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ABSTRACT

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Deterioration of Concrete Mix Designs According to XF1 and XF2 in the CIF- and CDF-Test – Evaluation of Existing Test Results and Literature Review

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During their planned lifespan concrete structures have to display a sufficient durability against the expected environmental impacts including frost and frost de-icing agent attack in principle. For concrete structures which have to meet the requirements of the exposition classes XF1 and XF2 according to the European concrete standard EN 206-1:2000-12 (moderate water saturation without and with de-icing agent, respectively) there is no sufficient laboratory test method to prove the frost resistance and the freeze-thaw resistance with de-icing agent, respectively. Normally, in laboratory test methods like the CIF and CDF test, capillary saturated concrete is tested whereas in practice mostly lower degrees of saturation can be expected depending on the local exposure conditions.

As a rule, the evaluation of concretes classified in XF3 and XF4 takes place after 28 freeze-thaw cycles. In comparison, concretes classified in XF1 and XF2 are considered to have distinct capillary porosity. Thus, damage can be expected at an earlier stage as it is mainly caused by a critical degree of water saturation. The assessment of concretes classified in XF1 and XF2 with the common CIF and CDF test can therefore be approached by monitoring the progress of damage. In the presented report data of available CIF and CDF tests from literature and own research work have been gathered and evaluated. In addition to data of concretes classified in XF1 and XF2 also concretes that do not meet the requirements of these exposition classes were taken into account.

The decisive value for the assessment of concretes with the CIF test is the decrease of the relative dynamic modulus of elasticity indicating the internal structural damage. According to RILEM recommendation the limit value amounts to 80 % compared to that initially measured. In the presented report the number of freeze-thaw cycles until reaching this limit value has been evaluated for concretes classified in XF1. For the assessment of freeze-thaw resistance with de-icing agent surface scaling is decisive. The limit value for concretes XF4 is 1.500 g/m² after 28 freeze-thaw cycles. The presented study examines the number of cycles performed by concretes XF2 up to this value.

Compared to concretes classified in XF3 and XF4 the evaluated data indicate for concretes XF1 and XF2 an averagely minor amount of freeze-thaw cycles until reaching the respective limit values. Provided that a characteristic number of freeze-thaw cycles can be determined to adapt the test period, it seems possible to use the common CIF and CDF test for assessment of concretes XF1 and XF2. Therefore, further evaluations should be conducted. Especially for concretes containing air voids, and those below the requirements of the exposition classes XF1 and XF2, more data is required.