

# Development of a quick and reliable method for determining frost resistance of concrete

## Summary

Traditional methods for determining frost resistance of concrete are very time-consuming. Sometimes these slow test methods hinder the construction process. One potential method for a quick frost resistance determination is the Air Void Analyzer (AVA) method. The purpose of this PhD project is to study if the AVA method is suitable for determining frost resistance of concrete. Among others the project includes extensive laboratory testing with both traditional and innovative test methods. The final goal is to provide construction companies a quick and reliable quality control method for determining frost resistance of concrete.

Research field:	Building and civil engineering and architecture
Supervisor:	Kristjan Lill
Availability:	This position is available.
Offered by:	School of Engineering
	Department of Civil Engineering and Architecture
Application deadline:	Applications are accepted between June 01, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

### Description

### Background

Concrete frost resistance is a critical property for ensuring the durability and longevity of structures, particularly in cold or variable climates. In Estonia, where frequent freeze-thaw cycles are common, this is especially important for infrastructure project such as roads, bridges, and other facilities. Traditional methods for assessing frost resistance, such as EVS 814 and ASTM C457, are reliable but time-consuming and do not allow for sufficiently rapid quality control during critical stages of construction.

In recent years, the AVA (Air Void Analyzer) methodology has gained increasing attention. It enables the analysis of the air-void microstructure in fresh concrete - specifically the distribution and specific surface area of air voids. Preliminary research conducted in the context of a master's thesis confirmed the potential of the AVA method as a rapid analysis tool. This doctoral thesis continues that line of research, focusing on further development of the AVA methodology, its validation in different concrete mixes and climatic conditions, and its standardization in the construction industry.

The objective of this doctoral thesis is the scientific enhancement and practical extension of the AVA methodology for assessing concrete frost resistance. Specifically, the aims are to:

- Define quantitative relationships between AVA parameters (e.g., specific surface area, distribution, and size distribution of air voids) and the results of traditional laboratory tests for frost resistance (EVS 814, ASTM C457).
- Investigate how variations in concrete composition and production parameters (including cement type, water-cement ratio, aggregates, and air-entraining admixtures) affect AVA results and their correlation with frost resistance.
- Identify the sensitivity limits of the AVA method and determine recommended threshold values for different environmental exposure classes (XF1-XF4 according to EVS-EN 206).
- Develop a methodological guideline for the application of AVA in concrete production, laboratory testing, and structural design, and contribute to the standardization of AVA in construction regulations.

#### Requirements

The call is open for candidates that fulfil the following requirements:

- University degree (M.Sc.) in civil, road or bridge engineering
- A clear interest in the research topic is preferred
- Strong and demonstrable writing and analytical skills
- Strong knowledge of the production and testing of concrete
- · Ability for independent research as part of a team, interest in the presentation and publication of scientific results



• Good command of the English language (speaking and writing).



To get more information or to apply online, visit https://taltech.glowbase.com/positions/1019 or scan the the code on the left with your smartphone.