GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Reinforced concrete bridges and prestressed concrete bridges, PG_00045879 | | |
| Field of study | Civil Engineering | | |
| Date of commencement of studies | February 2023 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-cycle studies | Subject group | Optional subject group<br>Subject group related to scientific research in the field of study |
| 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 | 5.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Railway Engineering -> Faculty of Civil and Environmental Engineering | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Marcin Abramski | |
| | Teachers | dr hab. inż. Marcin Abramski<br>dr inż. Arkadiusz Sitarski<br>dr inż. Przemysław Kalitowski | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 15.0 | 0.0 | 15.0 | 0.0 | 60 |

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 |
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| Number of study hours | 60 | 10.0 | 55.0 | 125 |

**Subject objectives**

Getting knowledge on advanced bridge structures made of reinforced and prestressed concrete

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
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| [K7_W02] knows principles of analysis, design and dimensioning of complex constructions and its elements | | [SW1] Assessment of factual knowledge |
| [K7_U02] can design and dimension complex steel, concrete (including reinforced), wood and masonry construtions and its details | | [SU1] Assessment of task fulfilment<br>[SU4] Assessment of ability to use methods and tools |
| [K7_W15] has deep and adequate knowlege of civil engineering, within offered specialization and profile | | [SW3] Assessment of knowledge contained in written work and projects |

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| Subject contents | LECTURE:<br><br>Prestressing of statically determinate and indeterminate bridge systems. Pre-tensioned and post-tensioned prestressed bridges. Limit envelopes. Excited bending moments. Principles of tendon routes designing. Anchorage zone of prestressing tendons.<br><br>Concrete beam bridges, including slab bridges (slab cross-section). Assigning of transverse and longitudinal cross-sections, determining of internal forces and support reactions, dimensioning of beam girders and slab girders with emphasis on skew slabs. Directions of principal moments. Principles of reinforcing of beam girders and slab girders, including skew slabs. Assumptions and methods of dimensioning of reinforcement, which is not laid in the direction of the principal moments. Prestressing the beams and slabs, including skew slabs and slabs of irregular shape. Designing of tendons routes (in the plan and profile) in beams and slabs, also skew slabs. Extradosed bridges. 'Concrete-concrete' composite bridges erected with the use of prefabricated prestressed beams. Supporting of beam and slab bridges, also skew slab bridges. Examples of design solutions for reinforced and prestressed beam girders and slab girders.<br><br>Concrete frame bridges. Static systems, solutions of framework bridges - single-span, single-span with cantilevers, multi-span - made of reinforced concrete and prestressed concrete. Determining dimensions of supports of frame bridges. Examples of design solutions.<br><br>Concrete arch bridges. Static systems, classification. Determining the structure dimensions. Deck arch bridges (arch bridges with the road above the structure). Sections of arches and vaults. Decks, connectors, sway braces. Tied-arch bridges (arch bridges with the road below the structure). The construction of deck, connectors (posts, suspension rods). The principles of calculations for arch bridges (rational shape of the arch axis, cross-sectional variability, arch stability, etc.). Techniques of arch erection: the classic method, arched bridges with rigid reinforcement, cantilever method, building two halves in a vertical position on the external supports and rotating them as a whole, etc. Examples of technical solutions.<br><br>Cable-stayed bridges with concrete slabs. Characteristics of the technical solutions, advantages and disadvantages. Static systems. General principles of construction of various elements (deck, cable arrangement, etc.). Suspension cables and their anchorage. Selected issues of designing cable-stayed bridges with concrete slabs. Examples of design solutions of bridges with a concrete deck.<br><br>Influence of rheological effects on static behaviour of concrete bridges.<br><br>Selected technological issues of erecting concrete bridges.<br><br>PRACTICAL CLASSES:<br><br>Analysis of normal stresses in the cross section of prestressed concrete bridges in various erection stages and with the use of various construction technologies. Solving exercises.<br><br>PROJECT:<br><br>Preliminary project of two-span prestressed post-tensioned bridge consisting of two or three girders. Realisation with the use of Finite Element Method program. Getting loads together, cross-sectional distributing of them, determining envelopes of bending moments and shearing forces, taking into account the influence of additional (induced) reactions and internal forces. Assuming prestressing tendons, designing the tendons routes. Dimensioning reinforcement sustaining shear force, calculating prestressing loss, dimensioning the zone of tendons anchorage. |
| Prerequisites and co-requisites | Subject *Concrete Bridges*, 7th semester, studies 1. Degree |

Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Project | 60.0% | 45.0% |
| Examination, theoretical and practical tasks (lectures) | 60.0% | 45.0% |
| Simple project task for unassisted solving | 60.0% | 10.0% |

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| Recommended reading | Basic literature | 1. PN-EN 1992-2:2010. Eurocode 2: Design of concrete structures. Part 2: Concrete bridges. Design and detailing rules.<br><br>2, Praca zbiorowa: Podstawy projektowania konstrukcji żelbetowych i sprężonych według Eurokodu 2. DWE, Wrocław 2006.<br><br>3. Madaj A., Wołowicki W.: Mosty betonowe. WKiŁ, Warszawa 2002.<br><br>4. PN-S-10042:1991. Obiekty mostowe. Konstrukcje betonowe, żelbetowe i sprężone. Projektowanie. |
| | Supplementary literature | 1. Szczygieł J.: Mosty z betonu zbrojonego i sprężonego WKiŁ Warszawa 1978.<br><br>2. Skarżewski J., Wołowicki W., Sturzbecher K.: Mosty sprężone przewodnik do ćwiczeń projektowych. Skrypt Politechniki Poznańskiej, Poznań 1982.<br><br>3. Ajdukiewicz A., Mames J.: Konstrukcje z betonu sprężonego. Wyd. Polski Cement, Kraków 2004. |
| | eResources addresses | Adresy na platformie eNauczanie:<br>Mosty z betonu zbrojonego i sprężonego - 2023/2024 - Moodle ID: 30909<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30909 |
| Example issues/ example questions/ tasks being completed | | |
| Work placement | Not applicable | |