British Standard

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British Standard

Structural use of timber

Part 4. Fire resistance of timber structures

Section 4.2. Recommendations for calculating fire resistance of timber stud walls and joisted floor constructions

Utilisation de bois en construction
Partie 4. Résistance au feu des structures en bois
Section 4.2 Recommandations pour le calcul de la résistance au feu des cloisons de colombage et planchers à solives en bois

Verwendung von Holz im Bauwesen
Teil 4' Feuerbeständigkeit von Holzbauten
Abschnitt 4.2 Empfehlungen für die Berechnung der Feuerbeständigkeit von Fachwerkwänden und Balkendecken

Foreword

This Section of BS 5268 has been prepared under the direction of the Civil Engineering and Building Structures Standards Policy Committee.

The Code of Practice CP 112 'The structural use of timber' has been allocated the new number BS 5268 as part of the integration of work on codes and standards.

Other Parts of this British Standard will be as follows.

Part 1 Limit state design, materials and workmanship (for later publication).

Part 2 Permissible stress design, materials and workmanship.

Part 3 Trussed rafters for roofs.

Part 4 Fire resistance of timber structures
Section 4.1. Recommendations for calculating fire resistance of timber members.
Section 4.2. Recommendations for calculating fire resistance of timber stud walls and joisted floor constructions.

Part 5 Preservation treatment for constructional timber*

Part 6 Timber frame wall design
Section 6.1. Dwellings not exceeding three storeys

Part 7 Recommendations for the calculation basis for span tables
Section 7.1. Domestic floor joists
Section 7.2. Joists for flat roofs
Section 7.3. Ceiling joists
Section 7.4. Ceiling binders
Section 7.5. Domestic rafters†
Section 7.6. Purlins†
Section 7.7. Purlins supporting sheeting or decking†

BS 5268 : Part 4 gives information by which the fire resistance of timber elements of construction may be calculated. Such calculations are possible because, in fire, the behaviour of timber, with many common materials used in association with it, is predictable with regard to the rate of charring and loss of strength. Timber itself has very low coefficients of thermal expansion and conductivity and does not undergo any rapid change of state.

Section 4.1 of BS 5268 : Part 4 gives information required for the calculation of fire resistance for individual timber members. This Section of BS 5268 extends the code to include composite timber elements.

Fire resistance is related to elements of construction and not to individual materials; the appropriate test on which this document is based is described in BS 476 : Part 8*. The stability (resistance to structural failure), integrity and insulation criteria may all be applicable. The performance of an element is expressed in terms of the periods of time for which it satisfies the appropriate criteria.

This Section of BS 5268 lays down methods for calculating fire resistance which relate to the standard procedures for fire resistance testing. It should not be assumed that the performance of elements in real fire situations will necessarily be the same.

Care should be taken when applying this method of calculation to existing construction to take account of the actual condition of the construction.

NOTE. The results obtained from fire resistance tests in accordance with BS 476 : Part 8‡, on any specific construction take precedence over results derived from the information given in this Section of BS 5268. Assessments by a competent authority of a particular construction are as valid as the result of the method of calculation given in this Section of this standard.

New information on the fire resistance performance of composite timber elements and their component materials is continually being obtained from fire tests. Competent authorities may use such new information in conjunction with this Section of BS 5268 to provide assessments of the performance of individual constructions where appropriate. However, information from other fire resistance testing should not be used to generate new or additional values for the various tables without formal endorsement by the committee responsible for preparing this Section of BS 5268.

This Section of BS 5268 does not include constructions which include proprietory or generic materials for which there are no British Standards. For information on such constructions reference should be made to test results provided by manufacturers or suppliers, or published lists of tested constructions.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

*Revision in preparation.
†In preparation
‡The test methods specified in BS 476 : Part 8 have been revised and replaced by BS 476 : Parts 20 to 23. The calculation methods of BS 5268 : Part 4 rely essentially on data gathered from tests to BS 476 : Part 8. In due course data will become available from the revised testing procedures which will then be incorporated into Section 4.2 of BS 5268. The definitions and terminology of BS 476 : Part 8 will be maintained until these revised ...

Contents

Recommendations

1 Scope

This Section of Part 4 of BS 5268 gives recommendations for calculating the fire resistance of timber framed walls and partitions and joisted floors as an alternative to testing. The recommendations are applicable to single and double leaf walls and partitions; and to floors in which the joists are fully or partly concealed.

The recommendations are applicable to loadbearing wall and partition constructions where actual stud sizes are not less than 62 mm x 37 mm (depth x breadth) (see figure 1) and to non-loadbearing wall and partition constructions where the actual stud sizes are not less than 48 mm x 37 mm (depth x breadth) (see **6.2.2** and **6.4**).

The recommendations are also applicable to joisted floor constructions where the actual joist breadth is not less than 37 mm.

This Section of BS 5268 : Part 4 is limited to constructions having a fire resistance requirement of 1 hour or less.

NOTE 1. The minimum dimensions of timber (depth x breadth, see figure 1) given in this Section of this British Standard are based on the actual sizes of studs and joists tested. They do not have any relationship to the dimensions of softwood given in BS 4471.

NOTE 2. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purpose of this Section of this British Standard, the definitions given in BS 6100, BS 4422 : Part 2 and in clause 2 of BS 5268 : Part 2 apply, together with the following.

2.1 fire resistance performance. Combination of appropriate stability, integrity and insulation values respectively, expressed in minutes, e.g. 30 min stability, 30 min integrity and 15 min insulation are expressed at 30 : 30 : 15 min (see clause **3**).

2.2 contribution indices. Contribution values to the fire resistance performance of linings, claddings, infill materials (in association with specific linings) and framing members.

NOTE. Contribution indices have been specifically devised for this Section of this British Standard.

2.3 load ratio. Ratio of the actual axial load to the permissible axial load in a stud in the cold condition, expressed as a percentage.

2.4 exposed lining. Face of the wall exposed to fire in a fire test.

2.5 unexposed lining. Face of the wall remote from fire in a fire test.

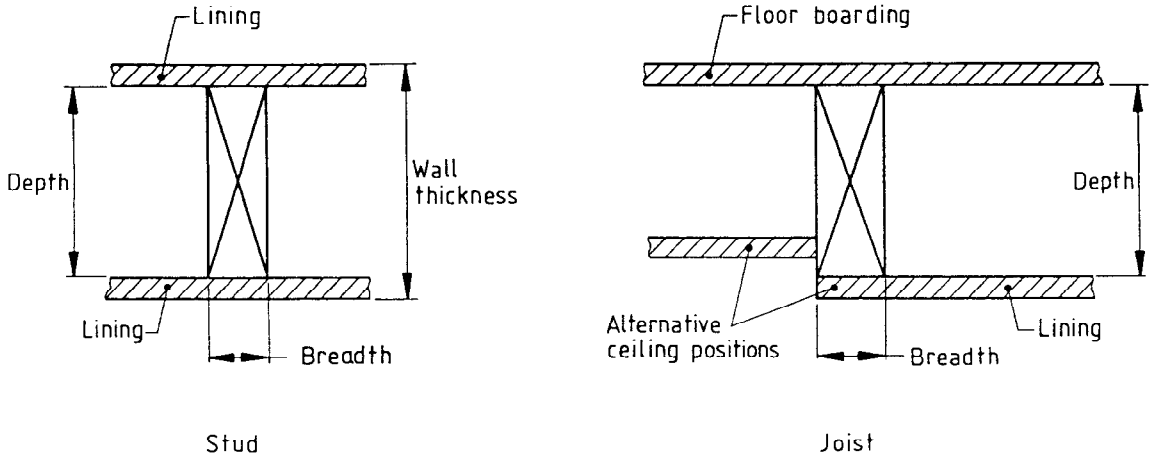


Figure 1. Diagram showing depth x breadth of stud and breadth of joist

3 Fire resistance criteria

The criteria for stability, integrity and insulation used throughout this Section of this British Standard are given in BS 476 : Part 8. In the case of stability, it should be emphasized that the criterion relates to the strength and deflection characteristics of an element, i.e. its ability to sustain the applied load throughout the period of the fire test and satisfy the reload criteria and, in the case of horizontal elements, its ability to comply also with a deflection limitation.

4 Materials

4.1 General

The methods of calculation used in this Section of this British Standard are only valid if the materials used in the construction of walls and floors, i.e. structural wall framing and joists, linings, claddings and infill insulation materials are supplied or manufactured in accordance with the requirements given in **4.2** to **4.11.**

NOTE. Although the use of asbestos based insulating board is not recommended by this British Standard, reference is made to it here to cover existing structures. It should not be used in new structures, where equivalent materials of comparable fire performance should be used.

4.2 Timber

Timber should be as follows.

(a) Structural wall framing and floor joists using species and grades of timber listed in BS 5268 : Part 2.

(b) Softwood boarding for floors and ceilings which comply with BS 1297 and the following specific requirements.

(i) Minimum density 420 kg/m^3.

(ii) For tongued and grooved (T and G) flooring, the tongue and groove shall comply with BS 1297.

(iii) Tongued and grooved ceiling boards. The tongue and groove machined to the profile given in figure 2.

(c) Hardwood tongued and grooved ceiling boards with a minimum density 650 kg/m^3 with the tongue and groove machined to the profile given in figure 2.

4.3 Plywood

Plywood should be as follows.

(a) Square edge and tongued and grooved floor boarding of species and grades listed in BS 5268 : Part 2.

(b) Wall linings contributing to the calculated structural stability of the wall using species and grades listed in BS 5268 : Part 6 : Section 6.1.

(c) Other wall linings and claddings of minimum density 500 kg/m^3.

4.4 Wood chipboard

Wood chipboard should be as follows.

(a) Square edge and tongued and grooved floor boarding, ceiling linings which comply with BS 5669.

(b) Wall linings contributing to the calculated structural stability of the wall: boards included in BS 5268 : Part 6 : Section 1.

(c) Other wall linings which comply with BS 5669.

4.5 Hardboards and fibre insulating boards

Hardboards and fibre insulating boards should be as follows.

(a) Medium boards of type HME or HMN which comply with BS 1142 : Part 2.

(b) Tempered hardboard of type TE or TN which complies with BS 1142 : Part 2.

(c) Bitumen impregnated insulating board which complies with BS 1142 : Part 3 with minimum density of 285 kg/m^3.

4.6 Gypsum products

Gypsum products should be as follows.

(a) Neat gypsum plaster which complies with BS 1191 : Part 1.

(b) Lightweight gypsum plaster which complies with BS 1191 : Part 2.

(c) Plasterboard which complies with BS 1230 : Part 1.

(d) Plasterboard jointing materials which comply with BS 6214.

4.7 Woodwool slabs

Woodwool slabs should comply with BS 1105 with a minimum density of 650 kg/m^3.

4.8 Expanded steel lath

Expanded steel lathing should comply with BS 1369.

4.9 Chicken wire

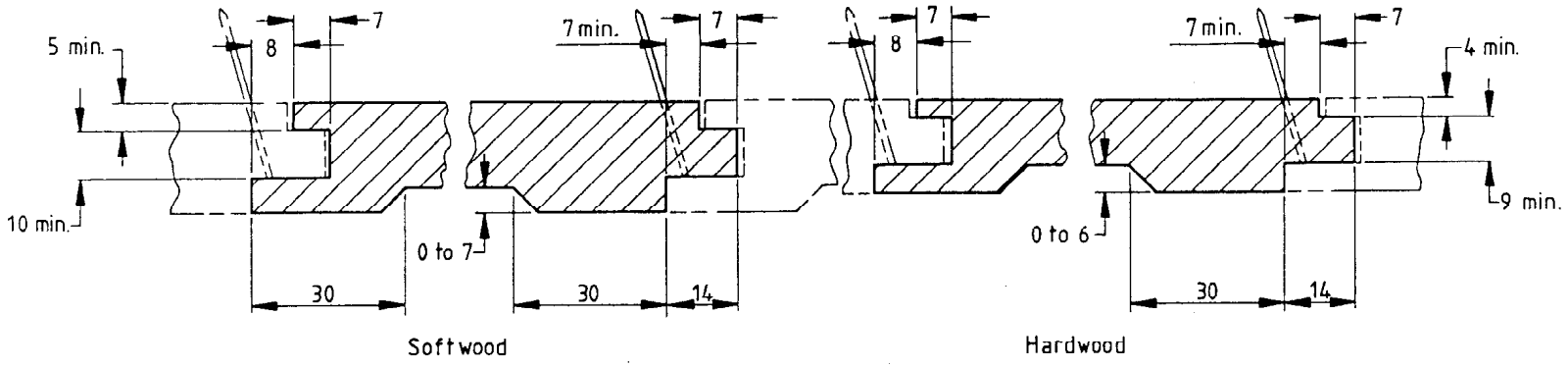
Chicken wire of 50 mm maximum mesh should comply with BS 1485.

4.10 Tile hanging

Tile hanging should be as follows.

(a) Clay tiles should comply with BS 402.

(b) Concrete tiles should comply with BS 473 and BS 550.



All dimensions are in millimetres.

Figure 2. Profiles for tongued and grooved ceiling boards

5 Construction details

5.1 General

The fire resistance of a wall or floor is dependent upon the construction details employed. For the contributions to fire resistance assumed in this Section of this British Standard to be valid it is essential that fixings and jointing methods are in accordance with the requirements of this clause and tables 7 and 11.

5.2 Fixings of linings

The spacings of fastenings given in tables 7 and 11 should not be exceeded and recommended edge distances should be observed. Fastenings should penetrate the supporting surface of the stud or joist whilst maintaining the edge distance. Particular attention should be given in this regard to the fixing of ceiling linings.

5.3 Joints in linings

Special regard should be given to the manner in which joints are made as the detail requirements for fire resistance may be different from and more stringent than those required for normal service conditions. All joints between board materials in single layer wall linings and claddings should be supported by timber or, where appropriate, fillets of the same material as the board. In multi-layer constructions all joints in the separate layers should be staggered.

The joints of tapered edged plasterboard sheets should be taped and filled. Square edge plasterboard sheets should be either tightly butted or the gaps filled with a gypsum based bedding compound. Bevel edged boards should have closely butted joints. Joints between boards of other types should be tightly butted or filled with an appropriate bedding compound. Where joints are emphasized by the intentional separation of adjacent boards particular attention should be paid to the adequacy of fixings and width of timber bearing. If the width of such an expressed joint exceeds 10 mm and penetrates to the stud or joist, fillets of a material of equivalent performance to the lining should be fixed over the stud or joist.

Negative tolerances on nominal board sizes should not be allowed to accumulate to the extent or prejudicing the fixing to stud or joist.

5.4 Installation of insulation materials

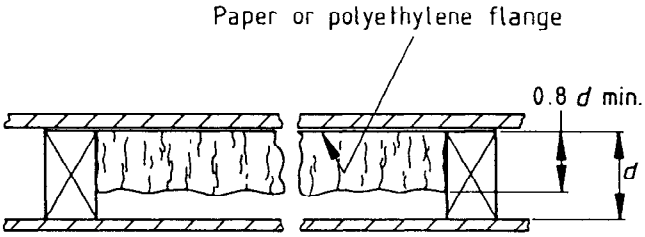
5.4.1 *General.* The performance in fire of a particular construction can often be improved by an appropriate combination of an insulation material and lining. These insulating materials may already be included in the construction for other reasons, e.g. thermal or sound insulation. To achieve this enhancement of fire resistance it is essential that the material and its fitting and fixing should comply with the requirements given in **5.4.2** and **5.4.3**. This may require a different or more stringent specification than would normally be employed for, say, thermal insulation.

5.4.2 *Insulation materials in walls.* The three recommended methods of installing wall insulation are given in figure 3. For each type of mineral fibre (glass or rock/slag) the thickness quoted is the minimum for that particular density. The overall thickness or method of fixing should be such that 80 % of the depth of the stud is covered by the insulating material. The systems (a) to (g) in figure 3 are used in tables 1 to 6 in combination with the lining material closest to the fire (exposed lining). There is no improvement in the performance of the lining remote from the fire (unexposed lining) and the contribution indices for this lining are the same as those for the particular board material without insulation.

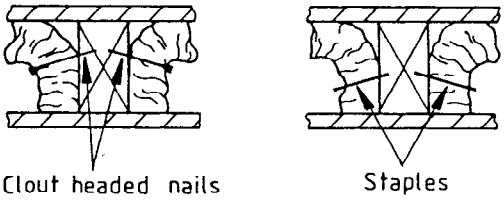
5.4.3 *Insulation materials in floors.* The two recommended methods of installing floor insulation are shown in figure 4. For each type of fibre (glass or rock/slag) the thickness quoted is the minimum for a particular density. The systems (h) to (k) in figure 4 are used in table 9 in combination with particular ceiling linings.

5.5 Fixing of ceiling linings between exposed joists

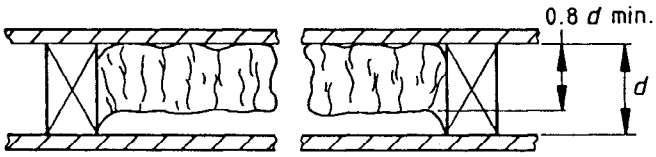
The ceiling lining should be fixed to timber battens (not) less than 25 mm × 25 mm in cross section) as shown in figure 5. The battens should be positioned so the exposed part of the joist below the ceiling level meets the stability criterion for the required period of fire resistance when calculated in accordance with **4.1** of this British Standard. The battens should be fastened to the sides of the joists with 60 mm long nails spaced at centres not exceeding 300 mm.



Flange fixing, systems a and b



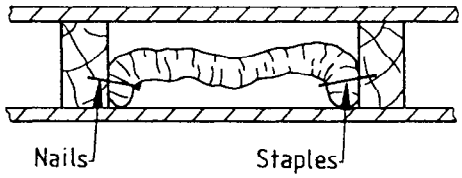
Maximum spacing of nails or staples 750 mm
Wrap round, systems c and d



Wedge, systems e, f and g

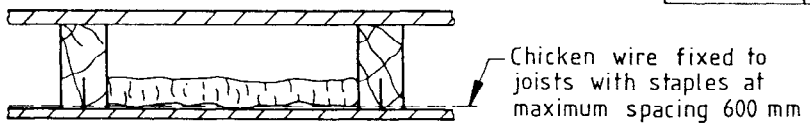
System	Type of fibre	Minimum thickness	Minimum density
		mm	kg/m^3
a	glass	60	16
	glass	80	12
b	rock/slag	60	23
c	glass	60	16
	glass	80	12
d	rock/slag	60	23
e	glass	60	16
	glass	80	12
f	rock/slag	75	23
g	rock/slag	75	48

Figure 3. Methods of fixing insulation materials in walls



Maximum spacing of nails or staples 300 mm
Wrap around, systems h and i

System	Type of fibre	Minimum thickness	Minimum density
		mm	kg/m^3
h	glass	60	16
	glass	80	12
i	rock/slag	60	23
j	rock/slag	50	48
k	rock/slag	60	23



Supported, systems j and k

Figure 4. Methods of fixing insulation materials in floors

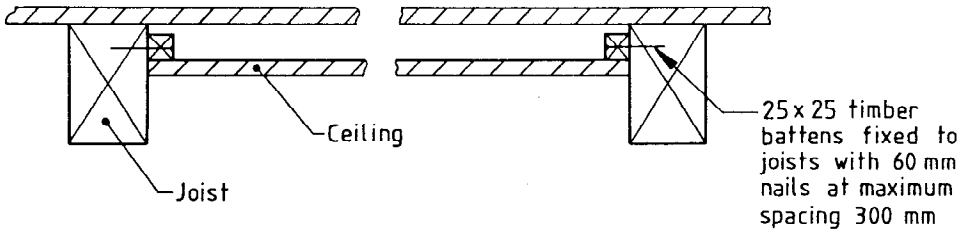


Figure 5. Method of fixing ceiling linings to exposed joists

6 Calculation method

6.1 General

For the purposes of this Section of this British Standard, the fire resistance of a timber framed wall or joisted floor construction is considered to be the sum of the contribution indices of its various components, i.e. studs, linings, etc., to the stability, integrity and insulation performance of the whole element.

Account has been taken of interactions between component parts in arriving at the contribution indices, in some cases by combining cavity insulation options with specific lining materials.

A wall or ceiling lining exposed to fire will protect the loadbearing timber structure depending on such factors as the composition of the lining, its thickness and the method by which it is fixed to the timber structure. The integrity and insulation characteristic of a construction can be improved by the inclusion of certain insulating materials within the cavities of a wall or floor. These materials may also protect the structural members and the 'linings' on the side of the element remote from the fire.

In view of the dependence of the performance of the element as a whole on its components and its assembly, it is essential that the requirements of clauses **4** and **5** with regard to materials, fixing and jointing are met if the potential fire resistance performance is to be realised.

NOTE. This Section of this British Standard may be used to confirm that linings, bracings, sheathings, etc., which are essential for the stability of a wall or floor in normal service conditions will continue to be adequate for the required period of fire resistance. When used to design constructions to give a necessary period of fire resistance, other requirements such as structural adequacy in normal conditions, thermal and sound insulation, durability and surface spread of flame characteristics should be considered separately.

6.2 Basis of the calculation method

6.2.1 *General.* A series of tables has been compiled on the basis of a large number of tests carried out in the UK over many years relating to different types of elements and required fire resistance performances. These tables give notional values for the contribution indices of the components of an element to its fire resistance. The assigned values are conservative reflecting the predictability of the particular component under fire test conditions and the confidence that can be placed on the test information available. The values presented are based as far as possible on test evidence relating to BS 476 : Part 8. Where information has been used from tests performed to BS 476 : Part 1, its relationship to the later test method has been assessed.

The contribution values tabulated should not be used in isolation nor those from different tables combined nor indices from other sources introduced. Similarly, only one contribution index for each component in an element should be used, see **6.2.3**. Any construction that does not totally comply with the requirements given in tables 1 to 11 should be tested or assessed by an appropriate authority.

6.2.2 *Stud sizes.* The tables relating to walls give values of contribution indices for stability for 100 % and 60 % load rates for stud breadth of (a) 37 mm to 43 mm, (b) 44 mm and greater, and a minimum depth of stud of 63 mm. For studs less than 63 mm depth the contribution index for stability for studs should be taken as zero.

NOTE. Insufficient information is available for stud breadth greater than 47 mm, but the application of the values for (b) will be conservative. When studs of breadth greater than 47 mm are used it is probable that either the insulation or the integrity criterion will control the choice of linings so that the larger timber sections will be unlikely to improve the overall performance of the wall; the influence of linings and insulations provided to meet the integrity and insulation criteria of the overall construction is one reason why it is not possible to apply the principles of BS 5268 : Part 4 : Section 4.1 to assess the stability contribution of timber sizes or load ratios beyond those tabulated. Such constructions should be tested or individually assessed.

6.2.3 *Multiple layer linings.* The contribution index of only one example of each component part of an element should be claimed. If a lining is to be used in double thickness its contribution index may not be doubled. If the contribution index of the double component is not listed separately, no more than the contribution of a single layer may be claimed.

6.3 Upgrading of existing structures

Care should be taken when the contribution indices are being considered in relation to upgrading the performance of an existing construction. The condition of the existing structure, the materials used and their fixings should be evaluated as these can influence significantly the performance of the applied linings.

It is not possible to assign contribution indices to older forms of construction, such as timber lath and plaster wall and ceiling linings, for their condition could be so variable as to render any evaluation worthless. An assessment of constructions of this type should be made by a competent authority taking into account both the condition and the contribution of the various component parts to the fire resistance. Specific examples are given, however, in tables 8 and 9 of floor constructions employing timber lath and plaster where connection of the ceiling to the joists is ensured and the ceiling is re-lined so that the fire resistance is achieved entirely by the new ceiling construction without any contribution from the joists or floor sheathing.

6.4 Non-loadbearing wall constructions

Constructions for non-loadbearing situations should be calculated as for the comparable loadbearing construction using the minimum load ratio. A more precise evaluation of performance can be established only by testing.

6.5 Explanation of tables

Separate tables are provided for the following fire resistance performances.

The summation of the contribution indices for a particular construction has to be not less than 100 for the maximum value of fire resistance performance required e.g. for fire resistance of 30 : 30 : 30 min each of the contribution indices should equal 100 (100 : 100 : 100) and similarly for fire resistance of 60 : 60 : 60 min the sum of the contribution indices should equal or exceed 100 : 100 : 100. Where either or both of the integrity and insulation criteria requirements are less than that for stability, the contribution indices may be reduced proportionally e.g. for a fire resistance requirement of 60 : 60 : 15 min the contribution indices should be not less than 100 : 100 : 25.

The use of the tables is explained by means of worked examples in appendix A.

		Fire resistance requirement (min)	Minimum contribution indices
Table 1	Internal single leaf walls required to provide	30 : 30 : 30	100 : 100 : 100
Table 2	Internal single leaf walls required to provide	60 : 60 : 60	100 : 100 : 100
Table 3	Internal double leaf walls required to provide	60 : 60 : 60	100 : 100 : 100
Table 4	External single leaf walls required to provide	30 : 30 : 15	100 : 100 : 50
Table 5	External single leaf walls required to provide	30 : 30 : 30	100 : 100 : 100
Table 6	External single leaf walls required to provide	60 : 60 : 15 60 : 60 : 60	100 : 100 : 25 100 : 100 : 100
Table 8	Timber floors, concealed joists required to provide	30 : 15 : 15 30 : 30 : 30	100 : 50 : 0 100 : 100 : 100
Table 9	Timber floors, concealed joists required to provide	60 : 60 : 60	100 : 100 : 100
Table 10	Timber floors, exposed joists to provide	30 : 30 : 30	100 : 100 : 100

Tables 7 and 11 give details of materials and fixings.

Table 1. Internal walls required to provide a fire resistance performance of 30 : 30 : 30 min. Single leaf walls of symmetrical/asymmetrical construction exposed to fire from one side at a time

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			1	***Asbestos insulating board**				
44	50	50	1.1	9.00 mm	Asbestos insulating board fixed direct	0	50	50
83	83	83	1.2		As above with infill systems a to g	0	50	50
67	83	83	1.3	12.0 mm	Asbestos insulating board fixed direct	0	64	64
83	83	83	1.4		As above with infill systems a to g	0	64	64
67	83	83	1.5	9.0 mm	Asbestos insulating board with fillets on studs	0	50	50
83	83	83	1.6		As above with infill systems a to g	0	50	50
83	97	97	1.7	12.0 mm	Asbestos insulating board with fillets on studs	0	64	64
			2	**Expanded steel lath**				
100	93	93	2.1		Expanded steel lath and 13.0 mm cement/sand or 13.0 mm gypsum/sand plaster	0	30	30
100	93	93	2.2		Expanded steel lath and 13.0 mm lightweight gypsum plaster	0	30	30
			3	**Hardboard (Type HME or HMN)**				
33	27	27	3.1	9.00 mm	Medium board	0	13	13
67	60	60	3.2		As above with infill systems c to g	0	13	13
57	30	30	3.3	12.0 mm	Medium board	0	34	34
83	83	83	3.4		As above with infill systems b to g	0	34	34
67	60	60	3.5	9.0 mm	Medium board backed with 9.5 mm plasterboard	0	40	40
83	83	84	3.6		As above with infill systems b to g	0	40	40
83	73	73	3.7	9.0 mm	Medium board backed with 12.5 mm plasterboard	0	47	47
73	67	67	3.8	6.0 mm	Medium board backed with 12.5 mm plasterboard	0	34	34
83	83	83	3.9		As above with infill systems b to g	0	34	34
			4	**Plasterboard**				
30	40	40	4.1	† 9.5 mm	Plasterboard	0	34	34
67	67	67	4.2	†	As above with infill systems b to g	0	34	34
90	97	97	4.3	†	As above with infill systems c to g	0	34	34
67	57	57	4.4	12.5 mm	Plasterboard	0	43	43
83	83	83	4.5		As above with infill systems b to g	0	43	43
100	83	83	4.6	19.0 mm	Plasterboard	0	60	60
100	83	83	4.7	†19.0 mm	Plasterboard (2 layers 9.5 mm)	0	60	60
57	50	50	4.8	† 9.5 mm	Plasterboard and 5.0 mm neat gypsum plaster	0	40	40
83	83	83	4.9		As above with infill systems b to g	0	40	40
83	73	73	4.10	† 9.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	0	30	30
83	73	73	4.11	12.5 mm	Plasterboard and 5.0 mm neat gypsum plaster	0	30	30
100	93	93	4.12	12.5 mm	Plasterboard and 10 mm lightweight gypsum plaster	0	30	30

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

*Asbestos based insulating board to BS 3536 or the equivalent non-asbestos fibre reinforced cement board (see **4.1**).

†Timber supports not to exceed 457 mm centres.

Table 1. *(concluded)*

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			5	**Plywood**				
40	34	34	**5.1**	12.0 mm	Plywood	0	27	27
73	73	73	**5.2**		As above with infill systems c to g	0	27	27
60	53	53	**5.3**	15.0 mm	Plywood	0	40	40
67	57	57	**5.4**		As above with infill systems b to g	0	40	40
83	77	77	**5.5**	18.0 mm	Plywood	0	50	50
67	60	60	**5.6**	9.0 mm	Plywood backed with 9.5 mm plasterboard	0	40	40
83	83	83	**5.7**		As above with infill systems b to g	0	40	40
83	73	73	**5.8**	9.0 mm	Plywood backed with 12.5 mm plasterboard	0	47	47
73	67	67	**5.9**	6.0 mm	Plywood backed with 12.5 mm plasterboard	0	34	34
83	83	83	**5.10**		As above with infill systems b to g	0	34	34
			6	**Wood chipboard**				
47	40	40	**6.1**	12.0 mm	Wood chipboard	0	27	27
73	73	73	**6.2**		As above with infill systems c to g	0	27	27
65	54	54	**6.3**	15.0 mm	Wood chipboard	0	40	40
67	57	57	**6.4**		As above with infill systems b to g	0	40	40
83	77	77	**6.5**	18.0 mm	Wood chipboard	0	50	50
67	60	60	**6.6**	9.0 mm	Wood chipboard backed with 9.5 mm plasterboard	0	40	40
83	83	83	**6.7**		As above with infill systems b to g	0	40	40
83	73	73	**6.8**	9.0 mm	Wood chipboard backed with 12.5 mm plasterboard	0	47	47
73	67	67	**6.9**	6.0 mm	Wood chipboard backed with 12.5 mm plasterboard	0	34	34
83	83	83	**6.10**		As above with infill systems b to g	0	34	34
			7	**Timber studs at centres not exceeding 610 mm (dimension and loading subject to the limitations given in 6.2.2)**				
17	0	0	**7.1**	37 to 43.5, full load ratio				
33	0	0	**7.2**	44 mm and above, full load ratio				
33	0	0	**7.3**	37 to 43.5, 60 % load ratio				
40	0	0	**7.4**	44 mm and above, 60 % load ratio				

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

Table 2. Internal walls required to provide a fire resistance performance of 60 : 60 : 60 min. Single leaf walls of symmetrical/asymmetrical construction exposed to fire from one side at a time

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			1	**Expanded steel lath**				
88	67	67	1.1		Expanded steel lath and 12.5 mm lightweight gypsum plaster	0	33	33
92	92	92	1.2		As above with infill systems b to g	0	33	33
88	67	67	1.3		Expanded steel lath and 16.0 mm lightweight gypsum plaster	0	33	33
			2	**Plasterboard**				
83	67	67	2.1	25.0 mm	Plasterboard (2 layers 12.5 mm)	0	33	33
92	92	92	2.2		As above with infill systems b, d, f, g	0	33	33
100	92	92	2.3	31.5 mm	Plasterboard (1 layer 19.0 mm and 1 layer 12.5 mm)	0	33	33
92	75	75	2.4	* 9.5 mm	Plasterboard and 16.0 mm lightweight gypsum plaster	0	33	33
88	67	67	2.5	12.5 mm	Plasterboard and 13.0 mm lightweight gypsum plaster	0	33	33
82	82	82	2.6		As above with infill systems b, d, f, g	0	33	33
88	67	67	2.7	* 9.5 mm	Plasterboard and 13.0 mm lightweight gypsum plaster	0	33	33
92	92	92	2.8	*	As above with infill systems b, d, f, g	0	33	33
80	58	58	2.9	12.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	0	25	25
88	88	88	2.10		As above with infill systems b, d, f, g	0	25	25
92	92	92	2.11		As above with infill systems f, g	0	25	25
67	50	50	2.12	19.0 mm	Plasterboard	0	25	25
84	84	84	2.13		As above with infill systems f, g	0	25	25
			3	**Plywood**				
75	58	58	3.1	22.0 mm	Plywood backed with 12.5 mm plasterboard	0	25	25
84	84	84	3.2		As above with infill systems b, d, f, g	0	25	25
92	92	92	3.3		As above with infill systems f, g	0	25	25
92	75	75	3.4	18.0 mm	Plywood backed with 12.5 mm plasterboard	0	33	33
57	42	42	3.5	18.0 mm	Plywood	0	25	25
84	84	84	3.6		As above with infill systems f, g	0	25	25
			4	**Wood chipboard**				
57	42	42	4.1	18.0 mm	Wood chipboard	0	25	25
84	84	84	4.2		As above with infill systems f, g	0	25	25
92	75	75	4.3	18.0 mm	Wood chipboard backed with 12.5 mm plasterboard	0	33	33
75	58	58	4.4	22.0 mm	Wood chipboard backed with 12.5 mm plasterboard	0	25	25
84	84	84	4.5		As above with infill systems b, d, f, g	0	25	25
92	92	92	4.6		As above with infill systems f, g	0	25	25
			5	**Timber studs at centres not exceeding 610 mm (dimension and loading subject to the limitations given in 6.2.2)**				
8	0	0	5.1	37 to 43.5 mm, full load ratio				
17	0	0	5.2	44 mm and above, full load ratio				
17	0	0	5.3	37 to 43.5 mm, 60 % load ratio				
20	0	0	5.4	44 to 74 mm, 60 % load ratio				
23	0	0	5.5	75 mm and above, 60 % load ratio				

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

*Timber supports not to exceed 457 mm centres.

Table 3. Internal walls required to provide a fire resistance performance of 60 : 60 : 60 min. Double leaf walls of symmetrical/asymmetrical construction exposed to fire from either side

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			1	Linings				
100	100	100	1.1	37.5 mm	Plasterboard (3 layers 12.5 mm)	–	–	–
100	100	100	1.2	31.5 mm	Plasterboard (1 layer 12.5 mm backed with 19.00 mm)	–	–	–
100	100	100	1.3	25.0 mm	Plasterboard (2 layers 12.5 mm) with infill systems b, d, f	–	–	–
100	100	100	1.4	25.0 mm	Plasterboard (2 layers 12.5 mm) backed with 12.0 mm plywood with infill systems b, d, f	–	–	–
100	100	100	1.5	25.0 mm	Plasterboard (2 layers 12.5 mm) backed with 15.0 mm chipboard, with infill systems b, d, f	–	–	–
100	100	100	1.6	25.0 mm	Plasterboard (2 layers 12.5 mm) backed with 19.0 mm chipboard	–	–	–
100	100	100	1.7	25.0 mm	Plasterboard (2 layers 12.5 mm) backed with 12.0 mm medium density hard-board (Type HMN or HME) or medium density fibreboard, with infill systems b, d, f	–	–	–
100	100	100	1.8	25.0 mm	Plasterboard (2 layers 12.5 mm) backed with 9.0 mm plywood	–	–	–
75	70	70	1.9	25.0 mm	Plasterboard (2 layers 12.5 mm) backed with infill systems a-f	10	30	30
75	70	70	1.10	12.5 mm	Plasterboard backed with 22.0 mm wood chipboard	10	30	30
75	70	70	1.11	12.5 mm	Plasterboard backed with 19.0 mm wood chipboard, and infill systems a-f	10	30	30
75	75	75	1.12	12.5 mm	Plasterboard backed with 12.0 plywood with infill systems b, d, f	10	30	30
75	70	70	1.13	12.5 mm	Plasterboard backed with 12.0 mm medium density hardboard (type HME or HMN), with infill systems b, d, f	10	30	30
			2	**Timber studs at centres not exceeding 610 mm (dimension and loading subject to the limitations given in 6.2.2)**				
15	0	0	2.1	37 mm to 43.5 mm, full load ratio				
30	0	0	2.2	44 mm and above, full load ratio				
30	0	0	2.3	37 mm to 43.5 mm, 60 % load ratio				
36	0	0	2.4	44 mm and above, 60 % load ratio				

NOTE 1. Individual infill between studs may be replaced by a single centrally positioned layer of wire mesh reinforced rock/slag fibre quilt of 25 mm minimum thickness with the wire mesh fixed to the studs with staples or nails.

NOTE 2. The construction specifications given in table 3 apply to load bearing elements that may not necessarily extend above the uppermost ceiling.

NOTE 3. Refer to table 7 for the specification of materials and conditions of fixing.

Table 4. External walls required to provide a fire resistance performance of 30 : 30 : 15 min. Single leaf walls of symmetrical/asymmetrical construction exposed to fire from the inside only

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			1	***Asbestos insulating board**				
44	50	50	1.1	9.0 mm	Asbestos insulating board fixed direct	0	17	10
83	83	83	1.2		As above with infill systems a to g	0	17	10
67	83	83	1.3	12.0 mm	Asbestos insulating board fixed direct	0	17	10
83	83	83	1.4		As above with infill systems a to g	0	17	10
67	83	83	1.5	9.0 mm	Asbestos insulating board with fillets on studs	0	17	10
83	83	83	1.6		As above with infill systems a to g	0	17	10
83	97	97	1.7	12.0 mm	Asbestos insulating board with fillets on studs	0	17	10
			2	**Expanded steel lath**				
100	93	93	2.1		Expanded steel lath and 13.0 mm cement/sand plaster	0	40	40
100	93	93	2.2		Expanded steel lath and 13.0 mm lightweight gypsum plaster	0	30	30
			3	**Fibre insulating board**				
27	20	20	3.1	12.0 mm	Fibre insulating board — bitumen impregnated	0	17	10
60	83	83	3.2		As above with infill system g	0	17	10
			4	**Hardboard (Type HME or HMN)**				
5	5	5	4.1	6.0 mm	Medium board	0	7	5
38	30	30	4.2		As above with infill system g	0	7	5
33	27	27	4.3	9.0 mm	Medium board	0	17	10
67	73	60	4.4		As above with infill systems f, g	0	17	10
57	30	30	4.5	12.0 mm	Medium board	0	17	10
83	83	83	4.6		As above with infill systems d, f, g	0	17	10
90	95	95	4.7		As above with infill system g	0	17	10
			5	**Plasterboard**				
30	40	40	5.1	† 9.5 mm	Plasterboard	0	17	10
67	83	73	5.2	†	As above with infill systems a to g	0	17	10
83	93	93	5.3	†	As above with infill system g	0	17	10
67	73	73	5.4	12.5 mm	Plasterboard	0	17	10
83	90	90	5.5		As above with infill systems a to g	0	17	10
90	93	93	5.6		As above with infill systems b, d, f, g	0	17	10
100	93	93	5.7	19.0 mm	Plasterboard	0	17	10
100	83	83	5.8	†19.0 mm	Plasterboard (2 layers 9.5 mm)	0	17	10
60	70	70	5.9	† 9.5 mm	Plasterboard and 5 mm neat gypsum plaster	0	17	10
83	90	90	5.10	†	As above with infill systems a to g	0	17	10
90	93	93	5.11	†	As above with infill systems b, d, f, g	0	17	10
83	93	93	5.12	12.5 mm	Plasterboard and 5 mm neat gypsum plaster	0	17	10
90	93	93	5.13		As above with infill systems a to g	0	17	10
83	93	93	5.14	† 9.5 mm	Plasterboard and 10 mm lightweight gypsum plaster	0	17	10
100	93	94	5.15	12.5 mm	Plasterboard and 10 mm lightweight gypsum plaster	0	17	10

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

*Asbestos based insulating board to BS 3536 or the equivalent non-asbestos fibre reinforced cement board (see 4.1).

†Timber supports not to exceed 457 mm centres.

Table 4. *(concluded)*

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			6	**Plywood**				
30	30	30	**6.1**	8.0 mm	Plywood	0	17	10
67	93	93	**6.2**		As above with infill system g	0	17	10
45	45	45	**6.3**	12.0 mm	Plywood	0	17	10
67	83	83	**6.4**		As above with infill systems b, d, f, g	0	17	10
83	93	93	**6.5**		As above with infill system g	0	17	10
54	54	54	**6.6**	15.0 mm	Plywood	0	17	10
83	90	90	**6.7**		As above with infill systems a to g	0	17	10
83	93	93	**6.8**		As above with infill systems b, d, f, g	0	17	10
90	93	93	**6.9**	18.0 mm	Plywood	0	17	10
93	93	93	**6.10**		As above with infill systems a to g	0	17	10
			7	**Wood chipboard**				
45	45	45	**7.1**	12.0 mm	Wood chipboard	0	17	10
67	83	83	**7.2**		As above with infill systems b, d, f, g	0	17	10
54	54	54	**7.3**	15.0 mm	Wood chipboard	0	17	10
83	93	93	**7.4**		As above with infill systems a to g	0	17	10
90	93	93	**7.5**	18.0 mm	Wood chipboard	0	17	10
93	93	93	**7.6**		As above with infill systems a to g	0	17	10
			8	**Exterior claddings**				
–	–	–	**8.1**	Brick/block leaf		0	0	10
–	–	–	**8.2**	Clay/concrete tiles on battens (backed with any of the selected sheathing materials)		0	0	10
–	–	–	**8.3**	Profiled steel sheeting (lapped joints) on battens		0	0	5
			9	**Timber studs at centres not exceeding 610 mm (dimension and loading subject to the limitations given in 6.2.2)**				
17	0	0	**9.1**	37 mm to 43.5 mm, full load ratio				
33	0	0	**9.2**	44 mm and above, full load ratio				
33	0	0	**9.3**	37 mm to 43.5mm, 60 % load ratio				
40	0	0	**9.4**	44 mm and above, 60 % load ratio				

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

Table 5. External walls required to provide a fire resistance performance of 30 : 30 : 30 min. Single leaf walls of symmetrical/asymmetrical construction exposed to fire from one side

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			1	***Asbestos insulating board**				
44	50	50	1.1	9.0 mm	Asbestos insulating board fixed direct	0	50	50
83	83	83	1.2		As above with infill systems a to g	0	50	50
100	90	90	1.3		As above with infill systems b, d, f, g	0	50	50
67	83	83	1.4	12.0 mm	Asbestos insulating board fixed direct	0	64	64
83	83	83	1.5		As above with infill systems a to g	0	64	64
100	90	90	1.6		As above with infill systems b, d, f, g	0	64	64
67	83	83	1.7	9.0 mm	Asbestos insulating board with fillets on studs	0	50	50
83	83	83	1.8		As above with infill systems a to g	0	50	50
100	90	90	1.9		As above with infill systems b, d, f, g	0	50	50
83	97	97	1.10	12.0 mm	Asbestos insulating board with fillets on studs	0	64	64
			2	**Expanded steel lath**				
100	93	93	2.1		Expanded steel lath and 13.0 mm cement/sand plaster	0	40	40
100	93	93	2.2		Expanded steel lath and 13.0 mm lightweight gypsum plaster	0	30	30
			3	**Fibre insulating board**				
27	20	20	3.1	12.0 mm	Fibre insulating board — bitumen impregnated	0	10	10
60	83	83	3.2		As above with infill system g	0	10	10
			4	**Hardboard (Type HME or HMN)**				
5	5	5	4.1	† 6.0 mm	Medium board	0	5	5
38	30	30	4.2		As above with infill system g	0	5	5
33	27	27	4.3	9.0 mm	Medium board	0	13	13
67	60	60	4.4		As above with infill systems f, g	0	13	13
57	40	40	4.5	12.0 mm	Medium board	0	34	34
83	83	83	4.6		As above with infill systems d, f, g	0	34	34
90	95	95	4.7		As above with infill system g	0	34	34
			5	**Plasterboard**				
30	40	40	5.1	† 9.5 mm	Plasterboard	0	34	34
67	73	73	5.2	†	As above with infill systems a to g	0	34	34
67	95	90	5.3	†	As above with infill systems b, d, f, g	0	34	34
83	95	95	5.4	†	As above with infill system g	0	34	34
67	73	73	5.5	12.5 mm	Plasterboard	0	43	43
83	90	90	5.6		As above with infill systems a to g	0	43	43
90	90	90	5.7		As above with infill systems b, d, f, g	0	43	43
100	95	95	5.8	19.0 mm	Plasterboard	0	60	60
100	83	83	5.9	†19.0 mm	Plasterboard (2 layers 9.5 mm)	0	60	60
60	70	70	5.10	† 9.5 mm	Plasterboard and 5.0 mm neat gypsum plaster	0	40	40
83	95	90	5.11	†	As above with infill systems a to g	0	40	40
90	90	90	5.12	†	As above with infill systems b, d, f, g	0	40	40
83	95	90	5.13	12.5 mm	Plasterboard and 5.0 mm neat gypsum plaster	0	44	44
90	95	90	5.14		As above with infill systems a to g	0	44	44
90	95	90	5.15		As above with infill systems a to g	0	44	44
83	73	73	5.16	† 9.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	0	30	30
100	93	93	5.17	12.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	0	30	30

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

*Asbestos based insulating board to BS 3536 or the equivalent non-asbestos fibre reinforced cement board (see **4.1**)

†Timber supports not to exceed 457 mm centres.

Table 5. *(concluded)*

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing	Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation			Stability	Integrity	Insulation
			6	**Plywood**			
30	30	30	**6.1**	8.0 mm Plywood	0	10	10
67	95	90	**6.2**	As above with infill system g	0	10	10
45	45	45	**6.3**	12.0 mm Plywood	0	27	27
55	55	55	**6.4**	As above with infill systems a to g	0	27	27
67	83	83	**6.5**	As above with infill systems b, d, f, g	0	27	27
83	95	90	**6.6**	As above with infill system g	0	27	27
54	54	54	**6.7**	15.0 mm Plywood	0	40	40
83	95	90	**6.8**	As above with infill systems a to g	0	40	40
83	95	90	**6.9**	As above with infill systems b, d, f, g	0	40	40
90	95	95	**6.10**	As above with infill systems g	0	40	40
90	90	90	**6.11**	18.0 mm Plywood	0	50	50
95	95	95	**6.12**	As above with infill systems a to g	0	50	50
95	95	95	**6.13**	As above with infill systems b, d, f, g	0	50	50
95	95	95	**6.14**	As above with infill system g	0	50	50
			7	**Wood chipboard**			
45	45	45	**7.1**	12.0 mm Wood chipboard	0	27	27
55	55	55	**7.2**	As above with infill systems a to g	0	27	27
67	83	83	**7.3**	As above with infill systems b, d, f, g	0	27	27
83	95	90	**7.4**	As above with infill system g	0	27	27
54	54	54	**7.5**	15.0 mm Wood chipboard	0	40	40
83	95	90	**7.6**	As above with infill systems a to g	0	40	40
90	95	95	**7.7**	As above with infill system g	0	40	40
90	95	95	**7.8**	18.0 mm Wood chipboard	0	50	50
95	95	95	**7.9**	As above with infill systems a to g	0	50	50
			8	**Exterior claddings**			
100	100	100	**8.1**	Brick/block leaf	0	0	10
37	30	30	**8.2**	Clay/concrete tiles on battens (backed with any of the selected sheathing materials)	0	0	10
20	15	15	**8.3**	Profiled steel sheeting (lapped joints) on battens	0	0	5
			9	**Timber studs at centres not exceeding 610 mm (dimension and loading subject to the limitations given in 6.2.2)**			
17	0	0	**9.1**	37 mm to 43.5 mm, full load ratio			
33	0	0	**9.2**	44 mm and above, full load ratio			
33	0	0	**9.3**	37 mm to 43.5 mm, 60 % load ratio			
40	0	0	**9.4**	44 mm and above, 60 % load ratio			

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

Table 6. External walls required to provide a fire resistance performance of 60 : 60 : 60 min and 60 : 60 : 15 min. Single leaf walls of symmetrical/asymmetrical construction exposed to fire from one side at a time

Indices of exposed linings contribution to:			Reference	Materials/components Linings, claddings, sheathings and framing		Indices of unexposed linings contribution to:		
Stability	Integrity	Insulation				Stability	Integrity	Insulation
			1	***Brickwork/blockwork (fixed to the studwork with metal ties**				
100	100	100	1.1	*100 mm	Brickwork/blockwork	0	100	100
			2	**Expanded steel lath**				
88	67	67	2.1		Expanded steel lath and 13.0 mm lightweight gypsum plaster	0	33	33
92	92	92	2.2		As above with infill systems b, d, f, g	0	33	33
88	67	67	2.3		Expanded steel lath and 16.0 mm lightweight gypsum plaster	0	33	33
			3	**Plasterboard**				
83	67	67	3.1	25.0 mm	Plasterboard (2 layers 12.5 mm)	0	33	33
92	92	92	3.2		As above with infill systems b, d, f, g	0	33	33
100	92	92	3.3	31.5 mm	Plasterboard (1 layer 19.0 mm and 1 layer 12.5 mm)	0	33	33
92	75	75	3.4	† 9.5 mm	Plasterboard and 16.0 mm lightweight gypsum plaster	0	33	33
88	67	67	3.5	12.5 mm	Plasterboard and 13.0 mm lightweight gypsum plaster	0	33	33
92	92	92	3.6		As above with infill systems b, d, f, g	0	33	33
88	67	67	3.7	† 9.5 mm	Plasterboard and 13.0 mm lightweight gypsum plaster	0	33	33
92	92	92	3.8		As above with infill systems b, d, f, g	0	33	33
80	58	58	3.9	12.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	0	25	25
88	88	88	3.10		As above with infill systems b, d, f, g	0	25	25
92	92	92	3.11		As above with infill systems f, g	0	25	25
83	92	92	3.12	12.5 mm	Plasterboard backed with 19.0 mm chipboard/plywood with infill system f	0	25	25
67	50	50	3.13	19.0 mm	Plasterboard	0	25	25
84	84	84	3.14		As above with infill systems f, g	0	25	25
92	92	92	3.15	28.5 mm	Plasterboard (1 layer 19.0 mm and 1 layer 9.5 mm)	0	25	25
			4	**Hardboard (Type TE or TN)**				
20	20	20	4.1	4.8 mm	Tempered hardboard	0	8	8
			5	**Plywood**				
27	20	20	5.1	8.0 mm	Plywood	0	10	10
92	75	75	5.2	18.0 mm	Plywood backed with 12.5 mm plasterboard	0	33	33
57	42	42	5.3	18.0 mm	Plywood	0	25	25
84	84	84	5.4		As above with infill systems f, g	0	25	25
			6	**Wood chipboard**				
92	75	75	6.1	18.0 mm	Wood chipboard backed with 12.5 mm plasterboard	0	33	33
57	42	42	6.2	18.0 mm	Wood chipboard	0	25	25
84	84	84	6.3		As above with infill systems f, g	0	25	25
			7	**Timber studs at centres not exceeding 610 mm (dimension and loading subject to the limitations given in 6.2.2)**				
8	0	0	7.1	37 mm to 43.5 mm, full load ratio				
17	0	0	7.2	44 mm and above, full load ratio				
17	0	0	7.3	37 mm to 43.5 mm, 60 % load ratio				
20	0	0	7.4	44 mm to 74 mm, 60 % load ratio				
23	0	0	7.5	75 mm and above, 60 % load ratio				

NOTE. Refer to table 7 for the specification of materials and conditions of fixing.

*Where sheathing to the studs is omitted, timber noggings are required for stability.
†Timber supports not to exceed 457 mm centres.

Table 7. Specification of materials and conditions of fixing for walls

Material	Thickness	Minimum nominal density	Fixing
	mm	kg/m^3	
Asbestos insulating board (see **4.1**)	9.0 12.0		Fixed with 50 mm × 4 mm diameter woodscrews at 400 mm centres
Clay or concrete tile hanging (to BS 402 or BS 473)			
Expanded steel lath (to BS 1369)			Lath to be fixed a minimum of 6 mm from a solid background to provide a plaster key. Fixing to supports to be at 100 mm centres with 38 mm galvanized nails or 32 mm galvanized staples. End laps to be not less than 50 mm, side laps to be not less than 25 mm and in both cases should be wired together at 150 mm intervals. Specified thickness of plaster to be measured from the face of the lath
Fibre insulating board bitumen impregnated (to BS 1142 : Part 3)	12.0	285	Nailing 100 mm centres at perimeter and 200 mm centres at intermediate supports with 40 mm nails.
Gypsum plaster (to BS 1191 : Part 1)			Neat coat of finish plaster to recommended thickness
Gypsum premixed lightweight plaster (referred to in tables as lightweight gypsum plaster) (to BS 1191 : Part 2)		700	Recommended undercoat plaster to be used on appropriate substrate
Medium density hardboard (to BS 1142 : Part 2)		560	Nailing 100 mm centres at perimeter and 200mm centres at intermediate supports with:
	9.0		30 mm nails
	12.0		40 mm nails
Tempered hardboard (to BS 1142 : Part 2)	4.8	960	30 mm nails
Plasterboard (to BS 1230 : Part 1)			**Fixing** Galv. nails with a minimum 7 mm diameter head at 150 mm centres; **Jointing** Tapered edge on decorative surface Joints filled and reinforced with paper tape; **Plastering** On grey surface Joints scrimmed as appropriate
	9.5		30 mm nails
	12.5		40 mm nails
	19.0		50 mm nails
	25.0		50 mm nails
	31.5		65 mm nails
	37.5		65 mm nails
Plywood (to BS 1455 or equivalent)		500	Nailing at 150 mm centres at perimeter and 300 mm centres at intermediate supports with:
	8.0		45 mm nails
	12.0		50 mm nails
	15.0		50 mm nails
	18.0		50 mm nails
Wood chipboard (to BS 5669)		600	Nailing at 150 mm centres at perimeter and 300 mm centres at intermediate supports with:
	12.0		50 mm nails
	15.0		50 mm nails
	18.0		50 mm nails
	22.0		60 mm nails
Infill insulation (to BS 5803)	See **5.4.2**		

NOTE 1. All materials should be fixed in accordance with the manufacturer's instructions. In the absence of such information the above fixings should be taken as the minimum. (See also clause **5**.)

NOTE 2. All joints between board materials in single layer wall linings and claddings should be supported by timber or, where appropriate, fillets of the same material as the board. In multi-layer constructions all joints in the separate layers should be staggered.

Table 8. Timber floors, concealed joists, required to provide fire resistance performance of 30 : 15 : 15 min and 30 : 30 : 30 min

Reference	Materials/components ceiling linings, boarding and framing		Indices of contribution to:		
			Stability	Integrity	Insulation
1	***Asbestos insulating board**				
1.1	† 9.0 mm	Asbestos insulating board — fillets only at transverse joints	67	77	77
1.2	† 9.0 mm	Asbestos insulating board — fillets at joints and transverse joints	73	77	77
1.3	12.0 mm	Asbestos insulating board — fillets at transverse joints only	83	100	100
2	**Expanded steel lath**				
2.1		Expanded steel lath and 13.0 mm lightweight gypsum plaster	100	100	100
3	**Plasterboard**				
3.1	† 9.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	83	83	83
3.2	12.5 mm	Plasterboard	67	67	67
3.3	12.5 mm	Plasterboard and 5.0 mm neat gypsum plaster	83	83	83
3.4	12.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	93	93	93
3.5	12.5 mm	Plasterboard and 13.0 mm lightweight gypsum plaster	100	100	100
3.6	†19.0 mm	Plasterboard (2 layers 9.5 mm)	67	67	67
3.7	†19.0 mm	Plasterboard (2 layers 9.5 mm) and 5.0 mm neat gypsum plaster	83	83	83
3.8	†22.0 mm	Plasterboard (1 layer 9.5 mm and 1 layer 12.5 mm)	93	93	93
3.9	25.0 mm	Plasterboard (2 layers 12.5 mm)	100	100	100
4	**Timber lath**				
4.1	16.0 mm	Lime plaster on timber lath (existing) underdrawn with chicken wire mesh and 12.5 mm plasterboard	100	100	100
4.2	16.0 mm	Lime plaster on timber lath (existing) underdrawn with chicken wire mesh and 9.0 mm asbestos insulating board	100	100	100
4.3	16.0 mm	Lime plaster on timber lath (existing) in and infill of 15 mm lightweight gypsum plaster on chicken wire with waterproof membrane underneath	100	100	100
5	**‡T and G boarding (as a ceiling lining)**				
5.1	22.0 mm	T and G boarding — softwood	67	67	67
5.2	19.0 mm	T and G boarding — hardwood	67	67	67
6	**Wood wool slabs**				
6.1	25.0 mm	Wood wool slabs and 10.0 mm lightweight gypsum plaster	100	100	100
7	**Timber joists**				
7.1	37 mm to 43.5 mm		33	0	0
7.2	44 mm to 49.5 mm		40	0	0
7.3	50 mm and above		40	0	0
8	**Floor boarding**				
8.1	15.0 mm	Softwood T and G (19 mm nominal)	0	23	23
8.2	21.0 mm	Softwood T and G (25 mm nominal)	0	33	33
8.3	15.0 mm	Plywood T and G	0	40	40
8.4	18.0 mm	Plywood T and G	0	45	45
8.5	21.0 mm	Plywood T and G	0	50	50
8.6	18.0 mm	Wood chipboard T and G	0	45	45
8.7	22.0 mm	Wood chipboard T and G	0	50	50
8.8	15.0 mm	Plywood square edged (all joints to be timber backed)	0	40	40
8.9	18.0 mm	Plywood square edged (all joints to be timber backed)	0	45	45
8.10	21.0 mm	Plywood square edged (all joints to be timber backed)	0	50	50
8.11	18.0 mm	Wood chipboard square edged (all joints to be timber backed)	0	45	45
8.12	22.0 mm	Wood chipboard square edged (all joints to be timber backed)	0	50	50
8.13	—	Softwood square edged — any thickness	0	0	0
8.14	—	Softwood square edged overlaid with 3 mm hardboard	0	33	33

NOTE. Refer to table 11 for the specification of materials and conditions of fixing.
*Asbestos based insulating board to BS 3536 or the equivalent non-asbestos fibre reinforced board (see **4.1**).
†Timber supports not to exceed 457 mm centres.
‡For special profiles see figure 1.

Table 9. Timber floors, concealed joists, required to provide a fire resistance of 60 : 60 : 60 min

Reference	Materials/components ceiling linings, boarding and framing		Indices of contribution to:		
			Stability	Integrity	Insulation
1	**Expanded steel lath**				
1.1		Expanded steel lath and 22.0 mm gypsum/sand plaster with infill system h, i, j or k	100	100	100
1.2		Expanded steel lath and 13.0 mm lightweight gypsum plaster	85	83	83
1.3		As above with infill system h, i, j or k	100	100	100
1.4		Expanded steel lath and 19.0 mm lightweight gypsum plaster	100	100	100
2	**Plasterboard**				
2.1	* 9.5 mm	Plasterboard and 19.0 mm lightweight gypsum plaster	100	100	100
2.2	12.5 mm	Plasterboard and 19.0 mm lightweight gypsum plaster	100	100	100
2.3	12.5 mm	Plasterboard and 15.0 mm lightweight gypsum plaster	93	93	93
2.4	31.5 mm	Plasterboard (1 layer 19.0 mm and 1 layer 12.5 mm)	80	80	80
2.5		As above with infill system i, j or k	88	88	88
2.6	25.0 mm	Plasterboard (2 layers 12.5 mm)	68	68	68
2.7		As above with infill system j or k	88	88	88
2.8	* 9.5 mm	Plasterboard and infill of 25 mm lightweight gypsum plaster on chicken wire with waterproof membrane beneath	84	100	100
3	**Timber lath**				
3.1	16.0 mm	Lime plaster on timber lath (existing) underdrawn with chicken wire mesh and 12.0 mm asbestos insulating board — fillets at transverse joints only	100	100	100
3.2	16.0 mm	Lime plaster on timber lath (existing) in and infill of 25 mm lightweight gypsum plaster on chicken wire with waterproof membrane underneath	100	100	100
4	**Wood wool slabs**				
4.1	25.0 mm	Wood wool slabs and 10.0 mm lightweight gypsum plaster	100	100	100
5	**Timber joists**				
5.1	37 mm to 43.5 mm		13	0	0
5.2	44 mm to 49.5 mm		16	0	0
5.3	50 mm and above		20	0	0
6	**Floor boarding**				
6.1	15.0 mm	Softwood T and G (19 mm nominal)	0	12	12
6.2	21.0 mm	Softwood T and G (25 mm nominal)	0	16	16
6.3	15.0 mm	Plywood T and G	0	20	20
6.4	18.0 mm	Plywood T and G	0	25	25
6.5	21.0 mm	Plywood T and G	0	30	30
6.6	18.0 mm	Wood chipboard T and G	0	25	25
6.7	22.0 mm	Wood chipboard T and G	0	30	30
6.8	15.0 mm	Plywood square edge (all joints to be timber backed)	0	20	20
6.9	18.0 mm	Plywood square edge (all joints to be timber backed)	0	25	25
6.10	21.0 mm	Plywood square edge (all joints to be timber backed)	0	30	30
6.11	18.0 mm	Wood chipboard square edge (all joints to be timber backed)	0	25	25
6.12	22.0 mm	Wood chipboard square edge (all joints to be timber backed)	0	30	30

NOTE. Refer to table 11 for the specification of materials and conditions of fixing.

*Timber supports not to exceed 457 mm centres.

Table 10. Timber floors, exposed joists, required to provide a fire resistance of 30 : 30 : 30 min

Reference	Materials/components ceiling linings, boarding and framing		Indices of contribution to:		
			Stability	Integrity	Insulation
1	**Exposed joists**				
	Structural stability to be calculated in accordance with BS 5268 : Section 4.1 : 1978 with an allowance for charring				
2	**Ceiling linings** (fixed to a minimum of 25 mm × 25 mm timber battens) (see 5.5)				
2.1	* 9.5 mm	Plasterboard	0	49	49
2.2	* 9.5 mm	Plasterboard and 5.0 mm neat gypsum plaster	0	60	60
2.3	*19.0 mm	Plasterboard (2 layers 9.5 mm)	0	75	75
2.4	12.5 mm	Plasterboard	0	70	70
2.5	12.5 mm	Plasterboard and 5.0 mm neat gypsum plaster	0	75	75
2.6	25.0 mm	Plasterboard (2 layers 12.5 mm)	0	100	100
2.7	18.0 mm	Wood chipboard or plywood	0	65	65
2.8	12.0 mm	Medium board (Type HME or HMN)	0	45	45
3	**Floor boarding**				
3.1	15.0 mm	Softwood T and G (19 mm nominal)	0	23	23
3.2	21.0 mm	Softwood T and G (25 mm nominal)	0	33	33
3.3	15.0 mm	Plywood T and G	0	40	40
3.4	18.0 mm	Plywood T and G	0	45	45
3.5	21.0 mm	Plywood T and G	0	50	50
3.6	18.0 mm	Chipboard T and G	0	45	45
3.7	22.0 mm	Chipboard T and G	0	50	50
3.8	15.0 mm	Plywood square edge (all joints to be timber backed)	0	40	40
3.9	18.0 mm	Plywood square edge (all joints to be timber backed)	0	45	45
3.10	21.0 mm	Plywood square edge (all joints to be timber backed)	0	50	50
3.11	18.0 mm	Chipboard square edge (all joints to be timber backed)	0	45	45
3.12	22.0 mm	Chipboard square edge (all joints to be timber backed)	0	50	50
3.13	—	Softwood square edged — any thickness	0	0	0
3.14		Softwood square edged overlaid with 3.2 mm medium density hardboard	0	33	33

NOTE. Refer to table 11 for the specification of materials and conditions of fixing.

*Timber supports not to exceed 457 mm centres.

Table 11. Specification of materials and conditions of fixing for floors

Specifications and conditions		Minimum nominal density	Fixing
Material	Thickness		
	mm	kg/m^3	
Asbestos insulating board (See **4.1**)	9.0 12.0		Fixed with 50 mm × 4 mm woodscrews at 400 mm centres
Expanded steel lath (to BS 1369)			Fixing to supports to be at 100 mm centres with 38 mm galvanized nails or 32 mm galvanized staples. End laps to be not less than 50 mm, side laps to be not less than 25 mm and in both cases should be wired together at 150 mm intervals.
Gypsum plaster (to BS 1191 : Part 1)			Neat coat of finish plaster to recommended thickness.
Gypsum premixed lightweight plaster (to BS 1191 : Part 2)		700	Recommended undercoat plaster to be used on appropriate substrate.
Galvanized chicken wire mesh (to BS 1485)			Nailed to joists through existing ceiling to provide independent support for the ceiling.
Hardwood T and G boarding for ceiling lining	19.0	650	See **4.2**(c) **Fixing** Secret nailing through tongue with 40 mm nails at 600 mm centres.
Plasterboard (to BS 1230 : Part 1)	9.5 12.5 19.0		**Fixing** Galv. nails with a minimum 7 mm diameter head at 150 mm with: 30 mm galv. nails 40 mm galv. nails 60 mm galv. nails **Jointing** Tapered edge on decorative surface. Joints reinforced with paper tape and filled. **Plastering** On grey surface. Joints scrimmed as appropriate: Use clout headed nails. Long edges supported by noggings not less than 38 mm wide (to coincide with outer layer in two layer construction).
Plywood floor boarding (T and G or plain edge)	12.0 15.0 18.0	420	**Fixing** Nailing at 150 mm centres at perimeter and 300 mm centres at intermediate supports with: 45 mm annular ring shank nails 45 mm annular ring shank nails 50 mm annular ring shank nails
Softwood T&G boarding for ceiling lining	22.0	420	See **4.2**(b) **Fixing** Secret nailing through tongue with 40 mm nails at 600 mm centres.
Wood chipboard (T and G or plain edge to BS 5669)	12.0 15.0 18.0	680	Nailing at 300 mm centres at perimeter and 400 mm centres at intermediate supports with: 30 mm annular ring shank nails 50 mm annular ring shank nails 50 mm annular ring shank nails
Wood wool slabs (BS 1105)	25.0	650	Nailed at 100 mm centres with 65 mm galvanized clout headed nails **Plastering** Minimum thickness to achieve finish to be two-coat plastering system not less than 10 mm with joints scrimmed.
Cavity infill (to BS 3958)	See **5.4.3**		

NOTE. All materials should be fixed in accordance with the manufacturer's instructions. In the absence of such information the above fixings should be taken as the minimum. (See also clause **5**)

Appendix

Appendix A. Worked examples

A.1 Example 1

A.1.1 Requirement

Internal single leaf wall to provide fire resistance 30 : 30 : 30 min.

A.1.2 Assumption

Stud width is 47 mm, spacing 600 mm and the load ratio does not exceed 60 %.

A.1.3 Procedure

The procedure should be as follows.

(a) Refer to table 1.

(b) Reference **7.4** of the table gives contribution indices of 40 : 0 : 0 for the stud.

(c) Select linings from categories 1 to 6, to provide contribution indices totalling 60 : 100 : 100 (the balance required to bring the total constructions to 100 : 100 : 100); assume 12.5 mm plasterboard (reference **4.4** of the table) giving 67 : 57 : 57 and 0 : 43 : 43 for the exposed and unexposed lining contributions indices respectively.

A.1.4 Recommended presentation

The presentation should be as follows.

Component	Table 1 reference	Description	Contribution indices
exposed lining	**4.4**	12.5 mm plasterboard	67 : 57 : 57
studs	**7.4**	47 mm at 600 c/c 60 % load ratio	40 : 0 : 0
unexposed lining	**4.4**	12.5 mm plasterboard	0 : 43 : 43
		totals	107 : 100 : 100
		requirement	100 : 100 : 100

The construction is capable of achieving fire resistance 30 : 30 : 30 min.

A.2 Example 2

A.2.1 Requirement

External single leaf wall to provide fire resistance from either side of 30 : 30 : 30 min.

A.2.2 Assumption

Stud width is 37 mm, spacing 400 mm and the load ratio does not exceed 60 %.

A.2.3 Procedure

The procedure should be as follows.

(a) Refer to table 5.

(b) Reference **9.3** of the table gives contribution indices of 33 : 0 : 0 for the stud.

(c) Select internal lining from categories 1 to 7; assume say 9.5 mm plasterboard (reference **5.1** of the table) with contribution indices 30 : 40 : 40 and 0 : 34 : 34 for the exposed and unexposed linings respectively.

(d) Select sheathing from categories 1 to 7 say 8 mm plywood (reference **6.1** of the table) with contribution indices 30 : 30 : 30 and 0 : 10 : 10 for exposed and unexposed linings respectively.

(e) Select exterior cladding from category 8 say clay/concrete tiles (reference **8.2** of the table) with contribution indices 37 : 30 : 30 and 0 : 0 : 10 for exposed and unexposed linings respectively.

A.2.3 Recommended presentation format

The presentation should be as follows.

(a) internal fire

Component	Table 5 reference	Description	Contribution indices
exposed lining	**5.1**	9.5 mm plasterboard	30 : 40 : 40
stud	**9.3**	37 mm at 400 c/c 60 % load ratio	33 : 0 : 0
unexposed lining	**6.1**	8 mm plywood	0 : 10 : 10
cladding	**8.2**	clay/concrete tiles	0 : 0 : 10
		totals	63 : 50 : 60
		requirements (see clause **6.5**)	100 : 100 : 100

(b) external fire

Component	Table 5 reference	Description	Contribution indices
cladding	**8.2**	clay/concrete tiles	37 : 30 : 30
exposed lining	**6.1**	8 mm plywood	30 : 30 : 30
stud	**9.3**	37 mm at 400 c/c 60 % load ratio	33 : 0 : 0
unexposed lining	**5.1**	9.5 mm plasterboard	0 : 34 : 34
		totals	100 : 94 : 94
		requirement (see clause **6.5**)	100 : 100 : 100

The assumed construction fails both internal and external fire requirements.

By using 12 mm medium board with 75 mm thick rock/slag mineral wool of minimum density 48 kg/m^3 (reference **4.7**) the contribution indices for the inner lining become 90 : 95 : 95 and 0 : 34 : 34 for exposed and unexposed conditions respectively.

The introduction of the mineral wool insulation improves the contribution indices for the 8 mm plywood which become (reference **6.2**) 67 : 95 : 90 and 0 : 10 : 10 for exposed and unexposed linings respectively. With the studs and exterior cladding remaining the same, the totals of the contribution indices are now 123 : 105 : 115 and 137 : 159 : 154 for internal and external fire respectively which meet the required fire resistance.

A.3 Example 3

A.3.1 Requirement

Timber floor, concealed joints to provide fire resistance of 30 : 15 : 15 min.

A.3.2 Assumption

Joist width is 44 mm.

A.3.3 Procedure

The procedure should be as follows.

(a) Refer to table 8.

(b) Reference **7.2** of the table gives contribution indices of 40 : 0 : 0 for the joist.

(c) Select ceiling lining for categories 1 to 6, assume 22 mm tongued and grooved softwood boarding (reference **5.1** of the table) with contribution indices of 67 : 67 : 67.

ɨ.4 Recommended presentation

ıe presentation should be as follows.

Component	Table 8 reference	Description	Contribution indices
ceiling	5.1	22 T and G softwood boarding	67 : 67 : 67
joists	7.2	44 mm wide joists	40 : 0 : 0
floor boarding		See note below	
		totals	107 : 67 : 67
		requirement (see clause **6.5**)	100 : 50 : 50

The construction is capable of achieving fire resistance 30 : 15 : 15 min.

NOTE. No contribution from floor boarding is required to meet the fire resistance so any structurally adequate boarding may be used.

Publications referred to

BS 402	Specification for clay plain roofing tiles and fittings
BS 473, 550	Specification for concrete roofing tiles and fittings
BS 476	Fire tests on building materials and structures
	Part 8 Test methods and criteria for the fire resistance of elements of building construction
	*Part 20 Method for determination of the fire resistance of elements of construction (general principles)
	*Part 21 Methods for determination of the fire resistance of loadbearing elements of construction
	*Part 22 Methods for determination of the fire resistance of non-loadbearing elements of construction
	*Part 23 Methods for determination of the contribution of components to the fire resistance of a structure
BS 1105	Specification for wood wool cement slabs up to 125 mm thick
BS 1142	Specification for fibre building boards
	Part 2 Medium board, medium density fibreboard (MDF) and hardboard
	Part 3 Insulating board (softboard)
BS 1191	Specification for gypsum building plasters
	Part 1 Excluding premixed lightweight plasters
	Part 2 Premixed lightweight plasters
BS 1230	Gypsum plasterboard
	Part 1 Specification for plasterboard excluding materials submitted to secondary operations
BS 1297	Specification for tongued and grooved softwood flooring
BS 1369	Steel lathing for internal plastering and external rendering
BS 1485	Specification for zinc coated hexagonal steel wire netting
BS 3958	Thermal insulating materials
BS 4422	Glossary of terms associated with fire
	Part 2 Building materials and structures
BS 4471	Specification for sizes of sawn and processed softwood
BS 5268	Structural use of timber
	Part 2 Code of practice for permissible stress design, materials and workmanship
	Part 4 Fire resistance of timber structures
	Section 4.1 Methods of calculating fire resistance of timber members
	Part 6 Code of practice for timber frame walls
	Section 6.1 Dwellings not exceeding three storeys
BS 5669	Specification for wood chipboard and methods of test for particle board
BS 5803	Thermal insulation for use in pitched roof spaces in dwellings
	Part 1 Specification for man-made mineral fibre thermal insulation mats
BS 6100	Glossary of building and civil engineering terms
BS 6214	Specification for jointing materials for plasterboard
*CP 112	The structural use of timber

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