

# Single-Stair High Rise Building Solutions

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## 1. PURPOSE

This guideline is principally concerned with the design, construction and commissioning of high rise buildings, which use a single fire-isolated stair as their means of egress.

The purpose of this guideline is to:

- describe the specific issues affecting occupant life safety and fire brigade intervention
- outline the Fire Rescue Commissioner's position in respect of building solutions that use a single fire-isolated stair as their means of egress
- enhance the awareness of operational firefighters
- identify a design, construction, commissioning and maintenance strategy that is acceptable to the Fire Rescue Commissioner
- inform industry of the Fire Rescue Commissioner's position in relation to Regulation 129 and 187 report and consent applications and any concurrent Section 160A modification referrals that may be received from the Building Appeals Board.

## 2. SCOPE

The scope of this guideline predominately relates to all high rise buildings that are constructed or are proposed to be constructed within the Fire Rescue Victoria district, which use a single fire isolated stair as a means of egress.

This guideline does not provide guidance in relation to the partial or staged occupation of a high rise building, which uses a single fire isolated stair as a means of egress. Guidance of this nature is beyond the scope of this guideline.

This guideline does not support the use of non-fire isolated stairs and open stairs in high rise buildings as a means of egress.

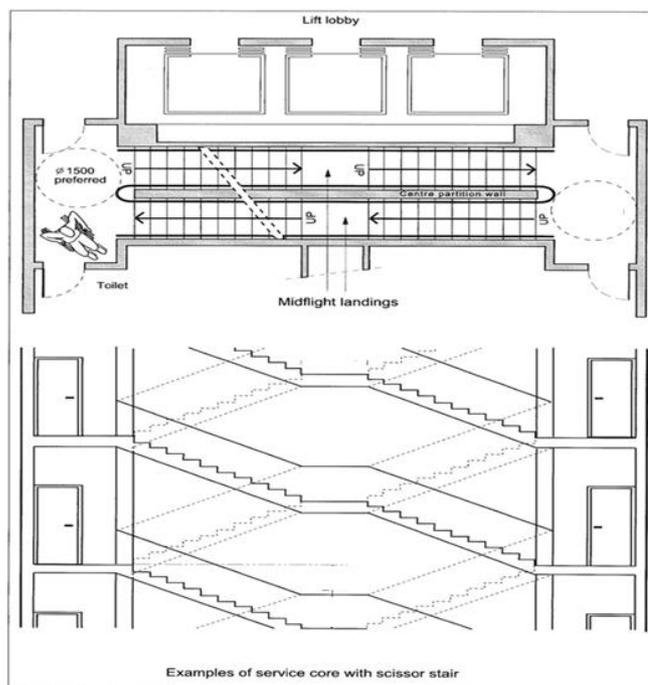
Furthermore, this guideline is not applicable for buildings over 150m in effective height and/or 50 storeys.

### 3. DEFINITIONS AND ABBREVIATIONS

<b>BAB</b>	Building Appeals Board
<b>BCA</b>	refers to the National Construction Code Series, Volume 1, Building Code of Australia
<b>DTS</b>	the deemed-to-satisfy provisions of the BCA
<b>FBIM</b>	Fire Brigade Intervention Model
<b>FEB</b>	Fire Engineering Brief
<b>FER</b>	Fire Engineering Report
<b>Fire Compartment</b>	has the same meaning as Section 1.4.5 of AS 2419.1 as replicated below:

*“The total space of a building; or any part of a building required by the Building Code of Australia to be separated from the remainder by walls and/or floors each having an FRL not less than that required for a firewall for that type of construction and where all openings in the separating construction are protected in accordance with the Building Code of Australia”*

<b>High Rise Building</b>	a building that is in excess of 25 metres in effective height, as defined by the BCA.
<b>IFEG</b>	International Fire Engineering Guidelines
<b>RBS</b>	Relevant Building Surveyor
<b>Scissor Stair</b>	a set of two interlocking stairways providing two separate paths of egress located within one stairwell enclosure. The stairs wind around each other and are fire separated from each other within the enclosure. An example of a typical scissor stair is shown in Figure 1 below (obtained from New Zealand Standard NZS 4121-2001):



<b>Transfer Floor</b>	a floor or level in a building used for ancillary or exclusive provision of a dedicated floor path of travel between one required exit and another
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## 4. BCA PERFORMANCE REQUIREMENTS

The relevant performance requirements applicable to high rise buildings which use a single fire isolated stair as their means of egress, have been identified within this guideline and are generally in accordance with the principles of Clause A0.10 of the BCA.

### 4.1 RELEVANT DEEMED-TO-SATISFY REQUIREMENTS

The following DTS provisions are generally considered to be applicable:

- CP9:** Access to and around the building
- D1.2:** Number of exits required
- D1.3:** When fire-isolated stairways and ramps are required
- D1.6:** Dimensions of exits and paths of travel to exits
- D1.7:** Travel via fire-isolated exits
- D3.2:** General building access requirements
- D3.3:** Parts of buildings to be accessible
- E2.3:** Provision for special hazards.

### 4.2 RELEVANT PERFORMANCE REQUIREMENTS

A number of performance requirements relating to exit stairs need to be met in order to satisfy the requirements of the BCA. Amongst these, the principle performance requirements are:

- DP1:** Access to be provided
- DP4:** Number, location and dimension of exits for evacuation
- DP5:** Fire isolated exits
- EP2.2:** Conditions within the evacuation route.

## 5. FIRE RESCUE COMMISSIONER'S POSITION

The Fire Rescue Commissioner does not actively support the design and construction of high rise buildings that use a single fire isolated stair as their means of egress due to the limitations they effectively impose upon occupant evacuation, fire brigade operations and the increased likelihood of fire fighters sustaining a fire ground injury. These limitations, difficulties and increased risks include, but are not limited to, the following:

- reduced options and redundancy for evacuation of occupants
- increased likelihood of slips, trips and falls for firefighters and occupants within the evacuation route and staging area
- reduced redundancy for the provision of a smoke and heat free environment for occupant evacuation and fire brigade intervention
- greater stairwell congestion caused by increased density of evacuating occupants and attending brigade members
- increased likelihood of the firefighters staging area becoming compromised due to increased congestion
- reduced tactical options and fire fighting safety that are imposed by the removal of second stair and subsequent staging area option
- excessive contra-flow issues e.g., delayed firefighter access and occupant evacuation caused by opposing travel direction in the staircase.

Although the Fire Rescue Commissioner prefers multiple stairs for egress, the Fire Rescue Commissioner recognises that particular building designs on smaller allotment sizes may become unfeasible if a second fire isolated exit stair is required in accordance with the BCA. In these instances, the Fire Rescue Commissioner believes that the implementation of a scissor stair case arrangement will generally compliment fire brigade operations without significantly compromising the building design.

## **6. FIRE SAFETY DESIGN REQUIREMENTS**

Designers of high rise buildings containing a single fire isolated stair that adopts the following fire safety design options and requirements are likely to be supported by the Fire Rescue Commissioner.

### **6.1 SPRINKLER AND HYDRANT SYSTEM INFRASTRUCTURE**

The sprinkler system and hydrant system may be serviced from the same water mains connections and/or pump set however, the infrastructure of both systems must remain independent and compliant with AS 2118.1, AS 2118.6 and AS 2419.1 as applicable. Where a combined water supply is proposed, it must adhere to the following design requirements:

- fixed on-site pumps provided to services both the sprinkler and hydrant systems shall meet the duty requirements of AS2419.1 and AS2118.1, including delivery of 150% of the combined flow at 65% of the required pressure
- pump set installations in single-stair buildings shall comprise of at least one compression ignition engine
- compliant control assemblies must be provided for the sprinkler system, as required by Section 8 of AS 2118.1-1999
- fire hose reel connections comply with Clause 4.4.2 of AS 2118.1-1999
- no other connection shall be made to the water supply, except where it can be demonstrated to the Fire Rescue Commissioner that the other connection would not decrease the overall performance or reliability of the water supply.

### **6.2 SPRINKLER SYSTEM**

The building shall be provided with an AS 2118.1 compliant automatic fire sprinkler system that is provided with an enhanced level of protection within egress routes and an appropriate level of system reliability, which includes:

- the provision of flow valve monitoring and independent isolation valves for each level contained within the stair accessible to firefighters
- the provision of isolation valves (other than a dedicated valve and isolation assemblies for the floor or storey) shall not be fitted to enable total isolation for two or more continuous storeys
- a dedicated and independent service input to the Alarm Signalling Equipment
- extension of the sprinkler system coverage into the fire isolated staircase, along with protection adjacent to the stair entrance door

- the provision of a Grade 1 water supply. Where this is to be achieved through the installation of static water supply tanks supplementing the town main supply, they shall be arranged as break tank(s) only. The minimum combined capacity in this case shall be the greater of:
  - 40,000 litres
  - 25,000 litres for a sprinkler system serving building occupancies that are classified as being no more hazardous than Ordinary Hazard (OH2) as defined by AS 2118.1-1999.

Note: fire brigade suction must be provided from the tank supply under positive head conditions only.

### **6.3 HYDRANT SYSTEM**

The fire hydrant system must be provided in accordance with AS 2419.1 which incorporates the following design additions and variations for improved reliability and redundancy:

- ring main or pressure zone isolations required under Clause 8.5.5 of AS 2419.1 must not be capable of isolating the service to fire hydrants on two or more continuous storeys so that an active hydrant is maintained at the level above and below the isolated floor for every isolation configuration
- compliant fire hydrant coverage in accordance with Clauses 3.2.3.1 and 3.2.3.2 of AS 2419.1-2005: *Fire Hydrant Installations – System Design, Installation and Commissioning* is achieved when measured from the fire hydrant located at the floor level below the level being assessed.

### **6.4 STAIRWELL PRESSURISATION SYSTEM**

The fire isolated stair must be provided with a stair well pressurisation system in accordance with AS.NZS 1668.1 which is provided with a reliable back-up power supply that ensures its operation in the event of a power failure. Alternative designs will be assessed on a case by case basis.

A smoke isolated lobby should also be considered to provide redundant protection to the single fire isolated stair.

### **6.5 FIRE DETECTION AND INTERCOM SYSTEM**

A smoke detection system compliant with Clause 4 of Specification E2.2a of the BCA must be provided in all public corridors and other internal common spaces.

An AS 1670.4 compliant Sound System and Intercom System for Emergency Purposes (SSISEP) must be installed throughout the building which provides occupants with early warning and direction in an emergency with automatic voice-over activated instructions.

A smoke isolated lobby should also be considered to provide redundant protection to the single fire isolated stair.

### **6.6 FIREFIGHTER ACCESS**

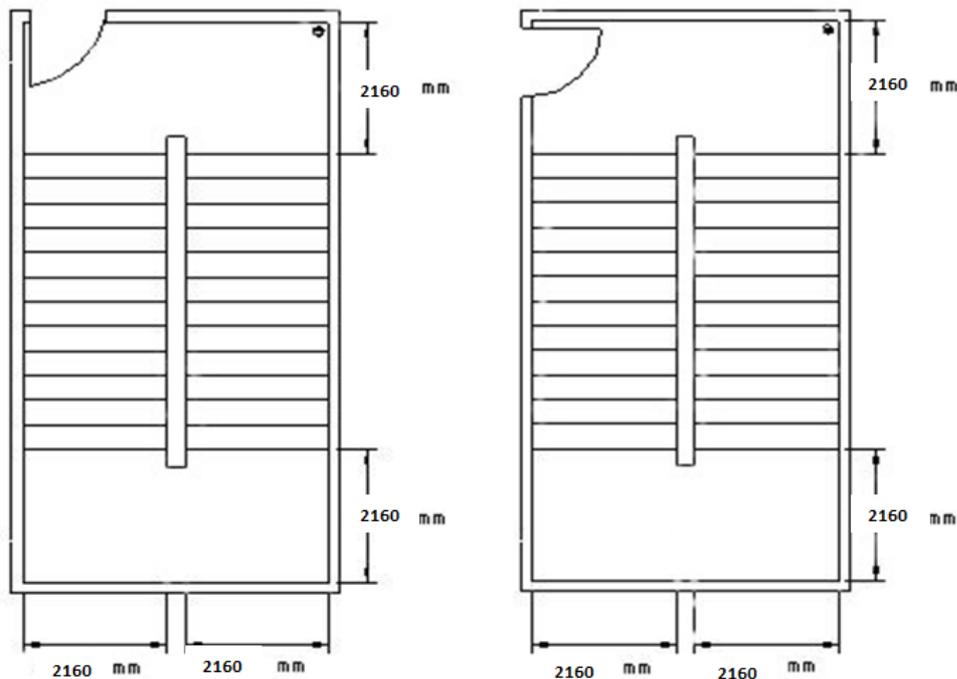
Floor re-entry provisions shall be provided as follows:

- re-entry from the fire isolated staircase to the adjacent floor area must be provided on at least every second storey and to all doors during the general fire alarm
- doors determined as re-entry doors must not be fitted with locks or any other measure to prevent or delay access at any time

- signage must be fixed to all re-entry doors advising that re-entry is available at that level. The signage must read “RE-ENTRY AVAILABLE AT THIS LEVEL” in type, colour contrast and size complying with Clause D2.23 (b) of the BCA.

## 6.7 ACCEPTABLE LANDING AND STAIRCASE DESIGN CONFIGURATION

The width and length of the landing and the effective width of the staircase must be increased in size by an additional 1160mm to the DTS requirements as indicated in Figure 2 below (i.e. DTS 1000 + 1160mm):



Furthermore, a smoke lobby is recommended to provide redundant protection to the single fire isolated staircase.

## 6.8 SEPARATION OF RUBBISH CHUTES

Where rubbish chutes are proposed, they shall not be installed within the fire isolated stair. They should be provided within a separate fire isolated shaft that is accessible by the building’s occupants through a separate smoke resistant room, cabinet or enclosure.

## 7. FIRE SAFETY DESIGN CONSIDERATIONS

The fire safety design strategy for any fire isolated single-stair high rise building solution must encompass systems that are provided with a high level of redundancy and reliability, which fully integrates with each other and do not promote an overburdening maintenance obligation for building owners and their maintenance providers.

The strategy must be underpinned by an appropriate emergency management plan that concurrently considers fire brigade operations and be inclusive of, but not limited to, the following:

- where evacuation strategies rely on the use of transfer floors and lifts, references may be made to FRV Fire Safety Guideline *GL-31 – Use of Lifts for Evacuation*. It should be noted however that neither this guideline, nor GL-31, provides specific guidance in relation to the concurrent use of

transfer floors and lifts. Reference to Australian Building Codes Board publication *Lifts Used During Evacuation* should also be made

- the provision of documented evacuation strategies and the minimum training requirements must be provided and implemented. Implementation of these requirements shall be listed as an essential service and be implemented by the building's emergency planning committee or emergency control organisation
- the evacuation strategy must be detailed in the FER and be specific to the proposed building solution rather than a generic strategy. All referenced material and assumptions adopted in the formulation of the strategy must be included, along with the following information:
  - evacuation modelling undertaken in accordance with the principles of IFEG
  - an FBIM assessment undertaken in accordance with FRV Fire Safety Guideline *GL-17 – Fire Brigade Intervention Model (FBIM) – General Provisions* to assess the likely extent of contra-flow between occupants and firefighters who may be using the staircase simultaneously. The outcomes of the assessment shall be used in the formulation of the building's evacuation strategy to ensure that congestion and the resulting contra-flow within the stair is minimised
  - consideration for occupants with a disability, and the relevant requirements of Part D3 of the BCA specific classification and/or business objectives. The cohesiveness of the evacuation plan, with respect to occupants with a disability, must be demonstrated and may require specialist consultation with appropriate professional bodies and accredited disability access consultancies

**Note:** all documentation used in the formulation of the evacuation strategy must be included in the FER.
- other emergency events must be addressed within the fire safety design strategy, e.g. gas leaks, bomb threats and other life safety hazards. In particular, access and egress provisions for the building should also consider the response of paramedics and their associated medical responder equipment and stretchers.

The above issues shall form part of the Fire Engineering Brief and the Fire Engineering Report provided to FRV as per FRV Fire Safety Guideline *GL-33 – Performance Based Design within the Built Environment*.

## **8. FIRE SAFETY SYSTEM COMMISSIONING AND DESIGN SPECIFICATION MANUALS**

### **8.1 FIRE SAFETY SYSTEM PERFORMANCE AND INTERFACE COMMISSIONING**

A commissioning demonstration of all active fire safety measures is recommended, which includes interaction and interfacing with other active fire safety measures. This may require physical validation and the successful demonstration of performance in the presence of delegates of the Fire Rescue Commissioner prior to occupation of the building.

Where required, the commissioning demonstration must validate the successful interaction and interfacing of individual safety measures to the design specifications, to show that the complete system achieves the fire safety design requirements of this guideline and those of the applicable fire safety engineering solution.

The Fire Rescue Commissioner will not offer their consent to an application that is made under Regulation 187 where the installed fire safety measures do not function as they are intended. Similarly, the Fire Rescue Commissioner will not offer their consent where the construction of the building differs from the design that was originally supported under Regulation 129.

## **8.2 DESIGN SPECIFICATION MANUALS – DESIGN, OPERATION, COMMISSIONING AND TESTING**

Fire safety specification manuals that encompass the operation, commissioning, testing and maintenance of the building fire safety system must be developed and include adequate detail to demonstrate the required performance for each individual safety measure, inclusive of interactions with other fire safety measures. This is particularly important for all fire safety measures included in a design that does not have a dedicated reference design standard.

Directions and procedures for conducting system interface testing at specified intervals must be included, along with single page network diagrams in the form of Cause and Effect charts, or similar, to clearly demonstrate the required interfacing of the fire safety systems.

The manual must be kept on site at all times and a copy of the manual must also be lodged with the relevant municipal council as part of the relevant building surveyor's Section 73 lodgement.

## **9. MECHANISMS FOR REFERRALS TO THE BUILDING APPEALS BOARD**

### **9.1 DESIGN STAGE**

A Section 160A determination from the Building Appeals Board shall be obtained where a single-stair high rise building proposal does not demonstrate full compliance with this guideline. A Section 160A application may be lodged either concurrently or prior to seeking the Fire Rescue Commissioner's report and consent under Regulation 129. The Building Appeals Board, upon receipt of an application for a Section 160A determination, is likely to seek the Fire Rescue Commissioner's advice prior to determining the matter.

Prospective report and consent applicants should therefore be aware that the Fire Rescue Commissioner will not consider any report and consent application under Regulations 129 and 187 that do not comply with this guideline, or have the written support of the Building Appeals Board under Section 160A of the Building Act 1993 (the Act).

### **9.2 CONSTRUCTION STAGE**

Non-compliant building work that cannot be remedied to achieve compliance with the approved building permit documentation and Building Regulations 2006 must also be referred to the Building Appeals Board for a Section 160A Determination. The Building Appeals Board, upon receipt of an Application for a Section 160A Determination, is likely to seek the Fire Rescue Commissioner's advice prior to determining the matter.

## **10. REQUIREMENT TO OBTAIN A REPORT AND CONSENT**

The requirement for the report and consent of the Fire Rescue Commissioner in respect to Regulations 129 and 187 are not removed where a solution complies with the minimum fire safety design requirements contained within Section 6 of this guideline. Similarly, compliance with this guideline does not obviate the need to obtain the Fire Rescue Commissioner's endorsement of the FEB and FER as identified in FRV Fire Safety Guideline *GL-33 – Performance Based Design within the Built Environment*.

Where the minimum fire safety design requirements referred to in Section 6 of this guideline are implemented, the Fire Rescue Commissioner also assumes that all other aspects of building solutions will be designed to a standard that is commensurate with the prescriptive provisions of the BCA. If any other deviations from the prescriptive provisions of the BCA are proposed, the entire design solution must also be referred to the Building Appeals Board for a Section 160A determination.

## **11. APPLICATION OF PRECEDENT**

Applicants who seek the Fire Rescue Commissioner's report and consent under Regulations 129 and 187 need to be aware that a supporting decision for one building solution does not automatically infer support for another building solution. Every building solution that is referred to the Fire Rescue Commissioner will be reviewed on a case by case basis.

**Note:** *this is a controlled document and may only be modified by authorised personnel after review by FRV Fire Safety Advisory Group.*