Position Paper

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Fire Safety Engineering

Putting Fire Safety Engineering on the right tracks

1. Building up on good trends

The 20th century has seen continuous improvement in fire safety of buildings. Especially in its 2nd half, the available statistics on fire casualties and damages show the successful implementation of fire prevention and fire safety strategies, mostly consisting of a conventional prescriptive approach. This approach is based on passive fire protection measures using methods of non-combustibility, fire compartmentation, and structural fire protection. Wherever applicable and practical, this basic approach has been complemented by active fire protection to further enhance the achieved safety levels. Important aspects of the prescriptive approach, which has achieved very high safety levels, are:

- Validation of the approach by real fire cases;
- Feedback from long years of experience;
- Redundancies present in the combination of requirements in regulations and in test protocols.

Especially for traditional buildings, the prescriptive approach remains the proven method accepted by all parties in the society: citizens, regulators, and industry. We foresee further developments of this method in the form of updating safety criteria based on current products used in construction (e.g. smoke emissions from combustible building parts, adequacy of test methods).

In comparison, Fire Safety Engineering (FSE) is a relatively new way in which fire protection measures can be calculated, using performance-based methods and a probabilistic approach rather than prescriptive data tables and/or simplified methods. Used correctly it has the potential to erase the difference in fire safety levels between national building regulations.

There is no single definition for FSE, but ISO/TR 13387-1 Fire Safety Engineering defines it as: "the application of engineering principles, rules and expert judgment based on a scientific appreciation of the fire phenomena, of the effects of fire, and of the reaction and behaviour of people, in order to:

- Save life, protect property and preserve the environment and heritage;
- Quantify the hazards and risk of fire and its effects;

- Evaluate analytically the optimum protective and preventative measures necessary to limit, within prescribed levels, the consequences of fire".

We need to ensure that the use of FSE builds up the good trend established in the 20th century in terms of improving fire safety in buildings.

2. The benefits and risks of the FSE approach

Performance-based design of buildings using FSE tools had opened new possibilities for to designing large and complex buildings such as airports, railway stations, shopping centres, exhibition halls and hospitals, which could not have been designed in the same way using existing prescriptive rules. This is a move in the positive direction for these buildings. But FSE it is also increasingly used for more common types of buildings.

With FSE, the basic scenarios for fire development started to be questioned, often leading to less onerous fire scenarios, which result in cost savings during construction; whilst this can be a great success when done correctly, it can also lead to risks of abuse as some will seek to lower the costs of fire scenarios regardless of whether or not it ensures a good level of fire safety.

Major pitfalls related to FSE have been highlighted[1]:

- The level of safety is not quantified (e.g. risk computations are not made);
- Quantitative performance evaluation formulas are not offered to determine if any particular fire safety subsystem is adequate;
- Redundancy is considered as something to expunge, not as a valuable aid to safety - an assumption is built in that fire dynamics are fully known;
- Designs start with, and are largely based on, fire scenarios which the designer is free to define or select;
- The role of tests in determining the fire performance of products is reduced or absent.

Despite risks of abuse, FSE provides methods to truly analyse real fire scenarios which may be less but also more onerous than the standard fire curves, but it is crucial to understand that a faulty FSE calculation could lead to lives being put at risk. Whereas prescriptive codes have been based on many years of experience with real fires, little or no experience is available today that buildings assessed using FSE have performed properly during a fire.

Whenever FSE tools and methods are used to meet and/or prove the performance criteria of building design, it would be desirable to know sensitivities of the calculation, input values, boundary conditions, and the final result. However, this is seldom the case. On the extreme end, one might suspect that optimisation for cost-reduction can become a goal of FSE design rather than achieving a high level of safety based on evaluating all the possible failures and designing appropriate safety measures. Unfortunately, it will take some time until fire

[1] Performance-based building codes: What will happen to the levels of safety?, Vytenis Babrauskas, Ph.D. (https://www.researchgate.net/publication/237701289_performance-based_building_codes_what_will_happen_to_the_levels_of_safety)

statistics prove whether the good trends established in fire safety in the previous century start to reverse or not, i.e. whether our buildings tend to be less robust in case of fire accident and more prone to failures or not.

3. Regulators remain responsible for safety, not technicians

The precautionary principle has to be applied whenever a change is made to safety levels, criteria, test protocols, or methods to prove compliance. Overly optimistic assumptions on the move towards performance-based codes may result in disasters. Whenever a new method is allowed for use, it must be properly examined as to its suitability to provide equal or higher level of safety than the previous one.

We begin to see examples of countries where the introduction of performance-based building design and implementing is questioned: Sweden, New Zealand[2][3][4][5][6]. In Europe, the current framework of the CPR has been created to facilitate free movement of building products and services, while defining the European fire safe buildings and competencies of individual private and public bodies. We sincerely hope that the progress towards better regulations and safer built environment will remain under the spotlight of the responsible regulators at all levels as well as the public, and responsibilities for the design of buildings, products and services will be ever clearer and more transparent. It is crucial that regulators ensure FSE is correctly used and does not lead to increased risks for fire safety.

Conclusion

The primary aims of FSE must continue to be to prevent the loss of life. Fire Safe Europe believes that FSE, when used appropriately, can contribute positively to a better appreciation of fire safety in buildings. Nevertheless, it is essential that it is used by qualified experts and that FSE assumptions are clearly expressed and properly evaluated. The success or otherwise of FSE depends very much on how it is applied. The misuse of FSE (be it deliberate or unintentional) in order to reduce costs or to change a building's use after completion is a risk that needs to be kept in mind. Since the misuse of FSE methods could lead to disastrous consequences, including the loss of life, caution is needed. The "precautionary principle" should always be abided by when it comes to fire safety measures.

[2] Safety in Case of Fire - The Effect of Changing Regulations, Lundin Johan, thesis, Lund University, 2005

[3] New Swedish regulations and a framework for fire safety engineering 2012, Caroline Cronsioe, Michael Stromgren, David Tonegran, Henrik Bjelland, 9th International Conference on Performance-Based Codes and Fire Safety Design Methods in Hong Kong

[4] Enhancing performance-based regulation: Lessons from New Zealand's building control system Peter John Mumford, thesis, Victoria University of Wellington, 2010

[5] Fifteen Years of Performance-Based Design in New Zealand, A.H. Buchanan, B.L. Deam, M. Fragiacomo, Tony Gibson, Hugh Morris (http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.598.657&rep=rep1&type=pdf)

[6] Performance-based building: lessons from implementation in New Zealand, John Duncan, Journal Building Research & Information, Volume 33, 2005 - Issue 2: Performance-based Building

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