

Supervisor Opinion

on the doctoral thesis of Ing. Iveta Nováková, named

BEHAVIOUR OF CEMENTITIOUS COMPOSITES EXPOSED TO HIGH TEMPERATURES

The doctoral thesis of Ing. Iveta Nováková deals with the current problematics of the resistance of cementitious composites exposed to high temperatures. Concrete, in terms of high-temperature resistance, is non-flammable and considered highly durable. However, concrete constructions that are not designed with enhanced resistance to high temperatures or inflammation show significant damage when exposed to high temperatures. This negative phenomenon is observed especially in the case of high-performance concrete and high-strength concrete. These modern types of concretes have a small number of air pores and exceptionally dense structures, which can cause explosive spalling of concrete and subsequent collapse of constructions. Existing constructions, which often do not meet current fire safety requirements, are another big issue. The development of new methods for the protection of concrete constructions are vital, especially those applicable on concrete lining in tunnels, underground garages and nuclear power plants.

For the above reasons, the topic of the dissertation thesis is both current and important for further development of the field focused on fire resistance of cementitious composites, and their subsequent usage in industrial scale.

The doctoral thesis is focused on developing methods to increase concrete resistance to high temperatures. The methods focus on the modification of the porous structure of concrete. The first method is the intentional heat treatment (IHT) method, designed to increase the fire resistance of existing concrete constructions. The second method focuses on the design of aerated concrete (AeA-FiResCrete), which incorporates suitable fire properties using the 'new generation' of air-entraining agents.

The doctoral thesis of Ing. Iveta Nováková is elaborate with its total of 191 pages of text, including a list of used literature and annexes. The thesis includes 133 figures and 46 tables. In the theoretical and experimental part, 244 sources are cited, which are appropriately related to the issue.

The theoretical part of the thesis summarizes research findings on the behaviour of cement composites under high temperatures. The experimental part of the thesis is divided into four stages. The individual stages are devoted to the selection and testing of input materials, mix-design, preparation of samples for testing and describing of regimes for testing. The other chapters deal with the development and testing of methods for porous structure modifications. The IHT method for increasing the fire resistance of existing concrete constructions and the method of using aerated concrete with suitable fire properties using the new generation of air-entraining agents are designed and evaluated. The PhD student has described the parameters for the tested concretes in detail. The results are thoroughly evaluated and discussed.

Besides the strength and modification of porous structures, the presence of so-called moisture clog was monitored during the experiments. The efficiency of developed methods was verified by testing concrete slabs according to the modified temperature curve ISO 834 (m-ISO). The slabs treated by the IHT method did not show any excessive cracking or explosive spalling

during the tests, according to the m-ISO curve. During the AeA-FiResCrete tests, the moisture clog was significantly higher than for the slabs treated by the IHT method. Thus, it can be assumed that the IHT method contributes to better fire resistance without any negative influence on the strength and durability of the concrete. The tested AeA-FiResCrete concretes showed only slight improvement in their resistance to high temperatures.

I positively evaluated the approach by which Ing. Iveta Nováková solved the assigned task. The PhD student executed wide, experimental work in several consecutive stages. The results were thoroughly and clearly analysed. The results of Ing. Iveta Nováková's dissertation thesis contribute to knowledge in the field of concrete behaviour under high temperatures. From a scientific point of view, I find the monitoring of the presence of so-called moisture clog and its explanation very contributory. The application of acquired knowledge, especially the intentional heat treatment method, will lead to better resistance in new and existing concrete constructions.

Ing. Iveta Nováková has participated in a number of research projects during her PhD studies:

- Kolarctic CBC Programme KO4068: DeConcrete Eco-efficient Arctic Technologies Cooperation (2019-2021) – project leader
- Research Council's BIA program Norway: CIRCULUS Sustainable concrete recycling (2019–2022) – team member
- Vegagerdin Iceland: Investigation of sprayed concrete with environmentally friendly basalt fibers instead of plastic fibers (since 2018) – main investigator
- Landsvirkjun Iceland: Eco-Crete Landsvirkjun (since 2017) – team member
- Technical Committee for Demolition and Excavation Waste, Standardisation Directorate TC800, Malta (since 2017) – committee member
- GREENBAS: Sustainable Fibres from Basalt Mining; financed from NORDMIND (2012–2017) – team member
- COST TU1207: Next Generation Design Guidelines for Composites in Construction (2013–2017) – team member
- Brno University of Technology Internal Grant Agency FAST-S-16-3748: Evaluation and analysis of cementitious composites resistance against high temperatures (2016) – team member
- Brno University of Technology Internal Grant Agency FAST-S-16-3772: Study and modification of durability ensuring adhesives for FRP/wood joints in humid exposure (2016) – team member
- Project of Czech Grant Agency GA15-23219S: Study of methods of nanoparticles dispersion, determination of conditions for preventing their re-agglomeration for application in cement composites (2015–2018) – team member
- Project of Czech Grant Agency P104/12/1988: Study of interactions of components of cementitious composites exposed to high temperatures (2012–2014) – team member
- Brno University of Technology Internal Grant Agency FAST-J-15-2809: Use of waste from prefabrication production of concrete components as a recycled aggregate for concrete (2015) – main investigator
- Brno University of Technology Internal Grant Agency FAST-J-14-2412: Study of the behavior of cement-based concrete exposed to high temperatures (2014) – main investigator
- TETRA: RecyFlowScreed (2010–2011) – team member.

During the PhD studies, Ing. Iveta Nováková has participated in a number of International traineeships:

- Freemovers internship, Universidad Central "Marta Abreu" de Las Villas (Scientific research focused on RC3 and recycled aggregates; Prof. Dr.Sc. Ing José Fernando Martirena Hernández), Cuba. (6. 2019 – 7. 2019)
- Erasmus+ exchange program, University of Malta (Participation on the preparation of Guideline for recycling and use of construction and demolition waste; Ruben Paul Borg), Malta. (02. 2017 – 04. 2017)
- Norway grants internship, Arctic University of Norway (Use of recycled concrete aggregates; Bjørn Reidar Sørensen and BoyArne Buyle), Norway (08. 2016 – 09. 2016)
- Norway grants internship, Reykjavik University (Basalt fibres as a dispersed reinforcement of concrete with higher resistance to elevated temperatures; Eythor R. Thorhallsson and Olafur Wallevik), Iceland. (08. 2016 – 09. 2016)
- FreeMovers, The University of Edinburgh (Fire resistance testing of various materials; Luke Bisby), Great Britain. (11. 2015 – 12. 2015)
- Brno University of Technology Internal Grant Agency, KU Leuven (Experimental result consultation with experts in the field of CDW recycling, Luc Boehme), Belgium. (10. 2014 – 11. 2014)
- SUPMAT Program internship, HS-Wismar (laboratory research of concrete exposed to fire; Ulrich Diederichs), Germany. (03. 2014 – 07. 2014).

In the submitted dissertation thesis, PhD student Ing. Iveta Nováková has demonstrated her capacity for independent scientific work. Furthermore, she has published 28 scholarly articles, and 11 of them are published in SCOPUS database, and her h-index is 2 with 22 citations. By solving the current research problematics, the PhD student has shown that she can master scientific methods for solving problems and that she can apply her theoretical knowledge to create new findings for the theory and appropriate implementation outcomes for the practice.

With respect to the above, I recommend accepting the dissertation thesis of Ing. Iveta Nováková for her presentation and defence.

I recommend that Ing. Iveta Nováková receives the scientific degree of PhD after a successful defence.

Brno

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