Large Scale Outdoor Fire Demonstration Program

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For:

Greenstone Industries
(now US GreenFiber)

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Executive Summary

The Large Scale Outdoor Fire Demonstration Program sponsored by Greenstone Industries, Inc. and conducted on June 23, 1998 was a demonstration of the combustion characteristics of buildings employing conventional residential wood frame construction practices. The demonstration illustrated the relative performance of both fiberglass and cellulose insulation in comparison to an otherwise identical non-insulated structure in terms of fire resistance, suitability as fire blocking and general combustibility. The intent of the demonstration was to communicate to builders, designers and the fire safety community with up-to-date information and recent research results using actual complex building assemblies built to full scale. An earlier demonstration with similar objectives, titled the Big Burn, was performed approximately twenty years ago with dramatic results. However, there were several technical shortcomings in the earlier effort that are addressed by this current state-of-the-art demonstration.

The demonstration was performed at the Maryland Fire and Rescue Institute under the supervision of both The Code Consortium, Inc. and Steven Winter Associates and documented by professional color video and photography. The three identical two-story wood structures separated by an equal distance in excess of twenty-eight feet to assure minimal radiative exchange between buildings, were built utilizing prevalent residential construction practices. In each of these buildings, a common size door and window rough opening was provided for access, view of the interior and necessary combustion ventilation. Visual access was provided by means of a wire glass window to view the progressive spread of combustion through the inter-story exterior wall cavity. Wood cribbing was placed at the first floor level and burned to simulate a room contents fire.

Each structure was instrumented with two independent channels of instrumentation and dataloggers to measure temperatures at several locations, including both the interior and exterior of the wall, and roof assemblies. The elapsed time and temperature of the first floor room fire were measured throughout the demonstration and complied well with the requirements of the Uniform Building Code Standard 26-4 and were consistent among the three units.

The results of this demonstration were very dramatic and correspond closely with the results achieved by the National Fire Laboratory of the National Research Council of Canada. The cellulose structure maintained its structural integrity in excess of 24 minutes longer than the fiberglass structure, translating to an increased fire resistance of 57% as compared to the 55% improvement achieved in the laboratory study. The critical mode of failure was the measure of resistance provided by the wall assembly.

1.0 Background

Greenstone Industries, Inc., a subsidiary of the Louisiana-Pacific Corporation contracted with Steven Winter Associates, Inc. and The Code Consortium, Inc. to design and document the results of a larger scale fire demonstration to assess the relative performance of common insulation products in conventional detached residential wood construction. Fire safety issues have long been the subject of debate within the insulation community but recent developments in building science research has prompted renewed interest in how these results apply to full-scale assemblies. An earlier demonstration performed by the Rhode Island Energy Corp. approximately twenty years ago, produced dramatic results. However, technical shortcomings associated with this effort, in both the design of the structures and the method of documentation, required a new effort utilizing both the results of research and established testing protocol, as a basis for comparison.

Recent efforts by the building science community have documented that walls insulated with cellulose insulation serve as continuous fire blocking material while dramatically increasing the fire resistance of the wall assembly. The most comprehensive research performed to date on this issue is the recently completed study by the National Fire Laboratory of the National Research Council of Canada. The ultimate objective of this report was to perform a comprehensive evaluation of common assemblies, utilizing standard methods that could be prescriptively adopted by building codes and trade associations. The study, jointly funded by the Canadian government and trade associations representing the gypsum, fiberglass and cellulose industries concluded the following:

> "The fire resistance performance of an assembly with glass fiber insulation in the wall cavity was slightly lower than that of a non-insulated assembly" and "The installation of cellulose fiber in the wall cavity provided an increase in the fire resistance performance of 22% to 55% compared to a non-insulated assembly."[1]

2.0 Objectives

How this improved fire performance would influence fire development in a complex assembly such as typical residential wood frame construction was unknown. While experimental results performed to standard scientific protocols are fundamental to any comparison, the study of full-scale structures is of value in demonstrating complex unforeseen influences and vulnerabilities of a particular assembly. Conventional wood frame construction practices include numerous elements that could conceivably mitigate the benefits of a more fire resistant insulation product such as two-story framing, wood roof trusses, exterior soffits exposed to fenestration openings, and plastic electrical receptacle box penetrations in the gypsum board finish. This demonstration considered all of these elements and attempted to determine their respective influences. The primary objective of this demonstration was to document whether the results of the earlier experimental data would correspond with a conventional building assembly.