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KIVISTUNUD BETOONI KATSETAMINE. OSA 19: ELEKTRILISE ERITAKISTUSE MÄÄRAMINE

Testing of hardened concrete - Determination of electrical resistivity

EESTI STANDARDIMIS- JA AKREDITEERIMISKESKUS
ESTONIAN CENTRE FOR STANDARDISATION AND ACCREDITATION

EESTI STANDARDI EESSÕNA

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EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 12390-19

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English Version

Testing of hardened concrete - Determination of electrical resistivity

Essais pour béton durci - Détermination de la résistivité électrique

Prüfung von Festbeton - Teil 19: Bestimmung des elektrischen Widerstands

This European Standard was approved by CEN on 9 January 2023.

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European foreword

This document (EN 12390-19:2023) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, Subcommittee SC1 “Concrete - Specification, performance, production and conformity”, the secretariat of which is held by SN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2023, and conflicting national standards shall be withdrawn at the latest by August 2023.

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

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Introduction

This test method is one of a series concerned with testing hardened concrete.

This document is based on current national standards and in particular the Spanish standard UNE PNE 83988 Part 1 and Part 2.

Resistivity is a property that quantifies how strongly a given material opposes the flow of electric current. Resistivity is the electrical resistance of a unit volume (e.g. 1 m^3) of a concrete. It is the inverse of conductivity, and it is obtained from the ratio between the voltage drop and the current (Ohm's law).

The resistivity of a water-saturated concrete is mainly a function of the pore size distribution and the connectivity/tortuosity of the pore system. It also depends on the pore solution composition, which is strongly affected by the cement type, additions, w/c ratio, aggregate type and the degree of hydration of the cement.

Resistivity is also dependent on temperature and for quality control testing, the temperature of the concrete specimens should be held within a defined range for comparable results.

The document is applied to water saturated concretes because the resistivity is affected by the degree of water saturation. A reduction in the moisture content increases the resistivity. Loss of continuity of the pore system by drying can have more impact on the resistivity value than a change in the volume of capillary porosity because drying can produce changes of more than one order of magnitude while a change in capillary porosity can be reflected in changes of two or three times.

In this document a 4-electrode arrangement is recommended as it avoids the voltage drop produced by the concrete/electrode interfacial resistance. This interfacial resistance can appear when using only two electrodes placed on parallel faces of the specimen, electrodes which apply the current and measure the voltage at the same geometrical point. If two electrodes are used, calibration is recommended with the 4 electrodes arrangement described in this document.

The measured resistivity is also affected by the electrical frequency of testing ([1], [2], [3], [4]) and so the measured resistivity could be increased by reducing the electrical frequency. In addition, for the same electrical frequency, the measured resistivity is dependent on the specific pattern of the electrical field across the specimen. Notwithstanding these differences, where the electrical resistivity is determined in the same conditions, in a frequency range where the electrode polarization phenomena are independent of its variation, changes in resistivity reflect changes occurring in the concrete.

An electrically conductive or porous aggregate also influences the magnitude of concrete resistivity. This should be considered when establishing threshold values as it prevents a comparison of resistivity values between concretes if the aggregates show a difference of half an order of magnitude (higher or lower) of resistivity. The same effect of decreasing the measured resistivity is produced when metallic or electricity conducting fibres or particles, are present.

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1 Scope

This document describes two methods for measuring the electrical resistivity of concrete in water saturated conditions: the volumetric method (see 3.1.3), which is the reference method, and the surface method (see 3.1.4). The document gives the procedure to calibrate the surface method by means of the reference-volumetric method. Both methods give the same resistivity result, provided the provisions of the present document (using the Form Factor (F_f) for equivalence between them) are followed.

NOTE The volumetric method is applicable to cast specimens or cores, while the surface method is suitable for use on cast specimens, cores and on construction sites, but not all of these applications are covered in this document.

The method can be applied to the normal range of concretes covered by current standards. It does not cover concretes containing metallic components or made with porous aggregates.

The use of resistivity to assess the potential for corrosion of reinforcement in existing structures is not specified in this document.

The use of resistivity to test cores taken from an existing structure, which require pre-conditioning by water saturation, is not covered in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12390-2, *Testing hardened concrete - Part 2: Making and curing specimens for strength tests*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp/ui

3.1.1
electrical resistance
R_e
voltage drop divided by current (in Ohm)

$$R_e = \frac{U}{I} \quad (1)$$

where

U is the difference in voltage drop before and after the application of the current between the voltage electrode; and

I is current circulating through the current electrodes

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