CASE STUDY
TOWER STRESS & STABILITY ANALYSIS

EIS

OVERVIEW

An EIS client was scheduled to replace a 654,515 lb and 160 ft tall tower during a turnaround and was concerned about its structural integrity during the lift. Corrosion had reduced the wall thickness at several locations, and years of operation had caused the tower to deform and accumulate additional weight. EIS was requested to complete a Finite Element Analysis (FEA) in order to safely perform the lift.

ANALYSIS RESULTS

1. As EIS conducted the FEA, we found that local thin areas (LTAs) of the tower were becoming unstable. This meant it was failing to meet global collapse acceptance criteria and confirmed that the lift would be unsafe to perform.

2. EIS continued to conduct analyses on the requested tower orientations to find what modifications needed to be made. To find a solution that could capture load transfer to the beams, both collapse and buckling analyses were completed.

3. With our results, we were able to calculate the appropriate size for support beams and deteremined that reinforcement plates should also be added on the outer surface of the skirt at the tail lug attachment points.

4. After completion of our analyses, we supplied the client with the required modifications to safely perform the lift. The client was satisfied with the results, and the tower was successfully pulled and laid on its saddles.

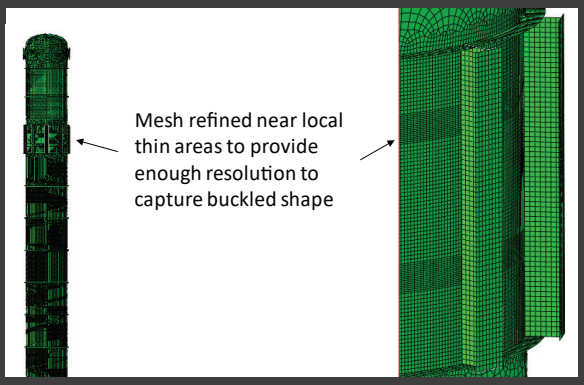
Review our Model and Modification Requirements and Tower Orientation Examinations on page 2.

CLIENT REQUIREMENTS FOR ANALYSIS

- Follow guidelines in ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, Part 5.
- Examine the following tower orientations: horizontal, 45°, and vertical.
- Consider only the weight of tower and internal loads.

MODEL & MODIFICATION REQUIREMENTS

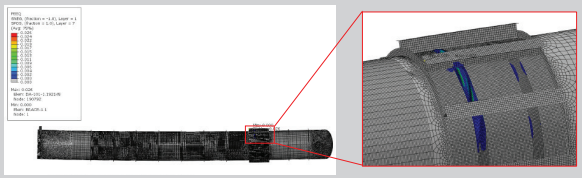
- ABAQUS finite element software used for FEA.
- Model was refined in critical areas to capture accurate stresses and buckling mode shapes.
- Vessel modeled using material properties of SA-285 Gr. C.
- Braces modeled using material properties of A-572 Gr. 50.
- 10-WT15X105.5 beams were added to stiffen local thin areas.
- Reinforcement plates were added to reinforce tail lug.

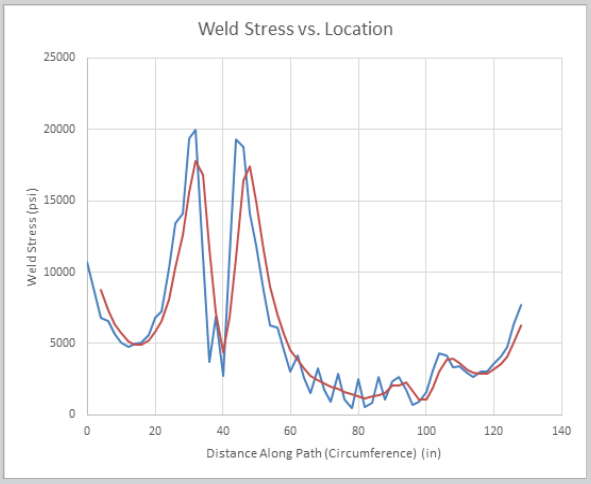


TOWER ORIENTATION EXAMINATIONS

HORIZONTAL ORIENTATION

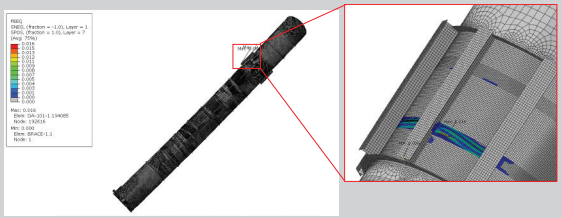
Type 3 analysis converged up to a load factor of 2.28. Plastic strain contour plot shown below. All areas with virtually no plastic strain shown in gray.





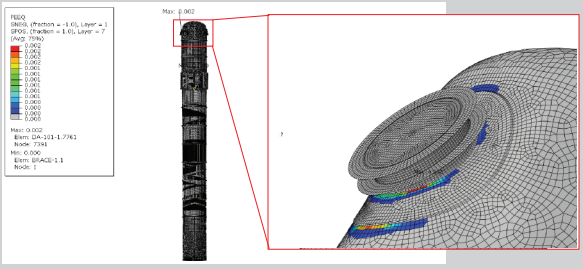
45° ORIENTATION

Converged up to a load factor of 3.15. Analysis was terminated at this point since load factor of 2.28 had been exceedeedy.



VERTICAL ORIENTATION

Only global collapse analysis was done since all areas were in tension. Checked configuration where tower was supported by trunnions only and when a load is placed on the tail lug to begin rotation. Both converged to a load factor of 3.0.



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