THE WARREN CENTRE

# Building Stronger Foundations – Discussion Paper

24 July 2019

## About the Warren Centre for Advanced Engineering

The Warren Centre brings industry, government, and academia together to create thought leadership in engineering, technology, and innovation. We constantly challenge economic, legal, environmental, social, and political paradigms to open possibilities for innovation and technology to build a better future.

Our 30 years' experience of leading the conversation through projects, promotion, and independent advice drives Australian entrepreneurship and economic growth.

The Warren Centre is pleased to have the opportunity to provide this submission to the Building Stronger Foundations Discussion Paper.

## Executive Summary

The Warren Centre is currently undertaking a deep review of the role of professional Fire Safety Engineers. In part 1, we offer advice on the specific context of Fire Safety Engineers from this recent and going work. The Warren Centre previously studied and recorded an engineering standard of care. In part 2, we offer insights on the duty of care based on that previous work.

## 1. Our current work – Fire Safety Engineering

The Warren Centre for Advanced Engineering based at the University of Sydney works to provide a forum for world class, evidence based, independent research on major issues of public policy. Our current "Professionalising Fire Safety Engineering" project is directly relevant to your Discussion Paper. This current research project is funded by and involves a wide range of organisations and individuals from governments, universities, developers, builders, insurers, fire safety consulting firms and fire services.

The Warren Centre research, prompted by broad industry concerns and then the Grenfell fire, has already examined the current regulations controlling the practice of fire safety engineers, and the current role, responsibilities, competency, education, and accreditation of fire safety engineers in all Australian jurisdictions including NSW.



**The Warren Centre for Advanced Engineering Ltd**
School of Information Technologies Building J12
University of Sydney NSW 2006
T: (02) 9351 3752 F: (02) 9351 2012

E: warrenc@sydney.edu.au W: thewarrencentre.org.au
twitter.com/thewarrencentre facebook.com/thewarrencentre

Three major reports published by the Warren Centre have made a series of recommendations for reform of regulation, education, and accreditation of fire safety engineers. Research into the future most effective role and responsibilities for fire safety engineers, and the new competencies required, is nearing completion.

The recommendations focus on ensuring the quality of design and construction and the resultant safety of buildings through effective regulation, sound professional practice and accountability of fire safety engineers. Essential to successful safety outcomes is close attention to competency, accreditation and audit/enforcement from concept design through to construction, commissioning and building handover. These Warren Centre recommendations are entirely consistent with the aspirations of your NSW Discussion Paper and the findings of the Hackitt and Shergold/Weir Inquiries.

A critical aspect of fire safety engineering in a building design and construction is that, unlike other disciplines such as architects and structural, mechanical engineers, etc, fire safety engineers do not typically develop detailed plans, drawings or specifications. Fire safety engineering is a very broad multi-disciplinary discipline in which fire safety engineers develop building fire safety strategies and reports which cover many fire safety measures including building egress, fire performance of structures, compartmentation, smoke control, fire detection and suppression, and fire-fighting facilities. A key role of the fire safety engineer is to produce one or more fire safety engineering reports to justify all NCC/BCA Performance Requirements that form part of building approvals.

These fire safety strategies are required to be converted into detailed design drawings and specifications by the full range of other “building designers” including architects and structural, mechanical, hydraulic engineers, etc in design, and are properly installed by builders and fire protection contractors during construction.

The role of the fire safety engineers should include the requirement to check that the approved fire safety strategy and range of fire safety measures have been correctly included in detailed design documents. Increasingly, it is clear that the role of fire safety engineers ought to be expanded to ensure systems are then constructed and installed properly in accordance with the fire safety strategy. Finally, fire safety engineers should work together appropriately through checks during commissioning. This, in essence, is the “chain of responsibility” concept articulated by Hackitt and Shergold/Weir to ensure the continuity and proper implementation of the fire safety strategy from concept design through construction to final handover at project completion.

Before addressing the four key areas for reform for a more robust regulatory framework for building and construction identified in the Response and Discussion Paper, we make the following points based on our Warren Centre research to date:

- The building regulations which control the role and registration of fire safety engineers are completely inconsistent across the eight states and territories of Australia
- It would be significantly advantageous for NSW and Australia to have these fully harmonised nationally. This would improve economic efficiency, public safety and consumer protection.
- In NSW, “fire safety engineers” have been registered as certifiers but not for their design role. This oddity of the NSW regulation appears to confuse the role of engineers as designers at the front end of the process. It is impossible to add safety with an inspection / certification at the end of the process.
- It is recommended that fire safety engineers, given their critical role in people safety, be included in the new NSW scheme for “building designers”, but the scheme should be based on the more stringent provisions of licensing rather than the lesser provisions of registration.
- The role of fire safety engineers should include a requirement for the fire strategy report for a building to address all the NCC Performance Requirements relevant to fire safety, and not just the Performance Solutions, in a holistic approach to ensure complete compatibility between DTS and Performance Solutions
- Fire safety engineers should be required to develop their Fire Engineering Brief (FEB) and Fire Engineering Report (FER) as part of a process of involvement from concept design through to a checking and inspection role in detailed design, construction, commissioning and handover, as strongly advocated by Hackitt and Shergold/Weir, based on the “chain of responsibility” concept.
- Licensing of fire safety engineers in NSW should be based on individuals holding professional accreditation with Engineers Australia (NER scheme) or the IFE Scheme, provided both schemes embrace the new competencies being developed through the Warren Centre research based on best practice, rather than the out of date competencies currently used by both schemes which have not been updated in 25 years.

Copies of the Regulation Report, Education Report and Methods Report which encompass the Warren Centre research findings and recommendations to are hyperlinked as part of this submission. A paper summarising the key findings presented at a major international fire safety conference in Portugal is also attached. They provide the detailed evidence to support our submission.

In relation to the four key areas of reform and the numbered questions in the Discussion Paper, we would be more than happy to provide Centre staff and key researchers to engage in detailed discussions on all these matters and present the evidence from our Reports. However, as a first pass, we provide some brief answers

to some of the key questions, using the numbers from the Discussion Paper:

1. Fire safety engineers should sign off and declare that the fire safety strategy and the proposed fire safety measures meet the Performance Requirements of the NCC before the fire safety reports are given to the certifier. This should not be limited to Performance Solutions only but should ensure that all DTS and Performance Solutions comply with the NCC and work together effectively and holistically as a totally integrated and effective package of fire safety measures.
2. The fire safety strategy and proposed fire safety measures should be statutorily declared at both the DA and CC/CDC stages and at the completion of construction and commissioning to ensure the finished building complies with the NCC fire safety requirements.
3. Changes to the design or during construction that have a material impact on fire safety should be referred back to the original fire safety engineer for review and the certification updated.
4. A statutory declaration should only be required for major variations which have a significant impact on fire safety.
5. The major obstacle is that of time. Proposed variations by designers or the construction company need to be referred back to the fire safety engineer in a timely fashion to permit a proper evaluation of the implications of the change.
6. No suggested options.
7. It does not seem possible to make the modifications system simpler but more robust at the same time.
8. The “plans” coming from fire safety engineers in the form of fire safety engineering reports should be made available to the Commissioner electronically together with building plans and specification which reflect the fire safety strategy and reports. They should be provided at the completion of design and before construction so that any defects found through audits are identified and corrected early before the building is completed.
9. Fire safety engineers as “building designers” play a very important role in design of buildings. They should provide their FEB and FER reports and any associated supporting information to ensure the building fire safety design is well understood by all parties.
10. There should be no circumstances where it would be difficult to document Performance Solutions and their compliance with the NCC/BCA. Otherwise those aspects of the fire safety strategy and level of fire safety would remain unknown and potentially be very dangerous. As stated previously, this documentation should apply to all DTS and Performance Solutions related to fire safety in a holistic and integrated manner. This will avoid the exact situation which occurred in the Lacrosse building design process and led to the fire in Melbourne.

11. The complete fire safety report to address all fire safety related Performance Requirements is valuable and essential as part of the process.
12. No other methods have been identified or seem feasible.
13. Fire safety engineers should be involved in inspections and witnessing of key elements of commissioning to ensure the approved fire safety strategy is correctly implemented as per approved “plans” and fire safety reports. This is exactly the “chain of responsibility” from concept design through to building completion highlighted as critical to improved building safety by Hackitt and Shergold/Weir. This should not involve fire safety engineers in detailed inspections and certification of fire related construction or installed fire safety systems which will rightly be undertaken by others but rather that the agreed fire safety related construction and fire safety systems as required by the strategy have been included in the finished building.
14. Builders should declare that the final building works as a complete package meet all the requirements of the NCC/BCA and the approved plans.
15. No specific comment
16. No specific comment
17. No specific comment
18. For fire safety engineers in NSW, they are not registered as designers, but can be registered as certifiers in the category of fire safety engineering. Based on the Warren Centre research, fire safety engineers should be licensed as ‘building designers’ rather than registered by the NSW BPB, based on professional accreditation obtained from Engineers Australia NER scheme or the international IFE scheme provided both schemes adopt a whole new approach to professional competencies for fire safety engineers (currently in development by the Warren Centre).
19. The minimum requirements should be as stated in the Discussion paper, plus a mandatory level of PI and PL insurance.
20. “Building designers” including fire safety engineers should carry a minimum level of PI and PL insurance to provide those suffering losses as a result of a building failure attributed to the designer some recourse to recovery of losses.
21. No specific recommendations.
22. Fire safety engineers should have the competencies spelt out in the appropriate professional accreditation schemes which are based on the requisite qualifications, skills, experience and personal attributes including ethics of a full professional.
23. For fire safety engineers, qualifications should generally be a Washington Accord bachelor’s degree in engineering, plus a graduate diploma or master’s degree in fire safety engineering from an accredited program. However, there must be alternative pathways to demonstrate equivalent

competencies, particularly under any transitional phase of regulatory reform.

24. See answer to question 19 above.
25. Strong powers of audit and enforcement should be provided to regularly examine performance and compliance of fire safety engineers and other registered "building designers". This has been the complete weakness in NSW and all other states and territories in Australia that has led to many industry problems.

26 to 30. In the specific context of Fire Safety Engineering, no comments are offered on the duty of care or consumer protection.

The Warren Centre supports very strongly this very timely NSW initiative for regulatory reform, especially for fire safety. Research by Prof Brian Meacham across seven countries, including Australia, suggests currently that less than 50% of designs for fire safety of buildings are undertaken by qualified and properly accredited fire safety engineers. This should not continue.

A move to proper education, accreditation, licensing and competency of fire safety engineers in NSW will bring major benefits flowing from a fully performance-based approach to building development in NSW in terms of:

- More cost effective and innovative designs
- Stronger controls over construction and commissioning
- Better public safety outcomes, and
- A full and proper professional career path for fire safety engineers

The Warren Centre and its research team and industry participants stand ready to enter into further dialogue and provide the NSW Government with the best available advice on regulatory reform, particularly as it affects fire safety.

## 2. Our previous work – Engineering Duty of Care

Beginning in 2006, the Warren Centre began deep engagement and collaboration across industry, engineering associations, universities and a broad range of practicing engineers to develop a widely accepted standard for the performance of a Professional Engineer. The project was known as "Professional Performance, Innovation and Risk" or "PPIR". The resultant standard was expressed in the PPIR Protocol for Performance. The standard can be applied prospectively or retrospectively. The standard applies to a Professional Engineer's work regardless of their status as a Chartered Professional Engineer or as a Registered Professional Engineer. From its inception, the authors of the Protocol carefully distinguished the scope of the Protocol as a third dimension separate from, but complementary to ethics and competency. In 2009 when the Protocol was published, the contributors specifically sought for the profession itself to take control and write a simple

document to record how engineers do their work. The Protocol aimed: to inform and to guide the Professional Engineer, who may be acting individually or as a team member; to inform and guide all relevant parties and other stakeholders on the role and obligations of Professional Engineers; and to define the essentials of performance against which the duty and standard of care of Professional Engineers can be assessed objectively in prospect and in retrospect.

The Protocol is recognised by the Board of Professional Engineers Queensland in the *Queensland Code of Practice for Registered Professional Engineers*.[1]

Turning to the specific questions for feedback, the following answers are suggested across the broader range of engineering (not specifically limited to Fire Safety Engineering above):

26. Architects and engineers are recognised by society and within established common law categories as experts on whom occupants and owners of buildings rely. The nature of modern contracting and the structure of the construction industry drives a degree of fragmentation of scope and sub-contracting that can critically affect the fitness of design and the integrity of final construction. As "layers" of construction are completed, it can be impossible to determine the fitness of substructures. As two examples, fire safety engineers and structural engineers deliver designs and expert inputs that are critical to the safety and quality of a modern building. In the United States, where there is a strong system of Professional Engineering accreditation, engineering is held with high community regard, in some regards on par with medicine, law and accounting as an expert profession. Over reliance on legalistic standards of care is no substitute for professionalism and pride in delivering expert service to the community. Dame Hackitt refers to a "race to the bottom" in the UK design and construction industry. Devolution to the cheapest solution in the market is a poor outcome. The tone in this discussion paper accepts too much legalism and fails to acknowledge the superior outcomes possible when greater professionalism, commitment to community, pride in workmanship and pride in expert accomplishment are the primary drivers for the behaviours of engineers.

27. We refer the Government to the Warren Centre's previous efforts to define a general engineering standard of care.

28. In our experience, it is common that contractual parties move boundaries of professional practice to different companies to achieve commercially suitable arrangements. We believe parties should retain freedom to contract. However, there must be a "chain of responsibility" from concept design through to building completion as highlighted by Hackitt and Shergold/Weir or grave mistakes can occur.

[1] Board of Professional Engineers Queensland, *Queensland Code of Practice for Registered Professional Engineers*, 29 Nov 2013, at https://www.bpeq.qld.gov.au/images/documents/Forms/180517%20BPEQ%20Code%20of%20Practice%20131129%20web.pdf .

29. and 30. No specific comment.

## Attachments:

Three Fire Safety Engineering reports are available for download at https://thewarrencentre.org.au/project/fire-safety-engineering/ . These are the Education Report; the Regulation, Control and Accreditation Report; and the Methods Report report. Two further reports are presently in late draft stage.

The CILASCI5 paper is attached.

The Protocol for Performance (Engineering Standard of Care) is available at https://ppir.com.au

### Contact

Ashley Brinson
Executive Director, The Warren Centre for Advanced Engineering

### About the Warren Centre for Advanced Engineering

The Warren Centre constantly challenges the economic, legal, environmental, social and political issues raised by innovation. We collaborate with industry, government and academia to achieve globally significant outcomes.

https://thewarrencentre.org.au/

THE WARREN CENTRE

# A MOVE TO FULL PROFESSIONALISM FOR FIRE SAFETY ENGINEERS

## – THE WARREN CENTRE RESEARCH

**Authors**

Peter Johnson, Fellow, Arup, Melbourne

Jose Torero, Professor, UCL, London

David Lange, Senior Lecturer, UQ, Brisbane

Ashley Brinson, CEO, The Warren Centre, Sydney

**Keywords**: fire safety engineers; performance-based codes; building regulations; competency; education.

# 1 INTRODUCTION

Many countries over the past 30 years have moved to performance-based building codes and regulations, including the provisions for fire safety. These countries include the Japan, UK, Sweden, USA and Canada, Australia and New Zealand, as well as Spain and Portugal [1], [2], [3].

These building codes generally permit 'alternative solutions' or 'performance solutions' to the traditional prescriptive or "Deemed-To-Satisfy (DTS)" provisions. However, for many buildings, the majority of measures for fire safety are still designed to the prescriptive requirements or are still designed using a prescriptive regulatory framework as a first approach, with concepts of "equivalence to the DTS" as the benchmark for alternative, performance based solutions.

At the same time, research into fire science and the whole field of fire safety engineering has developed internationally to provide new tools and data for performance-based fire safety design and analysis, although Torero et al [4] would claim that fire safety engineering is still effectively a "trade" and not a full profession. Similarly, Meacham [5] would suggest fire safety engineering as a discipline is still very much in its "adolescence" and "we have not experienced any transformational changes in technology and practice for some time". In part at least, Torero and Meacham have highlighted the fact that fire safety engineers need to lift their levels of competency to be more like the equivalent of structural and mechanical



**The Warren Centre for Advanced Engineering Ltd**
School of Information Technologies Building J12
University of Sydney NSW 2006
T: (02) 9351 3752 • F: (02) 9351 2012

E: warrenc@sydney.edu.au • W: thewarrencentre.org.au
twitter.com/thewarrencentre • facebook.com/thewarrencentre

ABN: 27 132 821 688

engineers if they are to become a true profession, take control of their designs, and avoid more regulatory control.

These concerns over competency of fire safety engineers have a clear international perspective. In his global review of performance-based fire safety engineering design and analysis, Meacham [1] examined current practice in a number of countries. In New Zealand he found there was a "perceived shortage of adequately qualified and competent fire safety engineers" and that "peer review was not working well". In Spain, he concluded that fire safety engineering was not a recognized profession and there was a lack of solid fire safety engineering educational programs. Similarly, in Portugal, Pedro et al [3] found that "building regulations were complex and fragmented", and there were concerns that "qualifications, duties and responsibilities of technicians (engineers) were not clearly defined".

In Australia for some years there have been concerns that this lack of a fully developed profession of appropriately competent fire safety engineering has prevented the full benefits of the performance-based building code have not been fully realized in terms of innovative design outcomes or cost-effective construction. [6]. At the same time, many people have questioned the whole culture and commitment to building quality and safety in the construction industry, which has been reflected in findings of various government inquiries over the past decade. [7] [8]

While these issues of quality and safety in the built environment in Australia had, to some extent, been recognized by the fire safety community, it took the Lacrosse building fire in Melbourne and the Grenfell building fire in London and the issue of combustible facades to really focus the mind of Australian governments, regulators and the professions as to the extent of the cultural and technical issues within the design and construction industry in Australia. A similar process was also detonated in the UK after the Grenfell building fire. The reaction in other countries has not been significant despite the fact that serious events have occurred recently in many countries. The purpose of this paper is to disseminate the Australian introspection to encourage other countries to take this experience and extend it to their own realities, where it is very likely that similar issues exist.

# 2 FIRES AND INQUIRIES

As stated, this debate as to the state of fire safety engineering globally has been bought into sharp focus with the tragic 2017 Grenfell Building fire in London [9], as well as the many other building façade fires around the world.

In Australia, two significant fires occurred in high rise residential buildings. The first was at the Lacrosse Building in 2014 [10], and the second more recently at the Neo 200 building in 2019. They both started on non-sprinklered apartment balconies and quickly ignited combustible external wall materials and spread vertically up the building external façades. In the case of the Lacrosse building, the fire spread from the 6th floor to the roof above the 21st floor in approximately 11 minutes, according to the local fire brigade report [11]. In the Neo 200 case, the fire was ignited on the 22nd floor of a 41 storey building but was stopped by the fire brigade at the 27th floor.

In both cases, there were no fatalities or serious injuries. Both buildings were fully sprinkler protected, had full detection and alarm systems, had two stairs and there was a rapid fire brigade response and immediate evacuation. Having said that, in the Lacrosse and Neo 200 buildings there was extensive damage to many apartments, and in the case of Lacrosse, the water supply for the sprinkler system was in serious danger of being overwhelmed due to the large number of sprinkler heads which opened on successive floors up the building.

While the Lacrosse fire initiated some government action in Australia to look at the combustible façade issues through 2015 and 2016, it was the Grenfell Building fire in 2017 [9] and the loss of 72 lives which shocked the world and generated major inquiries in the UK and Australia.

The resultant Hackitt Inquiry [12] prompted by the Grenfell fire in the UK, and the parallel Shergold/Weir Inquiry [13] into building regulations in Australia, have highlighted major flaws in the performance-based building regulatory and certification/approval processes, and very significant cultural issues with the whole building design and construction industry. The result has been poor quality buildings, including fire safety provisions, and major concerns for community health and safety.

In Australia, the Shergold/Weir report [13] was entitled "Building Confidence – Improving the Effectiveness of Compliance and Enforcement Systems for the Building and Construction Industry across Australia". Their key findings and recommendations included:

- The need to lift standards of practitioner competency and ethics
- Improvements in regulatory oversight of building performance
- A strengthening of compliance and enforcement through more rigorous accreditation

The key findings by Hackitt [12] included:

- A lack of clarity on roles and responsibilities in building projects, including for fire safety engineers
- Prescriptive regulation and guidance are not helpful in designing and building complex buildings
- An outcomes-based (performance based) framework requires people who are part of the system to be competent, to think for themselves rather than blindly following guidance, and to understand their responsibilities to deliver and maintain safety and integrity throughout the life cycle of a building.
- Any organization which accredits competence in any trade or profession associated with the built environment should themselves be accredited by a rigorous, publicly recognised and accepted method of accreditation.

These fires and the subsequent inquiry findings have illustrated the need for improvements in the clarity of roles and responsibilities for fire safety engineers (and others) as well as a need for a lift in competency with more rigorous methods of professional accreditation.

# 3 WARREN CENTRE PROJECT

In Australia, a group of fire safety engineers and researchers saw the urgent need to take leadership and undertake a major study into the future role, competency, education and accreditation of fire safety engineers in Australia back in 2014 and 2015. In part this was prompted by a report from the Australian Productivity Commission which suggested significant benefits could be realized by even greater use of the full provisions of the performance-based Building Code of Australia [6].

This group of engineers and researchers had the idea for a research project to be set up at the Warren Centre for Advanced Engineering at the University of Sydney. At that time there did not seem to be sufficient drive or interest across the whole Australian design and construction industry. However, by the second half of 2017, prompted by the Lacrosse and Grenfell fires, the impetus for research and reform had changed. This Warren Centre Project entitled "Professionalising Fire Safety Engineering" is now well underway.

The Warren Centre Project has involved small teams of key researchers supported by a wide range of specialists from the fire safety engineering and wider design and construction community through a Technical Management Committee and consultative extensive report review process. The Project is being funded by contributions from governments, fire engineering consultants, universities, the fire service and insurance sectors.

The Warren Centre project is using evidence based research around three key themes:

- The State of Fire Safety Engineering Regulation, Control and Accreditation in Australia
- The State and Future Role of Performance-Based Fire Safety Engineering in Australia
- The Effective Professionalisation of Fire Safety Engineers.
- In turn, these three themes of the research have been devolved into eight research tasks, of which three have now been completed, and a fourth has now been commenced, namely:
- Task 1.1, the 'Regulation Report', on the current state of fire safety engineering regulation, control and accreditation in Australia, with differences and deficiencies identified. [14]
- Task 3.1.1, the 'Education Report', on the current status of education, training and stated competencies for fire safety engineers, with international benchmarking. [15]
- Task 2.2, the 'Methods Report', a study of the benefits of an updated International Fire Engineering Guidelines (IFEG), the new Fire Safety Verification Method (FSVM) adopted in the latest Building Code of Australia, and the Society for Fire Safety (SFS) and other Practice Notes. [16]
- Task 2.3, the 'Roles and Competencies Report' (in progress), which is starting to look at the potential new roles for fire safety engineers and the competencies required for a fully developed profession.

## 3.1 The Regulation Report

The Task 1.1 'Regulation Report', authored by Kip, Wynn-Jones and Johnson [14], has highlighted the total inconsistency between the Australian states and territories in relation to regulation and accreditation of fire safety engineers.

The report shows that while Queensland and Tasmania license fire safety engineers, such that it is illegal to practice without a licence in those jurisdictions, the other states and territories have no controls whatsoever or have registration schemes which do not prevent people practicing fire safety engineering provided they do not claim to be registered or do not call themselves fire safety engineers.

Only in NSW is it mandatory for fire safety engineers to undertake construction site inspections, and only in the three states of Victoria, Queensland and NSW are there mandatory requirements to consult with the local Fire Brigade on certain matters, although in some jurisdictions consultation is undertaken on a voluntary basis.

Given the lack of regulatory controls over the practice of fire safety engineering in a number of Australian states and territories, principal authors Kip and Wynn-Jones suggest that "it follows that there is lack of audit and enforcement of fire safety engineers and their performance".

The Task 1.1 Regulation Report highlights that "these findings of national inconsistency and widespread lack of controls over fire safety engineering practice appear to discourage the use of performance-based fire safety engineering and threaten the likelihood of sound fire safety outcomes for the Australian community."

The authors recommend "the development of a national model set of regulatory controls for fire safety engineering, including for design fire safety engineers, peer reviewers, certifiers approving 'Performance Solutions' and fire brigade officials reviewing designs". They argue that these national regulatory controls need" to be developed and implemented across all Australian jurisdictions" and be based on "best practice and achieve national consistency".

This call for clear national consistency on regulatory controls in Australia echoes such calls in many other countries such as Portugal, where Pedro et al [3] highlight the different regional and municipal building regulations as well as national building regulations in a system overall which is quite fragmented and frustrating to many professional designers.

## 3.2 The Education Report

This report [15] starts with the proposition that the role of fire safety engineers "must be fulfilled by individuals who collectively possess the competencies, comprising professional attributes, skills and knowledge, required to demonstrate that a societally acceptable level of safety has been obtained."

This research team, led by Dr David Lange from University of Queensland and Professor Jose Torero from University College London, found:

- Competencies for fire safety engineers in Australia have not been updated in the past 30 years; they are almost all based on simple statements of knowledge required without reference to higher skills and attributes of learning.
- As a result, there is no agreed definitions of the attributes and skills of a professional fire safety engineer.
- This leads to the fact that the accreditation process for the fire safety professionals, at least in Australia, and probably many other countries as well, is misaligned with other engineering disciplines which exhibit full and proper professionalism.

- The report highlights that the recent façade fires illustrate the pitfalls and dangers of continuing as the discipline has done for so long; the continued evolution of design practices and the introduction of new design goals, materials and technologies in the built environment will challenge the professionalism of fire safety engineers.
- Working in the current regulatory, educational and accreditation environment, the discipline is unable to address these new challenges robustly and yet is forced to engage with them in practice.

In relation to fire safety education in Australia and globally, the report highlights:

- "there is some consistency in model curricula which exist when describing the knowledge required of a fire safety engineer. Nevertheless, these curricula have remained largely unchanged over the past 30 years while the challenges which fire safety professionals face have continued to evolve."
- Of the major fire safety engineering courses taught in Australia, only the BEng/MEng course at the University of Queensland is accredited by Engineers Australia.
- Internationally, there is wide variety of fire safety engineering courses with varying curricula which do not appear to be linked to contemporary or future competency requirements.
- This Education Report concludes with a call to action to:
- review the competencies and attributes required of future fire safety professional in Australia,
- transform educational and accreditation processes through which competence is attained and acknowledged, and
- reform the regulatory environment in which a true fire safety engineering professional should work to ensure they work competently and ethically.

## 3.3 The Methods Report

The team from the University of Queensland have also examined the utility, benefits and risks associated with three different types of documents available for fire safety engineers to use to assist in design and verification of fire safety designs for buildings. [16]

These documents reviewed are as follows:

- The Fire Safety Verification Method (FSVM) developed by ABCB and now incorporated in the National Construction Code/Building Code of Australia for 2019 [17]
- The International Fire Engineering Guidelines (IFEG) [18]
- Practice Notes, including those issued by the Society of Fire Safety (Engineers Australia) [19]

This research and report started by defining very carefully the engineering design process, and the difference between the design process and development of a building fire safety strategy on the one hand, and the verification against building code requirements on the other hand. This was based on the international engineering literature from authors such as Dym and Brown [20], and Torero et al [15]. They show that design is a balance of drivers and

constraints associated to any project, and the verification of the design against the Performance Requirements of a building code has to remain a separate and independent process. The report highlights that these design and verification roles of the design team fire safety engineers are, or should be, completely separate to the assessment or checking of a fire safety design by a compliance certifier or building official who is representing or acting in the public interest.

This Methods report highlights the fact that the Fire Safety Verification Method (FSVM) crosses over the boundary between a design or process document and a verification method. It thus has the potential to influence design outcomes and safety in an unsatisfactory manner.

The FSVM makes reference to establishing equivalence to the prescriptive of DTS provisions of the BCA as a means of verifying compliance of "Performance Solutions" for design where a mixture of "Performance Solutions" and "DTS Solutions" are combined into an overall design. And yet these DTS provisions are not defined in a way that makes any such comparison possible. The need for quantified Performance Requirements is a feature of his Report.

When some of these issues were examined in more detail in this Report, it is clear that in relation to the FSVM:

- This confusion between the DTS provisions as a tool for establishing equivalence and as a means for meeting a Performance Requirement is dangerous, since the DTS provisions have never been shown to result in a safe building when applied outside of the classifications of the code.
- In fact, the DTS provisions have never been shown to explicitly satisfy any specific performance objective since no explicit performance objective for a Fire Safety Strategy or the individual components of a Fire Safety Strategy have ever been defined.
- Further, this approach abstracts the overall objective of the Fire Safety Strategy into specifications for individual components. This means that partial solutions, comprising a combination of components of a DTS Solution and a Performance Solution are never actually verified to provide an acceptable level of safety.

In relation to the IFEG It is recognised that it is significantly out of date as building designs have changed in many cases, but fire engineering technologies and data have also similarly developed. The IFEG is a fire safety engineering process document and not a verification method. Its purpose is for guidance only. At least an Australian version is planned to be updated. Practice Notes are also non-mandatory and simply provide specific guidance to practitioners.

## 3.4 The Roles and Competencies Report

This research has only just commenced. However, it is clear that future competencies for fire safety engineers cannot be written until the future role or roles of fire safety engineers are defined and agreed.

The initial research has highlighted the following:

- The roles for fire safety engineers who are involved in design and verification of building projects are different from fire safety engineers undertaking peer review or involved with independent review within a fire services organization

- There need to be clear boundaries between the role a design/verification fire safety engineer plays and the other design team members such as architects and other engineers, the public official or their delegate in checking the design for building code compliance, and those involved in individual fire protection design and installation for example.
- The extent to which fire safety engineers should be involved in planning and early concept stages of projects, and also in detailed onsite inspections and commissioning during construction stages of projects, as encouraged by Hackitt and Shergold/Weir, needs to be defined.

It is clear from the international review of performance-based building regulations and fire safety engineering by Meacham [1] and in the paper by Pedro et al [3] that there is often confusion over roles and responsibilities of fire safety engineers and other practitioners, which can lead to concerns over the quality and safety of buildings.

# 4 CONCLUSIONS

The Warren Centre Project in Australia and the resulting research reports show that Australia has much work to improve fire safety practitioner regulation in order to achieve national consistency, to establish the future role, competence, education and accreditation of fire safety engineers, and to generate up to date and proper guidance documents necessary to lift fire safety engineering to a full and proper profession.

While the emphasis has been on Australia, considerable research efforts have been made to benchmark regulations, competencies, education and accreditation against international practice, although it is clear that many countries are facing the same major issues.

The key findings of the first three research reports have been:

- Fire safety design is still largely driven by a prescriptive mindset and design and analysis framework, and the role of fire safety engineers generally does not extend into construction, commissioning and inspections.
- The regulatory and control provisions lack total consistency across the different States and Territories of Australia, with some jurisdictions having no controls over fire safety engineering practice (not unlike other multi-jurisdiction countries like Spain and the USA)
- The three post-graduate fire safety engineering courses in Australia are all different, and only one has professional accreditation and an academic rigor and status that compares with the best internationally.
- There are no proper competencies established for fire safety engineers, with criteria used for current accreditation schemes some 20-25 years out of date.
- There is a challenge in Australia coming with the introduction of a complex Verification Method for assessment of designs for compliance with the Performance Requirements into the Building Code of Australia.

The aim of this Warren Centre research is to provide governments and professional bodies with a series of regulatory and education and accreditation reforms which will lift fire safety engineering to a full professional status. This should allow fire safety engineers to take total control of fire safety design and analysis of buildings in Australia. The hope is that other countries such as the UK, Spain and Portugal, with performance based building codes and

regulations, in full or in part, will consider and potentially adopt some of these research findings to address their own fire safety challenges in terms of the role, competence, education and accreditation of fire safety engineers.

# 5 REFERENCES

[1] Meacham, B.J., - "Performance Based Codes and Fire Safety Design; An International Perspective", NFPA Conference and Expo, Boston, 2017

[2] Johnson, P. - (2014), "Performance Based Design and Fire Safety Engineering in Australia", 10th International Performance Based Conference for the Society of Fire Protection Engineers, Brisbane

[3] Pedro, J. et al, -"The Portuguese Building Regulation System: A Critical Review". International Journal of Law in the Built Environment. Emerald Group Publishing Limited, Vol. 1 No. 2 (2009). p. 156-175 (20).

[4] Torero, J.L., - "Fire Safety Engineering: Profession, Occupation or Trade?" International Fire Professional Magazine Vol. 1 No. 1 July 2012, Institution of Fire Engineers, UK.

[5] Meacham, B.J., - "Fire Safety Engineering at a Crossroad", Case Studies in Fire Safety (1) (2014) 8-12, Elsevier.

[6] Productivity Commission 2004, "Reform of Building Regulation, Research Report",

Productivity Commission, Australia, November.

[7] Queensland Government, "Improving Building Certification in Queensland: Discussion Paper", Department of Local Government and Planning, Brisbane, August 2011

[8] Victorian Auditor-General, "Report: Compliance with Building Permits", Melbourne, December 2011

[9] E. Potten, E., - "Grenfell Tower Fire: Background", House of Commons Library, Briefing Paper, No: CBP 8305, 15 May 2018, London

[10] Genco, G., - (2015) "Lacrosse Building Fire", City of Melbourne.

[11] "Post Incident Analysis Report, Lacrosse Docklands, 673-675 La Trobe Street, Docklands", 25 November 2014, Melbourne Fire Brigade.

[12] J. Hackitt, J., - "Building a Safer Future – Independent Review of Building Regulations and Fire Safety: Final Report", Crown Copyright, May 2018.

[13] Shergold, P., Weir, B., - "Building Confidence: Improving the Effectiveness of Compliance and Enforcement Systems for the Building and Construction Industry across Australia". February 2018.

[14] Kip, S. et al, - "Fire Safety Engineering – Regulation, Control and Accreditation Report", The Warren Centre for Advanced Engineering, University of Sydney, Sydney, Australia, February 2019.

[15] Torero, J., et al, - "Fire Safety Engineering – Education Report", The Warren Centre for Advanced Engineering, University of Sydney, Sydney, Australia, January 2019.

[16] Torero, J., et al, - "Fire Safety Engineering – Methods Report", The Warren Centre for Advanced Engineering, University of Sydney, Sydney, Australia, April 2019.

[17] "The Fire Safety Verification Method (FSVM)", National Construction Code Volume One/Building Code of Australia for 2019, Australian Building Codes Board, Canberra, 2019.

[18] IFEG (2005), International Fire Engineering Guidelines; DBH, NZ; ABCB, Australia; NRC, Canada; ICE, USA.

[19] "Practice Notes for Fire Safety", Society of Fire Safety, Engineers Australia

[20] Dym, C., Brown, D., - (2012) "Engineering Design"; Cambridge: Cambridge University Press ISBN: 9781139031813