

Simplifying fire safety design

by David Yung, PhD, P.Eng.,
and Nouredine Benichou, PhD

How can you reduce construction costs without compromising a building's fire safety? The National Research Council (NRC), in collaboration with several partners since 1987, has developed a user-friendly computer model called FiRECAM™ (Fire Risk Evaluation and Cost Assessment Model), which can help identify cost-effective fire safety designs that meet building code requirements. The model is currently being evaluated by various task groups across the country, and plans for its deployment are being made at the NRC.

Life safety and property protection measures are a costly component in any construction project. FiRECAM™ provides the ability to identify alternative fire safety designs with equivalent life safety, thus allowing design flexibility that will often lead to lower construction costs without lowering the level of safety in a building. In addition, the planned introduction of objective-based codes in Canada, as well as the introduction of performance-based codes in many other countries, would benefit from risk assessment tools such as FiRECAM™ to evaluate the performance of fire safety designs for compliance with code objectives.

Special functions

FiRECAM™ can be used to assess the level of fire safety that a particular fire safety design will provide to occupants of an apartment or office building. As well, the model can assess the associated costs of fire protection systems, including capital and maintenance costs, and expected fire losses.

The model can also assess whether a proposed design meets the performance

requirements of a performance-based building code, or is equivalent in life risk performance to a code-compliant design as specified in a prescription-based code. This allows a designer to identify cost-effective fire safety designs providing the required level of fire safety.

How does it work?

In FiRECAM™, a user enters the design information for the building through a graphical user interface with pull-down menus. The required information includes the architectural layout of the building, the passive and active fire protection systems, and the occupant characteristics.

To evaluate risks and costs, FiRECAM™ simulates the ignition of a fire in various locations in a building, the development of the fire, smoke and fire spread, occupant response and evacuation, and fire department response. These calculations are performed by a number of sub-models, which are run repeatedly in a loop to obtain the expected risk to life values and fire losses from a set of probable fire scenarios that may occur in the building.

FiRECAM™ also uses statistical data to predict the probability of occurrence of fire scenarios, such as the type of fire that might occur or the reliability of fire detectors. Mathematical models are used to predict the time-dependent development and spread of a fire and the evacuation of building occupants. FiRECAM™ is the only comprehensive model in the world that predicts the probability of fire spread in a building and the fire department's response, and estimates fire costs, in addition to the typical modeling of fire growth, smoke spread, and human response and evacuation.

Evaluation and deployment

The FiRECAM™ Office Model is currently being evaluated by NRC's major partner in its development: Public Works and Government Services Canada

(PWGSC). Evaluation of the FiRECAM™ Apartment Model will be carried out in the near future, using the experience learned in evaluating the office model.

To evaluate FiRECAM™, PWGSC has formed six task groups across the country during the past year. Each task group consists of PWGSC regional staff, fire consultants, and building and fire department officials. Task group members are provided with the computer program and the necessary training, education and guidance, enabling them to learn how to use the model, interpret its results and understand its capabilities and limitations. When results differ from users' expectations, these differences are discussed and resolved—an important step in gaining the confidence of users and, ultimately, their acceptance and adoption of this program. Feedback gained from the evaluation process will also lead to improvements in the computer program.

NRC is currently planning the deployment of FiRECAM™ by considering such factors as licence agreements, training and technical support. Once the model is ready for general use and licensing agreement issues have been resolved, it will be made available to qualified users, such as fire consultants and regulatory officials. The plan is to release the software for general use toward the end of 2001. ◆

Dr. David Yung, P.Eng., is a senior research officer at the National Research Council of Canada (NRC) and manager of the FiRECAM™ Project, part of the NRC's Fire Risk Management Program. Since 1987, he has led a project to develop risk-cost assessment models for cost-effective fire safety designs and introduction of performance-based building codes. Dr. Nouredine Benichou is a research officer at the NRC and a member of the FiRECAM™ team. Since 1998, he has been working on fire resistance modelling for integration into fire risk assessment models.