FEA Submission Requirements

Finite Element Analysis (FEA) can be used to support pressure equipment design where the configuration is not covered by the available rules in the ASME code. We recommend that the designer will check with ABSA whether the usage of FEA is acceptable, this must be clarified before the design is submitted. When using this method for justifying Code compliance of the design, a complete FEA report having the elements listed below is required.

Special Design Requirement

As this analysis method requires extensive knowledge and experience with pressure equipment design and the FEA software and package involved, we require that the analysis and report **must be completed, certified and signed off** by a Professional Engineer, registered in any province or territory of Canada or any state of the United States of America. In all cases the Professional Engineer shall certify that he or she is experienced in pressure equipment design and the application of FEA. A summary of his or hers academic credentials and relevant experience in pressure equipment design and FEA usage must be presented, and it will be subject to ABSA's acceptance (provide references of the projects, or equipment and the name of the end user).

Executive Summary

The report should contain an executive summary, briefly describing how the FEA was used to support the design, the FEA model used, the results of the FEA, and conclusions relating to the FEA results supporting the design submitted for registration.

Introduction

The introduction shall describe the scope of the FEA analysis relating to the design, the justification for using FEA to support the design calculations, the FEA software used for the analysis, and the type of FEA analysis (i.e. static, dynamic, elastic, plastic, small deformations, large deformations, etc.)

Model Description

This report section is required to completely describe the FEA model used for the analysis. The description will include dimensional information and/or drawings relating the model geometry to the actual pressure equipment geometry. Simplification of geometry must be explained and justified as appropriate. The mesh and type (h, p, 2D, 3D), shape, and order (2^{nd} order or above) of the elements used must be described. If different types of elements are used, a description of how the different element were connected together is required. When using shell elements, describe the top or bottom orientation with plots of the elements and indicate if they are thick or thin elements.

The turn angle of each element used on inside fillet radii must be indicated.

Indicate how the size of mesh elements was chosen with reference to global or local (bias) mesh refinement.

When modeling items like flanges, describe in what manner the two separate flange faces are linked (e.g. contact elements)

Boundary conditions such as supports, restraints, loads, and forces shall be clearly described and shown (present the figures). The method of restraining the model to prevent rigid body motion must be indicated and justified. When partial models are used (typically based on symmetry), the rationale for the partial model shall be described with an explanation of the boundary conditions used to compensate for the missing model sections.

The accuracy of the model digitization shall be indicated, either by the described use of convergence studies or by comparison to the accuracy of previous successful in-house models. This section of the Report must include a proposed method to verify that the model results reflect the real response of the physical pressure equipment. This proposal will be subject to ABSA's acceptance.

Presentation of Results

The following figures must be presented (coloured prints):

1) Displacements (plot);
2) Deformed shape with un-deformed shape superimposed;
3) Stress plot with mesh, that will :
   a. Show discrete fringes → discrete colour separation for stress ranges or plots
   b. Allow comparison between the size of stress concentrations and the size of the mesh
4) Show plot with element stress and compare nodal (average) stress vs. element (non averaged) stress (if the small difference is less than 5%, the accuracy should be OK);
5) Compare reaction forces to applied loads;

When plots or figures have been presented, there must be discussion relating to each and every figure to explain what is the purpose of the figure and why it is of importance.

Analysis of Results

Overall model results and areas of interest. Results which are to be disregarded and justification for their exclusion.

Conclusions

Relate the results of the FEA to the defined allowable stresses of the Code of construction using the appropriate ASME methodology.