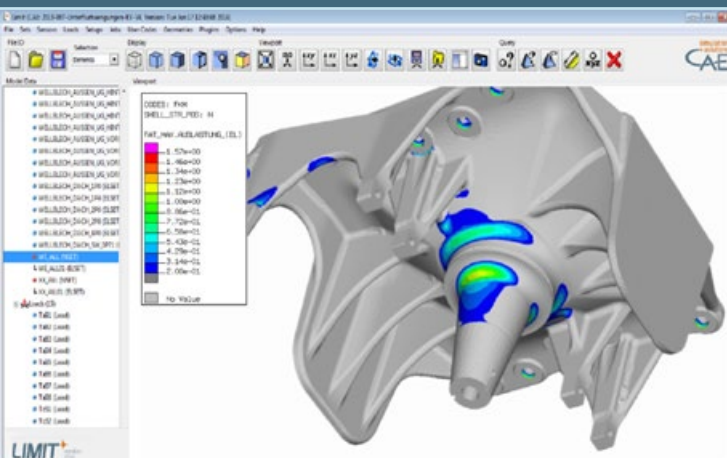


Complex load histories

Codes/Procedures

- **DVS1612:** German code, endurance strength, steel welds, rail-vehicles
- **DVS1608:** German code, fatigue strength, aluminum welds, rail-vehicles
- **EN17149:** European standard, fatigue strength, rail-vehicles, damage accumulation
- **BS7608:** British standard, fatigue design and assessment of steel products
- **IIW-Recommendations:** Fatigue design of welded joints and components
- **FKM-Guidelines:** Stress assessments for general purpose engineering applications
- **ERRI B12/RP17:** Fatigue assessment, steel welds, rail-vehicles
- **DangVan, Crossland:** Fatigue of railway wheels



Fatigue assessment center pin, 1200 load cases

Interfaces

			Altair OptiStruct

LIMIT FEATURES

Load Cases / Load Spectra

The loading definition is performed in two steps. At first, the user defines the Finite Element results, to be read from the result file. From these Finite Element results the load cases for the stress assessment are derived using the superposition principle or using only weighting factors for single load cases.

Furthermore the users can define load spectra, combining load case and cycle information or by applying the internal rain flow count algorithm [i.e. to measured data channels].

Multiaxiality

In case of multiaxial loading conditions critical section plane approaches can be used in combination with code specific stress criteria or with normal as well as scaled normal stresses.

Post Processing

All results are post processed within the LIMIT-Viewer. Detailed information on each assessment group is additionally listed in text files. The LIMIT-Viewer can be used for free.

Auto Report

LIMIT includes a module offering automated documentation. The user can define different views and visualization settings. These are used to generate a documentation of the geometry and the results. This feature leads to significant time savings when complex welded structures are analyzed.

Licensing

Node locked as well as network licenses are available.

Trial

Get a 30 day trial for free, including a 2 hour introduction webinar tailored to your needs.

LIMIT support and development

Support is provided by experienced engineers of CAE Simulation & Solutions. Our engineers constantly use LIMIT in customer projects and are thus experts in

- the usage of LIMIT
- the application of codes and all practical aspects
- software updates

Further more we actively involve our application engineers in the development of LIMIT. As a result features for efficient practical use are constantly added.

CAE Simulation & Solutions

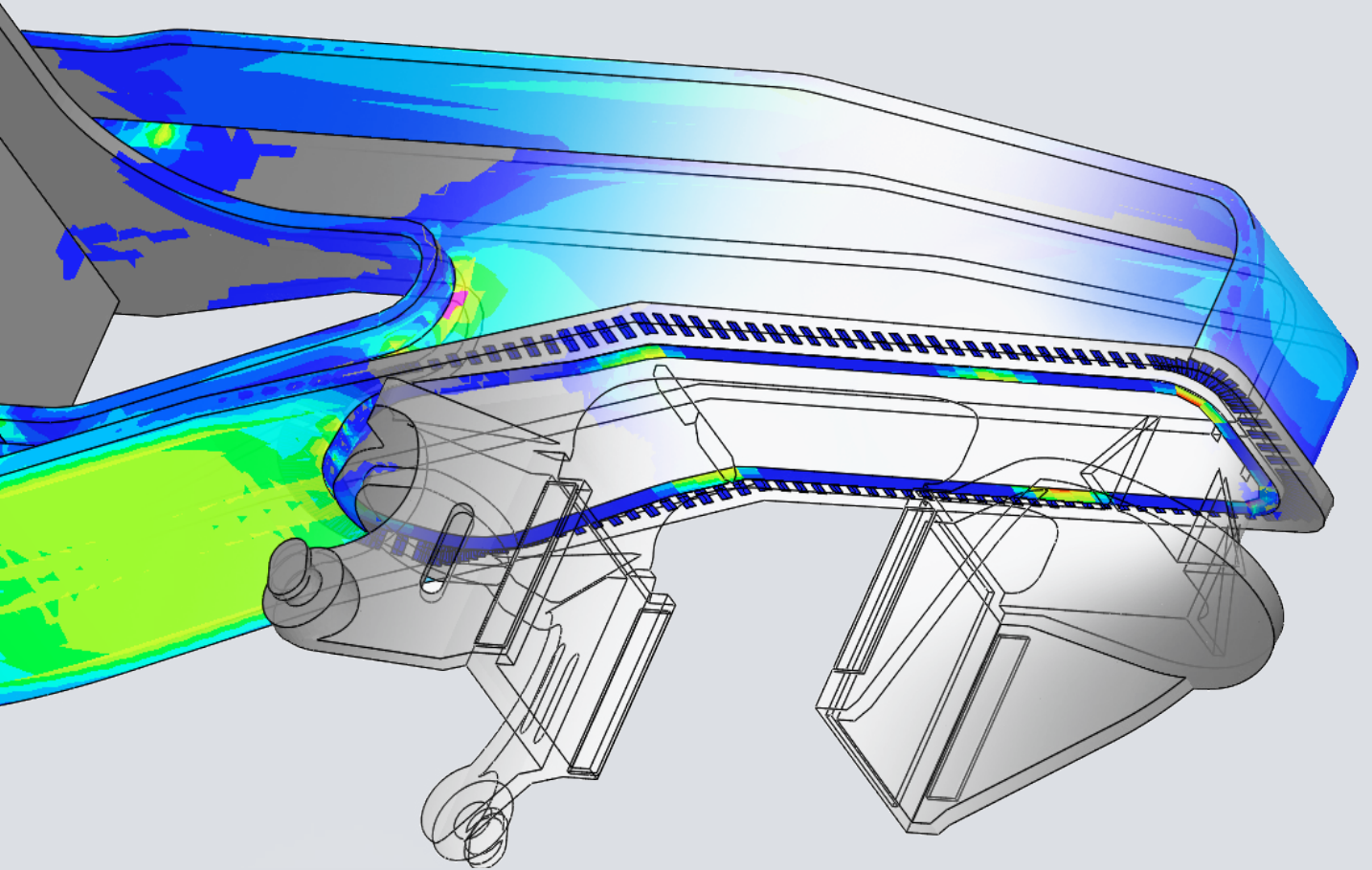
Maschinenbau Ingenieurdienstleistungen GmbH



Pitkagasse 2/1/16, 1210 Wien, Austria
Tel.: +43 [1] 974 89 91-0
office@limit-fatigue.com
www.limit-fatigue.com

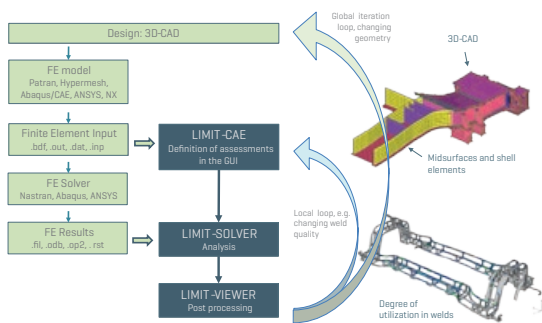
LIMIT ✦

stress evaluation

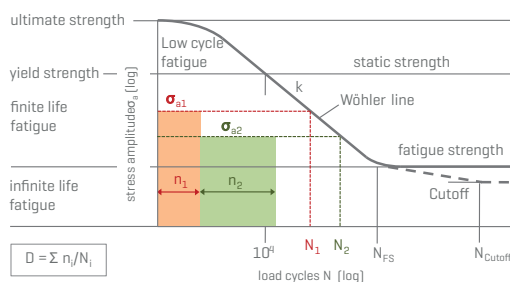


From Stress to Safety

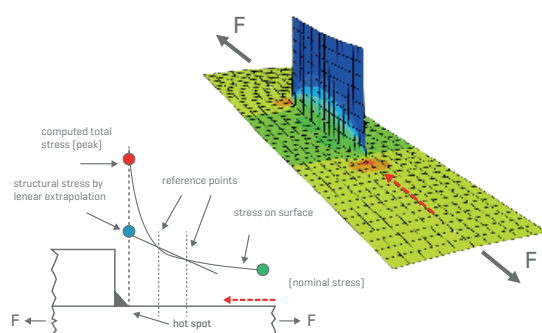
www.limit-fatigue.com



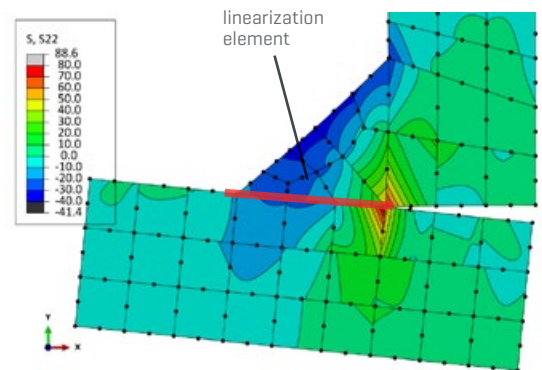
Assessment process using LIMIT



S/N-diagram



Stress concepts for welds



Linearization element in case of fillet weld

LIMIT ASSESSMENTS

The basic steps of strength assessments with LIMIT are

- import the FEA-model into LIMIT
- define load scenarios and load spectra
- define element sets for assessment
- apply codes and assessment types to these groups
- perform fatigue analysis using FEA results
- view results, generate a report

Types of strength assessments

The software LIMIT offers three different types of stress based strength assessments

- static strength
- variable amplitude fatigue strength [finite life fatigue]
- constant amplitude fatigue strength [infinite life fatigue]

These assessment types can be used for base material and welded structures, depending on the design code. For base material the stresses supplied by the FE codes are used directly in the sense of a local stress approach.

Welded structures are assessed using one of the following stress concepts:

- nominal stress
- structural hot spot stress
- effective notch stress

The structural stress is determined by linear extrapolation of the surface stresses from the reference points to the hot spot at the weld toe or by linearization of stresses across the relevant section. This approach facilitates FEA model generation and improves result accuracy. Weld assessment requires information about sheet thickness, weld geometry and weld path. LIMIT contains several functions which strongly facilitate the definition of the required parameters involved and calculates structural stresses in arbitrary meshes of shell and solid elements.

Structural stresses for weld assessments based on unstructured solid meshes

Within LIMIT there are two extraction algorithms for structural stresses based on solid element meshes. The first one can be compared with the application of strain gauges. By means of so-called sensor elements the displacement data is extracted at selected points and transformed into structural stresses following linear stress-strain relationships. The sensor elements can be envisaged as virtual shell elements, which are embedded into the geometrical mid-surfaces of continuum element models. Equivalent section forces and equivalent linearized stress distributions are calculated for the sensor element. The assessment points follow the specification of the IIW while the continuum element mesh does not have to obey these rules and may even be an unstructured tetrahedra mesh.

The second approach is called section assessment and was developed to investigate fillet or lap welds often used to join casted parts and sheets. Based on nodal forces linearized structural stresses are calculated even in the throat of fillet welds. The approach enables the assessment of weld roots based on rather coarse and unstructured meshes. Thus the efficient stress calculation with solid meshes and the accurate fatigue assessment of weld sections can be combined for reliable fatigue life prediction. On the cover page a detail of a bogie frame is shown including sensors [small quads] for the stress extrapolation at toe points and the section assessment [continuous band] for the weld throat.

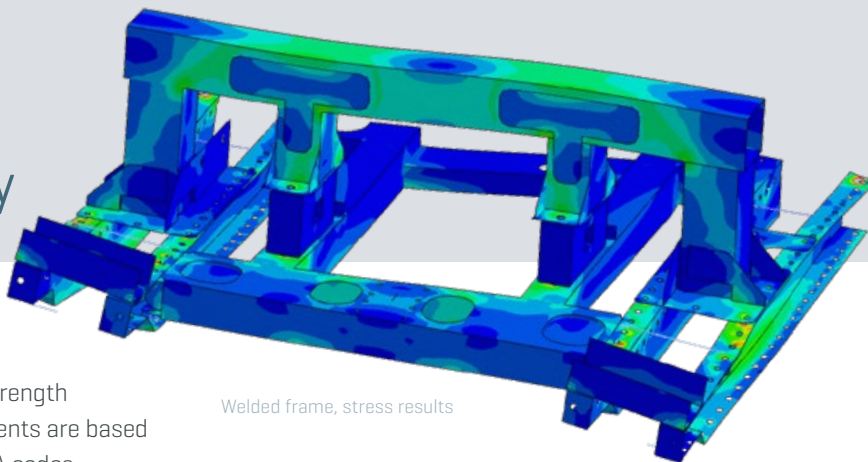
From Stress to Safety

WHAT IS LIMIT?

LIMIT is a post processing tool for performing strength assessments of metal structures. The assessments are based on stress results from standard commercial FEA codes.

LIMIT calculates the permissible stresses locally for every element including various effects like stress gradients, surface treatments, weld types, mean stresses, load case combinations, service lifetime etc. The resulting safety values give the information you really need to improve your design quickly and cost effectively.

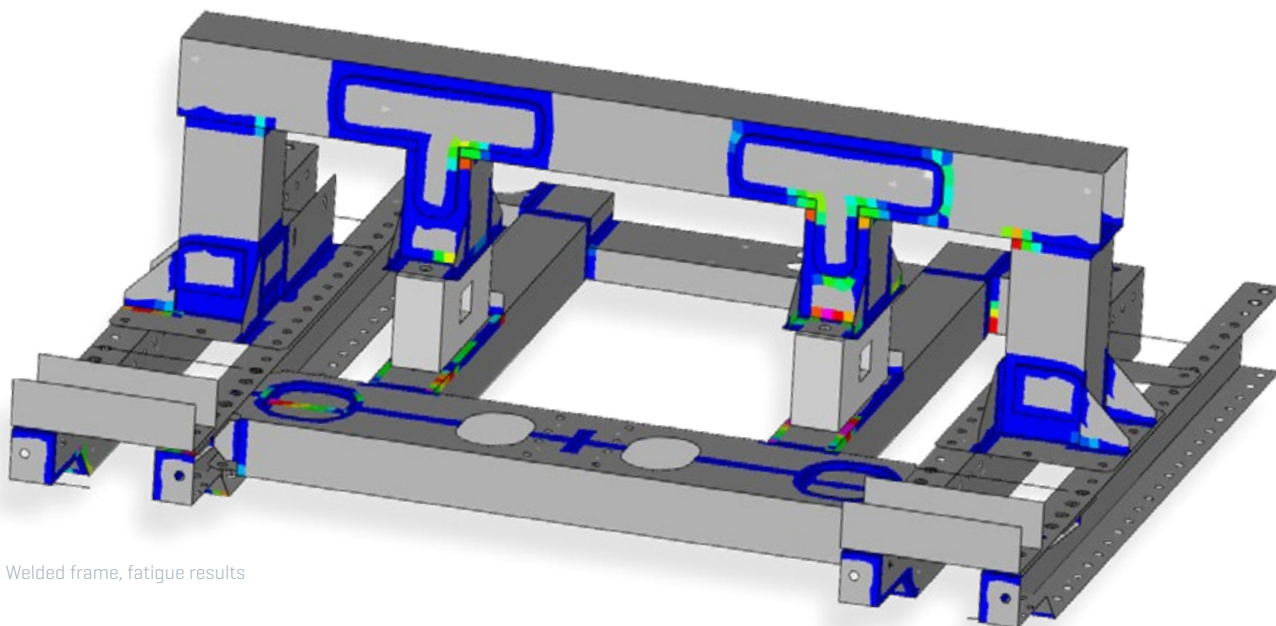
In welded structures, critical areas with respect to strength often don't coincide with areas of increased stresses, since the static and fatigue strength strongly depend on weld geometry and local loading conditions, as shown in the pictures of this page.



Welded frame, stress results

KEY FEATURES

- ♦ identification of all critical positions in the structure with respect to static failure or fatigue life
- ♦ calculation of corresponding safety values as defined in design codes / guidelines
- ♦ detection of critical loads and load combinations



Welded frame, fatigue results

TYPICAL APPLICATIONS OF LIMIT

Fast assessment of non welded structures:

- shell and solid FEA models
- highly efficient using FKM guideline
- various influences are taken into account: stress gradients normal to surface, surface hardening, treatment factors, complex load history etc.

Assessment of complex welded structures:

- shell and solid FEA models can be used
- efficient definition of large numbers of welds
- lots of weld definition templates available
- both static strength and/or fatigue strength
- detailed results information for weld throat and base material