

INVENTUM GmbH  
Hensstraße 3  
53173 Bonn  
GERMANY

## Scope / Speakers

Fatigue cracks and failures due to alternating stresses often appear unexpected and can cause a large amount of damage, human as well as material and financial (image damage and liability). The share of fatigue damages of the total amount of mechanical damages is substantial so managing fatigue related problems in an appropriate way is essential.

A fatigue failure may have different causes, such as the material quality, production process and possible mistakes, structural (detail) design, erroneous use of strength and reliability analysis, underestimation of the load spectrum and abuse of the product.

It is obvious that many aspects do affect the resistance against fatigue. Managing and preventing problems due to fatigue should be considered as a key capability of a structural engineer. FE analysis is an important tool for the analysis of strength of structures, not only for static strength but also for fatigue strength.

An important aspect in the is the amount on attention we are paying to the mechanics of fatigue and how to in the simulation. We are not teaching the course attendees some "tricks", we make them understand why they are doing things in a particular way.

The training provides you a flying start with FEM based fatigue analysis. One day is spent on fatigue subjects and one day on FEM. You cannot expect to be a specialist in both fields after these two days, but you will be able to perform the most frequently used analyses. The targeted audience is engineering staff on bachelors/master level with some FEM experience and some basic knowledge of fatigue of structures.

The course is independent of FE software packages. It is assumed that the course attendees are sufficiently accustomed to the FE software they use to perform a static analysis.

Course attendees are invited to bring a case from their own practice with them.

Chairman of the seminar is **Johannes J. Homan, M.Sc.**, Fatec Engineering, Bergschenhoek, The Netherlands.

Further speaker:

**Dr. M.E. Heerschap**, MGts, Waddinxveen, The Netherlands

## Venue / General Information

The seminar takes place at the Maternushaus, Kardinal-Frings-Straße 1-3, 50668 Cologne, Germany.

**Participation Fee for Members of the DGM:** Personal members or 1 non-member from a member institute / member company: 950,- EURO (inkl. 19% VAT.)

**Participation Fee:** 1.050,- EURO (inkl. 19% VAT.)

**The fee includes:**

- Attendance of the seminar sessions
- Comprehensive handouts
- Refreshments during the coffee breaks
- Lunch and dinner

**Cancellation policy:**

Any cancellation is subject to a cancellation fee of 50% of the fees involved. After 1st March 2013 the entire fee is due. Substitution is possible at any time.

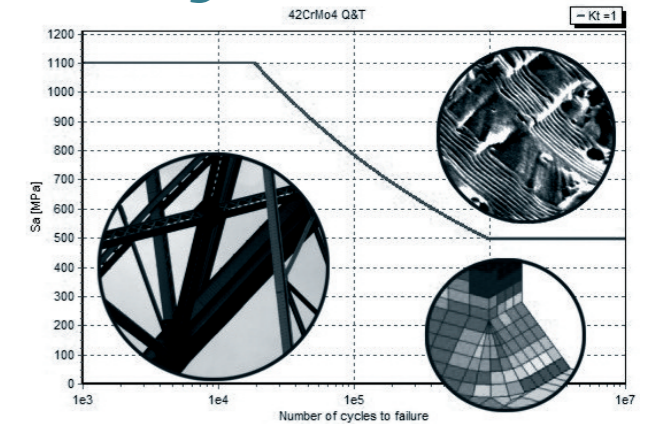
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**NEW****DGM**

European Advanced Training Course

# Fatigue and Finite Element Analysis



# 8-9 April 2013

Cologne, Germany

Fatec Engineering (NL)

INVENTUM GmbH

[www.inventum.de](http://www.inventum.de)

Chairman of the seminar

M.Sc.  
Johannes J. Homan

# Monday

- 09:00 J.J. Homan  
**Welcome / Introduction to the course "Fatigue & FEM"**
- 09:15 J.J. Homan  
**Introduction to fatigue**  
Basis: what is fatigue and what are significant aspects affecting fatigue.  
Fatigue properties of materials
- 10:30 Coffee break
- 11:00 J.J. Homan  
**Fatigue properties of structures**  
Fatigue performance of a structure: material response (material and surface quality) and structural response (stress concentrations). Fatigue analysis based on nominal stresses. Fatigue analysis based on hot-spot stresses.
- 12:30 Lunch break
- 13:30 M.E. Heerschap  
**Meshing for fatigue**  
Mesh size, element types, convergence study. Focus on the proper element choice. The effect of mesh density on the accuracy and the required accuracy. The necessity of the convergence study especially for fatigue analysis using FEM.
- 15:00 Coffee break
- 15:30 J.J. Homan  
**Fatigue in welded joints**  
What is welding, what is the effect of a weld on fatigue properties of a structure?  
Fatigue analysis: nominal stress method, structural hot spot stress method & notch stress method.

- 16:15 M.E. Heerschap  
**How to model a welded joint?**  
Discussion of different ways to model welds in FEM, for fatigue analysis. Brief discussion about other mechanical joint types.
- 17:00 End of the first day
- 18:30 Dinner

# Tuesday

- 09:00 M.E. Heerschap  
**Post-processing**  
Extrapolation, Gaussian points; principal stresses. Focus points of post-processing: What you see is NOT what you have computed! Discussion of post-processing techniques and the effect on the accuracy of the displayed results. The use of maximum principal stresses as compared to other stress measures.
- 09:30 M.E. Heerschap  
**Attention points in FEM**  
Singularities, linear vs. non-linear. Discussion on how to deal with singularities in a model. When do you have to use non-linear analysis instead of linear analysis? What are the consequences for your subsequent fatigue analysis?
- 10:15 Coffee break

- 10:45 J.J. Homan  
**Load spectra**  
What is a load spectrum? Cycle counting: how to translate a load spectrum into stress cycles. Damage accumulation under variable amplitude loading (Miner rule, effect of fatigue limit).
- 11:15 J.J. Homan  
**Multi-axial fatigue**  
Multi-axial stress states. Combinations of different load cases. 2D and 3D multi-axial fatigue. Proportional vs. non-proportional multi-axial fatigue.
- 11:45 J.J. Homan  
**Scatter in fatigue**  
Scatter in material properties, accuracy of calculations.
- 12:15 Lunch break
- 13:15 M.E. Heerschap  
**Verification and validation in FEM**  
Choice of elements, connectivity, properties, boundary conditions, element quality. How do you know it is the correct solution? Discussion of factor of safety.
- 13:45 M.E. Heerschap  
**Random vibrations and fatigue**  
Discussion on how to set-up a random vibration analysis and how to perform a fatigue analysis using the results from the random vibrations analysis.
- 14:30 Coffee break
- 15:00 J.J. Homan & M. Heerschap  
**Fatigue & FEM in practice**  
Examples of fatigue analysis by FE. Discussion of cases from own practice.
- 15:45 **Final remarks & discussion**
- 16:00 End of the training course

## Registration

### Fatigue and Finite Element Analysis

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..... DGM-Membership Number  DGM-member

..... Date of birth

..... Phone

..... Fax

..... E-Mail

..... Title, First Name(s), Name

..... Institute / Company

..... Department

..... Street

..... Post Code / City / Country

..... Date, Signature