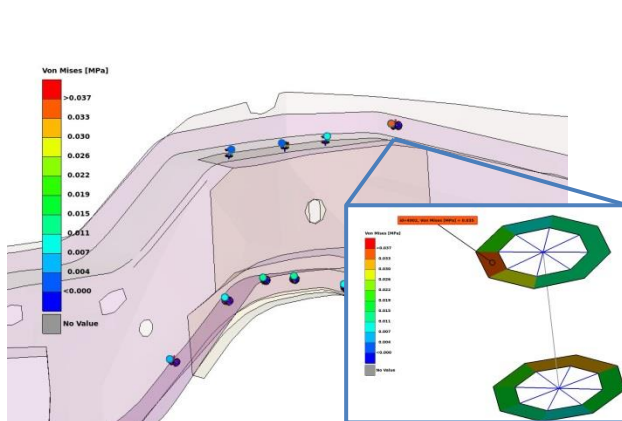# ANSA / META for Fatigue analyses

Introduction

Fatigue analysis as a part of the durability analysis plays an important role during the development of structures. Saving time and resources, CAE has an irreplaceable position in the stages of design and development of new structures. However, as numerous solvers exist, the process of conducting fatigue analysis can hinder obstacles that can affect the quality of the results. BETA CAE Systems, through the ANSA / META pre- and post- processing suite, offers the tools to cover all the multiple solution types required for advanced fatigue analyses.
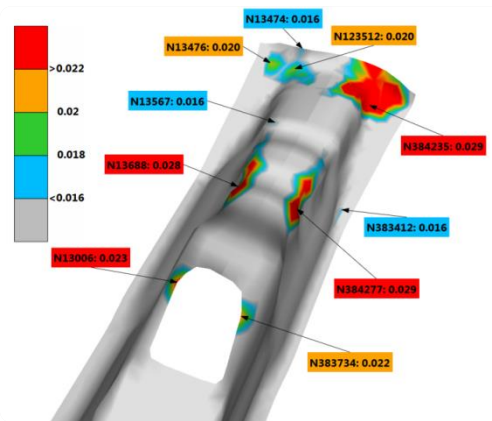
ANSA / META for fatigue analyses

Different tools have been developed in ANSA to serve the needs of fatigue analysis modeling for different solvers. This has been accomplished either through keywords, numerous representations for seamwelds, spotwelds and robscans, or integration scripts.

META offers advanced functionality for 2D and 3D post processing, such as identifications of critical points and areas, advanced process automation capabilities (toolbars, scripting) and support for numerous formats of different solvers. It supports the input of results from fatigue solvers either in universal file format of a dataset supported by META (e.g. Nastran, LMS Virtual. Lab, FE Fatigue, etc), or in ASCII column format. Additionally, files from the following fatigue solvers are also supported (FEMFAT, fe-safe, FDynam).

The solutions for each solver are represented below according to the solver.

Connection grouping per type and identification of critical areas

Hot spot identification

BETA CAE Systems International AG

D4 Business Village Luzern, Platz 4   T +41 415453650   ansa@beta-cae.com
CH-6039 Root D4, Switzerland   F +41 415453651   www.beta-cae.com
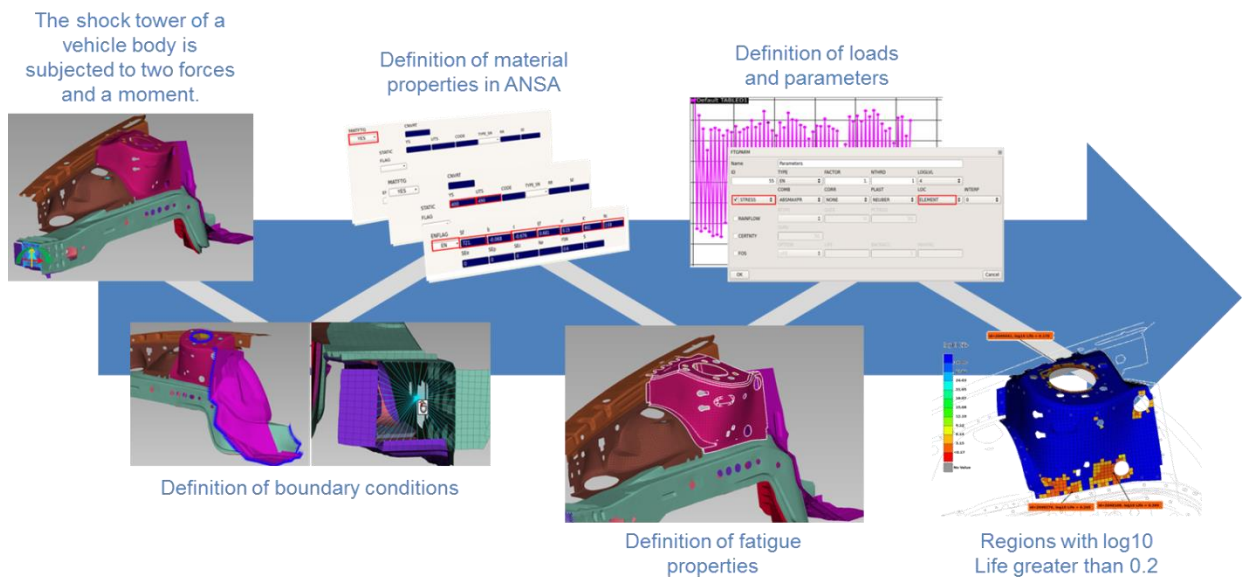
MSC Nastran embedded Fatigue*

ANSA offers the functionality to setup fatigue analyses for Nastran Embedded fatigue (NEF) in a single environment. FE analysis as well as fatigue analysis can be set up in one database. META fully supports 2013 and 2014 NEF formats including seamwelds and spotwelds results.

This is accomplished through a robust, yet fast and user friendly process the steps of which are listed below.

1. Initial Model Set-up.
2. Definition of fatigue material properties.
3. Definition of fatigue properties.
4. Definition of cyclic fatigue loadings.
5. Definition of fatigue parameters.
6. Evaluation of results in META.

The shock tower of a vehicle body is subjected to two forces and a moment.

Definition of material properties in ANSA

Definition of loads and parameters

Definition of boundary conditions

Definition of fatigue properties

Regions with log10 Life greater than 0.2

Benefits

By employing ANSA and META for Nastran fatigue analyses, numerous benefits are realized that greatly facilitate the CAE processes for fatigue analyses including:
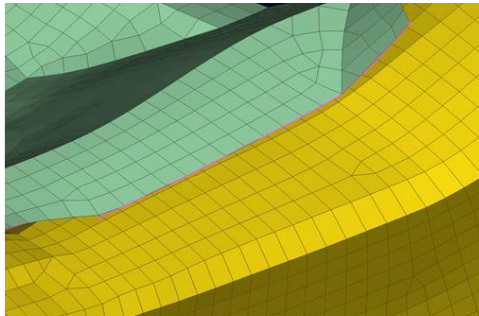
– The facilitation of the process as it can be performed in one database.
– The significant time reduction for large fatigue and durability simulations.
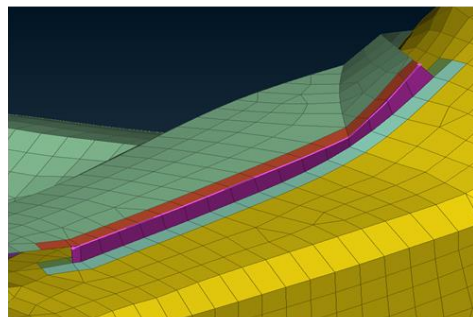
physics on screen

- The ability to perform fatigue analysis only in specific part of the model.
- The smaller file sizes.
- A far more transparent fatigue process as a fatigue calculation can be included with every stress run.
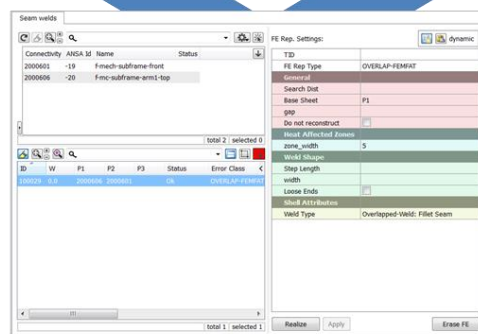- The automation capabilities of META that greatly reduce post- processing time duration.

FEMFAT*

ANSA provides semi and fully automated tools to create a FE-model of structures with seamwelds and spotwelds. The Connection Manager enables complete multiple connection type definitions in a single step. By using it, the user can define directly, ready-to-analyze FE-models which fulfill the definition criteria of FEMFAT in order to assess subsequently the seamweld fatigue calculation. The supported seamwelds are: OVERLAP-WELD, Y-JOINT-WELD, CRIMP-WELD, EDGE-WELD and LASER-WELD, SOLID-WELD. According to each representation, ANSA assigns to the welds and to the HAZs the respective material ids and the local coordinate system labels according to FEMFAT WELD guidelines. (Example OVERLAP WELD).
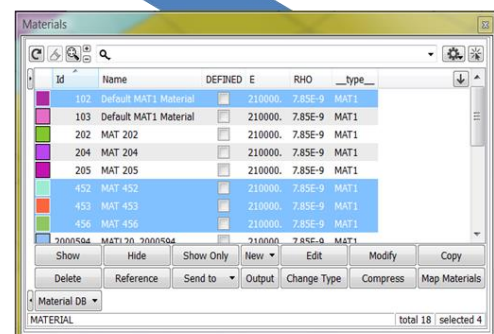

Initial parts to be connected
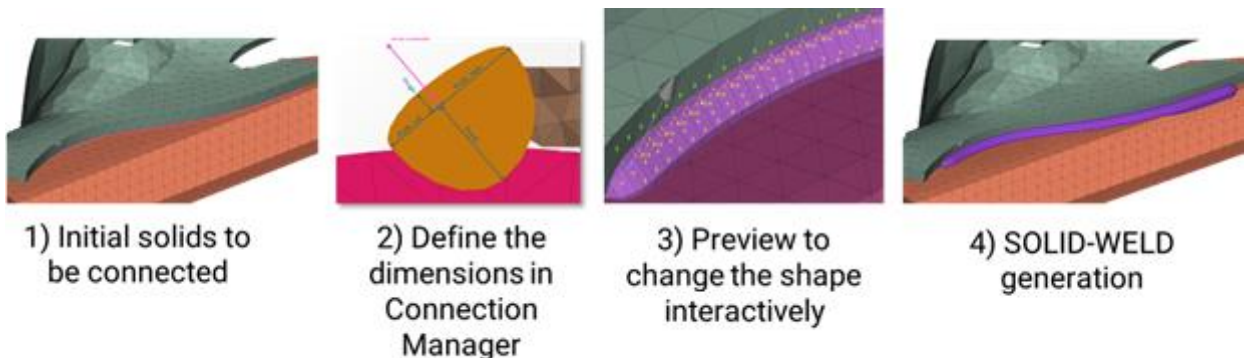

Overlap FEMFAT shell generation

Set-up through the connection manager

Assignment of material

physics on screen

SOLID-WELD is a detailed volume mesh representation. It is created and controlled as any other seamweld through the Connection Manager. Automatic mesh reconstruction at volume level is performed with local mesh refinement. The Weld shape is fully customizable. That means that users can define the four basic dimensions. A 3d-Preview is also available where the user can modify the shape interactively. Finally, node sets compatible with FEMFAT requirements, are generated automatically.

1) Initial solids to be connected

2) Define the dimensions in Connection Manager

3) Preview to change the shape interactively

4) SOLID-WELD generation

The same approach is followed for Spotwelds using the FEMFAT Spot Representation. Using the Connection manager, the user can generate FEMFAT Nuggets having numerous options (diameter of the nugget, definitions of zones, etc) . At the same time, ANSA can assign the respective materials according to FEMFAT guidelines.

FEMFAT spotweld representation

Benefits

- A variety of settings for all FEMFAT representations (width, zones, length, creation of sets, etc) from Connection Manager.
- Automatic generation through the Connection Manager.
- Automatic reconstruction of the mesh during the generation.
- Compatibility with the FEMFAT specifications. (materials, local coordinate system).
- Support of op2 FEMFAT formats in META.

physics on screen

fe-safe*

ANSA offers a script that outputs in Verity format the weld shells and heat-affected zones according to weld type (Lap Weld, Y-Weld,Edge-Weld, Crimp-Weld, etc.) in order to serve the needs of weld-fatigue analysis modeling. All the extra options needed (sets, coordinates systems, etc) are generated automatically from the script.

The shape of the resulting weld can be fully controlled through numerous options (Heat Affected Zones, Primary/Offset Row, Offset Distance, Height, etc) from the connection manager.

This script is available in the distribution package of ANSA.

Benefits

- The Verity Weld Definition script can be easily utilized during the process of identifying and modeling seamweld, leading to a significant time reduction during the weld fatigue analysis process.
- The automation capabilities of the connection manager as described in FEMFAT.
- Many options for the verity format through the script (Reference Length, Weld symmetry, Linerazitation AEC, Symmetry AEK etc.).
- Support of fe-safe (Abaqus, Ideas, ANSYS format) results in META.

The script interface

The generated verity file

FEMSITE*

ANSA supports the use of FEMSITE as an external assembler. The FEMSITE is called by ANSA during the realization of connections with the FEMSITE FE-Representation types. Through the Connection manager, the available FEMSITE representations are FEMSITE-SPOTWELD in case of spotwelds, and FEMSITE-ROBSCAN in case of Robscans. The Nastran or Permas format can be used

FEMSITE spotweld representation

Benefits

- The automation capabilities and powerful functionality of the Connection manager.
- Seamless communication between ANSA and FEMSITE.
- The available attributes for INCLUDEs.
- Support of bif/bof formats.

Benefits of employing ANSA and META for fatigue analysis

By employing the tools of ANSA for fatigue analyses, numerous benefits can be realized that greatly facilitate the CAE processes for fatigue analyses including:

- The time reduction of post processing processes and the accuracy increase due to the Connection Manager.
- The ability for modeling for numerous solvers in one single environment.
- The powerful meshing capabilities and quality of ANSA.
- An augmented toolbox for durability analyses.
- The powerful and unique functionality of META that greatly reduces post- processing complexity and time duration through the offered automation capabilities.

For more information contact
BETA CAE Systems.
Email: ansa@beta-cae.com

physics on screen