Z-post | Durability & damage analysis

- General post–processing package
- High level data manipulation
- Fatigue life estimation

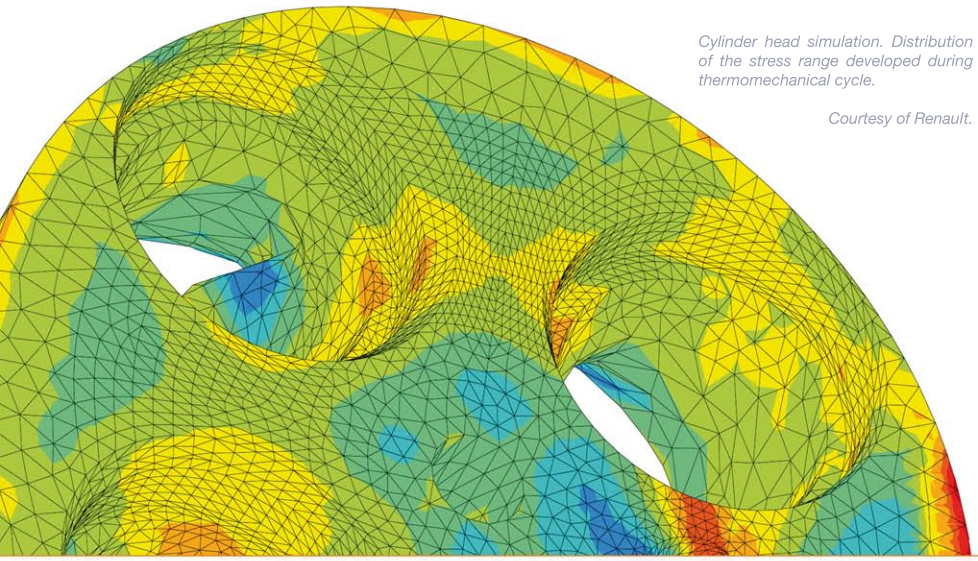
Z-post is a general purpose post-processing package designed to act on any type of data resulting from a Finite Element Analysis. Initially developed to post-process Zébulon's results, Z-post is now a generic post-processing software interfaced with the major FEA codes

Z-post contains a large collection of processes for efficient treatment and analysis of FEA results with special attention given to lifetime estimation and damage models

Z-post treats results from a Finite Element computation, and operates on data known on different structural locations: nodes, Gauss points, elements, and a collection of time steps.

Global and local post-processing

- global post-processings operate, for a given time step, on a set of variables and a region of the mesh; several numerical treatments are implemented, such as the computation of average values (**homogenization, mesh-independent** methods), brittle damage models for metals or ceramics (**Weibull, Beremin, Batdorf** probabilistic models), and many others.
- local post-processing takes the time history for each individual point and applies one or series of treatments to produce the final result. The currently implemented collection of post-processing ranges from elementary operators such as **max, min, norm, mises, trace**, to higher level models: creep models, classical HCF (**Sines, Crossland, Dang Van**), or strain, stress-based and mixed LCF fatigue models (**Manson-Coffin, Chaboche, SWT, Sehitoglu**), taking into account the creep-fatigue interaction when necessary.



Cylinder head simulation. Distribution of the stress range developed during thermomechanical cycle.

Courtesy of Renault.

User extensions

Users have several possibilities to extend the existing code capabilities :

- by using the process function, allowing to introduce a new model by its mathematical expression directly in the input file;
- with the help of the high level scripting language based on C++, giving access to internal utility and math objects (ARRAY, LIST, VECTOR, MATRIX, TENSOR...);
- by means of a Plug-in mechanism which gives access directly to the Object Oriented architecture of Z-post and thus allows an unlimited number of user extensions.

Efficient data manipulation

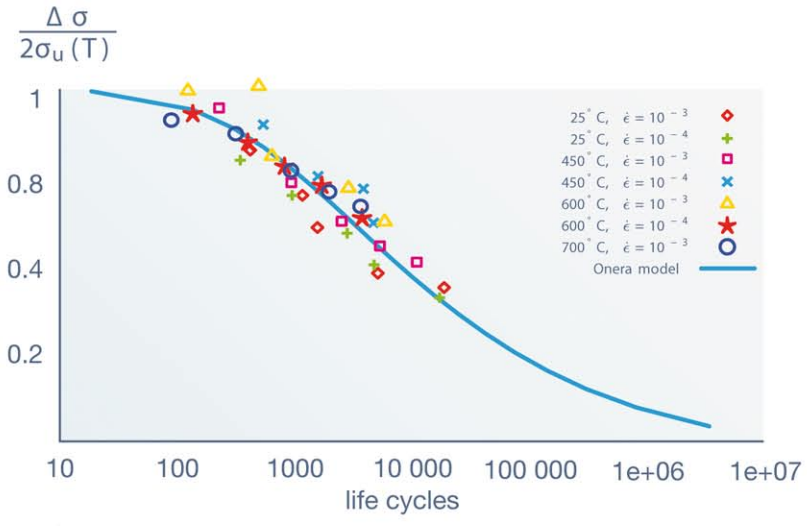
Z-post processes the FEA results through a pipeline. The method consists in assembling series of algorithms (processes) and data manipulation tools (readers/writers/field transfers) to transform the initial data into the processed ones.

```
****post_processing
 ***data_source odb
  **open results.odb
 ***local_post_processing
  **file integ
  **output_number 1-10
  **elset nickel
  **process trace sig
 ***global_post_processing
  **process average_in_element sigii
 ***local_post_processing
  **process function msig11
    sig11+(1./3.)(ave_sigii - sigii);
 ***global_post_processing
  **process node_extrapolation
   *list_var msig11t
****return
```

- start post-processing
- import data from external format
- data source file name
- switch to local post-processing
- operate on Gauss points
- select steps 1 to 10
- set current elset
- compute the trace of sig, named sigii
- switch to global post-processing
- average trace in each element
- switch to local post-processing
- add the average hydrostatic pressure on the deviatoric part of sig
- extrapolate Gauss points values to nodes
- end of post-processing

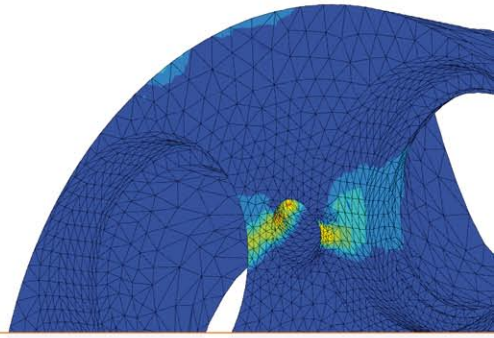
Fatigue lifetime estimation models

Z-post includes a number of advanced models and algorithms for creep-fatigue lifetime estimation, capable to simulate most key experimental observations



- valid in both LCF and HCF regimes (i.e. the whole S-N curve)
- multiaxial capabilities
- modeling of the mean stress influence (Haigh diagram, loading factor influence on S-N curve)
- possible coupling with creep damage to account for frequency effects
- possible nonlinear accumulation of damage for the correct representation of experimentally observed effects

- Very efficient algorithms are available in Z-post to compute the amplitude and extract the sub-cycles from a complex non-proportional 3D stress history (multiaxial rainflow method)
- Local post-processings are fully parallelized for optimal performances



Evaluation of damage produced by severe thermomechanical cyclic loading

Courtesy of Renault.