

FE Analysis of the APA Frame

Peter Sutcliffe, University of Liverpool.

Attachment to APA Frame review 23rd February 2016

Engineering Constraints:

Overall size 2566 wide x 4150 high

Material Stainless Steel 304L 100mm x 150mm x 5mm section

Modelled in ANSYS using shell elements for the frame and solid elements for the bolted lifting attachments.

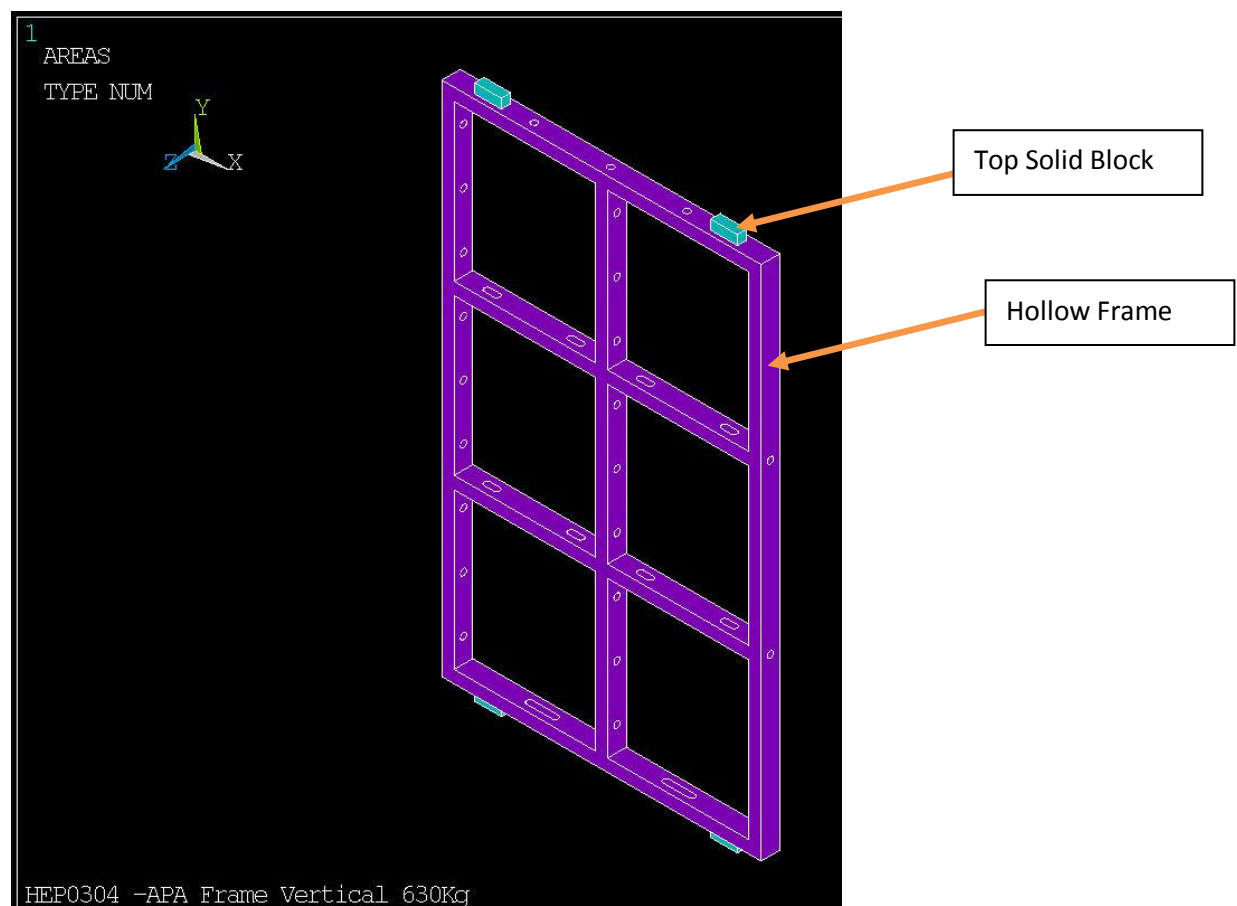
Assumptions:

Modulus of Elasticity – Stainless Steel 200GN/m^2

Density Stainless Steel – 7900Kg/m^3

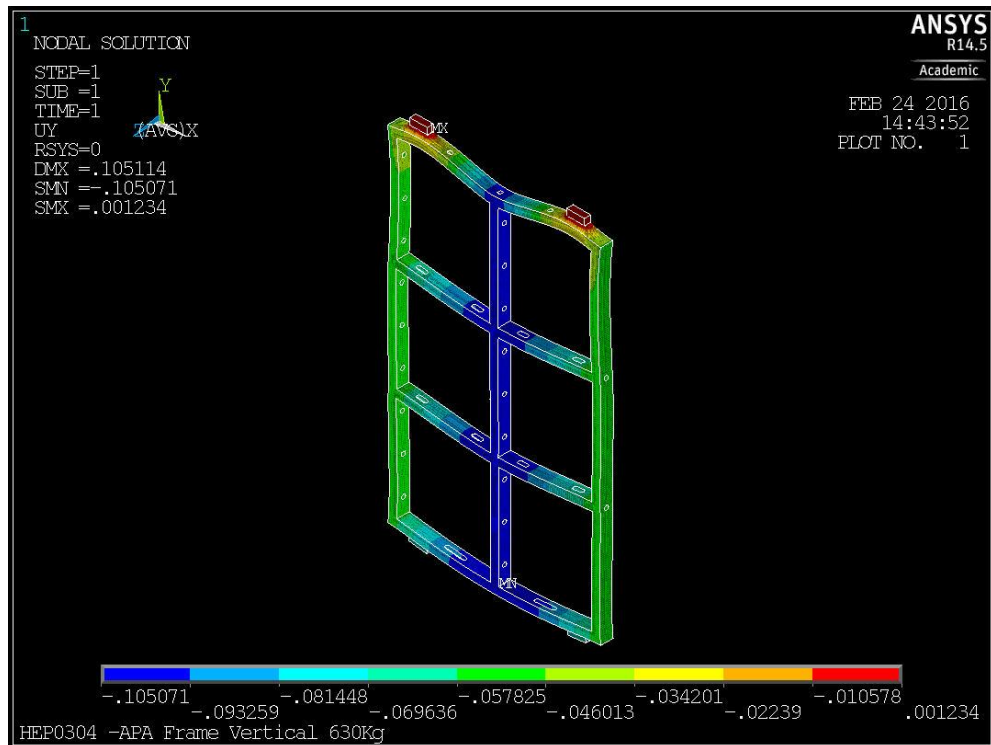
The bolted joint between the top blocks and structural steel frame as been assumed as a perfect joint.

Loads: Bare Frame 430Kg, Solid Blocks 40Kg, Levelling Bars total 50Kg, Other components + contingency 110Kg. Total mass added as an increased density to the full model



Results:

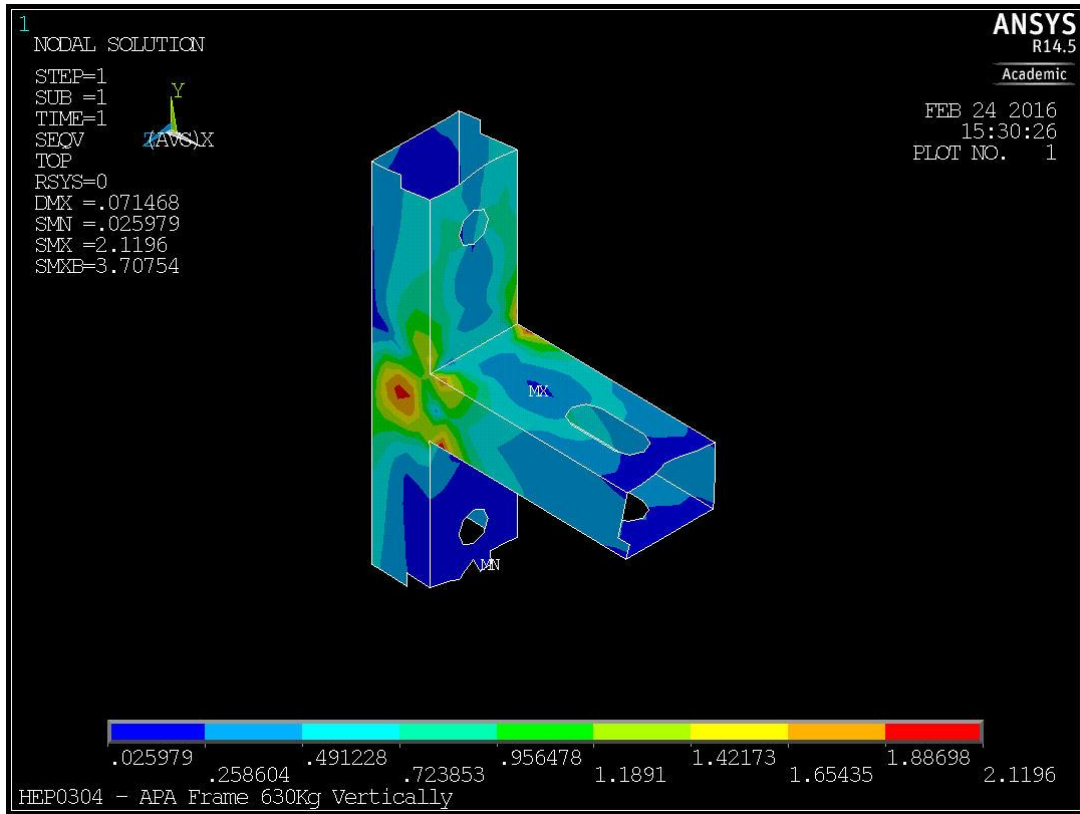
Load Case 1: Hung Vertically



Maximum Deflection 0.105mm

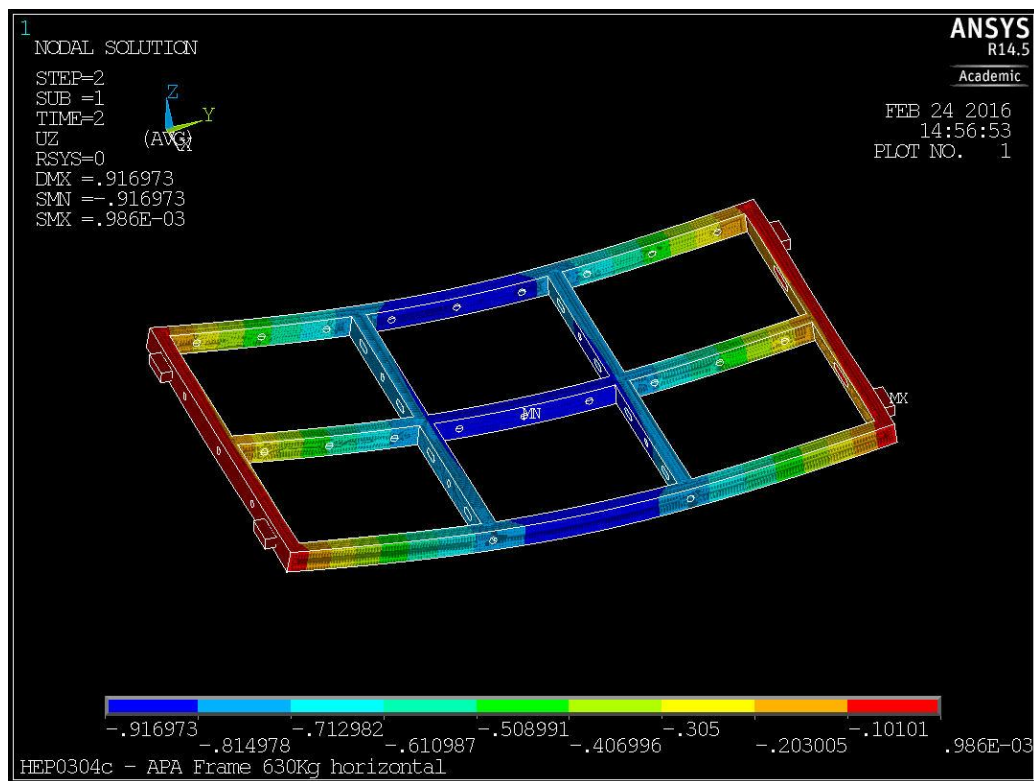


Maximum Stress 14.607MPa

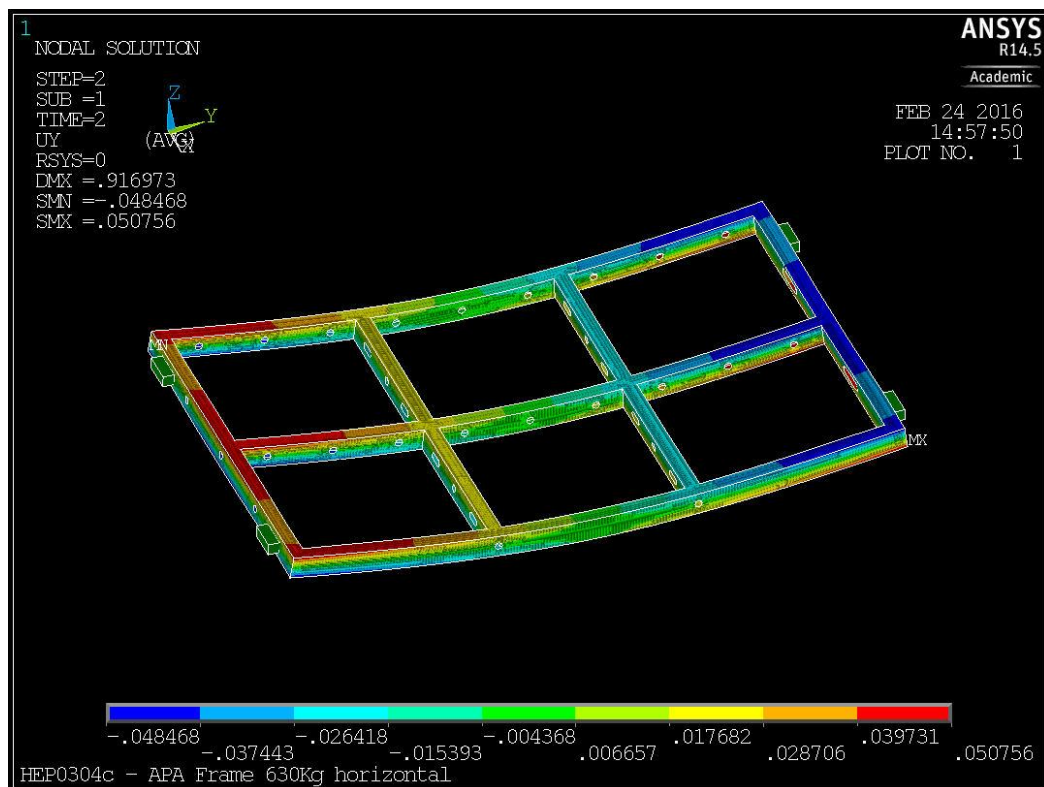


Maximum Stress at weld joint 2.12 MPa

Load Case 2: Hung Horizontally



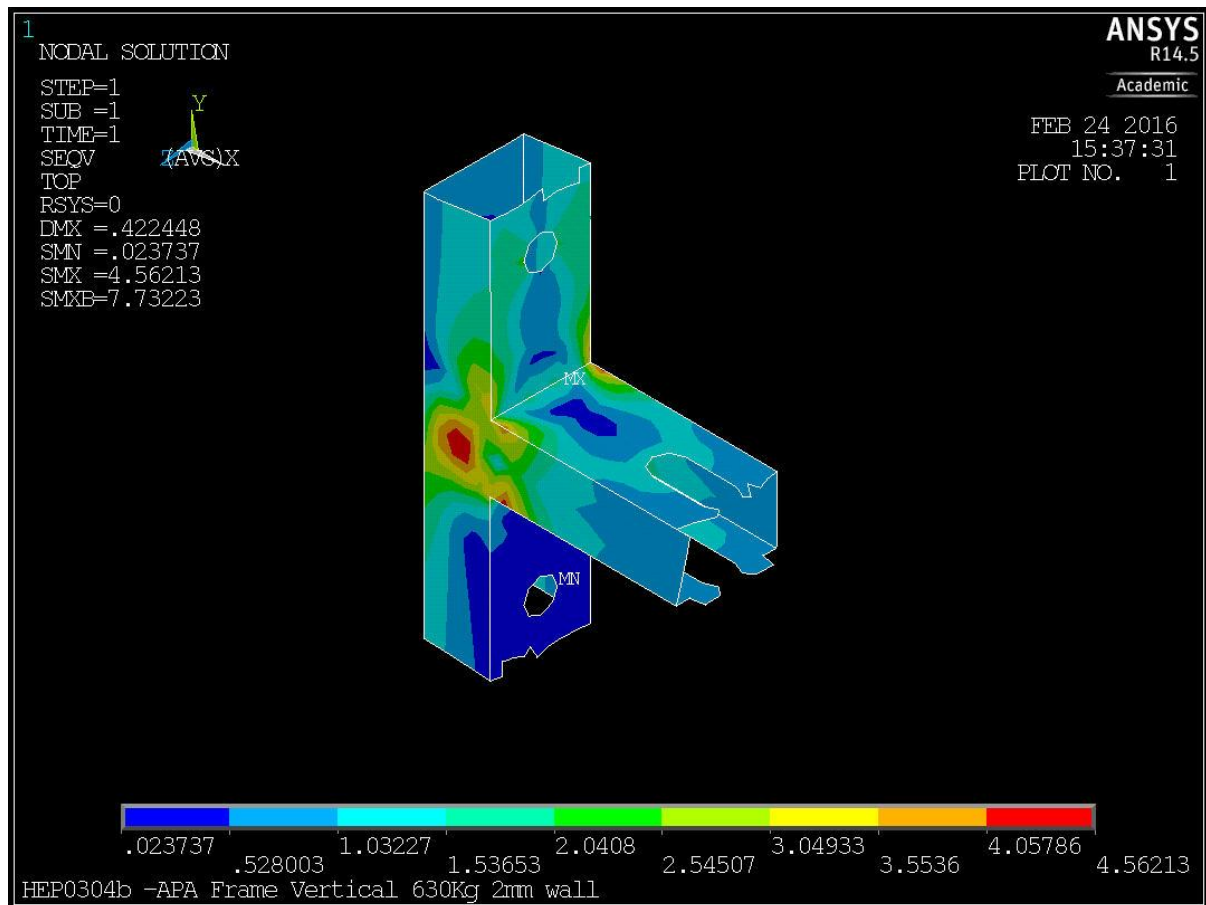
Maximum deflection in frame 0.916mm



Maximum contraction in frame in bending (Y direction) = 0.051 + 0.048 = 0.99mm

Load Case 3:

Assume wall thickness of 2mm section all over to emulate 2mm weld (2.5mm weld with contingency of 0.5mm) Density increased for 630Kg frame.

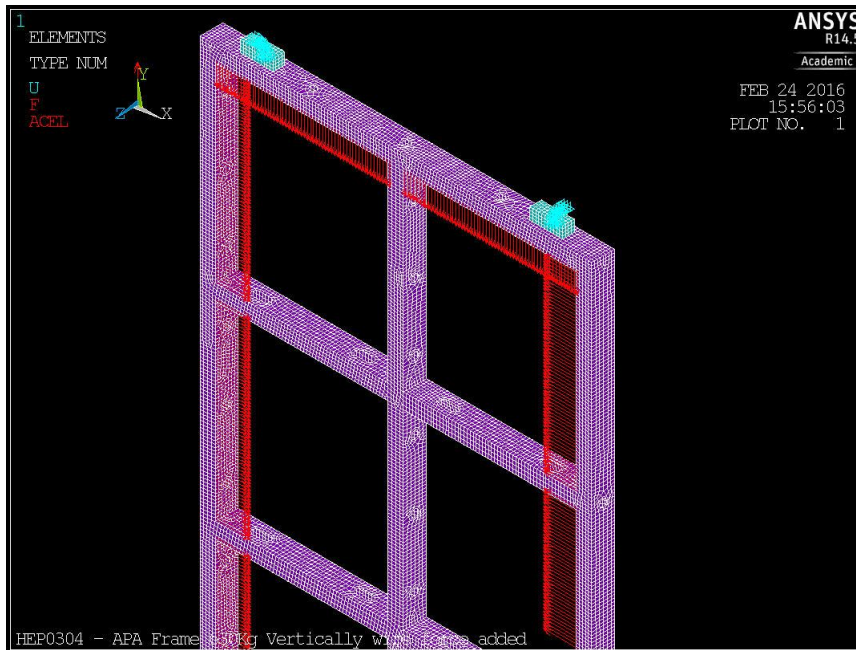


Maximum Stress 4.56MPa

Load Case 4: Hung vertically and 3000, 0.5Kg wire forces added to frame

855 wires vertically: 2100N/side

2145 wires horizontally: 5260N/side



Maximum bending in Z direction 0.121mm

Summary and Conclusions:

With the loads applied the following deflections and stresses have been shown:

Vertical deflection: 0.105mm

Vertical Stress around support blocks: 14.6MPa

Stress around weld joint: 2.12MPa

Horizontal deflection: 0.917mm

Assuming a 2mm section to simulate the welds: Max Stress around weld joint: 4.56MPa

Addition of 3000 wires with a load of 0.5Kg/wire hung vertically: Maximum bow in frame 0.121mm

With these results I can confirm the welds and structure are well in line with the yield stress 0.2% proof of Stainless Steel 304L of 170MPa (ref google azom.com) and within the agreed maximum deflections allowed.