COURSE DESCRIPTION CARD - SYLLABUS

Course name
Metal structures [S2Bud1E-KB>KM2]

Course

Field of study
Civil Engineering

Year/Semester
1/2

Area of study (specialization)
Structural Engineering

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
15

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Has knowledge of structural mechanics and material strength in the field of content of the Civil Engineering field of study. Knows the methods of designing metal structures according to Eurocodes. Knows global analyses methods. Knows the imperfections in steel structures. Is able to use Eurocode standards in the field of static calculations and dimensioning of steel structure elements. Is able to design structural elements of industrial halls and spatial trusses together with designing main joints. He can assess the sensitivity of a structure to second-order effects. Understands the need for lifelong learning and is able to interact and work in a group, taking on different roles in it. Is aware of the responsibility of the profession he is learning.

Course objective

Acquiring knowledge and skills in the construction and dimensioning of thin-walled structures. Acquiring the knowldge and skills in the construction and dimensioning of the overhead crane bams and portal frames subjected to loads from overhead cranes.

Course-related learning outcomes

Knowledge:

1. Know in detail the principles of analysing, constructing and dimensioning elements and connections in selected building structures
2. Have extended and detailed knowledge of material strength, modelling and constructing; have knowledge of using finite element method as well as non-linear calculations of engineering structures
3. Have advanced and detailed knowledge of the theoretical principles of structure analysis and optimization as well as design of selected building units

Skills:
1. Can prepare an evaluation and statement of strengths influencing both simple and complex building units
2. Can design elements and connections in complex building units, working both individually and in a team
3. Are able to correctly define a computational model and carry out an advanced linear analysis of complex building units, their elements and connections; are able to apply basic nonlinear computational techniques together with a critical evaluation of numerical analysis results
4. Utilizing the obtained knowledge, they can select appropriate (analytical, numerical, simulation, experimental) methods and tools to solve technical problems .

Social competences:
1. Take responsibility for the reliability of working results and their interpretation
2. Can realise that it is necessary to improve professional and personal competence; are ready to critically evaluate the knowledge and received content

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Completing the lecture - colloquium in the last class. Design exercises - the project and its oral defense. Tutorials - colloquium in the last class.
Grading scale:
5.0 - the student has obtained over 90% of points from the test or project defense,
4,5 - the student obtained from 80% to 90% of points from the test or project defense,
4.0 - student obtained from 70% to 80% of points from the test or project defense,
3.5 - the student has obtained from 60% to 70% of points from the test or project defense,
3.0 - the student has obtained from 50% to 60% of points from the test or project defense,
2.0 - the student has obtained less than 50% of the points from the test or project defense

Programme content

Lecture
Methods for constructing and dimensioning of overhead cranes (static diagrams, loads, dimensioning, connection details). Principles of construction and dimensioning of portal frames subjected to loads generated by the overhead cranes. Methods for constructing and dimensioning of thin-walled structures.

Tutorials - load collections from the cranes, calculation of effective characteristics of thin-walled structures

Project
Project of the overhead crane girder.

Course topics

Lectures:
The main characteristics of the overhead cranes.
Variable actions and dynamic factors. Representation of crane actions.
Principles of construction and dimensioning of portal frames subjected to loads generated by the overhead cranes.
Description of the crane runway beam and internal forces and stresses. Choosing a cross-section of the runway beam. Internal forces from characteristic loads. Maximum design loads. Material properties and material partial factors.

Characteristic values of resistances of the cross section.
Internal forces caused by torsion. Torsion of the thin-walled steel structures.
Shear resistance of the runway beam’s cross-section.
Compression resistance of the runway beam’s cross-section.
Assessment of the possibility of lateral-torsional buckling.
Verification of resistance of the web under concentrated load. Local vertical compressive stresses. Local shear stresses.
Serviceability Limit State. Limits for deformations and displacements. Limitation of web breathing.
Fatigue assessment. Fatigue loads from single crane action. Fatigue verification.
Introduction to thin-walled steel design.
Effective cross-section.

Tutorials:
Examples of load collection.
Vertical loads. Combinations of vertical loads from the pressure of crane’s wheels. Horizontal forces. Longitudinal forces and forces caused by acceleration and deceleration of the crane. Transverse forces caused by acceleration and deceleration of the crane. Horizontal forces caused by skewing of the crane. Horizontal force caused by acceleration or deceleration of the crab. Characteristic values of a crane actions.
Calculation of effective section properties for a cold-formed lipped channel section in compression.
Calculation of effective section properties for a cold-formed lipped channel section in bending. Calculation of effective section properties for a cold-formed Sigma-section in compression.

Project:
Project of the overhead crane girder.

Teaching methods

Form of classes: Lectures - problem lecture / seminar lecture / lecture with multimedia presentation. Test.

Form of classes: tutorials tests (load collections from the cranes, calculation of effective characteristics of thin-walled structures).

Form of classes: projects - oral defense of the project. Project of the overhead crane girder.

Bibliography

Basic
1. Design of Steel Structures, Luís Simões da Silva, Rui António Duarte Simões, Helena Gervasio, Publisher: ECCS Press and Ernst&Sohn, ISBN: 978-3-433-02973-2
2. Structural Stability of Steel: Concepts and Applications for Structural Engineers, Theodore V. Galambos, Andrea E. Surovek, John Wiley & Sons , 2008
3. Design of Steel Structures to Eurocodes, Vayas Ioannis, Ermopoulos John, Ioannidis George, ISBN 978-3-319-95474-5, DOI 10.1007/978-3-319-95474-5, Publisher: Springer International Publishing
4. Structural Design of Steelwork to EN 1993 and EN 1994, , Lawrence Martin, Elsevier, 2007
Additional
1. EN-1993-1-1 / EN-1993-1-3 / EN-1993-1-5 / EN-1993-1-8
2. EN-1993-6
3. EN-1990
4. EN-1991-1-1 / EN-1991-1-3 / EN-1991-1-4 / EN-1991-1-6

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50