

Subject description

Faculty of Architecture, WUT 2020, **Architecture** studies

Architecture for Society of Knowledge speciality

Contemporary Building Materials		ASK-KT-Bm	MSc level	semester 2
classes: lecture seminar/laboratory	hours/semester 15 15	Student's own workload hours: 16	Status: Obligatory Level: Advanced Context: technology	ECTS: 2
				Exam: No

Unit delivering this subject: Department of Building Materials Engineering
Institute of Building Engineering
Faculty of Civil Engineering
Warsaw University of Technology

Coordinator of the course: Ph.D, Tomasz Piotrowski

Learning outcomes and subject delivery methods

Objective of the course:

After the completion of the subject the students understand what is the Building Materials Engineering (BME), are aware of the existence of the relationship of composition-structure-property-application and know about the possibility of shaping the usability of building materials, particular composites. They are familiar with the idea of sustainable development and sustainable building materials. Students know and understand the essence of the various technical characteristics of construction materials. The students know the basics of construction physics affecting their energy efficiency. The lectures will get acquainted with the selected material solutions (cement-based composites) and system (facades, glass, steel construction connection). The aim of the subject and, in particular, design activities, is manufacturing in the listener the habit of searching for and analyzing material used in construction-technological solutions that take into account the relationship "microstructure-property-destiny the work". Students should be able to determine its effect on the durability of building structures and taken into account in the process of architectural design of buildings.

General description of the course:

The main content of the subject include:

- define the concepts of Building Materials Engineering -BME, taking into account the role and tasks of the BME and BME distinguishing features from other engineering materials.
- Submit feedback for sustainable development: man-material-technology-building-ecology as a determinant of the subject of the BME.
- Define material model: composition-structure-property-application.
- E3 = energy-ecology-economics as boundary conditions for engineering activities and the principle of sustainable development in relation to the construction.
- Technical characteristics of building materials and usability functions for building materials.
- Thermal considerations in the design of buildings
- Representation of the types of steel connections construction and glass/metal facades
- Division of building composites and control their properties, an example of cement-based composites
- Characteristics of cement binders and composites on the basis of this binder, the representation of the possibilities the design of microstructure of cement paste by active mineral additives
- The method of the description of the microstructure of building materials; the use of electron microscopy and image analysis, stereology and fractography.
- Corrosion and the question of compatibility and the design principles of repair, surface protection and strengthening of concrete structures
- Methods of diagnostics construction

Learning outcomes:

No. of the outcome/ area	Description
Knowledge	
W_01	Student has an ordered detailed knowledge, that comes from theory of building materials, materials science and physics buildings – including key materials architectural design issues
W_02	Student has a theory knowledge, that comes from detailed studies about development trends and current directions in building materials for engineering, architectural design, urban planning and conservation using the latest developments in material science
W_03	Student has an ordered detailed knowledge, that comes from a theory about the role and importance of the environment in the design of building materials, taking into account sustainable development
Skills	
U_01	Student can collect information from the literature, databases and other properly selected sources (including the Internet), also in English and another foreign language is considered the language of international communication, able to integrate the information, make their interpretation and critical analysis, and to draw conclusions and formulate and justify opinions and show their relationship with the design process in building materials engineering
U_02	Student can work individually, in a team, and interdisciplinary; has the ability to take a leading role in such teams, knows how to estimate the time required for the implementation of complex design tasks commissioned
U_03	Student is able to prepare and present a multimedia presentation, oral (public presentation) and graphical (poster) for the semester
U_04	Student can evaluate the usefulness and the possibility of the use of new technological developments in the field of usability engineering of building materials for the construction, taking into account the environmental aspects in the design of architecture

Social competences	
K_01	Student is aware of the responsibility for the work and willingness to comply with the principles of teamwork and responsibility for collaborative tasks and projects, at the same time, understanding the tasks and competencies of team leader
K_02	Student is able to think and act creatively
K_03	Student is capable of effective use of imagination, intuition, creative and independent thinking in order to solve problems, as well as to meet the conditions of the public related instances or presentations
K_04	Student has the ability to critically evaluate the material design

Learning contents:**Lecture:**

Define the concepts of Building Materials Engineering -BME, taking into account the role and tasks of the BME and BME distinguishing features from other engineering materials. Join the man-material-technology-building-ecology as a determinant of the subject of the BME. Material model: composition-structure-property-application. E3 = energy-ecology-economics as boundary conditions of engineering activities. The principle of sustainable development in relation to the construction works. Division of composite construction. Control the properties of composite construction. Functions of general interest materials for building materials. Design methods of the experiment and results. Materials and material optimization design methods. The method of the description of the structure of building materials; the use of electron microscopy and image analysis, stereology and fractography. Basic requirements for buildings in the light of the European directives. Acceptance of building materials according to their

expected use, with particular regard to thermal insulation, and different types of connections in the construction. The role of adhesion in composites construction: factors driving adhesion, a measure of adhesion. Application of surface engineering in the construction-architectural concrete and self-cleaning surfaces. Banks and the database, expert systems. Durability and reliability of material solutions. Basic mechanisms of corrosion of building materials, with particular emphasis on concrete structures. Design principles of repair, surface protection and strengthening of concrete structures: waterproofing injections and protective coatings. Diagnostic Policy construction, semi-and non-destructive methods for the evaluation of the quality of the structures.

Laboratories and seminars:

Computer simulation of cement hydration; the role of mineral additives in shaping transitional zone in cement-based composites-seminar exercises

Evaluation of thermal properties of selected material systems-analytical approach and computer-seminar exercises

Characteristics of selected properties microstructure image analysis-laboratory online

Self-compacting Concrete technology as an example of architectural concrete-practical work in the laboratory

Teaching methods and forms:

Lecture presentations available on Moodle

Seminars and laboratories (mandatory) in part through an e-learning platform

Consultations and design projects in groups. Public presentation and discussion of the progress of work at the end of the project: public presentation and evaluation of the final release.

Cycle 14 weeks

Operating in parallel, e-learning platform Moodle as a repository for course content and communication tool.

Method of testing the learning outcomes:

Outcome Number	Way of testing
Knowledge	
W_01	Lectures-exam The project – evaluation of presentation content and prepared content poster
W_02	Lectures-exam The project – evaluation of presentation content and prepared content poster
W_03	Lectures-exam The project – evaluation of presentation content and prepared content poster
Skills	
U_01	The project – evaluation of presentation content and prepared content poster, the value of the substance of the issues, the width of the theme shots, the quality of the collected materials, the correct way to submit
U_02	Project – assessment of the work of the team and the contribution of individual members in the preparation oral presentation and graphics and content poster
U_03	Project-review score presentation, oral and graphic and content poster
U_04	The project – assessment of the content of the presentation and the content poster prepared for the analysis of the suitability of the material solutions for use in the specific architectural project
Social competences	
K_01	The project – evaluation of presentation content and prepared content poster, the correct way to present the teamwork, the correctness of the description of the references to the sources
K_02	The project – assessment of creativity and presentation prepared a content poster
K_03	The project – meet the terms public related presentations
K_04	The project – assessment of the critical skills approach to solutions in materials in architecture

Literature:

- Building Materials in Civil Engineering, Edited by:H. Zhang, ISBN: 978-1-84569-955-0
- Eco-efficient Construction and Building Materials, F. Pacheco-torgal, L. Cabeza, J. Labrincha and A. De Magalhaes, ISBN: 978-0-85709-767-5
- Building Decorative Materials, Edited by:Y. Li and S. Ren, ISBN: 978-0-85709-257-1
- Innovative Materials for Building Energy Efficiency, Editors: R. Parameshwaran V. Vinayaka Ram R Karunakaran N Jalaiah, ISBN: 9780081022511
- Sustainability of Construction Materials, Edited by:J. Khatib, ISBN: 978-1-84569-349-7