

**Application form for research topics
in the field of engineering and technology
for candidates to the Doctoral School
in the academic year 2024/2025**

Proposed subject matter of a doctorate
Application of cement composites based on various materials in structural building elements
Scientific discipline (<i>delete as appropriate</i>)
AUTOMATION, ELECTRONICS AND ELECTRICAL ENGINEERING CIVIL ENGINEERING, GEODESY AND TRANSPORT MECHANICAL ENGINEERING
Proposed doctoral thesis supervisor
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Brief description of the research topics with an indication of the scientific issues (max. 350 words)
The proposed topics will concern theoretical considerations and tests of selected properties of structural concrete, modified with various waste materials. Currently, around two billion tons of waste is produced worldwide each year. Their use in the production of the most commonly used building material (i.e. concrete) seems to be purposeful. Therefore, the proposed research will use, inter alia, waste fibers from car tires, porcelain waste and waste from the production of traditional aggregates, etc. The list of materials that can be used is not exhaustive, and its scope will depend on the obtained results. Based on the analyzes and literature studies, the composition of the concrete mix will be determined, which will contain about 50% of waste materials. For the developed composition of "green" concrete, basic tests and analyzes will be carried out to check the suitability of the modified concretes and compare their properties with the characteristics of normal concrete. Then, tests of structural elements in a simple and complex state of stress will be carried out. During these tests, the selected limit states of the bearing capacity and serviceability of structural elements will be determined. Theoretical and numerical analysis will also be performed, including assessment of the suitability of "green" concrete for making structural elements. Finally, a methodology for calculating and designing structural elements with the use of selected waste materials will be proposed.

Justification of the purposefulness of taking up the research topics (max. 150 words)
In the modern world, the analysis of complex engineering problems becomes a challenge for many engineers. The use of traditional building materials and engineering programs for the design of engineering structures in many cases turns out to be insufficient. Therefore, in order to correctly design complex and modern building structures, advanced research methods, innovative materials and computational programs should be used, which are based on the finite element method and have the ability to conduct material nonlinearity analyzes. The problem presented in this way becomes then a complex scientific issue that needs to be solved in order to properly design the structural elements of a building object.
Proposed topics of doctoral theses within the proposed research subject matter (up to 3 topics)
<ol style="list-style-type: none"> 1. Theoretical and experimental analysis of selected properties of modern building materials. 2. Theoretical and experimental analysis of reinforced concrete elements in a simple and complex stress state. 3. Numerical analysis of complex issues of reinforced concrete building structures.
The sources of financing of the research topics (the subject matter of currently implemented research grants financed from external sources or as part of subsidies)
Currently, funding of research topics will be possible from subsidies to maintain the research potential of the Department or the Faculty.
Confirmation of the possibility of ensuring access to scientific apparatus and software necessary for the realization of the proposed research topics (<i>delete as appropriate</i>)
FULLY/ PARTIALLY/ NONE
If the answer is PARTIALLY or NONE please indicate a type of missing scientific apparatus and/or software and the sources of financing an access to them
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A list of up to 5 major supervisor's publications related to the proposed research topics, published in journals indexed in the Web of Science or Scopus for the period of the last 3 years (taking into account the IF Impact Factor and the MNiSW score)
<ol style="list-style-type: none"> 1. Logoń, D.; Kobaka, J.; Domski, J. Modifying Water–Frost Resistance and Mechanical Properties of Lime Mortar Using Siliceous and Fluidised Bed Fly Combusted Ashes Activated with Cement. <i>Materials</i> 2023, 16, 3013. (140 points), 2. Zakrzewski, M.; Gancarz, M.; Tvrda, K.; Laskowska-Bury, J.; Domski, J. Comparative Analysis of Waste, Steel, and Polypropylene Microfibers as an Additive for Cement Mortar. <i>Materials</i> 2023, 16, 1625. (140 points), 3. Zakrzewski, M., Sanok, A., Domski, J. (2023). Rheological Properties of Concrete Based on Waste Materials. In: Zembaty, Z., Perkowski, Z., Beben, D., Massimino, M.R., Lavan, O. (eds) <i>Environmental Challenges in Civil Engineering II. ECCE 2022. Lecture Notes in Civil Engineering</i>, vol 322. Springer, Cham. (20 points), 4. Sanok, A., Zakrzewski, M., Lehmann, M., Domski, J. (2023). Effect of the Addition of Waste Fibers on Some Properties of Concrete. In: Zembaty, Z., Perkowski, Z., Beben, D., Massimino, M.R., Lavan, O. (eds) <i>Environmental Challenges in Civil Engineering II. ECCE 2022. Lecture Notes in Civil Engineering</i>, vol 322. Springer, Cham. (20 points), 5. Domski J., Domska I. 2022. Wpływ wymiarów próbki na wartość naprężenia ściskającego przy 10% odkształceniu styropianu. <i>Materiały Budowlane</i> 604 (12): 111-114 (100 points)

A list of research grants financed by the National Science Centre, the National Centre of Research and Development and the European Research Council for the period of the last 5 years

1. Project: "B+R works carried out by WASCOVILLA S.C. and the Koszalin University of Technology on the creation of a complex of system solutions for the construction of multi-family residential buildings in a system of wooden structure residential modules connected at the height and length of the building "no. RPZP.01.01.00-32-0028 / 20, project manager.
2. Research on the technology of developing an innovative mixture for the production of concrete products using recycled aggregates - financed by the European Regional Development Fund under the Regional Operational Program of the West Pomeranian Voivodeship for 2014-2020, Activities 1.1 Research and development projects of enterprises, Project type 1 Small projects B + R, contractor of the research project.
3. Manufacturing of elements for an innovative energy-saving prefabricated building system, 2017-2020, National Center for Research and Development, Intelligent Development Operational Program 2014-2020, research project contractor.

A list of research services provided for industry related to the proposed research topics for the period of the last 5 years

1. Preparation of an expert opinion on the technical condition of the Physical Training Center (OSF), located at the Air Force Training Center in Koszalin.
2. Testing the elements of surface tops of gullies and sink basins made of recycle plastics according to the PN-EN 124-1 norm.
3. Bending test of precast reinforced concrete grids.
4. Testing the strength of welded and welded connections of reinforced concrete bars.
5. Testing the mechanical strength of plastic nozzles.
6. Foundation slab reinforced with steel fibers (cord) made of used car tires.