



Subject card

Subject name and code	Underground structures, PG_00041418						
Field of study	Civil Engineering						
Date of commencement of studies	February 2024	Academic year of realisation of subject			2024/2025		
Education level	second-cycle studies	Subject group			Optional subject group		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Geotechnics, Geology and Marine Civil Engineering -> Faculty of Civil and Environmental Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Adam Krasieński				
	Teachers		dr hab. inż. Adam Krasieński				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	0.0	30
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	30		5.0		15.0	50
Subject objectives	Providing students with knowledge about construction technology, types of structures as well as principles and methods of underground constructions calculating, especially tunnels. Presentation of techniques and requirements for ground and rock testing for the construction of tunnels and other underground constructions.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_K04] understands the necessity of dissemination civil engineering knowledge in the society and to support the professional ethos of a civil engineer	Student understands the need to provide the public with knowledge about the construction and operation of underground structures	[SK4] Assessment of communication skills, including language correctness [SK5] Assessment of ability to solve problems that arise in practice
	[K7_U14] is able to plan and to interpret the geotechnical investigations, to analyse the foundation stability; can design direct and deep foundations in complex soil conditions for complicated static and dynamical loads	Student is able to use the results of geotechnical investigations for underground structure designing; can design the underground structure	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
	[K7_U04] is able (using Finite Element Method), to define a calculation model and to perform advanced numerical analysis of complex constructions in: linear range and elementary nonlinear range, can critically evaluate the results of calculations.	Student can define numerical model and interpret the calculations results of the construction of tunnels and other underground structures	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W12] has deep and theoretically firm knowledge about geotechnical investigation, the rules of geotechnical design and engineering geology; knows the complicated processes in soil, techniques of foundations, draining systems, soil strengthening, geosynthetics applications, underground constructions and earthworks	Student has knowledge about soil substrate testing for underground structures purposes; knows the principles of designing underground structures; knows technologies of underground structures realization	[SW1] Assessment of factual knowledge
[K7_W02] knows principles of analysis, design and dimensioning of complex constructions and its elements	Student knows the principles of analysis, construction and dimensioning of underground structures, especially tunnels and their elements	[SW1] Assessment of factual knowledge	
Subject contents	<p>Information on underground structures: definition, application, classification, types of construction. Technologies for the construction of deep (hollow) tunnels. The interaction of rock mass with deep tunnels casing. Technologies of construction of shallow (opencast) tunnels. Technologies of construction of underwater tunnels. Technologies of construction of other underground structures: mining shafts, multi-storey basements of buildings, underground car parks, underground tanks. Calculation and design of deep tunnels. Calculation and design of shallow tunnels and other underground constructions realized open-cast. Maintenance and operation of underground structures. Review of technological and construction solutions of underground structures completed at home and abroad.</p>		
Prerequisites and co-requisites	<p>Basic knowledge of mathematics and physics issues at the level of technical studies. General knowledge of geology. Knowledge of the strength of materials. Knowledge of the basic principles of soil mechanics and foundations. Knowledge of structural mechanics regarding the calculation of statically indeterminate systems analytical and numerical. The ability to use a spreadsheet and programs for static analysis of the structure. Passing courses: geology, strength of materials, general mechanics, building mechanics, soil mechanic and foundations.</p>		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Rating from the project	60.0%	50.0%
	Presence at lectures	0.0%	10.0%
	Test of lectures	55.0%	40.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. Stomatello H.: Tunele i miejskie budowle podziemne. Arkady, Warszawa, 1970. 2. Lessaer S.: Miejskie tunele, przejścia podziemne i kolektory. WKŁ, Warszawa, 1979. 3. Gałczyński S.: Podstawy budownictwa podziemnego. Oficyna Wyd. Politechniki Wrocławskiej, 2001. 4. Furtak K., Kędracki M.: Podstawy budowy tuneli. Skrypt Politechniki Krakowskiej, 2005. 	

	Supplementary literature	1. Budownictwo betonowe, tom XV: Drogi, lotniska, koleje, budowle podziemne. Arkady, Warszawa, 1970. 2. Kuczyński J.: Miejskie budowle sanitarne i podziemne. PWN, Warszawa-Wrocław, 1980. 3. Świst E.: Hydrotechniczne i komunikacyjne budowle podziemne. Wybrane zagadnienia projektowania i budowy. Wydawnictwo STO, Bielsko-Biała, 2006. 4. Czasopisma techniczne: Geoinżynieria - Drogi, Mosty, Tunele, Inżynieria i Budownictwo"
	eResources addresses	Adresy na platformie eNauczanie: Budownictwo Podziemne - 24/25 - Moodle ID: 40583 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=40583
Example issues/ example questions/ tasks being completed	Classification of tunnels and underground constructions. Shapes and structures of deep and shallow tunnels. Technologies for making hollow tunnels. State of stress in the rock mass before and after excavation for tunnel. Calculation of the structure of deep tunnels without and including cooperation with the rock mass. Execution technology and rules for calculating of TBM tunnels. Technologies of making shallow tunnels in diaphragm walls and tight walls. Technology of performing and calculating underwater tunnels. Construction methods, structures and rules for calculating underground car parks. Design of a shallow tunnel in diaphragm walls or in tight walls.	
Work placement	Not applicable	

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