



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Concrete structures with BIM [S2Bud1-KB>KBzeBIM]

### Course

Field of study

Civil Engineering

Year/Semester

1/1

Area of study (specialization)

Structural Engineering

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

### Number of hours

Lecture

30

Laboratory classes

15

Other (e.g. online)

0

Tutorials

0

Projects/seminars

30

### Number of credit points

5,00

### Coordinators

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### Lecturers

prof. dr hab. inż. Mieczysław Kuczma  
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mgr inż. Mateusz Fabisiak  
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### Prerequisites

**KNOWLEDGE:** The student has knowledge of mathematics, physics and chemistry, knows the rules of analysis, construction and dimensioning of reinforced concrete elements of any building objects and knows the standards and guidelines for designing building objects and their elements. **SKILLS:** The student is able to evaluate and compile loads acting on building objects, can classify building objects, can design elements in complex reinforced concrete structures, and can choose tools (analytical or numerical) to solve engineering problems. **SOCIAL COMPETENCE:** Student is a responsible person willing to broaden her/his knowledge and to communicate and work in a team environment with her/his colleagues.

### Course objective

Understanding the principles of analysis and design of shell reinforced concrete structures.

### Course-related learning outcomes

none

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:

Lecture — Final exam

Projects — Completion of a project of a reinforced concrete silo or tank and defence of it in the form of test (1 h) at the last meeting.

## Programme content

Analysis of reinforced concrete structures according to Eurocode 2. Types of silos and tanks. Loads acting on silos and tanks and their calculation in combination. Differential equilibrium equations of shells. Surface structures as spherical and conical shells. Cylindrical shells. Liquid tanks. Silos for loose materials. Application of the finite element method and computer programs in the calculation of shell structures. Finite element method. BIM.

## Course topics

W1. Types of tanks and their loads

W2. Bulk material tanks

W3. Analysis of structures to Eurocode 2

W4. Liquid containers

W5. Stress tensor, strain tensor, Hooke's law

W6. Differential equilibrium equations for the shells

W7. Solution of structures by the FEM

W8. Interaction of the structure with its soil foundation

W9. Spherical and conical shells

W10. Cylindrical shells – an analytical solution. Boundary effect - the influence of the conditions of fixing the wall in the foundation on the distribution of forces

W11. Solutions of spherical dome on the supporting beam

W12. The concept of BIM (Building Information Modelling)

W13. Examples of BIM applications and computer programs

W14. Execution of tanks

W15. Repair and protection of reinforced concrete tanks

## Teaching methods

Lecture — Traditional lectures ( "chalk-and-talk"), with computer-assisted presentations.

Projects — Project of a reinforced concrete silo or tank.

## Bibliography

Basic

1. K. Grabiec, Żelbetowe konstrukcje cienkościenne. PWN, Warszawa-Poznań 1999.

2. A. Halicka, D. Franczak, Projektowanie zbiorników żelbetowych. Tom 1: Zbiorniki na materiały sypkie. PWN, Warszawa 2011.

3. A. Halicka, D. Franczak, Projektowanie zbiorników żelbetowych. Tom 2: Zbiorniki na ciecze. Wyd. 2. PWN, Warszawa 2014.

4. M. Knauff i in., Podstawy projektowania konstrukcji żelbetowych i sprężonych według Eurokodu 2. Dolnośląskie Wydawnictwo Edukacyjne, 2006.

5. J. Kobiak, W. Stachurski, Konstrukcje żelbetowe. Arkady, Tom 2 i Tom 4, Warszawa 1987 i 1991.

6. A. Seruga, Sprężone betonowe zbiorniki na ciecze o ścianie z prefabrykowanych elementów. Wyd. Politechniki Krakowskiej, Kraków 2015.

Additional

1. P. Lewiński, Zasady projektowania zbiorników żelbetowych na ciecze z uwzględnieniem wymagań Eurokodu 2: przykłady obliczeń. Wyd. ITB, Warszawa 2011.

## Breakdown of average student's workload

	Hours	ECTS
Total workload	135	5,00
Classes requiring direct contact with the teacher	77	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	58	2,00