



COURSE CARD

1. Basic information

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|--|--|-------------------------------------|
| Course name in English: | Advanced steel-concrete composite constructions | |
| Course name in Polish: | Zaawansowane konstrukcje zespolone stalowo-betonowe | |
| Number of hours: | 30 | |
| Type of course: | Elective course | |
| Form of course: | lecture | |
| Code of course: | ILQ100170W | |
| Course leader: | Prof. dr hab. inż. Wojciech Lorenc <i>Title Name Surname</i> | |
| Faculty of the course leader: | W2 Faculty of Civil Engineering | |
| Email address of the course leader: | wojciech.lorenc@pwr.edu.pl | |
| Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course): | Architecture and urban planning | <input type="checkbox"/> |
| | Automation, electronic, electrical engineering and space technologies | <input type="checkbox"/> |
| | Information and communication technology | <input type="checkbox"/> |
| | Biomedical engineering | <input type="checkbox"/> |
| | Chemical engineering | <input type="checkbox"/> |
| | Civil engineering, geodesy and transport | <input checked="" type="checkbox"/> |
| | Materials engineering | <input type="checkbox"/> |
| | Mechanical engineering | <input checked="" type="checkbox"/> |
| | Environmental engineering, mining, and energy | <input type="checkbox"/> |
| | Mathematics | <input type="checkbox"/> |
| | Chemical sciences | <input type="checkbox"/> |
| | Physical sciences | <input type="checkbox"/> |
| Management and quality studies | <input type="checkbox"/> | |

2. Objectives

Familiarization with contemporary steel-concrete composite structures.

Familiarization with advanced methods of laboratory tests of steel-concrete composite structures.

Familiarization with advanced methods of numerical simulation of behavior of steel-concrete composite structures.

3. Content

Detailed information about the course content, including topics and form of classes.

| No. | Topic | Number of hours | Form of classes |
|-----|-------|-----------------|-----------------|
|-----|-------|-----------------|-----------------|



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|----|---|---|---------|
| 1 | Subject and scope of the lecture, literature, rules of getting credit. State-of-the art of classic steel-concrete composite structures. Introduction to general composite section | 2 | lecture |
| 2 | Introduction to The History of the Theory of Structures. Working with old structures: strengthening and external prestressing of composite structures | 2 | lecture |
| 3 | Composite structures in buildings and bridges: main differences. Bridge construction – a strong driving force for developments in composite construction | 2 | lecture |
| 4 | Evolution of composite bridges. Basis of design of composite bridges. Un-cracked analysis and cracked analysis | 2 | lecture |
| 5 | From welded studs to composite dowels: evolution of shear connection. Fundamentals of Eurocode 4: steel skeleton | 2 | lecture |
| 6 | Evolution of composite dowels: from VFT to VFT-WIB | 2 | lecture |
| 7 | Composite dowels: searching for the shape and construction of first bridges. The first generation of bridges using composite dowels | 2 | lecture |
| 8 | Composite dowels: searching for design procedures and technology of production of steel part | 2 | lecture |
| 9 | Composite dowels: the final solution. Formal design procedures. The second generation of bridges using composite dowels | 2 | lecture |
| 10 | The concept of general composite section. The third generation of bridges using composite dowels. The forms constructed nowadays and predictable future | 2 | lecture |
| 11 | Laboratory testing of composite constructions: tests under static loads | 2 | lecture |
| 12 | Laboratory testing of composite constructions: tests under cyclic loads | 2 | lecture |
| 13 | FEM for purposes of laboratory testing | 2 | lecture |
| 14 | FEM for purposes of design. Development of EC4 | 2 | lecture |
| 15 | Final test | 2 | lecture |

4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

Has the necessary advanced knowledge of the mechanics of construction and civil engineering
Has the necessary knowledge of the steel-concrete composite constructions.
Has the necessary knowledge of the FEM.

5. Learning outcomes



List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

| Symbol | Learning outcome | |
|--------|--|-------------------------------------|
| | <i>KNOWLEDGE. Doctoral student knows and understands:</i> | |
| SzD_W3 | the main trends in the development of the scientific or artistic disciplines covered in the curricula; | <input checked="" type="checkbox"/> |
| SzD_W4 | research methodology; | <input checked="" type="checkbox"/> |
| SzD_W5 | the rules for the dissemination of scientific results, including in open access mode; | <input type="checkbox"/> |
| SzD_W6 | the fundamental dilemmas of modern civilization; | <input type="checkbox"/> |
| SzD_W7 | the legal and ethical conditions of scientific activity; | <input type="checkbox"/> |
| SzD_W8 | the economic and other relevant conditions of scientific activity; | <input type="checkbox"/> |
| SzD_W9 | basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results. | <input checked="" type="checkbox"/> |
| | <i>SKILLS. Doctoral student is able to:</i> | |
| SzD_U2 | use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres; | <input checked="" type="checkbox"/> |
| SzD_U3 | communicate on specialised topics to the extent that they enable an active participation in the international scientific community; | <input checked="" type="checkbox"/> |
| SzD_U4 | disseminate research results, including in popular forms; | <input checked="" type="checkbox"/> |
| SzD_U5 | initiate debates and participate in a scientific discourse; | <input type="checkbox"/> |
| SzD_U6 | be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment; | <input type="checkbox"/> |
| SzD_U7 | plan and implement an individual or collective research or creative activity, including in an international environment; | <input type="checkbox"/> |
| SzD_U8 | independently plan and act for one's own development and inspire and organize the development of others; | <input checked="" type="checkbox"/> |
| SzD_U9 | plan classes or groups of classes and implement them using modern methods and tools. | <input type="checkbox"/> |
| | <i>SOCIAL COMPETENCES. Doctoral student is ready to:</i> | |
| SzD_K3 | fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way; | <input type="checkbox"/> |
| SzD_K4 | maintaining and developing the ethos of research and creative environments, including: | <input checked="" type="checkbox"/> |



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| | - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection. | |
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6. Evaluation

Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.

Final test

7. Teaching methods

Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.

Lecture, presentation, laboratory testing, discussion, self work

8. Literature

List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.

- [1] Kurrer K-E. The History of the Theory of Structures: Searching for Equilibrium. Ernst & Sohn 2018.
- [2] Wojciech Lorenc, Maciej P. Kożuch, Sebastian Balcerowiak, Wybrane zagadnienia modelowania przęseł mostów belkowych z dźwigarów zespolonych stalowo-betonowych. Wrocław: Dolnośląskie Wydawnictwo Edukacyjne, 2018. 168 s.
- [3] Jacques Berthelley, Günter Seidl, Wojciech Lorenc Recent structures and bridges built with the CL steel-concrete connection. W: Tomorrow's Megastructures : 40th IABSE Symposium 2018, Nantes, France, 19-21 September 2018. Zurich : IABSE, 2018. art. S2-51, s. 1-9.
- [4] Dennis Rademacher, Wojciech Ochojski, Wojciech Lorenc, Maciej P. Kożuch Advanced solutions with hot-rolled sections for economical and durable bridges. Steel Construction. 2018, vol. 11, nr 3, s. 196-204.
- [5] Wojciech Lorenc Nośność ciągłych łączników otwartych w zespolonych konstrukcjach stalowo-betonowych. Wrocław: Oficyna Wydawnicza Politechniki Wrocławskiej, 2010. 131, [2] s.
- [6] Wojciech Lorenc The model for a general composite section resulting from the introduction of composite dowels. Steel Construction. 2017, vol. 10, nr 2, s. 154-167.
- [7] Wojciech Lorenc Non-linear behaviour of steel dowels in shear connections with composite dowels: design models and approach using finite elements. Steel Construction. 2016, vol. 9, nr 2, s. 98-106.
- [8] Wojciech Lorenc The design concept for the steel part of a composite dowel shear connection. Steel Construction. 2016, vol. 9, nr 2, s. 89-97.
- [9] Wojciech Lorenc. Nowe technologie budowy mostów zespolonych. W: Mosty hybrydowe : Seminarium Naukowo-Techniczne Wrocławskie Dni Mostowe, Wrocław, 29-30 listopada 2018 / [red. Jan Biliszczuk, Jerzy Onysyk]. Wrocław : Dolnośląskie Wydawnictwo Edukacyjne, [2018]. s. 101-118.
- [10] Günter Seidl, Wojciech Lorenc Innovative Konstruktionen im Verbundbrückenbau mit Verbunddübelleisten. Stahlbau. 2018, Jg. 87, H. 6, s. 547-554.



- [11] Wojciech Lorenc, Tomasz Kołakowski, Andrzej Hukowicz, Günter Seidl Verbundbrücke bei Elbląg : Weiterentwicklung der VFT-WIB-Bauweise. Stahlbau. 2017, Jg. 86, H. 2, s. 167-174.

9. Other remarks

Additional remarks, comments, (e.g., language of the course)

Course in English