

Characterization of Fires in Residential Buildings

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Program Area:	Building Systems	Start Date:	April 2005
Program Goal:	BF	Completion Date:	March 2010
Project No.:	4918	Date of Last Update:	March 31, 2007
Project Liaison(s):	Rodney McPhee, Canadian Wood Council; Claude Lamothe, Abitibi-Consolidated; Bill Love, Tembec		

Long Term Goals / Strategies

- Focus on members' customers and product end-use performance by conducting empirical fire tests and numerical simulations which quantify fires originating within the living spaces of Canadian residential structures, in order to characterize typical fires in those structures and thereby identify appropriate design-fire scenarios and design fires for Canadian building code purposes.
- Increase value of research through alliances with the National Research Council of Canada (NRC) and the other government and industry partners in this collaborative project.

Key Objectives

- Participate in a collaborative NRC-led research project involving fire experiments that quantify fires originating in living spaces within multi-family dwellings and numerical simulations of various fire scenarios that determine the characteristics of fires in the living spaces of residential buildings.

Key Actions and Deliverables

Deliverables	Expected Delivery Date
A collaborative research agreement with NRC and CWC for the first phase of a research program to be carried out primarily by researchers at NRC to characterize fires in the living spaces of residential buildings in Canada	April 2005
Reports and electronic data files describing the results of fire experiments and numerical simulations that quantify fires originating in the living spaces within multi-family dwellings.	March 2009 (rev.)
Characterization of design-fire scenarios and design fires in living spaces of multi-family dwellings.	September 2010 (rev.)

Status

This Forintek project was initiated in April 2005 in order facilitate Forinteks participation in a collaborative research project which NRC proposed to carry out in order to respond to explicit directions from the Canadian Commission on Building and Fire Codes (CCBFC). In part, the research is intended to provide information to assist with implementation of objective-based building codes in Canada. It will also assist the CCBFC to establish appropriate fire safety objectives for future editions of the National Building Code of Canada (NBCC). Finally, this research project complements research already being carried out by researchers at NRC investigating fire safety in Canadian housing. This is a collaborative research project where, as a member of the steering committee, Forintek will have ample opportunity to provide input into the research being undertaken, to vote on all decisions made regarding the direction of the research and on all reports describing the results of the research and the conclusions reached.

In mid-June 2005, officials of NRC disclosed that they were having great difficulty in attracting other partners for this project, and particularly partners representing manufacturers of home furnishings and governmental agencies responsible for regulating the performance of home furnishings. If the research was to achieve the objectives set for it by the Canadian Commission on Building and Fire Codes when they directed NRC to undertake the study, the participation of those agencies and industries would be essential. Therefore, the officials at NRC concluded that the research could not commence until 2006-2007. Since NRC had been unable to secure the requisite number of partners in this research project in order to enable it to commence in 2005 as originally planned, in October 2005, mid-year revisions were made to this project statement which reflected those delays in getting the research started.

Partners

Canadian Wood Council

Chair, Fire Safety Engineering, Carleton University

National Research Council Canada

Others to be determined

Rationale and Potential Impact

As described in a number of published papers and presentations by fire researchers at Forintek, Canadian fire statistics demonstrate that about 40% of the total number of fires and 74% of the total number of fire fatalities in Canada in 2000 occurred in residential buildings¹. Statistics such as these clearly demonstrate the need for engineered fire-safety-design solutions for residential buildings in Canada, and since these structures are primarily of wood-frame construction, the importance of Forintek being involved in this collaborative project, on behalf of the wood industry, is obvious. While the initial phase of the research will focus primarily on fires originating within the living spaces of multi-family wood-frame structures, the results will also be applicable to single-family dwellings.

An analysis of fire loss statistics by Forintek indicates that more than 70% of all fires in residential buildings commence with the ignition of one or more items of furnishing and/or contents within the living spaces of the buildings, and that less than 10% commence with the ignition of the buildings' structural members. However, the severity of the fires within the living spaces has a significant impact on the performance of those structural members and on the amount of protection that must be provided to them. Therefore, it is of critical importance that the threats to the major structural components of residential structures be quantified in order for the CCBFC to establish appropriate fire safety objectives for the structural elements in those assemblies

Proposed Approach

Early in the year, NRC was to establish a collaborative research agreement with Forintek, CWC and other partners to commence the first phase of a research program to be carried out primarily by researchers at NRC to characterize fires in the living spaces of residential buildings in Canada. By the end of the year, with guidance from its partners, NRC was to commence with empirical fire tests and numerical simulations to quantify fires originating in residential structures and to thereby identify appropriate design fires and design-fire scenarios for Canadian building code purposes.

Work Completed this Fiscal Year

Although L.R. Richardson retired on May 31, to provide continuity with this work, a contractual arrangement was made whereby he is continuing to assist Forintek with this project.

During the early fall, a consortium of interested parties was assembled by NRC to participate in planning (and funding) of this research. Current members of the consortium include: Canadian Concrete Masonry Producers Association, Masonry Worx, La Régie du Bâtiment du Québec, Forintek Canada Corp., Canadian Automatic

¹ Fire Losses in Canada – Annual Report 2000, published by Council of Canadian Fire Marshals and Fire Commissioners

Sprinkler Association, Canadian Wood Council, NRC Fire Research Program and NRC Canadian Codes Centre. In addition to providing much of the funding for the research, the consortium will provide technical input, advice and comments on:

- Project scope and direction
- Design of fire experiments
- Resolution of technical issues
- Written reports

Current funding for the project is \$555 000, of which \$105 000 is from NRC. Because there will not be as much money available as originally planned, the work may have to be scaled back. However, because the project is very important to the parties in the consortium, it was agreed that the work would start in 2006/2007 while NRC continued to try to entice additional partners to join the consortium. NRC is attempting to get the Gypsum Association and an association representing the home furnishing industry to join the consortium.

The first meeting of the consortium was held on October 30, 2006. NRC reported that although initially the study was to focus on fires in kitchens, living rooms and bedrooms, the CCBFC requested that *secondary residential suites* and *residential care facilities* be included. The consortium agreed to this extension of scope but clarification will be sought on what kinds of *secondary residential suites* and *residential care facilities* should be studied. The specific tasks to be performed for the study include:

1. Literature reviews: fire models, fire loads and fire test data
2. Surveys of floor plans
3. Survey of fire loads (much is already available)
4. Determine the distribution of tests based upon the results of Tasks 1 to 3
5. Design and conduct small- and medium-scale fire experiments (cone and furniture calorimeter)
6. Design and conduct full-scale room-fire tests
7. Analyze test results
8. Develop database of experimental results
9. Computer modelling of fire experiments (CFD models)
10. Parametric studies
11. Computer modelling of other configurations (and verification of model predictions)
12. Analytical work to develop a calculation method
13. Final report
14. Technology transfer.

During the meeting it was agreed that NRC would begin a literature review of fire models, fire loads and fire test data; a survey of floor plans; and a survey of fire loads for all five room-types.

The proposed deliverables for the study include:

- Interim research reports as specific tasks are completed
- Final research report at the end of the project
- Set of design fires for the areas studied, presented as profiles of heat release rate, temperature and combustion products
- A publicly available database of all experimental results which will be maintained by NRC
- A computational method for design fires for multi-suite dwellings that would be acceptable for use by the codes committees, and perhaps identified (referenced) in the appendix to the NBCC.

The next meeting of the project consortium will be convened in May 2007.

Publications

None.