Fire Technology, 60, 3767–3769, 2024

Manufactured in The United States
https://doi.org/10.1007/s10694-024-01614-9

Large Outdoor Fires and the Built Environment (LOF&BE): Summary of Workshops at 14th International Symposium on Fire Safety Science

Sara McAllister, USDA Forest Service, Missoula, MT, USA
Samuel L. Manzello, REAX Engineering, Berkeley, USA and Tohoku University, Sendai, Japan*
Sayaka Suzuki, Tokyo Institute of Technology, Tokyo, Japan
Alex Filkov, University of Melbourne, Creswick, Victoria, Australia
David Rush, University of Edinburgh, Edinburgh, UK
Rahul Wadhwani, USDA Forest Service, Missoula, MT, USA and Hong Kong Polytechnic University, Hong Kong, China
Yu Wang, University of Science and Technology of China, Hefei, China

1. Workshop Objectives

The International Association for Fire Safety Science (IAFSS) established the permanent working group known as LOF&BE (Large Outdoor Fires and the Built Environment), as an outgrowth of the 2017 Lund Workshops held in conjunction with the 12th IAFSS Symposium [1–3]. Subsequent workshops were held at the 11th Asia-Oceania Symposium on Fire Science and Technology (AOSFST) [4], Interflam 2019 [5], Virtual Workshops in 2020 [6], and 13th IAFSS Symposium (virtual) in 2021. LOF&BE aims to bring the community together to tackle large outdoor fire problems such as wildland fires, wildland-urban interface (WUI) fires, urban fires, and informal settlement fires. LOF&BE consists of three subgroups—Ignition Resistant Communities (IRC), Emergency Management and Evacuation (EME), and Large Outdoor Fire Fighting (LOFF). The IRC subgroup is focused on developing the scientific understanding that will lead to new standards, testing methodologies, and mitigation strategies indicative of large outdoor fire exposures, including the ones from wildland to communities and within communities. The EME subgroup is focused on developing the scientific basis for effective emergency management strategies for communities exposed to large out-

Sara McAllister, Samuel L. Manzello, Sayaka Suzuki—IAFSS LOF&BE Co-Leaders.

*Correspondence should be addressed to: Samuel L. Manzello, E-mail: manzello@reaxengineering.com, manzello@tohoku.ac.jp

door fires. The LOFF subgroup is providing a review of various tactics that are used, as well as the various personal protective equipment (PPE), and suggests pathways for research community engagement, including environmental issues in suppressing these fires. The LOFF subgroup is currently suspended and in place is the Fire Service Advisory Panel (FSAP). The FSAP will be consulted from time to time by the working group for advice.

The Large Outdoor Fires and the Built Environment (LOF&BE) held two workshops at the 14th IAFSS Symposium in Tsukuba, Japan on October 22, 2023. The first session focused on the Emergency Management and Evacuation (EME) subgroup. The second workshop session focused on the Ignition Resistant Communities (IRC) subgroup. In both workshops, progress from each subgroup was reported; several working group members gave short, invited presentations; and open discussions were held. A total of 53 participates pre-registered for the EME workshop, while 46 participants pre-registered for the IRC workshop. Countries of origin of the attendees include United States, Canada, Japan, China, Australia, New Zealand, South Africa, Spain, France, United Kingdom, Germany, and Norway.

For interested readers, the following information is provided in the supplementary materials:

Acknowledgements

The LOF&BE team would like to personally thank Professor Patrick Van Hees of Lund University, former IAFSS President, for his constant support and encouragement to form the working group. The authors would like to thank all the former subgroup leaders for their efforts: Raphaele Blanchi, Len Garis, Enrico Ronchi, Elsa Pastor, Maria Theodori, Daniel Gorham, Xinyan Huang, and Brian Lattimer.

SUPPLEMENTARY INFORMATION

The online version contains supplementary material available at https://doi.org/10.1007/s10694-024-01614-9.

References

1. Manzello SL, McAllister S, Suzuki S (2018) Large outdoor fires and the built environment: objectives and goals of permanent IAFSS working group. Fire Technol 54:579–581. https://doi.org/10.1007/s10694-018-0717-z
2. Manzello SL, McAllister S, Suzuki S (2018) Large outdoor fires and the built environment: objectives and goals of permanent IAFSS working group. Fire Saf J 98:1–2. https://doi.org/10.1016/j.firesaf.2018.03.003

3. Manzello SL, Blanchi R, Gollner MJ, Gorham D, McAllister S, Pastor E, Planas E, Reszka P, Suzuki S (2018) Summary of workshop large outdoor fires and the built environment. Fire Saf J 100:76–92. https://doi.org/10.1016/j.firesaf.2018.07.002
4. Manzello SL, McAllister S, Suzuki S, Blanchi R, Pastor E, Ronchi E (2019) Large outdoor fires and the built environment: summary of kick-off workshop. NIST Special Publication 1236 https://doi.org/10.6028/NIST.SP.1236
5. Manzello SL, McAllister S, Suzuki S, Blanchi R, Pastor E, Ronchi E (2019) Large outdoor fires and the built environment: summary of workshop at Interflam 2019, NIST Special Publication 1241 https://doi.org/10.6028/NIST.SP.1241
6. Suzuki S, McAllister S, Manzello SL, Filkov A, Gorham D, Huang X, Lattimer B, Theodori M (2020) Large outdoor fires and the built environment (LOF&BE): summary of virtual workshop, NIST Special Publication 1263, (2020) https://doi.org/10.6028/NIST.SP.1263

Appendix A Detailed Minutes of Discussions at EME and IRC Workshops

1. **Introduction**
    1.1. **Program of the Workshops**
    1.2. **List of Registered Participants and Attendees (Alphabetical Order by First Name)**
2. **Emergency Management and Evacuation (EME) Minutes**
3. **Ignition Resistant Communities (IRC) Minutes**

Appendix B: Presentations Delivered at the EME Workshop

Appendix C: Presentations Delivered at the IRC Workshop

Appendix D: Abstracts of the Invited Talks at the EME and IRC Workshops

1. Introduction

This report details the workshops held at the 14th IAFSS Symposium held in Tsukuba, Japan on October 22, 2023. Two workshops were held. The first focused on the EME subgroup, while the second focused on the IRC subgroup. The goals of the workshops were to engage the membership of IAFSS, report on progress made by the subgroups, and to initiate discussions on current and future work. Included in the programs were short, invited talks from members of the LOF&BE working group (Figure 1).

Figure 1 – Professor Richard Walls of Stellenbosch University presenting at the EME workshop.

1.1. Program of the Workshops

Program of the EME Workshop:

Time	Contents	Speakers
20 min	Introduction to LOF&BE	Manzello & McAllister & Suzuki (co-Leaders)
30 min	Progress on EME	Wang & Wadhwani (EME subgroup leaders)
30 min	Discussion	All participants
30 min	Short presentations	Flores-Quiroz & Walls, Wu
30 min	Discussion	All participants
10 min	Wrap up	

Short, invited presentations:

- Natalia Flores Quiroz and Richard Walls, "Large-scale urban fires in low-income areas: Where to next?" (Stellenbosch University), presented by Richard Walls

- Farian (Chia-Lung) Wu, “Emergency management issues: emerging emergency management issues in Taiwan – existing building fire safety” (Chang Jung Christian University)

Program of the IRC Workshop:

Time	Content	Speakers
20 min	Introduction to LOF&BE	Manzello & McAllister & Suzuki (co-Leaders)
30 min	Progress report on IRC	Filkov & Rush (IRC subgroup leaders)
30 min	Discussion	All participants
30 min	Short presentations	Penman, Rush, Yoshioka & Himoto & Kagiya, Vacca
30 min	Discussion	All participants
10 min	Wrap-up	

Short, invited presentations:

- Trent Penman, “Landscapes to loss – combining knowledge over scales” (University of Melbourne)
- David Rush, “Informal settlement fires – what are their next fire science imperatives” (University of Edinburgh)
- Hideki Yoshioka, Keisuke Himoto, and Koji Kagiya, “Large urban fires in Japan: History and management” (The University of Tokyo, National Institute for Land and Infrastructure Management, Tohoku Institute of Technology), presented by Hideki Yoshioka
- Pascale Vacca, “Tackling the improvement of standards and guidelines to account for real fire exposure” (Universitat Politècnica de Catalunya)

1.2. List of Registered Participants and Attendees (Alphabetical Order by First Name)

The following people registered for at least one workshop. Names marked with a * indicate those that signed in as an attendee.

Albert Simeoni (Worcester Polytechnic Institute, USA)
Andres Valencia (University of Canterbury, New Zealand)*
Arthur Rohaert (Lund University, Sweden)
Balsa Jovanovic (Ghent University, Belgium)
Bjarne C. Hagen (Western Norway University, Norway)*
Brian Meacham (Meacham Associates, USA)*
Bronwyn Forrest (University of Waterloo, Canada)
Change Zheng (Beijing Forestry University, China)
Chao Zhang (Wuhan University, China)*
Chia Lung Wu (Chang Jung Christian University, Taiwan)*
Chris Jelenewicz (Society of Fire Protection Engineers, USA)*
Dave Rush (University of Edinburgh, UK)*
David Purser (University of Central Lancashire, UK)*

Depeng Kong (China University of Petroleum, China)
Dheeraj Dilip Karyaparambil (Western Norway University of Applied Sciences, Norway)
Ding Yifei (Hong Kong Polytechnic University, Hong Kong Special Administrative Region of China)*
Elizabeth Weckman (University of Waterloo, Canada)
Eoghan O'Meara (Fire Dynamics Group, UK)*
Eric Kennedy (York University, Canada)*
Eric Mueller (National Institute of Standards and Technology, USA)
Erica Kuligowski (RMIT University, Australia)
Evan Ford (LMDG Building Code Consultants, Canada)
Fabian Brannstrom (Bergische Universität Wuppertal, Germany)
Felix Wiesner (University of British Columbia, Canada)*
Francesco Restuccia (King's College London, UK)*
Futoshi Tanaka (University of Fukui, Japan)*
Haeri Hong (Korea) – (Affiliation not listed)
Han Shun Hsu (National Fire Agency, Taiwan)
Hajar Zaidaoui (RATP Group, France)*
Hannah Carton (York University, Canada)*
Harry Mitchell (Imperial College, UK)
Hideki Yoshioka (University of Tokyo, Japan)*
Hongqiang Fang (City University of Hong Kong, Hong Kong Special Administrative Region of China)*
Hosein Sadeghi (King's College London, UK)
Jan-Wilhelm Brockmann (Bundeswehr Research Institute, Germany)*
Jonathan Reep (University of Edinburgh, UK)
Joseph Mitchell (M-bar Technologies and Consulting, USA)*
Juan Cuevas (Worcester Polytechnic Institute, USA)*
Katsuhiro Suzuki (Shimizu Construction Corporation, Japan)
Khalid Moinuddin (Victoria University, Australia)*
Leo Menzemer (Lund University/Danish Institute of Fire and Security Technology, Austria)
Liang Zhou (Chinese People's Armed Police Force Academy, China)
Linhao Fan (Zhengzhou University, China)
Masayuki Mizuno (Tokyo University of Science, Japan)*
Matthew Hoehler (National Institute of Standards and Technology, USA)*
Mehrdad Nouroozyan (University of Wuppertal, Germany)
Nikolaos Kalogeropoulos (Imperial College, UK)
Nieves Fernandez Anez (Western Norway University, Norway)*
Pascale Vacca (Universitat Politècnica de Catalunya, Spain)*
Peter Johnson (Arup, Australia)*
Rawan Alkandari (University of Leeds, UK)
Richard Walls (Stellenbosch University, South Africa)*
Sam Bennett (Fire Dynamics Group, UK)*
Sam Stevens (University of Edinburgh, Kindling; UK)*
Samuel L. Manzello (REAX Engineering, USA and Tohoku University, Japan)*
Sara McAllister (US Department of Agriculture (USDA) Forest Service, USA)*
Savannah Wessies (National Institute of Standards and Technology, USA)*

Sayaka Suzuki (Tokyo Institute of Technology, Japan)*
Sergio Zarate (University of Queensland, Australia)*
Supan Wang (Nanjing Tech University, China)*
Swathikrishna Punnoli Valayanad (University of Wuppertal, Germany)
Thomas Steinhaus (Munich Re, Germany)
Tobias Dehne (University of Wuppertal, Germany)*
Tong Herng Chin (Institute of Fire Engineers, Singapore)
Tony Xiao (University of Sydney, Australia)
Trent Penman (University of Melbourne, Australia)
Wai Cheong Tam (National Institute of Standards and Technology, USA)*
Warda Rafaqat (Western Norway University of Applied Sciences, Norway)*
Wenxuan Wu (University of Queensland, Australia)*
Xiaolei Zhang (University of Science and Technology of China, China)
Xiaoning Zhang (Hong Kong Polytechnic University, Hong Kong Special Administrative Region of China)
Xiaoyu Ju (University of Science and Technology of China, China)
Xinyan Huang (Hong Kong Polytechnic University, Hong Kong Special Administrative Region of China)
Yanfu Zeng (Hong Kong Polytechnic University, Hong Kong Special Administrative Region of China)
Yifei Lin (University of Queensland, Australia)*
Yoong Yoong Kwek (Building and Construction Authority, Singapore)
Yoshikazu Minegishi (Building Research Institute of Japan, Japan)*
Yu Wang (University of Science and Technology China, China)*
Zakary Campbell-Lochrie (University of Edinburgh, UK)

2. Emergency Management and Evacuation (EME) Minutes

The following are the minutes taken of the EME Workshop on October 22, 2023, 13:30-15:00:

The EME workshop began with an introduction of LOF&BE by Samuel L. Manzello.

There was a thank you from the audience for the high activity of the group.

Yu Wang gave presentation on EME subgroup activities:

- Example cases: Hawaii, Greece, Cape Town, and even China is starting to have WUI fires.
- Case studies: report 1: 16 authors, 40 cases, used a template to collect information about the fire and about the evacuation/emergency management; report 2: 26 cases, more diverse with different types of fires from more locations.
- Published review: 10 researchers. emerging issues and challenges emerged from paper.
- Work in progress: paper analysis, 11 members currently. Want to know what's happening (deeper understanding, beyond just listing facts of what happened).

Questions following Yu's presentation:

Question (Q): Lessons learned from other outdoor disaster? elaborate? A: Could learn from earthquake and hurricane or tsunami. Finding the safe way during an earthquake vs wildland fire is that there could be different time scales. Safe way in fire could change as you go. Earthquake happens, obstacles. Hurricanes have much more lead time ahead. Fires move and we don't always know where. Tsunamis happen quickly, and you know which way to go, but there's a lot of people trying to get there. Still trying to compare and contrast the disasters and what we can learn from them.

Q/Comment: Fires in New Zealand are new, but there's earthquakes, floods, etc. that people are used to, so include fires in the "risk paradigm." Fires get worse as time goes, less opportunities to get to the fire to attack them. In New Zealand, incorporating EME in activities to adapt to climate change. Include wildland fires as one of those points.

Q: How do you include fire spread in your decision support system? To some extent IRC is looking more at the fire spread process.

Q: Were there any spread models used/implemented during or prior to the fire event? A: Depends on the fire and the locations. Looking at that in more depth during the analysis paper. China is starting to incorporate fire into their disaster system. Want to include it in the large-scale, nationwide map. All the disasters together. Decisions made at the high level and directions then past down to local governments.

Natalia/Richard Walls presentation on informal settlement fires:
Growing numbers of low-income communities, hard to define, hard to tell where they start and stop, mix together. Construction types vary widely. 77 people just perished in an informal settlement fire in South Africa. Post fire is a mess, but people come right back because no one owns the land, have to reclaim space/dwelling. Rebuilt within 24-72 hours. Don't have time to plan a better way to rebuild. Research looking at fire spread propagation process/probabilities. Case studies of prior incidents, in particular in Cape Town - saw whole process in one case. Database of actual incidents is growing, includes human behavior: evacuation, suppression, looky-loos, people moving belongings out during the fire trying to save stuff (fuel loads move, firebreaks may fill in), etc. Case study of Rohingya refugee camp, very difficult to plan for and design for but will happen again. What do we know: studied 120-150 fires, large-scale experiments, CFD: now what? How can this help the world? traditional buildings have control, but low-income communities don't have standards/codes. If you do, then it legitimizes these structures and people won't want to follow the stricter standards. No quick solution. Challenges: no accurate fire spread because of the variability of the problem: firefighting, complex geometries, variable materials, moving fuel loads, localized winds, inhabitant activities, etc. Ignition studies on smaller components could be helpful and pass that information onto people to make better choices in construction materials, especially if they're cheap and easily accessible. Small fire trucks that can get into the communities (to help mitigate lack of fire services in these areas). What can actually be done? Many actors, little control over things. "Be a handbrake on stupidity." Stop politicians from investing in ineffective solutions. Need to support people on the frontline, in the communities. Get FPEs spread out in more areas and communities. Get researchers in the field - large scale is different than lab experiments. Need to understand human behavior (why you did what you did, ex: call police instead of fire department?) Need for more post-fire investigations.

Questions following Richard's presentation:
Q: Are there any differences between fire ignitions/spread between different informal settlements (ex: Cape Town vs Bangladesh)? Found in studies that many fatalities are from lack of fire compartmentalization. Someone simple solution there, but not so much here. A: Very low fatality rate in informal settlements - until there's multistory. Evacuation otherwise somewhat easy. Materials may be different (timber vs plastic sheeting, piles of rubbish, metal sheeting), but physics all kind of the same. Firebrands not well studied.

Q: Same vocabulary between actors (researchers, engineers, practitioners, communities, fire service). Perhaps there is a lack of this for the emerging problem of informal settlements. A: These fires happen possibly even faster than a wildland fire, by the time fire department arrives it has spread dramatically. Challenge: communication: sometimes it takes 20 min to get there because the police were called first, so everyone is angry that it took so long so they throw things at fire responders.

Farian Wu presented fire management issues in Taiwan:
UN says need more resilient communities by 2030. But how can this be done? structural vs non-structural. Taiwan doesn't much have wildland or informal settlements, lots of high-rise building (urban fires!). Typhoons and earthquakes (lots of buildings less than 40 years old). Structural (fire compartments, sprinklers). Non-structural (education about fire-prone areas, habits). New buildings have accumulated combustibles, improper living habits (PV panels, modifications); existing buildings (inequality of social resources). How can we make sure the fire doesn't start? Can we really guarantee that the fire won't spread from one building to another? Unfortunately, there's still fatality fires because they didn't really know that they needed to evacuate or how to do that. Ignored the fire alarms. Evacuated at first, but bosses told them to go back to work. Other cases didn't really know that there was a fire. Fire doors not installed. Ebbinghaus forgetting curve. In Taiwan, memory is short, events get forgotten quickly (like 2 weeks). Need to practice fire drills more often to not forget (is twice a year enough practice?). Government may think that the structural / non-structural things may be enough, but really need to translate and communicate these to the public. What happens to fire safety over time? If it was good 20 years ago, is it still good now?

Questions following Farian's presentation:
Q: Thank you for mentioning sustainable development and translating it to the public. Cascading risks: how fires effects and risks different in different communities. Economics, culture, recovery is different for different communities. A: Fire isn't included in disaster management in Taiwan. Especially since the statistics point to its importance. As people start moving to the WUI, need to warn people of the risks, and raise insurance. Recovery from fires can be faster than after other disasters (ex: tsunami in Japan, earthquake in Taiwan). Imbalance in funding for fire compared to other disasters.

Yu wrapped up workshop: thanks to Farian and Richard, and especially to EME members!

3. Ignition Resistant Communities (IRC) Minutes

The following are the minutes taken of the IRC Workshop on October 22, 2023, 15:20-17:70:

The IRC workshop began with an introduction of LOF&BE by Sayaka Suzuki.

Alex Filkov then gave a presentation on the progress of the IRC subgroup, with an open discussion following.

Open discussion followed on these topics:

- As the audience was not clear what fire type specific input was requested after the presentation, participants wanted to know if the questions were for only WUI fires. IAFSS LOF&BE is more than only WUI fires, so fires covered under the umbrella of IAFSS LOF&BE were discussed.
- As many of the discussion questions desired input on standards, the discussion moved into this area.
    - A participant from New Zealand indicated New Zealand has no WUI fire standards.
    - It was suggested that New Zealand adapt to Australia, as they have some WUI fire standards
        - Some in the audience wondered if performance-based design (PBD) applies to these fire types?
    - PBD for complex scenarios and shelters would be required.
- While not discussed in IRC presentations, it is clear there is a social part as well, and homeowner involvement is required in addition to standards and codes. In the end, it is up to homeowners to implement solutions to make for better ignition resistance.
- In terms of WUI definition, there were some comments about the recent Hawaii fires – is there a more proper definition of what WUI fires are in general?
- Participants also wondered about the few standards in place, do these even perform as promised, so is there any mechanism to actually evaluate published standards?
- The discussion moved into IRC Topic 3 (mitigation strategies indicative of large outdoor fire exposures).
    - It was suggested that home gardening and maintenance is important.
    - Education and in general, the public, do not really understand the risk from large outdoor fires.
    - It was suggested that many people are conducting risk assessment modeling with no understanding of fire science. Are these methods technically sound, any idea of what they are doing is correct? Suggested there should be some sort of minimum qualification for someone to engage in design work in the WUI.

Then moved into the invited, short presentations from working group members (Trent Penman, David Rush, Hideki Yoshioka, Pascale Vacca).

Open discussions followed on these topics:

- Once again, it was suggested of the importance of education.

- The issue of standards evaluation was put forward again, as from the prior standard discussion above – is there any evaluation of what actually passes a given standard test method?
- There remains a need for improved post fire data collection methods.
    - Standardization of post-fire data collection is required.
    - Inclusion of firebrands in both standards and in post fire data collection methods.
    - ISO TC92/WG13 (Fire Safety – Statistical Data Collection Working Group) and ISO TC92/WG14 (Large Outdoor Fires and the Built Environment Working Group) are two groups working on this.
        - ISO TC92 WG/14 is developing the ISO Firebrand Generator (it has since been published after this workshop).
    - Participants from Norway are struggling on how to actually influence of the politicians and other policy makers to make communities safe from large outdoor fires. In general, this is a struggle for all countries. Even before this, it may be a struggle to even join in ISO and other local standards organizations for researchers in general.

Alex and Dave wrapped up workshop: thanks to Trent, Hideki, Pascale, and especially to IRC members!

Appendix B: Presentations Delivered at the EME Workshop

Appendix C: Presentations Delivered at the IRC Workshop

Appendix D: Abstracts of the Invited Talks at the EME and IRC Workshops

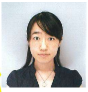
THE INTERNATIONAL ASSOCIATION
FOR FIRE SAFETY SCIENCE

Prepared for IAFSS Symposium
Tsukuba, JAPAN
October 22, 2023

Large Outdoor Fires & the Built Environment Working Group (LOF&BE)

Co-leaders


Sara McAllister
(USFS)


Sayaka Suzuki
(Tokyo Tech)


Samuel L. Manzello
(Tohoku University
& Reax Engineering)

What Does LOF&BE Mean?

Large Outdoor Fires & the Built Environment (LOF&BE)

Wildland fires (or forest fires)*, wildland-urban interface (WUI) fires, urban fires**, and informal settlement fires, which pose a threat to people

*Wildland fires also include (but not limited to) Wildfires, Bushfires, Mountain fires, Grassland fires, Veld fires; depending on location
** Urban fires include post-earthquake fires

LOF&BE Origins

Workshop held at 12th International Association of Fire Safety Science (IAFSS) Symposium in Lund, Sweden in 2017

- Presentations on regional perspectives
- Fire protection engineering works to understand fire dynamics within buildings
- Research into large outdoor fires, and how to potentially mitigate the loss of structures in such fires, lags behind other areas of fire safety science research
- Large outdoor fires affect many people in the world directly and indirectly, both short term and long term

Some Important Problems Initially Identified

Fire spread in large outdoor fires
- Very complex - interaction of topography, weather, vegetation, and structures
- Structure-structure fire spread can occur under similar mechanisms as in urban fire spread as well as WUI fire spread

Impact on fire and smoke on climate and health
- Long-term and short-term effects

Large outdoor firefighting
- Structure/Urban firefighting PPE and tactics different than wildland fire firefighting PPE and tactics; what needs to be done for WUI fire fighting?

Emergency management strategies
- How or when or whether to evacuate

Publication

- Overview of the large outdoor fire risk to the built environment from each region presented
- Critical research needs for this problem in the context of fire safety science are provided


Fire Safety Journal 100 (2018) 76–92

Contents lists available at ScienceDirect

Fire Safety Journal

journal homepage: www.elsevier.com/locate/firesaf

Summary of workshop large outdoor fires and the built environment

Samuel L. Manzello[a,*], Raphaele Blanchi[b], Michael J. Gollner[c], Daniel Gorham[d,1], Sara McAllister[e], Elsa Pastor[f], Eulàlia Planas[f], Pedro Reszka[g], Sayaka Suzuki[h]

[a] Fire Research Division, National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA
[b] Commonwealth Scientific and Industrial Research Organization (CSIRO), Melbourne, Australia
[c] University of Maryland, College Park, MD, USA
[d] National Fire Protection Association (NFPA), USA
[e] U.S. Forest Service, U.S. Department of Agriculture, Missoula, MT, USA
[f] Universitat Politècnica de Catalunya, Barcelona, Spain
[g] Universidad Adolfo Ibañez, Santiago, Chile
[h] National Research Institute of Fire and Disaster (NRIFD), Chofu, Tokyo, Japan

Summary paper from workshop in 12th IAFSS, Lund, Sweden (2017):
https://doi.org/10.1016/j.firesaf.2018.07.002

IAFSS Permanent Working Group Formed

The overall objectives are to bring
full depth of knowledge of the community
to work on these priority topics

Statement of purpose:
https://doi.org/10.1016/j.firesaf.2018.03.003 &
https://doi.org/10.1007/s10694-018-0717-z


Fire Safety Journal 98 (2018) 1–2

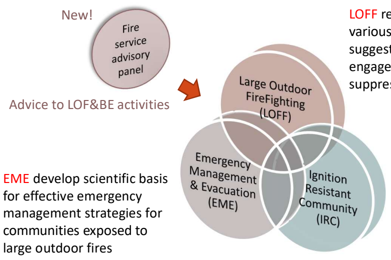
Contents lists available at ScienceDirect

Fire Safety Journal

journal homepage: www.elsevier.com/locate/firesaf

Large outdoor fires and the built environment: Objectives and goals of permanent IAFSS working group

IAFSS Permanent Working Group Formed



LOFF review various tactics used, as well as various personal protective equipment (PPE), and suggest pathways for research community engagement, including environmental issues in suppressing these fires

Those subgroups are related to each other

EME develop scientific basis for effective emergency management strategies for communities exposed to large outdoor fires

IRC is focused on developing the scientific understanding that will lead to new standards, testing methodologies, and mitigation strategies indicative of large outdoor fire exposures, including the ones from wildland to communities and within communities

General Approach

Phase 1 Collect information
- Codes and standards
- Best practices
- Current research

Phase 2 Identify the 'Gaps'
- Among codes and standards
- Among codes and standards and current research
- Among current research

Phase 3 Work on 'Products' solving the Gaps

Members

From University, Research Institute, Fire service, Industry

CSIRO, University of Queensland, Arup, NRC Canada, CALFIRE, Surrey Fire Service (Canada), Efectis, SWRI, Italian Fire and Rescue Service, RISE, American, Wood Council, Imperial College London, Exponent, Jensen Hughes, Stanford University, FM Global, LBNL, Oregon State University, BRI (Japan), IBHS, University of Maryland, University of Coimbra,

Many more....

Nearly 200 members from 27 countries (and growing!)

General Activities: Past Workshops

- Workshop @ 12th IAFSS Symposium, Lund, Sweden, 2017
- Kickoff Workshop @ 11th Asia-Oceania Symposium on Fire Science and Technology, Taipei, Taiwan, 2018
- Workshop @ Interflam, London, UK, 2019
- Virtual Workshops, 2020
- 3 Workshops @ 13th IAFSS Symposium, Virtual, 2021

Webinar Series

- Started in November 2020
- Occurred monthly
- Recordings posted to LOF&BE YouTube channel
- LOF&BE working group - YouTube

ISO TC92 (Fire Safety)

ISO: International Organization for Standardization
- 24,292 standards for e.g.: camera film speed, medical devices, risk management, energy management, food safety, child car seats, testing and calibration labs, information security management, etc…


Fire Safety Journal 91 (2017) 784–790
Contents lists available at ScienceDirect
Fire Safety Journal
journal homepage: www.elsevier.com/locate/firesaf
IAFSS 12th Symposium 2017
Experiments to provide the scientific-basis for laboratory standard test methods for firebrand exposure
Sayaka Suzuki[a], Samuel L. Manzello[b,*]

Informal relationship with ISO TC92/WG14
- "Large outdoor fires and the built environment"
- Samuel L. Manzello (convenor)
- 42 members from 15 countries
- Published ISO - ISO/TR 24188:2022 - Large outdoor fires and the built environment — Global overview of different approaches to standardization
- "Draft International Standard:" ISO Standard Firebrand Generator (ISO/DIS 6021)
  - Passed DIS ballot – proceeding to publication

Emergency Management & Evacuation (EME)

EME develop scientific basis for effective emergency management strategies for communities exposed to large outdoor fires

Previous sub-group leaders: Maria Theodori, Sayaka Suzuki, Enrico Ronchi

Sub-group leaders


Rahul Wadhwani

The Hong Kong Polytechnic University 香港理工大學


Yu Wang

中国科学技术大学 University of Science and Technology of China

Accomplishments: EME

- Published 2 case study reports

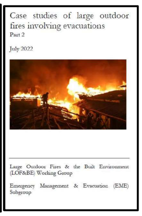
(after revising the template)

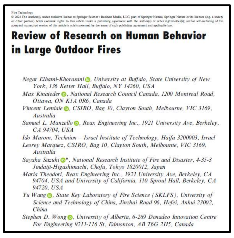
- Published 1 journal article:

E. Ronchi, S. Wong, S. Suzuki, M. Theodori, R. Wadhwani, S. Vaiciulyte, S. Gwynne, G. Rein, M. Kristoffersen, R. Lovreglio, I. Marom, C. Ma, D. Antonellis, X. Zhang, Z. Wang, N. Masoudvaziri, **Case studies of large outdoor fires involving evacuations**, Emergency Management & Evacuation (EME) Subgroup, Large Outdoor Fires & the Built Environment (LOF&BE) Working Group of the International Association for Fire Safety Science, 2021 February. https://doi.org/10.5281/zenodo.4504853

Y. Wang, R. Wadhwani, S. Suzuki, M. Theodori, E. Asimakopoulou, J. A. De Beer, N. Flores, M. A. Ibrahim, H. Johanna, K. Kempna, S. L. Manzello, A. Sharma, J. Smolka, A. Wickramasinghe, C. L. (Farian) Wu, T. Xia, **Case studies of large outdoor fires involving evacuations**, Emergency Management & Evacuation (EME) Subgroup, Large Outdoor Fires & the Built Environment (LOF&BE) Working Group of the International Association for Fire Safety Science, 2022 July. https://doi.org/10.5281/zenodo.6544760


Case studies of large outdoor fires involving evacuations
February 2021
Large Outdoor Fires & the Built Environment (LOF&BE) Working Group
Emergency Management & Evacuation (EME) Subgroup


Case studies of large outdoor fires involving evacuations
Part 2
July 2022
Large Outdoor Fires & the Built Environment (LOF&BE) Working Group
Emergency Management & Evacuation (EME) Subgroup


Fire Technology
© 2023 The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature. Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

Review of Research on Human Behavior in Large Outdoor Fires

Negar Elhami-Khorasani, University at Buffalo, State University of New York, 136 Ketter Hall, Buffalo, NY 14260, USA
Max Kinateder, National Research Council Canada, 1200 Montreal Road, Ottawa, ON K1A 0R6, Canada
Vincent Lemiale, CSIRO, Bag 10, Clayton South, Melbourne, VIC 3169, Australia
Samuel L. Manzello, Reax Engineering Inc., 1921 University Ave, Berkeley, CA 94704, USA
Ido Marom, Technion – Israel Institute of Technology, Haifa 3200003, Israel
Leorey Marquez, CSIRO, Bag 10, Clayton South, Melbourne, VIC 3169, Australia
Sayaka Suzuki*, National Research Institute of Fire and Disaster, 4-35-3 Jindaiji-Higashimachi, Chofu, Tokyo 1820012, Japan
Maria Theodori, Reax Engineering Inc., 1921 University Ave, Berkeley, CA 94704, USA and University of California, 110 Sproul Hall, Berkeley, CA 94720, USA
Yu Wang, State Key Laboratory of Fire Science (SKLFS), University of Science and Technology of China, Jinzhai Road 96, Hefei, Anhui 23002, China
Stephen D. Wong, University of Alberta, 6-269 Donadeo Innovation Centre For Engineering 9211-116 St, Edmonton, AB T6G 2H5, Canada

Ignition Resistant Community (IRC)

IRC is focused on developing the scientific understanding that will lead to new standards, testing methodologies, and mitigation strategies indicative of large outdoor fire exposures, including the ones from wildland to communities and within communities

Previous sub-group leader: Elsa Pastor, Daniel Gorham

Sub-group leaders


Alexander Filkov

The University of Melbourne


David Rush

The University of Edinburgh School of Engineering

Accomplishments:IRC

Revised and updated IRC objectives statement

Published 1 journal article

Openings for IRC subGL:
If you are interested to become an IRC sub-leader with Alex, **please send a CV and brief statement on why you would like to take on this role** in IAFSS LOF&BE to the co-leaders, Sara McAllister, Sayaka Suzuki, and Samuel L. Manzello.

<u>Applications will be accepted until the position is filled</u>.

Fire Safety Journal 140 (2023) 103871

Contents lists available at ScienceDirect

Fire Safety Journal

journal homepage: www.elsevier.com/locate/firesaf

A review of thermal exposure and fire spread mechanisms in large outdoor fires and the built environment

Alexander I. Filkov[a,*], Virginie Tihay-Felicelli[b], Nima Masoudvaziri[c], David Rush[d], Andres Valencia[e], Yu Wang[f], David L. Blunck[g], Mario Miguel Valero[h,p], Kamila Kempna[i], Jan Smolka[j], Jacques De Beer[k], Zakary Campbell-Lochrie[l], Felipe Roman Centeno[m], Muhammad Asim Ibrahim[n], Calisa Katiuscia Lemmertz[m], Wai Cheong Tam[o]

[a] Faculty of Science, the University of Melbourne, 4 Water st, Creswick, 3350, Australia
[b] Université de Corse, Campus Grimaldi, 20250, Corte, France
[c] University at Buffalo, 206 Ketter Hall, Buffalo, NY, 14228, USA
[d] School of Engineering, University of Edinburgh, United Kingdom
[e] Department of Civil and Natural Resources Engineering, University of Canterbury, 20 Kirkwood Avenue, Upper Riccarton, Christchurch, 8041, New Zealand
[f] State Key Laboratory of Fire Science, University of Science and Technology of China, Hefei, 230026, Anhui, China
[g] Oregon State University, Rogers 314, Corvallis, OR, USA
[h] Wildfire Interdisciplinary Research Center, Department of Meteorology and Climate Science, San Jose State University, San Jose, CA, USA
[i] Faculty of Safety Engineering, VSB-Technical University of Ostrava, 630/13, Lumirova, 70030, Czech Republic
[j] Faculty of Safety Engineering, VSB-Technical University of Ostrava, 630/13, Lumirova , 70030, Czech Republic
[k] Department of Fire Protection Engineering, University of Maryland, 4356 Stadium Dr, College Park, MD, 20742, USA
[l] School of Engineering, The University of Edinburgh, 190 Mayfield Road, Edinburgh, United Kingdom
[m] Department of Mechanical Engineering, Federal University of Rio Grande do Sul, Sarmento Leite Street, 425, Porto Alegre, 90050-170, RS, Brasil
[n] Department of Biology and Environmental Science, Linnaeus University, Stuvaregatan 2, 392 31, Kalmar, Sweden
[o] Fire Research Division, National Institute of Standards and Technology, 100 Bureau Drive, Gaithersburg, MD, USA
[p] Department of Fluid Mechanics, Universitat Politècnica de Catalunya, Barcelona, Spain

Large Outdoor FireFighting (LOFF)

<u>Currently suspended</u>

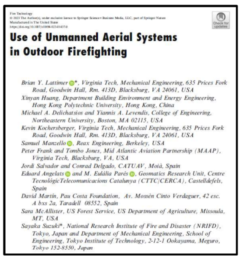
<u>Previous sub-group leaders:</u> Xinyan Huang, Brian Lattimer, Raphaele Blanchi

<u>Accomplishments:</u>

Published 1 journal article

<u>Next steps:</u>

Fire service advisory panel



Fire Technology
© 2023 The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature
Manufactured in The United States
https://doi.org/10.1007/s10694-023-01437-0

Use of Unmanned Aerial Systems in Outdoor Firefighting

Brian Y. Lattimer*, Virginia Tech, Mechanical Engineering, 635 Prices Fork Road, Goodwin Hall, Rm. 413D, Blacksburg, VA 24061, USA
Xinyan Huang, Department Building Environment and Energy Engineering, Hong Kong Polytechnic University, Hong Kong, China
Michael A. Delichatsios and Yiannis A. Levendis, College of Engineering, Northeastern University, Boston, MA 02115, USA
Kevin Kochersberger, Virginia Tech, Mechanical Engineering, 635 Prices Fork Road, Goodwin Hall, Rm. 413D, Blacksburg, VA 24061, USA
Samuel Manzello, Reax Engineering, Berkeley, USA
Peter Frank and Tombo Jones, Mid Atlantic Aviation Partnership (MAAP), Virginia Tech, Blacksburg, VA, USA
Jordi Salvador and Conrad Delgado, CATUAV, Moià, Spain
Eduard Angelats and M. Eulàlia Parés, Geomatics Research Unit, Centre TecnològicTelecomunicacions Catalunya (CTTC/CERCA), Castelldefels, Spain
David Martín, Pau Costa Foundation, Av. Mossèn Cinto Verdaguer, 42 esc. A bxs 2a, Taradell 08552, Spain
Sara McAllister, US Forest Service, US Department of Agriculture, Missoula, MT, USA
Sayaka Suzuki*, National Research Institute of Fire and Disaster (NRIFD), Tokyo, Japan and Department of Mechanical Engineering, School of Engineering, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo 152-8550, Japan

Fire Service Advisory Panel

Recognize the disconnect between fire researchers and practitioners
- Especially apparent in the Large Outdoor Fire Fighting (LOFF) subgroup

Hope to help close gap by establishing a Fire Service Advisory panel
- Goal: panel of ~10 international fire service/management personnel that collaborate with researchers to improve large outdoor firefighting
- Provide input on needs / challenges of the fire management related to large outdoor fires to all sub-groups
- Assist in identifying research topics to support fire management

Fire Service Advisory Panel (FSAP) – Current Members
Haonan Chen, USTC and Henan Fire and Rescue Brigade, China
Robert Cook, Tesco UK Fire Safety Manager, UK
Ethan Foote, CALFIRE, Retired, USA
Charles Scawthorn, University of California at Berkeley and SPA Risk LLC, USA
Chia Lung (Farian) Wu, Chang Jung Christian University and National Fire Agency, Taiwan

Thanks

THE INTERNATIONAL ASSOCIATION
FOR FIRE SAFETY SCIENCE

All the WG members

Contact us: sara.mcallister@usda.gov, suzuki.s.dq@m.titech.ac.jp, manzello@reaxengineering.com, manzello@tohoku.ac.jp

If you would like to join WG and or Fire Service Panel, please sign up from the link below or QR codes;

https://goo.gl/forms/0TMW2SbWi7mmHYIv1

Emergency Management & Evacuation (EME) Subgroup Workshop

Large Outdoor Fires and the Built Environment
(LOF&BE) Working Group

October 2023

Agenda

Time	Contents	Speakers
20 min	Introduction to LOF&BE	Manzello & McAllister & Suzuki (co-Leaders)
30 min	Progress on EME	Wang & Wadhwani (EME subGLs)
30 min	Discussion	All participants
30 min	Short presentations	Flores-Quiroz & Walls, Wu
30 min	Discussion	All participants
10 min	Wrap up	

Progress on EME

Time	Contents	Speakers
30 min	Progress on EME	Wang (EME subGLs)
30 min	Discussion	All participants

- Progress 1 Report: Case studies of large outdoor fires involving evacuations
- Progress 2 Report: Case studies of large outdoor fires involving evacuations (Part 2)
- Progress 3 Review: Research on human behavior in large outdoor fires
- Ongoing Analysis of the paper

EME cases

Hawaii, USA, Aug 8, 2023.
At least 100 people have died after wildfires occurred.

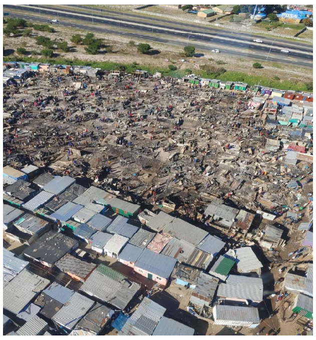
Rhodes, Greece, Jul 22, 2023.
More than 30,000 residents and tourists were forced to evacuate after the wildfire.

EME cases

Cape Town, South Africa, Apr 25, 2023.
6,000,000 m^2 of forest were destroyed in fire.

Chongqing, China, Aug 20, 2022.
Wildfire have covered nearly 700,000 m^2;
14,000 people involved in the firefighting

EME cases



Cape Town, South Africa,
Apr 16, 2023.
Fires broke out in Langa, leaving more than 1,000 people homeless.

Case studies of Large-outdoor fires

- Two Reports
- Report 1:
  16 Authors, 18 Affiliations
- Report 2:
  16 Authors, 18 Affiliations
  (3 common in both Reports)
- Report 1 doi:
  10.5281/zenodo.4504853
- Report 2 doi:
  10.5281/zenodo.6544760

Case studies of large outdoor fires involving evacuations

February 2021

Large Outdoor Fires & the Built Environment (LOF&BE) Working Group

Emergency Management & Evacuation (EME) Subgroup

Case studies of large outdoor fires involving evacuations
Part 2

July 2022

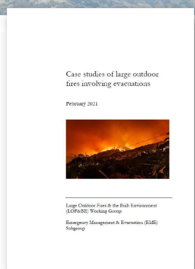
Large Outdoor Fires & the Built Environment (LOF&BE) Working Group

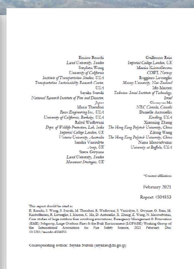
Emergency Management & Evacuation (EME) Subgroup

Progress 1: Report 1

Contributors:
Enrico Ronchi (Sweden), Stephen Wong (USA), Sayaka Suzuki (Japan), Maria Theodori (USA), Rahul Wadhwani (UK), Sandra Vaiciulyte (UK), Steve Gwynne (UK), Guillermo Rein (UK), Martin Kristoffersen (Norway), Ruggierto Lovreglio (New Zealand), Ido Marom (Israel), Chunyun Ma (Canada), Danielle Antonellis (USA), Xiaoning Zhang (China), Zilong Wang (China), Nima Masoudvaziri (USA)

- 16 researchers from 9 countries





Key points:

- Case studies collected based on template
- Around 40 case studies including WUI/wildland fires, urban fires and informal settlement fires
- 28 of those case studies are published as a report

Case studies collection

Templet

About the fire

1	Where?	Location of the incident
2	When?	Duration of the incident
3	How was the fire started?	Trigger event
4	Initial fire size	Scale of the initial fire
5	Area affected (burned area)	Area involved
6	Fuels involved in the fire	Vegetation, structures, etc.
7	WUI, urban, wildland or informal settlement fires?	Type of fire event
8	Average weather conditions	Environmental conditions during event
9	Geographical highlights	Landscape topography
10	Was there any fire break? (natural or artificial)	Constraints on the fire development
11	Did the Fire Service report extreme fire behaviour?	Recognised fire conditions
12	Number of structures and infrastructures affected (damaged)	Scale of physical impact
13	Estimated direct and indirect economic damage	Scale of physical impact
14	Did it occur in conjunction with multiple fires in the country?	Coincidence with other events (leading to resource issues)
15	Countries involved	Either as the incident spanned a border or because aid was provided.
16	Brief timeline of the key events	High-level narrative of key events.

About Evacuation & Emergency Management

17	Time of initial order to evacuate and locations	Precise commencement time allows evacuation delays or exposure conditions to be established.
18	Time when evacuation was considered completed	Allows length of evacuation to be established.
19	Deaths/Injuries	Impact of incident on human population-well-being.
20	The number of people evacuated	Impact of incident on human population-location.
21	The location people initially evacuated	Where people tried to escape – just from fire or went to shelter or anything
22	Reasons why people decided to evacuate	mandatory order, evacuation was recommended, they see the news or they see actual fire coming,
23	Evacuation type	Mode of transport (car, on foot, public service)
24	Any drill/education/instructions on large outdoor fires provided beforehand?	People's preparedness to large outdoor fires
25	Personnel involved in rescue operations	Complexity of procedural response to emergency.
26	Did the smoke hindered significantly the evacuation because of low visibility or health problems	Interaction between environmental conditions and the evacuation.
27	Possible causes of issues in management operations	Underlying factors that affected efficiency and effectiveness of procedural response.
28	References	Information sources
29	Name/Surname/Email/Date of who filled in this template	Information on who filled in the template and when

Case studies collection

•Case studies collected based on template above

•Currently efforts are made to include more urban/informal settlement fire case studies, case studies in Asia/Oceania, to balance out.

•Analysis & discussion

Case study	Year	Country	Type of fire
Sakata	1976	Japan	Urban
Okanagan Mountain Park	2003	Canada	Wildfire/WUI
San Diego	2007	USA	Wildfire/WUI
Victoria	2009	Australia	Wildfire/WUI
Swinley	2011	UK	Wildfire/WUI
Colorado Springs	2012	USA	Wildfire/WUI
La Gomera	2012	Spain	Wildfire/WUI
Black Forest	2013	USA	Wildfire/WUI
Falatanger	2014	Norway	Wildfire/WUI
Laerdalsoyri	2014	Norway	Urban
Västmanland	2014	Sweden	Wildfire/WUI
Shangri-La	2014	China	Informal Settlement (anciant villege)
Cadiz	2016	Spain	Wildfire/WUI
Fort McMurray	2016	Canada	Wildfire/WUI
Gatlinburg	2016	USA	Wildfire/WUI
Haifa	2016	Israel	Wildfire/WUI
Itoigawa	2016	Japan	Urban
Madeira	2016	Portugal	Wildfire/WUI
Atlas	2017	USA	Wildfire/WUI
British Columbia	2017	Canada	Wildfire/WUI
Creek	2017	USA	Wildfire/WUI
Imizamo Yethu	2017	South Africa	Informal Settlement
Nuns	2017	USA	Wildfire/WUI
Rye	2017	USA	Wildfire/WUI
Skirball	2017	USA	Wildfire/WUI
Thomas	2017	USA	Wildfire/WUI
Tubbs	2017	USA	Wildfire/WUI
Camp	2018	USA	Wildfire/WUI
Carr	2018	USA	Wildfire/WUI
Hill	2018	USA	Wildfire/WUI
Jämtland	2018	Sweden	Wildfire/WUI
Ranch	2018	USA	Wildfire/WUI
River	2018	USA	Wildfire/WUI
Mati	2018	Greece	Wildfire/WUI
Woolsey	2018	USA	Wildfire/WUI
Pigeon Valley (Nelson)	2019	New Zealand	Wildfire/WUI
Qinyuan	2019	China	Wildfire/WUI
Langa	2019	South Africa	Informal Settlement

Incidents analysis

Report 1: 28 cases

WUI fires: 24

Urban fires: 2

Informal fires: 1

Wildland fires: 1

•This report is geographically unbalanced, as many case studies were collected from North American and Europe.

•Most case studies involved a mandatory evacuation of the general population. However, evacuations were not always ordered such as during the South Africa's Imizamo Yethu informal settlement, where over 2000 structures were lost.

Region	Country	Number of case studies	Number of case studies
North America	USA	12	15
	Canada	3	
South America	/	0	0
Europe	Spain	2	6
	Norway	2	
	Portugal	1	
	Sweden	1	
Africa	South Africa	1	1
Asia	Japan	1	2
	Israel	1	
Oceania	Australia	1	2

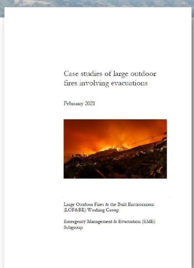
Progress 2: Report 2

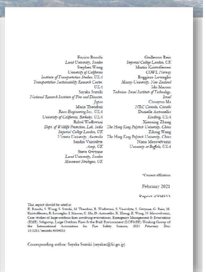
Contributors:
Yu Wang (China), Rahul Wadhwani (UK), Sayaka Suzuki (Japan), Maria Theodori (USA), Eleni Asimakopoulou (UK), Jacques Andre De Beer (USA), Natalia Flores (South Africa), M. Asim Ibrahim (Sweden), Hahlin Johanna (Sweden), Kamila Kempna (Czech Republic), Samuel L. Manzello (USA), Ankit Sharma (USA), Jan Smolka (Czech Republic), Amila Wickramasinghe (Australia), Chia Lung (Farian) Wu, Ting Xia (China)

- 16 researchers from 8 countries

Key points:

- Expanded based on the report 1
- The cases in this report came from more diverse regions (6 continents)
- Different types of large outdoor fires, including wildland fires, wildland-urban interface (WUI) fires, urban fires and informal settlement fires.





- 26 of those case studies are published as a report
- Analysis for a journal publication

Case studies collection

- Case studies collected based on template
- 26 case studies including WUI/wildland fires, urban fires and informal settlement fires
- More cases from Asia/Oceania regions
- Analysis & discussion

Case study	Year	Country/Region	Type of fire
Case study	Year	Country	Type of fire
Ash Wednesday bush	1983	Australia	Wildfire/WUI
Wakkanai city	2002	Japan	Urban fires
Beppu City	2010	Japan	Urban fires
Schultz	2010	USA	Wildfire/WUI
Bandra slum	2011	India	Informal settlements
Swinley	2011	UK	Wildfire/WUI
Colorado Springs	2012	USA	Wildfire/WUI
Black Forest	2013	USA	Wildfire/WUI
Shangri-La	2014	Mainland China	Informal settlement
Valparaiso fire	2014	Chile	Wildfire/WUI
Formosa Fun Coast – Color Play Asia Party	2015	Taiwan	Urban fires
Gatlinburg	2016	USA	Wildfire/WUI
Manilla	2017	Philippine	Wildfire/WUI
Rapa Nui Island	2017	Chile	Wildfire/WUI
Kemerovo fire	2018	Russia	Urban fires
Tathra wildfire	2018	Australia	Wildfire/WUI
Dalarna,Jämtlandand Gävlaborg fires	2018	Sweden	Urban fires
Mati fire	2018	Greece	WUI
Chowk Bazaar, Dhaka	2019	Bangladesh	Urban fires
Gosper's Mountain fire	2019	Australia	Wildfire
Kincade fire	2019	USA	WUI
Langa	2019	South Africa	Informal settlement
Qinyuan fire	2019	Mainland China	Wildfire
Balukhali campfire	2021	Bangladesh	Informal settlement
Lungeli fire	2021	India	Wildfire/WUI
Wooroloo wildfire	2021	Australia	Wildfire/WUI

Incidents analysis

Report 2: 26 cases,
WUI fires: 15
Urban fires: 7
Informal fires: 4

•This report adds more Asian cases to report1, and the types of case fires are more diverse.

•The type of fires in Asia is more diverse, and the number of urban fires has increased significantly, mainly because Asia is the fastest urbanizing region in recent years.

•Mandatory order of evacuation had not been listened is often the case of high casaualties.

Continent	Country/Region	Number of case studies	Number of case studies
North America	USA	5	5
South America	Chile	2	2
Europe	Greece	1	4
	Russia	1	
	Sweden	1	
	UK	1	
Africa	South Africa	1	1
Asia	Bangladesh	2	10
	Mainland China	2	
	Taiwan	1	
	India	2	
	Japan	2	
	Philippines	1	
Oceania	Australia	4	4

Progress 3: Review

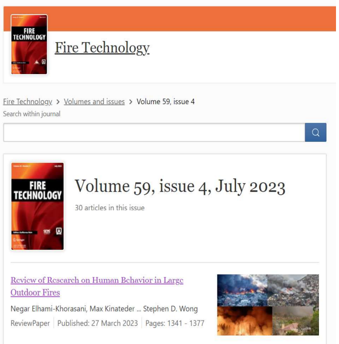
Contributors:

Negar Elhami-Khorasani (USA), Max Kinateder (Canada), Vincent Lemiale (Australia), Samuel L. Manzello (USA), Ido Marom (Israel), Leorey Marquez (Australia), Sayaka Suzuki (Japan), Maria Theodori (USA), Yu Wang (China), Stephen D. Wong (Canada)

- 10 researchers from 6 countries

Key points:

• Scientific understanding of human behavior in large outdoor fires
• Transportation modelling for evacuation
• Improved evacuation behavior modeling with new technologies (future)



Emerging Issues and Challenges

- Accurate and representative data collection methods
- Consistency of questions in survey or interview
- Development of decision support system (DDS)
- Optimum solution approach or flexible approach
- Effect of smoke both on the decision-making and the evacuation process itself
- Model validation
- Lessons learnt from other outdoor disasters
- Include vulnerable communities into emergency research

Work in progress: Paper analysis

•Titled: Analysis of historical large-outdoor fire incidents : a comprehensive study of emergency

•Team: 11 members currently

•Authors (Alphabetically)

Asimakopoulou, Eleni: University Of Central Lancashire, UK
Chen, Haonan: University Of Science and Technology, China
Chia-Lung, Wu: Chang Jung Christian University, Taiwan
Flores-Quiroz, Natalia: Stellenbosch University, South Africa
Ibrahim, Asim: Linnaeus University, Sweden
Manzello, Samuel: Reax Engineering, USA and Tohoku University, Japan
Menzemer, Leo: Lund University, Sweden
Rush, David: University of Edinburgh, UK
Sharma, Ankit: Case Western Reserve University, USA
Suzuki, Sayaka: Tokyo Institute of Technology, Japan
Wadhwani, Rahul: Hong Kong Polytechnic University, Hong Kong
Wang, Yu: University Of Science and Technology, China

Work in progress: Paper analysis

Introduction

- Definition of large-outdoor fires including what constitutes a fire to be classified in this category and policies involved in the evacuation and management during the incidents.
- Why it is significantly different from traditional fires aka wildland fires.
- Feature importance in fundamentals of fire science + evacuation + traffic+ management
- Discussion on the work carried out by the global fire community in developing a case study database

Methodology

- Fundamental reasoning behind drafting questionnaires for case studies
- Key metrics adopted before reviewing the case studies
- Methodology adopted in reviewing fire incidents, selecting the case study and developing a case study database

Results and Discussion

- Key factors affecting the evacuation such as population density, road network, pre-evacuation warning, communication outreach, preparedness of fire and emergency personnel, previous history of incidences
- How geological factors assisted/hindered evacuation or reduced/increased the fire damage
- Analysis of cases by continent and identifying the fire and emergency responses
- Trends observed with each case study including fatalities vs fire size vs population threatened

Conclusions

Short presentations

Time	Contents	Speakers
30 min	Short presentations	Flores-Quiroz & Walls, Wu
30 min	Discussion	All participants

Targeted questions

- How to communicate EME science in simplest useful language to community with higher population density living in informal settlement where fire compliances is not possible to avoid or reduce loss of life in responding to fire incidences. Is outreach goal to be considered?

- How to better integrate EME related finding of LOF with the end-users (e.g. fire and emergency personnel)?

Thank you!

Large Outdoor Fires and the Built Environment
(LOF&BE) Working Group

October 2023

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

IAFSS 2023 - Tsukuba

Large-scale urban fires in low-income areas: Where to next?

By: Natalia Flores Quiroz and **Richard Walls**

Overview of paper

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

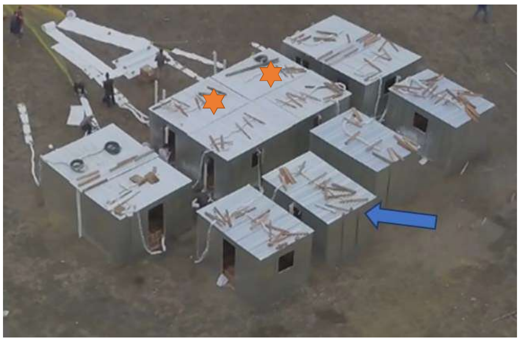
- Where are we now?
- Who is important?
- How can we make a difference?
- Where to next?




Fire spread

Fire spread

What do we know?



Fire spread

Results – Fire spread

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Fire spread

Time [min:sec]	Spread rate [dwelling/min]	Area spread rate [m^2/min]	Linear spread rate [m/min]
00:00 – 04:00	0.5	4.3	1.1
04:00 – 10:00	1.2	12.5	0.9 – 1.1
10:00 – 13:00	1.0	13.3	1.7
13:00 – 15:00	2.5	36.5	1.9
15:00 – 18:00	1.0	7.7	1.0
18:00 – 22:00	0.5	13.0	0.9
22:00 – 28:00	1.0	12.8	0.4-1.3
28:00 - 30:00	2.5	33.0	2-2.3
30:00 - 33:00	3.0	29	1.1-2.0

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Residents' behaviour

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Residents' behaviour

Residents' behaviour

Refugee camps

Fire Technology
© 2023 The Author(s)
Manufactured in The United States
https://doi.org/10.1007/s10694-023-01406-7

Incident Report and Analysis of the 2021 Cox's Bazar Rohingya Refugee Camp Fire in Bangladesh

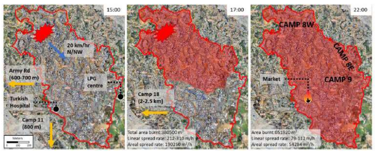


Figure 9. Estimated fire spread.

Figure 6. Photos of Cox's Bazar showing [40]: (a) fire incident, (b) fire aftermath, and (c) 2 days later where people are starting to rebuild.

What do we know?

Table 2. Comparison of large-scale fire incidents considering spread rates and wind speeds

	Fire event or experiment	Wind Speed [m/s] (km/h)	Separation between dwellings [m]	Area affected [m²]	No. of dwellings to which fire spread	Fire spread rates [m/min]
1	12 dwellings – This paper	0.7-5.7* (2.5-20.5)	1 – 2m	110 out of 160	6 out of 10	0-0.5
2	20 dwelling experiment[1] [5]	4.2-6.9 (15-25)	1 – 2.2m	310	16 out of 16	3.6 avg.
3	2017 Imizamo Yethu[2] [12]	7.8-12.8 (28-46)	Large range	76600	> 2000 destroyed	0.5-2.3
4	2016 Itoigawa[2] [17,25]	9 average 27 m/s max	Large range	40000	120 destroyed, 27 damaged	1.7 avg.
5	2019 Langa[2] [14]	1.7-3.1 (6-11)	Large range	550	42 destroyed	0.4-2.3
6	2020 Masiphumelele [26][3]	9.7-13.9 (35-50)	Large range	31000	> 1000 destroyed	0.5 avg.

[1] Experimental work.
[2] Real fire events.
[3] Case study applying a framework for fire investigations [13]
* Wind opposed to the direction of fire spread

What do we know?

- Around 120-150 informal settlement dwellings have been burnt worldwide in experiments with different parameters being considered.
- We have detailed knowledge of internal fire dynamics, flame behaviour, scaling, ignition and similar factors.
- Large-scale experiments of up to 20 dwellings have been conducted.
- Various materials used in communities have been characterized.
- Some case studies of real incidents conducted.
- Detailed CFD models have been developed.

So what? How can this help the world?

Impact of fire engineers

- Traditional fire engineering involves the application of codes and standards through engineering design, based on scientific principles, to mitigate the impact of fires. Various systems can be designed to manage and control fire.
- We have limited control of low-income communities.
- Separate codes and standards cannot be created for low-income communities. That would effectively normalize and sanction the conditions they are living in.
- We do not have big white horses (peer-reviewed-high-impact-journal-publications) to ride in on and save the day with a 'solution'. Community members and local fire departments are very smart. If there was a simple solution they would have found it by now.

What don't we know?

- Accurate large-scale spread models remain illusive due to factors such as below. However, they may be of benefit to investigating the influence of different options on fire risk.
  - Firefighting efforts
  - Complex geometries
  - Variable materials
  - Moving fuel loads
  - Localised wind effects
  - Inhabitants' activities
  - Homes being knocked down
  - Topography
- Ignition studies on smaller components of homes would be useful for understanding and improving home resilience.

What we don't know?

- We have living legends like Paul Chamberlain practically developing solutions in refugee/sheltered camps. Can we quantify and help this?

Images by Paul Chamberlain

What can we achieve?

- What can be done in an informal settlement?
  - Guide layouts.
  - Prepare for incidents.
  - Identify potential materials to be considered.
  - Assist NGOs.
  - Guide departments, municipalities, and decision-makers.
  - Evaluate suppression systems and other products.
- The most important people such as:
  - The community members.
  - NGOs and support organisations.
  - Municipalities and those developing infrastructure.
  - Fire departments.

Where to now?

- Supporting people on the frontline.
- Train developing world fire engineers.
- Document case studies from real incidents to increase our database of real-life spread rates and details.
- Potential for large-scale fire spread models still exists, provided we have better validation data (and treat answers with caution).
- Human behaviour during incidents wide open for study and could lead to many insights (after length ethical approvals).
- Identify ways to assist in other transient communities such as homeless settlements in cities.

Where to now?

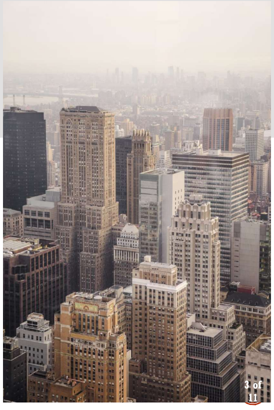
- Opportunities for supporting ongoing work for sheltered community work and activities.
- Temporary shelters (e.g. post earthquake) are often combustible and there is room for fire safety guidance for such structures.
- Enhance post-fire investigations.
- Whilst providing services (electrical, road, water, medical, social, etc.) it is often possible to include fire safety considerations.
- Making ourselves useful in whichever local context we find ourselves…

SAFER ENVIROMENT

How do we make sure we are safe?

Structural methods

Non-structural methods



New buildings

PROBLEMS

- accumulation of combustibles
- improper living habits.

Existing buildings

PROBLEMS

- Unlawful use, implies,
  - inequality of social resources
  - social-economic weakness

New buildings

Existing buildings

PROBLEMS

If we can deal with problems, fires can be avoided

- **Improve the current fire safety management**

Structural methods	**New buildings requires to improve the educational system on fire safety**
Non-structural methods	**Existing buildings requires the direct assistance from the AHJs.**

Imperative Issues

Structural methods

Non-structural methods

However, It's not what I thought.

In 2021, Kaohsiung, Taiwan. 46 died, and 41 injured.

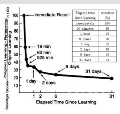
In 2023, Changhua, Taiwan. 8 died, and 14 injured.

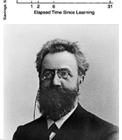
In 2023, Pingtung, Taiwan. 10 died, and 113 injured.

Do not know if they really need to 'evacuate'.

INDUSTRY-GOVERNMENT-ACADEMIC DIALOGUE

In less than two weeks, no one discussed the fire cases.





The Ebbinghaus Forgetting Curve

However, we can still do something!

Structural methods →

Non-structural methods →

Translate

→ 

QUESTIONS?

Thank you for your attention!
Contact: farianwu@mail.cjcu.edu.tw

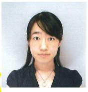
THE INTERNATIONAL ASSOCIATION FOR FIRE SAFETY SCIENCE

Prepared for IAFSS Symposium
Tsukuba, JAPAN
October 22, 2023

Large Outdoor Fires & the Built Environment Working Group (LOF&BE)

Co-leaders

Sara McAllister (USFS)



Sayaka Suzuki (Tokyo Tech)

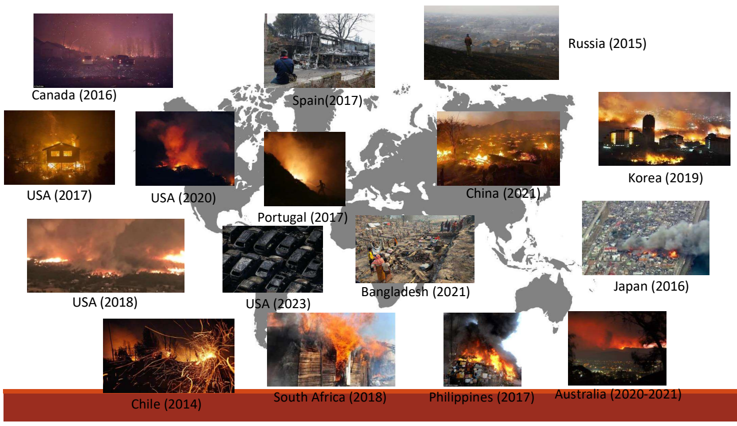
Samuel L. Manzello (Tohoku University & Reax Engineering)

What Does LOF&BE Mean?

Large Outdoor Fires & the Built Environment (LOF&BE)

Wildland fires (or forest fires)*, wildland-urban interface (WUI) fires, urban fires**, and informal settlement fires, which pose a threat to people

*Wildland fires also include (but not limited to) Wildfires, Bushfires, Mountain fires, Grassland fires, Veld fires; depending on location
** Urban fires include post-earthquake fires



LOF&BE Origins

Workshop held at 12th International Association of Fire Safety Science (IAFSS) Symposium in Lund, Sweden in 2017

- Presentations on regional perspectives
- Fire protection engineering works to understand fire dynamics within buildings
- Research into large outdoor fires, and how to potentially mitigate the loss of structures in such fires, lags behind other areas of fire safety science research
- Large outdoor fires affect many people in the world directly and indirectly, both short term and long term

Some Important Problems Initially Identified

Fire spread in large outdoor fires
- Very complex - interaction of topography, weather, vegetation, and structures
- Structure-structure fire spread can occur under similar mechanisms as in urban fire spread as well as WUI fire spread

Impact on fire and smoke on climate and health
- Long-term and short-term effects

Large outdoor firefighting
- Structure/Urban firefighting PPE and tactics different than wildland fire firefighting PPE and tactics; what needs to be done for WUI fire fighting?

Emergency management strategies
- How or when or whether to evacuate

Publication

- Overview of the large outdoor fire risk to the built environment from each region presented
- Critical research needs for this problem in the context of fire safety science are provided


Fire Safety Journal 100 (2018) 76–92

Contents lists available at ScienceDirect

Fire Safety Journal

journal homepage: www.elsevier.com/locate/firesaf

Summary of workshop large outdoor fires and the built environment

Samuel L. Manzello[a,*], Raphaele Blanchi[b], Michael J. Gollner[c], Daniel Gorham[d,1], Sara McAllister[e], Elsa Pastor[f], Eulàlia Planas[f], Pedro Reszka[g], Sayaka Suzuki[h]

[a] Fire Research Division, National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA
[b] Commonwealth Scientific and Industrial Research Organization (CSIRO), Melbourne, Australia
[c] University of Maryland, College Park, MD, USA
[d] National Fire Protection Association (NFPA), USA
[e] U.S. Forest Service, U.S. Department of Agriculture, Missoula, MT, USA
[f] Universitat Politècnica de Catalunya, Barcelona, Spain
[g] Universidad Adolfo Ibañez, Santiago, Chile
[h] National Research Institute of Fire and Disaster (NRIFD), Chofu, Tokyo, Japan

Summary paper from workshop in 12th IAFSS, Lund, Sweden (2017):
https://doi.org/10.1016/j.firesaf.2018.07.002

IAFSS Permanent Working Group Formed

The overall objectives are to bring
full depth of knowledge of the community
to work on these priority topics

Statement of purpose:
https://doi.org/10.1016/j.firesaf.2018.03.003 &
https://doi.org/10.1007/s10694-018-0717-z


Fire Safety Journal 98 (2018) 1–2

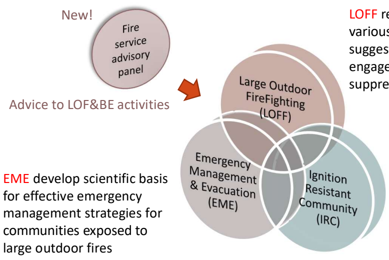
Contents lists available at ScienceDirect

Fire Safety Journal

journal homepage: www.elsevier.com/locate/firesaf

Large outdoor fires and the built environment: Objectives and goals of permanent IAFSS working group

IAFSS Permanent Working Group Formed



LOFF review various tactics used, as well as various personal protective equipment (PPE), and suggest pathways for research community engagement, including environmental issues in suppressing these fires

Those subgroups are related to each other

EME develop scientific basis for effective emergency management strategies for communities exposed to large outdoor fires

IRC is focused on developing the scientific understanding that will lead to new standards, testing methodologies, and mitigation strategies indicative of large outdoor fire exposures, including the ones from wildland to communities and within communities

General Approach

Phase 1 Collect information
- Codes and standards
- Best practices
- Current research

Phase 2 Identify the ‘Gaps’
- Among codes and standards
- Among codes and standards and current research
- Among current research

Phase 3 Work on ‘Products’ solving the Gaps

Members

From University, Research Institute, Fire service, Industry

CSIRO, University of Queensland, Arup, NRC Canada, CALFIRE, Surrey Fire Service (Canada), Efectis, SWRI, Italian Fire and Rescue Service, RISE, American, Wood Council, Imperial College London, Exponent, Jensen Hughes, Stanford University, FM Global, LBNL, Oregon State University, BRI (Japan), IBHS, University of Maryland, University of Coimbra,

Many more....

Nearly 200 members from 27 countries (and growing!)

General Activities: Past Workshops

- Workshop @ 12th IAFSS Symposium, Lund, Sweden, 2017
- Kickoff Workshop @ 11th Asia-Oceania Symposium on Fire Science and Technology, Taipei, Taiwan, 2018
- Workshop @ Interflam, London, UK, 2019
- Virtual Workshops, 2020
- 3 Workshops @ 13th IAFSS Symposium, Virtual, 2021

Webinar Series

- Started in November 2020
- Occurred monthly
- Recordings posted to LOF&BE YouTube channel
- LOF&BE working group - YouTube

ISO TC92 (Fire Safety)

ISO: International Organization for Standardization

- 24,292 standards for e.g.: camera film speed, medical devices, risk management, energy management, food safety, child car seats, testing and calibration labs, information security management, etc…

Informal relationship with ISO TC92/WG14

- "Large outdoor fires and the built environment"
- Samuel L. Manzello (convenor)
- 42 members from 15 countries
- Published ISO - ISO/TR 24188:2022 - Large outdoor fires and the built environment — Global overview of different approaches to standardization
- "Draft International Standard:" ISO Standard Firebrand Generator (ISO/DIS 6021)
  - Passed DIS ballot – proceeding to publication

Emergency Management & Evacuation (EME)

EME develop scientific basis for effective emergency management strategies for communities exposed to large outdoor fires

Previous sub-group leaders: Maria Theodori, Sayaka Suzuki, Enrico Ronchi

Sub-group leaders

Rahul Wadhwani

The Hong Kong Polytechnic University

Yu Wang

University of Science and Technology of China

Accomplishments: EME

- Published 2 case study reports

(after revising the template)

- Published 1 journal article:

E. Ronchi, S. Wong, S. Suzuki, M. Theodori, R. Wadhwani, S. Vaiciulyte, S. Gwynne, G. Rein, M. Kristoffersen, R. Lovreglio, I. Marom, C. Ma, D. Antonellis, X. Zhang, Z. Wang, N. Masoudvaziri, **Case studies of large outdoor fires involving evacuations**, Emergency Management & Evacuation (EME) Subgroup, Large Outdoor Fires & the Built Environment (LOF&BE) Working Group of the International Association for Fire Safety Science, 2021 February. https://doi.org/10.5281/zenodo.4504853

Y. Wang, R. Wadhwani, S. Suzuki, M. Theodori, E. Asimakopoulou, J. A. De Beer, N. Flores, M. A. Ibrahim, H. Johanna, K. Kempna, S. L. Manzello, A. Sharma, J. Smolka, A. Wickramasinghe, C. L. (Farian) Wu, T. Xia, **Case studies of large outdoor fires involving evacuations**, Emergency Management & Evacuation (EME) Subgroup, Large Outdoor Fires & the Built Environment (LOF&BE) Working Group of the International Association for Fire Safety Science, 2022 July. https://doi.org/10.5281/zenodo.6544760

Case studies of large outdoor fires involving evacuations

February 2021

Large Outdoor Fires & the Built Environment (LOF&BE) Working Group

Emergency Management & Evacuation (EME) Subgroup

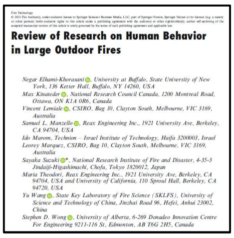
Case studies of large outdoor fires involving evacuations

Part 2

July 2022

Large Outdoor Fires & the Built Environment (LOF&BE) Working Group

Emergency Management & Evacuation (EME) Subgroup



Fire Technology

© 2023 The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature. Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

Review of Research on Human Behavior in Large Outdoor Fires

Negar Elhami-Khorasani, University at Buffalo, State University of New York, 136 Ketter Hall, Buffalo, NY 14260, USA
Max Kinateder, National Research Council Canada, 1200 Montreal Road, Ottawa, ON K1A 0R6, Canada
Vincent Lemiale, CSIRO, Bag 10, Clayton South, Melbourne, VIC 3169, Australia
Samuel L. Manzello, Reax Engineering Inc., 1921 University Ave, Berkeley, CA 94704, USA
Ido Marom, Technion – Israel Institute of Technology, Haifa 3200003, Israel
Leorey Marquez, CSIRO, Bag 10, Clayton South, Melbourne, VIC 3169, Australia
Sayaka Suzuki, National Research Institute of Fire and Disaster, 4-35-3 Jindaiji-Higashimachi, Chofu, Tokyo 1820012, Japan*
Maria Theodori, Reax Engineering Inc., 1921 University Ave, Berkeley, CA 94704, USA and University of California, 110 Sproul Hall, Berkeley, CA 94720, USA
Yu Wang, State Key Laboratory of Fire Science (SKLFS), University of Science and Technology of China, Jinzhai Road 96, Hefei, Anhui 23002, China
Stephen D. Wong, University of Alberta, 6-269 Donadeo Innovation Centre For Engineering 9211-116 St, Edmonton, AB T6G 2H5, Canada

Ignition Resistant Community (IRC)

IRC is focused on developing the scientific understanding that will lead to new standards, testing methodologies, and mitigation strategies indicative of large outdoor fire exposures, including the ones from wildland to communities and within communities

Previous sub-group leader: Elsa Pastor, Daniel Gorham

Sub-group leaders

Alexander Filkov

The University of Melbourne

David Rush

The University of Edinburgh School of Engineering

Accomplishments:IRC

Revised and updated IRC objectives statement

Published 1 journal article


Fire Safety Journal 140 (2023) 103871

Contents lists available at ScienceDirect

Fire Safety Journal

journal homepage: www.elsevier.com/locate/firesaf

A review of thermal exposure and fire spread mechanisms in large outdoor fires and the built environment

Alexander I. Filkov[a,*], Virginie Tihay-Felicelli[b], Nima Masoudvaziri[c], David Rush[d], Andres Valencia[e], Yu Wang[f], David L. Blunck[g], Mario Miguel Valero[h,p], Kamila Kempna[i], Jan Smolka[j], Jacques De Beer[k], Zakary Campbell-Lochrie[l], Felipe Roman Centeno[m], Muhammad Asim Ibrahim[n], Calisa Katiuscia Lemmertz[m], Wai Cheong Tam[o]

[a] Faculty of Science, the University of Melbourne, 4 Water st, Creswick, 3350, Australia
[b] Université de Corse, Campus Grimaldi, 20250, Corte, France
[c] University at Buffalo, 206 Ketter Hall, Buffalo, NY, 14228, USA
[d] School of Engineering, University of Edinburgh, United Kingdom
[e] Department of Civil and Natural Resources Engineering, University of Canterbury, 20 Kirkwood Avenue, Upper Riccarton, Christchurch, 8041, New Zealand
[f] State Key Laboratory of Fire Science, University of Science and Technology of China, Hefei, 230026, Anhui, China
[g] Oregon State University, Rogers 314, Corvallis, OR, USA
[h] Wildfire Interdisciplinary Research Center, Department of Meteorology and Climate Science, San Jose State University, San Jose, CA, USA
[i] Faculty of Safety Engineering, VSB-Technical University of Ostrava, 630/13, Lumirova, 70030, Czech Republic
[j] Faculty of Safety Engineering, VSB-Technical University of Ostrava, 630/13, Lumirova , 70030, Czech Republic
[k] Department of Fire Protection Engineering, University of Maryland, 4356 Stadium Dr, College Park, MD, 20742, USA
[l] School of Engineering, The University of Edinburgh, 190 Mayfield Road, Edinburgh, United Kingdom
[m] Department of Mechanical Engineering, Federal University of Rio Grande do Sul, Sarmento Leite Street, 425, Porto Alegre, 90050-170, RS, Brasil
[n] Department of Biology and Environmental Science, Linnaeus University, Stuvaregatan 2, 392 31, Kalmar, Sweden
[o] Fire Research Division, National Institute of Standards and Technology, 100 Bureau Drive, Gaithersburg, MD, USA
[p] Department of Fluid Mechanics, Universitat Politècnica de Catalunya, Barcelona, Spain

Openings for IRC subGL:
If you are interested to become an IRC sub-leader with Alex, **please send a CV and brief statement on why you would like to take on this role** in IAFSS LOF&BE to the co-leaders, Sara McAllister, Sayaka Suzuki, and Samuel L. Manzello.

Applications will be accepted until the position is filled.

Large Outdoor FireFighting (LOFF)

Currently suspended

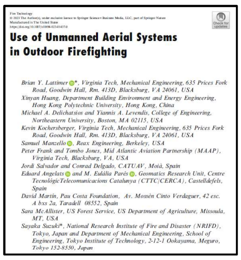
Previous sub-group leaders: Xinyan Huang, Brian Lattimer, Raphaele Blanchi

Accomplishments:

Published 1 journal article

Next steps:

Fire service advisory panel


Fire Technology
© 2023 The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature
Manufactured in The United States
https://doi.org/10.1007/s10694-023-01437-0

Use of Unmanned Aerial Systems in Outdoor Firefighting

*Brian Y. Lattimer**, Virginia Tech, Mechanical Engineering, 635 Prices Fork Road, Goodwin Hall, Rm. 413D, Blacksburg, VA 24061, USA
Xinyan Huang, Department Building Environment and Energy Engineering, Hong Kong Polytechnic University, Hong Kong, China
Michael A. Delichatsios and Yiannis A. Levendis, College of Engineering, Northeastern University, Boston, MA 02115, USA
Kevin Kochersberger, Virginia Tech, Mechanical Engineering, 635 Prices Fork Road, Goodwin Hall, Rm. 413D, Blacksburg, VA 24061, USA
Samuel Manzello, Reax Engineering, Berkeley, USA
Peter Frank and Tombo Jones, Mid Atlantic Aviation Partnership (MAAP), Virginia Tech, Blacksburg, VA, USA
Jordi Salvador and Conrad Delgado, CATUAV, Moià, Spain
Eduard Angelats and M. Eulàlia Parés, Geomatics Research Unit, Centre TecnològicTelecomunicacions Catalunya (CTTC/CERCA), Castelldefels, Spain
David Martín, Pau Costa Foundation, Av. Mossèn Cinto Verdaguer, 42 esc. A bxs 2a, Taradell 08552, Spain
Sara McAllister, US Forest Service, US Department of Agriculture, Missoula, MT, USA
*Sayaka Suzuki**, National Research Institute of Fire and Disaster (NRIFD), Tokyo, Japan and Department of Mechanical Engineering, School of Engineering, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo 152-8550, Japan

Fire Service Advisory Panel

Recognize the disconnect between fire researchers and practitioners
- Especially apparent in the Large Outdoor Fire Fighting (LOFF) subgroup

Hope to help close gap by establishing a Fire Service Advisory panel
- Goal: panel of ~10 international fire service/management personnel that collaborate with researchers to improve large outdoor firefighting
- Provide input on needs / challenges of the fire management related to large outdoor fires to all sub-groups
- Assist in identifying research topics to support fire management

Fire Service Advisory Panel (FSAP) – Current Members
Haonan Chen, USTC and Henan Fire and Rescue Brigade, China
Robert Cook, Tesco UK Fire Safety Manager, UK
Ethan Foote, CALFIRE, Retired, USA
Charles Scawthorn, University of California at Berkeley and SPA Risk LLC, USA
Chia Lung (Farian) Wu, Chang Jung Christian University and National Fire Agency, Taiwan

Thanks

THE INTERNATIONAL ASSOCIATION
FOR FIRE SAFETY SCIENCE

All the WG members

Contact us: sara.mcallister@usda.gov, suzuki.s.dq@m.titech.ac.jp, manzello@reaxengineering.com, manzello@tohoku.ac.jp

If you would like to join WG and or Fire Service Panel, please sign up from the link below or QR codes;

https://goo.gl/forms/0TMW2SbWi7mmHYlv1

14th International Symposium on Fire Safety Science
IAFSS2023 Tsukuba, Japan

Ignition Resistant Communities (IRC) subgroup Workshop

Large Outdoor Fires and the Built Environment (LOFBE)

Agenda

Time	Content	Speakers
20 min	Introduction to LOF&BE	Manzello & McAllister & Suzuki (co-Leaders)
30 min	Progress report on IRC	Filkov & Rush (IRC subGLs)
30 min	Discussion	All participants
30 min	Short presentations	Penman, Rush, Yoshioka & Himoto & Kagiya, Vacca
30 min	Discussion	All participants
10 min	Wrap-up	

Part 1 - Progress report on IRC

Time	Content	Speakers
30 min	Progress report on IRC	Filkov & Rush (IRC subGLs)
30 min	Discussion	All participants

- Updates on subgroup initiatives and their progress
- What worked and what didn't
- Discussion on current subgroup activities

Part 2 - Short presentations

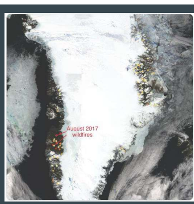
Time	Content
30 min	Short presentations
30 min	Discussion

- Trent Penman *Landscapes to loss – combining knowledge over scales* (University of Melbourne)
- David Rush *Informal settlement fires – what are their next fire science imperatives* (University of Edinburgh)
- Hideki Yoshioka, Keisuke Himoto, and Koji Kagiya *Large urban fires in Japan: History and management* (The University of Tokyo, National Institute for Land and Infrastructure Management, Tohoku Institute of Technology)
- Pascale Vacca *Tackling the improvement of standards and guidelines to account for real fire exposure* (Universitat Politècnica de Catalunya)

Part 1 - Progress report on IRC

Name	Region	Impact
2023 Hawaii wildfires	Hawaii	at least 97 people killed and >2,000 buildings destroyed
2023 Canadian Wildfires	Canada	6 human lives lost and >18 million hectares burned
2023 Greece Wildfires	Greece	28 people killed and 378,381 hectares burned
2022 Siberian Wildfires	Russia	16 human lives lost and 827 buildings destroyed
2021 Turkey Wildfires	Turkey	9 people killed and more than 1000 structures destroyed
2021 Greece wildfires	Greece	3 people killed and more than 150 houses destroyed
2020 Western United States	USA	37 people killed and about 20 billion USD in damages
2019 Black Summer fires	Australia	33 people killed and over 3,000 houses destroyed
2018 Camp fire	USA	85 fatalities and nearly 19,000 structures destroyed
2018 Attica fires	Greece	102 fatalities and approximately 3000 houses burned
2017 Thomas fire	USA	1,300 structures lost and 2.2 billion USD in damages
2017 British Columbia fires	Canada	1.2 million hectares burned and 65,000 people evacuated
2017 Wildfires	Portugal	112 human lives lost with 424,000 hectares burned
2016 Fort McMurray wildfire	Canada	2,400 houses lost and 6 billion CND in damages
2016 Wildfires	Portugal	4 people killed and more than 1,000 evacuated
2015 Wildfires	Russia	33 people killed and 1,300 houses burned
2015 South Australia fires	Australia	2 lives lost and 88 houses burned

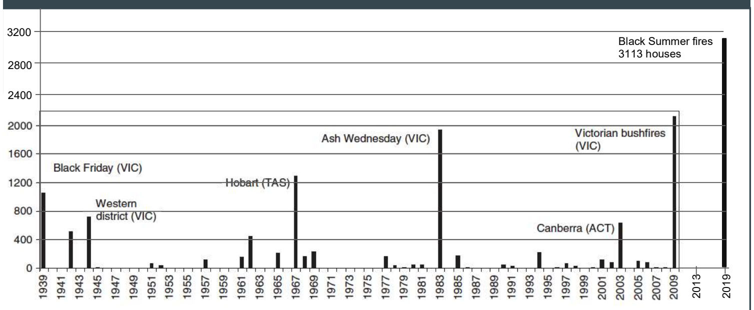
- Chile – wildfires in the tropical and temperate rainforests in 2014 and 2017 with 12 people killed and hundreds of homes destroyed
- Bolivia - 2017 wildfires resulted in 3 deaths, 1479 people injured and 3000 homes lost
- Sweden - 2014 wildfires killed one person, damaged or destroyed 71 buildings, and over 1000 people were evacuated
- Norway and Sweden - 2019 hundreds of people were forced to evacuate due to an extraordinarily high number of extreme wildfires



Greenland wildfires, 2017

Scotland wildfires, 2019

Number of houses destroyed in Australia



How big WUI and Built Environment is?

Continent	WUI, % (Chen et al, 2022)	Degree of urbanisation, % (statista.com)
North America	5.2	83
South America	5.2	81
Europe	13.0	75
Africa	4.1	44
Asia	3.6	52
Australia/Oceania	1.6	67
Global	4.4	57

Fire spread due to urban elements

Objectives and methodology

Aim

To develop the scientific understanding that will lead to new standards, testing methodologies, and mitigation strategies indicative of large outdoor fire exposures, including the ones from wildland to communities and within communities.

Status of the subgroup

Sub-group leaders: David Rush and Alex Filkov
Previous sub-group leader: Elsa Pastor, Daniel Gorham

Members: 124
[as of 17-October-2023]

Continent	Members #
North America (2)*	61
South America (2)	3
Europe (12)	36
Africa (2)	2
Asia (5)	12
Australia/Oceania (3)	10
Total	**124**

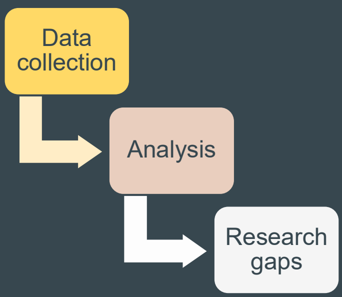
*the number in parentheses represents countries

Objectives and methodology

Topics

- IRC-1. Regulatory Framework and Standards Survey
- IRC-2. Fire exposure characterization
- IRC-3. Effectiveness of mitigation strategies in large outdoor fires

Objectives and methodology



Work Progress - Topic 1 - Standards survey

- Participant list (started in 2019)
  - Elsa Pastor
  - Alex Filkov
  - Asim Ibrahim
  - Maria Theodori
  - Daniel Gorham
  - Hideki Yoshioka
  - Eulàlia Planas

County	Documents
Australia	AS 1530.8 Parts 1 & 2 AS 3959 NASH 2014
United States	CBC Chapter 7A SFM Testing Standard 7A ASTM standard on external fire exposure
Japan	Building Standard Law Roof testing standard
France	XP CEN/TS1187 - 2014
Canada	FireSmart Guidebook - Alberta
International	FM Global NFPA 1144 ICC Wildland-Urban Interface Code

Work Progress - Topic 1 - Standards survey

Questions to address :

- Is it a standard explaining a method for fire testing? Is it a standard providing construction requirements? Is it a guideline providing construction advices? Etc.
- Who has developed the document? Where is this document being used? Is it mandatory by law in any region/country)?
- What are the types of large outdoor fire exposures considered in this document (flame contact, flame radiation, firebrands)? What are they representing? What are the elements receiving the fire exposure?

Work progress - Topic 2 - Fire exposures


Fire Safety Journal 140 (2023) 103871

Contents lists available at ScienceDirect

Fire Safety Journal

journal homepage: www.elsevier.com/locate/firesaf

ELSEVIER

A review of thermal exposure and fire spread mechanisms in large outdoor fires and the built environment

Alexander I. Filkov[a,*], Virginie Tihay-Felicelli[b], Nima Masoudvaziri[c], David Rush[d], Andres Valencia[e], Yu Wang[f], David L. Blunck[g], Mario Miguel Valero[h,p], Kamila Kempna[i], Jan Smolka[j], Jacques De Beer[k], Zakary Campbell-Lochrie[l], Felipe Roman Centeno[m], Muhammad Asim Ibrahim[n], Calisa Katiuscia Lemmertz[m], Wai Cheong Tam[o]

We would like to thank Torin Christensen for providing editorial feedback, Samuel Manzello and Sayaka Suzuki for their thoughtful comments and constructive feedback, Rafal Porowski for advising on the structure of subsection 3.3, and Daniel Gorham for initially managing subsection 2.1.

Work progress - Topic 2 - Fire exposures

- Started in October 2020, 2-year journey
- 16 co-authors
- 14 organisations
- 9 countries
- All continents except Africa
- 332 studies reviewed

Section 1: Wildland fire exposure to the built environment
- 2.1 Flame contact and convection
- 2.2 Radiation
- 2.3 Firebrands

Section 2: Settlement fire exposure to structures
- 3.1 Flame contact and convection
- 3.2 Radiation
- 3.3 Firebrands

Work progress - Topic 2 - Fire exposures

Findings
- Existing research has focused primarily on one mechanism of fire exposure (radiative, convective, or firebrands).
- Inconsistencies and differences in experimental protocols for measuring both flame and radiation under both laboratory and field conditions.
- Firebrand studies are largely limited to laboratory conditions and do not address all stages of spotting simultaneously.
- Significant lack of experimental data on the impact of fires on structures and fire transition between structures.
- Scarce post-incident data.
- Numerical studies lack full validation with experimental data and have limited applicability.

Work progress - Topic 3 - Fuel treatments/Mitigation strategies

Potential focus

1. Guidelines/recommendations on wildland, ornamental and man-made fuel treatments
2. Case studies on fuel treatment effectiveness
3. Fire resistant gardening guidelines
4. Mitigation strategies
5. Evidences of efficiency

Questions to discuss

- Topic 1: Are new standards needed? What constraints exist in improving or developing new standards?
- Topic 2: The review revealed gaps and inconsistencies. How should the fire safety community respond to these findings? What are the immediate steps forward?
- Topic 3: Is the topic still relevant or is there a new, emerging topic to consider?

Part 2 - Short presentations

Time	Content
30 min	Short presentations
30 min	Discussion

- Trent Penman *Landscapes to loss – combining knowledge over scales* (University of Melbourne)
- David Rush *Informal settlement fires – what are their next fire science imperatives* (University of Edinburgh)
- Hideki Yoshioka, Keisuke Himoto, and Koji Kagiya *Large urban fires in Japan: History and management* (The University of Tokyo, National Institute for Land and Infrastructure Management, Tohoku Institute of Technology)
- Pascale Vacca *Tackling the improvement of standards and guidelines to account for real fire exposure* (Universitat Politècnica de Catalunya)

Questions to discuss

- What immediate actions can be taken to improve the ignition resistance of communities?
- How can we influence policies and standards?
- What specific areas should be our focus?
- How can we collaborate with other scientific communities to improve ignition resistance of communities?
- What should be the future of IRC?

Thank you!

If you would like to join a WG, please sign up from the link below or using a QR code:

https://goo.gl/forms/0TMW2SbWi7mmHYlv1

Informal settlement fires: What are the next fire science imperatives.

Dr David Rush
University of Edinburgh

Informal settlements: the fire problem

ISs – unregulated spaces with little to no land rights.

Dense and combustible – extensive fire spread.

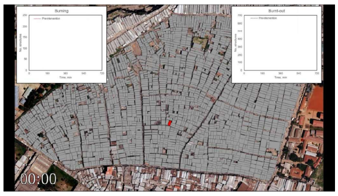
Urbanisation – increasing numbers of people in ISs (currently >1bn)

Cape Town (total) – 2009 – 3.5M
– 2023 – 4.9M

Large scale property loss:
Cape Town (≈5M ppl): **1612 fires, 11,279 homes destroyed** from 2009-2015

What we have learnt in past 5-10yrs

- Thermally thin compartment fire dynamics ≠ to global north knowledge
  - (times/temps to flashover, heat loss at boundaries etc.)
  - leakages at boundary v. important
- External flames size and fluxes lower than T-Thick compartments.
- Fire spread between structures
  - Separation distances +3m for "safety"
  - Heavily wind dependent!

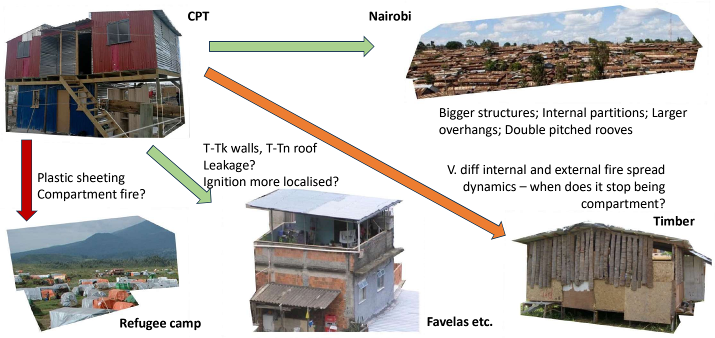


- Ability to model fire spread at scale starting to be developed
- Need more data to expand to full range of ISs

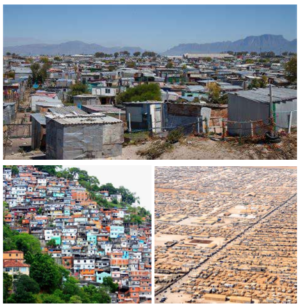
What still needs to be learnt in CPT?

- Fire spread driven by radiation and flame impingement
- More knowledge about **fire-wind interactions**
  - Modelling is OK, but need verification data
  - Both at single structure, and multiple structure configurations
- Interactions with
  - Burning rates, heat loss at boundaries, **flame shape and intensity,** convective cooling at "target"
- Nature of construction
  - Details of connections
  - Insulation?
- Fuel loads & types,
- Ignition sources
- **More mapped fires**
  - **Statistical and spatial analyses**
- **Topography??**

Extend CPT knowledge to other areas?



Extend CPT knowledge to other areas?



- S-S fire spread (e.g., shed-main)
  - Ideas/physics can transfer, but empirical correlations need to be specific
  - Topography – wind interaction will be important
  - Externally exposed ignitables?
- WUI
  - Different scales of physics at play (burning time, emitter areas, BRANDING)

THE UNIVERSITY of EDINBURGH Institute for Infrastructure and Environment

Conclusions

- We've learnt a lot about one area - Cape Town Informal Settlements
  - Still lots to learn there – particularly fire-wind interaction at compartment and settlement level.
- Can we extend this to other areas –
  - In certain places – yes – if typology is similar enough
  - Physics can transfer – empirical correlations cannot always
  - Will be situationally specific
- THEREFORE – need a lot of fire research to protect 1/8th of global population that is not currently well serviced
  - This doesn't go into how we then implement this knowledge!

LOF&BE: IRC (Ignition Resistant Communities) Workshop
Sunday 22 October 2023 – Tsukuba, Japan

"Large Urban Fires" in Japan - History and Management -

Hideki Yoshioka[1], Keisuke Himoto[2], and Koji Kagiya[3]

[1] The University of Tokyo
[2] National Institute for Land and Infrastructure Management
[3] Tohoku Institute of Technology

Contents

- History and examples of "large urban fires".
- Standard regulations on "large urban fires".
  – "City Planning Act", and "Building Standard Law".
- Brief introduction on "recent research projects".
- References

Urban Conflagrations in Edo Period

- Meireki Fire (1657)
  - 60% of urban area burnt
  - Castle tower burnt -> never reconstructed

Meireki Fire (1657)

Kanto Earthquake (1923)

Sakata Fire (1976)

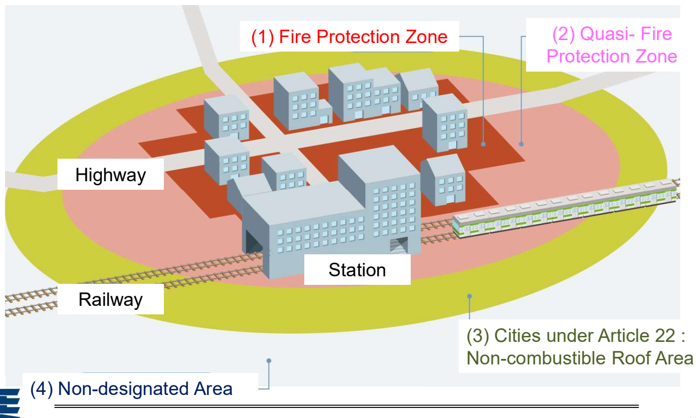
Kobe Earthquake (1995)

Tohoku Earthquake (2011)

Itoigawa Fire (2016)

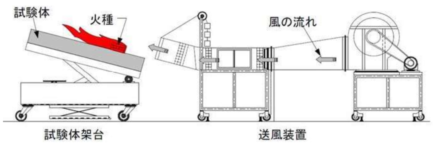
Standard Regulations on “large urban fires”

Concept of Zoning regulated by City Planning Act

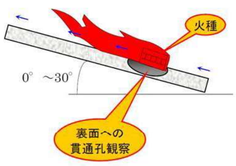


Roof test conducted in Japan Overview

In general, based on ISO 12468-1,
External exposure of roofs to fire -- Part 1: Test method

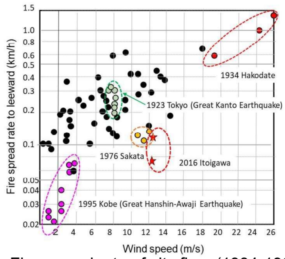


1.2m (W)
2.0m (L)

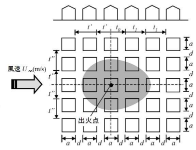


Research Activities 1940-1960's

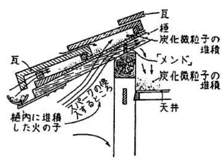
- Fire spread rate due to wind speed
- Firebrand scattering and accumulation behavior



Fire spread rate of city fires (1934-1960's) incl. recent fires Courtesy of Dr. Tokiyoshi Yamada



A formula of fire spread rate (by Hamada, 1951)

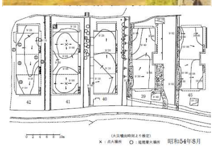


Accumulation of firebrand in a traditional Japanese wooden roof structure (by Kamei, 1960)

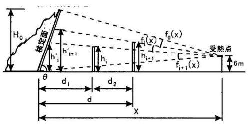
Research Activities 1980-2000's

- Comprehensive countermeasures against city fires

Test on the "shield effect" of green space and trees (1980)



Housing complex fire test in Saganoseki (1979)



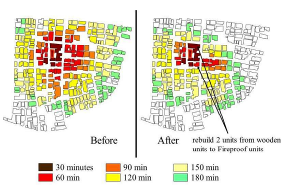
Comprehensive management technique of countermeasures (1982)

Research Activities 2000-

- Fire dynamics of wind effect on large outdoor fires
- Detailed physical simulation model of city fire

Joint research with NIST

Fire Research Wind Tunnel Facility (FRWTF) in BRI



Effect of countermeasures on fire spreading in a densely wooden built-up area

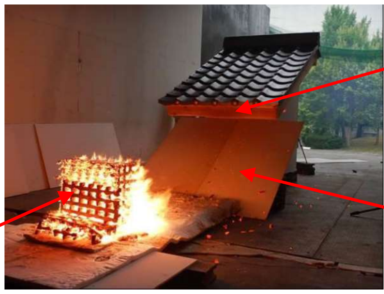
Application of JIS A 1310 (façade test): Fire spread to adjacent car

1.5 m distance.

Car tire caught fire at 19min 34sec.

After 20min, façade fire terminated.
Only “car fire” was observed.

Recent Experiments in Fire Wind Tunnel (BRI)



References: For More Details

- Hideki Yoshioka, Keisuke Himoto, and Koji Kagiya, “Large Urban Fires in Japan: History and Management”, Fire Technology, Volume 56, pp.1885–1901, 2020.
- ISO/TR 24188: 2022, “Large outdoor fires and the built environment — Global overview of different approaches to standardization”,
  - 5 Regulation principle and strategies
  - 6 Approach for roofing assemblies
  - 7 Approach for exterior walls and facades

Summary

- “Large urban fires” in Japan share common characteristics with “WUI fires”, in the mechanism of fire spread via flying fire brands with convection and radiation, within the scope of “large outdoor fires”.
- It is highly expected that LOF&BE (IAFSS) could make a contribution to mitigating the loss caused by those large fires, in conjunction with ISO/TC92/WG14, “Large outdoor fires and the built environment”.

Landscape risk

Presented by:

Professor Trent Penman

FLARE Wildfire Research, School of Ecosystem and Forest Science

I acknowledge the Traditional Owners of the land on which I work and live – the Wadawarrung and Dja Dja warrung. I pay my respect to their Elders (past and present) and families.

Landscape fire risk analysis

- Multi-million dollar industry
- Undertaken by
  - Fire and land management agencies
  - Energy network providers
  - Road and rail networks
  - Local governments
- Scrutinised by public, government and coronial inquiries

Landscape risk analysis

- Follows the risk principles set out in ISO 31000
- Seeks to identify the fire regime
  - Thousands of simulated fires
  - Weakly done through burn probability
- Identify the assets and locations most at risk
  - Commonly fixed assets
  - Environmental weak
  - Human health weaker

House loss in landscape risk

- Static values calculated primarily from fire front exposure
- Probabilistic function x number of houses per cell
- Usually ignores
  - Construction type
  - Garden/proximity to vegetation
  - Neighbour risk
  - Preparedness of household and neighbour
  - Suppression or suppression access

Improving risk estimates

- House loss models must
  - Defendable in court
  - Fit with fire simulation outputs
    - ROS, intensity, flame length or height, ember density
  - Be based on available or derivable data (state level)
  - Not be computationally expensive

IRC provide opportunities

- Local to landscape house loss
- Bring the combined expertise of fire engineers and landscape fire scientists together
- Seek to develop novel approaches to the derivation of house loss functions that are applicable globally
- Seeking interest/support for developing these collaborations

Thank you for listening

info@flarewildfire.com.au

flarewildfire.com.au

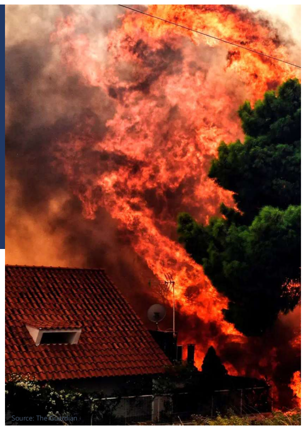
/flarewildfire

Tackling the improvement of standards and guidelines to account for real fire exposure

Pascale Vacca

LOF&BE IRC Workshop – IAFSS 2023
Tsukuba, Japan

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Centre for Technological Risk Studies



TACKLING THE IMPROVEMENT OF STANDARDS AND GUIDELINES TO ACCOUNT FOR REAL FIRE EXPOSURE

IRC AIMS

Detect knowledge gaps to provide recommendations for future research and standard development

Tackle the need of improving standards for real fire exposures

CURRENT NEEDS

Review whether current standards and guidelines for the **quantification of fire exposure** and for the **testing** of construction elements and materials reflect real fire exposure mechanisms

- What type of fire exposures are accounted for and what are not?
- What parameters should be re-defined?
- Should fire exposure scenario selection be re-evaluated?

Abstracts of the invited talks (EME) (in an alphabetical order)

Large-scale urban fires in low-income areas: Where to next?
By Natalia Flores-Quiroz/Richard Walls (Stellenbosch University)

In recent years there has been a focus on understanding fires in low-income settlements (LIS) (i.e., informal settlements, refugee camps, tented shelters). Studies have analysed topics such as fire dynamics, construction materials, separation distances, and risk perception. However, most of the research has focused on experimental work in informal settlements and on a limited number of countries. The reasons behind this are associated to the difficulty to document real LIS fires, accessing and interacting with LIS residents, and the lack of fire engineers in Low- and Middle-Income Countries. As the LOF&BE group moves forward we need to find out how to assist those on the frontline in making LISs safer. They are the people that have the greatest impact, and empowering them to make informed decisions could have far-reaching consequences. In order to achieve this, efforts should be placed on understanding (1) different settlements characteristics and culture, (2) community response, (3) real fires in LIS. This will also provide critical information to obtaining data for modelling spread, understanding human behaviour, identifying challenges and finding solutions. In this presentation we will focus on identifying areas where effort should be placed in order to improve fire safety in LIS.

Emerging emergency management issues in Taiwan- existing building fire safety
By Chia Lung (Farian) Wu (Chang Jung Christian University)

A typical emergency/disaster management comprises four phases: mitigation, preparedness, response, and recovery. The better the mitigation and preparedness will be easier to reduce the possible casualties in fire. However, as the buildings tend to be older, some lack maintenance, and most of the time, the AHJs may be unable to ensure that fire safety is at the same levels as before, even if the regulation empowers regular inspections. The problems in Taiwan were mainly focused on ‘who will be taking the responsibilities’ rather than digging into the fundamental issues we are facing. In this presentation, we will provide fire cases to discuss the current issues to identify what we can do more if there is not possible to rebuild new buildings and what the strategies maybe focus on

Abstracts of the invited talks (IRC) (in an alphabetical order)

Landscapes to loss – combining knowledge over scales
By Trent Penman (University of Melbourne)

Risk from wildfires to communities has become increasingly important, with many government policies and decision-making process based on these estimates of fire risk. Risk to individual houses and communities is a function of the landscape fire which is predominantly affected by the weather, topography and vegetation as well as the vulnerability of the house/community which is more based on the building design, access and egress options and community knowledge of fire. To develop and improve risk model standards we need to merge the two fields of research. We propose a working group to facilitate this approach. The new sub-group within LOFBE will bring together landscape fire scientists, engineers and social scientists to develop, test and implement the next generation of fire house loss models.

Informal settlement fires – what are their next fire science imperatives
By David Rush (University of Edinburgh)

Over the past 5-10 years, there has been a lot of fire science research on the South African Typology of informal settlements and their dwellings. This short talk will briefly describe what we do and don't know from that research and therefore what the next research questions should be that will aid in protecting these vulnerable communities. Parallels with WUI fires and other urban fire scenarios will be highlighted.

Large urban fires in Japan: History and management
By Hideki Yoshioka, (The University of Tokyo) Keisuke Himoto, (National Institute for Land and Infrastructure Management) and Koji Kagiya, (Tohoku Institute of Technology)

In Japan, ''Taika'' (large urban fire) is a fire when the total burnout floor area is 33,000 m^2 or more. This presentation first discusses the history of large urban fires in Japan, then examines the national standard regulations for fire safety in Japan aimed at mitigating the damage caused by those fires. Finally, an overview of current scientific research in methods of controlling urban fires in Japan is provided. Some parts of this presentation have been briefly introduced in *Fire Technology* paper in 2020 and ISO/TR 24188: 2022.

Tackling the improvement of standards and guidelines to account for real fire exposure
By Pascale Vacca (Universitat Politècnica de Catalunya)

As the different fire exposure mechanisms in WUI and settlement environments have been identified, there is a need to review whether current standards and guidelines for the quantification of fire exposure and for the testing of construction elements and materials reflect real fire exposure mechanisms. This review would highlight what type of fire exposures are accounted for and what are not, what parameters should be re-defined when considering the different exposure mechanisms, and whether fire exposure scenario selection should be reevaluated. In this regard, the collection of quantitative data form real fires is key in the parametrization of real fire exposure.