

FATIGUE OF WELDED STRUCTURES

SUMMARY: This course has been specially prepared to meet the specific requirements of Atlas Copco. It uses real world case studies to understand the engineering principles governing fatigue failure of welded structures. We reduce complex mathematics to simple hand calculations using Excel workbooks so that engineers at all levels can understand the concepts covered. Engineers will leave understanding how to apply the AWS rules for fatigue design and will pick up new engineering and Excel skills along the way.

WHO SHOULD ATTEND: The course is intended for design engineers.

COURSE LEADER: John Doyle BSc(Eng)., C.Eng., MIMechE., ACGI was born in 1965 and is a graduate of London's Imperial College with some 25 years of experience in solving engineering problems. After graduating he joined Rolls Royce where he attained chartered status with the Institute of Mechanical Engineers. Having risen to the position of Chief Mechanical Engineer with Bombardier Transportation he started his own engineering consultancy in 1995 called MoreVision. It specialises in engineering analyses applied to railway vehicles, construction equipment, oil and gas plant, cranes and mechanical items for theme parks. His client list includes Shell, Bombardier, Siemens, Volvo and Disney. He won a UK Government SMART competition for innovation.



Day 1: Concepts in Fatigue

The objective for the day is to understand the fundamental mechanics of fatigue. This initial work makes no mention of welds but introduces the most important characteristics of fatigue problems (dynamic stress, geometrical stress concentration, mean stress and the three stages of a fatigue failure). It forms a solid basis of understanding in preparation for the introduction of welds on the second day. Each presentation is followed by an Excel workshop to apply theory and aid knowledge retention.

CASE STUDY 1: Large Paper Roll on Steel Spindle

A US paper product manufacturer breaks steel spindles used for handling heavy paper rolls and does not understand why. We use this case study to diagnose their problem and introduce some important concepts in fatigue.



PRESENTATION: Stress drives fatigue. EXCEL WORKSHOP: Determine load and deflection using Excel FEM.

PRESENTATION: Dynamic nature of loads on structures. EXCEL WORKSHOP: Determine impact factor, maximum stress & stress range.

PRESENTATION: Understand the effect stress concentration. EXCEL WORKSHOP: Determine stress concentration factor for corner radius in shaft shoulder.

PRESENTATION: Understand cracks and fracture surfaces. EXCEL WORKSHOP: Fracture mechanics assessment of fatigue and fracture.

CASE STUDY 2: Universal's Pteranodon Flyer Roller Coaster Design

Theme park equipment captures the imagination of attendees as we add new concepts in fatigue.



PRESENTATION: Force and movement. EXCEL WORKSHOP: Determine loads due to motion.

PRESENTATION: Understanding Fatigue of un-welded materials. EXCEL WORKSHOP: Design a pinned joint. EXCEL WORKSHOP: Fatigue of steel pin.

CASE STUDY 3: Construction & Lifting Equipment

Fatigue design in response to changes in geometry.

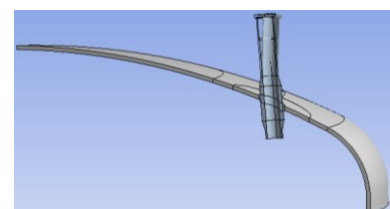
Presentation: Variable geometry loading. EXCEL WORKSHOP: Assessment of an excavator arm. EXCEL WORKSHOP: Assessment of telescopic lifting beam.



CASE STUDY 4: Nuclear Vessel Nozzle

This case helps attendees understand residual stress and how it influences fatigue strength.

PRESENTATION: Residual stress. EXCEL WORKSHOP: Develop SN curves for material with varying residual stress.



Day 2: So what is the Big Deal with Welds?

The objective of the day is to be able to apply the AWS method of weld fatigue assessment. Once learned it will be applied to as many real life examples as possible to gain experience in application of the method.

Weld Quality

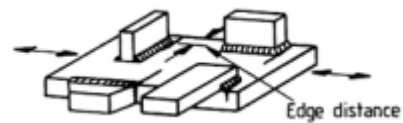
How organisations deliver good quality welds, the nature of weld material and their inherent defects.

PRESENTATION: Weld terminology, Weld symbols, Weld defects, Weld safety classification, Weld processes, Obtaining weld quality, Weld troubleshooting ; Origin of residual stress in welds.



The AWS Method of Fatigue Assessment

Learn how the AWS method accounts for SCF due to weld geometry, material defects in welds, effects of plate misalignment & residual stresses in welds.



PRESENTATION: The AWS method of fatigue assessment: How to recognise good and bad welds; Fatigue classification; Fatigue damage and miners rule; How to enhance fatigue performance; Variable fatigue loading and reservoir methods; Finite element methods and fatigue assessment. EXCEL WORKSHOP: AWS weld fatigue assessment. EXCEL WORKSHOP: Variable loading.

Fatigue in Weld Throats

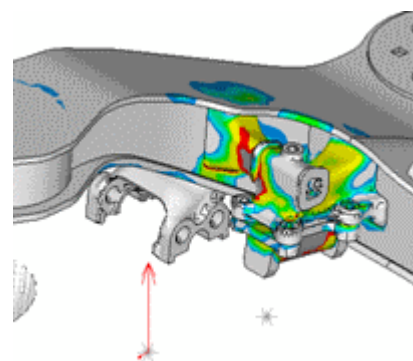
Make sure that your welds are not undersized and check fatigue failure through the throat of a weld.

PRESENTATION: Check stress in weld throat. EXCEL WORKSHOP: Weld strength elastic vector method & instantaneous centre method. EXCEL WORKSHOP: Weld throat fatigue failure. EXCEL WORKSHOP: Calculate weld throat stress from plate stress.

Fatigue case studies

Attendees are invited to play the role of fatigue investigator as we work through case studies making calculations with our new Excel tools as we go. Learn how to manage fatigue problems in service and how to enhance fatigue life.

PRESENTATION: Motor mounting bracket failure; Railroad car carrier failure; Disneyland attractions; Fatigue from random vibration; Railway running gear fatigue assessment; Life extension of welded steel tanks for Shell.



Certificates of Completion

CLOSE: