Internationell svetskonstruktör, IWSD - Kursprogram

Module 2: STRENGTH OF MATERIALS
Modul 2: Allmänt om hållfasthet

2.1 Static equilibrium/Statiska system, 3 tim

Objective:

To be acquainted with basic concepts of static equilibrium from simple structures and how these are applied in the analysis of simple structural elements.

Scope:

Equilibrium of forces
Equilibrium of moments
Action and reaction forces
Free body diagram
Shear and moment diagrams
Tension, compression, shear, bending and torsion force components

Expected result at comprehensive and standard levels:

Review basic principals of statics and dynamics that are relevant to understanding the behaviour of structures.
Explain different forces components that can act on a structure and how these are defined.
Compute of a statically determinate beam or other simple solid.
Identify statically determinate and statically indeterminate structures.
Present shear moment diagrams for beam and frame type structures.

2.2 Stress, strain and deformation/Spänning, töjning och deformationer, 3 tim

Objective:

To understand the basic concepts of stress, strain, strength and deformation of solids.

Scope:

Normal stresses and strains
Shear stresses and strains
Elastic deformation of solids
Static and dynamic forces
Plastic deformation of solids
Stress strain curves for materials
Yield strength
Mohr's circle

Expected result at comprehensive and standard levels:

Present basic definitions of normal and shear stresses.
Illustrate the relationship between stresses and strains for common structural materials.
Illustrate importance of yield strength and ultimate strength for simple structural elements.
Compute stresses and strains of simple statically loaded structural elements.
Illustrate yielding for combined loading.

2.3 Failure criteria for structures and structural materials/Brottkriterier, 4 tim

Objective: The student will be introduced to potential common failure modes for structures and structural materials.

Scope:

Yielding, Multiaxial stresses, Plastic collapse, Ultimate strength, Fatigue and fracture, Global buckling, Local buckling, Lateral buckling, Slenderness

Expected result at comprehensive and standard levels:

Illustrate common modes of failure for structural elements.
Compute ultimate load-carrying capacity for typical structural members based of strength of materials.
Explain features of real structures that differ from the idea solutions and how these affect strength.
Explain the basic principles of elastic and plastic design.
Illustrate selection process for simple structural elements based on strength of materials analysis.
Compute strength of a simple element based on both elastic and plastic strength.

2.4 Introduction to fatigue/Introduktion till utmattning, 6 tim

Objective:

The student will understand the keys concepts related to fatigue of materials and structures.

Scope:

Definition of a fatigue load cycle
Variable amplitude loading
Cumulative damage
Crack growth
Mean stress
Stress range
Stress concentrations
S-N curve
Fatigue limit

Expected result at comprehensive and standard levels:

Illustrate basic features of cyclic loading including stress range, stress amplitude, mean stress.
Illustrate variable amplitude loading and cumulative damage.
Explain importance of mean stresses, stress concentration and surface finish on fatigue life.
Illustrate concepts of fatigue strength, fatigue life and fatigue limit.
Compute design life for a simple structural element using S-N –curve.
Illustrate how relevant information can be obtained from design guidance documents, e.g., IIW Doc. XIII-1965-03/XV-1127-03 "Recommendations for fatigue design of welded joints and components".

2.5 Introduction to fracture mechanics/Introduktion till brottmekanik, 5 tim

Objective:

The student will be introduced to fracture modes and how the stress intensity factor can be used in modelling fatigue crack growth and brittle fracture.

Scope:

Stress intensity factor
Brittle fracture
Ductile fracture
Fatigue crack growth
Paris equation
Plastic zone
Critical stress intensity factor

Expected result at comprehensive and standard levels:

Explain mechanism and common features of ductile fracture of structures.
Explain mechanism and common features of brittle fracture of materials and structures.
Explain fatigue crack growth based on linear elastic fracture mechanics.
Illustrate relationship between fracture type and surface appearance.
Review an industrial failure case involving fracture.
Explain the stress intensity factor, stress intensity factor range and critical stress intensity factor.
Compute stress intensity factors for a simple geometry using geometry factors.
Review experimental method related to fracture.

2.6 Material properties/Materialegenskaper, 4 tim

Objective:

The student will understand several of the critical material parameters used to assess to suitability of a structure or structural material.

Scope:

Yield and ultimate strength
Elongation
Fracture toughness
Elastic modulus
Poisson ratio
Fatigue limit

Expected result at comprehensive and standard levels:

Explain the stress strain behaviour on common structural materials.
Demonstrate how material properties are derived from a tension test.
Compute the elastic and plastic limit load of a simple structural member.
Illustrate the importance and limitation of the fatigue limit in design.
Explain the importance of elongation /ductility for ultimate load design.