FPInnovations
FORINTEK

Simple Progress Report
General Revenue
March 2008

Technology Transfer/Dissemination of Results of Completed Research

Project Leader:	Jim Mehaffey, Building Systems Department, Fire Research Group, Ottawa Laboratory		
Program Area:	Building Systems	**Start Date:**	April 2004
Program Goal:	BF/BTT	**Completion Date:**	March 2008*
Project No.:	4479	**Date of Last Update:**	March 31, 2008
Project Liaison(s):	Rodney McPhee, Canadian Wood Council; Paul Newman, COFI/Canada Wood; Sylvain Labbé, Quebec Wood Export Bureau		

* See Status below.

Long Term Goals / Strategies

- Focus on members' customers and product end-use performance by dissemination of the results of completed fire research to the wider scientific community, code officials, design and construction industries, and to Forintek's members.

Key Objectives

- Write and submit for publication, a number of scientific papers, best-practice and design guides, and other documents; and present papers at scientific conferences, symposia, workshops, etc. which will disseminate the results of completed fire research carried out by Forintek over the past few years.
- Working in collaboration with officials at the Canadian Wood Council, propose changes to building codes, and testing and performance standards based upon fire research carried out by Forintek over the past few years.

Key Actions and Deliverables

Deliverables	Expected Delivery Date
Publication of a number of scientific papers, best-practice and design guides, and other documents; and presentation of papers at scientific conferences, symposia, workshops, etc.	March 2008*
In collaboration with officials at the Canadian Wood Council, submission of proposals for changes to Canadian building codes, fire test and product/material performance standards	March 2008*
Publication of a number of *Technotes,* brochures and other documents for use by Forintek's members and the wood industry at large	March 2008*

* The project is being extended as a consequence of the positive results in 2004/05, 2005/06 and 2006/07.

Status

This is the continuation of a project commenced in 2004-2005, when two papers were presented at the *5th International Wood and Fire Safety Conference* in the Slovak Republic; a poster presentation was made at the *10th International Fire Science and Engineering Conference* in Scotland; three papers were given during *Canada Wood Fire Safety Missions* to Korea and China; one paper was presented at the *Building Experts Committee* meeting in Vancouver; and one paper was presented at the *Toronto Wood Solutions Fair*.

In 2005/2006, one paper was published in and another submitted to the journal *Fire and Materials*; a paper was presented at an *International Symposium on Engineering Properties and Uses of Plantation Timber* in Korea; a poster presentation was made at the *8th International Symposium on Fire Safety Science* in Beijing; three presentations were made at the *4th International Seminar on Fire Protection Engineering* in Chile; and two presentations were made at the APEC Seminar *Building Confidence in Timber: A Seminar on Fire Safe Use of Timber Construction* in New Zealand.

In 2006-2007, two papers were presented at the *4th International Workshop on Structures in Fire* in Portugal; a paper was presented at a *Workshop on Fire Risk Assessment and Risk-based Fire Safety Design* in Japan; a paper was presented at the *11th International Conference Fire and Materials* in San Francisco; and an abstract of a paper was accepted for presentation at *Interflam 2007* in England.

Partners

Rodney McPhee, Canadian Wood Council; Paul Newman, COFI/Canada Wood; Sylvain Labbé, Quebec Wood Export Bureau.

Rationale and Potential Impact

In preparation for an external audit/evaluation of Forintek's fire research program over the previous ten years, in 1993 Forintek's fire researchers prepared a brief synopsis of the achievements/accomplishments resulting from that research program. The summary highlighted fourteen major subjects addressed by our fire research program during that time period and identified more than 120 major publications and presentations by Forintek fire research scientists which resulted from the research. At the same time, this self-examination of the research program identified many achievements in the research that had not been transferred into appropriate code revisions and changes to standards. It also highlighted the industry's pressing need for Forintek expertise and assistance in addressing numerous codes and standards issues related to fire safety and fire performance of wood structures and wood-based construction materials within Canada, the United States, Japan and China. Responding to those needs requires the frequent presentation of scientific papers and publication of articles in scientific and other journals based upon the results of Forintek's fire research. This project facilitates the communication of the Forintek's fire research results to the supporting members and to the wood industry at large.

Proposed Approach

Write and submit for publication, a number of scientific papers, best-practice and design guides, and other documents; and present papers at scientific conferences, symposia, workshops, etc. which will disseminate the results of completed fire research carried out by Forintek over the past few years.

Work Completed this Fiscal Year

J.R. Mehaffey was an invited speaker during a seminar on the *Use of Fire Safety Engineering in Performance-based Design* that was convened April 26-27 in Paris. The objective of the seminar was to solicit information on the status of performance-based design in various countries in an attempt to facilitate both the work on Fire Safety Engineering (FSE) in ISO Committees and the proposed implementation of a performance-based code in France. In particular, the seminar offered international experts the opportunity to discuss:

- How to express functional requirements and performance criteria;
- How to collect and interpret statistical data from real fires for use in FSE; and
- The actions required to have FSE accepted as a design methodology.

Mehaffey's paper was entitled *Establishing Functional Requirements and Performance Criteria.* The paper began with an introduction to performance-based design. The primary focus, however, was on the early steps in which fire safety objectives, functional requirements and performance criteria are established for a project by reference to regulation or by negotiation among affected parties. Objectives are qualitative expressions of the desired outcome of design expressed in broad terms such as life safety, property protection, continuity of operations, etc. Functional requirements translate these objectives into needed functionality; that is, they

describe the functions that the fire protection systems must perform to achieve the objectives. Like objectives, functional requirements are qualitative, but they apply at the level of elements of design and are more directly useable for engineering. Finally performance criteria must be established that can be used to determine whether proper functioning of the design has been achieved. Performance criteria are quantitative. They may be explicit expressing, for example, acceptable levels of visibility. On the other hand, they may be implicit whereby performance of a design must be demonstrated to provide a level of safety equivalent to that intended by prescriptive regulations. The presentation closed with an outline of two examples of performance-based design in which the fire safety objectives, functional requirements and performance criteria were established using the objective-based National Building Code of Canada.

J.R. Mehaffey delivered a paper entitled "Fire Performance of Wood-based Room Lining Materials" during the conference *Interflam 2007* in London, UK September 3-5. The paper was co-authored with J.P. Huczek and M.L. Janssens of Southwest Research Institute (SwRI). It summarised research conducted during 2005-2006 to characterise the fire performance of wood interior finish in a variety of international fire tests.

S. Craft wrote three papers summarising progress in the development of a finite element model to predict heat and mass transfer in a wood-joist floor assembly exposed to fire.

- A paper entitled "Predicting the Thermal Response of Gypsum Board Subjected to a Constant Heat Flux", by S.T. Craft, B. Isgor, G. Hadjisophocleous and J.R. Mehaffey has been accepted for publication in the journal *Fire and Materials*. The paper presents favourable comparisons between one-dimensional analyses using the model and cone calorimeter tests carried out at the US Forest Products Lab.
- S. Craft presented a paper entitled "Predicting the Temperature Rise in Light-Frame Wood Floor Assemblies Exposed to Fire" during the conference *Interflam 2007* in London, UK September 3-5. The paper was co-authored with J.R. Mehaffey, G. Hadjisophocleous and B. Isgor. It described the model in detail and compared its predictions with the results of medium- and full-scale fire-resistance tests conducted at the National Research Council Canada.
- A paper has also been written and submitted to the International Association for Fire Safety Science (IAFSS) to be considered for presentation at the conference to be held 21-26 September, 2008 in Karlsruhe, Germany. The paper presents the heat and mass transfer model and compares model predictions to full-scale experiments completed for validation.

S. Craft wrote two papers summarising progress in the study of the performance of adhesives at elevated temperatures.

- A paper entitled "Development of a Small-scale Elevated-temperature Tension Test" by S.T. Craft and R. Desjardins will be presented at and appear in the Proceedings of the 6th International Scientific Conference Wood and Fire Safety, May 12-15 in Slovakia.
- A more detailed paper entitled "Development of Small-scale Evaluation Methods for Wood Adhesives at Elevated Temperatures" by S.T. Craft, R. Desjardins and L.R. Richardson will be presented at and appear in the Proceedings of the 10th World Conference on Timber Engineering, June 2-5 in Japan. It presents the background of finger-joined lumber and adhesives exposed to fire, a review of the current test methods and a summary of the new tension test method.

A paper entitled "Fire Loads in Commercial Premises" by E. Zalok, G.V. Hadjisophocleous and J.R. Mehaffey has been accepted for publication in *Fire and Materials*. The paper presents the results of a survey of 168 commercial establishments that was conducted in Ottawa and Gatineau. Establishments surveyed included restaurants, hairdressing salons, travel agencies and pharmacies as well as retail stores. Five different types of combustible material groups were selected as the base of analysis: textiles, plastics, wood/paper, food, and miscellaneous. The data collected were analyzed to determine the total fire load in each establishment, the fire load density, and the contribution of different combustible materials to the total fire load.

May 23-25, 2007, Carleton University offered a short course for practitioners entitled course *Fire Dynamics Simulator and Smokeview*. Fire Dynamics Simulator (FDS) is a computational fluid dynamics model developed by NIST in the USA. Despite requiring significant computer resources (and time) to run, it is one of the most commonly used computer models in the field of fire safety. It is used by designers of fire protection systems, such as smoke management systems, and by fire investigators recreating the course of a fire. As part of the course, J.R. Mehaffey prepared and delivered two one-hour lectures entitled "Introduction/Overview of Fire Models" and "Context for Performance Based Design".

J.R. Mehaffey agreed to be one of three judges on the selection committee for the 2006 Lorne W. Gold Award. The Award is granted by the Institute for Research in Construction (IRC) to authors of an IRC publication ascertained to have made the best contribution during the last year to IRC's mandated goals. One judge was selected from NRC at large, another from IRC and the third from an industry research institute (Mehaffey). The following three papers were reviewed by the judges:

- "Guide for Sound Insulation in Wood Frame Construction" by J.D. Quirt, T.R.T. Nightingale and F. King.
- "Complex Fenestration Systems: Towards Product Ratings for Indoor Environment Quality" by A. Laouadi and A. Parekh.
- "Application of Hygrothermal Modeling Tool to Assess Moisture Response of Exterior Walls", P. Mukhopadhyaya, K. Kumaran, F. Tariku and D. van Reenen.

J.R. Mehaffey accepted an invitation to sit on the International Scientific Conference Board for the 6th international scientific conference *Wood & Fire Safety*. The conference will be convened May 11-15, 2008 in the Slovak Republic. *Wood & Fire Safety* has been offered every four years and has become an excellent venue for scientific exchange among international experts studying fire and wood products/structures.

Publications

Mehaffey, J.R., Huczek, J.P. and Janssens, M.L., 2007. Fire Performance of Wood-based Room Lining Materials. Proceedings of Interflam 2007, September 3-5, London, UK, Volume 1, pp. 21-31, Interscience Communications, London.

Craft, S.T., Isgor, B., Hadjisophocleous, G., and Mehaffey, J.R. 2008. Predicting the Thermal Response of Gypsum Board Subjected to a Constant Heat Flux. To appear in Fire and Materials.

Craft, S.T., Mehaffey, J.R., Hadjisophocleous, G.V. and Isgor, B., 2007. Predicting the Temperature Rise in Light-frame Wood Floor Assemblies Exposed to Fire. Proceedings of Interflam 2007, September 3-5, London, UK, Volume 2, pp. 967-978, Interscience Communications, London.

Craft, S.T., Desjardins, R., and Richardson, L.R. 2008. Development of Small-scale Evaluation Methods for Wood Adhesives at Elevated Temperatures. Proceedings of the 10th World Conference on Timber Engineering, June 2-5, Japan.

Craft, S.T., Desjardins, R. 2008. Development of a Small-scale Elevated-temperature Tension Test. Proceedings of the 6th International Scientific Conference Wood and Fire Safety, May 12-15, Slovakia.

Zalok, E., Hadjisophocleous, G.V., Mehaffey, J.R. 2008. Fire Loads in Commercial Premises. To appear in *Fire and Materials*.