Opis raziskovalnega dela *(Research work description*)

1. Članica UL (*UL member)*:

Fakulteta za gradbeništvo in geodezijo / Faculty of Civil and Geodetic Engineering

2. Ime, priimek in elektronski naslov mentorja/ice (*Mentor's name, surname and email*):

Matjaž Dolšek, mdolsek@fgg.uni-lj.si

3. Raziskovalno področje (*Research field*):

Gradbeništvo / Potresno inženirstvo, Civil Engineering / Earthquake Engineering

4. Opis raziskovalnega dela *(Research work description*):
Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce *(It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.)*.

Slov.:

Izkušnje kažejo, da močni potresi ogrožajo blaginjo ljudi, če se na tovrstne ekstremne naravne dogodke neustrezno pripravimo. Majhne skupnosti na potresno nevarnih območjih so še posebej ogrožene, kar je v Sloveniji prepoznano z Resolucijo o krepitvi potresne varnosti do leta 2050 »Prehitimo potres«. Ker potresi ogrožajo praktično celotno grajeno okolje in vsa področja delovanja skupnosti, posredno pa vplivajo tudi na naravo, je tematika raziskovalnega dela mlade raziskovalke ali mladega raziskovalca lahko tudi interdisciplinarna, kar terja sodelovanje med različnimi strokami. Zato je razpisanih več različnih tem raziskovalnega dela, s tem pa so k prijavi vabljene tudi kandidatke in kandidati z različnih strokovnih področji.

Možne teme raziskovalnega dela:

1. **Potresna odpornost obstoječih in novih gradbenih konstrukcij**
   - Preverjanje in zagotavljanje potresne odpornosti gradbenih konstrukcij je osnova za zagotavljanje potresne varnosti grajenega okolja. To je še posebej povezano z negotovostmi pri potresni analizi objektov, zlasti pri analizah obstoječih stavb ter pri uvajanju novih tehnologij gradnje ali novih standardov v prakso.
   - Ključne besede: stavbe, mostovi, vodne pregrade, drugi inženirski objekti, lesene konstrukcije, zidane konstrukcije, armiranobetonske konstrukcije, jeklene konstrukcije, nove gradbene tehnologije, Evrokod 8.
   - Priporočena osnovna znanja: gradbeništvo ali konstrukcijsko strojništvo.
   - Možno somentorstvo za specializirana znanja s področja gradbeništva oz. potresnega inženirstva.

2. **Potresi v okviru sestavljenih nevarnosti**
   - Potrese spremljajo različne sočasne nevarnosti, ki so lahko odvisne od potresa (npr. plazovi, likvefakcija, tsunami), neodvisne (npr. pandemija, pluvialne poplave, nevihte) ali verižne potresu (eksplozije, požari, širjenje nevarnih snovi), ki se običajno ne upoštevajo pri analizah potresnega tveganja.
   - Ključne besede: potresi, analiza sestavljenih nevarnosti, analiza tveganja sestavljenih nevarnosti, požar, eksplozije, širjenje nevarnih snovi, plazovi, poplave in druge nevarnosti.
   - Priporočena osnovna znanja: gradbeništvo ali znanja iz področja druge sočasne ali verižne nevarnosti, ki bo upoštevana v raziskavi.
   - Možno somentorstvo za področje druge izbrane nevarnosti.

3. **Potresno tveganje grajenega okolja in modeliranje kriznih situacij**
   - Za razvoj strategije zmanjševanja potresnih tveganj in omejitve posledic po potresih je treba analizirati potresno tveganje, vključno s simulacijo potresnih dogodkov in odzivom civilne zaščite na takšne dogodke.
   - Ključne besede: potresno tveganje mest, civilna zaščita, upravljanje v izrednih razmerah.

- Priporočena osnovna znanja: gradbeništvo ali okoljsko inženirstvo.
- Možno somentorstvo, če kandidat prihaja iz tujine.

4. **Informacijsko modeliranje grajenega okolja ali posameznih objektov za potrebe potresnega inženirstva**
   - Čeprav obstaja precej različnih baz podatkov, te niso optimalne za potrebe potresnega inženirstva v povezavi z analizami potresnega tveganja grajenega okolja in razvojem strategije prenove grajenega okolja.
   - Ključne besede: potresno tveganje grajenega okolja, BIM, GIS, GIS-BIM integracija, digitalni dvojček.
   - Priporočena osnovna znanja: gradbeništvo, geoinformatika, geodezija, računalništvo, informacijska tehnologija.
   - Predvideno somentorstvo s področja računalništva, IT ali geoinformatike.

5. **Prometni tokovi v kriznih situacijah**
   - Potresi lahko povzročijo ustavitev prometnih tokov, kar upočasni reševanje takoj po ekstremnih pojavih in oteži proces okrevanja skupnosti. Učinki tovrstnih ustavitev še niso dovolj dobro raziskani.
   - Ključne besede: potresna ranljivost cestne infrastrukture, potresna ranljivost mest, modeliranje prometnih tokov.
   - Priporočena osnovna znanja: potresno inženirstvo, gradbeništvo ali prometno inženirstvo.
   - Predvideno somentorstvo za področje prometnega inženirstva.

6. **Potresi in prostorsko načrtovanje**
   - Zaradi kompleksnosti industrijsko-urbanega okolja je treba analize potresnega tveganja vključiti v prostorsko načrtovanje in razviti strategije za potresno odporno in trajnostno urbanizacijo.
   - Ključne besede: potresno tveganje, strategija urbanizacije, integracija tveganj v prostorsko načrtovanje.
   - Priporočena osnovna znanja: gradbeništvo, urbanizem ali prostorsko načrtovanje.
   - Predvideno somentorstvo za področje urbanizma ali prostorskega načrtovanja.

7. **Zavarovanje grajenega okolja pred škodo zaradi potresov**
   - Eden izmed načinov omiljenja posledic potresov je zavarovanje pred potencialno škodo, vendar pa je modeliranje premij zaenkrat slabo povezano s potresnim tveganjem, ocenjenim s sodobnimi analizami.
   - Ključne besede: potresno tveganje grajenega okolja, potresno tveganje stavbe, zavarovanje, modeliranje škodnih zahtevkov, ocena premije, verjetnostni modeli škod.
   - Priporočena osnovna znanja: gradbeništvo ali ekonomija – aktuarstvo.
   - Predvideno somentorstvo za področje aktuarstva.

8. **Predlog kandidata**
   - Kandidatka ali kandidat po svoji presoji predlagata raziskavo (lahko interdisciplinarno), pri čemer je treba tematiko opredeliti v motivacijskem pismu. Lahko se predloži priporočilno pismo potencialnega somentorja.

Mladi raziskovalec bo član programske skupine Potresno inženirstvo in se bo usposabljal v okviru doktorskega študija Grajeno okolje na Fakulteti za gradbeništvo in geodezijo, Univerza v Ljubljani, z možnostjo izpopolnjevanja na drugih uglednih institucijah doma in v tujini. Tema doktorske disertacije mladega raziskovalca bo usklajena z raziskavami programske skupine Potresno inženirstvo (P2-0185), ki sodeluje v mednarodnih projektih in združenjih, kar bo zagotavljalo, da bodo raziskave aktualne in usklajene z mednarodnimi raziskavami.

Kandidat si izbere eno izmed predlaganih tem in pri vlogi predloži motivacijsko pismo in potencialno predlaga somentorja. Dodatne informacije so možne po e-pošti: mdolsek@fgg.uni-lj.si.

Eng.:

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. **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.
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. **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.
4. **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.
5. **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.
6. **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.
7. **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.

8. **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.
9. **Candidate proposal**
   - The candidate may propose a research topic (which can be interdisciplinary) at their discretion, specifying the topic in the motivation letter. A recommendation letter from a potential co-supervisor may also be submitted.

The young researcher will be a member of the Earthquake Engineering Research Program 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 Program (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 selects one of the proposed topics and submits a motivation letter with the option to suggest a potential co-supervisor along with the application. Additional information can be obtained via email: mdolsek@fgg.uni-lj.si.

5. Priloge, ki jih je treba priložiti ob prijavi *(Documents required to be submitted with the application)*:

☒ **potrdilo o doseženi izobrazbi *(proof of completed education)***

- kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja)
  (candidate who has completed a Master's degree (2nd Bologna level)):
  - diplomska listina / potrdilo o zaključku študijskega programa
    (diploma certificate / certificate of completion of the study programme)
  - priloga k diplomi / potrdilo o opravljenih obveznostih
    (diploma supplement / official transcript of records containing all grades obtained in the study programme)
- kandidat, ki še ni zaključil študija na 2. stopnji
  (candidate who has not yet completed a Master's degree):
  - potrdilo o do sedaj opravljenih obveznostih z ocenami magistrskega študijskega programa, s katerim se bo kandidat prijavil na doktorski študij
    (official transcript of records listing all courses and grades obtained so far in the Master's degree programme on the basis of which the candidate will apply for enrollment in a doctoral degree programme.)

☒ **nagrade –** univerzitetna Prešernova nagrada ali Prešernova nagrada članice Univerze v Ljubljani oz. druga enakovredna nagrada *(awards, e.g. Prešeren Prize of the University of Ljubljana, Prešeren Prize of a University of Ljubljana member and/or another equivalent award))*

☒ **bibliografija** *(bibliography)*

☒ **življenjepis** *(CV)*

☒ **motivacijsko pismo** *(motivation letter)*

☒ **opis dosedanjega sodelovanja pri raziskovalnem delu** *(description of the candidate's research work)*

☒ **osnutek idejne zasnove raziskovalnega dela** *(preliminary research proposal)*

☒ **priporočilno pismo** *(letter of recommendation)*

☐ **druge priloge** *(other attachments):*