



SZKOŁA GŁÓWNA  
GOSPODARSTWA  
WIEJSKIEGO

## Soil Improvement and Modification of Hydraulic Structures

### Educational subject description sheet

#### Basic information

<b>Field of study</b> Course Offer for exchange students - second cycle studies, including uniform master studies (MA programmes) <b>Speciality</b> - <b>Organizational unit</b> Course Offer for exchange students <b>Study level</b> second cycle studies, including uniform master studies (MA programmes) <b>Study form</b> full-time studies <b>Education profile</b> General academic		<b>Didactic cycle</b> 2024/25 <b>Subject code</b> PWMPWM2S_D.B100000P.06316.24 <b>Lecture languages</b> english <b>Mandatory</b> Elective subjects <b>Block</b> Basic subjects <b>Disciplines</b>
<b>Coordinator</b>	Andrzej Głuchowski	
<b>Teacher</b>	Andrzej Głuchowski	
<b>Period</b> Winter semester	<b>Examination</b> Exam  <b>Activities and hours</b> Lecture: 15 Auditorium exercises: 30	<b>Number of ECTS points</b> 3

## Goals

Code	Goal
C1	The aim of the course is to familiarize students with the methods used in practice to strengthen the soil subgrade for the foundation of various types of structures, in particular hydrotechnical structures founded in unfavorable geotechnical conditions, e.g. when the subsoil of these structures contains weak soils (organic, plastically coherent), expansive, anthropogenic, etc. These are temporary methods (during construction) and methods involving causing permanent changes in the properties of the ground that are beneficial to the stability of the structure. The issue of modernization and strengthening also applies to existing earthworks. The technology characteristics of individual methods and the principles of design calculations will be presented. The issues discussed concern damming dams, wet storage dams, flood embankments, port wharves and adjacent areas.

## Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
<b>Knowledge - Student knows and understands:</b>			
W1	types and properties of building materials, knows the principles of analysis and dimensioning of complex earth structures, knows the principles of foundation of complex buildings and strengthening the ground		Oral exam
W2	properties of building substrates, i.e. geological structure, mechanical properties of soil, properties of groundwater and mechanical impact of buildings on the substrate		Oral exam
<b>Skills - Student can:</b>			
U1	classify complex building structures, is able to compare complex impacts on building structures, is able to determine the geotechnical parameters of the subsoil and design the foundation of a building in various ground conditions		Project
U2	select and adapt the scope of monitoring to a specific task in accordance with the principles of geotechnical design supported by numerical methods		Project
<b>Social competences - Student is ready to:</b>			
K1	independent decision-making, has a critical approach to assessing one's own actions		Oral exam, Project

## Study content

No.	Course content	Subject's learning outcomes	Activities
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1.	<p>Lecture topics:</p> <p>Theoretical and experimental basis for the identification of weak soils.</p> <p>Characterization of difficult and unfavorable foundation conditions of buildings, assessment of the possibilities of improving these conditions, classification and review of soil strengthening methods, initial subsoil consolidation, staged construction of embankments, acceleration of consolidation using vertical drainage, dynamic consolidation, vibroflotation, vibroexchange, deep soil mixing, electrical methods, thermal, explosions, negative pressure, microwaves, nailing, injections, geotextiles, geogrids.</p> <p>Methods of strengthening the surface subsoil and its stabilization for the purposes of erecting additional structures such as permanent and temporary roads and construction sites.</p> <p>Rules for selecting the reinforcement method. Basics of monitoring hydrotechnical structures and data verification. Elements of the observational method.</p>	W1, W2, K1	Lecture
2.	<p>Subjects of the exercises:</p> <p>Subsoil strengthening project for the purpose of laying an embankment or foundations of hydrotechnical structures, including: analysis and assessment of geotechnical conditions of the subsoil, concept and justification of the subgrade strengthening method, design calculations and construction drawings, implementation technology and work quality control.</p>	U1, U2, K1	Auditorium exercises

### Course advanced

Activities	Methods of conducting classes
Lecture	Lecture
Auditorium exercises	Problem lecture, Case study

Activities	Examination method	Percentage
Lecture	Oral exam	50%
Auditorium exercises	Project	50%

Activities	Credit conditions
Lecture	the exam consists of answers to 3 of 15 previously presented questions
Auditorium exercises	The assessment consists of defending the project of strengthening the ground under a hydrotechnical structure

## Literature

### Obligatory

1. Van Impe W. F. 1989: Soil improvement techniques and their evolution. A. A. Balkema.
2. Nicholson P.G. 2015. Improvement and ground modification methods. Elsevier Inc.
3. JIE HAN. 2015. Principles and practise of ground improvement. Wiley.

### Optional

1. Frank, R., Bauduin, C., Driscoll, R., Kavvasdas, M., Ovesen, N. K., Orr, T., & Schuppener, B. (2005). Designers' Guide to EN 1997-1 Eurocode 7: Geotechnical Design-General Rules (H. Gulvanessian, Ed.).
2. J. Paul Guyer An Introduction to Foundation Investigations for Arch Dams. ISBN-10 : 1717858201
3. Kutzner, C. (2018). Earth and rockfill dams: Principles for design and construction. Routledge.
4. Goldin, A. L. (2017). Design of earth dams. Routledge.
5. Ewert, F. K., & Hungsberg, U. (2018). Rock grouting at dam sites. Springer International Publishing.

## Calculation of ECTS points

Activity form	Activity hours*
Lecture	15
Auditorium exercises	30
Preparing the project	25
Preparation for the exam	20
<b>Student workload</b>	<b>Hours</b> 90
<b>Number of ECTS points</b>	<b>ECTS</b> 3

\* hour means 45 minutes