Federal State Autonomous Educational Institution of Higher Education
"Peoples' Friendship University of Russia"

Academy of Engineering

Recommended by ISSC

THE WORKING PROGRAM OF THE DISCIPLINE

Name of the discipline Structural Design in Reinforced Concrete

Program focus (focus (profile), specialization)

08.04.01 Civil Engineering

Orientation of the program (profile)

Civil Engineering and Built Environment ,

Mechanics of materials and engineering structures,

Built environment of smart city

1. Goals and objectives of the discipline: The course " Structural Design in Reinforced Concrete " deals with the calculation of individual structural elements and some of the simplest structures. The resistance of materials is an experimental and theoretical science, where experimental data and theoretical research are widely used.

Various structures and structures designed and constructed by an engineer must necessarily have strength, that is, the ability to resist destruction under the action of external loads applied to them, rigidity, that is, the ability to resist deformations, and stability – the ability of a structure to maintain one form of balance. The solution of these three tasks is the main content of the discipline.

The aim of the discipline of developing the discipline "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 discipline "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. Place of discipline in the structure of OP VO:

Discipline Structural Design in Reinforced Concrete refers to the variable part of block 1 of the curriculum. Table 1 shows the previous and subsequent disciplines aimed at the formation of the discipline's competencies in accordance with the matrix of competencies of the Higher Professional Education Department.

Previous and subsequent disciplines aimed at developing competencies

Table # 1

Previous and subsequent disciplines aimed at developing competencies

n/п	a Code and name of the competence	Previous disciplines	Subsequent disciplines (groups of disciplines)
General professional competencies			
	PC -2, PC -4, PC -5, PC -6, PC -9, PC -11	Theoretical of Structural Analysis, Structural Dynamics, Basic Course(s) in Structural concrete design	Design of Structural concrete elements and detailing

3. Requirements for the results of mastering the discipline:

The discipline " Design in Reinforced Concrete Structures (Advanced " / "Design of structures made of prestressed reinforced concrete" is aimed at developing the following competencies among students:

-Development of project products based on the results of engineering and technical design for urban development (PC-2)

-Management of the complex of works on operation and repair of civil buildings (PC-4)

-Organization of construction works at the capital construction site (PC-5)

- Organizational, technical and technological preparation of construction production (PC-6)

- Conducting planning and economic work in a construction organization (PC-9)

-Preparation of the section of project documentation for metal structures of buildings and structures (PC-11)

To Know:
- in the field of methods of structural analysis.
- know the state standards and codes of design be able to use them.
- basic methods of calculation and design of building structures.
- know the main theoretical provisions of the discipline:
- requirements for safety of building products and quality of information and theoretical support of the calculation base.
- knowledge of specialized software and computing systems.

Be able to:
- use modern information technologies.
- be able to use the appropriate computer developments.
- use modern software and computing systems for the calculation of building structures.
- use information technology to solve specific tasks.

Own:
- application of theoretical knowledge in practice.
- search for the necessary information.
- use of the latest automated projecting systems.
- use of information support in the calculation of structures and structures.
- organization of high-quality calculation of structures and structures.
- search for new software and computing systems to solve the tasks.

4. Scope of discipline and types of educational work

The total workload of the discipline is 3 credit units.

Type of educational work	Total hours	modules			
		5			
Classroom Practice in Obtaining Professional Skills and Professional Experience (Research Practice). **lessons (total)**	36	36			
Including:	-	-	-	-	-
Lectures	18	18			
Practical lessons (PL)	18	18			
Seminars (S)	-	-			
Laboratory work (LW)		-			
Independent work (total)	72	exam			
Total labor intensity	108	108			
hour / credits	3	3			

5. Content of the discipline

5.1. Contents of discipline sections

№	The name of the discipline section	Section content (topics)
1.	**Basic concepts of the design of reinforced concrete structures**	Historical background. Concrete and reinforced concrete. Advantages of reinforced concrete as a structural material.Design Codes. SI Units and shaded areas. Admixtures. Calculation accuracy.

		Introduction to Loads. Dead loads. Live loads. Environmental loads. Selection of Design loads. Calculation accuracy.
2.	**Flexural and strength analysis of beams according ACI code**	- Ultimate or nominal flexural moments. Cracking moment. Elastic stresses—Concrete cracked. - Design methods. Advantages of Strength Design. Elastic Stresses—Concrete Cracked. Structural Safety. - Strength reduction or φ Factors. Minimum Percentage of Steel. Balanced steel percentage.
3.	**Analysis and Design of Beams (Single and Double Reinf; T-Beams; Continuous Beams)**	- 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.
4.	**Serviceability limit states of the structures (Deflection of Beams)**	Importance of deflections. Control of deflections. Calculation of deflections. Continuous-beam deflections. Types of cracks. Control of flexural cracks. ACI Code Provisions concerning cracks. Miscellaneouss cracks.
5.	**Shear and Torsion Design**	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 stresses. Design of torsional reinforcing. Additional ACI Requirements.
6.	**Bond, Development Lengths, and Splices.**	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
7.	**Columns. Design of short columns subject to axial load and bending. Slender columns.**	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. Slenderness effects. Slender columns in nonsway and sway frames. ACI Code treatments of slenderness Effects. Magnification of column moments in nonsway and sway frames.
8.	**Footings**	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.

5.2. Sections of disciplines and types of classes

No.	Discipline section No.	Lectures.	Practice	Lab. works	Seminars	Independent work of students	Total hour.
1.	**Basic concepts of the design of reinforced concrete structures**	1	1	0	0	8	10

2.	**Flexural and strength analysis of beams according ACI code**	2	2	0	0	8	12
3.	**Analysis and Design of Beams (Single and Double Reinf; T-Beams; Continuous Beams)**	3	3	0	0	14	20
4.	**Serviceability limit states of the structures (Deflection of Beams)**	2	2	0	0	8	12
5.	**Shear and Torsion Design**	2	2	0	0	8	12
6.	**Bond, Development Lengths, and Splices.**	2	2	0	0	8	12
7.	**Columns. Design of short columns subject to axial load and bending. Slender columns.**	3	3	0	0	14	20
8.	**Footings**	1	1	0	0	8	10

6. Laboratory workshop and Construction Field visits
No laboratory workshop provided.

7. Practical exercises (seminars)
for full-time and part-time education

Item no.	of the discipline section	Topics of practical classes (seminars)	Laborcapacity (hour.)
1	1	Basic concepts of the design of reinforced concrete structures	2
2	2	Flexural and strength analysis of beams according ACI code	4
3	3	Analysis and Design of Beams (Single and Double Reinf; T-Beams; Continuous Beams)	4
4	4	Serviceability limit states of the structures (Deflection of Beams)	4
5	5	Shear and Torsion Design	4
6	**6**	Bond, Development Lengths, and Splices.	6
7	**7**	Columns. Design of short columns subject to axial load and bending. Slender columns.	4
8	**8**	Footings	6
	Total:		**40**

8. Material and technical support of the discipline:

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(describes the material and technicalая basesanecessaryая for the implementation of the educational process in the discipline (module)).

Audience with a list of material and technical support	**Location**
Lecture hall No. 408 Equipment and furniture: - technical means: - projection screen; - Epson EH-TW 3200 multimedia projector;	city of Moscow, Ordzhonikidze str., 3

- a set of specialized furniture: tables, benches, chairs, blackboard.	
Training room for seminars, practical classes, current control and intermediate certification No. 418 Equipment and furniture: - training models; - screen; - NEC Z projector; - set of specialized furniture: tables, benches, chairs, blackboard.	city of Moscow, Ordzhonikidze str., 3
Educational and methodical office for independent, research work of students and course design No. 417 (Laboratory of engineering equipment of buildings and Structures) - a set of specialized furniture; - chalkboard, markerboard ; - ASUS computers-5 pcs., ASER monitors-5 pcs.; - Microlab System Subwoofer-1 pc.; - проекторEPSON EB X11 projector	. Moscow, Ordzhonikidze str., 3

9.Informational support of the discipline

(alist of information technologies used in the implementation of the educational process in the discipline (module), including a list of software and information reference systems (if necessary))

a) Software: PowerPoint

b) databases, information and reference systems and search engines:

1. RUDN University Online Library.
2. Guidelines for completing homework.
3. Tasks for completing homework on the personal page of the teaching staff in electronic form.
4. A point-rating system for evaluating students ' knowledge, displayed on the teacher's personal page.

10. Educational and methodological support of the discipline:

Basic literature:

1. Design of Reinforced Concrete (9th –Edition ACI 318-11 Code). 2014. Jack C. McCormac & and Russell H. Brown. Publisher: John Wiley & Sons, Inc.

Additional literature:

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] 2009. URL: http://scholar.lib.vt.edu/theses/available/etd-09052009-040428/

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. С. 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 с. URL: http://dlib.rsl.ru/rsl01004000000/rsl01004457000/rsl01004457312/rsl01004457312.pdf

11. Methodological guidelines for students on mastering the discipline (module)

Organization of classes on the discipline "Design in Reinforced Concrete (Advanced)" / "Designing of reinforced concrete structures " is carried out according to the following types of academic work: lectures, practical classes.

The implementation of the competence approach in the framework of the preparation direction of 08.04.01 Civil Engineering / Construction provides for a combination in the educational process of contact work with a teacher and extracurricular independent work of students to fully form and develop its professional skills.

Lectures are conducted in the stream audience, including using a multimedia projector in the form of an educational presentation. The main points of lecture classes are outlined by students, individual topics (parts of themes and sections) are proposed for independent study with the obligatory compilation of the abstract (verified by the teacher in the process of current control).

The purpose of practical classes is to receive knowledge with students and develop practical skills of work in the design of building structures. To achieve these goals, both traditional forms of operation are used - solving problems, work with technological equipment / specialized software when performing laboratory work with specialized software when performing a course project, etc.

Independent work covers the study of the learning individuals of the theoretical course. Independent work is carried out in an individual format based on educational and methodological materials of the discipline (applications 2-4). The level of material development on independently studied courses is checked when conducting current control and certification tests (credit) on discipline. Methodological recommendations with student are posted in the TUIS RUDN.

12. Fund of assessment funds for conducting intermediate certification of students in the discipline (module)

Materials for assessing the level of development of educational material of the discipline "Structural Design in Reinforced Concrete"(estimated materials), including a list of competencies, indicating the stages of their formation, description of the indicators and criteria of assessment of competencies at different stages of their formation, the description of the scales of assessment, typical assignments, or other materials needed for the assessment of knowledge, skills and (or) experience activities that characterize the stages of formation of competences in the process of development of educational programs, instructional materials, procedures evaluation of knowledge, skills and (or) experience activities that characterize the stages of formation of competences, fully developed and available to students on the page of discipline in TUIS RUDN.

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