A PARTIAL COMMENTARY ON THE NATIONAL BUILDING CODE

VANUATU

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FOREWORD

We had attempted to keep the language and style of the recently completed National Building Code reasonably simple. However we had to remain conscious of the fact that the Code will be called up in legislation as the primary document for building control. This placed some constraints on the language that we could use. A need has therefore arisen for an explanation of the complex provisions of the Code. The Commentary is aimed at satisfying this need to a large extent. The Commentary does not cover the Performance Requirements. These requirements have been couched in terms which would allow suitable flexibility. Any attempt at commenting on any of the Performance Requirements is likely to limit their generality. The Commentary therefore covers only the more difficult clauses of the Deemed-to-Satisfy provisions of the Code.

The time that was available to us to work on the Commentary was unrealistically short. Therefore only those clauses have been commented upon which in our view are the more difficult to understand. We have used plenty of diagrams to illustrate the various situations covered by these clauses.

The Commentary is just a set of comments on the provisions of the Code. The diagrams used are only illustrative examples and not definitive solutions to cover all circumstances. The Code alone is the authoritative document for the purposes of building control. Inspite of these limitations the Commentary should help users to find their way through the Code.

When working on the Commentary we noticed some errors in the Code. We have shown these errors and corrections in an Appendix to the Commentary so that it will help Code Administrators to issue formal advise of the corrections.

We have used several of the diagrams employed in the commentary on the Building Code of Australia as a guide to produce our diagrams. We are very thankful for this to the Australian Uniform Building Regulations Co-ordinating Council (AUBRCC) and the staff at the Division of Building, Construction and Engineering of the CSIRO, Australia. In particular I thank Hugh Knox, Manager, Regulations, Accreditations and Standards at the National Building Technology Centre, Sydney who has helped me through our discussions on several of the topics covered. Vishwa Goundar an artist in Suva, Fiji produced the diagrams for the Commentary. He has also produced the cover design. I thank him for his contribution. I am thankful to the Project staff, especially to Sashi Lata Pal, for their dedication in completing the Commentary in a very short time.

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Pacific Building Standards Project

Suva : December 1990

SECTION A GENERAL PROVISIONS

PART A1 INTERPRETATION

A1.1 Definitions

The definitions given in the Code are intended to give very specific meanings to the words and phrases used in the Code. Such meanings could be different from dictionary meanings and meanings in the Australian, New Zealand and other Standards called up in the Code. However for the purpose of the Code the defined meanings will have priority over all other meanings.

Charged Dry Riser Main System : Dry risers were traditionally left unfilled except when used for fire fighting. Keeping the dry *riser main* charged will accomplish the following:

(i) When the firemen attend to a fire in the building they can be confident that none of the valves in the system had been left open. With the system charged permanently any open valve will leak and alert the building maintenance staff.

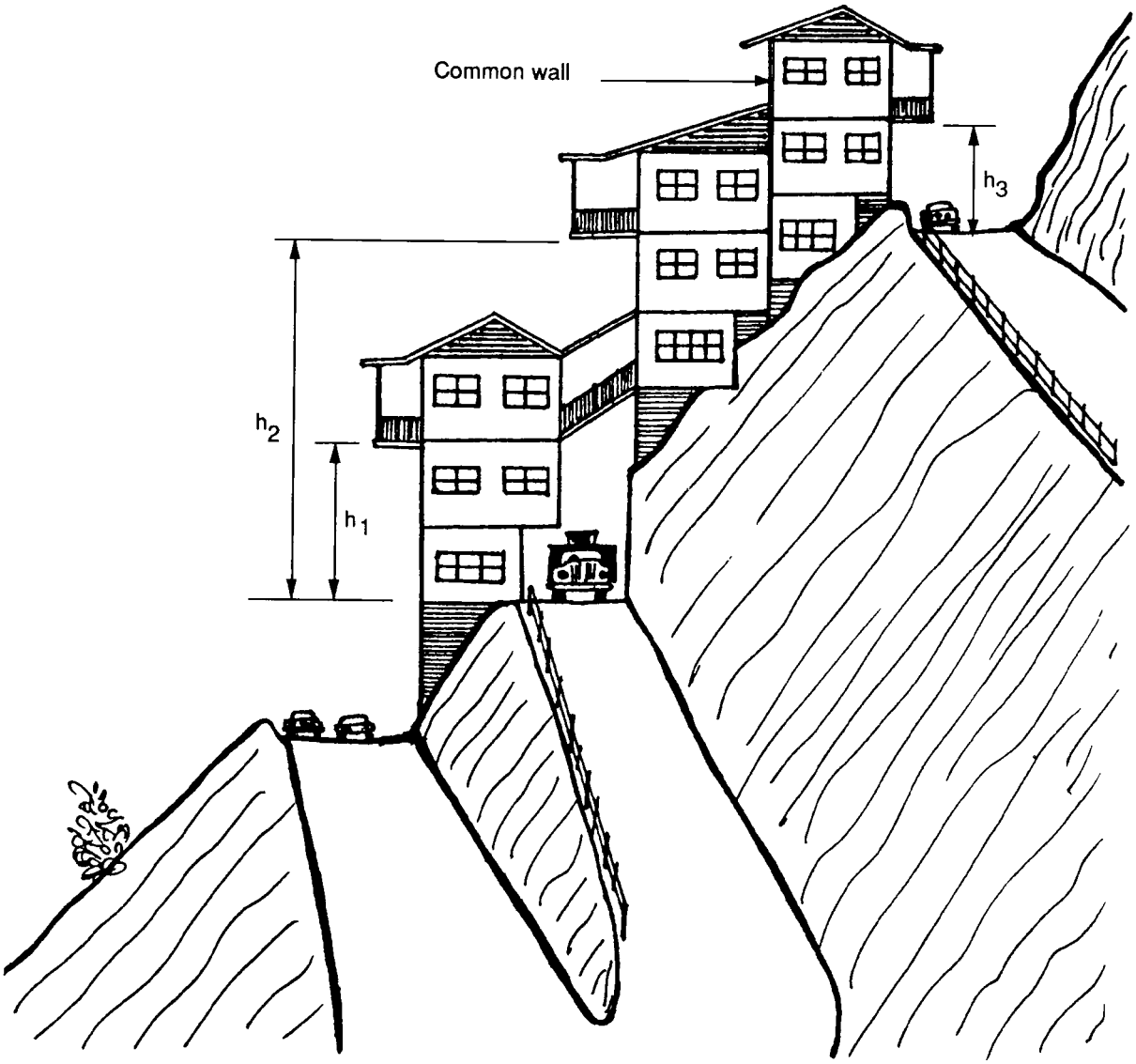
(ii) The greater confidence of the fire fighters and the quicker response of the system will cut the time lost during the initial crucial period of fighting the fire.

Combustible : All materials are *combustible* under appropriate conditions. For the purpose of the Code a material is deemed to be *combustible* if it fails to pass the requirements of AS 1530.1.

Effective Height : The *effective height* is an important measure in terms of the reach of fire fighting equipment. The safer practice will be to consider *effective height* from the lowest entrance level of a building by the side of which it is possible to station a fire engine. The definition however asks to measure *effective height* from the highest *storey* providing egress to a road or *open space*. The marginal reduction in safety is compensated by reduced cost. Measurement of *effective height* is illustrated in Sketch A1.1(i).

When there are a series of buildings which are connected together by passageways and/or *common walls* such as on a sloping ground so that the whole complex forms a single building for the purpose of the Code, it will be inappropriate to measure *effective height* for the whole building from the highest *storey* with egress to a road or *open space*. In such a case the *effective height* of each segment of the building is determined as if it were a separate building and the maximum value of the *effective height* of the different segments treated as the *effective height* for the whole building. This is illustrated in Sketch A1.1(ii).

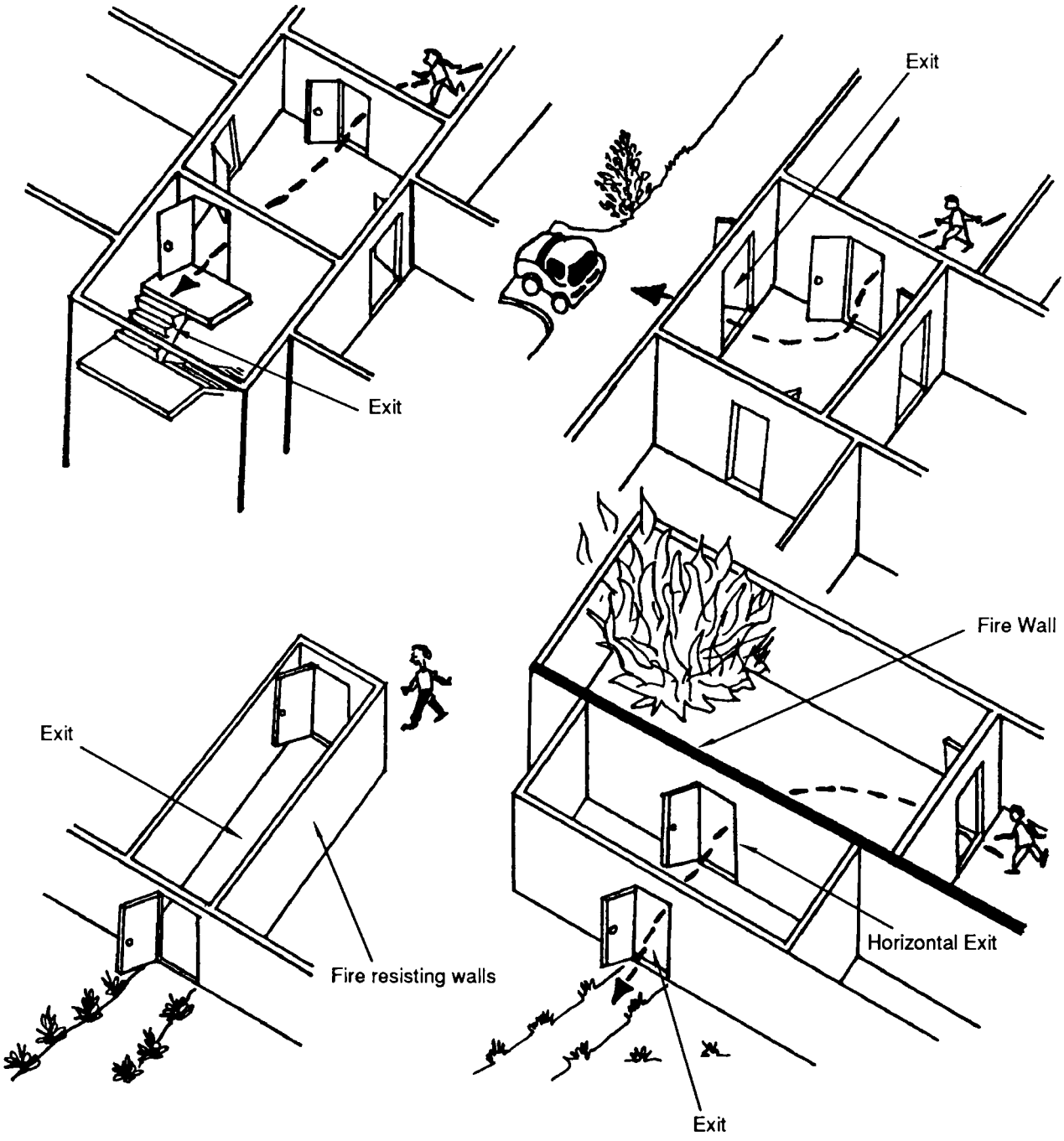
Sketch A1.1(i) Measurement of Effective Height



Effective height is the maximum of h_1, h_2 and h_3

Sketch A1.1(ii) Measurement of Effective Height of Stepped or Terraced Buildings

Exit : *Exits* as defined in the Code have the specific purpose of allowing a fast and safe egress in case of any emergency. The term has a range of meanings. A doorway for instance is an *exit* only when it directly opens to a roadway or *open space* unless it is a *horizontal exit.* Some of the different types of *exit* given in the definition are illustrated in Figure A1.1(iii).



Sketch A1.1(iii) Examples of Exits

Fire Compartment: Parts of a building can be separated from other parts by construction which will prevent the passage of fire and smoke from one part to another. Each such part is then known as a *fire compartment*. There is no requirement in the definition that a *fire compartment* should be protected from the spread of fire and smoke from other adjoining buildings. However there are other requirements in the Code which provide for this suitably.

The fire load in a compartment is generally proportional to its *floor area*/volume. Therefore limiting the *floor area*/volume of a *fire compartment* limits the severity and duration of a fire originating in it. Compartmentation protects the occupants from any fire outside the compartment. It also prevents the spread of fire from any compartment where it originated.

Where the fire service is not adequately equipped and manned or where sprinklers are not commonly used or where other such active means of fire protection are of limited availability, limiting the *floor area*/volume of *fire compartments* is an effective means of securing safety against fire.

Fire-resistance Level: The fire-resistance of any building element is expressed in terms of three criteria. These are:

Structural Adequacy - the element must have sufficient structural strength to continue to bear the loads for which it is designed for a sufficient time after it has been affected by fire.

Integrity - it must be capable of withstanding the effects of the fire for a sufficient time without changing shape or warping or undergoing any cracking, any of which might allow flames and smoke to pass through the element.

Insulation - it must be capable of limiting any rise in temperature from the fire side to the safe side to a prescribed value.

These are all determined by the standard fire resistance test in accordance with AS 1530.4 The results are expressed in minutes of duration over which the building element is capable of fulfilling the criteria. These are always expressed in the order of *structural adequacy* followed by *integrity* and then by the time for which it has sustained its insulating capability. Usually the times are expressed in multiples of 30 minutes.

An example of the *fire-resistance level* (FRL) of a wall is 90/60/30 which means that it will continue to bear the load for a period of 90 minutes after a fire of severity equivalent to the test fire, to be free from producing any cracking or warping for a period of 60 minutes and prevent any rise in temperature on the non-fire side by more than a prescribed level, for 30 minutes. If the wall is non-*loadbearing* and is only a *fire resisting* partition the very first figure in the value of the FRL would show a blank. In the example taken it would be -/60/30. In the case of a column the FRL will be relevant only for *structural adequacy*. The column by itself cannot prevent the passage of any smoke or flames nor can it prevent any rise in temperature around it. Therefore an example for a column would be 60/-/-. In the case of a fire door it will have no *loadbearing* capability and therefore its FRL will be expressed with the first value shown as a blank. An example would be -/60/30. If the door in this example is incapable of limiting the rise in temperature from one side to the other its FRL would be -/60/-.

Fire-source Feature: This is equivalent to an imaginary burning building. The Code allows buildings to be erected up to the allotment boundary, provided the stated requirements are fulfilled. If such a building were to catch fire it could endanger buildings in the neighbouring allotment through tongues of flame, flying brand, convection and radiant heat. Therefore the definition uses the appropriate land boundaries and the *external walls* of buildings within the allotment as *fire-source features*. The *external walls* of a Class 10 building is not considered to constitute any material danger.

Flammability Index: This is determined on the basis of AS 1530.2. It is a composite index that consists of

(a) the speed with which the material will catch fire,

(b) the heat produced as a result of burning and

(c) the extent to which the burning will spread within a given time.

The higher the *flammability index* the more the risk. The values range from 0 to 100.

The test is suitable only for sheet and woven materials which are reasonably pliable such as carpets and wall coverings and which do not readily melt or shrink away from an igniting flame.

Horizontal Exit: This has already been illustrated while commenting on *exit* . It must be remembered that a *horizontal exit* is not any door but one which is located in a *fire wall* that is *required* under the Code.

Non-combustible : This definition has been given separately for materials and for parts of a building or a construction.

In the case of any material it should not be *combustible* as explained in the definition of that term. However it can have thin finishes such as paint or wall paper with a thickness of no more than 1 mm. The *spread-of-flame index* should not exceed zero (see commentary on *spread-of-flame Index*). When the term is applied to construction or a part of a building, the construction or part must have *non-combustible* material on all exposed faces. The definition further gives a list of specific materials which are considered to be *non-combustible*.

Professional Consultant: The definition clearly specifies that the consultant must have appropriate experience in the relevant field. The consultant must either be registered under some existing legislation or must be a full member of a recognised Professional Institution or Association.

Site: The definition as given might give the impression that it is only that part of an allotment covered by the outline of the building. Such was not the intention when the term was defined. The term also includes the land in the vicinity of the building which is required to carry out its erection, continued use and demolition. There was

however no intention to treat the whole of very large allotments as *site*.

Smoke-Developed Index: This is an index which forms part of the early fire hazard properties of materials as tested under AS 1530.3 and relates to the optical density of the smoke produced under test conditions. The index ranges from 0 to10; the higher the value of the index, the greater the risk from smoke in case of fire. The thickness of the material as well as the weight-to-surface area ratio can affect the amount of smoke produced. Where fire retardants are used the amount of smoke produced will increase in the case of timber and cellulosic materials whereas with plastics, they would reduce the smoke produced.

Spread-of-Flame Index: This is also an index measure when a material is tested under AS 1530.3 and relates to the rate of release of heat by a burning material under test conditions of radiant heat. It is applicable to wall lining material. The range of index is from 0 to10. An index of 10 means that flames can spread through the wall lining to a ceiling at a height of 2.7 m within 10 seconds under standard conditions whereas an index of zero means that flames do not reach the ceiling within 4.5 minutes of test ignition. The use of fire retardants can substantially reduce the *spread of flame index*.

Window: The Code definition includes not only windows as are normally understood but also glazed doors, glass brick walls etc. which can transmit natural light from outside a building into a room when in the closed position.

A1.2 Adoption of Standards and other References

The building Code is a document containing only technical requirements. Matters which form contractual responsibilities should not therefore find any mention in the Code. It is for this reason that this clause specifically excludes any reference in the Australian and New Zealand Standards or other called-up documents, which deal with any matters of a contractual nature.

A1.3 Rereferenced Standards, etc.

All the Standards such as from Australia and New Zealand which are called-up in the Code refer to the latest edition of such Standards. These Standards are periodically revised by the organisations in the countries concerned. Code administrators should keep aware of changes to such Standards so that if any incompatibility arises as a result of a revision to a Standard an appropriate amendment to the Code is issued to exclude the effects of any such incompatibility.

A1.5 Mandatory Provisions

It is important to remember that the mandatory provisions of the Code are only the provisions of Section A and the Performance Requirements stated at the beginning of all other Sections. This in theory would allow a wide latitude for the designers/builders. Code administrators will find it very difficult to handle such a wide diversity of possibilities because of the very limited technical resources available to them to ensure that the mandatory provisions are fully met. This is why sub-section (b) of this clause demands that when designers/builders adopt the flexibility of using the Performance Requirements they are obliged to ensure that the final objectives and performance achieved are no less than what they could have achieved had they followed the deemed-to-satisfy provisions of the Code.

In the case of most normal buildings the trouble and expense of proving that any performance route adopted can achieve not less than the objectives and performance of the deemed-to-satisfy provisions, will discourage the use of this route. However such trouble and expense can be justified in the case of complex/large buildings by the overall savings possible.

Code administrators must remember that it is the objectives and performance attainable by the use of the deemed-to-satisfy provisions that are to be compared with what is proved to be achievable by the performance route. The details of the deemed-to-satisfy provisions are not relevant for such comparison and judgement. The onus of producing the proof for such comparison rests with whoever applies for the building permit.

PART A2 ACCEPTANCE OF DESIGN AND CONSTRUCTION

A2.2 Evidence of Suitability

This clause does not specifically require any legislation to support accreditation of building products. However if appropriate legislation were introduced and an appropriate administrative machinery set up it will allow for the easy acceptance of suitable products throughout the country without the need for satisfying each Approving Authority separately.

A2.3 Fire Resistance of Building Elements

See commentay on Specification A2.3.

A2.4 Early Fire Hazard Indices

See commentary on Specification A2.4.

PART A3 CLASSIFICATION OF BUILDINGS AND STRUCTURES

A3.1 Principles of Classification

The purpose for which a building is designed, constructed or adapted, legally determines the use to which the building can be put. Such use governs the risks associated with the building for its users and the public. This is the reason for the particular manner in which buildings have been classified in the Code.

A3.2 Classifications

Class 1 Buildings This is a classification which essentially deals with a single dwelling house or very simple forms of multiple dwellings. The different sub-classifications given are :

(a) a single house in its allotment;

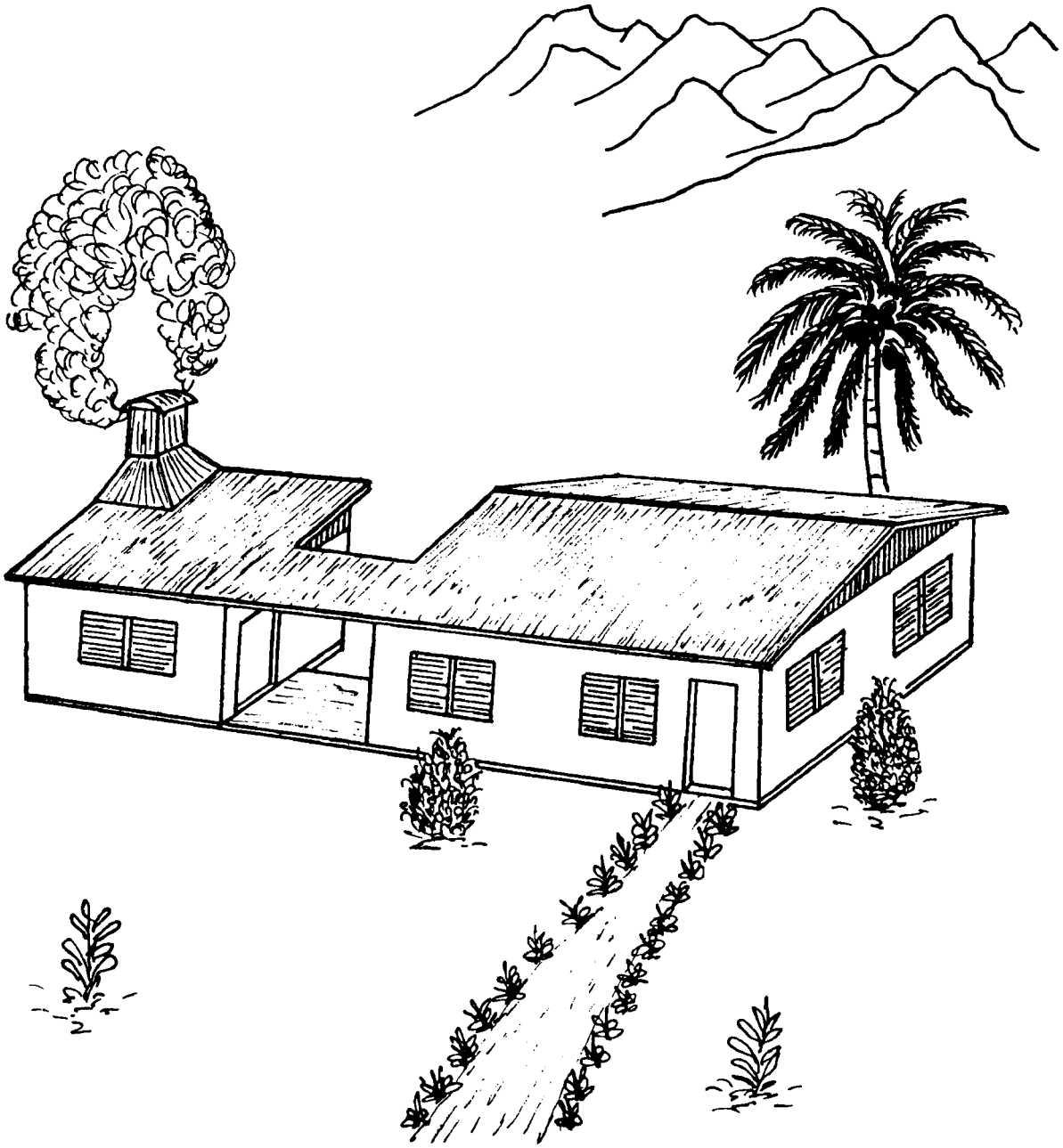
(b) two terrace houses or town houses separated by a *common wall* or a single houe or terrace house on its own. This sub-classification can easily form part of sub-classification (d) except that in the case of sub-classification (b) there is no limitation on the number of *storeys*;

(c) a large house some rooms of which are rented out to transient residents. This sub-classification would normally have belonged to Class 3. However by including it in Class 1 some concessions have been given. It will allow the operation of low tariff guest houses with the attendant advantages to the less affluent users. By limiting the total number of residents to 12 (including any permanent residents such as the owner's family) the overall risk to life and health is kept under check.

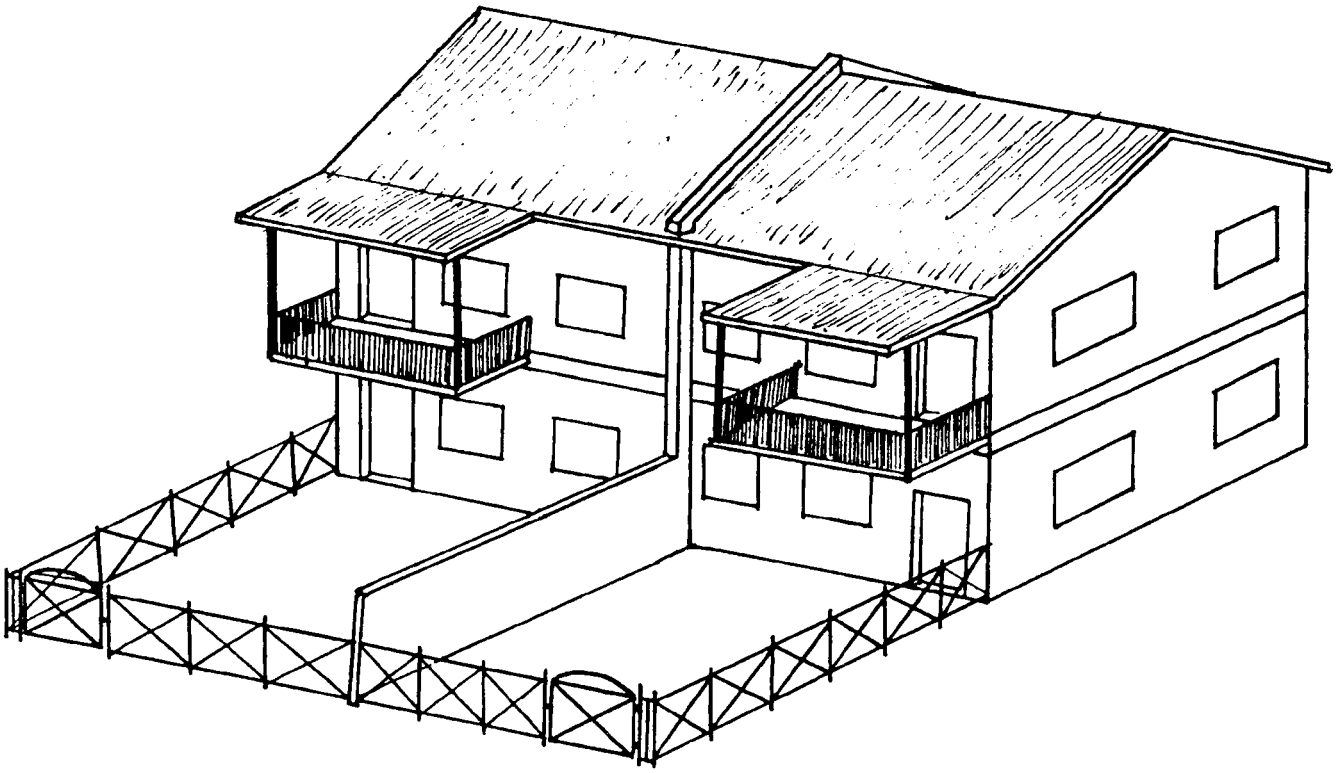
(d) This sub-classification limits the total number of *storeys* to 3 and is further subdivided into two. The first one is where there can be a number of *sole-occupancy units* separated by *common walls*. The second division allows for a building in which there are a total of only 2 *sole-occupancy units* located one above the other. In the case of sub-classification (d) each *sole-occupancy unit* must have its own direct egress to a road or *open space* without having to go through another *sole-occupancy unit*.

Examples of the sub-classfications (a) (b) and (d) are shown in the attached sketches.

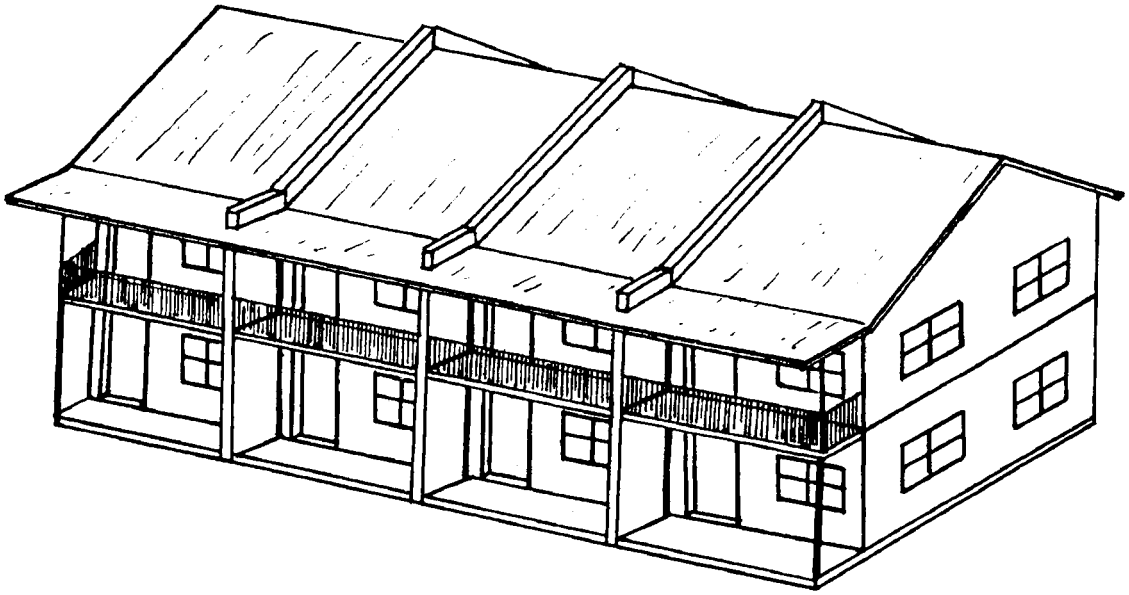
Class 8 This class includes laboratories, workshops, factories and such like. However a pathology laboratory in a *health-care building* and a trade workshop in a primary or secondary *school* are parts of Class 9 a and 9b respectively and do not form part of Class 8.



Sketch A3.2(a) Example of a Class 1 Building - A Single Dwelling with a Detached Kitchen

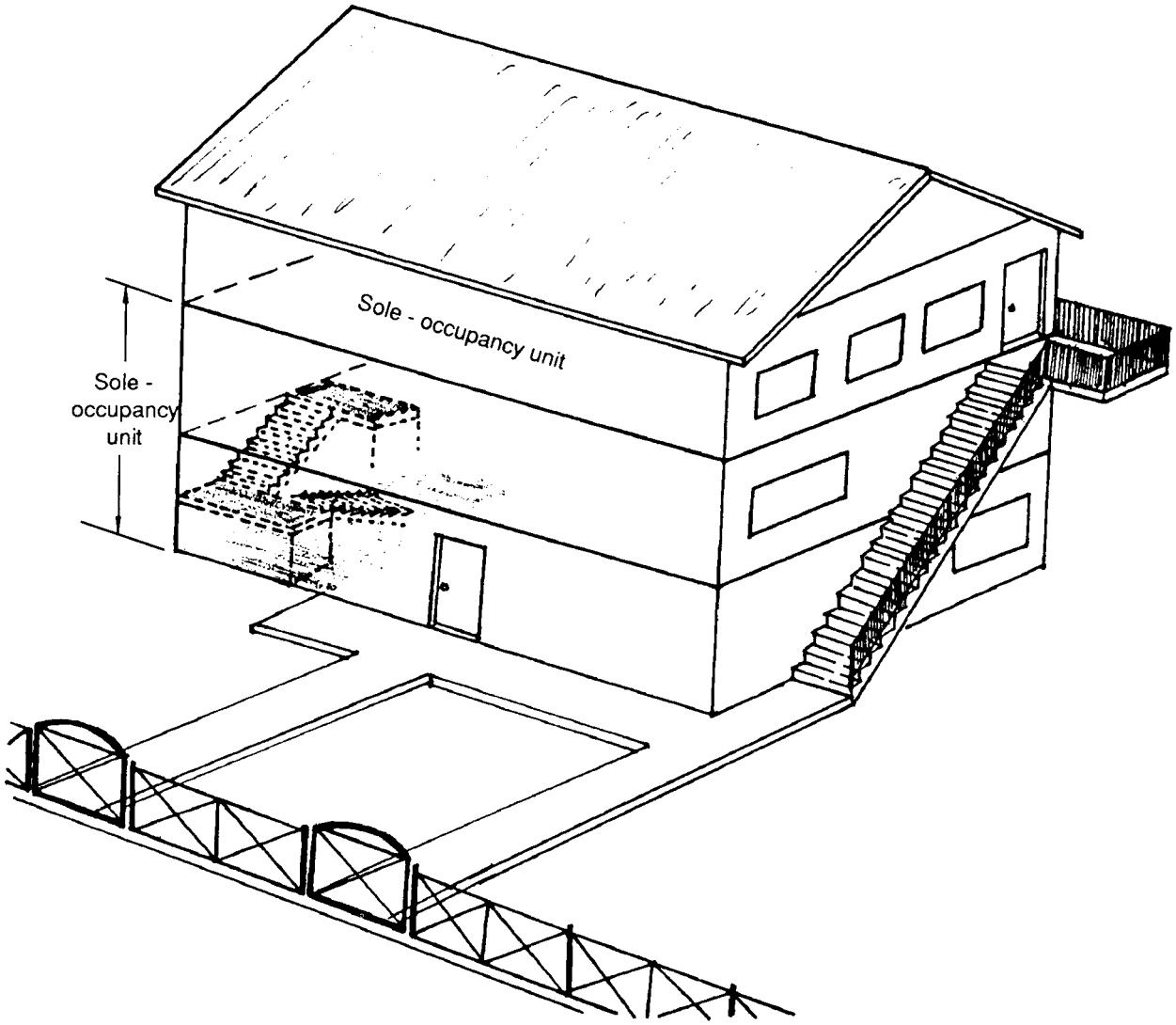


Sketch A3.2(b) Example of a Class 1 Building - Two Townhouses Separated by a Common Wall



Note : Each unit must have an independent egress to a road or open space

Sketch A3.2 (d) (i) Example of a Class 1 Building - A Number of Sole-Occupancy Units Separated by Common Walls



Sketch A3.2 (d) (ii) Example of a Class 1 Building - Two Sole-Occupancy Units Each With Independent Direct Egress to a Road or Open Space

A3.3 Multiple Classification

Quite often separate parts of a *storey* are put to different uses and therefore each part will need to be classified separately. In such a case it is necessary to have the part pertaining to each Class to fully comply with the detailed requirements for that Class. However there may be cases where only a very small part of the *storey* is put to a use different from that of the major part. In order to consider such cases the following two questions must be asked :

(i) does at least 90% of the *storey* pertain to one Class by virtue of the use to which it is put?

(ii) Is the remaining part used for purposes other than a laboratory?

If the answers to both the questions are "yes" then the whole *storey* may be classified as appropriate for the major purpose.

PART A4 UNITED BUILDINGS

A4.1 When Buildings are United

Some building owners may find it advantageous to have two or more adjoining buildings interconnected through openings in the dividing walls between them. In such a case it is allowable to treat the interconnected buildings as a single building. The dividing walls can be treated as *internal walls* and if any of these walls are on a boundary they are not treated as *fire-source features*. The requirements for openings in *external walls* will not apply (whereas other requirements for separation etc. might apply).

Treating the interconnected buildings as a single building will also mean that the *floor areas* will increase. If the *internal walls* have to be *fire-resisting* the openings in such walls will also need to be protected with fire doors etc. as required in Part NC3.

A4.2 Alterations in a United Building

The distinction between the meanings of *alteration* and *repair* as given in the definition at Part A1 of the Code must be clearly understood. If any *alteration* is done in a united building the altered building and parts must comply with the requirements of the Code. For instance if a dividing wall is on a boundary and the interconnecting opening in it is walled-up the boundary will become a *fire-source feature*.

Specification A1.3 Standards Adopted by Reference

The Code calls up either Australian or New Zealand Standards as *required*. In a few instances it calls up either one or the other. Where only the Australian Standards or the New Zealand Standards have been called up, Code users are allowed to make use of the equivalent New Zealand or Australian Standard. However when this is done it is necessary to ensure technical consistency. While adopting AS 1170 Part 2, the New Zealand Standard NZS 4203 deletes the requirements for cyclone effects. Therefore NZS 4203 Part 4 is not appropriate for use with this Code. The other parts (1, 2 & 3) of NZS 4203 are appropriate. It should be noted that the Standards Association of Australia and of New Zealand have decided to progressively modify their individual Standards to common Standards applicable to both countries. In a few short years the majority of important Standards will be common for both countries.

Specification A2.3 Fire Resistance of Building Elements

This Specification gives the *fire-resisting* properties of some of the building elements listed in it. It permits the calculation of the FRL of building elements based on the results of tests on prototypes. It must be remembered that any fire engineering calculations must be performed by a *Professional Consultant*.

Specification A2.4 Early Fire Hazard for Assemblies

These tests are done to comply with AS 1530.3. They apply to wall lining materials. The tests are based on a progressive increase in intensity of radiant heat which simulates what could reasonably happen during the early development of a fire. The early fire hazard indices are as follows:

1 Ignitability Index,

2 *Spread-of-Flame Index*,

3 Heat Evolved Index, and

4 *Smoke-Developed Index*

The *spread-of-flame index* and *smoke-developed index* have already been explained while commenting on the definition of these two terms in Part A1. The ignitability index relates to the time taken under standard test conditions when the volatile products from the material can easily be ignited by a small flame. The index is zero if ignition does not take place under the conditions. The maximum value of the index is 20 which indicates quick ignitability.

The heat evolved index relates to the amount of heat released by a burning material. The index ranges from 0 to10 and the higher the index the more the heat released and the involvement of the material in setting fire to other *combustible* materials nearby. The heat evolved index can be affected by the thickness of the material and its weight-to-surface ratio. Where fire retardants are effectively applied to materials the heat evolved index can be reduced.

SECTION B STRUCTURE

This section of the Code takes up only a few pages although the structural performance of buildings is extremely important to ensure the safety of the users and the public. This is because structural engineering is a highly developed technology as compared for instance to fire engineering. This allows the structural requirements of the Code to be principally listed in terms of appropriate structural Standards for design and materials.

B1.1 General Requirements

This clause demands provision against progressive collapse. This is mentioned because a relatively minor failure in a part of a structure can initiate a sequential set of failures in adjoining parts. The total damage would be substantial. Such progressive collapse has occurred in prefabricated structures. In such structures care must be taken to design, fabricate and erect adequate connections to take care of all likely forces. The tolerances specified in the design must not be exceeded in fabrication and erection.

Other precautions against progressive collapse include:

1 Designs that take into account severe local effects such as from explosion and the impact of vehicles, and

2 Design elements such that the failure of a critical element does not lead to the failure of the whole structure although other elements in it might be over stressed until remedial action is taken.

B1.4 Human Impact Against Glazing

The information on the design loads and the structural properties of glass is still at an evolutionary state. The details provided in the Code are based on the up-to-date information now available. It is necessary to monitor progress made in this area in the next few years and take account of more reliable information as and when it becomes available.

Statistics in countries around the world indicate that the majority of deaths and injuries as a result of fire, takes place in small domestic incidents. However building codes around the world are in general far less stringent on fire safety requirements for single dwellings as against the requirements for multiple dwellings and commercial buildings. One possible reason is that in the case of single dwellings the responsibility for prevention of uncontrollable fire usually rests with the owner and/or the residents. Secondly individual domestic incidents although they might result in great tragedy for the family concerned, do not affect large numbers of the public as would be the case with multiple dwellings and commercial buildings.

The provisions in this Section of the Code which apply to Class 1 and Class 10 buildings reflect the trend in other countries in that they are very minimal.

PART DC1 FIRE RESISTANCE AND STABILITY

DC1.1 External Walls of Class 1 Buildings

As long as Class 1 buildings are set back from the boundary and other buildings within the allotment the specified minimum distance, there is no need to comply with any fire resistance requirements. There are further concessions for Class 1 buildings allowed under other clauses in this Part.

DC1.7 Separating Floors

This requirement in the Code to have even minimally fire rated floors separating *sole-occupancy units* does not appear as part of the requirements for Type C construction for Class 2 and other Classes. (Table 5 of Specification NC1.1). This is a contradiction. An amendment to the Code appears necessary either in adding such a requirement to Type C construction or deleting this requirement from Section DC.

In actual practice a full lining of ordinary 10 mm thick plaster board beneath a well built floor of *combustible* material will give the fire rating prescribed in this clause.

PART DD1 CONSTRUCTION OF EXITS

DD1.1 Treads and Risers

Going up or down a very large number of consecutive steps in a stairway without intermediate landings for breaking the upward/downward motion can be very tiresome. This is why the maximum number of risers in any one flight is limited to 18. The relationship between the dimensions of the goings and risers given in Table DD1.1 of the Code are based on the attached Sketch DD1.1. The sketch illustrates the safe *pitch* for ramps, stairs and ladders.

The openings between risers have been limited to 100 mm because detailed statistics have shown that any larger opening will be unsafe for small mobile children.

DD1.2 Curved Stairs

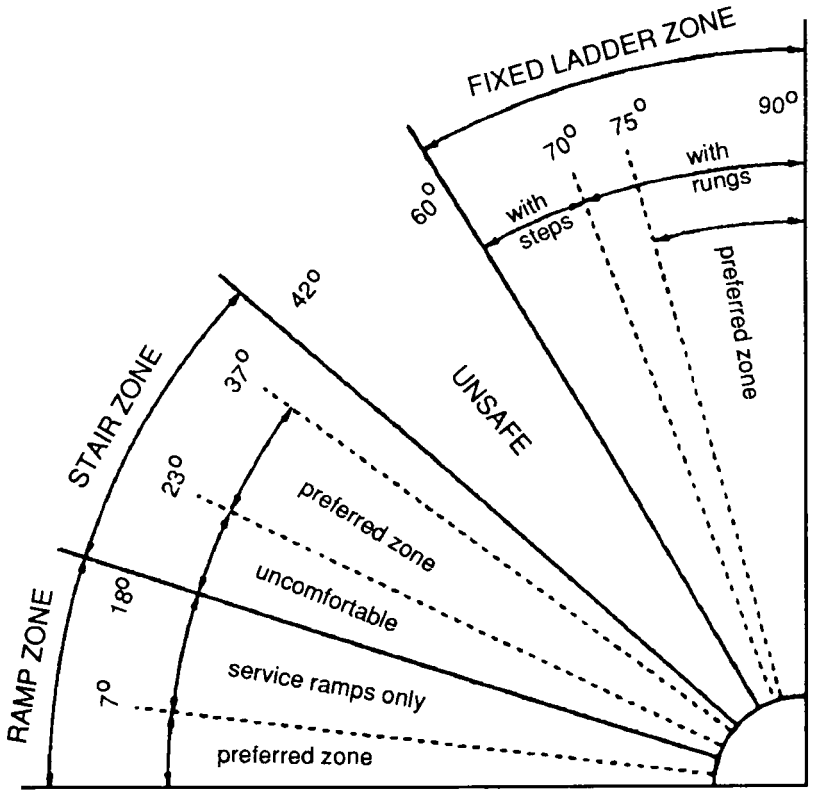
The requirements of this clause are intended to ensure the safety of the users without limiting practicality.

DD1.3 Balustrades

Once again the requirements of this clause emphasise the need for safety especially of small mobile children.

DD1.5 Number of Exits

A minimum of two *exits* has been specified. One of these *exits* can even be a *window* or a trap door. However when such unconventional *exits* are used the code specifies the minimum conditions which will ensure that they are safely usable during any emergency.



Sketch DD1.1 Recommended Pitch for Ramps, Stairs and Ladders

SECTION DE ELECTRICITY

The Australian Wiring Rules AS 3000 has been prescribed as the principal reference document for electrical safety. There is no corresponding single document published in New Zealand. In fact the New Zealand Ministry of Commerce has taken a decision to change over completely to AS 3000 and are already in the process of making this change. They are progressively issuing "Codes" to replace or add to provisions in their wiring Regulations. These "Codes" are extracts from AS3000. Sufficient time will be given by them for industry and practitioners to catch up with the total change over to AS 3000.

PART DF1 DAMP AND WEATHERPROOFING

DF1.4 Weatherproofing of Roofs and Walls

The code does not spell out any particular Standard for roof coverings. The current practice in the country is to use metal roofing, various brands of metal tiles etc. Heavier roof coverings such as clay tiles are not generally used. It is relevant to note that heavy roof coverings will increase the risk of damage during earthquakes.

Roofing manufacturers usually provide sufficient information on the correct ways of fixing their products. In addition many of them have had their products tested by recognised laboratories and have with them certificates to show the extent to which their products can withstand cyclonic wind loads. The cyclic change in forces on the roof during cyclones substantially weaken the roofing material and its immediate fasteners. The hairline cracks/ burrs produced when holes are drilled or punched in roofing sheets act as starting points for failure especially when the strength of the roofing material is substantially reduced as a result of cyclic loading. For the same reason when straps are used as fasteners, it is far better to buy them with factory punched holes.

With some fasteners such as roofing screws special cyclone washers are available. These washers help to reduce the force on the roofing material close to the fastener where the roof is structurally at its weakest.

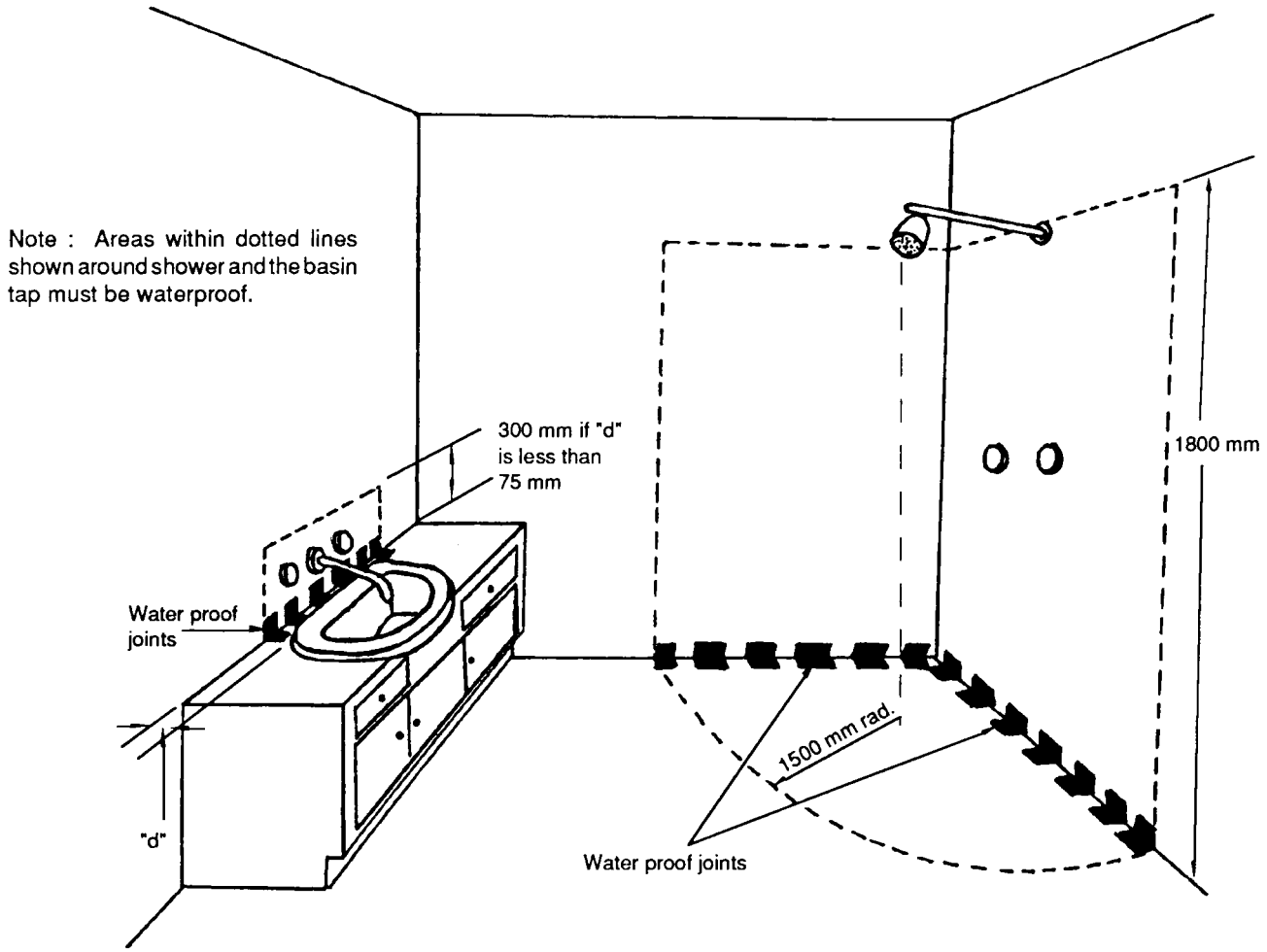
The only manufacturers known to us who manufacture such special load-spread washers for use with nails are:

Hylton Parker Fasteners
P O Box 31-401
Milford
Auckland
New Zealand

The cyclic pattern of loading during high winds also affects the fasteners in another way. If there is any slackness in the fastener (whether it be screws, nails, straps, fencing wire etc.) it would contribute to a sudden weakening of the fastener material and failure can be at much lower loads than otherwise. For this reason no slackness should be left in any fastener system used.

DF1.6 Waterproofing of Wet Areas in Building

The provisions in this clause can be improved in many innovative ways. However any variation from conventional practices might not be acceptable to approving authorities unless evidence is produced to show otherwise. AS 3740 which deals with the weatherproofing of wet areas within residential buildings gives details of construction techniques for wall/floor areas. Sketch DF1.6 shows the extent of waterproofing *required* by this clause.



Sketch DF1.6 Requirement for Water Proofing of Areas Around Showers, Basins, Sinks, etc.

PART DF2 COOKING AND SANITARY FACILITIES

DF2.1 Facilities Required

The facilities called up in this Clause are the absolute minimum that will ensure the maintenance of satisfactory health and sanitation.

PART DF3 ROOM SIZES AND HEIGHTS

DF3.2 Reduced Height Permissible

This clause permits the building of A-framed dwellings and other such designs without undue restriction.

PART DF4 LIGHT AND VENTILATION

DF4.5 Ventilation of Rooms

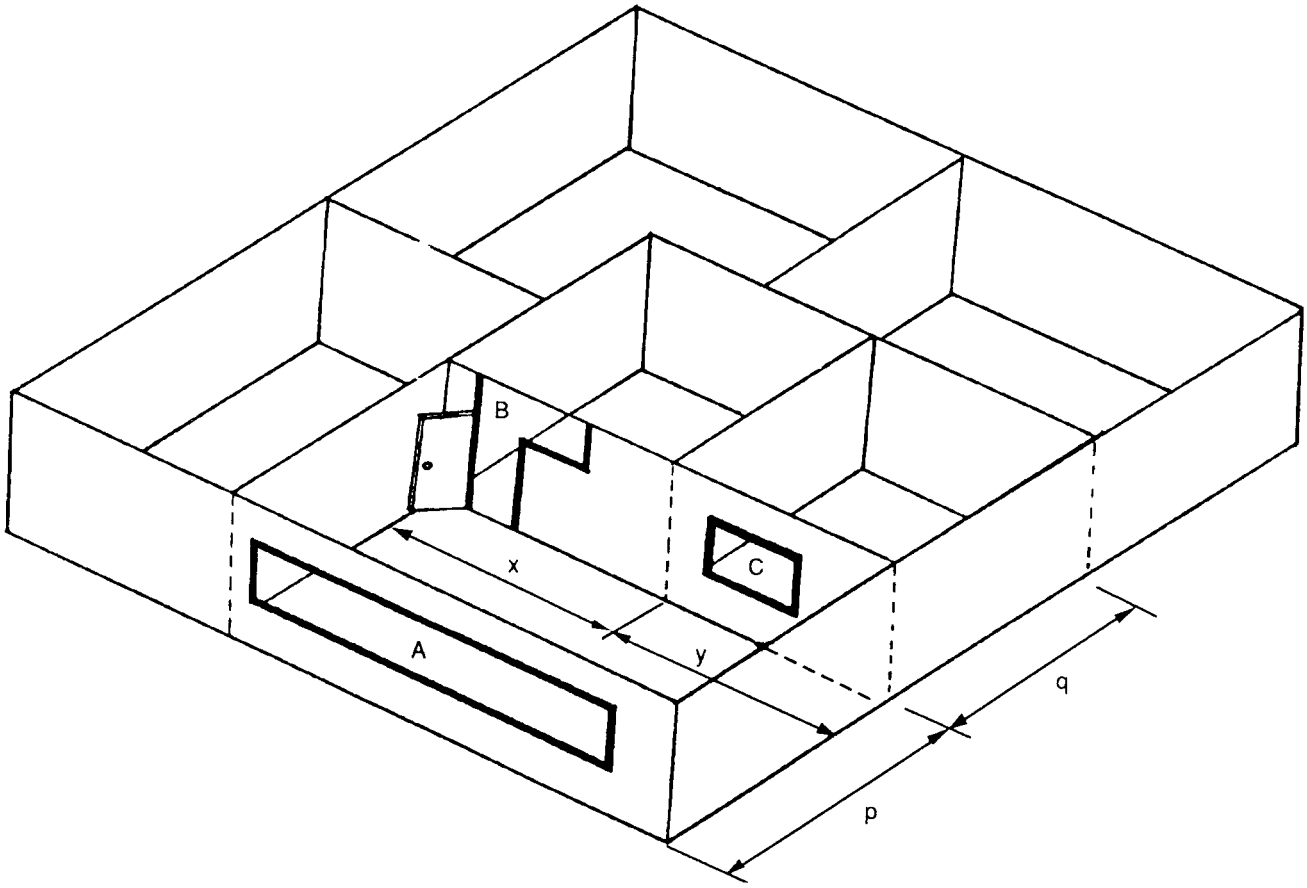
This clause *requires* natural ventilation for *habitable rooms*, *sanitary compartments* etc. However an allowance is given to provide mechanical ventilation where it is not practical to provide natural ventilation for toilets, laundries and such like. A mechanical ventilation system is *required* to comply with AS 1668.2. It is pointed out that the requirements of AS 1668.2 are quite exhaustive and compliance will only be necessary as is relevant to the particular application. For instance in the majority of the cases a suitably placed exhaust fan with the exhaust air being discharged outside the building should be sufficient.

DF4.7 Ventilation Borrowed from Adjoining Rooms

The principle of borrowing ventilation and lighting with the provision of *required* areas of openings is illustrated in the attached Sketch DF4.7.

DF4.10 Sub-floor Ventilation

The moisture that evaporates from the soil beneath a building can damage the material of the floor especially if it is of timber and create dampness and unpleasant odours. Damage can arise from rotting or attack by termites, dissolved salts penetrating into masonry supports as well as the rusting and other corrosion of metal framing components. In the case of timber flooring the clearances provided from the ground are the very minimum.



A must comply with the Code requirements for a floor area equal to $(p + q) . (x + y)$

B must comply with the Code requirements for a floor area equal to $x . q$

C must comply with the Code requirements for a floor area equal to $y . q$

Sketch DF4.7 Borrowed Lighting and Ventilation

PART DF5 WATERSUPPLY PLUMBING

DF5.3 Pipes which are not Easy to Access

There are many practical instances where watersupply pipes embedded in walls are damaged due to corrosion, heat or water hammer. If failure and leakages occur it becomes very expensive to locate the faults and repair the damage. In the mean time there will be continuing nuisance and dampness.

PART DF6 SANITARY PLUMBING AND DRAINAGE

DF6.6 Unvented Branch Drains

This clause refers to the cases where the risk of dangerous and unpleasant gases escaping into occupied premises is "minimal". The term "minimal" can lead to disputed interpretation. However the concession given is very much limited by the requirements of sub-clauses DF6.6.1 and DF6.6.2 of the Code.

The risk of escape of dangerous and unpleasant gases into occupied premises is most relevant to connections :

- from en-suite toilets/bathrooms which can affect sleeping occupants, and
- from kitchens in those cases where the dining area is not separated by walls from it.

In all other cases these risks can be taken without serious consequences. With all the limitations to the concession the number of occasions and the duration of such occasions when dangerous/unpleasant gases can escape would be quite small.

PART DF7 ROOF DRAINAGE

DF7.1 Design of Roof Gutters

The sizing of eaves gutters is much less stringent than that of external box and valley gutters. With eaves gutters the damage that is likely to be done to the building and the inconvenience to the occupants will generally be less serious than overflow from internal and valley gutters. This is why a provision has been made for the design of internal and valley gutters to *require* a capacity that is sufficient for a 100 year return rainfall intensity whereas the corresponding period for eaves gutters is only 20 years. This also explains the reason for the greater free board and greater longitudinal slope *required* for internal box gutters as compared to eaves gutters.

PART DG2 FIREPLACES, CHIMNEYS AND FLUES

DG2.2 Open Fireplaces Deemed-to-Satisfy

In the case of external kitchens the fire place meant for cooking is not intended to be covered by this clause.

SECTION NC FIRE RESISTANCE

There are two broad methods of protecting a building from fire. These are :

(a) Passive protection in which fire in any particular part of the building is contained by the use of fire resisting construction. The materials used and their disposition and layout give the building protection.

(b) Active fire protection in which suitable equipments are brought into action to prevent the spread of fire. These include sprinklers, fire hoses, the use of the fire service and so on.

This Section deals with the passive methods of fire protection.

The fire hazard to a building is determined by a combination of the use to which the building is put, the fire load in the building, its height, the openings in the building envelope, and the distance from other buildings. The intended use of a building is denoted by the system of classification given in the Code at Section A.

PART NC1 FIRE RESISTANCE AND STABILITY

NC1.1 Type of Construction Required

This clause states that all buildings of Class 2 to 9 (other than *open spectator stands* or *lightweight construction*) must be of Type A construction if of a *rise* of 5 or more *storeys*, and of Type B if of 3 or 4 *storeys rise* and to Type C if up to 2 *storeys* in *rise*.

The principle behind Type A construction is that all the structural elements of the buildings have to withstand the burn out of the contents. The difficulties of escaping from a fire from the higher *storeys* of a building have been recognised while prescribing the levels of fire protection for various building elements in the case of Type A construction. If the manner in which fire has spread prevents or delays the safe evacuation of occupants from the higher *storeys* of a building, the more stringent requirements of Type A construction can save lives by allowing the fire to be contained or to burn itself out without spreading to the higher *storeys*. Of course this will also depend on the fire load and other circumstances.

In the case of Type B construction the intention is that the external structural elements remain in place after a burn out of the contents. If the building is located at a distance of 18 m more from a *fire-source feature* the external envelope does not require any fire resistance. This reflects the fact that the likelihood of the building catching fire from an external source will be very small. The internal structural members including floors have been prescribed a lower fire resistance than for Type A construction. This should allow sufficient time for all occupants to be safely evacuated and for the safety of the fire service personnel fighting the fire. Type C construction has the least requirements. One reason is that in the case of buildings of up to 2 *storeys* it should not be too difficult for anyone to escape even from the upper *storey*, at worst sustaining light injuries.

NC1.3 Mixed Types of Construction

This clause demands that no part of a building be supported by another part of less *fire resisting* Type. It must be recognised that the support may be vertical, lateral or at any other angle.

NC1.5 Lightweight Construction

The main requirement for *lightweight construction* is the need to prevent any likelihood of mechanical damage to it. Any mechanical damage can substantially reduce the *integrity* and/or *insulation* criteria of fire resistance and thereby reduce or negate its intended purpose.

PART NC2 COMPARTMENTATION AND SEPARATION

NC2.2 General Floor Area Limitations

The size of the *fire compartment* reflects the possible fire load and therefore the severity and duration of any likely fire. The active fire fighting facilities available in the country are substantially limited. These considerations are reflected in the limitations to the maximum *floor areas* and volumes of any *fire compartment* in buildings of Class 5, 6, 7, 8 or 9b. Class 9a has more stringent requirements (clause NC2.5). In the case of Class 2, 3, and 4 buildings there is very little practical likelihood of any *fire compartment* being near in size to the maximum allowed for Class 5 to 9. Therefore it has not been felt necessary to specifically limit the *floor area* and volumes of *fire compartments* in Classes 2, 3 and 4. Besides, the requirement at Tables 3, 4 and 5 of Specification NC1.1 to have *fire resisting* walls between the *sole-occupancy units* of these Classes and of fire resisting floors in Tables 3 and 4 will ensure that the fire load in the compartments of these three Classes is sufficiently limited.

The note to the Table NC2.2 in the Code also puts a limit to *floor areas* of Class 2 and 3 buildings with a *rise* of no more than 4 *storeys* and where a *sprinkler system* with only a single water supply to Class C is installed. If these buildings are more than 4 *storeys*, they have to be of Type A construction and the requirement of Table 3 of Specification NC1.1 for *fire resisting* walls and floors will limit the dangers of any fire.

The reference in the note to the *sprinkler system* clearly takes account of the fact that a well designed *sprinkler system* can be a very effective means of controlling the spread of fire especially in the initial stages and thus saving lives.

NC2.3 Large Isolated Buildings of Class 5, 6, 7, 8 or 9b

(a) These are important concessions given in the matter of fire protection where buildings of the stated Classes and *floor area* up to 18000 m^2 are sufficiently away from other buildings when provided with *open spaces* around the perimeter, protected with a *sprinkler system* and have convenient access for fire service and other emergency vehicles.

(b) Larger than 18000 m² *floor area* is allowed for *fire compartments* where the conditions of (a) are met and suitable smoke exhaust systems are available.

(c) When buildings are closer than 6 m to each other it will be difficult to pass a fire engine between them. Also when the vehicular access is more than 45 m from the building it will not be easy to make full use of the capacity of the fire engine to fight the fire.

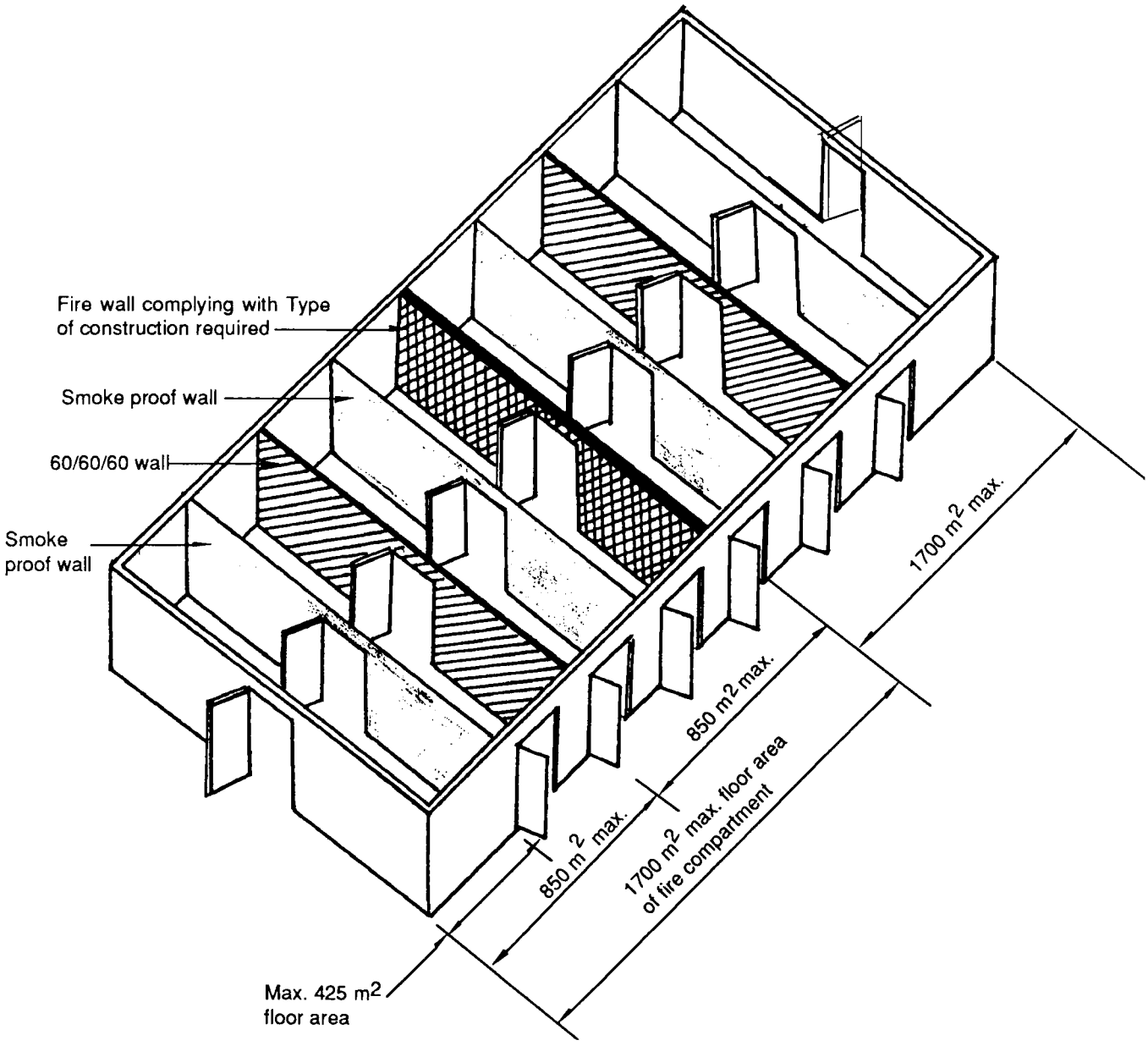
NC2.4 Requirements for Open Spaces and Vehicular Access

This clause spells out in detail the minimum requirements for *open spaces* and vehicular access which are considered necessary for gaining the concessions in clause NC2.3.

NC2.5 Class 9a Buildings

The limitations on the sizes of *fire compartments* in *health care buildings* are quite logically different from those of other Classes of buildings. These limitations are illustrated in Sketch NC2.5

There are further restrictions in the case of *health care buildings* in the matter of fire resistance *required* of the floors and ceilings. These requirements are tighter than given for other Classes for Types A, B and C construction in Tables 3, 4 and 5 of Specification NC1.1.



Sketch NC2.5 Limitations of Size of Fire Compartments in Ward Areas of Class 9a Buildings

NC2.6 Separation of Openings in External Walls

(a) Openings in *external walls* pose a danger because fires can find a way into the building through *windows* and other openings. Flames escaping from lower *storeys* find it relatively easy to pass through the openings in upper *storeys*. This clause deals with methods to reduce the risk of fire spread from lower to upper *storeys*.

Horizontal projections of at least 1350 mm are shown to be the most effective in preventing escaping flames from curving back on to the wall and entering through the openings above. Projections of this size are however not always economical and usually not very aesthetic. The 1100 mm projection required by the Code as one means of reducing risk of fire spread is a reasonable compromise.

The flames impinging on a horizontal projection from an opening tend to move along and across the projection and shoot up. This is why the horizontal projections have to extend at least 450 mm along the wall beyond the opening below.

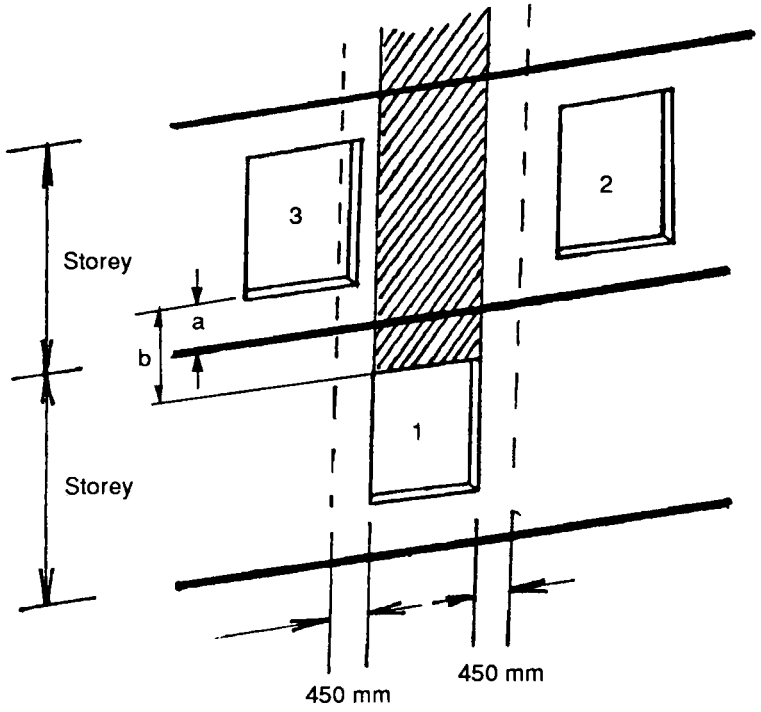
(b) Spandrel walls of at least 1100 mm between *windows* or other openings can also provide reasonable protection from the spread of fire through openings in the same building. Of the 1100 mm height of the spandrel wall at least 600 mm has to be above the intervening floor. This 600 mm also helps to protect the contents up to that height from being damaged by radiant heat from the fire plume from an opening below or from an adjacent building on fire. Spandrel walls also limit the overall area of openings in a wall thereby adding to safety.

(c) The third option available is to use fire rated glazing for the openings.

One corollary of this clause is that no protection is *required* by it for openings on the lowest *storey*. Another is that if the *windows* and other openings on consecutive *storeys* are staggered such that none are vertically above another and have an extra allowance of 450 mm on either side along the wall, no protection is *required*. This is illustrated in Sketch NC2.6(a). Sub clauses (a) and (b) are illustrated in Sketch NC2.6(b).

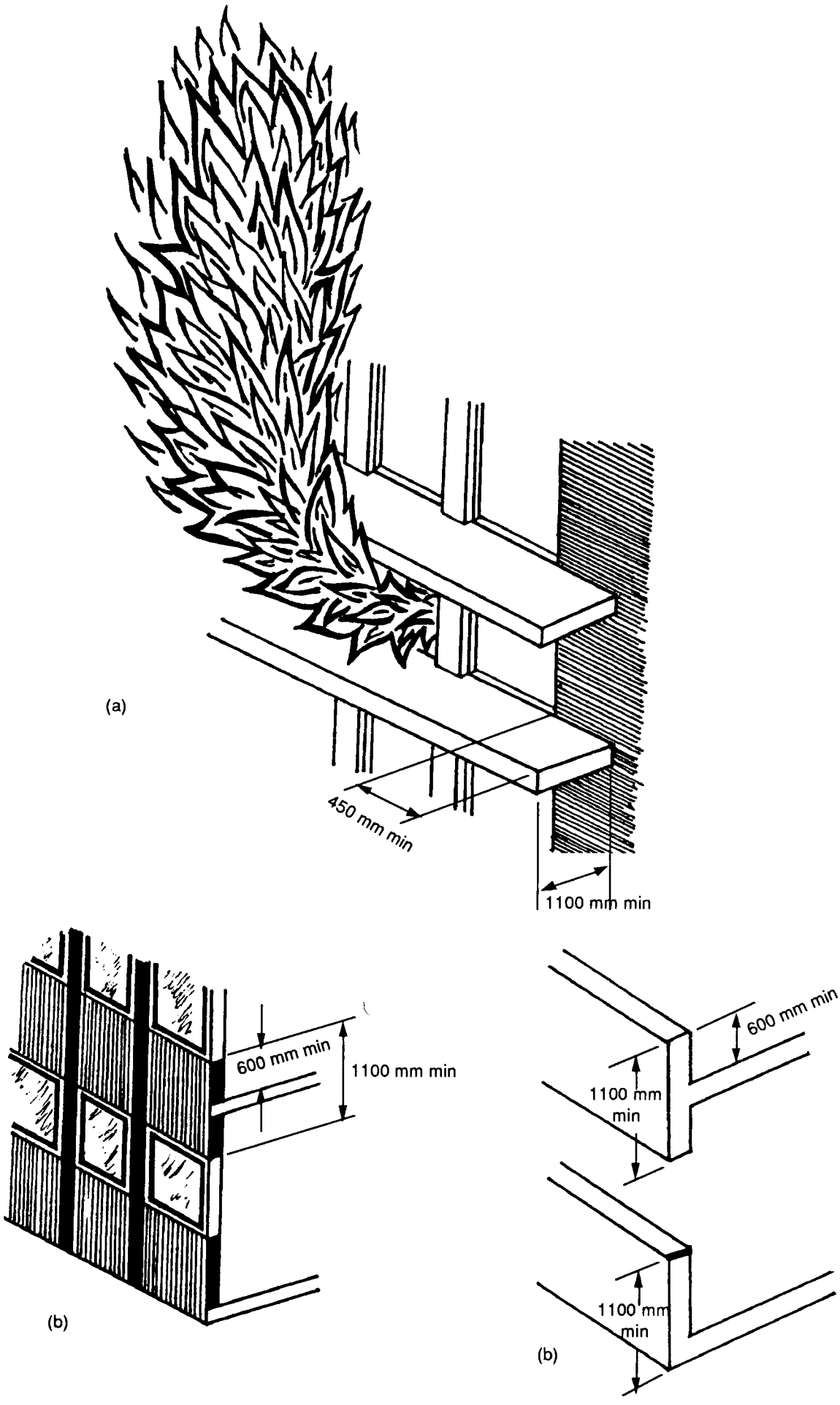
This clause also provides for the sealing of any openings and gaps between *storeys*. Disastrous fires have spread through gaps between *curtain/panel walls* and the building frame.

The clause does not apply to buildings of only 2 *storeys rise*. Therefore Type C construction is not covered by this clause.



Note : In the case of *windows* (1) and (2) no protection is required by clause NC2.6. For *windows* (1) and (3) either the dimension "a" should be a minimum of 600 mm and "b" a minimum of 1100 mm, or there should be a minimum horizontal projection of 1100 mm as shown in Sketch NC2.6(b)(a).

Sketch NC2.6(a) Protection of Openings on Walls



Sketch NC2.6(b) Protection of Openings With Horizontal Projections or Spandrel Walls

NC2.10 Separation of Lift Shafts

Lift *shafts* should have a FRL as given in Table 3, 4 or 5 of Specification NC1.1 if the *shaft* connects more than 2 *storeys* in an unsprinklered building or 3 *storeys* in a sprinklered buildings. This is to ensure that occupants in a building are not put at risk from fire and smoke spreading from one floor to another by the operation of the lift.

NC2.11 Stairways and Lifts in One Shaft

Clause ND1.3 demands that every *required exit* other than external stairways and open ramps must be fire isolated if it connects 5 or more consecutive *storeys*. In such cases if there is any lift in the building the stairway and the lift well must not be in the same *shaft*. Clause ND1.3 further *requires* that in the case of internal stairways and other such internal *exits* connecting 3 or more consecutive *storeys* they have to be smoke isolated. In such a case therefore in buildings which are up to a *rise* of 4 *storeys* there is no need to have stairway/ramps and lifts in separate *shafts*. However in such a case care must be taken to ensure that there is no chance of smoke being conveyed through the lift *shaft* by the operation of the lift. In practice this will mean that the lifts will have to be in a separate *shaft*. If the lift has to be in a *fire resisting shaft*, it will in any case need an independent *shaft* according to Clause NC2.11.

NC2.12 Separation of Equipment

This provision ensures that emergency equipment will continue to work for at least a period of one hour in case of any fire.

NC2.13 Electricity Substations

The Code provisions allow for the fact that there is always a risk of fire in electricity substations. There is also the risk of fire from outside or from another part of the building affecting substations.

PART NC3 PROTECTION OF OPENINGS

Usually in buildings the openings in walls, floors and other building elements make it more vulnerable to fire. Therefore the protection of openings and the maintenance of the closures need particular care.

NC3.1 Application of Part

This clause exempts minor openings such as control joints and small ventilation openings for subfloor ventilation. The Part applies to openings without the *required* FRL that is applicable to the building elements in which they are located.

NC3.2 Protection of Openings in External Walls

Fire can spread from one building to another through direct attack by flames, convection of heat, radiation or by flying brands. It is very impractical and uneconomical to provide the fire resistance to openings that is applicable to walls and other building elements. Therefore the more the openings, the greater the vulnerability of the building to fire.

This clause restricts the area and disposition of openings in the *external walls* of buildings.

It also details the requirements in relation to the distance from a *fire-source feature* (see commentary on the definition of *fire-source feature*). Sub-clause (a) limits the distance of a single *storey* building to 1 m and buildings of more than one *storey* to 1.5 m. This means that if there is a *window* door or other such opening in the external envelope, such an opening cannot be less than 1 m from the rear or side boundary for single *storey* buildings and 1.5 m for buildings with a *rise* of more than one *storey*.

Sub-clause (b) states that in case any opening is less than 3 m from the side or rear boundary, 6 m from the far boundary of a road adjoining the allotment or 6 m from another building on the allotment which is not Class 10, then such openings will have to be specially protected as per clause NC3.4. Sub-clause (c) further limits the total area of such openings in each *storey* to 1/3 of the area of the *external wall* of that *storey* unless the openings of the *storey* are at the ground level and face a public road or the building is an *open spectator stand*. The requirements of sub-clause (c) are illustrated in Sketch NC3.2(c).

NC3.3 Separation of Openings in Different Fire Compartments

The requirements of this clause are illustrated in Sketch NC3.3.

NC3.4 Acceptable Methods of Protection

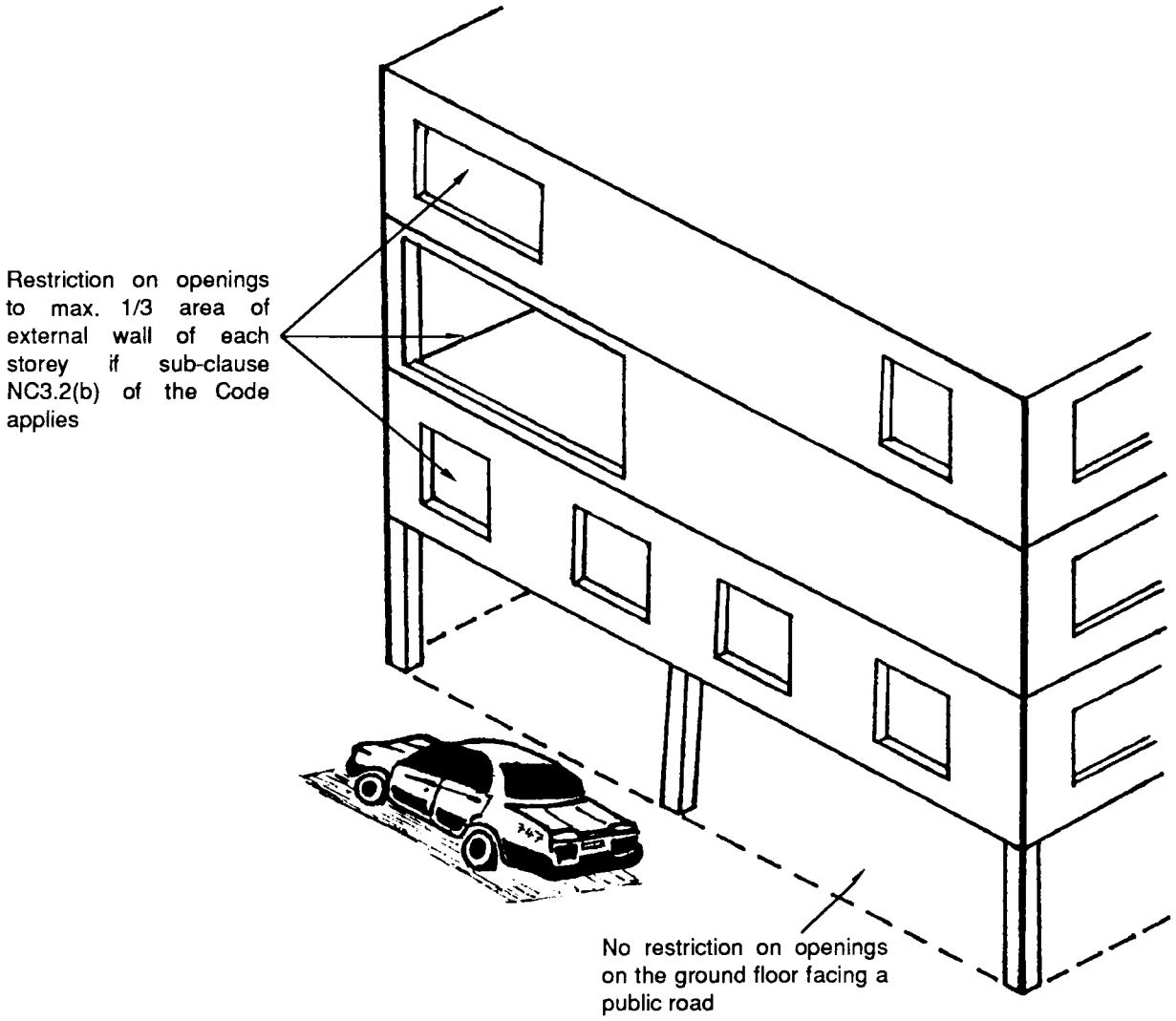
The values of FRL given in this clause for doors, *windows* and other openings are much lower than the maximum values of the FRL *required* in the case of Type A and B construction and even some of the walls to Type C construction. This reflects the practical difficulty of getting doors and *windows* with a substantially high fire rating at an economic cost. External drenchers for openings are an effective means of protecting openings; however they consume large quantities of water.

NC3.5 Doorways in Fire Walls

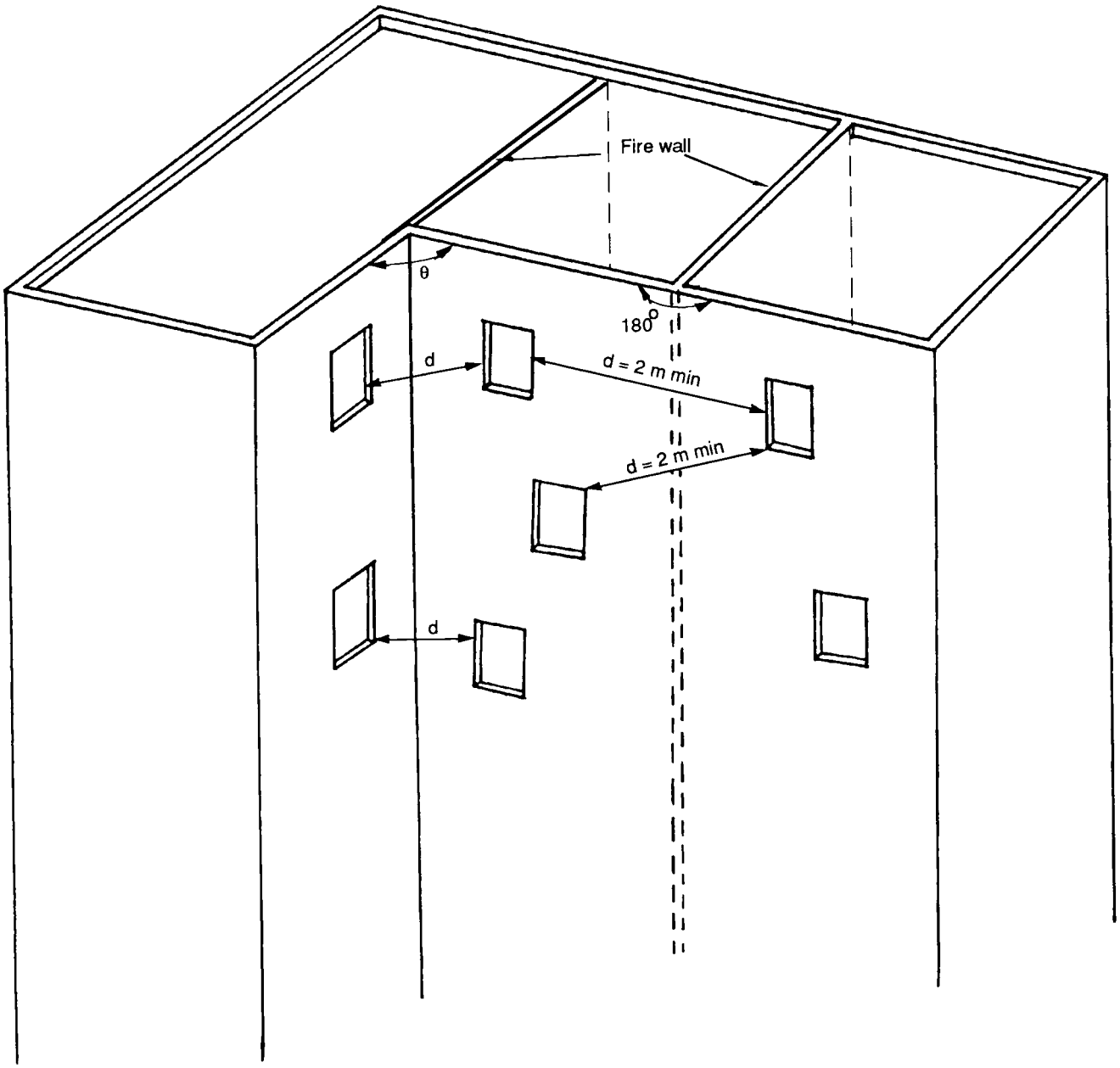
This clause *requires* that fire doors installed in *fire walls* must have the same FRL as that of the wall. A reference to the Specification NC1.1 indicates the following FRL requirements for *fire walls*.

Class of Building	Type of Construction		
	A	B	C
2, 3 or 4 Part	90/90/90	60/60/60	60/60/60
5, 6, 7, 8 or 9	120/120/120	90/90/90	60/60/60

This shows that any fire doors installed in *fire walls* must have the FRL of the fire wall corresponding to the Class and Type of building. It is very expensive to purchase and install fire doors with high ratings. Therefore a provision is made in sub-clause (a) for two fire doors or fire shutters on the same opening, each with half the FRL *required*. Apart from monetary savings this will also add to the



Sketch NC3.2(c) Limitation of Area of Openings in External Walls



The minimum values of "d" are listed in Table NC3.3 of the Code for different values of θ

Sketch NC3.3 Separation of Openings in Different Fire Compartments

insulation capability of the unit because of the air gap between the two sets of fire doors.

NC3.6 Sliding Fire Doors

A sliding fire door which is normally kept open has to allow sufficient time for any goods or people who are on the point of crossing through the door to pass through. At the same time it should close not too late after fire/smoke had been detected on either side of the door. This is why a minimum time of not less than 20 seconds and a maximum time of not more than 30 seconds are prescribed in sub-clause (a) for the *automatic* closure of the sliding door after fire/smoke has been detected. The door will still allow people to escape from the fire side to the safe side by manual opening and *automatic* closure. More sophisticated fire doors also have *automatic* mechanisms which allow it to be opened only from the fire side and not (by mistake) from the safe side.

The warning notice in sub-clause (d) alerts users to the fact that it is a sliding door and likely to automatically close in case of fire/smoke.

NC3.7 Protection of Doorways in Horizontal Exits

A look at the definition of *horizontal exit* and the commentary on it shows that this is also a doorway in a *fire wall* and therefore the requirements of this clause are complementary to those of clause NC3.5. There is a mandatory requirement in this clause for Class 7 or 8 buildings to have fire doors on each side of the doorway with half of that *required* for the *fire wall*. This is because in these Classes of buildings it is good to have as much extra *insulation* as is possible. The other requirement of this clause is that all other Classes of buildings must have a single fire door. The reason for this is that this doorway constitutes a *required exit* and it is much faster to operate a single door than two sets of doors.

NC3.8 Openings in Fire-Isolated Exits

These requirements ensure that fire isolated *exits* remain free of fire and smoke and thereby allow safe passage while escaping from fire. If it is a doorway which opens to a road or *open space* it does not have to comply with the FRL requirements of sub-clause (a). However such a doorway needs to comply with clause NC3.2.

NC3.9 Service Penetrations in Fire-Isolated Exits

Once again this clause ensures that the safety of passage through fire isolated *exits* is not compromised by any likelihood of fire and smoke entering such exits.

NC3.10 Openings in Fire-Isolated Lift Shafts

This ensures that the intentions of clause NC2.10 are not compromised.

NC3.11 Bounding Construction : Class 2, 3 and 4 Buildings

Sole occupancy units in Class 2 and 3 buildings as well as Class 4 parts are *required* to have their *common walls* with other *sole occupancy units* and bounding walls to comply with the requirements of Tables 3, 4 and 5 of Specification NC1.1. This ensures that any fire which starts in any specific *sole-occupancy unit* does not spread fire/smoke to other *sole-occupancy units* and common areas for a sufficient time to let everyone escape and for fire fighters to control the fire. It is in order to ensure this objective that this clause provides for some minimum requirements for the doorways. The actual protection level of the doorways has been kept fairly low in the Code because these Classes of buildings are residential and there is a need to keep costs down. However these doors will still provide ample time for all occupants to escape.

NC3.12 Openings in Floors for Services

This clause takes into account the greater heights of Type A and B construction as compared to Type C construction and therefore the greater risks involved from the spread of fire and smoke through openings in floors.

NC3.13 Openings in Shafts

Shafts can also operate like chimneys and thereby transport fire and smoke from floor to floor. Once again in the case of buildings of Type A or B construction which are greater in height than Type C buildings there is greater risk to the escape of occupants from fire and smoke.

NC3.14 Openings for Service Installations

This clause exempts the *external wall* and the roof from the requirement that their FRL or a *resistance to the incipient spread of fire* be maintained where services such as electrical cables, plumbing, etc. penetrate them. In the case of all other building elements any penetration must not impair the FRL or the resistance to the *incipient spread of fire*. The concessions to the *external wall* and roof are based on the following:

- in general *external walls* are sufficiently away from a *fire-source feature* that impairment to fire resistance properties at the isolated location where services penetrate them do not reduce safety in any appreciable way.

- usually for the sake of aesthetics and for prevention of rain penetraton all openings are reasonably closed to a good standard.

The concessions given in this clause will also enable residential buildings (Class 2, 3 and 4) to have an economical location of principal facilities such as toilets adjacent to the external envelope.

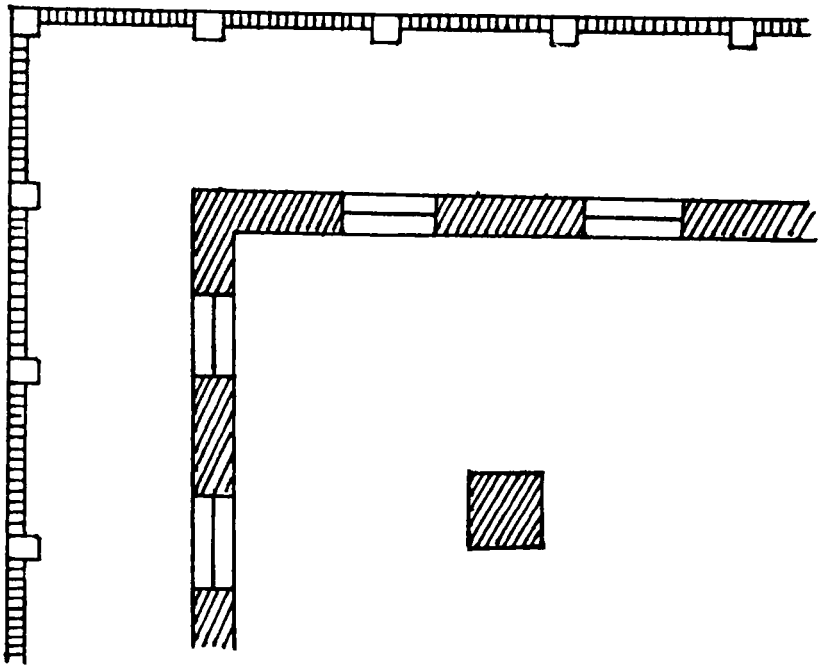
NC3.15 Installation Deemed-to-Satisfy

Sub-clauses (a) to (g) list various methods of satisfying the requirements of clause NC3.14. These measures are further amplified in Specification NC3.15. Where none of these deemed-to-satisfy provisions are applicable the designer/builder will have to produce a solution acceptable to the Approval Authority as satisfying the requirements of NC3.14.

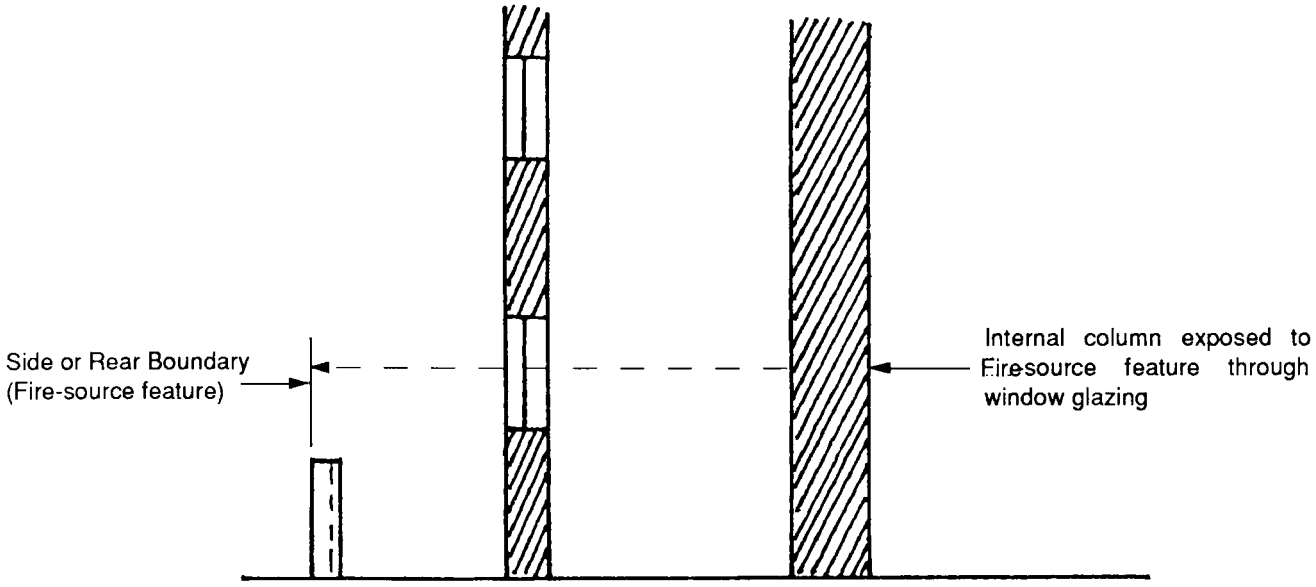
2 GENERAL REQUIREMENTS

2.1 Exposure to Fire-Source Features

The commentary explains *fire-source feature* as equivalent to an imaginary burning building. According to the Code definition this is the far boundary of a road adjoining the allotment, a side or rear boundary of the allotment, or an *external wall* of another building on the same allotment which is not of Class 10. Sub-clause (a) states that a part of the building element is exposed to a *fire-source feature* if there is no obstruction to any horizontal line between that part and the *fire-source feature* or a vertical projection of the feature. Any obstruction to be considered effective in preventing exposure must have a FRL of not less than 30/-/-. Further such obstruction must not be transparent or translucent. These are illustrated in Sketch Spec NC1.1 (i). Sub-clause (b) makes allowance for the case where different buildings are within the allotment. In such a case since the owner of the allotment has more control the requirements are relaxed.



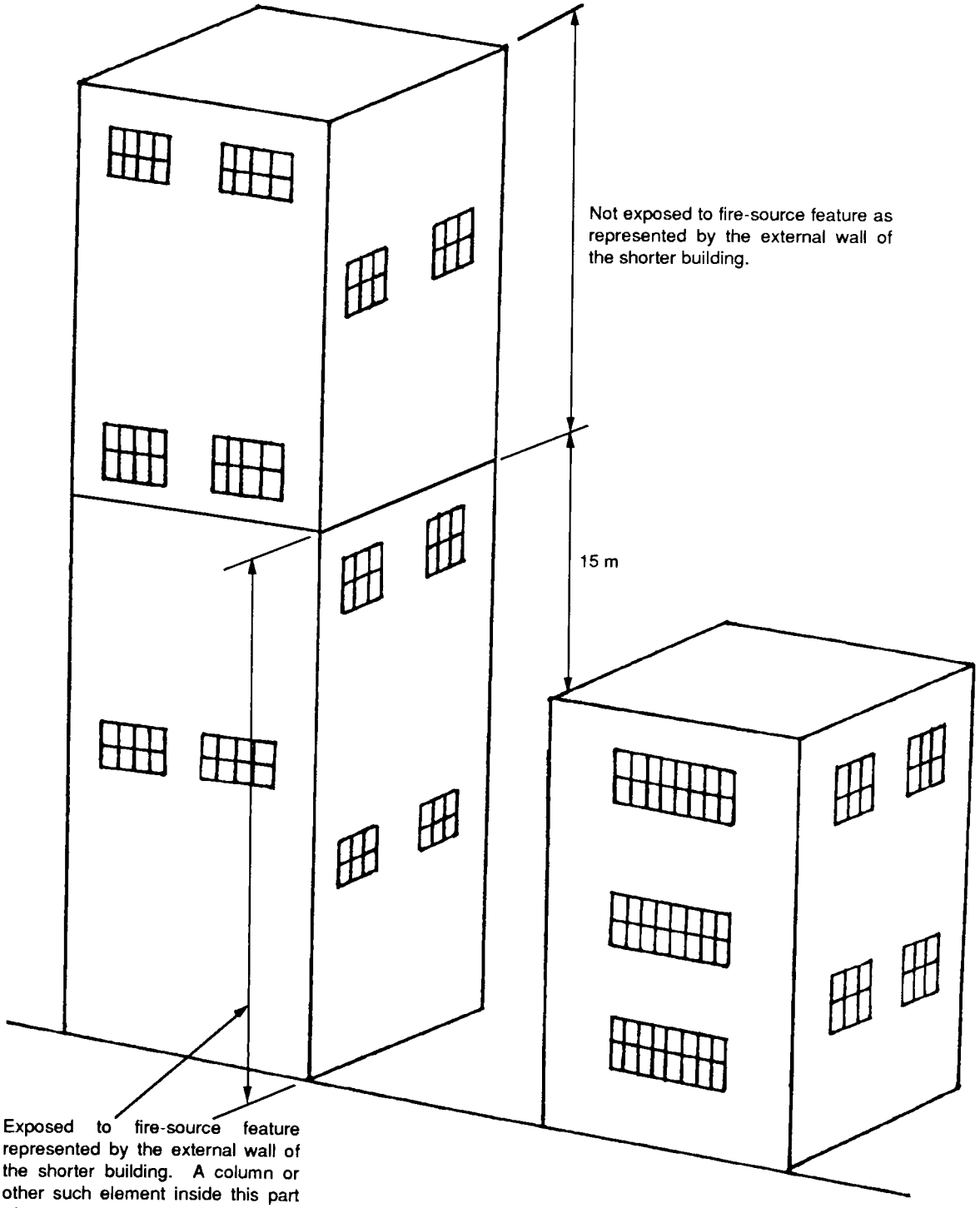
Plan



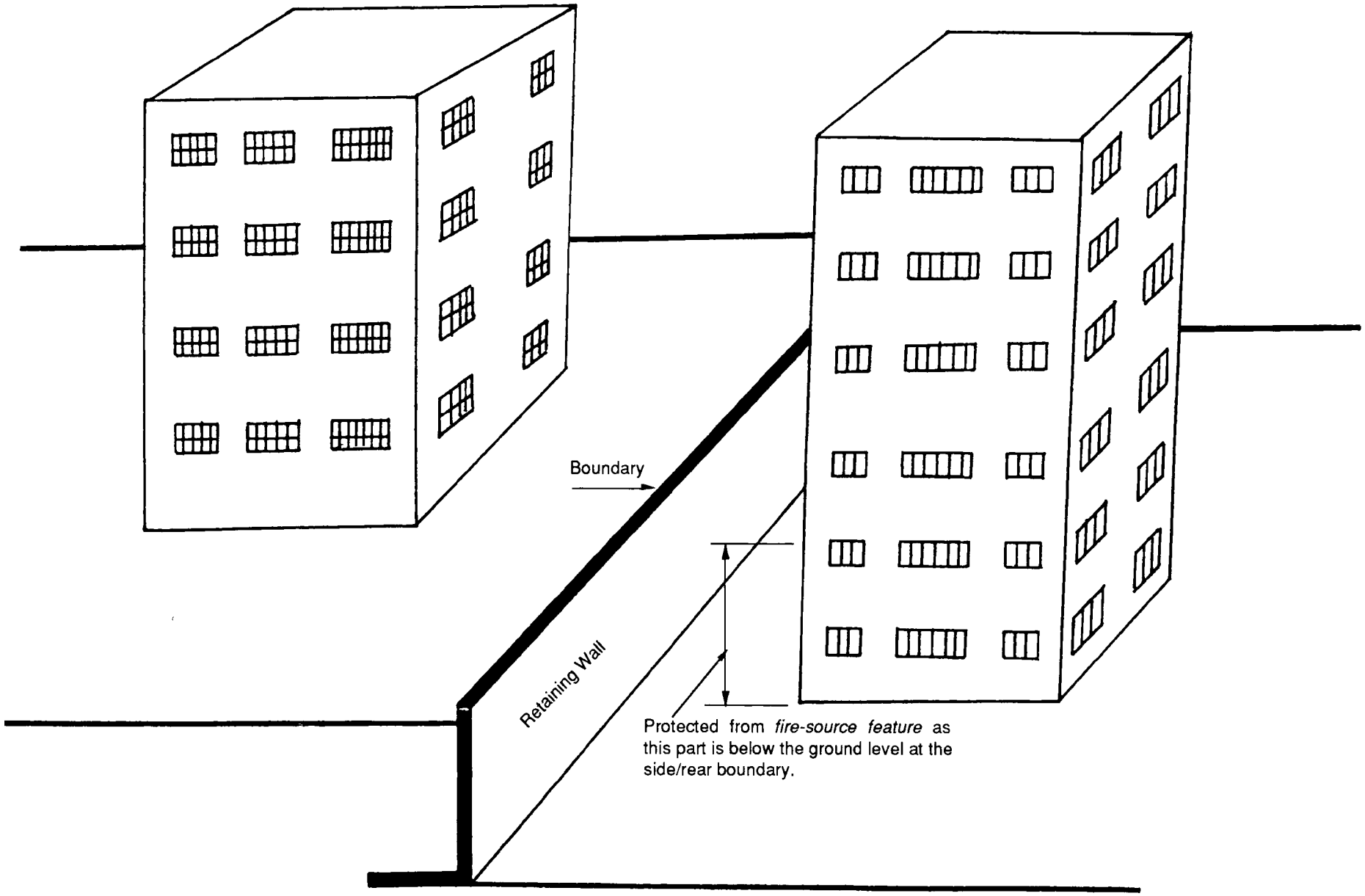
Section

Sketch Spec NC1.1 (i) Exposure to Fire-Source Feature

If there is a shorter building in the allotment and the taller building is more than 15 m higher than the highest part of the *external wall* of the shorter building, the part above 15 m is not considered exposed to the *fire-source feature* represented by the *external wall* of the building. (See Sketch Spec NC1.1(ii) This sub-clause also allows for the protection afforded by construction below finished ground level. (See Sketch Spec NC1.1(iii)). Sub-clause (c) complements the requirements regarding distances to *fire-source features* given in Tables 3, 4 and 5 of this Specification. The shorter the distance to a *fire-source feature* the greater the risk from fire. This sub-clause *requires* that any building element which is at varying distances from a *fire-source feature* must have the FRL applicable to the closest distance. A concession given by this clause is if the building element is divided into different independent parts then each part need only satisfy the FRL applicable to its shortest distance from the *fire-source feature*. When this sub-clause is applied it must be remembered that it does not override clause NC2.2.



Sketch Spec NC1.1 (ii) Exposure to Fire-Source Feature



Sketch Spec NC1.1 (iii) Protection From Fire-Source Feature

2.5 General Concessions

(c) Structures on roofs : Although the structures listed in this sub-clause do not have to comply with the requirements of this Specification, it must be remembered that the equipment listed in clause NC2.12 must comply with the requirements of that clause, namely walls having a FRL of not less than 60/60/60.

3 TYPE A FIRE-RESISTING CONSTRUCTION

This is the type of construction which is *required* when a building has a *rise* of 5 *storeys* or more. These buildings will have to comply with the requirements of clause 3.1 and Table 3 of Specification NC1.1.

3.1 Fire-Resistance of Building Elements

Building elements in Type A construction must comply with the relevant requirements of the various sub-clauses of this clause as well as those of Table 3. However the concessions for specific cases which are allowed under clauses 3.2 to 3.11 are applicable. Therefore before designing any building to Type A construction clauses 3.2 to 3.11 may be checked fully to take advantage of any of the concessions available. It will be noticed from Table 3 of the Specification that even where the distance between *loadbearing external walls* and any *fire-source feature* is 3 m or more, the minimum FRL required for Class 2, 3 or 4 is 90/60/30 and for Classes 5 to 9 120/60/30. Sub-clause 3.1(b) also *requires* that *external walls*, *common walls* and floors must be *non-combustible*. It will be useful to recall the definition of *non-combustible* and the relevant commentary for building elements to be *non-combustible*. It is sufficient if all exposed faces of the element are of *non-combustible* materials such as appropriate plaster boards.

3.3 Floor Loading of Class 5 and 9b Buildings : Concession

Where the floor loading of these Classes of buildings is sufficiently light (not more than 3 kPa) the fire load on such floors will usually be very low. As a consequence any fire on such a floor is not likely to have sufficient fuel for it to destroy the floor above and hence the concession.

3.11 Sprinklers : Concession

This concession recognises the effectiveness of sprinklers in saving lives (and in saving property).

4 TYPE B FIRE-RESISTING CONSTRUCTION

An examination of Table 4 shows that once the *loadbearing external walls* are more than 18 m from any *fire-source feature*, then such walls are not required to have any FRL. For non-*loadbearing* parts and for external columns this distance is reduced to 3 m.

Whereas with Type A construction there are a number of concessions for particular applications, in the case to Type B construction there are concessions only for car parks and for the use of sprinklers. The reason for this is that Type B construction is substantially less demanding than Type A.

5 TYPE C CONSTRUCTION

As the details given in Table 5 of the Specification indicate the overall requirements of Type C construction are very minimal. In fact if walls and columns are 1.5 m or more distant from any *fire-source feature* there is no FRL *required* for *external walls* and columns. It must noticed that *internal walls* such as those bounding *sole occupancy units* in Classes 2, 3 or 4 *require* a FRL. (This is true for Type A and Type B construction as well.) Since the overall requirements for Type C construction are very few the only concession allowed is for car parks.

SPECIFICATION NC1.5 STRUCTURAL TESTS FOR LIGHTWEIGHT CONSTRUCTION

There is a likelihood for *lightweight construction* to be damaged in day-to-day use. Once damaged it will lose its properties of fire resistance. The tests in this Specification are meant to ensure that such damage would not ordinarily take place. Clauses 7, 8, 9 and 10 of the Specification specify more stringent tests where *lightweight construction* is used in locations susceptible to greater damage.

SPECIFICATION NC 1.6 EARLY FIRE HAZARD INDICES

The different indices which denote early fire hazard have already been explained in the commentary. These indices are ignitability index, heat evolved index, *spread-of-flame index*, and *smoke-developed index*. The limitations for these indices for various uses given in the Specification will ensure reasonable safety for the occupants of the buildings concerned.

6 Fire-Retardant Coatings

While using fire-retardant coatings the precautions given under this clause in the Specification must be followed; otherwise it could lead to danger to occupants.

SPECIFICATION NC3.4 FIRE DOORS, SMOKE DOORS, FIRE WINDOWS AND SHUTTERS

Fire/smoke doors, fire *windows* and shutters were earlier not available with sufficient ability to provide high *insulation* levels. However in recent times good quality fire/smoke doors, *windows* and shutters have been developed. It is essential that these items not only comply with the FRL requirements as purchased but also when fixed in position and used. Regular maintenance should be carried out by qualified persons on fire/smoke doors, fire *windows* and shutters. These come in complete assemblies including hinges, door closers, etc. Test certificates and performance apply to the total assembly. Any variation even in minor detail could seriously reduce the performance.

SPECIFICATION NC3.15 PENETRATION OF WALLS, FLOORS AND CEILINGS BY SERVICES

This Specification gives the details by which penetration of building elements or installation of services etc. does not impair the *fire resistance levels* of those elements. There are several instances where fires have destroyed buildings through neglect to ensure proper levels of fire stopping of such penetrations, even though all the building elements had the *required* levels of fire resistance.

SECTION ND ACCESS AND EGRESS

One of the primary aims of this Section is to ensure that in an emergency all occupants of a building are able to get safely out of it in as short a time as is practical. Studies of experimental and actual fires have shown time and again that the alertness of the occupants, their familiarity with escape routes and prompt communication of any developing emergency are more important in saving lives than technical innovations and built-in preventive measures. While the Code cannot lay down standards for levels of awareness of the occupants in relation to escape routes it is desirable that building owners and occupiers incorporate the conduct of periodic escape drills to suit varying scenarios. However awareness and regularity of training cannot be relied upon in every case and therefore the need for passive and active fire protection.

PART ND1 PROVISION FOR ESCAPE

ND1.1 Application

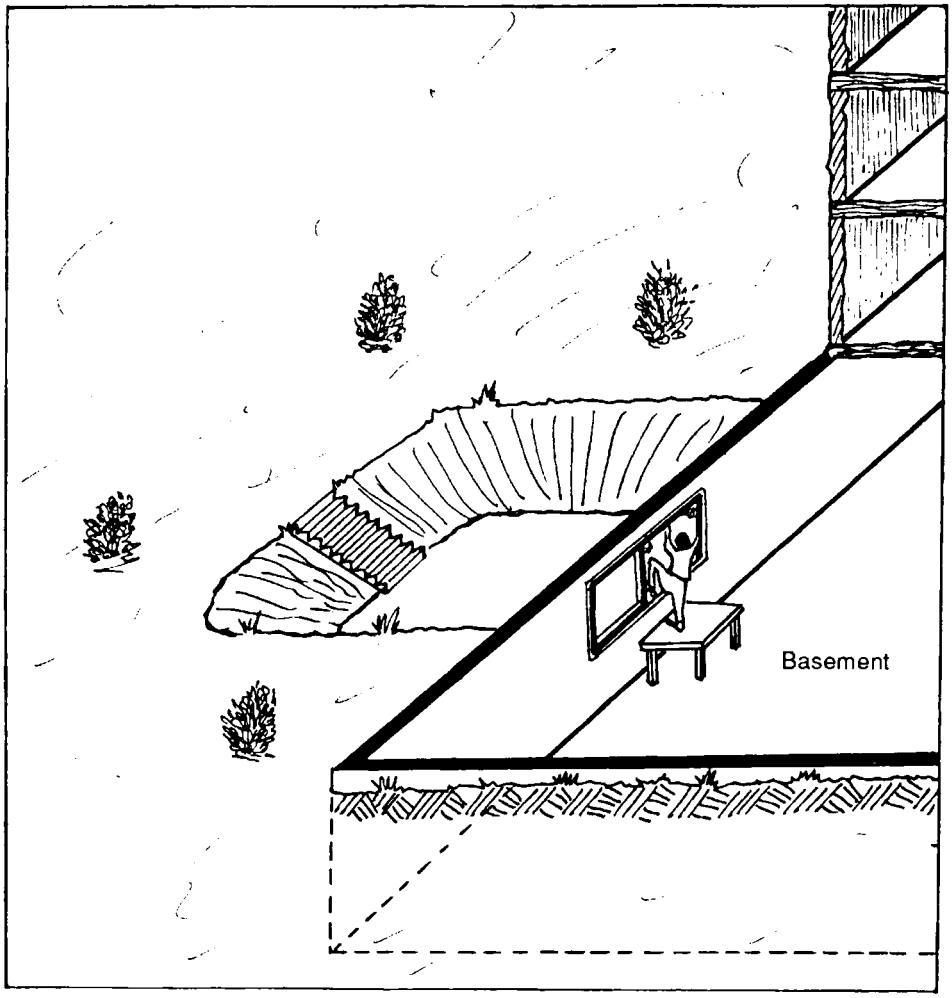
The **internal parts** of *sole-occupancy units* in Class 2, 3 or 4 part buildings are excluded from the application of this Part for the reason that even transient occupants of *sole-occupancy units* such as in Class 3 buildings will be able to have a good knowledge of the escape route **within the unit**. The Part fully applies to the facilities *required* outisde of the *sole-occupancy units* in Classes 2, 3 and 4.

ND1.2 Number of Exits Required

Sub-clause (a) demands that all buildings must have at least one *required exit*. This relates to *exits* as defined in the Code at Part A1. Sub-clause (b) demands a minimum of two *exits* in buildings of Class 2 to 8 with a *rise* of 3 or more *storeys* or *effective height* of more than 10 m. The main reason for this is that the level of active fire fighting protection available in the country is very limited and if a sole *exit* is blocked by fire or smoke the occupants will be at serious risk. Even where active fire protection systems of high reliability are available, there are known cases of failure during fires and consequent casualities.

Sub-clause (c) takes into account the special hazards associated with basements of more than a minimum area. An economic way of providing an alternate second *exit* is shown in the Sketch ND1.2.

Sub-clause (d) deals with Class 9 buildings. Class 9 buildings are *health care buildings* or *assembly buildings* and are more likely to have special demands for safe *exit* during an emergency. Such additional requirements are specified in this sub-clause as well as sub-clauses (e) and (f).



Sketch ND1.2 Alternate Exit From Basement

ND1.3 When Smoke or Fire-Isolated Exits are Required

For the reasons mentioned in the commentary on clause ND1.2 *required exits* must be free from fire and smoke. If the building has only 3 or 4 *storeys* smoke isolation of *required exits* is considered sufficient to allow for safe egress of all occupants. If the *exit* relates to a building of more than 5 *storeys* there is greater risk in terms of both the time required to evacuate all occupants and in terms of the height. This is why for such buildings fire isolation is required. Fire isolation includes smoke isolation and is more expensive.

ND1.4 Exit Travel Distances

The distances prescribed under the various sub-clauses for different Classes of building take into account the expected behaviour pattern of occupants. In addition in the case of Class 2, 3 or 4 buildings there is every likelihood of the need to evacuate on receipt of a warning while sleeping. In the case of Class 9a buildings there is the likelihood of sedated and incapacitated patients having to be evacuated.

The maximum distances specified will ensure that in the case of buildings of very large *floor area* there will be a sufficient number of *exits* available in an emergency.

ND1.5 Distance Between Alternative Exits

The chances of the occupants of a building escaping from within a building safely and in the shortest practicable time will be when all the *required exits* are spaced uniformly. In terms of other considerations this may not always be possible or desirable. In such cases there is a need to ensure that any two alternate *exits* are not too close to each other. If they are very close it is quite possible that a fire could block both *exits* at the same time. The Code therefore prescribes that these *exits* should not be closer than 9 m apart. Spacing alternate *exits* too far apart will also defeat their purpose. Also in the case of occupants who are likely to be asleep or under medical care the maximum distance between alternate *exits* must be shorter than in any other case. This requirement has also been included in this clause.

ND1.6 Dimensions of Exits

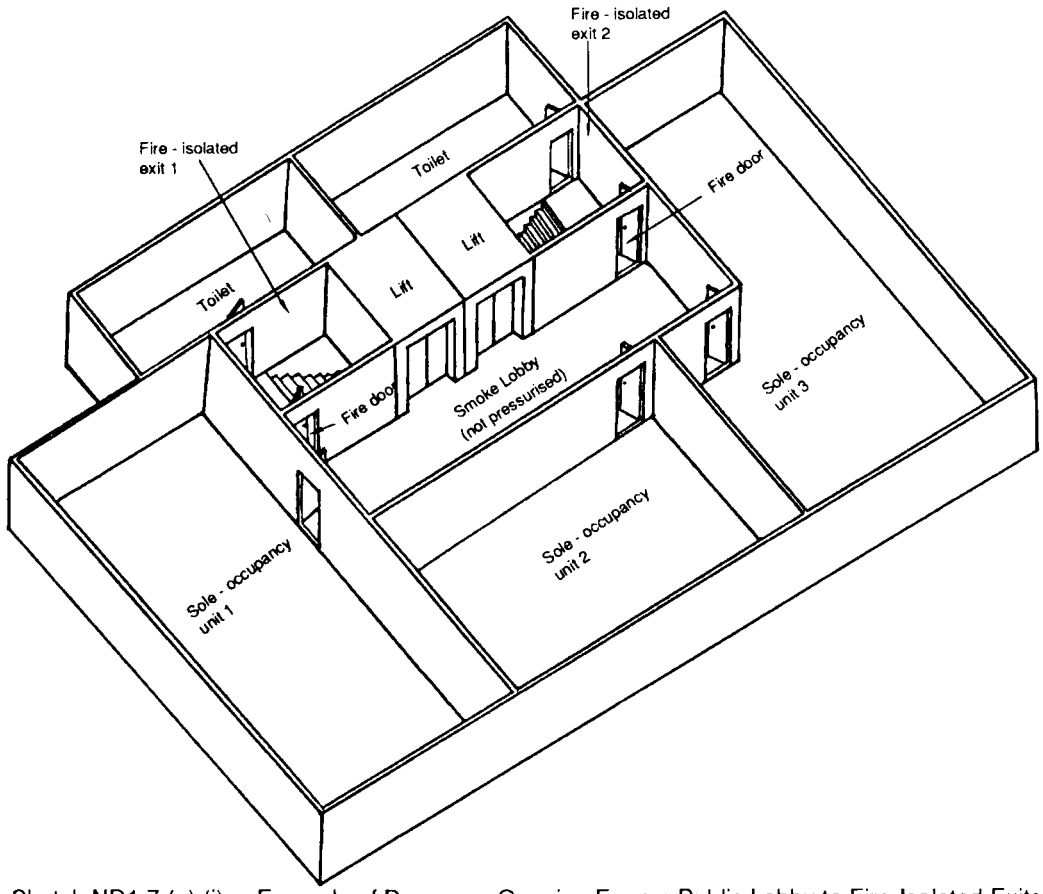
This clause spells out reasonable practical ways of complying with clause NDP2.1 of the Performance Requirements of this Section. Whereas the Performance Requirements are based on experimental analysis the provisions in ND1.6 are based on empirical practice.

ND1.7 Travel Via Smoke or Fire-Isolated Exits

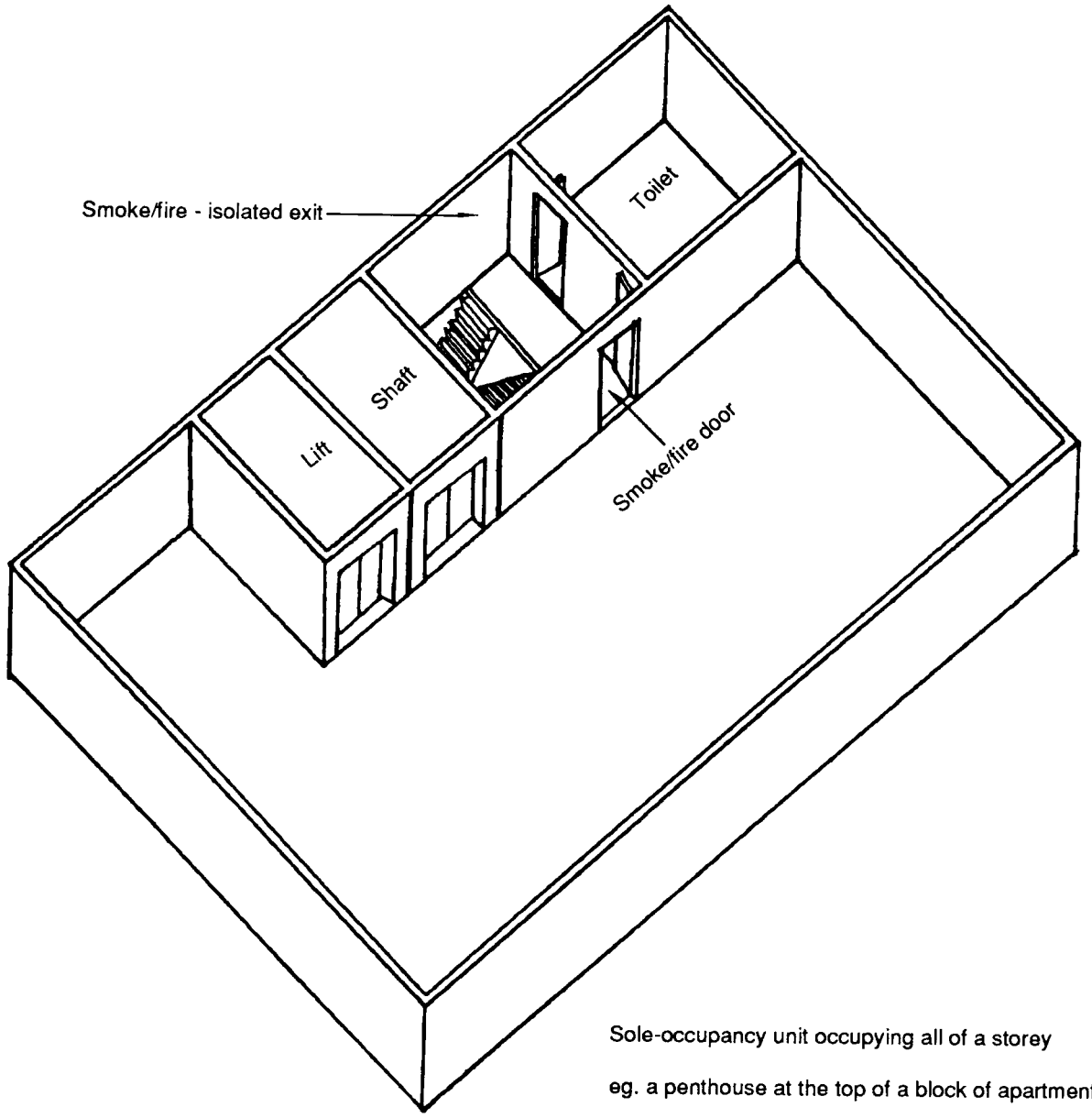
The requirements of this clause once again reflect the risk associated with different uses or situations. Sub-clause (c) allows for the case where a large number of occupants are likely to evacuate from a *storey* at the same time.

The 3 or more doors that open into the *exit* can allow smoke to enter the *exit* and endanger those who are using it. Hence the need to have a smoke lobby or pressurisation of the *exit*. The sub-clauses (c)(i) and (ii) are alternate options. Therefore where a smoke-lobby is provided as an option under this Clause, it need not be pressurised. However if for some other requirement the *exit* stairs or ramps have to be pressurised, the smoke lobby also must be pressurised.

Sketches ND1.7 (a) (i) and (ii) illustrated examples of doorways opening into a smoke or fire-isolated *exit*.



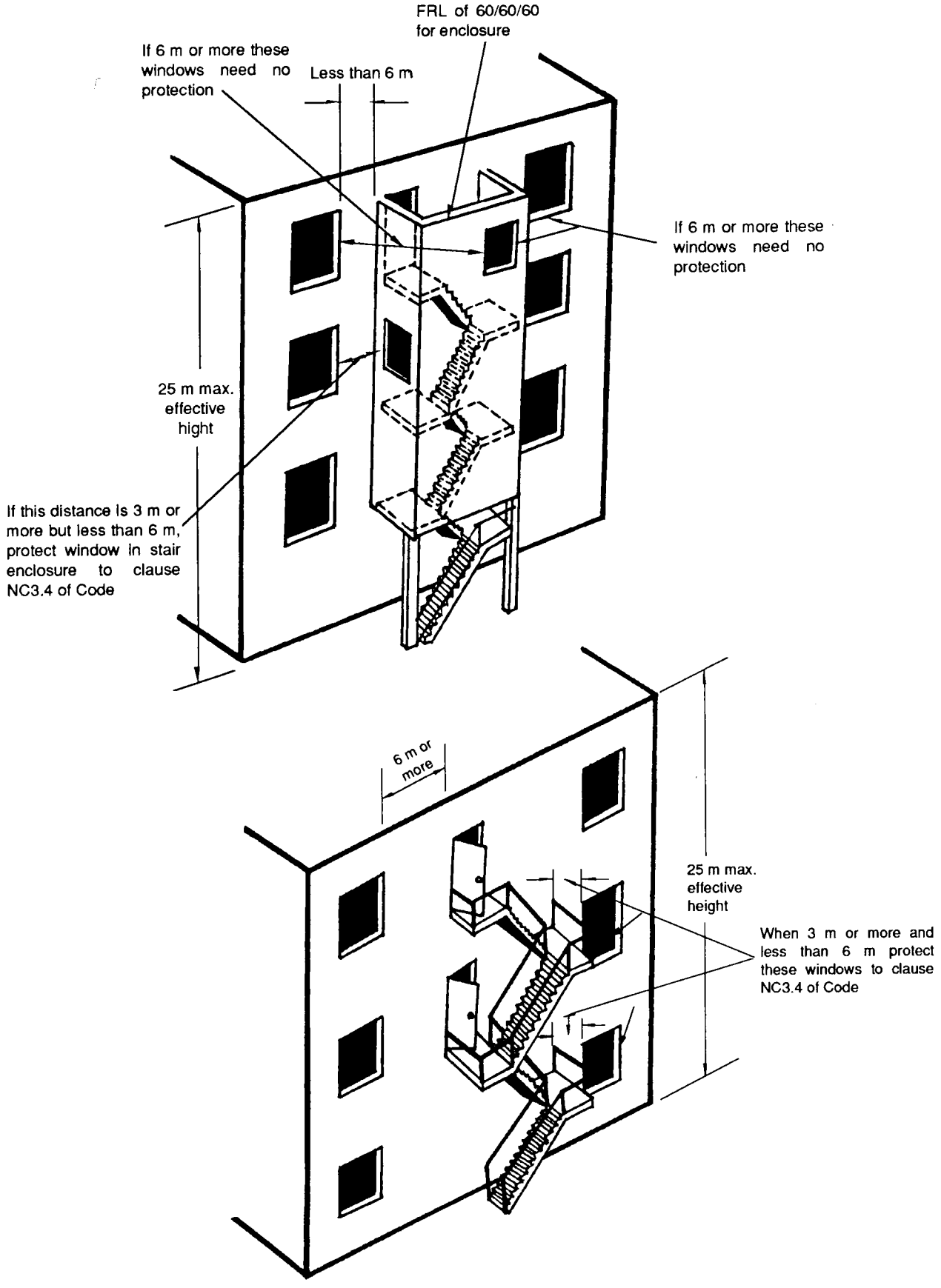
Sketch ND1.7 (a) (i) Example of Doorways Opening From a Public Lobby to Fire-Isolated Exits



Sketch ND1.7 (a) (ii) Example of Doorways Permitted to Open Directly From a Room to a Smoke or Fire-Isolated Exit

ND1.8 External Stairways

When external stairways are used as required *exits* there is a necessity to ensure that escape from the building through the stairway is safe. This clause ensures that vulnerable sections of the *exit* are suitably protected. This is illustrated in Sketch ND1.8.



Sketch ND1.8 Requirements for External Stairways

ND1.9 Travel by Non Fire-Isolated Stairways or Ramps

This clause complements clause ND1.3 and details the requirements and restrictions for the use of non *fire-isolated stairways* and ramps provided as *required exits*. It applies to internal *exits* in buildings with a rise of 4 *storeys* or less.

ND1.10 Discharge from Exits

These requirements ensure that once the occupants of a building have safely walked along an *exit* they will face no obstruction or risk from fire and smoke when entering a road or *open space*.

ND1.11 Horizontal Exits

Horizontal exits do not provide egress from a fire/smoke affected building. They only allow a quick means to escape from a fire/smoke affected part of a building to a safer part. This is why restrictions are placed on the circumstances under which *horizontal exits* can be recognised as *required exits*. The last sub-clause *requires* sufficient area on either side of a *fire wall* with a *horizontal exit* in it so that it will be possible to accommodate all the bed-ridden patients from both sides, on either side of the *fire wall* in the case of Class 9a buildings.

ND1.12 Non-Required Stairways, Ramps or Escalators

Non-*required* stairways, ramps and escalators usually do not comply with all the safety requirements of *required exits*. They are provided for only routine convenience. This is why there are restrictions placed on the provision of such non-*required exits*. In a *ward area* in a *health care building* these are prohibited. In other public buildings they are not allowed to connect more than 2 consecutive *storeys*. These restrictions will ensure that in an emergency the occupants do not use such *exits*. Such *exits* can be easily affected by fire or smoke. Moreover the unrestricted use of non-*required exits* can readily spread fire and smoke from one *storey* to another.

ND1.13 Number of Persons Accommodated

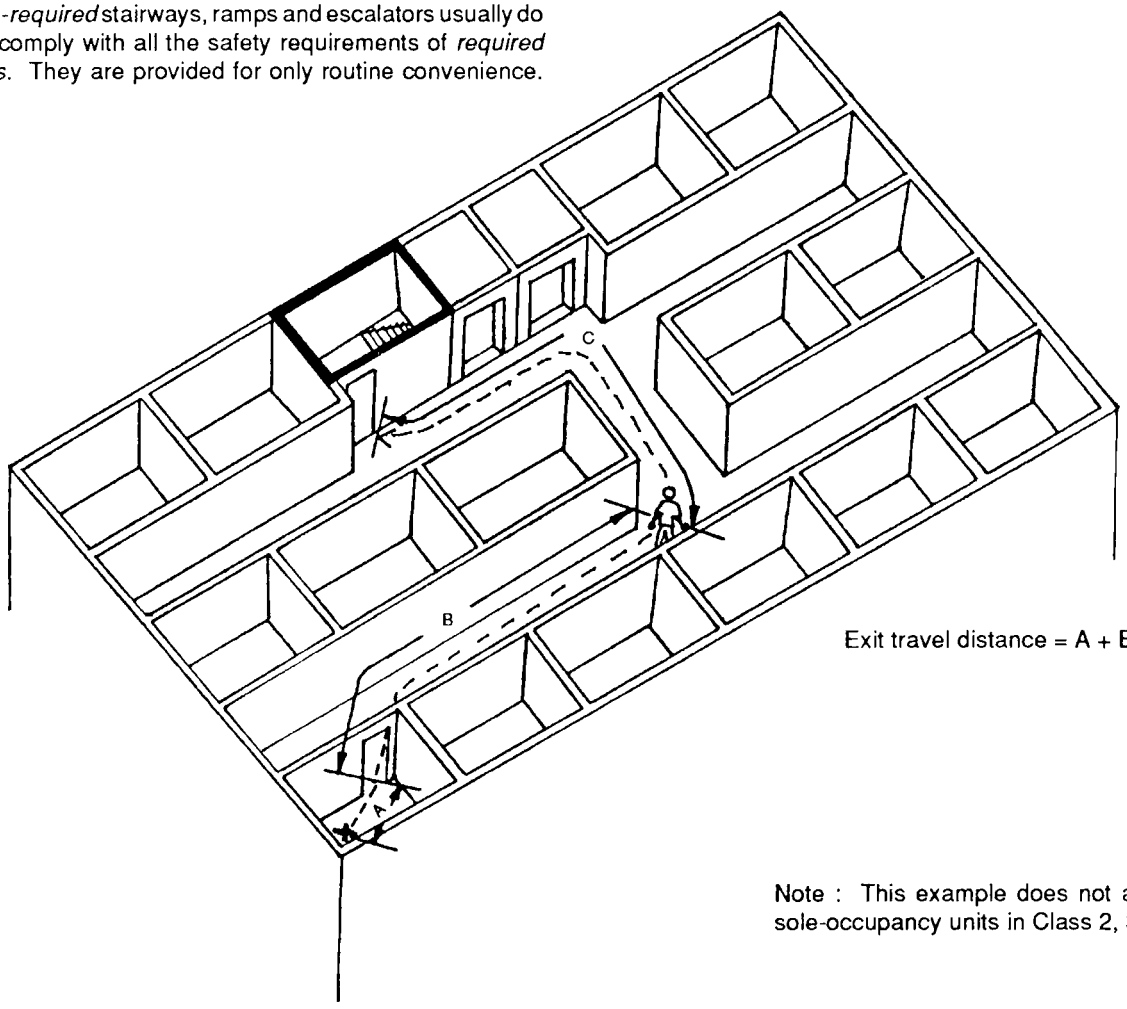
The accompanying Table in the Code gives the basis for calculating the number of persons for whose emergency evacuation *exits* have to be designed. Where it is possible to assess the number of occupants on a factual or more rational basis the Table should not be used for the assessment. Incidentally the Table is not meant for the design of the *floor areas* of buildings.

ND1.14 Measurement of Distances

In order to measure the distances mentioned in clauses ND1.4, ND1.5, ND1.7 and ND1.9 without confusion this clause states the meaning of the term "nearest part of an *exit*". This term is used in clause ND1.15.

ND1.15 Method of Measurement

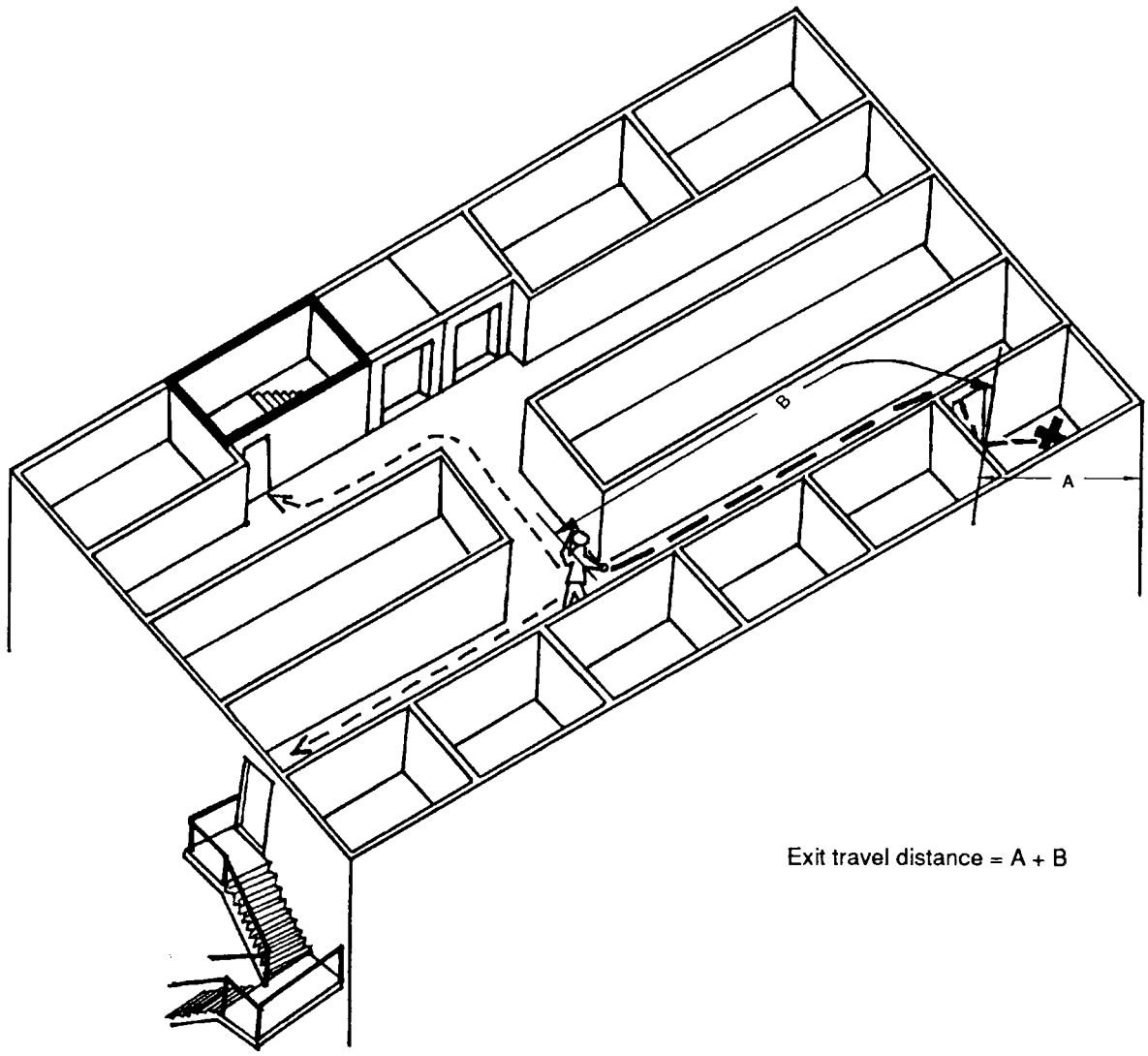
This clause specifies the routes along which the *exit* travel distances have to be measured. The attached sketches illustrate the method of measurement.



Exit travel distance = A + B + C

Note : This example does not apply to sole-occupancy units in Class 2, 3 or 4

Sketch ND1.15 (i) Example of the Measurement of Distance From Any Point on a Floor to a Single Exit



Exit travel distance = A + B

Note : This example does not apply to sole-occupancy units in Class 2, 3 or 4

Sketch ND1.15 (ii) Example of the Measurement of Distance From Any Point on a Floor to the Point From Which Travel in Different Directions toTwo Required Exits is Available

PART ND2 CONSTRUCTION OF EXITS

ND2.1 Application of Part

The requirements of this part do not apply to the residential Classes (2, 3 or 4 part) except for clauses ND2.13 and ND2.16. However it should be noted that clause ND2.21 b(i) makes a reference to the exclusion of Class 2 or Class 4 part.

ND2.2 Fire-Isolated Stairways

This clause provides precautions to prevent the outbreak of fire in *fire isolated stairways* and ramps. Apart from making them unsafe in the evacuation of the occupants, a fire in the *shaft* of a stairway or ramp can very quickly spread to floors where any doorway leading to the *exit* has been left inadvertently open. The chimney effect of the *shaft* makes even a small fire dangerous for those using the *exit*. The provisions of the clause also ensure that the *shaft* will retain its *structural adequacy*, *integrity* and *insulation* in case of any fire within it.

ND2.3 Non-Fire Isolated Stairways and Ramps

This clause gives some concessions to the requirements of clause ND2.3. Non *fire-isolated stairways* and ramps are those permitted under clause ND1.3 and the external stairways permitted under clause ND1.8. When timber is used as permitted under this clause it is necessary to ensure that any glue used with the timber does not produce dangerous smoke. This is why specific glues have been nominated under this clause. Moreover the minimum thickness of any timber used has been prescribed to ensure that the char produced from any fire will be able to reasonably protect the remaining thickness of the timber from burning and allow the safe passage of occupants and fire fighters.

ND2.4 Separation of Rising and Descending Stair Flights

This precaution is necessary to protect those who are using the descending flight of stairs to escape from the building in an emergency, inadvertently continuing on their downward progress into the basement. The separation of the two flights of stairs will alert users when they have reached the floor level for escape out of the building.

ND2.5 Open Access Ramps and Balconies

This clause complements clause NE2.2 which permits open access ramps or balconies as one means of excluding smoke from fire isolated *exits*. The requirements of this clause will ensure the quick dispersal of any smoke from the *exit*.

ND2.6 Smoke Lobbies

This clause is connected to clause ND1.7(c). The lobby will allow a more orderly evacuation of a large number of occupants by providing a safe waiting area.

ND2.7 Installations in Exits and Paths of Travel
ND2.8 Enclosure of Space under Fire-Isolated Stairs and Ramps
ND2.9 Width of Stairways

These 3 clauses aim to ensure that the *exit* is kept free of any risk of occurrence of fire within it and is free of obstructions for the rapid evacuation of occupants in an emergency. The reasoning behind sub-clause ND2.9(b) is that users of the stairway feel more safe in walking close to handrails. Therefore a very wide stairway without intermediate balustrades or handrails will generally not be useful over its full width.

ND2.21 Operation of Latch

This clause ensures that occupants can escape in an emergency into a safe *exit* with the least delay or confusion. In the case of *sole-occupancy units* in Class 2 and 4 parts the occupants will be quite familiar with the doors and therefore in such cases special requirements are not necessary for the latch.

ND2.22 Re-entry from Fire-Isolated Exits

In general re-entry from an *exit* requires a key to operate the entry door for reasons of security. However in *health care buildings* there may be a necessity for staff to re-enter a number of times in order to evacuate dependent patients. In very tall buildings it is possible that safety will be better assured by remaining within an unaffected floor rather than attempting to escape through the *exit*. Also in buildings of more than 25 m *effective height* it is usually not possible for fire fighters to use their ladders to gain access into the building and evacuate people incapacitated by possible fire/smoke or in any other way. These are the reasons why in these cases easy re-entry into the floors of the building is *required*.

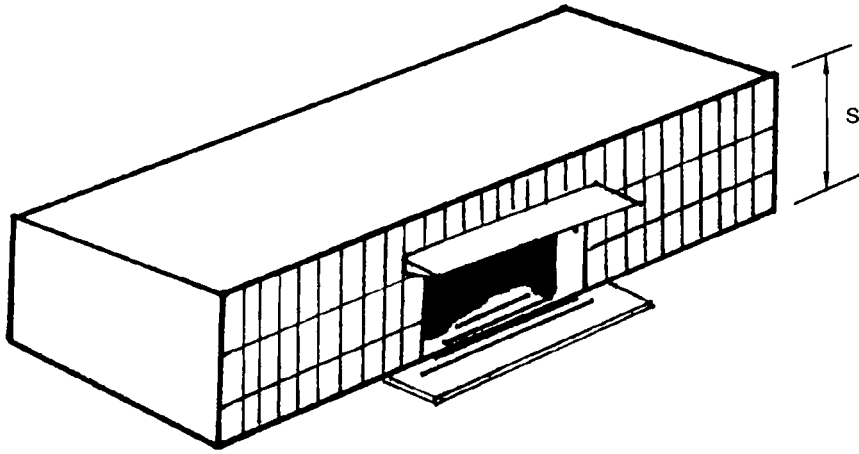
PART NE1 FIRE FIGHTING EQUIPMENT

NE1.3 Riser Main System

A rise of 5 *storeys* or more corresponds to the requirement for Type A construction. A *charged dry riser main system* is not very efficient. It will need a fire engine pump or other means to make it operational. However the available water supple system does not permit in some cases to have *wet riser main systems*. In such cases when buildings of more than 8 *storeys* are contemplated it will be necessary for the building owner to provide suitable means such as a large enough site storage of water and pumps.

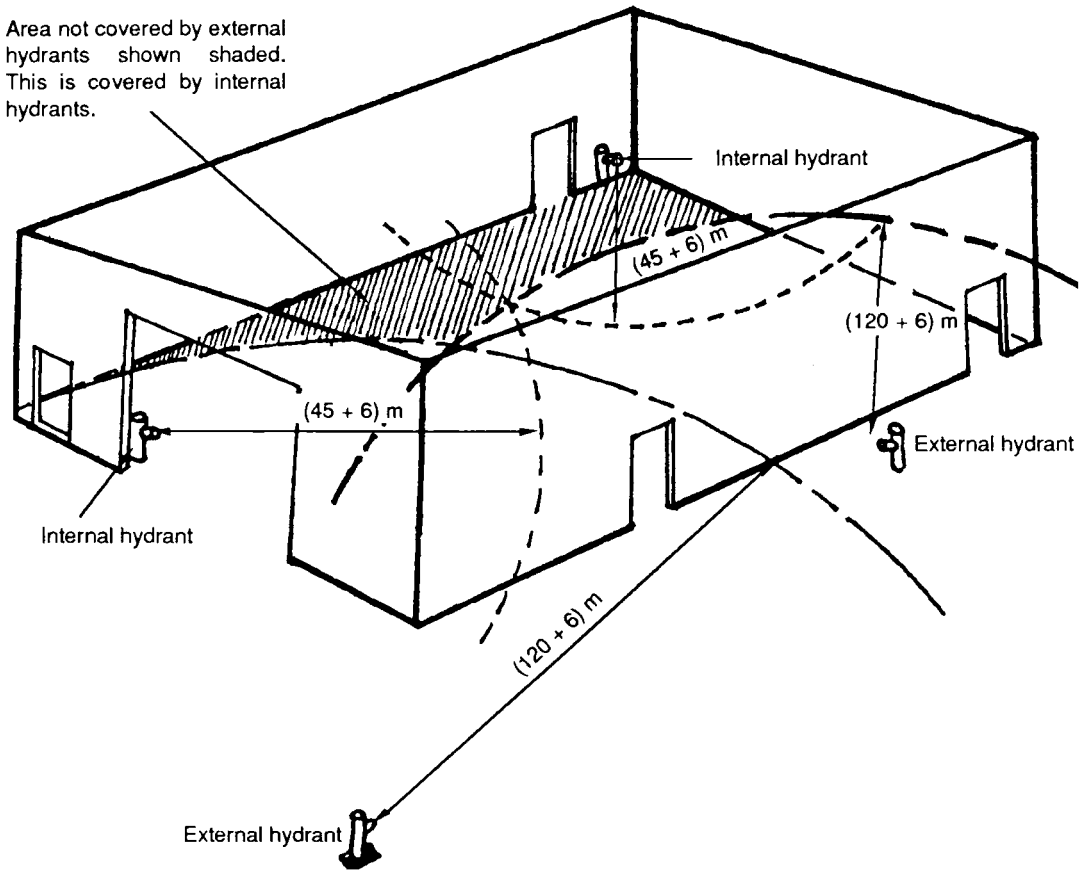
NE1.4 Where Hydrants are Required

Some of these requirements are illustrated in the attached sketches. The clause gives the circumstances when *hydrants* are *required*. *Hydrants* can be either external or internal. Where external *hydrants* are available sub-clause (b) gives the limitations of their use.



External hydrant

Distance from the external hydrant to the farthest point in the building to not exceed 126 m along a fire hose route, unless sufficient number of internal hydrants are also available. The floor area of the building not to exceed 750 m² per hydrant.



Sketch NE1.4 Arrangement of External and Internal Hydrants to Cover Total Area

NE1.5 Hose Reels

Hose reels are very useful when confronting a fire noticed at an early stage. They can also be handled by the occupants of the building. This is why the availability of hose reels has been more widely prescribed in the Code. A typical location of a hose reel is shown in the attached sketch.

NE1.6 Sprinklers

The requirements of this clause along with those of Table NE1.6 have been considered while limiting the areas of *fire compartments* in clause NC2.2.

NE1.7 Portable Fire Extinguishers

Like hose reels portable extinguishers can be handled by occupants with very little training. Where fires of different classes and types are possible great care must be exercised in the selection and location of extinguishers so that any inappropriate use of an extinguisher does not lead to a worsening of the situation.

NE1.8 Fire and Smoke Alarms

This clause deals with both *automatic* and manually operated evacuation alarm systems. The requirements are tailored to the risks associated with the Class and height of the building.

NE1.9 Fire Control Centres

A look at Specification NE1.9 shows that a separate room and all associated equipment are *required* only in the case of buildings of an *effective height* of more than 50 m. For buildings between 25 m and 50 m the requirements are very minimal.

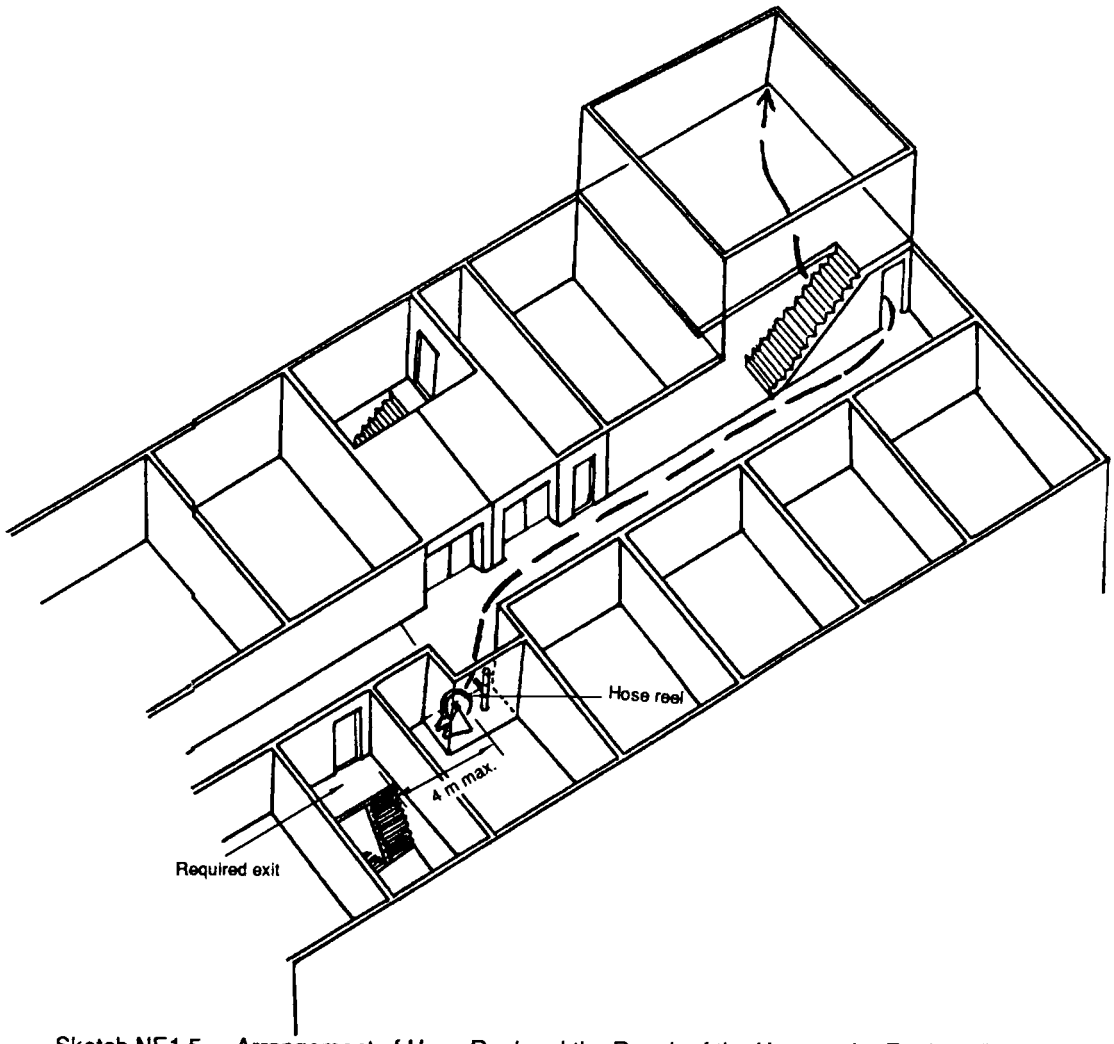
During a fire it is extremely important to have rational communication along with specific levels of command. Absence of such a communication set-up could lead to uncertainty in the minds of occupants and uninformed and risky behaviour. These risks are especially significant in the case of tall buildings and Class 6, 7 or 8 buildings.

PART NE3 LIFT INSTALLATIONS

The Code does not provide for the mandatory installations of lifts. Maintenance facilities available in the country are not the best.

PART NE4 EMERGENCY LIGHTING, EXIT SIGNS AND WARNING SYSTEMS

During a fire and other emergencies it is very likely that the normal power supply and lighting systems may not work. The failure of normal lighting in buildings during an emergency might lead to confusion on the part of those attempting evacuation. The provision of emergency lighting, suitable *exit* signs and the actuation of warnings will permit smooth and safe evacuation.



Sketch NE1.5 Arrangement of Hose Reel and the Reach of the Hose to the Farthest Point on the Floor

APPENDIX

While preparing the commentary a few mistakes were noticed in the Code. The corrections pertaining to these mistakes are given below. It will be appropriate to issue these formally when bringing the Code into use after the passing of the enabling legislation.

PART A1 Clause A1.1 Definitions

Non-combustible -

The inclusion of perforated gypsum lath with normal paper finish at (b) (ii) is not appropriate. Please delete this item and renumber the items from (i) to (iv).

Registered Testing Authority

The first line at item (b) should begin with the word " Commonwealth" and not "Council" of".

Site The definition as given can lead to disputes. It needs to also include the land in the vicinity of the building in order to erect it, make continued use of it and eventually to demolish it. Therefore a more appropriate definition would be as follows :

"The part of the allotment of land *required* for the erection, continued use, any alteration or addition, and demolition of a building."

PART B Clause B1.2 (a)

In the last sentence the reference to "at Figure 2.5.1 and 3.2.2" should be deleted. Any amendment to AS 1170 could change these figure numbers and it is therefore prudent to delete any reference to the numbers.

SECTION DC PERFORMANCE REQUIREMENTS Clause DCP1.2

The distance "1 m away" conflicts with the 1.5 m given in Clause DC1.3 of the Deemed-to-Satisfy provisions. For the sake of consistency both should be 1.5 m.

PART DF6 Figure DF6.11.2

The reference to "Public *sewer*" at part (a) of the figure in some editions of the Code should read "Public *sewer* or local treatment plant (eg. septic tank)".

SPECIFICATION NC1.1 Para 2.1 (a) (i)

The "not" after "a FRL of" should be deleted.

PART ND2 Clause ND2.1

Clause ND2.2.1 applies to Class 3. Therefore this should be clearly stated. Clause ND2.1 should be reworded as follows:

"This Part does not apply to the internal parts of the *sole-occupancy units* of Class 2, 3 and 4 buildings except for the following clauses :

(a) ND2.13 and ND2.16 - Class 2, 3 and 4 part.

(b) ND2.2.1 - Class 3."

PART ND2 Clause ND2.2.1 (b) (i)

The item "sole-occupancy unit" should be in italics.

SECTION NF PERFORMANCE REQUIREMENTS Clause NFP9.1

The Clause number should read "NFP8.1".

PART NF2 Table NF2-4

Under Class 5, 6, 7 and 9 buildings, the reference in the subject heading to "plus urinals" should be deleted.