Regulating fire safety using fire scenarios

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ABSTRACT

Advances in the scientific and technological understanding of fire have led to a drive to use fire models in advanced fire safety design. However the existing fire safety regulatory system may not have the tools needed to ensure fire safety.

Our current fire safety regulatory approach is an eclectic mix of prescriptive codes, performance standards, industry practice, engineering judgement and inertia. Most current "reform" efforts are focussed on performance based design. For the purpose of this paper **performance based design systems** include any analytical tools which predict the fire performance of buildings. **Performance based codes** are the legal systems for approving buildings designed and built using such analytical tools. Fire safety is generally a fragmented component of both design and regulation. Few designers have an integrated understanding of fire hazards and regulators as a group have not had the tools to evaluate and respond to fire safety problems. It is necessary to provide a structure for the discussions of performance based design methods and their use in performance based codes. While it is not yet clear that "performance based codes" are an effective response to problems in fire safety regulation, it is clear that the use of such codes will require dramatic redesign of the system for regulating fire safety technology.

Using fire scenarios is a critical step in current proposals on performance based design. However there is little agreement on how a scenario should be developed. We disagree with Meacham [1] that this is "fire safety engineering". The fire scenario incorporates the social demand for safety and thus is a social judgement, though specified in engineering terms. It is the critical regulatory tool in Performance based codes. Defining the fire scenarios is a major regulatory decision, since it describes what level of safety will be needed.

It is also critical that the "fire scenario" be described as part of an analytical system so that regulators will understand what it does and does not describe. We will exapnad the system presented in earlier work. Major system components include:

Fire Survey The fire survey is a description of a specific building environment relevant to fire. it includes the spatial organization, fire load, construction techniques materials and occupant characteristics. Fire surveys are "snapshots" i.e. they describe the building at a specific point

in time. Building surveying is well developed in the UK as a specific profession. In the US there is a tendency to incorporate evaluation into the basic building description.

Fire Scenario Specification The fire scenario specification defines a specific fire including its development variables. The time/temperature curve may be thought of as a fire scenario specification.

Fire Hazard The fire hazard incorporates the variables in the fire survey and the fire scenario. A fire hazard is thus the result of a specific fire scenario in a specific environment. Buildings have a large number of potential hazards. This use of the term hazard does not include any probabilistic components, unless they are incorporated in the fire scenario.

Fire Hazard Model The fire hazard model is an analytical tool for predicting the growth and development of fires of the general type described in the fire scenario. The fire hazard model incorporates the historical understanding of the development of fires.

Both fire surveys and fire scenarios are in some ways specific to a given environment; the more defined the overall environment and the fire model the fewer the variables that have to be defined in the fire scenario. As a result if all the relevant building environment variables were known and fire was both highly defined and predictable a fire scenario could be a simple ignition i.e. match. the fire model would then predict the spread of the fire. However, the current state of fire safety engineering does not appear to meet this standard. It may even be that below a certain ignition threshold subsequent fire development is not predictable. In either case existing fire models require the input of a developed fire and therefore as a practical matter a fire scenario must, at present, be defined separate from its associated fire survey.

Fire Hazard Analysis prediction of how the fire will develop from the fire scenario in the specific building survey conditions using the fire model. The analysis includes the attendant uncertainties and sensitivity analysis.

Fire Safety Evaluation Fire safety evaluation is an overall examination of the suitability of data, scenarios and models. It involves separate evaluation of risk and hazard models. It fulfills both regulatory and operational needs. From an operational perspective the goal is to optimize the cost of the design process including the cost of analysis and evaluation. From a regulatory perspective the goal is to determine whether or not approval of the proposed design is within the discretion of the regulator and the design satisfies the social policy objectives.

References

1. Meacham B.J. "Performance Based Codes and Fire Safety Engineering Methods: Perspectives and Projects of the Society of Fire protection Engineers" *Proc. INTERFLAM 1996* 545-553