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 steel

Recommended for educational field: 08.04.01 Civil Engineering

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 mastering the discipline " Structural design in steel " is to gain knowledge, skills, skills and experience in the field of theory and design of buildings and structures that characterize the stages of competence formation and ensure the achievement of the planned results of the development of the educational program.

The main objectives of the discipline " Structural design in steel " are:
- training of specialists of a wide profile in industrial and civil construction with an in-depth study of the basics of design, manufacture, installation, reinforcement of metal structures of buildings and structures;
- formation of skills of calculations and design of metal structures from the point of view of specific engineering tasks using design norms, standards, reference books;
- obtaining skills in the use of automation tools for the design of metal building structures.

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

The discipline Structural design in steel belongs to the variable part of Block 1 of the curriculum. Its study is based on the material of previous disciplines, and it is also the basis for the study of subsequent disciplines of the curriculum, 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			
		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: Building codes, Seismic forces, Analysis, and design of complex structures. Loads, philosophy of design, steel and properties,
		Basics of Linear Algebra; Introductory calculus (differentiation, integration, differential equations); Computer aided design; Engineering statics	Review of tension members, Review of compression members, Review of flexural members , Review of flexural members, Pure torsion of homogeneous sections; shear stresses due to bending of thin-wall open x-section , Torsional stresses in I-shaped steel sections
Professional competencies (type of professional activity of a civil engineer)			
	PC-2 PC-4 PC-5 PC-6 PC-9 PC-11	Basic knowledge of linear algebra (matrix analysis) is necessary for this course	Analogy between torsional and plane bending; load and resistance factor design for torsion , Allowable strength design for torsion, torsional buckling , Lateral support of beams;

			elastic and inelastic lateral torsional buckling of beams,
		Structural Analysis, Structural Dynamics, Basic Course(s) in Structural Steel Design	,Load and resistance factor design-I shaped beams; allowable strength design – I shaped beams Allowable strength design – I shaped beams, effective lateral unbraced length, Lateral bracing design,
		Structural Analysis, Structural Dynamics, Basic Course(s) in Structural Steel Design	biaxial bending of doubly symmetric I-shaped sections , Differential equation for axial compression and bendingstrain triangle, Quadrilateral element Seated beam connections, bean to column and bean to beam connections, Column base plate
Vocational Competencies of Specialization Structural mechanics			

3. 3. Requirements for the results of mastering the discipline:

PC-2- Development of design products based on the results of engineering design for urban planning activities
PC-4- Management of the complex of works on the operation and repair of civil buildings
PC-5- Organization of construction work at a capital construction facility
PC-6- Organizational, technical and technological preparation of construction production
PC-9- Conducting planned economic work in a construction organization
PC-11- Preparation of a section of design documentation for metal structures of buildings and structures
As a result of studying the discipline, the student must:
Know:
- in the field of methods of mathematical analysis.
- know the state standards and be able to use them.
- basic methods of calculation and design of building structures.
- know the main theoretical provisions of the discipline:
- requirements for 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.

- use information technology to solve specific tasks;
- use information technology in professional activities
.**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	Semesters			
		3			
Classroom Practice in Obtaining Professional Skills and Professional Experience (Research Practice). **lessons (total)**	54	54			
Including:	-	-	-	-	-
Lectures	36	36			
Practical lessons (PL)	18	18			
Seminars (S)	-	-			
Laboratory work (LW)	-	-			
Independent work (total)		exam			
Total labor intensity hour	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.	**Introduction to steel structures**	Introduction: Building codes, Seismic forces, Analysis, and design of complex structures. Loads, philosophy of design, steel and properties,
2.	**Members of steel structures**	Review of tension members, Review of compression members, Review of flexural members , Review of flexural members, Pure torsion of homogeneous sections; shear stresses due to bending of thin-wall open x-section , Torsional stresses in I-shaped steel sections
3.	**Steel structures analysis**	Analogy between torsional and plane bending; load and resistance factor design for torsion , Allowable strength design for torsion, torsional buckling , Lateral support of beams; elastic and inelastic lateral torsional buckling of beams,
4.	**steel structures design**	,Load and resistance factor design-I shaped beams; allowable strength design – I shaped beams Allowable strength design – I shaped beams, effective lateral unbraced length, Lateral bracing design,

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.	**Introduction to steel structures**	4	8	0	0	14	26
2.	**Members of steel structures**	4	10	0	0	14	28
3.	**steel structures analysis**	4	8	0	0	14	28

4.	**steel structures design**	4	8	0	0	14	28

6. Laboratory workshop
No laboratory workshop provided.

7. Educational, methodological, and informational support of the discipline

The organization of classes in the discipline "Advanced Steel Design" / "Special Course of metal structures" is carried out in the following types of educational work: lectures, practical classes.
The implementation of the competence approach within the training area 08.04.01 Civil engineering / Construction provides for a combination of contact work with the teacher and extracurricular independent work of students in the educational process for a more complete formation and development of their professional skills.
Lectures are held in a flow-through classroom, including with the use of a multimedia projector in the form of an educational presentation. The main points of the lecture sessions are outlined by students, individual topics (parts of topics and sections) are offered for independent study with the mandatory preparation of a summary (checked by the teacher in the course of the current control).
The purpose of practical classes is to provide students with knowledge and develop practical skills in the field of theory and design of buildings and structures.
To achieve these goals, both traditional forms of work are used – solving problems, working with technological equipment/specialized software, etc. , and interactive methods – group work, analysis of specific situations, etc.
Group work in the analysis of a specific situation develops the ability to analyze and diagnose problems. Using the method of analyzing a specific situation, students develop such qualification qualities as the ability to clearly formulate and express their position, the ability to communicate, discuss, perceive and evaluate information received in verbal form. Practical classes are held in special classrooms equipped with the necessary visual materials.
Independent work covers the study of individual issues of the theoretical course by students.
Independent work is carried out in an individual format on the basis of educational and methodological materials of the discipline (appendices 2-4). The level of mastering the material on independently studied questions of the course is checked during the current control and certification tests (exam and / or test) by discipline.

Basic literature:

1. Handbook of structural steel connection design and details. Akbar R. Tamboli. https://drive.google.com/file/d/1F2qQ2Ae8VOOyP-p2K4JxByBWjcaFtBvl/view

Дополнительная литература:

1. Filippo Berto (Ed.), Ricardo Branco (Ed.). Mechanical Behavior of High-Strength Low-Alloy Steels [Электронный ресурс] 2018. 1 с. ISBN 9783038972044 URL: https://www.mdpi.com/books/pdfview/book/767

2. Smart Lesley, Gagan Michael. Structures of metals [Электронный ресурс] // The Molecular World: The Third Dimension. 2002. ISBN 0-85404-660-7 DOI: http://dx.doi.org/10.1039/9781847557902-00015

3. Al-Samman T. Material and Process Design for Lightweight Structures [Электронный ресурс] 2019. 1 с. ISBN 9783038979586
URL: https://mdpi.com/books/pdfview/book/1319

7. Practical exercises (seminars)

No.	Discipline section No.	Subjects of practical classes (seminars)	Labor capacity (hour.)
1.	**Introduction to steel structures**	Introduction: Building codes, Seismic forces, Analysis, and design of complex structures. Loads, philosophy of design, steel and properties,	
2.	**Members of steel structures**	Review of tension members, Review of compression members, Review of flexural members , Review of flexural members, Pure torsion of homogeneous sections; shear stresses due to bending of thin-wall open x-section , Torsional stresses in I-shaped steel sections	
3.	**steel structures analysis**	Analogy between torsional and plane bending; load and resistance factor design for torsion , Allowable strength design for torsion, torsional buckling , Lateral support of beams; elastic and inelastic lateral torsional buckling of beams,	
4.	**steel structures design**	,Load and resistance factor design-I shaped beams; allowable strength design – I shaped beams Allowable strength design – I shaped beams, effective lateral unbraced length, Lateral bracing design,	

8. Material and technical support of the discipline:

Auditorium with a list of logistics	Location
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.	Moscow, st. Ordzhonikidze, 3
Classroom for independent work-Computer class No. 352 A set of specialized furniture; technical means: PolyVision Webster TSL 610 interactive whiteboard, Toshiba TLP XC3000 multimedia projector, Draper Luma 178x178 roll-up wall screen, Pirit Codex 1226 computer - 1 pc., GENIUS SP-i350 sound amplification equipment-1 pc., Xerox 3125-1 pc. printer, Epson 10V Photo scanner-1 pc., HP DesignJet 130+ NR (A1) plotter-1 pc., Pirit Doctrina computers-9 pcs., ViewSonic 22" LCD monitor VA2216w-9 pcs., 19" NEC monitor-1 pc., chalk board. Plaxis 2D Suit (Network license). Plaxis Professional (version 8) + Plaxis Dinamics Modul + PlaxFlow (version 1) - Education, 25 seats-registration number 90-07-019-00261-3 (2008), Abaqus, 20 seats-registration number 90-07-019-00317-7 (2010),	Moscow, st. Ordzhonikidze, 3

MS-office corporate. (RUDN Software) - Registration Code: 86626883 Parent Program: 86493330 Status: Active	

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. Advanced Finite Element Method in Structural Engineering. 2009. Publisher: Springer Berlin Heidelberg. ISBN: 978-3-642-00316-5
2. Norrie, D.H. A first course in the finite element method. 3(2)1987. 162–163 p. ISBN:0534552986.
3. Cook, R.D., Malkus, D.S., Plesha, M.E., Witt, R.J. Cook, Malkus, Plesha, Witt - Concepts and Application of Finite Element Analysis - 4a. ed. - J. Wiley - 2002 – 733 2002.

b) additional literature
1. Algorithms for Solving the Parametric Self-Adjoint 2D Elliptic Boundary-Value Problem Using High-Accuracy Finite Element Method [Text] = Algorithms for solving the Parametric Self-Adjoint elliptic boundary value problem in a two-dimensional domain by the high-order finite element method // Bulletin of the Peoples ' Friendship University of Russia: Mathematics. Computer science. Physics. - 2017. - no. T. 25 (1). - C. 36-55. http://dx.doi.org/10.22363/2312-9735-2017-25-1

2. Gusev Alexander Alexandrovich. Finite Element Method of High-Order Accuracy for solving Two-Dimensional Elliptic Boundary-Value Problems of Two and Three Identical Atoms in a Line : article in English / A. A. Gusev / / Bulletin of the Russian University of Friendship of Peoples: Mathematics. Computer science. Physics. - 2018. - no. t. 26 (3). - p. 226-243. http://journals.rudn.ru/miph/article/view/18988/16003

3. Solution of the Boundary-Value Problem for a Systems of ODEs of Large Dimension: Benchmark Calculations in the Framework of Kantorovich Method [Text] = Solution of boundary-value problems for systems of ODES of large dimension: reference calculations within the framework of the Kantorovich method. Computer science. Physics. - 2016. - No. 3. - p. 31-37.
http://journals.rudn.ru/miph/article/view/13387/12817

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

Methodological guidelines for students on the development of the discipline (module)
Lectures are delivered in classrooms equipped with technical training facilities and video projectors. Lectures should be presented in the form of PowerPoint presentations.
Laboratory work is carried out in a laboratory fully equipped for laboratory work.
Practical classes are held in classrooms equipped with technical training facilities. Practical tasks are analyzed, as well as examples of solving computational and graphical tasks.
Control measures consist of two control works (for 2 ak. one hour each), exam at the end of the semester.
Methodological recommendations for the student are posted in the TUIS.

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

Materials for assessing the level of mastering the educational material of the discipline « Structural design at steel ", including a list of competencies indicating the stages of their formation, a description of indicators and criteria for evaluating competencies at various stages of their formation, a description of the assessment scales, typical control tasks or other materials necessary to assess knowledge, skills, skills and (or) experience of activity, 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 of activities that characterize the stages of the formation of competencies are developed in full and are available for students on the discipline page in TUIS RUDN.

The program is compiled in accordance with the requirements of the ES HE in the RUDN.

Developer:

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