CHAPTER 3

STRUCTURAL FIRE PRECAUTIONS

3.1 GENERAL

3.1.1 General

The purpose of this chapter of the Code is to stipulate requirements to minimise the risk of spread of fire between adjoining buildings by separation, prevent the untimely collapse of buildings in the event of fire by the provision of a stable and durable form of construction and prevent the spread of fire between specified parts of the buildings by the division of such buildings into compartments.

3.2 PROVISION OF COMPARTMENT WALLS AND COMPARTMENT FLOORS

Compartment size-floor area & cubical extent

3.2.1 Any building other than a building of Purpose Group I which has -

(a) Any storey the floor area of which exceeds that specified as relevant to a building of that height in column (2) of Table 3.2A, or

(b) A cubic capacity which exceeds that specified as relevant in column (3) of Table 3.2A, shall be divided into compartments by means of compartment walls and compartment floors so that

(i) no such compartment has any storey the floor area of which exceeds the area specified as relevant to the building in column (2) of the Table, and

(ii) no such compartment has a cubic capacity which exceeds that specified as relevant in column (3) of the Table.

Cubical extent for compartment exceeding 4m in height

3.2.2 (a) In computing the cubical extent of compartments in single storey buildings such as factories, sport halls, markets, foodcourts, multi-purposes halls, cinemas, concert halls, churches, temples and similar buildings, the height of 4m shall be used where the actual height exceeds that figure.

If any compartment comprises more than one storey or contains mezzanine, galleries or lofts, the full height of the compartment shall be used in computing the cubical extent for each storey, mezzanine, galleries or lofts.

(b) Where two buildings are connected by external open-sided covered way or covered link-bridge, the buildings are considered as separate buildings, if the following conditions are complied with:

(i) Within the covered way or link-bridge there is no commercial activities or other usage that would pose a fire risk:

(ii) The width of the covered way or covered link-bridge shall not exceed 5m measured from eave to eave.

3.2.3 Cl.3.2.1 is not applicable if the building:

Exception to Cl.3.2.1

(a) is fitted throughout with an automatic sprinkler system which complies with the requirements in Chapter 6, and

(b) complies with Cl.3.2.4, Cl.3.2.6, Cl.7.5 and Appendix (4).

3.2.4. Compartmentation by Height

(a) In any compartment except those mentioned under sub-clause 3.2.4(c), up to a habitable height of 24m, no compartment shall comprise more than three storeys. This requirement can be relaxed for Atrium spaces provided the design of such spaces complies with the conditions stipulated under Cl.3.2.6.

Compart-mentation by height

(b) In any building which exceeds 24m in habitable height, no compartment shall comprise more than one storey for compartments at storey level exceeding 24m above average ground level, other than a compartment which is within a residential maisonette which may comprise two storey levels.

(c) Buildings under Purpose Group I may consist of more than 3 floors if they are occupied as a single household dwelling.

Single household dwelling

3.2.5 The following situations shall require compartmentation by provision of compartment walls and/or compartment floors -

Other cases requiring compartment walls & compartment floors

(a) Any wall and floor separating a residential apartment or maisonette from any other part of the same building, unless permitted (as in the case of an external wall adjoining an external corridor, for provision of window openings).

Purpose group II

(b) Any wall and floor separating part of a building from any other part of the same building which is used or intended to be used mainly for a purpose falling within a different purpose group, as identified under Table 1.2B, except the following:

Separation of purpose groups

(i) Ancillary offices located within a building or compartment of Purpose Group III, V, VI, VII and VIII.

(ii) Rooms or spaces for ancillary usage located within a building or compartment of Purpose Group III, IV, V, VI, VII and VIII as stipulated under Cl.1.2.2(B).

(iii) Rooms or spaces located within a sprinkler protected building, unless otherwise stated in following sub-clauses of 3.2.5 or other clauses in the Code.

(c) Any floor immediately over a basement storey if such storey-

Floor over a basement

(i) forms part of a building of Purpose Group I which has five or more storeys (including the basement storey) or a building or compartment of Purpose Group II to VIII. In the case of Purpose Group I building which has five or more storeys (including the basement storey), the basement level shall discharge directly to 1st storey grade level.

(ii) has an area exceeding 100m² except that in the case of a building or compartment of Purpose Groups IV,V and VII, the Relevant Authority may consent to exemption from the above requirements provided the building is fitted throughout with an automatic sprinkler system in compliance with the requirements in Chapter 6 and the floor at first basement storey level is constructed as a compartment floor if the building comprises of more than one basement storey.

(d) In any compartment below pavement level, no compartment shall comprise more than one storey, except in the case of Purpose Groups IV, V and VII as permitted under subclause (c) (ii) and in the case of basement used solely for car parking. No part of a basement storey shall be used for the bulk storage of highly inflammable liquids or substances of an explosive nature.

Basement floors

(e) The Fire Command Centre shall be separated from other parts of the same building by compartment walls and floors having fire resistance of at least 2 hours.

Fire Command Centre

(f) Kitchen Separation

(i) In an eating establishment where a kitchen is required for the preparation of food and where 'open flame' cooking appliances are used, the kitchen shall be separated from other parts of the same building by compartment wall and floor having fire resistance of at least 1 hour;

(ii) Openings in the compartment wall and floor shall comply with the relevant provisions of Cl.3.9 for protection of openings;

(iii) Doors shall have fire resistance of half an hour and fitted with automatic selfclosing device;

(iv) Where the flue or duct passes through the compartment wall or floor, the flue or duct shall be encased by noncombustible construction to comply with the requirements of Cl.3.9.5 and no damper shall be permitted to be installed in such flue or duct; and

(v) Separation requirement for kitchen could be exempted under the following conditions:-

(1) when all the cooking facilities in the kitchen are fitted with approved extinguishing systems; or

(2) when there are at least 25% of the perimeter walls (excluding air-well and void) of an eating establishment open directly to the external of the building, and provided any part of the floor space is within 9m from the nearest opening; or

(3) when there are at least 50% of the perimeter walls (excluding air-well and void) of an eating establishment open directly to the external of the building, and provided any part of the floor space is within 12m from the nearest opening; or

(4) when an eating establishment is separated from other parts of the same building by walls and floors having fire resistance of at least 1 hour and doors having fire resistance of at least half an hour; and provided –

* for a sprinkler protected building, there is no restriction to the floor area of the compartment; or

* for a non-sprinkler protected building, the floor area of the compartment shall not exceed 150m^2;

LPG cylinders provided for the 'open flame' cooking activities are not allowed to be located at the basement and the installation of LPG cylinders at other areas shall comply with the provisions in the Fire Safety (Petroleum) Regulations.

Notwithstanding all the above, the compartment where 'open flame' cooking activities is carried out shall not comprise more than one storey.

(g) Separation of theatre, cinema or concert hall from other parts of the building

A theatre, cinema or concert hall shall be separated from other parts of the same building, which is of a different purpose group, by compartment walls and floors having a fire resistance of at least 2-hour. If the building is protected by an automatic sprinkler system, the fire resistance rating of the compartment walls or floors can be reduced to 1-hour. Where openings are provided for access between the theatre, cinema or concert hall and any other part of the same building of a different purpose group, the openings shall either be protected by fire doors having the necessary fire resistance rating as the enclosing walls or floors, or be provided with lobby which complies with the following requirements:

(i) The lobby is enclosed by walls having fire resistance of at least one hour, is naturally ventilated complying with the requirements for ventilation of smoke stop lobbies, or mechanically ventilated to comply with the requirements in Chapter 7, and

(ii) All doors to the lobby shall each have fire resistance of not less than half an hour and fitted with automatic self closing device.

(h) Separation by Proscenium Wall in Theatres or Concert Halls

Separation by proscenium wall in theatres or concert halls

(i) In a place of public resort, such as theatres, and concert halls, capable of seating more than 500 persons and in which fly tower is used for stage scenery or when extensive stage scenery may normally be installed on the stage side, the stage shall be separated from the seating area by a proscenium wall of not less than 1 hour fire resistance in such a way that the stage and the audience seating area form separate compartments.

(ii) The proscenium opening shall be protected by fire curtain with fire resistance of at least 1 hour, automatically operated by a fusible link or a smoke detector. In lieu of fire curtain, a smoke curtain is acceptable, if engineered smoke control and automatic sprinkler systems are to be provided to the stage area.

(iii) Not more than three other openings may be provided in the proscenium wall. Such openings shall not exceed 2m^2 in area and shall be fitted with doors having fire resistance of not less than half an hour and fitted with automatic self closing device; and

(iv) The entire stage side of the proscenium wall shall be fitted with an automatic sprinkler system which complies with the requirements in Chapter 6.

(i) Hotel, Boarding Houses, Serviced Apartments, Hostels & Backpackers Hotel

Guestroom or accomodation unit

(i) Each guestroom or accommodation unit shall be compartmented from adjoining rooms and other parts of the same building by construction having fire resistance rating of at least 1 hour, unless otherwise permitted under Cl.2.7.2 for the provision of window openings between the guestroom or accommodation unit and external corridor, and

(ii) Guestroom or accommodation unit and other rooms or spaces which open into or form part of the guestroom or accommodation unit corridor shall be separated from the corridor to comply with Cl.2.7.1 and Cl.2.7.2.

(j) Workers' dormitories

Workers' dormitories

(i) Each dormitory bedroom shall be compartmented from adjoining rooms and other parts of the same building by construction having fire resistance rating of at least 1-hour, unless otherwise permitted under Cl.2.9.4 for the provision of window openings between the bedroom and external corridor;

(ii) Dormitory bedrooms and other rooms or spaces which open into or form part of the dormitory bedroom corridor shall be separated from the corridor to comply with cl.2.9.3 and cl.2.9.4; and

(iii) Kitchen shall be enclosed with minimum 1-hour fire rated compartment wall, including ½-hour fire rated door. Kitchen can be located within each floor, but shall not be within the dormitory bedroom.

(k) A motor vehicle workshop shall be separated from any other part of the same building by compartment walls and floors having fire resistance of not less than 2 hours, and if located in a basement storey of a building, shall be separated from any other part of the same building by compartment walls and floors having fire resistance of not less than 4 hours.

Separation of motor vehicle workshop

(l) (i) Areas in which spray painting or other allied processes are performed or carried out, shall be separated from other parts of the same building by compartment walls and floors having fire resistance of not less than 2 hours. Where spray painting booths that have built-in vapour extraction system complying with NFPA 33, the fire resistance requirement is not applicable.

Separation of spray painting room

(ii) Where a spray painting room or booth is protected by an automatic sprinkler system but not complying with NFPA 33, the fire compartment to the room or booth can be reduced from 2 hours to 1 hour.

(m) Coldroom

A coldroom is a store room used for the storage of materials or chemical under cold temperature. The enclosures to the coldroom are constructed partly or wholly of highly combustible insulation materials. The floor area shall be the aggregate floor areas of all the coldrooms located in a compartment or a unit.

(i) Where a coldroom has a floor area exceeding 10m², a separate outer layer of non-combustible construction, including the door, having minimum 1-hour fire resistance rating, shall be provided to compartmentalise the coldroom enclosure from other areas

(ii) Provision of the fire resisting outer layer enclosure, including the fire door to the coldroom would not be required if :

(1) The coldroom has a floor area not exceeding 20m² and is sprinkler protected in a building under Purpose Groups III, IV, V, VI, VII or VIII, and the storage materials shall not include highly flammable chemicals.

(2) The coldroom is located in a building under Purpose Groups I or II.

(3) The coldroom is located in a kitchen compartment (with or without 'open flame' cooking appliances) in an eating establishment, provided the floor area of the coldroom does not exceed 20m², and the kitchen is compartmentalised from other parts of the building by compartment walls and floor having minimum 1-hour fire resistance and door having minimum ½-hour fire resistance, irrespective of the relaxation allowed under cl.3.2.5(f)(v)

(iii) The insulation material for the coldroom shall pass Class B under BS EN 13501 or its equivalent.

(n) For non-sprinklered buildings, if the area of the store room exceeds 10m², it shall be compatmented from the other parts of the same building by compartment walls and floors having fire resistance of not less than 1 hour. No fire compartmentation is required for a store room which is housed within a sprinklered protected building. However store room exceeding 700m² and 100m² for above-ground and below-ground respectively are subject to the compartment size requirements stipulated under Appendix (4).

Store room

(o) Areas of Special Hazard

(i) Boiler rooms, transformer rooms, generator rooms, storage areas of materials that are highly combustible or flammable, and any other area of special high risk shall be separated from other parts of the building by compartment walls and floors having fire resistance of not less than 2 hours. If the building is protected by an automatic sprinkler system, the fire resistance rating of the compartment walls and floors can be reduced to 1 hour.

Areas of special high risk in a building

(ii) Rooms housing transformer containing flammable liquid and generator rooms shall be located against an external wall.

(p) Fire compartmentation between individual tenancy units within a terraced or flatted factory or warehouse building shall be provided. The entire enclosure of each of these units shall be fire compartmented with walls and floors of minimum one-hour fire resistance rating.

Tenancy unit

(q) Fire compartment between car parking area (Purpose Group VIII) and other areas shall be provided. The fire compartment walls and floors shall have minimum one-hour fire rating. — Car parking area

(r) Warehouse compartment size exceeding 700m² for above ground level and 100m² for below ground level are subject to full compliance of Appendix (4). — Warehouse

3.2.6 The Relevant Authority may consent to modify the requirements under Cl. 3.2.1 and 3.2.4(a) of this Code for the design of 'Atrium spaces' in a building provided the following conditions are complied with : — Provision for atrium spaces

(a) The minimum plan area of the Atrium void shall be not less than 93m² and no horizontal dimension between opposite edges of the floor opening is less than 6m wide; and

(b) Occupancy within the floor space of the Atrium meets with the specification for low or ordinary hazard content; and

(c) The atrium is open and unobstructed in a manner such that it may be assumed that a fire in any part of the space will be readily obvious to the occupants before it becomes a hazard; and

(d) The building is fitted throughout with an automatic sprinkler system to comply with the requirements in Chapter 6; and

(e) The building is fitted with an engineered smoke control system in accordance with Cl.7.6; and

(f) Provision of openings and enclosures, and the planning of means of escape shall be subject to the approval of the Relevant Authority.

3.2.7 Buildings of High Hazard Occupancy

(a) The compartment of buildings of high hazard occupancy shall not exceed one half of the sizes given in Table 3.2A and each compartment shall comprise one storey only; and — Buildings of high hazard occupancy

(b) No storey of a building, the habitable height of which is more than 24m, shall be used for the bulk storage of goods or substances of highly combustible nature unless the building is provided with a sprinkler system to comply with Chapter 6; and

(c) The type of storage materials or substances shall not include the following:

(i) materials that will flame up by themselves without the presence of any fire source below the ignition temperature of 200°C; and

(ii) combustible/highly flammable materials which include those highlighted in sub-clauses (a), (b), (c) and (d) of Cl.1.2.39.

3.2.8 The requirements of Cl.3.2.1 may be exempted under the following circumstances:

Exemption from Cl.3.2.1 on size limitation of compartment

(a) Buildings used solely for the sale, storage, processing and packaging of goods and substances of a non combustible nature, provided that any other parts of the buildings used otherwise as described shall be separated by compartment walls and compartment floors in compliance with the requirements of the relevant provisions for compartment walls and compartment floors, and

(b) Single storey buildings of Purpose Group VI, provided that the buildings are used solely for the sale, storage, processing & packaging of goods & substances of a non-combustible nature, and

(c) (i) Open sided car parking decks having not less than 50% of the sides permanently open and unobstructed, and such openings being evenly distributed along each of the perimeter walls and on every individual floor/deck, excluding perimeter walls to air-well, so as to provide cross ventilation to all parts of the car parking decks; and

(ii) No part of the floor space shall be more than 12m from the openings on the perimeter walls of the building or air-well. Air-well where provided for this purpose shall have a superficial plan area of not less than 10m², or 0.1m² for every 300mm of height, whichever is greater, and have a minimum dimension on plan of 2000mm, open vertically to the sky for its full height.

3.2.9 For additions and alterations to existing buildings, the areas undergoing such works must be separated from other occupied areas of the building in accordance with clause 3.15.15.

3.3 FIRE RESISTANCE OF ELEMENTS OF STRUCTURE

Minimum periods of fire resistance

3.3.1 Subject to any expressed provision to the contrary, any element of structure shall be constructed of non-combustible materials and to have fire resistance for not less than the relevant period specified in Table 3.3A having regard to the purpose group of the building of which it forms a part and the dimensions specified in that Table, provided that

(a) Any separating wall shall have fire resistance of not less than 1-hour, and

(b) Any compartment wall or compartment floor which separates a part of a building falling within Purpose Group II or III from any other part of the building falling within a purpose group other than Purpose Group II or III shall have fire resistance of not less than 1-hour.

Exemption for non loadbearing external walls

3.3.2 Requirement on fire resistance in Cl.3.3.1 shall not apply to :

(a) any part of any external wall which is non loadbearing and can, in accordance with Cl.3.5 be an unprotected area.

(b) steel structures for standalone carpark if the following conditions are fulfilled :

Exemption for steel structures for standalone carpark

(i) Each storey shall be provided with cross-ventilation by the provision of uninterrupted openings evenly distributed around the perimeter walls, excluding perimeter walls to air-well. The area of the openings shall not be less than 50% of all external walls or 15% of the footprint per storey, whichever is greater. This condition is not applicable if sprinkler system is installed throughout the carpark; and

(ii) No point on any storey shall be more than 12m from external air or air-well. Air-well where provided for this purpose shall have a superficial plan area of not less than 10m², or 0.1m² for every 300mm of height, whichever is greater, and have a minimum dimension on plan of 2000mm, open vertically to the sky for its full height. This condition is not applicable if sprinkler system is installed throughout the carpark; and

(iii) All floor beams shall be designed as a composite structure with the floor slab; and

(iv) Building is not more than 24m in habitable height. There shall not be any basement storey; and

(v) No other usages, other than the electrical services that serve only the car park, are permitted; and

(vi) Steel structures shall meet the specifications of BS 5950 Pt 8; and

(vii) These requirements are for carpark for passenger vehicles of Class 3 and below.

3.3.3 In the case of a single storey building or a building consisting of a first storey and one or more basement storeys, requirement on fire resistance in Cl.3.3.1 shall not apply to any element of structure which forms part of the first storey and consists of :

Exemption for single storey buildings

(a) A structural frame or a beam or column, provided that any beam or column (whether or not it forms part of a structural frame) which is within or forms part of a wall, and any column which gives support to a wall or gallery, shall have fire resistance of not less than the minimum period, if any, required by this code for that wall or gallery, or

(b) An internal loadbearing wall or a loadbearing part of a wall, unless that wall or part of it forms part of a compartment wall or a separating wall, or forms part of the structure enclosing a protected shaft or supports a gallery, or

(c) Part of an external wall which does not support a gallery and which may, in accordance with Cl.3.5 be an unprotected area.

3.3.4 The interpretation and application of Cl.3.3 shall be as follows:

Interpretation and application of this regulation

(a) Subject to the provisions of sub cl.(b) and any other expressed provision to the contrary, any reference to a building of which an element of structure forms a part means the building or (if the building is divided into compartments) any compartment of the building of which the element forms a part, and

(b) Any reference to height means the height of a building, but if any part of the building is completely separated throughout its height both above and below ground from all other parts by a compartment wall or compartment walls in the same continuous vertical plane, any reference to height in relation to that part means the height solely of that part, and

(c) If any element of structure forms part of more than one building or compartment and the requirements of fire resistance specified in Table 3.3A in respect of one building or compartment differ from those specified in respect of any other building or compartment of which the element forms a part, such element shall be so constructed as to comply with the greater or greatest of the requirements specified.

(d) If any element of structure is required to be of non combustible construction, the measure of fire resistance rating shall be determined by the part which is constructed wholly of non combustible materials. (With the exception of fire protecting suspended ceilings, surface materials for walls and ceilings and floor finishes may be combustible, if they are not relied on to contribute to the fire resistance of the wall or floor).

3.3.5 Any compartment wall separating a residential apartment or maisonette from any other part of the same building, shall not be required to have fire resistance exceeding 1-hour unless

Wall separating residential apartment or maisonette

(a) The wall is a wall forming part of a protected shaft and the minimum period of fire resistance required by the provisions of this code for the protecting structure is more than 1-hour, or

(b) The part of the building from which the wall separates the residential apartment or maisonette is of a different purpose group and the minimum period of fire resistance required by the provisions of this code for any element of structure in that part is more than1-hour.

3.3.6 In determining the fire resistance of floors, no account shall be taken of any fire resistance attributable to any suspended ceiling unless the ceiling is constructed specifically as a fire protecting suspended ceiling and the construction complies with the requirements under Table 3.3B for Limitations on Fire Protecting Suspended Ceilings.

Suspended ceiling

3.3.7 Fire rated boards are permitted to be used for protection to structural steel beams and columns in building if the following conditions are satisfactorily fulfilled :

Fire rated board

(i) Material shall be non-combustible (BS476 Pt 4 or Pt 11); and

(ii) It shall have fire resistance for not less than the relevant period specified in Table 3.3A having regard to the purpose group of the building of which it forms a part and the dimensions specified in that Table; and

(iii) It shall meet the criteria, in terms of water absorption and bending strength performance, when subject to test of BS EN 520 (for gypsum plaster board) or ISO 1896 (for calcium silicate or cement board); and

(iv) Dry wall shall meet the criteria, in term of impact & deflection performance, when subject to the test of BS 5588 Pt 5 Appendix A and BS 5234 Pt 2; and

Note : Fire rated boards should not be used to protect structural steel in areas which may be subject to explosion risks as the boards may be displaced by the force of the blast.

In buildings under Purpose Groups VI & VIII, where there may be presence of corrosive atmosphere that may affect the effectiveness of fire rated board for protection to structural steel members of buildings, such proposal shall be subjected to evaluation of the Relevant Authority.

3.4 TESTS OF FIRE RESISTANCE

3.4.1 Performance for the fire resistance of elements of structure and other forms of construction shall be determined by reference to the methods specified in BS 476: Part 20 to 23, which specify tests for stability, integrity and insulation.

Fire resistance

Specific requirements for each element in terms of the three performance criteria of stability, integrity and insulation are given in Table 3.4A.

3.4.2 An element of structure or other part of a building shall be deemed to have the requisite fire resistance if

"Deem to satisfy" provisions

(a) It is constructed to the same specification as that of a specimen exposed to test by fire in accordance with the method and procedure under BS 476: Part 20 to 23, and satisfied the requirements of that test for the three performance criteria of stability, integrity and insulation for not less than the specified period , or

(b) In the case of a wall, beam, column, stanchion or floor to which Appendix A to Cl.3.4 relates, it is constructed in accordance with one of the specification set out in that Appendix and the notional period of fire resistance given in that Appendix as being appropriate to that type of construction and other relevant factors is not less than the specified period.

3.4.3 The use of timber floors shall not be allowed, except:

Timber floors

(a) for an attic in buildings under Purpose Groups I and II; and

(b) in buildings designated for conservation where the timber floors are required to be retained, but subject to compliance with the technical guidelines for 'FIRE SAFETY REQUIREMENTS AFFECTING SHOPHOUSES UNDER CONSERVATION.'

(c) for buildings that were existing before 1969 under Cl.1.1.2.

3.5 EXTERNAL WALL

3.5.1 Requirements of External Walls shall be as follows:

(a) Any external wall of a building or a separated part of a building which constitutes or is situated within a distance of 1m from any point on the relevant boundary, or is a wall of a building or a separated part of a building which exceeds 15m in height shall

Requirements of external walls

(i) be constructed wholly of non combustible materials apart from any external cladding which complies with Cl.3.5.4 or any internal lining which complies with Cl.3.13.4, and

(ii) be so constructed as to attain the fire resistance required by this chapter, and

(b) Any beam or column forming part of an external wall and any structure carrying an external wall which is required to be constructed of non combustible material, shall comply with the provisions of sub cl. (a).

3.5.2 (a) The requirements of Cl.3.5.1(a)(i) for non combustibility of external walls shall not apply to the external wall of a building or separated part of a building Exceptions

(i) if that wall is:

(1) situated 1m or more from the relevant boundary; and

(2) not exceeding 15m in height; and

(3) separated as described in Cl.3.3.4(b); or

(ii) if that wall is situated 1m or more from the relevant boundary:

(1) of Purpose Group I and II of not more than three storeys, or

(2) of single storey construction and not exceeding 15m in height and floor area not exceeding -

Purpose Group III, IV, VII 3000m^2
Purpose Group V, VI 2000m^2
Purpose Group VIII 500m^2 ;

or

(3) other than single storey buildings, but not exceeding 7.5m in height and floor area not exceeding -

Purpose Group IV, VI, VII 25m^2 ;
Purpose Group V, VIII 150m^2.

(b) The requirements of Cl.3.5.1(a)(ii) for fire resistance of external walls shall not apply to the external wall of a building or separated part of a building –

(i) if that wall is situated 1m or more from the relevant boundary:

(1) for single storey buildings not exceeding 15m in height and floor area not exceeding 2000m² or 500m² under Purpose Groups VI or VIII respectively; and

(2) such wall shall be provided with minimum period of 15 minutes insulation from inside the building under BS 476: Part 20 to 23.

3.5.3 Except where otherwise provided, unprotected areas in any side of a building shall comply with the following:

Unprotected areas in any side of a building

(a) Any relevant requirements relating to the permitted limits of unprotected areas specified in Appendix B unless the building is so situated that such side can in accordance with Appendix B consists entirely of any unprotected area, and

(b) The extent of unprotected openings in an external wall of a building or compartment in relation to its distance from the lot boundary can be doubled that which is specified in Appendix B when the building or compartment is :

(i) used solely for the sale, storage and processing involving goods and substances of a non combustible nature, or

(ii) fitted throughout with an automatic sprinkler system in compliance with the requirements in Chapter 6.

(c) As an alternative to (b)(ii) above, the distance between the external wall of a building and the relevant boundary can be half that specified in Appendix B if the building is fitted throughout with an automatic sprinkler system in compliance with the requirements in Chapter 6.

(d) The extent of unprotected openings in an external wall of a building or part of building used for carparking in relation to its distance from the lot boundary or relevant boundary can be based on the floor having the largest extent of unprotected openings for the purpose of complying with Table 1 of Appendix B.

(e) (i) The extent of unprotected openings in an external wall of a building under purpose group I in relation to its distance from the relevant boundary can be based on the internal room/space in the building that has the largest extent of unprotected openings for purpose of complying with Table 1 of Appendix "B".

(ii) Internal walls enclosing the room/space in the building are not required to be fire rated but shall be constructed of non-combustible materials, except glazing.

3.5.4 Cladding on External Walls shall comply with the following:

Cladding on external walls

(a) If such cladding is situated less than 1 m from any point on the relevant boundary, it shall have surface complying with the requirements for Class '0', and

(b) If such cladding is situated 1m or more from the relevant boundary it shall have, if the building is more than 15m in height, a surface complying with the requirements specified for Class `0', except that any part of such cladding below a height of 15m from the ground may consist of timber of not less than 9mm finished thickness or of a material having a surface which, when tested in accordance with BS 476: Part 6 have an index of performance (I) not exceeding 20, provided that if the building is of Purpose Group VI or VIII, such cladding material shall, when tested in accordance with BS 476: Part 6 have an index of performance (I) not exceeding 12 and a sub index (i_1) not exceeding 6.

3.5.5 Any reference to Appendix B shall be construed as referring to the provisions of Part I of that Appendix together with the provisions of Part II.

Reference to Part I II of Appendix B

3.5.6 If two or more detached buildings are erected on land in common occupation, any external wall of any building so erected which faces an external wall of such other building, the relevant boundary shall be a notional boundary passing between those buildings and such boundary must be capable of being situated in such a position as to enable the external walls of those buildings to comply with the requirements of Cl.3.5.3.

Buildings on land in common occupation

3.5.7 For high and low parts of different compartments of a building abutting each other, either one of the following requirements shall be complied with to prevent spread of fire from the roof close to and lower than the external of the higher part:

Vertical fire spread

(a) the roof over the lower part of the building shall be fire rated in accordance with the element of structure for minimum 1 hour for a distance of 5m measured horizontally from the external wall of the higher part of building; or

(b) the external wall of the higher part of the building overlooking the roof below shall have the necessary fire resistance rating in accordance with the element of structures for minimum 1 hour for a vertical height of not less than 9m measured from the roof of the lower part of the building.

(c) the above requirements shall not be applicable to buildings or lower parts of the building which are sprinkler protected, or old shophouses which are subject to URA's Conservation Programme or built before 1969 referred to under Cl.1.1.1.1 and Cl.1.1.1.2.

3.6 SEPARATING WALLS

3.6.1 Every separating wall shall:

Requirements of separating walls

(a) Form a complete barrier in the same continuous vertical plane through the full height between the buildings it separates, including roofs and basements and shall be imperforate except for provisions of openings permitted under Cl.3.6.2, and

(b) Have the appropriate fire resistance to comply with the requirements of Cl.3.3, and

(c) Be constructed of non combustible materials, together with any beam and column which form part of the wall and any structure which it carries.

(d) Not include glass fire resisting walls.

(e) Exception

Subclause (a) need not be applied to wall between car porches of buildings under Purpose Group I. For terrace-housing situation, this exception will not apply if the carporch is spanning from one side boundary to the other.

3.6.2 A separating wall shall have no openings except for

Openings in separating walls

(a) A door required to provide a means of escape in the event of a fire, having the same fire resistance as that required for the wall and complying with Cl.3.9.2, or

(b) A door provided for the purpose of public circulation and permitted by the Relevant Authority, having the same fire resistance as that required for the wall and complying with Cl.3.9.2, or

(c) Opening for the passage of a pipe complying with the relevant provisions of Cl.3.9.3.

3.6.3 A separating wall shall be either carried up to form a close joint with the underside of a pitched roof of non combustible covering or carried up above the level of such roof covering. The junction between such separating wall and roof shall be properly fire stopped so as not to render ineffective the resistance of such separating wall to the effects of the spread of fire.

Separating wall - roof junction

3.6.4 If any external wall is carried across the end of a separating wall, such external wall and separating wall shall be bonded together or the junction of such walls shall be fire stopped to comply with the requirements of Cl.3.12.

Separating wall - external wall junction

3.6.5 No combustible material shall be built into, carried through or carried across the ends of or carried over the top of separating walls in such a way as to render ineffective such separating walls to the effects of the spread of fire.

Prohibition of combustible materials in separating walls

3.7 COMPARTMENT WALLS AND COMPARTMENT FLOORS

3.7.1 Every compartment wall or compartment floor shall be required to -

Requirements of compartment walls or compartment floors

(a) Form a complete barrier to fire between the compartments it separates, and

(b) Have the appropriate fire resistance to comply with the requirements of Cl.3.3, and

(c) Be constructed of non combustible materials (together with any beam or column which forms part of the wall or floor and any structure which it carries), and

(d) Have no fire resisting glass forming part of it unless permitted under Cl.3.15.13.

3.7.2 A compartment wall or compartment floor shall have no openings in it, except for

Openings in compartment wall or compartment floor

(a) A door which has the same fire resistance rating as the compartment wall and complies with the relevant requirements of Cl.3.4, unless permitted by other provisions of the Code, or

(b) A protected shaft which complies with the requirements of Cl.3.8, or

(c) The passage of a pipe or ventilation duct,

such openings in the compartment wall or compartment floor shall be protected to comply with the relevant provisions of Cl.3.9.

3.7.3 (a) Where a compartment wall or compartment floor forms a junction with any structure comprising any other compartment wall, or any external wall, separating wall or structure enclosing a protected shaft, such structures shall be bonded together at the junctions or the junctions shall be fire stopped to comply with the requirements of Cl.3.12.

Junction with other structures

(b) The opening occurring at the junction between the edge of a structural floor and the curtain walling shall be sealed to prevent the spread of smoke and flame from the lower floor to the upper floor via the opening. Materials to be used for sealing the opening shall have the requisite fire resistance rating as the elements of structure.

Opening in curtain walling

3.7.4 Where a compartment wall forms a junction with a roof, such compartment wall shall be carried up to form a close joint with the underside of the roof and shall be properly fire stopped or shall be carried up above the level of the roof covering and the junction between such compartment wall and roof shall be properly fire stopped so as not to render ineffective the resistance of such compartment wall to the effects of the spread of fire.

Compartment wall - roof junctions

3.7.5 No combustible material shall be built into, carried through or carried across the ends of any compartment wall or compartment floor or carried over the top of any compartment wall in such a manner as to render ineffective the resistance of such wall or floor to the effects of the spread of fire.

Prohibition of combustible materials

3.7.6 Every compartment wall or compartment floor shall be constructed of non-combustible materials, unless permitted by the Relevant Authority.

Non-combustibility of compartment walls or floors

3.7.7 Fire shutter is permitted to be used as compartment wall except for fire compartmentation of fire command centre and means of escape which include exit staircase, smoke-stop lobby/fire-fighting lobby, internal exit passageway, etc.

Use of fire shutter

3.7.8 The fire shutters, which are used to protect openings in compartment wall/floor, shall have the necessary fire resistance including thermal insulation, not less than that of the compartment wall/floor. However, fire shutters, which are installed at the edge of atria, voids such as escalator void areas and between floors and door way, need not have thermal insulation.

3.7.9 The commonly used shutters such as vertical, horizontal and lateral fire shutters shall comply with SS 489 and the following:

(a) For vertical fire shutter operated by gravity during fire condition:

Upon activation by fire alarm system or fusible link, the operating mechanism of curtains/leaves of vertical fire shutter shall be released. The curtain/leaves shall descend under gravity at a controlled rate.

(b) For electrically operated vertical, lateral and horizontal fire shutter (no fusible link is required):

Upon activation by fire alarm system, the electrical motor shall drive the curtains/leaves to descend and shall be backed up by emergency power supply. The power and signal cables shall be fire-rated.

3.7.10 The mode of activation for fire shutters at different locations shall be as follow:

(a) Fire shutters as separating wall between two buildings:

(i) Two buildings separated by a common fire shutter:

For vertical fire shutter operated by gravity and electrically operated fire shutters, it shall be linked to fire alarm systems of both buildings and shall be activated by fire alarm system of either building. Mode of activation by fusible link only is not permitted.

(ii) Two buildings separated by two separate fire shutters:

For vertical fire shutter operated by gravity and electrically operated fire shutters, each fire shutter shall be activated by the fire alarm system of its own building. Mode of activation by fusible link only is not permitted.

(b) Fire shutters as compartment wall/floor for limiting compartment area and cubical extent, as compartment between different purpose groups, as compartment of special rooms such as kitchen, electrical room, store room, etc. and as compartment of basement passenger/goods lift lobby:

(i) For vertical fire shutter operated by gravity, mode of activation by fusible link is acceptable.

(ii) For electrically operated fire shutter, mode of activation shall be by local smoke detectors.

(c) Fire shutters as compartmentation at atrium/voids or between floors (being part of the engineered smoke control design):

(i) Only electrically operated fire shutter is permitted. Signal to operate the respective fire shutter shall be from dedicated smoke detector installed at the respective smoke zone.

(ii) Vertical fire shutter operated by gravity activated by fusible link is not permitted.

3.8 PROTECTED SHAFTS

3.8.1 A protected shaft shall not be used for any purpose additional to those given as defined under Cl.1.2.47. — Purpose of protected shaft

All services such as, pipe/duct installation should not be located inside protected staircase. Likewise, no washroom is allowed to be located inside protected staircase.

3.8.2 Every protected shaft shall be required to — Requirements of protected shaft

(a) Form a complete barrier to fire between the different compartments which the shaft connects, and

(b) Have the appropriate fire resistance to comply with the requirements of Cl.3.3, and

(c) Be constructed of non combustible material (together with any beam or column which forms part of the enclosure and any structure which carries it).

3.8.3 A protected shaft shall have no openings in its enclosure, except - — Openings in protected shaft

(a) In the case of any part of the enclosure which is formed by a separating wall, any opening which complies with the requirements of Cl.3.6 for separating walls, or

(b) In the case of any part of the enclosure which is formed by a compartment wall or a compartment floor, any opening which complies with the requirements of Cl.3.7 for compartment wall or compartment floor, or

(c) In the case of any part of the enclosure which is formed by the protecting structure

(i) a door which has the appropriate fire resistance to comply with the requirements of Cl.3.4 for test of fire resistance, or otherwise permitted by provision of Cl.3.8.6, or

(ii) the passage of a pipe, excluding protecting structure to exit staircase and exit passageway, or

(iii) inlets to and outlets from and opening for the duct, if the shaft contains or serves as a ventilation duct,

such openings in the protected shaft shall be protected to comply with the relevant provisions of Cl.3.9 for protection of openings.

3.8.4 Every protecting structure shall be constructed wholly of non combustible materials except that floor, wall and ceiling finishes which do not contribute to the fire resistance of such protecting structure may not be required to comply with the requirements for non combustibility.

Non-combustibility of protecting structures

3.8.5 Ventilation of protected shaft shall comply with the following:

(a) A protected shaft used for the passage of people, such as exit staircases, shall be ventilated to comply with the relevant provisions of the Code.

Ventilation of protected shaft

(b) A protected shaft containing a pipe conveying gas shall be adequately ventilated directly to the outside air or have other modes of ventilation allowed under SS CP 51.

3.8.6 Any door fitted to an opening in protecting structure shall have fire resistance for not less than half the period required by other provisions of the Code for the protecting structure surrounding the opening.

Doors in protecting structures

Exception :

Any door fitted to an opening in protecting structure of a shaft containing services such as electrical cables, pipes (including gas pipe in separate shaft), ducts would not need to have the fire resistance rating if the door is located along the wall facing the external corridor.

3.8.7 (a) A protected shaft which contains an exit staircase shall not contain any services e.g. pipes, cables, ducts, etc., that are not solely serving the same exit staircase (even if the services are protected with fire rated dry construction), except for:

Protected shaft containing exit staircase

(i) cut-off sprinkler and pipe for that staircase; and

(ii) UPVC or cast iron rain water downpipes serving the roof directly above the exit staircase, and not routed through anywhere outside the staircase.

(iii) rising mains.

(b) The protecting structure shall be constructed of masonry, or drywall. If drywall construction is used, the following conditions shall be complied with :

(i) Drywall shall be non-combustible; and

(ii) Drywall shall have fire resistance for not less than the relevant period specified in Table 3.3A having regard to the purpose group of the building of which it forms a part and the dimension specified in that Table; and

(iii) Drywall shall meet the criteria, in terms of impact and deflection performance, when subject to the tests of BS 5588 Pt 5 Appendix A and BS 5234 Pt 2; and

(iv) Drywall shall meet the criteria, in terms of water absorption and bending strength performance, when subject to the test of BS EN 520 (for gypsum plaster board) or ISO 1896 (for calcium silicate or cement board); and

(v) The building shall have at least two independent exit staircase shafts (scissors staircases are considered as single shaft).

3.8.8 A protected shaft which contains a lift shall comply with the following: Lift shaft

(a) It shall not contain any pipe conveying gas or combustible liquid, other than those in the mechanism of a hydraulic lift.

(b) The protecting structure shall be constructed of masonry, or drywall. If drywall construction is used, the following conditions shall be complied with :

(i) Drywall shall be non-combustible; and

(ii) Drywall shall have fire resistance for not less than the relevant period specified in Table 3.3A having regard to the purpose group of the building of which it forms a part and the dimension specified in that Table; and

(iii) Drywall shall meet the criteria, in terms of impact and deflection performance, when subject to the tests of BS 5588 Pt 5 Appendix A and BS 5234 Pt 2; and

(iv) Drywall shall meet the criteria, in terms of water absorption and bending strength performance, when subject to the test of BS EN 520 (for gypsum plaster board) or ISO 1896 (for calcium silicate or cement board); and

(v) Drywall shall meet the criteria of Cyclic Loading and Dynamic test as specified under Cl.3.3 of Building Code of Australia Specification C 1.8.

(c) Where a lift is either located at the edge of atrium floors or at the external wall and outside the building, the lift shall be considered as not enclosed within a protected shaft.

(d) The protected shaft shall be vented in accordance with SS 550 Code of Practice for Installation, Operation and Maintenance of Electric Passenger and Goods Lifts. The vents shall be so arranged as to induce exhaust ventilation of the shaft. Where vents could not be provided because of the location of the lift shaft, ventilation duct protected by drywall complying with Cl.3.8.8(b) serving as ventilation of the shaft may be provided instead. If the duct is not to be fire rated, fire dampers shall be provided to the duct at the wall of the lift shaft, provided such relaxation shall not apply to shaft containing fire lift.

(e) Openings for the passage of lift cables into the lift motor room located above or at the bottom of the shaft shall be as small as practicable.

(f) Transom panel above lift entrance shall be considered as part of the protecting structure and shall therefore conform to the fire resistance requirements of the protected structure.

(g) If it serves any basement storey it shall be protected by a smoke-stop lobby with walls having 1 hour fire resistance and fire door of half-an-hour fire resistance. The protected lobby shall be mechanically ventilated.

Exception:

Where the lift landing area is adjoining an air-well or external space of minimum clear area 10m² and minimum width of 3m. The distance between the nearest edge of lift door opening to the air-well shall not exceed 3m.

(h) Private lifts that are provided for the exclusive use of occupants in residential units under Purpose Group II buildings shall comply with the following requirements : Private Lift

(i) Smoke detectors shall be provided at the lift landing area. The activation of any of the smoke detectors at the lift landing area shall cause the lift to home to the designated floor; and

(ii) Emergency power supply from a generating plant shall be provided to home the lift to the designated floor when there is a power failure in the building; and

(iii) The designated floor can either be on grade level or one level below grade level. If it is the latter, the lift shall home to a protected lobby, with direct access to an exit; and

(iv) The lift shall not be permitted to double-up as a fire lift; and

(v) Private lifts shall comply with SS 550.

3.8.9 A protected shaft used for the enclosure of services shall comply with the following: Protected shaft containing other services installations

(a) The protecting structure for protected shaft containing kitchen exhaust ducts and mechanical ventilation ducts serving areas specified in Cl.5.2.1(g)(i) to (iii) and (h) which pass through one or more floor slabs shall be of masonry or drywall. Such shaft shall be completely compartmented from the rest of the shaft space containing other ducts or any other services installations. Protected shaft containing ducts serving other areas which pass through two or more floor slabs shall be constructed of drywall. If the protecting structure for the protected shaft is constructed of drywall, the following conditions shall be complied with :

(i) Drywall shall be non-combustible; and

(ii) Drywall shall have fire resistance for not less than the relevant period specified in Table 3.3A having regard to the Purpose Group of the building of which it forms a part and the dimension specified in that Table; and

(iii) Drywall shall meet the criteria, in terms of impact and deflection performance, when subject to the tests of BS 5588 Pt 5 Appendix A and BS 5234 Pt 2; and

(iv) Drywall shall meet the criteria, in terms of water absorption and bending strength; and performance, when subject to the test of BS EN 520 (for gypsum plaster board) or ISO 1896 (for calcium silicate or cement board).

(b) Protected shaft used for the enclosure of electrical power services shall be interrupted at every floor level with barriers with fire resistance of at least half an hour. Protected shaft used for the enclosure of telecommunications cables shall be interrupted by barriers with fire resistance of at least half an hour at vertical intervals not exceeding 15m. Such cavity barriers shall comply with the relevant provisions of Cl.3.11.

(c) In the case of protected shafts which are interrupted by barriers with fire resistance of at least half an hour at every floor level or protected shafts containing sanitary pipes or water pipes, fire resisting doors opening into the protected shaft are not required to be installed with automatic self closing devices, provided such doors are kept closed and locked at all times.

Omission of self-closing devices

(d) All protected shafts containing services shall not be located within an exit staircase except for the case of residential apartment/maisonette development under Purpose Group II not exceeding 4-storey where smoke-stop lobby is not required.

Exception

3.9 PROTECTION OF OPENINGS

3.9.1 The provisions of this Clause are made in connection with the protection of openings permitted in elements of structure or other forms of fire resisting construction required to act as a barrier to fire and smoke.

Application

3.9.2 Fire doors for protection of openings shall comply with the following:

Fire doors

(a) Fire doors shall have the appropriate fire resistance as required by relevant parts of the Code, and two fire doors may be fitted in an opening if each door by itself is capable of closing the opening and the two doors together achieve the required level of fire resistance, and

(b) All fire doors shall be fitted with an automatic self closing device which is capable of closing the door from any angle and against any latch fitted to the door.The omission of the self-closing device to the bolted door leaf of a 2-leaf door is acceptable if the door is the entrance door to a residential unit under Purpose Group II.

(c) Where a self closing device would be considered a hindrance to the normal use of the building, fire doors may be held open as follows :

(i) by a fusible link, or

(ii) if the doors can be opened manually,by electromagnetic or electro mechanical devices which can be activated by the presence of smoke and/or the building alarm system,

(d) Any hinge on which a fire door is hung shall be of the type approved under the product listing scheme, and

(e) Any fire door fitted in an opening which is provided as a means of escape:

(i) shall be capable of being opened manually, without the use of key, tool, special knowledge or effort for operation from the inside of the building; and

(ii) shall not be held open by any means other than by an electromagnetic or electro mechanical device which can be activated by the presence of smoke and/or the building alarm system, provided that this shall not apply in the case of fire doors opening into pressurised exit staircases.

(iii) shall open in the direction of exit travel in accordance with Cl.2.3.9.

(f) Fire doors where required to be provided shall be constructed and installed to comply with specifications stipulated under SS 332 Specification for Fire Doors.

3.9.3 (a) Pipes which pass through a separating wall, compartment wall or compartment floor shall be kept as small as possible and fire stopped around the pipe. The nominal internal diameter of the pipe shall be not more than the relevant dimension given in Table 3.9A. Spacing between pipes shall be minimum 50mm or ½-diameter of the largest pipe, whichever is the larger.

Pipes

(b) Routing of gas pipes in basements

(i) All gas pipes that are routed in basement shall be API pipes with welded joints. These joints shall be 100% radiography checked in accordance with sub-clause 3.4.2(h) of SS CP 51. The gas pipes are not required to be fire rated if they are running outside essential areas such as exit staircases, smoke stop or fire fighting lobby, fire pump room, generator room, fire command centre, etc. If they run into essential area, they are required to be encased in masonry.

(ii) For mechanically ventilated basement, the gas pipes shall be provided with pipe sleeves for the venting of gas pipes. One end of the sleeve shall be exposed to the external as specified in sub-clause 3.4.2(g) of SS CP 51.

(iii) For naturally ventilated basement that complies with sub-clause 6.4.1(d)(iii)(b), the provision of pipe sleeve is not required.

3.9.4 Ventilation duct which passes directly through a compartment wall or compartment floor shall comply with the following

Ventilation ducts

(a) Where the ventilation duct does not form a protected shaft or is not contained within a protecting structure,

(i) the duct shall be fitted with a fire damper where it passes through the compartment wall or compartment floor, and

(ii) the opening for the duct shall be kept as small as practicable and any gap around the fire damper shall be fire stopped.

(b) Where the ventilation duct forms a protected shaft or is contained within a protecting structure, the duct shall be

(i) fitted with fire dampers at the inlets to the shaft and outlets from it, and

(ii) constructed and lined with materials in accordance with the requirements in Chapter 7.

(c) The installation of ventilation ducts and fire dampers shall comply with the requirements in Chapter 7.

3.9.5 Duct encasing one or more flue pipes which passes through a compartment wall or compartment floor shall be of non combustible construction having fire resistance of not less than half the minimum period of fire resistance required for the compartment wall or compartment floor through which it passes, except for kitchen flue pipes when the fire resistance shall be as required for the compartment wall or compartment floor.

Flues

3.9.6 (a) Air ducts, sanitary pipes, gas pipes, electrical conduits/cable tray and other services that are likely to permit passage of flame or smoke in the event of a fire shall not be permitted to pass through the following spaces:

(i) Fire Command Centre;

(ii) Fire Pump Room;

(iii) Emergency Generator Room;

(iv) Smoke Control Fans Room.

except where such services are required for the operation of these equipment.

Services passing through Fire Command Centre, Fire Pump Room, Emergency Generator Room and Smoke Control Fans Room

	(b)	Air ducts, sanitary pipes, gas pipes, electrical conduits/cable tray, and other services, excluding lifts, that are likely to permit passage of flame or smoke in the event of a fire shall not be permitted to run inside and/or pass through: (i) fire-fighting lobby; (ii) smoke-stop lobby. unless all these services are protected with 1 hour fire resistance enclosure, or separated with 1 hour fire resistance ceiling from the said lobby. If these services are required for the operation of the above lobbies, they need not be separately protected.	Services running inside and/or passing through fire-fighting lobby & smoke-stop lobby
3.10	**EXIT STAIRCASES**		
3.10.1		Every exit staircase, including the treads/risers and landing, shall be constructed of non-combustible materials. The exception is for buildings under Purpose Group I, where only the stringer or structures supporting the treads/risers and landing shall be constructed of non-combustible materials.	Non-combustibility of structure
3.10.2		The exit staircase shall be separated from other parts of the building by a masonry structure or drywall complying with Cl.3.8.7(c) which shall have fire resistance for not less than the period required by Cl.3.3 for Elements of Structure.	Structure separating exit staircase
3.10.3		Doors opening into the exit staircase shall have fire resistance of at least half an hour and fitted with automatic self-closing device.	Exit doors
3.10.4		Finishes to the ceilings/walls and floors of exit staircase shall be of non-combustible materials.	Finishes
3.11	**CONCEALED SPACES**		
3.11.1		Concealed spaces in a building shall be interrupted by construction of cavity barriers to restrict the spread of smoke and flames.	General provision
3.11.2		Cavity barriers shall be used to close the edges of cavities, edges around openings through a wall, floor and any other part of the construction which contains a cavity and to separate any cavity in a wall, floor or any other part of the construction from any other such cavity.	Closing the edges of cavities

3.11.3 Cavities including roof spaces shall be interrupted by cavity barriers where a wall, floor, ceiling, roof or other part of the construction abut the cavity, if there is provision for the element of structure to form a fire resisting barrier. Such cavity barriers shall be of fire resisting construction at least equal to the provision for that required for the fire resisting barrier.

Interrupting cavities

3.11.4 Cavities, including roof spaces, unless otherwise permitted, shall be sub divided so that the maximum distance between cavity barriers shall not exceed the relevant dimensions given under Table 3.11A.

Sub-division of extensive cavities

3.11.5 Cavity barriers shall be

(a) Constructed to provide at least half an hour fire resistance, and

(b) Tightly fitted to rigid construction or the junctions shall be fire stopped to comply with the requirements of Cl.3.12.

Fire resistance and fixing of cavity barriers

3.11.6 A cavity barrier shall have no opening in it except for:

(a) A door which has at least half an hour fire resistance and shall be kept closed all the time,

(b) A pipe which complies with the provision under Cl.3.9.3,

(c) A cable or conduit containing one or more cables,

(d) An opening fitted with suitably mounted automatic fire damper, and

(e) A duct which is fitted with a suitably mounted fire damper where it passes through the cavity barrier.

Openings in cavity barriers

3.11.7 The construction of raised floors for fixed stages and display platforms shall comply with the following requirements :

(a) The concealed space between the structural floor and raised floor shall not be used for storage purpose, and

(b) No services or installation shall be permitted within the concealed space other than electrical wiring in conduit in compliance with the requirements of SS CP 5 Code of Practice for Wiring of Electrical Equipment of Buildings, and

(c) All sides shall be properly sealed, and

Raised floors for fixed stages and display platforms

(d) The concealed space shall be sub divided by cavity barriers in compliance with the requirements of Cl.3.11.4 and Table 3.11A.

3.11.8 The construction of raised floors with or without accessible panels shall comply with the following requirements :

Raised floors with or without accessible panels

(a) The supporting structure shall be constructed of non combustible materials having a melting point of at least 800°C, and

(b) The concealed space between the structural floor and raised floor shall not be used for storage purpose, and

(c) No services or installation shall be permitted within the concealed space other than

(i) electrical wiring in metal conduit and metal trunking in compliance with the requirements of SS CP 5 Code of Practice for Wiring of Electrical Equipment of Buildings;

(ii) communication cables for computer equipment

(iii) fire protection installations serving the area, and

(d) Where the raised floor is used as a plenum, requirements in Cl.7.1.1(f) shall be satisfied, and

(e) Decking of the raised floor shall be constructed of non combustible material or where combustible material is used as core material, if allowed in the case of sprinkler protected buildings, the top, bottom, all sides and cut edges shall be covered with material with surface property complying with Class 0 (excluding materials for floor finishes), and

(f) In the case of raised floors with accessible panels, access sections or panels shall be provided such that all concealed spaces between the structural floor and raised floor are easily accessible, and

(g) Openings in the raised floor for entry of electrical cables shall be effectively closed to prevent entry of debris or other combustible material into the concealed spaces, and

(h) All sides shall be properly sealed, and

(i) The concealed space shall be sub-divided by cavity barriers such that the maximum unobstructed area within the concealed space does not exceed 930m^2, and

(j) Where the concealed space is fitted with an automatic sprinkler system which complies with the requirements in Chapter 6, cavity barriers are not required, and

(k) For a non-sprinklered protected building, if the height of the concealed space measured between the top of the structural floor and underside of the raised floor decking exceeds 150mm, it shall be fitted with automatic smoke detection system complying with requirements of SS CP 10 Code of Practice for the Installation and Servicing of Electrical Fire Alarm Systems. For a sprinkler protected building, the concealed space shall be fitted with automatic smoke detection system as above if its height is between 150mm to 400mm, and automatic sprinkler system if it exceeds 400mm.

(l) Where the height of concealed space measured between the top of the structural floor and the underside of the raised floor decking is less than 50mm, the requirements on provision of cavity barriers shall not be applicable.

Provision for concealed spaces between floor or roof and suspended ceilings

3.11.9 The Relevant Authority may consent to exempt from provision of cavity barriers within the concealed spaces of suspended ceiling, provided the following requirements are complied with :

(a) The concealed space shall not be used for storage purpose, and

(b) The supporting elements shall be constructed of non combustible material, and

(c) The exposed surfaces within the concealed space is of Class 0 flame spread, (excluding surfaces of any pipe, cable, conduit or insulation of any pipe) and

(d) In the case of a detector protected building, if the concealed space does not exceed 800mm in depth or if the concealed space is fitted with detectors which comply with the requirements of Chapter 6.

(e) In the case of a sprinkler protected building:

(i) if the concealed space does not exceed 400mm in depth, or

(ii) if the concealed space exceeds 400mm and does not exceed 800 mm in depth and no combustible material is used within the concealed space, (where the combustible content is small in quantity, the Relevant Authority, may, at its discretion, rule that such combustible content may be irrelevant in relation to this sub clause), or

(iii) if the concealed space is fitted with an automatic sprinkler system which complies with the requirements of Chapter 6.

(f) In the case of other buildings, if the concealed space does not exceed 800mm in depth.

3.11.10 Where the concealed space of suspended ceiling is fitted with an automatic sprinkler system which complies with the requirements in Chapter 6,

Exemption of cavity barriers in ceiling space

(a) The concealed space may be exempted from provision of cavity barriers, and

(b) Combustible materials and materials with other than Class 0 flame spread may be used for the supporting elements and exposed surfaces of materials within the concealed space, provided the ceiling is not situated over an exit passageway, smoke stop lobby or other designated means of escape facilities.

3.11.11 The concealed spaces of suspended ceiling over an exit passageway, smoke-stop lobby, exit staircase or other designated means of escape facilities, shall comply with the following:

Suspended ceiling over protected areas

(a) the ceiling supporting elements and the ceiling shall be constructed of non-combustible materials; and

(b) the exposed surfaces within the concealed space shall be of Class 0 surface flame spread.

(c) Where sprinkler system is installed within the concealed spaces at smoke-stop lobby/fire-fighting lobby, the ceiling supporting elements and its exposed surface may have a surface spread of flame not lower than Class 2.

3.11.12 Buildings under Purpose Group I are not required to comply with the requirements on the provision of cavity barrier in concealed spaces. Residential units in buildings under Purpose Group II need not comply with requirements on the provision of cavity barrier in concealed floor and ceiling spaces.

3.12 FIRE STOPPING

3.12.1 Openings for pipes, ducts, conduits or cables which pass through any part of an Element of Structure (except for a part which does not serve as a fire resisting barrier) or Cavity Barrier, shall be : — General provision

(a) Kept as few in number as possible, and

(b) Kept as small as practicable, and

(c) All gaps shall be filled with fire stopping materials.

3.12.2 Fire stopping shall be of material having the necessary fire resistance when tested to BS 476: Part 20 or other acceptable standards. — Fire stopping

3.12.3 Suitable fire stopping materials include : — Materials for fire-stopping

(a) Proprietary fire stopping and sealing systems (including those designed for service penetrations) which have been shown by test to maintain the fire resistance of the wall or other element, subject to approval by the Relevant Authority.

(b) Other fire-stopping materials include:

(i) cement mortar;

(ii) gypsum based plaster;

(iii) cement or gypsum based vermiculite/perlite mixes;

(iv) glass fibre, crushed rock, blast furnace slag or ceramic based products (with or without resin binders), and

(v) intumescent mastics.

The method of fire stopping and choice of materials should be appropriate to the situation and its application.

3.13 RESTRICTION OF SPREAD OF FLAME OVER SURFACES OF WALLS AND CEILINGS

3.13.1 Any reference to a surface being Class 0 shall be construed as a requirement that — Requirements for Class 0

(a) The material of which the wall or ceiling is constructed shall be non combustible throughout; or

(b) The surface material (or, if it is bonded throughout to a substrate, the surface material in conjunction with the substrate) shall have a surface of Class 1 and if tested in accordance with BS 476: Part 6 shall have an index of performance (I) not exceeding 12 and a sub index (i) not exceeding 6. — Requirements for a class other than Class 0 classification

3.13.2 Any reference to a surface being of a class other that Class 0 shall be construed as a requirement that the material which the wall or ceiling is constructed shall comply with the relevant test criteria as to surface spread of flame specified in relation to that class in BS 476: Part 7.

3.13.3 Class 0 shall be regarded as the highest class followed in descending order by Class 1, Class 2, Class 3 and Class 4, as set hereunder:

* Class 0 Surface of no Flame Spread. Those surfaces that conform to the requirements of Cl.3.13.1.

* Class 1 Surface of Very Low Flame Spread. Those surfaces on which not more than 150mm mean spread of flames occurs under the relevant test conditions.

* Class 2 Surface of Low Flame Spread. Those surfaces on which during the first 1½ minutes of test, the mean spread of flame is not more than 375mm and the final spread does not exceed 450mm under the relevant test conditions.

* Class 3 Surface of Medium Flame Spread. Those surfaces on which during the first 1½ minutes of test, the mean spread of flame is not more than 375mm and during the first 10 minutes of test is not more than 825mm under the relevant test conditions.

* Class 4 Surface of Rapid Flame Spread. Those surfaces on which during the first 1½ minutes of test the mean spread of flame is more than 375mm and during the first 10 minutes of test is more than 825mm under the relevant conditions.

3.13.4 The surface of a wall or ceiling in a room/space shall be of a class not lower than specified as relevant in the Table 3.13A, provided that

Class of flame spread to be not lower than specified

(a) Where an automatic sprinkler system is fitted throughout in the building in compliance with the requirements in Chapter 6, there is no control on the surface of flame rating in room/space, except for the following occupancies/usage:

(i) Health care facilities, including hospital, nursing home for handicapped, disabled, aged or persons with mental and / or mobility impairments.

(ii) Detention facilities.

(iii) Exit staircase, exit passageway and smoke-stop / fire-fighting lobbies.

(b) Where a building is not protected by automatic sprinkler system, surfaces of the walls and ceilings may be of a surface class not lower than Class 3 to the extent permitted by Cl.3.13.5 (a) and Cl.3.13.5 (b) respectively.

(c) If timber is used as the surface material for the walls along the side gangways of the auditorium which is not sprinkler protected, the requirements of this regulation pertaining to the requisite class of flame spread may be relaxed only in respect of those parts of such wall surfaces provided the aggregate area of such parts does not exceed 50 percent of the whole surface area of the side walls of the auditorium.

3.13.5 (a) Any part of the surface of a wall in a room or compartment may be of any class not lower than Class 3 if the area of that part (or if there are two or more such parts, the total area of those parts) does not exceed the following

Where class of flame spread may be of any class not lower than Class 3

(i) in the case of a building or compartment of Purpose Group III, 20m^2, or

(ii) in any other case, 60m^2.

(b) Any part of the surface of a ceiling may be of any class not lower than Class 3 if that part of the surface is the face of a layer of material the other face of which is exposed to the external air (skylight included) and

(i) * the ceiling is that of a room in a building or compartment of Purpose Group III, IV, V or VII or that of a circulation space excluding smoke-stop lobby, exit staircase and exit passageway in a building or compartment of any purpose group, and

* the area of that part does not exceed 2.5m², and

* the distance between that part and any other such part is not less than 3.5m, or

(ii) * the ceiling is that of a room in a building or compartment of Purpose Group VI or VIII, and

* the area of that part does not exceed 5.0m², and

* the distance between that part and any other such part is not less than 1.8m, and

(iii) that part and all other such parts are evenly distributed over the whole area of the ceiling and together have an area which does not exceed 20% of the floor area of the room, or

(iv) the ceiling is that of a balcony, verandah, open carport, covered way or loading bay which (irrespective of its floor area) has at least one of its longer sides wholly and permanently open, or

(v) the ceiling is that of a garage or outbuilding which (irrespective of whether it forms part of a building or is a building which is attached to another building or wholly detached) has floor area not exceeding 40m².

3.13.6 Wall and ceiling finishes in the form of thin sheet of not more than 1.0mm thickness mounted on a non-combustible substrate will not be subject to the requirement of surface spread of flame provisions provided that this exception shall not apply to smoke-stop/fire-fighting lobbies, exit staircases and passageways. Exception

3.14 ROOFS

3.14.1 Surface of materials for roof covering and roof construction shall have a surface spread of flame rating not lower than Class 1, or Class A when tested in accordance with ASTM E108, except in the case of Purpose Groups I and II, and in buildings that are protected throughout with automatic sprinkler system in compliance with Chapter 6.

Roof construction

3.14.2 The Relevant Authority may consent to the use of combustible material for roof construction for buildings of Purpose Groups III, IV, V and VII, which satisfy the following requirements :

Provision for buildings not exceeding four storeys

(a) Building does not exceed four storeys, and

(b) Roof space between the roof and the ceiling shall be sub divided by cavity barriers where required to comply with the relevant provisions of Cl.3.11, and openings in cavity barriers shall be fire stopped to comply with the requirements of Cl.3.12, and

(c) If the underside of the roof serves as the ceiling to a room or space, the elements of the underside of the roof shall comply with the relevant provisions of Cl.3.13 for restriction of spread of flame.

3.14.3 At the junctions with separating wall or compartment wall, roof construction shall comply with the relevant requirements under Cl.3.6.3 and Cl.3.7.4 respectively.

Roof junction with separating wall and compartment wall

3.14.4 Roof terrace shall not be roofed over. If it is either partially or fully roofed over, it shall be considered as a habitable floor.

Roof terrace

3.15 MATERIALS FOR CONSTRUCTION

3.15.1 (a) Materials used in the construction of building elements shall comply with the provisions stated under this section in addition to the performance requirements such as for fire resistance and limit to spread of flame as stipulated in other relevant sections of the code.

(b) Intumescent paints is allowed to be used for protection of structural steel members of all buildings provided : Intumescent Paints

(i) the paint shall be of a proprietary system that has been demonstrated to achieve the fire resistance performance as required in BS 476 Part 20/21 or its equivalent, together with the specified weathering tests as specified in the BS 8202: Part 2;

(ii) coating of intumescent paint onto structural steel, and subsequent maintenance shall conform to BS 8202: Part 2; and

(iii) all requirements stipulated in the Appendix to this clause: "Notes on the use of Intumescent Paints for Protection to Structural Steel Members of Buildings" shall be complied with. (Please see Appendix (6))

Note : In buildings under Purpose Groups VI & VIII, where there may be presence of corrosive atmosphere that may affect the effectiveness of intumescent paints for protection to structural steel members of buildings, such proposal shall be subjected to evaluation of the Relevant Authority

(c) Flame retardant chemicals are permitted to be used for upgrading of fire resistance rating or surface spread of flame of timber or any combustible materials, subject to the following:

(i) The chemical treatment process is part and parcel of the manufacturing process to produce the finished product ;

(ii) The chemical treatment is by means of pressure impregnation conforming to SS 572 – Use of Timber in Building Construction, or the manufacturer's specification in accordance to the prototype test, for timber and other combustible materials respectively.

(iii) The treated materials/products have been subjected to fire test as required under Cl 3.4.1 or Cl 3.13.1

3.15.2 All elements of structure shall be constructed of non-combustible materials in addition to the relevant provisions as follows:

Cl.3.3 for fire resistance of elements of structure,
Cl.3.5.1, 3.5.2 & 3.5.4 for External Walls,
Cl.3.6.1(c)/(d) & 3.6.5 for Separating Walls,
Cl.3.7.1(c)/(d), 3.7.5 & 3.7.6 for Compartment Walls and Compartment Floors,
Cl.3.8.2(c), 3.8.4, 3.8.7(c), 3.8.8(b), 3.8.8(e) and 3.8.9(a) for Protected Shafts.

3.15.3 Materials used for the protection of openings shall comply with the relevant provisions of Cl.3.9 of the code for protection of openings.

3.15.4 Exit staircases shall be constructed of non-combustible materials to comply with the provisions of Cl.3.10.1.

3.15.5 Materials used for the construction of raised floors shall comply with the provisions of Cl.3.11.8(a) and Cl.3.11.8(e).

3.15.6 Materials used for construction of ceiling and its supports shall comply with Table 3.13B, except for supports that are required to comply with Cl.3.11.9(b).

3.15.7 Construction of ceilings and ceiling supports located within sprinkler protected building shall comply with the provision of Cl.3.11.10(b).

3.15.8 Materials used for fire stopping shall comply with the relevant provisions of Cl.3.12.2 and 3.12.3.

3.15.9 Materials used on the surfaces of walls and ceilings are required to meet the requirements for restriction of spread of flame and to comply with the performance requirements as stipulated under Cl.3.13.

3.15.10 Materials used for roof construction shall comply with the provisions of cl.3.14.1 & 3.14.2.

3.15.11 Internal non-load bearing walls in buildings shall comply with Table 3.13B and the materials for surface finishes of internal non-load bearing walls shall not be treated as part of the wall and shall comply with the relevant provisions of Cl 3.13.

3.15.12 (a) Composite panels which consist of plastic core shall not be used either for the construction of internal non-load bearing walls, ceilings, external walls or as cladding to external walls of all buildings unless prior approval has been obtained from the Relevant Authority.

(b) Materials with surface flame spread rating of not lower than Class 2 shall be permitted to be used for the construction of partition for toilet cubicles. If the material used is of Class 3 surface flame spread rating, total exposed surface area of the partitions within the toilet shall not be more than 60m².

3.15.13 Fire rated glass wall/door to compartment walls, compartment floors, smoke-stop lobby and fire-fighting lobby, and protected shafts not containing exit staircase and fire lift.

In buildings which are protected by an automatic sprinkler system, fire rated glass can be used for the construction of compartment walls, compartment floors, enclosures to smoke-stop lobby and fire-fighting lobby, and protected shafts not containing exit staircase and fire lift, subject to the following:

(a) The walls and doors shall have the necessary fire resistance, including insulation, when subject to test under BS 476: Part 20-23; and

(b) The walls and doors shall meet the Class A of the Impact Performance requirements when subject to test under BS 6206 or AS 2208.

3.15.14 Walls, ceilings, roof covering and finishes shall not contain any plastic material.

3.15.15 For additions and alterations to existing buildings, non-combustible partitions shall be used for separation of areas undergoing A&A works from other occupied areas of the building.

TABLE 3.2A SIZE LIMITATION OF BUILDING AND COMPARTMENT

(1) Compartments	(2) Maximum Floor Area	(3) Maximum Cubical Extent
Compartment below ground level. No compartment to comprise more than one storey.	2000m²	7500m³
Compartments between average ground level and a height of 24m. No compartment to comprise more than 3 storeys.	4000m²	15000m³
Compartments above a height of 24m from average ground level. No compartment to comprise more than one storey.	2000m²	7500m³

TABLE 3.3A
(Minimum periods of fire resistance)

In this Table -

"cubical extent" means the cubical extent of the building or, if the building is divided into compartments, the compartment of which the elements of structure forms part;

"floor area" means the floor area of each storey in the building or, if the building is divided into compartments, of each storey in the compartment of which the element of structure forms part;

"height" has the meaning assigned to that expression by Cl 3.3.4 (b);

"NL" means No limit applicable.

PART I

BUILDINGS OTHER THAN SINGLE STOREY BUILDINGS

Purpose group (1)	Maximum dimensions			Minimum period of fire resistance (in hours) for elements of structure (*) forming part of-	
	Height (in m) (2)	Floor area (in m^2) (3)	Cubical Extent (in m^3) (4)	Above ground storey (5)	Basement storey (6)
I (Small residential)					
House having not more than 3-storeys	NL	NL	NL	½	1(a)
House having 4-storeys	NL	250	NL	1(b)	1
House having any number of storey	NL	NL	NL	1	1½
II (Other residential)					
Building or part (+) having not more than two storeys	NL	500	NL	½	1
Building or part (+) having 3-storeys	NL	250	NL	1(b)	1
Building having any number of storeys	28	3,000	8,500	1	1½
Building having any number of storeys	NL	2,000	5,500	1½	2
III (Institutional)	28	2,000	NL	1	1½
	over 28	2,000	NL	1½	2
IV (Office)	7.5	250	NL	½	1(a)
	7.5	500	NL	½	1
	15	NL	3,500	1(b)	1
	28	5,000	14,000	1	1½
	NL	NL	NL	1½	2

Purpose group (1)	Maximum dimensions			Minimum period of fire resistance (in hours) for elements of structure (*) forming part of-	
	Height (in m) (2)	Floor area (in m^2) (3)	Cubical Extent (in m^3) (4)	Above ground storey (5)	Basement storey (6)
V (Shop)	7.5	150	NL	½	1(a)
	7.5	500	NL	½	1
	15	NL	3,500	1(b)	1
	28	1,000	7,000	1	2
	NL	2,000	7,000	2	4
VI (Factory)	7.5	250	NL	½	1(a)
	7.5	NL	1,700	½	1
	15	NL	4,250	1(b)	1
	28	NL	8,500	1	2
	28	NL	28,000	2	4
	over 28	2,000	5,500	2	4
VII (Place of public resort)	7.5	250	NL	½	1(a)
	7.5	500	NL	½	1
	15	NL	3,500	1(b)	1
	28	1,000	7,000	1	1½
	NL	NL	7,000	1½	2
VIII (Storage and general)	7.5	150	NL	½	1(a)
	7.5	300	NL	½	1
	15	NL	1,700	1(b)	1
	15	NL	3,500	1	2
	28	NL	7,000	2	4(d)
	28	NL	21,000	4(c)	4(d)
	over 28	1,000	NL	4(c)	4(d)

Notes to Part I

For the purpose of Cl 3.3.1 the period of fire resistance to be taken as being relevant to an element of structure is the period included in columns (5) or (6) in the line of entries which specifies the floor area with which there is conformity or, if there are two or more such lines, in the topmost of those lines.

(*) A floor which is immediately over a basement storey shall be deemed to be an element of structure forming part of a basement storey.

(+) The expression "part" means a part which is separated as described in Cl 3.3.4(b).

(a) The period is half an hour for elements forming part of a basement storey which has an area not exceeding 50 m^2

(b) This period is reduced to half an hour in respect of a floor which is not a compartment floor, except as to the beams which support the floor or any part of the floor which contributes to the structural support of the building as a whole.

(c) This period is reduced to 2-hours for:
(1) unsprinklered , open-sided standalone car park buildings
(2) sprinkler protected, above-ground car park floors in standalone car park building or mixed-use building.

(d) Single basement carpark storey, which is sprinklered protected, the element of structure can be reduced to half the minimum period of fire resistance.

TABLE 3.3A - continued

(Minimum periods of fire resistance)

PART 2 - SINGLE STOREY BUILDINGS

Purpose group (1)		Maximum floor area (in m^2) (2)	Minimum period of fire resistance (in hours) for elements of structure (3)
I	(Small residential)	NL	½
II	(Other residential)	3,000	½
III	(Institutional)	3,000	½
IV	(Office)	3,000 NL	½ 1
V	(Shop)	2,000 3,000 NL	½ 1 2
VI	(Factory)	2,000 3,000 NL	½ 1 2
VII	(Place of public resort)	3,000 NL	½ 1
VIII	(Storage and general)	500 1,000 3,000 NL	½ 1 2 4(a)

Notes to Part 2

For the purpose of Cl 3.3.1 the period of fire resistance to be taken as being relevant to an element of structure is the period included in column (3) in the line of entries which specifies the floor area with which there is conformity or, if there are two or more such lines, in the topmost of those lines.

(a) This period is reduced to 2-hours for open-sided buildings which are used solely for carparking.

TABLE 3.3B
(Suspended ceilings)

Height of building (1)	Type of floor (2)	Required fire resistance of floor (3)	Description of suspended ceiling (4)
Less than 15m	Non-Compartment	1 hour or less	Surface of ceiling exposed within the cavity not lower than Class I (as to surface spread of flame).
	Compartment	Less than 1 hour	
	Compartment	1 hour	Surface of ceiling exposed within the cavity not lower than Class O (as to surface spread of flame); supports and fixing for the ceiling non-combustible.
15m or more	Any	1 hour or less	Surface of ceiling exposed within the cavity not lower than Class O (as to surface spread of flame) and jointless; supports and fixing for the ceiling non-combustible.
Any	Any	More than 1 hour	Ceiling of non-combustible construction and jointless; supports and fixings for the ceiling non-combustible.

Notes: (1) References to classes in the above table are to classes as specified in Cl.3.13.

(2) Where the space above a suspended ceiling is protected by an automatic sprinkler system it shall be exempted from the requirements for non-combustibility and surface spread of flame classification as specified in the above table provided the ceiling is not situated over an exit passageway, protected lobby or other required protected means of escape.

TABLE 3.4A
SPECIFIC PROVISIONS OF TEST FOR FIRE RESISTANCE OF ELEMENTS OF STRUCTURE ETC

Part of building		Minimum provisions when tested to BS 476: Part 20-23 (minutes)			Method of exposure
		Stability	Integrity	Insulation	
1	Structural frame, beam or column	*	no requirement	no requirement	exposed faces
2	Loadbearing wall which is not also an external wall, separating wall, compartment wall or protecting structure (See 4, 5, 6 or 7)	*	no requirement	no requirement	each side separately
3	Floors				
	(a) floor in upper storey of a 2-storey dwelling house (but not over a garage)	30	15	15	from underside (Note 1)
	(b) any other floor (including a compartment floor)	*	*	*	from underside (Note 1)
4	External walls				
	(a) any part less than 1m from point on relevant boundary	*	*	*	each side separately
	(b) any part of the wall of a building used for Assembly purposes which is 1m or more from the relevant boundary and is described in Note 2	* * (max. 60)	* * (max. 60)	15 * (max. 60)	from inside from outside
	(c) any part 1 m. or more from the relevant boundary and is not a part described in (b) above	*	*	15	from inside
5	Separating wall	* (min. 60)	* (min.60)	* (min. 60)	each side separately
6	Compartment wall	*	*	*	each side separately
7	Protecting structure any part	*	*	*	each side separately
8	Wall separating an attached or integral garage from a dwelling house	*	*	*	from garage side

Part of building			Minimum provisions when tested to BS 476: Part 20-23 (minutes)			Method of exposure
			Stability	Integrity	Insulation	
9	Doors					
	(a)	in a separating wall	No Provision	+ (min. 60)	no provision***	each side separately when fitted in its frame
	(b)	in a compartment wall if it separates a flat or maisonette from a space in common use	No Provision	30	no provision***	each side separately when fitted in its frame
	(c)	in a compartment wall or compartment floor not described in (b) above	No Provision	+	no provision***	each side separately when fitted in its frame
	(d)	in a protecting structure situated wholly or partly above the level of the adjoining ground in a building used for Flats, Other Residential, Assembly or Office purposes	No provision	30	no provision***	each side separately when fitted in its frame
	(e)	in a protecting structure not described in (d) above	no provision	** (min. 30)	no provision***	each side separately when fitted in its frame
	(f)	any other door (including a door in a cavity barrier and a door between a dwelling house and garage)	no provision	30	no provision***	each side separately when fitted in its frame
10	Casing around a drainage system		30	30	30++	from outside
11	Cavity Barriers (a) cavity barrier 1m x 1m or Larger		30	30	15	each side separately
	(b) any other cavity barrier		30	30	no provision	each side separately
	(c) ceiling		30	30	30	from underside

Modifications

++ No provision for insulation if the casing is more than 50mm from any pipe in the enclosure (except a pipe passing through the casing).

Notes

*	Period of fire resistance as specified.
+	Period of fire resistance for the wall or floor in which the door is situated.
**	Half the period of fire resistance for the wall or floor in which the door is situated.
***	This exemption does not apply to fire-rated glass door.
1	A suspended ceiling should only be relied on to contribute to the fire resistance of the floor if the ceiling meets the appropriate provisions given in Table 3.3B.
2	Any part of the wall which is 7.5m or less above the ground, or above a roof or any other part of the building to which people have access, if the building has 2 or more storeys.

TABLE 3.9A MAXIMUM NOMINAL INTERNAL DIAMETER OF PIPES

Situation	Pipe material and maximum nominal internal diameter [mm]		
	Non-combustible material[1]	Lead, aluminium or aluminium alloy, or uPVC[2]	Any other material
When the pipes penetrate the structure enclosing a protected shaft which is not an exit stairway or lift shaft	150	100	40
Any other situation	150	100 (stack pipe)[3] 75 (branch pipe)[3]	40

Notes

1) A non-combustible material (such as cast iron or steel) which if exposed to a temperature of 800 degrees Celsius will not soften nor fracture to the extent that flame or gases will pass through the wall of the pipe.

2) uPVC pipes complying with BS 4514:1983.

3) i) Within toilets, wash rooms or external corridors, maximum diameter of uPVC pipes may be increased to double the size given in the above table.

ii) Within areas of fire risk, such as kitchens, and adjacent to escape routes, uPVC pipes shall be enclosed by construction having fire resistance of at least one half hour.

iii) Where the size of uPVC pipes exceeds that specified under this Clause, approved fire collar shall be fitted at all positions where such pipes pass through constructions required to act as a barrier to fire.

TABLE 3.13A

Purpose group of building	**Classification of finishes to walls and ceiling relating to flame spread**							
	Non-sprinkler protected building				Sprinkler protected building			
	Room, compartment	Circulation space	Smoke-stop /fire-fighting lobby	Exit staircase & exit passageway	Room, compartment	Circulation space	Smoke-stop /fire-fighting lobby	Exit staircase & exit passageway
I (Small residential)	No control	N/A	N/A	N/A	No control	No control	2	0
II (Other residential)	No control	0	0	N	No control	No control	2	0
III (Institutional)	1	0	0	N	3*	3*	2	0
IV (Office)	1	0	0	N	No control	No control	2	0
V (Shop)	1	0	0	N	No control	No control	2	0
VI (Factory)	1	0	0	N	No control	No control	2	0
VII (Place of public resort)	1	0	0	N	No control	No control	2	0
VIII (Storage)	1	0	0	N	No control	No control	2	0

N Non-combustible to comply with BS 476 Pt 4.

3* Applies to Detention facilities and Health-care, including hospital, old-aged homes, nursing homes for mentally or physically disabled patients.

N/A Not Applicable

TABLE 3.13B

Purpose group of building	**Material construction (Homogenous)*** .					
	Non-sprinkler protected building			Sprinkler protected building		
	Internal non-load bearing wall and ceiling within room, compartment	Circulation spaces, e.g. common corridor, passageway, etc	Roof covering, including supports	Internal non-load bearing wall and ceiling within room, compartment	Circulation spaces, e.g. common corridor, passageway, etc	Roof covering, including supports
I (Small residential)	No control	N/A	N/A***	No control	No control	No control
II (Other residential)	No control	N	N/A***	No control	No control	No control
III (Institutional)	0	N	1	3**	3**	3**
IV (Office)	0	N	1	No control	No control	No control
V (Shop)	0	N	1	No control	No control	No control
VI (Factory)	0	N	1	No control	No control	No control
VII (Place of public resort)	0	N	1	No control	No control	No control
VIII (Storage)	0	N	1	No control	No control	No control

* Refer to the entire construction of the element.

0/1/3 The tests of BS 476 Pt 6 and/or Pt 7 shall be conducted with air gap

** Applies to Detention facilities and health-care, including hospital, nursing homes for handicapped, disabled, aged or persons with mental and/or mobility impairment.

*** Roof support can be of timber construction but not of plastic material. Roof covering shall not be of plastic material

N/A Not Applicable

N Non-combustible, including limited combustibility.

APPENDIX 'A' to C1 3.4

NOTIONAL PERIODS OF FIRE RESISTANCE

In this Appendix:

(a) "Class 1 aggregate" means foamed slag, pumice, blast furnace slag, pelleted fly ash, crushed brick and burnt clay products (including expanded clay) well-burnt clinker and crushed limstone.
"Class 2 aggregate" means flint gravel, granite, and all crushed natural stones other than limestones.

(b) Any reference to plaster means:
(i) in the case of an external wall 1m or more from the relevant boundary , plaster applied on the internal face only;
(ii) in the case of any other wall, plaster applied on both faces;
(iii) if to plaster of a given thickness on the external face of a wall, except in the case of a reference to vermiculite-gypum plaster, rendering on the external face of the same thickness;
(iv) if to vermiculite-gypsum plaster, vermiculite-gypsum plaster of a mix within the range of 1 ½ to 2:1 by volume.

(c) In the case of a cavity wall , the load is assumed to be on inner leaf only except for fire resistance period of four hours.

(d) Any material or type of construction or method of mixing, preparing, using, applying or fixing the material as referred to in the table, shall conform with the relevant provisions of the Building Control Act (Chapter 29) and the relevant Singapore Standard or Singapore Standard Code of Practice in respect of the material or such matters. In the absence of a Singapore Standard or Singapore Code of Practice on the material or such matters, the relevant British Standard or British Code of Practice or other accepted Standard or Code of Practice shall be applicable.

PART 1 : WALLS

A. Mansonry construction:

	Construction and materials	Minimum thickness excluding plaster (in mm) for period of fire resistance of										
		Loadbearing					Non-loadbearing					
		4 hours	2 hours	1½ hours	1 hour	½ hour	4 hours	3 hours	2 hours	1½ hours	1 hour	½ hour
1.	Reinforced concrete, minimum concrete cover to main reinforcement of 25 mm:											
	(a) Unplastered	180	100	100	75	75						
	(b) 12.5mm cement-sand plaster	180	100	100	75	75						
	(c) 12.5mm gypsum-sand plaster	180	100	100	75	75						
	(d) 12.5mm vermiculite-gypsum plaster	125	75	75	63	63						
2.	No-fines concrete of Class 2 aggregate:											
	(a) 13mm cement-sand plaster						150	150	150	150	150	150
	(b) 13mm gypsum-sand plaster						150	150	150	150	150	150
	(c) 13mm vermiculite-gypsum plaster						150	150	150	150	150	150

APPENDIX 'A' to C1 3.4 - continued

PART 1 : WALLS - continued

A. Mansonry construction - continued

	Construction and materials	Minimum thickness excluding plaster (in mm) for period of fire resistance of											
		Loadbearing						Non-loadbearing					
		4 hours	3 hours	2 hours	1½ hours	1 hour	½ hour	4 hours	3 hours	2 hours	1½ hours	1 hour	½ hour
3.	Bricks of clay, concrete or sand - lime:												
	(a) Unplastered	200	200	100	100	100	100	170	170	100	100	75	75
	(b) 13mm cement-sand plaster ..	200	200	100	100	100	100	170	170	100	100	75	75
	(c) 13mm gypsum-sand plaster ..	200	200	100	100	100	100	170	170	100	100	75	75
	(d) 13mm vermiculite-gypsum or perlite-gypsum* plaster	100	-	100	100	100	100	100	-	100	100	75	75
4.	Concrete blocks of Class 1 aggregate:												
	(a) Unplastered	150	-	100	100	100	100	150	-	75	75	75	50
	(b) 12.5mm cement-sand plaster .	150	-	100	100	100	100	100	-	75	75	75	50
	(c) 12.5mm gypsum-sand plaster .	150	-	100	100	100	100	100	-	75	75	75	50
	(d) 12.5mm vermiculite-gypsum plaster	100	-	100	100	100	100	75	-	75	62	50	50
5.	Concrete blocks of Class 2 aggregate:												
	(a) Unplastered	-	-	100	100	100	100	150	-	100	100	75	50
	(b) 12.5mm cement-sand plaster .	-	-	100	100	100	100	150	-	100	100	75	50
	(c) 12.5mm gypsum-sand plaster	-	-	100	100	100	100	150	-	100	100	75	50
	(d) 12.5mm vermiculite-gypsum plaster	100	-	100	100	100	100	100	-	75	75	75	50
6.	Autoclaved aerated concrete blocks, density 475 - 1200 kg/m^3	180	140	100	100	100	100	100	-	62	62	50	50
7.	Hollow concrete blocks, one cell in wall thickness, of Class 1 aggregate:												
	(a) Unplastered	-	-	100	100	100	100	150	-	100	100	100	75
	(b) 12.5mm cement-sand plaster	-	-	100	100	100	100	150	-	100	75	75	75
	(c) 12.5mm gypsum-sand plaster	-	-	100	100	100	100	150	-	100	75	75	75
	(d) 12.5mm vermiculite-gypsum plaster	-	-	100	100	100	100	100	-	75	75	62	62

* Perlite - gypsum plaster to clay bricks only.

APPENDIX 'A' to C1 3.4 - continued

PART 1 : WALLS - **continued**

A. Mansonry construction - continued

	Construction and materials	Minimum thickness excluding plaster (in mm) for period of fire resistance of											
		Loadbearing						Non-loadbearing					
		4 hours	3 hours	2 hours	1½ hours	1 hour	½ hour	4 hours	3 hours	2 hours	1½ hours	1 hour	½ hour
8.	Hollow concrete blocks, one cell in wall thickness, of Class 2 aggregate:												
	(a) unplastered	-	-	-	-	-	-	150	-	150	125	125	125
	(b) 12.5 mm cement-sand plaster ..	-	-	-	-	-	-	150	-	150	125	125	100
	(c) 12.5 mm gypsum-sand plaster ..	-	-	-	-	-	-	150	-	150	125	125	100
	(d) 12.5 mm vermiculite-gypsum plaster	-	-	-	-	-	-	125	-	100	100	100	75
9.	Cellular clay blocks not less than 50% solid:												
	(a) 12.5 mm cement-sand plaster ..	-	-	-	-	-	-	-	-	-	-	100	75
	(b) 12.5 mm gypsum-sand plaster ..	-	-	-	-	-	-	-	-	-	-	100	75
	(c) 12.5 mm vermiculite-gypsum plaster	-	-	-	-	-	-	200	-	100	100	100	62
10.	Cavity wall with outer leaf of bricks or blocks of clay, composition, concrete or sand-lime, not less than 100 mm thick and ;												
	(a) inner leaf of bricks or blocks of clay, composition, concrete or sand lime	100	100	100	100	100	100	75	-	75	75	75	75
	(b) inner leaf of solid or hollow concrete bricks or blocks of Class 1 aggregate	100	100	100	100	100	100	75	-	75	75	75	75
11.	Cavity wall with outer leaf of cellular clay blocks as 9 above and inner leaf of autoclaved aerated concrete blocks, density 480-1200 kg/m^3	150	140	100	100	100	100	75	75	75	75	75	75

APPENDIX 'A' to C1 3.4 -continued

NOTIONAL PERIODS OF FIRE RESISTANCE

PART 1 : WALLS – continued

B Framed and composite construction (non-loadbearing).

Construction and materials	Period of fire resistance (in hours)
1. Steel frame with external cladding of 16 mm rendering on metal lathing and internal lining of autoclaved aerated concrete blocks, density 480-1120 Kg/m^3 of thickness of –	
50mm	2
62mm	3
75mm	4
2. Steel frame with external cladding of 100mm concrete blocks and internal lining of 16mm gypsum plaster on metal lathing	4
3. Steel frame with external cladding of 16mm rendering on metal lathing and internal lining of 16mm gypsum plaster on metal lathing	1
4. Steel or timber frame with facings on each side of -	
(a) metal lathing with cement-sand or gypsum plaster of thickness of-	
19mm	1
12.5mm	½
(b) metal lathing with vermiculite-gypsum or perlite-gypsum plaster of thickness of-	
25mm	2
19mm	1 ½
12.5mm	1
(c) 9.5mm plasterboard with gypsum plaster of thickness of 5mm ...	½
(d) 9.5mm plasterboard with vermiculite-gypsum of thickness of-	
25mm	2
16mm	1 ½
10mm	1
5mm	½
(e) 12.5mm plasterboard-	
unplastered	½
with gypsum plaster of thickness of 12.5mm	1
(f) 12.5mm plasterboard with vermiculite-gypsum plaster of thickness of-	
25mm	2
16mm	1 ½
10mm	1
(g) 19mm plasterboard (or two layers of 9.5mm fixed to break joint) without finish	1
(h) 19mm plasterboard for two layers of 9.5mm with vermiculite-gypsum plaster of thickness of-	
16mm	2
10mm	1 ½
(i) 12.5mm fibre insulating board with gypsum plaster of thickness of 12.5mm ...	½
(j) 25mm wood wool slabs with gypsum plaster of thickness of 12.5mm	1

APPENDIX 'A' to C1 3.4 -continued

NOTIONAL PERIODS OF FIRE RESISTANCE

PART 1 : WALLS – continued

B Framed and composite construction (non-loadbearing) -continued.

	Construction and materials	Period of fire resistance (in hours)
5.	Compressed straw slabs in timber frames finished on both faces with gypsum plaster of thickness of 5mm	1
6.	Plasterboard 9.5mm cellular core partition-	
	(a) unplastered	½
	(b) 12.5mm gypsum plaster	½
	(c) 22mm vermiculite-gypsum plaster	2
7.	Plasterboard 12.5mm cellular core partition-	
	(a) unplastered	½
	(b) 12.5mm gypsum plaster	1
	(c) 16mm vermiculite-gypsum plaster	2
8.	Plasterboard 19mm finished on both faces with 16mm gypsum plaster	1
9.	Plasterboard 12.5mm bonded with neat gypsum plaster to each side of 19mm plasterboard	1 ½
10.	Three layers of 19mm plasterboard bonded with heat gypsum plaster	2
11.	Wood wool slab with 12.5mm rendering or plaster of thickness of-	
	75mm	2
	50mm	1
12.	Compressed straw slabs, with 75mm by 12.5mm wood cover strips to joints, of thickness of 50mm	½

C External walls (non-loadbearing) more than 1m from the relevant boundary.

	Construction and materials	
1.	Steel frame with external cladding of non-combustible sheets and internal lining of-	
	(a) 12.5mm cement-sand or gypsum plaster on metal lathing	4
	(b) two layers of 9.5mm plasterboard	½
	(c) 9.5mm plasterboard finished with gypsum plaster of thickness of 12.5mm	½
	(d) 12.5mm plasterboard finished with 5mm gypsum plaster	½
	(e) 50mm compressed straw slabs	½
	(f) 50mm compressed straw slabs finished with 5mm gypsum plaster	2

APPENDIX 'A' to C1 3.4 -continued

NOTIONAL PERIODS OF FIRE RESISTANCE

PART 1 : WALLS – continued

C External walls (non-loadbearing) more than 1m from the relevant boundary - continued.

	Construction and materials	Period of fire resistance (in hours)
*2.	Timber frame with external cladding of 10mm cement-sand or cement-lime rendering and internal lining of-	
(a)	16mm gypsum plaster on metal lathing	1
(b)	9.5mm plasterboard finished with12.5 mm gypsum plaster	1
(c)	12.5mm plasterboard finished with 5mm gypsum plaster	1
(d)	50mm compressed straw slabs	1
(e)	aerated concrete blocks :	
	50mm	3
	62mm	4
	75mm	4
	100mm	4
3.	Timber frame with external cladding of 100mm clay, concrete or sand-lime bricks of blocks, finished internally with 16mm gypsum plaster on metal lathing	4
*4	Timber frame with external cladding of weather boarding or 9.5 mm plywood and interal lining of-	
(a)	16mm gypsum plaster on metal lathing	½
(b)	9.5mm plasterboard finished with 12.5mm gypsum plaster	½
(c)	12.5mm plasterboard finished with 5mm gypsum plaster	½
(d)	50mm compressed straw slabs	½
(e)	aerated concrete blocks-	
	50mm	3
	62mm	4
	75mm	4
	100mm	4

* The presence of a combustible vapour barrier within the thickness of these constructions shall not be regarded as affecting these periods of fire resistance.

PART II: Reinforced concrete beams

Description	Minimum dimension of concrete to give a fire resistance in hours					
	4	3	2	1 ½	1	½
	mm	mm	mm	mm	mm	mm
1. Siliceous aggregate concrete:						
(a) average concrete cover to main reinforcement	65*	55*	45*	35	25	15
(b) beam width	280	240	180	140	110	80
2. As (1) with cement or gypsum plaster 15mm thick on light mesh reinforcement						
(a) average concrete cover to main reinforcement	50*	40	30	20	15	15
(b) beam width	250	210	170	110	85	70
3. As (1) with vermiculite/gypsum plaster+ 15mm thick:						
(a) average concrete cover to main reinforcement	25	15	15	15	15	15
(b) beam width	170	145	125	85	60	60
4. Light weight aggregate concrete:						
(a) average concrete cover to main reinforcement	50	45	35	30	20	15
(b) beam width	250	200	160	130	100	80

* Supplementary reinforcement, to hold the concrete cover in position, may be necessary.

\+ Vermiculite/gypsum plaster should have a mix ratio in the range of 1½ - 2:1 by volume.

PART III: Prestressed concrete beams

Description	Minimum dimension of concrete to give a fire resistance in hours					
	4	3	2	1 ½	1	½
	mm	mm	mm	mm	mm	mm
1. Siliceous aggregate concrete						
(a) average concrete cover to tendons ...	100*	85*	65*	50*	40	25
(b) beam width	280	240	180	140	110	80
2. As (1) with vermiculite concrete slabs 15mm thick , used as permanent shuttering :						
(a) average concrete cover to tendons ...	75*	60	45	35	25	15
(b) beam width	210	170	125	100	70	70
3. As (2) but with 25mm thick slabs:						
(a) average concrete cover to tendons ...	65	50	35	25	15	15
(b) beam width	180	140	100	70	60	60
4. As (1) with 15mm thick gypsum plaster with light mesh reinforcement:						
(a) average concrete cover to tendons ...	90*	75	50	40	30	15
(b) beam width	250	210	170	110	85	70
5. As (1) with vermiculite/gypsum plaster+ 15m thick:						
(a) average concrete cover to tendons ...	75*	60	45	30	25	15
(b) beam width	170	145	125	85	60	60
6. As (5) but with 25mm thick coating:						
(a) average concrete cover to tendons ...	50	45	30	25	15	15
(b) beam width	140	125	85	70	60	60
7. Lightweight aggregate concrete:						
(a) average concrete cover to tendons ...	80	65	50	40	30	20
(b) beam width	250	200	160	130	100	80

* Supplementary reinforcement , to hold then concrete cover in position , may be necessary.

\+ Vermiculite/gypsum plaster should have a mix ratio in the range of 1 ½ -2: 1 by volume.

PART IV: Reinforced concrete columns (all faces exposed)

Type of construction	Minimum dimension of concrete to give a fire resistance in hours					
	4	3	2	1 ½	1	½
	mm	mm	mm	mm	mm	mm
1. Siliceous aggregate concrete						
(a) without additional protection	450	400	300	250	200	150
(b) with cement or gypsum plaster 15mm thick on light mesh reinforcement	300	275	225	150	150	150
(c) with vermiculite / gypsum plaster*	275	225	200	150	120	120
2. Limestone aggregate concrete or siliceous aggregate:						
concrete with supplementary reinforcement in concrete cover	300	275	225	200	190	150
3. Lightweight aggregate concrete	300	275	225	200	150	150

* Vermiculite / gypsum plaster should have a mix ratio in the range of 1 ½ - 2:1 by volume.

Reinforced concrete columns (one face exposed)

Type of construction	Minimum dimension of concrete to give a fire resistance in hours					
	4	3	2	1 ½	1	½
	mm	mm	mm	mm	mm	mm
1. Siliceous aggregate concrete						
(a) without additional protection	180	150	100	100	75	75
(b) with vermiculite/ gypsum plaster* 15mm thick on exposed faces ... ... …	125	100	75	75	65	65

* Vermiculite / gypsum plaster should have a mix ratio in the range of 1 ½ - 2:1 by volume.

PART V: STRUCTURAL STEEL

A Encased steel stanchions (Mass per metre not less than 45 kg)

Construction and materials	Minimum thickness (in mm) of protection for a fire resistance of -					
	4 hours	3 hours	2 hours	1 ½ hours	1 hours	½ hours
A. SOLID PROTECTION* (unplastered)						
1. Concrete not leaner than 1:2:4 mix with natural aggregates-						
(a) concrete not assumed to be load-bearing reinforced+	50	-	25	25	25	25
(b) concrete assumed to be load-bearing, reinforced in accordance with BS 5950 ..	75	-	50	50	50	50
2. Solid bricks of clay, composition or sand-lime ..	100	75	50	50	50	50
3. Solid blocks of foamed slag or pumice concrete reinforced+ in every horizontal joint	75	60	50	50	50	50
4. Sprayed vermiculite-cement	-	-	38	32	19	12.5
B. HOLLOW PROTECTION++						
1. Solid bricks of clay, composition or sand-lime reinforced in every horizontal joint, unplastered ...	115	-	50	50	50	50
2. Solid blocks - of - foamed slag or pumice concrete reinforced+ in every horizontal joint, unplastered	75	-	50	50	50	50

APPENDIX 'A' to C1 3.4 -continued

PART V: STRUCTURAL STEEL - continued

A Encased steel stanchions (Mass per metre not less than 45 kg) – continued

Construction and materials	Minimum thickness (in mm) of protection for a fire resistance of -					
	4 hours	3 hours	2 hours	1 ½ hours	1 hours	½ hours
3. Metal lathing with gypsum or cement-lime plaster of thickness of -	-	-	38§	25	19	12.5
4. (a) Metal lathing with vermiculite-gypsum or perlite-gypsum plaster of thickness of	50§	-	19	16	12.5	12.5
(b) Metal lathing spaced 25mm from flanges with vermiculite-gypsum or perlite-gypsum plaster of thickness of	44	-	19	12.5	12.5	12.5
5. Gypsum plasterboard with 1.6mm wire binding at 100mm pitch -						
(a) 9.5mm Plasterboard with gypsum plaster of thickness of	-	-	-	-	12.5	12.5
(b) 19mm Plasterboard with gypsum plaster of thickness of	-	-	12.5	10	7	7
6. Gypsum plasterboard with 1.6mm wire binding at 100mm pitch-						
(a) 9.5mm plasterboard with vermiculite-gypsum plaster of thickness of	-	-	16	15	10	10
(b) 19mm plasterboard with vermiculite- gypsum plaster of thickness of	38§	-	20	13	10	10

* Solid protection means a casing which is bedded close to the steel without intervening cavities and with all joints in that casing made full and solid.

+ Reinforcement shall consist of steel binding wire not less than 2.3mm in thickness , or a steel mesh weighing not less than 0.48 kg/m2. In concrete protection, the spacing of that reinforcement shall not exceed 150mm in any direction.

++ Hollow protection means that there is a void between the protective material and the steel. All hollow protection to columns shall be effectively sealed at each floor level.

§ Light mesh reinforcement required 12.5mm to 19mm below surface unless special corner beads are used.

PART V: STRUCTURAL STEEL - continued

A Encased steel stanchions (Mass per metre not less than 45 kg) - continued

Construction and materials	Minimum thickness (in mm) of protection for a fire resistance of -					
	4 hours	3 hours	2 hours	1 ½ hours	1 hours	½ hours
B HOLLOW PROTECTION*- CONTINUED						
7. Vermiculite - cement slabs of 4:1 mix reinforced with wire mesh and finished with plaster skim. Slabs of thickness of	63	-	25	25	25	25

B Encased steel beams (Mass per metre not less than 30kg)

Construction and materials	Minimum thickness (in mm) of protection for a fire resistance of -					
	4 hours	3 hours	2 hours	1 ½ hours	1 hours	½ hours
A. SOLID PROTECTION + (unplastered)						
1. Concrete not leaner than 1:2:4 mix with natural aggregate -						
(a) concrete not assumed to be load bearing , reinforced++ ..	75	50	25	25	25	25
(b) concrete assumed to be loadbearing , reinforced in accordance with BS 5950 ..	75	75	50	50	50	50
2. Sprayed vermiculite - cement	-	-	38	32	19	12.5

PART V: STRUCTURAL STEEL - continued

B Encased steel beams (Mass per metre not less than 30kg) - continued

Construction and materials	Minimum thickness (in mm) of protection for a fire resistance of -					
	4 hours	3 hours	2 hours	1 ½ hours	1 hours	½ hours
B. HOLLOW PROTECTION*						
1. Metal lathing -						
(a) with cement-lime plaster of thickness of .	-	-	38	25	19	12.5
(b) with gypsum plaster of thickness of .. .	-	-	22	19	16	12.5
(c) with vermiculite-gypsum or perlite-gypsum plaster of thickness of	32	-	12.5	12.5	12.5	12.5
2. Gypsum plasterboard with 1.6mm wire binding at 100 mm pitch-						
(a) 9.5mm plasterboard with gypsum plaster of thickness of ..	-	-	-	-	12.5	12.5
(b) 19 mm plasterboard with gypsum plaster of thickness of ..	-	-	12.5	10	7	7
3. Plasterboard with 1.6mm wire at 100m pitch -						
(a) 9.5 mm plaster nailed to wooden cradles finished with gypsum plaster of thickness of .	-	-	-	-	-	12.5
(b) 9.5 mm plasterboard with vermiculite - gypsum plaster of thickness of	-	-	16	15	10	10
(c) 19 mm plasterboard with vermiculite-gypsum plaster of thickness of	32	-	10	10	7	7
(d) 19 mm plasterboard with gypsum plaster of thickness of ..	-	-	20	13	10	10

PART V: STRUCTURAL STEEL - continued

B Encased steel beams (Mass per metre not less than 30kg) - continued

Construction and materials	Minimum thickness (in mm) of protection for a fire resistance of -				
	4 hours	2 hours	1 ½ hours	1 hour	½ hour
B. HOLLOW PROTECTION*					
4. Vermiculite-cement slabs of 4:1 mix reinforced with wire mesh and finished with plaster skim. Slabs of thickness of	63	25	25	25	25
5. Gypsum-sand plaster 12.5 mm thick applied to heavy duty (Type B as designated in BS 1105: 1972 Wood wool slabs of thickness of ..	-	50	38	38	38

* Hollow protection means that there is a void between the protective materials and the steel. All hollow protection to columns shall be effectively sealed at each floor level.

+ Solid protection means a casing which is bedded close to the steel without intervening cavities and with all joints in that casing made full and solid.

++ Reinforcement shall consist of steel binding wire not less than 2.3mm in thickness , or a steel mesh weighing not less than 0.48 kg/m2. In concrete protection, the spacing of that reinforcement shall not exceed 150mm in any direction.

§ Light mesh reinforcement required 12.5mm to 19mm below surface unless special corner beads are used.

PART VI: STRUCTURAL ALUMINIUM

Encased aluminium alloy stanchions and beams
(Mass per metre not less than 16 kg)

Construction and materials		Minimum thickness (in mm) of protection for a fire resistance of -				
		4 hours	2 hours	1 ½ hours	1 hour	½ hour
A.	**SOLID PROTECTION***					
1.	Sprayed vermiculite-cement	-	-	-	44	19
B	**HOLOW PROTECTION+**					
1.	Metal lathing with vermiculite-gypsum or perlite-gypsum plaster of thickness of	-	32	22	16	12.5
2.	Metal lathing finished with neat gypsum plaster of thickness of	-	-	-	19	12.5
3.	Gypsum plasterboard 19 mm thick with 1.6 mm wire binding at 100 mm pitch finished with gypsum-vermiculite plaster of thickness of	-	22	16	10	10

* Solid protection means a casing which is bedded close to the alloy without intervening cavities and with all joints in that casing made full and solid.

\+ Hollow protection means that there is a void between the protected material and the alloy. All hollow protection to columns shall be effectively sealed at each floor level.

PART VII: TIMBER FLOORS

Construction and materials	Minimum thickness (in mm) of protection for a fire resistance of –		
	1 hour	½ hour	modified++ ½ hour
(A) Plain edge boarding on timber joists not less than 38 mm wide with ceiling of -			
(i) timber lath and plaster - thickness of plaster	-	16	16
(ii) timber lath and plaster with plaster of minimum thickness of 16 mm covered on underside with plasterboard of thickness ..	-	12.5	-
(iii) metal lathing and plaster - thickness of plaster			
(a) gypsum	-	16	-
(b) vermiculite	-	12.5	-
(iv) one layer of plasterboard of thickness	-	-	12.5
(v) one layer of plasterboard of minimum thickness of 9.5 mm finished with gypsum plaster of thickness ..	-	-	12.5
(vi) one layer of plasterboards of minimum thickness of 12.5 mm finished with gypsum plaster of thickness	-	12.5	-
(vii) two layers of plasterboard of total thickness ..	-	25	19
(viii) one layer of fibre insulating board of minimum thickness of 9.5 mm finished with gypsum plaster of thickness ..	-	5	-
(ix) one layer of fibre insulating board of minimum thickness of 12.5 mm finished with gypsum plaster of thickness ..	-	-	12.5
(x) wood wool slab 25 mm thick finished with gypsum plaster of thickness	-	5	-
(B) Tongued and grooved boarding of not less than 16mm (finished) thickness* on timber joists not less than 38 mm wide ceiling of -			
(i) timber lath and plaster - thickness of plaster	-	-	16
(ii) timber lath and plaster with plaster of minimum thickness of 16 mm covered on underside with plasterboard of thickness	-	9.5	-
(iii) metal lathing and plaster - thickness of plaster			
(a) gypsum	22	16	-
(b) vermiculite	12.5	12.5	-
(iv) one layer of plasterboard of thickness	-	-	9.5

PART VII: TIMBER FLOORS - continued

Construction and materials			Minimum thickness (in mm) of protection for a fire resistance of -		
			1 hour	½ hour	modified++ ½ hour
	(v)	one layer of plasterboard of minimum thickness of 9.5 mm finished with-			
		(a) gypsum plaster of thickness	-	12.5	-
		(b) vermiculite-gypsum plaster of thickness	12.5	-	-
	(vi)	one layer of plasterboards of minimum thickness of 12.5 mm finished with gypsum plaster of thickness ..	-	5	-
	(vii)	two layers of plasterboard of total thickness	-	22	-
	(viii)	one layer of fibre insulating board of minimum thickness of 9.5 mm finished with gypsum plaster of thickness	-	-	5
	(ix)	wood wool slab 25 mm thick finished with -			
		(a) gypsum plaster of thickness	-	5	-
		(b) vermiculite - gypsum plaster of thickness	10	-	-
(C)	Tongued and grooved boardings of not less than 21 mm (finished) thickness* on timber joists not less than 175 mm deep by 50 mm wide and ceiling of -				
	(i)	timber lath and plaster - thickness of plaster	-	16	-
	(ii)	metal lathing and plaster - thickness of plaster	-	16	-
	(iii)	one layer of plasterboard of thickness	-	-	9.5
	(iv)	one layer of plasterboard of minimum thickness of 9.5mm finished with -			
		(a) gypsum plaster of thickness	-	12.5	-
		(b) vermiculite - gypsum plaster of thickness	12.5	-	-
	(v)	one layer of plasterboard of minimum thickness of 12.5 mm finished with gypsum plaster of thickness	-	5	-
	(vi)	two layers of plasterboard of total thickness	-	19	-
	(vii)	one layer of fibre insulating board of thickness	-	-	12.5
	(viii)	one layer of fibre insulating board of minimum thickness of 12.5 mm finished with gypsum plaster of thickness ..	-	12.5	-
	(ix)	wood wool slab 25 mm thick finished with -			
		(a) gypsum plaster of thickness	-	5	-
		(b) vermiculite - gypsum plaster of thickness	10	-	-

* Or an equivalent thickness of wood chipboard

++ The term "modified ½ hour" refers to the requirements specified in item 3(a) of Table 3.4A

PART VIII: REINFORCED CONCRETE FLOORS (SILICEOUS OR CALCAREOUS AGGREGATE)

Floor construction		Minimum dimension to give fire resistance in hours					
		4	3	2	1 ½	1	½
		mm	mm	mm	mm	mm	mm
Solid slab	Average cover to reinforcement	25	25	20	20	15	15
	Depth, overall+	150	150	125	125	100	100
Cored slabs in which the cores are circular or are higher than wide. Not less than 50 % of the gross across section of the floor should be solid material	Average cover to reinforcement	25	25	20	20	15	15
	Thickness under cores	50	40	40	30	25	20
	Depth, overall+	190	175	160	140	110	100
Hollow box section with one or more longitudinal cavities which are wider than high	Average cover to reinforcement	25	25	20	20	15	15
	Thickness of bottom flange	50	40	40	30	25	20
	Depth, overall+	230	205	180	155	130	105
Ribbed floor with hollow infill blocks of clay , or inverted T-section beams with hollow infill blocks of concrete or clay. A floor in which less than 50 % of the gross cross section is solid material must be provided with a 15 mm plaster coating on soffit	Average cover to reinforcement	25	25	20	20	15	15
	Width or rib, or beam, at soffit	125	100	90	80	70	50
	Depth, overall+	190	175	160	140	110	100
Upright T-section	Average bottom cover to reinforcement	65*	55*	45*	35	25	15
	Side cover to reinforcement	65	55	45	35	25	15
	Least width or downstanding leg	150	140	115	90	75	60
	Thickness of flange+	150	150	125	125	100	90
Inverted channel sections with radius at intersection of soffits with top of leg not exceeding depth of section	Average bottom cover to reinforcement	65*	55*	45*	35	25	15
	Side cover to reinforcement	40	30	25	20	15	10
	Least width or downstanding leg	75	70	60	45	40	30
	Thickness at crown+	150	150	125	125	100	90
Inverted channel sections or U-sections with radius at intersection of soffits with top of leg exceeding dept of section	Average bottom cover to reinforcement	65*	55*	45*	35	25	15
	Side cover to reinforcement	40	30	25	20	15	10
	Least width or downstanding leg	70	60	50	40	35	25
	Thickness at crown+	150	150	100	100	75	65

* Supplementary reinforcement, to hold the concrete cover in position, may be necessary.

+ Non-combustible screeds and finishes may be included in these dimensions.

PART IX: PRESTRESSED CONCRETE FLOORS (SILICEOUS OR CALCAREOUS AGGREGATE)

Floor construction		Minimum dimension to give fire resistance in hours					
		4	3	2	1 ½	1	½
		mm	mm	mm	mm	mm	mm
Solid slab	Average cover to tendons	65*	50*	40	30	25	15
	Depth, overall+	150	150	125	125	100	90
Cored slabs in which the cores are circular or are higher than wide. Not less than 50 % of the gross across section of the floor should be solid material	Average cover to tendons	65*	50*	40	30	25	15
	Thickness under cores	50	40	40	30	25	20
	Depth, overall+	190	175	160	140	110	100
Hollow box section with one or more longitudinal cavities which are wider than high	Average cover to tendons	65*	50*	40	30	25	15
	Thickness of bottom flange	65	50	40	30	25	25
	Depth, overall+	230	205	180	155	130	105
Ribbed floor with hollow infill blocks of clay , or inverted T-section beams with hollow infill blocks of concrete or clay. A floor in which less than 50 % of the gross cross section is solid material must be provided with a 15 mm plaster coating on soffit	Average cover to tendons	65*	50*	40	30	25	15
	Width or rib, or beam , at soffit	125	100	90	80	70	50
	Depth, overall+	190	175	160	140	110	100
Upright T-sections	Average bottom cover to reinforcement	100*	85*	65*	50*	40	25
	Side cover to reinforcement	100	85	65	50	40	25
	Least width or downstanding leg	250	200	150	110	90	60
	Thickness of flange+	150	150	125	125	100	90
Inverted channel sections with radius at intersection of soffits with top of leg not exceeding depth of section	Average bottom cover to tendons	100*	85	65*	50*	40	25
	Side cover to tendons	50	45	35	25	20	15
	Least width or downstanding leg	125	100	75	55	45	30
	Thickness at crown+	150	150	125	125	100	90
Inverted channel or U-sections with radius at intersection of soffits with top of leg exceeding depth of section	Average bottom cover to tendons	100*	85*	65*	50*	40	25
	Side cover to tendons	50	45	35	25	20	15
	Least width or downstanding leg	110	90	70	50	45	30
	Thickness at crown+	150	150	125	125	100	90

* Supplementary reinforcement, to hold the concrete cover in position, may be necessary.

+ Non-combustible screeds and finishes may be included in these dimensions.

PART X: GLAZING

	Construction and materials	Minimum thickness of glazing in mm for a period of	
		1 hour	½ hour
1.	Glass , in direct combination with metal , the melting point of which is not lower than 982.2 °C , in square not exceeding 0.015 sq.m. in area		
	Thickness of glass	-	6.35
2.	Glass reinforced with wire not less than 0.46 mm in diameter laid to a square mesh measuring 12.70 mm from centre to centre of wire , and electrically welded at the intersections , or laid to a hexagonal mesh measuring 25.40 mm across the flat side ..		
	Thickness of glass	-	6.35
	In windows , doors , borrowed lights , lanterns and skylights , glass complying with paragraphs 1 or 2 of this Table shall be fixed with wood or metal beads or with a glazing compound in conjunction with sprigs or clips in panels not exceeding 0.372 sq.m. in area in timber frames (fixed shut) having a minimum width and thickness of 44.45 mm clear of rebates ..		
3.	Glass reinforced with wire as in paragraph 2 of this Table , in windows , doors , borrowed lights , lanterns and skylights , fixed with metal beads in panels not exceeding 1.115 sq.m in metal frames (fixed shut) all metal having a melting point not lower than 982.2°C , the thickness of glass	6.35	6.35
4.	Glass bricks or blocks in walls	-	98.43
	Laid in cement / lime / sand mortar with light wire reinforcing mesh in every third horizontal joint in a panel not exceeding 2.438 m in width or height set along the sides and head into recesses in the surrounding non-combustible construction. The depth of such recessed shall be not less than 25.40 mm , the glass blocks extending into the recesses to a depth of 12.70 mm and bedded upon layer of glass fibre. A non-hardening mastic shall be used to fill the spaces between the sides of the recesses and the faces of the panels		

In this Table the absence of a figure in a period column indicated that glazing described is not acceptable for the period applicable to that column.

APPENDIX 'B' TO C1 3.5

PART 1
CALCULATION OF PERMITTED LIMITS OF UNPROTECTED AREAS

General rules applicable to this Appendix

1. The permitted limit of unprotected areas in any side of a building or compartment shall be calculated by reference to the requirements of Part II.

2. For the purposes of this Appendix , the expression "unprotected area" has the meaning ascribed to it by C1 1.2.61, but in calculating the size of unprotected areas or the permitted limit of unprotected areas, the following provisions shall apply -

   (a) where any area of an external wall is an unprotected area, only because it has combustible material attached to it as cladding, the area of that unprotected area shall be deemed to be half the area of such cladding;

   (b) when unprotected openings in the same compartment are recessed at a distance or an angle to the plane of reference, the width of the unprotected opening can be reduced accordingly when projected to the plane of reference based on Table III and IV. However, such reduction is not applicable to the following:

      (i) Concave building profile or the like where a specific point on the receiving panel receives radiation from more than one source.
      (ii) When the unprotected opening is along a continuous circular profile where its size and angle cannot be determine.

   (c) no account shall be taken of any of the following:

      (i) an unprotected area which does not exceed 0.1 m^2 and which is not less than 1.5 m from any other unprotected area in the same side of the building or compartment (unless that other falls within (iii) below);
      (ii) one or more unprotected areas having an area (or, if more than one, the aggregate area) not exceeding 1 m^2 and not less than 4 m from any other unprotected area in the same side of the building or compartment (except any such area as is specified in (1) above);
      (iii) an unprotected area in any part of an external wall which forms part of a protected shaft ;
      (iv) an unprotected area in the side of a building not divided into compartments , if the area is not less than 28 m above any ground adjoining that side of the building.

PART II

Rules of calculation by reference to an enclosing rectangle

3. The conditions of this Part of this Appendix shall be satisfied if a building or compartment is so situated that no point on the relevant boundary is either between the relevant plane of reference and the side of the building or compartment or at a distance from the relevant plane of reference which is less than the distance specified in the Tables to this Part of this Appendix , according to the purpose group of the building or compartment, the dimensions of the enclosing rectangle and the unprotected percentage.

4. For the purpose of this Part of this Appendix:

   "relevant boundary" means as defined in C1 1.2.52 and for the purpose of this calculation is either parallel to the side of the building under consideration or at an angle of not more than 80° with that side ;

   "plane of reference" means any vertical plane which touches the side or some part of the side of a building or compartment but which (however far extended) does not pass within the structure of such building or compartment (and for this purpose , any balcony , coping or similar projection shall be deemed not to be part either of that side or of the structure) ; and the relevant plane of reference shall in each case be taken as that most favourable in that respect to the person erecting the building ;

   "enclosing rectangle" means the smallest rectangle on the relevant plane of reference which would-

   (a) enclose all the outer edge of any unprotected area of the building or , if the building is divided into compartments, of the compartment (other than any of an unprotected area which is at an angle of more than 80₀ to the plane of reference the outer edges being for this purpose projected on the plane of reference by line perpendicular to such plane:
   (b) have two horizontal sides; and
   (c) have height and width falling within those listed in the Tables to this Part of this Appendix:

   "unprotected percentage" means the percentage of the area of the enclosing rectangle which is equal to the aggregate of the unprotected areas taken into account in calculating the enclosing rectangle and as projected on it.

TABLE I - BUILDINGS OR COMPARTMENTS OF PURPOSE GROUPS

I (SMALL RESIDENTIAL) , II (OTHER RESIDENTIAL) ,III (INSTITUTIONAL) , IV (OFFICE) , VII (PLACE OF PUBLIC RESORT) & VIII (STORAGE & GENERAL – OPEN-SIDED CARPARKING DECKS ONLY)

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 3 m high									
3	1.0	1.0	1.0	1.5	1.5	1.5	2.0	2.0	2.0
6	1.0	1.0	1.5	2.0	2.0	2.0	2.5	2.5	3.0
9	1.0	1.0	1.5	2.0	2.5	2.5	3.0	3.0	3.5
12	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5
15	1.0	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0
18	1.0	1.5	2.0	2.5	2.5	3.0	3.5	4.0	4.0
21	1.0	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.5
24	1.0	1.5	2.0	2.5	3.0	3.5	3.5	4.0	4.5
27	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5
30	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5
40	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	5.0
No limit	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	5.0
Enclosing rectangle 6 m high									
3	1.0	1.0	1.5	2.0	2.0	2.0	2.5	2.5	3.0
6	1.0	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.0
9	1.0	2.0	2.5	3.0	3.5	4.0	4.5	4.5	5.0
12	1.5	2.5	3.0	3.5	4.0	4.5	5.0	5.0	5.5
15	1.5	2.5	3.0	4.0	4.5	5.0	5.5	5.5	6.0
18	1.5	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.5
21	1.5	2.5	3.5	4.0	5.0	5.5	6.0	6.5	7.0
24	1.5	2.5	3.5	4.5	5.0	5.5	6.0	7.0	7.0
27	1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5
30	1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	8.0
40	1.5	2.5	3.5	4.5	5.5	6.5	7.0	8.0	8.5
50	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.0	9.0
60	1.5	2.5	3.5	5.0	5.5	6.5	7.5	8.5	9.5
80	1.5	2.5	3.5	5.0	6.0	7.0	7.5	8.5	9.5
100	1.5	2.5	3.5	5.0	6.0	7.0	8.0	8.5	10.0
No limit	1.5	2.5	3.5	5.0	6.0	7.0	8.0	8.5	10.0

TABLES TO PART II OF APPENDIX 'B' TO C1 3.5 - continued
TABLE I - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 9 m high									
3	1.0	1.0	1.5	2.0	2.5	2.5	3.0	3.0	3.5
6	1.0	2.0	2.5	3.0	3.5	4.0	4.5	4.5	5.0
9	1.5	2.5	3.5	4.0	4.5	5.0	5.5	5.5	6.0
12	1.5	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
15	2.0	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.5
18	2.0	3.5	4.5	5.0	6.0	6.5	7.0	8.0	8.5
21	2.0	3.5	4.5	5.5	6.5	7.0	7.5	8.5	9.0
24	2.0	3.5	5.0	5.5	6.5	7.5	8.0	9.0	9.5
27	2.0	3.5	5.0	6.0	7.0	7.5	8.5	9.5	10.0
30	2.0	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.5
40	2.0	3.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5
50	2.0	4.0	5.5	6.5	8.0	9.0	10.0	11.5	12.5
60	2.0	4.0	5.5	7.0	8.0	9.5	11.0	11.5	13.0
80	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	13.5
100	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	14.5
120	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	14.5
No limit	2.0	4.0	5.5	7.0	8.5	10.5	12.0	12.5	15.0
Enclosing rectangle 12 m high									
3	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5
6	1.5	2.5	3.0	3.5	4.0	4.5	5.0	5.0	5.5
9	1.5	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
12	1.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5	8.0
15	2.0	3.5	5.0	5.5	6.5	7.0	8.0	8.5	9.0
18	2.5	4.0	5.0	6.0	7.0	7.5	8.5	9.0	10.0
21	2.5	4.0	5.5	6.5	7.5	8.5	9.0	10.0	10.5
24	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.5
27	2.5	4.5	6.0	7.0	8.0	9.0	10.5	11.0	12.0
30	2.5	4.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5
40	2.5	5.0	6.5	8.0	9.5	10.5	12.0	12.0	14.0
50	2.5	5.0	7.0	8.5	10.0	11.0	13.0	14.0	15.0
60	2.5	5.0	7.0	9.0	10.5	12.0	13.5	14.5	16.0
80	2.5	5.0	7.0	9.0	11.0	13.0	14.5	16.0	17.0
100	2.5	5.0	7.5	9.5	11.5	13.5	15.0	16.5	18.0
120	2.5	5.0	7.5	9.5	11.5	13.5	15.0	17.0	18.5
No limit	2.5	5.0	7.5	9.5	12.0	14.0	15.5	17.0	19.0

TABLE 1 - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 15 m high									
3	1.0	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0
6	1.5	2.5	3.0	4.0	4.5	5.0	5.5	5.5	6.0
9	2.0	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.5
12	2.0	3.5	5.0	5.5	6.5	7.0	8.0	8.5	9.0
15	2.0	4.0	5.5	6.5	7.0	8.0	9.0	9.5	10.0
18	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.0
21	2.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
24	3.0	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0
27	3.0	5.5	7.0	8.5	9.5	10.5	11.5	12.5	13.5
30	3.0	5.5	7.5	8.5	10.0	11.0	12.0	13.5	14.0
40	3.0	6.0	8.0	9.5	11.0	12.5	13.5	15.0	16.0
50	3.5	6.0	8.5	10.0	12.0	13.5	15.0	16.5	17.5
60	3.5	6.5	8.5	10.5	12.5	14.0	15.5	17.0	18.0
80	3.5	6.5	9.0	11.0	13.5	15.0	17.0	18.5	20.0
100	3.5	6.5	9.0	11.5	14.0	16.0	18.0	19.5	21.5
120	3.5	6.5	9.0	11.5	14.0	16.5	18.5	20.5	22.5
No limit	3.5	6.5	9.0	12.0	14.5	17.0	19.0	21.0	23.0
Enclosing rectangle 18 m high									
3	1.0	1.5	2.0	2.5	2.5	3.0	3.5	4.0	4.0
6	1.5	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.5
9	2.0	3.5	4.5	5.0	6.0	6.5	7.0	8.0	8.5
12	2.5	4.0	5.0	6.0	7.0	7.5	8.5	9.0	10.0
15	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.0
18	2.5	5.0	6.5	7.5	8.5	9.5	11.0	11.5	13.0
21	3.0	5.5	7.0	8.0	9.5	10.5	11.5	12.5	13.0
24	3.0	5.5	7.5	8.5	10.0	11.0	12.0	13.0	14.0
27	3.5	6.0	8.0	9.0	10.5	11.5	12.5	13.5	14.5
30	3.5	6.5	8.0	9.5	11.0	12.0	13.5	14.5	15.5
40	4.0	7.0	9.0	11.0	12.0	13.5	15.0	16.5	17.5
50	4.0	7.0	9.5	11.5	13.0	15.0	16.5	18.0	19.0
60	4.0	7.5	10.0	12.0	14.0	16.0	17.5	19.5	20.5
80	4.0	7.5	10.0	13.0	15.0	17.0	19.0	21.0	22.5
100	4.0	7.5	10.0	13.5	16.0	18.0	20.5	22.5	24.0
120	4.0	7.5	10.0	14.0	16.5	19.0	21.0	23.5	25.5
No limit	4.0	8.0	10.0	14.0	17.0	19.5	22.0	24.0	26.5

TABLE I - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 21 m high									
3	0.5	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.5
6	1.5	2.5	3.5	4.0	5.0	5.5	6.0	6.5	7.0
9	2.0	3.5	4.5	5.5	6.5	7.0	7.5	8.5	9.0
12	2.5	4.0	5.5	6.5	7.5	8.5	9.0	10.0	10.5
15	2.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
18	3.0	5.5	7.0	8.0	9.5	10.5	11.5	12.5	13.0
21	3.0	6.0	7.5	9.0	10.5	11.0	12.5	13.5	14.0
24	3.5	6.0	8.0	9.5	10.5	12.0	13.0	14.0	15.0
27	3.5	6.5	8.5	10.0	11.5	13.0	14.0	15.0	16.0
30	4.0	7.0	9.0	10.5	12.0	13.0	14.5	16.0	16.5
40	4.5	7.5	10.0	12.0	13.5	15.0	16.5	18.0	19.0
50	4.5	8.0	11.0	13.0	14.5	16.5	18.0	20.0	21.0
60	4.5	8.5	11.5	13.5	15.5	17.5	19.5	21.0	22.5
80	4.5	8.5	12.0	14.5	17.0	19.0	21.0	23.5	25.0
100	4.5	9.0	12.0	15.5	18.0	20.5	22.5	25.0	27.0
120	4.5	9.0	12.0	16.0	18.5	21.5	23.5	26.5	28.5
No limit	4.5	9.0	12.0	16.0	19.0	22.0	25.0	26.5	29.5
Enclosing rectangle 24 m high									
3	0.5	1.5	2.0	2.5	3.0	3.5	3.5	4.0	4.5
6	1.5	2.5	3.5	4.5	5.0	5.5	6.0	7.0	7.0
9	2.0	3.5	5.0	5.5	6.5	7.5	8.0	9.0	9.5
12	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.5
15	3.0	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0
18	3.0	5.5	7.5	8.5	10.0	11.0	12.0	13.0	14.0
21	3.5	6.0	8.0	9.5	10.5	12.0	13.0	14.0	15.0
24	3.5	6.5	8.5	10.0	11.5	12.5	14.0	15.0	16.0
27	4.0	7.0	9.0	11.0	12.5	13.5	15.0	16.0	17.0
30	4.0	7.5	9.5	11.5	13.0	14.0	15.5	17.0	18.0
40	4.5	8.5	11.0	13.0	14.5	16.0	18.0	19.0	20.5
50	5.0	9.0	12.0	14.0	16.0	17.5	19.5	21.0	22.5
60	5.0	9.5	12.5	15.0	17.0	19.0	21.0	23.0	24.5
80	5.0	10.0	13.5	16.5	18.5	21.0	23.5	25.5	27.5
100	5.0	10.0	13.5	17.0	20.0	22.5	25.0	27.5	29.5
120	5.5	10.0	13.5	17.5	20.5	23.5	26.5	29.0	31.0
No limit	5.5	10.0	13.5	18.0	21.0	24.0	27.5	30.0	32.5

TABLES TO PART II OF APPENDIX 'B' TO C1 3.5 - continued

TABLE I - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 27 m high									
3	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5
6	1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5
9	2.0	3.5	5.0	6.0	7.0	7.5	8.5	9.5	10.0
12	2.5	4.5	6.0	7.0	8.0	9.0	10.5	11.0	12.0
15	3.0	5.5	7.0	8.5	9.5	10.5	11.5	12.5	13.5
18	3.5	6.0	8.0	9.0	10.5	11.5	12.5	13.5	14.5
21	3.5	6.5	8.5	10.0	11.5	13.0	14.0	15.0	16.0
24	3.5	7.0	9.0	11.0	12.5	13.5	15.0	16.0	17.0
27	4.0	7.5	10.0	11.5	13.0	14.0	16.0	17.0	18.0
30	4.0	8.0	10.0	12.0	13.5	15.0	17.0	18.0	19.0
40	5.0	9.0	11.5	14.0	15.5	17.5	19.0	20.5	22.0
50	5.5	9.5	12.5	15.0	17.0	19.0	21.0	22.5	24.0
60	5.5	10.5	13.5	16.0	18.5	20.5	22.5	24.5	26.5
80	6.0	11.0	14.5	17.5	20.5	22.5	25.0	27.5	29.5
100	6.0	11.0	15.5	19.0	21.5	24.5	27.0	30.0	32.0
120	6.0	11.5	15.5	19.5	22.5	26.0	28.5	32.0	34.0
No limit	6.0	11.5	15.5	20.0	23.5	27.0	29.5	33.0	35.0

TABLE 2 - BUILDINGS OR COMPARTMENTS OF PURPOSE GROUPS

V (SHOPS), VI (FACTORY) & VIII (STORAGE & GENERAL – OPEN-SIDED CARPARKING DECKS – SEE TABLE 1)

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 3 m high									
3	1.0	1.5	2.0	2.0	2.5	2.5	2.5	3.0	3.0
6	1.5	2.0	2.5	3.0	3.0	3.5	3.5	4.0	4.0
9	1.5	2.5	3.0	3.5	4.0	4.0	4.5	5.0	5.0
12	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	5.5
15	2.0	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.0
18	2.0	2.5	3.5	4.0	5.0	5.0	6.0	6.5	6.5
21	2.0	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
24	2.0	3.0	3.5	4.5	5.0	5.5	6.0	7.0	7.5
27	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.0	7.5
30	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.5	8.0
40	2.0	3.0	4.0	5.0	5.5	6.5	7.0	8.0	8.5
50	2.0	3.0	4.0	5.0	6.0	6.5	7.5	8.0	9.0
60	2.0	3.0	4.0	5.0	6.0	7.0	7.5	8.5	9.5
80	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	9.5
No limit	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Enclosing rectangle 6 m high									
3	1.5	2.0	2.5	3.0	3.0	3.5	3.5	4.0	4.0
6	2.0	3.0	3.5	4.0	4.5	5.0	5.5	5.5	6.0
9	2.5	3.5	4.5	5.0	5.5	6.0	6.5	7.0	7.0
12	3.0	4.0	5.0	5.5	6.5	7.0	7.5	8.0	8.5
15	3.0	4.5	5.5	6.0	7.0	7.5	8.0	9.0	9.0
18	3.5	4.5	5.5	6.5	7.5	8.0	9.0	9.5	10.0
21	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.0	10.5
24	3.5	5.0	6.0	7.0	8.5	9.5	10.0	10.5	11.0
27	3.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
30	3.5	5.0	6.5	8.0	9.0	10.0	11.0	12.0	12.5
40	3.5	5.5	7.0	8.5	10.0	11.0	12.0	13.0	14.0
50	3.5	5.5	7.5	9.0	10.5	11.5	13.0	14.0	15.0
60	3.5	5.5	7.5	9.5	11.0	12.0	13.5	15.0	16.0
80	3.5	6.0	7.5	9.5	11.5	13.0	14.5	16.0	17.5
100	3.5	6.0	8.0	10.0	12.0	13.5	15.0	16.5	18.0
120	3.5	6.0	8.0	10.0	12.0	14.0	15.5	17.0	19.0
No limit	3.5	6.0	8.0	10.0	12.0	14.0	16.0	18.0	19.0

TABLES TO PART II OF APPENDIX 'B' TO C1 3.5 - continued

TABLE 2 - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 9 m high									
3	1.5	2.5	3.0	3.5	4.0	4.0	4.5	5.0	5.0
6	2.5	3.5	4.5	5.0	5.5	6.0	6.5	7.0	7.0
9	3.5	4.5	5.5	6.0	6.5	7.5	8.0	8.5	9.0
12	3.5	5.0	6.0	7.0	7.5	8.5	9.0	9.5	10.5
15	4.0	5.5	6.5	7.5	8.5	9.5	10.0	11.0	11.5
18	4.5	6.0	7.0	8.5	9.5	10.0	11.0	12.0	12.5
21	4.5	6.5	7.5	9.0	10.0	11.0	12.0	13.0	13.5
24	5.0	6.5	8.0	9.5	11.0	12.0	13.0	13.5	14.5
27	5.0	7.0	8.5	10.0	11.5	12.5	13.5	14.5	15.0
30	5.0	7.0	9.0	10.5	12.0	13.0	14.0	15.0	16.0
40	5.5	7.5	9.5	11.5	13.0	14.5	15.5	17.0	17.5
50	5.5	8.0	10.0	12.5	14.0	15.5	17.0	18.5	19.5
60	5.5	8.0	11.0	13.0	15.0	16.5	18.0	19.5	21.0
80	5.5	8.5	11.5	13.5	16.0	17.5	19.5	21.5	23.0
100	5.5	8.5	11.5	14.5	16.5	18.5	21.0	22.5	24.5
120	5.5	8.5	11.5	14.5	17.0	19.5	21.5	23.5	26.0
No limit	5.5	8.5	11.5	15.0	17.5	20.0	22.5	24.5	27.0
Enclosing rectangle 12 m high									
3	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	5.5
6	3.0	4.0	5.0	5.5	6.5	7.0	7.5	8.0	8.5
9	3.5	5.0	6.0	7.0	7.5	8.5	9.0	9.5	10.5
12	4.5	6.0	7.0	8.0	9.0	9.5	11.0	11.5	12.0
15	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0	13.5
18	5.0	7.0	8.5	10.0	11.0	12.0	13.0	14.0	14.5
21	5.5	7.5	9.0	10.5	12.0	13.0	14.0	15.0	16.0
24	6.0	8.0	9.5	11.5	12.5	14.0	15.0	16.0	16.5
27	6.0	8.0	10.5	12.0	13.5	14.5	16.0	17.0	17.5
30	6.5	8.5	10.5	12.5	14.0	15.0	16.5	17.5	18.5
40	6.5	9.5	12.0	14.0	15.5	17.5	18.5	20.0	21.0
50	7.0	10.0	13.0	15.0	17.0	19.0	20.5	23.0	23.0
60	7.0	10.5	13.5	16.0	18.0	20.0	21.5	23.5	25.0
80	7.0	11.0	14.5	17.0	19.5	21.5	23.5	26.0	27.5
100	7.5	11.5	15.0	18.0	21.0	23.0	25.5	28.0	30.0
120	7.5	11.5	15.0	18.5	22.0	24.0	27.0	29.5	31.5
No limit	7.5	12.0	15.5	19.0	22.5	25.0	28.0	30.5	34.0

TABLES TO PART II OF APPENDIX 'B' TO C1 3.5 - continued

TABLE 2 - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 15 m high									
3	2.0	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.0
6	3.0	4.5	5.5	6.0	7.0	7.5	8.0	9.0	9.0
9	4.0	5.5	6.5	7.5	8.5	9.5	10.0	11.0	11.5
12	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0	13.5
15	5.5	7.0	9.0	10.0	11.5	12.5	13.5	14.5	15.0
18	6.0	8.0	9.5	11.0	12.5	13.5	14.5	15.5	16.5
21	6.5	8.5	10.5	12.0	13.5	14.5	16.0	16.5	17.5
24	6.5	9.0	11.0	13.0	14.5	15.5	17.0	18.0	19.0
27	7.0	9.5	11.5	13.5	15.0	16.5	18.0	19.0	20.0
30	7.5	10.0	12.0	14.0	16.0	17.0	18.5	20.0	21.0
40	8.0	11.0	13.5	16.0	18.0	19.5	21.0	22.5	23.5
50	8.5	12.0	15.0	17.5	19.5	21.5	23.0	25.0	26.0
60	8.5	12.5	15.5	18.0	21.0	23.5	25.0	27.0	28.0
80	9.0	13.5	17.0	20.0	23.0	25.5	28.0	30.0	31.5
100	9.0	14.0	18.0	21.5	24.5	27.5	30.0	32.5	34.5
120	9.0	14.0	18.5	22.5	25.5	28.5	31.5	34.5	37.0
No limit	9.0	14.5	19.0	23.0	27.0	30.0	34.0	36.0	39.0
Enclosing rectangle 18 m high									
3	2.0	2.5	3.5	4.0	5.0	5.0	6.0	6.5	6.5
6	3.5	4.5	5.5	6.5	7.5	8.0	9.0	9.5	10.0
9	4.5	6.0	7.0	8.5	9.5	10.0	11.0	12.0	12.5
12	5.0	7.0	8.5	10.0	11.0	12.0	13.0	14.0	14.5
15	6.0	8.0	9.5	11.0	12.5	13.5	14.5	15.5	16.5
18	6.5	8.5	11.0	12.0	13.5	14.5	16.0	17.0	18.0
21	7.0	9.5	11.5	13.0	14.5	16.0	17.0	18.0	19.5
24	7.5	10.0	12.0	14.0	15.5	16.5	18.5	19.5	20.5
27	8.0	10.5	12.5	14.5	16.5	17.5	19.5	20.5	21.5
30	8.0	11.0	13.5	15.5	17.0	18.5	20.5	21.5	22.5
40	9.0	12.0	15.0	17.5	19.5	21.5	23.5	25.0	26.0
50	9.5	13.0	16.5	19.0	21.5	23.5	26.0	27.5	29.0
60	10.0	14.0	17.5	20.5	23.0	26.0	27.5	29.5	31.0
80	10.0	15.0	19.0	22.5	26.0	28.5	31.0	33.5	35.0
100	10.0	16.0	20.5	24.0	28.0	31.0	33.5	36.0	38.5
120	10.0	16.5	21.0	25.5	29.5	32.5	35.5	39.0	41.5
No limit	10.0	17.0	22.0	26.5	30.5	34.0	37.0	41.0	43.5

TABLE 2 - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 21 m high									
3	2.0	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
6	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.0	10.5
9	4.5	6.5	7.5	9.0	10.0	11.0	12.0	13.0	13.5
12	5.5	7.5	9.0	10.5	12.0	13.0	14.0	15.0	16.0
15	6.5	8.5	10.5	12.0	13.5	14.5	16.0	16.5	17.5
18	7.0	9.5	11.5	13.0	14.5	16.0	17.0	18.0	19.5
21	7.5	10.0	12.5	14.0	15.5	17.0	18.5	20.0	21.0
24	8.0	10.5	13.0	15.0	16.0	18.0	20.0	21.0	22.0
27	8.5	11.5	14.0	16.0	18.0	19.0	21.0	22.5	23.5
30	9.0	12.0	14.5	16.5	18.5	20.5	22.0	23.5	25.0
40	10.0	13.5	16.5	19.0	21.5	23.0	25.5	27.0	28.5
50	11.0	14.5	18.0	21.0	23.5	25.5	28.0	30.0	31.5
60	11.5	15.5	19.5	22.5	25.5	28.0	30.5	32.5	33.5
80	12.0	17.0	21.0	25.0	28.5	31.5	34.0	36.5	38.5
100	12.0	18.0	22.5	27.0	31.0	34.5	37.0	40.0	42.0
120	12.0	18.5	23.5	28.5	32.5	36.5	39.5	43.0	45.5
No limit	12.0	19.0	25.0	29.5	34.5	38.0	41.5	45.5	48.0
Enclosing rectangle 24 m high									
3	2.0	3.0	3.5	4.5	5.0	5.5	6.0	7.0	7.5
6	3.5	5.0	6.0	7.0	8.5	9.5	10.0	10.5	11.0
9	5.0	6.5	8.0	9.5	11.0	12.0	13.0	13.5	14.5
12	6.0	8.0	9.5	11.5	12.5	14.0	15.0	16.0	16.5
15	6.5	9.0	11.0	13.0	14.5	15.5	17.0	18.0	19.0
18	7.5	10.0	12.0	14.0	15.5	16.5	18.5	19.5	20.5
21	8.0	10.5	13.0	15.0	16.5	18.0	20.0	21.0	22.0
24	8.5	11.5	14.0	16.0	18.0	19.5	21.0	22.5	24.0
27	9.0	12.5	15.0	17.0	19.0	20.5	21.5	24.0	25.5
30	9.5	13.0	15.5	18.0	20.0	21.5	23.5	25.0	26.5
40	11.0	14.5	18.0	20.5	23.0	25.0	27.5	29.0	30.5
50	12.0	16.0	19.5	22.5	25.5	27.5	30.0	32.0	33.5
60	12.5	17.0	21.0	24.5	27.5	30.0	32.5	35.0	36.5
80	13.5	18.5	23.5	27.5	31.0	34.5	37.0	39.5	41.5
100	13.5	20.0	25.0	29.5	33.5	37.0	40.0	43.0	45.5
120	13.5	20.5	26.5	31.0	36.0	39.5	43.0	46.5	49.0
No limit	13.5	21.0	27.5	32.5	37.5	42.0	45.5	49.5	52.0

TABLES TO PART II OF APPENDIX 'B' TO C1 3.5 - continued

TABLE 2 - continued

Width of enclosing rectangle in metres	Distance in metres from relevant boundary for unprotected percentage not exceeding								
	20	30	40	50	60	70	80	90	100
Enclosing rectangle 27 m high									
3	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.0	7.5
6	3.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
9	5.0	7.0	8.5	10.0	11.5	12.5	13.5	14.5	15.0
12	6.0	8.0	10.5	12.0	13.5	14.5	16.0	17.0	17.5
15	7.0	9.5	11.5	13.5	15.0	16.5	18.0	19.0	20.0
18	8.0	10.5	12.5	14.5	16.5	17.5	19.5	20.5	21.5
21	8.5	11.5	14.0	16.0	18.0	19.0	21.0	22.5	23.5
24	9.0	12.5	15.0	17.0	19.0	20.5	22.5	24.0	25.5
27	10.0	13.0	16.0	18.0	20.0	22.0	24.0	25.5	27.0
30	10.0	13.5	17.0	19.0	21.0	23.0	25.0	26.5	28.0
40	11.5	15.5	19.0	22.0	24.5	26.5	29.0	30.5	32.5
50	12.5	17.0	21.0	24.0	27.0	29.5	32.0	34.5	36.0
60	13.5	18.5	22.5	26.5	29.5	32.0	35.0	37.0	39.0
80	14.5	20.5	25.0	29.5	33.0	36.5	39.5	42.0	44.0
100	15.5	21.5	27.0	32.0	36.5	40.5	43.0	46.5	48.5
120	15.5	22.5	28.5	34.0	39.0	43.0	46.5	50.5	53.0
No limit	15.5	23.5	29.5	35.0	40.5	44.5	48.5	52.0	55.5

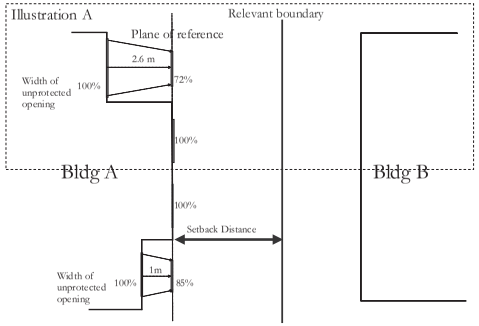
TABLE III TO PART I OF APPENDIX 'B' TO CL.3.5

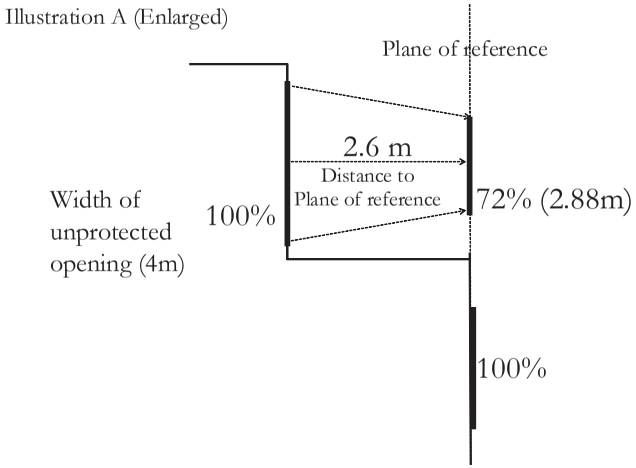
Percentage of the width of the unprotected openings upon their projection onto the plane of reference (in view of distance of the openings from the plane of reference)

Width of unprotected opening*	Distance to reference plane+																										
	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m	14m	15m	16m	17m	18m	19m	20m	21m	22m	23m	24m	25m	26m	27m
3m	72%	54%	41%	33%	28%	24%	21%	18%	16%	15%	13%	12%	11%	11%	10%	9%	9%	8%	8%	7%	7%	7%	6%	6%	6%	6%	6%
6m	85%	72%	62%	54%	47%	41%	37%	33%	30%	28%	25%	24%	22%	21%	19%	18%	17%	16%	15%	15%	14%	13%	13%	12%	12%	11%	11%
9m	90%	80%	72%	65%	59%	54%	49%	45%	41%	38%	36%	33%	31%	29%	28%	26%	25%	24%	22%	21%	21%	20%	19%	18%	17%	17%	16%
15m	94%	88%	82%	77%	72%	68%	64%	60%	57%	54%	51%	48%	46%	43%	41%	40%	38%	36%	35%	33%	32%	31%	30%	29%	28%	27%	26%
21m	95%	91%	87%	83%	79%	75%	72%	69%	66%	63%	61%	58%	56%	54%	51%	50%	48%	46%	44%	43%	41%	40%	39%	38%	36%	35%	34%
27m	96%	93%	90%	86%	83%	80%	77%	75%	72%	70%	67%	65%	63%	61%	59%	57%	55%	54%	52%	50%	49%	48%	46%	45%	44%	43%	41%
30m	97%	94%	90%	88%	85%	82%	79%	77%	74%	72%	70%	68%	66%	64%	62%	60%	58%	57%	55%	54%	52%	51%	49%	48%	47%	46%	45%
40m	98%	95%	93%	90%	88%	86%	84%	82%	80%	78%	76%	74%	73%	71%	69%	68%	66%	65%	63%	62%	60%	59%	58%	57%	55%	54%	53%
50m	98%	96%	94%	92%	90%	89%	87%	85%	84%	82%	80%	79%	77%	76%	74%	73%	72%	70%	69%	68%	66%	65%	64%	63%	62%	61%	60%
60m	98%	97%	95%	94%	92%	90%	89%	88%	86%	85%	83%	82%	81%	79%	78%	77%	76%	74%	73%	72%	71%	70%	69%	68%	67%	66%	65%
70m	99%	97%	96%	94%	93%	92%	90%	89%	88%	87%	86%	84%	83%	82%	81%	80%	79%	78%	76%	75%	74%	73%	72%	71%	70%	70%	69%
80m	99%	98%	96%	95%	94%	93%	92%	90%	89%	88%	87%	86%	85%	84%	83%	82%	81%	80%	79%	78%	77%	76%	75%	74%	74%	73%	72%
90m	99%	98%	97%	96%	95%	94%	93%	92%	90%	90%	89%	88%	87%	86%	85%	84%	83%	82%	81%	80%	79%	78%	78%	77%	76%	75%	74%
100m	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	90%	89%	88%	87%	86%	85%	84%	84%	83%	82%	81%	80%	80%	79%	78%	77%	77%
110m	99%	98%	97%	96%	96%	95%	94%	93%	92%	91%	90%	90%	89%	88%	87%	87%	86%	85%	84%	83%	83%	82%	81%	81%	80%	79%	78%
120m	99%	98%	98%	97%	96%	95%	94%	94%	93%	92%	91%	90%	90%	89%	88%	88%	87%	86%	85%	85%	84%	83%	83%	82%	81%	81%	80%

Note: * To take next higher width when actual width exceeds that of the table. Interpolation of the figures is not permitted.

+ To take the lower distance from table when actual distance exceeds that of the table. Interpolation of the figures is not permitted.





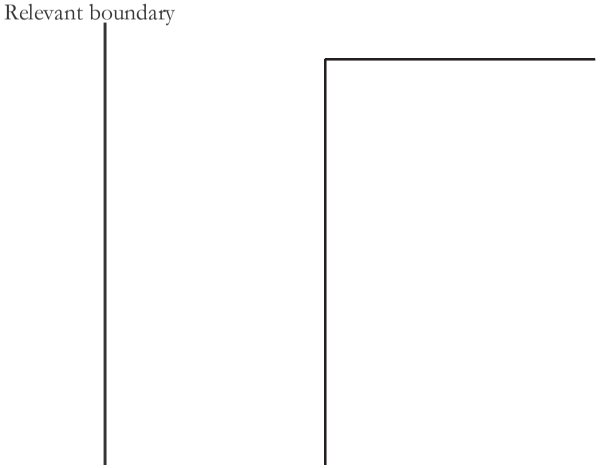


TABLE III TO PART I OF APPENDIX 'B' TO CL.3.5

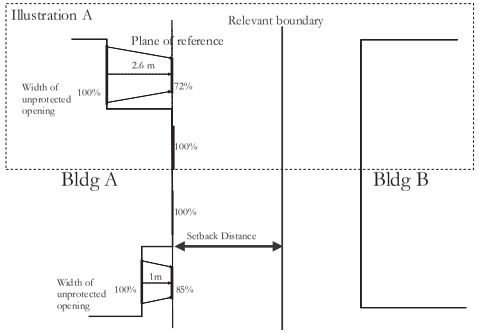
Percentage of the width of the unprotected openings upon their projection on the plane of reference (in view of distance of the openings from the plane of reference)

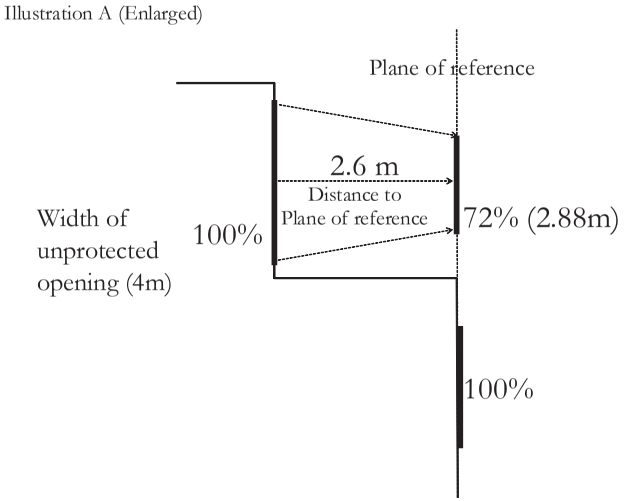
TABLE III - continued

Width of unprotected opening*	Distance to reference plane+																											
	28m	**29m**	**30m**	**31m**	**32m**	**33m**	**34m**	**35m**	**36m**	**37m**	**38m**	**39m**	**40m**	**41m**	**42m**	**43m**	**44m**	**45m**	**46m**	**47m**	**48m**	**49m**	**50m**	**51m**	**52m**	**53m**	**54m**
3m	5%	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
6m	11%	10%	10%	10%	9%	9%	9%	9%	8%	8%	8%	8%	7%	7%	7%	7%	7%	7%	6%	6%	6%	6%	6%	6%	6%	6%	6%
9m	16%	15%	15%	14%	14%	13%	13%	13%	12%	12%	12%	11%	11%	11%	11%	10%	10%	10%	10%	9%	9%	9%	9%	9%	9%	8%	8%
15m	25%	24%	24%	23%	22%	22%	21%	21%	20%	19%	19%	19%	18%	18%	17%	17%	17%	16%	16%	16%	15%	15%	15%	14%	14%	14%	14%
21m	33%	32%	32%	31%	30%	29%	28%	28%	27%	26%	26%	25%	25%	24%	24%	23%	23%	22%	22%	21%	21%	21%	20%	20%	19%	19%	19%
27m	40%	39%	38%	37%	37%	36%	35%	34%	33%	33%	32%	31%	31%	30%	29%	29%	28%	28%	27%	27%	26%	26%	25%	25%	24%	24%	24%
30m	43%	42%	41%	40%	40%	39%	38%	37%	36%	35%	35%	34%	33%	33%	32%	31%	31%	30%	30%	29%	29%	28%	28%	27%	27%	26%	26%
40m	52%	51%	50%	49%	48%	47%	46%	45%	45%	44%	43%	42%	41%	41%	40%	39%	39%	38%	37%	37%	36%	36%	35%	35%	34%	34%	33%
50m	59%	58%	57%	56%	55%	54%	53%	52%	51%	50%	50%	49%	48%	47%	47%	46%	45%	45%	44%	43%	43%	42%	41%	41%	40%	40%	39%
60m	64%	63%	62%	61%	60%	59%	58%	57%	57%	56%	55%	54%	54%	53%	52%	51%	51%	50%	49%	49%	48%	47%	47%	46%	46%	45%	45%
70m	68%	67%	66%	65%	64%	63%	63%	62%	61%	60%	59%	59%	58%	57%	57%	56%	55%	55%	54%	53%	53%	52%	51%	51%	50%	50%	49%
80m	71%	70%	69%	68%	68%	67%	66%	65%	65%	64%	63%	63%	62%	61%	60%	60%	59%	58%	58%	57%	57%	56%	55%	55%	54%	54%	53%
90m	74%	73%	72%	71%	71%	70%	69%	68%	68%	67%	66%	66%	65%	64%	64%	63%	62%	62%	61%	61%	60%	59%	59%	58%	58%	57%	57%
100m	76%	75%	74%	74%	73%	72%	72%	71%	70%	70%	69%	68%	68%	67%	66%	66%	65%	65%	64%	63%	63%	62%	62%	61%	61%	60%	60%
110m	78%	77%	76%	76%	75%	74%	74%	73%	72%	72%	71%	71%	70%	69%	69%	68%	68%	67%	67%	66%	65%	65%	64%	64%	63%	63%	62%
120m	79%	79%	78%	77%	77%	76%	76%	75%	74%	74%	73%	73%	72%	72%	71%	70%	70%	69%	69%	68%	68%	67%	67%	66%	66%	65%	65%

Note: * To take next higher width when actual width exceeds that of the table. Interpolation of the figures is not permitted.

+ To take the lower distance from table when actual distance exceeds that of the table. Interpolation of the figures is not permitted





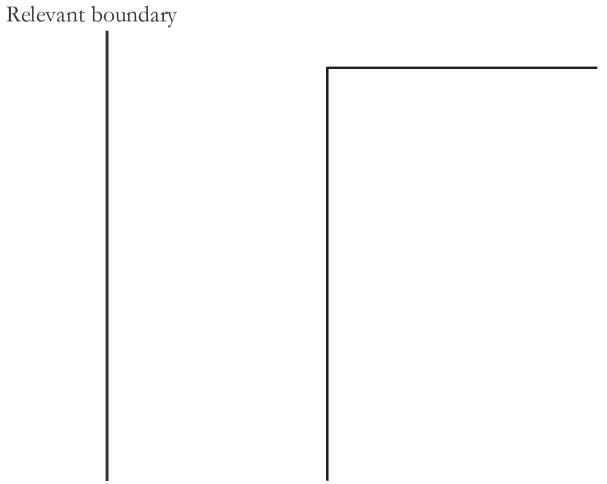


TABLE IV TO PART I OF APPENDIX 'B' TO CL.3.5

Percentage of the width of the unprotected openings upon their projection on the plane of reference (in view of the angle of openings with respect to the plane of reference)

Angle of unprotected opening to reference plane*	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
Actual percentage of unprotected opening width on reference plane	96%	91%	87%	83%	78%	74%	70%	66%	62%	58%	54%	50%	46%	43%	39%	36%	32%	29%

Note: *: To take the smaller angle from table when actual angle exceeds that of the table. Interpolation of the angles is not permitted.