Code compliance or fire engineering for life safety design – have we moved on?

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Our first article covered the importance of competence and ethics in fire engineering. In this first of the more detailed articles, we explore the current paradigm that fire safety solutions must be code compliant or performance based/engineered. We also consider if things really are being implemented correctly and whether our industry must take more responsibility for the quality of onsite delivery. Are we really achieving adequate minimum life safety standards if things stay as they are?

It has been very nearly 20 years since Margaret Law and Paula Beever delivered their paper 'Magic Numbers and Golden Rules' [1] in which the authors summarised: 'The magic numbers embodied in regulations are accepted without question whilst any engineering solution is subject to a disproportionately high standard of proof'.[1]

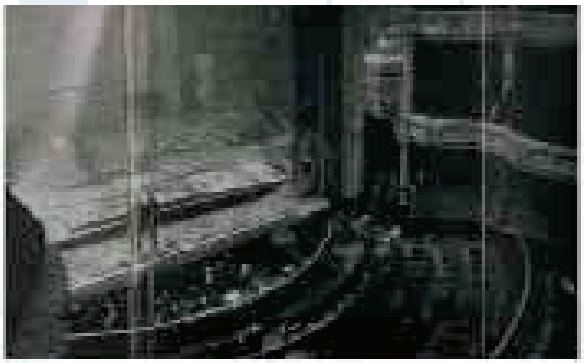
It was a provocative statement at the time. It referred to the deemed to satisfy recommendations in statutory guidance documents used to demonstrate compliance with the functional requirements of the regulations (which are not, in themselves, couched in engineering terms).

A lot has happened in the world since then, including changes to regulations governing fire safety, but have we yet arrived at a place where that statement can be confined to history?

Law also stated that: 'To move forward rules need to have an engineering basis and be goal related: the purpose of the rules needs to be understood by both researchers and regulators'[1]

and: '...a fire safety engineer must understand how to measure and quantify fire phenomena and fire safety'.[2]

Both of these are as true today as they were all those years ago. Fire engineers need to understand what the codes are effectively saying in engineering terms and, equally to understand the flaws in the codes or those parts that are not based on scientific or engineering principles.



1911 – Empire Palace theatre fire

For example, we are still dealing with the 2.5 minute 'rule' in respect of evacuation flow time. Lest we forget, it was generated from the investigation of the Edinburgh Empire Palace theatre fire of 1911 where the time taken for the audience to evacuate was roughly the same as the time it took the theatre orchestra to play the national anthem of the time. Is it now the basis from which the majority of UK codes take their recommendations for escape widths.

Similarly, the origin of the maximum 20m fire tender reversing distance is anecdotally linked to the maximum distance that horses pulling pumps could reasonably be encouraged to reverse without excessive use of a whip.

In 2008, BS9999 arrived on the scene. It was referred to in some quarters as the 'replacement for Approved Document B'. In others, that it could provide a half-way house between 'prescription' and 'fire engineering'. The reality is that it was neither of these but instead provides a more flexible approach.

It still presented a set of 'rules' in a prescriptive manner, some of which are the same as existing codes. The new 'rules' were again provided without explanation of their scientific and engineering origin or reference as to where the reader could go for the relevant information. There were a number of presentations/launches but the perception of 'magic numbers and golden rules' was perpetuated.

BS9999 divided opinion on a number of issues. For instance, lack of a specific recommendation to include the additional 'life safety requirements' of the sprinkler code. The view of some was that the exclusion of a statement similar to that included in Approved Document B was intentional. The other view was that a BS9999 life safety fire strategy would pick up the relevant guidance in the sprinkler code recommending that a sprinkler system provided as part of a life safety, should be provided with the additional life safety enhancements.

Thus BS9999 provided an up-to-date example of why it is important for fire engineers to be able to understand the background of the 'rules'.

Also, the recommendation introduced in the 2000 edition of Approved Document B for a maximum size for unsprinklered single storey shops of 2,000m^2 has since been subjected to regular scrutiny by many fire engineers. There have been many discussions within the profession and between members of the profession and the regulator and it is widely known that the retention of the provision came under review for the 2006 edition of Approved Document B. Based on the frequency and outcome of significant fires that have been experienced in unsprinklered single storey retail premises since 2006, it will be interesting to see what happens with the provision at the next review.

So we are still faced with the same 'magic numbers and golden rules' and the engineer (whether that be the designer or enforcer) is faced with the challenge of understanding and competently applying the code, research and engineering mix.

It is important to draw an early distinction here between code consultancy in its purest sense and the use of codes in a fire engineering context.

For example, in regulatory jurisdictions which require compliance with complex prescriptive building codes, 'Code Consultancy' exists as a competent profession to provide the client with an accurate interpretation of the codes and is not fire engineering.

In a functional based regulatory environment the engineer is required to demonstrate that the solution meets the functional requirement. The engineer has the choice of how to do this, from a blank sheet of paper to a fully code-based approach. It does not have to be either one thing or the other.

However, do we have an all-too-frequent 'hired gun' approach to the procurement and delivery of fire engineering? ie 'we need a fire engineer to get rid of sprinklers' or 'we need a fire engineer to reduce the period of applied fire protection'. This predetermined, polarised fire engineering approach analyses only one specific code recommendation thereby accepting the standard achieved by the remainder of the code. Ultimately this can result in the approach missing some key variable and conclude in well-placed scepticism on the original intent of the fire engineer's involvement. These commercial factors will be considered in more detail in future articles.

The term 'cherry picking' has become commonplace in enforcement circles as a means of countering design submissions based on a little taken from one code and a bit from another. Whilst sometimes this attitude cements itself into an unreasonable intransigence to accept design approaches that take proper steps to ensure that codes are combined properly, it again needs to be acknowledged that the attitude has taken root as a natural response to an environment that has proven fertile for 'hired gun' fire engineering.

So, still very frequently and for a variety and complex mix of reasons, fire engineers approach the consideration of design validity from the standpoint of identifying where it deviates from the 'code' and then justifying each deviation, ie a perpetuation of the status quo. Unfortunately this goes a long way to reinforcing the perception in the construction community that achieving fire safety is more about achieving 'ticks in boxes' rather than a clear motivation to ensure a coherent and balanced engineered design. This often leads to a piecemeal approach which is then difficult to tie together and can end up in project delivery diverging from the designers' intent.

Codes are therefore usually treated as the starting point. Whilst this is certainly due to regulatory authorities 'comfort' with the 'magic numbers', as touched on in the previous article, responsibility for part of this culture of accepted 'convenience' can be laid at the door of the fire engineer who knows that this is what is being expected and does not want to push against it.

We should again remind ourselves that the guidance in prescriptive codes is usually intended for 'more common building types' and is therefore not guaranteed to be the most appropriate starting point for many of today's projects. The built environment

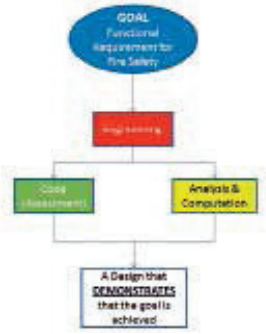
is constantly evolving and presents situations that are different to those which prevailed during code development. Situations where there are fire risks that are not 'typical' are increasingly common. Approval bodies must be more prepared to challenge the engineer from the outset on their code selection and supporting engineering reasoning. Equally, the engineer has to base the selection of a code based approach on robust engineering judgement.

'Finally the fire safety engineer needs a certain toughness – and I am referring to intellectual toughness. By this I mean that the engineer must be able to be tested and challenged and deal with matters in a rigorous, analytical and above all honest way. He must be aware of the rules but not use them as a shield'.[2]

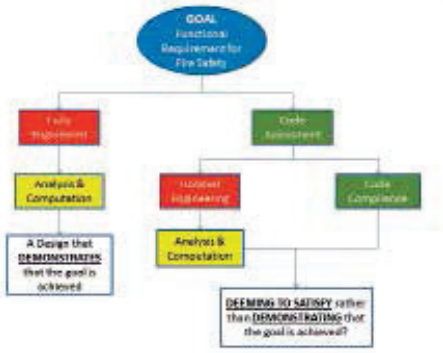
Not only is this still the case but there is an additional dimension required to this toughness today. Fire engineers find themselves regularly in meetings where the architect, QS, client etc may all be pointing to a clause in a code or an 'established or previously accepted construction practice' or the claim that it was 'signed off by Building Control on the last job' as evidence of acceptable design. The competent fire engineer has to be robust enough in the face of this pressure when he/she knows that this is not adequate for the current situation.

Purpose built self-contained residential accommodation for elderly people provides a good example of where the competent fire engineer needs to appreciate the limitations of the existing codes and consider where these fall short in fire engineering terms eg the actual levels of ambulance and management presence. It may be 'convenient' for the project team and the budget to categorise these premises as 'flats' as defined in the prescriptive code but, in truth, the risks demand a fire engineered approach from first principles to make sure that the strategy is appropriate.

These attitudes need to be in place to ensure that the fire engineering profession moves from an approach dictated by convenience to one which aligns more accurately to the following definition of 'fire engineering'[3]: 'Fire Engineering is the



An incorrect representation of fire engineering based on a perception that it is an 'alternative' to the code approach



A more appropriate representation of a balanced fire engineering approach

application of scientific and engineering principles, rules [Codes], and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire'.

There is not really much of a debate to be had about 'code' vs 'fire engineering' because fire engineering still includes appropriate use of codes underpinned by a sound knowledge of the source of their content and their flaws and short-comings. However, our industry must work together to ensure the overall life safety goal is achieved without being complicit with the self-perpetuation of the *status quo*.

After Design

Of course, fire engineering also has a 'life after design' even if, in the case of too many projects, the role of the fire engineer ends contractually at the point where Building Regulations approval is achieved.

Where the input of a qualified fire engineer is retained in the construction stage to objectively scrutinise detailed proposals and specifications, the fire engineer can ensure that the application of codes relevant to this part of the process will be appropriate.

However, where the construction team does not have this ongoing fire engineering support, construction delivery can become based on a patchwork of compliance with different codes, standards, NBS specifications, product certificates and datasheet etc. The documentation trail can even contain contradictory design information, omissions and, sometimes, misleading or factually incorrect material. There is often no one engaged in the project with the necessary competence to scrutinise the documentation. Effectively the detailed design and specification of the fire precautions becomes, to all intents and purposes, a paper collection exercise rather than being subject to appropriate

objective scrutiny.

Where fire engineering input does not provide some husbandry of the fire strategy it is commonplace that delivery reverts to this modus operandi and problems soon become 'locked in' and which may or may not become apparent, either before or after handover. Of course it is imperative that the built environment understand where the responsibility for correct and proper installation lies. It is absolutely not with Building Control and this will be covered in more detail in a future article.

The issues extend even beyond the point where fire engineers are traditionally engaged into product specification and certification, a field which requires competent knowledge of test standards and material performance. There are some serious issues for the built environment to deal with here, including the robustness of standard testing procedures and associated certification schemes. For instance, many designers have little awareness that it is possible to sell a product that has passed only one fire resistance test and has failed many others.

The 'magic numbers and golden rules' paper criticised a lack of pro-active cooperation between research and fire engineering communities at a 'defining the objectives' level. Actually, the fire engineering community must now improve its connectivity with the product testing and certification industry at the coal face of building construction. Otherwise good design may not be properly converted to the completed building and would just be a waste of time.

The prevalence of this sort of thing in new buildings is testament to the fact that there is more which needs to be done to ensure proper application of codes through the full sequence of project delivery.

A combination of the lack of knowledge on the applicability and limitations of testing standards and the lack of objective scrutiny of the claims in product manufacturer's literature is something that remains to be improved in the delivery of Total Fire Engineering.

A widespread lack of awareness and enforcement of Regulation 38 (the requirement for full details of the building fire strategy to be provided on handover to the occupier) has been reported. Does the paucity of engagement of fire engineers in the delivery of compliance of Regulation 38 provides further evidence of a general detachment of the fire engineer from the project before final commissioning and handover?

Our previous article referred to the concept of 'Total Fire Engineering'. This concept can only really be achieved if better charge can be taken by fire engineers of the implementation of codes throughout all the stages of project delivery.

So what should the fire engineering industry be doing?

'Of course there will always be a place for prescriptive standards: there should be a straightforward route for straightforward design. But let us not pretend that if these standards are applied they will always, in some magic way, give the best solution. As soon as they frustrate design we should be able to re-establish the rationale behind the rules and thereby develop new approaches'.[1]

The fact that things are not really all that different shows how accurate and prophetic this statement was. We need codes. We need fire engineering. There is no line that delineates when it is one or the other. Use of codes as part of a goal based approach to fire safety design and delivery of that design requires appropriate respect for the codes and this respect requires engineering competency. Our industry has to be much better at achieving the adequate life safety aim. Equally the standard of delivery must be improved. Have we reached a time where all complex or high risk projects need to be signed off by a chartered engineer? Do we need to move to a self-certification approach? How can we work with our colleagues in approval authorities to deal with the issues raised here? These thoughts will be the subject of our next article.

Finally, we would encourage those interested to read the papers referenced herein as many of the lessons and views are as true today as they were at time of print.

References:

[1] Proceedings of the 4th International Symposium on Fire Safety Science, Ottawa, Canada, 13-17 June 1994, pp78-84, 1994. International Association For Fire Safety Science (IAFSS), UK. Margaret Law and Paula Beever.

[2] What is a fire engineer? Journal of Applied Fire Science, 1 (1) 3-6 1990-1. Baywood Publishing Company Inc, USA. Margaret Law.

[3] http://www.ife.org.uk/about/about/fireengineering.