GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Analysis of bridge structures, PG_00052219		
Field of study	Civil Engineering		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Engineering Structures -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marek Szafrański	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	0.0	0.0	0.0	45

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	45	2.0	8.0	55

Subject objectives

Deepening knowledge in the field of:

1. Dynamic analysis of bridges under moving loads,
2. Fatigue analysis of bridges,
3. Strength and load capacity analysis of bridges,
4. Types and reasons of degradation of bridge structures,
5. Repairs, reinforcements and modernizations of bridges,
6. Tests of bridge structures,
7. Bridge equipment elements.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W15] has deep and adequate knowlege of civil engineering, within offered specialization and profile	1. Has knowledge of: a) dynamics of bridges under moving loads, b) fatigue analysis of bridges, c) damages and degradation processes of bridges, d) repairs, reinforcements and modernizations of bridges, e) tests of bridge structures, f) types and role of bridge equipment, g) strength and load capacity analysis of bridges	[SW3] Assessment of knowledge contained in written work and projects
[K7_U15] has advanced skills in civil engineering within offered specialization/profile	1. Has knowledge of: a) dynamics of bridges under moving loads, b) fatigue analysis of bridges, c) damages and degradation processes of bridges, d) repairs, reinforcements and modernizations of bridges, e) tests of bridge structures, f) types and role of bridge equipment, g) strength and load capacity analysis of bridges	[SU1] Assessment of task fulfilment

Subject contents

Course content – lecture
LECTURES

1. Transport infrastructure of Poland.
2. Dynamic analysis of bridges under moving loads.
3. Fatigue analysis of bridges.
4. Numerical analysis as the effective tool supporting the design stage, construction, repair and technical condition assessment of bridge structures.
5. Tests of bridge structures.
6. Damages of bridge structures.
7. Repairs, reinforcements and modernizations of bridge structures.
8. Technical equipment of bridges.

PRACTICAL

1. Dynamic analysis of the bridge span under moving loads (numerical analysis in the selected FEM software)
   - railway bridge span under railway vehicle action,
   - footbridge under pedestrian action.
2. Fatigue analysis of the railway/road bridge based on the design standards requirements.
3. Repair and strengthening of the bridge girder.

Prerequisites and co-requisites

Basic knowledge of:
1. Design of bridge structures.
2. Structural mechanics, dynamics and strength of materials.

Skills in the field of:
1. FE modeling and numerical analysis of structures.
2. Basics of signal processing.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Realization of exercises, electronic and printed form, date - current semester	60.0%	100.0%

Recommended reading

Basic literature

1. Bień J., [2010]: Uszkodzenia i diagnostyka obiektów mostowych, WKiŁ, 2010.
2. Madaj A., Wołowicki W., [2007]: Budowa i utrzymanie mostów, WKiŁ, 2007.
3. Flaga A. 2011. Mosty dla pieszych. WKŁ, Warszawa, 2011.
4. Chmielewski T., Zembaty Z. 1998. Podstawy Dynamiki Budowli. ARKADY, Warszawa, 1998.
5. Lewandowski R. 2006. Dynamika Konstrukcji Budowlanych. WPP, Poznań, 2006.
6. Czudek H., Pietraszek T., [1980]: Trwałość stalowych konstrukcji mostowych przy obciążeniach zmiennych, WKiŁ, 1980.
7. Kühn B, [2013]. Assessment of Existing Steel Structures: Recommendations for Estimation of Remaining Fatigue Life. Procedia Engineering, 66, 3-11 (2013).

	Supplementary literature	1. Bień J., [2002]. Modelowanie obiektów mostowych w procesie ich eksploatacji, Dolnośląska Biblioteka Cyfrowa, 2002 (www.dbc.eroc.pl) 2. Gruener M., [1983]. Korozja i ochrona betonu, Arkady, 1983. 3. Rybak M., [1983]. Przebudowa i wzmacnianie mostów, WKiŁ, 1983. 4. Bartoszewski J., [1962]. Wzmacnianie i poszerzanie mostów, WKiŁ, 1962. 5. Jasakow M., [1981]. Ochrona mostów przed korozją, WKiŁ, 1981. 6. Czudek H., Wysokowski A., [2005]. Trwałość mostów drogowych, WKiŁ, 2005. 7. Praca zbiorowa, [2012]. Trwałość obiektów mostowych. Seminarium Wrocławskie Dni Mostowe. DWE, Wrocław 2012. 8. Siwowski T., Kulpa M., [2014]. Ocena trwałości zmęczeniowej istniejącego mostu stalowego według Eurokodów. Czasopismo Inżynierii Lądowej, Środowiska i Architektury, JCEEA, t. XXXI, z. 61(1/14), s. 269-285. 9. Jarominiak A., Rosset A., [1986]. Katastrofy i awarie mostów, WKiŁ, 1986. 10. Żółtowski K. [2007]. Pieszy na kładkach: obciążenia i odpowiedź konstrukcji. Wydawnictwo Politechniki Gdańskiej, Gdańsk, 2007. 11. Biliszczuk J., Barcik W., Machelski Cz., Onysyk J. [2007]. Projektowanie stalowych kładek dla pieszych. DEW, Wrocław, 2007. 12. Charles P., Hoorpah E. et al. [2006]. Technical guide - Footbridges - Assessment of vibrational behaviour of footbridges under pedestrian loading. Sétra/AFGC, 2006. 13. Salamak M. [2003]. Rola tłumienia drgań w kładkach dla pieszych oraz metody jego identyfikacji. W: Projektowanie, budowa i estetyka kładek dla pieszych, Kraków 8.X, 5.XI, 3.XII, 2003. 14. Stahlbau Kalender [2008]. Dynamik, Brücken, Änderungen zu DIN 18800, Feuerverzinken, Berlin, Ernst & Sohn 2007. 15. Bachamnn H. et al. [1995]. Vibration Problems in Structures: Practical Guidelines. Basel, Birkhuser, 1995. 16. Lyons R.G. [2003]. Wprowadzenie do cyfrowego przetwarzania sygnałów. WKŁ, Warszawa, 2003. 17. Szafrański M., Żółtowski K. 2013. Modelowanie konstrukcji mostów pod kątem dynamicznym. Seminarium Mosty Kolejowe, Warszawa Jachranka, 28.02-01.03, 2013. 18. Fryba L. 1972. Vibration of Solids and Structures under Moving Loads. Thomas Telford, 1972.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Define a numerical model of the span and perform the mesh density convergence analysis. 2. Validate the model in terms of the dynamic parameters (mass, stiffness, damping) based on eigenvalue solution and free response of the span impulse excitations. 3. Define a time-step of the analysis based on the free response accuracy in the time and frequency domain. 4. Calculate the bridge response under moving vehicle series of moving forces load model. 5. Calculate the footbridge response under moving pedestrians pedestrian load functions. 6. Analyse the notches in the selected constructional detale. 7. Calculate the design value of nominal stress range based on the bridge time-response and Eurocod standard design requirements simplified lambda method. 8. For a given method of strengthening of the prestressed concrete girder calculate the tensile stress change in the reinforcement.	
Practical activites within the subject	Not applicable	

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