**Experimental study of the influence of polypropylene fibres on fire spalling of concrete**

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# Introduction

A deep understanding of the physics involved in the phenomenon of fire spalling of concrete is still lacking. However, many tests have shown that polypropylene fibres (PP-fibres) reduce the damage significantly. The aim of the project presented in this article is to investigate the spalling behaviour of concrete containing CEM I cement in combination with various amounts and sizes of PP-fibres. The fire tests will be conducted on two types of test specimens, large slabs, 1800 × 1200 × 300 mm3, tested on a large horizontal furnace with the standard fire curve (EN 1363-1) and the RWS curve; and small slabs, 500 × 600 × 300 mm3, tested on a small furnace. Additional tests will be done to determine mechanical and physical characteristics.

# Material and conditioning

A total of 21 different concrete mixes are included in this project. All mixes, except for one reference mix, are based on CEM I cement. The experimental program is based on four basic formulas, vct 0.40 and 0.45 with two different maximum sizes of aggregate. To these basic mixes, different amounts and sizes of PP-fibres are added.

In total 14 large slabs composed of 8 different mixes have been cast for testing on the horizontal furnace (1800 × 1200 × 300 mm3), Further small slabs,  500 × 600 × 300 mm3, were cast using the 8 mixes mentioned above, together with 13 additional mixes, for use in the small furnace. In total 42 small slabs, two for every concrete mix, were cast.

After casting, while waiting for fire testing, all specimens are stored under water. To investigate the moisture conditions at the time of fire tests, cubes and concrete filled plastic tubes, also stored under water, will be used. The plastic tubes are 300 mm long, have a diameter of 45 mm and are open at both ends. These are stored under water to be representative of the cross section of the 300 mm thick test specimens. On the day of the fire test, the cylinders inside the plastic tubes will be sliced and dried to determine the moisture and capillary saturation profiles in the test specimens [1-2].

# Instrumentation

The large slabs have thermocouples cast into the slab at depths of 10, 25, 40, 80 and 120 mm to measure the temperature change inside the specimen during the fire test. In total 8 of the 14 large slabs also contains pressure measurement pipes [3]. The pressure measurement pipes will be filled with oil during the fire tests. The small slabs are equipped with thermocouples at depths of 10 and 40 mm and 12 of the 42 small slabs contain pressure measurement pipes.

# Fire tests

Two large scale fire tests will be conducted in August 2007, one test with the RWS curve and one with the standard fire curve, EN 1363-1. During the test with the RWS curve, 8 large slabs will be tested simultaneously with a compressive load of approximately 10 % of the compressive strength at the test date. The load will be applied with an internal loading system [4]. During the test with the standard fire curve, 6 large slabs will be tested simultaneously under the same conditions as those for the test with the RWS curve.

# Additional testing

After the fire tests have been performed some of the tested concretes will be investigated further to study other physical and thermal characteristics. Therefore a large number of cylinders, cubes and notched beams have been manufactured.

Thermal properties will be tested using DSC (Differential Scanning Calorimetry) and TPS (Transient Plane Source) [5]. Mechanical testing will be conducted, including transient thermal creep tests, restrain force test and fracture energy tests. Residual permeability will be determined after different heat treatment and transient drying tests will be performed on different geometries.

# Discussion

In the final paper a compilation of the results from the fire tests will be presented and a discussion of the possible influence of the investigated parameters on the fire spalling behaviour will be made. The focus will be to determine and discuss differences between concrete with and without PP-fibres.

# References

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