Ministry of Education and Science of Ukraine

ODESA STATE ACADEMY OF CIVIL ENGINEERING AND ARCHITECTURE

Engineering and Construction Institute
Department of Reinforced Concrete Structures and Transport Facilities

SILABUS
Educational component – EK 5

Reinforced concrete structures and their seismic resistance

Educational level	Second (Master)
Field of knowledge	Compulsory.
Specialty	Architecture and construction
Educational program	Industrial and civil construction
Educational component scope	**4 credits ECTS** (120 academic hours)
Types of classroom training	lectures, practical classes
Individual tasks	CP
Forms of final (term) control	exam

Lecturer(s):
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When studying the educational component, higher education students will develop the following skills and competences the basic professional knowledge regarding the design of reinforced concrete and stone structures in the design of new and reconstruction of existing industrial buildings and basic information on the seismic resistance of buildings and structures are forming.

Requirements for studying the educational component: the acquisition of theoretical knowledge and practical skills in the following disciplines: resistance of materials, theoretical mechanics, construction mechanics, theory of elasticity, building materials, building structures, architectural structures, metal structures, soil mechanics and foundations.

Program learning outcomes:

PLO1. The ability to use the regulatory documentation in professional activities; draw up basic business contracts in the field of construction technologies; navigate the process of licensing certain types of activities; to navigate in scientific, special literature and laws.

PLO2. The ability to read original literature on the subject (with limited use of a dictionary) and extract the necessary information from it; make an annotation of a foreign language text in the subject; to communicate in a foreign language as required professionally in oral and written forms; to have the latest professional information through foreign sources.

PLO9. The ability to carry out inspections of the technical condition of buildings and structures, and to give an assessment of this condition; evaluate the further operational suitability of the building and structure or develop a project to restore this suitability; calculate the level of the required increase in the carrying capacity of the structure to ensure the operational suitability of the building.

PLO10. To design buildings and structures from modern materials and structures, including using software systems of computer design based on an effective combination of advanced technologies for their performance of multivariate calculations.

PLO13. The ability to design energy-efficient buildings and structures, including using computer design software systems based on an effective combination of innovative technologies, their implementation of multivariate calculations of concrete and reinforced concrete, metal, wooden and plastic structures.

PLO15. To design constructions of buildings and structures in order to ensure their strength, stability, durability and safety, to ensure reliability.

PLO16. The ability to find optimal solutions when creating certain types of construction products, taking into account the requirements of architectural and planning solutions, strength, durability, life safety, quality, cost, deadlines and competitiveness.

PLO17. The ability to perform calculation and experimental work on the multivariate analysis of the characteristics of specific construction objects in order to optimize construction processes.

Differentiated program learning outcomes:
to know:
- calculation methodology for the design of various building structures for static loads;
- valid normative documents;
- advantages and disadvantages of materials, main types of constructions from them and areas of their effective use.

to be able to:
- evaluate the work and stress state of buildings and structures as a whole, their structural elements;
- using the basic provisions of calculations, evaluate the strength, rigidity and stability of individual elements of reinforced concrete structures;
- to solve professional problems in the design of building elements, to calculate and evaluate their strength, stiffness and stability in order to make effective engineering decisions.

Thematic plan

1. **One-story frame industrial buildings.** Layout of the structural system. Structural elements and frames of one-story industrial buildings. Ensuring spatial rigidity.
2. **One-story frame industrial buildings**. Overhead cranes, operating modes. Crane beams. Schemes of anchoring columns to coordination (breakdown) axes. Division of the building into deformation blocks. Vertical and horizontal ties. Designs of lanterns.
3. Design and calculation of prefabricated reinforced concrete **one-story frame industrial buildings**. Loads acting on the building. Principles of practical calculation of single-story frames. CAD.
4. **One-story frame industrial buildings**. Bearing constructions of coatings. Basic information. Types of blood structures. Beams and roof trusses. Principles of calculation and construction.

5. **One-story frame industrial buildings.** Bearing constructions of coatings. Basic information. Ribbed covering slabs. Calculation and construction. Cover slabs of type 2T, large-sized reinforced concrete panels-shells of KZHS. Principles of calculation and construction.
6. **Bearing constructions of roofs**. Precast monolithic coatings of the type of short cylindrical shells. Principles of calculation and construction. Sloping shells of positive Gaussian curvature, rectangular in plan. Principles of calculation and construction.
7. **One-story frame industrial buildings.** Reinforced concrete columns. Structures of columns of one-story industrial buildings. Principles of calculation and construction.
8. **One-story frame industrial buildings.** Reinforced concrete foundations. Structures of the foundations of one-story industrial buildings. Principles of calculation and construction.
9. **Prestressed elements working for bending. Calculation based on the limit states of the second group.** Calculation of the formation of cracks and the width of their opening. Crack resistance of prestressed elements. Calculation of deformations. Peculiarities of calculating axis curvature in sections with and without a crack. Movement of reinforced concrete elements and their rigidity.
10. **Calculation** of centrally compressed and eccentrically compressed **stone structures**. Calculation of stone elements per cut. Calculation and design of elements of brickwork structures.
11. **Strengthening of reinforced concrete structures.** Reinforcement of floors, beams, columns. Strengthening of stone structures during the reconstruction and restoration of monuments of architecture and urban planning. Basic information.
12. **Seismic resistance of buildings and structures**. Causes and consequences of strong earthquakes. Structure of the Earth. Mechanics of earthquakes. Seismic waves. Instruments for recording oscillations. Means of protection of buildings and structures against the influence of seismic vibrations. The Richter magnitude scale, the MSK-64 intensity scale, the influence of soil conditions on the intensity of seismic impacts. Peculiarities of designing buildings and structures considering seismic influences in the Odesa region. Spectral method of determining seismic loads. General information.

Score criteria and diagnostic tools

The minimum and maximum score for the «exam» in the educational component «Reinforced concrete structures and their seismic resistance» ranges from 60 points to 100 points.

The educational component includes the following:

Course project - "Calculation and design of reinforced concrete structures in the seismic zones." The work consists of two parts: a calculation and report note and a graphic part.

Term control is carried out in the form of an exam.

The overall semester grade is the sum of the points of two components:
1) ongoing control during the semester by accumulating points: assessment of learning theoretical (lecture) material, performance of practical work on topics and individual work (course work) - 60 points in total;
2) final control during the examination session (exam) - the number of points from 24 to 40 points.

Information support

Main sources of information

1. Ministry of Regional Development of Ukraine. (2011). **DBN B 2.6-98:2009 Concrete and Reinforced Concrete Structures. Basic Provisions**. Kyiv, Ukraine.
2. Ministry of Regional Development of Ukraine. (2011). **DSTU B V.2.6-156:2010 Concrete and Reinforced Concrete Structures Made of Heavy Concrete. Design Rules**. Kyiv, Ukraine.
3. Ukrainian Research and Development and Standardization Center. (2019). **DSTU 3760:2019 Reinforcement Steel for Reinforced Concrete Structures. General Technical Conditions**. Kyiv, Ukraine.
4. Ministry of Regional Development of Ukraine. (2014). **DBN B.1.1-12:2014 Construction in Seismic Regions of Ukraine**. Kyiv, Ukraine.
5. Ministry of Construction of Ukraine. (2006). **DBN B.1.2-2:2006 Loads and Impacts. Design**

Standards. Kyiv, Ukraine.
6. Dominick R. Pilla (2019). **Elementary Structural Analysis and Design of Buildings: A Guide for Practicing Engineers and Students.** Taylor & Francis. 257 p.

Additional sources of information

1. Eberhard Meller. (2022). **Manual of Structural Design: Structural Principles - Suitable Spans - Inspiring Works.** De Gruyter.
2. Odesa State Academy of Civil Engineering and Architecture (OSACEA). (2023). **Guidelines to the practical classes in " Reinforced concrete structures and their seismic resistance "**. Odesa, Ukraine.