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**Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE
LUMUMBA
RUDN University**

Academy of Engineering

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Structural Design in Reinforced Concrete

course title

Recommended by the Didactic Council for the Education Field of:

08.04.01 Civil Engineering

field of studies / speciality code and title

**The course instruction is implemented within the professional education programme
of higher education:**

Civil Engineering and Built Environment

higher education programme profile/specialisation title

2024

1. COURSE GOAL(s)

The goal of the course Structural Design in Reinforced Concrete is to gain knowledge, skills, skills and experience in the design of construction structures, characterizing the stages of the formation of competencies and ensure the achievement of the planned results of the development of the educational program.

The main objectives of the course Structural design in Reinforced Concrete are:

- Collection, systematization and analysis of information source data for design and monitoring of buildings, structures and complexes from reinforced concrete.
- Feasibility study and the adoption of project decisions in overall on the object, coordination of works in parts of the project, design R / w parts and structures;
- Formation of design skills and calculation to solve specific engineering tasks using the design standards, standards, reference books, automated design tools for construction structures.
- Development of innovative technologies for the production of structures and systems, settlement techniques, including using the latest scientific achievements.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course Structural Design in Reinforced Concrete implementation is aimed at the development of the following competences (competences in part):

Table 2.1. List of competences that students acquire during the course «Structural Design in Reinforced Concrete»

Competence code	Competence descriptor	Competence formation indicators (within this course)
PC-2	Development of project products based on the results of engineering and technical design for urban development activities	PC-2.1 Capable of performing engineering and technical design and developing design products for building structures, grounds and foundations

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course Structural Design in Reinforced Concrete refers to the *elective component* of (B1) block of the higher educational programme curriculum.

Within the higher education programme students also master other disciplines (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course Structural Design in Reinforced Concrete.

Table 3.1. The list of the higher education programme components that contribute to the achievement of the expected learning outcomes as the internship results.

Competence code	Competence descriptor	Previous courses / modules, internships	Subsequent courses / modules, internships
PC-2	Development of project products based on the results of engineering and technical design for urban development activities		Life Cycle Economics of Buildings; Structural Design in Reinforced Concrete: Special Topics; Structural Dynamics; Structural Design in Steel: Special Topics; Modelling of Construction Processes; Applications of Finite Element Method for Civil Engineering problems;

			Sustainability in Civil Engineering; Optimization Methods in Civil Engineering; Structural Stability; Geometric Shaping and Analysis of Shells; Engineering Systems of Buildings; Design Practice; Technological Practice; Pre-Graduation Practice
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4. COURSE WORKLOAD

The total workload of the course Structural Design in Reinforced Concrete is 5 credits.

Table 4.1. Academic activities types by periods of the higher education programme

Type of academic activities	Total academic hours	Semester(s)			
		1			
<i>Contact academic hours</i>	36	36			
including:					
Lectures (LC)	18	18			
Lab works (LW)	0	0			
Seminars (workshops / tutorials) (S)	18	18			
<i>Self-studies academic hours</i>	117	117			
<i>Evaluation and assessment academic hours</i>	27	27			
<i>Course work / project, credits</i>					
Course workload	academic hours	180	180		
	credits	5	5		

5. COURSE CONTENTS

Modules	Contents (topics)	Academic activities types *
Section 1. Basic concepts of the design of reinforced concrete structures	Topic 1.1 Historical background. Concrete and reinforced concrete. Advantages of reinforced concrete as a structural material. Design Codes. SI Units and shaded areas. Admixtures. Calculation accuracy	LC, S
Section 2. Flexural and strength analysis of beams according ACI code	Topic 2.1 Ultimate or nominal flexural moments. Cracking moment. Elastic stresses -Concrete cracked. Topic 2.2 Design methods. Advantages of Strength Design. Elastic Stresses—Concrete Cracked. Structural Safety.	LC, S

Modules	Contents (topics)	Academic activities types *
	Topic 2.3 Strength reduction or ϕ Factors. Minimum Percentage of Steel. Balanced steel percentage	
Section 3. Analysis and Design of Beams (Single and Double Reinf; T-Beams; Continuous Beams)	Topic 3.1 Analysis of T-beams. Design of T-beams. Design of T-beams for negative moments. L-shaped beams. Load factors. Design of rectangular beams. Miscellaneous beam considerations. Determining steel area when beam dimensions are predetermined	LC, S
Section 4. Serviceability limit states of the structures (De-flection of Beams)	Topic 4.1 Importance of deflections. Control of deflections. Calculation of deflections. Continuous-beam deflections. Types of cracks. Control of flexural cracks. ACI Code Provisions concerning cracks. Miscellaneous cracks	LC, S
Section 5. Shear and Torsion Design	Topic 5.1 Shear Stresses in Concrete Beams. Shear Strength of Concrete. Shear Strength of Members Subjected to Axial Forces. Torsional reinforcing. Torsional moments that have to be considered in design. Torsional moment strength. Torsional stress-es. Design of torsional reinforcing. Additional ACI Requirements	LC, S
Section 6. Bond, Development Lengths, and Splices	Topic 6.1 Development lengths for welded wire fabric in tension. Development lengths for compression bars. Critical sections for development length. Effect of combined shear and moment on development lengths. Effect of shape of moment Diagram on development lengths	LC, S
Section 7. Columns. Design of short columns subject to axial load and bending. Slender columns	Topic 7.1 Types of columns. Axial load capacity of columns. Code requirements for cast-in-place Columns. Failure of tied and spiral columns. Design of axially loaded columns. Design formulas. Comments on economical column design. Axial load and bending. The Plastic centroid. Topic 7.2 Slenderness effects. Slender columns in nonsway and sway frames. ACI Code treatments of slenderness Effects. Magnification of column moments in nonsway and sway frames.	LC, S
Section 8. Footings	Topic 8.1 Design of wall footings. Plain concrete footings. Rectangular isolated footings. Combined footings. Actual soil pressures. Allowable soil pressures. Design of square isolated footings. Footings subjected to axial loads and moments. Load transfer from columns to footings. Footings supporting round or regular polygon-shaped columns.	LC, S

* - to be filled in only for full -time training: LC - lectures; LW - lab work; S - seminars.

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialized educational / laboratory equipment, software and materials for course study (if necessary)
Lectures	An auditorium for conducting lectures, equipped with a set of specialized furniture; a blackboard (screen) and technical means for multi-media presentations.	
Seminars	A classroom for conducting seminars, group and individual consultations, current and midterm assessment; equipped with a set of specialised furniture and technical means for multimedia presentations.	Computers, Multimedia projector, Screen for projector, Whiteboard, WiFi
Computer Labs	Not required	
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment	

7. RESOURCES RECOMMENDED FOR INTERNSHIP

Main readings:

1. Design of Reinforced Concrete (9th –Edition ACI 318-11 Code). 2024. Jack C. McCormac & and Russell H. Brown. Publisher: John Wiley & Sons, Inc

Additional readings:

1. Design Oriented Model for the Assessment of T-Shaped Beam-Column Joints in Reinforced Concrete Frames / Department of Structures for Engineering and Architecture, University of Naples “Federico II”, 80125 Napoli, Italy. / Antonio Bossio [и др.]. // Buildings. 2016. №7.4. ISSN 2075-5309 DOI: 10.3390/buildings7040118.

2. Loulizi A. Comparison of design methods for shear in reinforced concrete beams / VT [Электронный ресурс] 2019. URL: <http://scholar.lib.vt.edu/theses/available/etd-09052019-040428/>

3. T. F. Silva, J. C. Della Bella. Design of compression reinforcement in reinforced concrete membrane / Universidade de São Paulo. // Revista IBRACON de Estruturas e Materiais. №5.6. C. 820-847. ISSN 1983-4195 DOI: 10.1590/S1983-419520120006000070.

4. Brooks, John P. Reinforced concrete :. mechanics and elementary design / by John P. Brooks, 1911. 220 c. URL: <http://dlib.rsl.ru/rsl01004000000/rsl01004457000/rsl01004457312/rsl01004457312.pdf>

Internet sources:

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>
- EL "University Library Online" <http://www.biblioclub.ru>
- EL "Yurayt" <http://www.biblio-online.ru>
- EL "Student Consultant" www.studentlibrary.ru
- EL "Lan" <http://e.lanbook.com/>
- EL "Trinity Bridge"

2. Databases and search engines:

- electronic foundation of legal and normative-technical documentation <http://docs.cntd.ru/>
- Yandex search engine [https:// www .yandex.ru/](https://www.yandex.ru/)
- Google search engine <https://www.google.ru/>
- Scopus abstract database <http://www.elsevier.com/locate/scopus/>

The training toolkit and guidelines for a student:

1. Collection of lectures on the course Structural Design in Reinforced Concrete.

* The training toolkit and guidelines for the course are placed on the internship page in the university telecommunication training and information system under the set procedure..

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS INTERNSHIP RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course Structural Design in Reinforced Concrete results are specified in the Appendix to the internship syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

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