TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 16563

August 2013

ICS 91.100.30

English Version

Principles of the equivalent durability procedure

Principes de la procédure de durabilité équivalente

Verfahrensgrundsätze zum Nachweis gleichwertiger Dauerhaftigkeit

This Technical Report was approved by CEN on 22 June 2013. It has been drawn up by the Technical Committee CEN/TC 104.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. CEN/TR 16563:2013: E

Contents

Page

Foreword

This document (CEN/TR 16563:2013) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

Introduction

(1) The Equivalent Durability Procedure (EDP) is a scheme that builds on the traditional method of ensuring durable concrete by specifying established limiting values in terms of maximum w/c ratio, minimum cement content etc. Essentially, a reference value is determined and a candidate concrete can be confirmed as being of equivalent performance where testing and other appropriate assessments are made to demonstrate equivalent performance with this reference value or reference concrete. The reference value is determined based on concretes that satisfy fully the limiting value specification valid in the place of use and are representative of concretes that are successfully used in the local environment as providing a satisfactory service-life. To be considered a viable alternative, the proposed candidate concrete need to have a test performance that equals, or is better than, the reference value when tested by the same method and at the same age as used to establish the reference performance. Such a comparison leads to equivalent performance in the test at the age of testing. As the rate of improvement in resistance is not constant between concretes, the reference value will be appropriate for the constituents used in the candidate concrete.

(2) No relatively short-term laboratory test will give a precise quantitative indication of real performance of in-situ concrete. One reason for this is that concrete will continue to gain strength and resistance to the permeation of aggressive species in most natural environments, e.g. concrete will increase its resistance to the permeation of chloride ions with time, albeit at an ever decreasing rate. Such changes in performance over time, collectively called ‘ageing effects’, need to be taken into account when determining if the candidate concrete will provides an equivalent durability over the service-life.

NOTE With respect to durability, the changes can be positive or negative. For example, reaction with seawater may result in a surface layer that increasingly inhibits the penetration of chloride ions and hence improve durability. On the other hand, carbonation of concrete may release chlorides ions that were previously bound into the hydrate structure and, as these are then free to migrate towards any reinforcement, the durability may be reduced.

(3) Some CEN members have established national EDP type procedures which provide results that are likely to be reasonably indicative of in-situ performance or procedures whereby equivalent durability may be safely assumed for defined sets of materials. See Annex A to Annex H for some examples.

(4) This Technical Report provides guidance to National Standards Bodies who want to establish an EDP in their national provisions to EN 206.

1 Scope

This Technical Report sets out the principles of the equivalent durability procedure. It provides guidance on the selection of the reference value, production control, evaluation of conformity and the exchange of information between the parties.

2 Normative references

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

EN 196-1, *Methods of testing cement — Part 1: Determination of strength*

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

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

EN 450-1, *Fly ash for concrete — Part 1: Definition, specifications and conformity criteria*

EN 480-11, *Admixtures for concrete, mortar and grout — Test methods — Part 11: Determination of air void characteristics in hardened concrete*

EN 933-9, *Tests for the geometrical properties of aggregates — Part 9: Assessment of fines — Methylene blue test*

EN 1992-1-1, *Eurocode 2 — Design of concrete structures — Part 1-1: General rules, and rules for buildings*

EN 12350-1, *Testing fresh concrete — Part 1: Sampling*

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

EN 12390-3, *Testing hardened concrete — Part 3: Compressive strength of test specimens*

EN 12390-8, *Testing hardened concrete — Part 8: Depth of penetration of water under pressure*

CEN/TS 12390-9, *Testing hardened concrete — Part 9: Freeze-thaw resistance — Scaling*

CEN/TS 12390-10, *Testing hardened concrete — Part 10: Determination of the relative carbonation resistance of concrete*

CEN/TS 12390-11, *Testing hardened concrete — Part 11: Determination of the chloride resistance of concrete, unidirectional diffusion*

EN 12620, *Aggregates for concrete*

EN 13263-1, *Silica fume for concrete — Part 1: Definitions, requirements and conformity criteria*

EN 13295, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of resistance to carbonation*

EN 13369, *Common rules for precast concrete products*

EN 13396, *Products and systems for the protection and repair of concrete structures — Test methods — Measurement of chloride ion ingress*

EN 13670, *Execution of concrete structures*

EN 14216, *Cement — Composition, specifications and conformity criteria for very low heat special cements*

EN 15167-1, *Ground granulated blast furnace slag for use in concrete, mortar and grout — Part 1: Definitions, specifications and conformity criteria*

CEN/TR 15177, *Testing the freeze-thaw resistance of concrete — Internal structural damage*

ISO 5725-6, *Accuracy (trueness and precision) of measurement methods and results — Part 6: Use in practice of accuracy values*

ISO 16204, *Durability — Service life design of concrete structures*

BS 7979, *Specification for limestone fines for use with Portland cement*

BS 8500-1, *Concrete — Complementary British Standard to BS EN 206-1 — Part 1: Method of specifying and guidance for the specifier*

BS 8500-2, *Concrete — Complementary British Standard to BS EN 206-1 — Part 2: Specification for constituent materials and concrete*

DIN 1045-2, *Concrete, reinforced and prestressed concrete structures — Part 2: Concrete — Specification, properties, production and conformity — Application rules for DIN EN 206-1*

LNEC E 391, *Concrete. Determination of carbonation resistance* (In Portuguese)

LNEC E 392, *Concrete. Determination of the permeability to oxygen* (In Portuguese)

LNEC E 393, *Concrete. Determination of the absorption of water through capillarity* (In Portuguese)

LNEC E 463, *Concrete. Determination of diffusion coefficient of chlorides from non-steady state migration test* (In Portuguese)

NEN 8005, NEN, Nederlandse invulling van NEN-EN 206-1: *Beton — Deel 1: Specificatie, eigenschappen, vervaardiging en conformiteit* (Dutch supplement to NEN-EN 206-1)

NT BUILD 492, *Concrete, mortar and cement-based repair materials: chloride migration coefficient from non-steady-state migration experiments*

3 Terms and definitions

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

3.1
ageing effects
changes in a concrete resistance to aggressive species as the result of the progression of the hydration together with the time evolution of cement phase microstructure, its interaction with the penetration species and, in certain cases, of concrete surface changes due to its direct interaction with the external environment

Note 1 to entry: Example for interaction with the penetration species is: chloride binding.

Note 2 to entry: Example for direct interaction with external environment is: a skin effect when concrete is exposed to seawater.

3.2
candidate concrete
concrete comprising a closely defined set of constituents under investigation to determine the mix proportions that are likely to provide a durability performance equal to or greater than a reference value or reference concrete for the selected exposure class