Transilvania University of Brașov
INTERDISCIPLINARY DOCTORAL SCHOOL

ADMISSION TO DOCTORAL STUDIES Session September 2025

Field of doctoral studies: Civil Engineering and Installations
Doctoral supervisor: Prof. Dr. Hab. Alina Bărbulescu

TOPICS FOR THE ADMISSION TO DOCTORAL STUDIES

TOPIC 1: Designed for Durability: An experimental and AI-Based approach For Improving Concrete Properties Using Supplementary Cementitious Materials
Contents / Main aspects to be considered – • *Experimentally and statistically evaluate the influence of different Supplementary Cementitious Materials (SCMs) on the mechanical (e.g., compressive and tensile strength) and durability-related (e.g., water absorption, chloride penetration resistance) performance characteristics of concrete using comparative analysis and regression-based techniques.* • *Gather and examine laboratory data for concrete mixtures with various SCMs.* • *Develop, train, and optimize AI models (such as Artificial Neural Networks, Decision Trees) to forecast compressive and tensile strength based on SCM and other factors influencing the durability of concrete*
Recommended bibliography: • Lagaros, N.D. Artificial Neural Networks Applied in Civil Engineering. *Appl. Sci.* 2023, *13,* 1131. https://doi.org/10.3390/app13021131. • Hagan, M.T. et al. *Neural Networks Design. https://hagan.okstate.edu/NNDesign.pdf*
Prerequisites / Remarks: • Solid knowledge in Materials Resistance and Mechanics, programming skills in Python or R.
X Scientific Doctorate (full-time only) **☐ Professional Doctorate (full-time or part-time)**
☐ without tuition fee (state budget funded) **X with tuition fee or with funding from other sources than the state budget**

TOPIC 2: Impacts of Unoptimized Hydraulic Structure Designs on Road and Transport Infrastructure Resilience
Contents / Main aspects to be considered – • *The data analysis will encompass statistical analysis, risk assessment, life-cycle cost*

analysis, and sensitivity analysis to identify trends, evaluate risks, assess costs, and determine the impact of uncertainties.

- *Model development and validation will involve developing and calibrating numerical models to simulate flow conditions and assess performance, validated against field observations and historical rainfall/flood data.*
- *Optimization and sensitivity analysis will focus on identifying cost-effective and sustainable strategies while assessing the impact of uncertainties on model predictions.*

Recommended bibliography:

- **Impact and Vulnerability Analysis of Vital Infrastructures and Buit-up Areas. https://climate-adapt.eea.europa.eu/en/metadata/guidances/impact-and-vulnerability-analysis-of-vital-infrastructures-and-built-up-areas**
- **Galderisi, A.; Limongi, G. A Comprehensive Assessment of Exposure and Vulnerabilities in Multi-Hazard Urban Environments: A Key Tool for Risk-Informed Planning Strategies. *Sustainability* 2021, *13*, 9055. https://doi.org/10.3390/su13169055.**
- **Diaz-Sarachaga, J.M., Jato-Espino, D. Analysis of vulnerability assessment frameworks and methodologies in urban areas. Nat Hazards 100, 437–457 (2020). https://doi.org/10.1007/s11069-019-03805-y**

Prerequisites / Remarks:

- **Solid knowledge in Hydrology/Hydrotechnics and Related Fields;**
- **ArcGIS, Hec-Ras, R (or Python) Proficiency**

X Scientific Doctorate (full-time only)

☐ Professional Doctorate (full-time or part-time)

☐ without tuition fee (state budget funded)

X with tuition fee or with funding from other sources than the state budget

TOPIC 3: Assessing Structural Resilience in the actual environmental threats

Recommended bibliography:

- **Impact and Vulnerability Analysis of Vital Infrastructures and Buit-up Areas. https://climate-adapt.eea.europa.eu/en/metadata/ guidances/impact-and-vulnerability-analysis-of-vital-infrastructures-and-built-up-areas**
- **Galderisi, A.; Limongi, G. A Comprehensive Assessment of Exposure and Vulnerabilities in Multi-Hazard Urban Environments: A Key Tool for Risk-Informed Planning Strategies. *Sustainability* 2021, *13*, 9055. https://doi.org/10.3390/su13169055.**
- **Diaz-Sarachaga, J.M., Jato-Espino, D. Analysis of vulnerability assessment frameworks and methodologies in urban areas. Nat Hazards 100, 437–457 (2020). https://doi.org/10.1007/s11069-019-03805-y**

Prerequisites / Remarks:

- **Solid Knowledge of F.E.A.**
- **Proficiency in SolidWorks, ATENA, or other similar software**

X Scientific Doctorate (full-time only)

☐ **Professional Doctorate (full-time or part-time)**
☐ **without tuition fee (state budget funded)** **X with tuition fee or with funding from other sources than the state budget**

Doctoral supervisor,

Prof. Dr. Hab. Alina Bărbulescu

Signature,

Coordinator of the field of doctoral studies,

Prof. Dr. Hab. Carmen Elen Maftei

Signature