

**SYLLABUS**

# **Design for renewable energy systems 5 credits S7007B**

**Dimensionering av konstruktioner för förnybara energisystem**

**Course syllabus admitted: Autumn 2012 Sp 1 - Autumn 2015 Sp 2**

**DECISION DATE  
2012-03-14**

# Design for renewable energy systems 5 credits S7007B

## Dimensionering av konstruktioner för förnybara energisystem

### Second cycle, S7007B

Education level	Grade scale	Subject	Subject group (SCB)
Second cycle	U G#	Stålbyggnad	Building Technology

### Main field of study

Civil Engineering

## Entry requirements

Be admitted to the program Suscos

## Selection

The selection is based on 30-285 credits

## Examiner

Milan Veljkovic

## Course Aim

The aim of this course is to give students an understanding of the behaviour of steel tubular towers for wind turbines, using analytical and numerical methods and to practice design calculations. In addition other lattice towers and different types of concrete towers combination will be discussed. The Eurocodes are used throughout the course to calculate the structural resistance. The "International version of the codes" will be used in the course and students will have opportunity to borrow prepared compendiums which will be returned afterwards. This version of the Eurocodes is prepared by the international experts and is not nationally adjusted. The course describes different part of the tower: foundation, instability phenomena which are limiting for the resistance of a tower, different types of connections, as well as load analysis and safety strategy based on partial safety factors, tower production and maintenance. Understanding of economical and technical aspect involved in planning, design and construction of the wind farm, onshore and offshore will be provided. The aim is to have an understanding of theoretical background and engineering (design) models, and the resistance according to codes. Design concerning instability, assembling connections, foundations, design of details prone to fatigue load are based on theoretical models and design standards for wind tower certification and Eurocodes. Exercises using FE method, using commercially available software, are optional and may be performed to compare analytical and numerical results. Previous experience in FE analysis is not requested but it is advantageous.

## Contents

Seven topics, listed below are covered in the course. Design loads, including background of the approximation of external loads to design values of the crosssection forces, and resistance of the tower, including the foundation are main topics of the course. Basic

theory of practical methods used to approximate cyclic loading is given. Assembling connections of the towers are considered focusing on design of bolts. One of the most important parts of structural design is to identify the engineering model and define different failure modes that may occur for a chosen design load of a tower. The design resistance is checked for each failure mode. In the compulsory assignments students practice use of the structural codes and engineering models for calculation of cross section forces, critical forces and the design resistance. Elastic stability of circular cylindrical shell, considering axial load and combination of axial load and bending moment will be given. Postbuckling behaviour of a perfect and imperfect shell will analysed to understand background of the design rules. Finite element method is used to calculate resistance of the tower for axial force and combination of axial force and bending moment, and to estimate design force in the bolts of the flange connection ("unsymmetrical Tstub connection")

## Realization

Each course occasion's language and form is stated and appear on the course page on Luleå University of Technology's website.

Frontal lessons, seminar and home work

## Examination

If there is a decision on special educational support, in accordance with the Guideline Student's rights and obligations at Luleå University of Technology, an adapted or alternative form of examination can be provided. Approved compulsory assignments will be necessary to prepare a public presentation at the end of the course on the work performed during the course.

Grading system. Passed or not passed. A certificate awarding ECCS credits after the course accomplishment may be provided upon the request.

## Literature. Valid from Autumn 2012 Sp 1

Tutorial examples will be prepared in due time in format of handouts in following areas sustainability assessment, costs analysis, shell stability, flange connection-one half of the T-stub. Peer reviewed papers from journals and different web sources will be provided. Background material of research projects developed by the teachers Chosen chapters related to selected topics of theory of stability and connections

Eurocodes

ECCS recommendations

Guidelines,

Standards

## Course offered by

Department of Civil, Environmental and Natural Resources Engineering

## Items/credits

No items/credits available

## Syllabus established

by Eva Gunneriusson 2012-03-14