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Acceptable Solutions C/AS1 to C/AS7

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Appendix 1: Case Study
1.1 Introduction and scope

This commentary document is a companion to the Acceptable Solutions C/AS1 to C/AS7 for the New Zealand Building Code Clauses C1 to C6: Protection from Fire. It provides further explanation and background on:

- The provisions of the Acceptable Solutions
- The intent of the requirements, and
- In some cases, what these requirements do not apply to.

It is intended that the commentary will be a living document that is added to and updated as considered appropriate and necessary.

Any requests for additions or further explanation should be made to the Department of Building and Housing.

Where paragraph numbers are given in this document, these provide commentary for the corresponding paragraphs in the Acceptable Solutions (which all have a common numbering system for ease of use). Commentary is not provided for every paragraph in the Acceptable Solutions.

Scope

The Acceptable Solutions can be used for simple buildings categorised in any of the seven risk groups described in Table 1.1 of the Acceptable Solutions, except in the cases listed in Table 2 of this document. There is a corresponding Acceptable Solution for each risk group. No modelling or calculation other than simple mathematics is required.

Table 1 of this document and the commentary below provide further detail on each risk group and its associated Acceptable Solution.
Table 1: Description of risk groups and Acceptable Solutions

<table>
<thead>
<tr>
<th>Acceptable Solution</th>
<th>Risk group</th>
<th>Description</th>
</tr>
</thead>
</table>
| C/AS1 SH            | SH         | Detached houses and buildings subdivided into multiple dwellings, provided that:  
  - People from each dwelling have their own independent escape route to a safe place (ie, their own corridor and stairway), and  
  - The buildings are no more than two units high (there is no limit on the number of units side by side).  
  Not included: buildings with any corridor or stairway serving more than one dwelling, detached boarding houses with facilities for six or more guests (see risk group SM). |
| C/AS2 SM            | SM         | All multiple unit accommodation buildings not included in risk group SH.  
  Note: there are some minor differences in requirements depending on whether the accommodation is considered permanent (ie, the occupants would be considered to be familiar with the building and its features) or temporary. Apartments and flats are considered permanent accommodation, while hotels, motels, hostels, serviced apartments and similar buildings are considered temporary accommodation.  
  The Acceptable Solution for this risk group also specifies particular fire safety requirements for education accommodation, which has been singled out because of its particular nature. This category includes boarding schools (both primary and secondary education) and university halls of residence.  
  Not included: Early childhood education (see risk group CA). |
| C/AS3 SI            | SI         | All buildings or spaces where care is provided to occupants that are incapacitated in some way, are unable to evacuate unaided for any other reason, or would be delayed in their evacuation.  
  It includes detention spaces in police stations and courthouses (but not prisons) and hospitals (excluding special care facilities such as places using general anaesthetic, hyperbaric chambers etc), residential care homes and hospices. It also includes clinics that provide medical day treatment that requires the incapacitation/sedation of those undergoing the treatment; for example, by kidney dialysis, dental procedures or chemotherapy.  
  Not included: Early childhood education (see risk group CA) |
| C/AS4 CA            | CA         | Buildings or places where people congregate or visit, including any place where people are given treatment but are not incapacitated in any way.  
  This includes halls, recreation centres, public libraries (as long as the lending items can be accessed by an adult standing on the floor), cinemas, theatres, shops, places providing personal services (such as beautician and hairdressing salons), day schools, restaurants, cafes and early childhood centres. It also includes dental and doctors’ surgeries, provided those undergoing treatment are not incapacitated.  
  Not included: Dentists’ and doctors’ practices where patients are incapacitated such as with sedation (see risk group SI) |
<table>
<thead>
<tr>
<th>Acceptable Solution</th>
<th>Risk group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/AS5</td>
<td>WB</td>
<td>Places where people work, such as offices (including those providing professional services such as law, engineering and accountancy offices), factories and manufacturing plants (except where foamed plastics are part of the process), laboratories and workshops. It also includes storage areas, as long as the storage is less than 5.0 m high.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Not included:</strong> places where personal, rather than professional, services are provided (see risk group CA), manufacturing plants where foamed plastic is part of the process (see risk group WS or use C/VM2), warehouses or storage areas with storage height 5.0 m or greater (see risk group WS, or use C/VM2 if unsprinklered).</td>
</tr>
<tr>
<td>C/AS6</td>
<td>WS</td>
<td>Buildings where large quantities of commodities are stored or where the risk is higher than in other risk groups. This includes warehouses where the height of storage is 6.0 m or greater, climate-controlled stores where the storage height is 3.0 m or greater, and buildings that are used for trading or bulk retail where the products are stored at a height of 3.0 m or more above the floor.</td>
</tr>
<tr>
<td>C/AS7</td>
<td>VP</td>
<td>Any place where vehicles are parked or stored. This includes car, truck and bus parks as well as light aircraft hangars. These can be within a building used for other purposes or their own separate building.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Not included:</strong> car showrooms with fewer than six cars (see risk group CA).</td>
</tr>
</tbody>
</table>

**Commentary on the Acceptable Solutions and risk groups**

**C/AS1: Risk group SH** Risk group SH applies to detached houses and to buildings containing a number of separate residential units, provided there is no more than one unit above another. Therefore, the Acceptable Solution covers the fire safety requirements for a row of townhouses and maisonettes as well as two-storey apartment blocks.

While each household unit may have more than one floor, it must still have its own independent escape route. If the building provides a shared escape route, then C/AS2 will apply. If a detached house is used as a boarding house, it may have the facilities to accommodate up to five paying guests and still fall within this risk group. Boarding houses accommodating six or more paying guests are categorised as risk group SM.

The fire safety requirements for risk group SH are relatively minor and are limited to having maximum travel distances, restricting the use of foamed plastics on walls and ceilings, and protecting other property.

**C/AS2: Risk group SM** Risk group SM applies to any place where people sleep, except:

- those household units covered in risk group SH (C/AS1), and
- where people are cared for or detained (refer to risk group SI (C/AS3)).
Accommodation types

Permanent versus temporary accommodation

The Acceptable Solution for this risk group has different fire safety requirements depending on whether the buildings in this category provide permanent or temporary accommodation.

For the purposes of this Acceptable Solution, permanent accommodation is considered to be that where occupants live on a permanent basis such that this accommodation would be regarded as their residential address. Other accommodation within this category is considered to be temporary.

When developing this Acceptable Solution, a time limit of 90 days was suggested as determining the difference between permanent and temporary accommodation. However, it was accepted that, in certain cases, people may not live in a fixed place for 90 days but would still consider their residence status as permanent. Equally, temporary accommodation may be used as a more permanent place of residence (for example, serviced apartments might be used on a long-term or semi-permanent basis for working week accommodation), but this activity would still be classified as temporary accommodation.

Generally, houses that are used as student accommodation and the like would be regarded as permanent accommodation. However, student hostels provided by universities and other tertiary education institutions would be considered as temporary accommodation despite the fact that a student may reside in the hostel for a full academic year. The reason is that any student may only reside in the hostel for a few weeks or months. Such accommodation is also likely to be used outside the academic year to accommodate visitors for conferences or other events, and these occupants will not be familiar with that particular building.

Education accommodation

Education accommodation covers primary or secondary schools that have boarding students or that provide sleeping facilities for school-age occupants.

C/AS3: Risk group SI

Risk group SI includes all the activities associated with the care or detention of people (except for prisons or special care facilities such as those using general anaesthetic). It is important to note that buildings will fall into this category if occupants need to rely on others in any way or if they are restricted in their ability to escape from the building.

However, this risk group specifically excludes early childhood education activities, which are classified as risk group CA and have their own specific fire safety requirements.

C/AS4: Risk group CA

Risk group CA includes the activities in buildings that involve people in groups where a proportion of those people are not working. This includes schools and other education facilities, shops and shopping malls. Note that spaces being used for personal services such as hairdressers, beauty therapists, dentists and doctors are included in this risk group, unless any occupant is incapacitated in some way. In these cases the risk group for the building or part of the building will be SI.
**C/AS5: Risk group WB** Risk group WB covers the activities in *buildings* where people are working. Examples are offices including where professional services are provided (such as offices for lawyers, accountants or consultants) but not where a personal service is provided (such as doctors and dentists).

This *risk group* also includes warehouses with storage up to a height of 5.0 m. It has been deemed that storage above this height will require sprinkler protection for the purposes of compliance with an Acceptable Solution.

**Storage height and stack height:** the terms storage height and stack height are both used for the height to which items are stored in a warehouse or similar situation. When the Acceptable Solution refers to storage height, it generally means the height from the floor of the storage area to the top of the stack or pile.

However, in some cases storage may be on a raised platform, rack or *intermediate floor*. If there is no storage below the raised platform, rack or intermediate floor, then the storage height is the height from the bottom of the stack to the top, height ‘x’ in Figure 1.

**Figure 1: Storage height with intermediate floor**

![Diagram of storage height with intermediate floor](image-url)
If there is storage above and below the platform, rack or intermediate floor, then the storage height is determined as follows.

a) If the raised platform, rack or intermediate floor is fire rated and the upper storage is protected from spread of fire by either:

i) ensuring the fire rated floor extends 1.0 m beyond the lower stack, or
ii) providing a fire rated barrier extending 1.2 m above the intermediate floor at its outermost edge

then the storage height may be taken as the greatest height of storage above or below the raised platform, rack or intermediate floor, or

b) If the raised platform, rack or intermediate floor is not fire rated, or neither a) i) or ii) apply, then the storage height is taken as the height from the bottom of the lowest stack to the top of the uppermost stack.

**Capable of storage:** The Acceptable Solution uses the term ‘capable of storage’: this is generally taken to mean that designers should regard a building with a stud height of 6.0 m, for example, as capable of storage up to a height of about 5.0 m. It would usually be inconceivable that a warehouse with a stud height of 6.0 m would maintain a freeboard above the stack of, say, 3.0 m to 4.0 m, so that designers should design the building for the maximum future versatility (see Figure 2).

The height to which storage is capable will also be reduced by the presence of structural elements (roof structure) and building services (see Figure 2 c) and d)).

**Risk group** WB also includes smaller areas of storage (restricted to 4200 m² gross area) where the height to the apex of the building (to the underside of the roof cladding) is less than 8.0 m.
Risk Group is WS despite only 4 m high racking as the apex of the building is greater than 8 m

Risk Group WS despite only bulk storage bins as the apex of the building is greater than 8 m

Risk Group WB and firecell is <4200 m²

Figure 2: Capable of storage
Where storage is above 3.0 m in height, there are additional fire safety requirements (for example, an increase in property rating). This recognises the fact that storage above this height may increase the fire loads, so additional protection should be afforded for other property etc.

C/AS6: Risk group WS Risk group WS applies if buildings have higher fire loads and if fire breaks out it will grow rapidly. It includes warehouses capable of storage at a height of 5.0 m or greater, and retail and trading centres where the stock is stored at a height of 3.0 m or greater. This reflects the fact that, while a warehouse would usually have a low occupant load, retail and trading centres would have a higher occupant load and this would also include people that were unfamiliar with the building.

The explanation above for C/AS5: risk group WB relating to storage height and stack height, and the comments on ‘capable of storage’, also apply to this risk group and associated Acceptable Solution.

C/AS7: Risk group VP Vehicle parking areas of buildings, car parking buildings and similar activities present particular challenges with regards to fire safety. For this reason all of these activities have been grouped in a dedicated risk group. As such areas usually have a low occupant load at any given time, this is reflected in the fire safety requirements.

For the most part, the requirements for this risk group are provided in C/AS5 for risk group WB. The requirements specified in this Acceptable Solution are those that are specifically for risk group VP in addition to, or as a replacement for, those specified for risk group WB.

Outside the scope of the Acceptable Solutions

1.1.2 If any aspect of the building and its features or systems cannot be designed entirely within the scope of the Acceptable Solutions, the Verification Method C/VM2 must be used. A designer using C/VM2 should be fully conversant with fire engineering principles and should preferably be a recognised fire design engineer such as a Chartered Professional Engineer.

The Acceptable Solutions cannot be used for buildings with any complex features, such as buildings with multiple mezzanine floors or more than 20 storeys high, or any complex systems such as smoke management systems or stair pressurisation systems. These exclusions are detailed further in Table 2 of this document.
Table 2: Building features or systems outside the scope of the Acceptable Solutions

<table>
<thead>
<tr>
<th>Feature/Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse/storage buildings</td>
<td>with a storage height of greater than 5.0 m that are not protected with automatic fire sprinklers</td>
</tr>
<tr>
<td>Buildings</td>
<td>where foamed plastics are manufactured or processed, or buildings which are part of chemical processing plants</td>
</tr>
<tr>
<td>Prisons and district health board detention buildings</td>
<td>where occupants are unable to evacuate themselves because of the buildings’ security features</td>
</tr>
<tr>
<td>Treatment or care facilities</td>
<td>where occupants require a stay in place strategy eg, general anaesthetic operations/procedures, delivery rooms, intensive care units, hyperbaric chambers etc.</td>
</tr>
<tr>
<td>Buildings incorporating an atrium</td>
<td>such as multi-floor shopping malls</td>
</tr>
<tr>
<td>Buildings</td>
<td>with either intermediate floors that are larger than the limits specified in the Acceptable Solutions or with two or more intermediate floors in a firecell, or more than 100 people on the intermediate floor</td>
</tr>
<tr>
<td>Where smoke control is used</td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td>more than 20 storeys high from ground level</td>
</tr>
<tr>
<td>Buildings</td>
<td>that provide tiered seating for more than 2000 people or that have a primary egress for more than 100 people above the level of the playing surface</td>
</tr>
</tbody>
</table>

Hazardous substances not covered by these Acceptable Solutions

1.1.5 Processing, manufacturing and storage of hazardous substances in buildings, particularly if those substances are flammable or explosive, creates particular problems for the design of the building including compliance with the HSNO Act 1996. The Acceptable Solutions for Protection from Fire do not constitute compliance with the HSNO Act. If the building is going to be used in such a way, you will need to refer to the HSNO Act and associated regulations as additional measures will be required.

1.2 Using these Acceptable Solutions

General approach

The activities carried out in a building or part of a building determine its risk group or groups and therefore which Acceptable Solutions will apply (refer to Table 1).

Buildings or parts of buildings are categorised further depending on:

- the vertical distance occupants would have to cover to descend/ascend to escape from fire, and
- the type and number of occupants in a firecell.

These factors will affect the specific requirements of the relevant Acceptable Solution.

Note that application of the Acceptable Solutions depends largely on basic measurements such as building height, floor plan areas, wall openings and distances to relevant boundaries. Users should determine those measurements as accurately as possible before using these Acceptable Solutions.
Future flexibility

It is very likely that a building will undergo one or more changes of use over its lifetime. Even under the same use, floor layout and furnishing will probably alter to accommodate changes in technology and occupant practices. At initial construction time, owners should therefore consider the advantages of providing fire protection and fire safety systems to suit alternative occupancies, as these could be difficult or excessively expensive to install at a later date.

Multi-unit dwellings

Multi-unit dwellings may be designed using either C/AS1 or C/AS2 depending on their characteristics.

If the units are in a building with no more than one unit above another (regardless of how many floors are within each unit) and each unit has its own escape route (ie, there are no corridors or stairs shared by other units) then that building can be designed using the requirements for risk group SH. These requirements also apply to houses that are detached from other buildings: such houses are referred to as detached dwellings or single household units.

If the units are in a building with more than one unit above another (for example, a three-storey apartment building where each apartment is only one floor) or there is a common corridor or stairway used by more than one of the units as an escape route, then the requirements for risk group SM are to be used.

If a single dwelling has more than one floor, that floor does not have to be a fire separation and the limitations for intermediate floors do not apply in that case.

Primary risk group

1.2.2 The Acceptable Solutions allow for a building to be divided up into one or more firecells. In turn, each firecell may have a number of different activities being conducted within it and these may be categorised into one or more risk groups. In order to assign an overall risk group to each firecell, you must ascertain which of the applicable risk groups would require the greatest protection. This then becomes the primary risk group for that firecell.

1.2.3 For example, a two storey building has three firecells (each floor is a single firecell and the stairway is a third firecell). The building is used as a medical centre and contains offices and a beautician on the upper floor and consulting rooms and outpatient surgical facilities on the ground floor. In this case, the greatest protection on the upper floor would be required by the beautician, so the primary risk group for this firecell would be risk group CA. The greatest protection on the ground floor would be required by the surgical facilities, so this would be risk group SI.
1.3 Alterations and changes of use to buildings

For the fire design of new buildings, the whole of the relevant Acceptable Solution or Solutions will apply.

If an existing building is being altered or its use is changed, the building is required to comply with all clauses of the Building Code ‘at least to the same extent’ as before the alteration or change of use. (Note that ‘change the use’ is specifically defined in the Building (Specified Systems, Change the Use and Earthquake-prone Buildings) Regulations 2005.)

In the context of design for fire safety, the building must:

• After an alteration, comply as closely as possible with the current requirements for means of escape from fire, and
• After a change of use, comply as closely as possible with the requirements for means of escape from fire, protection of other property and structural performance.

Therefore, when using the Acceptable Solutions a user should consider the requirements as follows:

• When considering an alteration to a building with no change of use, the design of the building including the alteration should comply with all but Part 5 of the Acceptable Solution, and
• When considering alterations and any other building work resulting from a change of use, all of the Acceptable Solution must be considered.

A more efficient process may result from using Verification Method C/VM2 for designs involving an alteration or change of use. The Verification Method will allow a comparison of a fully Code-compliant design against one which the designer is proposing as the actual solution. This provides the ability to demonstrate how close to compliance the actual design is and therefore allows a justification for whether or not it is ‘reasonably practicable’.

1.4 Calculating occupant loads

1.4.1 The Acceptable Solutions require occupant loads to be determined for each firecell. To determine the occupant load for a particular space, apply the occupant density from Table 1.2 in the relevant Acceptable Solution to the gross floor area of that space. This includes any space occupied by furniture, fittings or internal partitions. If an activity is not specifically described in Table 1.2, select the one closest to the actual activity to determine the occupant load.

If there are a number of different activities in a firecell, it will be necessary to determine the occupant load for each part of the firecell where these occur. If a part of a firecell is to be used for different activities at different times, select the activity that has the greatest occupant density to determine the occupant load.
It will also be necessary to determine the *occupant load* for each floor of a multi-storey building so the required widths for vertical *escape routes* can be established.

It is not necessary to determine the *occupant load* for any spaces that may be occupied by the same people already accounted for in calculating *occupant loads* for another space. Examples are tea rooms, sanitary facilities and exitways. However, exercise some care if it is probable that the space may be used for a concurrent activity; for example, a meeting room in an office building that may be occupied by people from outside the office.

**C/AS3: Occupant loads for risk group SI**

**Number of beds:** In most situations, it is clear that the number of beds means the number of bed spaces provided. However, in some cases, people may be in care or undergoing treatment but may not actually be treated on, or recover in, a bed. In these cases, it is important to count these people as if they were on a bed.

**Fixed seating**

1.4.4 If a space has fixed seating, the *occupant load* can be taken as the number of seats. For churches and other similar venues using pew or bench-type seating, whether fixed or not, Table 1.2 allows for 0.45 linear metres per person of seating space. Take care if there is additional space over and above that allowed for *escape routes*, as this is more than likely to be used as standing space on occasions such as funerals where greater than normal attendance may occur.

**Justification for exceptions**

1.4.6 In some cases, the *occupant load* derived from Table 1.2 may be clearly more than that which would occur in practice. The stated *occupant load* may be reduced to more realistic levels, so that it is below a trigger point for a particular *fire safety system* (for example, if the *occupant load* is less than 1000, no sprinkler system is required). However, to do this, the proposal must be substantiated to the *building consent authority*.

1.4.7 In other cases, the *occupant load* may exceed the calculated amount. If so, justification for this will have to be provided to the *building consent authority* ensuring that the actual *occupant load* is the basis of the design followed for the Acceptable Solution. This may affect design elements such as *fire safety systems* and *escape route widths*.
Commentary on control of fire and smoke spread

Safeguards to control fire and smoke spread

In order to meet the performance requirements of NZBC C1 to C6, the Acceptable Solutions specify a number of safeguards to control fire and smoke spread. The most important are:

a) Internally, by:

   i) dividing a floor where people sleep and where the floor comprises more than one title into firecells to facilitate rescue and protect household units and other property
   ii) requiring floors to be fire separations, except where the floor is in a household unit or it is an intermediate floor
   iii) providing fire separations between firecells and safe paths, and
   iv) providing sprinklers within buildings, and

b) Externally, by:

   i) constructing external walls and aprons to avoid vertical fire spread outside the building, and
   ii) constructing external walls to limit horizontal fire spread by thermal radiation.

One or more of these safeguards will be required, depending on the risk group.

Precautions for protecting other property apply only to parts of a building which, if radiation or collapse occurred, would cause damage across a relevant boundary, or to an adjacent household unit or other sleeping space.

Control of internal fire and smoke spread

The extent to which internal fire and smoke spread must be controlled and the methods adopted will depend mainly on the risk groups and activities within the building. The time required for occupants to escape to a safe place must be controlled. Furthermore, the Building Act 2004 section 4(2)(i) requires household units, other residential units and other property to be protected from the effects of the spread of fire.

This control can be achieved by one or more of the following:

a) Subdividing firecells into smaller firecells or smokecells
b) Separating high-risk activities from other activities, especially for sleeping risk groups
c) Ensuring the integrity of construction joints and closures in fire separations and smoke separations
d) Preventing the movement of fire and smoke through concealed spaces and services ducts
e) Using appropriate materials and surface finishes
f) Installing equipment which, when fire occurs, activates automatically to suppress fire and smoke spread.
Part 2: Firecells, fire safety systems and fire resistance ratings
Acceptable Solutions C/AS1 to C/AS7

2.1 Provision of firecells

Firecells

2.1.1 A building may comprise one or more firecells depending on the fire hazard. Firecells are required to contain a fire for sufficient time to allow safe evacuation, and to prevent fire spreading to other firecells or adjacent buildings.

Firecells may also be divided into smokecells to restrict the spread of smoke and hot gases during escape.

2.2 Fire safety systems

Fire safety systems within firecells are required so that:

a) Occupants, in the event of fire, have reasonable warning and protection while making their escape to a safe place
b) The spread of fire is restricted, and
c) Fire Service personnel have sufficient time to undertake rescue operations.

C/AS2: Fire safety systems for risk group SM

The requirements for fire safety systems for risk group SM vary depending on the escape height and whether the activity is classified as permanent accommodation, temporary accommodation or education accommodation.

C/AS3: Fire safety systems for risk group SI

The requirements for fire safety systems for risk group SI reflect that the occupants are largely incapacitated or prevented from self-evacuating. So early warning by smoke detection is required and the building needs to be protected with an automatic fire sprinkler system to provide additional time for an evacuation.

C/AS6: Fire safety systems for risk group WS

Buildings in risk group WS have to be protected with automatic fire sprinkler systems because of the high fire load or fast fire growth that is likely in the event of fire.
C/AS7: Fire safety systems for risk group VP

If a vehicle stacking system is used for either boats or cars, the building has to be protected with an automatic fire sprinkler system. This requirement recognises the increased risk of fire spread where fire loads associated with cars and boats are spaced in a vertical alignment close together. It also recognises the difficulty that firefighters would face accessing the source of ignition and extinguishing a fire.

More than one risk group on a floor

2.2.4 If a building has more than one risk group, regardless of the number of floors, the fire safety requirements will be dictated by the primary risk group within each firecell. With regard to alarm and sprinkler systems, if one firecell requires an alarm or sprinkler system the rest of the building shall be protected with the same system, except in the following cases:

a) If a Type 1 system is installed in household units, then the Type 1 system does not have to be installed in spaces that are not household units
b) If a building is required to be protected with a Type 4 system then any household units must be protected with a Type 5 system
c) If household units are protected with a Type 5 system, then the areas that are not household units must be protected with a Type 4 system, and
d) If a Type 4 smoke detection system is being used, this does not have to be extended into vehicle parking areas or any other areas where smoke detectors may instigate unwanted activations. However, the space will have to be protected with heat detectors instead; for example, in accordance with the requirements of NZS 4512.

If a building has multiple alarm or sprinkler systems, these must be interconnected so that activation in any part of the building will sound an alarm in all parts of the building, except in the following cases:

a) The local smoke component of a Type 5 system, and
b) For risk group SI, if the building consent authority is satisfied that building management systems allow for notification of management and staff for their action without notifying other occupants. In this case, management and staff will be required to carry out the evacuation, which will generally be to a place of safety within the building rather than to a safe place. There must be the ability to sound a general alarm as well.
2.3 Fire resistance ratings

To prevent fire spread or structural collapse, the Acceptable Solutions require building elements to have fire resistance ratings (FRRs). The level of FRR required depends on the risk group of the building.

Fire resistance tests: The only way to determine the FRR of building elements is by using the standard tests specified in Appendix C of the Acceptable Solutions.

FRR components

An FRR comprises three numbers: these give time values in minutes for structural adequacy, integrity and insulation. Primary and secondary elements required to have an FRR will, depending on their function, need to satisfy one or more of these three criteria as follows:

a) Structural adequacy: usually provided by primary elements within a firecell. These include building elements which are part of the structure, and those providing support to other elements with an FRR within the same or adjacent firecells. Examples are: columns, beams, floors and walls (which may also be fire separations). Paragraph 4.3 of the Acceptable Solutions describes special situations where primary elements need not have an FRR.

b) Integrity: usually provided by secondary elements. Examples are fire separations, which are internal partitions and floors, areas of external walls not permitted to be an unprotected area, and some areas of roofs when close to another building or crossed by an exitway. Primary elements forming an integral part of a fire separation are also rated for integrity.

c) Insulation: applies to fire separations and is required where the transmission of heat through the element may endanger occupants on the other side or cause fire to spread to other firecells or adjacent buildings. For example, insulation is necessary for fire separations between sleeping spaces, where protecting a safe path or through external walls.

FRR values

The values applied to each of the three components of the FRR depend on the function and location of the building element to which the FRR applies. In some cases, all three numbers (for structural adequacy, integrity and insulation) will be the same. In others, the numbers will differ and some may have a value of zero.

For example:
If a rating (eg, 45 minutes) applies to an isolated column in a firecell, the FRR is 45/-/- . However, if the column is integral with a fire separation wall having an FRR of 30/30/30, the column FRR is 45/30/30.

2.3.1 The Acceptable Solutions use life and property ratings to differentiate whether a building element needs to perform for a period to allow occupants to escape (life rating) or to protect other property and to protect firefighters where required (property rating). Each of the
Acceptable Solutions specifies the life and property ratings to be applied for that risk group. When an FRR is specified for a particular situation, the life or property rating requirement can be ignored.

C/AS3 and C/AS6: FRR values for risk groups SI and WS

The FRR specified for risk groups SI and WS takes into account the fact that the firecells are protected with an automatic fire sprinkler system. Therefore, no further reductions are allowed.

2.3.3 If there are fire separations between different risk groups on the same floor, the FRR of the fire separation will be dictated by the highest of the required FRRs of each risk group. That FRR will also apply to the separations surrounding common areas and escape routes.

General requirements for FRRs

When applying FRRs to building elements such as wall and columns, it is necessary to consider the face of the element that will be exposed to fire. For example, if a wall is situated between two firecells that will be normally occupied, it is necessary to apply the FRR to both sides of the wall. If a wall is situated between an occupied firecell and a safe path, the exposure would only be from the occupied firecell side so it is only necessary to apply the FRR to this side.

If the required FRR is different on each side of the separation, it will be necessary to apply the higher of the required ratings to both sides of the separation.

In the case of floors, it is only required to rate the floor on the underside, as it is not very common for fires to burn through a floor and spread downwards.

If a column or beam is part of a vertical separation, or if a beam is part of a floor, they must have at least the same rating as the separation or floor they form part of. This ensures that the separation or floor will have the required performance.

If an element such as a column or a wall is located within a space and a fire can attack the element on all sides, this element must be constructed with a one-way fire rating all the way around (in the case of a column) or on both sides.

Similarly, if a column, beam or wall supports another building element that is part of a fire separation (such as a wall or floor), it must have an FRR at least equivalent to the element that it supports.

In addition, columns, beams and other structural framing elements must either:

- have the same FRR as the element they are attached to, or
- be designed so that, if they do collapse during a fire, this would not cause the collapse of the fire rated element.
For example, a beam attached to a *fire* rated wall may not itself need a *fire* rating as it is not providing support to any *fire* rated separation. However, it must either have the same rating as the *fire* rated wall or be designed so that, if it did collapse, it would not ‘push’ or ‘pull’ the wall down as a result of its failure.

**Unprotected areas**: In most cases, *external walls* only have to be rated from inside the wall. The exceptions are if the wall is closer than 1.0 m to the boundary or if the *building height* is greater than 10 m (it is important to note that it is the *building height* and not the *escape height* that is specified). In both these cases the wall must be rated from both sides. This is because the wall has to provide some protection from attack by *fire* either from across a boundary or from a *firecell below* the wall (it provides protection from vertical spread up the face of the *building*).

**FRR values**

**Applying insulation component in FRR**

2.3.12 *Insulation* ratings generally apply to all *fire separations* in unsprinklered *firecells* and *external wall areas* that are not part of the *unprotected area*. The *insulation* component is important as it prevents radiation from a *fire* from endangering escaping occupants or from spreading the *fire* by heating *building contents* to their ignition temperature. To protect escaping occupants, it is also important that the *insulation* component is applied to *external walls* close to any external *exitway* if this is the only way for people to escape. If there is an alternative route, you can assume that occupants will use this route instead.

2.3.13 *Fire* rated elements are not required to have an *insulation* rating if the *building* is sprinklered, as it is assumed that the sprinkler system will control the *fire* to the extent that radiation will not pass through the element.
3.1 General principles

3.1.1 Escape routes consist of unprotected routes (open paths) and protected routes (safe paths or smoke lobbies).

The basic principles for the design of means of escape from fire are:

- There should be alternative escape routes from most situations, and
- If direct escape is not possible (such as from a multi-storey building), a place of relative safety such as a protected stairway must be available on the escape route from the building. It must not be necessary to leave a safe path to reach a final exit on the way to a safe place.

There is always the possibility of the path of any escape route being rendered impassable by fire or the products of fire. In most cases, occupants should be able to turn their backs on a fire and walk away from it to a final exit, whether or not that is via a safe path. In some cases, a dead end (single direction of escape) is allowed. Whether or not this is the case, and how far an occupant is allowed to walk without a choice of alternative routes, depends on the risk presented by the building. This risk is represented by:

- The activity
- The area and height of the building, and
- The numbers of occupants using the dead end.

The unprotected part or open path is limited in length so that occupants do not have to walk excessive distances before reaching the comparative safety of a safe path or a final exit. The horizontal portion of a safe path is also limited in length, because the structure does not give indefinite protection to the passage of fire or smoke. Stairways are mostly designed as safe paths and, as such, are designed to be virtually ‘fire sterile’ areas.

The length of vertical safe paths is unrestricted because, once inside a vertical safe path, occupants can be considered to be out of immediate danger. However, in some risk groups and tall buildings, automatic fire sprinkler systems are required to increase the safety of people still further in the event of fire. So that stairways can be maintained free of hazards, the structure of stairs has to be robust enough to withstand flames and smoke for long enough for occupants to traverse the stairs and escape.
C/AS3: Means of escape for risk group SI: While the general principles for means of escape apply to risk group SI, the requirements of Acceptable Solution C/AS3 reflect the fact that, if a fire occurs, the occupants of these buildings will be delayed, will require assistance, will be moved to a place of safety before leaving the building, or may not leave the building at all. However, escape to a safe place outside and away from the building must be provided. This is because it is not sufficient to assume that people will be able to remain in the building as fire is a dangerous and unpredictable phenomenon. In spite of all mitigating measures taken during fire design and the actions of the Fire Service, it may be necessary to evacuate the building at any time during a fire event.

Accordingly, a high level of consultation with the building users should occur to ensure that the philosophy of the fire design is consistent with the building’s proposed use.

### 3.3 Height and width of escape routes

#### Width

**Horizontal escape routes** must be at least 850 mm in width. This width allows an occupant load of 121 (850 mm divided by 7 mm per person for risk groups other than SI) to use the escape route. If the occupant load exceeds this number, calculate the required width of the escape route by multiplying the occupant load by 7 mm per person.

For **stairways**, the escape routes must be at least 1000 mm in width. This width allows an occupant load of 111 (1000 mm divided by 9 mm per person) to use the escape route. If the occupant load exceeds this number, calculate the required width of the stairway by multiplying the occupant load by 9 mm per person.

In both cases, an alternative to providing wider escape routes would be to provide additional escape routes, each with a minimum width as required above.

In unsprinklered buildings the widths of escape routes must also provide for the case that one available route is blocked by the fire. Provision for a blocked escape route can be:

- Providing additional escape routes, or
- Providing the minimum number of escape routes required, but making these wider.

For example, if two escape routes are required and no additional escape route is provided, each escape route has to be sized for the required total width. If three escape routes are required and no additional escape route is provided, these must be wide enough to ensure that any two escape routes provide the required total width. This can be achieved by assuming the widest escape route of those provided is unusable.
If the building is protected with an automatic fire sprinkler system, it is assumed that the risk is low that a fire will grow to an extent that it is capable of blocking an escape route. Therefore, all of the escape routes can be regarded as escape route width.

Handrails and limitations to stairway widths

Where handrails are provided on both sides of a stairway and subdivide a wide stairway, each of the handrails may intrude into the stairway width by 100 mm. Therefore, the total obstruction would be 200 mm (maximum 100 mm each side). If there is a dividing handrail as well as the two side rails, the total obstruction would be 300 mm.

Obstructions

For d), note that door leaves may reduce the width of the exitway within which they are installed. Each door leaf and its furniture may reduce the exitway width by as much as 125 mm. Therefore, a double doorset may reduce the width by as much as 250 mm.

3.4 Length of escape routes

C/AS1: Travel distances for risk group SH

Travel distances for risk group SH can be extended by the installation of an automatic fire sprinkler system (Type 6 or NZS 4517 system) or a smoke detection and alarm system (Type 4 or 5 system) or both (Type 7 system). NZBC F7 requires single point smoke alarms (Type 1) to be installed for risk group SH. C/AS1 and F7/AS1 provide the requirements for their installation.

Open paths

The measurement of open path lengths can be very subjective when designing a new building. Typically, the finished layout of the building is not finalised, while the location of furniture and other contents that would obstruct direct passage to a door out of the firecell is unknown. For these reasons it is necessary to be conservative when determining the open path travel distance. To comply with the Acceptable Solutions, use the following method when the actual path of travel is unknown:

a) Start at the most remote point from an exit door. If this is a corner, the start point is 1.0 m away from the corner, in the direction of escape.
b) Follow a path that is located 1.0 m from the walls of the space.
c) At corners, make the path traverse a distance of 1.0 m from the corner.
d) Alternative paths may start at the same point.
e) Finish the open path length at a final exit door or a door to a smoke lobby or safe path.
Intermediate floors

3.4.3 On intermediate floors in circumstances where the Acceptable Solutions permit the actual measured length to be used for the open path travel distances, the alternative escape route required has to be out of the firecell at the intermediate floor level either straight to the outside (via an external escape route) or into a separate firecell (through a fire separation).

3.7 Special cases of open paths

C/AS4: Fixed seating for risk group CA

3.7.3 The Acceptable Solution specifies the arrangement of fixed seating in theatres and similar buildings. If the seating is tiered, the open path travel distances may be taken as the plan distance from the furthest seat to the exitway.

It is common to have multi-function spaces with seating that retracts to provide clear floor space. The requirements for seat spacing are the same in this form of seating when it is in use. When determining travel distances, treat the platforms upon which the seats are located as an intermediate floor. These platforms do not need to be fire rated.

3.9 Exitways

3.9.1 There are two types of safe path: a vertical safe path and a horizontal safe path. A vertical safe path is a fire separated stairway, while a horizontal safe path is usually a corridor that is fire separated. In most circumstances where both horizontal and vertical safe paths are required on an escape route, they must be separated from one another by a fire rated doorset.

Smoke lobby floor area

3.9.2 A smoke lobby that is provided in an escape route before a vertical safe path must have sufficient capacity to serve as a holding area for occupants who may be delayed by the movement of occupants from other levels using the safe path. Such a holding area is not required for occupants of the highest level served by a descending vertical safe path, or for occupants of the lowest level served by an ascending vertical safe path.

If a smoke lobby precedes a vertical safe path, the number of people that the smoke lobby should be designed to accommodate will be based on the number of people on the floor that are likely to use the vertical safe path. If the smoke lobby is part of a single means of escape, then the entire occupant load (100%) of the floor will have to traverse the smoke lobby to access the vertical safe path.

If there are more than two escape routes from the floor, it may be assumed that 70% of the occupant load of the floor will traverse the smoke lobby. Therefore, if there are two vertical safe paths each preceded by a smoke lobby, the combination of two smoke lobbies plus stairway and landings will accommodate 140% of the floor’s occupant load.
Safe paths

3.10.1 Safe paths are the parts of an escape route that are separated by fire rated construction from other parts of the building such as office spaces, conference rooms and sleeping areas. Generally, the safe path will contain very little in the way of contents and should be regarded as a sterile space. However, the Acceptable Solutions allow some limited activities in safe paths under certain conditions.

3.15 Doors subdividing escape routes

In most circumstances, doors must be hinged and must open in the direction of escape. If the number of people using the door is fewer than 50, the door is permitted by the Acceptable Solutions to open inwards. However, this is not good practice and should be avoided if at all possible.

If a doorway leads to a corridor and the open door would present an obstruction to people escaping along that corridor, the doorway must be recessed into the room. The exception is if there are fewer than 50 people in the room, in which case the door may open inwards.

If the number of people using a door is less than 20, manual sliding doors are allowed. This is useful for small offices or other building spaces with sliding doors on a secondary final exit that would otherwise not be permitted. The restriction to 20 people using the door recognises that the door may be secured in such a way that is not quickly obvious to an occupant, and that the door latches and method of opening may cause a delay in escape.

Roller shutters and tilting doors must not be used on an escape route as they significantly delay the time to escape. The only situations they could be considered are:

a) A small storage area that would be intermittently occupied, in which the only access is via the roller shutter, and which would have the shutter door open when it occupied, therefore allowing free egress, and
b) Roller shutters on individual retail units for example in a shopping mall, where staff would occupy the units briefly at the start and end of the trading day with the roller shutter in the closed but not locked position. At all other times, while customers were present, the roller shutter would be in the open position.

Not barred or blocked: It is important that doors on escape routes are not barred or blocked when the building is occupied and that any locking devices are easily operated. The use of a key for unlocking is not allowed as the door can be locked and the key removed.

Door opening forces: The door opening forces described in the Acceptable Solutions as those able to be opened using one or two hands are those able to be applied by an average, able-bodied person.
Vision panels

3.15.6 Vision panels are required in doors where the opening of a door could block or injure another occupant. As doors in residential units and on hotel rooms open inwards, it is not necessary for a vision panel to be fitted to them despite the fact that they open into a safe path. This maintains the privacy of the occupants of these spaces.

Panic fastenings

3.15.12 Panic fastenings are required on doors in buildings where there are large numbers of people in the following circumstances:

a) For retail building uses, if there are at least 500 people in the building, and
b) For other crowd and assembly uses, if there are at least 100 people in the building.

The reason for the higher limit for retail use is that there is potentially more control of the people in such building uses. Retail activities are generally during daylight or early evening hours; and other social factors come into play.

Other crowd and assembly activities are more likely to be evening and night activities. In these cases there is likely to be less control over the people and many of the buildings will be serving meals and refreshments: these factors lead to a higher risk. Therefore, a lower limit has been set before doors have to be easily opened using panic fastenings.

If a building requires panic fastenings, these must be fitted on all doors on an escape route that have the potential to be used by a large number of people, and which would normally be locked or otherwise secure from one side of the door. For the most part, these doors would be at the final exits from the building. However, there will be circumstances that doors elsewhere on the escape routes need panic fastenings fitted. These could be doors to stairs that are not used during the building’s normal operation (emergency exit only) or doors to back-of-house areas that aren’t normally used by building visitors.
Part 4: Control of internal fire and smoke spread
Acceptable Solutions C/AS1 to C/AS7

4.1 Firecells

4.1.1 If a building contains more than one firecell, each firecell must be separated from any other firecell. The FRR of the fire separations shall be determined by the ratings required for risk groups of the firecells either side of the fire separation. The higher of the required ratings will be the rating of the fire separation.

C/AS1: Internal spread of fire for risk group SH
Where there is more than one household unit in a building, each household unit must be separated from other household units by fire separations with FRRs of at least 30/30/30. The garage space for a household unit may be integral with it.

C/AS7: Service vehicle bays and unloading areas for risk group VP
C/AS7 allows service vehicle bays and unloading areas to be part of other support firecells. This allows some limited vehicle parking in the support firecell for a short time. However, the vehicle bay cannot be used for overnight parking or storage of other vehicles.

4.2 Glazing in fire and smoke separations

4.2.1 Glazing in fire separations must be fixed and not able to be opened. The glazing must also comply with the FRR of the fire separation in which it is installed, but it does not have to have a structural adequacy component as it does not generally take any load. Uninsulated fire resisting glazing is allowed in some cases where an FRR is required (for example, in sprinklered buildings) and in all cases where the glazing is in a smoke separation.

4.2.3 Smoke separations, including smoke lobbies, may be a 100% glazed area. Because there is no requirement to resist heat, non-fire resisting glazing may be used as long as it is toughened or laminated safety glass.

Fire doors and smoke control doors

4.2.4 If fire doors have any glazing other than a vision panel with an area less than 65,000 mm², this glazing must be fire resisting glazing with the same integrity and insulation value as the door. If the door requires an insulation value, an uninsulated vision panel up to the above specified area may be used without downgrading the insulation value of the door.

Glazing in smoke control doors must meet the same requirements as the smoke separations.
4.4 Fire stopping

4.4.1 It is essential that any holes or gaps in or around fire separations are effectively sealed to preserve the integrity of the fire separation. Where two fire rated walls meet or where a fire rated wall meets a fire rated ceiling system or roof, any gaps between them must be fire rated. If any penetrations for data cabling, plumbing or other services are put through the fire separation, these must be fire stopped using a system that is tested and designed for the size and type of penetration and for the building system through which it passes.

Proprietary systems are usually designed for a certain orientation (horizontal or vertical), for a particular size of penetration, and for a particular type of wall or ceiling (such as light timber frame or concrete masonry). It is important that the manufacturers’ instructions are followed for the installation of any fire stopping system or material, particularly in relation to any support required for the fire stopping system.

The FRR of the fire separation must be maintained where the lining of the wall is penetrated for installation of building components such as flush boxes for electrical outlets, or telephone and data connections. In these cases, either the wall around the penetration can be recessed or a proprietary system used.

The Acceptable Solutions require that the system used to protect any penetration has an FRR determined by a fire resistance test with the penetration in place (AS 1530.4) or in accordance with AS 4072 Part 1 as appropriate.

4.5 Firecell construction

4.5.1 Firecells are bounded by fire rated separations, external walls and, in many cases, an unrated roof. The FRR of a particular fire separation will depend on the risk group of the firecell on either side of the separation. If it is an external wall, the distance from the boundary may mean that it can be completely (100%) unprotected and therefore not require an FRR. Full floors in multi-storey buildings must have an FRR (this does not apply to floors within household units) in accordance with the life or property rating. The FRR of the supporting elements of intermediate floors and the access stairs will depend on the risk group of the firecell where they are located.

Fire and smoke separations must be completely sealed. They can only have openings for doors, other closures (such as access hatches) and for glazing. These components must have the same performance against the passage of fire, smoke or both as the rest of the fire and smoke separation. Any penetrations must be fire rated as described in Paragraph 4.4 of the Acceptable Solutions on fire stopping.
Junctions of fire separations

4.5.5 Where two fire separations meet, this junction must be fire rated. The junction must also have the FRR of the highest rated separation if these differ.

Junctions with roof

4.5.7 If walls extend to a roof, the integrity of the fire separation within the building can be maintained either by extending the wall above the roof line by a distance of 450 mm or by constructing the wall up to the roof line and sealing the junction. The latter is difficult to achieve for profiled metal roofing with a profile of less than 40 mm and also maintain the moisture management system of the roof. In this case, the wall may be terminated as close as possible to the roof line without interfering with the netting, fire retardant building paper or other moisture management measures (see Figure 4.3 of the Acceptable Solutions).

Ceiling space firecells

4.5.8 An alternative method of dealing with separation at roofs is to construct a fire rated ceiling void that extends over more than one firecell. In this case, the ceiling becomes the fire rated separation up to which the walls extend and the junctions are sealed. The ceiling only has to have an FRR for exposure below it. This is on the assumption that the ceiling void will be unoccupied and not used for storage, that the risk of ignition is low and, if ignition does occur, the fire will vent through the roof and will not be a significant hazard to people escaping the building. The space between the ceiling and roof then becomes a firecell. Any penetrations in the ceiling would also need to be fire rated.

Sealing of gaps

4.5.9 Any gaps and penetrations in and between fire and smoke separations must be fire rated. Any system used to seal the gaps must have an FRR determined in a fire resistance test in accordance with AS 1530.4.

4.6 Specific requirements

4.6.1 C/AS2: Risk group SM

Group sleeping areas and suites

Group sleeping areas (GSAs) and suites are particular arrangements of sleeping accommodation used in temporary accommodation. Refer to the definitions of these terms to ensure that the correct requirements for these areas are satisfied.

Occupants of GSAs, unlike occupants of suites, are not assumed to have any feeling of mutual responsibility. Typically, GSAs will be arranged as bunkrooms or dormitories. Acceptable Solution C/AS2 requires that halls (such as community and school halls) and wharenui used at any time for sleeping should be designed as GSAs.
Suites are self-contained units that providing sleeping accommodation for a number of people with some degree of mutual connection. A suite is usually arranged with one or more separate sleeping spaces in addition to living, sanitary and kitchen areas.

Household units

Household units in risk group SM must be separate firecells. However, those units may have more than one floor that is not a fire separation, provided that the travel distances are within the maximum allowed distance for this risk group.

C/AS3: Risk group SI

Group sleeping areas, suites and special care facilities

For risk group SI, GSA and suites are particular arrangements of sleeping accommodation used where care is provided. Refer to the definitions of these terms to ensure the correct requirements for these areas are met.

In particular, note that GSA requirements for risk group SI differ from the requirements in risk group SM. GSAs in this risk group may have 12 beds if they are fire separated from other GSAs. However, if there are two or more GSAs side by side, this allowance increases to 20. That is because the provision of an adjacent GSA, being a firecell, allows the movement of beds horizontally and this provides a temporary refuge while further evacuation is arranged.

Alternatively, the care situation may be designed as a suite with a limit of six beds. The suite can include other facilities that are shared between the occupants.

GSAs and suites are required to be separated from each other and from other spaces.

Acceptable Solution C/AS3 also provides the requirements for situations where, because of the nature of the procedures being carried out (such as sedation, chemotherapy etc), patient movement may be delayed even more than that expected for a general hospital ward.
4.10 Intermittent activities

Support activities

4.10.1 Intermittent activities that are directly supporting the primary activity of a risk group are deemed to be part of the main risk group activity. Therefore, they may be included in the same firecell as the risk group and do not require fire or smoke separation. The fire safety systems required for the risk group also apply throughout any separate spaces that contain the intermittent activities.

If the spaces are required to be a separate firecell, the fire separations have to have an FRR in accordance with the life rating.

Examples of spaces which provide support functions and which are occupied intermittently are: corridors, tea rooms, ironing rooms, laundries, waiting rooms, and kitchens in assembly halls.

Solid waste storage

4.10.2 When located adjacent to occupied spaces, solid waste storage areas must be enclosed and must be designed as their own firecell to protect occupants and provide them with time to escape.

If the solid waste storage area is in an intermittently occupied space such as a car park, it can be open to that space. This provides the opportunity for the alarm to be raised early if a fire does start, as the risk of large numbers of occupants being in the space is low. Fire spread should be contained by the fire separations around the intermittently occupied firecell.

Plant, boiler and incinerator rooms

4.10.3 Incinerators, plant, boilers or machinery which use solid fuel, gas or petroleum products as the energy source and that are large enough to require their own room all present a significant risk of ignition. Therefore, they must be contained in their own firecell. This requirement does not apply to domestic appliances such as water heaters or local heating. These plant and machinery rooms, no matter what level in the building they are located on, must also have an external wall with direct access from the outside. This is for ease of access if an incident does occur. In addition, if gas-powered plant or machinery is contained, the floor must be no lower than the ground level outside the room. This allows gases which are normally heavier than air to escape rather than accumulate low to the ground, as this creates a risk of ignition and rapid increase in pressures and flame spread. There may also be additional access from inside the building. However, the building must have a smoke lobby before entering the room and the lobby must contain at least a heat detector.
4.10.4 If the plant room is a completely separate building, it will have external walls and will most likely already have access direct from the outside. Therefore, the only relevant requirement is that, if gas-powered plant or machinery is used, the ground floor must be no lower than the ground outside.

4.11 Protected shafts

Lifts, conveyors and services

4.11.1 Lifts and other conveyances in a building can facilitate fire and smoke spread. Therefore, if they serve more than one firecell (e.g., lifts in a multi-storey building), they need to be enclosed in a fire separated protected shaft. The protected shaft must have an FRR determined by the FRR of the risk group of the adjacent firecell and must be rated for exposure on both sides. This includes the top and bottom of the shaft if these terminate below the roof or above the lowest floor.

In addition, in an unsprinklered building where lift doors open into an open path or horizontal safe path, the landing must be smoke separated from the adjacent space. This can be achieved by having a smoke lobby between the landing doors and the open or horizontal safe paths. It is understood that some lift manufacturers have landing doors that have a smoke control capability. If so, this would negate the need for a smoke lobby. However, the lift doors would have to have a test certificate stating compliance with a medium temperature smoke test such as AS 1530 Part 7.

Openings in protected shafts

4.11.4 Protected shafts must be surrounded by construction with an FRR. Accordingly, any openings in the protected shaft must be protected to the same extent as the protected shaft itself. However, the Acceptable Solutions provide a list of exceptions to this rule, principally because it is impractical to close the opening completely and the risk of fire spread is deemed to be low despite the existence of the opening.

Solid waste and linen chutes

4.11.5 Solid waste and linen chutes are a specific type of protected shaft. The requirement to protect with sprinklers within the shaft is intended to guard against fire spread via the shaft should a fire occur in the solid waste or linen collection area at the base of the shaft. If these areas are themselves protected with a fire sprinkler system, the risk of such spread is low and therefore the ‘in-shaft’ protection is not required. Additional protection is provided by requiring that the ends of the chute cannot be in an exitway.
4.13 Floors

Floors have to be fire rated for exposure from below. There is a low risk of a fire in a space spreading downwards through a floor.

Intermediate floors

It is the intention of the Acceptable Solutions to allow for mezzanine floors or galleries within a firecell that are open to the firecell floor below, but with some limitations. Household units can have floors that are not fire separations provided that the requirements for maximum allowable travel distances are met. However, in other types of building, it is not the intention to permit upper floors to not be fire separated from the ground floor. The Acceptable Solutions limit the area of, and number of people on, any intermediate floor and specify that, if an intermediate floor is present in a firecell, the escape height of that firecell is the height from which occupants have to escape from the intermediate floor.

While the space on the intermediate floor is not required to be a firecell, the floor does have to be fire rated to allow occupants to escape and, to a lesser extent, to allow firefighters access to search and conduct firefighting operations. The Acceptable Solution specifies the FRR of the intermediate floor, its supporting structure and the access stair or stairs.

4.14 Subfloor spaces

Subfloor spaces that are not normally occupied can present a risk of fire starting undetected and then growing to the extent that it jeopardises the occupied spaces of the building. Therefore, the Acceptable Solutions require that the floor above a subfloor space has an FRR unless the design of the space complies with a number of conditions that reduce the risk of fire ignition and growth taking place.

One of these conditions is to extend the vertical fire separations and external walls down to ground level to enclose the space. In the case of the external walls, the extension to ground level must be solid construction rather than open construction such as trellis work.

4.15 Concealed spaces

Concealed spaces in buildings present the potential for unseen fire and smoke spread. This is mitigated by ensuring that concealed spaces are fire and smoke separated from firecells and that narrow concealed spaces are sealed at regular intervals to reduce the extent of any spread. If a space such as a ceiling void is not itself separated from the firecell below, then the vertical fire separations must be extended so that the ceiling void is separated from any other parts of the ceiling void that would be above other firecells.

4.16 Closures in fire and smoke separations

Closures in fire separations include shutters, fire and smoke curtains, access panels and doors. Because closures are not load-bearing, they do not need a structural adequacy rating. In the case of sprinklered buildings, they also do not need an insulation rating.
4.17 Interior surface finishes, floor coverings and suspended flexible fabrics

Walls, ceilings and ducts – surface finish requirements

4.17.1 In the 2009 version of Acceptable Solution C/AS1, interior surface finishes were required to comply with indices that were achieved using a standard test (AS 1530.3). Building Code Clause C3.4 specifies the requirements for surface finishes of walls and ceilings and the requirements for floor coverings. These requirements are now based on ISO Standards. The Acceptable Solutions replicate the requirements and reference the ISO standard tests (ISO 9705 and ISO 5660). These are more accurate at predicting the behaviour of products when exposed to fire. The old test method (AS1530.2) remains only for the calculation of the flammability index for suspended flexible fabrics.

The Acceptable Solutions specify the maximum permitted Group Number of a surface finish for locations within buildings. In some cases, the Group Numbers include an ‘S’ suffix. This indicates that there is a maximum smoke production rate of the material in that location as well as a maximum total heat release of the product. The smoke requirement does not apply to surface linings in sprinklered spaces.

The Group Number of a product is determined from criteria provided in Verification Method C/VM2 Appendix A. It is expected that manufacturers of products will have their products tested and will be able to provide specifiers with the results of the testing.

Note that for sprinklered buildings, surface finishes must be assessed however there are relaxed criteria for the provision of sprinklers.

Floor coverings are required to satisfy limits on a criterion known as critical radiant flux.

C/AS1: Risk group SH

If foamed plastics or fibrous plastics are used in any part of the wall, ceiling or roof, they must comply as specified in the Acceptable Solution. The Group Number is established by subjecting the material to an ISO standard test (the method of assigning Group Numbers is explained in Verification Method C/VM2 Appendix A). The Acceptable Solution provides an exemption to this requirement for certain fixtures, fittings and building elements where the limited surface area is deemed not to present a major hazard.

Wood and wood products in floors

4.17.5 This requirement is specified to mitigate possible downward spread from a firecell through a floor system which has only been tested from the underside. The requirement uses the charring rate of timber down through the floor material. If the timber is part of a flooring system that has the stated FRR with the flooring as the exposed side, this would also provide the required protection against the downward spread of fire. In most cases, a concrete slab floor with a thin timber overlay would satisfy the requirement.
5.1 General principles

External walls and roofs (see Figure 3) must be constructed to avoid vertical and horizontal fire spread. Vertical spread up the outer face of the external wall of a building may occur as result of spread up an external cladding or through gaps between floors and walls which might exist in construction such as curtain walling.

Horizontal spread has to be prevented to protect other property, sleeping spaces in any adjacent building or external safe paths that may be present. Horizontal fire spread will occur as a result of either radiation from non-fire rated areas of a wall or from the collapse of part of the structure of a wall.

Figure 3: External walls and roofs
The necessary protection may be achieved by one or more of:

a) Separation distance between buildings
b) Using building elements that have an FRR
c) Restricting the use of combustible surface finishes
d) Limiting the areas of external walls and roofs that are close to a title boundary and that do not have an FRR (this includes unrated glazing and features such as roof lights)
e) Providing parapets, spandrels or aprons (see Figures 3 and 4)
f) Protecting the building with an automatic fire sprinkler system.

Figure 4: Spandrels, aprons and sprinklers

C/AS1: External spread of fire for risk group SH

Buildings in risk group SH must protect other property. This is achieved if these buildings are either 1.0 m or more from a relevant boundary. If they are within 1.0 m of the boundary, this can be achieved if the building has a two-way FRR of at least 30/30/30.

Note that eaves tend to extend closer to boundaries and that, if the external wall is required to be fire rated, this requirement also applies to any eaves. If the wall on its own is not required to be fire rated but the building has eaves that are wide enough to encroach within 650 mm of a boundary, both the eaves and the external wall must then be fire rated.

The Acceptable Solution specifies requirements for the surface finishes of external walls to reduce the possibility of the surface finish contributing to radiation across the boundary.
C/AS7: External spread of fire for risk group VP
Unit titled car park spaces and associated storage

The Acceptable Solutions allow unit titled car park spaces and any storage area within the parking area (up to given limits) to be open to other property such as a neighbouring car park space. In previous versions of the Acceptable Solutions, this situation required a waiver to the requirements of the Building Code to be issued.

5.2 Horizontal fire spread from external walls

The Acceptable Solutions provide the methods to achieve the required protection in this situation. These methods depend on the:

a) Distance from the building to a title boundary or another building on the same site
b) Building height, and
c) Width of a wall that faces a boundary.

For buildings other than those in risk group SH, fire spread horizontally across a boundary is mitigated by restricting the radiation that might be incident on property on the other side of the boundary. In the Acceptable Solutions, radiation is controlled by a combination of maintaining a distance from the boundary, reducing the area of wall that might potentially radiate heat from a fire across the boundary, and by sprinkler protection to reduce the potential for a fire to grow to a point where it will be a radiating hazard.

The methods used by the Acceptable Solutions to ensure that radiation is restricted depend on the distance between a wall facing a boundary and that boundary. If the wall is less than 1.0 m from the boundary, it must be almost completely fire rated. Small areas of the wall are allowed to be unprotected and fire resisting glazing on windows is also permitted, but within the limits specified in the Acceptable Solutions.

5.5 Table method for external walls

If the wall is 1.0 m or more from the boundary, then some of the wall may be allowed to be unrated. This allows windows and doors to be fitted in the wall without fire resisting glazing. How much of the wall has to be fire rated depends on a number of factors, including:

• The risk group
• Whether the building is sprinklered
• The width of the wall facing the boundary
• The angle that the wall makes with the boundary (in many cases, the building will not be on a rectangular title so that at least one of the walls will be at an angle to a boundary), and
• The distance of the wall from the boundary.
All of these factors were considered in developing Table 5.2 for each risk group. Table 5.2 can be used to calculate the proportion of a wall that is permitted to be unrated or to vary the distance between the building and the boundary so that all of the wall or a limited proportion of it can be unprotected.

If it is known what percentage of wall area will be glazed and therefore unprotected, the required distance between the wall and the boundary can be determined.

If the wall and the boundary are not parallel, take the distance to the boundary as the closest point between the wall and the boundary.

Note that if the wall is 1.0 m or more from the boundary, it may be rated from the inside only. If the wall is less than 1.0 m from the boundary it must be rated from both sides. This requirement recognises that, where the wall is closer than 1.0 m to the boundary, there is a responsibility for the wall to add to the protection of the building from any fire on the other side of the boundary.

5.6 Horizontal fire spread from roofs and open sided buildings

Open sided buildings

The Acceptable Solutions allow some relaxations where a building or part of a building is open-sided. These relaxations are allowed because there is a considerable area for any fire to vent and thus present a lesser hazard to neighbouring buildings.

For carports that are part of a residential building, it is acceptable for cars to be deemed as an insignificant fire load. However, distance requirements still apply.

The Acceptable Solutions specify the allowable distance between the roof and the relevant boundary.

C/AS1: carports and similar construction for risk group SH

Garages and carports are deemed to be part of a household unit: requirements for these are given in risk group SH. If the garage is a shared space where cars belonging to occupants of more than one household unit are parked, it must be separated from the rest of the building with fire rated construction so that the requirements to protect other property are satisfied.

This Acceptable Solution allows a carport to be closer than 1.0 m to the boundary without protection to other property provided that certain criteria are met. If the carport does not comply completely with any of the criteria, it must be protected as for an external wall (refer to Paragraph 5.2 above).
6.1 Fire Service vehicular access

Buildings must be provided with access that allows Fire Service vehicles to reach a position that makes it convenient for firefighters to get into the building and to any Fire Service inlets. The nature of the occupants of risk group SI means that they are more likely to require rescue by Fire Service personnel. Therefore, additional requirements for this risk group allow for the larger size of aerial appliances and the need to get these close to tall buildings.

If a building has a large footprint (which is most likely to occur for a single-storey building such as a warehouse) and is not protected with fire sprinkler systems, access to two sides of the building is required. This allows the Fire Service the ability to access the building in a number of places and means that their travel within the building is minimised to reach any fire source.

6.2 Information for attending firefighters

6.2.1 The control panel of active fire protection systems must be in a place on the outside of the building that is easy and convenient for firefighters to locate.

6.2.2 If the building contains or processes any hazardous substance, signage in accordance with NZBC F3 must be displayed as a warning to anybody in or close to the building, including firefighters.

6.3 Access within the building for firefighting and rescue operations

6.3.1 The requirements for means of escape and provision of fire safety systems given in the Acceptable Solutions allow the Fire Service to access the building in addition to providing for the escape of occupants.

6.4 Firefighting facilities

Fire hydrant system

6.4.1 Any building fire hydrant system must comply with NZS 4510. Compliance with this Standard provides for the location of inlets and outlets of the system and for the protection of any firefighters using it.

A building fire hydrant system is not required if the distance from the Fire Service attendance point to any point in the building is less than 75 m. As long as each Fire Service attendance point complies with the requirements of the Acceptable Solutions, there may be more than one Fire Service attendance point from which the 75 m may be measured.
Fire Service lift control

6.4.3 If the escape height of a building exceeds 10 m and lifts are provided, these lifts must be provided with Fire Service lift control. This allows the Fire Service to take control and to manage the movement of the lifts to allow them quicker access to upper floors for the purposes of rescuing occupants and also for moving firefighters and equipment to the floor of operations. NZS 4332 Paragraph 25.6 sets out the requirements and method of operation of a lift in Fire Service control. If the area around the lift landing doors is required to be in a smokecell and the lift is required to have Fire Service control, the smokecell cannot be formed using smoke curtains, but must be formed with permanent smoke separations and a smoke control door.
Part 7: Prevention of fire occurring
Acceptable Solutions C/AS1 to C/AS7

7.4 Downlights

7.4.1 The requirements for downlights have recently been changed and there are different specifications for commercial and residential buildings. In residential buildings it is now necessary to install luminaires with the ratings as specified; all of these types of luminaire can be abutted with insulation and some (IC) may be covered, providing the insulation is also suitable for such use.

In commercial buildings, where luminaires not meeting the specifications in the Acceptable Solutions are installed, the default requirement is to maintain a distance of 100 mm from the luminaire and any building element that may not withstand the heating resulting from the luminaire. This includes the insulation.

Where insulation is being replaced or retrofitted, then it will be necessary to maintain the 100 mm clearance regardless of the type of building unless the rating of the luminaire is clearly identified as one listed in the Acceptable Solutions.
Appendix 1: Case Study

Appendix 1 provides an example of a report prepared to communicate the design of a building complying with the Acceptable Solutions.

The contents of the design report also follow the requirements of IPENZ Practice Note PN22, which is also Department guidance.

It is provided to illustrate the level of information required in a design report and is not intended to be used as a template for design reports.
FIRE ENGINEERING DESIGN REPORT
ONLINE WAREHOUSE BUILDING
123 INFERNO DRIVE, PYROTOWN

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APPENDIX 1 – NZFS Correspondence

APPENDIX 2 – Drawings

APPENDIX 3 – Compliance Schedule Information

Issue 1 (Building Consent)
15th September 2012

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15 September 2012
Page 1 of 9
1 Purpose

The purpose of this report is to show compliance with the New Zealand Building Code (NZBC) for Means of Escape from Fire and Spread of Fire as required by the Building Act 2004 for a new building. This report is based on the Acceptable Solution C/AS6 to meet the NZBC Protection from Fire clauses C1-C6.

This report addresses the requirements of the Building Act 2004 only and does not address owners or tenants property protection unless specifically referenced. This report is specific to the building and client, it is not to be used by any third party and no responsibility is taken for any third party who uses this report.

Issues that may arise under the Fire Safety and Evacuation Regulations 2006 should be discussed directly with the New Zealand Fire Service (NZFS).

This report does not examine any storage, ventilation or bunding requirements for hazardous substances as defined in the Hazardous Substances and New Organisms Act 1996 (HSNO) or Building Code Clause F3-Hazardous Substances and Processes, and in particular the Hazardous Substances (classes 1 to 5 controls) Regulations 2001. It is assumed that any hazardous substances not stored as required by the Regulations are in such small quantities as to have minimal effect on the fire load of the building. Building owners should contact an EPA Test Certifier for advice on compliance.

This fire engineering design is a performance document, intended to be used by the Architect and other consultants in implementing their detailed design and preparing their working drawings and specifications. The consultants whose documentation is required to incorporate the requirements of this fire engineering design are expected to have read this report, understood the implications as it affects their scope of work and have incorporated the relevant Protection from Fire requirements into their drawings and specifications.

To ensure the above co-ordination of the Protection from Fire requirements has been undertaken the resulting drawings, specifications and other documents should be reviewed by the author of this report and when satisfied the design coordination statement as required by IPENZ Practice Note PN22 will be provided.

2 Introduction

The building is a new distribution warehouse with a large amount of racking for storage of the online website products. The building height is between 11-14m. The racking in the warehouse cannot be accessed on upper levels and the racking layout is known and is also submitted for Building Consent. There is a small lean-to area attached to the warehouse that is used for product photography, studio, workshop, forklift recharge area and the sprinkler valve room. The offices are beside this lean-to area and above the offices is a small staff room.

This report is based on drawings by ABC Architects, sheets no. 100, 101 and 102, dated 29th November 2011 as attached in Appendix 2. The drawings at the rear of this fire report in Appendix 2 form the fire engineering documentation.
3 Occupancy

The building contains the following risk groups and storage and escape heights based on Table 1.1 of C/AS6.

<table>
<thead>
<tr>
<th>Location</th>
<th>Risk Group</th>
<th>Storage Height</th>
<th>Escape Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse</td>
<td>WS</td>
<td>&gt;5m</td>
<td>0</td>
</tr>
<tr>
<td>Offices/Staffroom</td>
<td>WB</td>
<td>&lt;3m</td>
<td>3</td>
</tr>
</tbody>
</table>

The occupant numbers in the building are as follows based on Table 1.2 of C/AS6.

<table>
<thead>
<tr>
<th>Location</th>
<th>Floor Area (m²)</th>
<th>Occupant Density (m²/person)</th>
<th>Number of Occupants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse</td>
<td>10860</td>
<td>100</td>
<td>109</td>
</tr>
<tr>
<td>Studio</td>
<td>195</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Offices</td>
<td>275</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td>Photography</td>
<td>186</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>Staff Lunchroom</td>
<td>266</td>
<td>5</td>
<td>53</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>176</strong></td>
</tr>
</tbody>
</table>

Note: Occupant load in the lunchroom is not counted for the purposes of total occupant load of the building. But the occupant load of the space is required to ensure that sufficient escape routes are provided from this space.

4 Fire Safety Systems

The following table summarises the fire safety systems to be installed in the building as required by C/AS6/2.2.1.

6 Automatic fire sprinkler system with manual call points to NZS 4541:2007, NZS 4512:2010 and F7/AS1. This system is to be extended into the WB Risk Group as required by C/AS6/2.2.3.

18 Fire hydrant system to be installed in accordance with NZS4510.

An Early Suppression Fast Response (ESFR) automatic sprinkler system is being installed in the building. This is to be installed in compliance with NZS4541:2007 and NZS4512:2010. In-rack sprinklers are not being provided due to the use of the ESFR system. An onsite water supply is provided by a tank and diesel pump system. The fire protection engineer has undertaken a detailed fire sprinkler system design for the specifics of the building including specific storage issues. The building is designed for an ‘all-out’ evacuation scheme.

Emergency lighting is to be installed in the building in the locations and to provide the minimum Lux as required by F6/AS1. This report does not address Visibility in Escape Routes and it is therefore to be designed and detailed by others for compliance with clause F6 of the Building Code. Information in this report such as occupant load, escape routes and the location of EXIT signs will be required in order for the
electrical consultant to design adequate illumination. Note also that any escape routes marked on attached fire safety plans are not to be taken as ‘specific escape routes’ in terms of F6/AS1/1.3.2. However any ‘exitways’ are identified.

Fire hose reels and extinguishers are not required by C/A6 for this building. However they are required by the sprinkler standard NZS4541 and are recommended and may be required by the NZFS under the Fire Safety and Evacuation of Buildings Regulations, 2006. Fire hose reels are to be installed in the building in compliance with NZS4503.

5 Means of Escape

5.1 No. Escape Routes
The building is required to be provided with a minimum of two means of escape (C/A6/3.2.2). The escape routes are required to be separated by no less than 8.0 m (C/A6/3.6.2). There are many escape routes throughout the warehouse and office. The higher than required number of escape routes are provided to meet the travel length requirements detailed in section 5.4 of this design report.

The lunchroom requires two means of escape as there are over 50 people in the space. Given that this is a full fire rated floor (not an intermediate floor due to its floor area) the stair is required to egress direct to outside or into a safe path stair then to outside. There are two internal stairs shown on the drawings– one into offices and other to warehouse. An additional external stair is to be provided from the lunchroom and the internal stair to the offices is to be fire rated as shown on the drawings in Appendix 2.

5.2 Width & Height of Escape Routes
The following table details the minimum widths of escape routes in the building.

<table>
<thead>
<tr>
<th>Location</th>
<th>Horizontal Travel (mm)</th>
<th>Vertical Travel (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All areas</td>
<td>850</td>
<td>1000</td>
</tr>
</tbody>
</table>

The escape routes in the building as shown on the drawings comply with this requirement. (C/A6/3.3.2). The height of an escape route is to be a minimum of 2100mm, any doors are required to have a minimum clear height of 1955mm. (C/A6/3.3.1)

5.3 Capacity of Means of Escape
The capacity of the means of escape is determined by the size of the doors and escape routes. By observation, the capacity is sufficient for the design occupant load given the number of doors available and relatively low occupant load.
5.4 Travel Distances
In accordance with C/AS6/Table 3.2, the maximum permitted and actual dead end and open path travel distances are:

<table>
<thead>
<tr>
<th>Location</th>
<th>Allowable DEOP (m)</th>
<th>Allowable TOP (m)</th>
<th>Actual DEOP (m)</th>
<th>Actual TOP (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse worst case</td>
<td>50</td>
<td>120</td>
<td>48</td>
<td>120</td>
</tr>
<tr>
<td>Lunchroom</td>
<td>50</td>
<td>120</td>
<td>2</td>
<td>45</td>
</tr>
<tr>
<td>Studio</td>
<td>50</td>
<td>120</td>
<td>29</td>
<td>81</td>
</tr>
<tr>
<td>Offices</td>
<td>50</td>
<td>120</td>
<td>15</td>
<td>33</td>
</tr>
</tbody>
</table>

The travel distances are complied with as shown in the table.

5.5 Doors – swing and locking devices
Doors on escape routes are required to open in the direction of escape if there are more than 50 occupants using the doors. (C/AS6/3.16.3) The doors as shown on the drawings comply with this requirement.

All exit door locking devices should be clearly visible, located where such a device would normally be expected, designed to be easily operated without a key or other security device, and allow the door to open in the normal manner. (C/AS6/3.16.2)

Any doors that are electronically locked are required to unlock in the event of a fire alarm to allow people to escape. (C/AS6/3.16.7)

5.6 Signage
Fire exit signage shall be erected throughout the building in compliance with F8/AS1. Exit signage shall be internally illuminated as part of the emergency lighting system.

Signs are required on all stairwell and corridor smoke doors to identify them as smoke doors and that they are required to be kept closed.

5.7 Miscellaneous
Exit doors and exitways are to remain clear at all times. Exitways shall not be used for storage of goods, solid waste or solid waste containers, or for entry into solid waste chutes. (C/AS6/3.12.1)

Hold open devices are to be fitted to fire doors where the possibility for the door to be wedged open exists (eg. between the offices and stairs to the lunchroom). The hold open devices shall be released by the activation of adjacent smoke detectors, which are part of the fire alarm system and are to be located on both sides of the doors (C/AS1/3.16.9).
6 Internal Spread of Fire

6.1 Fire/Smoke Separations
As per C/AS6/2.3 the life rating is 60 minutes. The life rating applies to all fire separations required for compliance with sections 3 and 4 of C/AS6. In accordance with C/AS6/2.1.1 the sprinklered building may have an unlimited floor area.

The building is split into the following firecells with a minimum 60 minute fire resistance rating:

- Warehouse
- Upper level lunchroom – the fire separation is provided at the first floor walls and at ground level around the stair that opens into the offices. The location of fire rating is shown on the drawings in Appendix 2.

Fire ratings are to extend to the underside of the floor slab or roofing as applicable and as detailed in C/AS6/4.5.7 and C/AS6/Figures 4.2 & 4.3. Doors in the fire separation to be -/60/- SM fire doors with hold open devices as detailed in section 5.7 of this report.

6.2 Intermediate Floors
The building has an upper floor lunchroom that cannot be considered a limited area intermediate floor as per C/AS6/4.13.5 & 6 as it is greater than 35m². Therefore the floor must be treated as a full floor firecell as detailed in section 6.1 of this report.

6.3 Service Penetrations
Any gaps in, or services that penetrate, through fire or smoke rated construction are to be fire rated using certified proprietary systems such as fire collars, fire wraps, intumescent systems etc. The systems are to be installed as required by the certification and manufacturer of the product. (C/AS6/4.4) Particular attention should be made to the selection of proprietary system to ensure that the system is suitable for;

1. the orientation of the building element which is being fire stopped
2. the type of construction through which the penetration passes (concrete masonry, light timber frame etc)
3. size of the gap being stopped
4. size of the hole through which the penetration passes
5. type of penetration (copper pipe, plastic pipe, data cabling etc).

7 External Spread of Fire

7.1 Property Rating
The Property Rating is specified in Paragraph 2.3.1 of C/AS6. For the WS risk group this is 180 minutes. The construction of the building near the boundary uses either 150mm concrete panels or 180mm concrete panels. These achieve 3 hours and 4 hour fire ratings respectively which meets or exceeds the property rating of 180 minutes.

7.2 Boundary Exposures
All of the exterior walls are further than 1m from the boundary. All of the walls have at minimum a 2.4m high wall at the bottom. The lean-to wall is completely fire rated to the boundary therefore fire spread is assessed from the warehouse wall above the rear wall of the lean-to. The walls greater than 10m in height
are to have a two way fire rating regardless of their distance to the boundary – this is achieved with the concrete construction.

The Northern external wall along gridline A is just over 5m to the boundary. It has been agreed that the neighbouring land will be purchased by the owners of this building. Therefore it has been discussed with the Council and owners of the land currently that an encumbrance on the title (under section 75-77 of the NZ Building Act) is to be placed on both titles. This encumbrance recognises the spread of fire risk from the new building to the adjacent title. This encumbrance is to be placed over both titles and is to be carried out by the lawyers of both properties.

C/AS6/Table 5.2 provides the unprotected area allowances based upon the firecell width and distance to the boundary. C/AS6/Table 5.3 details the largest unprotected area allowed in the external wall. The following table details the allowances for the walls close to the boundary that have not been discussed above:

<table>
<thead>
<tr>
<th>Wall Elevation</th>
<th>Distance to Boundary (m)</th>
<th>Firecell Width (m)</th>
<th>Unprotected Area Allowed (%)</th>
<th>Single largest radiator allowed (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East - gridline 6 between E and J</td>
<td>2.5 (use 2)</td>
<td>&gt;20</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>South Warehouse wall above lean-to roof line</td>
<td>7</td>
<td>&gt;20</td>
<td>50</td>
<td>No restriction</td>
</tr>
<tr>
<td>South Gridline E between gridlines 6 &amp; 8</td>
<td>10</td>
<td>&gt;20</td>
<td>65</td>
<td>No restriction</td>
</tr>
<tr>
<td>Western Wall</td>
<td>&gt;20</td>
<td>&gt;20</td>
<td>100</td>
<td>-</td>
</tr>
</tbody>
</table>

The allowable unprotected areas in the table above have not been met in the South wall of the building and the concrete external wall must be extended up to a height as necessary to meet the areas in the table. The area in the East wall between gridline E and J that is unprotected is 95m². As per C/AS6/5.5.6 this unprotected area can be measured over a 30m width. For this building this means a 60m² unprotected area given the unprotected area is 2m high. This is too large as per Table 5.3 of C/AS6 and therefore the unprotected area must be split so that it meets the allowable 35m² for a single largest radiator. The distance between the two unprotected areas must be at least 2.5m. Alternatively the fire rated wall height can be increased to enable a long strip of 1.1m high to be unprotected over the length of the wall.

7.3 Canopy
The canopy off the building is acceptable given that at least two sides are open to the environment and no part of the roof is closer than 1 m to the boundary.

8 Surface Finishes
Surface finishes within the building are required to meet the following requirements for sprinklered buildings: (C/AS6/6.20.5, C/AS6/Table 6.2) The manufacturers will need to provide information on what group number their product meets.

- Exitways and Internal ducts: Group number 2
- All other occupied spaces: Group number 3
- Suspended flexible fabrics:
  - Fl < 12 in exitways
  - Fl < 5 in underlay where exposed to view in occupied spaces eg; building paper)
Flooring is required to meet the following requirements:

- Exitways = 2.2kW/m²
- All other occupied spaces = 1.2kW/m² minimum critical radiant flux

Any foamed plastics in the wall, ceiling or roof of the building have separate requirements to comply with C/AS6. Foamed plastics are required to comply with C/AS6/4.17.2 which requires the foamed plastic to achieve a group number as detailed above and they shall comply with the flame propagation criteria as specified in AS1366.

There are no surface finish requirements for external walls given the building is sprinklered, the distances to the boundary are greater than 1m and the building height is less than 25m. (C/AS6/5.8)

9 Structural Requirements

Primary structural elements are to achieve the fire resistance ratings specified in this report unless specifically noted otherwise. Any external walls that are required to be fire rated are to meet the post-fire structural stability requirements of AS/NZS 1170 as amended by Paragraph 2.2.4 of B1/VM1, this must be designed by the structural engineer.

10 Fire Fighting

The needs of the New Zealand Fire Service need to be considered and are to comply with Part 6 of C/AS6. Fire Service vehicular access must be provided as per section 6.1.1 of C/AS6. A hard standing must be provided within 20m of entrance – this is provided at front of the building where the offices and canopy are located. The fire alarm panel and fire service inlet is to be located close to the NZFS attendance point. Approval for the locations is to be sought from the NZFS by the fire alarm contractor. A building fire hydrant system is to be provided in the building in accordance with NZS4510.

11 Conclusion

This report shows that the proposed new building for Online Warehouse at 123 Inferno Drive, Pyrotown will achieve compliance with the NZ Building Code as required by the NZ Building Act for Protection from Fire. This is subject to the assumptions and requirements being met within this report. The main requirements of the report are summarised below however the report needs to be read in its entirety to ensure all requirements are met.

1. An Early Suppression Fast Response (ESFR) automatic sprinkler system is being installed in the building. This is to be installed in compliance with NZS4541.
2. A building fire hydrant system it to be provided in accordance with NZS4510.
3. Emergency lighting is to be installed in the building as required by F6/AS1.
4. Fire hose reels are to be installed in the building in compliance with NZS4503.
5. All exit door locking devices should be clearly visible, located where such a device would normally be expected, designed to be easily operated without a key or other security device, and allow the door to open in the normal manner.
6. Any doors that are electronically locked are required to unlock in the event of a fire alarm to allow people to escape.
7. Fire exit signage shall be erected throughout the building in compliance with F8/AS1. Exit signage shall be internally illuminated as part of the emergency lighting system.
8. Signs are required on all stairwell and corridor smoke doors to identify them as smoke doors and that they are required to be kept closed.
9. Hold open devices are to be fitted to smoke control doors where the possibility for the door to be wedged open exists (e.g. between the offices and stairs to the lunchroom). The hold open devices shall be released by the activation of adjacent smoke detectors, which are part of the automatic smoke detection system located on both sides of the doornset.

10. Fire separations are to be provided between the warehouse and upper floor lunchroom as shown on the drawings in Appendix 2. Fire separations are to extend to the underside of the floor slab or roof as applicable. Doors in the fire separation to be -60/-SM fire doors with hold open devices as detailed in section 5.7 of this report.

11. Any gaps in, or services that penetrate, through fire or smoke rated construction are to be fire rated using certified proprietary systems such as fire collars, fire wraps, intumescent systems etc. The systems are to be installed as required by the certification and manufacturer of the product.

12. External wall fire ratings to the boundary have been assessed and the walls comply except in the South wall of the building - the concrete external wall must be extended up to a height as necessary to meet the areas in the table.

13. The area in the East wall between gridline E and J that is unprotected is too large as per Table 5.3 of C/AS6 and therefore the unprotected area must be split so that it meets the allowable 35m² for a single largest radiator. Alternatively the fire rated wall height can be increased to enable a long strip of 1.1m high to be unprotected over the length of the wall.

14. Surface finishes are to meet Section 8 of this report.

15. Structural requirements for fire rated elements are to achieve the fire ratings specified in this report – this includes the intermediate floor and any external fire rated walls.

16. NZFS requirements are provided in section 10 of this report.
APPENDIX 1 – NZFS Corresponsence

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APPENDIX 2 – Drawings
Case Study

FIRE ENGINEERING DESIGN – ONLINE WAREHOUSE, 123 INFERNO DRIVE, PYROTOWN

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FIRE ENGINEERING DESIGN – ONLINE WAREHOUSE, 123 INFERN DRIVE, PYROTOWN

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## APPENDIX 3 – Compliance Schedule Information

The list of ‘Specified Systems’ below are for this building as identified by this fire design. The Specified Systems identified below are not a comprehensive list of systems pertaining to the building. Please ensure that a comprehensive check of all possible systems is carried out when completing the Compliance Schedule.

The extent of coverage of the specified systems and where appropriate their location is identified on the attached plan (N.B. not included for the purposes of this case study). This should be included with the compliance schedule for the building.

<table>
<thead>
<tr>
<th>SS</th>
<th>Specified System</th>
<th>Performance Standard</th>
<th>Maintenance</th>
<th>Inspections:</th>
<th>New</th>
<th>Modify</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Automatic systems for fire suppression</td>
<td>NZS 4541:2007</td>
<td>By IQP:</td>
<td>Weekly: as necessary</td>
<td></td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>Type: 6 sprinkler system</td>
<td></td>
<td>Monthly:</td>
<td>In accordance with NZS 4541 Paragraph 1202.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quarterly:</td>
<td>In accordance with NZS 4541 paragraph 1202.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yearly:</td>
<td>In accordance with NZS 4541 Paragraph 1202.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Biennial Routine Inspection:</td>
<td>In accordance with NZS 4541 Paragraph 1203.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Manual emergency warning systems for fire or other dangers</td>
<td>NZS 4512:2010</td>
<td>By IQP:</td>
<td>Monthly: In accordance with NZS 4512 Paragraph 602.</td>
<td></td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>Type: 2 manual alarm system</td>
<td></td>
<td>Yearly:</td>
<td>In accordance with NZS 4510 Paragraph 603.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Electromagnetic doors</td>
<td>BS7273 Part 4: 2007</td>
<td>By owner/occupier</td>
<td>Weekly: Check the local operation of release mechanism and closing of door on latch</td>
<td></td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>By IQP:</td>
<td>Monthly: Check release of doors on operation of fire alarm and closing of door on to latch</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yearly:</td>
<td>As for monthly plus maintain door, check closer for operation and latching of door.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Emergency lighting systems</td>
<td>AS 2293.3: 2005</td>
<td>By IQP:</td>
<td>Six monthly: In accordance with Paragraph 3.2 and Appendix B AS/NZS 2293.2</td>
<td></td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>Including illuminated signs</td>
<td></td>
<td>Yearly:</td>
<td>In accordance with Paragraph 3.3 AS/NZS 2293.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Signs relating to, a system or feature specified above.</td>
<td>Signs will be visible under all foreseeable conditions including interruption of mains power.</td>
<td>Ensure Emergency lighting systems illuminate any signs. Signs are clean and legible.</td>
<td>By owner/occupier</td>
<td>Monthly: Ensure signs in place where required, they are legible and clean and are illuminated. Record in log book.</td>
<td>By IQP: Yearly: As per monthly and complete report and required forms.</td>
</tr>
</tbody>
</table>

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### Case Study

**FIRE ENGINEERING DESIGN – ONLINE WAREHOUSE, 123 INFERNO DRIVE, PYROTOWN**

<table>
<thead>
<tr>
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<th>Specified System</th>
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<th>Inspections</th>
<th>New</th>
<th>Modify</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Final exits</td>
<td>Details: Designated final exit doors</td>
<td>All final exit doors to be free of obstructions both sides of the door and not to be locked or barred. Any panic furniture or simple fastenings should operate freely to release door. Full opening of door width is required.</td>
<td>Maintained in a safe condition: free from obstructions, locking, blocking, barring, storage of combustibles and ease of opening at the final exit.</td>
<td>By owner/occupier Daily: Check doors are not locked blocked or barred. Weekly: As daily plus ensure routes to final exits do not contain combustibles and any fastenings open easily and door swings to full width of opening. By IQP Yearly: As above, complete report to owner and complete required forms.</td>
<td>YES</td>
</tr>
<tr>
<td>15</td>
<td>Fire separations</td>
<td>Type: As shown on the drawings in the fire safety design report</td>
<td>All fire separations shall remain imperforate and any closures in the separation shall ensure they would prevent the passage of fire for the period given as the fire resistance rating.</td>
<td>All damage to fire separations (walls, floors, dampers, ceilings etc) shall be repaired as soon as practicable. Doors and other closures shall be checked for operation and security of closure.</td>
<td>By owner/occupier Weekly: Check for damage to separations and operation of doors and security of other closures. Any damage/ failure of door operation or other closure to be repaired ASAP. Record inspection in log book. By IQP Yearly: As above. Complete report to owner and complete required forms.</td>
<td>YES</td>
</tr>
<tr>
<td>15</td>
<td>Signs for communicating information intended to facilitate evacuation</td>
<td></td>
<td>Signs will be visible under all foreseeable conditions including interruption of mains power.</td>
<td>Immediate replacement or refurbishment of signs if missing, incorrect or illegible.</td>
<td>By owner/occupier Monthly: Ensure signs in place where required, they are legible and clean and are illuminated. Record in log book. By IQP Yearly: As per monthly and complete report and required forms.</td>
<td>YES</td>
</tr>
</tbody>
</table>