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Work Health & Safety legislation; the fire engineer's neglected duty?

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ABSTRACT

Fire engineers are in general, aware of their duties under Building legislation. However, they are often unfamiliar of separate duties under Work Health and Safety legislation.

This paper describes an Australian case-study, but one that is presented generally so as to have applicability in those other jurisdictions where similar Work Health and Safety obligations exist.

As society becomes safer, Work Health and Safety has evolved from being solely about the employer–employee relationship, to also impose duties on other participants, such as building designers. Fire engineers are building designers that by the very nature of their work, directly influence the safety of a workplace. Most buildings upon which fire engineering is practiced are workplaces.

Under Building legislation, fire engineers must design to minimum performance requirements. In the process, usually adopting the most cost effective approach and thereby creating economic benefits.

Under Work Health and Safety legislation however, fire engineers have a duty to adopt the highest possible level of precautions, unless it is not reasonably practicable to do so. The reasonably practicable test must follow the hierarchy of controls and consider all relevant matters, the last of which is cost.

Fire engineers that ignore Work Health and Safety duties, intentionally or not, are exposed to claims of negligence.

Introduction

Building legislation

Australia has a performance-based, building code [1]. The Building Code of Australia or BCA is given legal effect in each State and Territory under their respective Building Acts and Regulations.[1] In this paper, the various Building Acts and Regulations are referred collectively as 'Building legislation'.

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[1] Building Act 2004 (ACT), Environmental Planning and Assessment Act 1979 (NSW), Building Act 1993 (NT), Building Act 1975 (Qld), Development Act 1993 (SA), Building Act 2000 (Tas), Building Act 1993 (Vic), Building Act 2011 (WA).

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Performance-based building codes were first introduced in the 1990's to replace prescriptive building codes. They are outcome-focussed, or 'target based'. Performance-based building codes have been adopted in several international jurisdictions including but not limited to; Australia, Canada, Japan, the United Kingdom, the United States of America, New Zealand, and the Nordic Countries [2].

It is not the purpose of this paper to describe in detail the architecture of performance-based building codes, or the practice of fire engineering other than to say that a fire engineer has a duty to design to certain minimum performance requirements. For those interested, more comprehensive information can be found in resources such as the SFPE Engineering Guide to Performance-based Fire Protection [3] and International Fire Engineering Guidelines [4].

Work Health and Safety (WHS) legislation

Similarly to the Building legislation, Work Health and Safety (WHS) legislation is also given legal effect at State and Territory level.[2] Unlike the Building legislation however, harmonisation is intended to be at the Act level.

To that end, the Australian Federal Government enacted the Model Work Health and Safety Act 2011. This Model WHS Act has been passed in each State and Territory except at this stage in Victoria and Western Australia. For the purposes of this paper, being largely a discussion on duties of safety in design, the Victorian and Western Australian legislation is sufficiently similar to the Model WHS Act.

The various WHS Acts and Regulations are referred collectively as 'WHS legislation' to be as general as possible, so as to have relevance in those other jurisdictions where similar Work Health and Safety duties exist.

WHS duties

WHS legislation has shifted away from a paradigm that focused on the duties in the employer-employee relationship to a more expanded paradigm including upstream parties such as; contractors, designers, suppliers and manufacturers [5].

Under WHS legislation designers of structures that are used as workplaces have a duty to eliminate or minimise risks to health and safety in a workplace so far as is reasonably practicable.

This raises three key questions:

- Are fire engineers designers of structures and therefore duty-holders?
- What proportion of buildings that are fire engineered are workplaces?
- Does designing to a building code performance requirement, discharge the WHS duty to minimise a risk 'so far as is reasonably practicable'?

Fire engineers are designers

The opinion is sometimes expressed that fire engineers are not designers of buildings and so do not have the duties of designers under WHS legislation. This opinion is based on the practice, where fire engineering documentation is part of a compliance process rather than directly documented in the specifications and drawings. A building design is typically documented (that is specified and drawn), by the; architect, structural engineer and various services engineers each incorporating elements of the fire design and coordinated with the fire engineer.

This opinion incorrectly assumes documentation is design. Consider the kind of activities undertaken by fire engineers. Reports from 22 consultants were surveyed and the frequency of alternative solutions noted [6]. Each report considers multiple issues so these do not sum to 100%. The sample size is small and concentrated in geography and time but nevertheless useful in illustrating the point that these are 'design' activities.

The survey found:

- Fire resistance levels reduced/eliminated 68%.
- Travel distance increased 66%.
- Smoke exhaust volume reduced/eliminated 42%.
- Sprinklers reduced/eliminated 38%.
- Exits (reduced width/aggregate width/height) 34%.
- Exit discharge not to an open space 32%.
- Fire hose reel modification 28%.
- Fire distance levels eliminated 22%.

These activities clearly and profoundly influence the design of a building, and are therefore a priori design activities.

[2] WHS Act 2011 (ACT), (NSW), (NT) and (Qld), WHS Act 2012 (SA) and (Tas), OHS Act 2004 (Vic), OHS Act 1984 (WA).

Most fire engineered buildings are also workplaces

Workplaces are a common subset of buildings upon which fire engineering is practiced. Indeed, they are the majority of such buildings.

Building Approvals data was analysed to estimate the proportion of buildings that are workplaces and are therefore subject to WHS legislation. Data were obtained from the Australian Bureau of Statistics [7].

The ABS adopts a functional classification system with a hierarchical structure [8]. There are two basic classifications of residential and non-residential building. Residential is its own division whereas non-residential is a combination of three other divisions, as follow:

- Residential Buildings
- Non-residential Buildings
  - Commercial Buildings
  - Industrial Buildings
  - Other Non-residential Buildings

These four divisions are further subdivided into 19 classes and 30 subclasses.

For the purpose of approximating the proportion of fire engineering design where the subject building is a workplace:

- The simplifying assumption is made that all residential buildings are not workplaces and conversely that all non-residential buildings are workplaces. There will be exceptions but these will be few and compensatory.
- Simplifying assumptions are also made that one or two-storey residential buildings do not involve fire engineering design, multi-storey residential buildings of three or more storeys will involve fire engineering design and that all non-residential buildings will involve fire engineering design.

The task is to quantify the relative proportions of buildings that are residential (including the subclass of multi-storey residential) and non-residential. Given this, an approximate value for the proportion of fire engineering design that involves a workplace can be determined.

In terms of metrics, the two alternatives available from the ABS are; the number of building approvals or value of building approvals. The value metric is more appropriate.

In respect to the residential (non-workplace) to non-residential (workplace) ratios; refer to the following Fig. 1 and 2 for absolute and relative data respectively. These depict monthly data over a ten-year time-series to December 2013. A three-month running average has been applied to smooth the data. These figures indicate that residential building accounts for approximately 60% of all building work by value. There were two brief periods when non-residential building value exceeded that of residential. The main one prior to 2010, is due to ‘Building the Education Revolution’ or BER. BER was part of an

Fig. 1. Monthly building approvals by value for residential and non-residential.

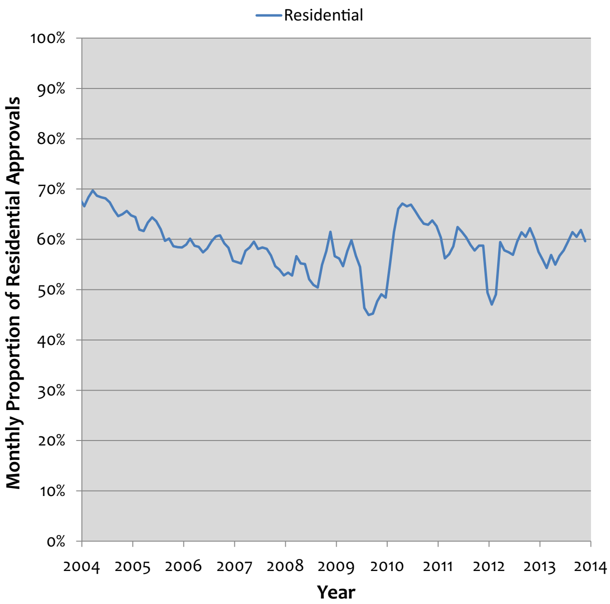

Fig. 2. Proportion of monthly residential building approvals by value.

economic stimulus plan in response to the global financial crisis. Under the BER approximately AUD$15 billion was spent on education buildings [9].

For the ratio of residential subclass of multi-storey i.e.; non-workplace yet involves fire engineering refer to the following Figs. 3 and 4 for absolute and relative data respectively. These also depict monthly data over a ten-year time-series to December 2013 with a three-month running average. Unfortunately, data for all residential (new and alterations) by sub-class was not found so these proportions are for new by sub-class only.

The data in Figs. 2 and 4 can be averaged and amalgamated in the pie graph of Fig. 5. For example on average multi-storey residential buildings account for approximately 20% of all residential building meaning 20% × 60% = 12% of all building work.

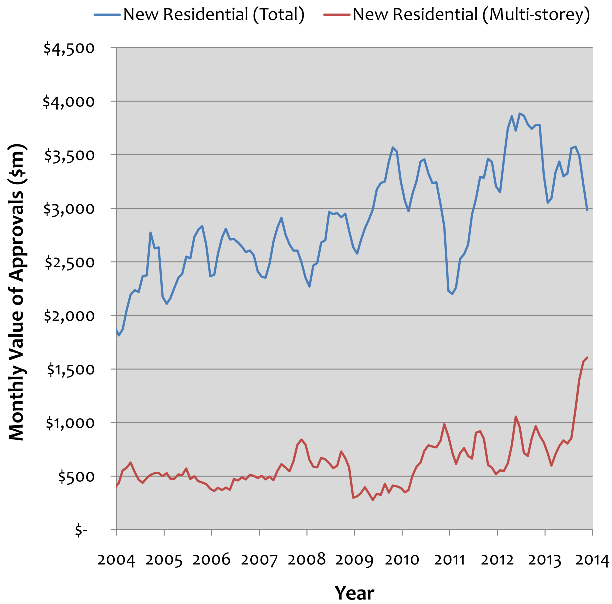

Fig. 3. Monthly building approvals by value for new residential and it's multi-storey subclass.

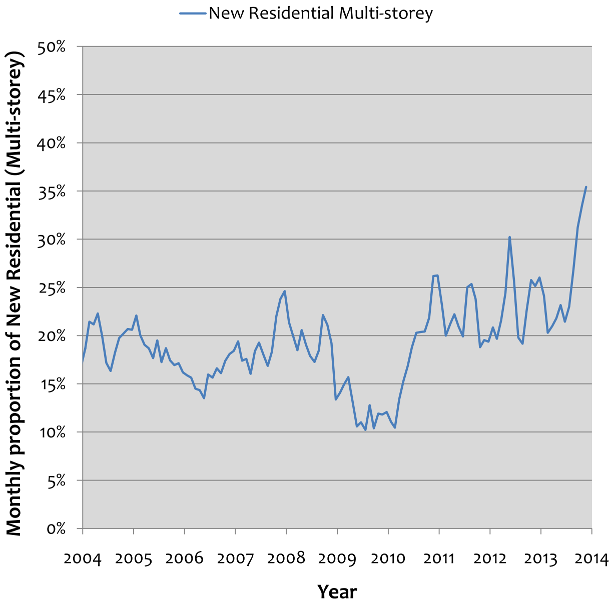

Fig. 4. Proportional of residential building that is multi-storey by value.

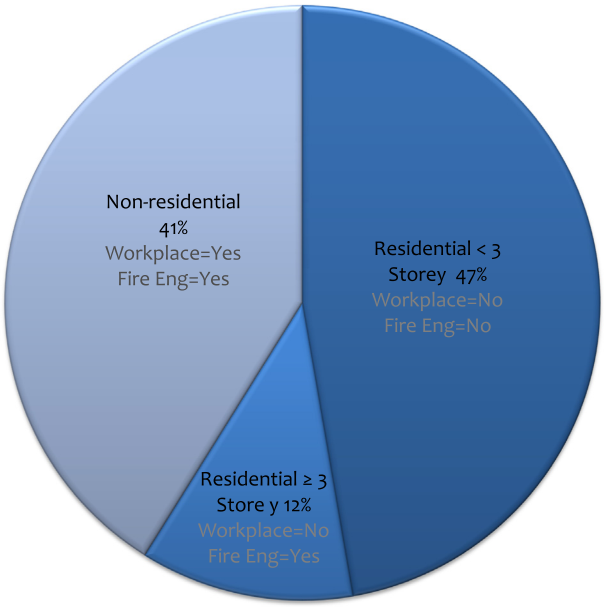

Fig. 5. Proportions by value of residential (<3 storeys), residential (⩾3 storeys) and non-residential.

Applying the earlier simplifying assumptions; fire engineering applies to the non-residential division (41%) and multi-storey residential sub-class (12%). The proportion by value of fire engineering where WHS Legislation can be expected to apply is:

$$41\%/(41\% + 12\%) \approx 77\%$$

It can be assumed that approximately three-quarters of fire engineering involve a building that is a workplace and therefore the duties of designers under WHS legislation apply.

Building legislation compliance does not necessarily mean WHS compliance

SFAIRP and ALARP

As established in the preceding sections, a fire engineer is a duty-holder under WHS legislation and this legislation applies to most buildings upon which fire engineering is applied. Therefore, a fire engineer has a legal duty to ensure that fire engineering design eliminates or minimises risks.

It is impossible to guarantee absolute safety and so this is not an absolute duty. It is qualified by 'so far as is reasonably practicable' or SFAIRP. Engineers often use the similar term; 'as low as is reasonably practicable' or ALARP.

The first point regarding SFAIRP and ALARP is that it is more prudent to use the legal term SFAIRP. Another more subtle and vastly more important point is that whilst many believe that ALARP and SFAIRP are equivalent, including apparently the UK's HSE [10], Robinson warns that they are not [11].

This is not just lexical semantics. There are key practical differences. For example under the ALARP demonstration of 'reasonably practicable', risks are viewed in three ranges; unacceptable, tolerable or broadly acceptable. Within the tolerable range, an engineer must consider incremental safety measures and apply the 'gross disproportionate' test. That is, they would adopt each measure until either (i) the cost of the risk measure was grossly disproportionate to benefit, or (ii) the residual risk was reduced to a broadly acceptable level.

Under the SFAIRP demonstration of 'reasonably practicable' there is no such thing as a broadly acceptable risk. The 'gross disproportionate' test is also applied, but the criterion isn't satisfied at a target risk. Furthermore, under SFAIRP it is not risks that are tested as 'reasonably practicable' but instead precautions. Also, under SFAIRP the duty-holder must adopt the hierarchy of controls in sorting and sequencing the potential precautions. The hierarchy of controls is discussed in more detail in the following sections.

It is possible that the same safety measures will be adopted under the ALARP and SFAIRP demonstrations of what is 'reasonably practicable', but it is not necessarily so. Robinson label's it 'naively courageous' to believe ALARP will (post-event) satisfy the duty of SFAIRP [11]. This is especially so in high-consequence, low-probability events.

The crux of the matter

Crucially, it is not enough for a fire engineering to assume that achieving Building legislation compliance discharges their duty under WHS legislation because; (i) Building legislation is not superior to WHS legislation, and (ii) while the principle of costs and benefits are inherent in Building legislation, the principle of 'gross disproportionate' is not.

Building legislation is target-based, sometimes also referred to as hazard-based. Duties are discharged when a certain target performance requirement is reached. Fire engineering under building legislation, in almost all cases, is cost-driven. This is not necessarily a bad thing. In a report by The Centre for International Economics it is estimated that in Australia performance-based codes provide $780 million in economic benefits annually [12]. Notably, these benefits are concentrated in the non-residential sector with $740 million in gains. Performance-based, fire engineering design is a significant contributor to these productivity gains as is demonstrated in case studies presented within the CIE report.

WHS legislation is precaution-based [13]. Clearly, a designer has not eliminated or minimised risks so far as is reasonably practicable, if more could reasonably have been done. WHS legislation requires a designer to start at the highest level and only do less when it can be justified. Although cost is relevant in determining what is reasonably practicable; (i) it must be considered last, only after the degree of risk is determined, and (ii) there is there is a clear presumption of safety ahead of cost especially where life safety is involved [14].

How to fire engineer to WHS compliance

The hierarchy of controls

A fire engineering designer has a duty to start at the highest level of precaution; elimination. Where it is not reasonably practicable to eliminate the risk, as will often be the case in fire safety, a hierarchy of controls must be followed. At each level, relevant matters are to be considered.

The hierarchy of controls is shown in the following figure, reproduced under creative commons licence, from the Safe Work Australia Guide 'How to determine what is Reasonably Practicable to meet a Health and Safety Duty' [14] (see Fig. 6).

As previously mentioned, the elimination of fire hazard in most building scenarios will not be practicable, although this must nevertheless be demonstrated and documented. In terms of the minimisation controls, examples include, but are not limited to:

- Substitution; materials with lower fire hazard properties.
- Isolation; passive fire separation.
- Engineering controls; automatic fire sprinklers, smoke hazard management and so on.
- Administrative controls; 'management in use' policies.
- A fire safety strategy relying on personal protective equipment as its highest level would be rare.

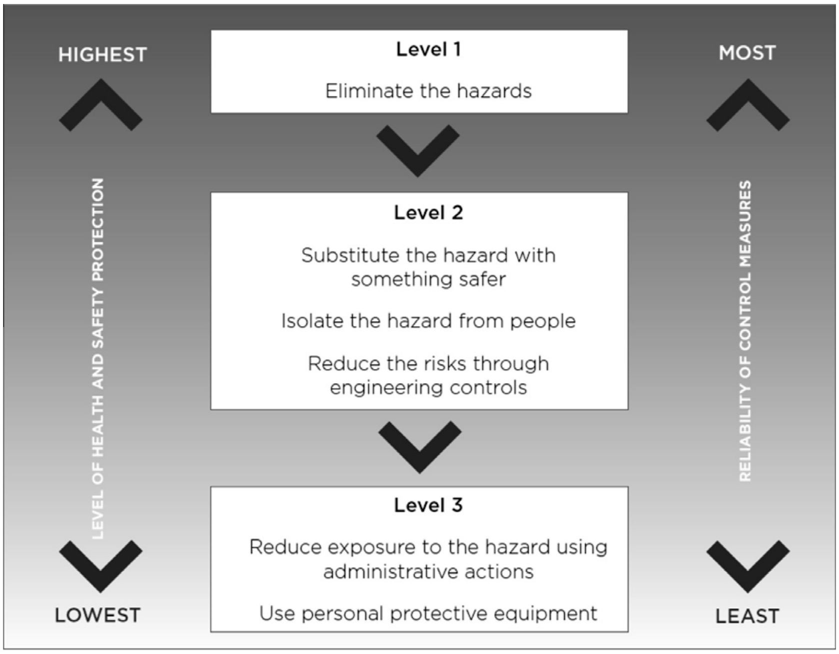

Fig. 6. Safe work Australia hierarchy of controls [14] (http://creativecommons.org/licenses/by-nc/3.0/au/).

Multiple levels of control might be applied should residual risk remain following each step. For example, a fire design might include isolation via passive fire separations and also engineering controls such as automatic fire sprinklers to deal with any residual risk associated with the potential failure of a fire separation.

Relevant matters

A fire engineering designer has a duty to do all which is, or was at a particular time, reasonably able to be done, taking into account and weighing up all relevant matters including:

- The likelihood of the hazard or the risk concerned occurring; and
- The degree of harm that might result from the hazard or the risk; and
- What the person concerned knows, or ought reasonably to know, about:
  - The hazard or the risk; and
  - Ways of eliminating or minimising the risk; and
- The availability and suitability of ways to eliminate or minimise the risk; and
- After assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

A designer must be particularly cautious of disregarding a precaution based on the first point above, that of a low likelihood of a risk. When things go wrong, the low likelihood argument post-event will have very little success [13].

What happens in practice?

Consider again, the sample of common fire engineering alternative solutions:

- Travel distance increased
- Smoke exhaust volume reduced/eliminated
- Sprinklers reduced/eliminated
- Exits (reduced width/aggregate width/height)
- Exit discharge not to an open space
- Fire hose reel modification
- Fire distance levels eliminated

Each of these reduces safety precautions. Regardless of whether or not there are trade-offs elsewhere in the fire safety strategy, if the building is a workplace then it is not good enough to simply justify these reductions against a Building Code performance target.

A fire engineer has a duty to cycle through the hierarchy of controls. Starting at the highest possible level of precaution, they must consider all relevant matters, all credible threats and all possible precautions. They can only discard precautions where it is demonstrable that the level of protection is not reasonably practicable. Cost is the last consideration.

Conclusions

As the safety culture evolves, Work Health and Safety (WHS) legislation has become more than an employer–employee relationship. It now imposes duties on other participants such as building designers who have an upstream influence on WHS.

Fire engineers are a category of designers who have a direct influence on safety precautions. Most buildings upon which fire engineering is practiced are workplaces. Fire engineers therefore have dual duties in such cases.

Under Building legislation, fire engineers must design to minimum building code performance requirements. In the process they most usually adopt the most cost effective approach, creating economic benefits.

This is not necessarily a bad thing except that it neglects that under WHS legislation fire engineers have a duty to adopt the highest possible level of precautions, and only do less if it is not reasonably practicable to adopt the highest precautions. The reasonably practicable test must follow hierarchy of controls and consider all relevant matters, the last of which is cost.

Fire engineers that ignore WHS duties, intentionally or not, are exposed to claims of negligence. The paradigm has changed towards a safety culture and fire engineering practice must change too. To many this will seem impractical and inefficient. However, it is the law

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