

## Opponent's review of the Doctoral Thesis

Candidate Ing. Michaela HerzfeldtTitle of the doctoral thesis Mechanical response of concrete structures to effects of ionizing radiationStudy Programme Civil EngineeringTutor prof. Ing. Petr Štemberk, Ph.D., D.Eng.Opponent Mgr. Kamil Sobek, Ph.D.e-mail kamil.sobek@cvrez.cz**Topicality of the doctoral thesis theme**

Commentary: The chosen topic is one of the key ones currently being investigated concerning the problems of extending the service life of NPPs. Its importance is also enhanced by the fact that with the help of the researched information, the durability of concrete structures can be considered. Still, at the same time, it is also possible to positively influence society's opinion on the safety of nuclear infrastructures.

 excellent     above average     average     below average     poor**Fulfilment of the doctoral thesis objectives**

Commentary: The presented dissertation thesis has achieved all goals excellently, and overall fulfilment is at a very high level appropriate for a dissertation thesis. The student was given the task of taking on a complex topic regarding fuzzy logic; however, the candidate demonstrated sufficient knowledge and expertise to such an extent that the given task was handled with grace.

 excellent     above average     average     below average     poor**Research methods and procedures**

Commentary: Methods used by the candidate are pretty straightforward. However, they demonstrate the need for specific skills and knowledge and a deep understanding of several parts of scientific areas. I very positively evaluate the involvement of geological sciences (mineralogy and petrology) and the related knowledge that plays an integral part in this context.

 excellent     above average     average     below average     poor**Results of the doctoral thesis – dissertant's concrete achievements**

Commentary: The candidate presents several outcomes for radiation-induced effects on minerals, aggregates, cement paste and concrete. In combination with fuzzy logic models, the student was able to capture specific trends within the proposed models with emphasis on RIVE, cracks and other problematic destructive phenomena (both mesoscale and macroscale). I highly emphasise the skilled use of ATENA software, where all the models were simulated, and the results were well described and presented.

<input checked="" type="checkbox"/> excellent	<input type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor
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### Importance for practice and for development within a branch of science

Commentary: Given the support of this research and great interest by the U. S. Department of Energy, ORNL, etc., the results are highly sought after and have straight applicability in the industry. These developments in this specific branch of civil engineering have significantly contributed to the field of concrete research regarding opportunities for further development.

<input checked="" type="checkbox"/> excellent	<input type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor
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### Formal layout of the doctoral thesis and the level of language used

Commentary: The presented thesis meets the highest requirements regarding layout, content, and readability, with only minor linguistic inaccuracies. I only negatively evaluate figure descriptions, where, especially in the graphs related to volumetric changes, it is essential to include such information, as the reader cannot connect information with certain minerals it represents.

<input type="checkbox"/> excellent	<input checked="" type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor
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### Statement on compliance with citation ethics

The presented thesis meets the requirement for citation ethics, with only minor similarities to related works (not higher than 3%), omitting the overlapping literature used. However, there are some overlaps with the works by Dr. Yuliia Khmurovska, especially "Vliv neutronového a gama ozařování na vlastnosti betonu a jeho mechanickou odezvu - České vysoké učení technické v Praze (2019)" which was not cited at all. This I find a little concerning.

### Remarks

On page 21, Tab. 3-3, you estimate that the volume change for minerals such as spinel, chromite, and magnetite is up to 0.9%. Why do you think the values are so low for these three minerals? Do they have something in common? Could there be other major disadvantages to these minerals if they are contained in the aggregates used for biological shielding concrete?

On page 22, you stated: "Serpentinized rocks and carbonate rocks, which are close to the dissociation temperature, however, tend to change their properties upon heating rather than irradiation". Could you explain the mechanisms behind such behaviour and why it happens, especially to serpentinised rocks and carbonates?

On page 22, you explain that siderite expands more than other carbonate rocks because of the presence of quartz. How does it work? Could you elaborate?

On page 29, Fig. 3-12, the statement magmatic or sedimentary is, from the geological point of view, a very broad description. What do you mean by magmatic or sedimentary? Are the magmatic rocks you are mentioning the ones that were formed below the surface (intrusive rocks)? Or do you mean extrusive rocks formed on the surface? What about the differences based on the size, shape and arrangement of the mineral grains of which the rock is composed? What about composition? Please elaborate.

Are there any metamorphic rocks which were included in the research or previously studied?

### Final assessment of the doctoral thesis

The research results show this topic's vast applicability and importance regarding concrete science, especially with an emphasis on NPP constructions.

The candidate has presented sufficient knowledge and expertise on the given topic. The candidate is also capable of conducting high-quality research, and all the skills presented will be a solid foundation for a future career.

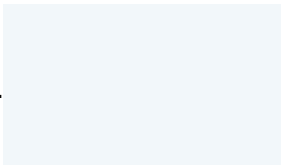
The thesis fulfils all the requirements for a dissertation to obtain the chosen academic degree.

I recommend that the Faculty of Civil Engineering of the Czech Technical University in Prague accepts this dissertation for the student's defense.

**Following a successful defence of the doctoral thesis I recommend the granting of the Ph.D. degree**

yes <input checked="" type="checkbox"/>	no <input type="checkbox"/>
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Date: 29.03.2024

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