SINGAPORE STANDARDS COUNCIL

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EN 1997-1 : 2004, IDT
(ICS 91.010.30 ; 93.020)

SINGAPORE STANDARD

Eurocode 7 : Geotechnical design

– Part 1 : General rules

(This national standard is the identical implementation of EN 1997-1 : 2004 and is adopted with permission of CEN, Avenue Marnix 17, 1000 Brussels)

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Standards
SPRING Singapore
1 Fusionopolis Walk,
#01-02 South Tower, Solaris
Singapore 138628
Email : standards@spring.gov.sg

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National Foreword

This Singapore Standard was prepared by the Technical Committee on Civil and Geotechnical Works under the purview of the Building and Construction Standards Committee.

This SS EN is the identical implementation of EN 1997-1 : 2004 'Eurocode 7: Geotechnical design – Part 1 : General rules' (incorporating the CEN Corrigendum EN 1997-1:2004/AC:Feb 2009) and is adopted with permission of CEN Rue de Stassart 36, B-1050 Brussels. The text altered by the Corrigendum is indicated by AC1> <AC1.

Attention is drawn to the following:

– The comma has been used throughout as a decimal marker whereas in Singapore Standards, it is a practice to use a full point on the baseline as the decimal marker.

– The Singapore Standards which implement European publications referred to in this document may be found in the SS Electronic Catalogue at: http://www.singaporestandardseshop.sg.

The EN gives values with notes indicating where national choices may be made. Where a normative part of the EN allows for national choice to be made, the range and possible choice will be given in the normative text, and a note will qualify it as a Nationally Determined Parameter (NDP). NDPs can be a specific value for a factor, a specific level or class, a particular method or a particular application rule if several are proposed in the EN.

The requirements of this SS EN 1997-1 : 2010 are to be read in conjunction with the Singapore National Annex (NA) to SS EN 1997-1 : 2010 which contains information on the Singapore Nationally Determined Parameters and is published separately.

National choice is allowed in EN 1997-1 through the following clauses:

– 2.1(8)P	– 2.4.7.3.4.1(1)P	– 7.6.3.2(2)P	– A.3.1
– 2.4.6.1(4)P	– 2.4.7.4(3)P	– 7.6.3.2(5)P	– A.3.2
– 2.4.6.2(2)P	– 2.4.7.5(2)P	– 7.6.3.3(3)P	– A.3.3.1
– 2.4.7.1(2)P	– 2.4.8(2)	– 7.6.3.3(4)P	– A.3.3.2
– 2.4.7.1(3)	– 2.4.9(1)P	– 7.6.3.3(6)	– A.3.3.3
– 2.4.7.1(4)	– 2.5 (1)	– 8.5.2(2)P	– A.3.3.4
– 2.4.7.1(5)	– 7.6.2.2(8)P	– 8.5.2(3)	– A.3.3.5
– 2.4.7.1(6)	– 7.6.2.2(14)P	– 8.6(4)	– A.3.3.6
– 2.4.7.2(2)P	– 7.6.2.3(4)P	– 10.2(3)	– A.4
– 2.4.7.3.2(3)P	– 7.6.2.3(5)P	– 11.5.1(I)P	– A.5
– 2.4.7.3.3(2)P	– 7.6.2.4(4)P	– A.2	

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

At the time of publication, this standard is expected to be used as a reference in the Building and Construction Authority's 'Approved Document – Acceptable Solutions'.

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

NOTE

1. *Singapore Standards are subject to periodic review to keep abreast of technological changes and new technical developments. The changes in Singapore Standards are documented through the issue of either amendments or revisions.*

2. *Compliance with a Singapore Standard does not exempt users from legal obligations.*

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1997-1

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.

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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.

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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 Anchorages 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 157

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 agreement[1] 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 Documents[2] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[3]. 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.

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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 works[4]. 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.

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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.

National choice is allowed in EN 1997-1 through the following paragraphs:

— 2.1(8)P, 2.4.6.1(4)P, 2.4.6.2(2)P, 2.4.7.1(2)P, 2.4.7.1(3), [AC1] 2.4.7.1(4), 2.4.7.1(5), 2.4.7.1(6), [AC1] 2.4.7.2(2)P, 2.4.7.3.2(3)P, 2.4.7.3.3(2)P, 2.4.7.3.4.1(1)P, 2.4.7.4(3)P, 2.4.7.5(2)P, 2.4.8(2), 2.4.9(1)P, 2.5(1), 7.6.2.2(8)P, 7.6.2.2(14)P, 7.6.2.3(4)P, 7.6.2.3(5)P, 7.6.2.3(8), 7.6.2.4(4)P, 7.6.3.2(2)P, 7.6.3.2(5)P, 7.6.3.3(3)P, 7.6.3.3(4)P, 7.6.3.3(6), 8.5.2(2)P, 8.5.2(3), 8.6(4), [AC1] 10.2(3), [AC1] 11.5.1(1)P

and the following clauses in annex A:

— A.2

— A.3.1, A.3.2, A.3.3.1, A.3.3.2, A.3.3.3, A.3.3.4, A.3.3.5, A.3.3.6,

— A.4

— A.5

Section 1 General

1.1 Scope

1.1.1 Scope of EN 1997

(1) EN 1997 is intended to be used in conjunction with EN 1990:2002, which establishes the principles and requirements for safety and serviceability, describes the basis of design and verification and gives guidelines for related aspects of structural reliability.

(2) EN 1997 is intended to be applied to the geotechnical aspects of the design of buildings and civil engineering works. It is subdivided into various separate parts (see 1.1.2 and 1.1.3).

(3) EN 1997 is concerned with the requirements for strength, stability, serviceability and durability of structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

(4) Numerical values of actions on buildings and civil engineering works to be taken into account in design are provided in EN 1991 for the various types of construction. Actions imposed by the ground, such as earth pressures, shall be calculated according to the rules of EN 1997.

(5) Separate European Standards are intended to be used to treat matters of execution and workmanship. They are denoted in the relevant sections.

(6) In EN 1997 execution is covered to the extent that is necessary to comply with the assumptions of the design rules.

(7) EN 1997 does not cover the special requirements of seismic design. EN 1998 provides additional rules for geotechnical seismic design, which complete or adapt the rules of this Standard.

1.1.2 Scope of EN 1997-1

(1) EN 1997-1 is intended to be used as a general basis for the geotechnical aspects of the design of buildings and civil engineering works.

(2) The following subjects are dealt with in EN 1997-1:

Section 1: General

Section 2: Basis of geotechnical design

Section 3: Geotechnical data

Section 4: Supervision of construction, monitoring and maintenance

Section 5: Fill, dewatering, ground improvement and reinforcement

Section 6: Spread foundations

Section 7: Pile foundations

Section 8: Anchorages

Section 9: Retaining structures

Section 10: Hydraulic failure

Section 11: Overall stability

Section 12: Embankments

(3) EN 1997-1 is accompanied by Annexes A to J, which provide:

— in A: recommended ▌AC1⟩ partial factor ⟨AC1▐ values; different values of the partial factors may be set by the National annex;

— in B to J: supplementary informative guidance such as internationally applied calculation methods.

1.1.3 Further Parts of EN 1997

(1) EN 1997-1 is supplemented by EN 1997-2 that provides requirements for the performance and evaluation of field and laboratory testing.

1.2 Normative references

(1) 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).

NOTE The Eurocodes were published as European Prestandards. The following European Standards which are published or in preparation are cited in normative clauses

EN 1990:2002	Eurocode: Basis of structural design
EN 1991	Eurocode 1 Actions on structures
EN 1991-4	Eurocode 1 Actions on structures - Part 4 Actions in silos and tanks
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 1997-2	Eurocode 7 Geotechnical design - Part 2: Ground investigation and testing
EN 1998	Eurocode 8 Design of structures for earth quake resistance
EN 1999	Eurocode 9 Design of aluminium and aluminium alloy structures
EN 1536:1999	Execution of special geotechnical work: Bored piles
EN 1537:1999	Execution of special geotechnical work; Ground anchors
EN 12063:1999	Execution of special geotechnical work; Sheet-pile walls