Potential of modelling firebrand load on structure in Wildland Urban Interface

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Is it feasible to model firebrand load on structure using a physics-based model in WUI?

HIGHLIGHTS

- Firebrand is a significant component of bushfire risk analysis due to its randomness and unforeseeable spreading patterns [1].
- Modelling firebrand flux and heat load on structures is important for predicting bushfire consequences and related risk assessments.
- A Physics-based Fire Dynamics Simulation(FDS) model is used to obtain qualitative results of visualizing firebrand transport in bushfire prone areas under different wind velocities.

MODEL SETUP

The length, width, and height of the simulation domain are 50 m, 20 m and 20 m respectively. The grid size used is 1 m x 1 m x 0.5 m. A static line fire with a magnitude of 18 640 kW/m [2] is set up at 5 m above the ground level representing crown fires and 20 m away from the obstructions. Wind velocity is kept constant and blowing direction is from left to the right of the domain. The average height of structures is about 3 m. Spherical particles with a diameter of 22 mm are ejected from fire at an angle of 45^0 to the horizontal plane. Firebrand particles' initial velocity is about 14 m/s and starting to emit after wind profile is established.

'Spherical drag law' and 'Lagrangian particle model' are applied [3] and the simulations have been run for 50 s. The qualitative analysis has been carried out at two driving velocities, 6 m/s and 13 m/s to identify the difference of firebrand movement.

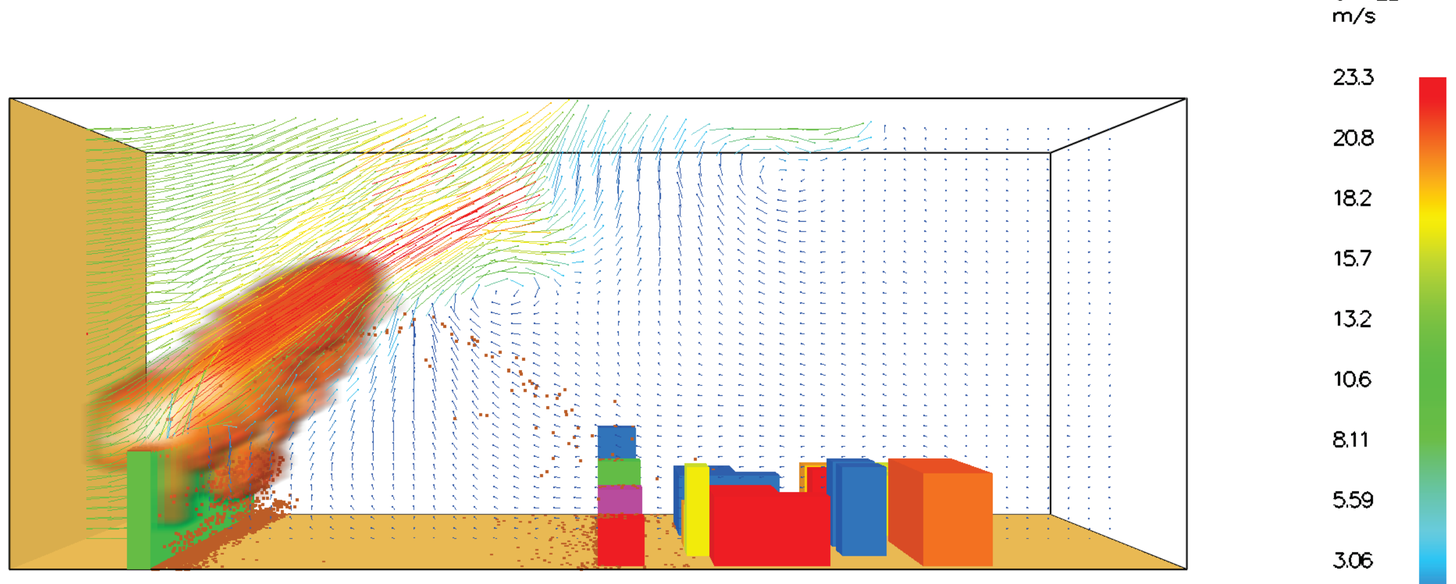

Figure1: Firebrand movement at 13 m/s wind velocity

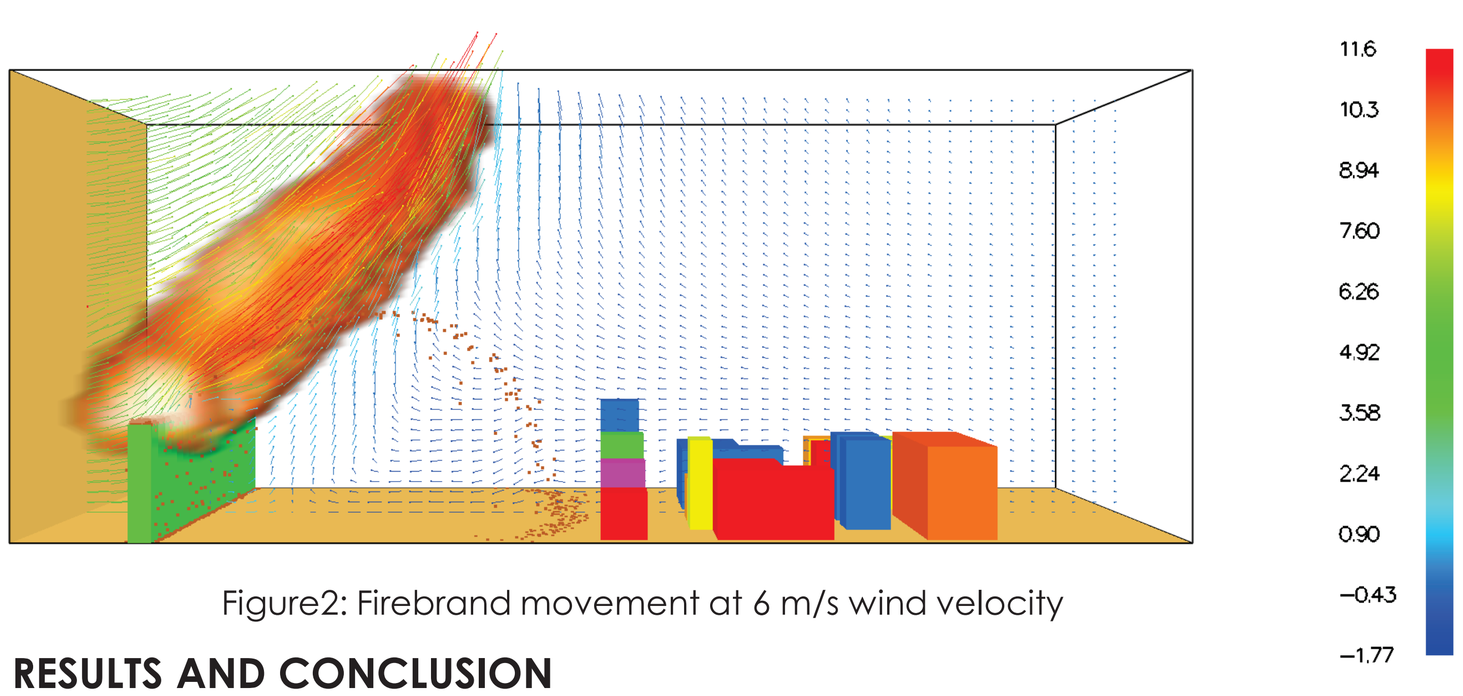

Figure2: Firebrand movement at 6 m/s wind velocity

RESULTS AND CONCLUSION

As observed in Fig 1, significant wind turbulence has occurred generating vortices due to obstruction from structure when the driving wind velocity is about 13 m/s. A considerable amount of firebrand traveled 18-22 m distance and landed on the first set of structures. However the majority of particles fell near to the fire front.

According to Figure 2, when wind velocity was about 6 m/s, most of the particles fell short of structures. These graphical images show that Spherical particles travel higher distance as the driving wind velocity increases. This preliminary study shows that firebrand loading on structure is possible using FDS. Sphericity, number and direction of the particles, driving wind speed, line fire intensity etc. can influence firebrand transportation.

References:

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