Computer Models
For
Fire and Smoke

Model Name:	FiRECAM™
Version:	1.6.1
Classification:	Risk Assessment Model
Very Short Description:	FiRECAM calculates the Expected Risk to Life (ERL) of the occupants and the Fire Cost Expectation (FCE) in a high-rise apartment or office building as a result of a set of probable fire scenarios that may occur in the building.
Modeler(s), Organization(s):	David Yung, Guylene Proulx, Noureddine Benichou, George Hadjisophocleous and Charles Dutcher, National Research Council of Canada
User's Guide:	FiRECAM™ User's Manual (NRC internal report in preparation)
Technical References:	Dutcher, C.R.; Yung, D.T.; Hadjisophocleous, G.V. FiRECAM System Model Documentation, Internal Report, Institute for Research in Construction, National Research Council Canada, 732, pp. 93, November 01, 1996 (IRC-IR-732)
Validation References:	Yung, D.T.; Hadjisophocleous, G.V.; Proulx, G. "Modelling concepts for the risk-cost assessment model FiRECAM and its application to a Canadian government office building," Fire Safety Science : Proceedings of the 5th International Symposium (Melbourne, Australia, 3/3/97), pp. 619-630, September 1, 1997 Bénichou, N.; Yung, D.T.; Hadjisophocleous, G.V. "Impact of fire department response and mandatory sprinkler protection on life risks in residential communities," 1, Interflam '99, 8th International Fire Science and Engineering Conference (Edinburgh, Scotland, 6/29/99), pp. 521-532, 1999

Proulx, G.; Hadjisophocleous, G.V. "Modelling occupant response and evacuation in apartment and office buildings," Pacific Rim Conference and Second International Conference on Performance-Based Codes and Fire Safety Design Methods (Maui, Hawaii, 5/3/98), pp. 279-293, May 9, 1998

Yung, D.T.; Hadjisophocleous, G.V. "Assessment of the impact of reliability of fire protection systems on life safety in buildings," 2, Proceedings of the ESREL'97 International Conference on Safety and Reliability (Lisbon, Portugal, 6/17/97), pp. 1391-1398, June 1, 1997

Cooper, J.; Yung, D.T. Fire Growth Model for Apartment Buildings, Internal Report, Institute for Research in Construction, National Research Council Canada, 734, pp.33, January 1, 1997 (IRC-IR-734)

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Hokugo, A.; Yung, D.T.; Hadjisophocleous, G.V. "Experiments to validate the NRCC smoke movement model for fire risk-cost assessment," 4th International Symposium on Fire Safety Science (Ottawa, Ont., Canada, 7/13/94), pp. 805-816, 1994

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Gaskin, J.; Yung, D.T. Canadian and U.S.A. Fire Statistics for Use in the Risk- Cost Assessment Model, Internal Report, Institute for Research in Construction, National

Research Council Canada, 637, pp. 18, January, 1993 (IRC-IR-637)

Hadjisophocleous, G.V.; Yung, D.T. "Model for calculating the probabilities of smoke hazard from fires in multi-storey buildings," Journal of Fire Protection Engineering, 4, (2), pp. 67-80, 1992

Takeda, H.; Yung, D.T. "Simplified fire growth models for risk-cost assessment in apartment buildings," Journal of Fire Protection Engineering, 4, (2), pp. 53-66, 1992

Availability: Fall 2001

Price: There is no cost when downloaded from the NRC web site

Necessary Hardware: 32 bit Windows, 95, 98, 2000 and NT

Computer Language: Visual Basic 6

Size: Approximately 50 MB of disk space and 32 MB of RAM required

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Detailed Description:

FiRECAM™ (Fire Risk Evaluation and Cost Assessment Model) is a user-friendly, computer program that can be used to assess the level of fire safety that is provided to the occupants in an apartment or office building by a particular fire safety design. As well, the model can assess the associated fire costs that include capital and maintenance costs of the fire protection system and expected fire losses. By comparison to the performance required in a performance-based code, or the implied performance of a code-compliant design as specified in a prescription-based code, the model can assess whether a proposed design meets the performance requirements, or is equivalent in life risk performance to the code-compliant design. This allows a designer to identify cost-effective fire safety designs that provide the required level of fire safety.

To undertake the evaluation of 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 interacting with each other. There are nine sub-models that are run repeatedly in a loop to obtain the expected risk to life values and the expected fire losses from a set of probable fire scenarios that may occur in a building. The computer model also includes three optional sub-models that can be run if the building fire characteristics and fire department response are not considered typical or if

fire costs are required. One sub-model is run only once to obtain the failure probability values of boundary elements. FiRECAM™ is the only comprehensive model in the world that includes the probability of fire spread in a building, the response of the fire department and the estimate of fire costs, in addition to the typical modeling of fire growth, smoke spread and human response and evacuation.

FiRECAM™ uses statistical data to predict the probability of occurrence of fire scenarios, such as the type of fire that may occur or the reliability of fire detectors. Mathematical models are used to predict the time-dependent development of fire scenarios, such as the development and spread of a fire and the evacuation of the occupants in a building. The life hazard to the occupants posed by a fire scenario is calculated based on how quickly the fire develops and how quickly the occupants evacuate the building in that scenario. The life hazard calculated for a scenario multiplied by the probability of that scenario gives the risk to life from that scenario. The overall expected risk to life to the occupants is the cumulative sum of all risks from all probable fire scenarios in a building. Similarly, the overall expected fire cost is the sum of fire protection costs (both capital and maintenance) and the cumulative sum of all fire losses from all probable fire scenarios in a building.