

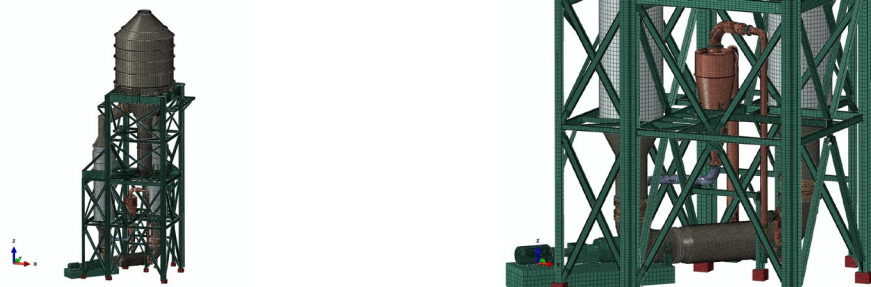
# Saba Metallurgical & Plant Engineering Services, LLC

401 Saint Louis St. · Madisonville, LA 70820 · Phone: 225-405-4015

## Cyclone – Mechanical New Design Evaluation (Finite Element Analysis, Computational Fluid Dynamics, Co-Simulation, Fluid Structure Interaction, Non-Linear Transient Vibration)

**Project Description:** When adding a large source of vibration to a tall structure, it is critical to evaluate that structure for its natural frequencies to avoid resonance with the forcing frequency of the vibration source. Additionally, if the structure is too flexible, then excessive vibrations can occur in this manner as well. Using a co-simulation between the computational fluid dynamics (CFD) software and the finite element analysis (FEA) software in a fluid-structure-interaction (FSI) study can achieve the required detailed analysis. Operating speeds are not the only forcing frequency in the system; there are also forcing frequencies from the flowing fluid. In the FSI, the cyclone is ramped up over time to a steady-state condition, where the vibration from the fluid forces on the structure can be evaluated, particularly for large or increasing vibration signatures. For the latter, this is an indication of resonance occurring. Separately, a natural frequency study can be conducted of the FEA model to better pinpoint both those beam members with potential resonance conflicts with the cyclone operating speed(s) and the forcing frequencies of the fluid flow. For the latter, the forcing frequencies can be identified in the FSI as vibration frequencies outside that of the equipment operating frequencies.

**3D CAD and FEA Models:** The meshed FEA model is shown below, with the cyclone better shown in the image to the right.



**CFD and FEA Results:** Fluid flow and vibration results are shown below. Modifications were required due to observed resonance.

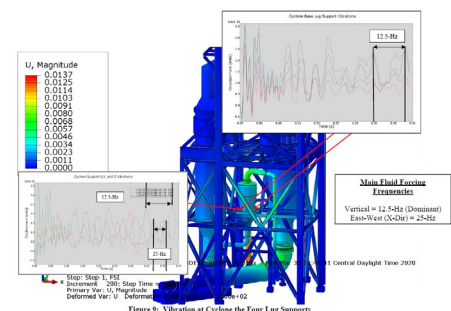
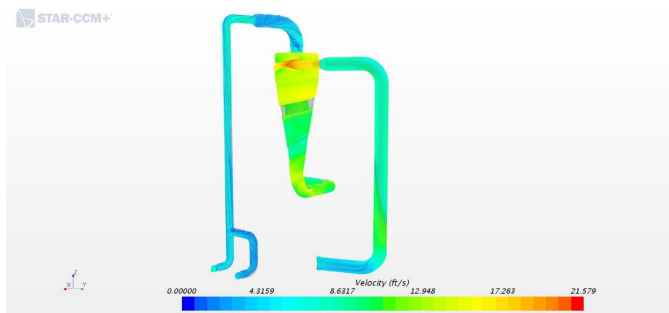


Figure 9: Vibration at Cyclone the Four-Leg Supports