



# FSD3400 Advanced Design of Welded Joints 6.0 credits

Avancerad dimensionering av svetsade konstruktioner

This is a translation of the Swedish, legally binding, course syllabus.

## Establishment

Course syllabus for FSD3400 valid from Autumn 2008

## Grading scale

G

## Education cycle

Third cycle

## Specific prerequisites

FEM (ANSYS), Linear elastic fracture mechanics (LEFM) and basic knowledge in solid mechanics, material mechanics and fatigue.

## Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

## Intended learning outcomes

This course discuss different advanced methods for fatigue design of welded structures; Nominal stress method, Hot Spot (geometric/structural) Stress method, Effective Notch

Stress method and applied linear elastic fracture mechanics (LEFM). Influence of different factors that effect the fatigue life and breakdown is discussed, such as; stress concentrations, weld defects, welding residual stresses, multiaxial stresses, etc.. Different post weld improvement techniques in order to increase the quality and the fatigue strength of welded structures is discussed. Different weld class system in order to assure the weld quality of welded joints in the design and during production is discussed and compared. Different design codes, guidelines for practice and recommendations for welded joints are discussed e.g. IIW:s "recommendations for fatigue design of welded joints and components". Evaluation and fatigue design of welded structures using FEM is treated regarding; boundary conditions, accuracy, non-linearity, sub-modelling techniques, 3D effects. Different state-of-the-art applied fracture mechanical softwares for prediction of the fatigue life of welded joints is presented, discussed and utilized.

## Course contents

### Disposition

In order to guarantee the strength of a welded structure different design codes have been developed during the last 30 years and have been applicable within the manufacturing industry with low accuracy and precision. As the Finite Element Analysis is nowadays a widely used tool new developed design codes are applicable with better accuracy and precision. After the course the students should be able to:

1. Choose method for fatigue life assessment accuracy for different types of welded joints and structures.
2. Perform two dimensional welding simulations in order to predict the residual stresses and distortion due to welding.
3. Understanding the effect of welding residual stress on the structural integrity.
4. Use appropriate fracture mechanical software in the fatigue design of welded joints (e.g. Franc2D, Afgrow).
5. Understand the influence of different types of weld defects and discontinuities on the fatigue strength of welded joints.
6. Perform fatigue life assessment of complex welded structures.
7. Choose relevant post weld improvement techniques for different welded applications.
8. Use weld quality systems.

The course runs parallel with the undergraduate course SD2420.

PhD graduate course (FSD3400) contains additional tasks.

## Course literature

Ett för ändamålet nyskrivet kurskompendium kommer att delas ut. Utdelade artiklar. Utdrag ur standarder, koder och normer. Rekommendation av litteratur för ytterligare studier kommer att meddelas vid kursstart.

A special written course compendium will be handed out. Extract from Articles, standard and design codes will be handed out. Recommended literature for further reading will be announced at the course start.

## Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

## Other requirements for final grade

3 exercises on fatigue design with FEM: examination; results presented at the lab occasion.

1 extended home assignment/casestudy: fatigue design of welded structures: examination; written report.

2 extended home assignment in fatigue design of welded structures using LEFM and FEM: examination; written report.

## Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.