

საქართველოს ეროვნული სტანდარტი

ეპროკოდი 8: მიწისკვრებისა და ელვრალი კონსტრუქციების ღაკროექტება.
ნაწილი 5: საპირკველები, შიშააკვებელი კონსტრუქციები და გეოტექნიკური
ასკვეტები

საქართველოს სტანდარტების, ტექნიკური რეგლამენტების
და მეტროლოგიის ეროვნული სააგენტო
თბილისი

საინფორმაციო მონაცემები

1 შეეშავებულია საქართველოს სტანდარტების, ტექნიკური რეგლამენტების და მეტროლოგიის ეროვნული სააგენტოს სტანდარტებისა და ტექნიკური რეგლამენტების დეპარტამენტის მიერ

2 დამტკიცებულია და შემოღებულია სამოქმედო საქართველოს სტანდარტების, ტექნიკური რეგლამენტების და მეტროლოგიის ეროვნული სააგენტოს 2009 წლის 8 მაისის №24 “ს” განკარგულებით

3 მიღებულია გარეკანის მეთოდით სტანდარტიზაციის საერთაშორისო ორგანიზაციის სტანდარტი ისო ენ 1998-5 : 2004 “**ევროკოდი 8: მიწისძვრებისადმი მდგრადი კონსტრუქციების დაპროექტება. ნაწილი 5: საძირკვლები,შემაკავებელი კონსტრუქციები და გეოტექნიკური ასპექტები**”

4 პირველად

5 რეგისტრირებულია საქართველოს სტანდარტების, ტექნიკური რეგლამენტების და მეტროლოგიის ეროვნული სააგენტოს რეესტრში: 2009 წლის 15 მაისი №268-1.3-2471

წინამდებარე სტანდარტის სრული ან ნაწილობრივი აღწარმოება, გირაჟირება და გავრცელება საქართველოს სტანდარტების, ტექნიკური რეგლამენტების და მეტროლოგიის ეროვნული სააგენტოს ნებართვის გარეშე არ დაიშვება

საინფორმაციო ნაწილი. სრული ტექსტის სანახავად შეიძინეთ სტანდარტი.

English version

Eurocode 8: Design of structures for earthquake resistance Part 5: Foundations, retaining structures and geotechnical aspects

Eurocode 8: Calcul des structures pour leur résistance aux séismes Partie 5: Fondations, ouvrages de soutènement et aspects géotechniques

Eurocode 8: Auslegung von Bauwerken gegen Erdbeben Teil 5: Gründungen, Stützbauwerke und geotechnische Aspekte

This European Standard was approved by CEN on 16 April 2004.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, 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

Contents

<u>FOREWORD</u>	4
<u>1 GENERAL</u>	8
1.1 <u>SCOPE</u>	8
1.2 <u>NORMATIVE REFERENCES</u>	8
1.2.1 <u>General reference standards</u>	8
1.3 <u>ASSUMPTIONS</u>	9
1.4 <u>DISTINCTION BETWEEN PRINCIPLES AND APPLICATIONS RULES</u>	9
1.5 <u>TERMS AND DEFINITIONS</u>	9
1.5.1 <u>Terms common to all Eurocodes</u>	9
1.5.2 <u>Additional terms used in the present standard</u>	9
1.6 <u>SYMBOLS</u>	9
1.7 <u>S.I. UNITS</u>	11
<u>2 SEISMIC ACTION</u>	12
2.1 <u>DEFINITION OF THE SEISMIC ACTION</u>	12
2.2 <u>TIME-HISTORY REPRESENTATION</u>	12
<u>3 GROUND PROPERTIES</u>	13
3.1 <u>STRENGTH PARAMETERS</u>	13
3.2 <u>STIFFNESS AND DAMPING PARAMETERS</u>	13
<u>4 REQUIREMENTS FOR SITING AND FOR FOUNDATION SOILS</u>	14
4.1 <u>SITING</u>	14
4.1.1 <u>General</u>	14
4.1.2 <u>Proximity to seismically active faults</u>	14
4.1.3 <u>Slope stability</u>	14
4.1.3.1 <u>General requirements</u>	14
4.1.3.2 <u>Seismic action</u>	14
4.1.3.3 <u>Methods of analysis</u>	15
4.1.3.4 <u>Safety verification for the pseudo-static method</u>	16
4.1.4 <u>Potentially liquefiable soils</u>	16
4.1.5 <u>Excessive settlements of soils under cyclic loads</u>	18
4.2 <u>GROUND INVESTIGATION AND STUDIES</u>	18
4.2.1 <u>General criteria</u>	18
4.2.2 <u>Determination of the ground type for the definition of the seismic action</u>	19
4.2.3 <u>Dependence of the soil stiffness and damping on the strain level</u>	19
<u>5 FOUNDATION SYSTEM</u>	21
5.1 <u>GENERAL REQUIREMENTS</u>	21
5.2 <u>RULES FOR CONCEPTUAL DESIGN</u>	21
5.3 <u>DESIGN ACTION EFFECTS</u>	22
5.3.1 <u>Dependence on structural design</u>	22
5.3.2 <u>Transfer of action effects to the ground</u>	22
5.4 <u>VERIFICATIONS AND DIMENSIONING CRITERIA</u>	23
5.4.1 <u>Shallow or embedded foundations</u>	23
5.4.1.1 <u>Footings (ultimate limit state design)</u>	23
5.4.1.2 <u>Foundation horizontal connections</u>	24
5.4.1.3 <u>Raft foundations</u>	25
5.4.1.4 <u>Box-type foundations</u>	25
5.4.2 <u>Piles and piers</u>	26
<u>6 SOIL-STRUCTURE INTERACTION</u>	27
<u>7 EARTH RETAINING STRUCTURES</u>	28
7.1 <u>GENERAL REQUIREMENTS</u>	28
7.2 <u>SELECTION AND GENERAL DESIGN CONSIDERATIONS</u>	28
7.3 <u>METHODS OF ANALYSIS</u>	28

საინფორმაციო ნაწილი. სრული ტექსტის საწარმოებელი შეიქმნა "სტანდარტი" შპს-ს მიერ.

7.3.1	<u>General methods</u>	28
7.3.2	<u>Simplified methods: pseudo-static analysis</u>	29
7.3.2.1	<u>Basic models</u>	29
7.3.2.2	<u>Seismic action</u>	29
7.3.2.3	<u>Design earth and water pressure</u>	30
7.3.2.4	<u>Hydrodynamic pressure on the outer face of the wall</u>	31
7.4	<u>STABILITY AND STRENGTH VERIFICATIONS</u>	31
7.4.1	<u>Stability of foundation soil</u>	31
7.4.2	<u>Anchorage</u>	31
7.4.3	<u>Structural strength</u>	32
<u>ANNEX A (INFORMATIVE) TOPOGRAPHIC AMPLIFICATION FACTORS</u>		33
<u>ANNEX B (NORMATIVE) EMPIRICAL CHARTS FOR SIMPLIFIED LIQUEFACTION ANALYSIS</u>		34
<u>ANNEX C (INFORMATIVE) PILE-HEAD STATIC STIFFNESSES</u>		36
<u>ANNEX D (INFORMATIVE) DYNAMIC SOIL-STRUCTURE INTERACTION (SSI). GENERAL EFFECTS AND SIGNIFICANCE</u>		37
<u>ANNEX E (NORMATIVE) SIMPLIFIED ANALYSIS FOR RETAINING STRUCTURES</u>		38
<u>ANNEX F (INFORMATIVE) SEISMIC BEARING CAPACITY OF SHALLOW FOUNDATIONS</u>		42

საინფორმაციო ნაწილი. სრული ტექსტის სანახავად შეიძინეთ სტანდარტი.

Foreword

This European Standard EN 1998–5, Eurocode 8: Design of structures for earthquake resistance: Foundations, retaining structures and geotechnical aspects, has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI. CEN/TC 250 is responsible for all Structural Eurocodes.

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 May 2005, and conflicting national standards shall be withdrawn at the latest by March 2010.

This document supersedes ENV 1998–5:1994.

According to the CEN-CENELEC Internal Regulations, the National Standard Organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Background of the Eurocode programme

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980's.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement¹ between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links *de facto* the Eurocodes with the provisions of all the Council's Directives and/or Commission's Decisions dealing with European standards (*e.g.* the Council Directive 89/106/EEC on construction products - CPD - and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

¹ Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on EUROCODES for the design of building and civil engineering works (BC/CEN/03/89).

საინფორმაციო ნაწილი. სრული ტექსტის სახსრავად შეიძინეთ სტანდარტი.

The Structural Eurocode programme comprises the following standards generally consisting of a number of Parts:

EN 1990	Eurocode :	Basis of Structural Design
EN 1991	Eurocode 1:	Actions on structures
EN 1992	Eurocode 2:	Design of concrete structures
EN 1993	Eurocode 3:	Design of steel structures
EN 1994	Eurocode 4:	Design of composite steel and concrete structures
EN 1995	Eurocode 5:	Design of timber structures
EN 1996	Eurocode 6:	Design of masonry structures
EN 1997	Eurocode 7:	Geotechnical design
EN 1998	Eurocode 8:	Design of structures for earthquake resistance
EN 1999	Eurocode 9:	Design of aluminium structures

Eurocode standards recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at national level where these continue to vary from State to State.

Status and field of application of Eurocodes

The Member States of the EU and EFTA recognise that Eurocodes serve as reference documents for the following purposes:

- as a means to prove compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC, particularly Essential Requirement N°1 – Mechanical resistance and stability – and Essential Requirement N°2 – Safety in case of fire ;
- as a basis for specifying contracts for construction works and related engineering services ;
- as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents² referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards³. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving full compatibility of these technical specifications with the Eurocodes.

² According to Art. 3.3 of the CPD, the essential requirements (ERs) shall be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for harmonised ENs and ETAGs/ETAs.

³ According to Art. 12 of the CPD the interpretative documents shall :

- a) give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary ;
- b) indicate methods of correlating these classes or levels of requirement with the technical specifications, e.g. methods of calculation and of proof, technical rules for project design, etc. ;
- c) serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.

The Eurocodes, *de facto*, play a similar role in the field of the ER 1 and a part of ER 2.

The Eurocode standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

National Standards implementing Eurocodes

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National annex.

The National annex may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e. :

- values and/or classes where alternatives are given in the Eurocode,
- values to be used where a symbol only is given in the Eurocode,
- country specific data (geographical, climatic, etc.), *e.g.* snow map,
- the procedure to be used where alternative procedures are given in the Eurocode.

It may also contain

- decisions on the application of informative annexes,
- references to non-contradictory complementary information to assist the user to apply the Eurocode.

Links between Eurocodes and harmonised technical specifications (ENs and ETAs) for products

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works⁴. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes shall clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1998-5

The scope of Eurocode 8 is defined in EN 1998-1:2004, **1.1.1** and the scope of this Part of Eurocode 8 is defined in **1.1**. Additional Parts of Eurocode 8 are listed in EN 1998-1:2004, **1.1.3**.

⁴ see Art.3.3 and Art.12 of the CPD, as well as 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

EN 1998-5:2004 is intended for use by:

- clients (e.g. for the formulation of their specific requirements on reliability levels and durability) ;
- designers and constructors ;
- relevant authorities.

For the design of structures in seismic regions the provisions of this European Standard are to be applied in addition to the provisions of the other relevant parts of Eurocode 8 and the other relevant Eurocodes. In particular, the provisions of this European Standard complement those of EN 1997-1:2004, which do not cover the special requirements of seismic design.

Owing to the combination of uncertainties in seismic actions and ground material properties, Part 5 may not cover in detail every possible design situation and its proper use may require specialised engineering judgement and experience.

National annex for EN 1998-5

This standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1998-5 should have a National annex containing all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

National choice is allowed in EN 1998-5:2004 through clauses:

Reference	Item
1.1 (4)	Informative Annexes A, C, D and F
3.1 (3)	Partial factors for material properties
4.1.4 (11)	Upper stress limit for susceptibility to liquefaction
5.2 (2)c)	Reduction of peak ground acceleration with depth from ground surface