Structural Application of ash in concrete

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INTRODUCTION

Worldwide the production of cement causes 5% of the total CO_2 emissions (WBCSD & IEA, 2010). This is a substantial amount for one single production, why it is desirable to lower the demand for cement. Cement is mostly used for concrete and is the adhesive component in concrete, why it also is responsible for main strength in the concrete. Some additives such as fly ash and microsilica does also provide strength for concrete. From this the idea rose to use sewage sludge ash (SSA), not only as an additive, but to replace a substantial amount of cement with SSA. SSA is a waste product, which for the time being is being deposited; as no better solution is known. If it is possible to use SSA to replace cement in concrete, it is, thus possible to reduce two environmental problems with one solution. Preceding projects has been made at DTU Civil Engineering, with investigations on mortar (concrete without a large fraction of stone) concerning: strength, chemical analysis, durability, workability etc. However this project is the first to test the SSA in concrete. The aim is to see the effects on the load carrying capacity for two types of structural members used in the construction industry: Beams and columns.

METHODS

A reference concrete is designed, and from this two types of SSA-concretes are made, with respectively 25 and 50 mass-% cement replaced with SSA. A trial casting is made to make sure it is possible to cast the concrete in a satisfactorily way. In the data processing the two SSA concretes has been compared to the reference concrete. The two experiments performed are a beam test, where the loading is perpendicular to the longitudinal direction of the beam, and a column test with loading parallel to the longitudinal direction. To get the strength properties of the concrete and reinforcement-steel a compression test for the concrete and a tensile test for steel are performed.

RESULTS

The compression test for the concrete showed a loss in strength when increasing the amount of SSA. This was expected, and it is also what previous projects have shown. The beam and column tests also showed a decrease in bearing capacity, however this decrease is small relatively to the respective reference samples.

CONCLUSION

From this project it can be concluded that adding SSA to concrete is a possibility with regards to the bearing capacity of beams and columns. The capacity of the members is still sufficiently high to be used in real projects. The durability demand, in characteristic strength, for concrete in passive exposure classes is only 12MPa (Energistyrrelsen, 2011), which the 50% SSA concrete also fulfils. As about 2/3^{rds} of all concrete in Denmark is used in passive exposure class this gives a potential saving of CO_2 of up to 1/3 of all cement related CO_2 emissions corresponding to a reduction in CO_2 emissions of 1.7 %.

BIBLIOGRAPHY

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