



THE FIRE PROTECTION RESEARCH FOUNDATION

Quantification of Green Building Features on Firefighter Safety

PROJECT SUMMARY

30 July 2013

Background: In 2010, the National Association of State Fire Marshals (NASFM) published a report on issues associated with sustainable building and development which are of concern to fire fighters. While this effort identified a number of community planning and building features of concern, data on the actual extent of the problem and specific means to resolve the issues at the various stages of building planning, design, construction and operation were not detailed.

In the two years since that seminal NASFM report, other research efforts have been undertaken to explore these and related issues in more detail, including by the Building Research Establishment in the UK, BRANZ in New Zealand and the Fire Protection Research Foundation (FPRF) in the USA. In addition, fire challenges of green buildings are identified as a critical research area for firefighter safety in the *Technology and Fire Service Science* area in the *Report of the 2nd National Fire Service Research Agenda Symposium*.

Based on the analysis that was conducted as part of the FPRF project, as well as data and information provided in research by NASFM, NIST, UL and others, there are clear indications of increased fire hazards and risks for firefighters associated with green buildings and green building elements, which if not understood, quantified and mitigated, will continue to lead to firefighter injuries and deaths. Outcomes from this effort will contribute directly to reducing the potential for fire ground injuries and deaths by facilitating recognition of green building related hazards and adopting tactical responses appropriate to expected fire environments and structural performance given contemporary construction and fire loads.

Research Goal, Objectives, and Aims: The goal of this project is to reduce firefighter injuries and deaths associated with unknown or unanticipated fire environments and structural responses associated with green buildings and green building elements. Objectives to meet this goal include:

- quantifying fire impacts of green building features on firefighter safety;
- developing a screening tool to aid in identifying risk-significant green building features and mitigation options; and
- better preparing the fire service for fires in green buildings.

To achieve these objectives, this project has the following specific aims:

- a) develop and test means by which to collect fire incident data specific to domestic fires involving green building features, particularly those resulting in firefighter injury or fatality,
- b) quantify increased fire hazards or risks, or decreased fire performance, associated with green building features in residential and commercial buildings by reviewing existing fire test data and by conducting fire performance tests on selected green building elements, including structural building envelop systems and naturally versus mechanically ventilated atria,
- c) develop a screening tool to aid fire risk and hazard assessment of green buildings and features for new and existing construction,
- d) investigate modifications to firefighting tactics as appropriate to green building technologies, and
- e) develop fire service education and training materials on safety hazards and tactics for green buildings.

Project Tasks: The tasks of this project are grouped according to the following four project areas:

1) Increasing Fire Incident Data Capture for Domestic Fires Involving Green Building Features and Elements.

This effort will (a) review domestic fire incident data reporting and fire investigation reports in Massachusetts and selected national locations to:

- a) determine if any relevant green building data are captured and if so how they are reported,
- b) investigate means to modify or supplement fire incident data collection so as to capture pertinent data on green or sustainable building elements and features,
- c) review NIOSH, NFPA and other investigation reports for structure fires involving firefighter injuries and fatalities for factors that may be a function of green or sustainable building features and elements,
- d) suggest modifications to fire investigation reporting to capture green or sustainable building features and elements, and
- e) develop relevant risk and hazard indicators.

Year 1 efforts will focus on analysis of MFIRS/NFIRS data and NIOSH, NFPA and other fire investigation reports. Year 2 will focus on development of risk and hazard indicators and potential modifications to a-d above. Year 3 will focus on testing of modified / supplemented data and investigation reporting.

2) Quantification of Fire Hazards and Risks Associated with Green Building Features.

This effort will characterize and quantify increased fire hazards or risks, or decreased fire performance, associated with green building features and elements in residential and commercial building applications. This will be done by collecting, analyzing and compiling data on the fire performance of green building elements, comparing performance to 'conventional' construction, and applying the data to the hazard / risk assessment approach to be developed in Project 3 (concurrent effort). Data will be obtained in two ways:

- 1) from existing studies on fire performance of green building elements and systems, such as is available in research reports on fire performance of lightweight engineered lumber (LEL) systems, and

- 2) from new data to be generated on the fire performance of green building features and elements for which quantified performance data do not currently exist.

Year 1 will focus on identifying systems and specifying tests and test parameters, as well as to analyze existing studies. Year 2 will focus on conducting tests. Year 3 will focus on data analysis.

3) Development of Hazard and Risk Assessment Framework and Tools. This effort will develop a hazard / risk assessment and ranking approach and computer-based (spreadsheet or other) hazard- and risk-informed screening and assessment tool to aid the fire service, engineers and others review designs for new buildings and renovations to existing buildings, and to review existing building stock, to identify fire hazards or performance deficiencies associated with green building features and elements that could materially impact firefighter and occupant safety.

Year 1 will focus on identifying suitable mechanisms for risk and hazard assessment and ranking, given the data which are available and which will be developed in the above projects. Various methodologies will be explored, from simple risk ranking to multi-attribute processes, with the aim to select an approach that best fits the state of data and needs of stakeholders, particularly the fire service. Year 2 will focus on structuring and carrying out a multi-stakeholder risk characterization effort, which will take advantage of knowledge gained from Year 1 efforts and the input from fire science and engineering experts, the fire service, architects and other key members of the green construction community, which will result in broadly agreed upon risks (hazards) of concern and relative weighting of each risk (hazard) for use in the risk / hazard assessment tool(s). Year 3 will focus on testing and implementing the tool(s).

4) Develop Recommended Changes to Tactics, Training, Codes and Standards. This effort is based on addressing the following three components: (1) investigation and modification of tactical firefighting responses for green buildings and green building elements, (2) development of education and training material on fire hazards of green buildings and new tactical responses that may be required, and (3) changes to codes, standards and guidelines where warranted. This activity will occur predominantly in year 3, and will include a workshop near to conclusion of the project

Implementation and Schedule: This research project is led by Worcester Polytechnic Institute (WPI) with collaborative support from the University of Maryland and the Fire Protection Research Foundation. The supporting role of the Foundation will be conducted in accordance with section 6 of the Foundation Policies and will be guided by a Project Technical Panel who will provide input to the project, review periodic reports of progress and research results, and review the final project report. This three year project is scheduled to be completed in July 2017.