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Firebrand production from building components fitted with siding treatments

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ABSTRACT

Firebrand production from real-scale building components under well-controlled laboratory conditions was investigated. Re-entrant corner assemblies were ignited and during the combustion process, firebrands were collected to determine the size/mass distribution generated from such real-scale building components under varying wind speed. In prior work, a unique ignition methodology was developed to generate firebrands from re-entrant corner assemblies constructed of wood studs and oriented strand board (OSB). In this study, this ignition methodology was applied to re-entrant corners constructed from wood studs/OSB but fitted with actual siding treatments (tar paper and cedar siding) to determine the influence of siding treatments on firebrand generation from wall assemblies. Firebrands were collected with pans filled with water, and then the size and mass of firebrands were measured after drying. The size and mass distributions of firebrands collected in this study were compared with the data from prior component tests as well as the limited studies available in the literature on this topic. Some firebrands were found to be lighter for a given projected area than others, likely produced from cedar siding or tar paper. The effects of applied siding treatments on firebrand production are discussed in detail.

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1. Introduction

Wildland–Urban Interface (WUI) fires have caused significant destruction to communities in Australia, Chile, Greece, Portugal, Spain, and the USA. In 2009, fires in Victoria, Australia caused the death of more than 100 people, destroying more than one thousand structures. The 2007 Fires in Greece destroyed several hundred structures and caused the deaths of more than 70 people.

For many years, firebrands have been known to be a significant cause of structure ignition in WUI fires as well as large urban fires. Sparse data exist with regard to firebrand size distributions from actual structures or large outdoor fires, such as WUI and urban fires [1–3]. Historically, most of the firebrand studies have focused on the travel distance of firebrands [4–7]. In WUI fires, the structures themselves may be a large source of firebrands, in addition to the vegetation [8–12]. Yet, due to lack of quantitative information available on production of firebrands from structures, it cannot be determined if firebrand production from structures is a significant source of firebrands in WUI fires. In the case of urban fires in Japan, structures are responsible for firebrand production, but as in the case of WUI fires, little is known about firebrand size/mass distributions produced.

For completeness, a review of the literature is provided regarding known studies on the quantification of firebrands from burning structures and actual WUI/urban fires. Only a *limited* number of studies have been conducted. These literature survey results are summarized in Table 1.

Vodvarka [1] measured firebrand deposition by laying out 3 m × 3 m sheets of polyurethane plastic downwind from five separate residential buildings burned in full-scale fire experiments. Three of the structures were standard frame construction with wood siding. The fourth was asphalt siding applied over sheet rock which covered the original shiplap. The fifth structure was a brick veneer over a wood frame. The total number of firebrands collected from these structure fires was 4748. Very small firebrands dominated the size distribution with 89% of the firebrands exhibiting projected areas less than 0.23 cm^2.

Vodvarka [2] measured the fire spread rate, radiant heat flux, firebrand fallout, pressures, and gas composition from eight separate building burn experiments. Firebrands were collected by laying out sheets of polyurethane plastic downwind from three of eight experiments. Two of the buildings were all wood construction; and one was cement-block construction, and had wooden floors and asphalt shingles over wood sheathing. In total, 2357 firebrands were collected. More than 90% of the firebrands had a

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Table 1
Summary of firebrand production studies from structures and WUI/urban fires.

	Peak fire intensity	Material used	Wind speed	Measurement techniques	Significant results
Vodvarka [1]	Not provided	Standard frame construction with wood siding /asphalt siding applied over sheet rock/brick veneer over a wood frame	Not specified	Sheets of polyurethane plastic	89% of firebrands less than 0.23 cm^2
Vodvarka [2]	Not provided	All wood construction /cement-block construction with wooden floors and asphalt shingles over wood sheathing	Not specified	Sheets of polyurethane plastic	85% of firebrands less than 0.23 cm^2
Yoshioka et al. [13]	1.08 MW/m^2	Fire prevented wood with outer wall siding and slate roofing	4 m/s	Pan filled with water and no water	83% of firebrands in the wet pan between 0.25 and 1 cm^2
Shinohara et al. [14]	Not measured	Not mentioned	An average wind speed of 7.2–12.1 m/s, with the maximum wind speed 20.1 m/s	Collected after fire	Most of the firebrands less than 10 cm^2 and 0.5 g
Ohmiya and Iwami [15]	Not measured	Not mentioned	An average 7 m/s	Survey	Most of the firebrands less than 5 cm maximum dimension
Structure Burn in CA [16]	Not measured	Wood and brick	6 m/s	Pans filled with water	All the firebrands less than 1 g most of the firebrands less than 10 cm^2
Components [17]	Not measured	OSB and wood 2 × 4 studs	6 m/s	Pans filled with water	More than 90% of firebrands were less than 1 g
			8 m/s		More than 90% of the firebrands less than 10 cm^2
Full-Scale Burn in wind tunnel [18]	1.76 MW/m^2	OSB and wood 2 × 4 studs	6 m/s	Pans filled with water	More than 90% of firebrands were less than 1 g More than 90% of the firebrands less than 10 cm^2
3 story school building burn [19,20]	Not mentioned	Wood and gypsum boards	4.6 m/s	Collected after fire	Most firebrands were found to be between 1 and 3 cm
Manzello and Foote [3]	Not mentioned	Not specified	4.5–6.7 m/s (sustained) gusts to 13 m/s	Trampoline outdoor furniture	More than 95% of firebrands less than 1.0 cm^2
Rissel and Ridenour [21]	Not mentioned	Not specified	5.4–6.3 m/s (sustained) gusts to 13 m/s	Trampolines	More than 90% of firebrands less than 0.5 cm^2