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# Building Controls Update No. 162

## Protection from Fire – Frequently asked questions update

**25 July 2014:** Since publication on 10 April 2012, the Acceptable Solutions and the Verification Method for Protection from Fire (C/AS1-C/AS7 and C/VM2) have been subject to an ongoing process of continuing improvement. Many of the improvements have been and will be informed by feedback and requests for clarification.

MBIE have developed a list of FAQs so that the answers to common questions can be shared openly. These FAQs are continuously updated as part of our ongoing monitoring of the implementation.

The FAQs are split into the following sections:

- **Acceptable Solution's C/AS1 – C/AS7 interpretations »**
- **Verification Method C/VM2 interpretations »**
- **Procedural issues »**

To provide feedback or recommend additions to the FAQs, please use the **"Ask a question"** page.

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# Protection from Fire

## Frequently asked questions

Since publication on 10 April 2012, the Acceptable Solutions and the Verification Method for Protection from Fire (C/AS1-C/AS7 and C/VM2) have been subject to an ongoing process of continuing improvement. Many of the improvements have been and will be informed by feedback and requests for clarification.

The FAQs are split into the following sections:

- **Acceptable Solution's C/AS1 – C/AS7 interpretations**
- **Verification Method C/VM2 interpretations**
- **Procedural issues**

If a building complies with an Acceptable Solution or Verification Method for Protection from Fire as adjusted by the interpretations listed on this site, it is also deemed to comply with the Building Code. It therefore does not need further specific engineering design.

The intent is that the interpretations produced here may be incorporated in the next amendment of the Acceptable Solutions, Verification Method, and commentaries as required.

If you can't find the answer to your question here, you can use our **'Ask a question'** form.

## 1. Acceptable Solutions C/AS1 – C/AS7 interpretations

In this section

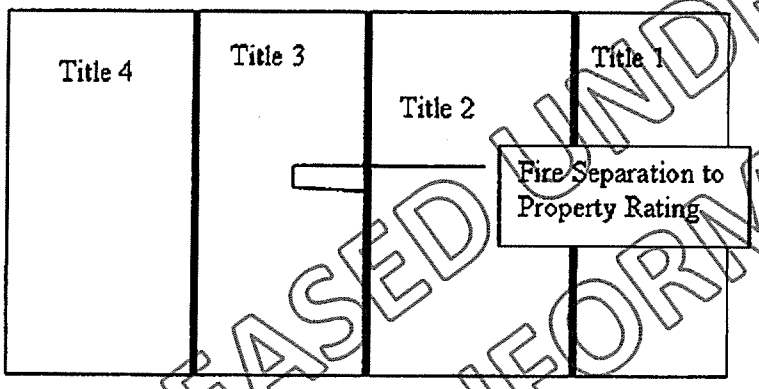
- **1.1 Are there any exceptions to the requirements of the Acceptable Solutions to extend an alarm or sprinkler system throughout a building?**
- **1.2 Why was the following consultation text in 3.11.1 not adopted.**
- **1.3 Figure 5.2 is different in C/AS3 than the other acceptable solutions? Do adjoining fire cells still have to comply?**
- **1.4 What is meant by "open path lengths from any point on the floor to no fewer than 2 exits" in 3.4.2 d)**
- **1.5 Does Paragraph 5.3 of C/AS1 mean fire spread from a lower roof does not need to be considered, because the building is not attached even if the gap is small?**
- **1.6 Are unrated portions of façade smaller than 0.1m$^2$ permissible in C/AS1 designs?**
- **1.7 What is meant by Capable Height of Storage?**
- **1.8 What is meant by "open path lengths from any point on the floor to no fewer than 2 exits" in 3.4.2 d)**

### 1.1 Are there any exceptions to the requirements of the Acceptable Solutions to extend an alarm or sprinkler system throughout a building?

The Acceptable Solutions for Protection from Fire require a fire alarm system and fire sprinkler system to be extended throughout a building, if a system is required in any part of the building.

However, the following exception applies where a single-storey building is separated at the ground floor into two or more unit titles, with fire separations (designed with the relevant property rating) between each unit.

**Figure 7.1 Single Storey Commercial Building**




Title 1 has a fire sprinkler system installed, Titles 2 and 3 may be unsprinklered (provided there is no other requirement to install a system in those titles). They are effectively treated as separate buildings.

This does not apply in a multi-storey building where the floors are unit title separations/boundaries.

**Notes:** C/AS7 also allows for sprinkler protection of the car park firecell to not be extended throughout a building when the criteria of C/AS7 2.2.3 have been met.

The Acceptable Solutions for Protection from Fire allow a heat detection system to be installed in certain areas in lieu of a smoke detection system .

**Back to top**

---

### 1.2 Why was the following consultation text in 3.11.1 not adopted?

"If an escape route enters a space exposed to the open air (e.g. an open stairway, a balcony, across a roof or a ground level path), it shall meet the requirements of a safe path between that point and the final exit unless the final exit can be reached within the dead end open path or total open path distance, whichever applies, including the travel distance along the external escape route".

It is recognised for many layouts, the above wording results in a safe building.

Example: In single fire cell buildings where the external escape route is subject only to radiation from that fire cell, and the travel distance to a place of safety is within the dead end open path travel distances for the building, occupants can escape safely.

However there were other configurations of external escape route that the consultation 3.11.1 text did not address, for example:

a) The risk in a row of shop units where each unit is a fire cell with an independent alarm. Here an external escape route that passes each unit would need protection even if it was within open path travel distance limitations.

b) The risk in an apartment building where there is a choice of external escape route but both pass different parts of another firecell containing the fire.

The original wording is retained, however we will continue to explore different layout permutations and further information will be provided as it is developed.

**Back to top**

---

### 1.3 Figure 5.2 is different in C/AS3 than the other acceptable solutions? Do adjoining fire cells still have to comply?

Yes, while the diagram in C/AS3 specifically reflects adjoining buildings, it is also applicable to adjoining fire cells (in the same way as the other C/ASs).

**Back to top**

---

### 1.4 What is meant by "open path lengths from any point on the floor to no fewer than 2 exits" in 3.4.2 d)

The total open path length shall be the maximum distance possible a point on the floor to the second nearest exit. In other words; the open path length shall be determined based on the assumption that the nearest exit is blocked and be taken as the maximum length possible from a point on the floor to the next closest exit. This can include a section of dead end open path as in Figure 3.8.

If there are fixed furnishings then the travel distance to the next closet exit shall be measured around the furnishings; if there are no fixed furnishings or their position is unknown then the travel distance shall be measured around the floor's perimeter all as shown in Figures 3.7(a) and (b).

**Back to top**

---

### 1.5 Does Paragraph 5.3 of C/AS1 mean fire spread from a lower roof does not need to be considered, because the building is not attached even if the gap is small?

To be considered not attached for the purposes of this clause, the external wall must be at least 1m from an adjacent wall and 0.65m from an adjacent eave?

**Back to top**

---

### 1.6 Are unrated portions of façade smaller than 0.1m$^2$ permissible in C/AS1 designs?

Yes, it is permissible to have unrated portions of façade smaller than 0.1m$^2$ provided they comply with Figure 5.1 and paragraph 5.4 of acceptable solution C/AS2.

**Back to top**

---

### 1.7 What is meant by Capable Height of Storage?

The term capable of storage is included to capture possible future uses of warehousing to prevent future upgrades due to a change of use. A designer of storage buildings should consider the possible future uses and design for flexibility in use.

Capable height of storage is the maximum height to which storage is possible within a particular building accounting for all relevant factors including, but not limited to, the materials stored, clearances needed to move materials around and floor loadings. For maximum future versatility the capable height of storage can be 1m below the height to the apex.

However where the fire safety systems in the building are designed for a particular maximum storage height, and it is possible that height may be exceeded, signs shall be provided advising of the maximum storage height. Those signs shall be provided in sufficient number, be clearly visible and readily understandable, and be maintained in good condition.

Note that outbuildings and do not need to be addressed for height of storage. An outbuilding is any building not intended for human habitation and accessory to the principal use of associated buildings. Outbuildings can include certain, essentially unoccupied, farm buildings such as hay barns, bunkers and machinery shelter. Buildings that people work in or otherwise occupy for long periods during the day and which contain amenities and services cannot be considered as Risk Group SH.

**Back to top**

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### 1.8 What is meant by "open path lengths from any point on the floor to no fewer than 2 exits" in 3.4.2 d)

The total open path length shall be the maximum distance possible a point on the floor to the second nearest exit. In other words; the open path length shall be determined based on the assumption that the nearest exit is blocked and be taken as the maximum length possible from a point on the floor to the next closest exit. This can include a section of dead end open path as in Figure 3.8.

If there are fixed furnishings then the travel distance to the next closet exit shall be measured around the furnishings; if there are no fixed furnishings or their position is unknown then the travel distance shall be measured around the floor's perimeter all as shown in Figures 3.7(a) and (b).

**Back to top**

---

### 1.9 Where there are more than one risk group in a firecell what constitutes the primary risk group?

The primary risk group is the worse-case activity within the firecell. The activity however can have other supplementary activities in support of the primary risk group. For an example a shop unit the primary risk group is the retail space (Risk Group CA) however there are other activities in support such as administration offices (Risk Group WB) and low level storage rooms (Risk Group WB). The primary purpose of the shop is a retail space and therefore the primary risk group is Risk Group CA with other risk groups are ancillary to the primary risk group. Ancillary risk groups must provide direct support and be integral to the main activity of the firecell.

An exemption is where the other activity includes high level storage (Risk Group WS), vehicle parking (Risk Group VP) or sleeping uses (Risk Group SH, SR) where these areas should be separate firecell otherwise the worse-case risk group governs the primary risk group.

**Back to top**

---

### 1.10 What is the intent of Paragraph 5.1.2 of C/AS1 Notional boundary – firecells on the same property?

Paragraph 5.1.2 requires boundary check between buildings of Risk Group SH that are on the same property title.

The intention of the requirement for fire separation in this paragraph is to protect buildings with a sleeping risk. For example should a fire occur in an unoccupied outbuilding that is close proximity to a house this could threaten the life safety of the sleeping occupants.

Paragraph 5.1.1 requires all walls within 1m of a boundary to be fire rated for 30/30/30 FR. For buildings on the same property a notional boundary would need to be 1m from both buildings i.e. 2m apart to not require fire rating. In the situation where external walls of two buildings are within 2m of each other, and at least one building has a sleeping use, at least one external walls that face each other is required to be fire rated.

This does not apply where the two buildings which are within 2m of each other are outbuilding and on the same property as there is no threat to sleeping risk or other property.

**Back to top**

---

### 1.11 Ask a question

If you can't find the answer to your question above, you can use our **Ask a question** form.

**Back to top**

---

## 2. Verification Method C/VM2 interpretations

In this section:

- **2.11 Ask a question**

### 2.1 Where a challenging fire is placed in the main entrance lobby of a building is it appropriate to consider the occupants evacuating through the balance of the exits for this ASET vs. RSET?

Yes, noting that for the other challenging fire scenarios in this building 50% of the occupants should be considered as evacuating via the main entrance for the ASET vs. RSET analysis.

**Back to top**

---

### 2.2 Why doesn't Table 3.3 (Pre-travel activity times) in C/VM2 give a time for a voice alarm signal for spaces in which the occupants are sleeping and familiar with the building?

The table reflects the current requirements in NZS 4512 and acceptable solution F7/AS1 for alarm systems that alert occupants who are sleeping and familiar with the building. Voice alarms are not required in these spaces.

Should a voice warning sound be used in lieu of the tonal sound, then the pre-travel time should be as per the tonal time (this reflects that the critical factor in a residential setting pre-travel activity time is the time to awake.

**For more information:**

- **See the NZ Standard for Fire Detection and Alarm Systems NZS 4512**

**Back to top**

---

### 2.3 Are the modifications to NZS 4541:2013 listed in Appendix B of the Acceptable Solutions applicable to Verification Method C/VM2 designs?

Yes, it is the intention that for compliance with the Building Code the parts of the sprinkler standard amended by Appendix B stand for all methods of compliance.

**Back to top**

---

### 2.4 When designing an apartment building can an engineer use the Property Rating specified in the Acceptable Solutions for Protection from Fire as a default inter-tenancy rating rather than calculate the burn out time of the spaces?

The Acceptable Solutions are intended to provide a conservative solution for the design of buildings. The fire resistance rating of inter-tenancy walls is dependent on the fire load, thermal properties, and ventilation of the fire compartment. Given the conservative basis of the Property Rating it would be expected that any calculated burn out time would, in most cases, be equal to or less than the rating required by the Acceptable Solution.

Therefore it is permitted to use the Property Rating of the Acceptable Solutions to determine the FRR of the inter-tenancy walls in an apartment building.

**Back to top**

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### 2.5 What does the text "Where occupants in the rest of the building use escape routes protected from the effects of fire (such as exit-ways), the effect of sprinklers to control the fire (with constant HRR) shall be ignored for assessing the performance required of the construction protecting the escape route" in the CF Scenario mean?

It means do not use a sprinkler controlled heat release rate if you are doing modelling to demonstrate that the barrier will remain effective in protecting the escape route. The effect of sprinklers is already accounted for by halving the fire load energy density as described in Table 2.3. This also which equates to a 50% concession if applying equation 2.1 in section 2.4.4.

**Back to top**

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### 2.6 Can any of the design inputs into C/VM2 be varied?

The Verification Method C/VM2 method is a complete design system with interrelated inputs and design parameters that result in an acceptable level of risk. Therefore it is not appropriate to vary the inputs and design parameters when using the C/VM2 method.

C/VM2 inputs cannot be replaced with elements from Acceptable Solutions C/ASx or specific design. Using other inputs can have significant effect on the outcome.

Should a designer wish to vary the design inputs other than listed in C/VM2 the design is an Alternative Solution and all design inputs must be justified.

However where the design input is not described in C/VM2 (eg. Boilers) the designer shall present a suitable input at the FEB stage and justify that it is appropriate for the project to be tested by the reviewer & NZFS. This is still within the framework of the Verification Method.

When using fire engineering design methodologies, designers are expected to exercise care and intelligent application of those design methodologies. The Verification Method is suitable for use by professional fire engineers who are proficient in the use of fire engineering modelling methods and who can apply appropriate judgement to the model inputs and results.

**Back to top**

---

### 2.7 What is intent of Block Exit (BE) Design Scenario?

The construct of this scenario has three requirements:

1. Any escape route (open path) that serves more than 50 people requires a second exit.

2. This scenario limits single escape stair to a maximum capacity of 150 people non-sprinklered or 250 people sprinkler protection. If there are more than one stair than this restriction does not apply. For buildings where one stair is a single means of escape from some floors but not others then stair shall be designed such that the maximum capacity is not exceeded.
3. The travel distance shall be limited along the escape route to reach the stair (i.e. open path). There is no requirement within C/VM2 to design for fires within the vertical stair enclosures (i.e. safe path) or limit travel distance in protected enclosures.

There is no fire engineering analysis required for this design scenario.

**Back to top**

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### 2.8 Which areas need visibility monitored for when the occupancy exceeds 1000 people in the firecell (C4.4)?

Clause C4.4 states that "Clause C4.3(b) and (c) do not apply where it is not possible to expose more than 1000 occupants in a firecell protected with an automatic fire sprinkler system."

This clause is intended to provide an additional level of safety for buildings where a large occupancy can be exposed to the adverse effects of a fire environment. However when carrying out a fire analysis the area in the immediate vicinity of the fire does not need to be assessed for visibility or FEDthermal and only areas remote from the fire where over 1000 people will be affected will be required to be assessed for all tenability criterion.

For the purposes of identifying what areas are considered in the immediate vicinity or remote from the fire, the following would apply:

- In an atrium, where sprinklers are provided, if the floor of fire origin has less than 1000 people then that floor does not need to be assessed for visibility and FEDthermal, however all other floors above or below require visibility, FEDco, and FEDthermal assessment.
- In a large area of the same level such as a sprinkler protected shopping centre, ballroom, arena, or conference room for example, the region immediately surrounding the fire origin that has less than 1000 occupants (determined by the occupant density) does not need assessment for visibility and FEDthermal however areas outside of this area require assessment.
- Other situations not described by the above should be discussed and agreed with FEB stakeholders during the FEB process.

This is what is meant by 'it is not possible to expose more than 1000 occupants'.

**Back to top**

---

### 2.9 When does the additional robustness check of vertical escape routes apply?

Design Scenario RS only applies to buildings where the occupancy exceeds: 150 people, or 50 people in a sleeping occupancy where the occupants are neither detained or undergoing some treatment or care, or 20 people detained or undergoing treatment or care or children in early childhood centres. If these occupancies are not exceeded the whole design scenario does not apply.

The additional robustness check for sprinklered sleeping occupancies only applies when the above occupancies are exceeded. This is an additional check for visibility in the stairwell due to the higher risk of an occupancy exposed in a single escape route and vertical escape route served by more than 250 people.

**Back to top**

### 2.10 When does the additional robustness check of vertical escape routes apply?

Design Scenario for Horizontal Fire Spread provides Design Fire for various occupancies apart from storage use. For storage buildings the following emitted radiant heat flux can be used for sprinklered and non-sprinklered occupancies:

| FLED | Emitted Radiant Heat Flux From Unprotected Areas | |
|---|---|---|
| | Without Sprinklers | With Sprinklers |
| <400 MJ/m2 | 83 kW/m2 | 58 kW/m2 |
| 400 – 800 MJ/m2 | 103 kW/m2 | 72 kW/m2 |
| >800 MJ/m2 | 144 kW/m2 | 101 kW/m2 |

Emissivity of *fire* gases shall be taken as 1.0.

**Back to top**

### 2.11 Ask a question

If you can't find the answer to your question above, you can use our **'Ask a question'** form.

**Back to top**

## 3.0 Procedural issues

In this section:

- **3.3 When is a fire-engineering brief required as part of the building consent documentation?**
- **3.4 Are the uses in Schedule 2 of the Building Specified Systems, affected by the Protection from Fire documents?**
- **3.5 How do I determine a 'change of use'?**
- **3.6 Is there any guidance about 'change of use' under section 115 of the Building Act?**
- **3.7 Which Building Code clauses are relevant to assessing the attributes of a building that relate to 'means of escape from fire' (as referred to in sections 112 and 115 of the Building Act 2004)?**
- **3.8 Will past determinations applied to the superseded C1 – C4 Building Code Clauses be applicable as guidance for the current C1 – C6 Building Code Clauses?**
- **3.9 Can a design based on the Acceptable Solution incorporate aspects of the Verification Method and still comply with the Building Code?**
- **3.10 Where can I find the Code clauses, Acceptable Solutions, and Verification Methods referenced in these questions and answers?**
- **3.11 Why is a Fire Engineering Brief (FEB) required for C/VM2 designs?**
- **3.12 Why was a concession for unrated intermediate floors consulted on but not included?**
- **3.13 When is the updated Commentary to Acceptable Solutions C/AS1-7 and Verification Method C/VM2 due to be published?**
- **3.14 How timber linings can be used in certain crowd uses**
- **3.15 Ask a question**

### 3.1 Is there any guidance on assessing 'means of escape from fire' for alterations to existing buildings?

The Ministry of Business, Innovation and Employment (MBIE) has developed "Guidance: Requesting information about means of escape from fire for existing buildings - A guide for Building Consent Authorities and Territorial Authorities" to help Building Consent Authorities (BCAs) or Territorial Authorities (TAs) decide what information on means of escape from fire to request, as part of a building consent application, to alter an existing building.

Where an ANARP assessment of means of escape from fire is undertaken using the C/VM2 method, the FEB process is part of that method.

- **Read the guidance 'Requesting information about means of escape from fire for existing buildings - A guide for Building Consent Authorities and Territorial Authorities' »**

**Back to top**

---

### 3.2 When does the Fire Service Commission become involved in a building consent application?

New Buildings for Protection from Fire using the Acceptable Solutions (C/AS1 – C/AS7) or Verification Method (C/VM2) do not need to be sent to the Fire Service Commission at the consent stage.
Designs need to go the Fire Service Commission for advice if:

- compliance with clauses C1-6, D1, F6, or F8 of the Building Code will be established by alternative solution – this would be the case, for example, for building types such as power generation plants, dairy factories, sub-surface buildings, or tunnels (the scope of the Acceptable Solutions or the Verification Method does not include these types of buildings).
- the consent application involves a modification or waiver of clauses C1-6, D1, F6, or F8 of the Building Code under Section 67 of the Building Act 2004.
- the consent application is for an alteration, or change of use to an existing building, except where the effect on fire safety systems is minor.
- The above instances do not apply if the building is an exempt building. The following buildings are exempt:
  - single household unit
  - vertically separated household unit with independent egress
  - outbuilding or ancillary building
  - internal fit out-unless it relates to 'change of use'
  - outbuildings or ancillary buildings
  - premises of diplomatic missions
  - any Crown buildings specified by Gazette notice.

**For more information**

- **Read the Building Controls Update No. 132: Gazette notice updated for fire design review »**

This explains the requirements of the gazette notice of 3 May 2012 and clarifies when a design needs to be sent to the Fire Service Commission.

**Back to top**

---

### 3.3 When is a fire-engineering brief required as part of the building consent documentation?

If a building consent application uses the Verification Method C/VM2 to show compliance with Code Clauses C1 to C6, a fire engineering brief (FEB) process, including a FEB report, is required as part of the consent documentation. The FEB process has to involve all stakeholders in the building, including but not limited to, the following:

- building owner and users
- design professionals
- Fire Service Commission
- building consent authority (BCA)

- insurer
- test certifier, if hazardous substances are in the building.

This means that the Fire Service Commission is included in the design process at an earlier stage than previously.

**For more information on FEBs**

- **Purchase the International Fire Engineering Guidelines (IFEG) from the Australian Building Codes Board (ABCB) website**, click on the **'Guidelines'** tab.

**Back to top**

---

### 3.4 Are the uses in Schedule 2 of the Building Specified Systems, affected by the Protection from Fire documents?

The Protection from Fire documents do not affect the 'uses' specified in Schedule 2 of the Building (Specified Systems, Change the Use, Earthquake-prone Buildings) Regulations 2005.

**Notes:** The 'uses' specified in Schedule 2 are often confused with 'purpose groups' from Acceptable Solution C/AS1 (2011) and 'risk groups' from Acceptable Solutions C/AS1 to C/AS7 (2012). 'Purpose groups' and 'risk groups' are not related to 'change of use'.

**Back to top**

---

### 3.5 How do I determine a 'change of use'?

Schedule 2 of the Building (Specified Systems, Change the Use, Earthquake-Prone Buildings) Regulations 2005 helps identify if there is a change of use to the building.

To determine if there is a 'change of use' to a building:

- Firstly, refer to Schedule 2 of the Building Regulations (Specified Systems, Change the Use, Earthquake-Prone Buildings) Regulations 2005 to confirm if the building is being used for another function. For example, changing a building's 'use' from apartments (SR) to a day-care centre (CS).
- Secondly, determine if the new use is more onerous than the old use in terms of complying with the Building Code. In the above example, a day-care centre would be more onerous as there are additional Building Code requirements including more fire safety requirements and additional requirements for access and facilities for people with disabilities.

If both of the above are satisfied, then the proposed new use is deemed a 'change of use'.

**For more information on 'change of use'**

- **See the Change of use »**

- See the answer to the question, **Any upgrade work that may be required as a result of the change of use may require a building consent** below.

**Back to top**

---

### 3.6 Is there any guidance about 'change of use' under section 115 of the Building Act?

MBIE published guidance for Change of Use for the Christchurch City Council to help them deal with changes of use for temporary business and/or housing relocations because of the Canterbury earthquakes. Although developed for Christchurch, the guidance explains the 'change of use' provisions in the Building Act and associated regulations, and provides practical advice on how to apply these.

- **Read the publication Change of Use: Meeting the requirements under section 115 of the Building Act 2004 »**

**Back to top**

---

### 3.7 Which Building Code clauses are relevant to assessing the attributes of a building that relate to 'means of escape from fire' (as referred to in sections 112 and 115 of the Building Act 2004)?

When the Building Act 2004 requires an assessment of the 'means of escape from fire' in a building, compliance with the following Building Code clauses must be considered:

| | |
|---|---|
| C3.4 | **Fires affecting areas beyond the fire source »** |
| C4 | **Movement to place of safety »** |
| D1 | **Access »** |
| F6 | **Visibility in escape routes »** |
| F7 | **Warning systems »** |
| F8 | **Signs »** |

**Back to top**

---

### 3.8 Will past determinations applied to the superseded C1 – C4 Building Code Clauses be applicable as guidance for the current C1 – C6 Building Code Clauses?

Determinations applying to Code Clauses C1-C4 and C/AS1 (2011), do not apply to the current Code Clauses C1-C6 and the Acceptable Solutions C/AS1-C/AS7, and Verification Method C/VM2 (2012).

**Back to top**

---

### 3.9 Can a design based on the Acceptable Solution incorporate aspects of the Verification Method and still comply with the Building Code?

A design based on an Acceptable Solution, (C/AS1 to C/AS7) must completely comply with **all** the requirements of the Acceptable Solution. It cannot incorporate aspects of the Verification Method and still be used to show compliance with the Building Code.

However, there is one exception, when the only non-compliance with the Acceptable Solution relates to the prevention of horizontal spread of fire. In this instance, a suitably qualified fire engineer may use the C/VM2 methodology to show compliance with this aspect of the Building Code.

This applies to both the extent of unprotected area using the methods described in Design Scenario (HS): Horizontal fire spread and the fire resistance rating of the external wall using the 'full burnout design fire'.

**Back to top**

---

### 3.10 Where can I find the Code clauses, Acceptable Solutions, and Verification Methods referenced in these questions and answers?

- **Read the Code clauses, Acceptable Solutions and Verification Methods »**

**Back to top**

---

### 3.11 Why is a Fire Engineering Brief (FEB) required for C/VM2 designs?

A FEB is, "a documented process that defines the scope of work for the fire engineering analysis and the basis for analysis as agreed by stakeholders" (IFEG). The FEB gives the opportunity for comments and consensus on the fire safety components of the schematic design.

This opportunity to receive feedback and achieve consensus in early design stages reduces consenting risk, and avoids rework where an issue with the fire design is not identified until consent stage, such as:

- changes to the fire design solution arising from changes to design assumptions made during preliminary design
- rework by all design disciplines to change the coordinated design and re coordinate the drawings
- delays late in the design if complex fire models have to be altered and re run

The FEB process identifies issues before the designs are fully developed and therefore avoids the rework and delay described above.

"A fire engineering brief (FEB) should be prepared... This task is of fundamental importance and forms the basis of the fire engineering process." IFEG

The FEB purpose is to set down the basis, as agreed by the relevant stakeholders, on which the fire safety analysis will be undertaken. A fire engineer should provide guidance on and technical justification for decisions made during the FEB process on matters including but not limited to:

- design fire locations
- design occupant groups
- analysis strategy, including the selection use and design parameters of any computer based design tool

The fire engineer needs to ensure the actual process used is appropriate for the design or evaluation. Where the fire engineering analysis considers a simple well defined problem, the FEB may be a short document, whereas complex and / or large projects could require a more substantial document. In order to achieve its purpose the FEB should be developed with input from the relevant stakeholders.

The consent review verifies that issues raised during the FEB process have been addressed in the consent documents submitted. This speeds up the consent review.

The intent of the FEB is to reduce compliance costs and avoid unexpected delays.

**For more information on FEBs**

- **Purchase the International Fire Engineering Guidelines (IFEG) from the Australian Building Codes Board (ABCB) website**, click on the **'Guidelines'** tab.

**Back to top**

---

### 3.12 Why was a concession for unrated intermediate floors consulted on but not included?

In the recent amendment to the Acceptable Solution and Verification Method, provisions for unrated (intermediate) flooring systems were considered. Due to a number of issues raised these were not incorporated in the final amendment, these issues include but were not limited to;

1. Concern that a perforated floor could not protect occupants for a sufficient duration to enable egress, particularly where there are single direction of escape travel paths on the floors requiring people to pass near to or over the fire.
2. Depending on the layout, disproportionate collapse was a concern e.g. where a localised fire exposing a supporting column could cause a floor platform to suddenly fail.
3. Fire fighters are unable to adequately risk assess an unrated solid floor in a fire event, they have no way of knowing whether the floor is structurally able to withstand the weight of fire fighters and their equipment.
4. Stacked imperforate flooring areas are a significant challenge for adequate sprinkler protection, the sprinkler standard does not set out provisions to address the particular risk of protecting multiple unrated perforate floors.

While not all of these issues would likely relate to any individual instance of an unrated (intermediate) floor, these and other challenges raised during work group discussions lead to the conclusion that further detailed investigation and guidance is necessary before implementing a concession for unrated floors. It was therefore, not implemented in either the Acceptable Solutions or Verification Method C/VM2.

Further work is planned to investigate the challenges associated with unrated floor systems so that, if appropriate, design guidance can be developed and published.

**Back to top**

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### 3.13 When is the updated Commentary to Acceptable Solutions C/AS1-7 and Verification Method C/VM2 due to be published?

The publishing of these commentaries will occur at a later date. However to support the July 2014 Amendments the following information is provided.

**C/AS3 & C/AS4 Paragraph 4.16.12 Fire dampers**

**Comment**

Smoke control system shut down on alarm activation, on its own, is not sufficient where a delayed evacuation strategy is in place. The commentary provides further guidance on smoke control in air handling in this case.

**Commentary**

There is an additional requirement where evacuation is delayed for ventilation ducts that pass through a fire and/or smoke separation. The performance of the smoke separating function must also not be compromised and a smoke damper (complying with AS/NZS 1668.1) is required. Delayed evacuation relates to any evacuation regime other than all building occupants moving directly to a place of safety outside, simultaneously and immediately on detection of fire.

**C/VM2 Paragraph 1.2 Scope**

**Comment**

There are some minor exceptions to 'all buildings', for example tunnels and open air stadia. Users should refer to the Commentary to this Verification Method for further information.

**Commentary**

When using other fire engineering design methodologies, designers are expected to exercise care and intelligent application of those design methodologies in the context of the New Zealand Building Code's quantitative performance criteria. This is because compliance with other design methodologies does not in itself demonstrate compliance with the New Zealand Building Code.

**C/VM2 Paragraph 2.2.1 Fire Modelling Rules for Life Safety Design**

e) All doors not described in Paragraph 2.2.1 b), c) and d) shall be considered to be open during the analysis unless for substantiated functional reasons as established at FEB the doors can be shown to be closed throughout the time period of analysis (see Commentary).

**Commentary**

An exception permitted by this Verification Method to the requirement to model doors as open (other than those listed in 2.2.1 b), c) and d)) is for doors which need to be closed for essential functional reasons or for which there is a high likelihood that they will be closed most of the time for security or other functional reasons. It is reasonable for the Building Consent Authority to accept specific doors to be closed for fire modelling purposes where the building owner can justify on reasonable grounds the basis for this expectation.

**C/VM2 Paragraph 2.5 Equivalent Time of Exposure**

**Comment**

Further guidance on the applicability of this approach and a suggested procedure is given in the commentary.

**Commentary**

The time period for which the construction is required to perform (if not explicitly stated in C/VM2) will depend on the function of the structural or separating element which will either be for life safety, fire-fighting or property protection. Fire resistance rating shall be provided as follows:

- If the purpose of the element is property protection then a full burnout fire rating will apply.
- Paragraph 4.8 Design Scenario (FO) Fire Fighting Operations describes which elements are required for fire-fighting and fire resistance rating is either burnout fire rating or derived from the period required to resist collapse.
- If the element is for life safety only for use while the occupants evacuate, the specified period of time referred to in C/VM2 Paragraph 2.5 will generally be the RSET as determined by Paragraph 3.2 Required Safe Time to Evacuate.

**C/VM2 Pre-travel Activity Times - Table 3.3 Buildings Where the Occupants are Considered Sleeping and Detained under the Care of Trained Staff (eg, prisons etc)**

**Commentary:**

The time taken for staff to respond to a fire alarm and attend the area where the fire alarm has occurred varies considerably. For this reason it is not possible to assign a fixed value either for pre-travel activity time or the duration of the evacuation once it is initiated, as each detention facility will be different. For detention facilities the selection of a pre-travel activity and evacuation time should be determined after consultation with facility management who will need to advise on staff movements and the likely evacuation procedure /duration to complete. The pre-travel activity and duration of the evacuation should be included and agreed to by the stakeholders as part of the FEB process.

Back to top

### 3.14 How timber linings can be used in certain crowd uses

The content below provides guidance for designers enabling them to submit for building consent based on a modification of Building Code Clause C3.4 (a) where Group Number 3 timber is proposed in crowd occupancy areas requiring Group Number 2.

Material Group numbers are described in the Building Code and the requirements are repeated within Acceptable Solutions C/AS1-7 relevant to each risk group. Group numbers are aligned with general building uses and can be broadly summarised as follows:

| Group Number | Building Use |
|---|---|
| Group Number 1 | Exitways, Importance level 4, Sleeping Use with Care or Detention |
| Group Number 2 | Crowd & Sleeping Use except within household units |
| Group Number 3 | All Other Uses |

It is important to ensure that materials used as internal surface linings do not unreasonably contribute to the fire risk including in crowd areas. These areas generally contain people who are unfamiliar with the building and its escape routes.

Crowd use is any of the uses within CS (Crowd Small), CL (Crowd Large), CO (Crowd Open) or CM (Crowd Medium) as defined in Schedule 2 of the Building (Specified Systems, Change of Use, and Earthquake-Prone Buildings) Regulations 2005.

It is however acknowledged that smaller premises used for crowd activities may by their nature have a low occupancy and efficient escape route features. Escape time in the event of a fire is therefore shorter and the probability of Group 3 internal surface finishes adversely affecting the ability to escape may be low. These can be used to justify applying for building consent based on a modification to Clause C3.4(a) to the effect that a material with Group Number 3 can be used.

Criteria to be included in justifying that the proposed modification is reasonable in a particular instance include:

- Escape route widths are double that required by Paragraph 3.3.2 of the relevant Acceptable Solution, and
- Open paths travel distances are half that specified in Table 3.2 of the relevant Acceptable Solution, and
- Finished floor to ceiling height is more than 3m, and
- The occupancy of the space is less than 250 people, and
- The firecell is at ground level and are served by at least two exitways or final exits.

The above consideration does not extend to exitways within crowd uses.

Where the above criteria are met Council, after taking advice from the Fire Service as required by Gazette Notice 49 may well consider it appropriate to issue a modification to Building Code Clause C3.4 (a) under Section 67 of the Building Act for crowd uses which would permit use of solid timber surface linings in buildings such as community halls, cafes, schools, recreation halls, small shops, and restaurants.

There are likely to be circumstances where these criteria are not met in full and if so designers need to look at the facts in each instance and put their arguments forward to Council justifying why they believe the modification is nevertheless reasonable.

**Back to top**

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### 3.15 Ask a question

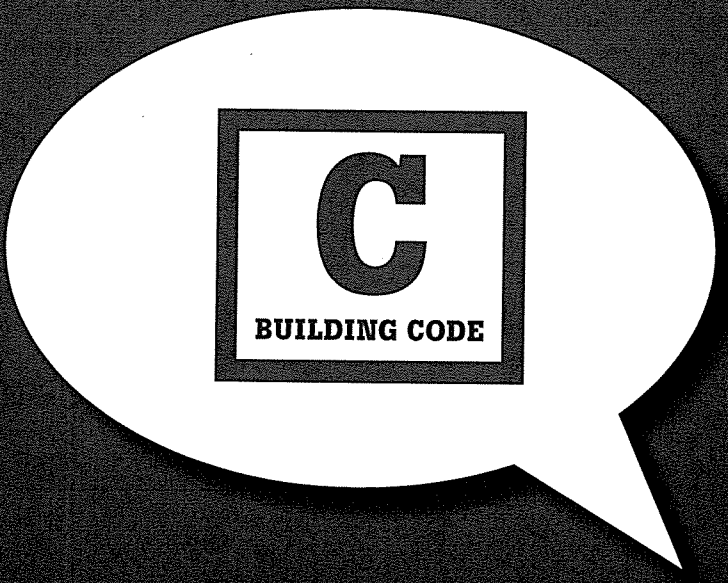
If you can't find the answer to your question above, you can use our **'Ask a question'** form.

**Back to top**

Ministry of Business, Innovation & Employment

# Commentary
## for Acceptable Solutions C/AS1 to C/AS7






December 2013

# Contents
## Acceptable Solutions C/AS1 to C/AS7

| **Document history** | |
|---|---|
| Date | Alterations |
| April 2012 | First edition published |
| February 2013 | Paragraph 2.2.4, Figure 2 and Table 1 |
| December 2013 | Paragraph 1.1.1, Figure 2 |

**This document's status**
This document is issued as guidance under section 175 of the Building Act 2004. While the Ministry has taken care in preparing this document it is only a guide and, if used, does not relieve any person of the obligation to consider any matter to which that information relates according to the circumstances of the particular case. The document may be updated from time to time and the latest version is available from the Ministry's website at www.dbh.govt.nz

# Part 1: General
## Acceptable Solutions C/AS1 to C/AS7

### 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**

**1.1.1** 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**

| Acceptable Solution | *Risk group* | Description |
|---|---|---|
| C/AS1 | SH | Detached houses and *buildings* subdivided into multiple dwellings, provided that:<br>• People from each dwelling have their own independent *escape route* to a *safe place* (ie, their own corridor and *stairway*), and<br>• The *buildings* are no more than two units high (there is no limit on the number of units side by side).<br>**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 | All multiple unit accommodation *buildings* not included in *risk group* SH.<br>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.<br>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.<br>**Not included:** Early childhood education (see *risk group* CA). |
| C/AS3 | 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.<br>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.<br>**Not included:** Early childhood education (see *risk group* CA) |
| C/AS4 | CA | *Buildings* or places where people congregate or visit, including any place where people are given treatment but are not incapacitated in any way.<br>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.<br>**Not included:** Dentists' and doctors' practices where patients are incapacitated such as with sedation (see *risk group* SI) |

| Acceptable Solution | *Risk group* | Description |
|---|---|---|
| C/AS5 | WB | 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.<br>**Not included:** 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). |
| C/AS6 | WS | *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 5.0 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. |
| C/AS7 | VP | 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*.<br>**Not included:** car showrooms with fewer than six cars (see *risk group* CA). |

**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.

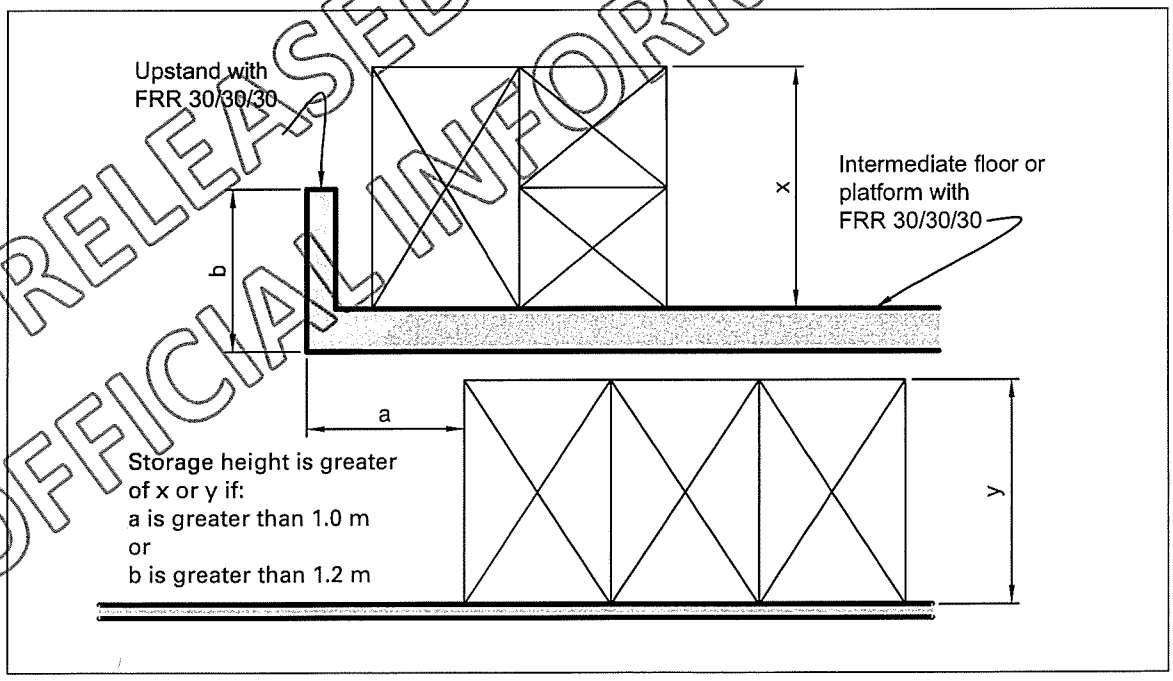
**C/AS5: Risk group WB** *Risk group* WB covers the activities in *buildings* where people are working. Examples are offices including where professional services are provided (such as offices for lawyers, accountants or consultants) but not where a personal service is provided (such as doctors and dentists).

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**



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

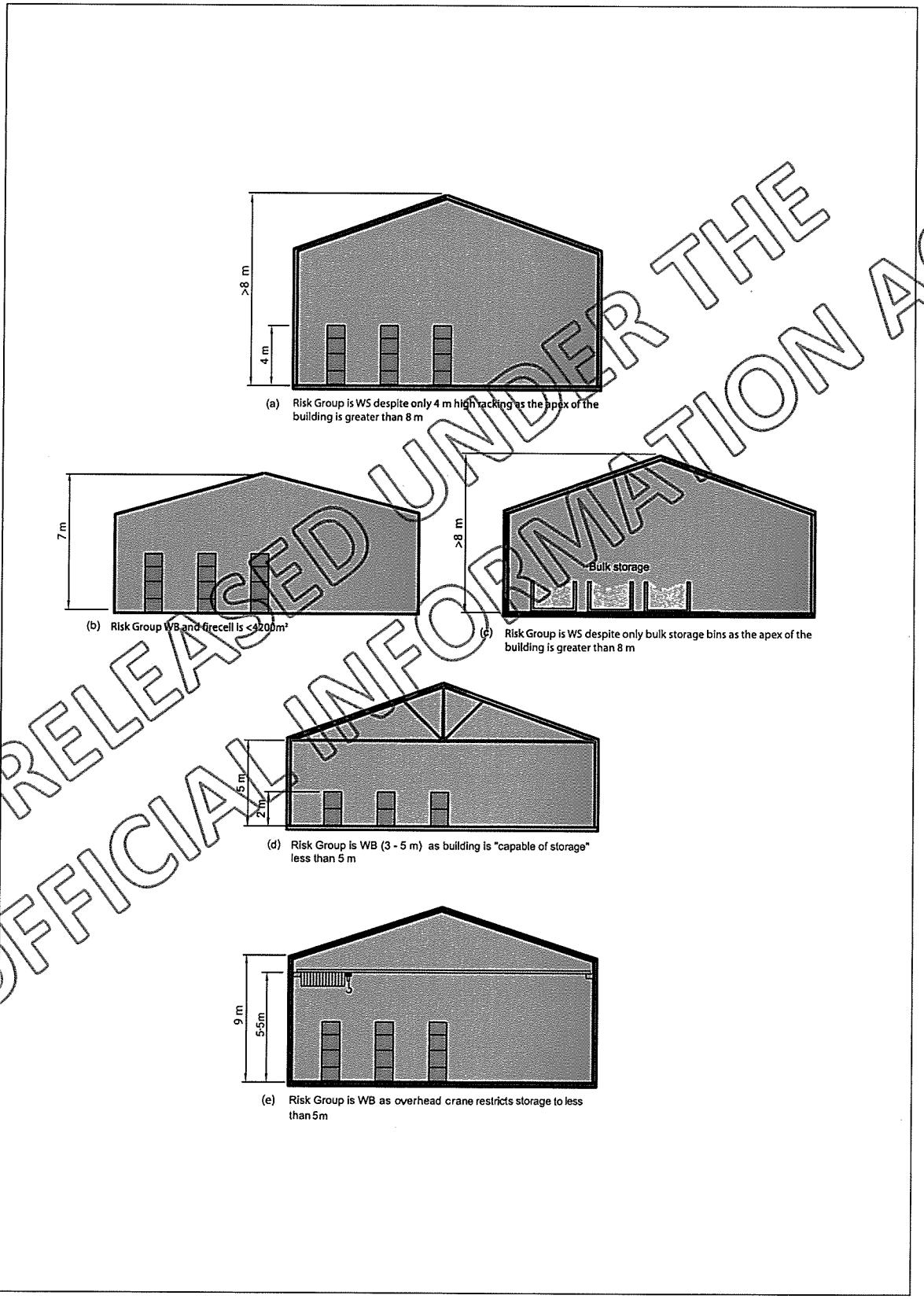
b) If the raised platform, rack or *intermediate floor* is not *fire* rated, or neither a) i) or ii) apply, then the storage height is taken as the height from the bottom of the lowest stack to the top of the uppermost stack.

**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 $m^2$ gross area) where the height to the apex of the *building* (to the underside of the roof cladding) is less than 8.0 m.

**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**

| |
|---|
| Warehouse/storage *buildings* with a storage height of greater than 5.0 m that are not protected with automatic *fire* sprinklers |
| *Buildings* where *foamed plastics* are manufactured or processed, or *buildings* which are part of chemical processing plants |
| Prisons and district health board detention *buildings* where occupants are unable to evacuate themselves because of the *buildings'* security features |
| Treatment or care facilities where occupants require a stay in place strategy eg, general anaesthetic operations/procedures, delivery rooms, intensive care units, hyperbaric chambers etc. |
| *Buildings* incorporating an atrium, such as multi-floor shopping malls |
| *Buildings* 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* |
| Where smoke control is used |
| *Buildings* more than 20 storeys high from ground level |
| Stadiums or grandstands 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 |

### 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

**2.2.1** *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.

# Part 3: Means of escape
## Acceptable Solutions C/AS1 to C/AS7

### 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

**3.3.2** 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

**3.3.3** 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

**3.3.6** 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

**3.4.1** *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

**3.4.2** 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 mm$^2$, 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, *GSAs* 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* (eg, 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

**4.13.2** 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

**4.13.3** 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

**4.14.1** 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

**4.15.1** *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

**4.16.1** 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.

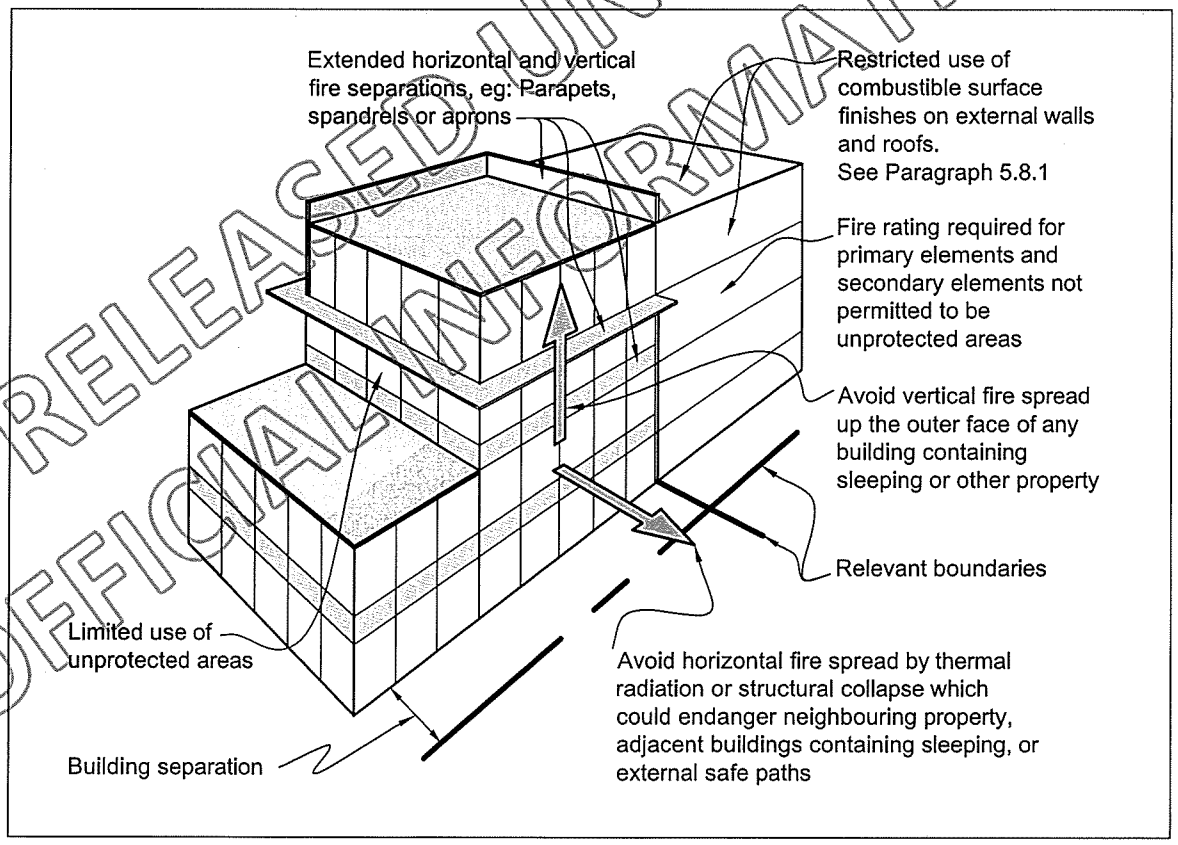
# Part 5: Control of external fire spread
## Acceptable Solutions C/AS1 to C/AS7

### 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.

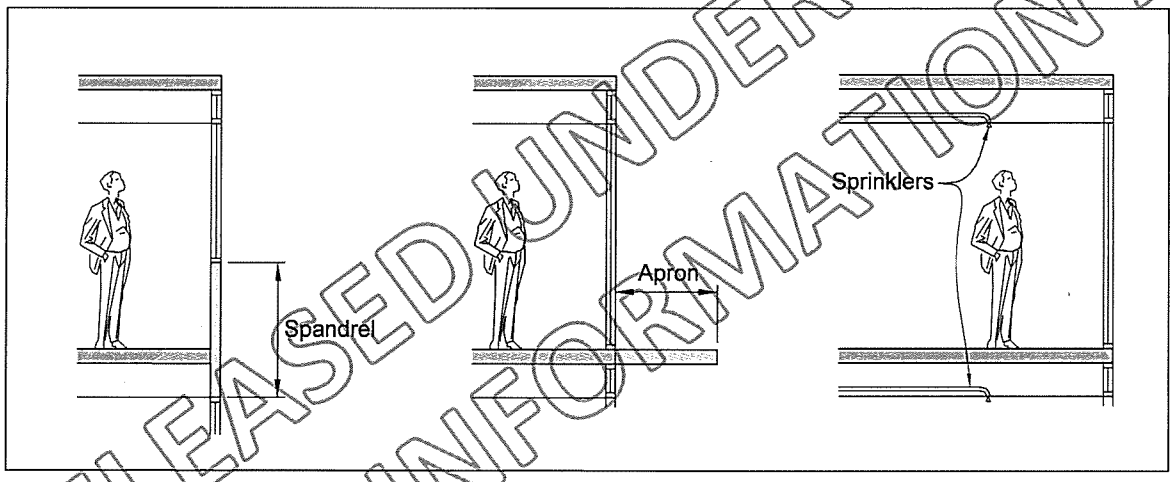
**Figure 3: External walls and roofs**



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

**5.2** 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

**5.5** 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

**5.6.5** 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).

# Part 6: Firefighting
## Acceptable Solutions C/AS1 to C/AS7

### 6.1 Fire Service vehicular access

**6.1.1** *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



## Table of Contents



**Issue 1 (Building Consent)**

**15th September 2012**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## 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.

| Location | Risk Group | Storage Height | Escape Height (m) |
|---|---|---|---|
| Warehouse | WS | >5m | 0 |
| Offices/Staffroom | WB | <3m | 3 |

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

| Location | Floor Area ($m^2$) | Occupant Density ($m^2$/person) | Number of Occupants |
|---|---|---|---|
| Warehouse | 10860 | 100 | 109 |
| Studio | 195 | 10 | 20 |
| Offices | 275 | 10 | 28 |
| Photography | 186 | 10 | 19 |
| Staff Lunchroom | 266 | 5 | 53 |
| **TOTAL** | | | **176** |

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/AS6 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/AS6/3.2.2). The escape routes are required to be separated by no less than 8.0 m (C/AS6/3.6.2). 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.

| Location | Horizontal Travel (mm) | Vertical Travel (mm) |
|---|---|---|
| All areas | 850 | 1000 |

The escape routes in the building as shown on the drawings comply with this requirement. (C/AS6/3.3.2). 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/AS6/3.3.1)

### 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:

| Location | Allowable DEOP (m) | Allowable TOP (m) | Actual DEOP (m) | Actual TOP (m) |
|---|---|---|---|---|
| Warehouse worst case | 50 | 120 | 48 | 120 |
| Lunchroom | 50 | 120 | 2 | 45 |
| Studio | 50 | 120 | 29 | 81 |
| Offices | 50 | 120 | 15 | 33 |

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 doorset (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 35m$^2$. 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:

| Wall Elevation | Distance to Boundary (m) | Firecell Width (m) | Unprotected Area Allowed (%) | Single largest radiator allowed ($m^2$) |
|---|---|---|---|---|
| East - gridline 6 between E and J | 2.5 (use 2) | >20 | 25 | 35 |
| South Warehouse wall above lean-to roof line | 7 | >20 | 50 | No restriction |
| South Gridline E between gridlines 6 & 8 | 10 | >20 | 65 | No restriction |
| Western Wall | >20 | >20 | 100 | - |

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 $95m^2$. As per C/AS6/5.5.6 this unprotected area can be measured over a 30m width. For this building this means a $60m^2$ 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 $35m^2$ 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 - FI < 12 in exitways
  - FI < 5 in underlay where exposed to view in occupied spaces eg; building paper)

Flooring is required to meet the following requirements:

- Exitways = 2.2kW/$m^2$
- All other occupied spaces = 1.2kw/$m^2$ 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.

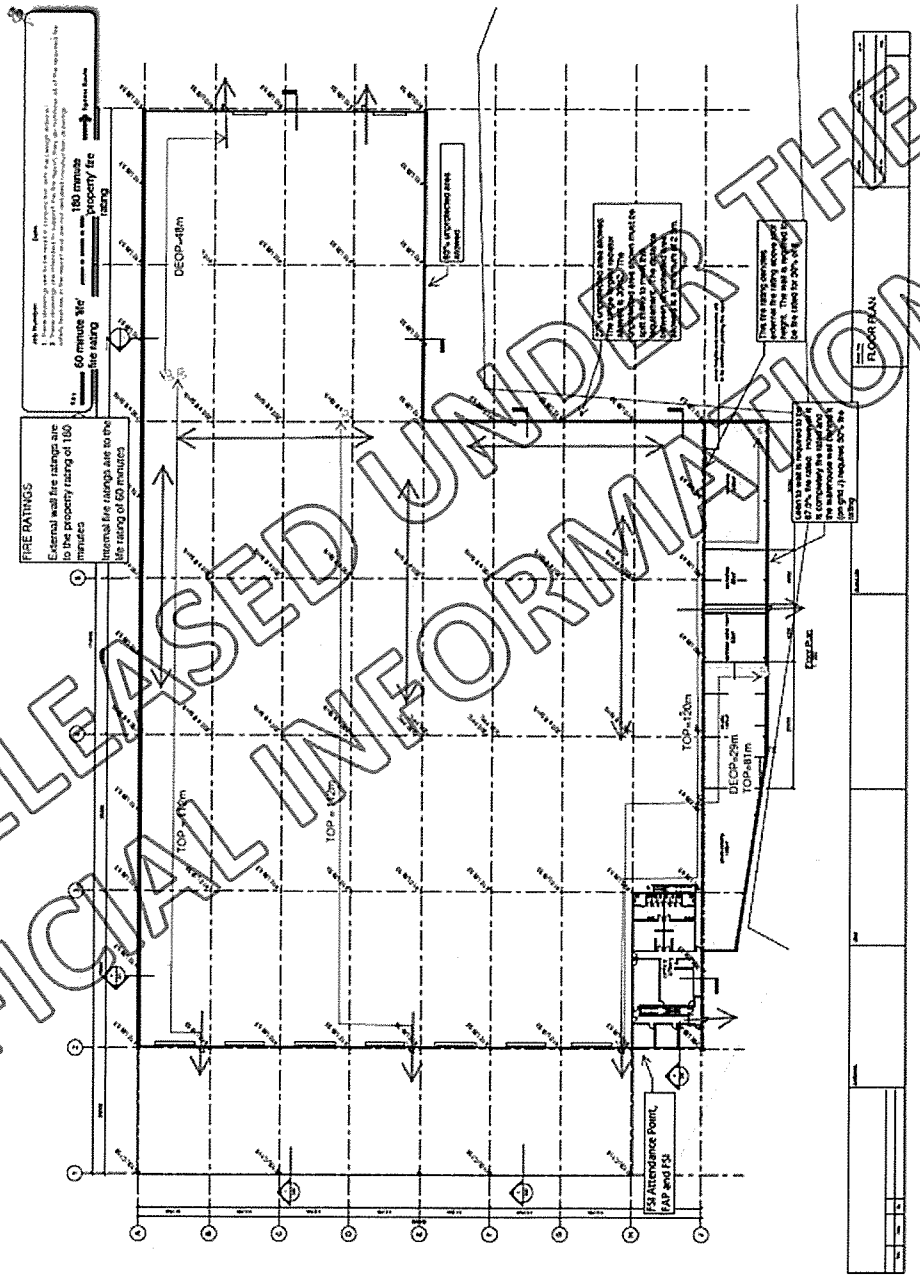
1. An Early Suppression Fast Response (ESFR) automatic sprinkler system is being installed in the building. This is to be installed in compliance with NZS4541.
2. A building fire hydrant system it to be provided in accordance with NZS4510.
3. Emergency lighting is to be installed in the building as required 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 doorset.
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 35m$^2$ 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.
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 Correspondence

*Deliberately left blank for this case study only*

## APPENDIX 2 – Drawings

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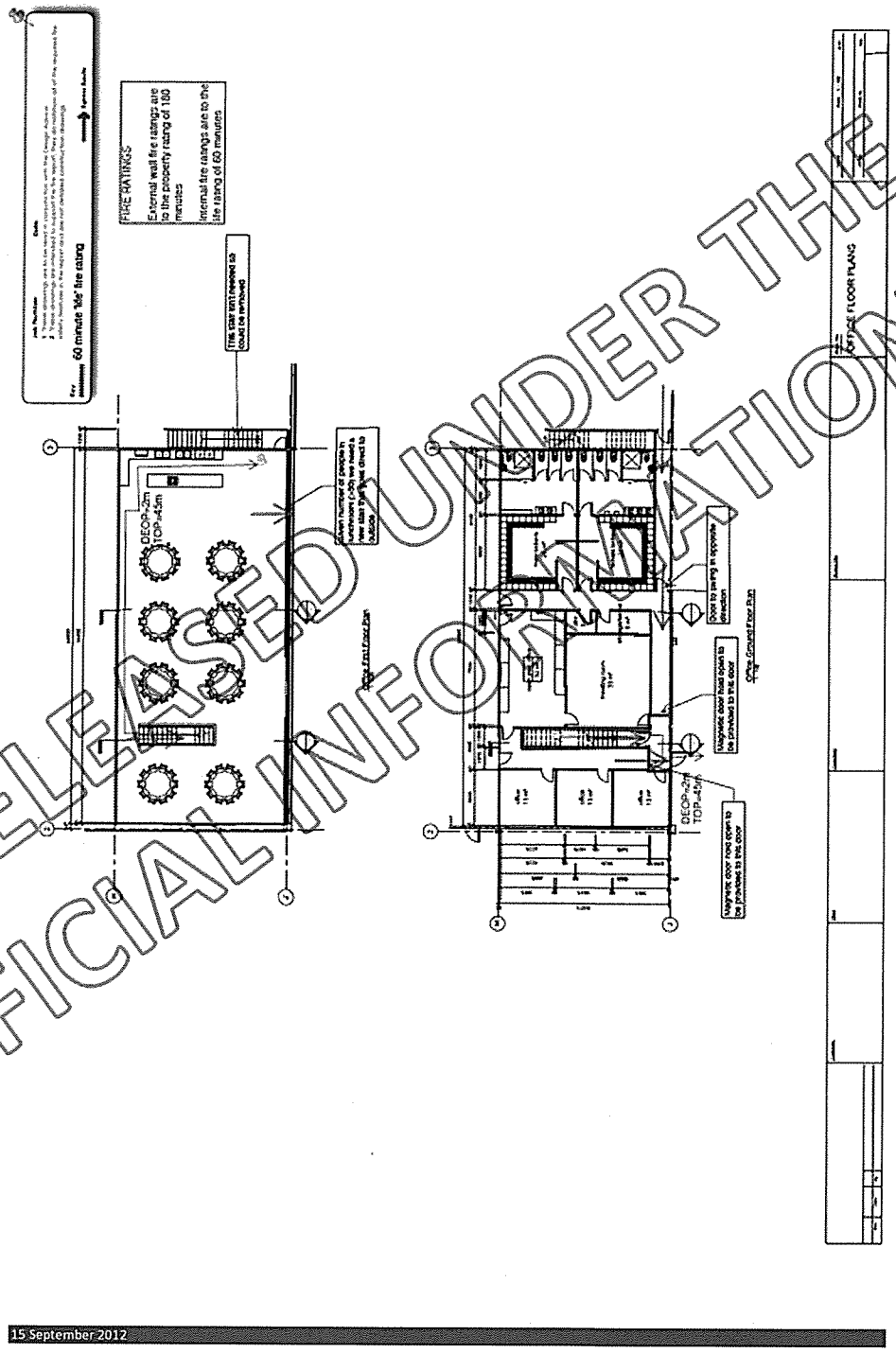

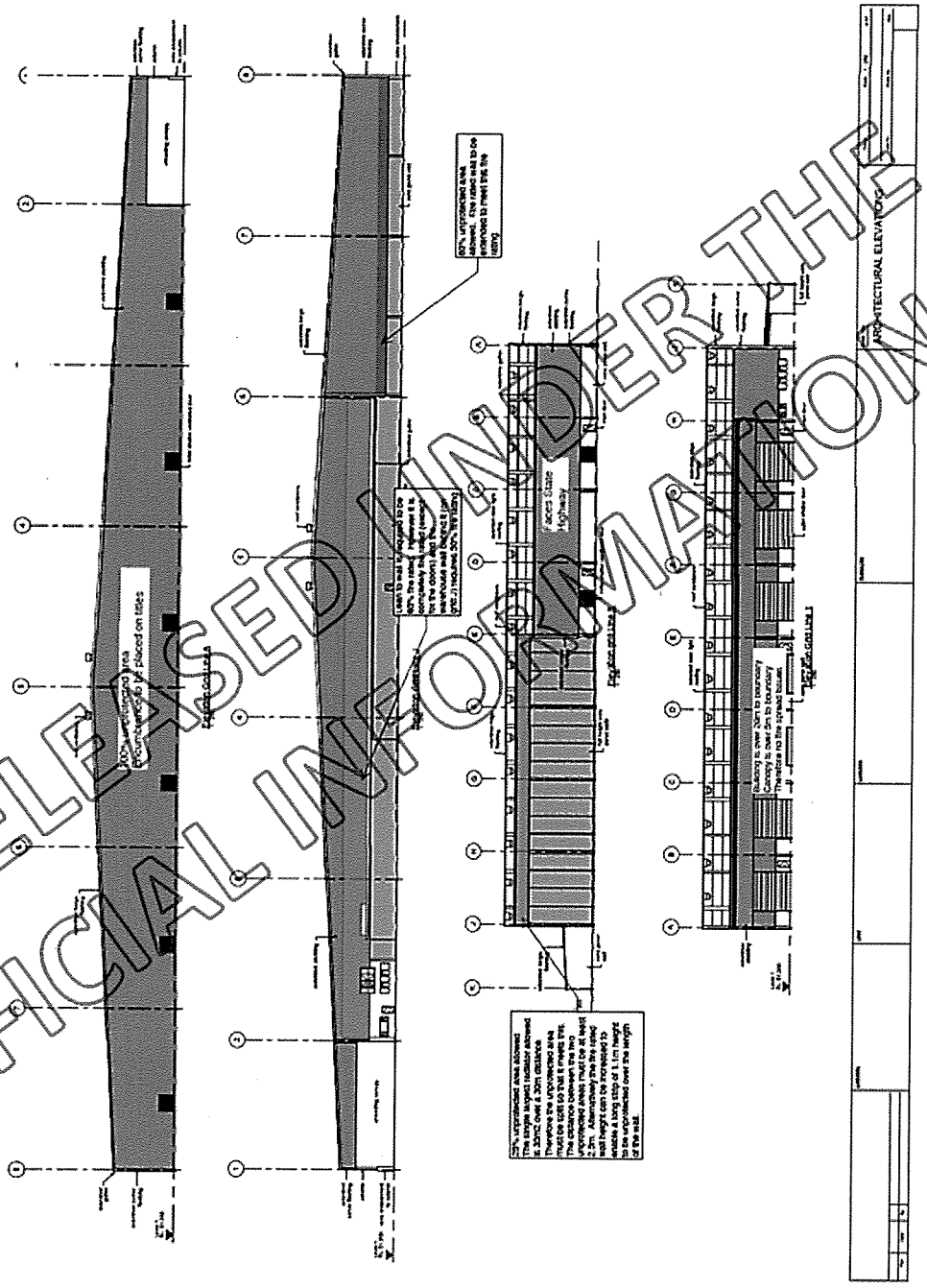

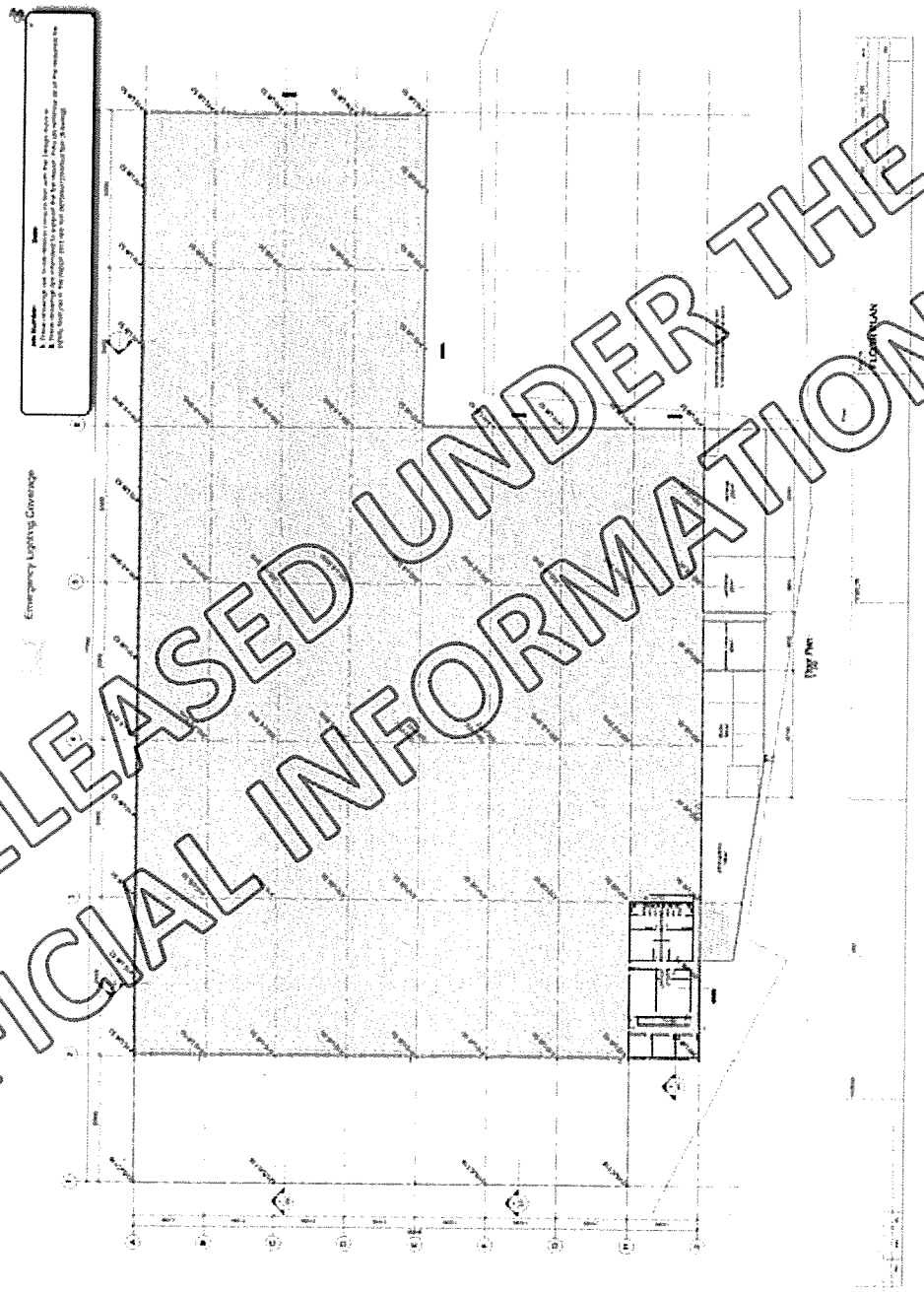

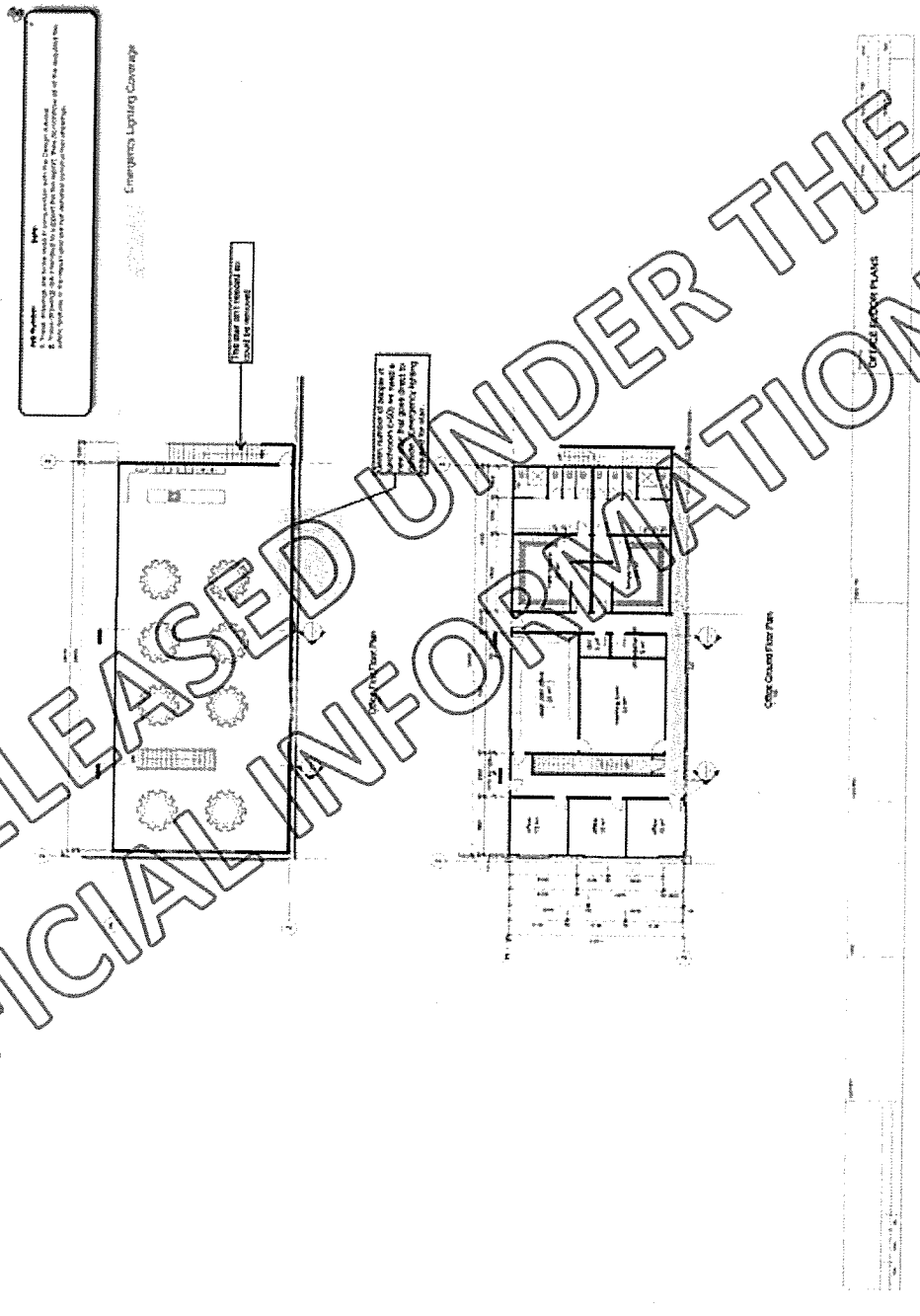

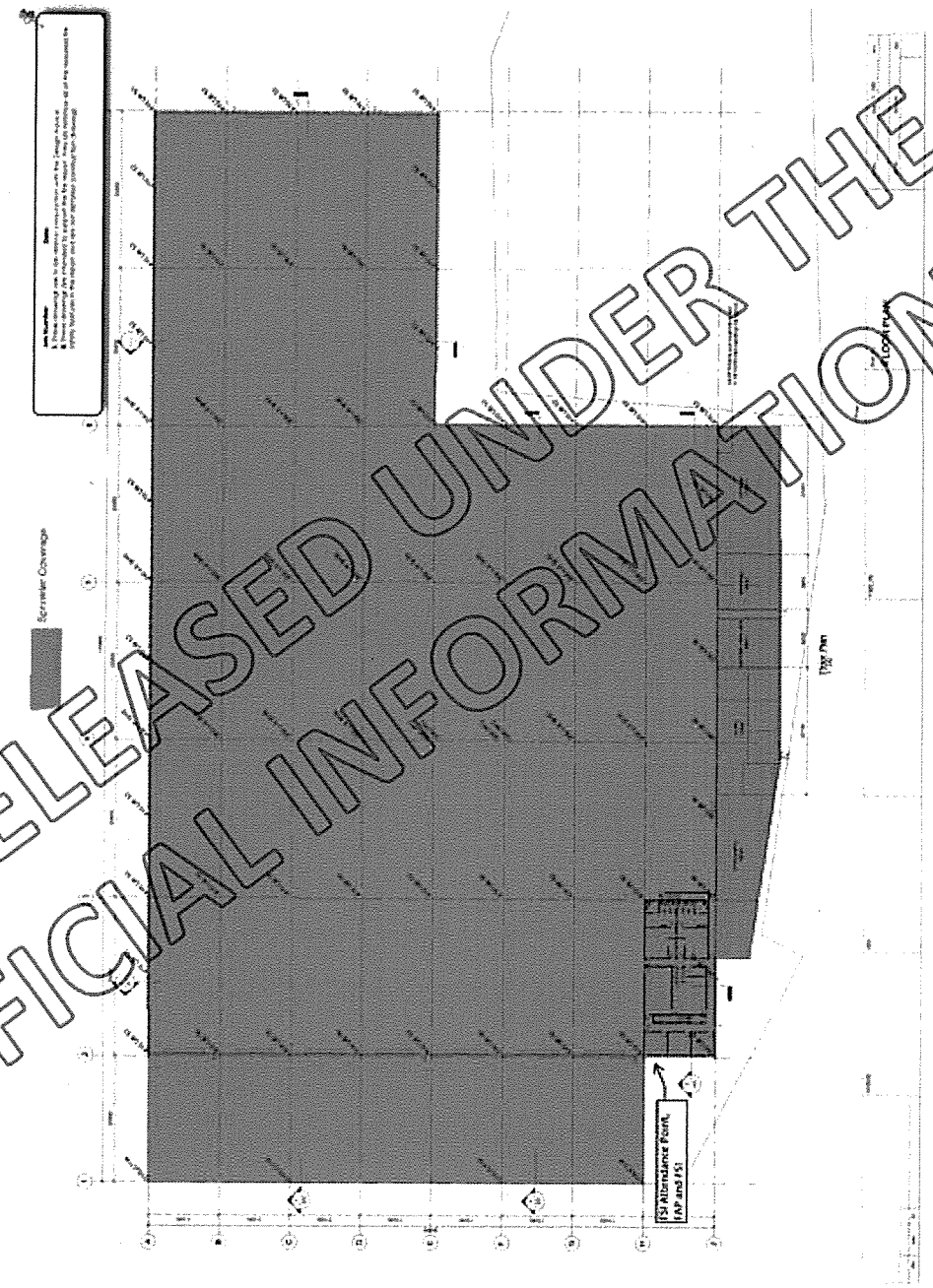


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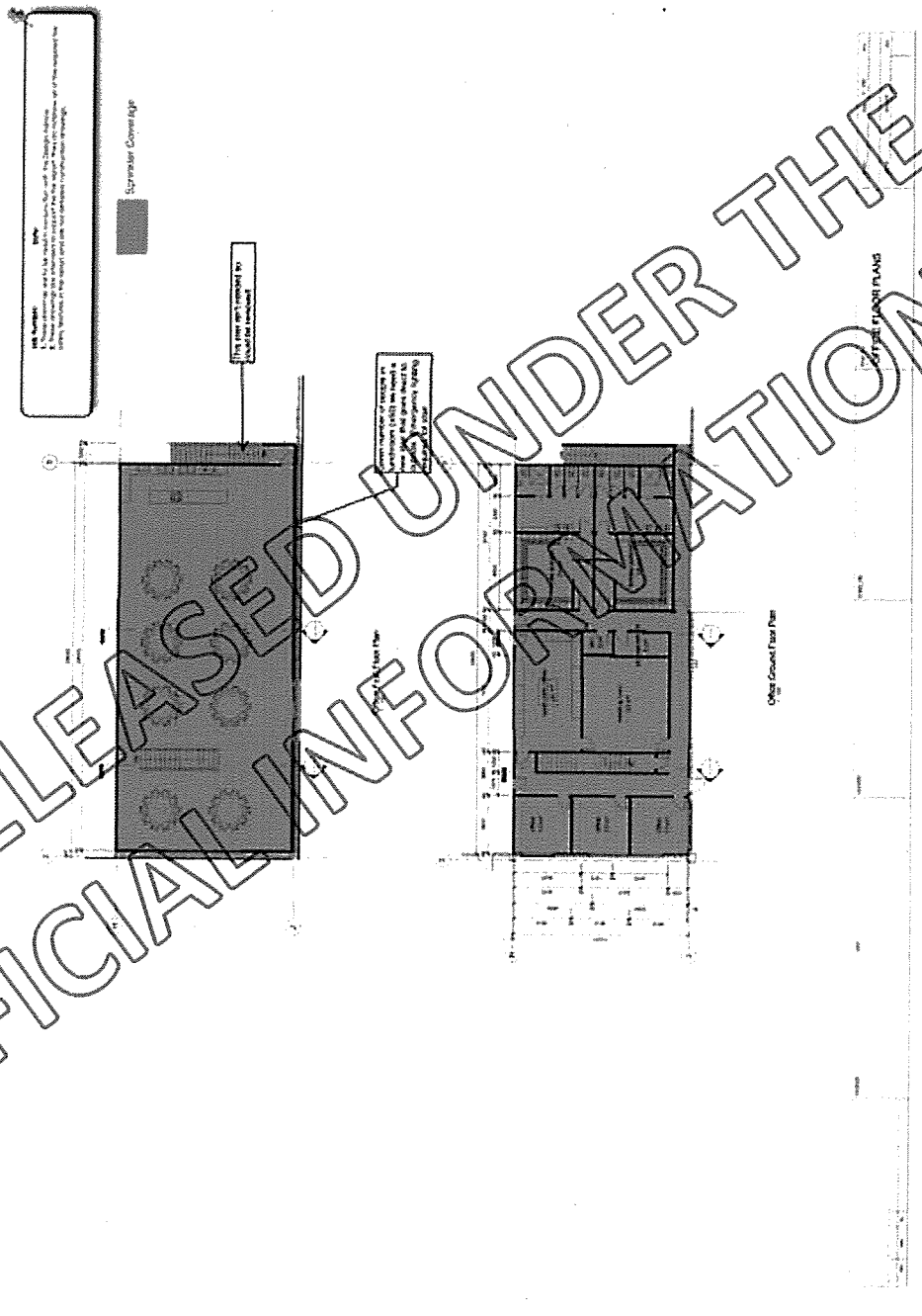

## APPENDIX 3 – Compliance Schedule Information

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.

| SS | Specified System: | Performance Standard: | Maintenance: | Inspections: | New | Modify |
|---|---|---|---|---|---|---|
| 1 | Automatic systems for fire suppression Type: 6 sprinkler system | NZS 4541:2007 | In accordance with NZS 4541:2007 Part 12 | By IQP:<br>**Weekly:** as necessary<br>**Monthly:** In accordance with NZS 4541 Paragraph 1202.2<br>**Quarterly:** In accordance with NZS 4541 paragraph 1202.3<br>**Yearly:** In accordance with NZS 4541 Paragraph 1202.5<br>**Biennial Routine Inspection:** In accordance with NZS 4541 Paragraph 1203. | YES | |
| 2 | Manual emergency warning systems for fire or other dangers Type 2 manual alarm system | NZS 4512:2010 | In accordance with NZS 4512:2010 Part 6 | By IQP:<br>**Monthly:** In accordance with NZS 4512 Paragraph 602.<br>**Yearly:** In accordance with NZS 4510 Paragraph 603. | YES | |
| 3 | Electromagnetic doors | BS7273 Part 4: 2007 | BS7273 Part 4: 2007 | By owner/occupier<br>**Weekly:** Check the local operation of release mechanism and closing of door on latch<br>By IQP:<br>**Monthly:** Check release of doors on operation of fire alarm and closing of door on to latch.<br>**Yearly:** As for monthly plus maintain door, check closer for operation and latching of door. | YES | |
| 4 | Emergency lighting systems including illuminated signs | AS 2293.3: 2005 | AS/NZS 2293.2:1995 Section 3 | By IQP<br>**Six monthly:** In accordance with Paragraph 3.2 and Appendix B AS/NZS 2293.2<br>**Yearly :** In accordance with Paragraph 3.3 AS/NZS 2293.2 | YES | |
| 14 | Signs relating to, a system or feature specified above. | Signs will be visible under all foreseeable conditions including interruption of mains power. | Ensure Emergency lighting systems illuminate any signs. Signs are clean and legible. | By owner/occupier<br>**Monthly:** Ensure signs in place where required, they are legible and clean and are illuminated. Record in log book.<br>By IQP.<br>**Yearly:** As per monthly and complete report and required forms. | YES | |

| SS | Specified System: | Performance Standard: | Maintenance: | Inspections: | New | Modify |
|---|---|---|---|---|---|---|
| 15 (2) | Final exits<br>Details: Designated final exit doors | 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. | Maintained in a safe condition: free from obstructions, locking, blocking, barring, storage of combustibles and ease of opening at the final exit. | By owner/Occupier<br>**Daily:** Check doors are not locked blocked or barred.<br>**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.<br>By IQP<br>**Yearly:** As above, complete report to owner and complete required forms. | YES | |
| 15 (3) | Fire separations<br>Type: As shown on the drawings in the fire safety design report | 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. | 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. | By owner/Occupier<br>**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.<br>By IQP<br>**Yearly:** As above. Complete report to owner and complete required forms. | YES | |
| 15 (4) | Signs for communicating information intended to facilitate evacuation | Signs will be visible under all foreseeable conditions including interruption of mains power. | Immediate replacement or refurbishment of signs if missing, incorrect or illegible. | By owner/occupier<br>**Monthly:** Ensure signs in place where required, they are legible and clean and are illuminated. Record in log book.<br>By IQP.<br>**Yearly:** As per monthly and complete report and required forms. | YES | |

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