Façade Fire Safety Design Practice Guide

Chris Chennell | GHD Fire

ENGINEERS AUSTRALIA
Society of Fire Safety

Society of Fire Safety Practice Guide
Façade Fire Safety Design

Scope

The following itemises the scope of this Guide:

- Providing an industry recognised fire risk assessment methodology for suitably qualified and competent professionals to determine the likelihood and consequences of fire spread via the facade of buildings.

- The Guide will be applicable to all façade designs, and not exclusively aluminium composite panels (ACPs), or ACP type systems, with the purpose of demonstrating that vertical compartmentation 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.

- The Guide will;
  - be a fire risk assessment tool to provide a methodology to demonstrate compliance of the façade design (both existing and new) with the National Code of Construction Performance Requirements (e.g. CP2), and,
  - enable a level of safety that is agreed with the project stakeholders, from which the project goals can be set.

- The Guide will be applicable to all buildings – both old and new – 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 for existing buildings, and enable Performance Solutions to be delivered for new buildings and where appropriate for existing buildings.

Lacrosse, Melbourne

- 25^{th} Nov 2014
- 400-500 Occupants
- 23 storeys
- 122 fire fighters involved

Grenfell, London

- 14^{th} June 2017
- 293 Occupants
- 24 storeys
- 72 deaths
- 250 fire fighters involved

- Flat 16, 4th floor.
- Fridge-freezer: **Ignition**
- Insulation: **Fuel**
- Cavity: **Spread**

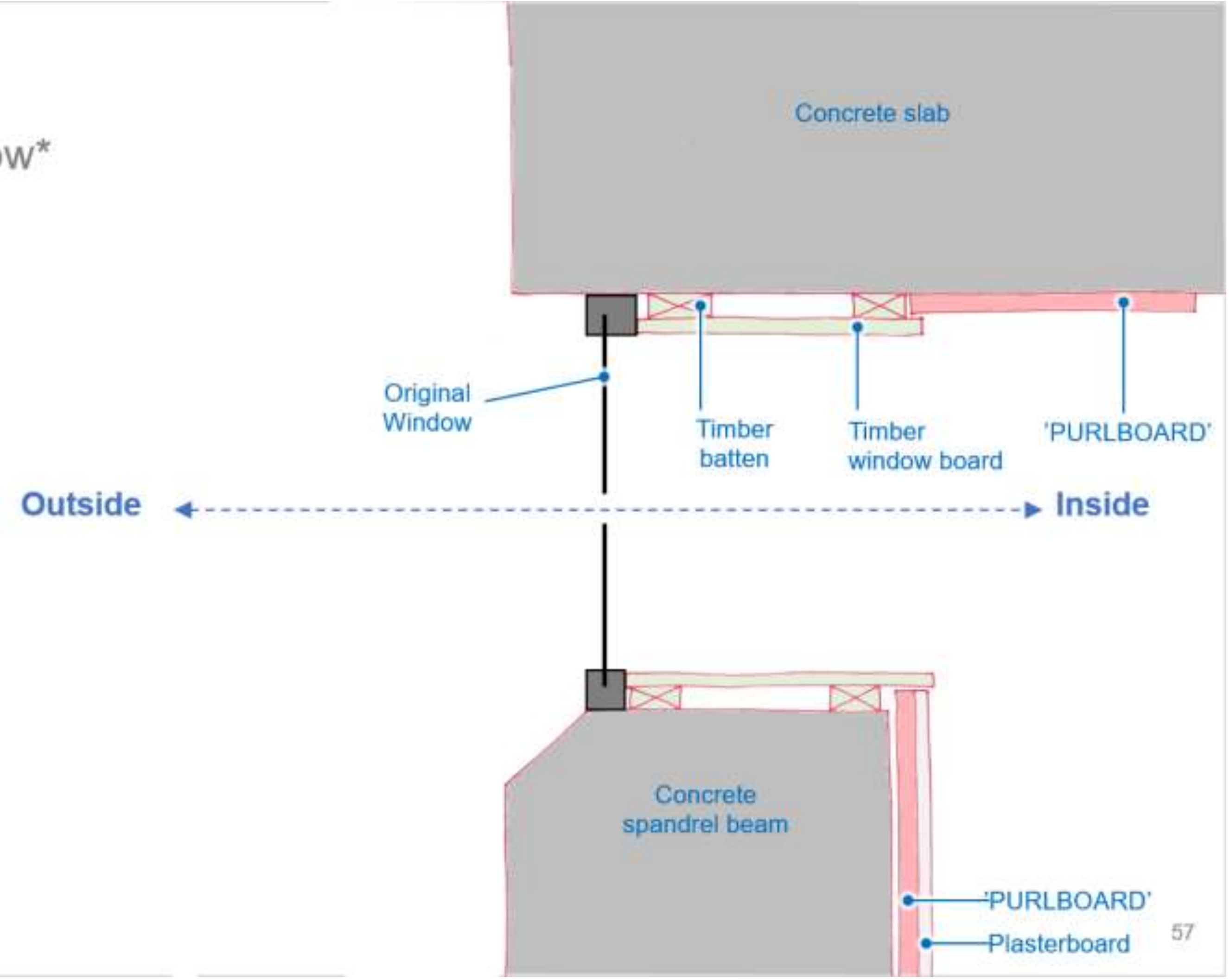
Grenfell, London

Grenfell, London

Grenfell, London

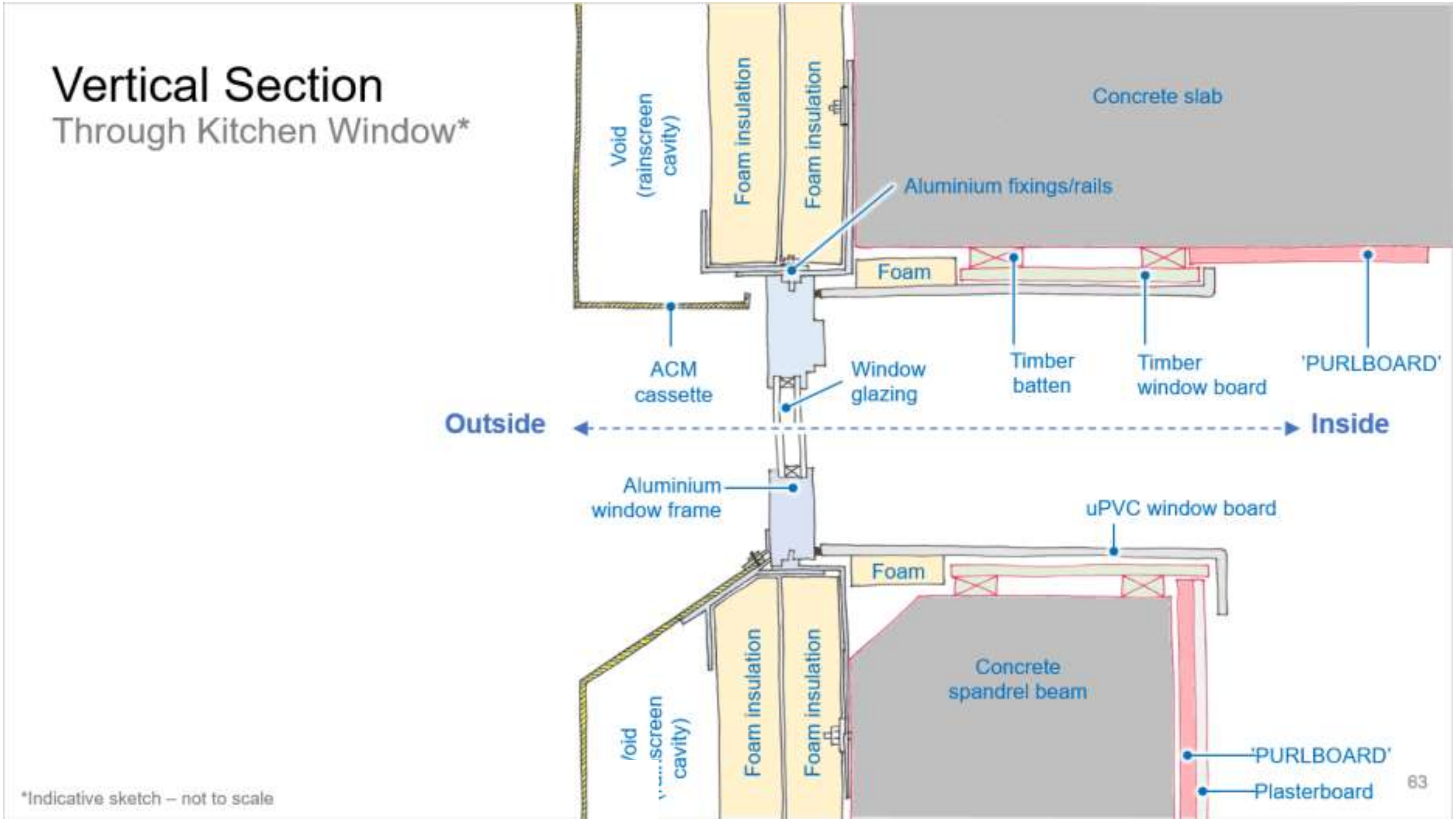
Vertical Section

Through Kitchen Window*



*Indicative sketch – not to scale

Grenfell, London



Taksim Iik Yardin Hospital, Istanbul

- Wheelie bin: **Ignition**
- Insulation: **Fuel**
- Cavity: **Spread**

GHD

Binaqadi, Baku

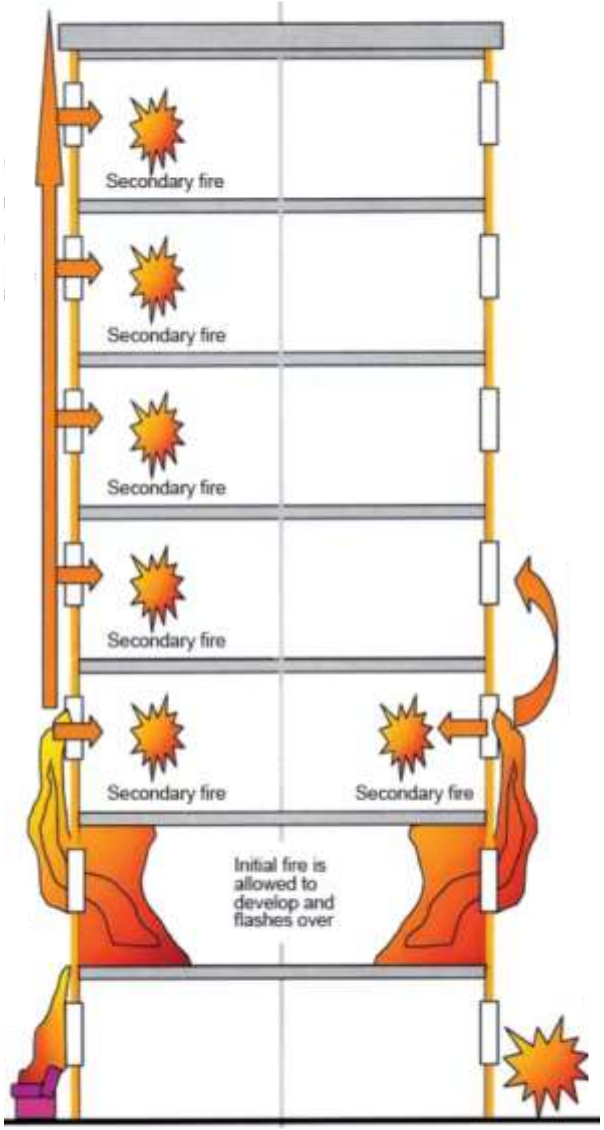
- ???: **Ignition**
- Insulation: **Fuel**
- Cavity: **Spread**

- 19th May 2015
- 16 storeys
- 15 deaths
- 63 injured

Jing’an, Shanghai

- 15th Nov 2010
- 28 storeys
- 58 deaths
- 70 injured
- Welding: **Ignition**
- Insulation: **Fuel**
- Cavity: **Spread**

Compartmentation



The most fundamental premise for fire precautions and life safety strategy for apartment buildings is effective fire compartmentation. This translates to enclosing each apartment and common means of escape (corridors and stairs) with fire resisting walls, the concept being that a fire within an apartment will be contained within that apartment for sufficient time to allow the contents to be burned out or for the Fire Service to extinguish the fire without the fire transferring to other areas of the building.

Dr H Phylaktou & Prof GE Andrews 23/06/2017

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Competency

It is expected that the fire risk assessment is to undertaken by suitably qualified and competent professionals.

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.

However, 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.

Stakeholder Engagement

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

- Clients
- Architect
- Building Surveyors
- Tenants
- Project Managers
- Council
- Owners/Operators
- Engineers
- Fire Brigade
- 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.

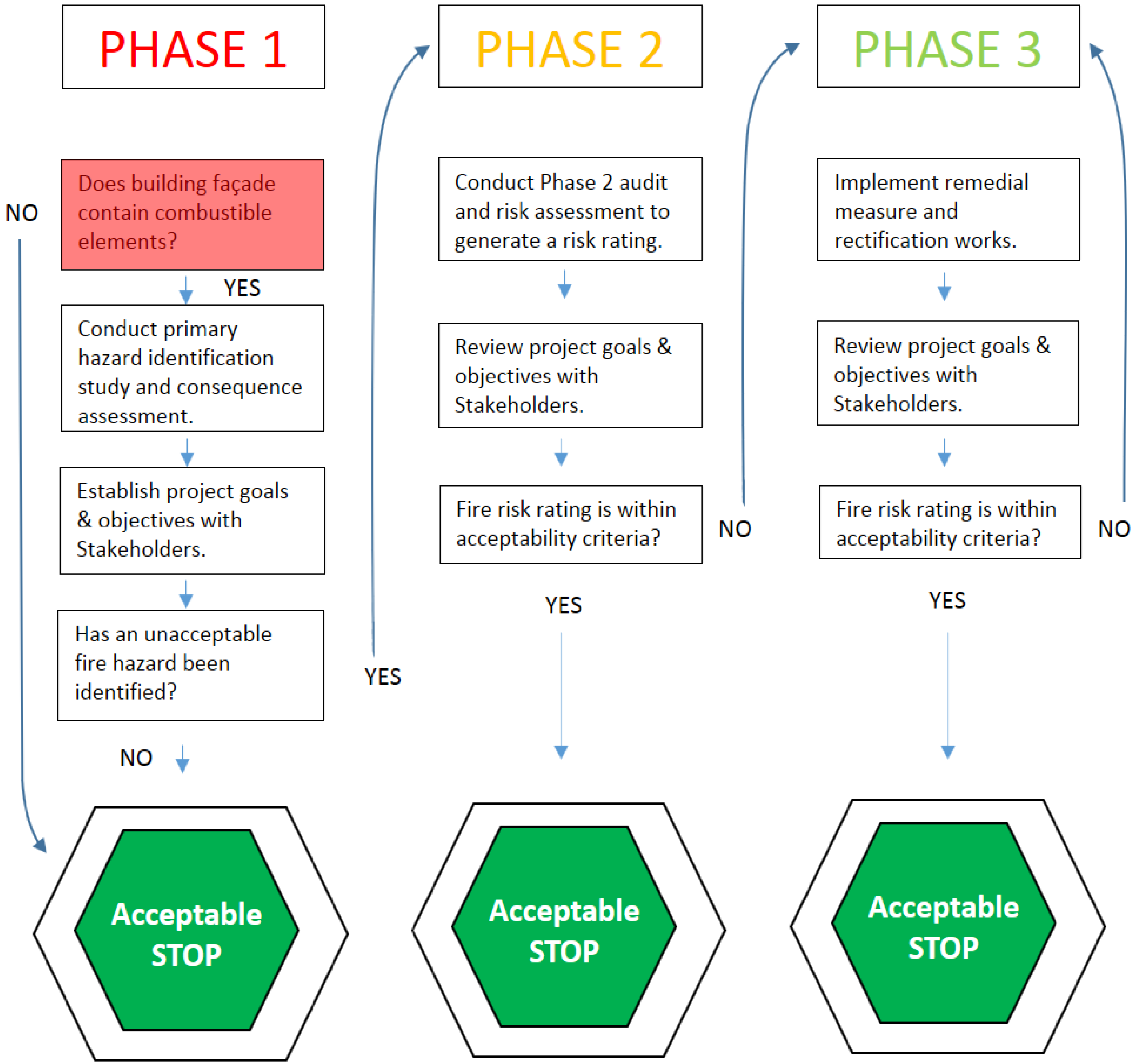
At the completion of each stage of this methodology, the Engineer is expected to present their proposals and findings to the Stakeholders.

Goals & Objectives

Goal (Examples)	Objective (Examples)
Life Safety	To ensure the building occupants, people within immediate vicinity, and, in adjoining properties, are able to reach a place of safety in tenable conditions.
Fire-Fighter & Emergency Personnel Safety	To ensure attending fire crews and emergency personnel can undertake operational procedures in tenable operational conditions.
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 ensure the insurability of the property at a reasonable cost by reducing the residual risk to a mutually acceptable level.

Quality Assurance vs Peer Review

ALARP vs SFAIRP


PHASE 1
PHASE 2
PHASE 3
Does building façade contain combustible elements?
NO
YES
Conduct primary hazard identification study and consequence assessment.
Establish project goals & objectives with Stakeholders.
Has an unacceptable fire hazard been identified?
NO
YES
Conduct Phase 2 audit and risk assessment to generate a risk rating.
Review project goals & objectives with Stakeholders.
Fire risk rating is within acceptability criteria?
NO
YES
Implement remedial measure and rectification works.
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NO
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Acceptable STOP
Acceptable STOP
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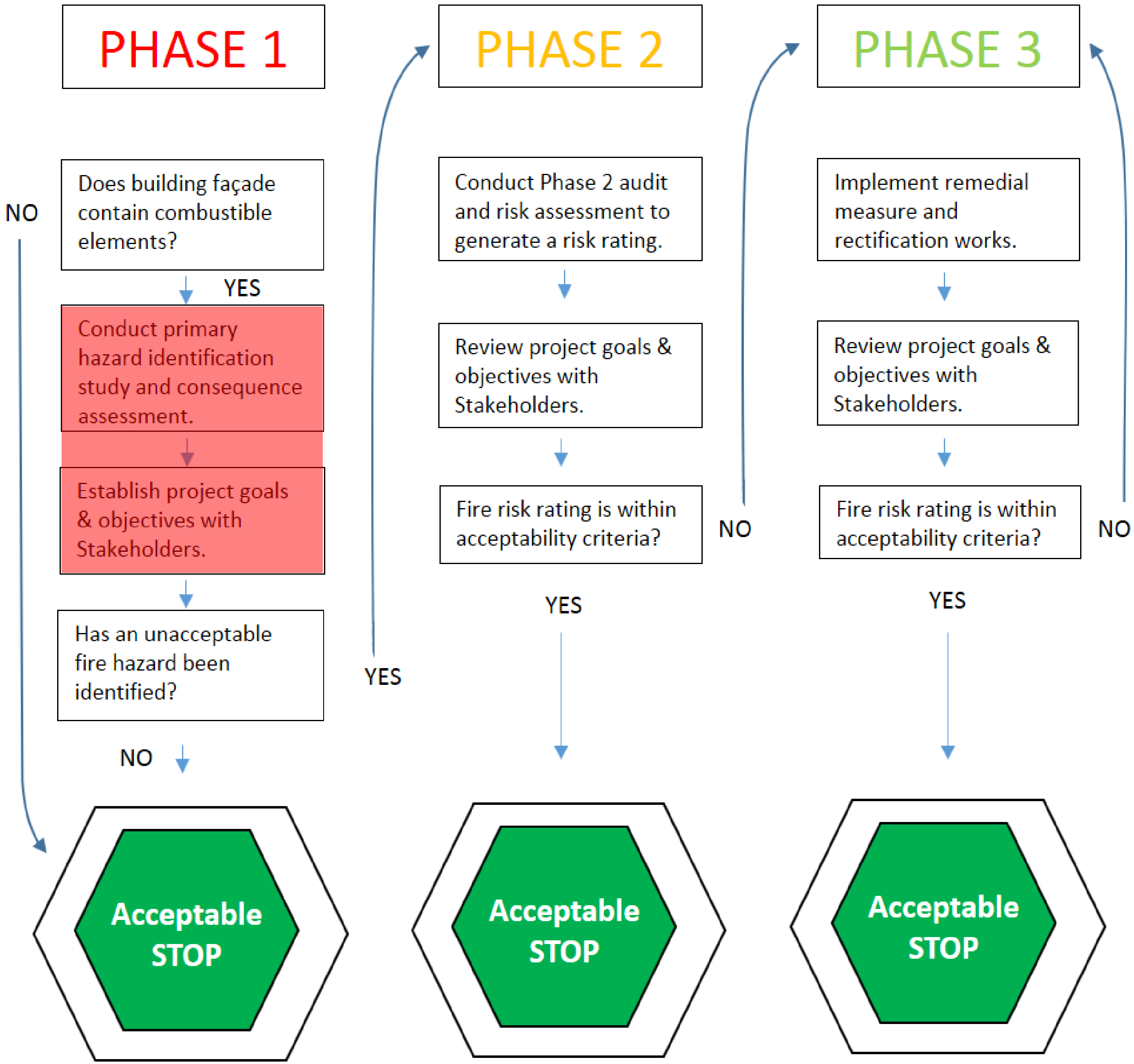
	BCA Reference	Test Description	Criteria	Comments
AS 1530.1-1994 – Combustibility test for materials	Clause A1.1 Definitions. The BCA defines non-combustible as: • Applied to a material – not deemed combustible as determined by AS 1530.1 – Combustibility Test for Materials; and • Applied to construction 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 methods 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 full 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 limitation of this test method is the variance found in external wall assemblies leading to many tests having to be conducted in order in order to validate its performance. The challenge would be how to assess the test data obtained to other wall assemblies with similar materials but are not identical to the tested prototype.
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 however it is unlikely to categorise the risk without further data from other test methods.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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.

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, causing vertical downward fire spread

Once all hazards have been identified they 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.

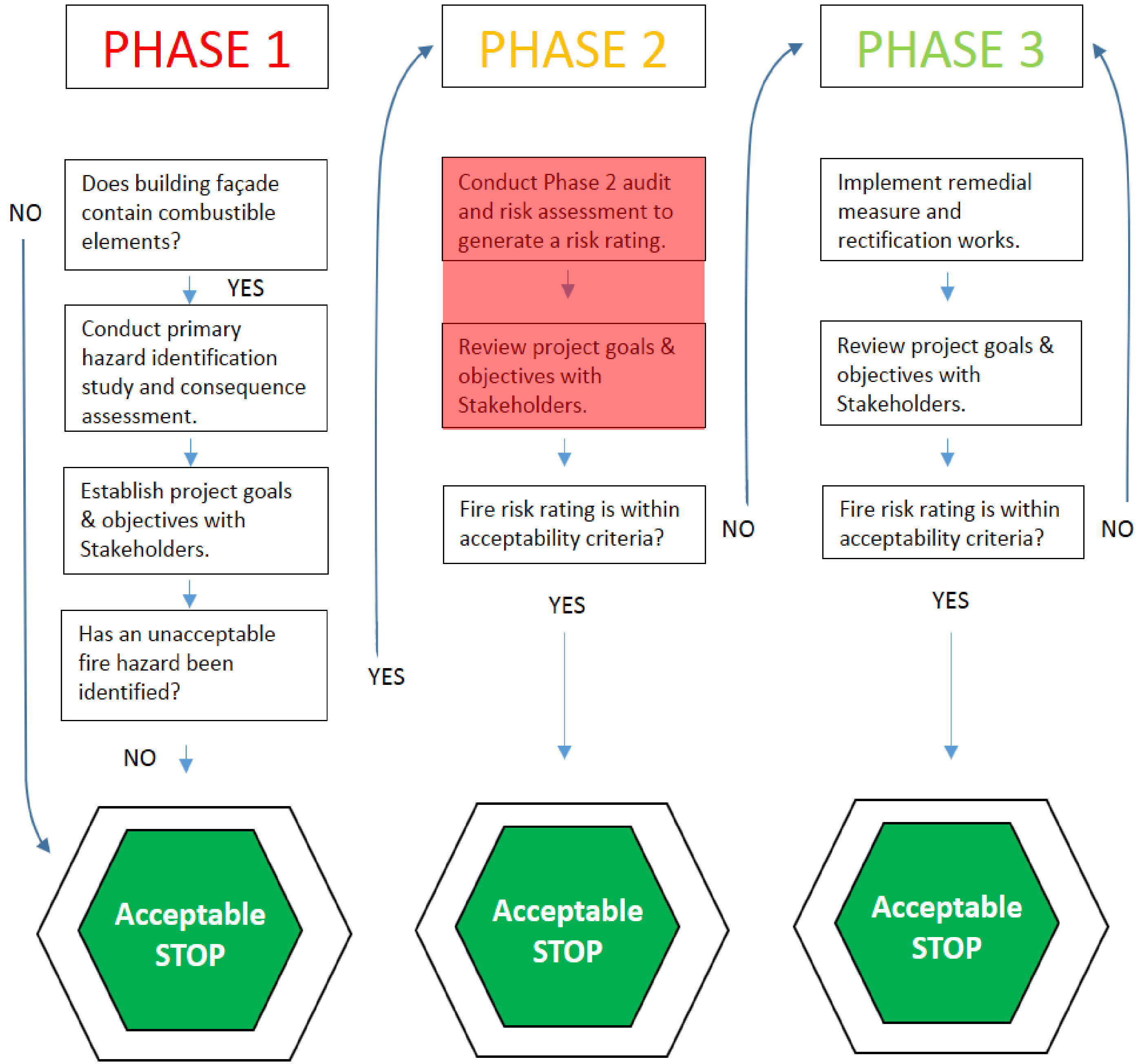
From this the project goals should be established and agreed.

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 agendas.

simultaneously

- Sprinkler system capacity being insufficient to effectively suppress a fire involving multiple floors

- Fire-fighters having insufficient access to adopt effective external fire-fighting where the building has been design for internal fire-fighting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Risk Assessment & Building Audit

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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 the external seating area
	Fire from discarded cigarette in smoking area
Fire Across the Boundary	Fire in building across the title boundary
	Bush fire event

Likelihood

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 projects 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.

Level of Risk	Action Required
Extreme	Immediate action is required. Building should not be occupied until rating is reduced.
High	Risk(s) shall be eliminated if possible, or mitigated if not possible to eliminate in a reasonably short timeframe.
Moderate	Risk(s) shall be mitigated and controlled/managed in a medium timeframe. It shall be ensured that these risk(s) do not become high or extreme if not mitigated.
Low	No further action is required and a record of the decision process is to be kept.

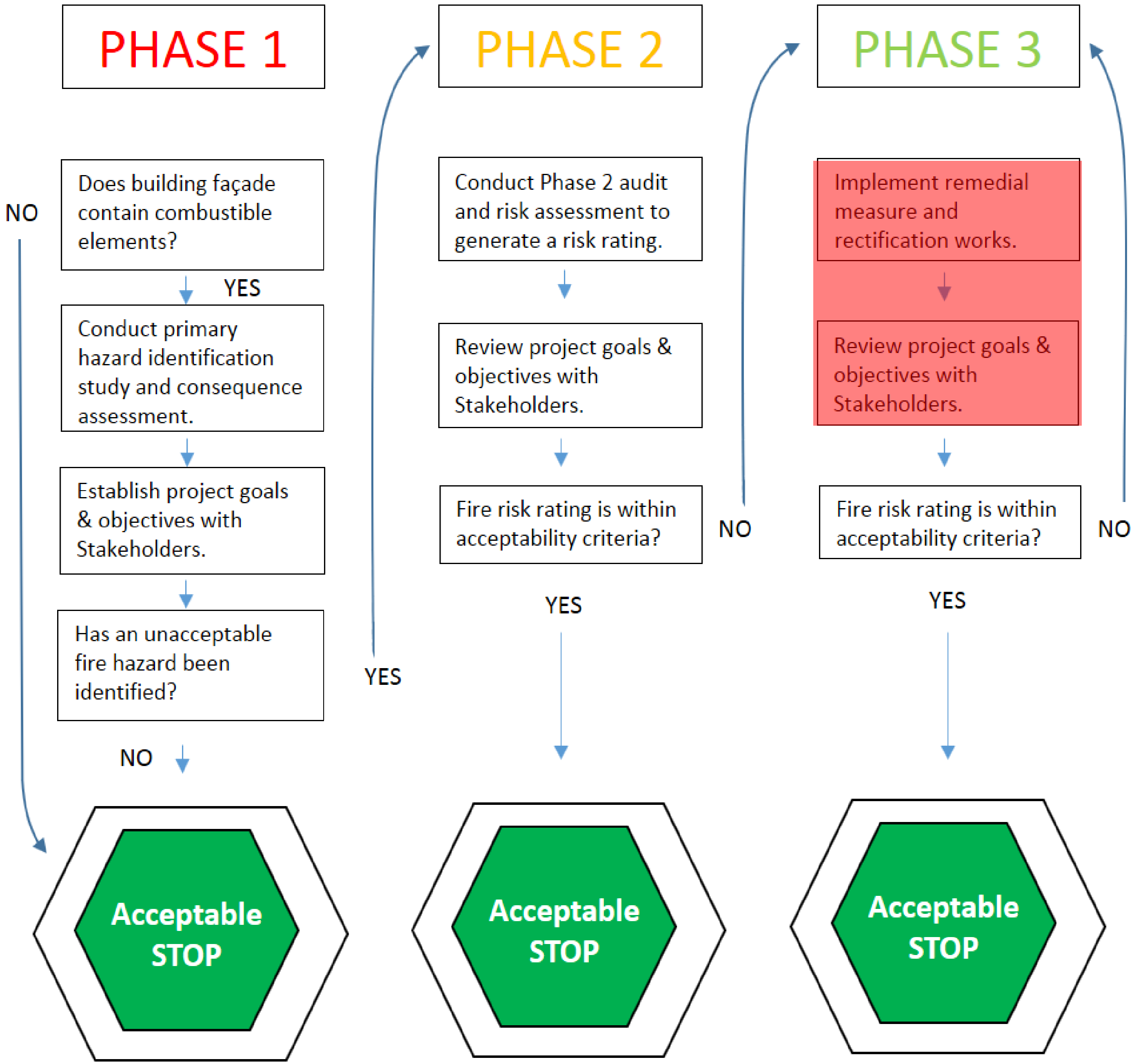
Risk Assessment & Building Audit

System	Elements
External Wall	External wall components, insulation materials/products, weatherproofing materials/products, unseen 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 Hydrants, Hose Reels, and Detection & Alarm.
Passive	ation.
Populat	n.
Means	oints,
Fire-Fighting	Access, Facilities, Intervention, Building, Landscape, External operations, Fire-fighter Tenability.
Existing Condition	Maintenance of systems, condition of the passive fire protection, warden training, fire safety management, occupant training.
Construction Fire Safety	Construction Staging, interim temporary fire safety measures, staff training, critical inspection stages.

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.

The resultant risk rating should be presented to the Stakeholders. It is expected that the resultant risk rating will 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 measure or rectification works.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Remediation & Rectification

At this phase of the risk assessment the number of fire scenarios that conflict with the project 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 project goals, financial and timeline constraints, and the agenda for 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 and 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 be take effect within 1-2 months
- Long term measures are expected to involve refurbishment or redesign and could require significant changes to the active, passive and operational fire safety design, and possibly require a building permit/statement

For new buildings the impact of change may be easier to manage. However, the implementation of change is recognised as being less where this is introduced early in the design.

Remediation & Rectification

System	Elements
Active Systems	Upgrade of automatic suppression (sprinklers) – to enhance coverage and system capacity, Upgrade to fire brigade facilities (hydrants) – to enable shorter response times, Enhance detection & alarm system to reflect building façade fire hazard.
Passive Protection	Removal or replacement of panels – partial or complete depending on the results of the risk assessment, Introduction of separation – barriers within
Oper	
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.

What happens next....?

Fire-resistance cladding developed by University of Melbourne researcher

November 21, 2018 News

A University of Melbourne researcher has led the successful development of an organic, non-combustible and lightweight cladding core – a product that was previously thought to be impossible to create.

Typically, lightweight cladding is made from organic, carbon-based, composite materials like plastic, but these materials by their nature are combustible. Non-combustible materials like steel, ceramic tiles or concrete are much heavier and more expensive to produce and install.

University of Melbourne Innovative Fire Engineering Group research leader Kate Nguyen has discovered that the plastic insulation around electrical cables uses tiny ceramic particles that activate and chemically interact with each other, forming and spreading a heat resistant network through the material.

In partnership with construction materials company Envirosip, who commissioned the research, Dr Nguyen began experimenting with different ceramic particles at the University's testing furnace at Creswick, north west of Melbourne.

Thanks for your attention!