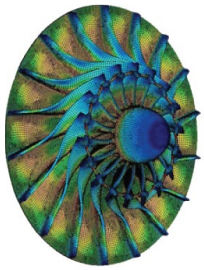

Saba Metallurgical & Plant Engineering Services, LLC

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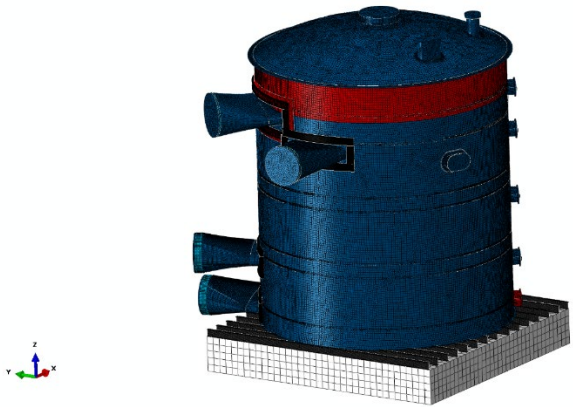
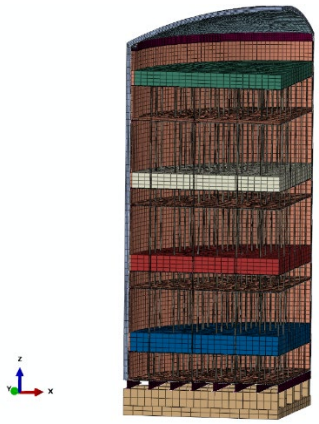
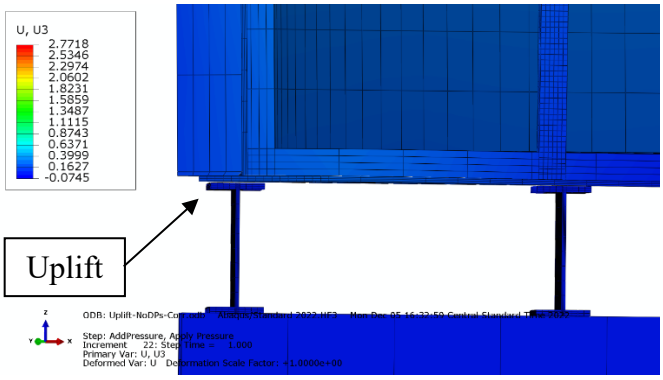
Chemical Reactor Catalyst Grating and Uplift Studies for Higher Pressures Fitness-for-Service (Finite Element Analysis, ASME FFS-1, Elastic-Plastic Methods, ESS LCF Method)

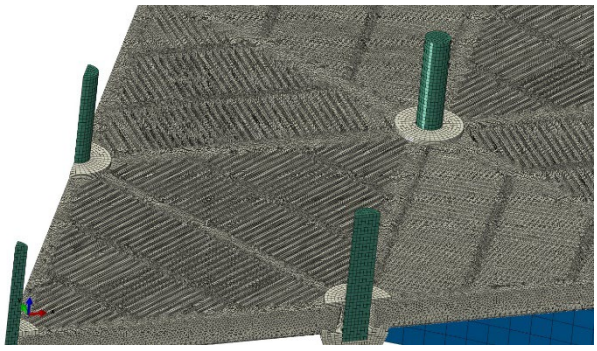
Project Description: A low pressure chemical reactor did not have a well established allowable working internal pressure and maximum allowable differential pressure across the catalyst grating. The plant was concerned with occasional pressure excursions and wanted a well-defined boundary for allowable pressures. The reactor was modeled in detail and evaluated for static pressure rating, low-cycle fatigue limitation, and the potential for up-lift of the bottom floor. Existing damages from previous high-pressure events were used as calibration/confirmation of the FEA results. Fillet welded joints were evaluated per ASME Section VIII Div. 2 Equivalent Structural Stress (ESS) method using FE-Safe/Verity.

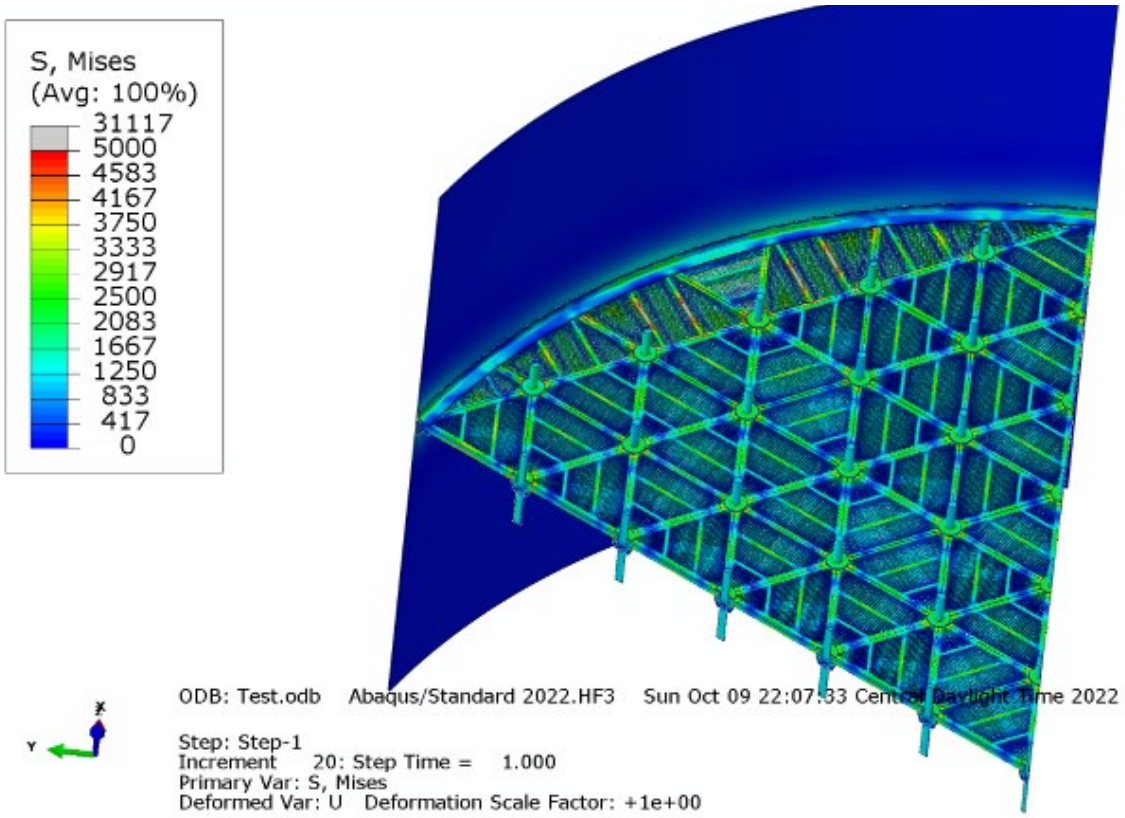
FEA Results: Pertinent images or this fitness-for-service study are shown below:

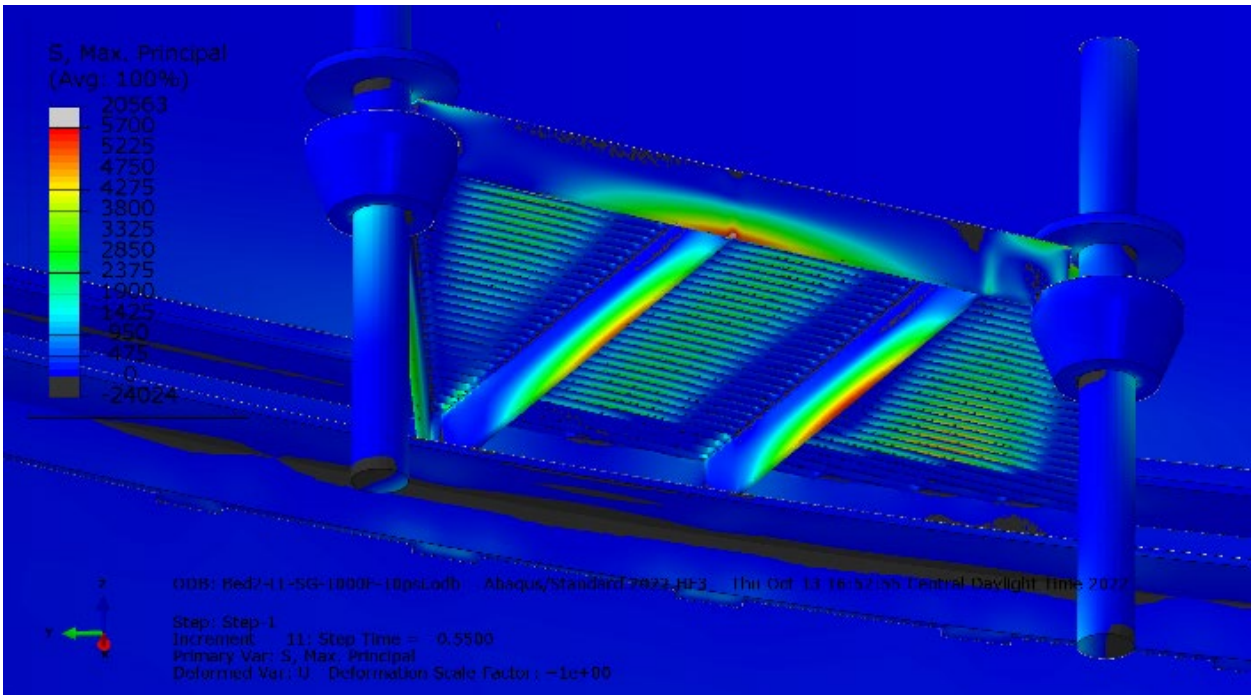









S, Mises
(Avg: 100%)
31117
5000
4583
4167
3750
3333
2917
2500
2083
1667
1250
833
417
0
ODB: Test.odb Abaqus/Standard 2022.HF3 Sun Oct 09 22:07:33 Central Daylight Time 2022
Step: Step-1
Increment 20: Step Time = 1.000
Primary Var: S, Mises
Deformed Var: U Deformation Scale Factor: +1e+00


S, Max. Principal
(Avg: 100%)
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5700
5225
4750
4275
3800
3325
2850
2375
1900
1425
950
475
0
-24024
Step: Step-1
Increment 11: Step Time = 0.5500
Primary Var: S, Max. Principal
Deformed Var: U Deformation Scale Factor: +1e+00