CHARACTERISTICS OF HEAT FLUX AND FIREBRAND GENERATION DATA OBTAINED FROM A FULL SCALE STRUCTURE BURN

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1. ABSTRACT

A full scale, proof-of-concept experiment was conducted to investigate firebrand production from a burning structure. In this experiment, NIST researchers were invited to set up instrumentation during a structure burn down. As the structure burned, firebrands were collected using an array of water pans. In addition, spatially resolved heat flux generated from the structure during burning as well as wind speed data were collected using custom, portable instrumentation packages. Results of the firebrand measurements are presented here.

2. INTRODUCTION

Fires in the Wildland-Urban Interface (WUI) have become a problem in the USA as well as many other countries throughout the world. WUI fires often result in catastrophic damage to property and displace tens of thousands of people. Anecdotal evidence as well as post-fire damage assessment studies suggest that wind driven firebrand showers are responsible for a majority of structure ignitions in WUI fires [1]. Without physical knowledge regarding how firebrands ignite structures in WUI fires, it is impossible to develop risk assessment and mitigation tools intended to reduce structure losses in these fires. Little, if any, data exists regarding firebrand production from actual structures.

To this end, in collaboration with the Northern California Fire Prevention Officers, (NORCAL FPO, a section of CALCHIEFS), a full scale, proof-of-concept experiment was conducted to investigate firebrand production from a burning structure. Once the firefighter training exercises were completed, a burn down of the structure was conducted by the Dixon and Vacaville Fire Departments. As the structure burned, firebrands were collected using an array of water pans positioned over a range of distance, downstream from the structure. In addition, spatially resolved heat flux as well as wind speed data were collected using custom portable instrumentation packages designed by NIST.

3. EXPERIMENTAL DESCRIPTION

The structure used for the experiments was a two story house located in Dixon, California. Debris piles were used to ignite the structure and it took approximately two hours after ignition for complete burn down. A large amount of water was poured onto the structure several times to control the fire since the house was located in downtown Dixon Firebrands were collected by using a series of water pans placed around the structure and on the road about 18 m downwind to the structure. as shown in Fig. 1. After deposition into the water pans, the firebrands were filtered from the water using a series of fine mesh filters.

The instrumentation packages used were designed to provide quantitative data on total heat flux, wind speed, wind direction, ambient temperature, and relative humidity near a structure [2]. Heat flux was measured using Directional Flame Thermometers (DFT's). The unique design of the packages allowed for wireless transmission of all data signals collected to a safe location. A difference in the instrumentation packages used here, and those described by Manzello *et al.* [2], was the cup and vain anemometers were replaced with bi-directional probes.

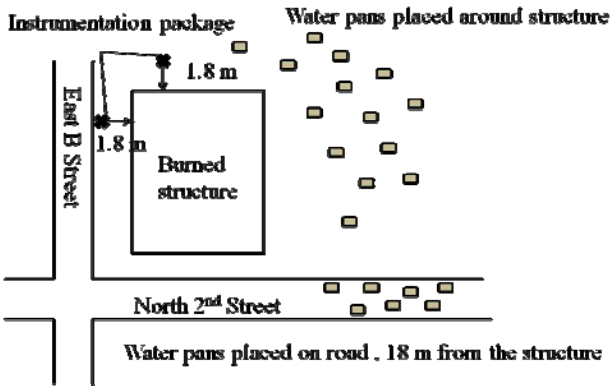

Figure 1 Location of instrumentation packages and water pans

4. RESULTS and DISCUSSIONS

The firebrands collected were compared with firebrand data from burning vegetation from a prior study [3] and are shown in Fig. 2.

Figure 2 shows that the size distribution of firebrands at two different places (one around a structure, the other is 18 m downwind from structure) were similar. It also shows that the size distribution of firebrands were similar to the one from vegetation.

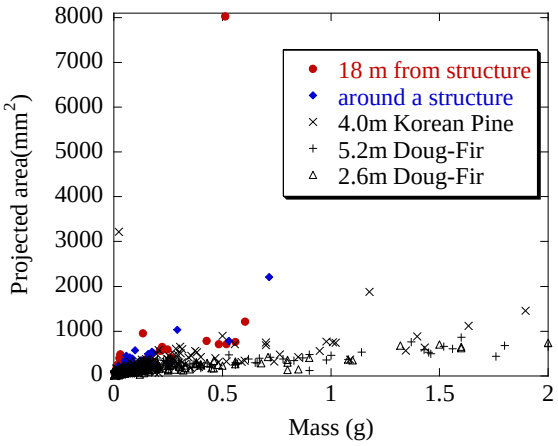

Figure 2 Mass and area of firebrands collected in this experiment, compared with firebrands generated by vegetation [4, 5].

All the firebrands collected from the burning house were less than 1 g and almost 85 % of firebrands collected 18 m from structure and 68 % of firebrands from around a structure were less than 0.1 g.

Figure 3 shows the size distribution of firebrands collected from the burning structure. Most of firebrands, both 18 m from structure and around structure have less than 10 cm^2 projected area. The size distribution of the firebrands was bigger and broader than those of Vovardka [4].

It is important to note that water was applied during the burn because this experiment was a part of fire fighter training.

5. SUMMARY

Collaborative work between the Northern California Fire Prevention Officers, (NORCAL FPO, a section of CALCHIEFS) and NIST was successfully accomplished and a structure burn down was completed. During the structure burn, heat flux, wind speed and firebrand size and mass were collected using instrument packages and a series of water pans. Only firebrand data was discussed in this paper. As mentioned above, to control the fire, water was applied. In real WUI fire, most of firebrands are produced without water being applied. Even though the situation is different, this study is constructive as serves as a first step to observe firebrand generation from a real structure since there are few studies which observed firebrand generation from real structures to date. In this study, the size and mass distribution of firebrands collected at the burn site were similar to those collected from vegetation burns and the size distribution of the firebrands was bigger and broader than in Vovarka's study.

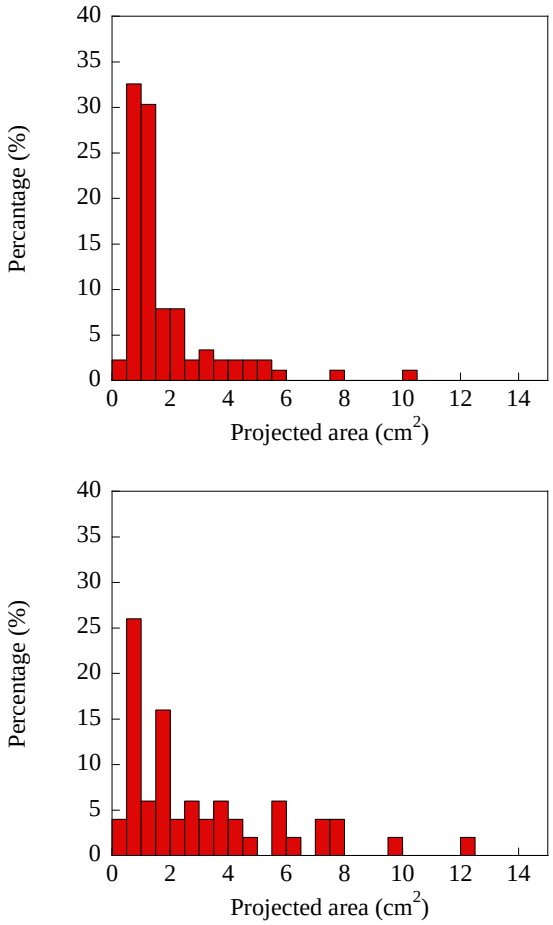

Figure 3 Size distribution of firebrands from structure; firebrand collected 18 m from structure (Top) and firebrands collected around the structure (Bottom).

ACKNOWLEGMENTS

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