

Eurocode 6: Design of masonry structures —

**Part 1-2: General rules —
Structural fire design —**

**(together with United Kingdom
National Application Document)**

ICS 13.220.50; 91.080.30

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Committees responsible for this Draft for Development

The preparation of this Draft for Development was entrusted to Technical Committee B/525, Building and civil engineering structures, upon which the following bodies were represented:

Association of Consulting Engineers
British Cement Association
British Constructional Steelwork Association Ltd.
British Masonry Society
Building Employers Confederation
Department of the Environment (Building Research Establishment)
Department of the Environment (Construction Sponsorship Directorate)
Department of Transport
Federation of Civil Engineering Contractors
Institution of Civil Engineers
Institution of Structural Engineers
National Council of Building Material Producers
Royal Institute of British Architects
Timber Research and Development Association

The following bodies were also represented in the drafting of the document, through subcommittees and panels:

Autoclaved Aerated Concrete Products Association
Brick Development Association
British Ceramic Research Ltd.
British Precast Concrete Federation Ltd.
Calcium Silicate Brick Association Limited
Concrete Block Association
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National foreword

This Draft for Development was prepared by Technical Committee B/525 and is the English language version of ENV 1996-1-2:1995 *Eurocode 6 — Design of masonry structures — Part 1-2: General rules — Structural fire design*, published by the European Committee for Standardization (CEN). This Draft for Development also includes the United Kingdom (UK) National Application Document (NAD) to be used with the ENV for the design of buildings to be constructed in the UK.

ENV 1996-1-2:1995 results from a programme of work sponsored by the European Commission to make available a common set of rules for the design of building and civil engineering works.

This publication is not to be regarded as a British Standard.

An ENV is made available for provisional application during a period of trial use of 3 years, but does not have the status of a European Standard. At the end of the trial period, the aim is to use the experience gained to modify the ENV so that it can be adopted as a European Standard.

The values for certain parameters in the ENV Eurocodes may be set by CEN members so as to meet the requirements of national regulations. These parameters are designated by □ (boxed values) in the ENV.

During the ENV period of validity, reference should be made to the supporting documents listed in the National Application Document (NAD). The purpose of the NAD is to provide essential information, particularly in relation to safety, to enable the ENV to be used for buildings constructed in the UK. The NAD takes precedence over corresponding provisions in the ENV.

The Building Regulations 1991, Approved Document A 1992, draws attention to the potential use of ENV Eurocodes as an alternative approach to Building Regulation compliance. ENV 1996-1-2 has been thoroughly examined over a period of several years and is considered to offer such an alternative approach, when used in conjunction with this NAD.

Compliance with ENV 1996-1-2:1995 and this NAD does not in itself confer immunity from legal obligations.

Users of this document are invited to comment on its technical content, ease of use and any ambiguities or anomalies. These comments will be taken into account when preparing the UK national response to CEN on the question of whether the ENV can be converted to an EN.

Comments should be sent in writing to BSI, British Standards House, 389 Chiswick High Road, Chiswick, London W4 4AL, quoting the document reference, the relevant clause number and, where possible, a proposed revision, by 15 December 1997.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to xiv, the ENV title page, pages 2 to 20 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

National Application Document

**for use in the UK with
ENV 1996-1-2:1995**

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Introduction

This National Application Document (NAD) has been prepared by Technical Committee B/525. It has been developed from the following:

- a) a textual examination of ENV 1996-1-2:1995;
- b) a calibration against BS 5628-3:1985, supporting standards and test data.

It should be noted that this NAD, in common with ENV 1996-1-2 and supporting CEN standards, uses a comma where a decimal point would traditionally be used in the United Kingdom.

1 Scope

This NAD provides information to enable ENV 1996-1-2:1995 (Eurocode 6: Part 1-2) to be used for the design of buildings to be constructed in the United Kingdom. Its application does not extend to civil engineering works.

2 References

2.1 Normative references

This NAD incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on page xiii. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this NAD only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This NAD refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this document are listed on page xiii, but reference should be made to the latest editions.

3 Partial safety factors and other values to be used in ENV 1996-1-2:1995

The numerical value of average γ_f to be used in satisfying 3.1.3 (1) and Annex C (5) should be taken as 1,35. It should be noted that for the purposes of using the fire resistance tables in Annex C, it will not normally be necessary to apply this value of average γ_f when the design of loadbearing members is carried out in accordance with the recommendations of ENV 1996-1-1, as the appropriate partial safety factors for structural design will be those from ENV 1996-1-1 and its NAD.

The maximum slenderness ratio for vertically loaded walls should not exceed the numerical value 27. For loadbearing walls, slenderness ratio is defined as the effective wall height divided by effective wall thickness as given in 4.4 of ENV 1996-1-1 and its NAD. This definition varies from that given in 3.3 (3)P of ENV 1996-1-2.

The maximum height-to-thickness ratio for non-loadbearing walls should not exceed the numerical value 40 or exceed the relevant size limitations given in ENV 1996-2, as appropriate.

4 Reference documents

Where reference is made in ENV 1996-1-2 and in this NAD to “national regulations”, such regulations are the following.

In England and Wales:

The Building Regulations 1991.
(SI 1991 No. 2768)

In Scotland:

The Building Standards (Scotland) Regulations 1990. [SI 1990 No. 2179 (S.187)] as amended.

In Northern Ireland:

The Building Regulations (Northern Ireland) 1994. (SRNI 1994 No. 243).

The supporting documents to these building regulations are detailed in the list of references on page xiii, [1] to [4]. Reference publications cited in ENV 1996-1-2, together with equivalent British Standards, are listed in Table 1 of this NAD.

5 Additional information and recommendations

5.1 Clause 1.1 Scope

“Non-separating functions” is not a defined term within the regulatory context of the United Kingdom and is not part of the scope of this NAD.

5.2 Clause 1.3 Definitions

“Fire wall” is not a defined term within the regulatory context of the United Kingdom and is not part of the scope of this NAD.

“Non-separating wall” is not a defined term within the regulatory context of the United Kingdom and is not part of the scope of this NAD.

5.3 Clause 1.4 Symbols

Paragraph (1)

The partial safety factor, average γ_f , is defined as the total design load divided by the total characteristic load. This definition corrects an apparent error in ENV 1996-1-2.

The criterion “M” for mechanical impact is not used within the regulatory context of the United Kingdom and is not part of the scope of this NAD.

Table 1 — Reference in ENV 1996-1-2 to other publications

Document referred to	Document title	Status	UK document ^a
89/106/EEC	Construction Products Directive [5]	EC Directive	—
ID	Essential Requirement no. 2. Safety in case of fire [6]	Interpretative Document	—
ENV 1991-1	Eurocode 1: Basis of design and actions on structures— Part 1: Basis of design	Published 1994	DD ENV 1991-1:1996
ENV 1991-2-2	Eurocode 1: Basis of design and actions on structures — Part 2-2: Actions on structures — Actions on structures exposed to fire	Published 1995	DD ENV 1991-2-2:1996
ENV 1996-1-1	Eurocode 6: Design of masonry structures — Part 1-1: General rules for buildings — Rules for reinforced and unreinforced masonry	Published 1995	DD ENV 1996-1-1:1996
ENV 1996-2	Eurocode 6: Design of masonry structures — Part 2: Design, selection of materials and execution of masonry	In preparation	BS 5628:-3:1985 ^b
EN 771-1	Specification for masonry units — Part 1: Clay masonry units	In preparation	BS 3921:1985 (1995) BS 6649:1985 BS 4729:1990
EN 771-2	Specification for masonry units — Part 2: Calcium silicate masonry units	In preparation	BS 187:1978 BS 6649:1985 BS 4729:1990
EN 771-3	Specification for masonry units — Part 3: Aggregate concrete masonry units (Dense and lightweight aggregates)	In preparation	BS 6073-1:1981
EN 771-4	Specification for masonry units — Part 4: Autoclaved aerated concrete masonry units	In preparation	BS 6073-1:1981
EN 771-5	Specification for masonry units — Part 5: Manufactured stone masonry units	In preparation	BS 6457:1984
EN 771-6	Specification for masonry units — Part 6: Natural stone masonry units	In preparation	BS 5390:1976 (1984)
EN 772-13	Methods of test for masonry units — Part 13: Determination of net and gross dry density of masonry units	In preparation	—
EN 998-2	Specification for mortar for masonry — Part 2: Masonry mortar	In preparation	—
EN 1363-1	Fire resistance tests — Part 1: General requirements	In preparation	BS 476-20:1987
EN 1364-1	Fire resistance tests on non-loadbearing elements in buildings — Part 1: Walls	In preparation	BS 476-22:1987
EN 1365-1	Fire resistance tests on loadbearing elements in buildings — Part 1: Walls	In preparation	BS 476-21:1987
EN 1366-2	Fire resistance tests on service installations — Part 2: Dampers	In preparation	—
EN 1366-3	Fire resistance tests on service installations — Part 3: Penetration seals	In preparation	—
EN 1366-4	Fire resistance tests on service installations — Part 4: Linear gap seals	In preparation	—
ISO 1000	SI units and recommendations for the use of their multiples and of certain other units	Published 1992	BS 5555:1993

^a The EN standards will in due course be published in the UK as correspondingly numbered BS EN standards.

^b After ENV 1996-2 is published, the corresponding UK document will be DD ENV 1996-2.

5.4 Clause 2.1 Performance requirements

5.4.1 Paragraph (1)P

Guidance on the structural performance required of a wall and the applicability of the loadbearing, integrity and insulation criteria are given in the relevant supporting documents to the appropriate building regulations.

5.4.2 Paragraph (5)P

The criterion “M” for mechanical impact is not used within the regulatory context of the United Kingdom and is not part of the scope of this NAD.

5.5 Clause 2.2 Actions

Paragraph (1)P

Thermal actions may be obtained from ENV 1991-2-2 or from the relevant supporting documents to the appropriate building regulations. However, in some instances, the designer may need to consider alternative performance criteria such as might be specified for insurance purposes.

5.6 Clause 3.1.2 Wall types, function

5.6.1 Paragraph (3)

“Non-separating wall” is not a defined term within the regulatory context of the United Kingdom

5.6.2 Paragraph (4)

The requirements for external walls should be sought from the relevant supporting documents to the appropriate building regulations. No distinction is to be made for walls less than 1,0 m in length.

5.6.3 Paragraph (5)

“Fire wall” is not a defined term within the regulatory context of the United Kingdom.

5.7 Clause 3.1.3 Cavity walls

Paragraph (3)

The fire resistance period for a non-loadbearing cavity wall is limited to a maximum of 240 min when fire resistance is determined by this method.

5.8 Clause 3.1.4 Junctions, joints

5.8.1 Paragraph (2)P

Replace the text of (2)P with the following.

Joints in walls, or between walls and other fire separating members, shall be designed and constructed so as to meet the required fire resistance.

5.8.2 Paragraph (3)P

Delete the text of (3)P.

5.9 Clause 3.1.5 Fixtures, pipes and cables

Paragraph (1)

Replace the second sentence of (1) with the following.

For non-loadbearing walls, vertical chases and recesses should leave at least 2/3 of the required minimum thickness of the wall, including any integrally applied fire resistant finishes such as plaster, but be not less than 60 mm. Horizontal and inclined chases and recesses in non-loadbearing walls should leave at least 5/6 of the required minimum thickness of the wall, including any integrally applied fire resistant finishes such as plaster, but be not less than 60 mm, and should not be positioned within the middle one-third height of the wall. The width of individual chases and recesses in non-loadbearing walls should be not greater than twice the required minimum thickness of the wall, including any integrally applied fire resistant finishes such as plaster.

Guidance is given in the relevant supporting documents to the appropriate building regulations on matters relating to the passage of pipes and services through separating walls and, in particular, the need for fire stopping. The EN 1366 series is not yet published.

5.10 Clause 3.2 Materials for use in masonry walls

5.10.1 Paragraph (3)

Frogs should not comprise more than 20 % of the gross masonry unit volume in order to conform to the recommendations of paragraph (3) of 3.2

5.10.2 Paragraph (6)

The tables referred to in 3.5 and Annex C only apply to walls with filled vertical joints unless alternative jointing arrangements are shown by supporting test data to be adequate.

5.11 Clause 3.3 Additional requirements related to masonry walls

Paragraph (3)P

The tables referred to in 3.5 and Annex C may be used for assessing the fire resistance of loadbearing and non-loadbearing single-leaf and cavity masonry walls within the slenderness limitations given in clause 3 of this NAD. Loadbearing walls should additionally meet all regulatory requirements for structural stability in respect of the individual and combined actions and should be designed in accordance with ENV 1996-1-1 and its NAD.

5.12 Annex A Testing the fire resistance of masonry walls

Paragraph (2)

None of these standards has yet been published. Their UK alternatives, where available, are given in Table 1 of this NAD.

5.13 Annex B Guidance on the selection of fire resistance periods

Paragraphs (2) and (3)

The CEN/TC 127 standards referred to are EN 1363, EN 1364, EN 1365 and EN 1366, as listed in Table 1 of this NAD. None of these standards has yet been published. Their UK alternatives, where available, are given in Table 1 of this NAD.

5.14 Annex C Assessment by tables

5.14.1 Paragraph (1)

Fire resistance data for loadbearing masonry in the United Kingdom is based on tests undertaken on walls which are normally subjected to full design load, N_{Rd} . Non-loadbearing walls are assumed to carry no actions other than their own self-deadweight. Loadbearing walls which are not subjected to full design load, N_{Rd} , usually achieve higher fire resistance performance in respect of the stability criterion, R , than those which are fully loaded. Table C.2 gives recommendations for walls loaded up to $0,6N_{Rd}$.

As United Kingdom regulations for the fire safety design of masonry walls do not define or regulate for non-separating walls, fire walls or walls less than 1,0 m in length, only the following tables of fire resistance are applicable for use in the United Kingdom. These tables give the thicknesses which should be used in the United Kingdom to provide standard fire resistance periods for the types of masonry wall construction given in Tables C.1, C.2, C.5 and C.9 of ENV 1996-1-2:1995.

Table 2	(Table C.1 of ENV 1996-1-2:1995) Loadbearing single-leaf walls subject to load up to a resistance of N_{Rd} ÷ average γ_F ; separating function REI.
Table 3	(Table C.2 of ENV 1996-1-2:1995) Loadbearing single-leaf walls subject to load up to a resistance of $0,6N_{Rd}$ ÷ average γ_F ; separating function REI.
Table 4	(Table C.5 of ENV 1996-1-2:1995) Non-loadbearing single-leaf walls; separating function EI.
Table 5	(Table C.9 of ENV 1996-1-2:1995) Loadbearing cavity walls with one leaf loaded, subject to load up to a resistance of N_{Rd} ÷ average γ_F ; separating function REI.

Note that Table C.9 of ENV 1996-1-2 purports to cover loadbearing cavity walls with both leaves loaded. The loading of both leaves is not, however, applicable in the UK. Table 5 of this NAD therefore gives the appropriate values for loadbearing cavity walls with *one* leaf loaded.

Cavity walls comprising two non-loadbearing leaves designed in accordance with 3.1.3 3) and Table 4 should be limited to a maximum fire resistance period of 240 min.

Table 1 to Table 5 provide generalized data which has been derived from fire resistance tests carried out in accordance with the relevant Parts of BS 476 or its predecessors. For particular applications, specific fire resistance test data may be used to support wall thicknesses less than those given in the tables.

Where the tables show no wall thickness for a particular combination of construction material and fire resistance, this is either because no standard thickness of the relevant material will provide that fire resistance, or because no suitable fire test data is available. Data for these cases should *not* be extrapolated from the remainder of the table.

The data in the tables is based on currently accepted and published information derived from fire tests carried out in the United Kingdom. No method has yet been established for incorporating European fire test data into harmonized tables. The tables in this NAD are presented in the format used in ENV 1996-1-2.

Information on types of masonry wall other than those described in Tables 2 to 5 is given in BS 5628-3:1985 and Building Research Establishment Report BR 128 [7].

Use may also be made of alternative sources of data on the results of fire resistance tests of masonry systems undertaken in accordance with BS 476-20:1987, BS 476-21:1987 or BS 476-22:1987.

5.14.2 Paragraph (2)

The data in row a) of the tables applies to walls with no plaster finish and to walls with a sand-cement/sand-gypsum plaster finish.

In the United Kingdom, row b) of the tables refers to walls finished with vermiculite gypsum plaster (1½ : 1 to 2 : 1 by volume). Perlite gypsum plaster may be used on fired-clay masonry units and other materials with similar surfaces without affecting the fire performance indicated in these tables.

In all instances the finish should be not less than 13 mm plaster or rendering on each face of a single-leaf wall and on the fire-exposed face of a cavity wall.

5.14.3 Paragraph (5)

The average value of γ_f to be used in the United Kingdom is 1,35; see clause 3 of this NAD.

5.14.4 Paragraph (6)

Tables C.3, C.4, C.6, C.7 and C.8 of ENV 1996-1-2:1995 are not applicable in the United Kingdom.

Table 3 — Loadbearing single-leaf walls subject to load up to a resistance of $0,6N_{Rd}$ ÷ average γ_f ; separating function REI (equivalent to ENV 1996-1-2, Table C.2)

Material	Finish ^a	Minimum masonry thickness mm					
		Standard fire resistance min					
		30	60	90	120	180	240
Clay units conforming to EN 771-1							
Group 1 units $\rho \geq 1\,000\text{ kg/m}^3$ laid in general-purpose mortar	a)	90	100	100	140	170	200
	b)	90	90	100	100	140	170
Group 1 solid units $\rho \geq 1\,200\text{ kg/m}^3$ laid in general-purpose mortar	a)	90	90	100	100	170	170
	b)	90	90	90	100	100	140
Group 2a units $\rho \geq 700\text{ kg/m}^3$ laid in general-purpose mortar	a)	—	—	—	—	—	—
	b)	—	—	—	—	—	—
Group 2b units $\rho \geq 700\text{ kg/m}^3$ laid in general-purpose or lightweight mortar	a)	—	—	—	—	—	—
	b)	—	—	—	—	—	—
Group 3 units laid in general-purpose mortar	a)	—	—	—	—	—	—
	b)	—	—	—	—	—	—
Calcium silicate units conforming to EN 771-2, laid in general-purpose or thin-layer mortar							
Group 1 units $\rho \geq 1\,000\text{ kg/m}^3$	a)	90	100	100	170	190	—
	b)	90	90	100	100	170	—
Group 1 solid units $\rho \geq 1\,600\text{ kg/m}^3$	a)	90	90	100	100	170	190
	b)	90	90	90	100	100	190
Aerated concrete units conforming to EN 771-4, laid in general-purpose or thin-layer mortar							
Group 1 units $400 \leq \rho \leq 550\text{ kg/m}^3$	a)	100	100	100	120	140	150
	b)	90	100	100	100	120	150
Group 1 units $\rho > 550\text{ kg/m}^3$	a)	90	90	100	100	120	150
	b)	90	90	90	90	100	100
Aggregate concrete units conforming to EN 771-3 and manufactured stone units conforming to EN 771-5, laid in general-purpose, thin-layer or lightweight mortar							
Group 1 units $500 \leq \rho \leq 1\,500\text{ kg/m}^3$	a)	70	75	90	90	100	100
	b)	60	60	75	75	90	90
Group 1 units $\rho > 1\,500\text{ kg/m}^3$	a)	75	75	90	90	100	140
	b)	60	75	75	75	90	100
Group 2 units $500 \leq \rho \leq 800\text{ kg/m}^3$	a)	75	90	90	100	125	140
	b)	75	75	75	90	100	125
Group 2 units $\rho > 800\text{ kg/m}^3$	a)	90	100	125	140	140	150
	b)	75	90	90	125	125	140

^a a): for walls with no plaster finish and walls with a sand-cement/sand-gypsum plaster finish;
b): for walls finished with vermiculite gypsum plaster (1½ : 1 to 2 : 1 by volume); see 5.14.2.

Table 4 — Non-loadbearing single-leaf walls; separating function EI (equivalent to ENV 1996-1-2, Table C.5)

Material	Finish ^a	Minimum masonry thickness mm					
		Standard fire resistance min					
		30	60	90	120	180	240
Clay units conforming to EN 771-1							
Group 1 units $\rho \geq 1\,000\text{ kg/m}^3$ laid in general-purpose mortar	a)	65	100	100	100	170	200
	b)	65	65	90	100	140	170
Group 1 solid units $\rho \geq 1\,200\text{ kg/m}^3$ laid in general-purpose mortar	a)	65	65	90	100	170	170
	b)	65	65	90	100	100	140
Group 2a units $\rho \geq 700\text{ kg/m}^3$ laid in general-purpose mortar	a)	215	215	215	215	—	—
	b)	215	215	215	215	215	215
Group 2b units $\rho \geq 700\text{ kg/m}^3$ laid in general-purpose or lightweight mortar	a)	215	215	—	—	—	—
	b)	—	—	—	—	—	—
Group 3 units laid in general-purpose mortar	a)	—	—	—	—	—	—
	b)	—	—	—	—	—	—
Calcium silicate units conforming to EN 771-2, laid in general-purpose or thin-layer mortar							
Group 1 units $\rho \geq 1\,000\text{ kg/m}^3$	a)	65	100	100	100	170	—
	b)	65	65	90	100	140	—
Group 1 solid units $\rho \geq 1\,600\text{ kg/m}^3$	a)	65	65	90	100	170	170
	b)	65	65	90	100	100	170
Aerated concrete units conforming to EN 771-4, laid in general-purpose or thin-layer mortar							
Group 1 units $400 \leq \rho \leq 550\text{ kg/m}^3$	a)	65	65	70	70	100	100
	b)	50	65	70	70	100	100
Group 1 units $\rho > 550\text{ kg/m}^3$	a)	50	60	60	65	100	100
	b)	50	50	50	65	90	100
Aggregate concrete units conforming to EN 771-3 and manufactured stone units conforming to EN 771-5, laid in general-purpose, thin-layer or lightweight mortar							
Group 1 units $500 \leq \rho \leq 1\,500\text{ kg/m}^3$	a)	50	70	75	75	90	100
	b)	50	50	60	70	75	75
Group 1 units $\rho > 1\,500\text{ kg/m}^3$	a)	50	75	90	90	100	100
	b)	50	60	75	75	90	100
Group 2 units $500 \leq \rho \leq 800\text{ kg/m}^3$	a)	50	70	75	100	115	125
	b)	50	50	70	75	90	100
Group 2 units $\rho > 800\text{ kg/m}^3$	a)	95	100	125	140	140	140
	b)	70	80	90	100	125	125
^a a): for walls with no plaster finish and walls with a sand-cement/sand-gypsum plaster finish; b): for walls finished with vermiculite gypsum plaster (1½ : 1 to 2 : 1 by volume); see 5.14.2.							