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B-RISK live

With BRANZ's ground-breaking B-RISK modelling software, fire safety engineers can now carry out simulations, input probabilistic design fires and model the effectiveness of various fire safety systems.

IN A COLLABORATION between the fire research team at BRANZ and the University of Canterbury, the recently completed 5½ year B-RISK project has resulted in a new fire design tool for engineers.

Compliance with the Building Code

To meet Building Code clause C *Protection from fire*, fire engineering design must demonstrate that the occupants of a building can safely escape in a fire, fire-fighting and rescue operations would be relatively safe, and the fire wouldn't affect neighbouring property and impact the environment unduly.

Simple buildings can be designed to the Acceptable Solutions, but for more complex buildings, a fire engineer follows the Verification Method C/VM2, which stipulates various design fire scenarios that must be checked, along with associated fire modelling rules and acceptance criteria.

If the building design complies with the relevant scenarios, the design is deemed to have met the Code objectives.

Better results from combining fire models

Fire modelling is used to demonstrate that occupants can escape from a building safely.

A deterministic fire model or calculation estimates the conditions in the building at a given time and allows the performance of different building components to be assessed. However, it generally can't consider the performance of the whole building with its different fire protection systems and occupancies so the overall safety level in the building can't be quantified. To do this, deterministic calculations must be combined with probabilistic analysis.

Probabilistic models include assigning probability distributions to the input parameters and iterative calculations carried out where different values are sampled from the input distributions for each of the calculation cycles. Cumulative distributions of probability are generated that indicate the probability of a tenability threshold being exceeded.

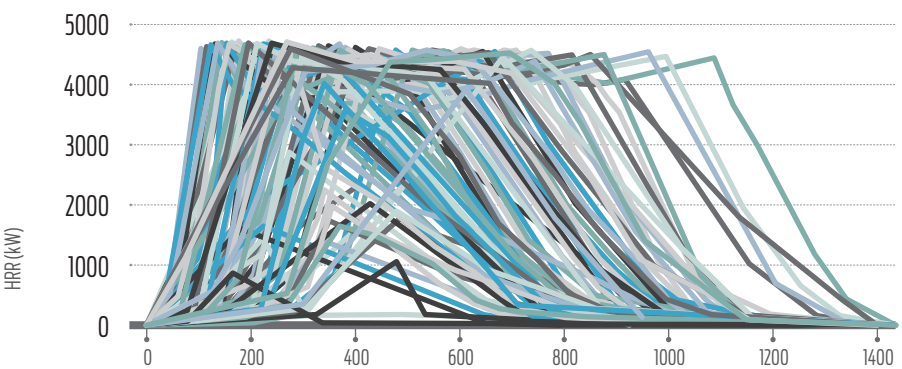

Figure 1: Heat release rate (HRR) curves for multiple random iterations.

Could move to risk-informed regulations

Instead of current Building Code compliance, which requires that conditions in the building not exceed a specified tenability threshold, possible future regulations could require that a specified probability of exceedance be achieved - risk-informed regulations.

Risk-informed fire models are needed to demonstrate compliance with risk-informed fire safety regulations. This was why B-RISK was developed, although risk-informed fire safety regulations are still some time away from being enforced in New Zealand. B-RISK combines both deterministic and probabilistic functionality - also known as a quantitative risk analysis (QRA) model.

B-RISK for practitioners and researchers

B-RISK can be operated in two modes - the NZBC-VM2 and the Risk Simulator modes.

The NZBC-VM2 mode is where the prescribed parameters and rules of C/VM2 are preloaded into the model. It gives users the option of input distributions and Monte Carlo simulations, enabling sensitivity analysis for variables not fully prescribed

in C/VM2 to be carried out. It is primarily for everyday practitioners as part of the building consent process.

The Risk Simulator mode combines the deterministic and probabilistic functionality of a QRA model and is primarily for the research community, as significant experience and expertise is required to select appropriate statistical distributions for input parameters.

Risk Simulator cutting edge

The Risk Simulator mode of B-RISK has several innovative features that put the model at the cutting edge of fire safety engineering internationally.

Monte Carlo simulation

Multiple runs can be carried out where selected input parameters can be described with a statistical distribution – that is, randomly sampled to obtain the input values for successive iterations. The outputs from the multiple simulations can be displayed in the form of cumulative density functions.

Design fire generator

An important input for any fire modelling is the design fire, an estimate of the size and duration of the fire – the heat release rate (HRR) curve – in the building. The NZBC-VM2 user mode utilises the prescribed HRR curves contained in C/VM2. For the iterative Risk Simulator mode, B-RISK has a submodel that automatically generates a new HRR curve for each iteration in the Monte Carlo simulation. The submodel is known as a design fire generator (DFG).

The DFG works by randomly sampling items from a database, populating the fire compartment with them, setting one item randomly as the first item ignited and then calculating the combined HRR for the compartment as subsequent items ignite. Figure 1 shows this principle for multiple random iterations.

Alpha t-squared fires

The Risk Simulator mode also gives users the option of using t-squared fires as the input for each iteration, but with a statistical distribution for both the fire growth (alpha) constant and peak HRR value.

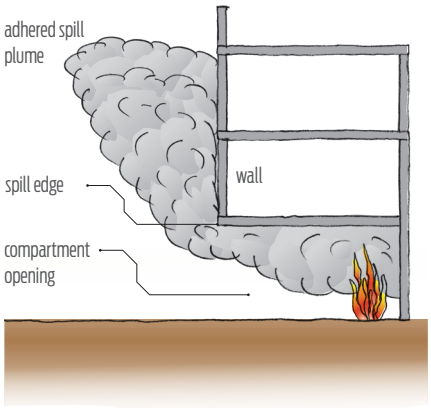

Figure 2: Spill plume rising into atrium space.

The total heat released by the fire will also vary if a statistical distribution is assigned to the fire load energy density.

Spill plumes

Another important feature is the ability to model spill plumes. These occur when the plume of smoke from a fire leaves a fire compartment opening and entrains additional air as the plume rises in an atrium (see Figure 2).

Accurate modelling of spill plumes allows smoke extract systems to be sized correctly.

Fire safety system effectiveness

Modelling of fire safety systems, such as detectors, alarms and sprinklers, is common in many fire-engineering models. What makes B-RISK different is that it allows users to assign statistical distributions to various fire safety system parameters, as well as the reliability and effectiveness of the systems.

Taking B-RISK nationwide

Workshops held in March introduced B-RISK. A more comprehensive workshop is planned for later in the year.

Note Both the software and BRANZ Study Report SR 282 *B-RISK user guide and technical manual* can be freely downloaded from the BRANZ website www.branz.co.nz.

The B-RISK project was jointly funded by the Building Research Levy and the Ministry of Business, Innovation and Employment (MBIE).