APA Shipping Frame FEA

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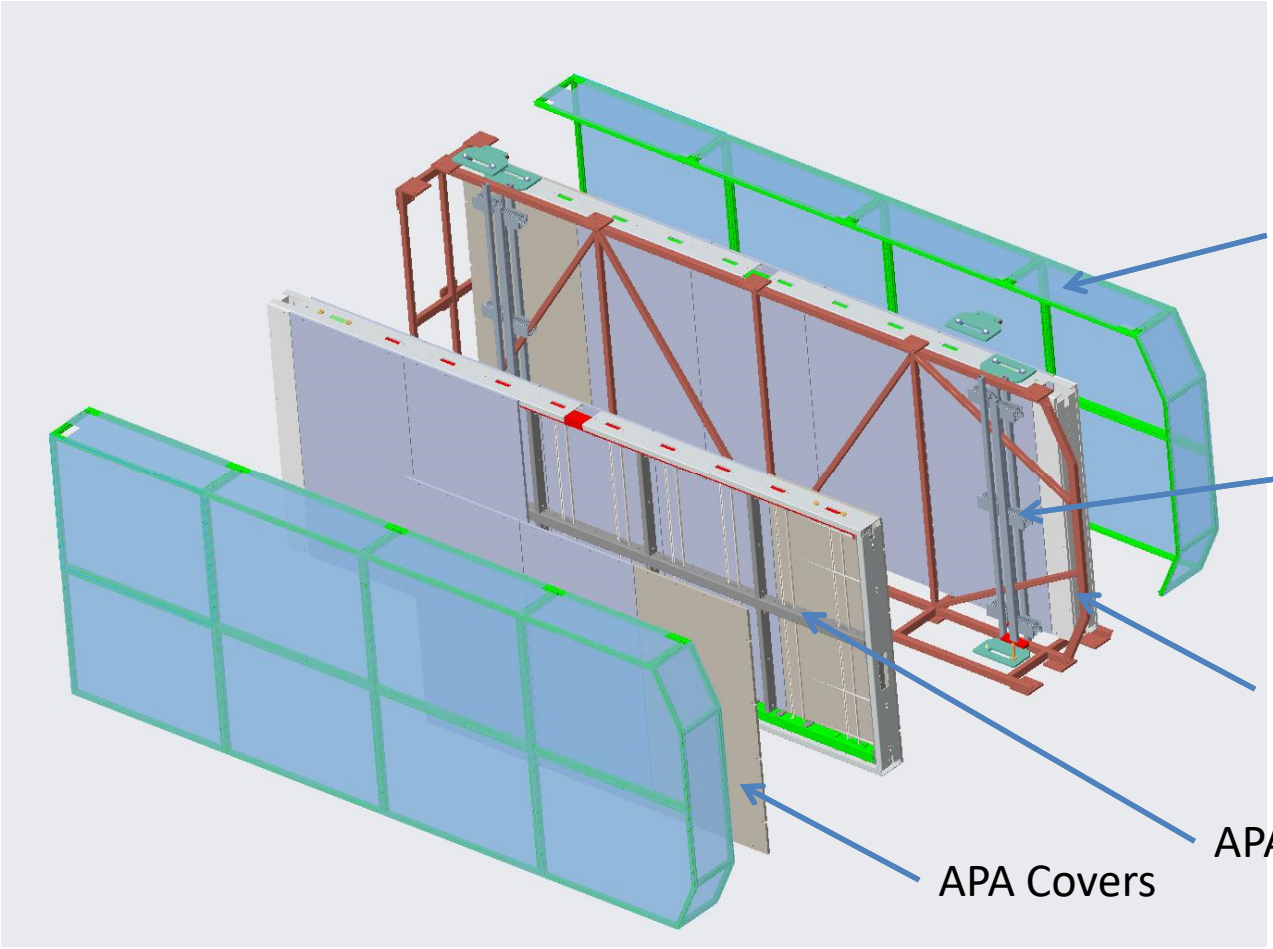
APA Shipping frame

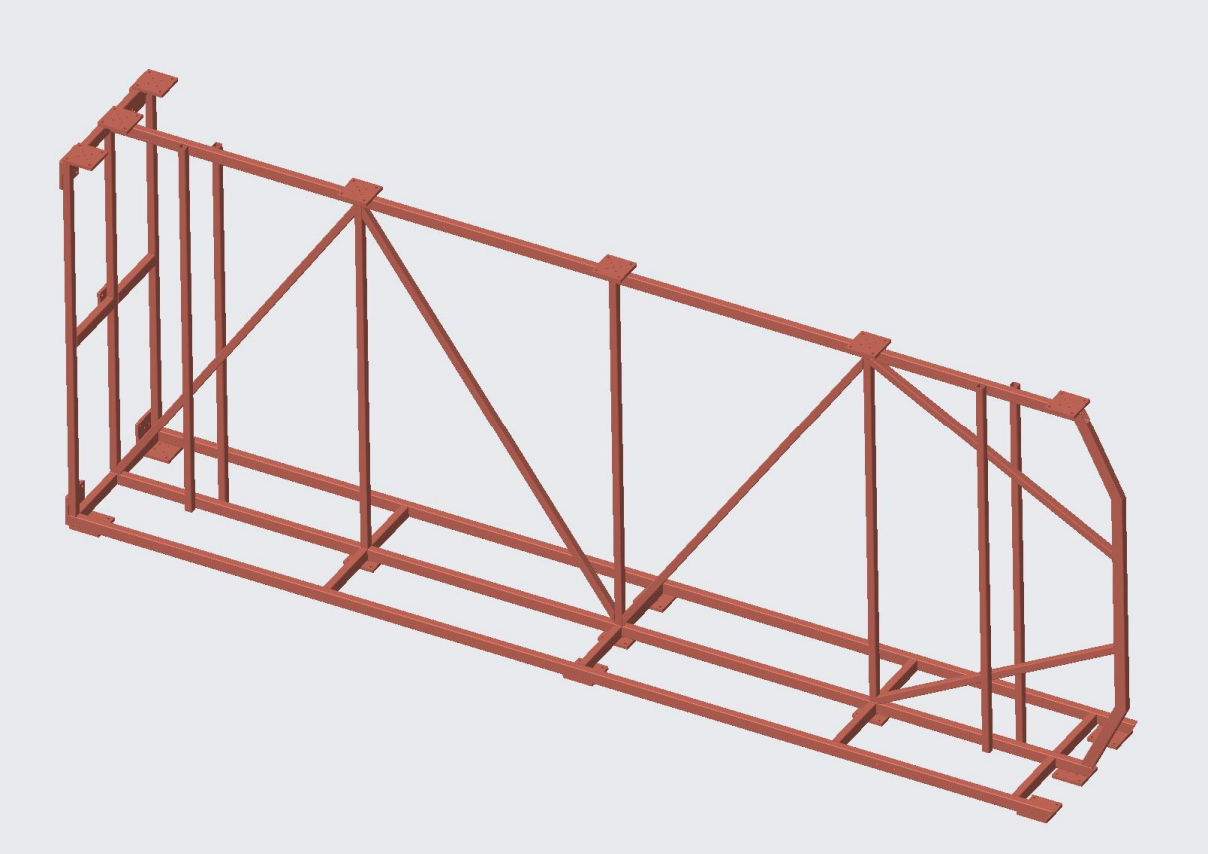
- The design of the APA transport frame is becoming final, and drawings produced
- FEA is underway and working on different load cases
- The current structure is now on EDMS
  - https://edms.cern.ch/document/2157225/1

Transport Frame assembly



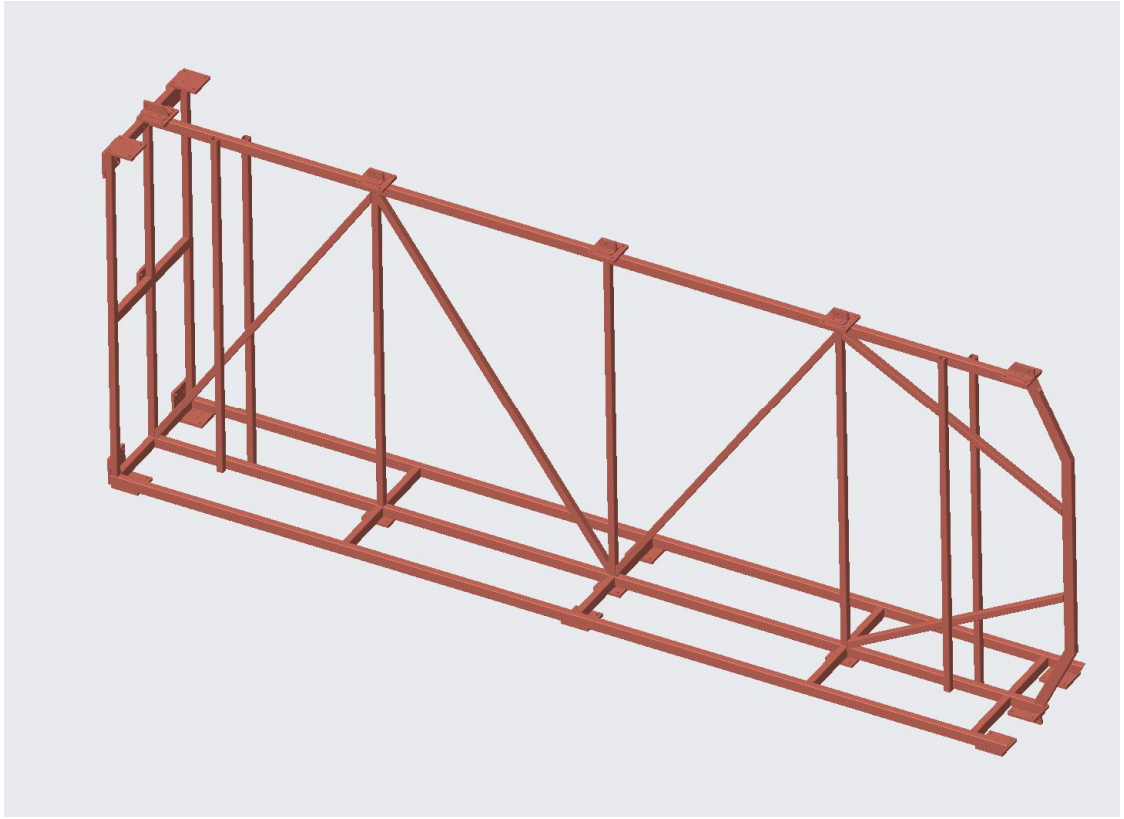
Steel transport frame

- Transport frame manufactured from 2x2” and 2x3” steel section.
  - 3” Section EN10219 S355J2H
  - 2” Section hot rolled EN10210 S355J2H
  - Plate hot rolled EN10025-2: 2004 S355J2H.
- Drawings are complete
- Initial quotes have been done in the UK and US



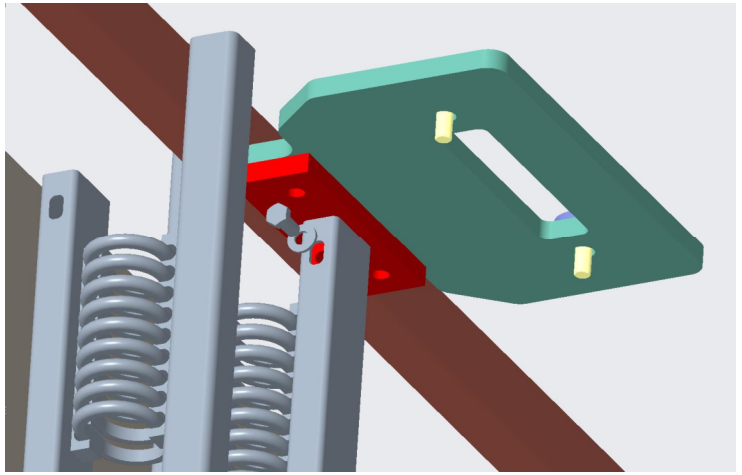
Attachment points

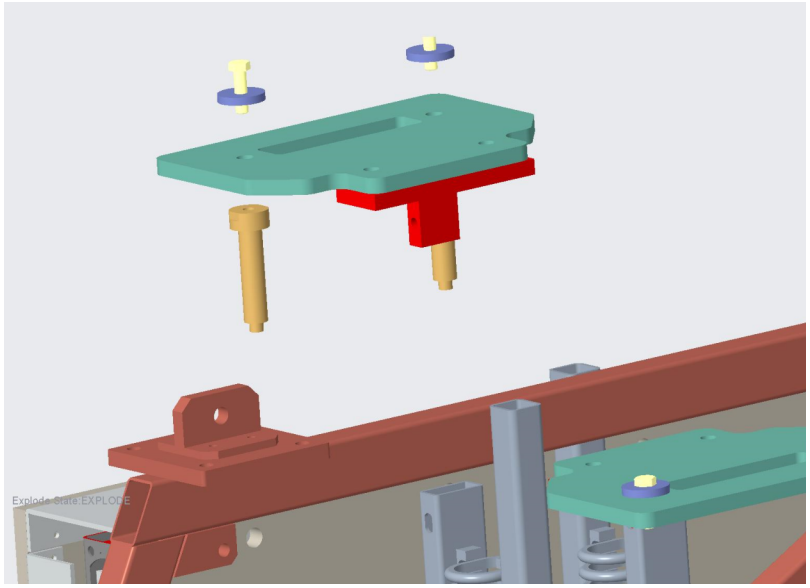
- Each frame has attachment points which gives a full 360° rotation

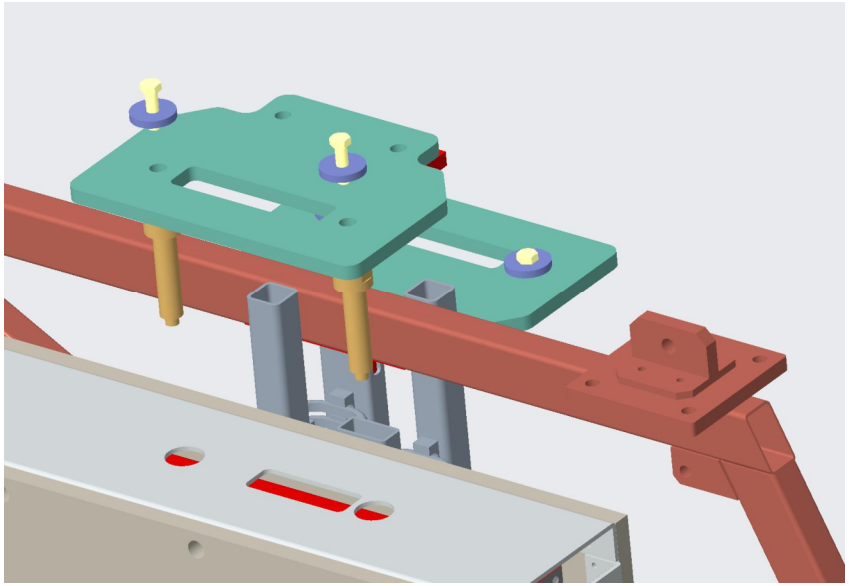


APA Bracket arrangement

- Exploded view of top bracket arrangement
- Bolt and washer holds the top bracket in position

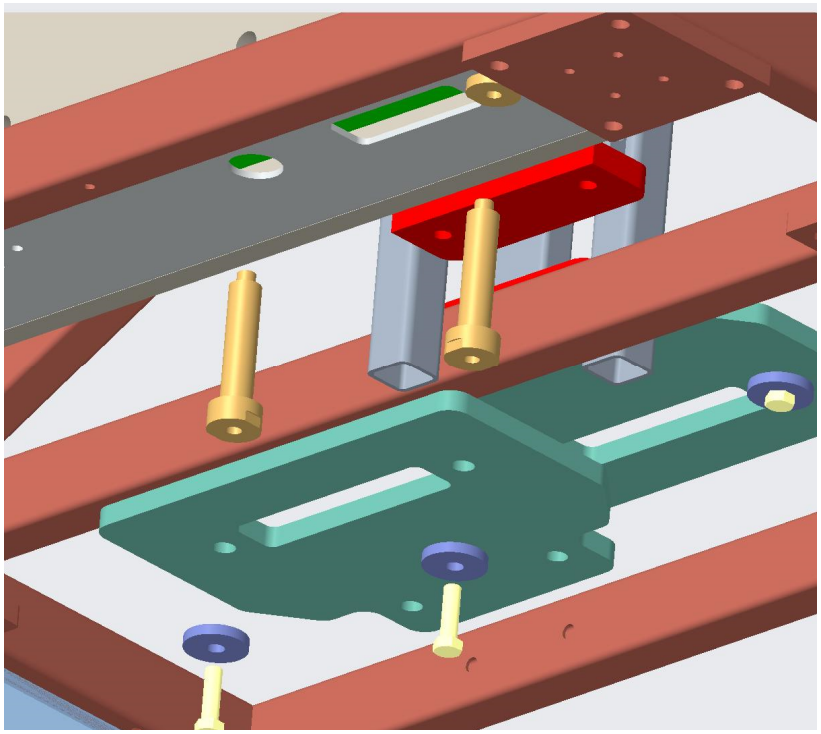


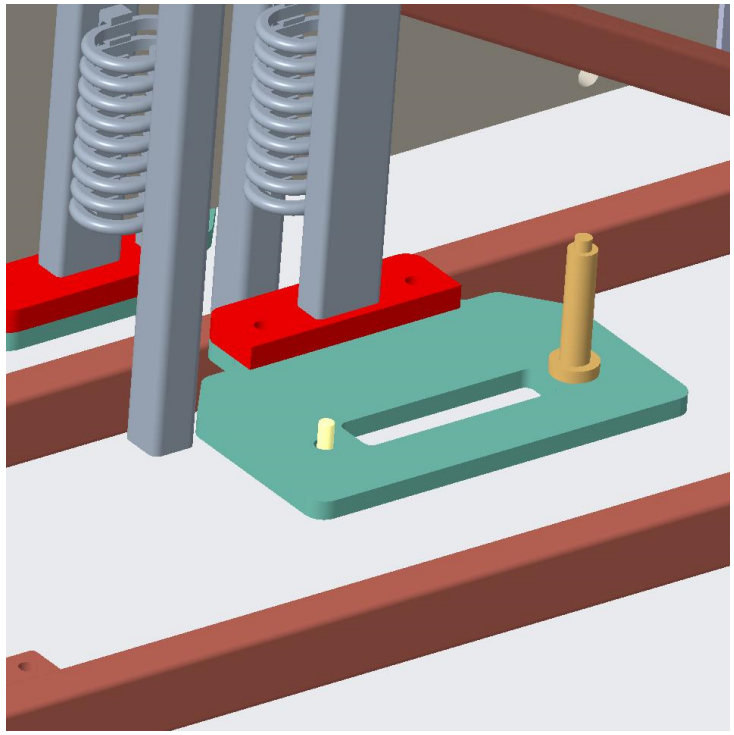




Bottom Bracket arrangement

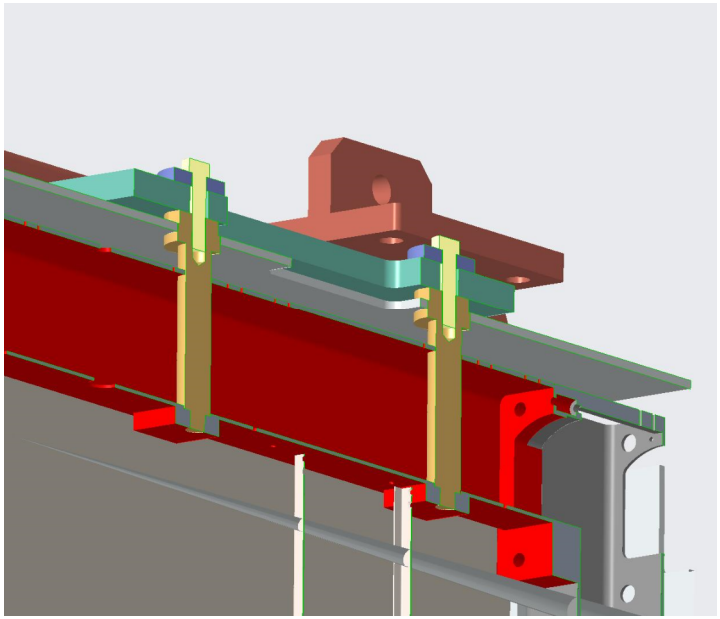
- The bottom bracket (shown in red) is welded to the vertical RHS

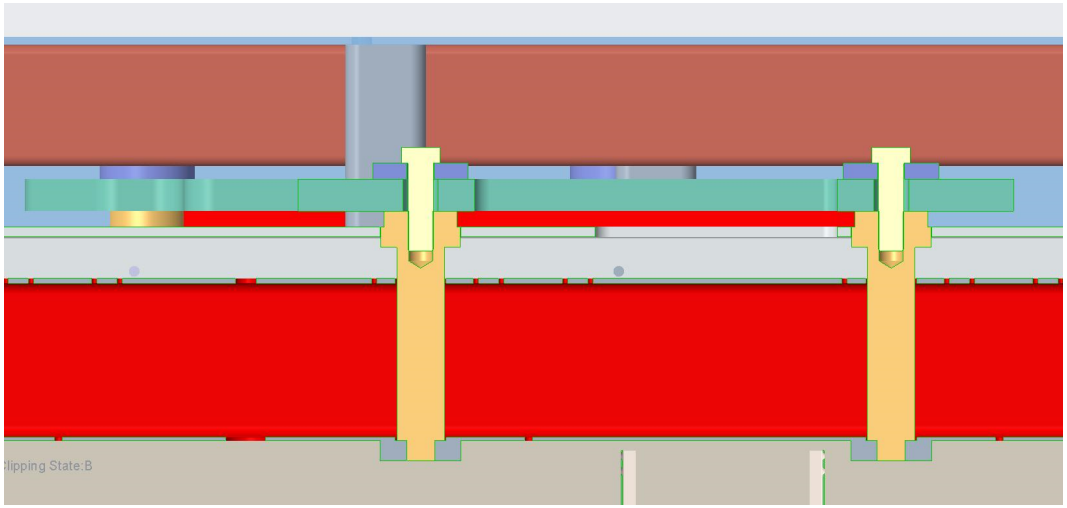




APA Connection to support

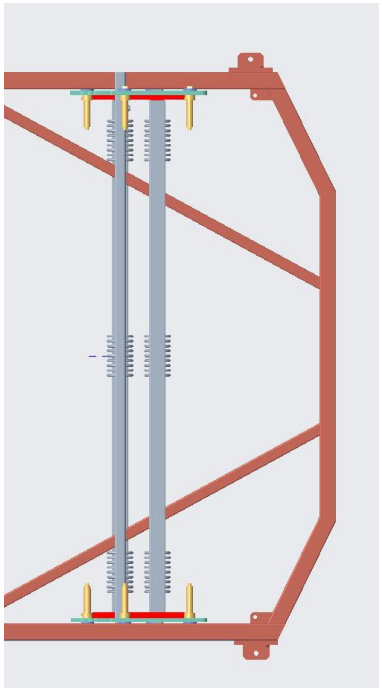
- Section through top bracket assembly

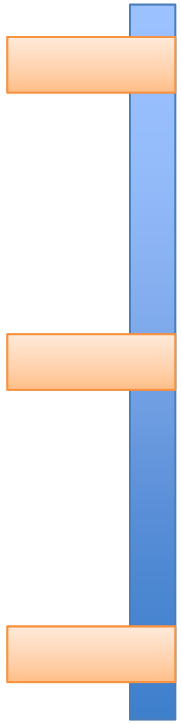




Anti Vibration Mounts

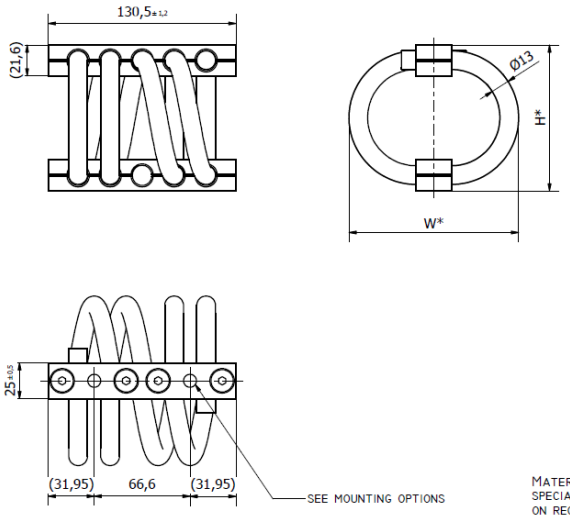
- Had a meeting with the UK vendor, AVMR who supply Vibrostop (cavoflex) wire rope mount systems
- Their main concern is that positioning the mounts vertical is not a good idea as they will be ‘cantilevered’ and have no support in that direction and will tend to permanently droop.
- The solution is to have the 6 mounts positioned horizontally.
  - The reason is that the main concerns are with the horizontal transport and lifting by crane etc. which will include the ‘10cm’ drop. The other concern is the long term creep on the wire rope mounts if they are in the vertical position.
  - Less concern was thought for being slung under the cage and the 2g force from the cage braking.





Anti Vibration Mounts

- Quick analysis done and data sheet provided
- Cost is £109 each for 900 units
- £3000 if a detailed study is needed



MATERIAL
SPECIAL VE
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IN STAINLE

Vertical direction Z

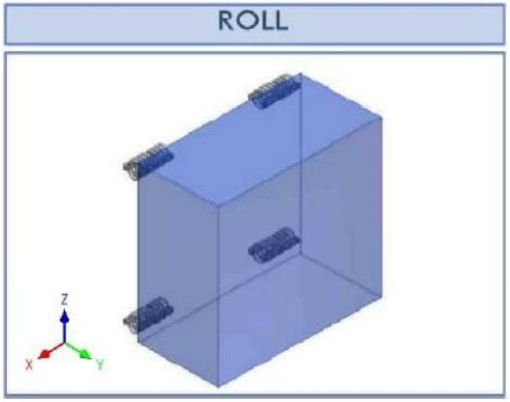
Requirements	
Supported Load Wt [kg]	474
Max transmitted acceleration At [g]	4
Shock input velocity [m/s]	0.6
Wall mounts	
Number	6
Isolator dimensions	131 x 83 x 102
Actual static deflection [mm]	6.6
Suspension results	
Max system response deflection dz [mm]	44
Actual system deflection [mm]	18.2 ok
Natural shock freq [Hz]	6.2
Max transmitted acceleration At [g]	2.1 ok
Vibration natural freq [Hz] [input ±1 mm]	6.2

Transversal direction Y

Requirements	
Supported Load Wt [kg]	474
Max transmitted acceleration At [g]	4
Shock input velocity [m/s]	0.6
Wall mounts	
Number	6
Isolator dimensions	131 x 83 x 102
Suspension results	
Max system response deflection dy [mm]	38
Actual system deflection [mm]	9.4 ok
Natural shock freq [Hz]	7.6
Max transmitted acceleration At [g]	2.6 ok
Vibration natural freq [Hz] [input ±1 mm]	9.7

Longitudinal direction X

Requirements	
Supported Load Wt [kg]	474
Max transmitted acceleration At [g]	4
Shock input velocity [m/s]	0.9
Wall mounts	
Number	6
Isolator dimensions	131 x 83 x 102
Suspension results	
Max system response deflection dy [mm]	44
Actual system deflection [mm]	17.5 ok
Natural shock freq [Hz]	6.2
Max transmitted acceleration At [g]	3.2 ok
Vibration natural freq [Hz] [input ±1 mm]	6.2



Disclaimer: the recommendation made herein for shock isolation products is based on simplified shock model and standardized shock input waveforms that may not be representative of the actual shock inputs that will be found during the actual shock event planned (both tests and lifetime).
The customer assumes all responsibility for properly verifying the recommended isolator and for proper installation of the mounts.
AVMR is not liable for costs associated with loss, damage, or lost revenue, caused by actual test or lifetime conditions.

Please contact us for further clarification or for reviewing the selection:

tel. 01985 219 032

email: sales@antivibrationmethods.co.uk

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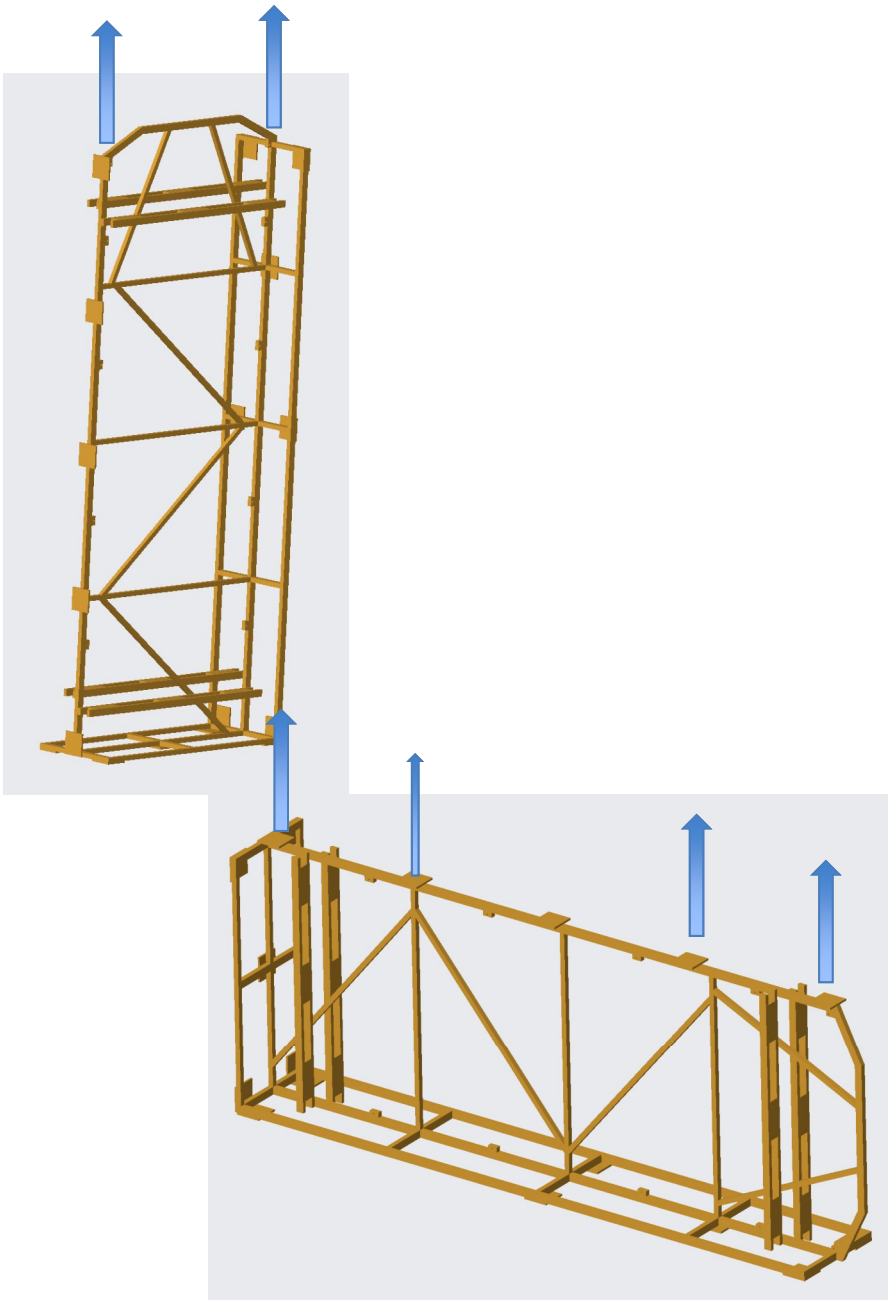
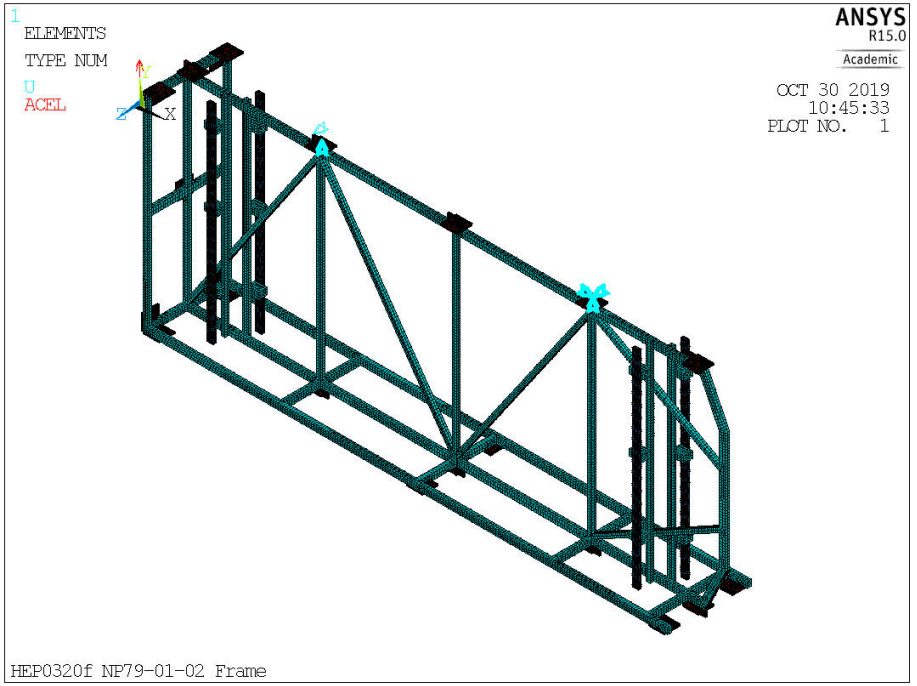
FEA of transport frame- Engineering assumptions

- Material Carbon Steel
  - 3” Section EN10219 S355J2H
  - 2” Section hot rolled EN10210 S355J2H
  - Plate hot rolled EN10025-2: 2004 S355J2H.
- 3” x 10 SWG (3.251mm)
  - Main Structural support
- 2” x 10 SWG (3.251mm)
  - Inner Parts
- No springs
- APA represented by ‘weights’ attached to vertical struts.
- FEA model uses both shell and solid elements.
- Lifting at 2 positions horizontal
- 2 positions vertical



FEA of transport frame-Loads Applied

- Mass of 1 APA 473.8Kg
  - 2 APAs 947.6
- Mass of Frame and all attachment pieces
- 1205Kg
  - Mass of Steel Frame 455Kg
  - Mass of APA connecting pieces and springs 110Kg x 4
  - Mass of Aluminium Side Frame 90Kg x 2
  - Mass of panels (acrylic) 130Kg
- E Carbon Steel 200GPa
- Yield stress 355MPa
- Max tensile strength 510-680MPa
- Load Safety Factor 1.4



Total Mass of Frame Assembly

- APAs
- Transport Frame Assembly

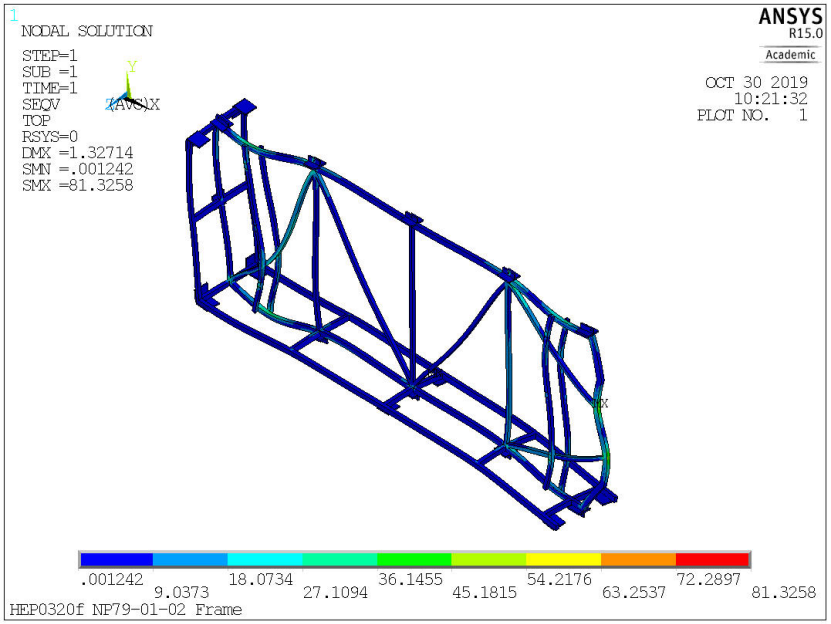
Total 2153Kg

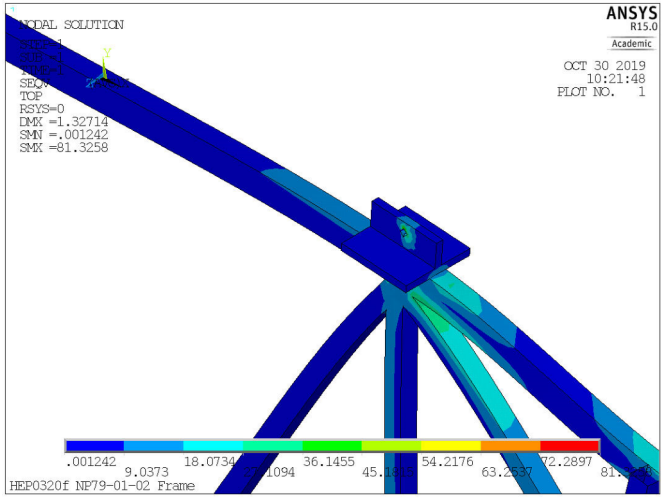
With 1.4 LSF

Total 3014Kg current FEA 29569N

Horizontal LSF 1.4

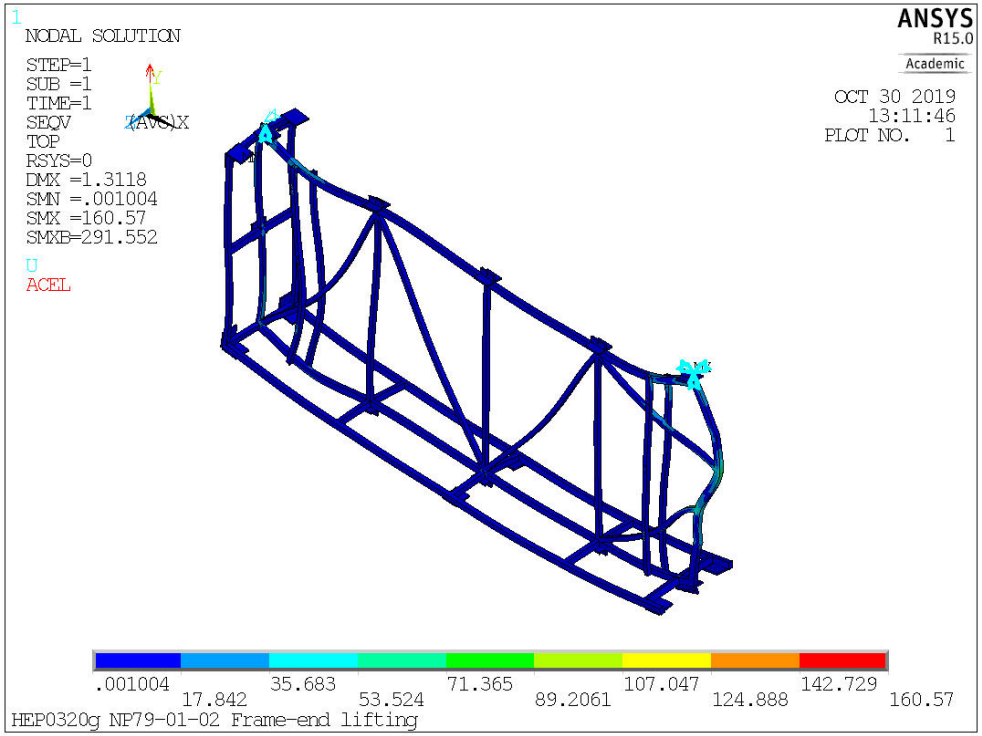
- Maximum deflection 1.2mm
- Maximum stress 81MPa
- Resultant force 29953N

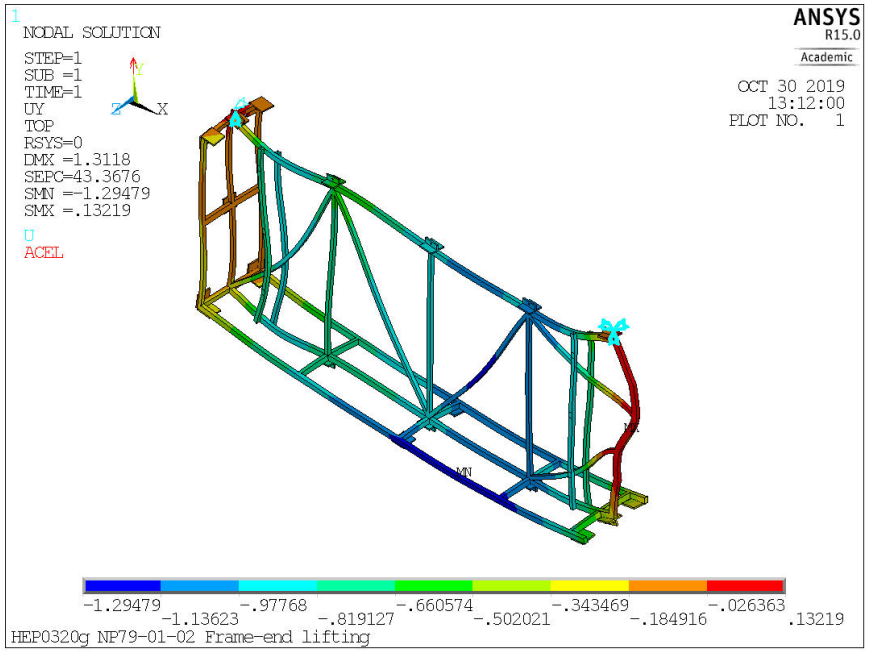


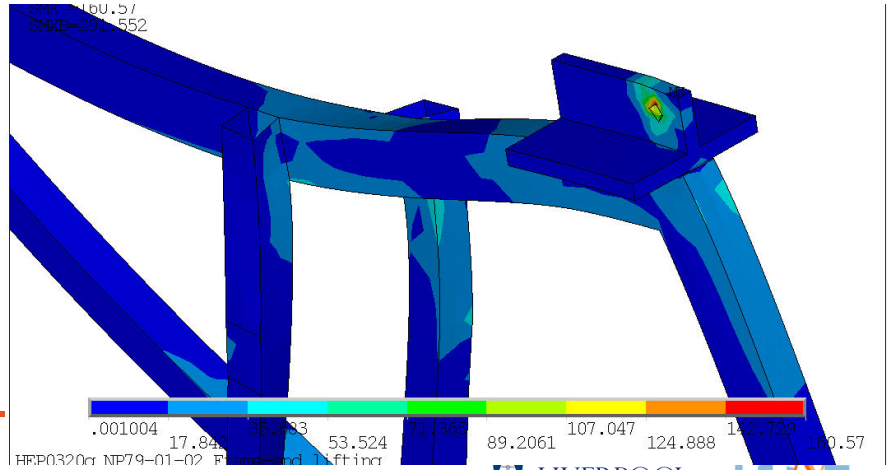


Horizontal end lifting LSF 1.4

- Maximum deflection 1.3mm
- Maximum stress 160MPa
- Resultant force 29953N







Conclusions and future work

- The stresses and deflection in the new design are shown to be smaller by around 50% under standard lifting
- Around 40% when end lifting
- This shows the design can be moved forward to the PDR in January
- The FEA will need to be continued and a stress report written by 29th November for internal review.
- Final draught 13th December ready for reviewers