SLOVENSKI STANDARD
SIST EN 13584:2003

01-december-2003

Proizvodi in sistemi za zaġļ ito in popravilo betonskih konstrukcij - Preskusne metode ï Doloļ evanje lezenja pri tlaļ nem preskusu proizvodov za popravilo

Products and systems for the protection and repair of concrete structures - Test methods - Determination of creep in compression for repair products

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung des Kriechens von Betonersatzsystemen im Druckversuch

Produits et systemes pour la protection et la réparation des structures en béton - Méthodes d'essai - Détermination du fluage en compression des produits de réparation

Ta slovenski standard je istoveten z: **EN 13584:2003**

ICS:

91.080.40	Betonske konstrukcije	Concrete structures

SIST EN 13584:2003 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13584

August 2003

ICS 91.080.40

English version

Products and systems for the protection and repair of concrete structures - Test methods - Determination of creep in compression for repair products

Produits et systèmes pour la protection et la réparation des structures en béton - Méthodes d'essai - Détermination du fluage en compression des produits de réparation

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung des Kriechens von Betonersatzsystemen im Druckversuch

This European Standard was approved by CEN on 12 June 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 13584:2003 E

Contents

Foreword

This document (EN 13584:2003) has been prepared by Technical Committee CEN/TC 104, "Concrete and related products", the Secretariat of which is held by DIN.

It has been prepared by sub-committee 8 “Products and systems for the protection and repair of concrete structures” (Secretariat AFNOR).

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 February 2004, and conflicting national standards shall be withdrawn at the latest by February 2004.

This European Standard is one of a series dealing with products and systems for the protection and repair of concrete structures. It describes a test method used to evaluate the creep in compression of repair grouts, mortars and concretes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a method for measuring creep under compressive load in products and systems for the repair of concrete structures, as defined in prEN 1504-3.The method is suitable for repair mortars and concretes with polymer binders (PC) and repair grouts, mortars and concretes with hydraulic binders (CC) and polymer cement binders (PCC).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

EN 1504-1, *Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 1: Definitions.*

prEN 1504-3, *Products and systems for the protection and repair of concrete structures - Definition, requirements, quality control, evaluation of conformity - Part 3: Structural and non-structural repair.*

EN 12190, *Products and systems for the protection and repair of concrete structures - Test Methods - Determination of compressive strength of repair mortar.*

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

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions contained in EN 1504-1 and prEN 1504-3 apply, supplemented by the following.

3.1
creep load (P_1)
25 % of the compressive strength of the repair product or system under test, measured in accordance with EN 12190

3.2
compressive stress
the force per unit area of the original cross section of a test specimen under the application of a compressive load

3.3
compressive strain
the deformation produced by a compressive stress expressed as the change per unit of the original dimension of the test specimen

3.4
elastic compressive strain
the compressive strain measured immediately following the application of a load up to the elastic limit (see Figure 1)

3.5
shrinkage strain
the strain due to shrinkage measured at the control specimen

3.6
creep strain
the time-dependent amount of compressive strain above the elastic compressive strain measured under the application of a constant load (see Figure 1)

3.7
creep coefficient
the ratio of creep strain to elastic compressive strain

3.8
elastic recovery strain
the amount of compressive strain lost by a test specimen measured immediately following unloading to zero stress (see Figure 1)

3.9
creep recovery strain
the time-dependent amount of compressive strain lost by a test specimen following unloading to zero stress after the elastic recovery (see Figure 1)

3.10
creep recovery coefficient
the ratio of creep recovery strain to elastic recovery strain

4 Principle

In the test for creep in compression, a prism of 4:1 aspect ratio is subjected to a constant compressive load and the change in compressive strain with time is measured during the creep phase. After unloading the change of strain with time is measured during the creep recovery phase. The effect of superimposed shrinkage is taken into consideration in the calculation of creep strain, elastic compressive strain etc.

5 Apparatus

5.1 Compressive creep rig: comprising a support frame and flat jack arrangement capable of maintaining the creep load (see **3.1**) along the longitudinal axis of the compressive creep test specimens (see **5.5**) for at least 26 weeks and be capable of applying a load at a rate of between 200 N/s and 1 000 N/s. The vertical pillars connecting the platens of the rig (see **5.2**) shall have a stiffness (axial load/axial deflection) of not less than 250 kN/mm. They incorporate a means of adjustment to provide a parallelism tolerance between the upper and lower platen of 0,06 mm.

NOTE A suitable hydraulic compressive creep rig capable of testing two test specimens simultaneously is illustrated in Figure 2. The incorporation of a gas/oil accumulator in the hydraulic system serves to extend the time between occasions when it will be necessary to pump oil in order to maintain the constant values for the duration of the test. The compressive load and hence the compressive stress applied to the test specimens can then be monitored by a load cell conforming to ISO 376 inserted between the upper test specimens and the upper platen of the rig.

5.2 Load platens in contact with the specimens (see **5.5**) shall have a stiffness (axial load/central deflection) of not less than 2 500 kN/mm to avoid excessive deformation during loadings. The flatness tolerance for the area of the platen in contact with the load cell shall conform to EN 12390-1.

5.3 Spacing blocks used between the test specimen and the flat jack (see **5.1**) to reduce the test space and to compensate for any bow developed in the faces of the flat jack when under pressure. The spacing blocks are either circular or square in section, to enable the test specimens to be correctly centred and support them over the whole area of their ends. The property of the material, the surface flatness and the surface texture of the contact faces of all spacing blocks shall conform to EN 12390-1.

5.4 Spherical seating is incorporated between the load cell (see **5.1**) and the top end piece of the compressive creep test specimen (see **5.5**) to prevent eccentric loading.

5.5 Moulds shall be of metal and suitable for the casting of the compressive creep test specimens in the form of prisms 40 mm x 40 mm x 160 mm within the tolerances for dimensions and shape of EN12390-1.

5.6 Strain gauges, with a gauge length of 100 mm and a maximum sensitivity of 20 μm/m. The strain gauges shall be connected to equipment capable of providing readings of the strain at any time. They shall be calibrated by a method traceable to a national or international standard of length measurement. The error shall not exceed 2 % of the actual strain.

5.7 Standard laboratory climate, in accordance with annex A.

5.8 Mixer of the standard type specified for producing cement mortars in EN 196-1 or **forced action pan mixer** for mixing the constituents of the repair mortar or concrete.

6 Preparation

6.1 General

The following procedure shall be used to prepare a minimum of three specimens for the test, conforming to EN 12390-1.

6.2 Casting of test specimens

The components of the product under test shall be maintained at the standard laboratory climate (see **5.7**) for at least 24 hours before mixing. The repair product or system shall be mixed in accordance with the manufacturer's recommendations and then compacted in the moulds to form the compressive creep test specimens. The specimens shall then be cured in accordance with annex A until ready for testing.

NOTE For preference, a supplier's complete pack of pre-weighted components should be used, but where this is not practicable the proportioning of the components should be strictly in accordance with the manufacturer's recommended procedure.

6.3 Conditioning

On completion of curing, the specimens shall be conditioned for at least 24 hours in the standard laboratory climate (see **5.7**). For the total period of test, the test specimens and all parts of the test equipment in close contact with them, if not the entire test equipment (see **5.1** to **5.4**), shall be maintained under the standard laboratory conditions (see **5.7**).

6.4 Measurement

Measure the height, width and length of each specimen at the mid point of each side to an accuracy of ± 0,1 mm and calculate its cross-sectional area from the height and width..

7 Procedure

The following procedure shall be used for measuring the compressive creep of each specimen.

7.1 Preparation for testing

Fit two strain gauges (see **5.6**) to opposite cast sides of the test and control specimens, their gauge lengths being centrally located over the longitudinal axis of the specimens.

Wipe clean the bearing surfaces of the load platens (see **5.2**) and spacing blocks (see **5.3**) of the creep rig, and the ends of the test specimens. Place the test specimens in the test rig such that the load is applied through the longitudinal axis and centre the whole assembly carefully.

Do not use packing at any of the interfaces between the test specimens, spacing blocks, load cell or platens.

7.2 Pre-loading cycle

Apply the load smoothly within the required rate (see **5.1**) until the specified creep load P_1 (see **3.1**) is indicated for the product under test.

Smoothly reduce the load to 0,1 P_1 and re-apply the creep load P_1 at least twice to ensure the specimens and platens are well seated and that the strain gauges are indicating consistently, recording the maximum strain reading on each occasion and then returning the load to 0,1 P_1.

If the two maximum strain readings are not within a range of ± 10 % of their mean value at creep load P_1, remove the load, re-centre the test specimen and then repeat the procedure. If it is not possible to reduce the difference in strain to within the range of ± 10 %, do not proceed with the test on that specimen. Select another specimen from the same batch and continue until two acceptable specimens have been found.

7.3 Creep loading cycle

Immediately following the pre-loading cycle (see **7.2**), zero the strain gauges at load 0,1 P_1, and re-apply the creep load P_1 smoothly within the required rate (see **5.1**) and maintain the load. Immediately take a reading from both strain gauges.

Take readings from both strain gauges at hourly intervals for the first six hours, while ensuring the creep load is maintained at P_1. After this period, take a reading 24-hours after the time of starting the creep loading cycle and then after every 24-hour period for the next ten days. Thereafter, take twice weekly until the termination of the creep phase of the test. Check regularly that the total load P_1 is maintained and restore it when necessary.

7.4 Creep recovery

After 26 weeks, unload the specimen smoothly within the required rate (see **5.1**) and immediately take a reading from the strain gauges. Thereafter take readings at zero load at daily intervals until the termination of the creep recovery phase of 4 weeks.

7.5 Compressive strength testing

Following the creep recovery phase (see **7.4**), load each specimen in axial compression in accordance with EN 12390-3 and record the maximum load at the point of failure.

7.6 Shrinkage control specimen

Keep the control specimen in the standard laboratory climate (see **5.7**) alongside the specimens in the creep rig and take shrinkage strain readings at the same time intervals as for the specimens under load. The control specimens shall be stood on end to facilitate uniform drying from the sides.

8 Calculation

To separate the effect of shrinkage, calculate the creep strain (see **3.6**) for each loaded test specimen as the mean compressive strain (see **3.3**) measured by each pair of strain gauges minus the mean shrinkage strain (see **3.5**) measured by the strain gauges on the shrinkage control specimen at the time of measurement.

For each loaded test specimen plot a curve of the calculated creep strain against time for the loading, creep and creep recovery phases of the test. Identify on the curve the magnitude of the elastic compressive strain (see **3.4**) at the applied creep load P_1, the creep strains at durations of 1 week, 4 weeks and 26 weeks, the elastic recovery strain (see **3.8**) and the creep recovery strain (see **3.9**) at durations of 1 week and 4 weeks following unloading.

Calculate the creep coefficient (see **3.7**) at durations of 1 week, 4 weeks and 26 weeks.

Calculate the creep recovery coefficient (see **3.10**) at durations of 1 week and 4 weeks after unloading.