SFPE EUROPE

AN OFFICIAL PUBLICATION OF SFPE

A word from the Editor

All,

Final issue of the year, I know all of you are waiting for the Christmas gifts so I wanted to give them to you a bit earlier than usual (suspecting that you wouldn't read this issue directly in the morning of the 24th…).

This Christmas special is a bit different as I have included four articles that already have been published earlier in SFPE publications, some recently and some a few years back, I have included them because they belong to the top 10 list of read articles in our different publications.

I would like to highlight our first article which has been prepared by the IMFSE team, it gives you an overview of 2024 student dissertations. I am very confident that these will be used by professionals in the industry for real life projects. Tremendous quality of the work done by the IMFSE students.

Each year we are keeping a steady publication rate of around 20+ articles, I believe this very last issue for 2024 reflects well the subjects we have presented during the year, a strong focus on emerging technologies and sustainability.

This time of the year is always very busy for everyone, finishing off projects and planning for the Christmas holidays. That said, I really hope that you will have some time to spare and be able to read at least some of the articles in this final issue of the year.

I would also like to promote the upcoming SFPE Europe conference that is being planned for early April in Edinburgh. I can assure you that there are a high number of very interesting presentations to be given. I really hope to see you all at the event. Put this in your calendars now so that you won't forget it.

I will keep it short for this final Editors column of the year and I just wanted to say I hope you will like these "Christmas gifts" from SFPE to you.

If there are readers out there that feel that you have an important subject that you would like to share with the industry do not hesitate to contact us, we can make that happen.

As always, a great thanks to the people who have put in a lot of time and effort to make this issue a reality. The next issue will come to you in March. Finally, I really hope all of you will enjoy the holiday break.

Yours sincerely,
Jimmy Jönsson, Managing Editor

SFPE EUROPE

AN OFFICIAL PUBLICATION OF SFPE

SFPE Europe Q4 2024 Issue 36

A Message from the SFPE Europe Chair

Dear SFPE Europe Members and Fire Safety Enthusiasts,

We are delighted to announce that the upcoming SFPE European Conference & Expo on Fire Safety Engineering will take place on April 9-10, 2025, in the vibrant and historic city of Edinburgh, United Kingdom. This event promises to be an exceptional gathering of professionals, researchers, and practitioners dedicated to advancing fire safety engineering.

We are thrilled to share that the conference received an overwhelming 115 submissions from contributors around the globe. The program committee has worked diligently to review each submission, ensuring the selection of a dynamic and diverse lineup of presentations that reflect the latest innovations, research, and best practices in fire safety engineering.

In addition to the rich technical program, the conference will feature the prestigious SFPE Europe Fire Safety Engineering Award and the SFPE Europe Fire Safety Engineering Lifetime Achievement Award, celebrating outstanding contributions to the field. We encourage you to explore the criteria for these awards and consider nominating deserving individuals. More details will be found on the SFPE Europe website.

This conference is an unparalleled opportunity to connect with peers, exchange ideas, and gain insights into the future of fire safety engineering. Mark your calendars and stay tuned for more updates as we prepare to welcome you to Edinburgh for this exciting event.

We look forward to seeing you there!

I wish you all a wonderful Christmas!

Robert McNamee

SFPE Europe Chair

SFPE EUROPE

AN OFFICIAL PUBLICATION OF SFPE

IMFSE Master's dissertations in 2024 – A brief overview

By: R. Hadden[1], B. Merci[2], E. Planas[3] and E. Ronchi[4]

[1]School of Engineering, University of Edinburgh, UK

[2]Dept. of Structural Engineering and Building Materials, Ghent University – UGent, Belgium

[3]Dept. of Chemical Engineering, Universitat Politècnica de Catalunya·BarcelonaTech

[4]Division of Fire Safety Engineering, Lund University, Sweden

Introduction

Since the start of the International Master of Science in Fire Safety Engineering (IMFSE), there has been a wide variety of topics in the IMFSE master's dissertations [1]. In this article we aim to provide a brief overview of the 2024 edition, and more details can be found on [1]. This overview is provided per institute.

University of Edinburgh

At The University of Edinburgh, there were five dissertations across a range of topics. David Xiao investigated whether gas phase temperatures in compartment fires are the same in full scale and reduced scale experiments. It is often expected that gas temperatures in compartment fires are the same at full scale and in reduced scale experiments, however it has been observed that this only applies to well ventilated compartment fires, and not to under ventilated compartment fires. Using numerical simulations, three methods for how to adjust reduced scale data to predict full scale temperatures were investigated, and the best method was identified. Samiksha Bastola undertook a cost benefit analysis to evaluate the societal implications of installing interlinked fire alarm systems in dwellings across Scotland and England using statistical data. The finding underscored the challenges with accessing appropriate data as well as the need for holistic approaches to fire safety. Luis Urbina Pita assessed the fire hazards present in the domestic gas system operating with hydrogen to support decision making in a potential transition. Using Failure Mode and Effects analysis and developing Fault Tree analyses, causes of failures and the consequences were identified. Interestingly the current available information was not sufficient to allow a cost benefit analysis to be undertaken.

Two theses were undertaken to investigate the challenges to fire safety strategies posed by engineered timber buildings. Sadia Hanif undertook work to identify the ignition and burning of timber in a ceiling orientation when subjected to an impinging plume. Specifically, the impact of downstand

beams on the time to ignition and feedback to the floor was investigated. Rebekka Marteinsdottir studied the initiation and propagation of smouldering of timber. This experimental work explored the effects of the energy balance and grain orientation. The study successfully quantified smouldering propagation rates and depths under different, relevant conditions, shedding new light on the factors that may influence smouldering in mass timber structures.

Ghent University

At Ghent University, there were two master's dissertations where multi-phase aspects with liquids played a central role. One study (by Chiraz Alili) focused on low-frequence oscillatory fire behaviour as observed in mechanically ventilated airtight compartments, while the other (by Pedro Vargas Rolon) considered spray cooling of hot surfaces, with fire control applications in mind. Both studies were fundamental in nature, using CFD as a tool to advance fire safety science, with Tarek Beji as main supervisor. Tillmann Bruder, under supervision of Ruben Van Coile, performed a cost optimization study on the use of passive fire protection measures in the context of structural fire safety in infrastructure tunnels. Mahsa Zeinolabedini and Farith Hinojosa Coca revisited a range of empirical correlations as commonly used in fire-safety engineering, the former in free-burn scenarios and the latter for compartment fires. They performed validation studies, using CFD simulations, under supervision of Georgios Maragkos. And Lakmini Abeysuriy assessed the potential of zone models as tool in the context of the design of smoke and heat control systems, with Bart Merci as academic supervisor.

As usual there were also dissertations in collaboration with associated partners and industry partners. This year Bart Merci supervised a dissertation, performed by Yingzhu Wang at ETH Zürich (with Andrea Frangi and IMFSE alumnus Chamith Karannagodage as supervisors), on the development of simplified zone model calculations in the context of fire dynamics in timber compartments. Lakmini Abeysuriya also worked on zone models for use as a tool in early design phases of smoke and heat control systems, supervised by Bart Merci and Matteo Pachera (Sweco).

Universitat Politècnica

At Universitat Politècnica de Catalunya (UPC) two master's dissertations were completed on CFD modelling of industrial fires and explosions. One of them (by Vanessa May Josol with Alba Àgueda as main supervisor) focused on investigating a new approach to simulating jet fires by using a combination of FLACS and FDS software. The other (by Pouria Safari with Eulalia Planas as main supervisor) explored OpenFOAM's capability to simulate the different stages involved in Boiling Liquid Expanding Vapour Explosions (BLEVEs).

Additionally, at UPC, two more master's dissertations were conducted on the topic of wildland-urban interface (WUI) fires. Matheus Pontes (under the co-supervision of Elsa Pastor and the IMFSE alumnus Pascale Vacca) applied a performance-based design (PBD) methodology to identify the vulnerabilities and propose solutions to enhance property protection of a campsite located in a touristic WUI in Costa Brava (Spain), as part of the EU-supported WUITIPS project aimed at improving safety in touristic areas exposed to wildfire risk. The other student, Saurabhkumar Singh (under the supervision of Pascale Vacca) focused on refining and improving the Urban Interface Index (WUIX), a vulnerability assessment tool for the WUI mesoscale, using high-resolution satellite imagery and machine learning techniques.

An additional master's dissertation was carried out by Ashwant Singh on the topic of WUI fires in collaboration with the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia (with Raphaelle Blanchi and Justin Leonard as main supervisors at CSIRO and Elsa Pastor and

Pascale Vacca as UPC co-supervisors). The aim was to develop feasibility research of WUI PBD using a CSIRO experimental case reproduced in FDS.

At UPC, Eulalia Planas, in collaboration with Santos Bendicho from the industry partner SODECA co-supervised the master's dissertation developed by Anis Jayaram. This dissertation explored, using CFD tools, the interaction of ventilation systems with flammable and toxic gases released from electric vehicle batteries and leaks from hydrogen vehicle tanks in enclosed car parks, varying ventilation configurations to produce flow patterns to analyse changes in toxicity and flammability.

Lund University

At Lund University, two master dissertations related to the topic of wildfire safety through modelling tools. One student (Amina Labhiri) investigated the use of simulations to inform evacuation guidelines in touristic areas. This thesis was supervised by Enrico Ronchi and was part of the EU-supported WUITIPS project aimed at improving safety in touristic areas exposed to wildfire risk. Another student (Fredrik Buhk) conducted his thesis under the supervision of Patrick van Hees in collaboration with the Federal Institute for Materials Research and Testing (BAM) in Germany, with Anja Hofmann-Böllinghaus as co-supervisor. The thesis investigated the use of a particle model of the wildland-urban interface part implemented in the Fire Dynamics Simulator (FDS) to numerically analyse the influence of the local vegetation on the surface fire spread. Another student (Maria Binte Mannan) also conducted her thesis in collaboration with BAM under the supervision of Patrick van Hees and Bernhard Schartel, focusing on the fire behaviour and fire stability of wood species and joint types. This thesis was experimental and included a total 160 small-scale tests (100 cone calorimeter tests and 60 fire stability tests) which helped identifying key influential factors during the fire tests.

Lund University has also a longstanding collaboration with the European Organization for Nuclear Research (CERN) in the domain of fire safety. This resulted in several master thesis conducted at CERN by IMFSE students over the years (often alongside IMFSE alumni now working at CERN). This year, one student (Maskim Labkouski) conducted his thesis on the topic of Life cycle analysis of fire detection systems under the supervision of Margaret McNamee and Brecht Debrouwere from CERN. The thesis adopted a Present Net Value methodology to assess the costs and benefits of replacing current fire detection systems. Another student (Cheuk Lam Chung) conducted a study concerning the evacuation of the Compact Muon Solenoid facility at CERN (co-supervisors at CERN were Oriol Rios, Saverio La Mendola and Lorenzo Contini). The thesis included the collection of human behaviour data from an evacuation drill in the facility as well as their use for evacuation simulations.

Two more thesis topics related to the area of evacuation in collaboration with industry partners, both under the supervision of Enrico Ronchi. One thesis (by Ahmed El Sharkawi) was in collaboration with GAE Engineering and investigated evacuation safety in arenas through the study of crowd density. Another thesis (by Yuyao Xue) was in collaboration with OFR (Michael Spearpoint as co-supervisor) and focussed on the suitability of phased evacuation strategies for multi-purpose residential buildings which was investigated through evacuation simulations.

It is our hope that this article served as an invitation to read more on these dissertations [1] and to explore our IMFSE programme in more detail [2].

References

[1] https://imfse.be/theses

[2] https://imfse.be/

SFPE EUROPE

AN OFFICIAL PUBLICATION OF SFPE

Wildfire risk reduction and property protection in the United States

By: Michele Steinberg, National Fire Protection Association, USA

The content of this article was also featured in a jointly developed informational paper presented at the 2024 UK Wildfire Conference titled, "Creating an evidence-based strategy for a UK community wildfire resilience framework for property protection," (Amato et al.)

Introduction

Wildfires have always been part of natural ecosystems across the United States. The risk to people and property has risen dramatically in recent decades due to more than a century of fire suppression in forests and rangelands, unchecked development of vulnerable structures into wildfire-prone landscapes, and the impacts of a changing climate influencing wildfire spread and magnitude.

Today, nearly half the nation's building stock is exposed to the threat of wildfire. Privately owned property exists in a cultural context where protection of structures is seen not as the job of the private property owner, but as the job of government - namely, firefighters. As a leading global fire safety organization, the National Fire Protection Association (NFPA) seeks to eliminate the wildfire threat to life and property via education, outreach, and advocacy. Our *Outthink Wildfire* policy initiative is rooted in two realities – first, wildfires are going to happen; and second, the fire service will not be able to extinguish these fires at a pace to save people and property in their path.

Descriptions of a variety of initiatives and programs provide a sense of how various US entities address the wildfire paradox – the need for natural fire in ecosystems vs. the threat fire poses to people and property. US physical, social and political contexts differ from those in other countries, but there are common themes and strategies that lend themselves to use across the globe.

ON FIRE: The Report of the Wildland Fire Mitigation and Management Commission

The Wildland Fire Mitigation and Management Commission, established under President Biden's Bipartisan Infrastructure Law, released a pivotal report on September 27, 2023 (Wildland Fire Mitigation and Management Commission 2023). Marking a milestone in the ongoing efforts to address the escalating wildfire crisis in the US, the report makes nearly 150 recommendations for action by Congress

and represents one of the most comprehensive examinations of the wildfire system to date. These recommendations include:

- Encourage critical risk reduction measures for private properties most at risk through tax credits for structural improvements.
- Offset costs for retrofits and new builds for economically disadvantaged residents through grants and cost-share opportunities for underserved, low-income, or otherwise disadvantaged households located in high-hazard wildfire areas.
- Expand and fund technical assistance programs and develop resources for communities at greatest risk and with limited capacity to improve wildfire resilience.
- Increase financial support and technical resources to jurisdictions to hire staff and enhance capacity to adopt, enforce, and maintain science-based building codes or standards that govern construction, design, and site development in all wildfire-prone regions.
- Provide funding to enhance local community capacity in accessing, implementing, and coordinating risk reduction strategies. This includes support for non-governmental organizations, universities, institutions, and other public and private organizations working at the local level.

National Cohesive Wildland Fire Management Strategy

The mandate of the Wildland Fire Mitigation and Management Commission also included a review and validation of the longstanding National Cohesive Wildland Fire Management Strategy, a strategic framework developed to address US wildfire issues. The Cohesive Strategy was established to improve the nation's ability to prepare for, respond to, and recover from wildland fires while enhancing the safety of firefighters and communities. Mandated by the Federal Land Assistance, Management, and Enhancement Act of 2009 (FLAME Act), and under the direction of the Western Fire Leadership Council (WFLC), the Cohesive Strategy focuses on three main goals:

1. Resilient landscapes: Landscapes, regardless of jurisdictional boundaries, are resilient to fire, insect, disease, invasive species, and climate change disturbances, in accordance with management objectives (U.S. Fire Administration 2024).
2. Fire-adapted communities: Human populations and infrastructure are as prepared as possible to receive, respond to, and recover from wildland fire (that impacts communities) (U.S. Fire Administration 2024).
3. Safe and effective, risk-based wildfire response: All jurisdictions, responding in all land types, participate in making and implementing safe, effective and efficient risk-based wildfire management decisions (U.S. Fire Administration 2024).

Firewise USA®

Starting in 1998, NFPA collaborated with the federal land management agency USDA Forest Service to develop wildfire safety education programming to address the need for risk reduction on private property. The national Firewise USA® recognition program was born from these efforts and formally launched in 2002. Today, there are more than 2,500 participating sites across 35 states, representing more than 1.7 million people voluntarily taking part in wildfire safety work.

The program relies on research-backed recommendations to prepare homes to withstand embers and prevent flames or surface fires from igniting structures and their surroundings within the home ignition

zone (HIZ), which extends 100 feet (30 meters) from the home. As the HIZ often extends onto adjacent parcels, it is crucial for neighbors to collaborate in reducing their shared wildfire risk, acknowledging that wildfire threats are not confined to individual properties.

Administered through the NFPA, Firewise USA operates through a network of partnerships, primarily at the state and local levels. Each state typically designates a state liaison, often an employee of the agency hosting the official state forester, to steer the implementation of Firewise USA within the state. This individual plays a pivotal role in setting the program's direction, reviewing and approving site applications, and managing annual renewal applications.

Communities apply for recognition from NFPA by meeting the following criteria:

- Organize a board or committee of residents and experts and identify a resident leader.
- Collaborate with local wildfire experts to complete a community wildfire risk assessment and use the findings to create a three-year action plan.
- Complete educational and risk reduction activities annually, based on the action plan.
- Document the above actions, including hours and funding expended, in an initial application to NFPA.
- To remain in good standing in following years, communities must document their annual activities through a renewal application, and must update their action plan every three years, and their risk assessment every five years.

Fire Safe Councils

Regional approaches in the Western US have also met with success in community engagement and risk reduction. Fire Safe Councils (FSCs) are community-driven organizations dedicated to wildfire prevention, preparedness, and mitigation (California Fire Safe Councils). Emerging as a successful model for empowering communities to enhance wildfire resilience, FSCs serve as a bridge between government agencies, local residents, businesses, and other stakeholders. While these councils may adapt to local conditions, they share a common purpose and set of activities aimed at reducing the risk of wildfires, and are guided by key objectives:

- Education and awareness: Conduct educational programs and outreach to raise awareness about wildfire risks and safety measures within local communities.
- Mitigation planning: Collaboration with local authorities to develop comprehensive wildfire mitigation plans that include strategies for reducing fuel loads, creating defendable spaces, and improving infrastructure.
- Coordination: Facilitate coordination and collaboration among various entities involved in wildfire management, including fire departments, emergency services, and local governments.
- Community engagement: Encourage residents to take an active role in wildfire preparedness and response, fostering a sense of shared responsibility.

Community Wildfire Protection Plans

Community wildfire protection plans (CWPPs) are collaborative, community-driven frameworks for wildfire risk mitigation, developed at the municipal or county level (Communities Committee, National Association of Counties, National Association of State Foresters, Society of American Foresters, Western Governors' Association 2004). CWPPs offer a comprehensive approach, engaging communities in

identifying and prioritizing wildfire risks. Entities have considerable flexibility to develop plans that are tailored to their individual needs, resulting in a wide range of scope, scale, and goals for CWPPs across the country. They also promote coordinated planning and mitigation efforts, and in many cases, are considered a prerequisite for grant access to state and federal resources.

CWPPs were initiated by the federal government through statutory authority of the Healthy Forests Restoration Act of 2003 (federal legislation). The Act directed federal land management agencies to address hazardous fuels on public lands, and to prioritize work near high-risk residential communities. While federal agencies have no real authority to compel municipal government to act, recent specific funding tied to the development of a CWPP has reinvigorated these planning documents as an effective mechanism to enhance coordination between local, state, and federal government agencies. The Community Wildfire Defense Grant Program, initiated by the US Forest Service in 2023, now provides a specific funding source for local governments to develop CWPPs and funds priority mitigation projects that have been identified in a CWPP.

Wildland-Urban Interface (WUI) and Building Codes

A WUI code is specifically designed to mitigate the risks from wildfire to life and property in areas where properties interface or intermix with wildlands, grasslands, or rural open spaces with vegetation. The standards within a WUI code will vary according to the scope that a community is willing to adopt and enforce. Typically, however, a WUI code includes the following topics:

- Structure density and location: number of structures allowed in areas at risk from wildfire, plus setbacks (distance between structures and distance between other features such as slopes).
- Building materials and construction: roof assembly and covering, eaves, vents, gutters, exterior walls, windows, non-combustible building materials, and non-combustible surface.
- Vegetation management: tree thinning, spacing, limbing, and trimming; removal of any vegetation growing under tree canopies (typically referred to as ladder fuels), surface vegetation removal, and brush clearance; vegetation conversion, fuel modifications, and landscaping.
- Emergency vehicle access: driveways, turnarounds, emergency access roads, marking of roads, and property address markers.
- Water supply: approved water sources and adequate water supply.
- Fire protection: automatic sprinkler system, spark arresters, and propane tank.

Examples of model codes for protection of property from wildfire include NFPA 1140, 2022 edition (NFPA 2022); Chapter 17 of NFPA 1, 2024 edition (NFPA 2024); NIST's Hazard Mitigation Methodology(NFPA 2024; Maranghides et al. 2022) and the International Wildland-Urban Interface Code, 2021 edition (ICC 2021). While these codes have great potential for institutionalizing safety in the built environment, very few local jurisdictions and only two state governments use and enforce these helpful regulatory tools (Insurance Institute for Business & Home Safety, National Fire Protection Association® (NFPA®) Wildfire and Research Divisions, Verisk Analytics, Inc. 2023).

Conclusion

The US approach to managing the threat of wildfire to people and property is necessarily diverse and collaborative, operating at all levels of government, as well as the private and nonprofit sectors. The nation continues to grapple with balancing prevention and preparedness with response and suppression,

and with challenges in finding consensus around solutions. As a complex problem, wildfire disasters resist simple solutions. While there are obvious differences in managing wildfire threat globally, fires themselves know no borders. Hence through knowledge transfer we can learn from each other how to approach and deliver successful wildfire mitigation practices.

References

Amato, Victoria, Montiel Ayala, Megan Dolman, Fiona Newman Thacker, Andy Elliott, Rob Gazzard, Linda Kettley, Michele Steinberg, and James Mcneil. *Creating an Evidence-Based Strategy for a Uk Community Wildfire Resilience Framework for Property Protection Uk Community Wildfire Resilience Framework for Property Protection Contributors Purpose*.

California Fire Safe Councils. "Fire Safe Councils.", accessed 11/19, 2024.

Communities Committee, National Association of Counties, National Association of State Foresters, Society of American Foresters, Western Governors' Association. 2004. *A Handbook for Wildland-Urban Interface Communities*.

ICC. 2021. *The International Wildland-Urban Interface Code* International Code Council.

Insurance Institute for Business & Home Safety, National Fire Protection Association® (NFPA®) Wildfire and Research Divisions, Verisk Analytics, Inc. 2023. *Living with Wildfire*.

Maranghides, Alexander, Eric D. Link, Steven Hawks, Jim Mcdougald, Stephen L. Quarles, Daniel J. Gorham, and Shonali Nazare. 2022. *WUI Structure/Parcel/Community Fire Hazard Mitigation Methodology* National Institute of Standards and Technology (U.S.).

NFPA. 2024. *NFPA 1 Fire Code* National Fire Protection Association.

NFPA. 2022. *NFPA 1140 Standard for Wildland Fire Protection*. Quincy, MA: National Fire Protection Association.

U.S. Fire Administration. "What is the Cohesive Strategy and Why was it Created?", last modified Marc, accessed 11/19, 2024, https://www.usfa.fema.gov/wui/cohesive-strategy/.

Wildland Fire Mitigation and Management Commission. 2023. *ON FIRE: The Report of the Wildland Fire Mitigation and Management Commission*. Washington DC.

SFPE EUROPE

AN OFFICIAL PUBLICATION OF SFPE

Article 3 - Green Buildings

Article 4 – Fire Safety of Batteries and Micro-mobility Devices - Q4 2023 (FPE Magazine)

Article 5 – Virtual Reality

Article 6 – WIND TURBINES - 2019 Q4 (FPE Magazine)