



Institut luxembourgeois de la normalisation
de l'accréditation, de la sécurité et qualité
des produits et services

ILNAS-EN 1997-1:2004

**Eurocode 7: Geotechnical design - Part
1: General rules**

Eurocode 7: Calcul géotechnique - Partie
1: Règles générales

Eurocode 7 - Entwurf, Berechnung und
Bemessung in der Geotechnik - Teil 1:
Allgemeine Regeln

11/2004



National Foreword

This European Standard EN 1997-1:2004 was adopted as Luxembourgish Standard ILNAS-EN 1997-1:2004.

Every interested party, which is member of an organization based in Luxembourg, can participate for FREE in the development of Luxembourgish (ILNAS), European (CEN, CENELEC) and International (ISO, IEC) standards:

- Participate in the design of standards
- Foresee future developments
- Participate in technical committee meetings

<https://portail-qualite.public.lu/fr/normes-normalisation/participer-normalisation.html>

THIS PUBLICATION IS COPYRIGHT PROTECTED

Nothing from this publication may be reproduced or utilized in any form or by any mean - electronic, mechanical, photocopying or any other data carries without prior permission!

EUROPEAN STANDARD ILNAS-EN 1997-1:2004 **EN 1997-1**
NORME EUROPÉENNE
EUROPÄISCHE NORM November 2004

ICS 91.120.20

Supersedes ENV 1997-1:1994

English version

Eurocode 7: Geotechnical design - Part 1: General rules

Eurocode 7: Calcul géotechnique - Partie 1: Règles
générales

Eurocode 7: Entwurf, Berechnung und Bemessung in der
Geotechnik - Teil 1: Allgemeine Regeln

This European Standard was approved by CEN on 23 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

Foreword	5
Section 1 General	9
1.1 Scope	9
1.2 Normative references	10
1.3 Assumptions	11
1.4 Distinction between Principles and Application Rules	11
1.5 Definitions	12
1.6 Symbols	13
Section 2 Basis of geotechnical design	19
2.1 Design requirements	19
2.2 Design situations	21
2.3 Durability	22
2.4 Geotechnical design by calculation	23
2.5 Design by prescriptive measures	35
2.6 Load tests and tests on experimental models	36
2.7 Observational method	36
2.8 Geotechnical Design Report	36
Section 3 Geotechnical data	38
3.1 General	38
3.2 Geotechnical investigations	38
3.3 Evaluation of geotechnical parameters	39
3.4 Ground Investigation Report	47
Section 4 Supervision of construction, monitoring and maintenance	49
4.1 General	49
4.2 Supervision	49
4.3 Checking ground conditions	51
4.4 Checking construction	52
4.5 Monitoring	53
4.6 Maintenance	54
Section 5 Fill, dewatering, ground improvement and reinforcement	55
5.1 General	55
5.2 Fundamental requirements	55
5.3 Fill construction	55
5.4 Dewatering	59
5.5 Ground improvement and reinforcement	60
Section 6 Spread foundations	61
6.1 General	61
6.2 Limit states	61
6.3 Actions and design situations	61
6.4 Design and construction considerations	61
6.5 Ultimate limit state design	62
6.6 Serviceability limit state design	65
6.7 Foundations on rock; additional design considerations	67
6.8 Structural design of spread foundations	68
6.9 Preparation of the subsoil	68
Section 7 Pile foundations	70
7.1 General	70
7.2 Limit states	70
7.3 Actions and design situations	70

7.4	Design methods and design considerations	72
7.5	Pile load tests	74
7.6	Axially loaded piles	76
7.7	Transversely loaded piles	86
7.8	Structural design of piles.....	88
7.9	Supervision of construction	88
Section 8	Anchorage	91
8.1	General	91
8.2	Limit states	92
8.3	Design situations and actions.....	92
8.4	Design and construction considerations	93
8.5	Ultimate limit state design	94
8.6	Serviceability limit state design.....	95
8.7	Suitability tests.....	95
8.8	Acceptance tests	96
8.9	Supervision and monitoring.....	96
Section 9	Retaining structures	97
9.1	General	97
9.2	Limit states	97
9.3	Actions, geometrical data and design situations	98
9.4	Design and construction considerations	101
9.5	Determination of earth pressures	102
9.6	Water pressures	105
9.7	Ultimate limit state design	105
9.8	Serviceability limit state design.....	109
Section 10	Hydraulic failure	111
10.1	General.....	111
10.2	Failure by uplift	112
10.3	Failure by heave	114
10.4	Internal erosion.....	114
10.5	Failure by piping	115
Section 11	Overall stability	117
11.1	General.....	117
11.2	Limit states	117
11.3	Actions and design situations.....	117
11.4	Design and construction considerations	118
11.5	Ultimate limit state design	119
11.6	Serviceability limit state design.....	121
11.7	Monitoring.....	121
Section 12	Embankments	123
12.1	General.....	123
12.2	Limit states	123
12.3	Actions and design situations.....	123
12.4	Design and construction considerations	124
12.5	Ultimate limit state design	125
12.6	Serviceability limit state design.....	126
12.7	Supervision and monitoring.....	126
Annex A (normative)	Partial and correlation factors for ultimate limit states and recommended values	128
Annex B (informative)	Background information on partial factors for Design Approaches 1, 2 and 3	138
Annex C (informative)	Sample procedures to determine limit values of earth pressures on vertical walls	141
Annex D (informative)	A sample analytical method for bearing resistance calculation	156

Annex E (informative) A sample semi-empirical method for bearing resistance estimation	160
Annex F (informative) Sample methods for settlement evaluation	161
Annex G (informative) A sample method for deriving presumed bearing resistance for spread foundations on rock.....	163
Annex H (informative) Limiting values of structural deformation and foundation movement	165
Annex J (informative) Checklist for construction supervision and performance monitoring	167

Foreword

This document (EN 1997-1) has been prepared by Technical Committee CEN/TC250 "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 by **March 2010**.

This document supersedes ENV 1997-1:1994.

According to the CEN/CENELEC Internal Regulations, the national standards organizations 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 to 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 1980s.

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 Commissions 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).

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

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).

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.

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.

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.

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), *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 should clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to Eurocode 7

EN 1997-1 gives design guidance and actions for geotechnical design of buildings and civil engineering works.

EN 1997-1 is intended for clients, designers, contractors and public authorities.

EN 1997-1 is intended to be used with EN 1990 and EN 1991 to EN 1999.

In using EN 1997-1 in practice, particular regard should be paid to the underlying assumptions and conditions given in 1.3.

The 12 sections of EN 1997-1 are complemented by 1 normative and 8 informative annexes.

National annex for EN 1997-1

This standard gives alternative procedures and recommended values with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1997-1 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.

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