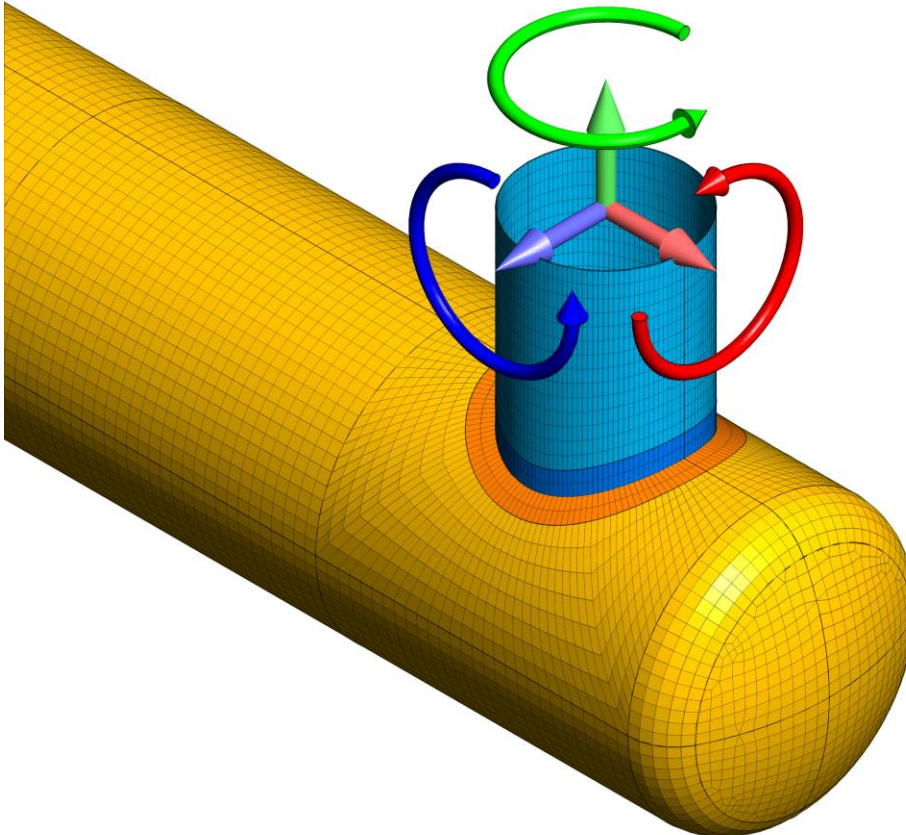


**Keywords:** Femap, NX Nastran, programming, automation, Application Programming Interface, API, VBA, Microsoft Excel, ASME, Section VIII, Div. 2, code analysis, membrane stress, pressure vessel, nozzle, repad, NQA-1, stainless steel, static analysis, stress analysis.

**Main Graphic:**



**Caption:** ASME Section VIII Pressure Vessel - Nozzle Load Application with Software Automation.

**Case Study Section:** Stress and Deflection

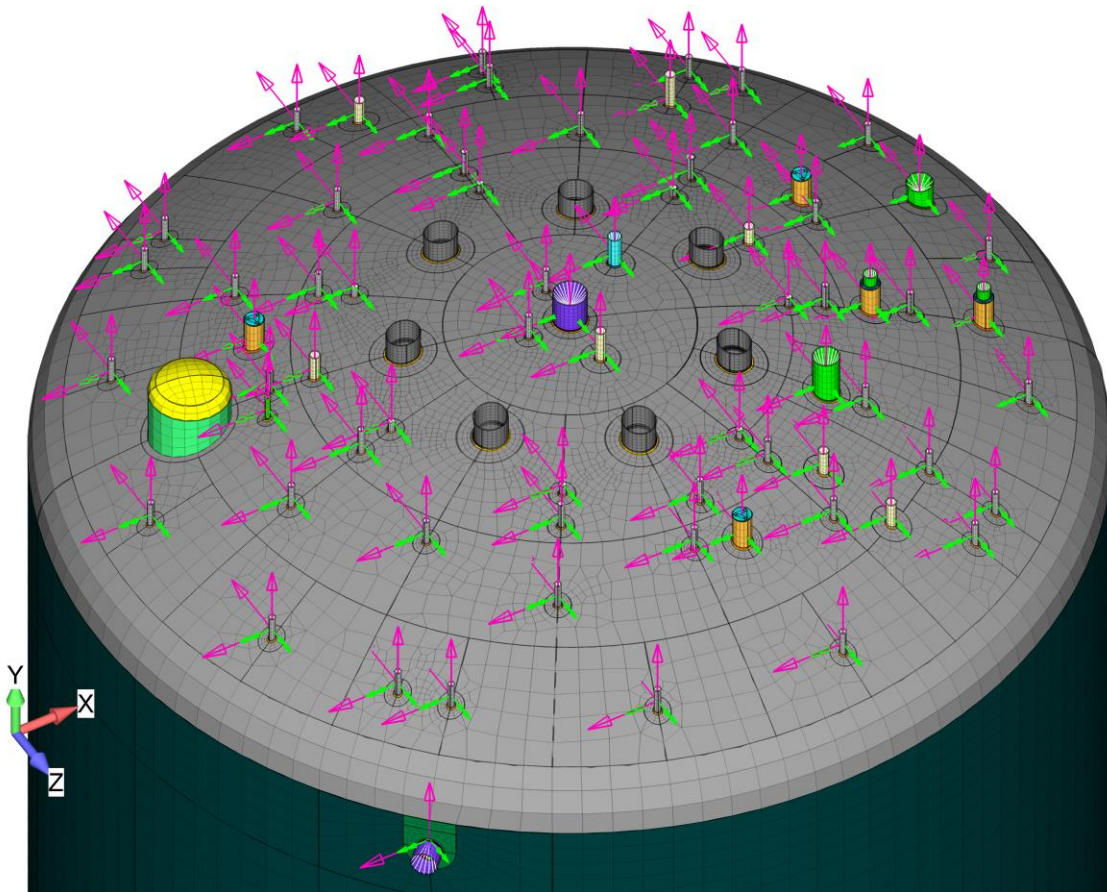
## ASME Section VIII Pressure Vessel - Nozzle Load Application with Software Automation

**Analysis Type:** Static, Stress, ASME Section VIII Div. 2

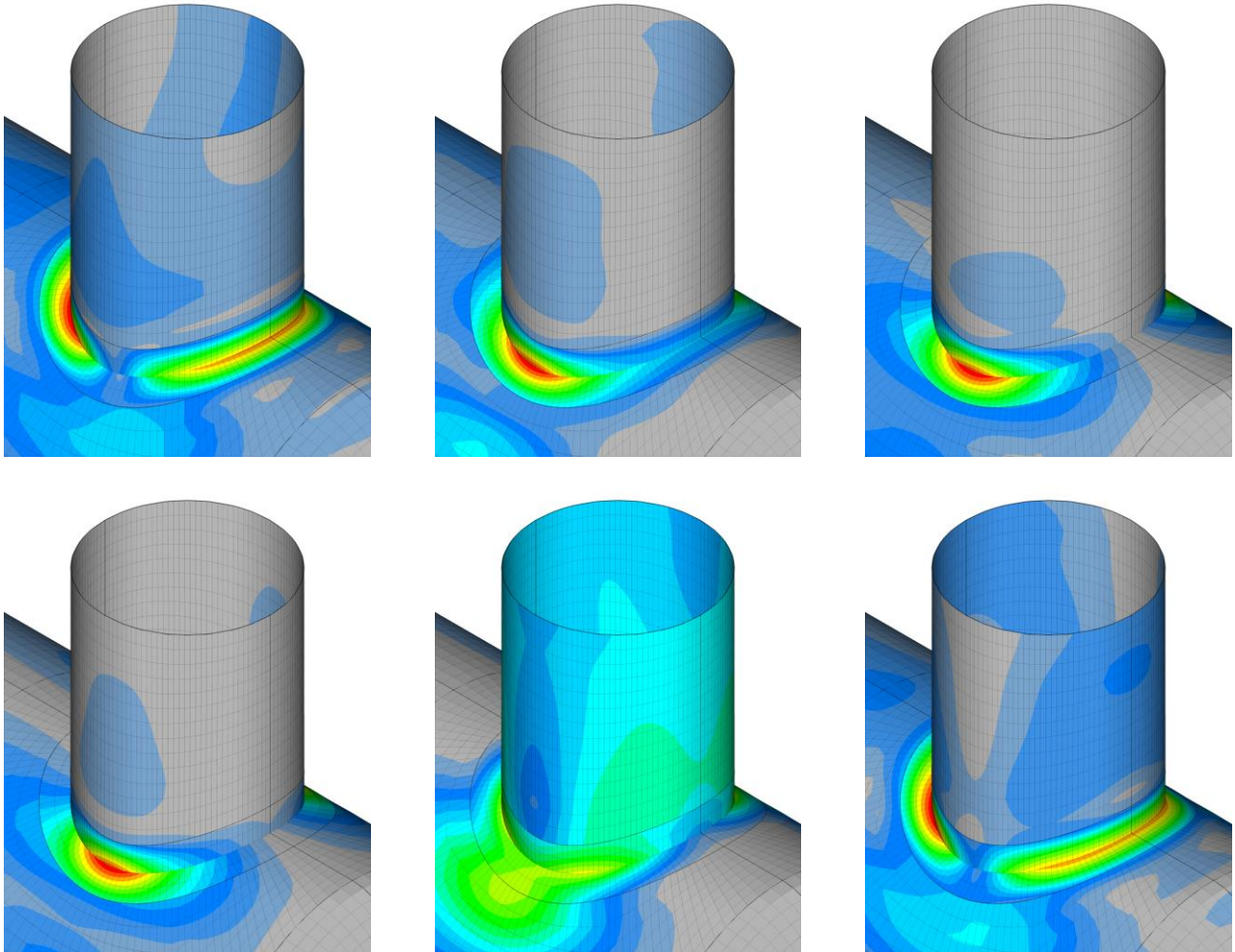
Generally, the nozzles of an ASME Section VIII pressure vessel can be checked with hand calculations. A simple nozzle on a flat head is a perfect example of a structure that can be idealized as a cantilever beam. What happens if the nozzle is on a curved shell or a dished head? At point will that curvature start to dramatically affect stresses at the nozzle? What if the nozzles are packed tightly together? What if the nozzle has a repad? It very quickly moves from a simple hand calculation to something that requires FEA.

For the vessel in this case study, nozzle forces and moments were given for weight, seismic and thermal load cases in the X, Y and Z direction. There were approximately 70 nozzles. That results in 1,260 individual loads that need to be applied to the model. Even for the most efficient FE modeler, this task could take all day. Checking for errors in data entry doubles the work time. If the end client changes the loads, it all starts over again.

To automate this task, the Femap Application Programming Interface (API) was employed. With the load provided in a Microsoft Excel spreadsheet, a VBA macro could be written that would create the loads in Femap using the values in Excel. Every time the loads were changed, the spreadsheet would be updated and loads would be applied to the model with the click of a button.



**Figure 1:** The top head of the vessel with nozzle forces and moments applied.



**Figure 2:** The program is useful for a single nozzle as well. With some additional programming, the macro could set up and instigate the analyses in Femap. This means that by the time the analyst has switched from Excel to Femap, the stress results will be populating the model.