

THE WORKING PROGRAM OF THE DISCIPLINE

Name of the discipline Structural Design in Reinforced Concrete: Special Topics

Recommended for speciality:

08.04.01 Civil Engineering

Program specialization (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 purpose of developing the discipline "Structural Design in Reinforced Concrete: Special Topics/ "Designing of reinforced concrete structures (special courses)" 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: Special Topics" / "Design of reinforced concrete structures (special courses)" 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 EP VO:

The discipline "Structural Design in Reinforced Concrete: Special Topics" / "Design of reinforced concrete structures (special courses)" refers to the variable part of the curriculum block 1. Its study is based on the material of previous disciplines, as well as it is basic for studying follow-up curriculum disciplines, the list of which is presented in Table 1.

Prior and subsequent disciplines aimed at the formation of competencies

№	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
General cultural competences			
General professional competencies			
Professional competencies (type of professional activity of a civil engineer)			
	PC-2	Since this course is a Masters level course, it is expected that the students should be exposed to Structural Analysis, Matrix Algebra & Basic Mathematics courses	Introduction to finite element analysis , Direct stiffness approach: Spring elements , Bar and truss elements , Introduction to differential equations and strong formulation
	PC-8	Basics of Linear Algebra; Introductory calculus (differentiation, integration, differential equations); Computer aided design; Engineering statics	Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis Virtual Work and Variational Principle

	PC-16	Basic knowledge of linear algebra (matrix analysis) is necessary for this course	Principle of minimum potential energy and weak formulation, Finite element formulation of linear elasto-statics, Constant strain triangle, Quadrilateral element
	PC-18	Basics of Linear Algebra; Introductory calculus (differentiation, integration, differential equations); Computer aided design; Engineering statics	Practical considerations in FEM modeling, Convergence of analysis results, Higher order elements, Isoparametric formulation, Numerical integration
	PC-21	Basics of Linear Algebra; Introductory calculus (differentiation, integration, differential equations); Computer aided design; Engineering statics	Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame
Vocational Competencies of Specialization Structural mechanics			

3. 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:

PC-2- knowledge of methods for assessing the innovative potential, the risk of commercialization of the project, technical and economic analysis of the designed objects and products .

PC-8- possession of methods for fixing and protecting intellectual property objects, managing the results of research activities and commercializing intellectual property rights .

PC-16- the ability to organize work on the implementation of author's supervision in the production, installation, commissioning, commissioning of products and production facilities.

PC-18- the ability to conduct technical expertise of construction projects .

- the ability to draw up instructions for the operation of equipment and checking the technical condition and residual life of construction sites and equipment, the development of technical documentation for repairs.

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	Module			
		6			
Classroom Practice in Obtaining Professional Skills and Professional Experience (Research Practice). lessons (total)	32	32			
Including:	-	-	-	-	-
<i>Lectures</i>	16	16			
<i>Practical lessons (PL)</i>	16	16			
<i>Seminars (S)</i>	-	-			
<i>Laboratory work (LW)</i>	-	-			
Independent work (total)	40	ЭК-за-мех			
hour	Total labor intensity	108	108		
	cred-its	4	4		

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	<p>Topic 1.1 Historical background. Concrete and reinforced concrete. Advantages of reinforced concrete as a structural material.</p> <p>Topic 1.2 Design Codes. SI Units and shaded areas. Admixtures. Calculation accuracy.</p> <p>Topic 1.3 Introduction to Loads. Dead loads. Live loads. Environmental loads. Selection of Design loads. Calculation accuracy.</p>
2.	Flexural and strength analysis of beams according ACI code	<ul style="list-style-type: none"> - 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. Miscellaneous 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
	Total	16	16	0	0	76	108
	Course Project	-	-	-	-	-	-
	Off-Set	-	-	-	-	36	36
	Total	16	16	-	-	112	144

6. Laboratory workshop and Construction Field visits

No laboratory workshop provided.

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.

Lectitions 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.

7. Educational, methodological, and informational 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. 2017. №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. Bafekrpour E. Advanced Composite Materials: Properties and Applications [Электронный ресурс] 2017. 1 с. ISBN 9783110574432 URL: <https://doi.org/10.1515/9783110574432>
5. Brooks, John P. Reinforced concrete :. mechanics and elementary design / by John P. Brooks [Электронный ресурс] 1911. 220 с. URL: <http://dlib.rsl.ru/rsl01004000000/rsl01004457000/rsl01004457312/rsl01004457312.pdf>

Resources of the Internet information and telecommunications network»:

1. EBS RUDN and third-party EBC, to which students of the university have access on the basis of concluded contracts:
 - Electronic library system RUDN - EBC RUDN <http://lib.rudn.ru/megapro/web>
 - EBC "University Library online" <http://www.biblioclub.ru>
 - EbS Yuraight <http://www.biblio-online.ru>
 - EBC "Student Consultant" www.studentlibrary.ru
 - EBC "LAN" <http://e.lanbook.com/>
2. Sites of ministries, departments, services, manufacturing enterprises and companies whose activities are profile for this discipline:
3. Databases and search engines:
 - Electronic Fund of Legal and Regulatory Technical Documentation <http://docs.cntd.ru/>
 - Search engine for Yandex <https://www.yandex.ru/>
 - Google search engine <https://www.google.ru/>
 - SCOPUS scrapervative database <http://www.elsevierscience.ru/products/scopus/>

7. Practical exercises (seminars)

A project work design which includes every design topic will be performed through the course run.

8. Material and technical support of the discipline:

Auditorium with a list of logistics	Location
Lecture room - An educational audience for lecturing type classes: Aud. № 348. Specialized furniture set; Chalk board.	Moscow, st. Ordzhonikidze, 3
Educational laboratory for laboratory and practical training - laboratory of building materials and building structures, aud. №24A Combined testing machine C040N + C092-11 "MATESTA", Vibropotchka Laboratory C282 Matest and SMEZ-539, Normal hardening and wet storage cabinet CNT-72, camera Radar universal PBU-1, Molds for concrete samples, concrete mixers-2pcs., Concrete Meter of Concrete Pos-50mg4, Vica Devices, Device Aistheov, Moisture Meter Electronic Water Meter - MG4U, Ultrasonic Defectoscope A1220 Monolith, Shaking table with cone and ruler, etc. Installation and testing devices.	Moscow, st. Ordzhonikidze, 3

9. Information support of the discipline

a) software

Specialized software for conducting lectures and practical classes, completing coursework and independent work of students:

RUDN University software: Plaxis 2D Suit (Network license). Plaxis Professional (version 8) + Plaxis Dinamics Modul + PlaxFlow (version 1) - Education Registration number 90-07-019-00261-3

MS-office corporate, Registration code: 86626883

Parent program: 86493330

Status: Active).

b) databases, reference and search systems

- electronic fund of legal and normative-technical documentation

<http://docs.cntd.ru/>

- Yandex search engine <https://www.yandex.ru/>

- Google search engine <https://www.google.ru/>

- SCOPUS abstract database <http://www.elsevierscience.ru/products/scopus/>

- Site of the Ministry of Construction and Housing and Communal Services of the Russian Federation <http://www.minstroyrf.ru/>

- Electronic library system RUDN - EBS RUDN

<http://lib.rudn.ru/MegaPro/Web>

- EBS "University Library Online" <http://www.biblioclub.ru>

- EBS Yurayt <http://www.biblio-online.ru>

- EBS "Student Consultant" www.studentlibrary.ru

- EBS "Doe" <http://e.lanbook.com/>

10. Educational and methodological support of the discipline:

a) main 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. 2017. №7.4. ISSN 2075-5309 DOI: 10.3390/buildings7040118.

2. Warren, F. D. A handbook on reinforced concrete :. for architects, engineers, and contractors / by F. D. Warren [Электронный ресурс]. - D. Van Nostrand Company : Crosby Lockwood & Son, 1996. 271 с. URL: <http://dlib.rsl.ru/rsl01004000000/rsl01004438000/rsl01004438723/rsl01004438723.pdf>

3. Tekeli H., Atimtay E., Turkmen M. A simplified method for determining sway in reinforced concrete dual buildings and design applications. Analysis of RC dual buildings / Department of Civil Engineering; Suleyman Demirel University; Isparta; Turkey [Электронный ресурс] // The Structural Design of Tall and Special Buildings. 2012. №. С. n/a-n/a. ISSN 1541-7794 DOI: 10.1002/tal.761

b) 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. 2017. №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. C. 820-847. ISSN 1983-4195 DOI: 10.1590/S1983-419520120006000070.

4. Bafekrpour E. Advanced Composite Materials: Properties and Applications [Электронный ресурс] 2017. 1 с. ISBN 9783110574432 URL: <https://doi.org/10.1515/9783110574432>

5. Brooks, John P. Reinforced concrete :. mechanics and elementary design / by John P. Brooks [Электронный ресурс] 1911. 220 с. URL: <http://dlib.rsl.ru/rsl01004000000/rsl01004457000/rsl01004457312/rsl01004457312.pdf>

11. Methodical instructions for students on mastering the discipline (module)

Methodological instructions for the implementation of students' IWS are contained in the book: Galishnikova V.V. Computational Mechanics [Text / electronic resource] = Computational Mechanics: Education and Methodical Complex / V.V. Galishnikov. - The book is in English; Electronic text data. - M.: PFUR, 2013. -- 155 p. - ISBN 978-5-209-05047-6: 194.47.

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

The evaluation fund found for current monitoring and interim certification of students on the discipline "Design in Reinforced Concrete (Advanced)" / "Design of reinforced concrete structures (special couplings)" is presented in Appendix 1 to the working program of discipline and includes:

- a list of competencies with the indication of the stages of their formation in the process of mastering the educational program;
- description of indicators and criteria for assessing competencies at various stages of their formation, description of the estimation scale;
- typical control tasks or other materials necessary to assess knowledge, skills, skills and (or) experiences characterizing the stages of the formation of competencies in the process of mastering the educational program;
- Methodological materials that determine the procedures for assessing knowledge, skills, skills and (or) experience characterizing the stages of the formation of competencies.

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Program manager



M.I. Rynkovskaya

Director at the Department of Civil engineering



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