

**FGG****UNIVERSITY OF LJUBLJANA**
Faculty of Civil and Geodetic Engineering

Position of PhD student – young researcher, full employment, 4 years

Location: Faculty of Civil and Geodetic Engineering, University of Ljubljana, Slovenia

Duration: 4 years

Employment: Full-time with a competitive salary and additional benefits

Tuition Fee: Fully covered by the Faculty, with additional funding available for research and dissemination activities

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Description of the problem

Experience shows that strong earthquakes threaten the well-being of people if we are inadequately prepared for such extreme natural events. Small communities in earthquake-prone areas are especially vulnerable, which has been recognized in Slovenia through the Resolution on Strengthening Earthquake Safety by 2050. Since earthquakes threaten practically the entire built environment and all areas of community functioning, and indirectly affect nature as well, the topic of the research work of a young researcher can be interdisciplinary, requiring cooperation among various disciplines. Therefore, several different research topics have been announced, and candidates from different professional fields are invited to apply for the call.

Possible research topics:

1. **Ensuring earthquake safety of nuclear and radiation facilities**
 - The structures, systems, and components of nuclear power plants must be designed to be earthquake-resistant, especially if they are located in earthquake-prone areas. This topic is relevant both for ensuring the resilience of Slovenia and because of the planned construction of new nuclear power plants worldwide, despite limited development in the field of earthquake risk assessment for nuclear power plants.
 - Keywords: nuclear and radiation safety, earthquake risk, and design of structures, systems, and components, seismic fragility analysis, probabilistic safety studies.
 - Recommended foundational knowledge: civil engineering, mechanical engineering, nuclear physics, or electrical engineering.
 - Possible co-supervision in mechanical engineering, nuclear physics, or electrical engineering.
2. **Earthquakes within the framework of compound hazards**
 - Earthquakes are accompanied by various dependent hazards (e.g., landslides, liquefaction, tsunamis), potential independent hazards (e.g., pandemics, pluvial flooding, storms), and cascading hazards (e.g., explosions, fires, hazardous material spread), which are often not considered in earthquake risk analyses.
 - Keywords: earthquakes, compound hazard analysis, compound risk analysis, fire, explosions, hazardous material spread, landslides, floods, and other hazards.
 - Recommended foundational knowledge: civil engineering or knowledge from other fields of concomitant or cascading hazards to be considered in the research.
 - Possible co-supervision in another selected hazard field.
3. **Traffic flows in crisis situations**
 - Earthquakes can cause the disruption of traffic flows, which delay immediate response and hinder recovery processes. The effects of such disruption are still insufficiently understood.

- Keywords: seismic vulnerability of road infrastructure, earthquake vulnerability of cities, traffic flow modeling.
 - Recommended foundational knowledge: earthquake engineering, civil engineering or traffic engineering.
 - Expected co-supervision in traffic engineering.
4. **Earthquake risk of the built environment and modeling of crisis situations**
- To develop strategies for reducing earthquake risks and mitigating post-earthquake consequences, it is necessary to analyze earthquake risks, including simulating earthquake events and responses from civil protection to such events.
 - Keywords: earthquake risk of cities, civil protection, emergency management, digital twin in crisis situations.
 - Recommended foundational knowledge: civil engineering or environmental engineering.
 - Possible co-supervision in the specific field of earthquake engineering or if the candidate is from abroad.
5. **Earthquake resistance of existing and new building structures**
- Verifying and ensuring the earthquake resistance of building structures is essential for ensuring the earthquake safety of the built environment. This is particularly related to uncertainties in seismic analysis of buildings, especially for existing buildings, and the introduction of new construction technologies or new standards into practice.
 - Keywords: buildings, bridges, water dams, other engineering structures, timber structures, masonry structures, reinforced concrete structures, steel structures, new construction technologies, Eurocode 8.
 - Recommended foundational knowledge: structural engineering or structural mechanical engineering.
 - Possible co-supervision in specialized structural engineering or earthquake engineering.
6. **Information modeling of the built environment or individual facilities for earthquake engineering purposes**
- Although there are several existing databases, they are suboptimal for earthquake engineering related to built environment risk analysis and the development of strategies for the renovation of the built environment.
 - Keywords: earthquake risk of the built environment, BIM, GIS, GIS-BIM integration, digital twin.
 - Recommended foundational knowledge: civil engineering, geoinformatics, geodesy, computer science, information technology.
 - Expected co-supervision in computer science, IT, or geoinformatics.
7. **Earthquakes and spatial planning**
- Due to the complexity of the industrial-urban environment, earthquake risk analyses need to be integrated into spatial planning, and strategies for earthquake-resistant and sustainable urbanization need to be developed.
 - Keywords: earthquake risk, urbanization strategy, risk integration in spatial planning.
 - Recommended foundational knowledge: civil engineering, urban planning, or spatial planning.
 - Expected co-supervision in urban planning or spatial planning.
8. **Insurance of the built environment against earthquake damage**
- One way to mitigate the consequences of earthquakes is through damage insurance, but modeling premiums are still poorly connected to contemporary seismic risk analysis.
 - Keywords: seismic risk of the built environment, seismic risk of buildings, insurance, damage claim modeling, premium assessment, probabilistic damage models.
 - Recommended foundational knowledge: civil engineering or economy – actuarial science.
 - Expected co-supervision in actuarial science.
9. **Earthquake engineering and law**
- The construction law in Slovenia allows for the possibility that earthquakes can collapse buildings and consequently endanger lives, while other actions on civil structures should not cause their collapse and put people at risk. On the other hand, the Slovenian National Assembly has adopted the Resolution on Strengthening Earthquake Safety in Slovenia, as it has been realized that Slovenia is an earthquake-vulnerable community, which will not be solved without legislative changes.
 - Keywords: community earthquake resilience, construction legislation, law.
 - Recommended foundational knowledge: civil engineering or law.
 - Expected co-supervision in law.
10. **Earthquakes and selected field**
- The candidate, based on their discretion, proposes an interdisciplinary research topic, which must be defined in the motivation letter and accompanied by a recommendation letter from a potential co-supervisor.

The young researcher will be a member of the Earthquake Engineering Research Programme and will undergo training within the doctoral program Built Environment at the Faculty of Civil and Geodetic Engineering, University of Ljubljana, with the possibility of further training at other prestigious institutions both domestically and internationally. The topic of the doctoral dissertation will be aligned with the research of the Earthquake

Engineering Research Programme (P2-0185), which participates in international projects and associations, ensuring that the research will be up-to-date and aligned with global research.

The candidate will choose one of the proposed topics and submit a motivation letter with the application. Additional information can be obtained via email: mdolsek@fgg.uni-lj.si.