Capability Statement
Structural Analysis

Introduction

The effects of external and internal loads on structures are determined using structural analysis modelling tools, which are today predominantly based on Finite Element (FE) methodology. Stress and displacement equations are calculated for a wide variety of different loads (e.g. mechanical, thermal, electromagnetic, seismic, etc) and structural supports in either their static or dynamic implementation. This approach is widely used in engineering analysis to:-

- Determine stresses (stress matrix, principal stresses)
- Define structural displacements & deformations
- Investigate heat transfer & electromagnetics
- Undertake modal analysis to determine vibration characteristics
- Assess structural (yield) acceptance
- Simulate rigid body dynamics
- Carry out impact & material disintegration analysis

MMI Engineering has many years of experience using different structural FEA tools, especially ANSYS Mechanical and ABAQUS. Long and close collaboration with software vendors like ANSYS and Dassault Systèmes has enabled us to develop our unique engineering capabilities.

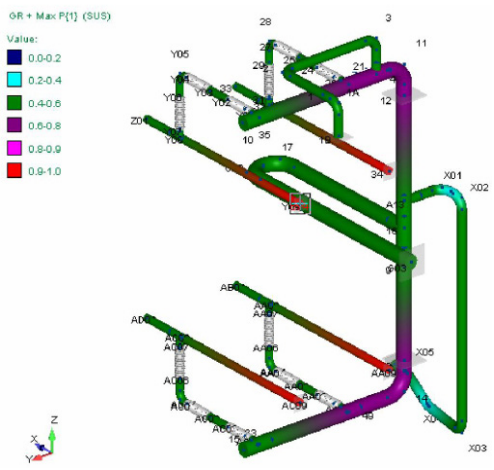

Figure 1: Bentley AutoPipe analysis of a cooling manifold for RF antenna showing areas reaching or exceed the max allowable stress for a given support arrangement

Project Examples

MMI was commissioned to perform a structural analysis of a cooling network, which was performed using Bentley AutoPipe engineering software. Due to thin wall approximation used in network structural codes, such piping system analysis is much faster when it covers the structural assessment of much larger systems.

The conducted network analysis helped to determine the most appropriate strategy for supporting the cooling manifold, while minimising the use of bellows, which are introduced to compensate for thermal displacements, although they do represent a weak element in high pressure systems. Due to geometrical complexity of large piping networks, it is crucial for a model to represent large sections of the network and not only localised areas.

Another project example involved MMI completing a structural assessment of an ITER NBDI residual ion dump cooling arrangement, using elastic and elasto-plastic finite element analysis. The investigated structure was subjected to a high coolant pressure (50 barg) together with large thermal and electro-magnetic loads. Irradiation effects were also taken into account.

The calculated stresses and deformations were compared against ITER structural design criteria for in-vessel components (i.e. an extension of French structural code RCC-MR). Both main design elements and welded joints were assessed. Where necessary, stresses were linearised so that local stress conditions could be checked in detail. The results enabled MMI to recommend design improvements that would reduce localised
stress levels.

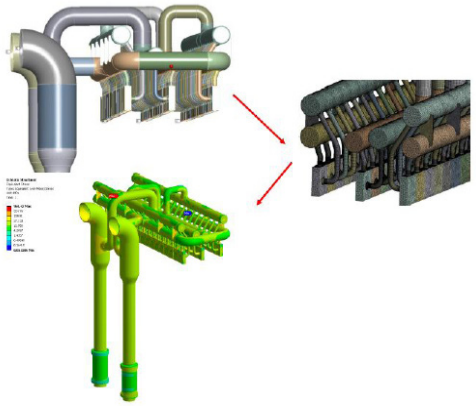

Figure 2: Structural analysis of a cooling manifold for ITER NBDI residual ion dump system

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