Fermilab

Particle Physics Division
Mechanical Department Engineering Note

Number: MD-ENG-294 Date: Dec. 16, 2010

Project Internal Reference:

Project: NOvA

Title: FHEP Air Spring/Wheel Mount Stress and Deflection

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Reviewer(s):

Key Words: NOvA, FHEP, Block Pivoter, Stress, Deflection

Abstract Summary: The following engineering note determines the stress and deflection that result from the internal pressure of the air spring that is to be mounted on the Wheel Support Weldment (opposite) as part of the block pivoter for the NOvA project.

Applicable Codes:

In order to evaluate the stress and deflection in the Wheel Support Weldment assembly, the parts were modeled using the I-DEAS modeling and finite element analysis software.

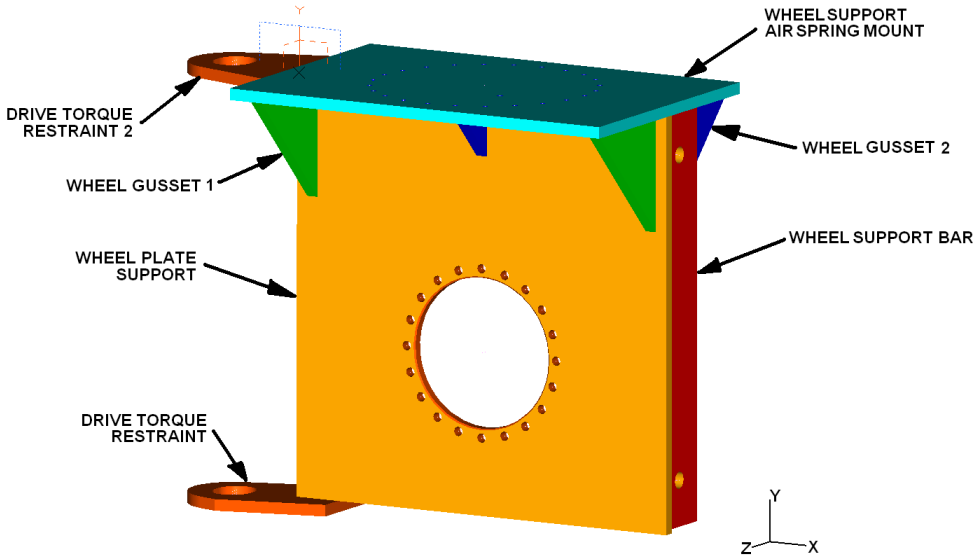

Figure 1: 3D model of the Wheel Support Weldment assembly

There were several sets of restraints that were added to the model. The first set of restraints was placed the x- and y-translation and x- and y-rotation of the center hole of the wheel plate support. The second set of restraints is placed on the y- and z-translation and the y- and z-rotation of the holes where the cotter pins are to be inserted in the wheel support bars. The last set of restraints is on the x- and z-translation and the x- and z-rotation of the drive torque restraint plates. Also, a pressure of 100 psi, the pressure inside the air spring, was placed on the center of the wheel support air spring mount.

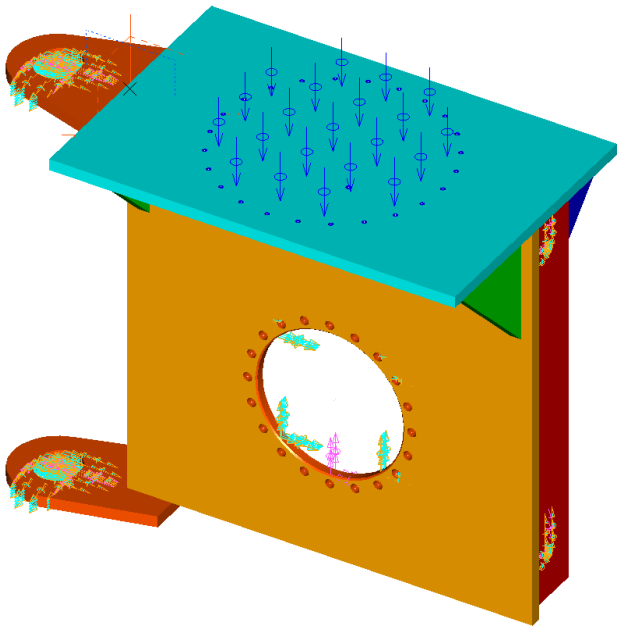

Figure 2: Boundary restraints and loads on the assembly

After the boundary conditions were set, various mesh sizes were applied to the model and a model solution was determined. Using a mesh size of 2.5, the maximum stress in the assembly was about 10 ksi.

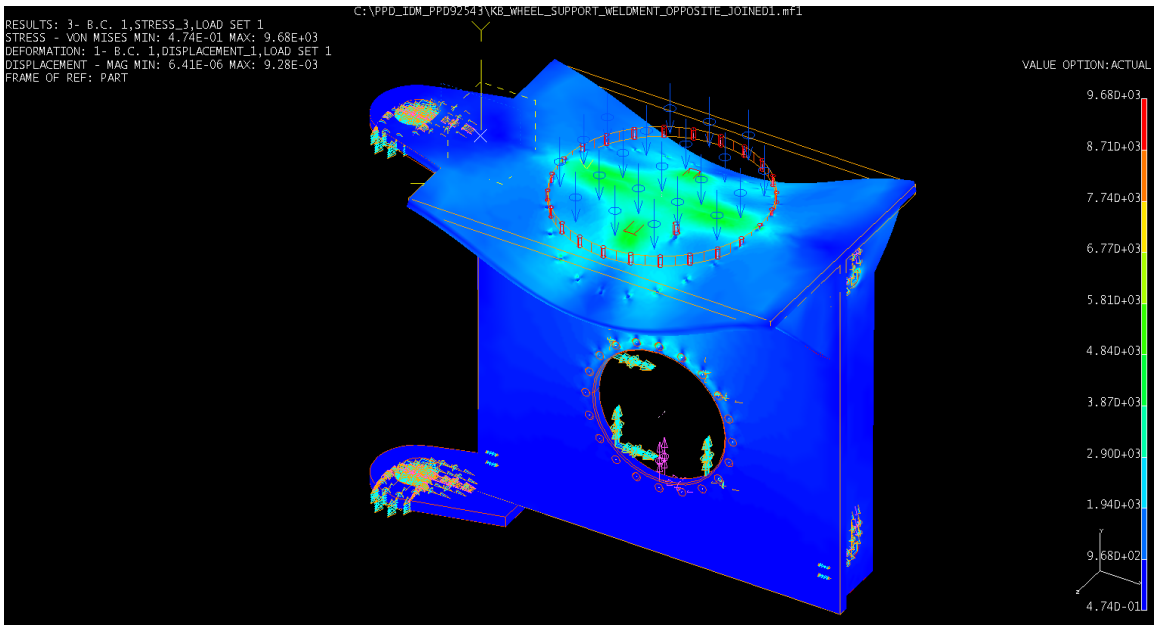

Figure 3: Mesh size=2.5, Max. Stress=9.68 ksi, Max. Deflection = 0.0093 in.

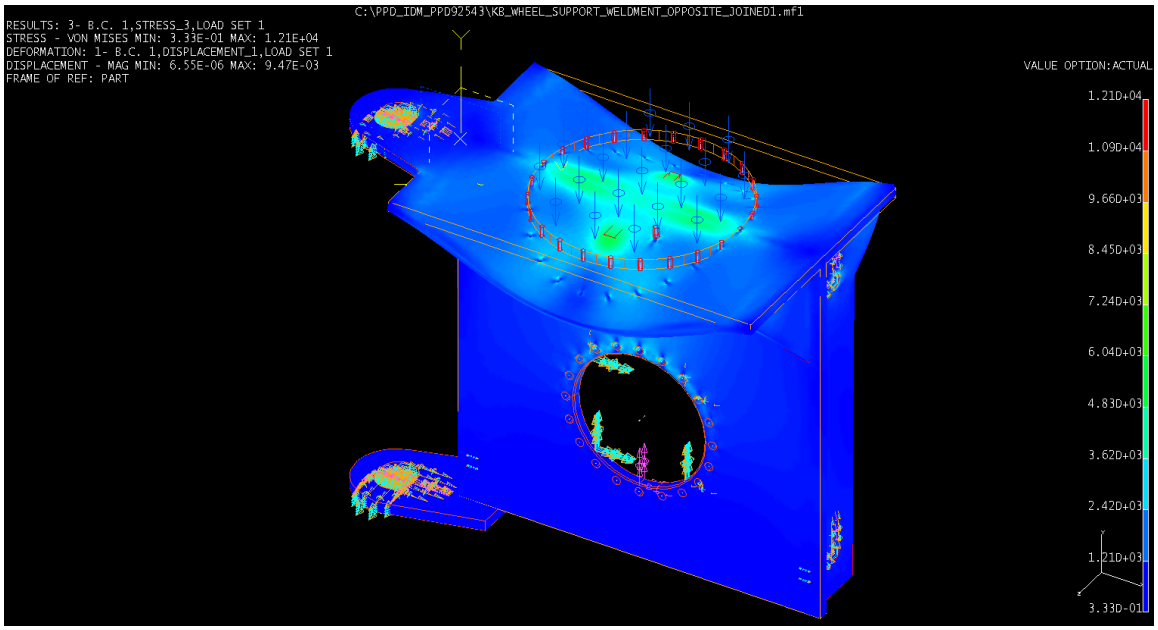

Figure 4: Mesh size=0.875, Max. Stress = 12.1 ksi, Max. Deflection = 0.0095 in.

Using a mesh size of 0.875, the maximum stress in the assembly was just above 12 ksi. The material that is used to construct this assembly is ASTM A36 steel, which has a yield strength of 36 ksi. The maximum allowable stress is 0.6 times the yield strength. With a range of 10-12 ksi, the maximum stress in the assembly is well below the maximum allowable value of 21 ksi. The maximum stress in the model occurred where the edge of wheel gusset 2 met the underside of the wheel support air spring mount. The maximum deflection of the assembly, about 0.01 in., can be considered to be negligible.

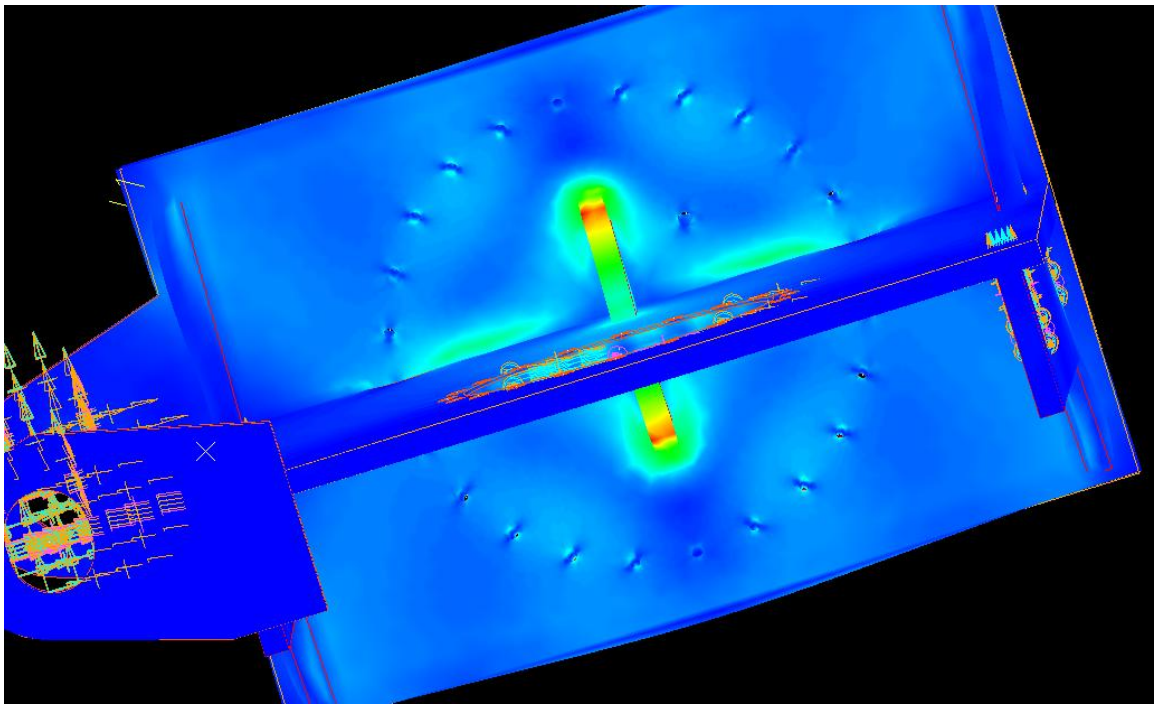

Figure 5: Location of the maximum stresses