

WORK PROGRAMME OF THE ACADEMIC DISCIPLINE

Construction in Difficult Engineering-Geological Conditions

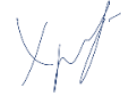
type of discipline, code for EP	<i>compulsory, EC 6</i>
semester	<i>1</i>
number of ECTS credits	<i>5,0</i>
form of final semester control	<i>exam</i>
language of instruction, teaching and assessment	<i>English</i>
department	<i>Geotechnics, Underground Structures and Hydrotechnical Construction</i>

for higher education applicants:

level of higher education	<i>second (Master's degree)</i>
branch of knowledge	<i>G Engineering, manufacturing and construction</i>
specialty	<i>G19 Building and Civil Engineering</i>
educational programme	<i>Industrial and Civil Engineering</i>
form of study	<i>full-time</i>

Developers:

Iryna KHRAPATOVA, PhD (Eng.),
Associate Professor of Geotechnics,
Underground Structures and
Hydrotechnical Construction Dpt.

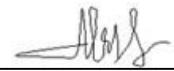


The work programme was approved at the proceedings of the Department of
Geotechnics, Underground Structures and Hydrotechnical Construction
Minutes dated August 25, 2025 No.1

**The work programme of the discipline corresponds to the Educational
Programme:** «Industrial and Civil Engineering»

Guarantor of the Educational Programme

Vadym ALEKSANDROVYCH, PhD (Eng.),
Associate Professor, Head of the GUS & HC Dpt.

**Deputy Director of SC&EE**

Kateryna SOROKINA, PhD (Eng.), Associate Professor



1. The purpose of the discipline

The aim of teaching this discipline is to master the basics of designing and constructing economical structures and advanced technologies for laying foundations and bases in complex engineering and geological conditions.

The main objectives of the discipline are to provide students with the necessary level of knowledge in the process of designing the most economical, technological, and reliable foundation solutions that allow for maximum use of the bearing capacity of foundations in difficult engineering and geological conditions.

2. Interdisciplinary connections

The study of this discipline is directly based on basic knowledge of the design and calculation of building structures, bases and foundations; technology and organization of construction processes; and the use of basic types of building materials and products.

3. Learning outcomes

Programme learning outcome	Teaching methods	Forms of evaluation	Learning outcomes of the discipline
PLO 02. Apply specialized conceptual knowledge, including modern scientific achievements, as well as a critical understanding of modern problems in the field of construction and civil engineering to solve complex problems of professional activity.	Verbal, visual, practical. Problem solving, lecture note-taking, Student self-work.	Written assessment, oral assessment; graphic assessment; testing, solving practical problems during individual tasks, defending individual tasks. Exam in the discipline based on tickets.	LO02.1 Correctly assess the bearing capacity of soils in difficult engineering-geological conditions on a base of modern scientific approaches. LO02.2 Select technically and economically rational types of bases and foundations, taking into account modern methods and practices. LO02.3 Design the most common types of bases and foundations on subsiding and man-made soils using modern scientific achievements.

PLO 08. Track the latest achievements in the chosen specialization and apply them to create innovations.			PLO08.1 Apply innovative methods and technologies to assess the bearing capacity of soils. PLO08.2 Use modern software packages to optimize the selection of foundation types. PLO08.03 Implement the latest engineering solutions in the design of foundations in particularly difficult engineering and geological conditions.
PLO 11. Adhere to the norms of academic integrity and know the basic legal norms regarding the protection of intellectual property and commercialization of the results of research, invention, and design activities			PO11.01 Present the results of soil assessment and design decisions in accordance with academic integrity standards. PO11.02 Use the results of scientific research and own design decisions, taking into account copyright and intellectual property protection.

4. Programme of the discipline

Module 1. Construction in Difficult Engineering-Geological Conditions

Content module 1. Complex engineering and geological conditions

General information about subsiding soils and types of subsidence phenomena is considered. The relative subsidence of soils is determined. General information about landslides and measures to counteract landslide phenomena is considered. Measures to eliminate the impact of suffusion deformations are provided. General information about karst phenomena and saline soils is considered. The peculiarities of construction in karst areas are given.

Content module 2. Construction in difficult engineering and geological conditions

General information about swelling soils. Features of construction on swelling soils. Measures to prevent the negative impact of swelling soils are studied. General information about flooded areas is considered. The consequences of flooding are studied. General information about loose soils is provided. A classification of loose soils is given. The construction of bases and foundations on loose soils is considered.

General information about weak soils and the specifics of construction on weak soils is provided.

Content module 3. *Calculation and design of foundations in difficult engineering and geological conditions*

Information is provided on seismic activity in Ukraine. The main requirements for construction in earthquake-prone areas and the seismicity of construction sites depending on soil category are considered. General information about areas with underground workings is considered. A classification of undermined areas is provided. The peculiarities of construction in undermined areas are studied. General information about the anthropogenic impact on buildings and structures is considered.

5. Structure of the academic discipline and time allocation

Content modules	Number of hours				
	total	lectures	practice	lab	independent work
MODULE 1	150	16	32	-	102
Content module 1	30	6	12	-	12
Content module 2	45	6	10	-	29
Content module 3	30	4	10	-	16
Individual task	30	-	-	-	30
Final semester control	15	-	-	-	15

6. Themes of the lectures

Theme	Contents (plan)	Number of aud. hours
Content module 1		
Topic 1. Foundations on loess subsidence soils.	General information about subsidence soils. Determining the relative subsidence of soils. Types of subsidence phenomena	2
Topic 2. Foundations in landslide areas	Slope processes. General information about landslides, collapses, avalanches, and mudslides. Measures to counteract landslide phenomena.	2
Topic 3. Foundations in karst areas. Foundations on saline soils.	General information about karst phenomena. Features of construction in karst areas. General information about saline soils. Measures to eliminate the impact of	2

	sufosion deformations	
Content module 2		
Topic 4. Foundation on swelling soils.	General information about swelling soils. Features of construction on swelling soils. Measures to prevent the negative impact of swelling soils.	2
Topic 5. Bases and foundations in flooded areas.	General information about flooded areas. Consequences of flooding	2
Topic 6. Foundations on alluvial and embankment soils. Foundations on weak soils.	General information about loose soils. Classification of loose soils. Construction of bases and foundations on loose soils. General information about weak soils. Features of construction on weak soils.	2
Content module 3		
Topic 7. Design features of earthquake-resistant foundations and structures.	General information on seismic activity in Ukraine. Basic requirements for construction in seismically hazardous areas. Seismicity of the construction site depending on the soil category	2
Topic 8. Arrangement of bases and foundations in areas with underground workings. Design of foundations under conditions of man-made impact.	General information about areas with underground workings. Classification of undermined areas. Features of construction in undermined areas. General information about man-made impacts on buildings and structures. Impact of new construction on existing buildings. Measures to avoid negative man-made impacts on the bases of buildings and structures.	2

7. Themes of the practical classes

Theme	Contents (plan)	Number of aud. hours
Content module 1		
Topic 1. Analysis of engineering and geological conditions	Principles of design of bases and foundations. General classification of foundations. Analysis of engineering and geological conditions of the construction site.	2
Topic 2. Foundation on natural subsidence soil.	Choosing the depth of the foundation for the column. Determining the dimensions of the foundation base.	4
Topic 3. Determination of foundation settlement and subsidence.	Determination of foundation settlement using the layer-by-layer summation method. Subsidence calculation.	4
Topic 4: Foundation design at $R = P_{sl}$	Determining the size of the foundation sole. Calculation of the foundation on water-saturated subsidence soil	2
Content module 2		
Topic 5. Foundation on pre-compacted soil	Design of a foundation compacted by heavy tamping. Design of a foundation on a compacted base.	6
Topic 6. Foundation on a soil cushion	Foundation on a soil cushion. Foundation cutting through the subsidence layer. Foundation reinforcement.	4

Content module 3		
Topic7. Calculation and design of pile foundations	Depth parameters of pile foundation. Load-bearing capacity of a single pile of friction.	10

8. Individual task (IT)

Calculation and graphic work “Base and foundations of industrial buildings and structures in difficult engineering and geological conditions.”

The purpose of the calculation and graphic work is to consolidate, enhance, and generalize the knowledge acquired by students while studying the discipline “Construction in difficult engineering and geological conditions.”

9. Methods of control and the procedure for assessing learning outcomes

Methods of ongoing assessment:

- solving practical problems while completing individual assignments – written assessment/

Methods of modular control (by content modules):

- testing;
- evaluating the completion of calculation and graphic assignments – oral, written, and graphic assessment (tables, diagrams).

Methods of final semester control:

- written exam based on exam tickets.

Structure of the discipline and distribution of points

Content modules	Maximum number of points				
	total	pract.	lab	independent work	
				tasks	module control
MODULE 1	100	-	-	-	-
Content module 1	15	10	-	-	5
Content module 2	20	15	-	-	5
Content module 3	20	15	-	-	5
Individual task	15	-	-	-	-
Final semester control	30	-	-	-	-

Types of tasks, means of control and maximum number of points

Types of the tasks and means of control	Distribution of points
Content module 1	15

Practical exercise №1 Analyze the engineering and geological conditions of the construction site. (written assessment)	2
Practical exercise No. 2 Select the depth of the column foundation and determine the dimensions of the foundation sole. (written assessment)	2
Practical exercise No. 3 Determine the settlement of the foundation using the layer-by-layer summation method. (written assessment)	4
Practical exercise No. 4 Perform calculations for a foundation on water-saturated subsidence soil. (written assessment)	2
Test on theoretical material CM1.	5
Content module 2	20
Practical exercise No. 5 Perform the design of the base, compacted by heavy tamping, and the design of the foundation on the compacted base. (written assessment)	7
Practical exercise No. 6 Perform calculations for a foundation on a soil cushion and foundation reinforcement. (written assessment)	8
Test on theoretical material CM2.	5
Content module 3	20
Practical exercise No. 7 Perform the calculation and design of the pile foundation. (written assessment)	15
Test on theoretical material CM3.	5
Individual task (written and oral control)	15
Preparation of the calculation part (written and graphic assessment)	10
Presentation and defense of work (oral assessment)	5
Final control - exam (written control)	30
Theoretical question 1 (written assessment)	10
Theoretical question 2 (written assessment)	10
Practical task (written assessment)	10
TOTAL FOR THE MODULE	100

Grading scale

100-point scale	Level of competence	Four-point / two-point scale	
		exam	test
90-100	high	excellent	passed
82-89	sufficient	good	
74-81		satisfactory	
64-73	average		
60-63	low		failed
35-59			
0-34		unsatisfactory	

11. Material, technical and information support

Methodological support

1. Web-course "*Construction in difficult engineering and geological conditions*" using the distance learning system "MOODLE" for applicants of the second level (Master's degree) on specialty 192 Building and Civil Engineering of the educational and professional program "Industrial and Civil Engineering". - <https://dl.kname.edu.ua/course/view.php?id=3924>

Recommended literature and information resources

1. Genadiy Strizhelchik, Irina Khrapatova, Oleksandr Liapin and Olexandr Bondarenko. Geotechnical risks in the reconstruction of buildings and structures affected by explosion. IOP Conference Series: Earth and Environmental Science, Volume 1499, International Conference on Urban Infrastructure Sustainable Development and Renovation (MistoBUD-2025) 30/01/2025 - 01/02/2025 Kharkiv, Ukraine. <https://iopscience.iop.org/article/10.1088/1755-1315/1499/1/012019>
2. Genadiy Strizhelchik, Viacheslav Iegupov, Irina Khrapatova Ensuring urban resilience construction in difficult engineering and geological conditions (geotechnical view) IOP Conference Series: Earth and Environmental Science, Volume 1499, International Conference on Urban Infrastructure Sustainable Development and Renovation (MistoBUD-2025) 30/01/2025 - 01/02/2025 Kharkiv, Ukraine. <https://iopscience.iop.org/article/10.1088/1755-1315/1499/1/012048>
3. Khrapatova I.V., Krotov O.V. The analysis of the SDC of the system «basement – pile foundation – structure» with the accounting of swelling properties of soil. Academic Journal. Series: Industrial Machine Building, Civil Engineering. – 2 (49)' 2017. p. 54-60 https://znp.nupp.edu.ua/files/archive/ua/49_2017/09.pdf

Hardware, equipment, software products

No need.