

TITLE

THE IMPACT OF PERFORMANCE BASED REGULATIONS ON THE APPROVAL PROCESS FOR FIRE SAFETY IN BUILDINGS.

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ABSTRACT

Building regulations are in a state of transition, from a traditionally prescriptive approach, to performance based regulations. Fire regulations for buildings are still prescriptively applied but there is a move to performance based design and regulation. The use of performance regulations will mean that the regulatory authorities will need to come to terms with a new way of assessing the suitability of proposals for approval. The current approval process in Victoria is looked at as is a comparison of prescriptive and performance regulations. Issues relating to the use of fire engineering, performance based regulations and fire computer models are raised and explored. Implications for the approval authorities include the need for appropriate education, user friendly computer programs, establishment of performance criteria and protection against litigation.

KEY WORDS

Performance based regulations, prescriptive regulations, fire engineering, computer models, fire safety, building regulations, regulatory authorities.

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INTRODUCTION

The present trend towards performance based regulations and standards in building codes will impact upon the way that approval authorities assess building design. This will have special significance in relation to building regulations pertaining to fire protection.

This paper focuses upon how the approval authorities can cope with the transition from the use of the traditional prescriptive fire regulations to performance based fire regulations.

The use of performance based fire regulations will require the approval authorities to rethink the method by which new and alternative designs are assessed. These designs often involve the use of fire engineering and computer modelling techniques and are a radical departure from designs based on prescriptive requirements.

Most building codes require a design to be independently assessed to ensure that the proposal complies with the community's expectations for a safe building. These expectations are expressed through the building regulations. Assessment of fire regulations is usually undertaken either by a building regulatory authority or a fire authority. This procedure varies from country to country and often from jurisdiction to jurisdiction within that country.

In Australia the parties responsible for this function vary from state to state. In Victoria a building design must be assessed by a building surveyor to ensure that it complies with the requirements of the Building Regulations 1994. These regulations cover every aspect of new buildings and alterations or extensions to existing buildings, including structural and safety provisions. A building surveyor can either be employed by a municipal council or be a private building surveyor to undertake this role. The fire authorities, in Victoria this is the Metropolitan Fire Brigade and the Country Fire Authority, are required to approve fire systems that are used by the brigade at the scene of a fire such as hydrants and boosters etc. The remaining fire safety systems such as sprinkler systems, smoke control, detection systems, firewalls etc are approved by the building surveyor.

The regulations require the fire authorities to provide an opinion on a fire safety matter should a designer wish to vary a regulatory requirement of use an alternative design or system. It is also common for a building surveyor to request the fire authorities to comment on a design proposal in situations where they do not legally have to be consulted.

This procedure may also vary if government departmental property is involved. Some government departments have a role in assessing fire designs for their own property.

It is not the purpose of this paper to suggest which authorities should, or should not, play a part in the building approval process. For that reason the paper will not differentiate between the parties but use the generic term of "approval authorities" to encompass all parties whose role involves approval of fire regulations.

PRESCRIPTIVE REGULATIONS

In Victoria the applicable building regulations comprise of the Building Code of Australia (BCA). This is now the case in all the territories and states throughout Australia. The BCA is predominantly a prescriptive based building code.

Prescriptive regulations, also known as "deem to satisfy" regulations, dictate what solutions are to be undertaken to ensure that a building design complies with the regulations. Another definition would be that they establish specific acceptable solutions or limits that cannot be exceeded (S and S Consultants 1991).

For example, under the BCA, any building over 25 metres in height is considered to be a serious fire risk and a fire sprinkler system must be installed. No alternative is permitted. The regulations then stipulate what sprinkler system is to be installed and to what specification e.g. location of heads, water pressure and flows etc. Theoretically, no variation is allowed, although some regulatory systems do have a process to permit variances.

Prescriptive regulations are based on traditional construction techniques, good practice, convention, controlled fire test results, experience and observations noted from real fires. To date they appear to have served the community well.

The main advantage of prescriptive regulations are that they are relatively easy to understand and comply with! Little interpretation is necessary, training in using them is straight forward and they minimise litigation in that compliance with the regulation protects both the designer and the approval authority. The approval process for prescriptive regulations are efficient in a bureaucratic sense, and rapid. This point is referred to by Brandie in a report to the Cullen Inquiry into the Piper Alpha (off shore oil installation) disaster

"... it tends to be the case that it is technically 'easier' to have such standard designs approved by the authorities than would be the case if the 'non-standard' approach was taken.

The alternative non-standard approach, being at this time somewhat unconventional, would require to be carefully guided through the regulatory authorities."

This is also the case with fire regulations for the building industry, and has led to a "crutch mentality" in that building designers prefer the use of the prescriptive building codes because they are easier to understand and get approval (Corbett 1991)

On the other hand, use of prescriptive fire regulations have been criticised in that they are too restrictive to innovative design and are judged to be incomplete, inefficient, inconsistent and unduly expensive (Building Regulation Review Task Force 1991).

PERFORMANCE BASED REGULATIONS AND FIRE ENGINEERING.

Performance based regulations are being offered as the alternative format for fire regulations. Performance based regulations establish criteria designed to ensure achievement of the regulatory objectives without compulsory prescription of a specific solution (S and S Consultants, 1991).

The trend for the adoption of performance based fire regulations is international (Milton 1992). The Building Code of Australia already has some performance requirements in its structural provisions. The Building Regulation Review Task Force has developed a five part Building Regulation Reform Strategy with one of the main objectives being a performance based building code (Beck 1991)

Internationally countries, such as England, Canada, New Zealand, The Netherlands, Scandinavia and in some parts of the USA, already have performance based regulations. Milton (1992) has identified that the European Economic Community have a commitment to performance based regulations. The EEC put out a directive in December 1988, The EEC Construction Products Directive, that sets out a framework for the establishment of performance based European Standards. This is also the policy of the International Organisation for Standardisation (ISO).

Recent advances in fire engineering have meant that there are now the methods and expertise to use performance based regulations. "Fire Safety Engineering" means using engineering principles for evaluating fire hazards and the design of fire protection measures (Pedersen 1992).

The interest in performance based fire regulations has coincided with the advances in fire engineering. The major advance in fire engineering has been the development of computer models for determining the behaviour of fire in a building.

In spite of the complexity of fire behaviour, the intricate mathematical routines involved and the intensification of research data the enhanced capabilities of personal computers over the last twenty years has meant that there is now a medium by which fire behaviour predictions can be relatively quickly and reliably made (Quaglia 1992).

FIRE ENGINEERING.

Defining the term "fire engineering" is a difficult process. The term means different things to different people. "The definition causes difficulty because the subject nature of the fire safety engineering draws in very many academic and practical pursuits." (Galea 1994).

An example of the varying definitions is provided by Deakin (1994):

The application of engineering principles, rules and expert judgement based on a scientific appreciation of the fire phenomena, the effects of fire, and of the reaction and behaviour of people, in order to:

- *save life, property and preserve the environment and heritage*
- *quantify the hazards and risk of fire and its effects*
- *evaluate analytically the optimum protection and preservation measures necessary to limit, within defined levels, the consequences of fire.*

Another definition was provided by Peter Johnson of Scientific Services Laboratories in a private communication in 1994:

Fire engineering is the application of fire science in a performance based approach that addresses fire safety as a total design package

One of the most comprehensive definitions was provided by Professor Ed Galea of the University of Greenwich (UK) in 1994:

Fire safety engineering draws together practical expertise in the form of Experience, Management skills, Judgement and Sociological awareness and an equal measure of Mathematical Modelling in the form of Architecture, Engineering, Physics etc. However, the main thrust of Fire Safety Engineering is the development of work practices and physical environment which results in efficient life and property safety. To do this the Fire Safety Engineer must assess risk and balance the pro's, con's and costs of alternative fire safety strategies.

As can be seen by the above definitions, not only is there difficulty with the definition of the term, but there is also confusion with the term. Sometimes it is referred to as "Fire Engineering" whilst others use the term "Fire SAFETY Engineering".

This difficulty also extends to the term "Fire Engineer". The issue of who is a fire engineer is not within the parameters of this paper, but is in itself an important issue.

THE ROLE OF THE APPROVAL AUTHORITIES.

A great deal of work is being undertaken from the engineering and technical aspects of fire safety in buildings with much work and discussion around the fire modelling data, fire testing data and the use of computers for fire modelling. Discussion in relation to the implementation and administration of performance based fire regulations is not as prevalent. In discussions that have taken place there is a concern that, whilst there are many barriers to the introduction of performance based fire regulations, the main barrier is the acceptance of this new technology by the approval authorities. Those involved in the process consider that this is a major cause for concern and that not enough attention has been given to the administration of these regulations. (Grubits, 1992; Law, 1991; Corbett, 1991).

This issue was a major topic for a conference in Worcester, Massachusetts, USA in May 1991 (The Conference on Fire Safety Design in the 21st Century). At this conference fire safety professionals cited lack of acceptance by the approval authorities as a major barrier to the introduction of performance based fire regulations.

The foreword to the conference report lists the following barriers to the introduction of fire safety design innovations:

- Lack of explicit, defined fire safety goals in building codes and standards.
- Resistance to change and the momentum of tradition.
- Lack of appropriate educational qualifications among key participants in the fire safety design and regulatory process.
- Ineffective transfer of new engineering methods to practitioners in validated and useful form.
- Economic incentives and disincentives
- Fear of Liability and law suits
- Failure of institutions to embrace innovations.

Some of these barriers are of special significance to approval authorities.

Studies undertaken so far indicate that the main problem (Grubits, 1992; Law, 1991; Corbett, 1991) is the lack of education in fire engineering and fire technology amongst building practitioners and approval authority staff. Corbett (1991) notes:

"There is no doubt that performance codes make the life of a code official more complicated, if not impossible. It is necessary for the code official to be on the same education plane as the designer. Most often, code officials do not have extensive training in fire protection engineering methods."

This point is supported by Dungan (1991):

"Without the proper education in the fundamentals of science and engineering, progress in advancing innovative methods of fire safety design will slow or stop. Engineering education in both the design and enforcement professions is essential for implementing positive change. Some believe that a cook-book or checklist approach to fire safety can be achieved without engineering. Some may even feel threatened by allowing engineering, particularly if they lack the technical background to verify its acceptability. Continuing education is necessary for all of us to grow professionally so we will be up to the technical challenges of tomorrow."

Burke(1991) explains that one needs to have confidence in new technology before one takes on the responsibility of accepting it. The traditional prescriptive codes were easier to understand and enforce and the regulatory authorities are comfortable with this method. Education of fire technology and fire engineering principles will increase this confidence.

An example where education has overcome the barrier of acceptance by regulatory authorities of performance based regulations is given by Law (1991), she explains that Building Control Officers in the U.K. prefer performance based regulations. The major reason for this positive attitude is the better educational standard that these officers now have.

But better education is not as simple as it sounds. It would take a significant amount of budget resources and commitment from regulatory authorities to train their staff in the new technology, especially if bureaucracy departments were also under budget restraints. The training would require the staff to undertake lengthy and detailed courses, placing a burden on the staffing of departments.

Not only would staff resources be under pressure during the re-education process but according to one commentator, the assessment of performance based designs would also require more staff resources than the traditional prescriptive method (S and S Consultants, 1991).

What type of education would be most appropriate? To study a computer model or even several computer models to validate a fire engineered application would be a lengthy learning process due to the large amount of different computer models that exist and are still being developed (Cote, 1990; McCormick, 1991; Friedman, 1991).

Assuming that the re-education process is under way, what methods do the regulatory authorities use to assess fire engineered designs whilst the expertise is yet not available.

In New Zealand a performance based building code is already operating and the lack of expertise by the regulators is recognised. Until this expertise is established they recommend that certain discretionary powers be discouraged and that review of designs be by "Peer Review". They envisage that a minimum period of five years is needed before the expertise is available (Buchanan 1994).

OTHER ISSUES

Whilst education fire engineered performance based building regulations is important, it is not the only issue. The building regulations must have the mechanism to permit alternative designs to be approved. If the code does not empower the approval authority to accept alternative designs then the education process is wasted. An example of a clause to permit acceptance of alternative designs is provided in the American Uniform Building Code (1988 edition):

"The provisions of this code are not intended to prevent the use of any material or method of construction not specifically prescribed by this code, provided any alternate has been approved and its use authorised by the building official.

The building official may approve any such alternate, provided he finds that the proposed design is satisfactory and complies with the provisions of this code and that the material, method of work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in suitability, strength, effectiveness, fire resistance, durability, safety and sanitation.

The building official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use. The details of any action granting approval of an alternate shall be recorded and entered in the files of the code enforcement agency."

Another issue related to the previous one is the protection of the approving authority against legal action. Since the approval of performance requires judgement there is always the concern that legal action may be taken against the approving authority should a mistake occur. Without a safeguard or immunity built into the regulations this concern will lead to conservatism on the part of the approval authorities.

The problem of setting performance levels is an inherent problem of performance based regulations. One of the major obstacles to implementation of performance regulations is to establish the criteria against which the alternative design shall be measured. Some regulations require the alternative solution to meet the performance level of the prescriptive requirements, or an approved verification method (such as a design code) or a published "Acceptable Solution" as in New Zealand or in accordance with an "Approved Document" as in the U.K.. The EEC are intending to publish interpretive documents to assist in the interpretation of performance standards.

An important factor in enabling approval authorities to be confident in dealing with fire engineered designs is for the technology and information to be in a user friendly format. The design and the report must be in a form and a format that is readily understandable by the regulatory community, in terms that are part of their regular vocabulary and in a form understandable by the community and its designated authority having jurisdiction (Callahan 1991).

CONCLUSION

This paper raises and explores some of the issues relating to the use of fire engineered performance based regulations in terms of the approval process for building designs.

The performance based approach has been compared to traditional prescriptive regulatory approval process. Implications for the approval authorities include the need for appropriate education; the user friendliness of computer models, the capacity to explore other alternatives; the establishment of suitable assessment criteria; and protection against litigation.

This is not an exhaustive list of issues relating to the use of performance based regulations for fire safety in buildings. While the main issues have been identified in this paper, each will require closer scrutiny and discussion. Other issues may well surface during the process of adopting a performance based regulatory approach.

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