REFINEMENT AND VALIDATION OF FIREBRAND TRANSPORT SUB MODEL FOR A PHYSICS BASED BUSHFIRE PREDICTION MODEL: DESIGN OF A FIREBRAND GENERATOR

bushfire&natural HAZARDSCRC

Rahul Wadhwani[1], Duncan Sutherland[1,2], Khalid Moinuddin[1], Graham Thorpe[3], Lyndon Macindoe[1]

[1]Centre for Environmental Safety and Risk Engineering, Victoria University, Melbourne, [2] Department of Mechanical Engineering, University of Melbourne, [3] College of Engineering and Science, Victoria University, Melbourne

INTRODUCTION:

Firebrands are burning pieces of, for example, bark, leaf litter, and twigs. Firebrands can be transported by wind from metres to kilometres from the head fire. [1]

Firebrands are responsible for causing spot fires during the spread of bushfire. Firebrands are the primary factor in house loss during bushfire [2]

The NIST firebrand dragon, shown in Fig 1(a), [3] provides knowledge of how firebrands interact with infrastructure.

The bend in the NIST firebrand dragon causes formation of a Dean's vortex [4] and, as a result, a non-uniform exit velocity and uneven acceleration of the firebrands. See the simulated velocity in Fig 1 (a).

The non-uniform velocity profile increases the difficulty of studying the aerodynamics of firebrands.

RESEARCH QUESTION: HOW TO CONSTRUCT FIREBRAND GENERATOR WITH A UNIFORM VELOCITY PROFILE AT THE EXIT?

METHOD:

The Dean's vortex is caused by the bend in the pipe. We constructed a prototype concentric tube firebrand generator to eliminate the Dean's vortex (Fig. 2). The air is pumped into the outer pipe (III) from the blower (II), this creates suction pressure in the inner pipe (I) to provide acceleration to the firebrands. We conducted simulations of the airflow through the firebrand generator

- Prototype initial design leads to toroidal velocity profile (Fig. 3 (a), (b))
- Increased tube length to reduce the toroidal profile to get uniform velocity profile (Fig. 3 (a), (b))

CFD Simulation using FDS, proved the hypothesis used in construction of firebrand generator (Fig. 1(b)).

Results:

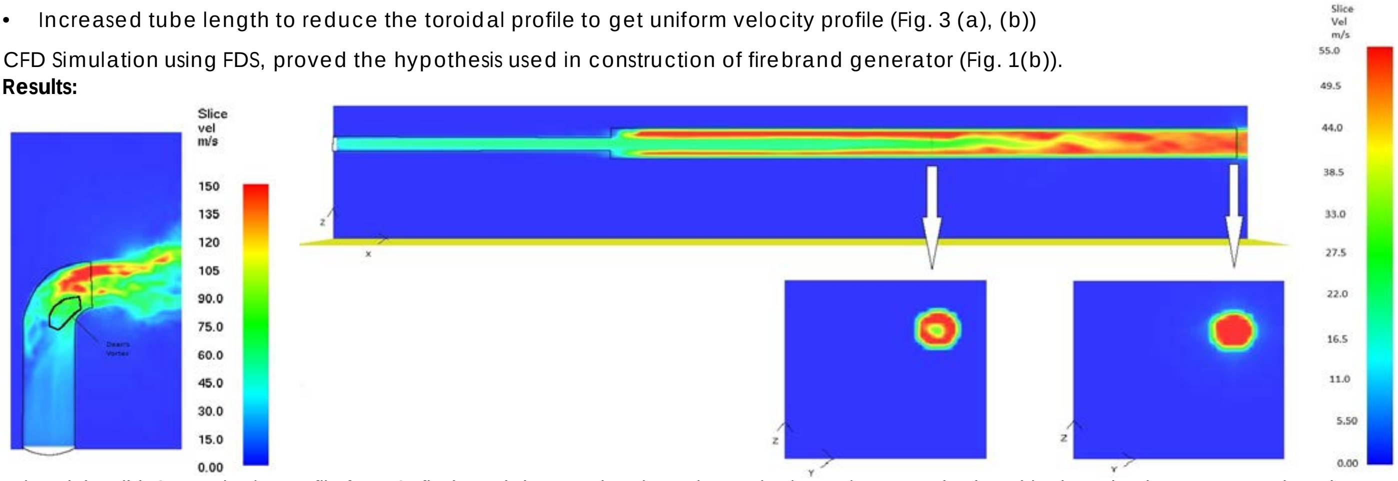

Fig. 1(a) & (b) CFD velocity profile for NIST firebrand dragon showing a low velocity region near the bend in the tube (Dean's vortex) and VU Firebrand generator showing the cross-sectional velocity profile becoming more uniform as the length of the outer tube increases.

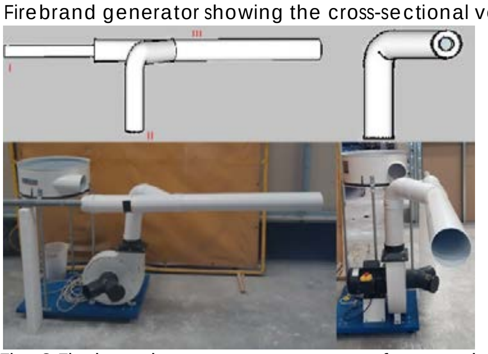

Fig. 2 Firebrand generator prototype front and side view

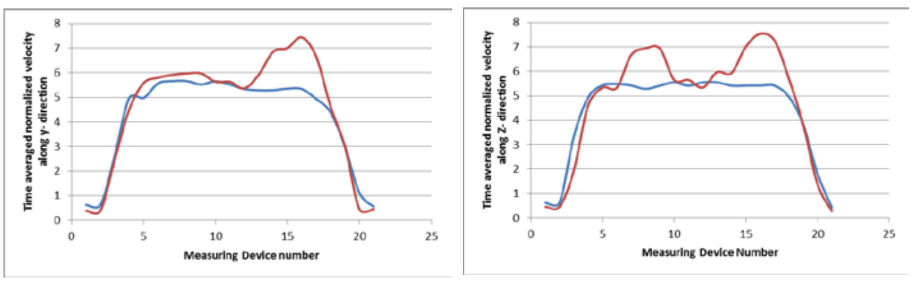

Fig. 3 (a) & (b) Simulated average velocity profile in two perpendicular directions (Y) and (Z) as shown in Fig. 1(b) Extended design Original design

FUTURE WORK: Measurement of experimental velocity profiles (on going).

Scattering pattern of firebrands is used to study the aerodynamics of firebrand and their likelihood to cause spotfire.

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