Concrete without cement

Investigation of material properties with a focus on real structural applications

Globally concrete is the most used construction material thus being an indispensable part of today's society. However, concrete also plays a major role in global CO_2 emission. The majority of this emission is caused by cement – one of the main ingredients in modern concrete. Approximately 8-10% of the global CO_2 emission can be attributed to the production of cement. Therefore, in order to reach the climate goals, construction materials with less environmental impact are required.

A promising example of such a material is concrete without traditional cement, which has the potential to reduce CO_2 emission by 80-90% in comparison to conventional concrete. For this type of concrete cement, which acts as a binder between aggregate in concrete, is replaced with other materials such as waste products from power plants or manufactured materials with highly reduced energy input compared to cement.

Adaption of new materials on a large scale by the construction industry is generally not an easy task as materials and designs have to meet high European and national standards. The main reason in hesitation with new materials is consequently a lack of sufficient knowledge about material properties and if standard procedures can be applied to ensure a safe structure.

The objective of this project is to study relevant material properties of a selected range of cement free concrete materials and to obtain a deeper understanding of their short- and long-term material behaviour.

By combining experimental and numerical investigations at different scales, the project seeks to link the material properties to the expected structural behaviour thereby identifying suitable design models.

The project being able to demonstrate reliable behaviour predictions of cement free concrete will be a major milestone.

Suitable design models will be a big step in adaption of cement free concrete material and enable a wider range of applicators to use such materials.

The project is expected to begin in 2023 and end in 2026. Leading industry experts such as Carola Edvardsen (Chief concrete specialist, COWI) and Jose Manuel Suarez Diaz (Associate technical director, COWI) will be joined by leading research experts on materials (Ole M. Jensen, DTU) and structures (Linh Hoang, DTU) from the Technical University of Denmark. This highly qualified expert team will guarantee a good supervision of the industrial PhD candidate (Marvin Glissner). Industry support from Denmark and abroad is expected.