

Invitation to state of the art training

Advanced Design of Welded Structures, SK8

Target audience: Design, Simulation, Analysis, Research and Development.

Date: Wednesday-Friday June 7-9, 2017

Place: Weld on Sweden, Videum Science Park, SE-351 96 Växjö

Lecturer: Professor Zuheir Barsoum

The most frequently joining process of lightweight metallic materials and structures is welding. In order to guarantee the strength of welded structures different design codes have been developed during the last 30 years and have been applicable within the manufacturing industry with low accuracy and precision. However, nowadays high strength steels are utilized in load carrying structural applications in order to produce more lightweight welded structures which need more accurate design methods in order to assure the structural integrity. As the finite element analysis is nowadays a widely used tool new developed design codes are applicable with better accuracy and precision. In this course, methods for fatigue analysis of welded structures using FEM and fracture mechanics are taught.

Goals

After completion of the course the participant will be able to:

- Chose appropriate method for fatigue life assessment with reasonable accuracy for different types of welded joints
- Describe the effects of welding residual stress on the structural integrity
- Explain the influence of different types of weld defects and discontinuities on the fatigue strength of welded joints
- Choose appropriate analysis method and perform fatigue life assessment of complex welded structures
- Chose relevant post weld improvement techniques for different welded applications and explain their effect on the fatigue strength
- Use weld quality systems in order to assure the structural integrity and fatigue strength of welded structures

Prerequisites

The participant is expected to have knowledge in solid mechanics, material mechanics and fatigue. The participant is also expected to have basic knowledge in FEM, Linear Elastic Fracture Mechanics (LEFM).

Course contents

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 affect the fatigue life and breakdown of welded structures is discussed, such as; stress concentrations, weld defects, welding residual stresses, multi-axial stress states, etc. Different post weld improvement techniques in order to increase the weld quality and the fatigue strength of welded structures are discussed. Different weld class systems 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 studied, e.g. IIW:s (International Institute of Welding) "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 software's for prediction of the fatigue life of welded joints is presented, discussed and utilized.

Course literature

- A. Samuelsson J., Barsoum Z. and Jonsson B., *Advanced Design of Welded Structures*, Compendium (PDF).
- B. A. Hobbacher, *Recommendations for Fatigue Design of Welded Joints and Components* ISBN 9783319237565 Springer International Publishing.
- C. Extract from scientific journal articles, standard and design codes (PDF).

Computer labs

Computer exercises are scheduled during the course. During these hours assistance with the exercises is provided during the lab.

The computer exercises are compulsory and consider the different fatigue design methods in application to FEM. The finite element software used through out the course is the in-house used software.

Course overview

Day 1: Wednesday June 7, 2017 at 09 to 17

Introduction to fatigue design of welded structures

- Notches, stress concentration, weld defects and residual stresses
- Fatigue assessment methods, global methods: Nominal stress and Geometric hot spot stress
- Fatigue assessment methods, local methods: Effective notch stress method and Linear Elastic Fracture Mechanics (LEFM)

Day 2: Thursday June 8, 2017 at 08 to 16

- Fatigue assessment methods, local methods: (continues)
- Special aspects, improvement techniques and case studies
- Multiaxial fatigue, spectrum loading and residual stress relaxation
- Weld quality systems: overview, defect assessment and criteria's
- Finite element modelling: overview, boundary conditions, accuracy, nonlinearities, sub-modelling, effects of 3D-modelling

Day 3: Friday June 9, 2017 at 08 to 15

- Computer labs
 - L1 - Introduction to the effective notch stress method
 - L2 - Fatigue life analysis of welded structure using fracture mechanics
 - L3 - Fatigue life analysis of a 45-degree butt weld joint
 - L4 - Welded joint design of pipeline connections

Fee: 22 900 SEK. The course fee includes digital course literature, coffee, lunch and certificate of attendance. VAT will be added by 25%. Payment terms 30 days.

Registration via the website or to Ali Bahrami ali@weldonsweden.se, +46703336354.

Said about the SK8 course from previous participants:

«Full poäng. Det var bra med räkneövningar för att riktigt cementera metoderna. Jag lärde mig väsentliga saker för mitt jobb. Den hade en tydlig verklighetsförankring. Läraren var mycket kompetent och intresserad av kursdeltagarnas frågor. Kursen har utvecklat min förmåga och jag har nu en bättre förståelse för hur jag ska analysera FEM-resultat i samband med svetsade konstruktioner. Jag har lärt mig både om nya tillvägagångssätt för framställande av FEM-modell samt nya analysmetoder för livslängdsprediktering.»

«Jeg synes, at kurset var meget godt og interessant. Læreren var meget interessant at høre på. Han kendte meget til udmattelse, og var meget åben med sine erfaringer. Jeg har lidt bedre forståelse for IIW-rekommendationerne. Jeg overvejer nu at bruge notch metoden til beregning af udmattelse i svejsninger.»

«The teacher has a very good way of communicating with students. The best was explanation and clarification of different methods for fatigue life calculation, including the practical examples. I feel now more confident in my work when doing fatigue checks.»

International Welded Structures Designer, IWSD

The course leads to international diploma at two levels: **IWSD-S**, Standard and **IWSD-C**, Comprehensive.

The IWSD course starts on October 30, 2017 - Notification dead line: September 30, 2017