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(Reaffirmed 1994)

Indian Standard

FIRE SAFETY OF BUILDINGS (GENERAL) : DETAILS OF CONSTRUCTION — CODE OF PRACTICE

(First Revision)

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards on 20 June 1989, after the draft finalized by the Fire Safety Sectional Committee had been approved by the Civil Engineering Division Council.

The technical interpretation of fire safety of buildings is to convey the fire resistance of buildings in terms of hours when subjected to a fire of known intensity. The fire grading of the building itself enables the correct amount of storage and class of materials, or appropriate 'fire load' to be apportioned for that particular application; the converse also holds good, thus, a building being required to accommodate a particular fire load for a given period would require the shell or fabric materials and construction to be designed accordingly.

Loss of life in fires is mainly due to smoke and hot gases being inhaled by occupants before actural flames have developed to a serious degree within the room concerned. Smoke and hot gases spread through doorways and ventilators which are normally impossible to keep closed. The essential requirements for fire safety in so far as materials and details of construction are concerned, are that the flame smoke and hot gases should not spread so rapidly as to give the occupants insufficient time to escape. Should a fire occur, the construction should not further tend to spread the fire.

In order to reduce spread of fire, it is necessary that:

a) the fire should not spread rapidly from one room to another through the floors, partitions between rooms, and particularly between rooms and passages and staircases, that is, the structural elements should have adequate fire resistance; and

b) the materials which are exposed to possible ignition, that is, wall and ceiling linings should not easily ignite, nor should the fire spread rapidly over the surface of the materials.

With a view to cover these aspects, this standard dealing with details of construction was first formulated in 1960. This revision has been based on useful information collected as a result of research in the country and abroad over the past 25 years.

The provisions given in this standard are those which are necessary at the time of construction of building new or addition or alterations for adopting fire safety measures. The provisions are applicable for all types of buildings including high rise buildings (above 15 m in height). The standard does not include other fire safety measures required to be adopted in the buildings of various occupancies in respect of provision of first-aid, fire fighting measures, alarm and extinguishing systems, operation of fire lifts, etc; details of which are covered in relevant Indian Standards formulated/under formulation for each type of occupancy.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

FIRE SAFETY OF BUILDINGS (GENERAL): DETAILS OF CONSTRUCTION — CODE OF PRACTICE

(First Revision)

1 SCOPE

1.1 This standard lays down the essential requirements of fire safety of buildings with respect to details of construction.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
IS 655 : 1963	Specification for metal air ducts
IS 941 : 1985	Specification for blower and exhauster for fire fighting (*second revision*)
IS 1644 : 1988	Code of practice for fire safety of buildings (general) : Exit requirements and personal hazard (*first revision*)
IS 1646 : 1982	Code of practice for fire safety of buildings (general) : Electrical installation (*first revision*)
IS 3809 : 1979	Fire resistance test of structure (*first revision*)
IS 4355 : 1977	Specification for fire-resistant brattice cloth (*first revision*)
IS 12459 : 1988	Code of practice for fire protection of cable runs
IS 12777 : 1989	Fire safety — Flame spread of products — Methods for classification

3 TERMINOLOGY

3.0 For the purpose of this standard, the definition of various terms will be as under.

3.1 Fire Resistance

Ability of an element of building construction, component for structure to fulfil, for a stated period of time, the required stability, fire integrity and/or thermal insulation and/or other expected duty in a standard fire resistance test (*see* IS 3809 : 1979).

3.2 Fire Separation

The distance in metres measured from any other building on the site, or from other site or from the opposite side of street or other public space to the building for the purpose of preventing the spread of fire.

3.3 Fire Resisting Wall

The wall, either load bearing or non-load bearing. capable of specifying the criteria of fire resistance (*see* 3.2) with respect to collapse, penetration and excessive temperature rise.

3.4 Separating Wall

The wall provides complete separation of one building from another or part of a building from another part of the same building to prevent any communication of fire or any access or heat transmission to wall itself which may cause or assist in the combustion of materials of the side opposite to that portion which may be on fire.

3.5 Venting Fire

The process of inducting heat and smoke to leave a building as quickly as possible by such paths that lateral spread of fire and heat is checked, fire fighting operations are facilitated and minimum fire damage is caused.

4 TYPES OF CONSTRUCTION

4.0 General

The design of any building and the type of materials used in its construction are important factors in making the building resistant to a complete burn-out and in preventing the rapid spread of fire, smoke or fumes, which may otherwise contribute to the loss of lives and property.

4.1 The types of construction according to fire resistance are classified into four categories, namely, Type 1, Type 2, Type 3 and Type 4 construction. The fire resistance ratings for various types of construction for structural and non-structural members should be as given in Table 1.

4.2 For buildings above 15 m in height non-combustible materials should be used for construction and the internal walls of staircases should be of brick work or reinforced concrete or any other material of construction with min-i mum of 2 hours rating. The walls for the

chimney shall be of Type 1 or Type 2 construction depending upon whether the gas temperature is above 200 °C or less.

4.3 The fire resistance of an element of structure or combination of elements is determined from one of the following three methods. The fire test is done according to IS 3809 : 1979.

a) Information as established by research data (*see* Note).

b) Direct application of the results of fire resistance test on an element of structures.

c) On the basis for calculating the fire resistance of a structural element. (This method is not applicable to columns or walls.)

NOTE — In the absence of research data available in this country, the data as arrived by Building Research Establishment (UK) (*see* Guidelines for the Construction of Fire Resisting Structural Elements) has been adopted in this standard. Therefore, while using this data it may be ensured that the specification of material of construction are same as adopted in this Report. However, as and when data from indigenous source is available, the same will be incorporated in the standard.

5 WALLS

5.1 The fire ratings of some types of constructions for walls (*see* Note below **4.3**) are given in Tables 2 to 7. The specifications of materials should be so selected as to give these ratings.

Table 1 Fire Resistance Ratings of Structural Elements (in Hours)

(*Clauses* 4.1 *and* 5.10)

Sl No.	Structural Element		Type of Construction			
			Type 1	Type 2	Type 3	Type 4
1	Exterior walls:					
	a) Fire separation less than 3·7 m	i) Bearing	4	2	2	1
		ii) Non-bearing	2	1½	1	1
	b) Fire separation of 3·7 m or more but less than 9 m	i) Bearing	4	2	2	1
		ii) Non-bearing	1½	1	1	1
	c) Fire separation of 9 m or more	i) Bearing	4	2	2	1
		ii) Non-bearing	1	1	1	1
2	Fire walls		4	2	2	2
3	Fire separation assemblies (like fire check doors)		4	2	2	2
4	Fire enclosures of exitways, exitway hallways, and stairways		2	2	2	2
5	Shaft other than exitways elevator hoistways		2	2	2	2
6	Exitway access corridors		1	1	1	1
7	Vertical separation of tenant spaces		1	1	1	1
8	Dwelling unit separation Non-load bearing partitions		1	1	1	1
			← At least half an hour →			
9	Interior bearing walls, bearing partitions, columns, girders, trusses (other than roof trusses) and framing	i) Supporting more than one floor	4	2	2	2
		ii) Supporting one floor only	3	1½	1	1
		iii) Supporting a roof only	3	1½	1	1
10	Structural members support walls		3	1½	1	1
11	Floor construction including walls		3	1½	1	1
12	Roof construction	i) 5 m or less in height to lowest member	2	1½	1	1
		ii) More than 5 m but less than 6·7 m in height to lowest member	1	1	1	1
		iii) 6·7 m or more in height to lowest member	0	0	0	0

Table 2 Masonry Walls: Solid (Required to Resist Fire from One Side at a Time)

(*Clause* 5.1)

Nature of Construction and Materials	Minimum Thickness (mm), Excluding any Finish, for a Fire Resistance (Hours) of									
	Load Bearing					Non-Load Bearing				
	1	1½	2	3	4	1	1½	2	3	4
1 Reinforced* cement concrete	120 (25)	140 (25)	160 (25)	200 (25)	240 (25)					
2 Unreinforced cement concrete	150	175	—	—	—					
3 No-fines concrete with:										
a) 13 mm cement/sand or gypsum/sand						150	150	150	150	150
b) 13 mm lightweight aggregate gypsum plaster						150	150	150	150	150
4 Bricks of clay:										
a) Without finish	90	100	100	170	170	75	90	100	170	170
b) With 13 mm lightweight aggregate gypsum plaster	90	90	90	100	100	75	90	90	90	100
5 Bricks of sand lime:										
a) Without finish	90	100	100	190	190	75	90	100	170	170
b) With 13 mm lightweight aggregate gypsum plaster	90	90	90	100	100	75	90	90	90	100
6 Blocks of concrete:										
a) Without finish	90	100	100	—	—	75	90	100	140	150
b) With 13 mm lightweight aggregate gypsum plaster	90	90	90	100	100	75	75	75	90	100
c) With 13 mm cement/sand or gypsum/sand						75	90	90	100	140
7 Blocks of lightweight concrete:										
a) Without finish	90	100	100	140	150	75	75	75	125	140
b) With 13 mm lightweight aggregate gypsum plaster	90	90	90	100	100	50	63	75	75	75
c) With 13 mm cement/sand or gypsum/sand						75	75	75	90	100
8 Blocks of aerated concrete:										
a) Without finish	90	100	100	140	180	50	63	63	75	100
b) With 13 mm lightweight aggregate gypsum plaster	90	90	100	100	150					

*Walls containing at least 1 percent of vertical reinforcement.
( ) Minimum thickness of actual cover to reinforcement.

Table 3 Masonry Walls: Hollows (Required to Resist Fire from One Side at a Time)

(*Clause* 5.1)

Nature of Construction and Materials	Minimum Thickness (mm), Excluding any Finish, for a Fire Resistance (Hours) of										
	Load Bearing					Non-Load Bearing					
	1	1½	2	3	4	½	1	1½	2	3	4
1 Bricks of clay:											
a) Without finish	170	170	170	200	200	75	100	100	170	170	200
b) With 13 mm lightweight aggregate gypsum plaster	100	100	170	170	170	75	75	90	100	100	170
2 Block's of concrete:											
a) Without finish						90	125	125	140	140	150
b) With 13 mm cement/sand or gypsum/sand						90	125	125	140	140	140
c) With 13 mm lightweight aggregate gypsum plaster	190	200	200	—	—	75	90	90	100	125	125
3 Blocks of lightweight concrete:											
a) Without finish	100	100	100	—	—	75	90	90	100	140	150
b) With 13 mm cement/sand or gypsum/sand						75	75	75	100	140	140
c) With 13 mm lightweight aggregate gypsum plaster						63	63	75	75	90	100

Table 4 Framed Construction, Load Bearing (Required to Resist Fire from One Side at a Time)

(*Clause* 5.1)

Nature of Construction and Materials/ Timber Studs at Centres not Exceeding 600 mm, Faced on Each Side with	Minimum Thickness (mm) of Protection for a Fire Resistance of 1 h
1 Plasterboard layers with joints staggered, joints in outer layer taped and filled — Total thickness for each face	25
2 One layer of 12·7 mm plasterboard with a finish of lightweight aggregate gypsum plaster	13
3 Metal lath and plaster, thickness of plaster:	
a) Sanded gypsum plaster (metal lathing grade)	22
b) Lightweight aggregate gypsum plaster	13

Table 5 Framed Construction, Non-Load Bearing (Required to Resist Fire from One Side at a Time)

(*Clause* 5.1)

Nature of Construction and Materials/Steel or Timber Frame at Centres not Exceeding 600 mm, Facings on Both Sides of	Stud Construction	Minimum Thickness (mm) of Protection for a Fire Resistance of			
		½ h	1 h	1½ h	2 h
A) *Dry lining with materials fixed direct to studs (without plaster finish)*:					
1 One layer of plasterboard with taped and filled joints	Timber or steel	12·7			
2 Two layers of plasterboard with joints staggered, joints in outer layer taped and filled — Total thickness for each face	Timber or steel	19	25		
3 One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating board not less than 9 mm thick, or by timber	Timber Steel	9 12			
4 One layer of wood wool slabs	Timber	25			
5 One layer of chipboard or of plywood	Timber or steel	18			
B) *Lining with materials fixed direct to studs, with plaster finish*:					
1 Plasterboard of thickness:					
a) With not less than 5 mm gypsum plaster finish	Timber or steel	9·5			
b) With not less than 13 mm gypsum plaster finish			12·7		
C) *Wet finish*:					
1 Metal lath and plaster, thickness of plaster:					
a) Sanded gypsum plaster	Timber or steel	13			
b) Lightweight aggregate gypsum plaster	Timber Steel		13 13	19	25

Table 6 Framed External Walls Load Bearing (Required to Resist Fire from One Side at a Time)

(*Clause* 5.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of 1 h
Timber studs at centres not exceeding 600 mm with internal linings of	
1 Plasterbord layers with joints in outer layer taped and filled, total thickness of plasterboard	31

Table 7A Framed External Walls Non-Load Bearing Required to Resist Fire Only from Inside the Building

(*Clause* 5.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Modified Fire Resistance of					
	½ h	1 h	1½ h	2 h	3 h	4 h
A) *Steel frame with an external cladding of non-combustible sheets (excluding sheet steel), with a steel supporting framework and internal lining of*:						
1 Metal lath and plaster, thickness of plaster:						
a) Sanded gypsum plaster (metal lathing grade)	13	13				
b) Lightweight aggregate gypsum plaster	10	13	15	15	15	19
2 Two layer of plasterboard with joints staggered joints in outer layer taped and filled — Total thickness	21	32				
3 Plasterboard of thickness:						
a) With not less than 5 mm gypsum plaster finish	12·7					
b) With not less than 13 mm gypsum plaster finish	9·5					
c) With not less than 10 mm lightweight aggregate gypsum platser	9·5					
4 One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating board not less than 9 mm thick, or by timber	9	9	12	12	12	12
5 One layer of wood/wool slabs without finish		50				
6 One layer of compressed straw building slabs:						
a) Without finish	50					
b) With not less than 5 mm gypsum plaster finish		50				
7 Aerated concrete blocks	50	50	63	63	75	100
8 Bricks of clay:						
a) Without finish	75	75	90	90	100	100
b) With not less than 13 mm lightweight aggregate gypsum plaster			75	75	90	90

Table 7B Framed External Walls Non-Load Bearing Required to Resist Fire Only from Inside the Building

(*Clause* 5.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection to Provide Sufficient Insulation to Achieve a Modified Fire Resistance of up to 4 h
B) *Steel frame with an external cladding of sheet steel fully lapped, steel bolted and fixed to steel sheeting rails, with timber or steel supporting framework and internal lining of*:	
1 Metal lath and plaster, thickness of plaster:	
a) Sanded gypsum plaster (metal lathing grade)	13
b) Lightweight aggregate gypsum plaster	10
2 One layer of plasterboard with joints taped and filled	12·7
3 Plasterboard of thickness, with not less than 5 mm gypsum plaster finish	9·5
4 One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating board not less than 9 mm thick, or by timber	9
5 One layer of wood/wool slabs	25
6 One layer of compressed straw building slabs	50
7 One layer of chipboard or of plywood	18
8 Aerated concrete blocks	50
9 Bricks of clay	75
10 Any internal decorative lining with a cavity fill independently supported and retained in position of mineral fibre insulating material (excluding glass) at a density of 48 kg/m³	50

Table 7C Framed Walls Non-Load Bearing Required to Resist Fire Only from Inside the Building

(*Clause* 5.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of 1½ h
C) *Timber frame with external cladding of weather boarding or external plywood, 9·5 mm with an internal lining of*:	
1 Plasterboard not less than 9·5 mm thick, finished with:	
a) Gypsum plaster	13
b) Lightweight aggregate gypsum plaster	10
2 Plasterboard not less than 12·7 mm thick, finished with:	
a) Gypsum plaster	10
b) Lightweight aggregate gypsum plaster	10
3 One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating board not less than 9 mm thick, or by timber	9 12

5.2 The separating walls should be carried through the roof to a height of at least 60 cm above except in the case of reinforced brick/ concrete slab roof where it should be bonded flash with a top level of the slab. At the time of designing openings, particular attention should be paid to all such factors as will limit fire spread through these openings. Every opening in the wall should be protected by fire resisting doors having the fire rating of not less than 1 hour. Similar protection should also be done in other openings like rope races, motor alley ways, staircases, etc, of rating not less than 2 hours. However, for Types 1, 2, 3 construction, a doorway or opening in a separating wall of any floor should be limited to 5·6 m² in area with a maximum height of 2·75 m and maximum width of 2 m.

5.3 When building(s) and/or compartment(s) are separated by separating wall(s) and there is a *verandah* on one or more sides of such building(s) and/or compartment(s), it is necessary that the separating wall should be built out across the *verandah* and be carried through the roof of the same; otherwise the building(s) and/or compartment(s) should be regarded as having internal communication and, therefore, subject to danger of spread of fire.

5.4 When opening in walls are provided to allow cable, etc, the space around cables and the wall should be protected according to the provision given in IS 12459 : 1988. However, such space in case of openings provided to allow plumbing/ gas/steam pipes and similar services should be sealed with filler material of fire rating not less than that of the walls in which these are situated.

5.5 Where openings are permitted, they should not exceed three-fourths of the area of the wall in case of an external wall.

5.6 A separating wall should be supported in a vertical line by a similar separating wall through all storeys below. The separating wall should be carried and bonded to the floor of appropriate fire-resisting construction.

5.7 When a separating wall runs parallel to the axis of the north light opening or gabled roof, the screen wall should be carried through, and 60 cm above the top of the north light opening except in cases where the screen wall becomes of such a height that horizontal distance between the north light opening and the roof of the adjoining building and/or compartment or between two sloping faces of the two consecutive roofs at the level of the top of the screen wall, is at least 6 m.

If, however, the separating wall is at right angles to the axis of the north light opening or the gabled roof, the 'saw tooth' gaps should be bricked up and screen wall extended above the ridge of the north light or the gabled roof.

5.8 All separating walls should be built out to extend 15 cm beyond the eaves of the roof so as to effectively cut off the roofs of the parts so separated. The eaves should be cut away on each side of this extension of the separating wall. If there is an opening on both sides of the separating wall within 3 m of the wall, those on one side should be bricked up to full thickness of wall, or an alternative should be provided with fire resisting doors of fire rating not less than of 2 hours for walls of 4 hours rating and 1 hour for other rating.

5.9 Common wooden roof members (trusses, joists and purlins) should not pass through the separating walls but they may be embedded therein provided they do not extend more than 22·5 cm into wall and are separated from the similar roof member in the adjoining building by at least 11 cm or solid wall material.

5.10 Partition is used for separating sections or rooms of a building but is not expected to have a fire resistance equal to any of the values. In fact, in practice it should not be considered otherwise than structure of light dimension and strength consistent with the purpose for which it is used. The minimum fire rating of the partition is given in Table 1.

6 COLUMNS AND BEAMS

6.1 The fire ratings of some types of construction are given in Tables 8, 9, 12 and 13 (*see* Note below **4.3**). The specifications of materials should be so selected as to give these ratings.

7 FLOORS AND ROOFS

7.1 The fire ratings of some types of construction is given in Tables 10, 11, 14, 15, and 16. The specifications of materials should be so selected so as to give these ratings.

Table 8 Reinforced Concrete Columns

(*Clause* 6.1)

	Nature of Construction and Materials		Minimum Dimensions (mm), Excluding any Finish, for a Fire Resistance of					
			½ h	1 h	1½ h	2 h	3 h	4 h
1	Fully exposed	Width	150	200	250	300	400	450
		Cover	20	25	30	35	35	35
2	50 percent exposed	Width	125	160	200	200	300	350
		Cover	20	25	25	25	30	35
3	One face exposed	Thickness	100	120	140	160	200	240
		Cover	20	25	25	25	25	25

Table 9 Concrete Beams

(*Clause* 6.1)

	Nature of Construction and Materials		Minimum Dimensions (mm), Excluding any Finish, for a Fire Resistance of					
			½ h	1 h	1½ h	2 h	3 h	4 h
1	Reinforced concrete (simply supported)	Width	80	120	150	200	240	280
		Cover	20	30	40	60	70	80
2	Reinforced concrete (continuous)	Width	80	80	120	150	200	240
		Cover	20	20	35	50	60	70
3	Prestressed concrete (simply supported)	Width	100	120	150	200	240	280
		Cover	25	40	55	70	80	90
4	Prestressed concrete (continuous)	Width	80	100	120	150	200	240
		Cover	20	30	40	55	70	80

Table 10 Concrete Floors

(*Clause* 7.1)

	Nature of Construction and Materials		Minimum Dimensions (mm), Excluding any Finish, for a Fire Resistance of					
			½ h	1 h	1½ h	2 h	3 h	4 h
1	Reinforced concrete (simply supported)	Thickness	75	95	110	125	150	170
		Cover	15	20	25	35	45	55
2	Reinforced concrete (continuous)	Thickness	75	95	110	125	150	170
		Cover	15	20	20	25	35	45

Table 11 Concrete Floors: Ribbed Open Soffit

(*Clause* 7.1)

	Nature of Construction and Materials		Minimum Dimensions (mm), Excluding any Finish, for a Fire Resistance of					
			½ h	1h	1½ h	2 h	3 h	4 h
1	Reinforced concrete (simply supported)	Thickness	70	90	105	115	135	150
		Width	75	90	110	125	150	175
		Cover	15	25	35	45	55	65
2	Reinforced concrete (continuous)	Thickness	70	90	105	115	135	150
		Width	75	80	90	110	125	150
		Cover	15	20	—	35	45	55

Table 12 Encased Steel Columns, 203 mm × 203 mm (Protection Applied on Four Sides)

(*Clause* 6.1)

	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of				
		1 h	1½ h	2 h	3 h	4 h
A)	*Hollow protection (without an air cavity over the flanges)*:					
	1 *Metal lathing with trowelled lightweight aggregate gypsum plaster	13	15	20	32	
	2 Plasterboard with 1·6 mm wire binding at 100 mm pitch, finished with lightweight aggregate gypsum plaster not less than the thickness specified:					
	a) 9·5 mm plasterboard	10	15			
	b) 19 mm plasterboard	10	13	20		
	3 Asbestos insulating boards, thickness of board:					
	a) Single thickness of board, with 6 mm cover fillets at transverse joints		19	25		
	b) Two layers, of total thickness				38	50
	4 Solid bricks of clay, composition or sand lime, reinforced in every horizontal joint, unplastered	50	50	50	75	100
	5 Aerated concrete blocks	60	60	60		
	6 Solid blocks of lightweight concrete Hollow protections (with an air cavity over the flanges)	50	50	50	60	75
B)	*Asbestos insulating board screwed to 25 mm asbestos battens*	12	19			
C)	*Solid protections*					
	1 Concrete, not leaner than 1 : 2 : 4 mix (unplastered):					
	a) Concrete not assumed to be load bearing, reinforced†	25	25	25	50	75
	b) Concrete assumed to be load bearing	50	50	50	75	75
	2 Lightweight concrete, not leaner than 1 : 2 : 4 mix (unplastered) concrete not assumed to be load bearing, reinforced†	25	25	25	40	60

*So fixed or designed, as to allow full penetration for mechanical bond.

†Reinforcement shall consist of steel binding wire not less than 2·3 mm in thickness, or a steel mesh weighing not less than 0·5 kg/m². In concrete protection, the spacing of that reinforcement shall not exeed 200 mm in any direction.

Table 13 Encased Steel Beams, 406 mm × 176 mm (Protection Applied on Three Sides)

(*Clause* 6.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of					
	½ h	1 h	1½ h	2 h	3 h	4 h
A) *Hollow protection (without an air cavity beneath the lower flange)*:						
1 *Metal lathing with trowelled lightweight aggregate gypsum plaster (metal lathing grade)	13	13	15	20	25	
2 Plasterboard with 1·6 mm wire binding† at 100 mm pitch, finished with lightweight aggregate gypsum plaster not less than the thickness specified:						
a) 9·5 mm plasterboard	10	10	15			
b) 19 mm plasterboard	10	10	13	20		
3 Asbestos insulating board, thickness of board:						
a) Single thickness of board, with 6 mm cover fillets at transverse joints			19	25		
b) Two layers, of total thickness					38	50
B) *Hollow protection (with an air cavity below the lower flange)*:						
1 Asbestos insulating board screwed to 25 mm asbestos battens	9	12				
C) *Solid protection*:						
1 Concrete, not leaner than 1 : 2 : 4 mix (unplastered):						
a) Concrete not assumed to be load bearing, reinforced‡	25	25	25	25	50	75
b) Concrete assumed to be load bearing	50	50	50	50	75	75
2 Lightweight concrete§ not leaner than 1 : 2 : 4 (mix) unplastered	25	25	25	25	40	60

*So fixed, or designed, as to allow full penetration for mechanical bond.

†Where wire binding cannot be used, expert advice should be sought regarding alternative methods of support to enable the lower edges of the plasterboard to be fixed together and to the lower flange, and for the top edge of the plasterboard to be held in position.

‡Reinforcement shall consist of steel binding wire not less than 2·3 mm in thickness or a steel mesh weighing not less than 0·5 kg/m². In concrete protection, the spacing of that reinforcement shall not exceed 200 mm in any direction.

§Concrete not assumed to be load bearing, reinforced.

Table 14 Timber Floors — Tongued and Grooved Boarding, or Sheets of Tongued and Grooved Plywood or Wood Chipboard, of not Less than 21 mm Finished Thickness

(*Clause* 7.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of		
37 mm (minimum) timber joists with a ceiling of:	½ h	1h	2 h
1 Timber lathing and plaster, plaster of thickness	15		
2 Metal lathing and plaster, thickness of plaster:			
a) Sanded gypsum plaster (metal lathing grade)	15		
b) Lightweight aggregate gypsum plaster	13	13	25
3 One layer of plasterboard with taped and filled joints	12·7		
4 Two layers of plasterboard with joints staggered, joints in outer layer taped and filled total thickness	19	31	
5 One layer of plasterboard not less than 9·5 mm thick, finished with:			
a) Gypsum plaster	5		
b Sanded gypsum plaster	13		
c) Lightweight aggregate gypsum plaster	13		
6 One layer of plasterboard not less than 12·7 mm thick, finished with:			
a) Gypsum plaster	5		
b) Lightweight aggregate gypsum plaster	10		
7 One layer of asbestos insulating board with any transverse joints backed by fillets of asbestos insulating board not less than 9 mm thick, or by timber	9	12	

Table 15 Timber Floors — Tongued and Grooved Boarding, or Sheets of Tongued and Grooved Plywood or Wood Chipboard, of not Less than 15 mm Finished Thickness

(*Clause* 7.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of		
37 mm (minimum) timber joists with a ceiling of:	1½ h	1 h	2h
1 Timber lathing and plaster, plaster of thickness	15		
2 Metal lathing and plaster, thickness of plaster for:			
a) Sanded gypsum plaster (metal lathing grade)	15		
b) Lightweight aggregate gypsum plaster	13	13	25
3 One layer of plasterboard with taped and filled joints	12·7		
4 Two layers of plasterboard with joints staggered, joints in outer layer taped and filled total thickness	22	31	
5 One layer of plasterboard not less than 9·5 mm thick, finish with:			
a) Gypsum plaster	5		
b) Sanded gypsum plaster	15		
c) Lightweight aggregate gypsum plaster	13		
6 One layer of plasterboard not less than 12·7 mm thick, finished with:			
a) Gypsum plaster	5		
b) Lightweight aggregate gypsum plaster	10		
7 One layer of asbestos insulating board, with any transverse joints backed by fillets of asbestos insulating board not less than 9 mm thick, or by timber	9	12*	

*Finished on top with 25 mm minimum thick glass fibre or mineral wool laid beetween joints.

Table 16 Timber Floors — Any Structurally Suitable Flooring of Timber or Particle Boards

(*Clause* 7.1)

Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of	
37 mm (minimum) timber joists with a ceiling of:	½ h	1 h
1 Timber lathing and plaster, plaster of thickness	15	
2 Metal lathing and plaster, thickness of plaster for:		
a) Sanded gypsum plaster (metal lathing grade)	15	
b) Lightweight aggregate gypsum plaster	13	19
3 One layer of plasterboard with joints taped and filled and backed by timber	12·7	
4 Two layers of plasterboard with joints staggered, joints in outer layer taped and filled total thickness	25	
5 Two layers of plasterboard, each not less than 9·5 mm thick, joints between boards staggered and outer layer finished with gypsum plaster	5	
6 One layer of plasterboard not less than 9·5 mm thick, finished with:		
a) Sanded gypsum plaster	13	
b) Lightweight aggregate gypsum plaster	15	
7 One layer of plasterboard not less than 12·7 mm thick, finished with:		
a) Sanded gypsum plaster	15	
b) Lightweight aggregate gypsum plaster	13	
8 One layer of asbestos insulating board with any transverse joints backed by fillets of asbestos insulating board not less than 9 mm thick, or by timber	12	

7.2 In case of a building more than 15 m in height, all floors should be compartmented with area not exceeding 750 m² by a separation wall with 2 hours fire rating, for floors having provision of sprinklers. The area may be increased by 50 percent. In long buildings, the fire separation walls should be at distance not exceeding 40 m. For departmental stores, shopping centres and similar occupancies, the area may be reduced to 500 m². Where this is not possible provision of the sprinklers should be kept with appropriate spacing.

7.3 A surface covering of non-combustible and non-toxic material should be laid directly on the incombustible floor. Wood flooring may be laid directly on such surface covering, or directly on such floor provided that in either case there is no intervening space and that any wood fillets for affixing such flooring is bedded not more than 2·5 cm in the non-combustible floor.

7.4 In the case of building used for storage purposes, the floor surface should conform to the above, in addition, it should be at least 15 cm above the ground level or the level of the door sills whichever is higher, and should slant towards the doors.

7.5 An opening through a floor should comply with the following:

a) At the time of designing openings particular attention should be paid to all such factors which will limit fire spread through these openings.

b) When opening in floors are provided to allow cable, etc, the space around cable and the floor should be protected according to th eprovision given in IS 12459 : 1988. However, such space in case of openings provided to allow plumbing/gas/steam pipes and similar services should be sealed with filler material of fire rating not less than 1 hour.

c) Openings for steam, gas and/or water pipes and electrical conduits, whether of iron or earthenware, should have a radial clearance, to allow for any heat expansion, not greater than 3 mm.

d) The enclosure for staircases and hoists should be constructed entirely of brick, concrete or of reinforced concrete or similar material of construction having 2 hours rating. Every opening from the enclosure on to a roof used as floor or to any other part of the building should be fitted with a fire resistant door of rating not less than 1 hour.

e) If any staircase or hoist extends to the top storey of a building the roof of which is not a roof used as a floor, the enclosing walls should be carried through and at least 45 cm above the roof of the building and a skylight or window glazed should be provided above the roof of the building. Alternatively, if the roof of the building is used as a floor, it should comply with (d), and this should also apply for any furnace or motor chamber communicating with the staircase or hoist enclosure.

7.6 Linings or false ceilings should not be permissible in buildings and in situations, where permitted, such additions should not detract in anyway from minimum fire rating of half an hour.

In some cases, requiring provision of skylights, monitor lights or north lights in the roofs and where these are necessary, the glazings should be of glass in metal frames for fire rating of half an hour minimum.

7.7 Composite roofs may be used over as addition to the roofs of buildings as a weatherproofing, but should not be considered as a roof in itself, that is, without the support of a non-combustible construction beneath, unless it is of not less than half an hour fire resistance.

8 AIR-CONDITIONING

8.1 Air-conditioning systems should be so installed and maintained as to minimize the danger of spread of fire, smoke or fumes thereby from one floor or fire area to another, or from outside into any occupied building or structure.

8.2 Air-conditioning systems circulating air to more than one floor area should be provided with dampers designed to close automatically in case of fire and thereby prevent spread of fire or smoke. Such a system should also be provided with automatic controls to stop fans in case of fire, unless arranged to remove smoke from a fire, in which case these should be designed to remain in operation.

8.3 Air-conditioning system serving large places of assembly (over 1 000 persons), large departmental stores or hotels with over 100 rooms in a single block should be provided with effective means for preventing circulation of smoke through the system in the case of a fire in air filters or from other sources drawn into the system even though there is insufficient heat to actuate heat sensitive devices controlling fans or dampers. Such means should consist of approved effective smoke sensitive controls.

8.4 Air-conditioning should conform to the following:

a) Escape routes like staircases, common corridors, lift lobbies, etc, should not be used as return air passage.

b) The ducting should be constructed of metal in accordance with IS 655 : 1963.

c) Wherever the ducts pass through fire walls or floor, the opening around the ducts

should be sealed with fire resisting materials of same rating as of walls/floors.

d) As far as possible, metallic ducts should be used even for the return air instead of space above the false ceiling.

e) The material used for insulating the duct system (inside or outside) should be of flame resistant (*see* IS 4355 : 1977) and non-conductor of heat.

f) Area more than 750 m² on individual floor should be seggregated by a fire wall and automatic fire dampers for isolation should be provided.

g) In case of more than one floor, arrangement by way of automatic fire dampers for isolating by ducting at every floor from the main should be made. Where plenumus used for return air passage, ceiling and its fixtures and air filters of the air handling units should be flame resistant [*see* **8.4** (e)]. Inspection panels should be provided in the main trunking. No combustible material should be fixed nearer than 15 cm to any duct unless such ducting is properly enclosed and protected with flame resistant material. The fire dampers should be located in conditioned air ducts and return air ducts passages at the following points which will operate automatically and are simultaneously switch off air handling fans:

   i) at the fire separation wall,

   ii) where ducts/passages enter the central vertical shaft,

   iii) where the ducts pass through floor, and

   iv) at the inlet of supply air duct and the return air duct of each compartment on every floor.

In case of buildings more than 24 m in height in non-ventilated lobbies corridors, smoke extraction shaft should be provided. The automatic fire damper should be so arranged so as to close by gravity in a direction of movement and to remain tightly closed upon operation.

9 SMOKE AND FIRE VENTING

9.1 Provision has to be made for venting which allows escape of hot gases and smoke release by accidental burning of combustible material stored or are being processed inside a building, and will give ample time for all the inmates to escape before the roof collapses either in part or wholly in the event of fire. Provisions in this regard are essential for industrial buildings; details of which are covered in a separate Indian Standard. The provision in regard to the domestic buildings are given in **9.2**. The form of vent should be a ventilator-cum-exhaust which in addition to the requisite grading of fire rating be easily openable.

9.2 Smoke venting facilities, where required for safe use of exits in windowless buidings, underground structures, large area factories, departmental store, domestic dwelling, theatres, cinemas, lecture halls, etc, or where required should be automatic in action.

9.3 Natural draft smoke venting should utilize roof vents or vents in walls at or near the ceiling level; such vents should be normally open, or if closed, should be designed for automatic opening in case of fire, by release of heat smoke sensitive elements, breakage of glass, or melting of plastic under the influence of heat; or by other approved means.

9.4 Where smoke venting facilities are installed for purposes of exit safety, these should be adequate to prevent dangerous accumulation of smoke during the period of time necessary to evaluate the area served, using available exit facilities with a margin of safety to allow for unforeseen contingencies.

9.5 The discharge apertures of all natural draft smoke vents should be so arranged as to be readily susceptible to opening by fire service personnel.

9.6 Power operated smoke exhausting systems may be substituted for natural draft vents (*see* IS 941 : 1985).

9.7 In case of buildings more than 15 m in height the staircase should be ventilated to the atmosphere at each landing and a vent at the top, the vent openings should be 0·5 m in the external wall and top. If the staircase cannot be ventilated because of location or other reasons, the provision should be made for pressurization (50 Pa) to be separated automatically with the fire alarm. The roof of the shaft in the latter case should be 1 m above the surrounding roofs. Glazing or glass bricks should not be used in the staircase.

10 SERVICE DUCTS

10.1 Service ducts should be enclosed by walls and doors (if any) of 2 hours fire rating; if ducts are larger than 1 m³ the floor should seal them, but provide suitable openings for the pipes to pass through, with the gaps sealed.

10.2 A vent opening at the top of the service shaft should be provided between one-fourth and one-half of the area of the shaft.

11 BASEMENTS

11.1 Each basement should be separately ventilated. Vents with cross-sectional area (aggregate.) not less than 2·5 percent of the floor area spread evenly round the perimeter of the basement should be provided in the form of grills or breakable stallboard lights or pavement lights or

by way of shafts. Alternatively, a system of air inlets should be provided at basement floor level and smoke outlets at basement ceiling level. Inlets and extractors may be terminated at ground level with stallboard or pavement lights as before, but ducts to convey fresh air to the basement floor level have to be laid. Stallboard and pavement lights should be in positions easily accessible to the fire brigade and clearly marked 'SMOKE OUTLET', or 'AIR INLET' with an indication of area served at or near the opening.

11.2 The staircase of basements should be of enclosed type having fire resistance of not less than 2 hours and should be situated at the periphery of the basement to be entered at ground level only from the open air and in such positions that smoke from any fire in the basement should not obstruct and exit serving the ground and upper storeys of the building and should communicate with basement through a lobby provided with fire resisting self-closing doors of 1 hour fire resistance. If the travel distance exceeds 18·50 m, additional staircases should be provided at proper places.

11.3 In multi-level basements, intake ducts may serve all basement levels, but each basement and basement compartment should have separate smoke outlet duct or ducts. Mechanical extractors for smoke venting (*see* IS 941 : 1985) from low basement levels should also be provided, with provision of automatic operation of system actuation of heat/smoke sensitive detectors or sprinklers and also manully. Mechanical extractors should have an inter-locking arrangement, so that extractors should continue to operate and supply fans should stop automatically with the actuation of fire detectors. Mechanical extractors should be designed to permit 30 air changes per hour in case of fire or distress call. However, for normal operation, only 28 air changes should be maintained. Mechanical extractors should have an alternative source of supply. Ventilating ducts should be integrated with the structure and made out of brick masonry or RCC as far as possible and when this duct crosses the transformer area or electrical switch board, fire dampers should be provided. Basement/sub-basement should not be used for storage, cooking purposes, garrage and shops unless provision is made for sprinkler system. If cut-outs are provided from basements to the upper floors or to the atmosphere all sides of the cut-out openings in the basements should be protected by automatic spray in the event of a fire.

12 CHIMNEYS

12.1 Over and above the provisions given in **4.2**, the following provisions should be followed:

a) A clearance of at least 4 cm between the outer surface of the chimney and any adjacent combustible material forming part of a wall lining enclosing the chimney.

b) The fire resistance of any structure surrounding a flew or flew pipe should be not less than that for external walls. In the case of flew pipe there should be an air space between it and the surrounding structure of sufficient width to permit access to the pipe for inspection and repair.

c) When a flew pipe passes though any other room or an enclosed roof space it should be protected by structure having a fire resistance equal to the external walls.

d) The chimney excluding the pot should be carried to a minimum height of 1 m above the highest point of its junction with the roof.

e) The outlet of a flew from domestic appliance having a roof covering should be at least 2·5 m in a horizontal plain from the roof of any structure built upon the roof or at least 0·6 m higher than any ridge within 2·5 m.

f) If the roof covering is not fire resistant, no flew outlet should be lower than the ridge for the highest point of the roof or less than 1 m above any ridge within 2·5 m.

g) Where a metal chimney passes through a roof covering which is not fire resistant, it shall be guarded by a suitable iron or metal thimble extending not less than 22·5 cm above and below roof construction and of a size to provide not less than 15 cm clearance on all sides of chimneys.

13 STAIRCASES AND LIFTS

13.1 Staircases

The details with regard to the provisions of staircases have been given in IS 1644 : 1988.

13.2 Lifts

13.2.1 The general requirements for the provision of lifts should be as follows:

a) Walls of lifts and enclosures should have a fire rating of 2 hours; lift shaft should have a vent at the top of area not less than 0·2 m^2.

b) Lift motor room should be located preferably on top of the shaft and separated from the shaft by the floor of the room.

c) Landing doors in lifts and enclosures should have a fire resistance of not less than 1 hour.

d) The number of lifts in one lift tank should not exceed 4. Individual shafts in a bank should be separated by a wall of 2 hours fire rating.

e) Lift care door should have a fire resistance rating of not less than 1 hour.

f) Collapsible gates should not be used for lifts and should have doors with fire resistance of at least 1 hour.

g) In opening other than the lift lobby door in the lobby enclosure wall should also have the minimum fire resistance of one hour.

h) Exit from the lift lobby, if located in the core of the building should be to a self-closing stop door of minimum 1 hour fire rating.

j) Lifts should not normally communicate to the basement.

k) Suitable arrangements, such as providing slope in the floor of lift lobby should be made to prevent water used during fire fighting, etc, on any landing from entering the lift shaft.

m) The sign should be posted and maintained at every floor at or near the lift indicating that in case of fire occupants should use the stairs unless instructed otherwise. The sign should also contain a plan for each floor showing the location of staircase.

13.2.2 *Fire Lifts*

13.2.2.1 Where applicable, fire lifts should be provided with a minimum capacity for 8 passengers with floor area of not less than 1·4 m² and fully automated with emergency switch on the ground level. In general, building over 15 m in height should be provided with fire lifts. Each fire lift should be equipped with suitable intercommunication equipment communicating with the control room on the ground floor of the building. The number and location of fire lifts in a building should be decided after taking into consideration various factors like building, population, floor areas, section of building (comparmentation), etc. The words 'fire lift' should be conspicously displayed in illuminous paint on the lift landing door at each floor level.

14 REFUSE AREA

14.1 In case of buildings more than 24 m in height, refuse area of 15 m² or an area equal to 0·25 m² per person to accommodate the occupants of two consecutive floors, whichever is higher, should be provided as under. Refuse area should be provided on the peripheri of the floor and open to air at least on one side protected with suitable railings:

a) For floors above 24 m and up to 39 m — one refuse area on the floor immediately above 24 m.

b) For floor above 39 m — one refuse area on the floor immediately above 39 m and so on after every 15 m.

15 REFUSE CHUTES

15.1 Refuse chutes should have an enclosure wall of non-combustible material with fire resistance of not less than 2 hours. They shall not be located within the staircase enclosure or service shafts, or air-conditioning shafts. Inspection panel and doors should be tight fitting with 1 hour fire resistance; the chutes should be as far away as possible from exits.

16 DRAINAGE

16.1 It is essential to make provision for drainage of any such water on all floors to prevent or minimize water damage of the contents.

The drain pipe should be provided on the external wall for drainage of water from all floors. On large area floors several such pipes may be necessary which should be spaced 30 m apart. The pipe should conform to relevant Indian Standards.

17 ELECTRICAL SERVICES

17.1 The electrical services should conform to the following (*see* also IS 1646 : 1982):

a) The electric distribution cables/wiring should be laid in a separate duct. The duct should be sealed at every alternative floor with non-combustible materials having the same fire resistance as that of the duct. Low and medium voltage wiring running in shaft and above false ceiling should run in separate conduits.

b) Water mains, telephones lines, inter-com lines. gas pipes or any other service line should not be laid in the duct for electric cables.

c) The inspection panel doors and any other opening in the shaft should be provided with fire doors having fire resistance of not less than 1 hour.

d) Medium and low voltage wiring running in shafts, and within false ceiling should run in metal conduit. Any 230 V wiring for lighting or other services above false ceiling should have 660 V grade insulations. The false ceiling including all fixtures used for its suspension should be of non-combustible material.

e) An independent and well-ventilated service room should be provided on the

ground floor with direct access from outside or from the corridor for the purpose of termination of electric supply from the licensees service and alternative supply cables. The doors provided for the service room should have fire resistance of not less than 2 hours.

18 FINISHES

18.1 There are certain aspects, applicable to particular occupancies only, which may affect the spread of fire, smoke or fumes and thus the safe evacuation of the building in case of fire. Some such aspects are as follows:

a) Interior finish and decoration;

b) Seating, aisles, railings and turnstiles in place of assembly;

c) Service equipment and storage facilities in buildings other than storage buildings; and

d) Hazards on stage, in waiting spaces, projection booths, etc, in theatres and cinemas.

18.2 The use of flammable surface finishes on walls (including external facade of the building) and ceilings affects the safety of the occupants of a building. Such finishes tend to spread the fire and even though the structural elements may be adequately fire resistant, serious danger to life may result. It is, therefore, essential to have adequate precautions to minimize spread of flame on wall, facade of building and ceiling surfaces.

Any materials used for various surfaces and decor should be such that the flame spread rating should not be more than the values given in **18.3** to **18.6** and in addition should not generate toxic smoke/fumes.

18.3 Susceptibility to fire of various types of wall surfaces is determined in terms of flame spread (*see* IS 12777 : 1989).

18.3.1 In case of buildings more than 15 m in height, the interior finish material should not have rating exceeding Class 1.

18.3.2 The situation under which materials falling into various classes should be used in building construction is given below:

Class 1	*Class 2*	*Class 3*
May be used in any situation	May be used in any situation, except on walls, facade of the building and ceilings of staircases and corridors	Should be used only in living rooms and bedrooms (but not in rooms on the roof) and only as a lining to solid walls and partitions. Not on staircases or corridors or facade of the building

NOTE — Panelling (lining) should be permitted in a limited area. It should not be permitted in a vestibule.

18.3.3 When frames, walls, partitions or floors are lined with combustible materials the surfaces on both sides of the material should conform to the appropriate class.

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