

**FACULTY OF CIVIL ENGINEERING**

**SUBJECT CARD**

**Name in Polish:** Konstrukcje betonowe – obiekty  
**Name in English:** Concrete Structures - objects  
**Main field of study (if applicable):** *Civil Engineering*  
**Specialization (if applicable):** Civil Engineering  
**Level and form of studies:** ~~1st~~ 2nd level\*, full-time / ~~part-time~~\*  
**Kind of subject:** obligatory / ~~optional~~ / ~~university-wide~~\*  
**Subject code:** CEB007561  
**Group of courses:** YES / NO\*

|   | Lecture   | Classes                              | Laboratory                          | Project   | Seminar                             |
|---|---|--------------------------------------|-------------------------------------|---|-------------------------------------|
| Number of hours of organized classes in University (ZZU)                        | <b>30</b>                                       |                                      |                                     | <b>30</b>                                       |                                     |
| Number of hours of total student workload (CNPS)                                | <b>60</b>                                       |                                      |                                     | <b>60</b>                                       |                                     |
| Form of crediting   | Examination / <del>crediting</del> with grade * | Examination / crediting with grade * | Examination=/crediting with grade * | <del>Examination</del> / crediting with grade * | Examination=/crediting with grade * |
| For group of courses mark (X) final course                                      |   |                                      |                                     |   |                                     |
| Number of ECTS points   | <b>2</b>  |                                      |                                     | <b>2</b>  |                                     |
| including number of ECTS points for practical (P) classes                       |   |                                      |                                     | <b>2,0</b>                                      |                                     |
| including number of ECTS points for direct teacher-student contact (BK) classes | <b>1,1</b>                                      |                                      |                                     | <b>1,1</b>                                      |                                     |

\*niepotrzebne skreślić

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Student possesses the knowledge of general mechanics, mechanics (strength) of materials and the rules of general designing of building constructions.
2. Student is able to define correctly the construction and their elements calculation models, that are used for analytical and computer analysis of complex constructions.
3. He knows the principles of forming, dimensioning and constructing complex reinforced concrete structure of the building and engineering objects.
4. He is able to use selected computer software that enables to design selected complex reinforced concrete constructions.

**SUBJECT OBJECTIVES**

- C1. Familiarizing students with the rules of designing complex reinforced concrete constructions as a rational joint of beams, columns, shells, plates and beam-walls.
- C2. Forming the ability of independent modelling and analyzing complex, diversified reinforced concrete structures using analytical and computer calculations.
- C3. Familiarizing students with the principles of forming, calculating and constructing main reinforced concrete elements forming up: the supporting construction of volume general building and engineering building objects such as industrial buildings and multi-storey framework buildings as well as roofs, walls, bottoms and foundation of liquids tanks, silos and reinforced concrete tower buildings.

C4. Reaffirming the ability of an effective cooperation in a project team including the multi-field character of project process.

### SUBJECT EDUCATIONAL EFFECTS

**Relating to knowledge:**

PEK\_W01 Student knows and comprehends the rules of idealizing, numerical modelling and analyzing the complex reinforced concrete structures.

PEK\_W02 Student possesses profoundly wide knowledge of analysis, dimensioning and constructing the complex reinforced concrete structures.

PEK\_W03 Student is familiar with the principles of static work under the influence of diversified loads over the beam and column reinforced concrete constructions, slab reinforced concrete constructions, beam-walls reinforced concrete constructions and shell reinforced concrete constructions.

**Relating to skills:**

PEK\_U01 Student is able to classify and analyze analytically or numerically the complex reinforced concrete structures in relation to varied forces, and consequently, to critically assess the obtained results.

PEK\_U02 Student is able to design the complex reinforced concrete constructions and prepare a necessary project documentation.

**Relating to social competences:**

PEK\_K01 Student is aware of importance of non-technical aspects in an engineer's work as well as of indispensability of continuous learning.

PEK\_K02 Student effectively cooperates with a project team and respects the safety regulations to protect himself and the project team members during work.

### PROGRAMME CONTENTS

| Form of classes - lecture |  | Number of hours |
|---------------------------|--|-----------------|
| Lec1                      | Forming principles and outline of the analysis of a column-and-girder-frame construction of the industrial buildings with overhead traveling cranes.   | 2               |
| Lec2                      | Forming, analyzing and constructing reinforced and prestressed single- and multi-span two-way reinforced concrete slabs.   | 2               |
| Lec3                      | Forming, analyzing and constructing solid web girders and prestressed roof trusses.  | 2               |
| Lec4                      | Designing overhead crane girders and single- or double-tee columns in industrial reinforced concrete buildings.  | 2               |
| Lec5                      | Forming and designing the construction of the multi-storey framework reinforced concrete buildings.  | 2               |
| Lec6                      | Designing column-and-girder constructions. Reinforcing the slab floor against punching.  | 2               |
| Lec7                      | Forming, analyzing and constructing reinforced concrete beam- walls; designing folded plate covers.  | 2               |
| Lec8                      | Outline of the principles of forming and usage of the reinforced concrete shells as the thin-walled constructions, used in volume general building and industrial building objects.                                | 2               |
| Lec9                      | General rules of forming the thin-walled covers. Designing monolithic and prefabricated reinforced concrete domes.   | 2               |
| Lec10                     | Designing underground, on-the-ground and tower reinforced concrete tanks for liquids.  | 2               |
| Lec11                     | Designing the underground and on-the-ground box-shaped (rectangular shaped) tanks for liquids used in municipal and industrial building  | 2               |
| Lec12                     | An outline of forming and designing cooling towers, reinforced concrete chimneys and other reinforced concrete tower objects. Technological background of thin-walled reinforced concrete constructions' erection. | 2               |

|       |   |           |
|-------|---|-----------|
| Lec13 | Forming slender and corpulent silo bins as well as silo batteries in corn elevators. Principles of setting loads in silos and the outline of studies on the influence of loose materials on the silo's construction elements. | 2         |
| Lec14 | Designing silos and bunkers with the diversified heights, detached and blocked ones.  | 2         |
| Lec15 | Technological aspects of designing thin-walled constructions made of concrete; the rules of performing proofed expansion joints and working joints.   | 2         |
|       | <b>Total hours</b>  | <b>30</b> |

| <b>Form of classes - class</b> |                    | <b>Number of hours</b> |
|--------------------------------|--------------------|------------------------|
| Cl1                            |                    |                        |
| ...                            |                    |                        |
|                                | <b>Total hours</b> |                        |

| <b>Form of classes - laboratory</b> |                    | <b>Number of hours</b> |
|-------------------------------------|--------------------|------------------------|
| Lab1                                |                    |                        |
| ...                                 |                    |                        |
|                                     | <b>Total hours</b> |                        |

| <b>Form of classes - project</b> |  | <b>Number of hours</b> |
|----------------------------------|--|------------------------|
| Proj1                            | Handing out the project topics in a field of complex reinforced concrete constructions in the form of domes and cylindrical and rectangular shaped tanks for liquids.  | 2                      |
| Proj2                            | Conditions for preparation of two initial geometrical construction variants; talking over a choice of construction materials and technological background of discussed construction variants.  | 2                      |
| Proj3                            | Approval of variant choice for a project use; talking over the rules of creating calculation models used for static analysis performed with the help of the following methods: analytical, Finite Element Method (FEM) or simplified methods | 2                      |
| Proj4                            | Presenting the rules of compiling loads in a construction and defining the extreme inner forces. Describing the characteristics of defining the loads in tanks for liquids.  | 2                      |
| Proj5                            | Talking over static calculations with the use of analytical methods and FEM for the selected construction variant. Checking up the results applying the simplified methods.  | 2                      |
| Proj6                            | Selection of the parts of the analysed constructions for further analysis and dimensioning. Discussion over the rules of preparing building and working drawings of thin-walled reinforced concrete structures.                              | 2                      |
| Proj7                            | Taking over the results of statical analysis and characteristics of thin-walled elements' dimensioning, taking into consideration ultimate and serviceability limit states   | 2                      |
| Proj8                            | Discussion over the typical mistakes and faults in analysis and preparation of the construction drawings.  | 2                      |
| Proj9                            | Discussion over the dimensioning results of the selected parts of a construction.  | 2                      |
| Proj10                           | Initial evaluation of the submitted drafts of reinforcement members.   | 2                      |
| Proj11                           | Discussion over the characteristics of outlining the thin-walled cross-sections and forming trusses and connection zones of construction component   | 2                      |

|        |   |           |
|--------|---|-----------|
|        | elements.   |           |
| Proj12 | Evaluation of cross-section geometry, insert placement and submitted assembly and working drawings                        | 2         |
| Proj13 | Talking over the rules of applying technical characteristics and guidelines on gathering the final project documentation. | 2         |
| Proj14 | Final evaluation of submitted working drawings.   | 2         |
| Proj15 | Collection of the projects. Crediting with notes. Final summing-up.   | 2         |
|        | <b>Total hours</b>  | <b>30</b> |

| <b>Form of classes - seminar</b> |                    | <b>Number of hours</b> |
|----------------------------------|--------------------|------------------------|
| Sem1                             |                    |                        |
| ...                              |                    |                        |
|                                  | <b>Total hours</b> |                        |

| <b>TEACHING TOOLS USED</b>   |
|--|
| N1. Lecture – Informative lecture, problem-solving lecture, multimedia presentations.                  |
| N2. Project – Discussing over the project requirements, overview of possible solutions , consultations |

| <b>EVALUATION OF SUBJECT EDUCATIONAL RESULTS ACHIEVEMENT</b>                           |  |   |
|--|--|---|
| <b>Evaluation</b><br>(F – forming (during semester), P – concluding (at semester end)) | Educational result numer (reference)                           | Method of evaluating educational result achievement |
| P (project)  | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_U01<br>PEK_U02<br>PEK_K02 | Completion of a project and its presentation        |
| P (lecture)  | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_U01<br>PEK_U02            | Exam  |
| P (laboratory etc.) =  |  |   |
| P (lecture) =  |  |   |

| <b>PRIMARY AND SECONDARY LITERATURE</b>  |
|--|
| <b><u>PRIMARY LITERATURE:</u></b>  |
| [1] Nawy E., Concrete Construction Engineering. Handbook. CRC Press, New York 2008.  |
| [2] Limbrunner G. F., Agdhayere A. O., Reinforced Concrete Design. Prentice Hall, New Jersey 2010.   |
| [3] Kobiak J., Stachurski W., Konstrukcje żelbetowe, t. 2, t. 4. Arkady, Warszawa 1987, 1991.  |
| [4] Grabiec K., Żelbetowe konstrukcje cienkościennie. PWN, Warszawa - Poznań 1999.   |
| [5] Stachowicz A., Ziobroń W., Podziemne zbiorniki wodociągowe. Obliczenia statyczne i kształtowanie. Arkady, Warszawa 1986.                     |
| [6] Halicka A., Franczak D., Projektowanie zbiorników żelbetowych. Tom I. Zbiorniki na materiały sypkie. Wydawnictwo Naukowe PWN, Warszawa 2011. |

[7] Łapko A., Jensen B. C., Podstawy projektowania i algorytmy obliczeń konstrukcji żelbetowych. Arkady, Warszawa 2005.

**SECONDARY LITERATURE:**

- [1] Budownictwo Przemysłowe, t. XIII. Zbiorniki, zasobniki, silosy, kominy i maszty. Arkady, Warszawa 1966.
- [2] Starosolski W., Konstrukcje żelbetowe, t. 2. Wydawnictwo Naukowe PWN, Warszawa 2008.
- [3] Sekcja Konstrukcji Betonowych KILiW PAN, Podstawy projektowania konstrukcji żelbetowych i sprężonych według Eurokodu 2. Dolnośląskie Wydawnictwo Edukacyjne, Wrocław 2006.
- [4] Zybura A., Konstrukcje żelbetowe wg Eurokodu 2. Atlas rysunków. Wydawnictwo Naukowe PWN, Warszawa 2010.
- [5] Satereh M., Darvas R., Concrete Structures, Prentice Hall, New Jersey 2007.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**Concrete Structures - objects**  
AND EDUCATIONAAL EFFECTS FOR MAIN FIELD OF STUDY *Civil Engineering*  
AND SPECIALIZATION **Civil Engineering**

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)** | Subject objectives *** | Programme content ***            | Teaching tool number *** |
|----------------------------|---|------------------------|----------------------------------|--------------------------|
| <b>Knowledge</b>           |   |                        |                                  |                          |
| <b>PEK_W01</b>             | K2S_CEB_W16, K2_W06, K2_W07, K2_W08   | C1, C2, C3             | Lec1 to Lec15<br>Proj2 to Proj14 | N1<br>N2                 |
| <b>PEK_W02</b>             | K2S_CEB_W18, K2_W07   | C1, C3, C4             | Lec1 to Lec15<br>Proj2 to Proj14 | N1<br>N2                 |
| <b>PEK_W03</b>             | K2S_CEB_W16, K2_W04   | C1, C2                 | Lec1 to Lec15<br>Proj2 to Proj14 | N1<br>N2                 |
| <b>Skills</b>              |   |                        |                                  |                          |
| <b>PEK_U01</b>             | K2S_CEB_U18, K2S_CEB_U19, K2_U09, K2_U11  | C2, C3                 | Lec1 to Lec15<br>Proj2 to Proj14 | N1<br>N2                 |
| <b>PEK_U02</b>             | K2S_CEB_U18, K2_U11, K2_U12   | C1, C2, C3, C4         | Lec1 to Lec15<br>Proj2 to Proj14 | N1<br>N2                 |
| <b>Social competence</b>   |   |                        |                                  |                          |
| <b>PEK_K01</b>             | K2_K01, K2_K02  | C2, C4                 | Lec1 to Lec15<br>Proj2 to Proj14 | N1<br>N2                 |
| <b>PEK_K02</b>             | K2_K03  | C4                     | Proj1 to Proj15                  | N2                       |

\*\* - enter symbols for main-field-of-study/specialization educational effects

\*\*\* - from table above