

National Standards Authority of Ireland

IRISH STANDARD

I.S. EN 1998-3:2005

ICS 91.120.25

National Standards Authority of Ireland Glasnevin, Dublin 9 Ireland

Tel: +353 1 807 3800 Fax: +353 1 807 3838 http://www.nsai.ie

Sales http://www.standards.ie

This Irish Standard was published under the authority of the National Standards Authority of Ireland and comes into effect on: August 14, 2005

NO COPYING WITHOUT NSAI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

© NSAI 2005

BUILDINGS

Price Code Y

Údarás um Chaighdeáin Náisiúnta na hÉireann

EUROCODE 8: DESIGN OF STRUCTURES

ASSESSMENT AND RETROFITTING OF

FOR EARTHQUAKE RESISTANCE - PART 3:

This is a free 10 page sample. Access the full version online.

Eurocodes National Forword.

This Irish Standard is the official English language version of EN 1998-3:2005, prepared by Technical Committee CEN TC 250 "Structural Eurocodes". This document supersedes ENV 1998-1-4:1996.

This standard forms part of a package of 58 Eurocodes, which covers the basis of structural design, actions (loadings), the main structural materials, geotechnical design and design provisions for earthquakes. The European Commission document – Guidance Paper L – Application and Use of Eurocodes provides guidance on the elaboration, implementation and use of Eurocodes.

Where a normative part of this EN allows for a choice to be made at the national level the range and possible choices are given in the normative text and a Note will qualify it as a Nationally Determined Parameter (NDP).

To enable EN 1998-3:2005 to be used in Ireland the Nationally Determined Parameters will be published in a National Annex after public consultation has taken place.

Until the National Annex is available, publication of this European Standard is solely for educational/training purposes and this standard should not be used in project design until the relevant National Annex is available.

Note: For Use of this European Standard after Publication of the Irish National Annex.

I.S. EN 1998-3:2005 may now be used in Ireland. The Nationally Determined Parameters, which have been prepared by the NSAI National Eurocode Advisory Committee, are included as an informative annex to the standard.

The National Annex to I.S. EN 1998-3:2005 is also available as a separate publication as recommended in Guidance Paper L.

In Line with international standards practice the decimal point is shown as a comma (,) throughout this document.

This is a free 10 page sample. Access the full version online.

EUROPEAN STANDARD NORME EUROPÉENNE EUROPÄISCHE NORM

EN 1998-3

June 2005

ICS 91.120.25

Supersedes ENV 1998-1-4:1996

English version

Eurocode 8: Design of structures for earthquake resistance -Part 3: Assessment and retrofitting of buildings

Eurocode 8: Calcul des structures pour leur résistance aux séismes - Partie 3: Evaluation et renforcement des bâtiments Eurocode 8: Auslegung von Bauwerken gegen Erdbeben -Teil 3: Beurteilung und Ertüchtigung von Gebäuden

This European Standard was approved by CEN on 15 March 2005.

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

© 2005 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN 1998-3:2005: E

Co	ontents Page				
FO	FOREWORD				
		0			
1	GENERAL	9			
1.1	SCOPE	9			
1.2	NORMATIVE REFERENCES				
	1.2.1 General reference standards	10			
1.3	ASSUMPTIONS				
1.4	DISTINCTION BETWEEN PRINCIPLES AND APPLICATION RULES				
1.5	DEFINITIONS				
1.6	SYMBOLS				
	1.0.1 General				
	1.0.2 Symbols used in Annex A				
17	1.0.5 Symbols used in Annex D	12			
1./	5.1. UNITS				
2	PERFORMANCE REQUIREMENTS AND COMPLIANCE CRIT	TERIA 14			
2.1	FUNDAMENTAL REQUIREMENTS	14			
2.2	COMPLIANCE CRITERIA	15			
	2.2.1 General	15			
	2.2.2 Limit State of Near Collapse (NC)				
	2.2.3 Limit State of Significant Damage (SD)				
	2.2.4 Limit State of Damage Limitation (DL)				
3	INFORMATION FOR STRUCTURAL ASSESSMENT	17			
3.1	GENERAL INFORMATION AND HISTORY				
3.2	REQUIRED INPUT DATA				
3.3	KNOWLEDGE LEVELS				
	3.3.1 Definition of knowledge levels				
	3.3.2 KL1: Limited knowledge				
	3.3.3 KL2: Normal knowledge				
	3.3.4 KL3: Full knowledge				
3.4	IDENTIFICATION OF THE KNOWLEDGE LEVEL	21			
	<i>3.4.1 Geometry</i>				
	3.4.2 Details				
	3.4.3 Materials				
2 -	3.4.4 Definition of the levels of inspection and testing				
3.5	CONFIDENCE FACTORS	23			
4	ASSESSMENT	24			
4.1	GENERAL	24			
4.2	SEISMIC ACTION AND SEISMIC LOAD COMBINATION	24			
4.3	STRUCTURAL MODELLING	24			
4.4	METHODS OF ANALYSIS	25			
	<i>4.4.1 General</i>				
	4.4.2 Lateral force analysis				
	4.4.3 Multi-modal response spectrum analysis				
	4.4.4 Nonlinear static analysis				
	4.4.5 Non-linear time-history analysis				
	4.4.6 <i>q-factor approach</i>				

	4.4.7	Combination of the components of the seismic action	
	4.4.8	Additional measures for masonry infilled structures	
	4.4.9	Combination coefficients for variable actions	
	4.4.10	Importance classes and importance factors	
4.5	SAFE	TY VERIFICATIONS	
	4.5.1	Linear methods of analysis (lateral force or modal response spect	trum
	analysis) 28	
	4.5.2	Nonlinear methods of analysis (static or dynamic)	
	4.5.3	q-factor approach	
4.6	SUMN	MARY OF CRITERIA FOR ANALYSIS AND SAFETY VERIFICATIONS	29
5	DECIS	ONS FOR STRUCTURAL INTERVENTION	
5.1	CRIT	ERIA FOR A STRUCTURAL INTERVENTION	
	5.1.1	Introduction	
	5.1.2	Technical criteria	
	5.1.3	Type of intervention	
	5.1.4	Non-structural elements	32
	5.1.5	Justification of the selected intervention type	32
6	DESIG	N OF STRUCTURAL INTERVENTION	
6.1	RETR	OFIT DESIGN PROCEDURE	
AN	NEX A	(INFORMATIVE) REINFORCED CONCRETE STRUCTUR	RES.35
AN	NEX B	(INFORMATIVE) STEEL AND COMPOSITE STRUCTURE	E S 55
AN	NEX C	(INFORMATIVE) MASONRY BUILDINGS	

Foreword

This European Standard EN 1998-3, Eurocode 8: Design of structures for earthquake resistance: Assessment and Retrofitting of buildings, 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 December 2005, and conflicting national standards shall be withdrawn at the latest by March 2010.

This document supersedes ENV 1998-1-4:1996.

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).

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

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 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

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 hENs 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.

CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving a 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.

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 (informative).

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 1998-3

Although assessment and retrofitting of existing structures for non-seismic actions is not yet covered by the relevant material-dependent Eurocodes, this Part of Eurocode 8 was specifically developed because:

 $^{^4\,}$ 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.



The remainder of this document is available for purchase online at <u>www.saiglobal.com/shop</u>

SAI Global also carries a wide range of publications from a wide variety of Standards Publishers:

















Click on the logos to search the database online.