DESIGNER'S GUIDE

Firefighting operations on automatic sprinklers systems

F5-06 GD

Introduction

When to use

Use this chapter to provide a consistent Fire and Emergency New Zealand position on design considerations and use of automatic fire sprinkler systems within buildings. The primary objectives are to:

- outline the Fire and Emergency position on appropriate life safety and building design considerations for owners, designers and other building practitioners on automatic fire sprinkler systems,
- identify and overcome the limitations of the C/AS7 Acceptable Solution for Buildings Used for Vehicle Storage and Parking and C/VM2 Verification Method: Framework for Fire Safety Design methodologies when considering the benefits and operation of automatic fire sprinkler systems.
- describe specific issues affecting firefighting operations when using automatic fire sprinkler systems.

Scope

The scope of this chapter relates to any automatic fire sprinkler system within a building. The higher the building, the more challenging the conduct of both internally- and externally-based firefighting becomes. Automatic fire sprinkler systems can enable the fire to be controlled, or even extinguished, early in its development, allowing more time for the emergency services to manage the incident.

NZ Building code performance requirements

Standards

Fire Safety C Protection from fire clauses C1 – C6 define NZ Building Code performance requirements of the Building Act 2004. C5 is the performance requirement on 'Access and Safety for Firefighting Operations'.

Part 6 of the Acceptable Solutions provides limited information on requirements for firefighting operations therefore, Fire and Emergency NZ considers that guidelines are required.

Several NZ Standards exist for sprinkler systems. The current documents include:

- NZS 4541:2013 Automatic fire sprinkler systems
- NZS 4515:2009 Fire sprinkler systems for life safety in sleeping occupancies (up to 2000 m^2)
- NZS 4517:2010, 'Fire sprinkler systems for houses'.

These documents specifically relate to NZS 4541 and to 4515. Systems installed to these standards may require inlets and/or monitoring features in order to make them compliant.

The Acceptable Solutions form one 'deemed to comply' design solution for buildings, but does not specifically address firefighting operational considerations in relation to automatic fire sprinkler systems and other firefighting facilities. In addition to the standards cited above, the following list includes standards and guidance relating to building fire safety systems that are mandated for a variety of buildings. This is not an exhaustive list.

- NZS PAS 4509:2008 NZFS Firefighting Water Supplies Code of Practice
- NZS 4510:2008 Fire Hydrant Systems for Buildings
- NZS 4512: 2010 Fire Detection and Alarm Systems in Buildings.

Definitions

	The following definitions apply for the purpose of this chapter. Defined terms (in italics) used throughout this document, are consistent with the Building Act 2004, New Zealand Building Code (NZBC) and Acceptable Solutions C/ASx.
BRE (British Research Establishment)	A research unit established by the UK government to consult, conduct research and testing for construction and the built environment.
C/ASx	NZBC Fire Design Acceptable Solution parts 1 – 7 (x represents numbers 1 – 7).
FEB (Fire Engineering Brief)	A formal process as outlined in the International Fire Engineer Guidelines for all stakeholders to define the scope of work for the fire engineering analysis and the basis for analysis as agreed by stakeholders.
FRR (Fire Resistance Rating)	This is a defined term in the NZBC C Fire Documents. 'The term used to describe the minimum fire resistance required of primary and secondary elements as determined in the standard test for fire resistance' (refer to NZBC for full description).
Attendance point	A single point of emergency response attendance per building, as referenced in clause 6.2.1 of the C/ASx documents, and to comply with Clause C5.3 of NZBC. This will give access to: • indications of fire location • controls for fire safety systems • inlets for fire sprinkler or hydrant systems. **Note:** An attendance point where facilities are provided to meet the provisions of NZBC C5-7 giving firefighters clear information, will be the initial tasking and safety briefing point for crews before deploying to any other access point.
Address point	This point is part of the data set administered by Land Information New Zealand, (LINZ). It is the address (point) where the building is commonly known to be located. The address point can be either singular, or a range of individual points as described on the LINZ data set.
Firefighter access point	NZBC clause C6.3 applies. Additionally, for access points which are not linked to the requirements for an attendance point described above, it will be advantageous to the building owner for the Provisions requirements of NZBC Clause C5.7 to apply. See the note in the Attendance point definition. Failure to provide these may mean that briefings for safety and tasking may delay arrival at the additional access points.
Fire service vehicular access	C/AS Part 6: Firefighting Clause 6.1.1 describes this. Additionally, for the health and safety of our personnel, this access must: • not involve a canopy, or other part of a structure to drive or park under • be located outside a horizontal collapse zone requirement of 1.5 times height of the tilt slab • be within 135 m of a firefighting water supply. If the access meets these requirements then it is deemed usable, and the 75 m hose run may be measured from this hard-standing.

Background

Acceptable Solutions requirements

The Acceptable Solutions C/ASx Part 2 require automatic fire sprinklers in new buildings where the following conditions exist:

- escape height exceeds 25 m
- occupant load exceeds 1000
- education accommodation (dormitories, etc.)
- in storage buildings where storage height exceeds 5m in height
- vehicle stacking systems
- childcare facilities that have an escape height exceeding 2 m.

Design methodologies using either the C/VM2 and/or performance-based design approaches may be able to demonstrate NZBC compliance without the need for automatic fire sprinklers. Existing buildings that do not have a sprinkler system may be justified in not installing a system based on the life risk within, and features of, the building and the scope of the works proposed.

Fire and Emergency recommendation

Fire and Emergency NZ recommends the installation of automatic fire sprinklers in buildings as this can provide a robust and reliable means of promoting life safety and property protection as well as securing benefits in terms of less onerous internal and external passive fire protection. In many cases, the mitigation of fire loss and disruption will significantly enhance business continuity in the event of an incident.

The standards cited in NZ Building code performance requirements above provide more detailed information on the requirements of automatic fire sprinkler systems.

Firefighting considerations

Recommended Fire and Emergency requirements for buildings above 25 m tall

Successful firefighting operations in multi-level buildings largely depend on the fire safety features that have been installed.

Designers are required to consider firefighting operations to ensure compliance with the NZBC. However, for tall high-rise buildings, additional considerations should be explored to enable adequate, reliable supplies of water to be available for sprinkler activations and to support firefighting operations. Fire and Emergency recommends that designers meet with Fire and Emergency as early as possible in the design phase (e.g. during the FEB process) to discuss the firefighting requirements.

Minimum recommended requirements

Listed below are the minimum recommended Fire and Emergency requirements for multi-level buildings above 25 m tall.

- A reliable automatic fire suppression system covering the entire building complex, for control or complete extinguishment of the fire. A fully compliant system in accordance with NZS 4541:2013 is likely to provide early fire suppression and control thus reducing the likelihood of fire spread. Although assumptions are made as to the reliability of water supplies in the Acceptable Solutions, the failure of a single water supply would place the building, and any occupants unable to escape, in danger.
- A building hydrant system in accordance with NZS 4510:2008, with the outlets inside a safe path stairwell.
- A fully compliant fire detection system in accordance with NZS 4512:2010 to provide early warning for building occupants. A detection system monitored by Fire and Emergency will raise an early response from the nearest fire crews. Fire and Emergency is committed to reducing false alarms, therefore it is important to select the most suitable detection system that is fit for purpose.
- Acceptable firefighter access onto the fire floor. This is normally from a safe place via a (potentially pressurized) safe path stairwell.
- Multi-level buildings <500 m^2 and <10 m below ground require one pressurised safe path stairway.
- Multi-level buildings >500 m^2 and >10 m below ground require two pressurised safe path stairways.

- Stairway pressurisation in accordance with AS/NZS 1668.1:2015. Firefighters must be able to enter and operate from a safe path stairwell from the entry point to the lowest and highest levels of the building. Vision (viewing) panels are required in the safe path stairwell to allow firefighters to gain first-hand knowledge on the possible location of the fire and its development. An Entry Control Officer (ECO) sets up and operates from the safe path stairs in a multi-level building.
- An automatic smoke ventilation or smoke exhaust/extract system in a multi-level building to assist with firefighting operations. This is especially important for basement fires as visibility is lost very early, often before the first crew arrives, so their origin is difficult to locate. Additionally, heat and smoke have very little opportunity to escape so can congest the vertical means of escape. Firefighters must have full access and ability to control the ventilation/extraction system if required.
- Where firefighting lifts are provided, compliance with these recommendations and NZS 4332:1997, BS 9999:2017 and/or BS EN 81-72:2015 will promote their safe use by firefighters during an incident.

Methods of building construction and automatic fire sprinkler systems

Impact from construction methods and features

There are various construction methods and building features used in buildings that may have an impact on smoke and fire spread, occupant evacuation and firefighting operations.

Tall, undivided spaces (e.g. atria and high-bay warehouses), may significantly delay the operation of sprinkler heads and adversely affect the projection of water onto the fire. These could pose significant design challenges and may directly affect the way in which an incident is managed.

Design issues and considerations

Sprinkler systems main components

Automatic sprinkler systems are made up of four main components. These components are the:

- water supply
- valve-set which controls and monitors the flow of water into the building
- network of hydraulically designed pipe work that distributes the water around the building
- sprinkler head/s (which are the active element that releases the water upon the fire).

Designers must consider the following factors when designing automatic fire sprinkler systems in buildings to allow firefighters to effectively use them. Location of:

- fire sprinkler inlets
- sprinkler house (pump/valve set)
- sprinkler floor isolation valves.

These are expanded in detail in the sections that follow.

Co-location of firefighting facilities

First attending appliance

The attendance point of the fire appliance is an important consideration in the planning and conduct of operations. Once committed to a location and providing water to building hydrant or sprinkler inlets, it becomes difficult to relocate fire appliances without interrupting those water supplies. The first appliance will generally act as the control point for smaller fires. This appliance will not be relocated except in serious operational safety concerns.

Possible consequences if firefighting facilities not co-located

Given that use of the water supplies may be maintaining reasonably safe conditions for firefighters, further operational procedures may require the withdrawal of personnel from inside and close to the building. This type of interruption may allow a fire to redevelop and/or place firefighting personnel at risk.

If inlets and fire alarm panels are not co-located, the first attending appliance (that would normally provide the water and gain information prior to entering a building) may be required to attend different points around a building. This means that effective firefighting is likely to be delayed while personnel move from one point in the perimeter to another, or are involved in setting separate water supplies to each of the base appliances.

A further factor is that the fire appliances carry a fixed stock of hose. If the hose is used to provide water to more than one location, the firefighting operations may require additional lengths of hose. This would normally be provided by mobilising another appliance to the scene of the fire. The time taken for another appliance to arrive may further delay firefighting and the commitment of a further appliance means that it is likely to take longer for firefighters to arrive at the scene if another fire occurs in the same area.

For all the above reasons, it is highly advantageous to co-locate firefighting facilities so that a single appliance can provide the water necessary. This will also release more personnel to engage in the firefighting effort rather than being involved on water management roles.

Fire and Emergency approval required for sprinkler inlet locations

While NZS 4541:2013, paragraph 610.2, requires sprinkler inlet locations to be approved by Fire and Emergency, NZS 4510:2008, paragraph 5.1 requires the inlet to be located within 18 m of a road way or suitable hardstanding. The access to the inlet is to be unobstructed.

Note: NZS 4510:2008, paragraph 5.1 also refers to this Firefighting Operations designers guide in respect of Fire and Emergency's operational requirements.

Fire sprinkler inlet location

Situations where sprinklers required

In new buildings, the Acceptable Solutions, C/AS1 - C/AS7 requires a sprinkler system to be installed in all the following situations:

- Escape height greater than 25 m.
- Occupant load greater than 1000 people.
- A building with a single means of escape and an escape height greater than 10 m.
- In all Sleeping Care (SC) and Sleeping Detention (SD) firecells even if a single floor.

This is not a definitive list and other situations may exist where sprinklers are required within the Acceptable Solutions framework. Each building must be considered on a case by case basis. Property owners may elect to install a sprinkler system for asset protection, Fire and Emergency NZ would support such installations.

Fire sprinkler inlet location requirement

The requirements for the location of the fire sprinkler inlet (FSI) and its enclosure are listed in NZS 4541:2013, paragraphs 610.2 and 610.3.

Note: These requirements are almost identical to that of a building hydrant inlet (BHI).

As indicated above, it is normally recommended that the FSI and building hydrant inlet (BHI) are co-located with the Fire Alarm Panel (FAP), within 5 m of each other (see NZS 4512:2010). This will assist with our operational requirements and reduce the time taken to commence firefighting operations.

Figure 1: Fire sprinkler inlet enclosure

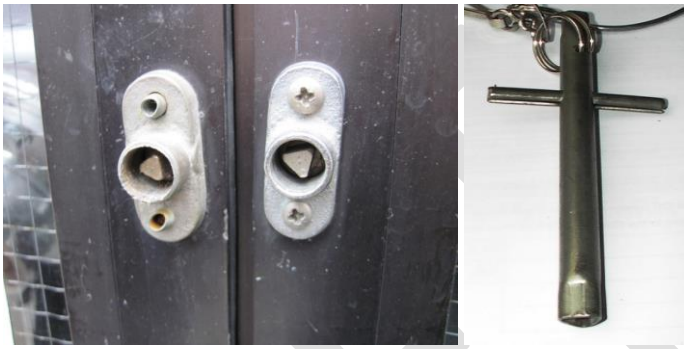

Figure 2: Fire sprinkler inlet enclosure locking device and key

Sprinkler house (pump/valve set) location

Location requirements

NZS 4541:2013, paragraph 404.2.2 indicates the requirements for the main stop valve.

Building designers should be advised that Fire and Emergency NZ require access to the 'sprinkler valve house' in order to check the correct operation of the sprinkler system (by checking the position of the main valves) and to isolate/drain and shut down the system as and when required to prevent unnecessary water damage.

The valve house should be readily and easily accessible and its location should be clearly marked on the fire panel.

Enclosure requirements

The enclosure itself should be easily identifiable and be clearly marked with a sign consisting of black or white letters on a white or black background as shown below.

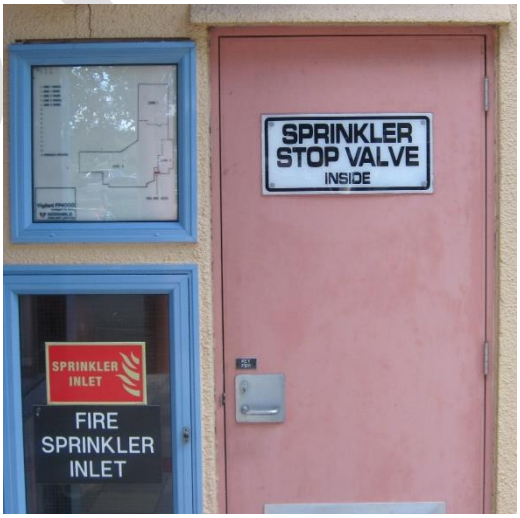

Figure 3: Sprinkler enclosure signage

The enclosure should be secured using a padlock opened with a Lockwood 197 key or FB11. The valves should be secured with a padlock opened with a Lockwood 144 key.

Lockwood 197
(sprinkler enclosure)

FB11
(sprinkler enclosure)

Lockwood 144
(control valves padlock)

Figure 4: Keys commonly held by Fire and Emergency

The enclosure should not be used for anything other than housing the sprinkler/pump system installation control valves. The room should also be of a sufficient size and the system arranged to allow for firefighters to operate valves and view gauges. It is a requirement of the Standard that the enclosure have artificial lighting and sprinkler protection.

See standard: NZS 4541:2013, paragraphs 404.1, and 607 for further information.

Locations and indication of sprinkler floor isolation valves

Requirements

NZS 4541:2013, paragraph 211, specifies that buildings with more than six floors must have floor isolation valves. Where isolation valves are present in a building, Fire and Emergency recommends that they are installed to allow for access by firefighters.

Floor isolation valves

Floor isolation valves are used by fire crews after a fire event to stop the flow of water to the sprinkler system in a portion of the building. The ability to isolate portions of the sprinkler system allows for the rest of the building to remain protected even after a fire incident. If isolation valves are not present, fire crews must use the main stop valve and cut off the sprinkler system water supply to the entire building. This practice renders the sprinkler system inoperative and greatly reduces the building's level of protection and the safety of the building occupants. It may also place the building in a non-compliant situation with Council building consent.

NZS 4541:2013 paragraph 404.2.4 states that floor isolation valves be located where:

- they are accessible from floor level (no elevation aids are needed)
- the unlocking, unchaining and operation of valves are not hindered by physical limitations or objects
- the valve is in a secured space access that can be gained by standard Fire and Emergency keys.
- locations of floor isolation valves are to be clearly shown by signage.

Note: It is recommended that the zone index or mimic panels indicate the location of floor isolation valves.

Installation recommendation in all large buildings

Fire and Emergency NZ recommends that subsidiary floor valves be installed in all large buildings. This is particularly appropriate in buildings such as shopping malls or large open area buildings where the sprinkler system may serve multiple shops or zones on a single floor. In accordance with NZS 4541:2013, paragraph 404.2.4 of these valves shall be:

- fitted with a listed supervisory device
- located in a prominent position
- clearly labelled
- accessible from floor level or by a permanent access ladder/platform provided for fire crews.

Installation of subsidiary floor valves allows fire crews to turn off the water supply to a portion of the sprinkler system to isolate an area and reduce water damage while maintaining sprinkler coverage to the rest of the building.

Part 212.5 requires the location of flow switches to be shown on the Fire Information Panel (FIP). In addition, their location should be identified by signage in a stairway that attending fire crews will use, i.e. the fire stairway containing the hydrant outlets.

Sprinkler checklist

Checklist

Brigade inlet – *sprinkler and hydrant* location(s) suitable?	**Yes**	**No**
Does the location suit our operational needs?		
Is the location of inlets tied in with the building address point?		
Are they within 5 m of the Fire Alarm Panel in the main entrance?		
Are they in clear view of, and within 20 m, of appliance *'hard standing'* or the roadway?		
Is access to the BHI unobstructed?		
Is brigade inlet connection (BIC) on the outside wall of the building preferably on the front face?		
Is the BIC protected from falling debris? (if building has glazed exterior walls)		
Sprinkler house (pump/valve set) location suitable	**Yes**	**No**
Type of door key – Lockwood 197 or FB11 (state)		
Type of key securing valves – Lockwood 144 key (state)		
Sprinkler floor isolation valves location suitable	**Yes**	**No**
Floor isolation valves location clearly indicated?		
Can the valves be accessed by fire crews on each floor without ladders?		