

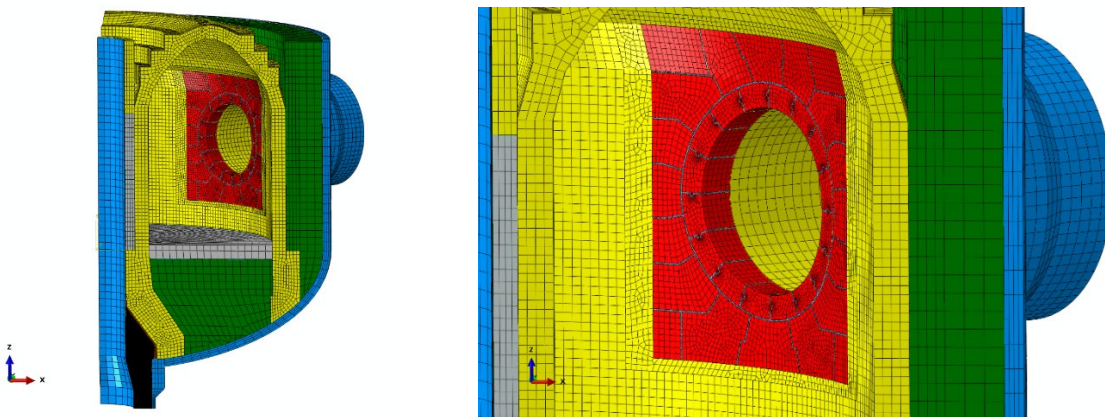
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Internal Brick Arch Collapse – Mechanical Repair Plan (Finite Element Analysis and Fracture Mechanics)

Project Description: A brick arch structure internal to a vessel collapsed in a relatively short period from the equipment being placed into service. Evaluation of a brick structure does not follow the standard ductile yielding fracture analyses of typical working steels, as the bricks and mortar behave in a brittle manner. For this analysis, XFEM, the fracture mechanics module within Abaqus is used to first replicate the observed wall damage, and then used to create, test and recommend a new brick arch design. For this model, a quarter symmetry model is created, containing the metal shell, various layers of bonding, and the brick and mortar.

FEA Model: The original design ¼-symmetry meshed model is shown below:



FEA Results: The cracking established under thermal expansion loading matched that observed in the field, with the results shown below. A new radial pattern was devised, tested and shown to be substantially stronger.

