

Dissertation Release

02.06.2022

Developing computational methodologies for modelling fire spread, performing unidirectionally coupled fire-structure analysis and investigating fire intervention tactics.

Title of the dissertation	Understanding fire spread, its influence on structures and fire intervention tactics through computational methods.
Contents of the dissertation	Fire accidents and experiments in large compartments show that fires tend to spread across the compartment depending on the fuel and ventilation availability, and these fires are being called travelling fires. Understanding travelling fires would require several large-scale experiments, which are not always possible due to restrictions on the outlay, time and the number of parameters that can be investigated. This thesis provides a reliable and robust computational fluid dynamics (CFD) -based simulation methodology to support and complement the experimental and analytical works. Additionally, the thesis provides simulation methodologies to explore the fire-structure interaction, and to evaluate the efficiency of fire intervention tactics. Similarly, a coupled CFD-Finite Element (FE) analysis method was validated using experiments and the method was used to study the structural response of a steel truss exposed to two fire spread scenarios highlight the influence of fire spread direction, fire load and opening arrangement on the structural response. Finally, fire intervention using firefighting water sprays was simulated to investigate the efficacy of the structural cooling tactic and the simulation results indicate that the efficacy of the tactic mainly depends on the availability of resources; and attempting a fire intervention with too few resources may accelerate fire spread as the water evaporation enhances the turbulence inside the compartment, which moves the hot gases toward the unburned fuel.
Field of the dissertation	Fire Safety Engineering, Civil Engineering
Doctoral candidate	Rahul Kallada Janardhan, M.Sc. (Tech.), born in 1991 in Hyderabad, India
Time of the defence	15 June 2022 at 14:00 hours
Place of the defence	Aalto University, Undergraduate Centre, Otakaari 1, 02150 Espoo, Finland, lecture hall M1 and remotely via Zoom: https://aalto.zoom.us/j/65784027007
Opponent	Professor Wojciech Węgrzyński, Institut Techniki Budowlanej, Poland
Supervisor	Professor Simo Hostikka, School of Engineering, Aalto University, Finland
Electronic dissertation	https://aaltodoc.aalto.fi/handle/123456789/114663
Doctoral candidate's contact information	Rahul Kallada Janardhan, Aalto University, rahul.janardhan@aalto.fi, +358 503279844