

Fire Safety Challenges of Green Buildings

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Executive Summary

A global literature review was undertaken to (a) identify actual incidents of fires in green buildings or involving green building elements, (b) identify issues with green building elements or features which, without mitigating strategies, increase fire risk, decrease safety or decrease building performance in comparison with conventional construction, (c) identify reports, studies and best practice cases which speak to the issue of addressing fire risk introduced by specific green building design elements, and (d) identify research studies in which building safety, life safety and fire safety have been incorporated as an explicit element in green building indices. In addition, consideration was given to how one might express the level of increased risk or hazard, or decreased performance, associated with fire performance of green building features. Steps were also taken to identify gaps and specific research needs associated with understanding and addressing fire risk and hazards with green building design.

Outcomes of this effort include the following:

- There are currently no fire incident reporting systems in the United States or other countries surveyed which specifically collect and track data on fire incidents in green buildings or on items labeled as green building elements or features. Unless changes are made to reporting systems such as NFIRS, it will be difficult to track such fire incident data.
- Web searches and surveys have identified more than two dozen reported fire incidents that are related to green issues. Examples include fires associated with photovoltaic (PV) panels and roof materials, fire and safety hazards attributed to increased energy efficiency aims in residential buildings (primarily insulation related), fire involving insulating materials, fires associated with exterior cladding that contains combustible insulation materials or coatings, and fire performance of timber frame buildings with lightweight engineered lumber (LEL) components.
- Studies related to green building and fire issues produced by BRE, BRANZ, FMGlobal and the NASFM have been identified. Research on specific building elements with green attributes, but not necessarily labeled as green, such as lightweight engineered lumber (LEL), has been identified at UL and NRC Canada.
- From the materials reviewed, a comprehensive list of green building site and design features / elements / attributes has been compiled. The list is titled "Table 4. Green Building / Site Elements and Attributes" and can be found in Section 3.

- From the materials reviewed, a list of fire-related hazards and risk factors, associated with green building elements, has been compiled. The list is titled “Table 5. Hazard, Risk and Performance Attributes” and can be found in Section 4.
- Using Table 4 and Table 5, a set of matrices relating green attributes and potential fire hazards was developed. The matrix concept is illustrated in “Figure 1. Matrix of Green Attributes and Potential Fire Hazards” and can be found in Section 5. The complete set of matrices is detailed in Appendix E.
- Using the matrices identified above, an approach for illustrating the relative fire risk or hazard, or decreased fire performance, associated with green building elements, was developed. The relative risk matrix is illustrated in “Figure 2. Relative Fire Risk/Hazard Level of Green Attributes” and can be found in Section 5. A complete matrix, which is based on a qualitative expert judgment approach for illustrating relative risk levels, can be found in Appendix F.
- Potential mitigation strategies for addressing the relative increase in fire risk or hazard associated with the green building elements and features have been identified. These are presented at a basic level (e.g., provide automatic sprinkler protection). In many cases, adherence with existing test standards, codes and related design guidelines associated with conventional construction will help mitigate potential increases in fire risk or hazard associated with green building elements. Approval or certification of products which meet loss prevention criteria, and are indicated as having some type of green attribute which might gain credit in a green certification scheme, have been identified within the FM Approvals system and UL Product Certification system.
- Review of a sample of green rating schemes for which data were readily available, including LEED (residential and retail), BREEAM (new buildings), GREEN MARK (residential and nonresidential), as well as the IgCC, indicates that fire safety objectives are not explicitly considered. However, as noted above, implementation of certain green features could have a negative impact on fire or life safety if not mitigated. A qualitative approach, using text and pictograms, was used to reflect areas of fire and life safety concern, as illustrated in “Figure 4. Fire Hazards with Green Building Features” and “Figure 5. Extract from GREEN MARK Assessment for Potential Unintended Fire Consequences”, which can be found in Section 5. Detailed matrices of the assessment of the green rating schemes for potential unintended fire consequences can be found in Appendix G.
- It was determined that the green building rating scheme of the German Sustainable Building Council (DGNB) includes criteria for fire prevention (<http://www.dgnb-system.de/dgnb-system/en/system/criteria/>, accessed last on 10/29/12). Detail on the weights of fire prevention attributes relative to the green attributes was not able to be verified; however, it is understood that some credit is given for fire protection features such as smoke extract, automatic sprinklers, and structural fire protection.

- It was determined that BREEAM-in-USE (<http://www.breeam.org/page.jsp?id=373>, last accessed on 10/29/12), a recent BRE scheme to help building managers reduce the running costs and improve the environmental performance of existing buildings, incorporates fire risk reduction attributes. The fire risk reduction attributes related to such issues as whether a fire risk assessment has been conducted, are emergency plans in place, and so forth. No indication of consideration of fire protection systems was identified.

In order to fill gaps in knowledge to better address fire issues with green building features, further research is suggested in several areas.

- To address the lack of reported fire experience with green buildings and green building elements, especially in buildings which have a green rating or certification, a modification is required to fire incident data reporting systems as NFIRS. This could perhaps be done in collaboration with the USGBC and/or AIA, and parallel organizations in other countries. If this avenue is pursued, there will be challenges associated with how responding fire departments are able to identify LEED, BREEAM, or other such ratings for buildings. In cases where ratings or certifications are posted on buildings (e.g., LEED, Energy Star, BREEAM or other), this information could be readily captured by fire fighters responding to fire incidents in the building. In cases where such ratings or certifications are not posted, inclusion of specific features such as 'double-wall façade' or 'LEL' might be added to the incident reporting system, or additional guidance can be provided to first responders in identifying green attributes of buildings.
- To address the lack of analysis on fire 'risk' associated with green building elements, it is suggested that a more extensive research project is needed to review existing studies and reports on fire performance of green building elements, even if not explicitly identified as such (e.g., LEL). Research is needed to (a) develop a clear set of comparative performance data between green and 'conventional' methods, (b), develop an approach to convert the relative performance data into relative risk or hazard measures, and (c) conduct a risk (or hazard) characterization and ranking exercise, with a representative group of stakeholders, to develop agreed risk/hazard/performance levels.
- To explore the extent to which current standard test methods are appropriate for evaluating both green and fire safety criteria, and result in adequate mitigation of fire risk / hazard concerns, investigation into level of fire performance delivered by current standard test methods and into the *in situ* fire performance of green building elements is recommended.
- To address the lack of published case studies in which increased fire risk or hazards associated with green building elements have been specifically addressed, groups such as SFPE, NFPA, AIA and the USGBC can be encouraged to hold symposia on these topics and encourage publication of case studies in proceedings and associated journals. While such some studies have been published, they mostly reflect 'issues or concerns' with green building features without significant quantification of impacts and formal risk analysis.

- To address the lack of studies which have investigated incorporating building safety, life safety and fire safety as explicit elements in green building indices, joint research efforts between the FPRF and the USGBC and other promulgators of such indices could be explored with the aim to incorporate fire and life safety objectives as fundamental elements in green rating schemes and codes.
- To facilitate better collection of relevant data on fire safety challenges with green buildings in the future, a fire and green building data repository could be established. This might build on an existing effort (e.g., <http://www.firemarshals.org/programs/greenbuildingsandfiresafetyprojects.html>) or be supported by the FPRF or other organizations.