GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Stability and Ultimate Load Capacity of Bar Structures A, PG_00069721		
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	Optional 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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Structural Mechanics -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marcin Krajewski	
	Teachers	dr inż. Marcin Krajewski prof. dr hab. inż. Jarosław Górski	

Lesson types							
	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	5.0	0.0	20.0	0.0	0.0	25
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=8511						

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	25	0.0	0.0	25

Subject objectives	
	The aim of the course is to introduce students to the fundamentals of plasticity theory and the stability of engineering structures, as well as to prepare them to perform stability analyses, including lateral-torsional buckling, and load-bearing capacity analyses of both planar and spatial structural beam systems .During the course, students acquire knowledge of the constitutive laws of materials and the principles of determining the load-bearing capacity of cross-sections and structural beam systems..Another important objective of the course is to develop students' skills in applying computational methods to the analysis of numerical models of structures made in reality. Particular emphasis is placed on comparing the results of numerical analyses with experimental test results. Students also learn how to interpret the results of computational analyses.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U06] Conduct engineering activities in civil engineering subject area, using and applying practical knowledge and understanding of materials, equipment and tools, processes and technologies.	The student is able to determine the critical and ultimate loads of structural systems composed of beam elements using computational methods.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K6_K01] Is aware of the key aspects of professional, ethical and social responsibility related to management, business operation, decision making and opinion formulation in civil engineering.	The student is able to determine the stress and deformation states in structural systems composed of beam elements using computational methods	[SK5] Assessment of ability to solve problems that arise in practice
[K6_W06] Demonstrates practical knowledge and understanding of materials, devices and tools, processes and technologies in the field of civil engineering (and their limitations).	The student gains knowledge of engineering structures made in reaility. The student is able to perform linear buckling analyses and physically and geometrically nonlinear static analyses of structural beam systems with the use of computational software.	[SW1] Assessment of factual knowledge
[K6_U07] Design and build engineering structures in a sustainable manner, with care for the natural environment and a minimum carbon footprint	The student gains knowledge of engineering structures made in reaility.	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_W07] Understand the investment's impact on the environment and the interrelationships and dependencies between the building structure and the natural environment	The student gains knowledge of engineering structures made in reaility.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

Introduction to the theory of plasticity. Constitutive laws of materials.

Determination of the ultimate load-bearing capacity of cross-sections of structural members. Limit states of beams and frames.

Fundamentals of structural stability theory.

Examples of structural stability analysis.

Course content – laboratory

Computational stability analysis of beam structural systems inclouding numerical modelling of experimentally tested structures and comparison of numerical analysis results with experimental test results.

Lateral-torsional buckling of flexural members – numerical modelling of experimentally tested structures and comparison of numerical analysis results with experimental test results. Buckling modes.

Fundamentals of nonlinear static analysis of beam structural systems using computational methods. Numerical analysis of the load-bearing capacity of selected structural systems composed of bar elements.

Prerequisites and co-requisites

Completion of courses in Basic Mechanics, Structural Mechanics, and Computational Structural Analysis, Experimental Methods in Structural Mechanics, Experimental Methods in Strength of Materials.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory – Assessment Test	0.0%	40.0%
Laboratory – Computer-Based Assessment	60.0%	60.0%

Recommended reading	Basic literature	1. Bielewicz E.: Strength of Materials. Gdańsk University of Technology, Gdańsk, 1992 (or other editions). 2. Biegus A.: Ultimate Load-Bearing Capacity of Steel Beam Structures. PWN, 1997. 3. Szeptyński P.: A Brief Introduction to the Theory of Plasticity. 2020. 4. Weiss G., Giżejowski M.: Stability of Metal Structures – Beam Systems. Arkady, 1991. 5. Rykaluk K.: Stability Problems of Metal Structures. Dolnośląskie Wydawnictwo Edukacyjne, 2012. 6. Jones R. M., Buckling of Bars, Plates, and Shells. Blacksburg: Bull Ridge Publishing, 2006. ISBN 978-0-9787223-0-2. 7. Timoshenko S. P., Gere J. M., Theory of Elastic Stability. Warsaw: Arkady, 1963
	Supplementary literature	Ambroziak A., Kłosowski P., Autodesk Robot Structural Analysis. Fundamentals of Structural Analysis. 3rd ed. Gdańsk: Gdańsk University of Technology Publishing House, 2015. ISBN 978-83-7348-639-3.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Determine the ultimate load-bearing capacity of a structure. Identify the structural feilure mechanism using computational methods. Determine the critical buckling load and the corresponding buckling mode of 2D and 3D structures modelled using beam elements. Determine the critical lateral-torsional buckling moment of a beam subjected to bending using computational methods. Determine the equilibrium path of a structure using computational methods. Determine the internal forces and structural deformations using computational methods.	
Practical activites within the subject	Not applicable	

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