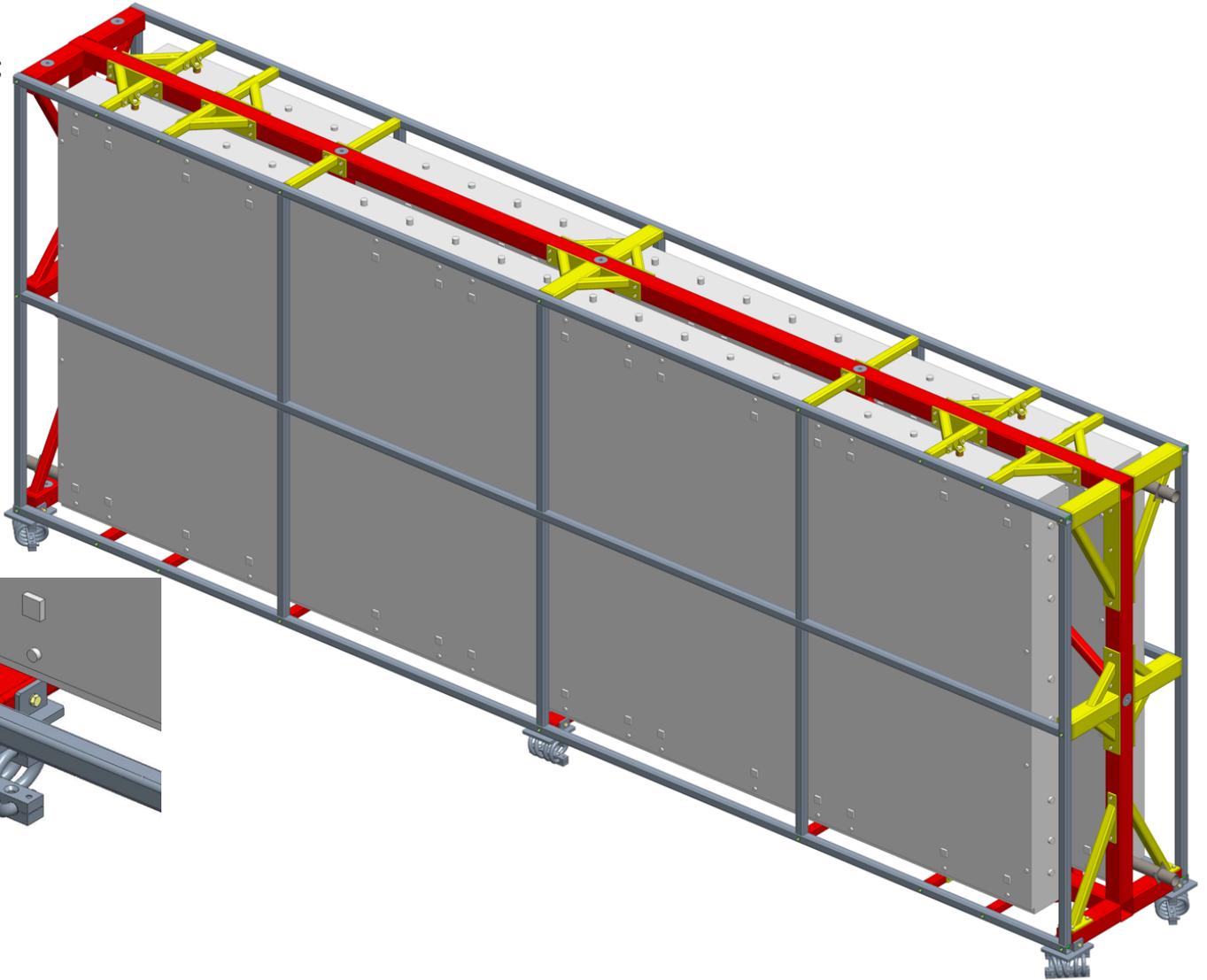
Add the edges covers (skins) over the arms (not shown)



Mount isolators on their mounting plates (2 styles – corner and middle)



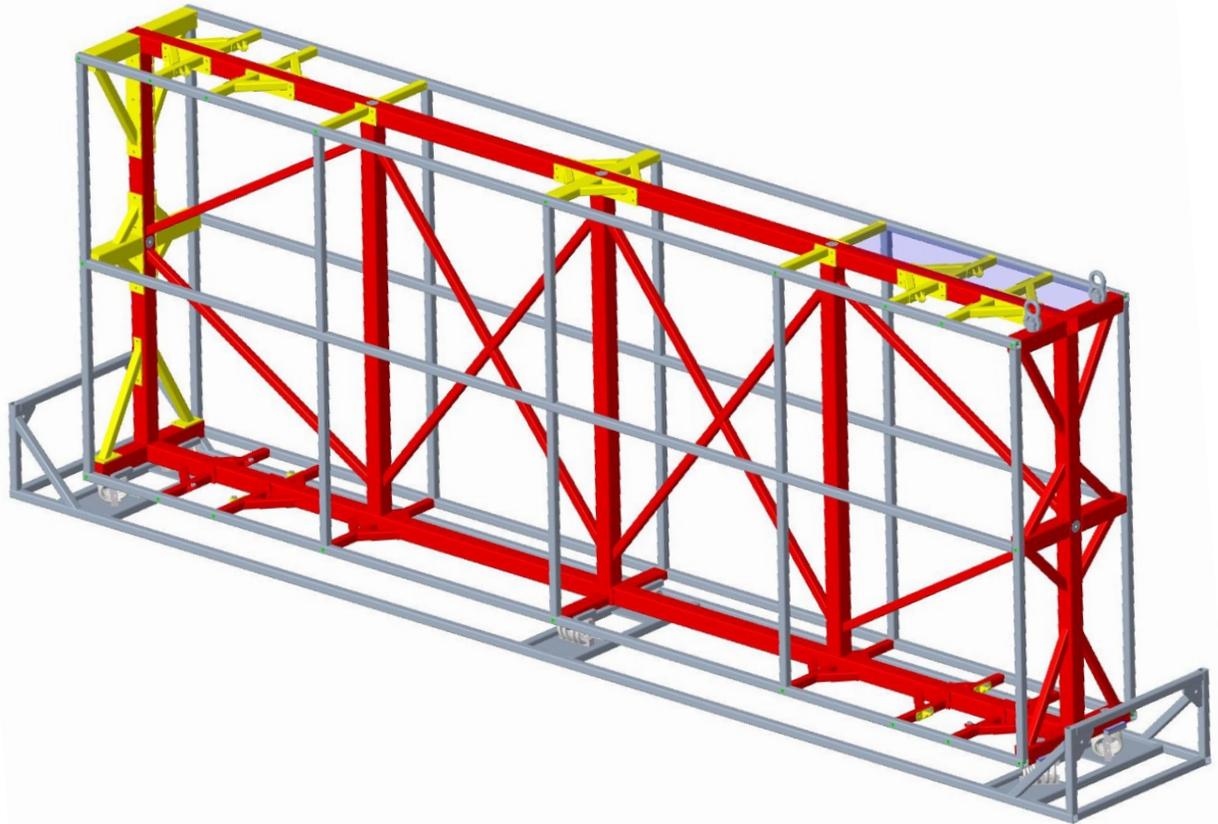
With APA on blocks, mount isolators;
Cover the access ports in on skins
Frame is sealed in foil wrapping;



Rig frame onto shipping base “cradle”

Cradle secured to a wooden shipping crate

Base is a WIP – assuming some lower mounting plates so it is a top access)



On shipping arrangements

- Peter has been working with a broker on updated shipping quotes
 - The frames are tight to fit into the width required for US permit-free shipping (2.59m, 8ft)
 - Compared 2 single frames shipped separately vs 2 in a single larger crate
 - The final case dims must be approx. 788 x 259 x 300 cm³
- Updated quote
 - Manufacture of one large case to carry 4 x APA's in two frames, deliver to Daresbury, pack on site including sealing in double foil bag and fitting external tarpaulin to the case: £ 9437
 - Collection of case from Daresbury, (Daresbury riggers to load onto vehicle) transport to Liverpool docks, terminal handling charges, seafreight to arrival Baltimore USA, US port handling charges and on carriage to delivered DAP Lead, South Dakota: £ 10975
 - This equates to £5103 per frame vs £7115 for separate crates
- Current plan is to go back to coupling to the frames so they sway together (avoiding the “clang” mode)
 - This removes the need for ~200mm of space between the frames for independent motion
 - [Frame width 990mm] *2 + [110mm frame motion on isolators] *2 ~ 2200mm
 - Seems like that works well with this adjustment – 20cm per side for + tolerances + crate + tiedowns
- Height, length, and mass are all comfortable

Packaging and transport

