Society of Fire Safety Practice Guide
Façade/External Wall Fire Safety Design

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Approved By:
The Society of Fire Safety.
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Introduction

The Society of Fire Safety (SFS) has produced this practice guide (herein referred to as the "Guide") in response to the numerous fires globally involving fire spread via the building façade. Since the Lacrosse fire in Melbourne, 2014, state governments across Australia have been undertaking audits on existing building stock, as well as buildings not yet completed, to determine which ones pose an unacceptable level of fire risk. Since the occurrence of the Grenfell Tower fire in London, 2017, this process has been accelerated due to the recognised risk to life these events may pose.

Background

Façade fires have become more prolific globally in recent times. Since the Grenfell Tower fire and what could be called a number of 'close calls' with façade fires including the Lacrosse fire, it has become apparent that the quality of Australian building stock in relation to façade fire safety should be reviewed. As buildings, building materials and building solutions become more complex and interrelated, continuing fire safety industry guidance is required to assess the fire safety performance of buildings. Risk assessment of buildings should be viewed as a holistic exercise, in looking at all facets of the building design, construction and occupancy that can contribute to overall fire safety. This is not a new concept. However, it is now clear that in many cases the nature of the façade, in combination with other (or lack of other) fire safety features, can present an undue risk for both life safety and property, in both new and existing buildings.

Objective

The Guide will provide a fire risk assessment methodology for suitably qualified and competent professionals to determine the potential hazard of fire spread via the facade of existing buildings.

The Guide offers a pathway to deliver a risk assessment appropriate to the situation being assessed and enables a level of safety to be defined, from which the assessment goals can be set and agreed with building stakeholders.

Disclaimer

This is document is published as a general Guide only, not as engineering (or other professional) advice in respect of any design or building. Anyone using this Guide should obtain and rely upon their own specific engineering and other professional advice.

Terminology

The language used within this Guide is based upon the terminology used by the Australian fire safety industry and the National Construction Code (NCC)/Building Code of Australia (BCA).

The following terms utilised in this Guide are defined here;

- Façade: the envelope of a building consisting of the external wall (as per NCC definition), insulation & weatherproofing, and attachments. Reference should be made to the ABCB Advisory Note – *Fire Performance of External Walls and Cladding*
- Hazard: *Fire hazard means the danger in terms of potential harm and degree of exposure arising from the start and spread of fire and the smoke and gases that are thereby generated.* (BCA)
- Remedial measures may include rectification works such as full or partial replacement of façade panels, changes to active and/or passive fire protection of the building and enhancements to the management & operation of the building.
- Suitably qualified and competent professional: *Means a person recognised by the appropriate authority as having qualifications and/or experience in the relevant discipline in question.*
- Stakeholder: any party with an interest in the building. (See *Stakeholder Engagement*)
- Risk, likelihood & consequence: as defined in AS/NZS ISO 31000:2009 *"Risk management – Principles and guidelines".*
- Appropriate authority: *means the relevant authority with the statutory responsibility to determine the particular matter.* E.g. building surveyor, council or municipal building surveyor, the fire brigade.
- Peer review: an evaluation by a suitably qualified and competent professional who can demonstrate independence from the building, the design, and/or the risk assessment.

Scope

The following itemises the scope of this Guide:

- The Guide will be applicable to most typical façade designs, and not exclusively aluminium composite panels (ACPs), or ACP type systems, with the purpose of demonstrating that vertical compartmentation (prevention of uncontrolled vertical fire spread) is maintained. Focus will be placed on occupant life safety and prevention of fire spread to adjacent property, but can also be utilised for property protection, business continuity and fire-fighter safety. (note – ACP is the terminology used in Australia whereas ACM or MCM (Aluminium Composite Materials – Metal Composite Materials) are commonly used in other parts of the world).
- The Guide will be applicable to most typical existing buildings in Australia, to enable consideration of risk factors such as building height, use, materials, and occupancy. Specific guidance has been included to address the limitations placed on additional fire safety measures and enable Performance Solutions to be delivered where appropriate.
- The methodology will be applicable to existing building facades; to laminates, composite panels, and other cladding systems. Further information on the various systems and construction detail can be found in other references (Fire Hazards of Exterior Wall Assemblies Containing Combustible Components, White, N. Delichatsios, M 2014). Consideration should be given to the composition of the building façade as an entire system, including (but not limited to);
  - The external wall
  - Cladding panels
  - Insulation materials & products
  - Weatherproofing materials & products

Competency

It is expected that the fire risk assessment is to be undertaken by suitably qualified and competent Fire Safety Engineers.

BCA definition of an *Engineer* is;

Professional engineer means a person who is—

a) if legislation is applicable — a registered professional engineer in the relevant discipline who has appropriate experience and competence in the relevant field; or
b) if legislation is not applicable—
  i. a Corporate Member of the Institution of Engineers, Australia; or
  ii. eligible to become a Corporate Member of the Institution of Engineers, Australia, and has appropriate experience and competence in the relevant field.

For the purposes of this Guide, the term "Engineer" will be used to denote this level of competency.

Limitations

Where compliance with the performance requirements of the NCC cannot be achieved (total replacement) for an existing building remediation works, this Guide can be used to demonstrate that the level of fire risk can be decreased to a mutually acceptable level (stakeholders), through various other remedial measures or rectifications works.

It should be recognised that the variability of fires and circumstances means that all risk can never be eliminated and at no time be shown as not having some risk to loss of life or injury to occupants or fire fighters. Current DtS buildings all have this inherent risk - deemed acceptable by the community as determined by the Australian Building Codes Board's production of the NCC.

The methodology suggests that a risk rating is to be determined but does not offer a risk rating tool. Likewise, the Guide presents a methodology that could result in remedial measures being required but does not specify which measures or act as a rectification standard.

Each building poses its own unique design complexities so the level of competency for the appointed Engineer should be ratified by the building Stakeholders before appointment.

Noted limitations are detailed throughout this document.

Various States and Territories have and potentially will develop their own guides, regulations, Ministers guidelines, etc, which where present, should be followed in their entirety and would take precedence.

Due to the ongoing changes, testing, and fires involving façade materials, this guide will be updated on a regular (annual) basis, and practitioners using this guide should ensure the current version is utilised.

Please also see the Disclaimer Statement on page 1.

Risk Assessment

A risk assessment approach will likely be required where a Deemed to Satisfy (e.g. remove and replace) approach may not be financially viable.

The building industry in Australia, including the Australian Building Codes Board (ABCB), generally adopts the "As Low As Reasonably Practicable" (ALARP) approach for risk management (e.g. AS/NZS ISO 31000), at the time of preparation of this Guide. Such an approach is hazard based and risk driven, and a risk level will be considered acceptable if it can be demonstrated that the risk has been reduced to a level that is as low as reasonably practicable. The criteria to determine the reasonably practicableness is typically based on the notion that the level of risk meets the acceptable risk criteria or target.

On the other hand, the Commonwealth Work Health and Safety Act 2011 (WHS Act) and Work Health and Safety Regulations 2011 (WHS Regulations) require the duty holder, defined as a person conducting a business or undertaking who has a duty under the WHS Act and Regulations to manage risks to health and safety, to eliminate risks to health and safety so far as is reasonably practicable, and if it is not reasonably practicable to eliminate risks to health and safety, then to minimise those risks so far as is reasonably practicable (SFAIRP).

In building construction projects and under the definition in the WHS Act, a person conducting a business or undertaking includes but is not limited to the Developer, the Project Manager, the Construction Manager, all Consultants who contribute to and participate in the design of the building and associated infrastructure, the Certifier (this term varies between states), and various installation Contractors.

The following paragraphs provide a brief summary on the differences between ALARP and SFAIRP and the reason why this Practice Guide recommends an SFAIRP approach should be undertaken for façade fire safety designs.

The ALARP process evaluates what is the risk associated with the hazard and then determines whether that risk (likelihood of occurrence and consequence of the hazard) can be made as low as reasonably practicable. The determination of the "reasonably practicable" is typically based on the low or moderate risk rating from a risk matrix (pre-determined risk criteria) or a target based on statistical analysis. Generally, if extensive cost is required to be expended but the risk reduction level is insignificant then such risk reduction work will be considered to be not reasonably practicable.

The SFAIRP process evaluates:

- What is the likelihood of the hazard occurring and the degree of harm that might result from the hazard;
- What the duty holder concerned knows, or ought reasonably to know, about the hazard or the risk as well as ways of eliminating or minimising the risk;
- The availability and suitability of ways to eliminate or minimise the risk, and then determines whether the cost associated with available ways of eliminating or minimising the risk is grossly disproportionate to the risk.

The key difference between the ALARP and SFAIRP approaches is that the former is risk focussed whereas the latter is precaution focussed and criticality driven which may perhaps be best summarised by Chief Justice Gibbs of the High Court of Australia[1] as follows:

"Where it is possible to guard against a foreseeable risk, which, though perhaps not great, nevertheless cannot be called remote or fanciful, by adopting a means, which involves little difficulty or expense, the failure to adopt such means will in general be negligent."

This means that it is irrelevant how low the estimated risk is, if more can be done for very little exertion, then the failure to do so will be negligent, in the event of an incident.

Considering the façade fire safety issue is not just a life safety issue, but also an issue related to the insurability of the building and building practitioners professional liability, the SFAIRP approach is recommended.

Methodology

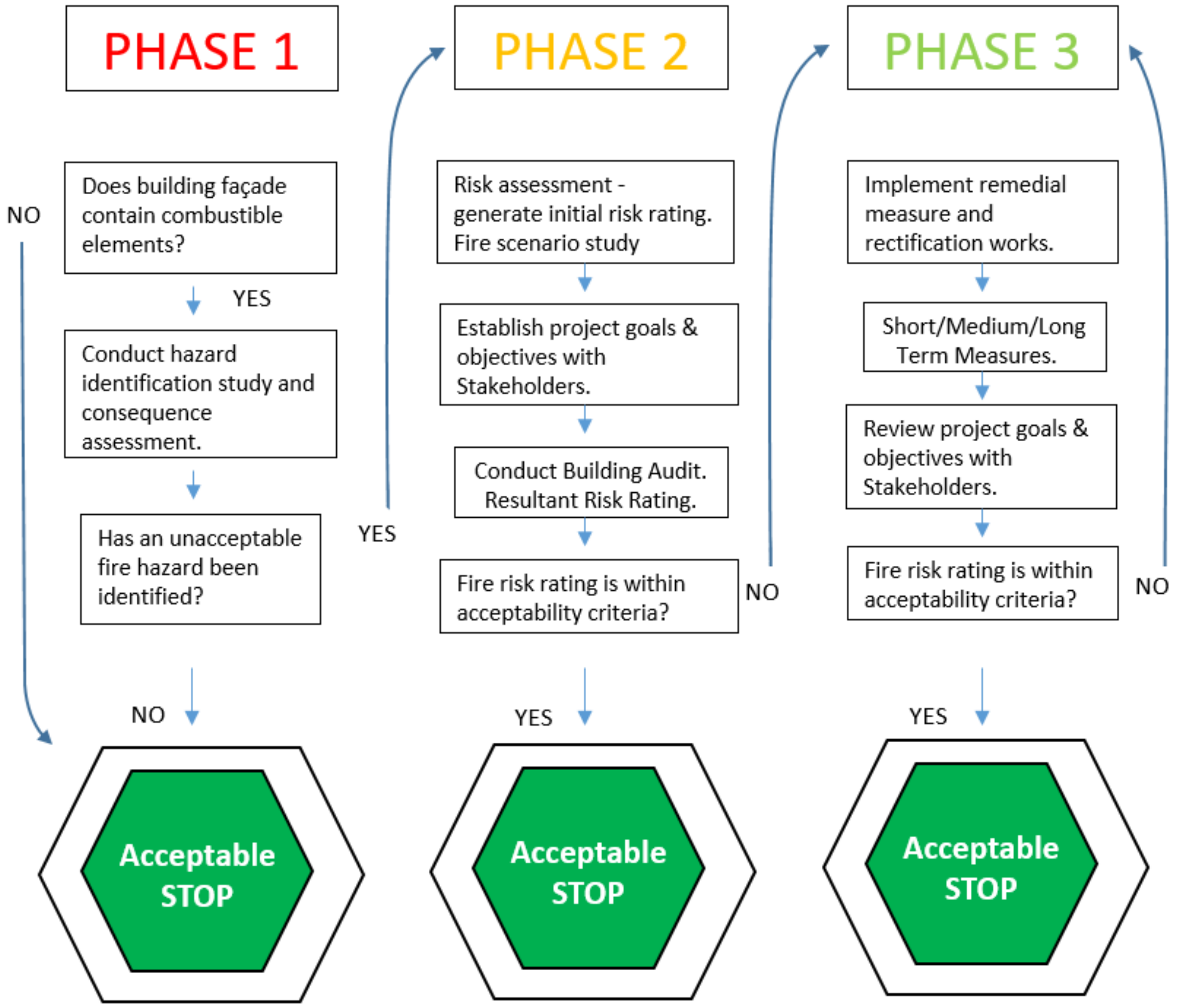
Herein the Guide will offer the Engineer a series of questions to raise when undertaking an assessment of the risk of fire spread due to combustible elements in a building façade and their impact upon the fire safety of the building. The methodology will be split into three phases, as follows;

- Phase 1 – Initial Review
- Phase 2 – Detailed Assessment
- Phase 3 – Remedial Measures and Rectifications Works

Interwoven into these phases will be continual communication with the Stakeholders. It is expected that Stakeholders will be involved in developing the audits, risk assessments and acceptability requirements, and finally to determining remedial measures & rectification works.

The flow chart below graphically illustrates the proposed Phases.

[1] Quote extracted from the article 'Near enough not safe enough' by Richard Robinson published in the Engineers Australia magazine January 2014 issue (pp. 32-34).



The assessment should be developed in collaboration with the relevant Stakeholders for the assessment project. These could include, but are not limited to;

- Clients
- Architect
- Building Surveyors
- Owners/Operators
- Engineers
- Fire Brigade
- Tenants
- Project Managers
- Council
- Insurers
- Designers
- Builders

An efficient and thorough risk assessment should involve Stakeholders from the beginning. It is expected that, much like the International Fire Engineering Guidelines (IFEG), the stakeholder engagement should have occurred before any detailed assessment is carried out. The Engineer should have identified who needs to be involved in the decision process, so that the project goals can be agreed, and the objectives of the assessment met. At the completion of each stage of this methodology, the Engineer is expected to present their proposals and findings to the Stakeholders.

> As the need for Stakeholder engagement is expected through this Guide, the expectation and requirements will be highlighted in a text box to alert the Engineer when questions need to be raised.

The Fire Brigade should be consulted during any risk assessment as a key Stakeholder. The risk to fire-fighters from a building façade fire can be significant, especially where external fire-fighting would be required.

Regulatory Framework

It is expected that an assessment will be, where appropriate, presented to the appropriate authorities for endorsement. As a risk assessment methodology for Engineers to use, the focus will be on achieving compliance with the NCC, specifically the Performance Requirement, but not limited to: CP1, CP2, CP4, CP9, EP1.4, EP2.2.

Compliance with the NCC is achieved by satisfying the Performance Requirements. The Performance Requirements can only be satisfied by:

(a) Performance Solution; or
(b) Deemed-to-Satisfy Solution; or
(c) A combination of a Performance Solution and Deemed-to-Satisfy Solution.

A Performance Solution can be assessed using a number of Assessment Methods, which are defined in the NCC Building Code of Australia Volume 1. Where compliance cannot be met via the Deemed-to-Satisfy Provisions or NCC Verification Methods, namely CV3, a suitable risk assessment should be conducted to demonstrate compliance with the Performance Requirements, to the satisfaction of all Stakeholders.

Assessment Goals & Objectives

Example assessment project goals and objectives are listed herein. The Engineer should not be alone in defining these, rather the decision should be a collaborative process, to be undertaken with the Stakeholders. Whilst setting the assessment project goals and objectives, the acceptance criteria should also be defined. Stakeholders in conjunction with the Engineer should agree upon whether an ALARP (or hazard) based paradigm (which is consistent with the BCA) or if a SFAIRP (or precaution based) paradigm should be adopted as a basis of the risk assessment.

Each phase of reporting must identify with the assessment project goals and objectives to develop the risk mitigation strategies for the building and occupants.

Example Goals & Objectives

Goal	Objective
Life Safety	To enable the building occupants, people within immediate vicinity, and, in adjoining properties, to reach a place of safety in tenable conditions.
Fire-Fighter & Emergency Personnel Safety	To enable attending fire crews and emergency personnel to undertake operational procedures in tenable conditions.
Property Protection	To minimise potential Ignition sources, introduce appropriate loss reduction and/or fire protection measures, and confirm systems' efficacy and reliability.
Adjoining Asset Protection	To limit the impact on any adjoining building structure and contents, or community spaces, as a direct result of a fire involving the façade of the subject building.
Business Continuity	To limit the impact on the commercial viability of the building or its use as a direct result of a fire event.
Insurance Requirements	To enable the insurability of the property at a reasonable cost by reducing the residual risk to a mutually acceptable level.

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Holistic Approach to Building Fire Safety Design

It is expected that a thorough appreciation of the overall fire safety for the subject building be obtained. For example, reliance may fall on the sprinkler system to contain a fire and alert occupants, or the structural performance of the primary elements to withstand fire spread. The condition of the building is integral to any assessment undertaken.

The Engineer should consider the following aspects of the building fire safety design (see Appendix 1 – Fire Safety Design Aspects, for further detail) – which is not an exhaustive list. Note: It is expected that the Engineer will recognise their knowledge limits and should a skill set be lacking – e.g. Environmentally Sustainable Design, Façade Design, Buildability, Staging, etc. – then a suitable qualified person/organisation – e.g. ESD Engineer, Architect, Structural Engineer, Mechanical Engineer etc. – be appointed to ensure all necessary details can be obtained.

System	**Elements**
External Wall	External wall components, insulation materials/products, weatherproofing materials/products, potential fire spread routes and cavity barriers, structural walls elements, attachments/ancillary element, orientation of façade to building compartments and to the title boundary, design of balconies, ignition hazards and fuel sources.
Fire Safety Systems	Automatic suppression (sprinklers), internal and external hydrants, hose reels, and detection & alarm.
Passive Protection	Vertical and horizontal compartmentation, structural fire resistance, internal compartmentation, building separation.
Population	Building use, occupancy profile, management, no. of occupants, fire-fighter intervention.
Means of Escape	Exit width capacity, location of exits (internal /external), exits construction, assembly points, assess an "all-out" scenarios involving a multi-level/high-rise external cladding fire.
Fire-Fighting	Access, facilities, intervention, building, landscape, internal & external operations, fire-fighter tenability.
Existing Condition	Maintenance of systems, condition of the passive fire protection, warden training, fire safety management, occupant training.
Remedial activity Construction Fire Safety	Construction staging, interim temporary fire safety measures, staff training, critical inspection stages.

Existing Building Assessments

The ability of an existing building's fire safety design to be assessed is limited when compared to a new building. Reviewing documents from the Essential Safety Measurement log (different terminology is used in various jurisdictions – Fire Safety Schedule, etc.), or from the base building design, may not provide sufficient detail for the Engineer to determine the condition of the overall building fire safety design.

At the very least it is expected that an invasive survey of the façade system be carried out. Building façade composition should also be thoroughly investigated with panel core composition testing conducted to identify the presence and quantity (%) of combustible material. The composition of the insulation materials/products and weatherproofing materials/products should also be determined along with the installation/framing system. Reliance should not be placed solely on the building permit/statement specifications.

Condition surveys of the active fire safety systems relied upon in the assessment should be carried out. These should focus on the design, coverage, capacity and reliability of these systems. Any deficiencies of the active systems should be identified, and rectification measures assessed. Should upgrades not be possible then the existing condition of these systems should be recognised in the assessment. Each jurisdiction has regulations on maintenance and testing which should be considered through review of documentation and verification of fire protection systems condition.

It is also suggested that surveys of the building's passive fire safety should be carried out to determine what resistance to *structural adequacy, integrity, insulation*, exists.

The operation of the building should be fully appreciated. It may be difficult to immediately improve passive and active systems in existing buildings, however, there may be scope for immediate improvement in how an existing building's fire safety is managed. For example, immediate remedial measures could be introduced by removing transient fire sources, training occupants, enhancing warden actions, etc. In combination with medium and long-term rectification measures, the operational fire safety management can significantly improve life safety for the occupants. The Engineer should be involved in providing recommendations to improve the emergency management planning of the building.

Hazard Identification Study

The objective of the hazard identification study is to undertake a systematic review of the subject building and façade design. It is expected that this study will form the basis for Phase 1 of this methodology.

Risk Rating

Although this Guide does not offer a risk rating methodology, it is recognised that the recent production of the Department of Environment, Land, Water & Planning and Victorian Cladding Taskforce risk assessment tool (DELWP/VCT Tool) and the NFPA EFFECT Tool both are available risk ranking tools – which could be used in this methodology for Phase 1. AS/NZS 31000 is another recognised methodology for developing a means of rating the risk of fire hazards – which could be used in this methodology for Phase 1 and Phase 2.

> The risk rating for the subject building should be presented to the Stakeholders, along with the rationale for the inputs, so that the Engineer is not determining the risk rating in isolation. The risk rating should be agreed upon by all Stakeholders before further studies be carried out or remedial measure adopted.
>
> Through collaboration with the Stakeholders, the risk ratings should be continually updated as further studies are concluded and information is verified.

Reliability/Robustness Study

As the performance of the building is dependent on numerous passive, active and operational fire safety design aspects, the impact of these not performing as intended should be assessed during the risk assessment.

Quality Assurance

In all instances it is expected that the quality assurance of the assessment should involve review by individuals or organisations of suitably qualified and competent professionals. At the least, this should involve author self-check, a technical check by a second colleague, and, verification by a third person.

Peer Review

As the methodology in this guideline is dependent on a given level of subjectivity – e.g. when applying a risk rating, when assessing the reliability of systems, when assessing means of escape pre-movement time – it is expected that the fire risk assessment be subjected to a peer review by a Fire Safety Engineer. The peer review should be independent from the risk assessment, be appointed by the client, be a suitably qualified and suitably registered competent professional, and, the appointment agreed with the stakeholders including the appropriate authorities. An independent peer reviewer must be able to demonstrate no conflict of interest and must have clear guidelines as to the tasks and responsibilities in the process and their liability in the results and recommendations they supply. The peer reviewers' comments must be included in the final assessment – shared with all the relevant stakeholders.

. Referral to the state government bodies (such as the Victorian Building Appeals Board (BAB)) may be required by the appropriate authority and can be considered as meeting this peer review.

In a majority of cases it would be unlikely that a peer review would be needed where an assessment finishes at Stage 1, however once it moves to stage 2, a peer review would be required.

Existing Building Assessments

This methodology for existing buildings is split into three Phases. The Engineer should follow this methodology in full as illustrated here;

- Phase 1 – Initial Review: a series of questions to enable the Engineer to generate a hazard identification profile and primary risk rating
- Phase 2 – Detailed Assessment: the same questions in more detail to help the Engineer generate a comprehensive risk rating
- Phase 3 – Remedial Measures and Rectifications Works: offer guidance to the Engineer on the level of removal, reduction, or management needed to reduce the risk rating

Phase 1 – Initial Review

Identification of combustible elements in the building facade is the first stage of any assessment. For new/recently built buildings, this will be evidenced by the product specifications and architectural details. For older buildings, this can be determined by composition testing of panels and invasive auditing of the building façade. Integral to this will be the type of cladding product, the fixing mechanism, the presence and type of sarking and insulation.

Note: If the façade/external wall is determined to not contain combustible elements it may be that no further assessment is required. This should be presented to the stakeholders and agreement as to the need for further work made.

Product & System Testing

The behaviour of the façade system in a fire should be appreciated. Where the façade products are known, review of e product testing reports from appropriate and recognised standard fire test, should be carried out to determine the response of the building façade or components of the façade system to fire. A summary of the regulatory test methods currently in use is provided in Appendix 2 – Testing Regime.

Where the identity of the facade panel and the whole facade system (fixing, sarking, insulation, etc.) cannot be identified with certainty, representative samples of the façade panels need to be taken and sent to an accredited lab (listed in the Insurance Council of Australia (ICA) protocol), to determine the panel core composition and category. The dimensions of the cavity, type of sarking and type of insulation should also be obtained during the sample taking. Insulation and sarking identification may be carried out visually by experienced practitioners or by material test methods on samples.

Hazard Identification Study

The purpose of the hazard identification study is to define which aspects of the building have the potential to cause harm and conflict with the assessment project goals. The study should cover all aspects of the buildings fire safety design with respect to the façade – active, passive, operational – and review fire scenarios within the building, external to the building, and across the title boundary – to identify all possible hazards.

Typical fire hazards relating to building façade design include:

- Presence of combustible material – Polyethylene, Expanded Polystyrene, Wood, PIR/PUR Insulation, etc. – causing compartmentation to be breached by vertical upward fire spread and combustible materials, e.g. thermoplastics, also causing vertical downward fire spread

- Façade system fixing failing and causing vertical compartmentation to be breached by downward spread, or, a falling hazard for egressing occupants/attending emergency personnel
- Fire spread via cavities, or, fire spread from the interior of the building spreading to the exterior of the building via openings, balconies, windows, doors
- Means of escape capacity being insufficient to accommodate multiple floors evacuating simultaneously
- Sprinkler system capacity being insufficient to effectively suppress a fire from an external façade fire involving multiple floors
- Fire-fighters having insufficient access to adopt effective external fire-fighting where the building has been designed for internal fire-fighting

The intent of the hazard identification study is to catalogue all possible hazards to ensure all eventualities can be investigated later. The initial hazard identification study carried out should focus on 'consequences' so at this early stage a broad sweep of all possible occurrences should be catalogued.

It is also during this initial phase that the Engineer should be carrying out site inspections to record visual observations of note. The condition of the building should be assessed. Questions that should be asked, but may not be the only ones, are set out in Appendix 1 – Fire Safety Design Aspects.

Once completed, the hazard identification study should be presented to the Stakeholders. In collaboration with the Stakeholders, the Engineer should use the hazard identification study to discuss the consequence of their occurrence. From this the assessment project, goals should be established and agreed.

Assessment project goals that have been agreed with all Stakeholders will invariably be a combination of life safety, fire-fighter safety, and property protection/asset protection, as each party will have varying requirements.

Once the assessment project goals have been agreed, and hazards identified, the next stage of the risk assessment can commence. However, at this point should the presence of fire hazards be acceptable to the Stakeholders it may be that the assessment ceases. Phase 2 should only commence if necessary and instructed by the Stakeholders.

Phase 2 – Detailed Assessment

When the assessment project goals have been set in agreement with the Stakeholders, the fire scenarios that conflict with the goals can be further studied to generate a risk rating. As described in the Methodology there are multiple methods to rating risk that the Engineer can adopt.

Fire Scenario Study

All feasible fire scenarios should be identified resulting from the hazard identification study. From these there should be a series of potential fire events that could conflict with the project goals. It is expected that the hazard identification study will include internal fire events, external fire events, and, possible fires in adjoining properties. Examples are given here.

Example Design Fire Scenarios

Fire Scenario	Description
Internal Fire	Fire on the floor plate
	Fire in the kitchen
	Fire on the balcony
External Fire	Fire in car underneath building façade/awning
	Fire in waste bin and skips
	Fire in the external seating area
Fire Across the Boundary	Fire in building across the title boundary
	Bush fire event

Risk Rating – Initial

The likelihood and consequence of each scenario should be assessed. It is expected that an initial risk rating be generated. The initial risk rating of each scenario should be used by the Engineer to identify which is unacceptable to the Stakeholders and/or conflict with the project goals and objectives.

Resultant from this will be the categorisation of the fire scenarios. The categorisation of the fire scenarios should generate a required action. Again, these actions should be presented and agreed with the Stakeholders.

> The initial risk rating should be presented to the Stakeholders. At this stage the project goals should be reviewed again, and consensus met on the categorisation of risk. Those scenarios that pose an unacceptable conflict with the assessment goals should be identified. These again will be limited in number meaning that the Stakeholders can approve which scenario requires further study by the Engineer.

Detailed Building Audit

With the now finite list of fire scenarios that present an unacceptable conflict with the assessment goals, further study by the Engineer can now commence. These studies will form the basis for the detailed building audits. The expected questions to answer during any audit are listed in Appendix 1 – Fire Safety Design Aspects.

Egress & Access Study

Should a scenario present itself that could conflict with an occupant's ability to reach a place of safety, for example, then it is expected that a detailed evacuation study be carried out. It is expected that an evacuation study will be required where a fire involving a façade could impact on the means for people to affect an evacuation. The safe time to escape from the building without a façade fire risk should be compared to the safe time to escape from the same building with a façade fire risk – where the hazard of a fire involves multiple floors.

Likewise, the ability of the fire brigade and emergency personnel to access the building and tackle the fire should be carried out. Key factors to consider will be the conflict of egressing occupants with attending crews (i.e. contraflow), the ability of fire-fighters to reach a high-level external wall fire, and access to the exterior and interior of the building in the event of a façade fire. Note that the Fire Brigade Intervention Model (FBIM) does not consider façade fires.

Passive & Active Fire Protection

Contingent on the generation of an applicable fire scenario will be the ability for the complete building fire safety design to resist fire spread. It is expected that the subject buildings holistic fire safety be assessed against the fire hazards identified. Reliance of 100% reliability for both Active and Passive elements should not be applied, as the age and condition will show failure points in such systems.

External Construction

It is expected that the Engineer will have a full appreciation of the external wall build up. As has been shown from the numerous case studies in recent years, the key aspects to consider in this are;

- The panel – core composition, fixing mechanism, testing results
- The external wall – insulation materials, weatherproofing, fire resistance, installation/framing system
- The façade design – orientation of cladding, connection of compartments, cavity protection

Fire Safety Management & Operation

Where reliance on human intervention is integral to the buildings holistic fire safety, these requirements should be considered in the assessment. Record keeping, and training logs should be audited or training & management expectations mandated following the principles set out in documents such as AS3745 *"Planning for emergencies in facilities"* or AS 4083 *"Planning for emergencies – health care facilities*"

Reliability/Robustness Study

At this stage the potential for multiple system failures should be studied to investigate the reliability of the assessment – with the aim to enhance its robustness.

i.e. *what happens if the sprinkler water supply fails? what happens if the fire wardens are all on leave? what happens if a stair is blocked by a fire event?*

Should any such consequences result in a conflict with the project goals, measures should be implemented to;

- improve the reliability of that system, or
- enhance the robustness of the overall design such that the impact is minimal

Risk Rating – Resultant

Once further studies have been carried out, the risk rating should be revisited. With detailed information on the ability of people to escape, the fire brigade to attack a fire, the building's passive protection to resist fire, the efficacy of active systems to protect from a fire, and the function of the occupants to manage a fire safely, a resultant risk rating should be generated.

The resultant risk rating should be presented to the Stakeholders. It is expected that the resultant risk rating may vary from the initial risk rating with the input from the further studies.

With the resultant risk rating it is expected that a reduced number of fire scenarios will have been identified that will require remedial measures or rectification works. Should no remediation measures or rectification works be identified by the Stakeholders, it may be that the assessment ceases. Phase 3 should only commence if necessary and instructed by the Stakeholders.

Phase 3 – Remedial Measures & Rectification Works

At this phase of the risk assessment the number of fire scenarios that conflict with the assessment goals & objectives are expected to be limited in nature.

By collaborating with the Stakeholders, the risk rating of the fire scenarios will be better defined during Phase 2 following further studies. From this, the choice of remedial measures and rectification works will be limited by the assessment goals, financial and timeline constraints, and the requirements of each of the Stakeholders. It is expected that the building insurer will play an important part during this decision process.

Short/Medium/Long Term

The choice of when to make changes to an existing building will be driven by urgency, the time to undertake, and the impact on its occupancy/use;

- Short term measures are those that can take immediate effect within 1-2 weeks
- Medium term measures are not expected to require a building permit/statement and should take effect within 1-2 months
- Long term measures are expected to involve complete or partial replacement and could require significant changes to the active, passive and operational fire safety design, and possibly require a building permit/statement

Possible Remediation or Rectification

Appendix 3 – Possible Remedial Measures & Rectification Works, provides a series of possible remedial measures and rectification works that could be applied and categorised into short/medium/long term, with examples summarised herein.

System	Elements
Active Systems	Upgrade of automatic suppression (sprinklers) - to enhance coverage where not already provided, upgrade to fire brigade facilities (hydrants) – to extend coverage, enhance detection & alarm systems to provide enhanced warning of a façade fire.
Passive Protection	Removal or replacement of panels – partial or complete depending on the results of the risk assessment, introduction of separation – barriers within cavities and/or creating fire breaks to arrest spread via the façade, enhanced internal separation – to the building compartmentation strategy, or, the isolation of fire escape routes.
Operational	Eliminate, or if not possible isolate, all combustibles that can create a fire exposure to the façade, both external and internal. Manage the use of balconies and external spaces. Staff training and increased warden to occupant ratio.
Means of Escape	Afford people greater choice of escape routes along with effective training, demonstrate that the total building evacuation time can be decreased.

Fire-Fighting	Enhance access routes to and within the building to reflect the building facade fire hazard, increase information – building info packs, signage, staff interface – for attending crews.

Once the rectification measures have been defined again these should be presented to the Stakeholders for approval. Integral to this will be the practicalities of implementing these measures and the impact they have on the building, its occupancy and its operation. As such all parties will need to be consulted to determine a strategy for the adoption of the measures.

Construction Staging – Remedial Works

If staged construction is necessary, or if partial occupation of the building during works is anticipated, the Engineer should be consulted to generate a staged construction strategy inclusive of interim protection measures to address potentially impaired (shut off) fire protection systems and/or the lack of elements of the fire safety design whilst works are undertaken.

Critical Stage Inspections –

When the replacement building façade system is delivered to site the Building Surveyor, Engineer and Façade Installer should be present to inspect the components against the building permit/statement details, the Fire Engineering Report, and the Manufacturers Installation guide. Likewise, at critical stages of the installation these three parties should be present to inspect the installation.

Ongoing Maintenance

Periodic audits should be mandated in the occupancy permit/ statement, to be undertaken by the Engineer, to ensure the building fire safety does not degrade over time. This should include condition surveys of the façade.

Appendix 1 – Fire Safety Design Aspects

System	Element	Subject	Questions
Building Facade	External Wall Composition	Panel	Are the panels Category 1, 2 or 3 core materials, (per ICA protocol): rendered EPS: EPS, PU, PIR, Rockwool, etc., cored metal panels; etc.? Does the panel require to be core composition tested from an accredited laboratory?
		Insulation & Weatherproofing Material/Product	What is proposed/present: EPS, PU, PIR, Fibreglass, Rockwool, sarking, foil faced plastic bubble insulation, etc. Does the building façade form the weatherproofing for the building? How does this system work? What materials/products are present to achieve this?
		Installation Mechanisms	How is the façade attached to the external wall? Does the façade form the insulation properties or the weatherproofing for the building?
		Cavities	Is there a cavity? Where is it – between the cladding and the insulation or between the insulation and structural wall? What is its dimension? Are there any cavity barriers?
		Structural Wall Elements	What is proposed/present: Fire rated reinforced concrete, steel frame with internal and external lining (specify type), open steel frame, etc? Does the construction incorporate timber framing?
		Attachments	What are they and what are they made of? Dimensions and fixing details? Orientation to ignition sources and openings? Does the façade protect penetrations from presenting a fire spread hazard?
		Quantity & location	What is the extent of cladding (% of wall surface, fire load & continuity? Is cladding located at inaccessible Highrise areas?
	Balcony Design	Protection	Are sprinklers provided to the balcony? Does the façade design contain spandrels and fire breaks between compartments?
		Hazard	Do the balconies contain ignition hazards and fuel load? Can these spaces be managed?
		Design	What materials are used for the walls, ceilings, balustrades, and do these pose a potential for fire spread?
	Openings	Vents/Louvres	Do these pose a risk of façade ignition? What protection methods have been used to address fire spread? What are their orientations to the building façade?
		Doors/Windows	Do these pose a risk of façade ignition? What protection methods have been used to address fire spread? What are their orientations to the building façade? Is there the potential for a building façade fire to impede occupant evacuation, or access for emergency services?
	Ignition Source	Ignition of panel or cavity	Are there electrical or other ignition sources mounted on the wall or in the cavity. Examples are light fittings, power points, electrical cabling, exhaust fans, lightning conductor cabling etc.
	Fire Source	Internal	What scenarios could cause an internal building fire to spread to the external façade? What protections measures are in place to control a fire?
		External	What scenarios could cause a building façade fire to spread into the building and/or to adjacent buildings? Does the site contain multiple buildings? Does the site consist of transient fire hazards (e.g. parked cars/motor bikes, rubbish bins or skips) or stationary fire hazards (e.g. generators, storage, garden beds and shrubs, public seating, etc.)?
		Boundary	What is the distance from the title boundary to the building façade? What protection measures are in place to protection against spread across the boundary?

Active Systems	Sprinklers	System Design	Design details for each occupancy hazard class, their location and Pressure and Flow requirements – e.g. Light Hazard – office floors 3 to 20, – 510 L/min @ 340 kPa; Ordinary Hazard 1 – Plant Rooms Lower Basement, Floors 20 and 41, etc. Coverage – extent and exclusion: e.g. sprinklers to balconies, beneath awnings, specific plant area protection (gas, foam)? Identify which standard was used for design, the year of installation, temperature rating, fast or standard response, type and orientation
		Reliability	e.g. Two multi stage fire pumps, one diesel driven, one electric – each sized to meet the highest sprinkler demand – rating 1200 L/min @ 1000 kPa. Water supply from a full-sized suction tank with automatic in-fill (top up only) from town main? Power supply is from well gridded utility, emergency generator for emergency lighting and essential services – not including fire pump?
	Hydrants (Internal)	System Design	Design details, location and flow and pressure requirements, e.g. Designed to AS 2419.1 – 2005, for 2 operating hydrants 20 L/sec @ 700 kPa at most remote hydrant?
		Coverage	Does the location of the hydrants facilitate fighting fires where multiple elevations of the building being involved in a fire simultaneously? Is there any feasible access to external cladding on Highrise levels?
	Hydrants (External)	System design	Does the pressure and flow in the mains provide sufficient water for an external fire event that could involve multiple floors?
		Coverage	Does the orientation of the hydrants facilitate multiple elevations of the building being involved in a fire simultaneously?
	Detection & Alarm	Building Alarm Strategy	Cascade alarm, staged evacuation, simultaneous evacuation, phased alarm, progressive horizontal evacuation?
		System Design	Can a full building evacuation be initiated? Is a remote monitoring service provided? Does the General Fire Alarm immediately alert the Fire Brigade?
		Reliability	Power supply is from well gridded utility, emergency generator for emergency lighting and essential services? Are the system loops designed to offer protection against a single point of failure?
Passive Fire Protection	Vertical compartmentation	Spandrels	Are they present (external or behind the cladding), what are they constructed with (if fire resistant or fire rated), how do they interact with the building façade? E.g. 1m high, 100mm 1 hr FR precast concrete with no insulation and cladding attached to steel frame secured by 12mm anchors to the concrete.
		Fire stopping slab to façade	Does the compartmentation extend from the walls and floors to the exterior of the building? How are these potential fire spread routes protected?
		Cavity barriers	How is fire spread within a cavity protected against? What frequency of cavity barriers per floor is present? Each floor or each compartment?
	Internal compartmentation	Strategy	How is the building divided into compartments? Has this been designed to consider fire spread via the building façade? Could a fire event occur that means the building compartmentation strategy is breached?
		Duration	What duration of fire resistance is utilised to form the compartmentation strategy? Is this duration sufficient for a building façade fire?
Population	Building Use	NCC/BCA Classes and location (floors or parts of) Use – fuel load and ignition sources	Identify the location and type occupancies (Building Classes) and describe them. For example: BCA Class 6 includes retail, restaurants, market or barbers' shop, all of which house significantly different fuel types and ignition hazards. Identify potential fuel sources and ignition sources from the use of the space. Cross check that the sprinkler design for those areas is appropriate, if not, there is a potential for an uncontrolled internal fire spreading to the building façade?
	Occupancy Profile	Occupancy – characteristics, familiarity	Mobility, recognition of threats, shared safety ownership, awareness of building geometry, use of escape routes, age range, dependency on others, etc, all influence the time people take to initiate action in the event of a threat. BCA Class 9b includes both assembly public spaces and schools, both of which would have differing characteristics.

		Occupant vulnerability	Vulnerability of occupants (old and young), such as those in hospitals, aged care facilities as well as child care centres presents a challenge in evacuation of these occupants. Consider added vulnerability for occupants, particularly aged or people with disabilities, in relation to building heights and increased travel distances via exit stairs.
	Management	Management – staff: visitor ratio, training, wardens, security presence	The intervention of people trained to respond can significantly reduce the time people take to escape. Such information can be essential to formulation of the rectification measures, especially when categorising into short, medium, long-term measures.
	No. of occupants / Sole occupancy units	No of people directly affected by a fire event.	Assess the extent of the façade system fire spread against projected population distribution.
	Firefighting intervention	Impact on egress	Impact on egress provisions by operational fire-fighting tactics including fire fighters' opposing flow in fire stairs.
Means of Escape	Exit width capacity	Issues that may affect and/or reduce the exit capacity	Estimate/determine the aggregate egress width of the stairs and compare with expected occupant numbers to ensure that exit width is compliant with BCA limits. Alternatively, review any existing fire engineering reports for the evacuation times for each level and for a building wide evacuation. Are there are items (permanent or temporary) in the exits that would reduce the width of the exits and whether these items are combustible? Consider risk of all-out scenarios involving a multi-level/high-rise external cladding fire.
	Location of exits (internal /external)	Location and design of exits	Determine the location of the exits. Do stairs discharge internally into a lobby or under-croft or canopy which may have combustible elements? Is there travel in two different directions from the discharge points? Do the occupants have to pass by openings in the same building once they discharge from the building?
	Exits construction	Fire exit construction details	Determine if the exits are fire-isolated exits or non-fire-isolated exits. Are the exits constructed of combustible materials – including ACP's?? Are there any installations in the exits that are not exempted by the BCA? Are there unprotected or improperly protected service penetrations in the exits?
Fire-Fighting	Access	Fire stairs, access size, travel distance, capacity, evacuating occupants, mobility impaired	Has there been design consultation with the fire brigade? Have they confirmed how they would typically tackle a fire for the subject building and assist with evacuation and external fire brigade provisions? Can perimeter access be gained to all elevations that contain combustible elements?
		Fire-fighter tenability	Falling debris and wind direction hazards should be assessed re impact in fire-fighter access.
	Facilities	Facilities available for Fire Brigade use	Assess fire brigade and building facilities available with respect to the building size, height, occupancy, and type, including fire appliances/trucks, telescopic monitors (if needed), internal hydrants, Fire Brigade boosting, fire lifts.
	Intervention	Internal building intervention	Time line assessment. Consider fire brigade response, access, combustible façade location, fire brigade facilities, potential obstructions (traffic, access, falling debris, evacuating occupants, other).
	Building	Location	Is the building located in the CBD, suburbs or rural? How far is the building located from the nearest fire station?
	Landscape	Safe clearances to external and street hydrant, building set-backs, fire appliance hard stand, façade height.	Is it a large isolated building with access on all sides? Or is it an infill site with poor road access? Available external or street hydrants for façade water supplies? Suitable Fire Brigade appliance/truck hard stand areas? Consider height of combustible façade materials and hose reach. Consider façade materials and potential falling debris restricting Fire Brigade access.
	External operations	Consultation with the brigade required	Assess Fire Brigade operational needs for external fire control including availability of telescopic monitors, external hydrants, reach, protecting exposures, and neighbouring structures.

Existing Condition	Essential Safety Measures	Maintenance of systems	Periodic testing, keeping of logs, repairs of defects – are these up to date and reflective of the existing condition?
		Fire protection	Condition of the existing passive protection inclusive of penetration protection condition and maintenance. Condition, maintenance and testing of the existing active systems.
		Warden training & site wide fire safety maintenance	Training records, understanding from occupants of actions to take in the event of fire, appreciation of the alarm strategy and systems in the building.
	Management	Training	Maintaining training records, frequency of training, actions for occupants
		Occupants	Interview occupants to ascertain the general understanding of the level of fire safety management
Construction	Staging	Interim measures	Temporary protection to compensate for partially complete works
		Active System	Temporary alarm system, off site monitoring, increase 24/7 fire wardens
		Management	Construction worker training, fire safety management, maintain fuel control and ignition source control

Appendix 2 – Testing Regime

Reaction to fire tests measure how materials burn and are used by regulators to control the types of materials that can be used on external walls/facades. Fire test methods can be categorized by size (small, mid or large scale) or whether the test applies to a material, a product or the whole system. Typically, small scale tests provide data on material properties but cannot provide information on whole system performance which requires large scale testing. The limitations and scope of a test method must be clearly understood and considered when applying test data to an assessment.

Each of the various reaction to fire tests measure a sub set of the following reaction to fire behaviour:

- Combustibility of material
- External flame spread (via building façade)
- Flame spread via external wall cavities
- Propensity to produce burning parts and falling debris

In Australia, the reaction to fire tests are summarised in the Table below. The class of building, numbers of storeys, location and use of the material/system and other parameters determine which method is applicable.

The NCC also provides an acceptance pathway for some materials as they are “deemed” to be compliant or not required to comply. Section C1.9 applies to external walls. In particular C1.9 (e) list combustible materials that *may be used wherever a non-combustible material is required*. It names some specific materials such as plasterboard; gypsum and fibrous plaster; and fibre reinforced cement sheet. Prefinished metal sheets may have a combustible surface if less than 1mm thick and is tested to AS1530.3. Bonded laminates will required testing of each lamina to AS 1530.1, the whole product to AS 1530.3 and limits apply to the thickness of the adhesive layers.

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	BCA Reference	Test Description	Criteria	Comments
AS 1530.1-1994 – Combustibility test for materials	Clause A1.1 Definitions. The BCA defines non-combustible as: • Applied to a material – not deemed combustible as determined by AS 1530.1 – Combustibility Test for Materials; and • Applied to construction or part of a building – constructed wholly of materials that are not deemed combustible	A small-scale material property test to expose 5 specimens to >750˚C. Parameters of the specimen as follows: • Diameter of 45 mm • Height of 50 mm • Volume of 80 cm3	Combustibility Criteria: • Mean duration of sustained flaming > 0s • Mean furnace thermocouple temperature rise >50˚C • Mean specimen surface temperature rise >50˚C	This method is a small scale test for each component or element of the system. This is unable to assess the whole system response. The test is pass/fail.
AS 5113-2016 – Fire propagation testing and classification of external walls of buildings.	CV3 CV3 is a verification method used to demonstrate compliance with CP2 in relation to the avoidance of spread of fire via the external wall of a building. CV3 has a number of clauses, one of which requires that the external wall system be tested for external wall (EW) performance in accordance with AS 5113 and has achieved the classification EW. In addition to achieving an EW rating, additional requirements such as sprinkler protection to balconies and specific sprinkler design criteria apply.	A large-scale test method which requires testing the whole façade system to BS 8414 or ISO 13785-2. The specimen tested is a full-scale wall test with a form of construction that is representative of the intended installation including cavities, substrates, fixings and cavity barriers. Each wall assembly includes a wing wall to account for re-radiation. The EW classification is achieved when a series of performance criteria that have been satisfied.	The full set of performance criteria for ISO 13785-2 and BS 8414 tests is set out in Section 5.4.3 and 5.4.5 of AS 5113, respectively. The performance criteria set out external and internal fire spread based on temperatures measured by thermocouples at defined heights and locations not exceeding set temperatures for a set period of time.	The strength of the method is that it gives highly relevant information of the whole system and potential interaction of various building products and their arrangement when directly exposed to fire. The limitation of this test method is the results apply to the system tested and extrapolation to assemblies with similar materials but are not identical to the tested prototype is challenging. Further research and standards are currently being developed outside Australia.
AS1530.3	Clause C1.9 deems some laminate materials appropriate for use in certain situation. This clause references AS 1530.1 and AS 1530.3	A small-scale test to expose 5-9 specimens to radiant heat and pilot flame. Parameters of the specimen as follows: • Width of 450 mm • Height of 600 mm	Four indices are generated; • Ignitability • Spread of Flame • Heat Evolved • Smoke Developed BCA Clause C1.10 and Specification C1.10 uses the spread of flame, heat evolved and smoke developed indices to regulate the fire hazard properties of a very limited number of materials and assemblies that are not floor linings and floor coverings, and wall and ceiling linings. AS1530.3 is also referenced in Clause C1.9 - laminate materials.	This test method may provide some data for the cladding material however it is unlikely to categorise the risk of the whole wall system without further data from other test methods. This test method may not properly identify fire risk for materials that have a metal or reflective facing and thermoplastic components.
Internal lining	Clause C1.10 applies to internal linings.			The following 3 standards apply to internal linings and may provide some information on fire performance of materials but there are substantial limitations.

	BCA Reference	Test Description	Criteria	Comments
AS5637.1	Specification C1.10 Clause 4(b) requires the determination of the group number for wall and ceiling linings to be determined in accordance with AS 5637.1.	This standard provides requirements on the test methods AS 3837, ISO 5660 and AS ISO 9705	Criteria for the selection and suitability of each test method is provided. The limitations of the small scale test methods exclude certain materials and systems.	The information gathered from the BCA wall lining test methods may provide information on potential flame spread however this may not fully assess risk of external wall systems.
AS3837	Average specific extinction area (a measure of smoke production) and group number may be determined by this method for some materials. This test method is also a secondary reference via AS5637.1	A small scale test to expose 3-6 specimens (each 100 x 100 mm) to radiant heat and pilot flame. Several parameters are measured as follows: Time to ignition Heat release rate CO and CO2 production Smoke production This data may be used to predict performance in the AS ISO 9705 for some materials. The methods has limitations for laminates such as ACP which require each layer to be tested individually or the whole composite tested to AS ISO 9705.	A group number and Average specific extinction area can be determined for some lining materials that are suitable for the small scale test and prediction method. Predicted time to flashover in AS ISO 9705 is used to determine group number of 1 to 4. Group 4 materials which cannot be used in class 2 to 9 buildings. Group 1 is the best performing category.	The information gathered from the BCA wall lining test methods may provide information on potential flame spread however this may not fully assess risk of external wall systems. AS 3837 is similar to ISO 5660. Group 1 is the best performing category but is not equivalent to non-combustibility.
AS ISO 9705	This test method is a secondary reference via AS5637.1	A large-scale test to expose lining specimens in a room 2.4 x 3.6 x 2.4m high to a gas flame of 100 – 300kW. Several parameters are measured as follows: Time to ignition Heat release rate CO and CO2 production Smoke production Time to flashover of the room This data may be used to predict performance in the AS ISO 9705 for some materials.	A group number and Smoke growth rate index ($SMOGRA_{RC}$) can be determined for lining materials.	The information gathered from the BCA wall lining test methods may provide information on potential flame spread however this may not fully assess risk of external wall systems. This method has fewer limitations than the smaller scale test methods.

Large scale test methods

There are several internationally-recognised large-scale façade test methods including NFPA 285, BS 8414, and ISO 13785 that are currently used for regulation of façade fire performance in other countries. Each of these methods has pros and cons. The issues include the size of the ignition source, radiant heat level impinging on the specimen, inclusion of a wing wall to account for re-radiation. Even large-scale tests cannot cover the full range of construction variations and addition elements such as downpipes, cabling etc. that may occur.

"Ancillary Elements" in the NCC does provide concessions for some materials in external walls and is applicable where all other elements of the wall are compliant. Installation of a combustible element in the wall system would require the reconsideration of any ancillary elements.

Existing buildings

The fire and characterisation test applicable to compliance of new buildings is often of little use for existing buildings. The majority of the products or systems are either unknown, too difficult to replicate and test or obviously non-compliant. Proxy tests which provide some data on which to base a risk to life approach are available.

In the UK a total calorimetry screening method was developed for ACP to rank the core materials into 3 categories aligning with the European classification based on the energy release. A guide on the proportion of polymer to mineral (fire retardant) filler was listed and this forms the basis of the BRE categories and the Insurance Council of Australia (in conjunction with the FPA, Engineers Australia) risk ranking protocol.

European classification	D	B	A2
Calorimeter energy release	>35MJ/kg	>3 and <35 MJ/kg	<3 MJ/kg
Approximate % polymer	100	30	7
BRE category	3	2	1
ICA/FPA/EA protocol	A	B	C

There are several methods to determine the proportion of polymer to filler. Ashing test, XRay Diffraction, Fourier-transform infrared spectroscopy (FTIR), Thermogravimetric analysis (TGA) and other methods provide data and may be required to be used in combination to enable calculation of the polymer content and therefore ranking. Refer to the Insurance Council's Aluminium Composite Panel Residual Hazard Identification Protocol for accredited laboratories who can identify and quantify the types of materials present in panels[2].

The number of specimens that need to be removed and tested to provide a level of confidence that the façade material is confirmed will differ for each project. A decision will need to be made based on parameters such as the extent of coverage, building risk profile, types of panel, differing colour of panels, visual inspection outcomes, location of ignition sources etc.

[2] http://www.insurancecouncil.com.au/issues-submissions/issues/insurance-industry-aluminium-composite-panels-residual-hazard-identificationreporting-protocol

BRE Global on behalf of DLGC ran a total of 7 Façade Tests on 3 different categories of ACP's with 3 different Insulations and made the results publicly available. The installations included vertical and horizontal cavity barriers. The following summarizes the key parameters and the results. Ref: https://www.gov.uk/guidance/building-safety-programme.

The insulations used in the tests were PIR, Stone Wool and Phenolic. No manufacturer's names or product designations were provided however the PIR and Phenolic insulation was assumed to be compliant/fire retardant. The following was reported:

- PIR – 100 mm, foil faced, density 31.2 kg/m3, moisture content from 2.4% to 3.9%
- Stone wool – 180 mm, density 47.7 kg/m3, moisture content from 0.5% to 0.6%
- Phenolic – 100 mm, foil faced, density 32 kg/m3, moisture content 8.5%

Summary of the 7 fire tests, observations and results in accordance to the BR135 extracted from the report are:

Test	ACP/Insulation	Result	Time to (min)			
			Flaming debris burning > 20sec	Pool fire at base	Flames at or above test rig	Test terminated (crib ext. after 30 min)
1	Cat 3/PIR	Fail	5	8	7	9
2	Cat 3/RW	Fail	5	Unavailable	7	7
3	Cat 2/PIR	Fail	8	9	25	25
4	Cat 2/RW	Pass	7	9.5	-	60
5	Cat 1/PIR	Pass	9	10	-	60
6	Cat 1/RW	Pass	9	-	-	60
7	Cat 2/Phenolic	Fail	8	12	28	29

*PIR (Polyisocyanurate), RW (Rock Wool)

The BRE Global tests provide our best indication to date as to the fire behaviour of the three most common categories of ACP's installed on Australian buildings. One very important difference however is that cavity barriers were provided in all tests, whereas the provision of cavity barriers was not required in Australia and hence typically were not specified or installed.

Thus, the expectation is that the fire performance seen in the BRE Global results in the table, would probably be worse with no cavity barriers installed. This is a significant concern for the Category 2 (FR or Fire Rated) ACP's with any sort of combustible/fire retardant insulation or sarking installed behind the ACP.

1. Category 3 ACP's – those with near 100% PE core, will burn aggressively vertically (both up and down from the ignition point), regardless of the type of insulation or sarking behind.
2. Category 2 ACP's – those with around 30% PE in their core, will burn vertically beyond two floors above the ignition point if the insulation or sarking behind is combustible/fire retardant.
3. Category 1 ACP's – those with no more than 7% PE (classified limited combustibility in the UK), should not propagate a fire beyond two floors above the ignition location, with combustible/fire retardant insulation or sarking.
4. Category 2 and 1 ACP's should not propagate a fire beyond two floors above the ignition point, with non-combustible insulation and/or sarking behind.

Limitations

The limitations and applicability of any test data must be thoroughly understood when being relied on as a basis for a risk assessment. Cladding systems with combustible elements over extended areas are likely to require data from large-scale tests as this has the most robust correlation to fire risk with the least limitations.

CodeMark Certificates

CodeMark certificates are currently recognised in the NCC as a route to compliance, however in the case of ACP's and some other cladding products, the desktop review methodology involved, and the information provided in the certificate, is considered insufficient to conduct a thorough risk assessment or performance solution. Some regulators have released statements that CodeMark certificates are not appropriate or accepted in relation to ACP's and some other cladding products.

Appendix 3 – Possible Remedial Measures & Rectification Works

Rectification	Short Term	Medium Term	Long Term
Removal of cladding (partial or full), or replacement	N/A	If solely an attachment/ancillary element (i.e. no insulation or weatherproof) and/or easily accessible	Building permit/statement required to remove or replace building façade
Enhanced passive protection	N/A	Introduce cavity barriers	Fire stop around openings, doors, windows, vents, louvres
			Improve the passive protection afforded occupants internally (fire isolated routes)
Enhance active systems	Temporary detection coverage (i.e. wireless detection and alarm)	Increase coverage of detection & alarm system Increase reliability of detection & alarm system	Enhance sprinkler coverage to areas that have been identified in the risk assessment
	Undertake full service of sprinkler system to determine condition	Undertake full survey of the sprinkler system to determine application for protection of the hazard	
Assess the means of escape	Full building inspection to assess condition of egress routes and management of evacuation strategy	Improve occupant training and conduct evacuation drill to generate realistic design data for assessment	Place controls on the occupancy numbers to align with the results of the means of escape assessment
Ignition hazards	Remove, control, or manage transient ignition hazards – refuse, cars, BBQ, balcony storage	Remove, control or manage ignition sources – electrical penetrations, damaged panels, BBQ gas mains, lightning rods	Remove ignition sources that increase the building façade fire risk