

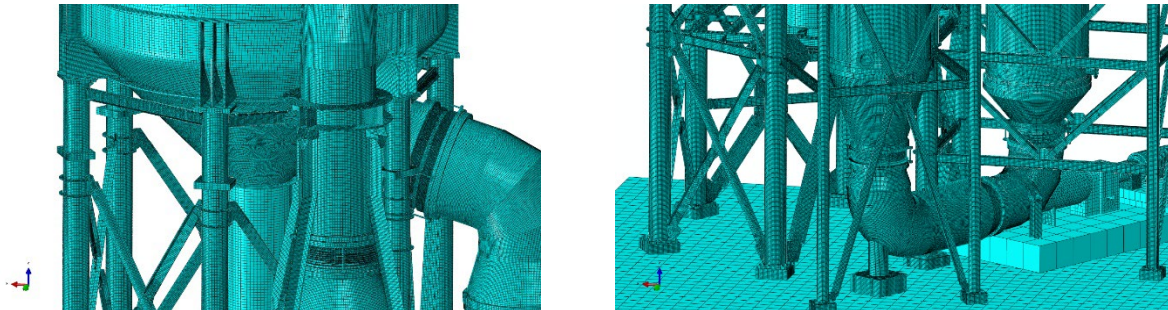
## Saba Metallurgical & Plant Engineering Services, LLC

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### Caustic Vessel/Structure Vibration – Mechanical Repair Plan (Finite Element Analysis and Vibration Analysis)

**Project Description:** Modification had been made to a caustic vessel from a straight to tangential entry nozzle. Additionally, the structure had been modified and made weaker and more flexible. Upon startup, the equipment vibration was so high that bolting began to break off the structure within a day or two. The first step in correcting this issue was to re-create the vibration in a finite element analysis (FEA) model. Evaluation was made for natural frequency and compared to field vibration data. The main low frequency vibration matched that of the lowest natural frequency, a side-to-side sway of the vessel/structure. The highest vibration data matched the natural frequency of the main horizontal supports the vessel was bolted. Additional vibration data peaks matched various structural component (diagonal beams) natural frequencies. With the culprit areas identified, structural reinforcement was created and tested. Those structural members now showed noticeably increased rigidity.

**FEA Model:** The meshed FEA model is shown in the below images:



**FEA Results:** Results from the evaluation stage of identifying the vibration issue are shown below. Several structural reinforcements were made, and the desired stiffening observed in the FEA model. Using the same loads as the evaluation model, the modified structure showed much lower vibration levels. The changes were implemented in the field and the vibration levels reduced to acceptable levels.

