THE WORKING PROGRAM OF THE DISCIPLINE

Наименование дисциплины Analysis and Design of Structural Systems

Recommended for the direction of training / specialty
08.06.01 Technique and technology of construction/ Техника и технологии строительства
(the code and name of the direction of training / specialty are indicated)

Focus of the program (profile)

Building designs, buildings and constructions (реализуется на английском языке)

(name of the educational program in accordance with the direction (profile))

1. Goals and objectives of the discipline:

The **purpose** of mastering the discipline **"**Analysis and Design of Structural" is the acquisition of knowledge, abilities, skills and experience in the field of theory and design of buildings and structures that characterize 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 are:

1.training of specialists of a wide profile in industrial and civil construction with in-depth study of the basics of design, manufacture, installation, strengthening of building structures of buildings and structures;

2. the formation of skills in calculations and design of specific engineering problems using design norms, standards, reference books;

3. the use of automation tools for the design of building structures.

2. Place of discipline in the structure of EP HE:

The discipline **"**Analysis and Design of Structural Systems" refers to the variable part of block 1 of the curriculum.

Table 1 shows the previous and subsequent disciplines aimed at the formation of discipline competencies in accordance with the competence matrix of EP HE.

Table No. 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			
	GPC-1	Methodology of Scientific Research.	Advanced Structural Mechanics Technology and Organization of Construction Scientific Research State Exam PhD Qualification Thesis and Presentation
	GPC-2	Methodology of Scientific Research. Scientific Seminar Scientific Research	Advanced Structural Mechanics Technology and Organization of Construction Scientific Research State Exam PhD Qualification Thesis and Presentation .
Professional competencies (type of professional activity of a builder)			
	PC-1	Methodology of Scientific Research Scientific Seminar Scientific Research	Advanced Structural Mechanics Analysis and Design of Structural Systems Technology and Organization of Construction Practice in Obtaining Professional Skills and Professional Experience

			(Research Practice)Scientific Research Scientific Research 2 State Exam PhD Qualification Thesis and Presentation
Vocational and specialized competency specialization Structural Mechanics			

3. Requirements for the results of mastering the discipline:

The process of studying the discipline «Building designs, buildings and constructions: the theory of buildings and structures» is aimed at developing the following competencies:

- possession of the methodology of theoretical and experimental research in the field of construction (GPC-1);

- possession of the culture of scientific research in the field of construction, including the use of the latest information and communication technologies (GPC-2);

- possession of methods for the development of scientific and methodological foundations of research, improvement, theoretical, experimental and feasibility studies for the use of various technical solutions and technologies in construction (PC-1).

As a result of studying the discipline, the student must:

Know:
- basic principles and methods of calculating building structures;
- the principles of drawing up and analyzing design schemes for various structures and structures for their calculation for given impacts;
- basic principles and methods of development of scientific and methodological foundations of research, improvement, theoretical, experimental and feasibility study of the application of various technical solutions.

Be able to:
- to determine the main external influences on the structure - power, temperature, settlement of supports;
- to carry out calculations of statically definable bar plane structures such as multi-span beams, trusses, arches, frames;
- to use the basic principles and methods of theoretical, experimental and feasibility studies of various technical solutions in construction.

Own:
- the skills of correct assessment of the stress-strain state of the structure.
- the ability to assess the correctness of the calculation results.
- the ability to carry out an experimental and feasibility study of various technical solutions and technologies in construction

4. The scope of the discipline and types of educational work

The total workload of the discipline is 3 credit points.

Type of educational work	Total hours	Semesters				
		4				
Classroom lessons (total)	52	52				
Including:	-	-	-	-	-	

Lectures		18	18			
Practical lessons (PL)		38	38			
Seminars (S)		0	0			
Laboratory work (LW)		0	0			
Independent work (total)		34	34			
Total labor intensity	hours	108	108			
	credits	3	3			

5. Discipline content
5.1. Contents of discipline sections

№	The name of the discipline section	Section content (topics)
1.	**Design of building structures**	Constructions of multi-storey industrial buildings. Purpose of buildings. Appointment of sizes. Number of floors. Column grid. Main supporting structures. Multi-storey prefabricated frames. Structural schemes for dividing multi-storey frames into prefabricated elements. Joints of multi-storey prefabricated frames. Multi-storey monolithic and prefabricated monolithic frames. Units of a monolithic multi-storey frame. Reinforcement of nodes. Practical calculation of multi-storey frames. Preliminary selection of sections of frame elements. Determination of stiffness. Estimated efforts.
2.	**Computer modeling of structural systems**	Fundamentals of the finite element method. Basic concepts of FEM. Choice of basic functions and basic unknowns. Finite element research. Connection of FEM with methods of structural mechanics of rod systems. Application of FEM for solving linear and nonlinear problems. Geometric and physical nonlinearity. Sustainability problems. Systems with one-way connections. Computer implementation. Graphical user environment. Drawing up the canonical equations of the FEM. Solving systems of equations. Solvers. Coordinate transformation. Implementation of boundary conditions. Calculation for given displacements. Determination of the geometric characteristics of sections. Determination of efforts and stresses. Design force combinations (DCS) and design load combinations (DCL). Finite Element Models. Modeling of structural solutions of units.

5.2. Sections of disciplines and types of classes

№	The name of the discipline section	Lekts.	Pract. work	Lab. work	Semin	IWS	Total hour.
1.	**Design of building structures**	9	19	0	0	17	45
2.	**Computer modeling of structural systems**	9	19	0	0	17	45

6. Laboratory workshop

No laboratory workshop provided

7. Practical lessons

№	Discipline section number	Topics of Practical lessons (seminars)	Labor capacity (hour.)
1.	**1**	Constructions of multi-storey industrial buildings. Purpose of buildings. Appointment of sizes. Number of floors. Column grid. Main supporting structures. Multi-storey prefabricated frames. Structural schemes for dividing multi-storey frames into prefabricated elements. Joints of multi-storey prefabricated frames. Multi-storey monolithic and prefabricated monolithic frames. Units of a monolithic multi-storey frame. Reinforcement of nodes. Practical calculation of multi-storey frames. Preliminary selection of sections of frame elements. Determination of stiffness. Estimated efforts.	
2.	**2**	Fundamentals of the finite element method. Basic concepts of FEM. Choice of basic functions and basic unknowns. Finite element research. Connection of FEM with methods of structural mechanics of rod systems. Application of FEM for solving linear and nonlinear problems. Geometric and physical nonlinearity. Sustainability problems. Systems with one-way connections. Computer implementation. Graphical user environment. Drawing up the canonical equations of the FEM. Solving systems of equations. Solvers. Coordinate transformation. Implementation of boundary conditions. Calculation for given displacements. Determination of the geometric characteristics of sections. Determination of efforts and stresses. Design force combinations (DCS) and design load combinations (DCL). Finite Element Models. Modeling of structural solutions of units.	

8. Material and technical support of the discipline:
Lecture room - Specialized room number 298 - "Modeling of large-span building structures"
Equipment and furniture:
- a set of specialized furniture;
- chalk board;
- projection screen;
- multimedia projector EPSON EMP-X5.
Educational-methodical room for independent, research work of students № 352 - computer class of the Laboratory of Hydrological and Technical Safety of Hydraulic Structures.
Equipment, furniture, technical means:
- a set of specialized furniture;
- chalk board;
- interactive whiteboard PolyVision Webster TSL 610;
- Toshiba TLP XC3000 multimedia projector;
- roll-up wall screen Draper Luma 178x178;
- computer Pirit Codex 1226 - 1 pc .;

- sound amplifying equipment GENIUS SP-i350 - 1 piece;
- Xerox 3125 printer - 1 pc .;
- Scanner Epson 10V Photo - 1 pc .;
- plotter HP DesignJet 130+ NR (A1) - 1 pc .;
- Pirit Doctrina computers - 9 pcs .;
- LCD ViewSonic 22 "VA2216w monitor - 9 pcs .;
- 19 "NEC monitor - 1 pc.
(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).

9. Information support of the discipline

а) software
The use of specialized software in the study of the discipline is not provided.
б) databases, reference and search systems
- EBS of RUDN University and third-party EBS to which university students have access on the
basis of concluded agreements:
- RUDN University Electronic Library System - RUDN University Library System
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/
2. Websites of ministries, departments, services, manufacturing enterprises and companies whose
activities are core to this discipline:
Ministry of Construction of Russia http://www.minstroyrf.ru
3. Databases and search engines:
- 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/

10. Educational and methodological support of the discipline:

а) Main literature
1. Yudina, AF Metallicheskie i zhelezobetonnye konstruktsiy [Metal and reinforced
concrete structures]. Editing: textbook for universities / A.F. Yudin. - 2nd ed., Rev. and add.
- Moscow: Yurayt Publishing House, 2019 .-- 302 p. - (Series: Specialist). - ISBN 978-5-
534-06927-3. - Text: electronic // EBS Yurayt [site]. - URL: https://biblio-
online.ru/bcode/434494 (date of access: 01.04.2019).
2. Krivoshapko, SN Architectural and building structures: a textbook for academic
bachelor's degree / SN Krivoshapko, VV Galishnikova. - Moscow: Yurayt Publishing
House, 2019 .-- 460 p. - (Series: Bachelor. Academic course). - ISBN 978-5-534-03143-0. -
Access mode: HYPERLINK https://biblio-online.ru/bcode/432798
3. Tukhfatullin, BA Numerical methods of calculation of building structures. Finite element
method: textbook. manual for academic bachelor's degree / BA Tukhfatullin. - 2nd ed., Rev.
and add. - Moscow: Yurayt Publishing House, 2019 .-- 157 p. - (Series: Bachelor. Academic
course). - ISBN 978-5-534-08899-1. - Access mode: HYPERLINK https://biblio-
online.ru/bcode/442338

б) additional literature

1. Krivoshapko, SN Construction of buildings and structures: textbook for SPO / SN Krivoshapko, VV Galishnikova. - Moscow: Yurayt Publishing House, 2019 .-- 476 p. - (Series: Professional Education). - ISBN 978-5-534-02348-0. - Access mode: HYPERLINK https://biblio-online.ru/bcode/433396

2. Dedyukh, RI Materials science and technology of structural materials. Fusion welding technology: textbook. manual for applied baccalaureate / RI Dedyukh. - Moscow: Yurayt Publishing House, 2019 .-- 169 p. - (Series: Universities of Russia). - ISBN 978-5-534-01539-3. - Text: electronic // EBS Yurayt [site]. - URL: https://biblio-online.ru/bcode/433979 (date of access: 01.04.2019).

3. Yudina, AF Building structures. Editing: textbook for SPO / A.F. Yudin. - 2nd ed., Rev. and add. - Moscow: Yurayt Publishing House, 2019 .-- 302 p. - (Series: Professional Education). - ISBN 978-5-534-07027-9. - Access mode: HYPERLINK https://biblio-online.ru/bcode/442133

4. Shambina S.L. Structural mechanics [Text / electronic resource]: Lecture notes. / S.L. Shambina. - Electronic text data. - M .: Publishing house of RUDN, 2015 .-- 48 p. : ill. - ISBN 978-5-209-06779-5: 42.15. Access mode:
http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=447028&idb=0

11. Methodical instructions for students on mastering the discipline (module)
1. Course of lectures on the discipline "Analysis and Design of Structural Systems (Appendix 2).
2. Guidelines for independent work of students in the discipline "Analysis and Design of Structural Systems (Appendix 3).

12. Fund of assessment tools for intermediate certification of students by discipline (module)
The fund of assessment tools, formed for the current monitoring of progress and intermediate certification of students in the discipline " Analysis and Design of Structural Systems " is presented in Appendix 1 to the work program of the discipline and includes:

- a list of competencies formed in the course of studying the discipline;

- description of indicators and criteria for assessing competencies, description of assessment scales;

- typical control tasks or other materials necessary to assess knowledge, skills, abilities and (or) experience of activities, characterizing the level of competence formation;

- methodological materials defining the procedures for assessing knowledge, skills, skills and (or) experience of activities, characterizing the level of competence formation.

The materials are developed in full and are available for students on the discipline page at the TUIS RUDN University.

The program has been drawn up in accordance with the requirements of the ES of HE RUDN University.

Developers:

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