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Further guidance on the application of EN 13791:2019 and background to the provisions

Guide pour l'application de la norme EN 13791:2019 et contexte des spécifications

Weiterführende Anleitung zur Anwendung der EN 13791:2019 und Hintergrund zu den Regelungen

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (CEN/TR 17086:2020) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by Standards Norway.

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This document should be read in conjunction with EN 13791:2019.

Introduction

(1) To achieve a balanced standard, CEN/TC 104/SC 1/TG 11 comprises experts with different backgrounds and affiliations. The membership of TG 11 is given in Table 1.

Table 1 — Membership of the European Technical Standard Committee, CEN/TC 104/SC 1/TG 11, responsible for the revision of EN 13791

Member	Affiliation
Professor Tom Harrison	Convenor
Dr Chris Clear	Secretary
Vesa Anttila	Rudus, Finland
Prof. Wolfgang Breit (papers only)	Technische Universität Kaiserslautern, Germany
Dr Neil Crook	The Concrete Society, UK
Ir. F.B.J. (Jan) Gijsbers	CEN/TC250/SC2
Bruno Godart	IFSTTAR, France
Dr. Arlindo Gonçalves	Laboratório Nacional de Engenharia Civil, Portugal
Christian Herbst	JAUSLIN + STEBLER INGENIEURE AG, Switzerland
Rosario Martínez Lebrusant	Jefe del Área de Certificación y Hormigones, Spain
Dorthe Mathiesen (papers only)	Danish Technological Institute, Denmark
David Revuelta	Instituto Eduardo Torroja, Spain
Dr.-Ing. Björn Siebert followed by Dr Enrico Schwabach	Deutscher Beton- und Bautechnik-Verein E.V.
Prof. Johan Silfwerbrand	Swedish Cement and Concrete Research Institute, Sweden
Ceyda Sülün followed by Francesco Biasioli	ERMCO
José Barros Viegas (papers only)	BIBM
Dr.-Ing. Ulrich Wöhnl	German expert and member of former TG11
Christos A Zeris (papers only)	National Technical University of Athens, Greece

(2) In addition, guidance on rebound hammer and pulse velocity testing was provided by David Corbett of Proceq, Switzerland and statistical help with combining core and indirect test results was provided by André Monteiro of the Laboratório Nacional de Engenharia Civil, Portugal.

(3) Contact and exchange of information was also maintained with RILEM Technical Committee TC ISC 249, which works on onsite non-destructive assessment of concrete strength.

(4) Where a reference is cited to a paragraph without being preceded by a reference to a standard, e.g. EN 13791:2019, Clause 6, the reference is to a paragraph in this document. For example '13.3 (2)' means paragraph (2) in 13.3 of this document.

1 Scope

This document explains the reasoning behind the requirements and procedures given in EN 13791 [1] and why some concepts and procedures given in EN 13791:2007 [2] were not adopted in the 2019 revision. The annex comprises worked examples of the procedures given in EN 13791:2019.

2 Symbols and abbreviated terms

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

CLF	core length factor
CoV	coefficient of variation
f_{c} or $f_{c,cube}$	compressive strength of standard test specimens, 2:1 cylinder or cube
$f_{c,1:1core}$ or $f_{c,2:1\ core}$	core compressive strength associated with a length: diameter ratio of either 1:1 or 2:1
f_{cd}	design compressive strength in the structure
f_{ck}	minimum characteristic compressive strength of test specimens based on 2:1 cylinders
$f_{ck,\ cube}$	minimum characteristic compressive strength of test specimens based on cubes
$f_{c,is}$	*in situ* compressive strength
$f_{ck,is}$	characteristic *in situ* compressive strength (expressed as the strength of a 2:1 core of diameter ≥ 75 mm)
$f_{ck,is,28}$	assumed characteristic compressive strength in the structure
$f_{ck,is,>28}$	assumed characteristic compressive strength in the structure after 28 days
$f_{ck,spec}$	specified minimum characteristic strength
$f_{ck,spec,cube}$	specified minimum characteristic cube strength (Some CEN members specify cube strength)
$f_{c,is,highest}$	highest value of $f_{c,is}$ for a set of '*n*' results.
$f_{c,is,lowest}$	lowest value of $f_{c,is}$ for a set of '*n*' results
$f_{c,is,est}$	estimated *in situ* compressive strength at a specific test location
$f_{c,is,reg}$	indirect test value converted to its equivalent *in situ* compressive strength using a regression equation
$f_{c,m}$	mean (average) concrete compressive strength of 2:1 test cylinders
$f_{c,m(n)is}$	mean (average) value of a set of '*n*' values of $f_{c,is}$
k_{n}	factor applied to the sample standard deviation
k_{t}	reduction factor for α_{cc}
m	number of valid indirect test results in test region under investigation
n	number of core test results
p	number of parameters of the correlation curve
R^2	coefficient of determination

s	estimate of the overall standard deviation of *in situ* compressive strength
s_c	residual standard deviation, which is a measure of the spread of the core strength test data around the fitted regression curve
s_e	standard deviation of all the estimated strength values, which is a measure of the spread of the estimated core strengths around its mean value
s_r	sample standard deviation of reference element(s)
s_s	sample standard deviation of element(s) under investigation
UPV	ultrasonic pulse velocity
$\bar{X}_r$	mean UPV/rebound number of the reference element
$\bar{X}_s$	mean UPV/rebound number of the element under investigation
x_0	indirect test value at test location '0' (where the *in situ* strength is required for structural assessment purposes)
$x_{i,cor}$	indirect test value at test location *i* that is used for the correlation
$\bar{x}$	mean (average) of the *m* indirect test values used for the correlation
α_{cc}	coefficient taking account of long term effects on the concrete compressive strength
γ_c	partial safety factor for concrete for persistent and transient design situations

3 General principles adopted for the revision

(1) The scope of the revision retains covering both the estimation of compressive strength for the structural assessment of an existing structure (EN 13791:2019, Clause 8) and assessment of compressive strength class of supplied concrete in case of doubt (EN 13791:2019, Clause 9). Presenting EN 13791 as two parts was considered as it would emphasize the differences between the estimation of compressive strength for a structural assessment and assessment of compressive strength class of supplied concrete in case of doubt. It was decided to keep EN 13791:2019 as a single standard to avoid duplication of requirements.

(2) EN 13791 was not drafted to cover exceptional situations. EN 13791 aims to cover the most common situations.

(3) As the objective was to produce a technically sound European standard and not a collation of national provisions, the requests to refer to provisions valid in the place of use were resisted. Nevertheless, techniques not specified and topics not addressed by EN 13791:2019 may be detailed in national provisions or left to the investigator involved.

(4) Requirements have been placed in the EN 13791:2019 normative text and guidance in its Annex A and this document.

(5) Statistical principles are applied and this has consequences when there are small sets of data. For all other things being equal, a small set of data will lead to a lower estimate of the characteristic *in situ* compressive strength when applying the EN 13791:2019, Clause 8 procedures. On the other hand, in the EN 13791:2019, Clause 9 procedures, the smaller data set, the lower is the risk of rejecting concrete.

(6) Uncertainty of measurement is not taken into account but there are recommendations as to the minimum number of test results to help ensure the estimates are reliable. This means that with respect to uncertainty of measurement, the producer and user risks are the same.

(7) EN 13791 [1] is drafted to be compatible with EN 1990 [3], EN 1992-1-1 [4] and EN 206 [5]. The recommended value of 0,85 for the factor η in A.2.3(1) of EN 1992-1-1:2004 [4] has been applied and if