

PUBLISHED DOCUMENT

Background paper to the UK National Annex to BS EN 1991-1-2

ICS 13.220.50, 91.010.30, 91.080.01



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ISBN 978 0 580 50604 8

The following BSI references relate to the work on this standard:
Committee reference B/525/1

Publication history

First published April 2007

Amendments issued since publication

Amd. no.	Date	Text affected
17225	29 June 2007	ISBN corrected
Corrigendum No. 1		

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Foreword

Publishing information

This Published Document has been prepared by BSI Subcommittee B/525/1.

This Published Document is published by BSI and came into effect on 30 April 2007. It was prepared by Subcommittee B/525/1, *Actions (loadings) and basis of design*, under the authority of Technical Committee B/525, *Building and civil engineering structures*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

This Published Document is a background paper that gives non-contradictory complementary information for use in the UK with BS EN 1991-1-2 and its UK National Annex.

Use of this document

As a guide, this Published Document takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this Published Document is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions in this document are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

The word “should” is used to express recommendations of this document. The word “may” is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word “can” is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this document. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Contractual and legal considerations

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

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Introduction

When there is a need for guidance on a subject that is not covered by the Eurocode, a country can choose to publish documents that contain non-contradictory complementary information that supports the Eurocode. This Published Document provides just such information and has been cited as a reference in the UK National Annex to BS EN 1991-1-2.

1 Scope

This Published Document is a background paper that gives non-contradictory complementary information for use in the UK with BS EN 1991-1-2 and its UK National Annex.

This Published Document gives non-contradictory complementary information on:

- a) background to the decision made in NA to BS EN 1991-1-2 for combination rules for mechanical actions for structural analysis;
- b) guidance on BS EN 1991-1-2:2002, Annex A and Annex B; and
- c) replacements for informative annexes BS EN 1991-1-2:2002, Annex C, Annex E and Annex F.

2 Combination rules for mechanical actions for structural analysis [BS EN 1991-1-2:2002, 4.3.1 (2)]

NA to BS EN 1991-1-2 recommends that the representative value of the variable action Q_L should be taken as the frequent value $\psi_{1,L}Q_L$, for certain situations as described in 2f). The reason for this is given by the following.

- a) Based on BS EN 1990:2002, 6.4.3.3 equation 6.11b simplifies to the combination of actions for accidental design situations as:

$$G + A + \psi_{1 \text{ or } 2,L}Q_L + \sum \psi_{2,i}Q_i$$

where

G is the permanent action;

A is the accidental action (which may involve an explicit action or refer to the situation after an accidental event such that $A = 0$);

Q_L is the leading variable action (i.e. that which has the largest effect);

Q_i are other variable actions which can be imposed, snow or wind loads;

ψ_1 is the frequent combination factor;

ψ_2 is the quasi-permanent combination factor.

- b) In the case of fire, the accidental action A results in increased temperatures and hence reduced resistances of structural members such that $A = 0$ after the accidental event.

- c) BS EN 1991-1-2:2002, **4.3.1** (2) allows the use of ψ_1 or ψ_2 in the accidental design situation for fire.
- d) The values for ψ given in NA to BS EN 1990:2002, Table NA.A1.1 for buildings are summarized in Table 1.

Table 1 **Summary of values for ψ given in BS EN 1990:2002, Table NA.A1.1**

Action		ψ_1	ψ_2
Imposed loads in buildings	Domestic, residential areas; office areas	0,5	0,3
	Congregation areas; shopping areas	0,7	0,6
	Storage areas	0,9	0,8
	Roofs	0	0
Snow on buildings for sites located at altitude $H \leq 1\,000$ m above sea level		0,2	0
Wind loads on buildings		0,2	0

- e) Based on a comparison with existing UK practice, two cases related to the following ultimate limit states from BS EN 1990:2002, **6.4.1** have been identified in g).
 - 1) EQU: Loss of static equilibrium of the structure or any part of it considered as a rigid body, where minor variations in the value or the spatial distribution of actions from a single source are significant, and the strengths of construction materials or ground are generally not governing.
 - 2) STR: Internal failure or excessive deformation of the structure or structural members, including footings, piles, basement walls, etc., where the strength of construction materials governs.
- f) The recommendation would be that ψ_1 is used for EQU cases and ψ_2 for STR cases. Thus for overturning of otherwise “rigid” perimeter columns during fire at actual or potential site boundaries EQU would be considered with wind included; and for internal structural collapse occasioned by member weakening during fire STR would be considered based on imposed loads without wind or snow.
- g) Thus, the loads to apply in the fire limit state in addition to the permanent actions are given in Table 2.

Table 2 Loads to apply in the fire limit state in addition to the permanent actions for leading variable action ψ_1 or ψ_2

Case		EQU (ψ_1 chosen)	STR (ψ_2 chosen)
If imposed (I) loads leading	Domestic, residential; office areas	0,5I	0,3I
	Congregation areas; shopping areas	0,7I	0,6I
	Storage	0,9I	0,8I
	Roofs	0	0
If snow (S) loads leading	Domestic, residential; office areas	0,2S + 0,3I	0,3I
	Congregation areas; shopping areas	0,2S + 0,6I	0,6I
	Storage	0,2S + 0,8I	0,8I
	Roofs	0,2S	0
If wind (W) loads leading	Domestic, residential; office areas	0,2W + 0,3I	0,3I
	Congregation areas; shopping areas	0,2W + 0,6I	0,6I
	Storage	0,2W + 0,8I	0,8I
	Roofs	0,2W	0

3 Guidance on BS EN 1991-1-2 informative annexes

3.1 Parametric temperature–time curves (BS EN 1991-1-2:2002, Annex A)

3.1.1 General

A major exercise was carried out to validate the parametric expressions against well documented fire test data. It was generally found that the temperature–time response predicted by the parametric expressions either closely matched the measured fire curve or over-predicted (safe) response.

A comparison between calculated and measured response for a low fire load is shown in Figure 1.

A comparison between calculated and measured response for a high fire load is shown in Figure 2. While there appears to be a difference in temperature time curves between the calculated and measured response when this is considered in relation to the thermal response of a lightly protected structural member this is not significant.