

Bond in ASR-damaged slabs and shells without transverse reinforcement

More than 600 concrete bridges in Denmark, as well as many other concrete structures globally, are at risk of a harmful chemical reaction called Alkali Silica Reaction (ASR). ASR causes expansion and cracking of the concrete, weakening its strength and durability, and raising concerns about the safety and structural integrity of these bridges. These concerns mainly regard structures in which the capacity relies on the mechanical properties of the concrete, such as concrete slabs and shells without transverse reinforcement. Such structures are widely used in bridges. Additionally, the understanding of the structural effects of ASR, particularly regarding the bond between the steel reinforcement and the concrete, is still limited and especially for slabs and shells with transverse reinforcement, the research is negligible. As a result, concerns about the capacity of these structures arise, leaving bridge owners and administrators without the essential knowledge needed to develop a reliable strategy for assessing the ASR-damaged bridges.

The aim of this industrial PhD study concerns slabs and shells without transverse reinforcement and is twofold. Firstly, we aim to gather experimental data to understand how ASR affects the bond between steel reinforcement and the concrete. Secondly, we aim to establish a model that can determine the bond and anchorage capacity. To make the model practical and widely applicable, it will be based on mechanical properties obtained from concrete cores drilled out of the structures in question.

The outcome of this project will enable a more reliable assessment of ASR-damaged structures, e.g. in bridges. This will greatly contribute to making informed decisions regarding whether these structures should undergo strengthening, replacement, or can be kept in service in their current state. The cost of demolishing existing structures and building new ones is high both economically and environmentally. With the result of this industrial PhD project, the number of ASR-damaged bridges that are demolished due to uncertainties about the residual load-carrying capacity will be reduced. This will help decrease CO₂ emissions and the use of natural resources by the construction industry.

This industrial PhD study has received research funds from COWIfonden and Innovation Fund Denmark. The project is a collaboration between COWI and the University of Southern Denmark (SDU Structures).

PhD candidate: Jesper Kierkegaard Hansen.

Supervisors: Associate Professor Henrik Brøner Jørgensen (University Supervisor, SDU Structures), Søren Gustenhoff Hansen (Main Supervisor, COWI), and Poul Linneberg (Co-supervisor, COWI).

Project duration: 2024 – 2027.