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Testing the freeze-thaw resistance of concrete - Internal structural damage

Prüfung des Frost-Tauwiderstandes von Beton - Innere Gefügestörung

This Technical Report was approved by CEN on 31 August 2005. It has been drawn up by the Technical Committee CEN/TC 51.

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Foreword

This document (CEN/TR 15177:2006) has been prepared jointly by Technical Committee CEN/TC 51 "Cement and building limes", the secretariat of which is held by IBN/BIN and by Technical Committee CEN/TC 104 "Concrete and related products", the secretariat of which is held by DIN.

No existing European Standard is superseded.

It is based on the Austrian Standard ÖNORM B 3303 "Testing of Concrete" and on the RILEM recommendation "Test methods of frost resistance of concrete" of RILEM TC 176 IDC. These tests have since been developed by individual countries. This document takes into account those developments.

Introduction

Concrete structures exposed to the effects of freezing and thawing need to be durable, to have an adequate resistance to this action and, in cases such as road construction, to freezing and thawing in the presence of de-icing agents. It is desirable, especially in the case of new constituents or new concrete compositions, to test for such properties. This also applies to concrete mixes, concrete products, precast concrete, concrete elements or concrete in situ.

Many different test methods have been developed. No single test method can completely reproduce the conditions in the field in all individual cases. Nevertheless, any method should at least correlate to the practical situation and give consistent results. Such a test method may not be suitable for deciding whether the resistance is adequate in a specific instance but will provide data of the resistance of the concrete to freeze-thaw-attack and freeze-thaw-attack in the presence of de-icing agents.

If the concrete has inadequate resistance there are two types of concrete deterioration when a freeze-thaw attack occurs, internal structural damage and scaling. The three test methods in this document describe the testing for internal structural damage. The scaling is dealt with in prCEN/TS 12390-9.

This document contains three different test methods, which are well proved in different parts of Europe. Always they produce consistent results. For that reason no single test method can be established as reference test method. In the case that two laboratories will test the same concrete, they have to agree to only one test method with the same measurement procedure.

The application of limiting values will require the establishment of the correlation between laboratory results and field experience. Due to the nature of the freeze-thaw action, such correlation would have to be established in accordance with local conditions and still have to be done.

1 Scope

This document specifies three test methods for the estimation of the freeze-thaw resistance of concrete with regard to internal structural damage. It can be used either to compare new constituents or new concrete compositions against a constituent or a concrete composition that is known to give adequate performance in the local environment or to assess the test results against some absolute numerical values based on local experiences.

Extrapolation of test results to assess different concrete i.e. new constituents or new concrete compositions requires an expert evaluation.

NOTE Specification based on these test methods should take into account the behaviour of concrete under practical conditions.

There is no established correlation between the results obtained by the three test methods. All tests will clearly identify poor and good behaviour, but they differ in their assessment of marginal behaviour.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 206-1, *Concrete – Part 1: Specification, performance, production and conformity*

EN 12390-1, *Testing hardened concrete – Part 1: Shape, dimensions and other requirements of specimens and moulds*

EN 12390-2, *Testing hardened concrete – Part 2: Making and curing specimens for strength tests*

EN 12504-4, *Testing concrete – Determination of ultrasonic pulse velocity*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
freeze-thaw resistance
resistance against alternating freezing and thawing in the presence of water alone

3.2
freeze-thaw resistance with de-icing salt
resistance against alternating freezing and thawing in the presence of de-icing salt

3.3
scaling
loss of material at the surface of concrete due to freeze-thaw attack

3.4
internal structural damage
cracks developed inside concrete which may not be seen on the surface, but which lead to an alteration of concrete properties, e.g. reduction of the dynamic modulus of elasticity