1. Raziskovalna organizacija (*Research organisation)*:

Univerza v Ljubljani, *Fakulteta za gradbeništvo in geodezijo*

2. Ime in priimek mentorja (*Name and surname of a mentor*):

Tomaž Hozjan

3. Področje znanosti iz šifranta ARRS (*Primary research field*):

2. Tehnika,
2.01Gradbeništvo

4. Kontaktni e-naslov mentorja (*Contact of a mentor)*:

tomaz.hozjan@fgg.uni-lj.si

5. Kratek opis programa usposabljanja (*Short description of the program)*:

Požarna odpornost gradbenih konstrukcij predstavlja eno izmed ključnih zahtev za določanje njihove varnosti. Kljub temu, da so metode za zagotavljanje požarne odpornosti novogradenj relativno dobro razvite, pa tega ne moremo trditi za gradbene konstrukcije, ki so že bile izpostavljene požarom. Razlog za to je predvsem v tem, ker relativno težko ocenimo stopnjo poškodovanosti in s tem povezano spremembo materialnih parametrov konstrukcije. Nosilnost in stabilnost gradbene konstrukcije po požaru, ter s tem povezano sanacijo, danes pogosto ocenimo s poenostavljenimi računskimi metodami skladno s tehničnimi predpisi v kombinaciji z vizualnim pregledom poškodovane konstrukcije in standardnih porušnih eksperimentalnih raziskav.

Natančneje lahko požarno odpornost in poškodovanost gradbene konstrukcije določimo, če eksperimentalne raziskave povežemo s sodobnimi numeričnimi orodji, ki omogočajo analizo konstrukcije tako pred kot po požaru. Trenutni numerični modeli za račun požarne odpornosti nosilne konstrukcije temeljijo na dobro poznanih konceptih mehanike kontinuuma tako pri časovni določitvi temperatur po konstrukciji kot pri določitvi mehanskega obnašanja konstrukcije med požarom. Pri poroznih gradbenih materialih, kot sta les in beton, je časovna določitev razporeditve temperatur po konstrukciji še bolj zapletena v primerjavi z neporoznimi materiali, saj je tu poleg prenosa toplote potrebno upoštevati tudi prenos vlage in s tem povezane fizikalne in kemijske procese.
Poleg same zasnove numeričnega modela je natančnost le teh zelo odvisna tudi od ustreznih materialnih parametrov pred in po požaru. Le-ti so zaradi omejenega nabora in zahtevnosti izvedbe porušnih preiskav težko izmerljivi in relativno nenatančni. Napredek v razvoju računalniške tehnologije in merilnih tehnik, ki smo mu priča v zadnjih letih, nam omogoča razvoj številnih novih, pogosto neporušnih preiskav, s katerimi precej natančneje določimo številne parametre različnih materialov tako pred kot po požaru. Upoštevanje teh realnejših materialnih parametrov med in po požaru bi v kombinaciji z natančnimi numeričnimi modeli vsekakor močno izboljšalo natančnost določitve obnašanja konstrukcij po požaru in njihove požarne varnosti.

Vsebina in cilji predlaganega programa usposabljanja so neposredno povezani s predhodno predstavljeno problematiko za določanje požarne odpornosti gradbenih konstrukcij. Tako program vsebuje razvoj naprednega numeričnega modela, ki bo omogočal natančnejšo oceno požarne odpornosti in nosilnosti različnih gradbenih konstrukcij iz poroznih materialov. Za dosego tega cilja bodo poleg ustreznih numeričnih tehnik v model vključeni tudi materialni parametri, ki bodo pridobljeni z lastnim eksperimentalnim delom. Pri tem bodo uporabljene številne nove, napredne in po večini neporušne (npr. ultrazvočne) tehnike določanja različnih lastnosti (poroznih) materialov tako pred kot po obremenitvi z visokimi temperaturami.

Fire resistance of civil engineering structures presents one of the basic requirements of all structures to determine their overall safety. While various well developed methods exist for maintaining fire safety of new buildings, this is generally not the case for the buildings which had been previously exposed to fire, mainly due to difficulties in estimation of degree of damage and associated changes in material parameters. Consequently, bearing capacity, stability, and renewal requirements of such buildings are usually estimated using simplified numerical procedures according to relevant standards, visual inspection of construction`s failures, and on the basis of various destructive experimental tests.

A proper combination of experimental and advanced numerical techniques allowing analysis of construction before and after the fire results in a more detailed and accurate estimation of fire resistance of civil engineering structures. Nowadays, numerical models for determination of fire resistance of civil engineering structures are based on well known concepts of continuum mechanics when both heat transfer and mechanical behavior of the structure during fire are analyzed. When compared to nonporous building materials, accurate determination of the heat transfer is much more difficult when porous materials (e.g. wood, concrete) are taken into account. This is mainly due to the fact that in the case of porous materials, besides heat transfer also moisture transfer and associated physical and chemical processes have to be adequately taken into account.
In addition to a proper formulation of numerical models, the accuracy of such models significantly depends on an appropriate determination of material parameters before and after fire. Due to relatively low number of destructive techniques and their complexity, an accurate determination of many material parameters is extremely difficult. Advances in computer technology and testing techniques during recent years have allowed the development of various new, advanced and often nondestructive techniques, which allow more accurate determination of different material parameters before and after the fire. A proper combination of such material parameters and accurate numerical models would significantly improve the accuracy of determination of behavior of civil engineering structures after fire as well as their fire resistance.

The aim and associated content of the proposed project is directly related to the previously described subject. Therefore, the main objective of the project is the development of a new, advanced numerical model for accurate determination of the fire resistance of various civil engineering structures made of porous building materials. Real material parameters determined on the basis of our own comprehensive experimental work will be adequately included in such model. Various new, advanced, and mainly nondestructive (e.g. ultrasonic) techniques for determination of different properties of (porous) materials before and after exposure to extreme temperatures will be used for this purpose.