



## COURSE CARD

### 1. Basic information

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:	<a href="mailto:wojciech.lorenc@pwr.edu.pl">wojciech.lorenc@pwr.edu.pl</a>	
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
1	Subject and scope of the lecture, literature, rules of getting credit. State-of-the art of classic steel-concrete	2	lecture



	composite structures. Introduction to general composite section		
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: - 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.	<input checked="" type="checkbox"/>



## 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. Kozuch, 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. Kozuch 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 Biliszczyk, Jerzy Onysyk]. Wrocław : Dolnośląskie Wydawnictwo Edukacyjne, [2018]. s. 101-118.
- [10] Günter Seidl, Wojciech Lorenc Innovative Konstruktionen im Verbundbrückenbau mit Verbunddübeln. 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