

# FIRE ENGINEERING



THE UNIVERSITY  
OF QUEENSLAND  
AUSTRALIA

**DESIGN STANDARDS**

**DS-10**

## Document Register

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**Disclaimer**

Refer to the Disclaimer within the UQ Design Standards.

**Reference Documents**

Refer to the UQ Design Standards for the list of documents and associated standards to be referenced for design work.

The designer is to coordinate between disciplines and standards.

# Introduction

## 1.1 Intent of Fire Engineering Design

The intent of fire engineering design is to achieve a building design that provides building occupants with an appropriate level of fire safety while achieving the functional intent and desired use of the building.

The strategy for achieving an appropriate level of fire safety for building occupants is referred to as the 'fire safety strategy' building and will typically include a combination of prescriptive measures and fire engineering requirements.

## 1.2 Objective of Fire Engineering Standard

The objective of UQ's Standard for Fire Engineering is to detail the intended process for Fire Engineering Design for UQ's buildings and to provide an overview of the minimum requirements that are required for UQ buildings with respect to fire engineering.

## 1.3 Glossary

This document is to be read in conjunction with the definitions of terms listed in Part A1 of the NCC (1) and the following:

### Performance Solution

A Compliance Solution which complies with the Performance Requirements other than by reason of satisfying the Deemed-to-Satisfy Provisions.

### Assessment Method

A method used for determining that a Compliance Solution complies with the Performance Requirements.

### Compliance Solution

A solution which complies with the Performance Requirements and is:

- a) Performance Solution; or
- b) a solution which complies with the Deemed-to-Satisfy Provisions; or
- c) a combination of (a) and (b).

A Compliance Solution will comply with the NCC if it satisfies the Performance Requirements.

### DTS: Deemed-to-Satisfy (Provisions)

The prescriptive provisions of a code that are deemed to meet the Performance Requirements.

### Fire Engineering Brief (FEB)

A documented process that defines the scope of work for the fire engineering assessment and the basis for analysis as agreed by stakeholders.

### Fire Engineering Report (FER)

A document which is to detail the analysis, arguments, calculations and modelling used to verify the design meets the relevant Performance Requirements.

### Fire Safety Strategy

One or any combination of the methods used in a building to:

- a) warn people of an emergency,
- b) provide for safe evacuation,
- c) restrict the spread of fire, or
- d) extinguish a fire.

It includes both active and passive systems.

### Performance Requirement

A requirement which states the level of performance which a Compliance Solution must meet.

**Sub-System**

A part of a Fire Safety System that comprises Fire Safety measures to protect against a particular hazard (eg smoke spread). Note: The Australian Fire Engineering Guidelines (IFEG) defines six sub-systems. This also comprises the Fire Safety Strategy.

**To The Degree Necessary**

Consideration of all the criteria referred to in the Performance Requirement to determine the outcome appropriate to the circumstances, whereby in certain situations it may not be necessary to incorporate any specific measures to meet the Performance Requirement.

**University of Queensland (UQ)**

Where applicable, University of Queensland will be abbreviated to be "UQ".

# 2. Fire Engineering Design Process

## 2.1 Regulatory Background

Where a building is proposed, the building must be designed in accordance with the National Construction Code (NCC). The NCC is performance-based code, and as such, it sets the minimum required level for safety for building.

Compliance with the NCC is achieved by complying with the Governing Requirements of the NCC; and by complying with the Performance Requirements.

In accordance with NCC Clause A2.1, the Performance Requirements of the NCC are satisfied by one the following conditions:

1. A Performance Solution, or
2. A Deemed-to-Satisfy (DTS) Solution, or
3. A combination of (1) and (2).

While buildings can be designed and built in accordance with NCC DTS requirements, as building increase in complexity and size, often the NCC DTS requirements became difficult or impractical to achieve based on the purposed design. Therefore, in order to facilitate these designs, a Fire Engineer can be involved to assess the identified deviation from the NCC DTS requirements and propose an alternative design (i.e. Performance Solution) that achieves compliance with the Performance Requirements while still maintaining the design intent.

## 2.2 Role of a Fire Engineer

The extent of a fire engineers' involvement on a project varies from project to project depending on the complexity of the building and if Performance Solutions are required for the building.

The primary role of a Fire Engineer is to provide fire safety engineering guidance to the design team in order to achieve a building design that meets the Performance Requirements of the NCC. Based on the design agreed by the design team and relevant authorities, the Performance Solution/s relevant to the building can then be formally documented in the form of a Fire Engineering Brief (FEB) and a Fire Engineering Report (FER).

## 2.3 UQ Project Background

It is recognised that UQ has strong history in constructing innovative and technically challenging buildings. Furthermore, as the student population grows and the campus becomes increasingly built-up, buildings are likely to be required to be larger and more complex in order to facilitate the intended use of the building now, and into the future.

Given this, it is likely that UQ projects will generally require a Fire Engineer to be involved in order to facilitate the proposed design while maintaining compliance with the NCC Performance Requirements.

## 2.4 Project Design Team

While the exact composition of the Project Design Team may vary based on a project's complexity, the Project Design Team is intended to consist of the following:

- UQ P&F Manager/Office
- Project Manager
- Building Certifier
- Architect
- Mechanical Engineer
- Fire Engineer
- Hydraulic Engineer
- Fire Protection Designer
- Electrical Engineer

## 2.5 UQ Review Team

The UQ Review Team is intended to consist of the following:

- UQ P&F Manager/Office
- UQ Building Certifier UQ Fire Safety Office
- UQ Senior Electrical Engineer
- UQ Senior Mechanical Engineer
- Other UQ Infrastructure Team (as required)

## 2.6 Fire Engineering Process Schematic

The fire engineering process typically is broken into four (4) main stages:

1. Preliminary Design Advice
2. Fire Engineering Brief (FEB)
3. Fire Engineering Report (FER)
4. Construction Phase – Endorsement of implementation of FER

A typical schematic of the fire engineering design process is illustrated in Figure 2.1 with further detail regarding the individual process and aspects of each stage detailed in Section 2.7.

## 2.7 Fire Engineering Process

The following sections provide a detailed overview of the fire engineering process.

### 2.7.1 Stage 1 – Preliminary Design Advice

Once the architectural design is progressed to the conceptual/preliminary design stage, the drawings shall be provided to the project Building Certifier for their preliminary review of the proposed design and to identify the NCC DTS departures.

After the Building Certifier has completed the initial review to identify compliance items, the project Fire Engineer shall undertake their review of the building to assess whether the proposed Performance Solutions are appropriate and viable and are in line with the building's fire safety strategy.

For projects with a greater complexity that require detailed fire modelling (eg. smoke modelling), preliminary fire modelling may be required at this stage to inform advice provided to the design team.

When the Fire Engineer has completed the review of the building and the proposed Performance Solutions, guidance shall be provided to the Project Team regarding whether the Performance Solutions can be progressed and whether additional fire safety systems/elements/requirements are required to support the Performance Solutions. For projects with a greater complexity, a preliminary Fire Safety Strategy Report (FSSR) may be beneficial at this time in order to detail the Fire Engineering Requirements to support the proposed design.

After the provision of the Fire Engineering design advice, the project team (including service design if applicable) is recommended to review the proposed approach to ensure it meets the design intent and does not cause unforeseen issues.

Once the design has been agreed on by the Project Team, the proposed approach shall be provided to the UQ Review Team to assess the proposed fire engineering approach.

When approval is received from both the Project Team and the UQ Review Team, the proposed fire safety strategy for the building shall be progressed to the Fire Engineering Brief stage.



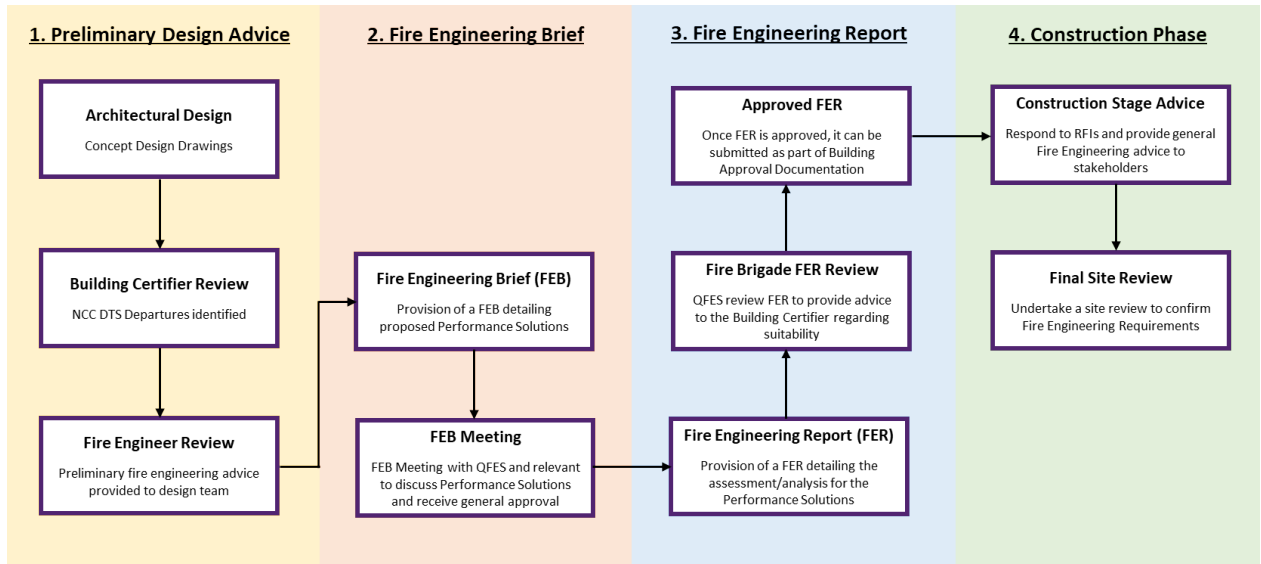


Figure 2.1 – Fire Engineering Design Schematic

NOTE: For simple projects and/or for projects where the building is proposed to be NCC DTS compliant, a Fire Engineer may not be involved in Stage 1.

If Performance Solutions arises later on during the project, the fire engineering process may initiate at Stage 2 or Stage 3 depending on the Building's Certifier's requirements.

### 2.7.1 Stage 2 – Fire Engineering Brief (FER)

Based on the confirmed fire engineering scope (i.e. Summary of Performance Solutions), a Fire Engineering Brief (FEB) shall be prepared that describes the overall Fire Safety Strategy for the building and details the proposed Fire Engineering Outcomes/Requirements.

The FEB shall also detail the approach, methodology, parameters, inputs, assumptions, initiatives and acceptance criteria for the proposed performance solutions for stakeholder discussion and agreement. This will enable all parties to agree on the philosophies of any modelling, and to fully understand the project specific outcomes and how these are will be achieved.

The FEB shall be issued to the Project Team for their initial review and comment. If required by the review, the FEB shall be updated to confirm the agreed changes and to reflect the Design Team input.

Once the FEB has been agreed on, the FEB shall be issued to as a formal document to the relevant stakeholders including the Building Certifier. The Building Certifier can then submit the FEB to the QFES and lodge a Meeting Request.

On the date by the Project Team and the QFES, a FEB meeting shall be conducted by the Fire Engineer, Building Certifier, QFES and other relevant stakeholders to discuss the proposed Performance Solution/s.

The intent of the FEB Meeting is to receive general approval to proceed to the FER stage and where applicable, incorporate any comments/concerns raised by QFES.

Should the QFES not provide general approval to proceed on specific Performance Solutions, the FEB may need to be further revisited by the Fire Engineer and Project Team and re-submitted to the QFES for further discussion.

Once general approval is received, the FEB shall proceed to the Fire Engineering Report stage.

### 2.7.2 Stage 3 –Fire Engineering Report (FER)

The Fire Engineering Report (FER) shall document the qualitative or quantitative analysis required to demonstrate that the proposed Performance Solution complies with the relevant Performance Requirements of the NCC.

Computer Modelling (as applicable) and provision of concept fire engineering documentation to achieve the items identified as variations to the NCC DTS is anticipated to covered in this stage.

The FER shall be issued to the Project Team and the UQ Review Team for their review and comment. Once approval is received by both teams, the FER is to be provided to the Building Certifier to allow them to issue it to the QFES for their review and sign-off.

### 2.7.3 Stage 4 – Construction Phase

Construction phase involvement may not be necessarily required for less complex projects; however, a description of the involvement has been included for completeness.

Where required, it is expected that the Fire Engineer will provide general fire engineering advice to stakeholders in relation to the scope and content of the FER. Where additional Performance Solution arise/are requested during construction phase, these proposals shall be reviewed by the Project Team and UQ Review Team prior to progressing the solutions to completion.

Once the building is near completion, where required by the Building Certifier, the Fire Engineer shall attend site to visually witness the requirements specified within their FER and associated documentation. Once all requirements are confirmed, a Letter of Compliance shall be provided to the Building Certifier as evidence that the building, as constructed, meets the intent of the FER and associated documentation.

# 3. UQ Fire Engineering Requirements

## 3.1 Introduction

In order to achieve a level of fire and life safety which meets University of Queensland's objectives, Fire Engineering Requirements and the requirements for the Maintenance of Fire Safety Systems have been detailed in the following sections.

## 3.2 Fire Engineering Requirements

All items of fire and life safety, where not specifically addressed as by way of a Performance Solution are to be in accordance with NCC DTS provisions or as accepted by the Authority Having Jurisdiction (AHJ) and other Regulatory Authorities.

All specific design requirements relating to other disciplines (eg. Dry Fire) must be provided in accordance with the relevant UQ Design Standard.

### Fire and Smoke Resistance

a) Structural and passive elements must be provided in accordance with the NCC DTS requirements, unless otherwise addressed by way of a Performance Solution.

### Compartmentation and Separation

b) Compartmentation and separation must be provided in accordance with the NCC DTS requirements, unless otherwise addressed by way of a Performance Solution.

### Protection of Openings

c) Where openings are required to be protected, they must be protected in accordance with the NCC DTS requirements, unless otherwise addressed by way of a Performance Solution.

### Provisions for Escape

d) Provisions for escape (eg. travel distances, aggregate egress width) must be provided in accordance with the NCC DTS requirements, unless otherwise addressed by way of a Performance Solution.

### Fire Hydrants, Hose Reels and Extinguishers

f) Fire hose reels must be provided in accordance with the NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.

g) Fire hydrants must be provided in accordance with the NCC DTS requirements and/or Fire Brigade requirements, unless otherwise addressed by way of a Performance Solution.

h) Portable fire extinguishers must be provided in accordance with the NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.

### Fire Sprinkler Systems

i) Where required, automatic fire sprinklers must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.

j) Fire sprinklers (eg. wall wetting fire sprinklers) providing active protection to glazed elements (eg. openings) must be fed from separate reticulation pipe work connected to the fire hydrant system and/or fire sprinkler system complete with flow switch, monitored isolation valves and permanent signage stating, 'FIRE WALL SPRINKLER SYSTEM – DO NOT ISOLATE'.

### **Smoke Detection and Alarm System**

- a) Where required, a Smoke Detection and Alarm System must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.
- b) Where required, a Smoke Alarm System must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.
- c) Where required, a Heat Detection System must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.

### **Smoke Exhaust System**

- d) Where required, a Smoke Exhaust System must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.
- e) Where required, a smoke and heat vents must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.

### **Stair Pressurisation**

- f) Where required, a stair pressurisation system must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.

### **Lift Installations**

- g) Where required, Emergency lifts must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.

### **Occupant Warning**

- h) A Building Occupant Warning System (BOWS) or an Emergency Warning and Intercom System (EWIS) must be provided in accordance with NCC DTS provisions, unless otherwise addressed by way of a Performance Solution.
- i) The BOWS or EWIS must be interconnected with UQ's site-wide existing system in accordance with UQ's operational requirements.
- j) The building's Fire Detection and Control Indicating Equipment (FDCIE) must be compatible with UQ's site-wide infrastructure.

### **Emergency Lighting and Exit Signs**

- k) Emergency lighting must be provided in accordance with the NCC DTS requirements, unless otherwise addressed by way of a Performance Solution.
- l) Exit signs must be provided in accordance with the NCC DTS requirements, unless otherwise addressed by way of a Performance Solution.

### **Commissioning**

- m) All fire safety equipment or equipment associated with fire safety must be correctly commissioned including integrated testing.
- n) Prior to building sign-off, UQ's maintenance contractor who will be responsible for maintaining the building's fire safety systems must review the commissioned system to ensure compliance with UQ's operational requirements.

### **Maintenance**

- o) Equipment and Safety Installations Special Fire Services and Fire Safety Installations must be maintained in accordance with current and future building maintenance legislation. Failure to do so will render the outcomes of this document invalid, null and void.
- p) Maintenance of Equipment and Safety Installations Maintenance of Special Fire Services and Fire Safety Installations must be undertaken by an independent, suitably qualified and/or competent representative licensed with the Queensland Building and Construction Commission (QBCC), i.e. qualified maintenance company or Building Manager's representative – not by the Building Owner.
- q) Evacuation routes must be maintained in an efficient condition and kept readily accessible, functional and clear of obstruction so that egress from the building is maintained, as per the requirements of the Building Regulations 2006, or any legislation that supersedes it.
- r) The following additional Special Fire Services and Fire Safety Installations (where applicable) must be carried out:
  - i. Fire Sprinkler System
    - Prior to wall wetting fire sprinkler isolation, formal approval by the building management is required.

- s) Up to date logbooks must be provided on site.

#### **Other Provisions**

- t) The design team must provide relevant information to UQ to assist UQ in preparation of emergency control organisation and procedures in accordance with AS 3745-2010.
- u) The design team must provide relevant information to UQ to assist UQ in preparation of fire and evacuation plans in accordance with the Building Fire Safety Regulation 2008 and/or future legislation, when it comes into force.
- v) The design team must provide relevant information to UQ to assist UQ in preparation of instructions on the fire and evacuation plan in accordance with the Building Fire Safety Regulation 2008 and/or future legislation, when it comes into force.
- w) A sign must be provided adjacent to the Fire Detection and Control Indicating Equipment (FDCIE) or in the main entry listing the Performance Solution applicable to the building. The sign must be incised, inlaid or embossed letters on a metal, wood, plastic or similar plate, securely and permanently attached to the wall.
- x) A copy of the approved Fire Engineering Report must be provided at building handover and be located at one of the following:
  - i. within the FDCIE; or
  - ii. in the Essential Safety Measures log book cabinet; or
  - iii. Maintenance manual for the fire protection systems.

### **3.3 Maintenance of Fire Safety Systems**

The design team must provide relevant information to UQ to assist UQ in preparation of procedures to maintain and service fire safety systems in accordance with the minimum maintenance requirements as detailed in AS1851 and summarised in Table 3.1.

Table 3.1 – Minimum Maintenance Requirement

Structural Features	Standard	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	3 Yearly	5 Yearly	12 Yearly	24 Yearly
<b>Fire Resistance</b>										
Passive Fire and Smoke Systems	AS 1851 Section 17			■	■	■				
<b>Fire Fighting Equipment</b>										
Sprinklers (including Deluge Systems)	AS 1851 Section 2	■ (1)	■		■	■	■		■ (2)	■ (3)
Pumpsets	AS 1851 Section 3	■ (1)	■		■	■		■		
Fire Hydrant Systems	AS 1851 Section 4		■ (5)		■	■		■		
Delivery Layflat Fire Hoses	AS 1851 Section 5					■				
Hose Reels	AS 1851.2 Section 14				■	■				
Portable and Wheeled Fire Extinguishers	AS 1851.1 Section 15				■	■		■		
Fire Blankets	AS 1851 Section 16				■					
<b>Smoke Hazard Management</b>										
Smoke control	AS 1851 Section 18		■	■	■	■		■		■ (4)
Detection	AS 1851 Section 6		■		■	■		■		
Smoke and Heat Alarm	AS 1851 Section 7		■		■	■				
Gaseous	AS 1851 Section 11		■		■	■		■		
Aerosols	AS									

Structural Features	Standard	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	3 Yearly	5 Yearly	12 Yearly	24 Yearly
Aerosols	AS 1851 Section 12		■		■	■		■		
<b>Emergency Lighting, Exit Signs and Warning System</b>										
Sound Systems	AS 1851 Section 9		■		■	■		■		
Intercom Systems	AS 1851 Section 10		■		■	■				
Emergency Lighting and Exit Signs	AS 2293.2				■					
<b>Essential Safety Measures and Other Provisions</b>										
Fire Alarm Monitor	AS 1851 Section 8					■				
Evacuation	AS 1851 Section 19		■		■	■				

Legend

■ Required maintenance procedures to be carried out by a licensed and/or competent maintenance contractor

**Specific Notes for Table**

Deletion of weekly tests are conditional (see AS 1851 Clause 2.2.1 and 3.2.1).

Dry pendant sprinklers 12 years after installation. Fast response sprinklers at 12 years, then 12 years, then every six (6) years.

All other sprinklers at 24 years, then every six (6) years.

Thermal links only.

Fire pumps only (see Pumpset Maintenance).

This table is for information only. All maintenance requirements shall be confirmed by referring to the relevant and current legislation.

**General Note**

- Logbooks and/or maintenance tags are required to be provided on site in accordance with AS 1851. These documents must be available on site at all times.

# 4. References

1. **Australian Building Codes Board.** *National Construction Code 2016, Amendment 1, Volume One, 'Building Code of Australia Class 2 to Class 9 Buildings'*. s.l. : Australian Building Codes Board, 2016.