



Subject card

Subject name and code	, PG_00069224						
Field of study	Civil Engineering						
Date of commencement of studies	October 2023		Academic year of realisation of subject		2026/2027		
Education level	first-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	4		Language of instruction		Polish		
Semester of study	7		ECTS credits		5.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Geotechnical and Hydraulic Engineering -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Adam Krasieński				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	30.0	0.0	0.0	0.0	45
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=2393						
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	45		10.0		70.0	125
Subject objectives	Introducing students to general issues related to the construction, execution, and design of various types of underground structures, such as communication tunnels, multi-story building basements, deep excavations, underground tanks, underground sewers and pipelines. Methods and techniques for constructing deep (bored) tunnels, shallow (cut-and-cover) tunnels, underwater tunnels, and multi-story building basements. Methods for determining loads and designing structures for deep and shallow tunnels, underground tanks, and sewers. Two or three calculation and design tasks.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_K04] Engages in independent lifelong learning and individually follows the development of science and technology in the field of civil engineering.		He or she is involved in learning new techniques for the construction, calculation and design of tunnels and other underground structures.		[SK2] Assessment of progress of work [SK3] Assessment of ability to organize work		
	[K6_K03] Can effectively, clearly and unambiguously convey information, describe activities and communicate their results/ outcomes to engineers or a wider audience using appropriate communication methods and tools.		Can effectively and clearly convey information and describe activities related to the types of structures and construction techniques for underground structures, including tunnels and underground car parks.		[SK4] Assessment of communication skills, including language correctness [SK3] Assessment of ability to organize work [SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	Course content – lecture 1. Introduction: definition and classification of underground structures, practical examples 2. Deep (excavated) tunnels - structures and construction technologies 3. Shallow (cut-and-pit) tunnels and culverts - structures and construction technologies 4. Immersed underwater tunnels - structures and construction technologies 5. Drainage and waterproofing of tunnels 6. Issues concerning the use and operation of tunnels: ventilation and lighting 7. Underground pipelines and collectors - structures and foundation methods 8. Multi-story building basements (parking lots and garages) - structures and construction methods 9. Underground and buried tanks 10. Review of examples of underground structures completed in Poland and around the World Course content – exercises 1. Loads and rock mass effects on deep tunnels - calculation examples 2. Static analysis of deep tunnels - calculation and modeling methods, calculation examples 3. Static analysis of shallow tunnels in lined excavations - calculation methods and procedures with examples 4. Static analysis of shallow backfilled tunnels - static diagrams and calculation procedures with examples 5. Static analysis of underground culverts - static diagrams, modeling, and calculation procedures with examples 6. Static analysis of pipelines and underground collectors - calculation diagrams and calculation procedures with examples 8. Static analysis of multi-story underground parking garages 9. Two or three individual calculation and design tasks: a) Calculation of the lining of a deep tunnel b) Calculation of a shallow tunnel in an excavation lining c) Calculation of a shallow backfilled tunnel d) Calculation of an underground collector (pipeline)														
Prerequisites and co-requisites	Intermediate knowledge of topics in the following fields: - general mechanics and structural mechanics - soil mechanics and foundations - building structures: masonry, reinforced concrete, and steel - matrix and computer-aided methods of structural analysis														
Assessment methods and criteria	<table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Colloquium of lectures</td><td>55.0%</td><td>40.0%</td></tr><tr><td>Calculation tasks from the exercises</td><td>60.0%</td><td>50.0%</td></tr><tr><td>Attendance at lectures</td><td>0.0%</td><td>10.0%</td></tr></table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Colloquium of lectures	55.0%	40.0%	Calculation tasks from the exercises	60.0%	50.0%	Attendance at lectures	0.0%	10.0%
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Recommended reading	Basic literature	1. Lessaer S.: "Urban Tunnels, Underpasses, and Collectors". WKŁ, Warsaw, 1979. 2. Glinicki S.P.: "Underground Structures". Białystok University of Technology Script, 1994. 3. Gałczyński S.: "Basics of Underground Construction". Wrocław University of Technology Publishing House, 2001. 4. Furtak K., Kędracki M.: "Basics of Tunnel Construction". Cracow University of Technology Script, 2005. 5. Teaching materials provided by the teacher.													
	Supplementary literature	1. Stomatello H.: "Tunnels and Urban Underground Structures." Arkady, Warsaw, 1970. 2. Kuczyński J.: "Urban Sanitary and Underground Structures." PWN, Warsaw-Wrocław, 1980. 3. Magazines: "Geoengineering Bridges, Roads, Tunnels," "Engineering and Construction," "Maritime Engineering and Geotechnics" 4. Foreign textbooks and journals 5. Publications available on websites													
	eResources addresses														
Example issues/ example questions/ tasks being completed	1. List the classical methods for excavating deep tunnels. Discuss and outline one of them. 2. The assumptions and principles of tunnel construction using the New Austrian Method (NATM). 3. Discuss the TBM method for constructing tunnels bored in undrained rock masses and saturated ground masses. 4. Generally describe the changes in stress and strain in the rock mass resulting from excavation of a tunnel. 5. What factors determine the need for a tunnel lining in elastic and elastic-plastic rock masses? 6. Provide the assumptions and physical model for determining the loads of deep tunnels using the Terzaghi method (homogeneous and layered rock mass). 7. Explain the essence of the calculation method for deep tunnels, taking into account the interaction of the tunnel lining with the rock mass. Provide sample static tunnel diagrams for calculations and modeling principles. 8. Characterize the structures of shallow, backfilled tunnels with direct foundations. 9. Draw static diagrams, load diagrams, and bending moment diagrams for shallow, backfilled tunnels with direct foundations. 10. Discuss and outline the construction procedure for underwater tunnels using the pre-cast method. 11. Discuss the construction methods for multi-story underground parking garages. 12. List and characterize ventilation methods for communication tunnels. 13. Calculate and design the structure of a deep tunnel. 14. Calculate and design the structure of a shallow tunnel. 15. Calculate and design the structure of an underground collector.														
Practical activities within the subject	Not applicable														