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International Activities for Developing Performance-based Fire Codes

Richard W. Bukowski. P.E.
Building and Fire Research Laboratory, NIST
Gaithersburg, MD, 20899-0001 USA

INTRODUCTION

The purpose of this paper is to review the status of current activities associated with the development of performance-based fire codes in various countries across the globe, as well as the coordinated activities of international standardization and pre-standardization research in this field. Every attempt was made to include the latest developments but some activities in individual countries that do not participate in international conferences or standards activities may have been overlooked.

ISO TC92SC4 and CIB W14

The activities of ISO TC92SC4 and CIB W14 are focused on the development of the field of Fire Safety Engineering (FSE) to underpin and enable the transition to performance-based fire codes by providing the means to evaluate the ability of fire safety designs to meet the performance objectives of the code. The detailed activities of these groups is the subject of another paper in this symposium and will not be treated here.

It should be noted, however, that there is a related group in CIB whose activities should be followed; this is TG11, Performance Building Codes. It is likely that performance building and fire codes will go hand-in-hand in any individual country. Further, the issues being debated in CIB TG11 have direct analogs in the movement toward performance fire codes. In particular, the development of detailed objectives is an issue which has received little attention on the fire side but is a major item on the building side.

AUSTRALIA

The Australians were among the first to begin movement towards performance-based codes; based in large part on the visionary Warren Centre Conference and reports published in 1989. This has led to the formation of the Fire Code Reform Centre Ltd. (FCRC), a non-profit corporation focused on facilitating the reform of the Building Code of Australia (BCA). The format which has been proposed by the Building Regulations Review Task Force (BRRTF) is similar to the draft Code of Practice recently circulated for review in the UK and to the New Zealand approach, but is not intended to replace the current requirements, only to provide a performance-based means of certifying alternative designs.

CANADA

Working closely with Vaughan Beck at the Victoria Institute of Technology in Australia, David Yung and his colleagues at the National Fire Laboratory of the National Research Council of Canada have developed FiRECAM (Fire Risk Evaluation and Cost Assessment Model) as a key element of the performance fire code effort there and in Australia. Extensive work is underway to convert the Canadian National Building Code to a performance form by 2001, in the form of performance objectives as the substantive code document with a set of supporting documents which will include a set of "acceptable solutions" and a methodology for evaluating alternative approaches. A Strategic Planning Task Group has suggested a better description of these codes is "objective-based codes," and this terminology has appeared elsewhere as well.

ENGLAND AND WALES

In 1985 the Building Regulations were revised to utilize performance language and to allow alternative designs which could be shown to provide equivalent performance using any reasonable method. In the process, these regulations were reduced from 307 pages to only 23 (although much of the prior prescriptive code requirements were appended as "Approved Documents"). As these new approaches gained acceptance it became clear that the methods used to establish equivalency needed codification, so a Code of Practice was developed by Warrington Fire Research under the leadership of John Barnfield, Geoff Deakin, Gordon Cooke, and a host of other experts in the field. This Code of Practice, currently under public review, is similar to the New Zealand Design Guide, the Japanese Regulations for Comprehensive Designs for Fire Protection, and others, but (at least in the draft as released), attempts to establish acceptable levels of risk of life loss; in the home ($1.5x10^{-5}$ per person per year), and elsewhere ($1.5x10^{-6}$), as well as limiting the risk of >10 deaths per incident to $5x10^{-7}$ per building per year and >100 deaths per incident to $5x10^{-8}$ per building per year.

NEW ZEALAND

The 1992 edition of the New Zealand Building Code introduced a performance-based format while keeping the prescriptive requirements as an "acceptable solution." The performance-based approach with its supporting calculations are required for any occupancy with fire loads exceeding 1500 MJ/m^2. Similar to the situation in England there is a Fire Engineering Design Guide, published by the Centre for Advanced Engineering at the University of Canterbury which serves as the Code of Practice for engineering calculations performed in support of a performance-based design. This linkage to the University has produced a burgeoning graduate degree program to educate the fire protection engineers needed to make the system work -- a fact which seems to be overlooked in some countries developing performance-based codes.

In a controversial move, New Zealand decided that the protection of property at the regulated occupancy is not a matter for the code but is rather between the owner and his insurance company. Thus, the code only includes provisions to protect the property of third parties. This has upset the insurance industry who find that they must develop and enforce their own regulations in addition to those in the code.

SWEDEN

The Swedish codes also have been extensively revised to incorporate performance language throughout. Their latest code, adopted in 1994, includes design criteria within the code document under subsequent headings of the same section. They are developing a guidance document similar in structure to the UK Code of Practice and New Zealand's Design Guide, which will include functional requirements, calculation methods with examples which represent acceptable solutions, uncertainties, and suggestions for solutions which exceed the minimum. Sweden has an advantage in that (like many European countries) fire department officers are all trained as fire protection engineers and have the educational basis for understanding and evaluating engineering calculations.

UNITED STATES

Efforts in the U.S. are more diffuse since the legal responsibility for building and fire codes lies with 50 states and derives from the activities of a number of private code and standards organizations. In the area of fire codes, the principal organization is the National Fire Protection Association (NFPA) and its Life Safety Code (NFPA 101). The NFPA has recognized the need to provide leadership in the evolution of its documents to a performance basis, and has taken several crucial steps. They constituted an in-house task group to develop recommendations to their Board of Directors. This group has written a white paper in which they suggest:

> 1. Establish a standard format for a performance-based code which can serve to guide the process of conversion of existing documents or the development of new documents by committees. The structure would include sections on (1) fire safety goals, (2) assumptions, (3) fire scenarios, (4) approved

calculations and (5) prescriptive requirements ("approved solutions").

2. Establish a support system to provide technical guidance to both staff and technical committees. This would include recruitment of a staff person with expertise in fire safety engineering calculations and their application to code equivalency analysis. Additionally, establish a Performance-based Support Team under NFPA's Standards Council as an advisory body to assist staff and committees.

3. Begin to work with specific committees to develop prototype, performance-based documents which can serve as models to other committees for format, content, and process.

4. Partner with other organizations to begin to address the needs for supporting products and services such as handbooks, seminars, and educational programs, software and data resources, certification of methods and of professional competence in applying them, and training of and support for enforcers.

Other key players in the U.S. are the (professional) Engineering Societies, especially the Society of Fire Protection Engineers (SFPE). In 1988 the first edition of the *SFPE Handbook of Fire Protection Engineering* was published, which has been widely praised as an essential compilation of the state-of-the-art. The second edition of this landmark publication is due to be published by the end of 1995. They are cooperating with the American Society of Civil Engineers (ASCE) to produce a standard containing engineering methods for structural fire safety calculations. The SFPE has organized a series of Engineering Seminars on Performance-based Fire Safety Engineering and on performance-based design, and has recently hired a technical director to provide a focal point for these and other activities, and to provide improved technical support to its membership.

On the building code side, the three U.S. model building code organizations are actively pursuing the goal of resolving differences among their codes and achieving a single, national model code by the turn of the century. This will greatly facilitate the ability of the U.S. to achieve a performance-based building code in the form being studied in the rest of the world. But this is not to say that the transition will have to wait until then. The U.S. codes have long contained "equivalency clauses" which allow enforcers to accept alternate methods which provide equivalent performance. These clauses are increasingly being invoked where the equivalency is being established through the identical calculations which are being included in the Codes of Practice cited previously. Code officials are gaining experience with and comfort in these methods as more projects are completed under their use.

OTHER COUNTRIES

It is known that a number of other countries have some type of program under way to develop performance-based fire and/or building codes. These include Poland, Romania, Peoples Republic of China, Finland, Norway, Italy, Germany, France, Spain, South Africa, and probably many more. Central and South America is exhibiting increased interest in codes and standards in general and in performance-based approaches in particular. The NFPA has recently entered into an agreement with a Mexican organization to begin to translate NFPA standards into Spanish for use in that country. An organization in Venezuela requested permission from NIST to produce a Spanish language version of FPEtool to support engineering calculations there. With the recent decision of the (U.S.) National Science Foundation to utilize performance-based methods in the design of a new South Polar Research Station, the trend has touched every continent on the globe.