ENGINE HOUSE
105 WELLINGTON STREET
ST KILDA, VIC 3182
T: 1300 077 959
E: INFO@BASIC.EXPERT

04 November 2019

Client	Lightweight Structures Association Australasia Inc
Location	PO Box 4047, Oatley NSW 2223
Author	Jonathan Barnett, Oscar Salt
Scope	Guide to Preparing a Performance Solution for Fabric
Revision No.	DRAFT.7
Distribution	Peter Lim, Lisa James

ABN 73 627 430 586

Revision No	Written by	Reviewed and approved by	Date
DRAFT.7	OS	JRB (RBP EF39413)	20191104

1 Executive Summary

1.1 Introduction

Many PVC and PTFE architectural coated fabrics which are available on the Australian market perform very well in fire. They do not contribute a significant fuel load nor the generation of toxic gases beyond typical furnishings in modern buildings.

However, for many uses they do not comply with the Deemed-to-Satisfy Provisions of the National Construction Code, Building Code of Australia (**the BCA**). This is because they are deemed combustible when tested in accordance with the referenced Australian Standard AS 1530.1—1994. Passing this standard is required for the Deemed-to-Satisfy provisions of the BCA for Type A and Type B construction. These are the construction types for most multi-story commercial and residential buildings.

However, it is possible to use architectural coated fabrics in such buildings using an alternative compliance pathway called a Performance Solution (this used to be called an Alternative Solution). The Performance Solution requires that compliance with the Performance Requirements of the BCA must be demonstrated. This usually requires an assessment by a fire safety engineer using an approach that is acceptable to the Appropriate Authority:

- Documentary evidence that the use of a product achieves certain requirements of the BCA
- Verification Methods provided in the BCA
- Other Verification Methods that are accepted by the Appropriate Authority
- Expert Judgment
- Comparison with the Deemed-to-Satisfy Provisions

1.2 Roles for the Manufacturer or Supplier

In order to use one of these assessment methodologies, manufacturers can assist by providing appropriate test results, product datasheets, CodeMark certificates of conformity, studies of actual fires, fire statistical databases, and fire report templates for use by fire safety engineers.

1.2.1 Test reports

The best fire test results to use comply with Australian Standards and have been conducted at a laboratory approved by the BCA. These includes AS 1503.2, AS 1503.3, and AS/NZS 3837. International tests such as EN 13501, NFPA 701 and ASTM E84 may also be useful. In and of themselves, test reports are not sufficient to meet the assessment requirements of the BCA but are a necessary starting point for use by a fire safety engineer.

1.2.2 Datasheets

Product datasheets provide product specific information, but to be useful need to be tied to the relevant test reports. Because such datasheets are not verified or prepared by an independent authority, they have less weight and must be used with much more caution than

a test report. Likewise, reference within a product datasheet to a test result has much less veracity than an actual test report and only limited value in the development of a Performance Solution.

1.2.3 Certificates of conformity

CodeMark certificates of conformity are managed by third parties on behalf of the Australian Building Codes Board. The scheme was redeveloped in 2016 however, due to practical difficulties with implementation some CodeMark providers are now withdrawing from the market. As a result, this scheme is likely to be either significantly modified or withdrawn.

1.2.4 Fire data

Fire loss information is a very valuable information source for engineers developing Performance Solutions. However, the collection of relevant data in Australia is very limited and of questionable quality. Data from overseas is of better quality and can be used in Australia. In some industries, manufacturers engage forensic engineers to prepare detailed reports on their product behavior in actual fires. These independent reports can be of immense value, both for a comparison with the Deemed-to-Satisfy provisions of the BCA and as the basis for a risk assessment which can lead to the justification of a Performance Solution.

1.2.5 Report templates

Finally, although each building and use of architectural coated fabrics requires a bespoke Performance Solution, there are commonalities in Performance Solution reports that can be documented and provided to fire safety engineers.

1.3 Meeting the Performance Requirements of the BCA

1.3.1 Performance Requirements

The development of a Performance Solution must meet the objectives of the BCA and address all of the Performance Requirements. The primary objectives are occupant protection against fire, enabling of fire brigade intervention, and protection of neighboring property. These objectives are met through Performance Requirements; the most relevant for a Performance Solution involving architectural coated fabrics are CP2 Spread of Fire and CP4 Safe Conditions for Evacuation. The Performance Solution addresses how the coated fabric's material behavior, location, and construction/fixing details impact CP2 and CP4.

1.3.2 Fire Brigade

Fire brigade intervention is usually less of an issue for architectural coated fabrics as such materials tend to be easy to extinguish. However, their location can be important and must be evaluated to ensure they do not impede access to brigade entrance into a building or the use of firefighting equipment such as booster connections and sprinkler control rooms.

1.3.3 Performance Solution documentation

Performance Solutions are usually developed following the International Fire Engineering Guide process. This requires the development of a Fire Engineering Brief (**FEB**) which documents the basic building's properties, occupant characteristics and fire brigade capabilities. The FEB documents the proposed Performance Solution and the assessment methodologies and becomes the basis for stakeholder involvement in the design process. One of the most useful tools for justifying a Performance Solution is Risk analysis and risk assessment. This should follow standard approaches such as those outlined in AS/NZS 31000.

The FEB is followed by the development of a Fire Engineering Report which documents the FEB and provides justification of the Performance Solution.

1.4 The Next Step

This report details the steps needed to move forward with assisting the development of Performance Solutions for architectural coated fabrics. We have discussed an actual application of such fabrics and outlined the thought process that would be needed to develop an appropriate Performance Solution.

In reviewing the necessary process, we do not believe it will be useful to try to develop a Deemed-to-Satisfy route for fabrics. Instead we believe it is worthwhile to promote the development of Performance Solutions. This will require research, testing to Australian standards, and the development of tools to assist fire safety engineers in achieving this in a cost effective and timely manner.

TABLE OF CONTENTS

2 Preface

2.1 Defined Terms

2.1.1 In this document we define the following terms:

- Lightweight Structures Association Australasia Inc (**LSAA**)
- Basic Expert Pty Ltd (**Basic Expert**)
- The National Construction Code (**the NCC**)
- The Building Code of Australia (**the BCA**)
- The Australian Building Codes Board (**the ABCB**)

2.2 Assumptions

2.2.1 This document is based on the National Construction Code 2019.

2.3 Limitations

2.3.1 Only Section C (Fire Resistance) Performance Requirements are investigated in this document. This is the most relevant section of the BCA for architectural coated fabrics.

2.3.2 This document does not consider the state and territory variations and additions to the Deemed-to-Satisfy Provisions of the BCA.

2.4 List of Documents Reviewed

2.4.1 We have reviewed the following documents:

- [BCA2019] NCC 2019 Building Code of Australia – Volume One; Australian Building Codes Board; May 2019
- [BCAGuide] NCC 2019 Guide to BCA Volume One; Australian Building Codes Board; May 2019
- [AS 1530.1—1994] Methods for fire tests on building materials, components and structures Part 1: Combustibility test for materials; Standards Australia; 21 March 1994
- [AS 1530.2—1993] Methods for fire tests on building materials, components and structures Part 2: Test for flammability of materials; Standards Australia; 13 April 1993
- [AS/NZS 1530.3:1999] Methods for fire tests on building materials, components and structures Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release; Standards Australia/Standards New Zealand; 05 November 1999
- [AS/NZS 3837:1998] Method of test for heat and smoke release rates for materials and products using an oxygen consumption calorimeter; Standards Australia/Standards New Zealand; 05 November 1998
- [NFPA 701] Fire Tests for Flame Propagation of Textiles and Films; National Fire Protection Association; 05 November 2018
- [AS/NZS 31000] Risk management—Principles and guidelines; Standards Australia/Standards New Zealand; 20 November 2009
- [SFPE Handbook] SFPE Handbook of Fire Protection Engineering; Hurley, M.J. et al; 5th edition 2016

- [IFEG] International Fire Engineering Guidelines Edition 2005; Australian Buildings Codes Board; March 2005
- [SFS Guide] Society of Fire Safety Practice Guide Facade/External Wall Fire Safety Design; SFS Facade Fire Safety Design Committee; February 2019
- [UMelb] Risk Assessment Methodology; University of Melbourne; Version 2.2 May 2018; Retrieved 20 June 2019 from https://safety.unimelb.edu.au/data/assets/pdf_file/0007/1716712/health-and-safety-risk-assessment-methodology.pdf

3 Historical Background

3.1 Basic Expert's Thoughts

3.1.1 We know of one example of a Queensland building from earlier this year where Building Surveyor approval for the use of an architectural coated fabric was refused without a Performance Solution.

3.1.2 We also know of multiple buildings around Australia where Building Surveyor approval for the use of architectural coated fabric has been granted without a Performance Solution.

3.1.3 This lack of consistency in regulation, combined with the industry's relatively poor understanding of these fabric products, has motivated the development of this guide.

3.1.3.1 We hope that by understanding how a fire engineer would develop a Performance Solution for fabric products, LSAA members are able to begin to consider how best to educate and influence industry and political organizations.

3.1.3.2 Through education and political influence comparable to that undertaken by the timber industry, the LSAA may be able to develop a Deemed-to-Satisfy pathway for the compliant use of fabric products without the FEB/FER process.

4 Compliance in Australia ([BCA2019])

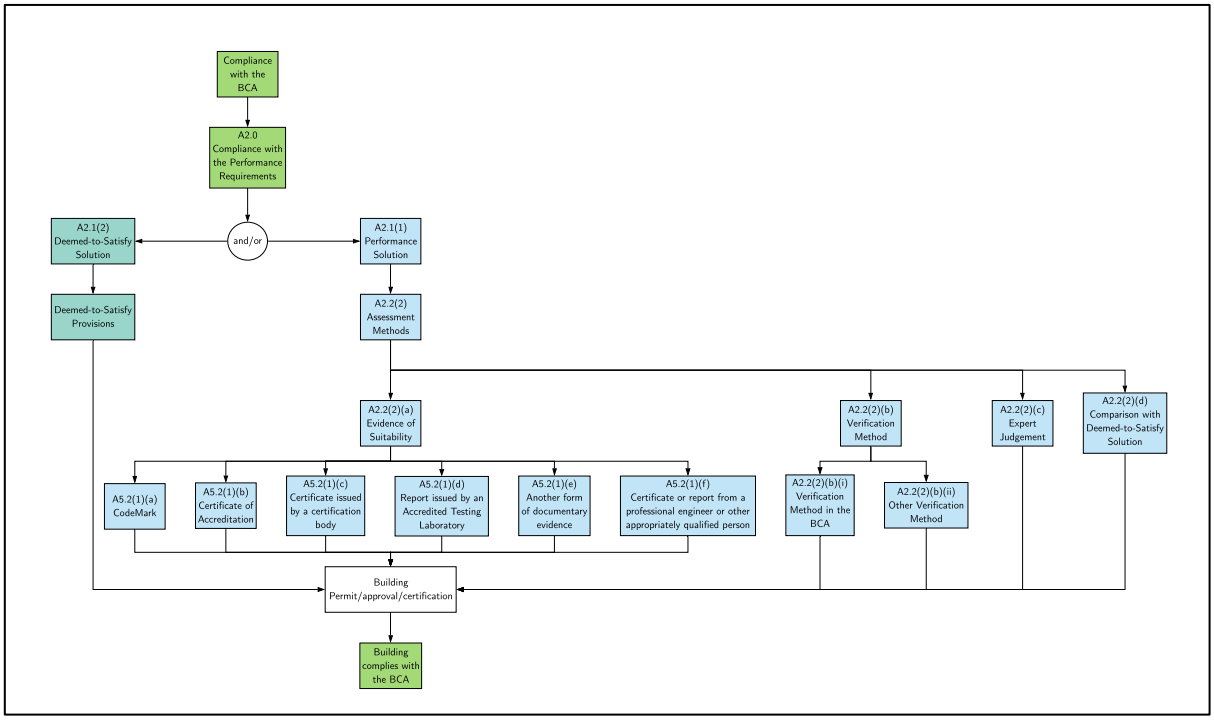

Figure 1—Complying with [BCA2019]

4.1 Introduction

4.1.1 This section will provide explanations and extracts from [BCA2019] relevant to the compliance of fabric with the BCA.

4.2 Defined Terms

4.2.1 Appropriate authority:

> the relevant authority with the statutory responsibility to determine the particular matter. ([BCA2019] p. 641)

4.2.2 Verification Method:

> … a test, inspection, calculation or other method that determines whether a Performance Solution complies with the relevant Performance Requirements. ([BCA2019] p. 664)

4.3 Compliance with the BCA

4.3.1 Buildings that are required to comply with [BCA2019] must satisfy the Performance Requirements.

4.3.2 The Performance Requirements can only be satisfied by a Performance Solution, a Deemed-to-Satisfy Solution, or a combination of both.

4.4 Deemed-to-Satisfy Solutions

4.4.1 The BCA contains the Deemed-to-Satisfy Provisions—a solution that satisfies these Provisions satisfies the Performance Requirements and is called a Deemed-to-Satisfy Solution.

4.5 Performance Solutions

4.5.1 A Performance Solution is an alternative method of satisfying the Performance Requirements.

4.5.2 A Performance Solution is only compliant when an appropriate Assessment Method (see Figure 1 and Section 4.6) is used to demonstrate that the Performance Solution satisfies all relevant Performance Requirements.

4.5.3 A Performance Solution must be prepared by a fire safety engineer qualified to practice within the relevant jurisdiction. The engineer may rely on information provided by product manufacturers but any report must be developed by the engineer.

4.6 Assessment Methods

4.6.1 The BCA defines five Assessment Methods which may be used alone or in combination; paraphrasing [BCA2019] A2.2(2):

- Documentary evidence that the use of a product achieves certain requirements of the BCA
- Verification Methods provided in the BCA
- Other Verification Methods that are accepted by the Appropriate Authority
- Expert Judgment
- Comparison with the Deemed-to-Satisfy Provisions

4.6.2 Any compliant Performance Solution must use one or more of these Assessment Methods.

5 How to Prepare a Performance Solution for Fabric

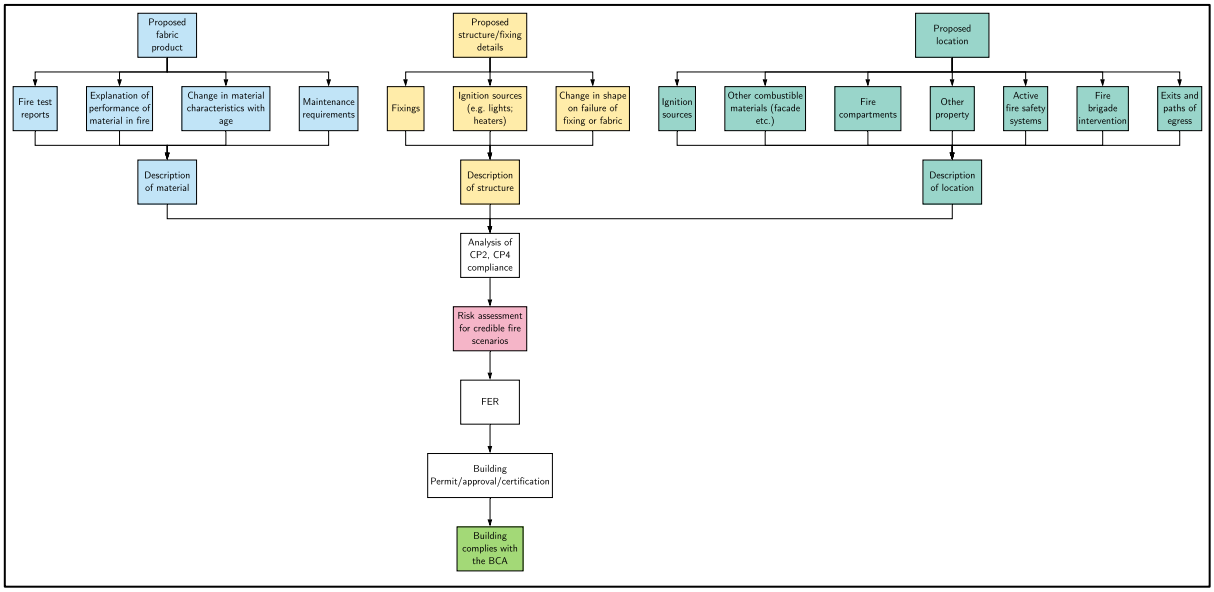

Figure 2—Preparing a Performance Solution for fabric

5.1 Introduction

5.1.1 For structures incorporating fabric (large sails, facades, canopies, etc.) to be compliant with [BCA2019] they must be addressed through a Performance Solution as they are not addressed in the Deemed-to-Satisfy Provisions.

5.1.1.1 There are particular concessions available which permit compliance of architectural coated fabrics under the Deemed-to-Satisfy Provisions in buildings required to be of Type C construction; consideration of these concessions is beyond the scope of this report.

5.1.1.2 This report considers Performance Solutions for the use of fabrics in buildings required to be of Type A and Type B construction.

5.1.2 This section outlines the process through which a Performance Solution for fabric may be prepared.

5.1.3 We require this guide be used in combination with the International Fire Engineering Guidelines Edition 2005 ([IFEG]).

5.1.3.1 [IFEG] is a document published by ABCB in collaboration with Canadian, American, and New Zealand building code bodies.

5.1.3.2 [IFEG] presents a standard process to follow in undertaking fire engineering and covers the communication with stakeholders required at each stage.

5.1.3.3 A detailed explanation of [IFEG] and how to implement it is beyond the scope of this report.

5.2 Fabrics and Deemed-to-Satisfy

5.2.1 All components of all external walls in a building required to be of Type A or Type B construction must be non-combustible:

> [BCA2019] Clause C1.9
> (a) In a building required to be of Type A or B construction, the following building elements and their components must be non-combustible:
> (i) External walls and common walls, including all components incorporate in them.... ([BCA2019] p. 67)

5.2.2 Any fabric structure attached to the external face of an external wall would be an ancillary element; such a fabric structure must be entirely non-combustible or be:

> [BCA2019] Clause C1.14(i)
>
> An awning, sunshade, canopy, blind or shading hood other than one provided under ([BCA2019] Clause C1.9(a)(i)) that—
> (b) meets the relevant requirements of Table 4 of Specification C1.10 as for an internal element; and
> (c) serves a storey—
> (i) at ground level; or
> (ii) immediately above a storey at ground level; and
> (d) does not serve an exit, where it would render the exits unusable in a fire. ([BCA2019] p. 70)

5.2.3 Any uses of combustible fabric structures in Type A or Type B construction that do not satisfy [BCA 2019] Clause C1.14(i) can only be compliant when addressed as part of a Performance Solution.

5.2.3.1 Popular architectural coated fabrics employ a PVC or PTFE coating—both these coatings are combustible when tested in accordance with [AS 1530.1—1994] and thus the fabric as a whole is deemed combustible.

5.3 'Non-combustible'

5.3.1 'Non-combustible', as defined in the BCA, means:

> (a) applied to a material — not deemed combustible as determined by AS 1530.1 — Combustibility Tests for Materials; and
> (b) applied to construction or part of a building — constructed wholly of materials that are not deemed combustible. ([BCA 2019] p. 656)

5.3.2 [AS 1530.1—1994] is a standard test that subjects a sample of material to a furnace held at a constant 750°C; a material is deemed to be combustible if any of the following occur during the test:

> (a) The mean duration of sustained flaming, as determined in accordance with Clause 3.2, is other than zero.
> (b) The mean furnace thermocouple temperature rise, as determined in accordance with Clause 3.1, exceeds 50°C.
> (c) The mean specimen surface thermocouple temperature rise, as determined in accordance with Clause 3.1, exceeds 50°C. ([AS 1530.1—1994] p. 10)

5.3.3 Under these conditions, 'materials which are not deemed combustible... are expected not to burn appreciably even when exposed to severe fire conditions' ([AS 1530.1—1994] p. 20).

5.4 Satisfying the Performance Requirements

5.4.1 The most relevant Performance Requirements of [BCA2019] for external uses of fabric are referred to as CP2 and CP4; see Section 12.

5.4.2 To satisfy these Performance Requirements we will consider the use of fabrics: the material itself; the construction/fixing details; and its location relative to other materials, fire source features, and paths of egress, amongst other things.

5.4.3 The aspects in 5.4.2 must demonstrate that the respective use of the fabric achieves the Performance Requirements for the use to be compliant with [BCA2019]; if the fabric fails in any of these aspects, we will not be able to show that it is safe and/or compliant.

5.4.4 It will not always be possible to develop a compliant Performance Solution for fabric; the same material used in different ways in different structures may mean that one use will be safe and compliant and the other will not.

5.5 Considering CP2 and CP4

5.5.1 [BCAGuide] explains these two Performance Requirements:

5.5.2 CP2; quote from [BCAGuide]:

> CP2 deals with the spread of fire both within and between buildings (including risk of spread of fire via the external walls of the building), and which does not only result from the structural failure of a building element.
>
> CP2 does not make any reference to non-combustibility or a fire-resistance level (FRL). Non-combustibility and FRLs are only included as part of the Deemed-to-Satisfy Provisions. However, proponents of a Performance Solution should note these requirements, as part of developing the Performance Solution, if considered to be applicable. See CF2.
>
> CP2(a)(i) aims to avoid a situation where fire either endangers occupants evacuating by way of exits, or impedes the capacity of emergency services personnel to access the building and fight the fire or rescue occupants.
>
> CP2(a)(ii) aims to minimise the risk… for example, if [people] were sleeping and consequently having difficulty escaping a fire. For this reason, CP2(a)(ii) requires that sole-occupancy units and corridors used for escaping be provided, to the degree necessary, with protection to avoid the spread of fire.
>
> CP2(a)(iii) aims to minimise the risk of fire spreading from one building to another that could endanger the occupants of both buildings and impede the actions of the fire brigade. See CV1 and CV2 for two means of verifying, under certain circumstances, whether or not the requirements of CP2(a)(iii) will be achieved.

Other assessment methods for determining compliance with the Performance Requirements are in A2.2.

CP2(a)(iv) aims to minimise the risk of fire spreading through a building that could endanger the occupants and impede the actions of the fire brigade. CP2(a)(iv) requires that a building must have elements that will avoid the spread of fire in a building. This includes avoiding the risk of fire spread via the external walls of the building. CP2(a)(iv) covers the risk of fire spread across the building fa- cade due to the increased risk of spread to other compartments of the building, to other adjacent buildings, and the difficulty of firefighting external fires occurring at higher levels.

CP2(a) uses the term "to the degree necessary". This word usage is designed to provide flexibility in the way this provision is implemented.

It means that the BCA recognises that different building elements require differing degrees of protection to avoid the spread of fire. The expression is intended to allow the appropriate authority to determine the degree of compliance necessary in each particular case after considering each building scenario.

Any decision made in this context can extend to not requiring an item to be installed or a particular level of performance to be achieved, if that is the appropriate action to be taken.

Building elements must be appropriate to avoid spread of fire, taking into consideration the matters listed in CP2(b) including:

- the likelihood or risk of a fire occurring in the building;
- the size, load or intensity of any fire in the building;
- the difficulty of evacuation and/or rescue;
- the building exposure to fire in another building, or risk of spreading a fire to another building;
- the fire safety systems in the building, which can affect the rate of fire spread (eg if a sprinkler system is installed in a building, it will either extinguish the fire or reduce its growth rate);
- the size of a fire and the difficulties in effecting an evacuation;
- the fire-fighting operations of the fire brigade and the resources available to it;
- the consequences of the failure of the element (another way of expressing this is to consider that if the element fails, could it result in the failure of another element); and
- the time taken from the start of the emergency to the occupants reaching a safe place.

If a Performance Solution is being used, it may be appropriate to assess it using the Section C Deemed- to-Satisfy Provisions for guidance purposes. It is stressed, however, that compliance with the Deemed- to-Satisfy Provisions is not compulsory if alternative means can be found to satisfy the appropriate authority that the Performance Requirements will be achieved. The building proponent should refer to A2.2 for guidance on acceptable assessment methods for determining compliance with the Performance Requirements. ([BCAGuide] p. 26 – 27)

5.5.3 CP4; quote from [BCAGuide]:

> CP4 deals with the fire hazard properties of materials used in the construction of a building. These include such matters as their smoke, toxic gas and heat generation capacities.
>
> CP4 uses the term "to the degree necessary". This word usage is designed to provide flexibility in the way this provision is implemented.
>
> …
>
> The materials used in the building must be appropriate to avoid the spread of fire and the generation of smoke, heat and toxic gases after consideration of the matters listed in CP4. The reason for each of these matters is as follows:
> - If the occupants can evacuate in a short time, then the smoke, heat and toxic gases generated prior to the completion of the evacuation will be less likely to have an impact on the safety of the occupants than if a longer evacuation time is required.
> - The number, mobility and other characteristics of the occupants influence the time taken for the evacuation of the building. If the number of occupants is large, or they are not mobile, such as patients in a hospital or residents of an elderly people's home, the evacuation time could be long. Such an evacuation time may allow the fire to develop and generate greater amounts of smoke, heat and toxic gases that will endanger the safety of the occupants trying to evacuate.
> - The function or use of the building has an impact on the types of materials and linings that are part of the building's fire load. This directly influences the rate of spread of any fire in the building.
> - Any active fire safety system installed in the building, such as a sprinkler system, may limit the spread of fire and allow additional time for the evacuation of the occupants.
>
> The Deemed-to-Satisfy Provision applicable to CP4 is C1.10. C1.10 limits the early fire hazard characteristics of materials susceptible to the effects of flame or heat, particularly during the early stages of a fire. ([BCAGuide] p. 28 – 29)

5.6 The Material

5.6.1 In considering the fabric itself, we will look at tests reports and supplementary explanations acceptable by the appropriate authority, as per Assessment Methods A2.2 (2)(b)(ii) and A2.2 (2)(c) (see Subsection 4.6).

5.6.2 The evidence we need to demonstrate compliance of a material with [BCA2019] is the combination of a lab test report of a standard test (e.g. AS 1530.2) and an explanation of what this means for the performance of the material in fire.

5.6.3 We will also need information from the manufacturer regarding how characteristics of the material change with age, and a fire engineer will need to explain how this affects the performance in fire.

5.6.4 An example of manufacturer information relevant in this regard is provided in Section 14.

5.6.5 We require that maintenance on the fabric be conducted in accordance with the manufacturer's instructions; the fire engineer may need to prescribe additional maintenance measures.

5.7 Construction/fixing Details

5.7.1 Now that we know how the material will perform in fire, we need to consider the other materials used in the fabric structure and determine whether they compromise the performance of the fabric in fire.

5.7.2 The 'other materials' we will be looking at will be things like rope, adhesives, chains, wires, hooks, and lighting elements integrated into the fabric structure (e.g. LED strips).

5.7.2.1 The nature of these materials requires investigation beyond the scope of this report.

5.7.2.2 In brief, combustible materials are not likely to be able to be used in conjunction with architectural coated fabrics; non-combustible 'other materials' will likely be required, with this to be assessed on a case-by-case basis.

5.7.3 We also consider the arrangement of the fixings and whether the failure of a fixing or the fabric around it would significantly alter the shape of the structure.

5.8 Location of the Fabric Structure

5.8.1 When considering the location of the fabric, we do so in relation to (paraphrasing the provisions of CP2(b); examples are not exhaustive):

- ignition sources (barbecues, air conditioning units, powerpoints, high-intensity lights)
- relevant Occupancy Classes of the building (Class 2 Occupancy[1] implies that not all occupants are awake at all times)
- other combustible materials (expanded polystyrene, Aluminum Composite Paneling, High Pressure Laminate)
- fire compartments (does the fabric bridge interconnect fire-isolated stairways, fire-rated structures, or floors of a building)
- other property (adjacent buildings)
- active fire safety systems (sprinklers, curtain drenchers)

[1] 'A Class 2 building is a building containing two or more sole-occupancy units' ([BCA 2019] p. 33)

- fire brigade intervention (distance from appliances, ability to apply water to the fire-affected area)[2]
- exits and paths of egress

5.8.2 A major consideration is the proximity of fabric to other combustible materials, particularly those used on facades; the presence of expanded polystyrene or polyethylene-core Aluminum Composite Paneling in close proximity is unfavorable to the successful writing of a Performance Solution for fabric.

5.8.2.1 Fires involving combustible cladding materials generate large amounts of heat and debris in a short amount of time; while fabric that becomes involved in these fires may not significantly contribute to the fuel load, it may generate significant amounts of smoke, which Performance Requirement CP4 requires that we consider.

5.8.2.2 Consideration needs to be given to the ability of gases and smoke to vent and diffuse away from evacuating occupants and attending firefighters.

5.9 Putting it Together

5.9.1 Our Performance Solution for fabric must include:

- A description of the fabric material according to Subsection 5.6 with references to test reports
- A description of the construction/fixings according to Subsection 5.7
- A description of the fabric structure according to Subsection 5.8
- An analysis of the compliance of the use of the fabric under Performance Requirements CP2 and CP4 according to Subsection 5.5
- A risk assessment for credible fire scenarios involving the fabric according to Section 13

5.9.2 Our Performance Solution must also include explanations of the legislative framework applicable to the building at the time, and the Assessment Method by which the Performance Solution will be shown to be compliant.

5.9.2.1 The Assessment Method we use is the Verification Method: 'Other Verification Method', combined with Expert Judgment.

[2] TODO

6 Evidence of Suitability

6.1 Accredited Testing Laboratories

6.1.1 Test reports from international testing laboratories may be referenced in the Performance Solution under the following conditions:

- The testing laboratory is accredited by a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA).
- The standard test is under the scope of the testing laboratory/was under the scope at the time the test was conducted.

6.2 Relevant Tests for the Performance of Fabric in Fire

6.2.1 Below is a non-exhaustive list of standard tests and a summary of their methodology and reported quantities:

- AS 1503.2: small sheet of material in vertical orientation subject to alcohol fire; returns flame speed factor, flame spread factor, heat factor, and material flammability index
- AS 1503.3: small sheet of material in vertical orientation subject to gas pilot flame; returns ignitability, spread of flame, heat evolved, and smoke developed indices
- AS/NZS 3837: small sheet of material in vertical or horizontal orientation subject to piloted or un-piloted ignition at specific applied heat levels; returns heat release rate, mass loss rate and effective heat combustion, and smoke obscuration
- EN 13501: standard for fire classification of products based on results of other tests; returns combustibility, smoke emission, and droplet/particle production indices
- NFPA 701: small sheet of material in vertical orientation subject to gas pilot flame; returns pass/fail according to duration of flaming, length of char, and duration of flaming of drops/debris
- ASTM E84: large sheet of material in horizontal orientation subject to large pilot flame; returns flame spread and smoke developed indices

6.2.2 We consider AS 1530.2 and AS 1530.3 to be the most relevant tests for Performance Solution writing; EN 13501 is great also but requires a more involved explanation of the methodology and results within the Performance Solution.

6.3 Other Required Documentation

6.3.1 For fabric used over and around exits and paths of egress, we need to know the dripping and debris characteristics of the material, but this information doesn't have to come from a standard test—this information may come from the fire engineer's expert judgement based on the fabric composition if a classification of the material under EN 13501 is not available.

6.3.1.1 Product datasheets (produced by the manufacturer) may be used by the fire engineer as evidence of the fabric composition. These do not carry the same weight as an actual test report however and should only be used as supplementary evidence.

6.3.2 Product datasheets may be used as evidence of the primary coating materials (e.g. PVC, PTFE) to provide for a general description of the fire performance; product datasheets may also be used as evidence for fire retardants in the fabric.

6.3.3 We also need information on the composition of the connections/fasteners used in the structure—the failure of these components in fire may compromise the fabric structure and impede egress from the building.

6.3.3.1 Again, product datasheets for the connections/fasteners may be used by the fire engineer as evidence of their composition and expected performance in fire.

6.3.4 As per Performance Requirement CP4 (see Appendix A), we also need to know about smoke and toxic gases generated by the fabric—at this stage we do not know of any good tests relevant in this regard to fabric.

6.3.4.1 We think that knowing whether the coating is primarily PVC or PTFE is enough to permit discussion of the smoke and toxic gases generated; typical PVC generates large amounts of dense smoke when exposed to flame while typical PTFE does not.

7 Example Application of the Guide

Figure 3—Fabric structure in Queensland

7.1 Introduction

7.1.1 Précontraint® 502 PVC coated polyester fabric (**Précontraint® 502**) was installed in 2015; the PVC coating of this material is combustible according to AS 1530.1.

7.1.2 We thus need to write a Performance Solution for this use of fabric.

7.1.3 The writing of a complete Performance Solution for this fabric structure is beyond the scope of this report; we will outline the structure and required content.

7.2 Material Properties

7.2.1 Précontraint® 502 has [AS 1530.2—1993] spread factor, speed factor, heat factor, and flammability indices of 0, N/A, 0, and 0 respectively, as per a test conducted by CSIRO in 2013 (Report No.: FNF10968; 24 October 2013).

7.2.2 Précontraint® 502 is coated with PVC. PVC produces large amounts of dense smoke when subject to flames.

7.2.3 These two pieces of information indicate that the fabric itself is likely to perform well in fire, although we will have to consider the smoke it produces.

7.2.4 Précontraint® 502 comes with a 10-year warranty with care and cleaning instructions to maintain the condition of the fabric over the course of the warranty.

7.2.4.1 In the Performance Solution we would reference this warranty and these instructions and specify appropriate actions to be taken at the end of the warranty, which may include full or partial replacement of the fabric.

7.3 Construction/fixing details

7.3.1 We don't have any information on the fixings used in this fabric structure; for this example, we will assume that the fixings are all stainless steel.

7.3.2 Under this assumption the arrangement and composition of the fixings is not likely to compromise the performance of the fabric in fire.

7.3.2.1 For illustrative purposes we may imagine an extreme fire scenario example such as the development of a large flaming fire involving the light marked by the red circle in Figure 3.

7.3.2.2 Such a fire could cause the fabric near this light to separate from the wall anchor and change the shape of the structure, impeding egress for evacuating persons (further consideration given in Subsection 7.4).

7.3.2.3 While this may be an unrealistic or extremely rare event that should not be investigated in the Performance Solution for this structure, this is the kind of thinking we require for robust and consistent application of this guide.

7.4 Location of the Fabric

7.4.1 Google Street View captures and architectural drawings were used as references for this subsection.

7.4.2 We make the following notes on the location of this structure:

1. This structure is located above the only path of egress for the retail areas
    a. This also means that there is no possibility of the occupant warning system advising occupants to seek alternative exits in the event of a fire involving the fabric structure
2. The fabric is secured to concrete, which is non-combustible
3. There are no significant sources of ignition near the fabric
    a. There is the LED light marked by the red circle in Figure 3, however a fault with this light is not likely to generate enough heat and flame to mean that the fabric would pose a risk to evacuating occupants. This is due to the low voltage and operating temperature of LED fixtures.
4. This structure is located in such a way that any toxic gases and smoke would diffuse to atmosphere and pose little risk to the public and occupants
5. This structure does not compromise the ability of the fire brigade to apply water to likely fire-affected areas
6. There are no significant fuel loads (e.g. gas storage or combustible cladding) located near the structure

7. This structure is in close proximity to the property boundary
8. There are no sprinklers servicing this structure

7.5 Risk Analysis

7.5.1 We already included an example of a fire scenario in 7.3.2.1 through 7.3.2.2; another scenario may be a large fire spreading from the restaurant kitchens to the structure through the furnishings.

7.5.1.1 These scenarios are developed through stakeholder consultation as part of the Fire Engineering Design Brief process; see Section 13 for further detail.

7.5.1.2 In this example Performance Solution, we consider the combustible nature of the fabric to have no effect on the likelihood or consequences of fires that could involve the structure.

7.6 Compliance Analysis

7.6.1 This material, fixed in this way, in this location, complies with Performance Requirements CP2 and CP4.

8 Example Application 2 of the Guide

Figure 4—Currumbin Wildlife Sanctuary shade structure; "Currumbin Wildlife Sanctuary - Fabritecture", Fabritecture, 2019. [Online]. Available: https://fabritecture.com/project/currumbin-wildlife-sanctuary/. [Accessed: 22- Oct- 2019].

8.1 Introduction

8.1.1 Précontraint® 1002 S2 PVC coated polyester fabric (**Précontraint® 1002**) was installed in 2018; the PVC coating of this material is combustible according to AS 1530.1.

8.1.2 We thus need to write a Performance Solution for this use of fabric.

8.1.3 The writing of a complete Performance Solution for this fabric structure is beyond the scope of this report; we will outline the structure and required content.

8.2 Material Properties

8.2.1 Précontraint® 1002 has [AS 1530.2—1993] spread factor, speed factor, heat factor, and flammability indices of 1, N/A, 1, and 2 respectively, as per a test conducted by CSIRO in 2014 (Report No.: FNF11130; 20 May 2014).

8.2.2 Précontraint® 1002 is coated with PVC. PVC produces large amounts of dense smoke when subject to flames.

8.2.3 These two pieces of information indicate that the fabric itself is likely to perform well in fire, although we will have to consider the smoke it produces.

8.2.4 Précontraint® 1002 comes with a 12-year warranty with care and cleaning instructions to maintain the condition of the fabric over the course of the warranty.

8.2.4.1 In the Performance Solution we would reference this warranty and these instructions and specify appropriate actions to be taken at the end of the warranty, which may include full or partial replacement of the fabric.

8.3 Construction/fixing details

8.3.1 Architectural drawings indicate that all fixings for this structure are galvanized steel; the arrangement and composition of the fixings is not likely to compromise the performance of the fabric in fire.

8.4 Location of the Fabric

8.4.1 Nearmap captures, architectural drawings, and the project page on the Fabritecture website[3] were used as references for this subsection.

8.4.2 We make the following notes on the location of this structure:

1. Exit paths serving the structure pass beneath and next to the structure for short distances
    a. Although the structure is open for most of the perimeter (which is good for evacuation), we note that the architectural drawings provide for wheelchair seating and stroller parking—these people are likely to be unable to travel over rough terrain and require use of the exit paths
2. The fabric is secured to steel, which is non-combustible
3. There are no significant sources of ignition near the fabric
    a. There are lights at several locations (example marked by the red circle in Figure 4), however a fault with this light is not likely to generate enough heat and flame to mean that the fabric would pose a risk to evacuating occupants. This is due to the distance between the light and fabric, and the structure permitting good ventilation to these lights
4. This structure is located in such a way that any toxic gases and smoke would diffuse to atmosphere and pose little risk to the public and occupants
5. This structure does not compromise the ability of the fire brigade to apply water to likely fire-affected areas, although fire brigade intervention will be delayed due to the location of the structure in the wildlife sanctuary
6. There are no significant fuel loads (e.g. gas storage or combustible cladding) located near the structure
7. This structure is not in close proximity to the property boundary
8. There are no sprinklers servicing this structure

[3] https://fabritecture.com/project/currumbin-wildlife-sanctuary/

8.5 Risk Analysis

8.5.1 We could not determine any credible fire scenarios for this fabric structure; we consider the combustible nature of the fabric to have no effect on the likelihood or consequences of fires that could involve the structure.

8.5.1.1 A scenario involving an electrical fault in the light marked by the red circle in Figure 4 could be investigated, but this scenario is unlikely to damage the structure in such a way that it would present a risk to occupants. This would also be the case for an incendiary event.

8.6 Compliance Analysis

8.6.1 This material, fixed in this way, in this location, complies with Performance Requirements CP2 and CP4.

9 Evaluation of Documentation Provided

9.1 Good Bits

9.1.1 The technical information on Chukoh PTFE products was very good.

9.1.1.1 The fire engineer writing the Performance Solution needs information on all characteristics of the fabric that would affect performance in fire, and how these characteristics change with age.

9.1.1.2 The Chukoh technical information documents contain detailed information about testing and results for mechanical characteristics, thermal characteristics, and weatherability.

9.2 Knowledge Gaps

9.2.1 The main gaps in the documentation provided to us has been in relation to example applications.

9.2.2 The additional information required would be materials used in building facades, fixing composition, proximity to required paths of egress, proximity to ignition sources etc. as per Subsection 5.7 and Subsection 5.8.

9.2.3 We really need to know as much as possible about the materials and electrical/gas appliances around the fabric—this information could come from external finish schedules, wall type drawings, floor plans, or even destructive testing if documentation is not available.

10 Moving Forward

10.1 Fabrics and Deemed-to-Satisfy—Future Considerations

10.1.1 As we presented in Section 5, several aspects of the use of the fabric must be considered in demonstrating compliance with the Performance Requirements.

10.1.2 A Deemed-to-Satisfy Solution route for fabrics would require the writing of provisions that would specifically address all details of the aspects we have considered for our Performance Solutions.

10.1.3 At this time we don't think it is feasible to write these provisions in such a way that they would guarantee achievement of the Performance Solutions in all appropriate applications. This is because the Performance Solutions are site specific and it's not clear how to write generic ones.

10.1.4 We do not consider that a Deemed-to-Satisfy Provision based on substrate non-combustibility is appropriate at this time.

10.1.4.1 We understand that many fabric products available in Australia are considered non-combustible in other countries; at present our Performance Requirements require investigation into characteristics of fabric structures beyond their combustible status.

10.1.5 To begin to develop Deemed-to-Satisfy Provisions, extensive information of fabric structures and their performance in fire will be required; forensic reports on such fires are likely the most valuable instruments for this purpose.

10.1.5.1 These forensic reports are likely produced during the insurance claim process—it may be possible to obtain anonymized copies of these reports.

10.2 Education and Political Influence

10.2.1 The traditional means for educating an industrial group is through lectures and short courses delivered in person or using modern media. It might be possible to do this with traditional providers to the traditional professional community such as Engineers Education Australia. Such offerings could be both introductory in nature for industry members and more advanced for engineering professionals.

10.2.2 Political influence is beyond the scope of this report. However, because building regulations are state based, each state will need to be investigated and bespoke approaches developed. Once this is done, the ABCB can be approached to provide a uniform approach under COAG.

10.3 Recommendations for Suppliers, Fabricators, and Contractors

10.3.1 In order to provide an industry wide approach to the issue, it is important that there be a consensus amongst the key industry stakeholders to develop a uniform approach to government lobbying and industry education. The specific details are likely to be challenging because the knowledge base and ability to provide appropriate product information is often dependent on local resources.

11 Summary

11.1.1 This document presents a guide, that when used along with [IFEG], may be used by a fire engineer to prepare a Performance Solution for the use of architectural coated fabrics in buildings required to be of Type A or Type B construction.

11.1.2 Three distinct aspects of the use of fabric are considered, including the relevant documentary evidence for each.

11.1.3 Two example applications of the guide were presented which also provided advice on how to apply a standard fire engineering risk assessment methodology.

11.1.4 This guide ended by evaluating existing fabric product documentation and the viability of influencing the ABCB to develop a Deemed-to-Satisfy route for architectural coated fabrics.

12 Extracts from [BCA2019]

12.1 CP2

12.1.1 Quote:

(a) A building must have elements which will, to the degree necessary, avoid the spread of fire—
  (i) to exits; and
  (ii) to sole-occupancy units and public corridors; and
  (iii) CP2(a)(ii) only applies to a Class 2 or 3 building or Class 4 part of a building.
  (iv) between buildings; and
  (v) in a building.

(b) Avoidance of the spread of fire referred to in (a) must be appropriate to—
  (i) the function or use of the building; and
  (ii) the fire load; and
  (iii) the potential fire intensity; and
  (iv) the fire hazard; and
  (v) the number of storeys in the building; and
  (vi) its proximity to other property; and
  (vii) any active fire safety systems installed in the building; and
  (viii) the size of any fire compartment; and
  (ix) fire brigade intervention; and
  (x) other elements they support; and
  (xi) the evacuation time. ([BCA2019] p. 61)

12.2 CP4

12.2.1 Quote:

To maintain tenable conditions during occupant evacuation, a material and an assembly must, to the degree necessary, resist the spread of fire and limit the generation of smoke and heat, and any toxic gases likely to be produced, appropriate to—

(a) the evacuation time; and
(b) the number, mobility and other characteristics of occupants; and
(c) the function or use of the building; and
(d) any active fire safety systems installed in the building. ([BCA2019] p. 62)

13 Risk Assessments

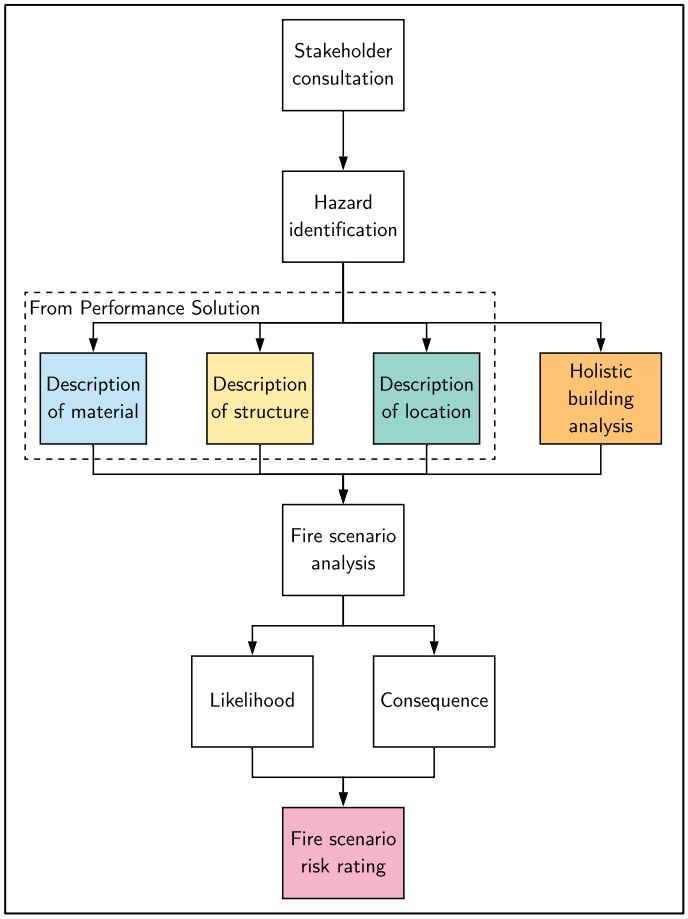

Figure 5—Conducting a fire scenario risk assessment

13.1 Risk Assessment as part of Performance Solutions

13.1.1 The risk assessment starts with evaluating credible fire scenarios. These are not the worst case (such as due to war or a terrorist attack), but reasonable ones similar to that contemplated by the National Construction Code. For many structural fabrics they would include:

- An internal building fire that ignites nearby fabric
- An external fire exposure which is not in direct contact with the fabric but might cause ignition such as a vehicle fire or a bush fire
- Direct flame impingement such as a flare up from a BBQ or an electrical fault in a nearby light fixture or power point

The design fire scenarios are developed as part of the Fire Engineering Brief process and are finalized only after stakeholder consultation (see Subsection 13.6).

13.2 Risk Rating

13.2.1 The determination of the risk rating (the risk assessment) is based on evaluating the likelihood and consequence of each fire scenario.

13.2.2 The NCC uses a risk standard of As Far As Reasonably Practicable (AFARP), however with the introduction of Engineers Australia's Society of Fire Safety Practice Guide and in accordance with modern litigation practice, it is becoming more common for Performance Solution to assess risk on the principal of So Far As Is Reasonably Practicable (SFAIRP). From [SFS Guide]:

> 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.

13.2.3 Often the term "reasonably practicable" is based on a low or sometimes moderate risk ranking.

13.2.4 Generally, if the cost is extensive but the risk reduction level is insignificant then such risk reduction work will not be reasonably practicable. The SFAIRP process requires four steps [SFS Guide]:

- Risk identification: establish what risks are present.
- Risk assessment: understand the nature of the risk and what could happen and why including the degree of potential harm (potential severity of injuries and the number of persons that might be injured if the risk occurs). This should be assessed based on the worst credible fire.
- Risk control: Achieve a level of control So Far As Is Reasonably Practicable (SFAIRP). A hierarchy of controls must be considered ranging from complete elimination, partial elimination, ignition control (including isolation of combustible elements), active system controls, management practices. The cost for each of these controls must then be determined. Costs include financial, aesthetic, constructability, convenience elements. The resulting cost benefit analysis can be qualitative or quantitative but must be consistently applied.
- Check controls: Check that controls are operating effectively (this is mostly needed for Active Fire Protection systems).

13.3 Hazard Identification

13.3.1 The first step in the process is identification of the hazard. This starts with an identification of the fabric and its flammability properties (ignitability, potential for flame spread, heat release rate).

13.3.2 The impact of attachment details, including method and location (proximity to other structures) is also assessed.

13.3.3 The context is then evaluated using a holistic analysis of the entire building. This includes and evaluation of active and passive systems, people movement and fire brigade intervention. This assessment is critical in the evaluation of the consequences of the scenarios identified in Subsection 13.4.

13.3.4 Active systems include internal and external automatic sprinklers and detection and alarm systems. Passive systems include the evaluation of barriers to fire spread such as floors ceilings and walls and openings therein.

13.3.5 Finally, the impact on occupants is assessed. Occupant ability to egress in a suitable time frame is based on their characteristics whereas fire brigade personnel vulnerability is based on intervention activities and the effectiveness of Personal Protective Equipment.

13.4 Fire Scenario Analysis

13.4.1 Typical fire scenarios based on the Hazard Identification of Subsection 13.3 are then assessed. For structural fabrics this includes external fire sources as well as internal ones within any nearby buildings and underneath (within) the fabric enclosure (covering).

13.4.2 The likelihood of these scenarios is then assigned as defined in Table 1.

13.5 Risk Assessment

13.5.1 The subjective probability of risk is demonstrated in Table 1. The descriptions are derived from [SFPE Hand- book] Table 75.4, p. 2970, from [UMelb] and from [AS/NZS 31000].

Table 1: Likelihood—Probability of fire occurring and causing undue fire spread via the fabric structure

Probability Rating	**Description**
Almost Certain	Expected to occur several times during the lifetime of the building
Probable	Likely to occur at least once during the lifetime of the building
Possible	Would not be surprising if it occurred, but would not be anticipated
Unlikely	Not likely to occur during the lifetime of the building
Rare	Extremely unlikely to occur during the lifetime of the building

13.5.2 Given the occurrence of a fire, Table 2 describes the consequences in terms of life safety (occupants including fire fighters) and property. The consequence is independent of the probability of occurrence and is the incremental consequence due to the presence of the fabric, not the total consequence of a fire in the building.

Table 2: Consequences

Rating	**Criteria—Life Safety**	**Criteria—Property Damage**
High	Multiple fatalities and injuries	Building destroyed
Moderate	Injuries requiring off-site medical treatment	Major equipment and portion of building destroyed
Low	Injury requiring on-site first aid	Reparable damage to building; significant downtime
Negligible	No injury or very minor requiring no treatment	Minor repairs to building

13.5.3 The probability of occurrence and the resultant consequence are evaluated in a Risk Assessment Matrix in accordance with Table 3 to determine the overall incremental increase in risk due to the presence of the fabric.

Table 3: Risk Assessment Matrix

	Likelihood					
Consequences		Rare	Unlikely	Possible	Probable	Almost Certain
	Negligible	Very Low	Low	Low	Moderate	Moderate
	Low	Low	Low	Moderate	Moderate	High
	Moderate	Low	Moderate	Moderate	High	High
	High	Moderate	Moderate	High	High	Extreme

13.6 Stakeholders

13.6.1 Stakeholders include some or all of the following ([SFS Guide]):

- Architects
- Building Surveyors
- Owners/Operators
- Tenants
- Engineers
- Project Managers
- The Fire Brigade
- Councils
- Insurers
- Designers
- Builders

13.6.2 Stakeholders are typically consulted in the development of Table 3. For some projects they are also consulted in identifying the parameters in Table 1 and Table 2; the definitions of likelihoods and consequences.

14 Manufacturer's Warranty

SAINT-GOBAIN

SHEERFILL ARCHITECTURAL MEMBRANE
10 YEAR LIMITED WARRANTY – 100% COVERAGE

For the Warranty Period of ten (10) years, subject to all the terms and conditions contained herein, Saint-Gobain Performance Plastics Corporation ("SGPPL") warrants the SHEERFILL® Shade Mesh Architectural Membrane (the "Product") for Compliance with Specifications and Non-Combustibility (collectively the "Limited Warranty"), as described below:

A) COMPLIANCE WITH SPECIFICATIONS
SGPPL warrants that at the time of delivery from the SGPPL plant of manufacture the Product shall meet all technical specifications stated in the SGPPL Data Sheet. It is the responsibility of the purchaser to adhere to the SGPPL Product Handling and Maintenance Recommendations. Proof of maintenance must be recorded and will be made available to SGPPL if requested at any time.

B) NON-COMBUSTIBILITY
SGPPL warrants that the Product shall remain non-combustible a period of ten (10) years following the delivery of the Product from the SGPPL plant of manufacture.

REMEDY UNDER LIMITED WARRANTY
SGPPL'S OBLIGATION UNDER LIMITED WARRANTY: SGPPL agrees to provide, to the extent and for the time period of ten (10) years, 100% of the fabric, fabrication and installation costs to repair or replace at SGPPL's sole option, the Product which may prove defective or otherwise fail to perform as stated above under normal use, maintenance and service, as determined by SGPPL during the warranty period (a "Defect" or "Defective Product"), not to exceed the original sales price to the original purchaser of the Product.

WARRANTY EXCLUSIONS
This Limited Warranty does not apply to any Product or any part thereof that, in the sole judgment of SGPPL, (i) has been subject to misuse, neglect, alteration or accident, such as accidental damage to the exterior finish, or which has been subject to excess wear and tear, friction, scratches or perforations which exceed normal use; (ii) has been exposed to harmful chemicals, abused by machinery, equipment or any person, exposed to excessive pressures or sources, exposed to abnormal weather conditions, falling objects, explosions, fire, floods, riots, civil commotion, exterior forces, faulty or inadequate installation, act of war, radiation, harmful fumes or foreign substances in the atmosphere; (iii) has been damaged during handling of the Product, or which has been subjected to high atmosphere pollution, aggressive detergents, and aggressive cleaning; or (iv) has been used in architectural structures not in accordance with accepted engineering standards or repaired or altered by anyone other than SGPPL in any way so as, in SGPPL's sole judgment, to affect the quality, efficiency or effectiveness of the Product.

Any claim made by the purchaser of the Product under this Limited Warranty shall be made in writing by registered mail with acknowledgement of receipt to SGPPL at the address listed below no later than thirty (30) days following the discovery of the alleged defect. Failure to notify SGPPL within thirty (30) days following the discovery of any defect shall render this Limited Warranty null, void and of no legal effect with respect to that particular defect. After notification of an alleged defect, SGPPL shall be entitled to inspect the Product in order to take appropriate steps for timely corrective measures. In the event SGPPL representatives are denied the right to inspect the alleged defect, this Limited Warranty shall be null, void and of no legal effect with respect to such defect.

Figure 6—Saint-Gobain Performance Plastics Corporation Sheerfill Warranty (p. 1 of 2)

WHAT THE PURCHASER MUST DO

The purchaser must complete, sign and deliver to SGPPL at the address listed below, the attached Warranty Application Form that identifies the application and use for which the Product is to be employed and any material or relevant conditions or circumstances to which the Product shall be exposed. A fully completed Warranty Application Form must be returned to SGPPL for each Product to be covered under this Limited Warranty. This Limited Warranty shall become effective only upon SGPPL's signed approval and the return to the purchaser of this Limited Warranty with reference to the project identified by the purchaser.

LIMITATION OF WARRANTY

THIS LIMITED WARRANTY CONSTITUTES THE EXCLUSIVE WARRANTY AND REMEDY WITH RESPECT TO THE PRODUCT AND IS IN LIEU OF AND SUPERSEDES ALL OTHER REPRESENTATIONS AND WARRANTIES, WHETHER WRITTEN OR ORAL, EXPRESS OR IMPLIED. SGPPL EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THIS LIMITED WARRANTY CONSTITUTES THE SOLE AND EXCLUSIVE REMEDY FOR ANY PARTY RELATING TO THE PRODUCT OR FOR ANY BREACH OF THIS WARRANTY. OTHER THAN AS PROVIDED IN THIS LIMITED WARRANTY, ANY USER OF THE PRODUCT HEREBY AGREES AND ACKNOWLEDGES THAT NO OTHER WARRANTIES ARE OFFERED OR PROVIDED IN CONNECTION WITH OR FOR THE PRODUCT OR ANY PART THEREOF.

LIMITATION OF LIABILITY

SGPPL SHALL NOT BE LIABLE FOR ANY LOSS OF PROFITS OR REVENUE, LOSS OF USE OF EQUIPMENT OR FACILITY, COST OF CAPITAL OR FOR ANY OTHER SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE RESULTING FROM OR IN ANY MANNER RELATING TO THE PRODUCT COVERED HEREBY, ITS DESIGN, USE, ANY INABILITY TO USE THE SAME OR ANY DELAY IN THE DELIVERY OF SAME. THE SOLE AND EXCLUSIVE REMEDY WITH RESPECT TO ANY DEFECTIVE PRODUCT SHALL BE REPAIR, CORRECTION OR REPLACEMENT THEREOF, PURSUANT TO THE FOREGOING PROVISIONS. SGPPL'S TOTAL LIABILITY FOR THE PRODUCT OR ANY BREACH OF THIS LIMITED WARRANTY SHALL NOT EXCEED THE ORIGINAL SALES PRICE TO THE ORIGINAL PURCHASER OF THE PRODUCT.

Should SGPPL determine that it is impractical to repair or replace the Product, the purchaser's sole and exclusive remedy shall be the refund of the purchase price of the Product, or part thereof which is determined by SGPPL to be defective.

The terms and provisions of this Limited Warranty shall be governed by, construed under and enforced in accordance with, the laws of the United States of America, without regard to Uniform United Nations Conventions.

Any questions, inquiries or claims under this Limited Warranty shall be directed to:

Saint-Gobain Performance Plastics Corporation
701 Daniel Webster Highway
Merrimack, NH 03054 USA

SHEERFILL is a registered trademark of Saint-Gobain Performance Plastics Corporation

Figure 7—Saint-Gobain Performance Plastics Corporation Sheerfill Warranty (p. 2 of 2)