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# Monitoring Building Regulations and Temporary Structure Fire Safety In Victoria, Australia

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Submitted by:

Tyler Carroll
Lesley Drohan
Brandon Sweet
Michael Zervas

Submitted to:

Project Advisors:
Professor Robert Kinicki
Professor Stephen Weininger

Project Liaisons:
Johanna Bidwell, David Kearsley, Katherine Kolar, and John Shaw - Victoria Building Commission, Technical and Research Services


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## Abstract

This study examined international building regulation monitoring and evaluation systems. It produced a *Regulation Review* guide to assist the Building Commission in Victoria, Australia with developing regulation-specific monitoring procedures. Investigation into permit practices in Australia and abroad, combined with regulation research and fire load analysis, explored fire risks and provided recommendations to improve temporary structure fire safety regulations.

## Authorship

The four team members contributed equally to the work on this project and report.

## Acknowledgements

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Johanna Bidwell

Katherine Kolar

David Kearsley

Dennis Hogan

John Shaw

Robert Kinicki

Stephen Weininger

Holly Ault

Field experts consulted regarding fire, evaluation methods, and temporary structure inspections. Names and credentials are in Appendix B.

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## Executive Summary

In an environment where being proactive with legislation is almost impossible because reaction is more cost effective than taking preemptive measures, the Victoria Building Commission ("the Commission") is attempting change. The overall building legislation in Australia is the Building Code of Australia (BCA), a collection of building codes governing all construction nationally. In Victoria, the BCA is applied with direction from the *Building Act 1993* ("the Act") and the *Building Regulations 2006* ("the Regulations"). The Commission, created under the Act, is responsible for maintaining the Regulations. In Victoria, regulations only have a ten-year lifespan before they expire, or sunset, and need to be reviewed and updated through Regulatory Impact Statements. There is no information for the Commission as to whether a specific regulation is necessary, has acted the way it was intended, or needs to be amended in some way. The solution is a monitoring and evaluation system that studies building regulations and continually evaluates their performance.

One cluster of the Regulations focuses on controlling temporary structures through occupancy permits. The permit process, and associated structure inspection process, needs to be monitored. Temporary structures include tents, marquees, booths or other prefabricated buildings with a floor area greater than $100m^2$, seating stands for 20 or more people, and stages greater than $150m^2$. Types and uses of these constructions are continually developing and diversifying. Within these categories, structures can be multiple stories high and thousands of square meters in area, making the variety of buildings difficult to regulate. The complexity of structures is advancing so quickly that governing legislation cannot keep up. Temporary structure contents can range greatly, too. These interiors can include anything from full size kitchens to advanced audiovisual displays. Furnishings may consist of tables, chairs, curtains, carpets, or even artificial grass. All building materials and contents contribute to the fire load, the measure of combustible material per unit area, within the structure. The Building Commission is interested in the fire risk created by variable temporary structure fire loads, and if they should control the risk through regulations.

This study's first objective was to investigate monitoring and evaluation systems both within Australia and abroad. The initial plan was to find an international monitoring system and apply it in Victoria. Contacts in the United States and Canada provided information as to building regulations in their jurisdiction, but the team did not find any systems that sufficiently

analyse regulations to supply a basis for changes or amendments. The group began investigating general forms of monitoring and evaluation with the hope of developing a plan for the Commission. An evaluation officer from the Victoria Department of Planning and Community Development (DPCD) explained types of monitoring. She explained that the DPCD helps communities to develop evaluation systems for programs or local projects.

Using a DPCD planning worksheet as a guide, the team created focus questions for monitoring building regulations. The questions help researchers determine information they need to gather in order to assess a given regulation's performance. To demonstrate the use and application of the focus questions, the group implemented them in the study of temporary structures. By first monitoring and evaluating temporary structures and the legislation that governs them, the group was able to apply the same knowledge of evaluation to the broad scope of building regulations in general.

After conducting the investigation, the team developed a list of recommendations for the Commission:

- ***Develop a priority system for regulations to be monitored***- Due to the large amount of legislation, and the lack of resources available, the Commission will need to prioritize regulations to be monitored. Items considered should include safety risks addressed by the regulation, cost versus benefit analysis, and if monitoring is actually necessary.
- ***Use focus questions to develop monitoring and evaluation systems***- Focus questions, developed by the team and located in Appendix G, allow researchers to create evaluation plans specific to the regulation being studied.
- ***Apply study conclusions to necessary action***- Once results of monitoring and evaluating a regulation are available, they should be applied to improving the regulation. This could be through immediate action or by applying the findings as supporting evidence in Regulatory Impact Statements.

These recommendations will allow the Building Commission to create their own systems to monitor building regulations.

The project's second goal was to analyse fire loads of temporary structures and determine if further regulatory action is necessary from the Building Commission. The team completed this objective by interviewing authorities, reviewing pertinent legislation, and conducting on-site

examinations of temporary structures. Representatives interviewed from Victorian and international organisations work with current permits and regulations of temporary structures. Interviewed parties included Commission employees, the Municipal Building Surveyor from the Melbourne City Council, and a fire safety officer from the Metropolitan Fire Brigade (MFB). The team conducted these interviews to discern which organisations were involved with different parts of the permit process. Specifically, the study looked for gaps between inspections of the governing bodies to assess possible changes to the overall system. The group learned that legislators designed the initial regulations to cover tents, as was appropriate at the time, but the regulations no longer seem sufficient. The original regulations were meant for circus tents, not multiple story buildings with complex engineering such as handicap chair and elevator lifts or scaffolding. With such changes, temporary structures are rapidly progressing to the point where they are almost undistinguishable from permanent structures.

Through interviews and research, the team concluded that temporary structures mimic their permanent counterparts in use, design, and fire loads. Fire loads can add risk to an otherwise safe building, but, despite the many similarities between the two structure types, the requirements for safety features remain drastically different. Additionally, structure contents, or fire loads, are not officially inspected. A safety officer at the MFB revealed that he does not perform any official inspections, but makes written safety recommendations that are often followed due to the experience and respect of the officer. With no one inspecting these contents, and no legislation to back up any recommendations made, there is a significant risk of the high fire loads of these structures.

Legislation examined included the BCA and the Regulations, which provided guidelines for structure safety features. Although the team was trying to be proactive and prevent a possible incident, regulations are normally only created reactively. This is because the cost of implementing new regulations outweighs the benefit, unless a problem occurs. The group searched permit processes and regulations in each of the fifty United States to ascertain requirements abroad. In the state of Maine, temporary and permanent structures are regulated the same ways, supporting the team's findings that temporary structures should be treated more like permanent buildings.

The team also visited two large events employing temporary structures, the Melbourne Grand Prix and the Avalon International Airshow, to assess the structures' fire loads.

Photographs taken at the events helped show the similarity between temporary and permanent structures. Comparisons showed that structures contained similar fire loads, yet permanent buildings contained significantly more fire defenses, proving the need for the Commission to take additional precautions.

After studying the interview and research results, the team developed a list of recommendations for the Commission. The suggestions accounted for data retrieved from inspectors, safety officers, and legislation.

- ***Require early notification devices in temporary structure***s- the most important step in emergency fire procedures for any building is getting people out safely. Early warning devices, such as smoke alarms, would give occupants more time to evacuate the structure.
- ***Stipulate smoke and heat ventilation in temporary structures***- technologies are currently available to place vents in the roofs of temporary structures. Allowing exit points for heat and smoke would lengthen the time occupants have to vacate the premises.
- ***Standardize safety requirements and inspections across Victoria***- normalizing requirements for inspections and permits across jurisdictions within Victoria will help ensure consistency and structure safety.
- ***Perform further fire risk analysis for temporary structures***- as already executed with permanent structures, fire risk analysis should be implemented with temporary structures. Analysis of burn times due to building materials and fire loads versus required evacuation times would aid in determining necessary safety requirements of temporary structures.
- ***Analyse costs versus benefits of new or amended regulations***- feasibility of regulation changes should be investigated so the Building Commission can take informed, required actions.

Ultimately, the team addressed fire safety in temporary structures. By implementing the recommendations, relevant authorities can increase fire safety in temporary structures and enhance the overall safety in buildings in Victoria by keeping legislation current.

# Chapter 1: Introduction

The Victoria Building Commission in Victoria, Australia is facing two concerns with regards to building safety. Understanding the current procedures used to monitor building regulations as a whole and the actual evaluation of current fire safety regulations for temporary structures are the issues at hand. Worcester Polytechnic Institute assembled a group of students to investigate and address these two concerns.

Building regulations must be updated to remain contemporary with modern construction techniques, building materials, and safety technologies. In the United States the International Codes, including building codes, are updated every three years by a self monitoring system. The general public can submit code changes to the International Code Council (ICC). However, unreasonable alterations can be countered by industry through appeals. In Canada, the Institute for Research in Construction (IRC), a part of the National Research Council of Canada (NRC), is responsible for issuing the national building codes. The NRC-IRC researches several key areas related to construction in order to update Canada's building codes every five years. The United Kingdom (UK) uses a national Building Act originally written in 1984. To make sure building codes are current, the UK established The Building Regulations Research Programme, whose main objective is to discover scientific evidence supporting annual amendments to the Building Act. In Victoria, the Building Commission is responsible for updating regulations; the current process consists of regulation renewal once every ten years. All of these organisations have a process to update regulations. However, methods through which regulations can be evaluated to determine if they in fact require updates are not clearly defined.

The project's first goal was to examine the monitoring and evaluation systems of the United States, Canada and the United Kingdom. Suggestions to the Building Commission for a guide that would help with developing a monitoring plan for any given regulation resulted from this study. The group researched monitoring methods and conducted interviews with representatives from the Commission and the Department of Planning and Community Development in Victoria and emailed contacts in the countries of interest.

Investigating fire regulations and permitting procedures for temporary structures was the second aspect of this project. A temporary structure is defined as any structure that can be readily and completely dismantled and removed from asite between periods of actual use [Manitoba 2001]. The popularity of large Australian entertainment events employing temporary

structures is growing. Everything from sporting events to major exhibitions and displays are increasing in attendance and size. Victoria plays host to the Avalon International Airshow, the Melbourne Grand Prix and the Spring Racing Carnival, all of which have grown in size annually. Because these events are becoming major tourist attractions in Victoria, they have a significant effect on the city's economy.

Due to this growing interest, structures have become more advanced to accommodate larger crowds. They are now ranging in size from small marquees to large, two-story buildings or tents, and can potentially house full size kitchens or other features traditionally seen only in permanent structures. The increases in crowd size as well as structure size, the intricacy of design, and the variety of contents may pose fire-related risks, which are not currently addressed by Victorian legislation. Existing permit processes in Victoria examine the structural integrity of a building and the safety of an event, but not structure contents [John Shaw, personal communication, 03/02/09; Joseph Genco Interview].

The Building Commission requires occupancy permits that ensure the safety of temporary structures and their obedience to their corresponding building codes and regulations. The Commission has empty structures professionally inspected by certified engineers before issuing permits. To host an event, coordinators must then obtain Places of Public Entertainment (POPE) permits for specific land use from the local city council. Permit applications examine the type and duration of the event as well as expected attendance levels. Inspections take place to ensure event safety.

The project's second goal was to evaluate current fire regulations specific to temporary structures and decide whether potential risks are great enough to revise the system in place. The team implemented surveys and interviews of local authorities from the Metropolitan Fire Brigade and Melbourne City Council to complete this task. Additionally, the group consulted employees of the Commission for help and information. Using this data, the group assessed structure fire loads and safety risks to make recommendations regarding fire regulations for temporary structures.

# Chapter 2: Background

The task presented to Worcester Polytechnic Institute by the Victoria Building Commission ("the Commission") highlights both the broad picture and a particular example of building regulations in Victoria. This chapter provides a background on regulations monitoring, temporary structure regulations and related building issues.

To begin, this chapter examines the building regulations in Australian States and Territories, with special emphasis on Victoria. The section provides an understanding of current Australian legislation on national and state levels, discussing history, legislation reviews, and analyses of regulating and monitoring bodies within each jurisdiction.

Next, the section examines monitoring and evaluation systems in the United States, Canada and the United Kingdom. The team also explores variations in regulation maintenance procedures in the selected countries, in addition to the need for modern practices.

Focusing on regulations regarding one specific type of building, the chapter's third section explores temporary structures. This section presents types and uses of these buildings, highlighting the enormous variety of structures at events drawing large crowds. Team investigations then focus on current permit processes for temporary structures in Victoria with regards to structures themselves, their uses, and risks associated with them.

Finally, the fourth section discusses fire load risks of temporary structures and fire dynamics. Aspects of events, including type and use of structure and risks accompanying large-scale proceedings, play an important role in safe and effective permitting practices. Additionally, this portion reviews crowd-drawing attractions featured in Victoria.

## 2.1 Building Codes and Regulations of Australia

Building regulations are a necessary aspect of maintaining safe and livable surroundings. Basic safety building codes and regulations began in Europe with the *London Building Act 1667* after the Great Fire of London in 1666. Regulations slowly advanced up until the nineteenth century when they became more sophisticated [Bromley - The London Borough 2008]. As cities developed and buildings became more diverse, stricter regulations were necessary to maintain safe environments.

Building regulations are implemented by local governments to ensure the health and safety of people in and around buildings, accessibility for all people, and the efficient use of energy [Australian Building Codes Board 2009]. Building documents typically deal with fire safety, energy use, structural design, heating and air-conditioning, plumbing, and other general safety regulations.

The building industry environment is always changing, and therefore regulations must adapted to keep up with new developments. The government must monitor current building regulations to make the best decisions when updating them. Effective monitoring should consist of assessing existing,and developing new, regulations as needed.

### 2.1.1 National Building Codes of Australia

In Australia, national building codes are a relatively recent development. Prior to the 1970s, uniformity between States and Territories was nonexistent. Currently, each jurisdiction uses regulations to aid in the application of national standards.

#### *History of Building Codes in Australia*

In Australia, there were traditionally eight different building codes, one for each of the Australian State and Territory, starting in the early nineteen hundreds when the Commonwealth of Australia was first founded. Rather than continuing separate processes, the regional governments agreed to share their resources, and the Interstate Standing Committee of Uniform Building Regulations was formed in the 1960s. The first code document written by this committee was the Australian Model Uniform Building Code (AMUBC) which was released in the 1970s. The AMUBC was a step forward in improving the regulation of all States and Territories in Australia [Australian Building Codes Board 2009].

#### *The Building Code of Australia*

The Building Code of Australia (BCA- "the Code") is produced by the Australian Building Codes Board (ABCB), which maintains the codes [BCA 2007, p 7]. The goals of the BCA are to "enable the achievement of minimum necessary standards of relevant health, safety (including structural safety and safety from fire), amenity and sustainability objectives efficiently" [BCA 2007, p 7]. Each Australian State and Territory adopts the Code, which

annually incorporates amendments, and adapts it with its own legislation. State legislation consists of an Act of Parliament and subordinate legislation which "empowers the regulation of certain aspects of buildings and structures, and contains the administrative provisions necessary to give effect to the legislation" [BCA 2007, p 7]. Each provision of the BCA is subject to, or may be overridden by, State and Territory legislation. In this way, State and Territory building Acts and Regulations utilize the national BCA to regulate building control systems.

Figure 1 below shows the relationship between the BCA and State and Territory legislative documents.

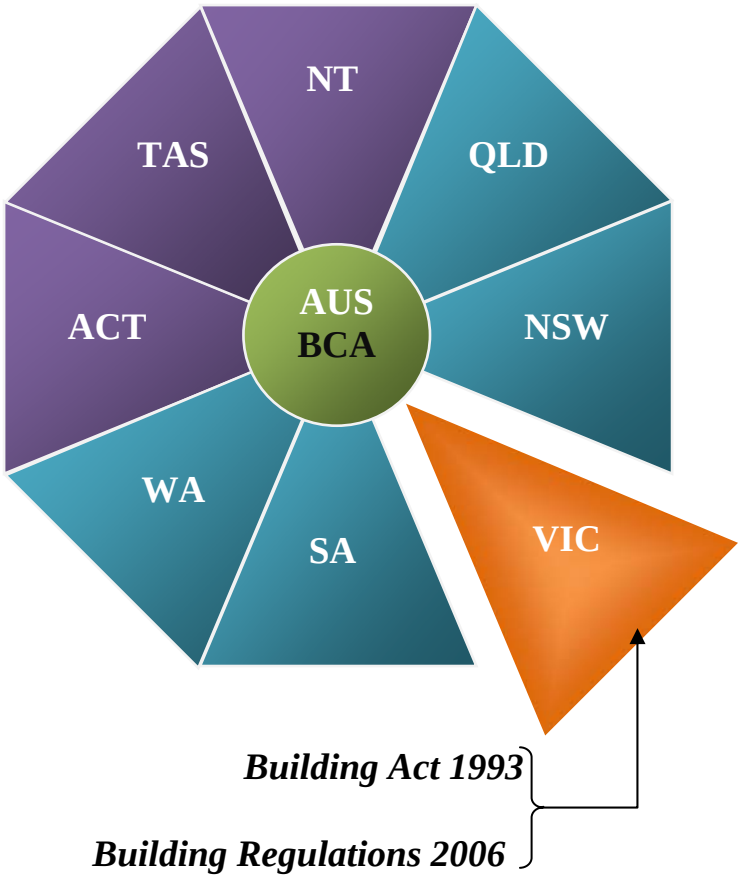


**Figure 1: Diagram of the Relationship between the BCA and State or Territory Legislation**

Each of the five States (blue, orange) and three Territories (purple) of Australia has its own regulations which apply the national Building Code of Australia. In the case of Victoria, as shown, the *Building Act 1993* and *Building Regulations 2006* are the legislative documents currently in effect within the state.

### 2.1.2 Building Regulations in Victoria

In Australia, building regulations are State and Territory specific as the governments see fit to adapt and enforce the Building Code of Australia. Each state distributes control of building systems differently, with Victoria's organisations being used as models for other jurisdictions [Brett O'Hara Interview].

***Victorian Legislation***

The Victorian government developed the *Building Act 1993* ("the Act") to regulate both building and plumbing work and standards. Additionally, the Act provides systems for issuing building permits, accrediting building materials, and providing for the certification of building and plumbing works [*Building Act 1993,* section 1]. It covers consistencies regarding building permits, standards, inspections, and occupations [*Building Act 1993*, Table of Provisions]. Since its establishment in 1993, the Act has become a primary example for other states and territories to adopt and alter to better fit their own region [Building Commission 2009]. The objectives of the Act include protection of the safety and health of people who use buildings and places of public entertainment and enhancing the amenity of buildings [section 5, subsection 1]. Along with safety, the Act facilitates the adoption and efficient application of the BCA, cost effective construction and maintenance of buildings and plumbing systems, and construction of environmentally and energy efficient buildings [section 5, subsection 1]. The Act also aids the achievement of an efficient and competitive building and plumbing industry [section 5, subsection 1].

The *Building Regulations 2006* ("the Regulations") standardize and regulates building practices within Victoria. Applying only within the State, regulations "provide for matters for the purpose of the *Building Act 1993*" [*Building Regulations 2006 (Version No. 004)*, regulation 101]. The goals of the Regulations are to prescribe standards for the construction and demolition of buildings and of safety for places of public entertainment, and relating to the maintenance of fire safety and safety measures [regulation 101]. Matters regarding the use and maintenance of buildings and places of public entertainment are also regulated along with requirements relating to specific structures such as pools, spas, and cooling towers [regulation 101]. The Regulations take into account registered building practitioner qualifications and accreditation of building products, construction methods, designs, components and systems connected with building work

[regulation 101]. The Regulations are less tangible than the BCA because they provide legislation for matters contained in the codes. One example is that the Regulations establish qualifications of building practitioners who are then responsible for making sure buildings comply with the BCA.

***The Victoria Building Commission***

In Victoria, the Building Commission maintains building regulations. This self-funded, statutory authority regulates building control systems in Victoria and was established under the *Building Act 1993*. The Act and associated legislation set out Victoria's building control system. This includes the registration and regulation of the following: building practitioners, standards in construction and building maintenance, protection of the health and safety of building users, and overseeing of the building and occupancy permit system [Welcome to the Building Commission 2009].

Supported under the Act by the Victoria Building Commission are four statutory bodies:

1. Building Advisory Council – "the peak advisory council for the administration of Victoria's *Building Act 1993*" [Building Advisory Council 2009]
2. Building Appeals Board – "responsible for determining appeals, disputes and assessing modification and compliance requests relating to building legislation arising under the Act or the Regulations" [BAB Support Services 2009]
3. Building Practitioners Board – "responsible for registering building practitioners and regulating their conduct and ability to practice" [BPB Practitioner Services 2009]
4. Building Regulations Advisory Committee – "responsible for providing advice on building regulatory matters and accreditation of building products" [Building Regulations Advisory Committee 2009]

The Commission exists to "ensure the safety, livability and sustainability of Victoria's built environment" [Welcome to the Building Commission 2009]. Working under national legislation (BCA), the Building Commission manages building legislation, standardizes building practices, advises Government and provides essential services to the industry and consumers through the Regulations [Building Commission 2009; Welcome to the Building Commission 2009].

***Creating and Amending Regulations in Victoria***

Regulations cover a diverse range of issues, including specifications for building permits, building inspections, occupancy permits, enforcement procedures, and maintenance requirements [Regulatory Impact Statement 2006]. The state of Victoria has a process, known as the Regulatory Impact Statement (RIS), to create new regulations and regulation amendments as a result of changing government policies or "sunsetting" (expiring) regulations. All regulations sunset at the same time every ten years, meaning the *Building Regulations 2006* will all expire in 2016. RIS procedures can take anywhere from twelve months to over two years to fully complete once the regulations expire. However, in many cases, amendment proposals have non-regulatory solutions and no changes or new regulations are needed.

A problem the Building Commission faces is that, without any data from monitoring these regulations over time, it is difficult to update them effectively. This challenge stems from the Commission not knowing which regulations perform as expected and which need adjustment or removal. The Commission should be in charge of monitoring regulations, but there is no current system in place [John Shaw, personal communication, 03/02/09].

The definition of a monitoring system is an on-going method to collect data on a program's activities and outputs designed to provide feedback on whether the program is fulfilling its functions, addressing the targeted population, and/or producing those services intended [Bureau of Justice Assistance 2009]. Building regulations use monitoring systems designed for data collection to ensure that each regulation is necessary and performs effectively. Monitoring systems vary, but all attempt to guarantee that every building regulation performs as expected.

### 2.1.3 Building Regulations in Other Australian States and Territories

All States and Territories in Australia have their own legislative systems. Several jurisdictions have both a building act, which is typically an adaptation of the BCA, and a regulation plan for further enforcement, as Victoria does.

While Tasmania, Queensland, and South Australia have their own specific legislation, the other States and Territories adopt the BCA directly. Additionally, Queensland created its own code document, the *Queensland Code and Practice for the Building and Construction Industry*, which only includes codes specific to the region. Queensland and South Australia both have

building acts in place that were developed during the1970s. Tasmania is more up to date, having introduced their building act in 2000 and a new regulation plan in 2004 [State & Territory Essential Safety Measure Regulations 2008]. There are other forms of legislation that States and Territories follow, such as fire safety and emergency procedure documents, but not all pertain directly to building regulations.

The main difference between other States and Territories and Victoria is the lack of an organisation dedicated to building legislation administration. There are groups, such as South Australia's Building Policy Branch of Planning (SA BPB), which work to enforce building regulations and to make planning decisions for building development. The SA BPB is not involved in maintaining the regulations [Building Policy in South Australia 2009]. The Department of Planning in New South Wales functions similarly to other planning departments, but has no involvement with regulations monitoring [Department of Planning 2009]. Some states have boards dedicated to amending building regulations such as the Building Appeals Board of the Northern Territories. However, this board only makes decisions based on suggestions made by industry and the public [State & Territory Essential Safety Measure Regulations 2008].

Following the example set by Victoria Building Commission, the Government of Western Australia is establishing its own building commission. The government drafted legislation in 2007 to form a commission and hopes to have it implemented by July 2009 [Building Commission Western Australia 2009]. Until then, the Commission in Victoria remains the only organisation in Australia committed to the maintenance and advancement of its state-specific regulations.

### 2.1.4 Summary of Regulations within Australia

Within Australia, States and Territories individually adopt the national BCA as it pertains to each jurisdiction. Regulations are in place to apply the codes, but there are no systems to monitor their effectiveness and applicability. In Victoria, the Building Commission is attempting to devise a strategy to monitor and evaluate the Regulations. The WPI research team investigated regulations and monitoring to make recommendations regarding this goal.

## 2.2 Building Regulations outside Australia

Three countries of interest to the Victoria Building Commission with regards to methods of building regulation maintenance are Canada, the United Kingdom, and the United States.

### 2.2.1 Canadian Regulations and Monitoring

In Canada, building codes are the provinces' jurisdiction. In every Canadian region besides Ontario, the National Building Code of Canada is the model building code. First published in 1941 and revised every five years since 1960, this building code covers construction, renovation and demolition. It also maintains the safety of buildings with specific regard to public health, fire protection, accessibility and structural sufficiency [National Building Code of Canada 2005]. The Canadian Commission on Building and Fire Codes develops the national model code.

A division of the National Research Council of Canada (NRC), the Institute for Research in Construction (IRC), carries out research on issues of strategic importance, including building envelop and structure, fire research, indoor environment and urban infrastructure, to the Canadian construction sector. The Council publishes model building and fire codes, which provinces may choose to adopt with or without modifications, or to ignore and adopt their own codes [Institute for Research and Construction 2009]. However, the NRC-IRC has not conducted research in monitoring and evaluating building codes.

### 2.2.2 Regulations and Monitoring in the United Kingdom

In the United Kingdom, regulations require approval for most building work; contractors must consult either local authorities or private building surveyors to achieve compliance with the regulations. The *Building Act 1984* applies across England and Wales while the *Building (Scotland) Act 2003* is valid in Scotland [Building Regulations 2009].

Each year the UK's Community and Local Governments direct projects to ensure the development and maintenance of building regulations. These projects, known as the Building Regulations Research Programme, investigate regulations and keep them current. Some current projects include the development of the building regulations as a whole, the review and revision of approved documents, the development of new and revised codes and standards and the introduction of new technologies and design solutions [Building Regulation Research

Programme 2005]. Projects for 2008-09 cover four areas: sustainability, building control system review, periodic regulation review, and safety and standards [Building Regulations Research Newsletter 2008]. The governments use the project results to produce Building Division Research Documents, which aim to develop scientific evidence in support of amendments to building regulations. The Community and Local Governments use these documents to update the building regulations of the United Kingdom almost every year [Building Division Research Documents 2007].

### 2.2.3 Current Regulations and Monitoring in the United States

In the United States, the International Code Council (ICC) creates and updates regulations which individual states and municipalities adapt. Every three years all International Codes, consisting of Building, Fire, Residential, Mechanical and Plumbing Codes, go through review cycles and adoptions. Private or public companies and the general public can all submit changes to the ICC, which is responsible for coordinating all code revisions. Any state, city or local jurisdiction can adapt or make local amendments to the base codes once they are reviewed, voted upon and adopted. With the code changing every three years, building regulations stay current with most technological advances; however, newer technology occasionally forces Fire Code officials to look at the intent of the codes and not the letter of the codes. Regulations must be flexible while still providing adequate safety measures [Virginia Holtzclaw, personal communication, 31/01/09].

ICC monitoring is done by stakeholders of, or anyone with interest in, the model code. Their requests for change are first evaluated by the ICC and the special code development committees. Requests are then brought to public hearings where motions to accept or reject changes are voted on. The ICC publishes changes periodically and distributes them several times. Depending upon stakeholder feedback, the Council makes amendments available for public comment during the code development cycle both before and after the public hearings [Alberto Herrera, personal communication, 08/04/09].

### 2.2.4 Summary of Regulations outside Australia

Internationally, countries follow their own codes and regulations. The United States, the United Kingdom, and Canada each have codes based on a national standard and adopted at the

regional level. Like Australia, none of these countries have clear methods to monitor their codes and regulations.

## 2.3 Regulating Temporary Structures

Within Australia, States and Territories deal with safety and regulation of all buildings; temporary structures are one specific type of regulated constructions. Regulations are in place to maintain structural safety of structures through permits. Current processes require event organizers to apply for permits before constructing and using temporary tents, buildings, or other constructions. This project investigates the need for amendments of temporary structure regulations pertaining to fire risk.

### 2.3.1 Types and Uses

All buildings in Victoria, including temporary structures, are regulatedby the Building Commission. In Victorian legislation, 'prescribed temporary structures' are defined by the Act. With regards to building regulations, temporary structures used as 'places of public entertainment' are more specifically identified as follows:

(a) tents, marquees or booths with a floor area greater than $100m^2$,

(b) seating stands for more than 20 persons;

(c) stages or platforms (including sky borders and stage wings) exceeding $150m^2$ in floor area;

(d) prefabricated buildings exceeding $100m^2$ other than ones placed directly on the ground surface.

[*Buildding Regulations 2006,* regulation 1104]

The regulations do not encompass controls for tents, marquees or booths with a floor area *less* than 100 $m^2$.

Figure 2 shows exhibition tents erected for the 2007 Avalon Airshow 2007. As the image shows, the main tent is many times larger than the airplanes seen alongside it. Also visible along the bottom of the photo is a row of smaller chalets set up for private viewing of the aerial displays. The Act and the Regulations classify all of these constructions as temporary structures. This proves that temporary structures vary widely in their complexity, capacity, and

employment. The sheer size and diversity of buildings classified as temporary structures is remarkable.

**Figure 2: Airshow 2007 Tents and Exhibition Halls**

Uses of temporary structures fluctuate greatly, and the structures' forms depend on these varying uses. Races, sporting events, fashion shows, and festivals are common events where temporary structures are found. Structures may be used as stages, such as at concerts or fashion shows, or to house large dinners or galas. In Victoria, events include the Melbourne Grand Prix, Avalon Airshow and the Spring Racing Carnival.

Figure 3 below shows the Motorola stand at the Melbourne Cup, the largest horserace of the Spring Racing Carnival, in 2008. Images shown include both interior and exterior views of the structure, which is two stories in height and complex in interior design.

**Figure 3: Exterior and Interior Views of the 2008 Melbourne Cup Motorola Stand**

### 2.3.2 Regulating Temporary Structures through Occupancy Permits

Internationally, governing bodies require permits for temporary structures. Variations exist between Australia, the United States and Canada regarding information required from event or marquee organizers requesting permission for events.

***Regulating Temporary Structures within Victoria***

Although provisional, temporary structures are buildings used to house people and contents needed for large events. Regulations are in place in Victoria as described by the Regulations. One method of regulation used by the Victoria Building Commission is the requirement of occupancy permits for all structures falling within their jurisdiction. Occupancy permits for temporary structures may be issued subject to specified conditions relating to safety features of the structure [regulation 1105].

Through such regulations, essential safety measures for each structure are defined as per the Act [regulation 1202]. Occupancy permits must include safety measures pertaining to the building and specifics, such as performance level, for said measures. Safety performance levels must be determined by the relevant building surveyor so that each measure fulfils its purpose [regulation 1203]. Maintenance of each permitted structure must be documented by the owner in addition to reports approved by the Building Commission [regulations 1208-1211].

### 2.3.3 Permitting of Temporary Structures

Occupancy permits are one facet of regulations for temporary structures. These permits are used in all Australian States and Territories, in addition to the UK, US, and Canada.

#### *Permit Processes within Victoria*

The current-day Victorian permit process for temporary structures is efficient in many ways. Between the Building Commission and the Municipal Councils, occupancy permits and event-specific permits are given for structures. An occupancy permit indicates that a prescribed temporary structure, designed in agreement with engineering principles and then erected in accordance with the approved documentation and conditions as listed on the occupancy permit, is suitable for public occupation [Info for Applicants 2008]. The permit itself, as seen in Appendix C, lists condiions of the its validity as well as safety requirements.

Municipal Councils grant event permits known as POPEs (Places of Public Entertainment); event organizers are required to file permit applications with the city before the construction of temporary structures [City of Melbourne 2009]. Applications for a POPE consist of the location and duration of the event and its Business Activity Classification (BAC) code [POPE 2009]. Permits address the conditions on the Building Commission-issued occupancy permits as well as occupancy number and fire safety for the event as a whole.

Shown in Appendix D, the POPE application is in accordance with the Act and the Regulations, and includes information pertaining to owners, contractors, and laborers. Appendix D also shows a paperwork checklist required in order to host the event; this includes first aid facilities, emergency plans and the permit itself. Although the checklist addresses event safety, it does not take into account the possible danger from contents of the temporary structure(s) onsite. Anything within a structure, including building materials, floor coverings, and moveable

contents such as tables or chairs, can be fuel for a fire. In not taking into account contents of a structure, the governing bodies do not pay attention to potential fire risks.

Organisations such as the Melbourne Certification Group (MCG), an assembly of building professionals including inspectors and surveyors, carry out inspections of erected buildings [City of Melbourne 2009]. Inspectors check marquees during set up and as part of event documentation; they can also request details of the structure layout or fitout [Katherine Kolar Interview].

***Permit Processes in Other Australian States and Territories***

In Australia, temporary building permits are issued at the state level. Regulations require permits when deemed necessary by the specific building act in each State or Territory. Each building act has its own definition to classify temporary structures.

A comparable organisation to the Building Commission in Victoria, is the Queensland Heritage Council, which handles Queensland permits. Under Queensland's state legislation, the *Building Act 1971*, temporary structures fall into three categories. If the structure is small enough, it is automatically exempt from a permit by the General Exemption G3 under section 35(4) and section 37 of the *Queensland Heritage Act 1992* [General Exemption G3 2005]. The next size group of temporary structures is required to apply for an exemption certificate and may or may not have it granted by the Heritage Council. The largest category of structures includes those greater than 500m$^2$. These structure types require an application for a development permit due to the increased risk of damaging the location [Guideline G3.1 2006]. Permits go through the Integrated Development Assessment System, a process described in the *Integrated Planning Act 1997*, for assessing and deciding Queensland development applications, before being approved [Integrated Development Assessment System 2008]. Furthermore, local governments regulate temporary structures as well. In addition to approval from the Heritage Council, the structures must comply with local government regulations.

For certain temporary structures, Tasmania requires approval for permits issued under the *Building Act 2000*. In order to gain approval, an event organizer needs the assistance of a certified Building Surveyor to complete the application form and to assess whether the structures are exempt from the need of a permit. If the structures meet all necessary requirements, the surveyor issues a Certificate of Likely Compliance. Upon completion, the event organizer

submits the application to the Sullivans Cove Waterfront Authority for review [Temporary Occupancy Permit Information Sheet 2006].

***Permit Processes outside Australia***

One of the most valuable approaches to improving current temporary structures permit processes is to review similar systems in the United States and Canada, and adapt preexisting techniques used in parallel situations for use in Victoria.

In the United States, each state is responsible for permit processes within their jurisdiction. Arizona, an area of similar climate to Victoria, requires permits for temporary structures set up for special events. Multiple departments review the event to make sure all aspects meet requirements of the International Code, environmental requirements, policies, and risk management (safety issues/city requirements). Before an event comes to a city, the coordinators go through a committee; during this process the organizer submits all necessary paperwork, including structural designs on any equipment and or buildings, to the city. The Fire Department and Building Department inspect all facilities, stages, and structures, to ensure compliance with all applicable codes before the event starts. Event organizers must correct any problems immediately [Virginia Holtzclaw, personal communication, 31/01/09].

In Canada, there are variations in temporary structure permits from those used in Victoria. The Canadian permit still requires basic information concerning the name, owner, and event organisation [Government of Canada 2006]. However, a key difference is that Canada requires identification of any culinary equipment present in the structure. Organizers must record culinary equipment, along with examples of food or alcoholic beverages to be served, on the application [City of Vancouver Tent and Stage Application Form 2009].

### 2.3.4 Summary of Temporary Structures

Temporary structures vary greatly in their size, complexity and uses. In Victoria, regulations govern permits for empty structures, but do not incorporate the structures' contents. This lack of knowledge means that fire risks caused by contents within structures are unknown. The Building Commission wants to determine if there is sufficient risk from unknown temporary structure contents to justify additional action on their part.

## 2.4 Fire Risks, Loads, and Defenses

In Victoria, temporary structures used as places of public entertainment pose safety hazards because they attract large crowds. The overall attendance at attractions has grown, leading to additional fire risks from increased temporary structure size. A media release from the Minister for Industry and Development states that a record 182,000 people attended the 2007 Avalon Airshow, which calls itself "the nation's largest and most comprehensive aviation, aerospace and defence exposition" [Avalon 2009]. Attendance increased 6% over the 2005 Airshow [Airshow Attendance Takes Off 2007]. The Melbourne Food and Wine Festival attendance exceeded 300,000 in 2008, and "promises to be bigger and better than ever" in 2009 [Melbourne Food and Wine 2009]. Clearly, the growing popularity of these events poses safety challenges from large crowds and elaborate venues, which add fire loads in these structures.

In all of the regulations for temporary structures, fire safety is addressed through defenses such as fire extinguishers and clear exits or entryways. However, there are no regulations currently in place regarding fire load of these buildings. Determining the actual level of risk associated with each structure is impossible.

One of the major fire-related dangers within temporary structures is flammable material present around ovens, stoves, or open flames. For example, the Melbourne Food and Wine Festival utilizes kitchen appliances; creating a way to reduce the risk associated with such setups is necessary. Another danger is spectators' progression through the structure causing potential damage to wiring for display terminals. Exposed live wires are a fire hazard. A basic knowledge of fire loads and fire dynamics is necessary when determining the right precautions against fire dangers for temporary structures.

### 2.4.1 Fire Load Assessment

The technical definition of fire load is the measure of all combustible material in a compartment divided by the floor area of that compartment, in kilograms per square meter [Fitzgerald 2004]. Fire load represents the potential fuel available to a fire and can vary depending on the type of material present. An area of a structure is said to have a "heavy fire load" when it is filled with a large amount of combustible materials. Fire load calculations should also include the building itself if it is combustible [Fitzgerald 2004].

### 2.4.2 Basics of Fire Dynamics

When a fire occurs, it is not an isolated event but rather a dynamic situation. Fires in specific incorporate interactions between material size, shape, crowd flow, and fire defenses. The resulting combinations determine whether a fire will propagate or extinguish. A fire will burn until all its fuel sources, building materials or structure contents, are used, unless acted upon by an external force, such as fire-limiting sprinklers or fire brigade action [Fitzgerald 2004]. If present in the temporary structures, walls may act as barriers to resist fire spread until the implemented defenses work in unison to possibly extinguish the fire [The European Steel Design Education Programme 1993].

### 2.4.3 Fire Safety Precautions

The more safeguards associated with events, the smaller the probability that fires will get out of control. Safety precautions against high fire loads incorporate both active and passive defenses. Active protections are comprised of sprinkler systems and fire detectors which initiate when smoke sensors trigger. A passive protection is the path of egress, defined as a "continuous and unobstructed path from any location in a building to a public way." The passageway includes proper exits and stairwells if applicable [Fitzgerald 2004]. Evacuation assistance services use the route to enter structures efficiently, making it less difficult to extinguish a fire and aid in rescue services. Fire extinguishers are another passive defense if placed in easily accessible locations to be used by the public in an emergency.

### 2.4.4 Summary of Fire Risks, Loads, and Defenses

Attendance at large Australian events is growing, increasing the size of temporary structures needed to house the crowds. Fire loads of these buildings also increase as more materials are present, but additional regulations have not been implemented to compensate. Assessment of fire loads incorporates the layout, type, and amount of the structure's contents. It is important to assess temporary structures fire risks to determine if the Building Commission should take action to ensure public safety.

## 2.5 Summary

Building regulations are important for safety and integrity of structures, but they are only effective if kept up to date. Technologies change quickly over time, and regulations must adapt to these changes. There are no universal systems to monitor regulations and update them; every country has its own methods or lack thereof. Within the United States, regulations are self-monitoring, allowing those governed to directly participate in changes to the International Codes every three years. The Institute for Research in Construction in Canada performs research on key areas in construction and uses those results to update the building codes every five years. In the United Kingdom, the Building Regulations Research Programme develops scientific evidence to support building regulations amendments, which occur almost every year. Inside Victoria, Australia there is no defined method to evaluate the effectiveness of building regulations. Every ten years, codes come up for assessment and there are no data to identify whether or not the regulations need to be adjusted. Overall, it is necessary to keep building regulations current with modern technologies through continual reevaluation.

Regulations are in place for all types of buildings in Victoria. One type of moderated constructions is temporary structures, which vary in their size and use. To ensure the safety of the public during events, coordinators must apply for permits before they are allowed to build the structure, and inspectors must investigate the structure's integrity before use. In Victoria, the contents and subsequent fire loads of structures are not known when on-site inspections take place. Therefore, looking at fire loads and fire dynamics is necessary to ensure public safety.

# Chapter 3: Methodology

This project examined the "big picture" of regulations monitoring systems, and then focused on the specific example of monitoring and evaluating temporary structure regulations in Victoria, Australia. Although both levels of focus are tied together, there were two distinct goals of this project, and therefore the team used two completion methods.

The project's first aim was to research building regulation monitoring and evaluation procedures in order to recommend a plan for a system in Victoria. Initially, the study investigated building regulation maintenance systems in the United States, Canada, the United Kingdom, and Australia. The group then consulted with experts, including WPI faculty members, Commission employees, and contacts nationally and abroad. The team also interviewed an expert specializing in general monitoring and evaluation systems. We used this information to form recommendations for the Building Commission.

To monitor and evaluate the regulations for temporary structures, the group examined permits and processes in Victoria, other Australian regions, and in the United States. Once the group understood the overall process for the different permits involved, and where the responsibilities lay among the various organisations involved, we investigated fire risk involved with these structures. The team interviewed experts in fire-related organisations and gained a fundamental fire dynamics background. We also compared regulations of temporary structures to those associated with their permanent counterparts. Based on this knowledge, we conducted basic fire analysis of temporary structures using previously established data regarding fire loads. After compiling and cataloging all this information, the team made recommendations to the Building Commission about temporary structure fire safety.

## 3.1 Regulations Monitoring

Research began by reviewing monitoring and evaluation systems in the United States, Canada, the United Kingdom and Victoria, Australia to propose improvements to Victoria's current building regulations amendment process.

Figure 4 shows the relationship between the objectives and the final deliverables of this project. This study evaluated research regarding existing procedures for regulations monitoring both within Australia and abroad. Consequently, we recommended that a system be implemented by the Building Commission based on the following analysis. The team consulted

the Department of Planning and Community Development in Victoria in order to suggest an acceptable system.

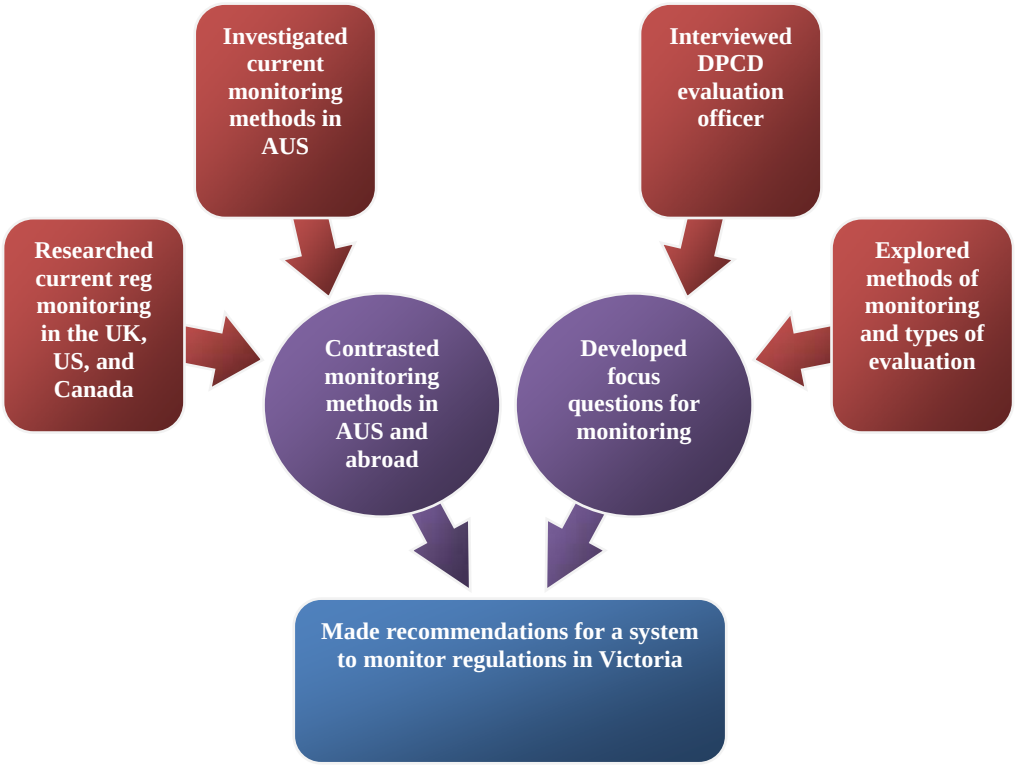


**Figure 4: Diagram of Objectives as they relate to the Project Goal**

### 3.1.1 Assessment of Monitoring Regulations in Current-Day Victoria

Understanding procedures used to monitor and evaluate building regulations in Victoria, and the rest of the Australia, was necessary for recommending changes to current practices. The team learned about regulation assessment systems in Victoria via online investigation of the Commission's website [Building Commission 2009]. We worked closely with Johanna Bidwell, a Research Officer at the Comission. The group also interviewed Helen Rechter, a Commission Regulatory Development Advisor, to study the process of updating expiring regulations. Topics explored included types of evaluation, methods of data collection, and how to reach desired audiences for information gathering and reporting. Following Ms. Rechter's recommendation, the group read the Regulatory Impact Statement guide to fully understand this process.

### 3.1.2 Investigation of International Regulation Monitoring Practices

With the intention of understanding international monitoring processes, this study explored the development and maintenance of building regulations in the United States, Canada,

and the United Kingdom. The team consulted experts from or associated with the Fire Protection Engineering department at WPI, specifically, Drs. Brian Meacham and Jonathan Barnett because they have worked in Australia and are knowledgeable in the area of building and fire codes.

Online investigation proved to be the most accessible tool for researching processes of evaluating and updating building regulations. The team searched government and regulation websites to identify procedures used in the countries of interest, the United States, Canada, and the United Kingdom. Websites visited included the following:

1. Canada *The NRC Institute for Research in Construction* [http://irc.nrc-cnrc.gc.ca/index_e.html]
2. UK Communities and Local Government *Building Division Research Documents 2006-2007* [http://www.communities.gov.uk/planningandbuilding/planningbuilding/buildingregulationsresearch/buildingdivisionresearch/]
3. International Code Council [http://www.iccsafe.org/news/about/]

In the United States, the group contacted Virginia Holtzclaw of the Chandler, Arizona Fire Department, and learned about United States monitoring and evaluation processes. The team emailed the UK Building Regulations Research Programme, asking about the scientific research they perform on building regulations. We emailed the NRC-IRC of Canada, and contacted the Canadian provinces. Inquiries sent to each jurisdiction requested information regarding any data gathering or monitoring systems in place to update local building regulations.

### 3.1.3 Monitoring and Evaluation Systems

Before being able to make recommendations, the team studied the development process for general monitoring of evaluation plans. We met with Mandy Charman, an Evaluation Officer from the DPCD and asked her how evaluation plans are established and her ideas of monitoring building regulations. Taking her recommendation, the group completed a guide which helps develop an evaluation plan for outcome, not performance projects. We applied the idea and constructed our own guide. This guide, called the *Regulation Review: Developing a Monitoring and Evaluation System*, targeted building regulations through focus questions to create a plan to monitor any regulation. The team discussed this guide with Ms. Bidwell to ensure it was feasible and that the questions produced information leading to successful monitoring plans.

## 3.2 Monitoring of Fire Regulations Related to Temporary Structures

The current permit process for temporary structures in Victoria requires an engineering structural design and tested fire-retardant building materials for approval. Permits apply in Victoria for a period of three years. The team completed an evaluation of the current permit processes inside Australia and investigated permitting methods in other nations. Then we examined further action based on Building Commission suggestions.

Figure 5 shows the relationships between the objectives for this project segment and the ultimate goal of making recommendations regarding fire regulations for temporary structures. Recommendations were based on interviews, research, calculations, and on-site inspections.


**Figure 5: Diagram of Objectives as they relate to the Project Goal**

### 3.2.1 Temporary Structure Permitting Nationally and Abroad

To properly assess the temporary structure permit process, the team investigated procedures in all Australian States and Territories and in the United States. We needed a

background of current permit processes to effectively advise the Building Commission on improvements for temporary structure fire safety regulations. By conducting interviews and contacting various organisations through email, the team understood the permit process for temporary structures and the responsibilities of each organisation involved.

***Victoria's Temporary Structure Permit Processes***

The study's main focus was Victoria. The team interviewed Building Commission employees John Shaw and Katherine Kolar about the Commission's involvement in the permit process; the discussion focused on occupancy permits. Specifically, the group inquired about inspections of temporary structures, requirements of hiring companies, and the feasibility of possible process improvements.

To thoroughly examine effects of occupancy permits, the team contacted various hiring companies about regulations of structures they design and erect. On the suggestion of Ms. Kolar, the group searched for hiring companies on www.yellowpages.com.au, and we contacted the follwing nine companies through email: No Fuss Solutions, Harry the Hirer, Moreton Hire, Harts Party Hire, Oz Party Hire, Werribee Party Hire, Grampians Event Hire, Bourke Hire and AABCO. We formulated six focus questions for the hirers:

1. To what level are you liable for content of an erected structure hired from your company?
2. Please describe how your structures are examined prior to being approved for an Occupancy Permit from the BC.
3. What fire protection/prevention plans do you have in place for your structures?
4. Would additional regulations regarding temporary structures be helpful or limiting to your business?
5. What changes, if any, would you recommend for current permitting and regulations of temporary structures?
6. Is there any other information you would like to provide us with?

The first response was Peter Van Zeyl, Business Development Manager of Harts Party Hire, who asked for a phone interview. The group gave him a description of the project and asked him the six focus questions. With the help of Ms. Kolar, we set up a joint interview with No Fuss Solutions' Managing Director Geoff Tucker and Brett O'Hara from Harry the Hirer and asked them the same questions. These interviews helped us comprehend permits and assess the

feasibility of potential recommendations. Mr. Tucker and Mr. O'Hara gave us insight into permitting in other Australian States.

***Other Australian Regions' Temporary Structure Permit Processes***

The group looked into temporary structures permit processes in other Australian States and Territories. Since Victoria was the only jurisdiction that had a building commission, the team searched for local councils or other organisations responsible for permits or building regulations. We emailed each State or Territory with a brief introduction of the project and asked about their permit processes. Specifically requested was if they relied on Victoria's occupancy permit or had their own version. All of the contact information, organisations contacted and responses were cataloged in a spreadsheet (Appendix K).

***United States Temporary Structure Permit Processes***

To gain a different perspective, the group researched temporary structures in the United States and examined building regulation organisations in each state. We cataloged names of organisations in addition to local authorities' names and contact information. Next, the team sent out emails to each of the fifty states requesting information on each respective state's temporary structure permits. If the recipient could not answer the questions directly, the email asked if they had contacts who could be of further assistance. Responses are in Appendix J.

### 3.2.2 Temporary Structure Inspection Processes

To determine the extent of current safety precautions affecting temporary structures, the team explored structure inspection processes and events at multiple levels. Beyond investigating regulations of the buildings through Commission occupancy permits, we interviewed members of the Melbourne City Council (MCC) and the Metropolitan Fire Brigade (MFB). The group also developed a survey to pose to event organizers regarding structure contents.

***Interviews with Local Authorities***

The team interviewed Joseph Genco, the Municipal Building Surveyors at the MCC, at the suggestion of Katherine Kolar. In the interview, we inquired as to the function of the MCC in the permitting and inspection process for temporary structures; the group paid specific

attention to structures at events requiring POPE permits. Mr. Genco showed us photos from Spring Racing Carnival marquee inspections on-site at Flemington Racecourse.

Additionally, our project investigated the role of fire safety organisations in the inspection process. Mr. Genco put us in contact with Bob Hetherington, a station officer in the Building Inspection & Compliance Department at the MFB. We interviewed Mr. Hetherington regarding his responsibility in the inspection process for temporary structures, as well as his knowledge of fire safety risks associated both with large events and with the buildings themselves. Topics covered included temporary structure legislation, responsibilities of the MFB and trained safety officers at large events, and fire concerns in and around temporary structures. Mr. Hetherington showed us photographs from his inspections at several large events, highlighting event organizers' inexperience with fire safety and the growing diversity of temporary structures themselves.

***Development of a Fire Load Survey***

The team compiled a list of possible dangers associated with common building materials and equipment (Appendix C). The list's purpose was to give a basis for risk assessment; it helped us develop a survey to be given to event organizers regarding safety of temporary structures. The survey focused on features such as plumbing, electrical work, furniture, kitchen appliances (Appendix F). Our questionnaire asked organizers to record quantities of several hazards in their structures.

Originally, the survey included a section to determine common physical characteristics among structures, including spatial organisation and crowd distribution. The questionnaire covered active and passive fire defenses, such as the number of smoke detectors and fire extinguishers present and the ease of ingress into or egress out of the structures. Finally, our survey inquired as to the number and frequency of on-site structural inspections that the structures and events underwent prior to opening. These survey sections were determined inappropriate for event coordinators because they were not relevant to the inspected group.

### 3.2.3 Analysis of Safety Risks of Temporary Structures

The purpose of our study was to provide the Victoria Building Commission with recommendations regarding regulations of temporary structures. Specifically, the team was

asked to explore the fire risk created by contents of structures and the growing complexity of their design and use. To do this, the team learned about fire risk assessment, fire development, and current regulations for temporary and permanent structures. We then applied this information to analyse a few of the more complex structures' fire loads and the dangers they create. We interviewed Tony O'Meagher, a fire protection engineer from the MFB. Questions focused on the most efficient and accurate ways to conduct a fire load analysis for temporary structures; the team also asked for websites or manuals containing fire load information. Consequently, we collected data from the International Fire Engineering Guidelines, Edition 2005, which contained the fire loads for over 450 varying structures. The group averaged the fire load of comparable structure types to make a plausible fire evaluation of temporary structures. In addition, we collected information through the National Institute of Standards and Technology website (www.NIST.gov) by conducting keyword searches for temporary entertainment and fire loads on over 5000 documents contained in the website.

We gathered additional information that correlated high fire load to fire development through the CFAST program. This computer program, supplied by fire protection engineer David Kearsley, displays visual differences in fire development based on changes in the fire load of a compartment. In an interview, Mr. Kearsley answered supplemental questions pertaining to fire analysis and explained current safety limitations of temporary structures.

Next, the team compared temporary structures and permanent structures with regards to building and safety regulations. The BCA and the Regulations were examined. Additionally, group members attended two large events in Victoria, the Avalon Airshow and the Grand Prix, and took photographs of temporary structures as supporting data on the relative scale and contents of structures. Based on the layouts and contents of temporary structures, as determined through information contained in the BC's occupancy permits and photographs, we assessed structures' fire loads by using predetermined fire loads of comparable permanent structures. Our investigation analysed differences in fire loads, and correlations between required fire defenses were analysed. The team did this to demonstrate the differences in requirements between permanent and temporary structures and prove that temporary structures should be regulated further as permanent buildings are.

# Chapter 4: Results and Recommendations

There were two separate goals in this project. The first was to recommend a plan to the Building Commission for a building regulation monitoring and evaluation system. Working toward this result, the team interviewed experts in Victoria, Australia, in addition to the United States, and Canada. Section 4.1 contains these results, conclusions, and associated recommendations. The second objective was to monitor and evaluate building regulations regarding fire risks of temporary structures. The group interviewed individuals involved in the permit process and made calculations involving fire loads of temporary structures at the Grand Prix and the Avalon Airshow. Section 4.2 includes our findings and analysis as well as suggestions for the BC.

## 4.1 Regulations Monitoring Results

The "big picture" component of our investigation researched monitoring and evaluations systems so the team could recommend a method which the Building Commission could potentially apply to building regulations. First, the group interviewed two Commission employees and contacted the United States, Canada, and the United Kingdom via email to investigate their current monitoring systems. We formed a plan, entitled *Regulation Review: Developing a Monitoring and Evaluation System*, by meeting with an evaluation expert at the Department of Planning and Community Development (DPCD) and studying the BC's Regulatory Impact Statements (RISs) and the current procedures used to amend regulations in Victoria.

### 4.1.1 Assessment of Current Monitoring Regulations in Victoria

The definition of a monitoring system is an on-going method to collect data on a program's activities and outputs, designed to provide feedback on whether the program is fulfilling its functions, addressing the targeted population, and/or producing those services intended [BJA 2009]. Building regulators could use monitoring systems designed for data collection to ensure regulations are necessary and effective.

After meeting with Johanna Bidwell, a Research Officer at the Building Commission, the group learned that Victoria does not have a monitoring system for building regulations. There is a regulation updating process which the Commission uses to investigate regulation changes and

renewals. However, the Building Commission waits until a regulatory problem arises, or until a regulation nears expiration, before taking action. This method requires a procedure to evaluate regulations, but does not incorporate continuous monitoring.

The team met with Helen Rechter, a Commission Regulatory Development Advisor, to learn about the evaluation process because this is her area of expertise. All regulations expire at the same time every ten years; this means all of the 2006 regulations will sunset in 2016. Ms. Rechter explained that sunsetting regulations are evaluated by the Building Commission through Regulatory Impact Statements (RISs). A RIS, which aims to evaluate the cost effectiveness and necessity of addressed regulations, consists of an elaborate fact collection process which involves extensive time and resource input. Because information is collected for the RIS only when the Regulatoins are set to expire, facts gathered do not represent fluctuations over time. This lack of data is the reason the Commission is trying to implement a regulation monitoring and evaluation system. A detailed description of the RIS and its development is presented in Appendix N.

A problem the Building Commission faces is that, without any records from monitoring these regulations over time, it is difficult to update them effectively. This challenge stems from the Commission not having data outlining which regulations perform as expected and which need adjustment or removal. We were told that the Commission should be in charge of overseeing regulations, but there is no current monitoring system [John Shaw, personal communication, 26/01/09].

### 4.1.2 Investigation of International Regulation Monitoring Practice

After emailing three international organisations, including the United States' International Code Council (ICC), the National Institute for Research in Construction (NRC-IRC) in Canada and the United Kingdom's Building Regulations Research Programme, the group received two responses about international regulation monitoring practices.

The ICC is the leading developer of codes used as models around the United States and internationally [ICC 2009]. In an email response from Alberto Herrera, an International Associate of the ICC, shown in Appendix K, he stated the ICC has, "a process to develop and update [US] model codes in which code officials, the industry, design professionals and the general public participate by sending their opinions and requests for changes to […] code"

[Alberto Herrera, personal communication, 08/04/09]. However, Mr. Herrera continued by saying the ICC does not have a specific database to store information on building regulations, and that requests for change are the only monitoring that occurs. There is no actual data collection system whose purpose is to provide relevant scientific facts to support code amendments [Alberto Herrera, personal communication, 08/04/09].

On the NRC-IRC website, the organisation states that it is responsible for code support and product evaluation service in Canada. The group contacted them to elicit more details and received a response from Anne Gribbon, a secretary of the Canadian Commission on Building and Fire Codes. Ms. Gribbon stated that the NRC-IRC, "has not conducted research in monitoring and evaluating building codes"; rather the building codes are under the jurisdiction of each individual province [Anne Gribbon, personal communication, 29/04/09]. Furthermore, the research performed by the NRC-IRC is related to issues in construction, not building regulations. Ms. Gribbon provided a list of contacts for each of the 13 Canadian Provinces and the team followed up by emailing each contact. British Columbia, Manitoba, Nova Scotia, Prince Edward Island, Quebec, Saskatchewan, the Northwest Territories and Yukon, responded to the inquires (see Appendix I). Every responding province stated that they adopt the national building code with very few regional changes and that the only monitoring occurring is initiated by requests submitted by stakeholders such as builders, architects, building officials, and engineers. This monitoring scheme is similar to that of the ICC; there is no actual data collection, only requests submitted when a potential problem is identified.

On their website, the Building Regulations Research Programme in the United Kingdom claimed responsibility for developing sound scientific evidence in support of reviews and amendments of their Approved Documents. This is the type of monitoring and evaluation of building regulations that the team was looking for; however, we did not receive a response from this organisation. It would benefit the Commission to attempt contact with them.

### 4.1.3 Monitoring and Evaluation Systems

Realizing that neither the United States nor Canada has a satisfactory system in place that the Commission could adopt, the project team interviewed Mandy Charman, an evaluation officer at the DPCD, intending to utilize her expertise in the development of our own monitoring system (Appendix H). Ms. Charman described an evaluation planning guide which the DPCD

uses to develop monitoring methods for community programs and to evaluate them based on the outcome and effect. This system does not entirely fit with the purposes of the BC, which needs to monitor regulations by evaluating their performance. However, the DPCD guide did provide an effective basis for designing a building regulation-specific guide. We created a plan similar to the DPCD process but applying to building regulations. Ms. Bidwell worked closely with us to organize this new guide which, equipped with focus questions, helps develop a plan of action to perform a proper building regulation evaluation.

The document, entitled *Regulation Review: Developing a Monitoring and Evaluation System*, includes four sections, as shown in Appendix G. Each section consists of a brief but descriptive purpose statement and a list of focus questions meant to help direct monitors towards the most effective course of action, and to encourage new approaches they may not have considered. The sections are as follows:

1. Understand the Building Regulation - determine the purpose of a given regulation and the reasons for monitoring it
2. Recognize Potential Problem Related to the Regulation - brainstorm possible problem areas associated with the regulation
3. Identify Gaps in Knowledge and Explore Data Gathering Methods- determine data already known, as well as where more information needs to be collected and chose the best method to acquire the data desired
4. Review Original Thoughts and Assumptions - verify assumptions made, and determine if a problem not initially seen is present
5. Form Conclusions - finalize a course of action regarding the regulation and how to implement the data

When discussing *Regulation Review* with the group, Ms. Bidwell pointed out one additional issue - the lack of sufficient resources to carry out this procedure and monitor all building regulations.

### 4.1.4 Recommendations for Further Action

The team made recommendations to the Building Commission regarding regulation monitoring. These suggestions were limited by time and contact constraints as well as Commission practices. This section discussed the recommendations and associated limitations.

***Recommendations***

There are many types of monitoring systems, not all of which would suit every regulation. The Building Commission should consider pros and cons of each approach as it relates to building regulations. We suggest the Commission make contact with our most promising lead, the Building Regulations Research Programme in the United Kingdom. The Programme website stated that they performed scientific studies on building regulations. Unfortunately, the team never received responses to our inquiries. The Commission would likely benefit from making contact with this organisation and exploring their regulation research methods.

Additionally, not all regulations can be monitored because there are far too many and the cost would be too high. A priority structure is needed and would require consultations with stakeholders and members of the BC. Safety aspects of the regulations also need to be considered along with their implications [Johanna Bidwell Interview]. The Building Commission is already in the process of prioritizing regulations based on potential risks and problems that arise. We recommend the Commission complete this analysis so monitoring of the regulations can begin.

We suggest the Building Commission utilize *Regulation Review* to design building regulation monitoring plans after they form a priority-based selection process. However, this is just a provisional guide, and as experimentation goes on, changes will most likely need to be made to ensure effectiveness and usefulness. The plan was partially based on the process which the team used in monitoring temporary structure fire safety regulations. After consulting Ms. Bidwell and updating the guide further, we followed our step-by-step procedure in the manual, answering the questions with respect to temporary structures to provide a test of the guide's effectiveness. If used and developed into a more finished document, *Regulation Review* could be increasingly helpful in improving Victoria's building regulations by continually monitoring them before they reach their sunsetting period. We also recommend the Commission create a database to store all gathered information from the monitoring process for future reference.

Finally, we recommend the Commission use the regulation review results to take appropriate legislative action. If essential, the results could support immediate action for additional, amended, or removed regulations. Should urgent proceedings be determined

unnecessary, the results could be fed back into the Regulatory Impact Statement process to substantiate conclusions at a later date.

Our team noted that building regulations all expire at the same time every ten years. Instead of having all regulations sunset at once, we recommend the Building Commission have cycled expirations. The Commission could separate the regulations into two groups which would alternately end after a decade, making the RIS process half as intensive every five years. An addition to this system would have been more frequent Regulatory Impact Statements as a method of monitoring the regulations. This would allow the Commission to evaluate their regulations when they were not about to expire while providing numerous sets of data to support regulation amendments. However, RISs require large amounts of time and effort to accomplish, making more frequently completing the process very costly. Johanna Bidwell also informed us that this plan would make the renewal process more difficult and unorganized.

## 4.2 Temporary Structure Permitting Nationally and Abroad

This segment's aim was to assess fire safety of temporary structures in Victoria. The team interviewed experts from organisations involved in the permit process for temporary structures, contacted the fifty United States and seven remaining Australian States and Territories to examine their permit processes, made calculations of fire load and crowd movement, and compared temporary structures to similar permanent structures. Section 4.2 begins with results from interviews with officials in the Building Commission, Melbourne City Council, Metropolitan Fire Brigade and Hiring Companies, email responses from other nations, and concludes with the findings from our temporary structure fire safety investigation. Finally, we used our conclusions to make recommendations to the Commission regarding temporary structure safety.

### 4.2.1 Temporary Structure Permitting Nationally and Abroad

This portion addresses Australian and American States and Territories' permit processes. The team emailed each Australian State and Territory regulatory authority, as well as every US State, to learn about temporary structure permitting procedures outside Victoria.

### *Other Australian Regions' Temporary Structure Permit Processes*

The research group had no previous knowledge of temporary structure permit processes in other Australian States and Territories. By emailing all the other regions, the group learned of the practices in Tasmania and the Australian Capital Territory (ACT). Tasmania's Department of Infrastructure, Energy and Resources confirmed that various local councils are responsible for all the permits in their areas and that some local councils are stricter than others with regards to requirements such as numbers of inspections (Appendix K). The ACT response reiterated that inspection methods are left up to local councils and may vary greatly. Ultimately, we found that the Victoria Building Commission is the only government department of its kind in the nation and that permits in other Australian regions are left up to local councils, providing for a great deal of variety between permits and practices [Ed Johnstone, personal communication, 04/09/09].

The team discovered that Western Australia is currently forming its own Building Commission, modeling it after Victoria's. We also learned that several states required occupancy permits from Victoria's Building Commission rather than issuing their own. This information showed that other states were more lenient than Victoria and took no additional measures to assess the temporary structure fire loads. It also shows that Victorian standards are widely respected throughout Australia.

### *American States' Temporary Structure Permit Processes*

After discovering that temporary structures are regulated at the state level in America, the team contacted all fifty states through email [Virginia Holtzclaw, personal communication, 31/01/09]. We inquired about their specific methods; responses are shown in Appendix J. After receiving 13 responses and multiple follow ups, the team found that most states regulate temporary structures at the town or county level. One of the most notable responses was from Maine, which requires all temporary structures to obey permanent structures regulations. This shows that temporary structures are regulated strictly in at least one location. Other general responses revealed that some states require numbers of culinary appliances and other high risks features to be listed on their permits. These results helped by providing examples of places where temporary structures' permit conditions are stricter than Victoria's, which could support possible amendments to the process in Victoria.

### 4.2.2 Details of Victorian Permitting and Structure Inspections

The team interviewed experts in the Building Commission and employees of hiring companies to learn about Victoria's permit process. The process for temporary structure and Places of Public Entertainment (POPE) permits is outlined in Figure 6 below. In Victoria, temporary structure hirers must acquire occupancy permits for each of their structures from the Building Commission when required as outlined in the *Building Act 1993* [Application for Prescribed Temporary Structures 2005]. Hirers then erect their structures for event organizers, who must obtain POPEs from the local council. Council inspectors look at the event and building contents to the extent legislated by the Victorian government.

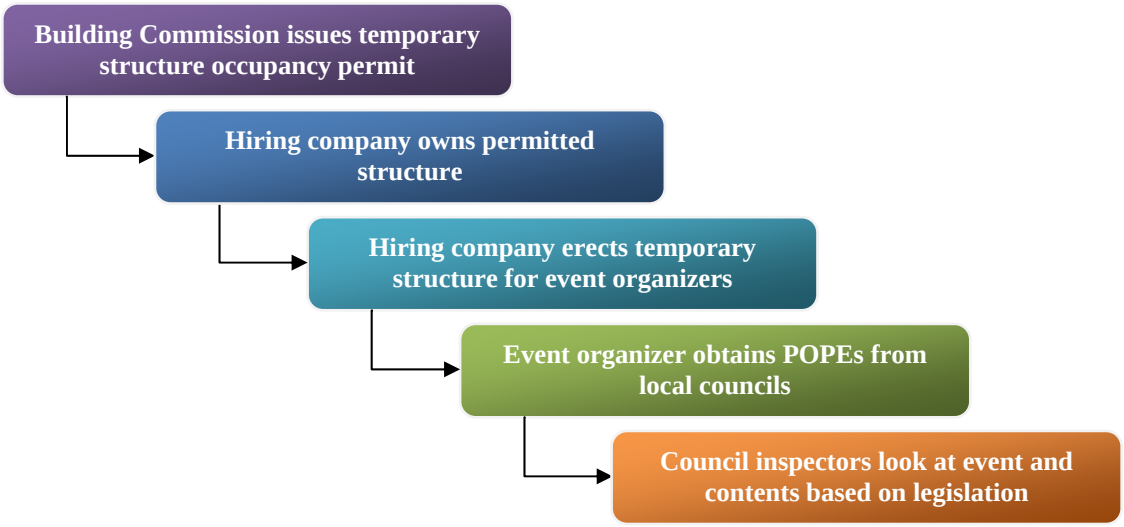


**Figure 6: Flow Chart of Temporary Structure and Event Permitting**

***Building Commission Occupancy Permit Process***

One of the goals of the Building Commission is to reduce the risk associated with temporary structures during major events. The Commission requires a variety of information from applicants before issuing permits. To start, structural plans and specifications must be included with the permit application along with any special design requirements such as soil and wind factors [Application for Prescribed Temporary Structures 2005]. Fire tests for all covering materials are also required and must have results complying with smoke and flame spread indices in accordance with the BCA.

As seen in Appendix D, the permit itself lists conditions for its validity as well as safety requirements. Conditions that must be met by the structure include numbers of entrances and exits, fire extinguisher placement, occupancy maximum, resistance to a defined maximum, and terrain category the structure can safely be erected in [Application for Prescribed Temporary Structures 2005]. Additionally, the structure must comply with the BCA and the Regulations as determined by a certified engineer. Both the Occupancy Permit and the Certificate of Compliance must be displayed when the structure is erected [John Shaw Interview; Katherine Kolar Interview]. However, the structures are empty at the time of inspection. Hence, the governing agency usually has little idea as to the future contents of the structure or the safety hazards they may create.

Once all the required documentation is submitted, the Building Commission can issue a permit in approximately two weeks; they last up to three years. Upon permit renewal, the structure must be found compliant with all current applicable standards [Information for Applicants 2008]. Part of the permit renewal process includes documentation of maintenance work carried out on the structure during the period since the last renewal; buildings must remain in a suitable condition and meet the requirements of the occupancy permit [Information for Applicants 2008].

The team's initial assumption was that the Building Commission is responsible for inspecting all temporary structures yes would not be aware of their contents. The group was also unsure of how long permits are valid for and if the Commission received structural designs or plans. Interviews with John Shaw and Katherine Kolar, Technical Advisors at the Building Commission clarified our understanding on the overall process through interviews detailed in Appendix H.

Interviews with hiring companies including, Peter Van Zeyl from Harts Party Hire, Geoff Tucker from No Fuss Solutions and Brett O'Hara from Harry the Hirer further clarified the process (Appendix H). Hiring companies obtain permits for a structural design, not a specific structure. This means that if a hiring company obtains an occupancy permit for a 10m x 10m structure, they are allowed to erect as many 10m x 10m structures as they want as long as the structural designs do not change.

Both interviews from Building Commission and hiring company employees verified that neither organisation had any knowledge of the contents of structures. This information supports

our supposition that if no organisation is aware or responsible for the contents of the structure, then there could be significant fire risks.

***Temporary Structure Inspection Processes***

Through interviews with staff at the Melbourne City Council (MCC) and the Metropolitan Fire Brigade (MFB), team learned about temporary structure inspections to. Since we knew occupancy permits issues by the Commission did not regulate for fire loads, it was important to determine if any additional permits or rules were followed by other inspection organisations.

Joseph Genco, the Municipal Building Surveyor at the MCC, explained that surveyors inspect temporary structures in accordance with the Regulations. If the buildings are part of a large event, they may also require a POPE, a permit for the event itself. Surveyors examine safety requirements of an event and the temporary structures present. They often require additional exits or exit signs to create or identify paths of egress. Building surveyors can also have structure users rearrange kitchen equipment to ensure fire safety [Joseph Genco Interview]. Additionally, they inspect materials used in walls, ceilings, flooring and siding. Such building materials, like masonite and medium density fiberboard (MDF), require fireproofing certification every 12 months, in accordance with National Fire Protection Association (NFPA) codes [Bob Hetherington Interview]. Any problems must be fixed and are consequently re-investigated by the inspector.

Bob Hetherington, a Safety Officer with the Metropolitan Fire Brigade, additionally emphasized the lack of safety inspection standards when he noted that the MFB has no official involvement in the temporary structure permit or inspection process. Though he has inspected events and buildings for the past 15 years, Mr. Hetherington's services are volunteered or requested, not required [Bob Hetherington Interview]. Recommendations made by a safety officer of his experience are not usually to taken lightly, but there is no legislation to require changes or suggestions he may make regarding set up, contents, or fire load. Conditions placed on the event or through the structure's occupancy permit are legislated, making event coordinator compliance compulsory. However, while they may note a structure's contents during assessments, the inspectors cannot regulate "fitouts" without supporting legislation [Joseph Genco Interview].

From the MCC and MFB discussions, we gathered that practitioners inspecting temporary structures would favor, even appreciate, additional regulations. Stipulations of occupancy and POPE permits do not cover all aspects of temporary events, such as structure contents. Contents affect the fireproofing of a structure and that fire protection codes, based on the NFPA codes, are very subjective [Bob Hetherington Interview]. He stated that regulations would help inspectors work, providing basic requirements that structure owners or event organizers could not argue against. Mr. Genco argued that temporary structure regulations are too simplistic, with unclear definitions and standards needing clarification.

. The summed floor area of temporary structures erected each year "possibly exceeds the space of houses going up and down" [Geoff Tucker Interview. In as industry built on swift construction and easy use of structures, regulations have implications for hirers, event planners, and regulatory bodies (councils) [Bob Hetherington Interview]. For example, if the Building Commission required more structural inspections, increased documentation and cost would ensue [Joseph Genco Interview]. Additionally, in the hiring business, speed matters, and time does not always favor regulation. Event organizers may call only 24 to 48 hours before an event requesting a specific structure, based on required size and style. Mr. Genco clarified that this makes inspecting and regulating temporary structures difficult.

An additional point made by the hiring representatives, as well as Mr. Hetherington and Mr. Genco, was that local councils across Victoria do not all handle structure and event permits the same way. Within Melbourne, the MCC is strict with regards to public safety at large events and sometimes employs Mr. Hetheringon's volunteer MFB inspection services [Joseph Genco Interview]. However, in other municipalities covering rural or semi-rural area, inspections are minimal or nonexistent and occupancy permits are rarely even requested [Geoff Tucker Interview]. Mr. Hetherington added that his inspections are performed only within the City of Melbourne because of his good relationship with the MCC; outside of the city, inspections by fire safety officers are unlikely [Bob Hetherington Interview]. Brett O'Hara and Geoff Tucker explained that inconsistent requirements for permits and inspections across the jurisdictions make following regulations difficult for the hiring companies. We then pointed out that the discrepancies could create safety problems in areas where local councils do not require safety inspections of the property or erected structures.

### 4.2.3 Analysis of Temporary Structures

This section discusses fire safety aspects of temporary structures. It focuses on fire load estimation, fire regulations and defenses in permanent and temporary structures and types of temporary structure fires, and their effect on evacuation.

***Temporary Structure Fire Load Estimations and Comparisons with Permanent Buildings***

Fire load information was found in the SFPE *Handbook of Fire Protection Engineering* and programs from the NIST website. The site contained CFAST, a program which allows users to model fire dynamics in prescribed conditions. Unfortunately, years of experience and much more time than we have would be necessary to simulate the effects of varying fire loads accurately. An interview with David Kearsley, a Research Officer from the Commission, confirmed that worthwhile simulations can take months or years to complete. Additionally, high fire load situations are more difficult to control in the occurrence of a fire, a conclusion based on test evidence, simulations from CFAST, and real events [David Kearsley Interview].

The group also conducted an interview with Tony O'Meagher from the MFB regarding fire load calculations. Mr. O'Meagher offered two possible systems to estimate the fire load of temporary structures. One method involved a complete list of temporary structure contents. From the list, corresponding heat energies for each material could be determined. The total fire load would be calculated by dividing the total floor area by the total amount of energy released from the contents (Mega Joules per square meter [$MJ/m^2$]). Mr. O'Meagher emphasized two difficulties with this method. First, gathering a comprehensive list of the structure's contents and the materials they were made of would be complicated and could result in calculation errors. Second, finding specific energies associated with the variety the materials presented would be challenging.

Tony O'Meaghers's alternative method to calculate fire load was derived from the *International Fire Engineering Guidelines, Edition 2005*. The Canadian NRC-CNRC, the Australian ABCB, and the American ICC all accept data from this resource as credible and relevant. Consequently, as a fire protection engineer, Mr. O'Meagher recommended using the information to calculate fire loads for temporary structures. He explained how fire loads for 450 different types of buildings were categorized by use. For our purposes, the most efficient method would be to pick the model buildings that most accurately resemble the style and have

similar contents to the temporary structure, and average these fire loads together. As a result, the group looked at calculating the fire load of exposition halls at the Melbourne Grand Prix and the Avalon International Airshow. This analysis was based on group observations and photos taken at the event (see Appendix M).

The first fire load calculation was done on the exposition hall at the Grand Prix. A majority of the contents were racing simulation video games and remote control cars open to public use. Accordingly, the group agreed that the fire load for a "toy store" would be an appropriate estimation to consider. The hall also had exhibits with informational pamphlets, books, and visual displays pertaining to previous grand prix events. The most appropriate categorization of this setup was an "expositional hall, furniture including decoration." Additionally, the group thought that an "office, business" fire load could be applied because large tables were used to distribute pamphlets and information. All the appropriate fire loads, "office, business" (800 MJ/$m^2$) "exposition hall, furniture including decoration" (500 MJ/$m^2$) and "toy store" (500 MJ/$m^2$) were averaged together [International Fire Engineering Guidelines 2005]. The total fire load calculation for the exposition hall at the Grand Prix is shown in Figure 7.

$$800\frac{MJ}{m^2} + 500\frac{MJ}{m^2} + 500\frac{MJ}{m^2} = 1800\frac{MJ}{m^2}$$

$$\frac{1800\frac{MJ}{m^2}}{3}$$

$$\textit{Total estimated fire load} = 600\frac{MJ}{m^2}$$

**Figure 7: Appropriate fire load average for Melbourne Grand Prix Exposition Hall**

The Avalon Airshow's exhibition hall, a floor plan of which is in Appendix L, was much more intricate than the structure at the Grand Prix. The total floor area for this hall was 13,800$m^2$, comprised of five consecutive tent structures, two 10m x 30m Uniflex tents fixed between three 40m x 110m Losberger tents. MortonHire, the company who constructed the tent, provided the schematic to the Building Commission for the occupancy permit. The image shows

the five interconnected structures and the locations of exhibits and fire safe guards within them. It includes illuminated, over-door and directional exit signs, hose reels, as well as dry chemical and water extinguishers. Using the floor schematic as a guide, in addition to firsthand observations, the group estimated the hall's fire load with two methods.

The first involved taking an average of all structures similar to those the group saw in the Airshow exposition hall, as we did with the Grand Prix calculation. The first type was an "Office, Engineering" building, having a fire load of 700 MJ/m$^2$, because international engineering companies used booths to display their newest technologies and ideas. Additionally, sections of the structure were designated as offices and meeting rooms, as shown in Appendix L. A fire load of 400 MJ/m$^2$ was also used because the two Uniflex tents were designed as "Internet café/lounges." The last three fire loads of 500 MJ/m$^2$ came from upholstery, electronics, and an exhibition hall [International Fire Engineering Guidelines 2005]. Different companies owned sections of the exposition hall and attracted crowd interest through decorations and upholstery. Similarly, display terminals, computers and large lighting fixtures were located throughout the structure. "METHOD 1" of Figure 8 below shows the average fire load calculation.

**METHOD 1**

$$700\frac{MJ}{m^2} + 400\frac{MJ}{m^2} + 500\frac{MJ}{m^2} + 500\frac{MJ}{m^2} + 500\frac{MJ}{m^2} = 2600\frac{MJ}{m^2}$$

$$\frac{\frac{2600MJ}{m^2}}{5}$$

$$\textit{Total estimated fire load} = 520\frac{MJ}{m^2}$$

**Figure 8: First Method to Calculate Fire Load of the Avalon Airshow Exhibition Hall**

Figure 9's "METHOD 2" calculated a weighted fire load average. The team addressed the five sections separately and then averaged them together with respect to their percentage of the total floor area. The two Uniflex structures were designated cafés, but have a relatively small overall floor area. The three Losberger exhibition halls were more varied in their set up and contribute to the majority of the structures floor space. By multiplying a section's fraction of the

total floor area by its corresponding fire load and adding the results together, we calculated a more accurate fire load.

The two methods yielded similar fire loads. After further examination of the *International Fire Engineering Guidelines*, the team found that fire loads of permanent structures usually fall between 300 MJ/m$^2$ and 800 MJ/m$^2$. Our temporary structure fire load estimations therefore fall within the given permanent structure fire load range, providing a basis for comparisons between temporary and permanent structures.

**METHOD 2**

$$Area\ of\ Uniflex\ 10m * 30m = 300m^2$$

$$Area\ of\ Losberger\ 40m * 110m = 4400m^2$$

$$Total\ area\ of\ tent = 3(4400m^2) + 2(300m^2) = 13800m^2$$

**Café (2 Uniflex structures)**

$$\text{Fraction of total area} = \frac{600m^2}{13800m^2} = .0435$$

$$400\frac{MJ}{m^2} * .0435 = 17.4\frac{MJ}{m^2}$$

**Office, Engineering, Electronics, Upholstery, Exhibition Hall (3 Losberger structures)**

$$\text{Fraction of total area} = \frac{4400m^2 * 3}{13800m^2} = .9565$$

$$\text{Average fire load} = 500\frac{MJ}{m^2} + 700\ \frac{MJ}{m^2} + 500\ \frac{MJ}{m^2} + 500\ \frac{MJ}{m^2} = 2200\frac{MJ}{m^2}$$

$$\frac{\frac{2200MJ}{m^2}}{4}$$

$$= 550\frac{MJ}{m^2}$$

$$550\frac{MJ}{m^2} * .9565 = 526\frac{MJ}{m^2}$$

***Total estimated fire load*** $= 526\frac{MJ}{m^2} + 17.4\frac{MJ}{m^2} = 543\frac{MJ}{m^2}$

**Figure 9: Second Method to Calculate Fire Load in the Avalon Airshow Exhibition Hall**

Not only do permanent and temporary structures have similar fire loads, but visual inspections showed structural design and content layout similarities. Bob Hetherington provided

pictures of temporary structures at Victorian events, and the group photographed comparable spaces to demonstrate permanent and temporary structure resemblances. Figure 9 shows the exterior of a temporary structure at the Volvo World Ocean Race. The design and building materials used to construct the building are visibly similar to those used in permanent shops and cafes in almost any town, as evidenced by the McDonald's restaurant in Figure 11.


**Figure 10: Structure at Volvo World Ocean Race [Bob Hetherington]**

**Figure 11: McDonald's Restaurant [www.waymaking.com]**

Figures 11 and Figure 12 show interior similarities between a structure at the Gift and Homewares Show and the interior of a souvenir shop in Melbourne, Victoria. When compared side by side, the buildings are barely distinguishable.

**Figure 13: Gift and Homewares Show [Bob Hetherington]**

**Figure 12: Souvenir Shop, Melbourne VIC [Lesley Drohan]**

Current regulations regarding temporary structures were originally made in 1994. At that time, circus tents were the largest and most complex temporary buildings [David Kearsley

Interview]. However, over the last 15 years, these structures have become increasingly sophisticated, growing closer to permanent constructions in design and use. The images above comparing temporary and permanent buildings support our conclusion that the similarity between the two types of structures is undeniable, and should therefore be considered from a regulation standpoint.

***Fire Regulations and Defenses of Permanent versus Temporary Structures***

As shown above, temporary structures are becoming more like permanent structures. For this reason, the team explored fire safety regulations of permanent buildings to determine if some of the same requirements could be applied to temporary structures.

In Australia, all buildings fall into one of ten classes, defined by use, as described by the BCA. Regulations and codes followed in Victoria align themselves with these ten classes. Temporary entertainment structures are considered Class 9b buildings, buildings of a public nature used for assembly [regulation 1102]. Buildings in Class 2 through 9 are required by the BCA to be constructed to maintain structural stability during a fire and to be provided with safeguards to prevent fire spread [BCA CF1 and CF2]. With regards to performance, these buildings must

> have elements which will, to the degree necessary, maintain structural stability during a fire appropriate to – […] (b) the fire load; and (c) the potential fire intensity; and (d) the fire hazard; and […] (g) any active fire safety systems installed in the building; and […] (i) fire brigade intervention; and […] (k) the evacuation time. [BCA CP1]

Regulations cover areas such as fire resistant construction and access to building by emergency personnel. They also require that buildings contain sprinkler systems, smoke detectors, heat and smoke ventilation, fire extinguishers, exit signs and hose reels [BCA 2007].

Sprinkler systems in particular have been shown to control the spread of a fire, allowing for full evacuation. The NIST website, www.NIST.gov, shows a U.S. Fire Administration experiment whose objective was to examine the effectiveness of residential sprinkler systems. The Fire Administration used two model rooms each consisting of a sofa, love seat, end table, lamp and carpeting. These features yielded a fire load of approximately 400 MJ/$m^2$, a value comparable to a furniture store under the *International Fire Engineering Guidelines*. Table 1 shows the fire development in each room during different time intervals. Room A had no

sprinkler system and reached the critical flashover point after 195 seconds; after 210 seconds the room was engulfed in flames. Room B never reached flashover, and the sprinkler system controlled the fire, showing the effectiveness of the suppression system [Building and Fire Research Laboratory 2002].

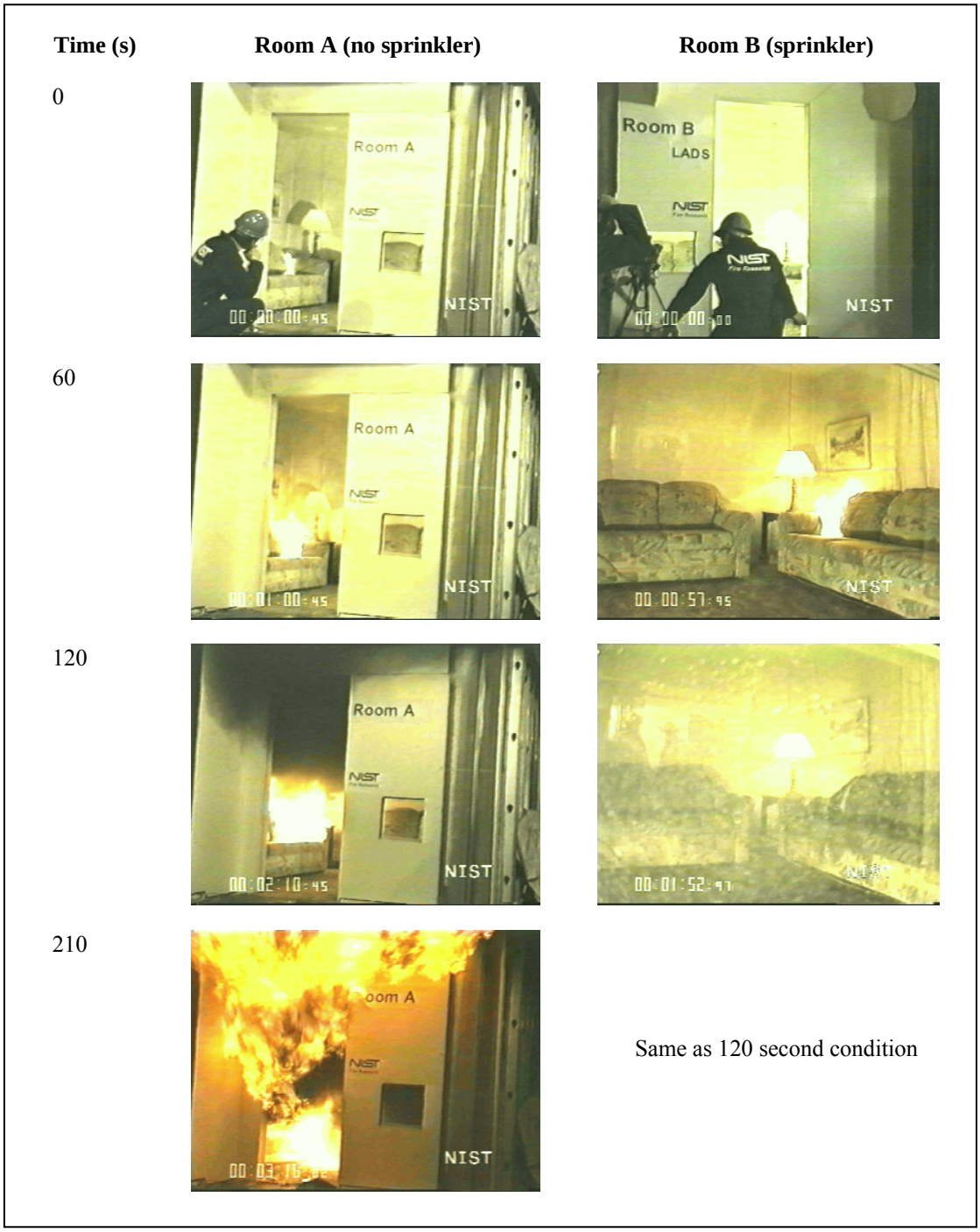


**Figure 14: Elapsed-Time Sprinkler Efficacy Test [www.NIST.com]**

Only limited fire defenses are put into temporary structures [Joseph Genco Interview]. Mr. Genco and Mr. Hetherington specified that temporary structures contain no sprinkler systems, smoke detectors, or carbon monoxide detectors. In some rare cases, like the International Airshow, hose reels may be present [Bob Hetherington Interview]. Mr. Hetherington gave the group pictures of fire hazards created by event organizers in violation of his recommendations (Appendix M).

Temporary structures only require occupancy permits, through which the Building Commission expresses stipulations on fire safety features and defenses [regulations 1104 and 1105]. Through fire proofing requirements placed on structure building materials, the structures themselves are mostly safe [Joseph Genco Interview]. However, fire loads pose an added risk to buildings which could be otherwise safe [Bob Hetherington Interview]. The regulations do not take into account fire loads for temporary structures, creating a large gap between fire defenses in permanent buildings and those in temporary structures.

***Evacuation from Temporary Structures***

Upon suggestions from both Tony O'Meagher and David Kearsley, the group looked into possible evacuation times from temporary structures. Crowd movement data, included in Appendix C, assess evacuation from buildings. While experts calculate available versus required safe evacuation times (ASET vs. RSET) as part of the permanent building design process, engineers do not analyse evacuation times for temporary structures [David Kearsley Interview]. This analysis could be valuable if performed with temporary structures. However, the depth and focus of such a study were beyond our scope. Instead, the group studied types of potential temporary structure fires. We concluded that, while the specifics of crowd flow out of structures were important for final analysis, understanding a fire's effect on evacuation was an easier way to address public safety without having expert knowledge.

David Kearsley described two generic types of fires that could occur in temporary structures. The more dangerous are smoldering fires, which usually go unnoticed for extended periods of time. After developing, they create smoke quickly and, with little ventilation in these structures, there is an increased chance of people asphyxiating. The others are flaming fires which are less dangerous in temporary structures because of ventilation. Flames can burn holes in a structure's ceiling, allowing heat and smoke to dissipate. Furthermore, most structures have

PVC ceilings that are designed to self-extinguish, preventing further fire spread. Release of heat and smoke provides people with more time to evacuate the structure and decreases the possibility of suffocation from smoke.

### 4.2.4 Recommendations for Further Action

There have not been serious temporary structure fires in Victoria, or Australia as a whole. Therefore, a change to the Regulations would not be a reaction to an issue, but rather a proactive attempt to prevent potential fires. We understand that passing legislation for structure safety is a difficult undertaking without supporting evidence.

Although, as the team has shown, temporary structures and permanent buildings have become increasingly similar over the past 15 years, they do not require equivalent safety measures and regulations. In our research, we determined many seemingly obvious courses of action would not be feasible for temporary structures. For example, although hose lines, hydrants and sprinklers may seem to be the best fire defenses, as demonstrated in Table 1, such infrastructure is not always accessible. Temporary structures may be erected in areas where there are no water mains to access easily. Additionally, the framework necessary to pipe water to sprinkler systems would not be financially feasible to set up and takedown with each use of the structure. Taking into account resources available to temporary structures, we recommend that two safety features be made mandatory, smoke and heat vents and early notification devices.

The most important aspect of temporary structure safety is getting people out of the building; these elements would give occupants more time to get out of the structure. Technologies are currently available to place vents in the roofs of temporary structures. Visibility within structures quickly disappears as smoke accumulates; ventilation would allow smoke and heat to escape the structure, increasing visibility and decreasing the danger of burns. Additionally, early warning devices such as smoke detectors would add to available evacuation time by notifying occupants of hazards at the earliest possible moment.

Furthermore, we recommend safety requirements and inspections of temporary structures be standardized across Victoria by adding legislation that more clearly defines the roles and responsibilities of city councils within the State. Through conversations with Joe Genco, Bob Hetherington, and the three hiring company representatives, the team discovered variations in the way local councils handle occupancy and event permits as well as inspections. By demanding a

higher level of involvement from inspectors, the Building Commission would automatically increases the safety of events. Normalizing requirements for inspections and permits across jurisdictions within Victoria will help maintain safety. It will also create an easier system for hiring companies to work with because each locality will have the same temporary structure regulations.

ASET vs. RSET, or available versus required safe evacuation times, for getting occupants out of structures should be examined. This analysis is already used with permanent buildings, and could be applied to temporary buildings. Analysis of burn times due to building materials and fire loads versus required evacuation times would also aid in determining necessary safety features required in temporary structures. Finally, we recommend the Building Commission analyse cost versus benefit of amended or additional regulations for temporary structures. Costs scrutinized must include potential loss of life as quantitatively determined through statistical studies of fire occurrences, types, and severity of fatalities. These types of projects are beyond the team's scope and ability, but would definitively show the need for new or amended temporary structure regulations based on fire loads.

From this study, the team found that while fire loads may not be a feasible factor to inspect due to financial constraints, they do affect the safety of buildings. Taking this into account, we recommend the Commission collect additional data to support or discourage regulation changes. These alterations may require, as the Building Commission sees fit, permits for structure contents, additional inspections of outfitted structures, or a declaration of the structure's contents included with event permits.

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# Appendix A: Glossary

***ABCB***: Australian Building Codes Board - The ABCB is a joint initiative of all levels of government in Australia and includes representatives from the building industry. The Board was established under an Inter-government Agreement signed by the Australian, State and Territory governments in March 1994 and reaffirmed in April 2006.

***AFAC***: Australasian Fire Authorities Council – The AFAC is the peak industry body for fire, land management and emergency service organisations in Australia and New Zealand.

***AMUBC***: Australian Model Uniform Building Code - The AMUBC was the first nationwide building code used in Australia and was developed in the early 1970's. This code was used up until 1990 when the Building Code of Australia was developed after many complaints about the poor design and organisation of the codes in the AMUBC.

***BAB***: Building Appeals Board - responsible for determining appeals, disputes and assessing modification and compliance requests relating to building legislation arising under the *Building Act 1993* or *Building Regulations 2006* [BAB Support Services 2009]

***BAC***: Building Advisory Council - the peak advisory council for the administration of Victoria's *Building Act 1993* [Building Advisory Council 2009]

***BC:*** Victoria Building Commission – an organisation developed by the Act to manage Victoria's building control systems

***BCA***: Building Code of Australia – The BCA is a uniform set of regulations, produced and maintained by the ABCB, designed for construction of buildings and other structures around Australia [BCA 2007].

***BP***: Building Policy Branch - Advises the Minister for "planning in relation to public construction policy and regulation" [Building commission 2008]

***BPB***: Building Practitioners Board - responsible for registering building practitioners and regulating their conduct and ability to practice [BPB Practitioner Services 2009]

***BRAC:*** Building Regulations Advisory Committee - responsible for providing advice on building regulatory matters and accreditation of building products [Building Regulations Advisory Committee 2009]

***Building Inspection***: An inspection generally carried out prior to the purchase of a property to ensure the building is structurally sound. Contracts of sale can be made subject to the satisfactory building inspection

***Building Regulations***: Legal or statutory rules set up by a local council to control the manner and quality of buildings in its jurisdiction. The rules are generally designed to ensure public health and safety as well as acceptable standards of construction

***Class 9b Buildings***: a building of a public nature- an assembly building [BCA 2007]

***DPCD***: Department of Planning and Community Development - A subdivision of the Building Policy Branch

***Fire compartment:*** the total space of a building [BCA, p 25]

***Fire load***: the sum of the net calorific values of the combustible contents which can reasonably be expected to burn within a fire compartment, including furnishings, built-in and removable materials, and building elements [BCA, p 26]

***Fire dynamics***: integration of the physical and chemical components of a fire

***Flashover***: a transitional phase in the development of a fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly, resulting in full room involvement or total involvement of the compartment or enclosed area

***FPE***: Fire Protection Engineering – A field of study offered at Worcester Polytechnic Institute encompassing to prepare men and women for careers in fire protection engineering practice, advanced levels of specialization, research, and teaching.

***HHR***: Heat Release Rate - The rate at which heat is generated by a fire. Measured in units of energy per time, such as joules per second, which is the same as a watt. Because fire creates so much heat that it is usually quantified in kilowatts or megawatts.

***ICC***: International Code Council - The ICC is a membership association that develops codes used in the construction of residential and commercial buildings across the majority of the United States.

***MFB***: Metropolitan Fire Brigade - The MFB covers over 1000 square kilometers and protects millions of Melbourne residents. It is records some of the fastest response times as well as the highest percentage of fire containment in all of Australia.

***NFPA***: National Fire Protection Association - The NFPA is a nonprofit organisation that provides consensus codes and standards, research, training, and education to help reduce the troubles caused by fires and fire related hazards in the United States.

***NIST***: National Institute of Standards and Technology – The NIST was found by the U.S. Department of Commerce to promote US innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life.

***NRC***: National Research Council of Canada - The National Research Council (NRC) is the Canadian Government's premier organisation for research and development [National Research Council Canada 2009].

***NRC-IRC***: Institute for Research in Construction – The NRC-IRC is the leading construction research agency in Canada, carrying out applied and contract research on issues of strategic importance to the Canadian construction sector [National Research Council Canada 2009].

***Path of Egress***: a continuous and unobstructed path from any location in a building to a public way

***Places of Public Entertainment***: in section 3 of the Act -

(a) Class 9b buildings having an area greater than 500m$^2$ and prescribed temporary structures are prescribed classes of buildings; and

(b) places having an area greater than 500m$^2$ are a prescribed class of places

***PC:*** Parliamentary Counsel - Provides Victory with a range of high quality services related to development, drafting, publication and implementation of legislation [Office of the Chief Parliamentary Counsel 2008]

***PIC:*** Plumbing Industry Commission - Maintains the effectiveness and efficiency of Victoria's plumbing regulatory system [Plumbing Industry Commission 2008]

***POPE***: Application for Occupancy Permit for Places of Public Entertainment

***RAP:*** Regulatory Amendments Proposals - Proponents of regulation must submit RAP's to ensure that research has been done and data has been gathered to help fulfill VCEC requirements [Building Commission 2008]

***RIS:*** Regulatory Impact Statement - An evaluation that proves a problem exists, government action is justified, and regulation in the form of subordinate legislation is the best (required when "an appreciable economic or social burden" affects any sector) [PricewaterhouseCoopers 2006]

***RPT:*** Regulatory Project Team - Consists of members from the Building Commission, Plumbing Industry Commission, and the Building Policy Branch and is assembled to pass regulation and determine operational details, including a time table.

***Temporary Structure***: any structure that can be readily and completely dismantled and removed from the site between periods of actual use

For the purpose of regulations:

(a) tents, marquees or booths with a floor area greater than $100m^2$;

(b) seating stands for more than 20 persons;

(c) stages or platforms (including sky borders and stage wings) exceeding $150m^2$ in floor area;

(d) prefabricated buildings exceeding $100m^2$ other than ones placed directly on the ground surface.

***SARC:*** Scrutiny of Acts and Regulations Committee - Scrutinizes the bills and regulations introduced into Parliament while reviewing redundant, unclear, or ambiguous legislation [Parliament of Victoria 2009]

***Sunsetting Regulations:*** Regulations set to expire within a specific period of time

***VCEC:*** Victorian Competition and Efficiency Commission - Reviews the current state evaluation of regulation to determine if more evaluation needs to be done

# Appendix B: Field Experts Consulted

The following experts were consulted with regards to their area of expertise. The names and titles of each individual are recorded below.

Bidwell, Johanna

*Research Officer, Technical and Research Services; Victoria Building Commission*

Charman, Mandy

*Evaluation Support Officer; Department of Planning and Community Development (Victoria)*

Genco, Joseph

*Municipal Building Surveyor; Melbourne City Council*

Hetherington, Robert

*Station Officer, Building Inspection & Compliance Department; Metropolitan Fire Brigade*

Kearsley, David

*Research Officer, Technical and Research Services; Victoria Building Commission*

Kolar, Katherine

*Technical Advisor, Technical and Research Services; Victoria Building Commission*

Meacham, Brian

*Associate Professor; Worcester Polytechnic Institute- Fire Protection Engineering*

O'Hara, Brett

*Representative; Harry the Hirer*

O'Meagher, Tony

*Fire Engineering Consultant; Metropolitan Fire Brigade*

Rechter, Helen

*Regulatory Development Advisor, Technical and Research Services; Victoria Building Commission*

Shaw, John

*Technical Advisor, Technical and Research Services; Victoria Building Commission*

Tucker, Geoffrey

*Managing Director; No Fuss Solutions*

Van Zeyl, Peter

*Business Development Manager, Harts Party Hire*

# Appendix C: Fire Risk Assessment

In this section:



### *Criteria for Fire Risk Assessment*

- Materials/equipment used in structure (building, contents)
    - Stoves/ovens/open flames/gas containers
    - Cabinetry
    - Movable furniture (chairs, tables, booths/stalls, etc.)
    - Plumbing (sinks, toilets, showers)
    - Electrical systems (cable, internets, telephone lines, regular electricity)
        - Exposed vs. unexposed lines
    - Multiple separations or wide open space?
    - Number of entrances/windows
    - Upholstery (carpeting, wall hangings, plush anything, curtains)
    - Ceilings (false, fabric- fire proof?)

- Safety Systems
    - Fire defenses
        - Sprinklers/hose lines
        - Extinguishers
        - Smoke/CO detectors
        - Fire escapes/emergency exits
        - Generators
        - Path of egress (unobstructed path to outside)
            - Directional crowd flow?
            - Large congregation areas?
    - Medical systems
        - On-site treatment?
        - Specialized equipment?

### *Fire Assessment at the Micro Level*

Micro level analysis takes individual factors, such as fire load, into account [Fitzgerald 2004]. The technical definition of fire load is the measure of all combustible material that is in a compartment divided by the floor area of that compartment, in kilograms per square meter [Fitzgerald 2004]. Fire load represents the potential fuel available to a fire and can vary depending on the type of material. An area of a structure is said to have a "heavy fire load" when it is filled with a large amount of combustible

materials; this calculation should include the building itself if it is combustible. The heat release rate (HRR) indicates the rate of a specific material's released energy when burned in terms of watts (W), kilowatts (kW) or megawatts (MW). Peak HHR examples of common items are shown below in Table 1 [Brannigan 2008].

**Table 1: Typical Peak Heat Release Rates of Common Items**

| Fuel | (kg) | (lb) | Peak HRR (kW) |
|---|---|---|---|
| Wastebasket, small | 0.7-6.1 | 1.5-3 | 4-18 |
| Trash bags, 11gal with mixed plastic and paper trash | 1.1-3.4 | 2-7 | 140-350 |
| Cotton mattress | 11.8-13.2 | 26-29 | 40-970 |
| TV sets | 31.3-32.7 | 69-72 | 120-290 |
| Plastic trash bags/paper trash | 1.2-14.1 | 2.6-31 | 120-350 |
| PVC waiting room chair, metal frame | 15.4 | 34 | 270 |
| Cotton easy chair | 17.7-31.8 | 39-70 | 290-370 |
| Gasoline/kerosene in 0.61m$^2$ (2ft$^2$) pool | 19 | | 400 |
| Christmas trees, dry | 6.4-7.3 | 14-16 | 500-650 |
| Polyurethane mattress | 3.2-14.1 | 7-31 | 810-2630 |
| Polyurethane easy chair | 12.2-27.7 | 27-61 | 1350-1990 |
| Polyurethane sofa | 51.3 | 113 | 3120 |

Micro level analysis also includes safety precautions against high fire load setups and incorporates both active and passive defenses. Active protections are comprised of sprinkler systems and fire detectors that initiate when smoke sensors trigger [Fitzgerald 2004]. A passive protection is the path of egress, defined as "a continuous and unobstructed path from any location in a building to a public way." The passageway includes proper exits and stairwells if applicable to the temporary structure [Fitzgerald 2004]. Evacuation assistance services use the route to enter structures efficiently, making it less difficult to extinguish a fire and aid in rescue services. Fire extinguishers are another passive defense if placed in easily accessible locations to be used by the public in an emergency.

### *Fire Dynamics at the Macro Level*

When a fire occurs, it is not isolated, but a dynamic situation which integrates all parts of micro level analysis. Fires incorporate interactions between material size, shape, crowd flow, and fire defenses [Fitzgerald 2004]. The resulting combinations determine whether a fire will propagate or extinguish. Buildings' structural plans employ securities to contain fires while people evacuate. Evacuations plans include the number of entrances and exits present, the setup of the structure, and any available specialized equipment. A complete list of criteria used to evaluate the risk can be seen in Appendix B.

A fire will burn until all its fuel, building materials or structure contents, is used unless acted upon by an external force, such as fire preventative sprinklers or fire brigade action [Fitzgerald 2004]. Walls, if present in the temporary structures, may act as barriers to resist fire spread until the implemented defenses work in unison to possibly extinguish the fire [The European Steel Design Education Programme 1993]. The more safeguards associated with the events, the smaller the probability that the fire will get out of control (Table 2).

**Table 2: Preventative Fire Measures and Corresponding Probability of Uncontrolled Risks**

| *Types of Active Measures* | *Probabilities of fires getting out of control* |
|---|---|
| Public Fire Brigade | 1/10 |
| Sprinklers | 2/100 |
| Public Fire Brigade combined with Alarm System | 1/1000 |
| Public Fire Brigade combined with Alarm System and Sprinkler System | 1/10000 |

### *Crowd Movement and Human Behavior*

Expert knowledge of evacuation and fire safety would be necessary to make accurate calculations on available and required safe evacuation times (ASET and RSET). To accurately measure evacuation time, we first examined crowd movement in emergency situations through data from the SFPE *Handbook of Fire Protection Engineering, 2nd Edition*.

Information relating to movement focuses on several key areas, including crowd density, speed, and flow. Crowd density is the number of people per $m^2$ in the egress pathway. Speed is the distance per time, or meters per second (m/s), and the flow is "the number of people that pass a reference point per second" [SFPE 1995]. Under moderate crowd conditions traveling through an average passageway, engineers use a density of approximately 1 person per $m^2$, a speed of 1 m/s, and a flow of 1.33 people per second. For typical one story temporary structures, doorways and walkways govern flow because they are the most restricted areas of egress. Egress paths of ten meters in length, a relatively short distance to travel, can allow enough time for smoke levels to reach a critical point of 2.1 meters above the ground. This level of smoke is an accepted value among fire protection engineers at which a situation becomes hazardous. Consequently, evacuation becomes more difficult as visibility and breathing becomes a concern.

Evacuation also becomes difficult when a critical density of 8 people per $m^2$ is reached due to rapid accumulation caused by panic or overcrowding. Information from the SFPE Handbook on studies

from *Wood's Pioneer Survey of Behavior in Great Britain*, in addition to case studies of major U.S. fires and research on human behavior (see below), proves that panic in a fire is rare. Although panic is uncommon, evacuation analysis shows that over-crowding can still be hazardous as more people will take longer to exit a structure. From group observations, no crowd control limitations have been set on temporary structures and thus over-crowding seems quite common.

Some general conclusions about fire-related human behavior:

1. Panic is rare. Normal patterns of behavior, movement route choices, and relationships with others tend to persist during emergency situations. Behavior tends to be altruistic and reasonable.
2. A central motivation and activity in fire is to seek information about the nature and seriousness of the situation.
3. Evacuation, and response to fire generally, is often a social response-people tend to act in group fashion.
4. Problems that are encountered during building use will tend to persist and exacerbate situations in emergencies

National Bureau of Standards (NBS) recommendations on crowd movement as it relates to building design:

1. Strive for simplicity in all access and movement routes- this lessens the need for directional graphics and ushers.
2. Capacity-handling channels should be continuous walking surfaces, such as ramps. Stairs are satisfactory to shorten channels not subject to heavy pedestrian load.
3. To the greatest extent possible, ingress systems should be "reversible" and useable whenever emergency egress is necessary.

# Appendix D: Example Temporary Structure Occupancy Permit

File no: PF/77
Occupancy Permit No: TSM 2008-0016

Building Commission

**FORM 6**

Level 27, Casselden Place
2 Lonsdale Street, Melbourne
Victoria, Australia 3000
PO Box 536E, Melbourne
Victoria, Australia 3001
Telephone +61 3 9285 6400
Facsimile +61 3 9285 6464
Dx 210 299 Melbourne
www.buildingcommission.com.au

**Building Act 1993**
Building Regulations 2006
Regulation 1005

## OCCUPANCY PERMIT

**To**
Owner: Sheryl Treloar
Robian International
210 Hutton Street
ADELAIDE SA 5000

**Property details**

Municipal District: Statewide-Victoria

**Places of Public Entertainment**

Place of public entertainment: **Prescribed Temporary Structure**

Prescribed class of temporary structure:

- **6 metre span 4metre bay aluminium framed marquee 3.6 m in height unlimited in length.**
- **9 metre span 3metre bay aluminium framed marquee 4.2 m in height unlimited in length.**

Public entertainment to be conducted: **N/A**

Period of operation of use: **This permit will lapse on 13 October 2011 unless a renewal is sought before that date.**

**Conditions**

**Occupation is subject to the following conditions:**

1. The siting of the structures must be approved by the municipal building surveyor of the municipal district.

2. The permit does not allow the structure to be attached to any other structure. If this is intended detailed plans will be required to be submitted to the Building Commission prior to the issue of an amended occupancy permit.

3. The structure must be erected in accordance with the submitted engineering design and all documentation being –

*Frame section and elevation by Robian Industries.*

*Engineering computations by Hayden Design Pty Ltd: 94580: pages 1 to 19, 1A, 2A and computer printouts.*

*General Notes by Hayden Design Pty Ltd.*

*Calculations prepares by Koukourou Engineers Job No: 36204A Amendment A dated 11.10.2001.*

*Computations Job No. MF-0160-01SE for 9m span and 3m bay spacing structure pages 1-20 prepared by TGM Group Pty Ltd dated 07/05.*

*Computations Job No. MF-0160-01SE for 6m span and 4m bay spacing structure pages 1-20 prepared by TGM Group Pty Ltd dated 01/04.*

4. The structure must only be used in terrain categories 2.5, 3 and 4.

5. The structure must be evacuated when the wind speed exceeds 90kph.

6. The owner of the structure or hirer must obtain confirmation in the form of a Certificate of Compliance - Inspection issued by a registered building practitioner in the category of building surveyor, building inspector, civil engineer or supervisor - (Temporary Structures class 1 or class 2 as appropriate) stating that all conditions of the occupancy permit have been complied with following the erection of the structure.

7. Number of persons accommodated must be calculated:
   a) at a ratio of one person for every 0.5$m^2$ of occupiable floor area; **or**
   b) by reference to the seating capacity; **or**
   c) in accordance with Clause D1.13 of the Building Code of Australia (BCA).

8. Extinguishers must be provided as follows:
   a)
      (i) one (1) x 9 litre water fire extinguisher for every 200 $m^2$ or part thereof **or**
      (ii) one (1) x 4.5 kg AB(E) dry chemical powder extinguisher for every 100 $m^2$ or part thereof; and
   b) One (1) x 4.5 kg AB(E) dry chemical powder extinguisher must be located adjacent to:
      (i) any electrical generation equipment or power boards;
      (ii) any flammable liquid or gas containers;
      (iii) any area where food preparation is being carried out that involves cooking.

*Note:- Should the event be of a major nature which requires an occupancy permit to be issued for a place of public entertainment, the above item may be negated following discussions with the relevant fire authority and municipal building surveyor upon condition of the attendance of any fire appliances, provision of hose reels or hydrants and attendance of staff as agreed.*

9. All extinguishers must be maintained in accordance with AS 1851 – 2005.

10. Every extinguisher must be positioned on a substantial hook or bracket not more than 1.2 metres above the ground and its base must not be less than 100 mm above the ground with signage in accordance with AS 2444.

11. A copy of the Certificate of Compliance - Inspection referred to above must be issued to the lessee/hirer of the structure, and displayed on a wall near the main entry.

**TSM 1.1 Exit width**

1) Exits for structures up to 200 $m^2$ must have an aggregate width of 2 metres with a minimum width for any one exit of 1 metre; **or**
2) Exits for structures between 200 $m^2$ - 300 $m^2$ must have an aggregate width of 3 metres with a minimum width for any one exit of 1 metre, and,
3) Exits must be spaced as evenly as possible around the perimeter of the structure.

**TSM 1.2 Exit signs**

1) One photo luminescent or self-contained battery operated exit sign must be installed above each exit.
2) Where structures are fully open on at least 3 sides, the exit and exit sign requirements need not be complied with.

**TSM 1.3 Sanitary facilities**

1) For structures under 200 $m^2$ at least one closet pan for male patrons and one closet pan for female patrons; **or**, one unisex facility where not more than 100 persons will be accommodated.
2) For structures between 200 $m^2$ - 300 $m^2$, at least one closet pan for the use of male patrons and at least 2 closet pans for female patrons, with corresponding wash basins for each sex.

*Note 1:- that a single unisex facility for use by people with disabilities is required when sanitary facilities are required to be provided, this facility can also be counted as part of the number of facilities generally required. When more than 5000 people are to be accommodated in the structure a total of two unisex facilities or one unisex facility and one closet pan and washbasin for each sex are to be provided for people with disabilities.*

*2:- Item 1.3 does not apply where equivalent permanent facilities are available within the venue or if the event is of a major nature which requires an occupancy permit to be issued for a "place of public entertainment" and stipulates toilet facilities that are required.*

**TSM 2 FOR MARQUEES, TENTS OR BOOTHS GREATER THAN 300 $M^2$**

**TSM 2.1 Exit width**

Exits to be provided shall have a width not less than:

| | | | |
|---|---|---|---|
| ☐ | up to 100 persons | ☐ | one metre |
| ☐ | between 100 and 200 persons | ☐ | one metre plus 250mm for each additional 25 persons in excess of 100 |
| ☐ | more than 200 persons | ☐ | two metres plus 500mm for every 75 persons (or part of 75) in excess of 200 persons |

**TSM 2.2 Distance of travel and exit requirements**

1) The maximum distance of exit travel must be:
   a) not more than 20m to one exit; **or**
   b) not more than 20m to a point where travel to two exits are available and where this occurs the total exit travel distance must not exceed 40m.

2) Exits must be :
   a) spaced as evenly as possible around the perimeter of the structure; **and**

b) policed at all times during use to ensure that they are kept clear in case of an emergency.

**TSM 2.3 Exit signs**

Exit signs and emergency lighting must comply with the following:

a) one photo luminescent or self-contained battery operated exit sign must be installed in accordance with AS 2293.1 above every exit;
b) maintained in accordance with AS 2293 Part 2.; and
c) directional and/or oversized exit signs may also be required.

**TSM 2.4 Sanitary facilities**

Toilet facilities must be provided at a ratio of:-

| User | Maximum number served by- | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Closet fixtures | | | Urinals | | | Washbasins | | |
| | 1 | 2 | each extra | 1 | 2 | each extra | 1 | 2 | each extra |
| MALE | 250 | 500 | 500 | 100 | 200 | 100 | 150 | 300 | 150 |
| FEMALE | 75 | 150 | 75 | | | | 150 | 300 | 150 |

*Note 1: that a single unisex facility for use by people with disabilities is required when sanitary facilities are required to be provided, this facility can also be counted as part of the number of facilities generally required. When more than 5000 people are to be accommodated in the structure a total of two unisex facilities or one unisex facility and one closet pan and washbasin for each sex are to be provided for people with disabilities.*

*2: Item 2.5 does not apply where equivalent permanent facilities are available within the venue or if the event is of a major nature, which requires an occupancy permit to be issued for a "place of public entertainment" and stipulates toilet facilities that are required.*

**Approved location for display of occupancy permit:**

The approved location for the display of this permit for the purpose of regulation 1007 is adjacent to the main entry in a weather proof cover.

**Suitability for occupation**

The place of public entertainment to which this permit applies is suitable for occupation subject to compliance with all conditions of this permit.

**Relevant Building Surveyor: Building Commission**

Signature:.....

**Tony Arnel**
**Building Commissioner**

Permit No: **TSM 2008-0016** Date of issue: **2 October 2008**

Building Commission
PO Box 536
MELBOURNE VIC 3001

# Appendix E: Occupancy Permit for Places of Public Entertainment

## Occupancy Permit for Places of Public Entertainment (POPE)

Form 5, Building Regulations 2006, Regulation 1002

Hotline 03 9658 9658
enquiries@melbourne.vic.gov.au
www.melbourne.vic.gov.au

city of Melbourne

## FACT SHEET

**Are you considering having any enclosed event (Places of Public Entertainment) greater than 500m$^2$?**

Pursuant to Section 49 of the Building Act 1993 a person must not conduct a public event or occupy Places of Public Entertainment (POPE) unless an Occupancy Permit (OP) has been issued for the venue by the Municipal Building Surveyor. This requirement binds both, the Crown, State and Federal Government and their agencies.

A Place of Public Entertainment is defined as an area greater than 500m$^2$, which is enclosed or substantially enclosed by a fence or barrier.

**Is the event to be held within the City of Melbourne's parks, gardens or reserves?**

Any event held within the City of Melbourne's parks, gardens or reserves must be approved by the **Event Operations Team** 9658 9750.

**Is the event to be held on any Council controlled roadways or footpaths?**

Any event held on Council controlled roadways or footpaths must be approved by the **Event Operations Team** 9658 9750.

**Are you erecting any Prescribed Temporary Structures*, Temporary structures or scaffold structures, access platforms, gantries, towers or the like?**

Additional Siting Permits may be required for any Structures built or occupied prior to the issue of the POPE.

* ***A Prescribed Temporary Structure is***

- A stage or platform exceeding 150m$^2$
- A tent, marquee or booth with a floor area greater than 100m$^2$
- A seating stand that accommodates more than 20 persons
- A prefabricated building with a floor area exceeding 100m$^2$

which is used as an assembly building/place of public entertainment

**Application for an Occupancy Permit** must be made to the Municipal Building Surveyor at least 15 working days prior to the commencement of the event. For events of a major nature advice and briefing sessions are available and additional time will be required to assess the application.

Applications are required to be presented in the format detailed on the opposite side of the page. ***Applications not made in this format will be returned.***

**Please note:**
All permits must be obtained prior to occupying the event. Failure to comply with these requirements may result in penalties and fines being issued and include the cancellation of the event.

For more information on any of the issues covered in this fact sheet, please contact City of Melbourne building Branch on 9658 9658.

# Places of Public Entertainment (POPE)
# Application Format

1. **Brief description of event and Index detailing application content**

2. **Completed Application Form**

3. **Schedule of all proposed P*rescribed Temporary Structure(s)*, Temporary structures* and existing buildings to be used during the event. The schedule must detail:**
   - Structure being used (name corresponding with site plan)
   - Building Commission Occupancy Permit number for the Prescribed Temporary Structure
   - Use of structure (assembly/supporting structure/temporary seating, stage etc.)
   - Size of the structure in metres
   - Proposed amount of people the structure will hold

4. **Three (3) copies of clearly labelled site plans to scale identifying the following:**
   - Locality plan showing the boundary of the proposed POPE and boundary conditions
   - Location of all existing building(s), proposed Temporary Structures and all other tents, caravans, trailers, scaffolds, marquee platforms, gantries, screens or the like
   - Location of emergency exits (widths included) and emergency vehicle access
   - Location of toilets, drinking taps and medical facilities

5. **Prescribed Temporary Structures or permanent structures** (These are to be sectioned separately eg 5.1, 5.2)

   Each Prescribed Temporary Structure or permanent structures in each section is to include:
   - Copy of the Building Commission Occupancy Permit (OP)
   - Plan of the structure to scale detailing floor layout and any current or proposed fire safety system (fire safety systems include fire extinguishers, fire blankets, emergency lights, exit signs and exit widths

NOTE

Building Commission Occupancy Permits for Prescribed Temporary Structures in the majority of cases require the structure to be based on the ground. Structures placed on platforms or requiring extension legs may require a revised OP from the Building Commission.

6. **Supporting structures for Prescribed Temporary Structures, Temporary Structures or gantries, towers, access platforms or the like greater than 1 meter above ground level** (These are to be sectioned separately eg 6.1, 6.2)

   Temporary structures not required to be issued with a Building Commission Occupancy permit require documentation to be supplied to council to the satisfaction of the Municipal Building Surveyor including;
   - Approved Form-Certificate of Compliance-Design and drawings from a registered engineer
   - Documentation detailing fire hazard amenities and Fire safety

   Each supporting structure / scaffold / gantry / tower, or like structure in each section is to include:
   - Approved Form-Certificate of Compliance-Design and Drawings from a registered engineer
   - Locality plan

7. **Sanitary and drinking facilities detailing the following**
   - Site plan detailing location of facilities
   - Schedule detailing the number of facilities provided
   - Male/Female/Disabled toilets
   - Wash hand basins
   - Fountains/taps provided at that location

   (A guide is provided on the following page)

8. **Details of first aid facilities to be in accordance with Table F2.101 of the BCA**. (A guide is provided on the following page)

9. **Emergency procedure manual and plans, including the number of fire safety officers and first aid/ambulance officers attending.**

**The application fee for an Occupancy Permit is as follows:**

| | |
|---|---|
| 500m$^2$ to 1,000m$^2$ | $850 |
| 1,001m$^2$ to 5,000m$^2$ | $1,050 |
| 5,001m$^2$ to 10,000m$^2$ | $1,650 |
| 10,0000m$^2$ or more | $2,050 |

Any variations to a completed Occupancy Permit issued by the Municipal Building Surveyor will incur a fee of $150.00

Each application fee includes one (1) preliminary inspection and one (1) final inspection. Any additional inspections will be charged at a fee of $100 per inspection.

# Places of Public Entertainment (POPE)
# Paperwork Check List

| Format Ref | Paperwork Check list | | Note | Complete |
|---|---|---|---|---|
| 1. | **Description of event and index** | | | |
| 2. | **Application Form (FORM 5)** | | | |
| 3. | **Schedule of proposed buildings and structures to be used during the event** | | | |
| 4. | **Three (3) copies of detailed site plans** | | A | |
| 5. | **Prescribed Temporary Structures / permanent structure plan** | | B | |
| | Building Commission Occupancy Permit | | C | |
| | Plan of structure and details | | | |
| 6. | **Support structure / scaffold / gantry / tower / platform structure or the like** | | | |
| | Building Commission Occupancy Permit<br>Copy of Approved Form-Certificate of Compliance-Design with drawings | | D | |
| | Scaffold structure | | | |
| | Concourse / platform | | | |
| | Gantry / tower | | | |
| | Temporary Seating (Building Commission Occupancy Permit may be required) | | | |
| 7. | **Sanitary Facilities** | | E | |
| | Male | 1 urinal per 200 persons, 30% of which must be water closets | | |
| | Female | 1 water closet per 100 persons | | |
| | Disabled | 1 unisex disabled water closet per 100 water closets or part thereof | | |
| | Wash hand basins | 1 wash basin per 150 persons | | |
| | Drinking Fountains | 1 per 150 persons | | |
| 8. | **First aid facilities** | | F | |
| | 1 room | 5001 – 10,000 persons | | |
| | 2 rooms | 10,001 – 15,000 persons | | |
| | 3 rooms | 15,001 – 30,000 persons | | |
| | *1 room for each extra 15,000 persons or part thereof* | | | |
| 9. | **Emergency procedure manual** | | | |
| | **Additional Siting Permit required** | | G | |
| | **Is event in City of Melbourne park, garden or reserve** | | H | |
| | **Is event held on Council controlled roadways or footpath** | | I | |

**Notes:**

**A.** Plans must show extent of grounds, building(s) to be used, (for small single structure events emergency lighting, emergency exit signs and exit widths, location and type of fire extinguisher/fire blanket and sanitary facilities can be shown on the site plan.

**B.** For large venues or multi structure site, individual detailed plans showing emergency exits and exit widths, exit signs and emergency lighting, location and type of fire extinguisher/blanket.

**C.** Check expiry date and whether permit covers type of structure to be used.

**D.** Check expiry date, drawing and computation (if provided) ref numbers against Approved Form.

**E.** This is the minimum number of sanitary facilities and may vary upon review of the application.

**F.** First aid facilities station minimum room size of $24m^2$. Rooms must contain a sink or wash hand basin. First aid facilities must be located so as to be convenient to a public road and accessible from within and outside the arena or ground. Smaller events are still required to have first aid facilities.

**G.** Additional Siting Permits may be required for any Prescribed Temporary Structures (marquee greater than $100m^2$, stage greater than $150m^2$ or seating stand with more than 20 persons, prefabricated buildings with a floor area exceeding $100m^2$) that form part of an event.

**H.** Any event held within the City of Melbourne's parks, gardens or reserves must be approved by the **Event Operations Team** 9658 9750.

**I.** Any event held on Council controlled roadways or footpaths must be approved by the **Event Operations Team** 9658 9750.

City of Melbourne

# Application for Occupancy Permit for Places of Public Entertainment (POPE)

Form 5, Building Regulations 2006, Regulation 1002

**To.**

| | | |
|---|---|---|
| The Municipal Building Surveyor | Telephone | 9658 9658 |
| City of Melbourne, PO Box 1603, Melbourne VIC 3001 | Facsimile | 9650 5310 |

**From.**

| | | |
|---|---|---|
| Owner of Land ☐ Event Organiser ☐ | | |
| Company: | Telephone | |
| Billing address: | Facsimile | |
| Emergency contact person: | Mobile | |

**Event Address Details**

| | |
|---|---|
| Name of event | |
| Number Street/Road | Suburb |
| Reserve or oval Name: | Melways ref |

**Duration of Event**

| | | |
|---|---|---|
| Commencing: | To | Attending population per day* |
| Day event ☐ | Night event ☐ | Both ☐ |

*Attending population is to include public, staff and volunteers etc…

**Place of Public Entertainment**

| Part of Building | Intended Use | BCA Class |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**Applicant's declaration**

I am authorised to apply for this permit on behalf of the client and I hereby undertake to comply with requirements of the Building Act 1993, Building Regulations 2006 the Building Code of Australia and any special conditions as required by an Authorised Officer of the Council. I understand by making this application I will be invoiced for application fee and any other fees as described on page 2 of this document.

| | |
|---|---|
| Signature of owner/event organiser/hirer | Date |
| Print name | On site contact number |

The personal information requested on this form is being collected by Melbourne City Council for the Management of Building Works or Works on Roads in order to comply with the Activities Local Law 1999 and Building Regulations 2006. The Council will use this information only for that purpose or for directly related purposes. You may apply to Council for access to your personal information or to amend the same. If you do not provide this information your permit application cannot be processed.

# Appendix F: Fire Load Survey for Event Organizers

Does your structure include any of the following? If yes and applicable, indicate to the best of your knowledge the number of each in the space provided.

| *Item* | *Present in My Structure?* | *Number of Item* |
|---|---|---|
| Stoves/ovens | ☐ YES ☐ NO | _____ |
| Gas Containers | ☐ YES ☐ NO | _____ |
| Fire pits/grills | ☐ YES ☐ NO | _____ |
| Cabinetry | ☐ YES ☐ NO | |
| Chairs | ☐ YES ☐ NO | _____ |
| Tables | ☐ YES ☐ NO | _____ |
| Vender stalls/booths | ☐ YES ☐ NO | _____ |
| Upholstery: | | |
| Carpeting | ☐ YES ☐ NO | |
| Curtains | ☐ YES ☐ NO | _____ |
| Electrical Equipment: | | |
| Lighting Fixtures | ☐ YES ☐ NO | _____ |
| Televisions or computer stations | ☐ YES ☐ NO | _____ |
| Exposed Wiring | ☐ YES ☐ NO | |
| Unexposed Wiring | ☐ YES ☐ NO | |
| Air conditioning | ☐ YES ☐ NO | |
| Heating units | ☐ YES ☐ NO | |
| Plumbing features: | | |
| Sinks | ☐ YES ☐ NO | _____ |
| Toilets | ☐ YES ☐ NO | _____ |
| Other | ☐ YES ☐ NO | _____ |
| Specified entrances/exits | ☐ YES ☐ NO | _____ |
| Windows | ☐ YES ☐ NO | _____ |
| Ceilings | | |
| Drop Down/False | ☐ YES ☐ NO | |
| Cloth | ☐ YES ☐ NO | |
| If yes, is it fireproof? | ☐ YES ☐ NO | |
| Flooring | ☐ YES ☐ NO | |

# Appendix G: Developed Guide for Regulation Monitoring

## *Regulation Review: Developing a Monitoring and Evaluation System*

*I. Understand the Building Regulation*

The purpose of Step I is to understand the regulation being evaluated. Knowing what regulation is being explored and who it affects is essential in evaluating regulations. The following four questions help determine parties who should be contacted with regards to your evaluation:

1. What regulation is to be monitored/evaluated?
2. What is the purpose of the regulation? What has it been designed to achieve?
3. What objective of the *Building Act 1993* does the regulation relate to?
4. Who are the stakeholders that are involved in, or affected by, the regulation?

*II. Recognize Potential Problems Related to the Regulation*

Step II focuses exploration on a specific issue, or set of issues, related to the regulation being monitored/evaluated as well as how it is, or should be, enforced.

1. Why is the regulation being investigated? What are the key issues?
2. Consult with previously identified stakeholders.
3. What is the purpose of the regulation?
4. Is the purpose of the regulation being fulfilled? What is or is not working?
5. Is there any type of compliance or enforcement which should be involved?
    a. Is this occurring?

*III. Identify Gaps in Knowledge and Explore Gathering Methods*

Step III determines what information is currently known, and where more needs to be collected., then figures out how to collect the needed data.

1. What existing data or information exist about this regulation and the issue(s)?
2. What data and information are required to improve understanding of the regulation and issue(s)?
3. What techniques will help to fill the data gaps?

*IV. Review Original Thoughts and Assumptions*

Step IV aids in clarifying initial assumptions about the issue(s) at hand and seeking additional problems discovered during the process.

1. Did you make any assumptions about the problem(s) in your original investigation?
    a. Are any assumptions relevant?
2. Did studies prove that the issue(s) truly exist?
    a. If yes, are they addressed by another organisation or stakeholder?
3. Were any other problems uncovered during your investigation?
    a. How do any additional problems affect your study?

*V. Form Conclusions*

Step V focuses on choosing a course of action and analysing results and consequences of the desired action.

1. What are your findings?
    a. Are they credible? Why or why not?
2. Do your findings support new, removed, or amended regulations?
    a. What are the cost/benefit implications?
    b. What effect will changes have on the stakeholders?
3. Will this data be saved for later use, or will immediate action be needed?
    a. How will your conclusions be used?

# Appendix H: Interview Minutes

**27.03.09**

*Interview: Joseph Genco*
*Title: Municipal Building Surveyor (MCC)*

Regulations

- Ill-suited to majoring buildings
- Promote domestic buildings
    - Too simplistic
- Another set for complex buildings?
- Lodging of permits
    - Poorly described
    - OP: convoluted, complex
    - Do not deal with multi-level structures
- Temporary Structures
    - Legislation is too simplistic
        - Unclear definitions
        - Standards need clarification
    - Used as a guide for MBS
        - Increased inspections = increased documentation
        - Events from hiring companies might be 12-24hours in advance
            - Asking for more info may not be feasible
        - When do they get involved?
    - Class 6, class 9b

POPEs

- What is a POPE?
    - Why permit?
        - What are they trying to achieve?
    - Class of buildings
- Events Team
    - Coordinate events
    - Focused on safety (think they do)
        - Actually developers- push on coordinators
- If OP = yes:
    - Applications- info and checklist
    - Size control- BC Ops (confusing)
- If OP = no:
    - Extra criteria
    - When should MBS get involved?
        - Smaller
            - Still require compliance of design from engineer
            - Usually not compliance from the erector
        - Same as BC?
- Beyond original legislation
    - Started with just circus tents

    - Now trying to cope with variety and complexity
        - Stairs
        - Treds
        - Stages (sub boards, electrical safety)
- As a whole
    - Public safety, amenity
    - Ops = set of certified documents
        - MBS need conditions of the OP met
            - Structure certified by erector
    - Use BCA as a guide
    - Requirements:
        - Emergency evacuation plans, emergency access plans, building plans, fire services needed or there
            - Tech docs are protected
                - Constructor does not pass to owner/erector
        - Any cooking?
        - Know what is in structure
            - Require documentation of contents
            - Inspection then POPE
                - Fire proofing, egress
                    - MFB *Bob Hetherington
                - Must be modified and re-inspected if there is a problem
            - Fire loads?
                - No appliances known
                - Floor, wall, ceiling coverings, siding
                    - Materials and fitouts must be fireproof
                        - Required certification within 12 months
                        - Common materials: masonite, MDF
                - Is building safety enough to cover fire loads? Hmm

**30.03.09**

*Interview: Helen Rechter*
*Title: Research and Technical Development Officer, Building Commission*

Questions for Helen

1) Who is PricewaterhouseCooper and what is there relation to the RIS?
2) What people or groups are responsible for collecting data and composing the RIS if it is required?
3) I noticed that on a previous RIS there was a company called PricewaterhouseCooper. Who is the company and what relation do they have to the RIS?
4) What if there is not enough data in the RIS to satisfy VCEC? What then happens to the proposed regulation?
5) Is the RIS essentially a way to monitor the effectiveness of expiring regulations to see if they are still needed? Or does this statement just collect data to prove that new legislation is needed?

Answers:

1) Agency who are expert's contract out RIS. Relationship with people and help to gather data. Everyone involved in draft. They turn every aspect into a monetary value.
2) Never enough data/they may say you are going in the wrong direction.

a. If you talk to VCEC they are usually nice and more helpful. They also give you a better idea of the type of information you need.
b. It can get knocked back, or denied.
c. The harder evidence the better because this is easiest to convert into a monetary value.

"Minister" is the "Minister for the planned regulation". Minister for planned regulation change is head. An example of this is the Minister for planning is responsible for planning regulations.

Audit of regulation with RIS?? Can't do this because there is a lack of resources.

BIA is the RIS for legislation.

Set up monitoring to make RIS easier (through a way to measure regulation-which is extremely hard to do). With this information they ask whether they still need this regulation and they can determine if it has been useful. As of right now, there is no way to measure or count to show results. Then again, what exactly should be measured? Numbers are the most effective way to make an RIS, rather than antidotal. They don't know the efficiency of the act.

**31.03.09**

*Interview: Peter Van Zeyl*
*Title: Business Management Director, Harts Party Hire*

Liability
- Risk is event organizers'
- Liable only for integrity of the structure

Examinations
- Follow BC guidelines
    - Exits, safety officers, toilets

Fire Protection/ Prevention
- Follow Regulations
    - Submit plans (geographic, schemes- emergency lighting, fire exits)
    - Planner is responsible
    - Inspection for compliance

Additional Regulations - helpful or limiting
- Private vs. public functions
    - Clarify regulations
- Size based
    - Large = fees for inspections & OP, POPE
    - Small = no permits

Suggestions for changes
- Clarifications on regulations
- Cost effectiveness
    - High costs harms industry

**06.04.09**

*Interview: Mandy Charman*
*Title: Evaluation Support Officer (DPCD)*

- Evaluation support officers- evaluation project planning
    - Develop/oversee evaluations
    - Outcomes related to evaluation
        - Ex. community strength, development
- New organisation/coordination method → stronger communities
    - Not done in the past (eval)
        - Specific across programs
    - Make sure investments have desired impact
        - Risk assessment
        - Spending accountability
            - Relative to future investments
    - Slow start (3-4 yrs already)
- Online materials to plan evaluation
    - Relation to any project – use as a guide
    - What are: objectives? Time loads? Budgets?
        - DPCD contracts out all or part of evaluation
            - Manage contractors
            - Haven't been able to provide right info for contractors before now
                - Info gathered wasn't helpful
            - Basic
    - Evaluation planning tool
        - What do you want to monitor?
        - Collect meaningful data
            - Needs to be valuable
            - Tangible output info
            - Perceived output vs. objectives
                - Thematic vs. specific
                - How is everything together?
                    - Stepwise- map of expectations
                    - How do we know at each level?
        - Got vs. Need to know
        - How to – set up eval framework
            - monitoring for evaluation
- Data gathering
    - Techniques
        - Focus groups
        - Interviews (face to face)
        - Case studies
            - Anecdotal to hard facts
                - Qualitative vs. quantitative
                    - Thematic analysis- meaningful
                - Generalizable
        - Surveys
            - Costly
            - Difficult to design

                - Used along with other techniques
            - Audits
            - Partnerships with other organisations
            - census
        - Simple and systematic
            - Use combination

**08.04.09**

*Interview: Bob Hetherington*
*Title: Station Officer, Building Inspection & Compliance Department (MFB)*

- 15+ yrs experience inspecting
    - MFB has no official involvement in temporary structure inspections
    - How did he get involved?
        - Theatres, pyrotechnics – contacts in temporary structure areas ask advice of Bob
        - Some events wanted safety inspections
            - No official reg for his services
    - Inspects major events in Melbourne
        - Footy final, racing carnival, airshow, tennis, concerts, grand prix, etc
        - Because of MCC- has good working relationship
            - Inspections are MBS only
                - Site plan different from actual
                    - Hard to monitor
                    - No council stops an event
                - POPE is for substantially enclosed areas
                    - BH looks for fire truck access/egress
                        - If yes, ambulance/police can fit too
            - No inspections outside Melbourne
                - Unlikely councils require them
        - Looks at contents and occupant loading
            - Gives recommendations in a letter
                - Don't have to follow, but legally should:
                    - Uniform and 30+ yrs experience is convincing
            - Or through council (notice and order)
            - Cloths- 12 months fireproofing because of NFPA codes
- Regs do not take enough into account enough
    - BC- writing legislation don't think of consequences
        - Regs don't say 'you must…' for buildings after 94
    - New/changed have ramifications across industry
        - New class of buildings needed?
    - "Common sense doesn't prevail always"
        - Proactive vs. reactive legislation
            - Always reactive
            - No evidence to be proactive
- Fire load is a risk to something that might not be a risk (structure)
    - Concerns: flashover, smoke
    - Contents affect purpose of fireproofing
        - Regs are very subjective
        - More regs would help regulators do their job

- No arguments with owners

- Safety officers
  - MBS can ask for safety officers
  - Training left to MFB/Commission
    - Courses being rewritten
  - Authorized under Building Act – can fine for noncompliance
  - Responsibilities:
    - Restrict public access, pyrotechnic safety, toilet #s, emergency procedure guide (Occ Health and Safety)
    - At discretion of MBS
- MFB- pulled away from process
  - (Choice or regs? –unknown)
    - Minimal staff
  - Can give building infringement notices
    - Send message about compliance
    - Owners only do the minimal requirements
    - Fines- cost more to give than what is received from payment
      - Owners will risk it- make more at event than fine paid
- Temporary structures
  - Temp permanent- using temp structure materials as permanent
    - Ex. roofs (cloth vs. iron)
    - Lower cost, even with necessary replacements over time
  - Marquees over long periods of time: more fires- more damage
  - Hoses should be present for longer terms
  - Permanent buildings- no give or take
    - BCA is recipe for making buildings
    - Building Act 94 allows alternative solutions- anything you want to do with BCA
    - Temp structures not covered
- Hierarchy of legislation
  - Regs-Act- BCA- Aus Standards-NFPA codes-other codes (top to base)

**09.04.09**

*Interview: Brett O'Hara, Geoff Tucker*
*Title: Harry the Hirer, Managing Director (No Fuss Solutions)*

- Harry the Hirer
  - Brett- registered building practitioner- certifies compliance with engineer
  - Company has 6 OPs
    - 25 structure variations
      - Employ engineer- make own pieces
      - Integrity of frames
      - 40pg engineering specs documents
    - Want 1 OP for all-easier for staff and inspectors
  - Don't always know structure use
  - Provide fire extinguishers/safety for buildings (hirer)
    - Users are responsible for contents
      - And protection of contents
      - Now: councils have varying regs

        - MCC is strict, Kinglake doesn't care
        - Hard to keep track of variations
- General
    - BC knows about maybe ¼ of temp structures going up around VIC
    - No guidelines for temporary structures
        - OPs: multi-level (owner/manufacturer)
            - Most companies buy temporary structures
                - Manufacturers have OPs- responsibilities
        - Easier for BC
            - Hirer should be responsible for OP
    - BC regs are benchmark for other AUS states
        - Used as a guide
        - NSW- deal with local councils
        - Some states accept BC OP
    - Competitive industry
    - Process:
        - Plans go to MCC
            - Good at inspections before events
            - MCC marks plans- doors, extinguishers, size, tables/chairs
            - Temporary structures erected to engineering specs
                - Nothing to do with contents
                    - AV, kitchen unknown
                    - User should be responsible for extinguishers
        - Make fair, not difficult- WANT standards across councils

**21.04.09**

*Interview: David Kearsley*
*Title: Research and Technical Development Officer, Building Commission*

- movement
    - People offsite, emergency personnel onsite
    - Responsibility to protect people- inc. buildings
    - MFB for EVENT NOT STRUCTURE
    - Consider actual fire
        - Flame is good, smoke is the problem
    - Fire examples:
        - Mecca fire (Saudi Arabia) ~300 dead
        - India computer fair ~35 dead
            - Too much smoke to see in 37sec
    - New structures
        - Fire safety provisions not in place
            - Inflate Australia- air filled walls
            - 10,000$m^2$ structure- Germany
- SFPE- Society of Fire Protection Engineers
    - Use avg fire load values
        - Reasonable, easy to deal with
    - Careful how info is justified- might be old (1970s, 1980s)
    - Programs are available (CFAST)

- Recommendations to maintain occupancy safety
    - Goal is to be proactive
    - Evolve regs to accommodate
    - Complex system

**22.04.09**

*Interview: David Kearsley*
*Title: Research and Technical Development Officer, Building Commission*

- Methodology
    - Talk to CFA- Generally more proactive than MFB
    - Compare temporary structures to permanent buildings
        - MFB must sign off on permanent buildings before occupancy
            - Fire loads considered in permanent?
            - Fire defenses
        - Temporary structures now
            - Need sign off- not necessarily from fire experts
            - Might have safety officers
    - Consider limitations and feasibility
        - Cost vs. benefit of recs
        - Hoses/hydrants- cannot always have
        - NOT overall event
        - Scope- add to intro
    - Consider evacuation
        - ASET vs. RSET (available vs. required safe evacuation time)
        - 2.1m – height needed from clear view (do not want smoke this close to ground)
        - 1m/s- walking time
        - BCA does not accommodate for getting disabled out
        - Size of structure
            - 10x10 was biggest when regs were written
            - Common sizes now: 200-300$m^2$, 500$m^2$, 1000$m^2$
- Work in area
    - BCA? Regs? Nothing
        - Need consistency across country
        - Get national government to look at temporary structures as permanent buildings
            - HOW- from a national perspective
    - Consequences of letting the structure burn
        - Holes in roof = good
            - let heat/smoke out
            - material will burn itself out
        - Smoke/heat vents?
            - Tephlon blast release
            - Technology IS available

# Appendix I: Contacts in Canada

***Email Sent***

Hello,

My name is (NAME OF WRITER), and I am an American student from Worcester Polytechnic Institute. Currently, I am fulfilling a graduation requirement consulting for the Victoria Building Commission in Victoria, Australia.

My team and I are researching permitting and regulations of temporary structures. We are concerned with fire load and fire risks of structures, such as tents, booths, and seating stands.

We were hoping you could provide us with some information as to how temporary structures are permitted or controlled in (STATE). If you cannot provide this information, do you know of anyone we could contact?

Thank you for your help.

Regards

(NAME OF WRITER)
Research Student- Regulatory Development
Building Commission

***Contact Info and Responses for States which Responded***

***British Columbia***
Contact: Jun'ichi Jensen
Email: Building.Safety@gov.bc.ca

We do not collect this data, specifically. We do monitor the industry through the engagement of various stakeholders, such as builders, architects, building officials, and engineers.

***Manitoba***
Contact: Tammy Harper M. Ed.Admin, Manager, Building Policy and Sustainability-Office of the Fire Commissioner
Email: Tammy.Harper@gov.mb.ca

In Manitoba, the provincial codes are based on the National Codes, which are reviewed every 5 years. In Manitoba the Building Standards Board reviews the proposed changes in the National Codes once they are published, and makes amendments to suit Manitoba conditions. There is no monitoring process other than these reviews.

***Northwest Territories***
Contact: Bill Wyness
Email: Bill_Wyness@gov.nt.ca

The NWT Fire Prevention Act of the NWT adopts the National building code of Canada and the National Fire Code of Canada unchanged for building regulation for our small jurisdiction.

The regulatory agency is the Office of the NWT Fire Marshal, present incumbent Stephen Moss. The OFM published advisory information bulletins augmenting specific requirements of the national model codes. Website access is available.

Augmented content for economics and durability of buildings, specifically excluded from the objectives of the Canadian national model codes, are dealt with in the NWT by our department which publishes a "Good Building Practice for Northern Facilities" (GBP's), currently being revised and re-issued in a new 2009 version next month. It will be web accessible as is the GBP 2000 version.

I am a member of the CCBFC (Canadian Commission on Building and Fire Codes) one of the 27 voting Commissioners from all parts of Canada, accountable for the development of the codes and advising on the research basis for code changes.

Information in some detail about the Canadian building codes system, its legislation sanctions, protocols and organization is available at the NRC-IRC website segment devoted to the CCBFC.

If you would like additional information about the NWT building safety regulations environment, and how it compares and contrasts as a Territory (rather than as a Province) with other parts of Canada, please email back and share more insight as to your review goals.

I am also a member if the US Based International Codes Commission (ICC) so have some sense of the comparative similarities and differences in the US model of building standards and codes, having observed the four major codes development organizations in the US try to come together in a national org over the past ten years.

I am informed the NFPA is ascendant currently and gaining prominence as the lead codes and standards development org stateside. The Canadian standards regulatory environment, upon which so much of the building regulations safety depends, is changing rapidly since 2000 with an evolution toward international standards consistency.

---

Good luck with your quest. The appended overview document, “Canada’s Code Development System” may be informative to you about the organization and policy environment for codes development in Canada, and the roles taken by the participant organizations.

Research is done by collaboration between the task group technical specialist leaders from IRC the Institute for research in Construction – the Canadian Codes Centre (CCC) – a part of the National Research Council, Standing Committees of the CCBFC, PTPACC, the Provincial Territorial Policy Advisory Committee on the Codes, and in-house NRC or hired external consultants, as and when.

Standing Committees are hybrid project focussed groups of volunteers from industry, the code users (governments and code deployers /enforcers) and technical professional groups (architects engineers fire protection specialists and similar) each led by one or more specialist technical advisors from the CCC.

A contemplated code revision can be initiated by a number of routes. The appropriate standing committee organizes the content of the change(s) by assigning Working Groups focussed on a specific aspect of the change request, which in turn assigns its members to a Task Group assigned a narrows scope piece of research, which it must perform and return he outcome to the WG and the SC.

The cascade of outcomes at the detail stage is funnelled upward through review stages and eventually sanctioned by formal motion and vote at the CCBFC.

My suggestion by way of responding to your question where you can get further information, is to request more detailed information from the Secretary of the CCBFC, Anne Gribbon, P. Eng. (Anne.Gribbon@nrc-cnrc.gc.ca ).

These following observations are my personal opinions about the process, and not to be regarded as official views sanctioned by the CCBFC.

The system provides for both consistency and continuity of change, as well as and diversity and the balancing of interests. It is intended to foster orderly evolution rather than radical change. The system is designed with built-in checks and balances: no one particular interest group can highjack a code requirement and skew it to its particular economic benefit. That is a major benefit, as are the outcomes (the code changes) balanced in application and broadly applicable in general to all portions of Canada, big and small jurisdictions. The bigger jurisdictions (Ontario, Alberta, Quebec and British Columbia) are mandated by senior legislation make substantial changes when adopting the model codes and they publish a variant of the national model code peculiar to the needs and conditions and political environment of that jurisdiction (Eg. French language for Quebec, Eg. A Part 10 for Relocatable Industrial Accommodate in Alberta for the oil sands development, Eg. A new Part 10 for Energy Conservation in B.C.).

The costs associated with this consensus process appear to be twofold: it takes longer, so that all voices can be heard, and therefore at times technical changes in products or components in buildings innovate faster than the code approval process can appear to respond to. The second cost is a kind of periodic 'gridlock' associated with work flow process management and the valuable but periodically scarce time provided by volunteers serving on technical committees. Authority to initiate and stimulate innovation is also diffused across the participants, which can occasionally bring about loss of focus or slower response time compared to less egalitarian organizational structures.

Contact: Stephen Moss, Fire Marshal, Municipal and Community Affairs- Government of the Northwest Territories
Email: Stephen_Moss@gov.nt.ca

The Northwest Territories adopts the National Building Code and National Fire Code of Canada as published by the National Research Council with no local changes. Effectively they meet all but a very small portion of our needs. We also publish a series of Fire Marshal's Bulletins to clarify issues that may arise. On occasion we use Firefighting Assumptions to require a higher level of fire protection based on fire department response concerns. You can find them in section A-3 of the National Building Code of Canada for reference. This provision allows us flexibility to require more protection for buildings in remote or poorly protected areas, such as small communities, camps, or very large buildings in any community based on their ability to protect it.

As for whether the regulations are still needed, I would say now, more than ever. With the recent shift in the economy, people tend to try to cut corners to save money and protect the bottom line. My experience has been that he codes are seen as the place to begin negotiations by builders, not as the absolute minimum which they are intended to be. I do not think more regulation is the answer, but in some recent cases we need to step back on what has been decided as acceptable because the changes are detrimental to firefighters and occupants during a fire.

***Nova Scotia***

Contact: Ted Ross, Building Code Coordinator, Public Safety Division- Nova Scotia Labour & Workforce Development
Email: ROSSTG@gov.ns.ca

I am the Building Code Coordinator for the Province of Nova Scotia.

We do not formally collect data on building regulations, specifically if regulations are doing their job, if they are still necessary, and if new regulations need to be put into place.

We do have however a close working relationship with all partners and stakeholders which bring to light issues that require to be addressed.

We do require proposed code changes to meet specific criteria for review not unlike our national code change process.

In NS we have a stakeholder lead Building Advisory Committee. All NS proposed changes are vetted by them for amendment to the NBC and NPC.

I do not have the time today to go into details but our website is http://www.gov.ns.ca/lwd/buildingcode/

In recent years we re-aligned our sprinkler requirements to be more like the NBC. We also have more stringent application of Barrier free provisions in NS than the NBC.

***Prince Edward Island***

Contact: Don Walters
Email: dewalters@gov.pe.ca

Prince Edward Island is Canada's smallest Province. Check out the Provincial web site. www.gov.pe.ca/

We are one of the last Provinces to adopt the National Building Province wide. The cities of Charlottetown (Capitol) and Summerside have adopted the 2005 National Building Code (NBC). If you do a search for information on the National Building Code, it should answer a lot of your question on how it applies.

We collect information on building approvals but not on building regulations. There is a national process in place for the Provinces /Territories and the public to amend and make changes to the Model Codes. The National Building Code amendment process is a five year cycle. All Provinces and Territories have representatives on the Provincial Territorial Policy Advisory Committee on Codes and various National technical code committees. The new National Building Code is in the last phase of that cycle which involves public consultation. It will be published in 2010. There were hundreds of recommended changes. A lot of the recommended changes were as a result of information Provinces and Territories collected during the administration of a new code. The code cycle is ongoing.

A lot of the Provinces do maintain records on building construction issues and a lot of these are moved forward in the form of a proposals to amend the National Code. Some end up being approved.

It is an ongoing cycle. As technology, building materials and standards for public health and safety improve and are upgraded, the codes are amended to meet those demands. The Code amendment and approval process is one of the most successful systems in the World. Through the Provincial/Territorial Policy Advisory Committee on Codes (PTPACC), the Minister's of Provincial and Territorial Governments responsible for Codes are kept advised on Code matters. The National Research Council oversee the Code cycle and approval process. There should be lots of information on-line.

I rambled on a bit from you initial question. If I can provide you with any further information, please drop me a note.

***Quebec***

Contact: Nathalie Lessard
Email: Nathalie.Lessard@rbq.gouv.qc.ca

I guess I am the ciontact you are looking for
We are the organism responsable for updating and validationg building code
We use the national core model that we modify

There is also buildings excluded from our jurisdiction and are under municipal or another governmental minister jurisdiction
You can reach me for nay further details

***Saskatchewan***

Contact: William N. Hawkins, Chief Building Official Building Standards- Ministry of Corrections, Public Safety and Policing
Email: Building.Standards@gov.sk.ca

The Province of Saskatchewan adopts the National Building Code with very few amendments by regulation under The Uniform Building and Accessibility Standards Act (the UBAS Act). As one of the small provinces in Canada our approach has been to work through the nationalcode development process in cooperation with other provinces and territories, utilize the benefits of research and trends from other parts of Canada and adjust as necessary for our purposes in Saskatchewan. We do not have enough resources to undertake the research and analysis of code development on our own. This approach has worked well for us and we continue to participate at the national tables and benefit from that dialogue.

Our collection of data on building regulations is very minimal. I do some very basic assessment on the uptake and provision of services in Saskatchewan. It simply measures the population by municipality, whether or not the municipality exercises a building bylaw and the demonstrates by percentage how many municipalities do and how much of our population benefits directly from the application of building standards. Approximately 81 per cent of the population does. I use this analysis to promote the development of new programs within our government. My vision is to see 100 per cent of the population covered and my mission is to move programs and regulations in a direction to achieve that goal.

Municipalities in Saskatchewan are responsible, by legislation, to administer and enforce the UBAS Act. However, there is no follow-up mechanism in the UBAS Act to address those municipalities that choose not to. This suggests that regulations are only partially doing their job and that they should be amended to facilitate moving closer to the vision.

http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/U1-2.pdf
http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/U1-2R5.pdf
http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/U1-2R6.pdf

I hope this helps you with your research. I have attached links to our legislation, regulation and our website, where you may glean additional information about how our system works in Saskatchewan. Certainly though please feel free to contact me again if you have more questions.

***Yukon Territory***

Contact: Stan Dueck CRBO, Manager, Building Safety Branch- Consumer & Protective Services
Email: Stan.Dueck@gov.yk.ca

In Yukon we use the National Building Code of Canada, which has been adopted through our Building Standards Act and Regulations. Yes, Building Standards Act and Regulations are and always will be required.

### *Contact Info for States which did not Respond*

***Alberta***
Contact: NA
Email: safety.services@gov.ab.ca

***New Brunswick***
Contact: NA
Email: DPS-MSP.Information@gnb.ca

***Newfoundland***
Contact: NA
Email: fhollett@mail.gov.nl.ca

***Nunavut Territory***
Contact: no contact found
Email: none

***Ontario***
Contact: NA
Email: codeinfo@gov.on.ca

# Appendix J: Contacts in the United States

***Email Sent***

Hello,

My name is (NAME OF WRITER), and I am an American student from Worcester Polytechnic Institute. Currently, I am fulfilling a graduation requirement consulting for the Victoria Building Commission in Victoria, Australia.

My team and I are researching permitting and regulations of temporary structures. We are concerned with fire load and fire risks of structures, such as tents, booths, and seating stands.

We were hoping you could provide us with some information as to how temporary structures are permitted or controlled in (STATE). If you cannot provide this information, do you know of anyone we could contact?

Thank you for your help.

Regards

(NAME OF WRITER)
Research Student- Regulatory Development
Building Commission

***Contact Info and Responses for States which Responded***

***Iowa***
Contact: Ljerka Vasiljevic, Design/Construction Engineer Senior- State Fire Marshal`s Building Code Bureau
Email: vasiljev@dps.state.ia.us

Attached is a section of the Iowa State Building Code that addresses temporary structures. Please note that the state building code is not mandatory requirement throughout the State and that local jurisdictions may have different and more restrictive requirements.

***Kentucky***
Contact: George Mann, Deputy Commissioner-Dept. Housing, Buildings & Construction
Email: George.Mann@ky.gov

Section 107.1 of the 2007 Kentucky Building Code grants the building official the authority to issue permits for temporary structures. I refer you to section 107 as is located in the attached link.

http://dhbc.ky.gov/NR/rdonlyres/0B6DAABF-C0D7-480F-8ABAB42CD1FF32D4/0/2007KBC2nd Printing.pdf

Section 3103 of the 2006 International Building Code will allow Temporary structures to be utilized for a period not to exceed 180 days. Tents and other membrane structures erected for a period of less than 180 days must comply with the 2006 International Fire Code. Those structures erected for a period of 180 days or more are to comply with the code as a permanent structure.

No matter how long the structure is up, plans and a permit application shall be filed with the authority having jurisdiction for permit.

***Maine***

Contact: Phil Carey; Senior Planner Land Use Program- Maine State Planning Office
Email: Phil.carey@maine.gov

As John Delvechio noted, regulations that would address temporary structures are most likely to be those adopted at the local level. Having worked as the planner in one Maine municipality, I can tell you that in that particular town there was no distinction between permanent and temporary structures. Placement or erection of a temporary garage, warehouse, etc. had to comply with use and dimensional requirements of the zone and was subject to the applicable level of review, which was determined by its size. Smaller structures required only a building permit from the Codes Officer (CEO) while larger ones might require review by the Planning Board. In both cases, the temporary nature of the structure would influence how the review standards were applied (e.g. landscaping requirements that might apply to a permanent structure might be waived for a temporary one), but requiring a review did help to ensure that the structure did not create unanticipated problems. It also provided a vehicle for consideration of the appropriate length of time the structure should be in place and a means for stipulating a date by which it needed to be removed. I think a review would have been particularly appropriate for a temporary structure, if by this you mean a circus tent or any other structure that would be open to the public.

My experience provides just one example. You've picked a hard state to research because, as John said, we have 495 jurisdictions and this is a strong "home rule" state. The approach to temporary buildings will vary from town to town. I imagine the larger towns and cities tend to have specific regulations or policies while the regulation of temporary structures in the smaller, more rural communities is lax or non-existent. Indeed, there are some small communities that do not require a permit for construction of a permanent structure, let alone a temporary one.

Contact: Rich Baker
Email: Rich.P.Baker@maine.gov

I apologize for not responding to you inquiry regarding temporary structures and any permitting requirements that you sent to John Delveccio at the Maine State Planning Office. I don't have a lot to contribute toward your work, but will comment on State requirements for structures in the shoreland zone (areas within 250 feet of tidal waters, lakes, rivers and freshwater wetland that are at least ten acres in size. All structures, except for water-dependent structures, have mandatory setback requirements. That setback distance is 100 feet on lakes and 75 feet elsewhere, except for industrial areas where the setback requirement may be as little as 25 feet. There is no distinction between temporary and permanent structures. However, there are times when the setback requirement may be overlooked for very short durations. As an example, I have had persons inquire about bringing a gazebo into the setback area for a day or two for a wedding. Most code enforcement officers would not raise objection as long as it is removed promptly.

***Maryland***
Contact: Edward Landon, Director-Maryland Codes Administration
Email: landon@mdhousing.org

Permits are required locally.

***Nebraska***
Contact: Doug Hohbein, Chief Plans Examiner
Email: doug.hohbein@nebraska.gov

The Nebraska State Fire Marshal's Office has adopted the 2000 edition of the Life Safety Code, published by the National Fire Protection Association (NFPA). The Life Safety Code and associated pamphlets such as NFPA 102 regulate the types of structures you addressed in your question.

***New Hampshire***
Contact: Robert B. Farley, Deputy State Fire Marshal
Email: Robert.Farley@dos.nh.gov

Permits are required under the State Fire Code.

There is no state level permitting process for temporary structures. All permitting of this type is handled at the local jurisdiction level. The requirements will vary from city to city and from town to town.

***New Jersey***
Contact: James Harding, P.E. NYSDOS Codes Division
Email: James.Harding@dos.state.ny.us

The NJBA manages the financing and construction/renovations of buildings and facilities used by State agencies and is not involved in code enforcement.

The Department of Community Affairs, Division of Codes and Standards is New Jersey's state code enforcement agency and implements and oversees the enforcement of a Statewide Uniform Construction Code in New Jersey including building, plumbing, fire protection, electrical, mechanical, barrier free and rehabilitation subcodes. Please visit their website for additional information: http://www.nj.gov/dca/codes/index.shtml

***New York***
Contact: NA
Email: codes@dos.state.ny.us

We regulate temporary structures used for assemblies of persons through our Uniform Fire Prevention and Building Code (regulations of this agency) and through other regulations promulgated by the Departments of Health and Labor. Contact the appropriate agency for more information about its regulations.

With regard to fire and building codes, you will find information about accessing our codes on the internet below. I would refer you to two sections of the FCNYS in particular, section 2403 and section 403 which are partially included below.

***North Carolina***
Contact: Richard Strickland, Chief Fire Code Consultant
Email: Richard.Strickland@ncdoi.gov

Booths are considered temporary structures under our NC State Building Code and they would be regulated with by a building permit under Section 3103 of the NC State Building Code. The construction of the temporary booth would have to meet all of the requirements of the building code for a permanent structure with the exception of a permanent foundation.

Temporary tents are tents erected for a period of 180 days or less in a twelve month period and they are regulated by Ch. 24 of the NC State Fire Code. Tents have to be certified as fire resistant, meet spacing requirements from other structures and provide adequate exits based on size and number of people. The fire code requires an operational permit to use a temporary tent.

***South Carolina***
Contact: Gary Wiggins
Email: wigginsg@llr.sc.gov

Booths, tents and other structures used for short term events, such as fairs, circuses, exhibits, etc., are regulated on a local (municipal and county) basis. Placement may be subject to building, fire and/or zoning requirements. If a structure is, or contains an amusement ride, it must be inspected by the state.

***South Dakota***
Contact: John Irvine, Building Official
Email: John.Irvine@ci.pierre.sd.us

Local jurisdictions regulate the use of temporary structures for purposes. Typically, the applicant submits a plan outlining the proposed placement and duration of the project and the local boards/commissions act on that application. There is not any state regulation of temporary structures, unless of course, they are going to be located on state property.

***Vermont***
Contact: Michael Greenia, Assistant State Fire Marshal
Email: mgreenia@dps.state.vt.us

In Vermont we adopt the NFPA # 1 Uniform Fire Code. The codes are adopted under state law. In that code chapter 25 deals with tents and membrane structures. Statewide we require a permit and inspections for tents that are used for public events over 1200 sq ft. I have attached the permit that is required to be submitted.

***Virginia***
Contact: Emory Rodgers, Deputy Director of Building & Fire Regulation- Department of Housing and Community Development

Email: Emory.Rodgers@dhcd.virginia.gov

Virginia uses the ICC International Fire Code Chapter 24 and International Building Code Chapter 27 and NEC for power. No permit is required for tents less than 900 square feet or for portable stages under 150 square feet but still these structures must comply with the code.

Permits are issued by the localities. We will have a locality send you there permit form. When you say larger structures, they almost always are permenent and not temporary. The temporary structures are mostly for weekend events, for shows in parks or holidays like the 4th of July or graduations, etc. These structures are seldom constructed and most are metal frame construction. Being outside there isn't really a fire load issue and the more important issues are structural and wind loads. There is generally one inspection only by the local building department with usually the building inspector. In some cases there is an electrical permit so there is a 2nd permit and the local electrical inspector will do that inspection. Some of our larger departments have combination inspectors so one inspector does all the inspections.

***Wisconsin***
Contact: Dan Thompson, Executive Director- League of Wisconsin Municipalities
Email: danthomp@lwm-info.org

I am not aware of any state regulation of temporary structures in Wisconsin. Most municipalities in Wisconsin probably have adopted some local ordinances on the matter. I am not aware of any person who has created a central file of such ordinances. You would have to search each code of municipal ordinances separately. We have over 600 cities and villages in Wisconsin. That's a lot of searching.

***Contact Info for States which did not Respond***

***Alabama***
Contact: Katherine Lynn
Email: Phyllis.thomas@bc.alabama.gov

***Alaska***
Contact: NA
Email: fire_webmaster@dps.atate.ak.us

***Arizona***
Contact: Virginia Holztclaw
Email: EMAIL

***Arkansas***
Contact: NA
Email: info@aba.state.ar.us

***California***
Contact: NA
Email: cbsc@dgs.ca.gov

***Colorado***
Contact: Julie Rodriguez
Email: julie-rodriquez@usa.net

***Connecticut***
Contact: NA
Email: dps.feedback@po.state.ct.us

***Delaware***
Contact: Daniel Muterspaw
Email: dan.muterspaw@state.de.us

***Florida***
Contact: Candice Fuller
Email: candie.fuller@dca.state.fl.us

***Georgia***
Contact: NA
Email: engineering@mail.oci.state.ga.us

***Hawaii***
Contact: NA
Email: dcab@doh.hawaii.gov

***Idaho***
Contact: C.Kelly Pearce, admin
Email: kelly.pearce@dbs.idaho.gov

***Illinois***
Contact: NA
Email: dgamble@cdb.state.il.us

***Indiana***
Contact: William D. Milligan
Email: dmilligan@omnicityusa.com

***Kansas***
Contact: Lynne Ladner; City Administrator
Email: cityadministrator@cityofhiawatha.org

***Louisiana***
Contact: Denise Jobe
Email: Denise.Jobe@dps.la.gov

***Massachusetts***
Contact: NA
Email: DPSInfo@state.ma.us

***Michigan***
Contact: NA
Email: bccfoia@michigan.gov

***Minnesota***
Contact: Steve Hernick
Email: steve.hernick@state.mn.us

***Mississippi***
Contact: found no contact
Email: none

***Missouri***
Contact: NA
Email: form

***Montana***
Contact: NA
Email: form

***North Dakota***
Contact: NA
Email: lcouncil@nd.gov

***Nevada***
Contact: NA
Email: form

***New Mexico***
Contact: NA
Email: form

***Ohio***
Contact: NA
Email: thale@clarkcountyohio.gov

***Oklahoma***
Contact: NA
Email: sue@pels.state.ok.us

***Oregon***
Contact: Chris Huntington
Email: Chris.S.Huntington@state.or.us

***Pennsylvania***
Contact: NA
Email: form

***Rhode Island***
Contact: NA
Email: RICRB@gw.doa.state.RI.us

***Tennessee***
Contact: NA
Email: tninspections@gmail.com

***Texas***
Contact: NA
Email: form

***Utah***
Contact: Shauna Hoover, Permit Technician
Email: ucadm.shaunal@state.ut.us

***Washington***
Contact:
Email: buildingdept@washintongov.org

***West Virginia***
Contact: no contact found
Email: none

***Wyoming***
Contact: NA
Email: webmaster@state.wy.us

# Appendix K: Contacts in the Australian States and Territories

***Email Sent***

Hello,

My name is (NAME OF WRITER), and I am an American student from Worcester Polytechnic Institute. Currently, I am fulfilling a graduation requirement here in Australia by consulting for the Victoria Building Commission in.

My team and I are researching permitting and regulations of temporary structures. We are concerned with fire load and fire risks of structures, such as tents, booths, and seating stands.

We were hoping you could provide us with some information as to how temporary structures are permitted or controlled in (STATE). If you cannot provide this information, do you know of anyone we could contact?

Thank you for your help.

Regards

(NAME OF WRITER)
Research Student- Regulatory Development
Building Commission

***Contact Info and Responses for States which Responded***

***Australian Capital Territory***
Contact: Mark Towart, Duty Planner- Development Assessment
Email: Mark.Towart@act.gov.au

As per your request, please see attachment which is an extract from the Planning and Development Regulation 2008 in regards to temporary buildings and structures

***Tasmania***
Contact: Eddie Johnstone, Webmaster - Department of Infrastructure, Energy and Resources
Email: webmaster@dier.tas.gov.au

The information you require is controled by the local government level in Tasmania. The link below will take you to a list of the 29 Local Councils in Tasmania. The largest councils are Hobart and Launceston respectively.

http://www.councilconnect.tas.gov.au/councilc/redirect.do?cdet=true

***Contact Info for States which did not Respond***

***New South Wales***
Contact:
Email:

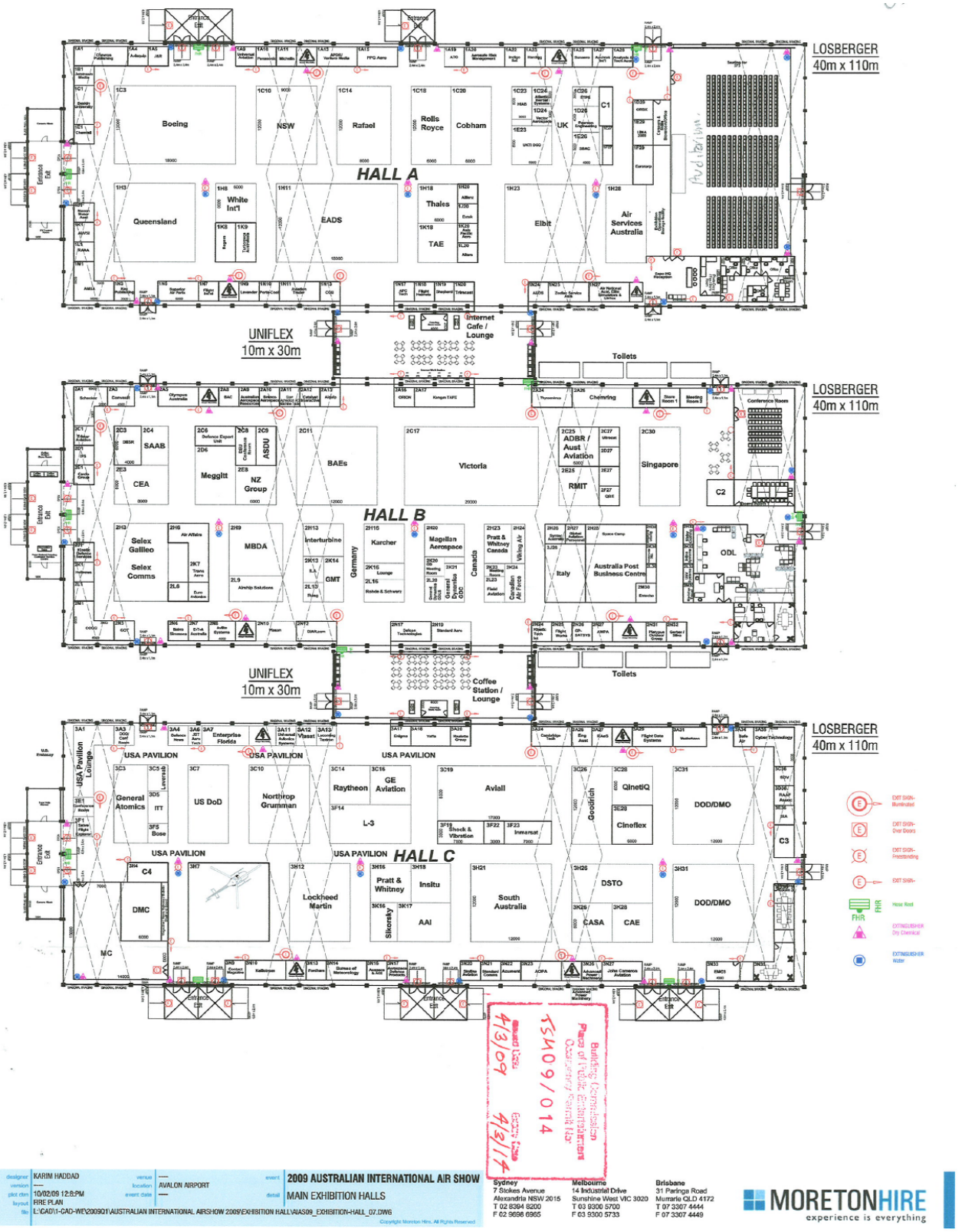
***Northern Territories***
Contact: NA
Email: bas.lpe@nt.gov.au

***Queensland***
Contact: NA
Email: planning@dip.qld.gov.au

***South Australia***
Contact: NA
Email: plnsa.building@saugov.sa.gov.au

***Western Australia***
Contact:
Email:

# Appendix L: Avalon Airshow Exhibition Structure 2009



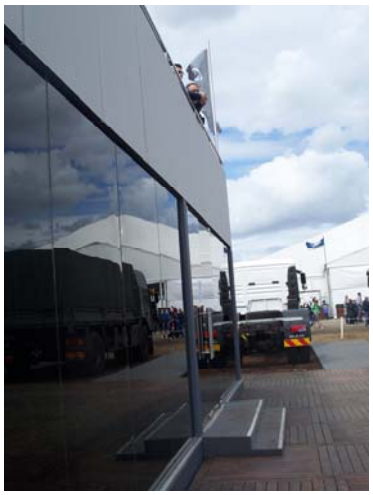
# Appendix M: Photos of Temporary Structures

*Team-Taken Photos from the Avalon Airshow*



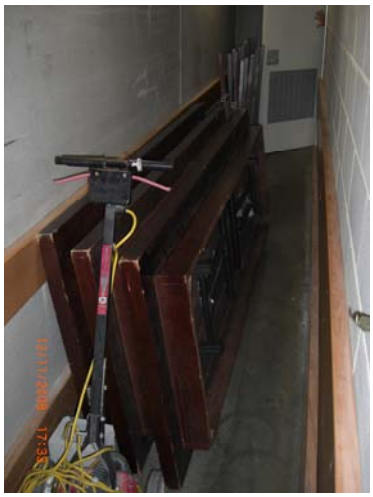



Aircon
Rentals
1800 626 996



*Photos of Temporary Structures Safety Risks from Large Events in Melbourne*
(Provided by Bob Hetherington)





# Appendix N: Amending Regulations in Victoria

A stakeholder submits a Regulatory Amendments Proposal (RAP) to begin the evaluation process. All RAPs are reviewed quarterly by directors belonging to the Building Commission, Plumbing Industry Commission (PIC), and Building Policy Branch (BP), who make a judgment on their direction. In many cases, the proposals have non-regulatory solutions; otherwise, regulation development continues. A brief must be given to the Minister to gain approval [Building/Plumbing Regulation and Regulation Amendment Manual 2008].

If the Minister approves development, a Regulatory Project Team (RPT), consisting of BC, PIC and the BPB representatives, collects data and examines other options. They take into account the cost analysis of each option. The final decision on the regulation is given to the managers and directors of these industries [Building/Plumbing Regulation and Regulation Amendment Manual 2008].

During the third stage of the process, a brief which outlines all the possible options, a risk analysis, benefits, and a recommendation must be prepared and given to the Minister. If any part of this process has a non-regulatory solution, then the Minister is responsible for appointing the correct organization to carry out the process. If a regulatory response is still adequate, the next step is to prepare a draft of the regulation. The Parliamentary Council (PC) and the BP are responsible for reviewing these drafts. During the same period, there should be communication with the Victorian Competition and Efficiency Commission (VCEC) [Building/Plumbing Regulation and Regulation Amendment Manual 2008]. This organization is responsible for evaluating regulation in order to increase accountability, build regulation support, and improve legislation [Richard Clarke 2008]. They also determine whether a Regulatory Impact Statement (RIS) is required. The Regulatory Impact Statement "assesses the proposed regulation consistent with the government's guidelines" [PricewaterhouseCoopers 2006]. The six tasks of the RIS are outlined below:

- Identify the problem to be addressed
- Specify the desired objective of the proposed measure
- Explain the nature of the proposed measure, its expected impact and enforcement regime
- Assess the cost and benefits of the proposed measure
- Assess the proposed measure against alternative options

- Assess the net impacts of the proposed Regulations in relation to that of the alternatives

This part of the process is extremely time intensive and requires a great deal of data and analysis. The VCEC must be satisfied with the Regulatory Impact Statement before the processes is continued. The amount of detail usually results in several draft submissions before it is approved. For the RIS to be adequate, an exposure draft of the regulation is given to the VCEC [Building/Plumbing Regulation and Regulation Amendment Manual 2008].

Then VCEC submits the Regulatory Impact Statement to the Regulatory Project Team. Another briefing on the project status is prepared for the Minister to seek approval to publish the RIS. Both the exposure draft and RIS must be advertised in the newspapers and published on the BC, PIC, and BP websites for a minimum of 28 days. During this time, people may make comments, which are assessed and responded to. Stakeholders, the Building Regulations Advisory Council, and the Plumbing Industry Advisory Council are updated with the comments. From the comments, the Building Policy Branch decides whether an amendment to the draft of the regulation is required. Both the Parliamentary Council and Minister must be briefed and instructed on any amendments. Once all amendments are completed, the Parliamentary council must be asked to issue a Section 13 Certificate. Another briefing must be given to the Minister seeking approval and continue with the regulation. Additionally, a Notice of Intention must be published in the daily newspapers before the regulation is passed [Building/Plumbing Regulation and Regulation Amendment Manual 2008].

The final part of the process is to actually make the regulation. The "Governor-in-Council makes the regulation." Regulations are laid before both Houses of Parliament within 6 sitting days after the notice is published. The proper paperwork is given to the Scrutiny of Acts and Regulations Committee (SARC). Once the paperwork is filed, the final regulation is published once again and the process ends [Building/Plumbing Regulation and Regulation Amendment Manual 2008].