NIST Special Publication 1235

Summary of Workshop on Global Overview of Large Outdoor Fire Standards

Organized in Conjunction with ISO TC92 Task Group 03

Samuel L. Manzello

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National Institute of Standards and Technology
U.S. Department of Commerce

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Engineering Laboratory

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February 2019

U.S. Department of Commerce
Wilbur L. Ross, Jr., Secretary

National Institute of Standards and Technology
Walter Copan, NIST Director and Under Secretary of Commerce for Standards and Technology

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Abstract

Large outdoor fires have the potential to negatively impact the built environment. Wildland fires that spread into communities, known as wildland-urban interface (WUI) fires, have become a global problem. Large urban fires, including those that have occurred after earthquakes, are another example of large outdoor fires. Once a WUI fire reaches a community, a large urban fire may develop. Presentations were delivered related to national and regional summaries from across the globe of large outdoor fire standards intended to make communities less vulnerable to these fires. Understanding from these national and regional summaries will be used as a basis for future standardization work on this topic in ISO TC92.

Key words

Large Outdoor Fires; Urban Fires; Wildland-Urban Interface (WUI) Fires

Table of Contents

1. Introduction

1.1. Workshop Objectives

Large outdoor fires have the potential to negatively impact the built environment. Wildland fires that spread into communities, known as wildland-urban interface (WUI) fires, have become a global problem. Large urban fires, including those that have occurred after earthquakes, are another example of large outdoor fires. Once a WUI fire reaches a community, a large urban fire may develop. Presentations were delivered related to national and regional summaries from across the globe of large outdoor fire standards intended to make communities less vulnerable to these fires. Understanding from these national and regional summaries will be used as a basis for future work on this topic in ISO TC92.

1.2. Program of the Workshop

Welcome/Goals/Objectives (9:00 am)
Samuel Manzello, National Institute of Standards and Technology (NIST), ISO TC92 TG03 Convener, USA

Current Wildland-Urban Interface (WUI) Building Codes and Standards in the USA (9:40 am)
Daniel Gorham and Stephen Quarles, Insurance Institute for Business & Home Safety (IBHS), USA

A Review of Design Guidance on Wildland-Urban Interface (WUI) Fires (10:00 am)
Paolo Initini, Lund University, Sweden and Polytechnic University of Bari, Italy
Enrico Ronchi, Lund University, Sweden
Steven Gwynne and Noureddine Bénichou, National Research Council, Canada

Wildland-Urban Interface (WUI) Fires in Spain: Summary of the Policy Framework and Recommendations for Improvement (10:20 am)
Elsa Pastor, Universitat Politècnica de Catalunya-Barcelona Tech (UPC), Spain

Large Urban Fires in Japan – History and Management (10:40 am)
Hideki Yoshioka, National Institute for Land and Infrastructure Management (NILIM), Japan
Keisuke Himoto, National Institute for Land and Infrastructure Management (NILIM), Japan
Koji Kagiya, Building Research Institute (BRI), Japan
Takeyoshi Tanaka, Kyoto University, Japan

Regulatory Controls for Buildings in Bush-fire Prone Areas in the Oceania Region (11:00 am)
Greg Baker, Olsson Fire & Risk, New Zealand
Alex Webb, CSIRO Infrastructure Technologies, Australia
Peter Whiting, BRANZ Ltd, New Zealand

Concluding Remarks/Next Steps
Samuel Manzello, National Institute of Standards and Technology (NIST), ISO TC92 TG03 Convener, USA

1.3. List of Registered Participants (Alphabetical Order by Surname)

Alfredo Arnedo (SENER, Spain)
Noureddine Bénichou (National Research Council, Canada)
Jungmin Choi (Fire Insurers Laboratories of Korea, Korea)
Horacio Colina (ATILH, France)
Rita Fahy (National Fire Protection Association, USA)
Daniel Gorham (Insurance Institute for Business & Home Safety, USA)
Eric Guillaume (Efectis, France)
Tetsuya Hayakawa (TSV, Japan)
Yoshihiro Hase (Mitsubishi Chemical, Japan)
Kazunori Harada (Kyoto University, Japan)
Patrick van Hees (Lund University, Sweden)
Anja Hofmann (BAM, Germany)
Paolo Intini (Lund Unversity, Sweden/Polytechnic University of Bari, Italy)
Koji Kagiya (Building Research Institute, Japan)
Yangkyun Kim (Korea Institute of Civil Engineering and Building Technology, Korea)
Samuel Manzello (National Institute of Standards and Technology, USA)
Brian Meacham (Meacham Associates, USA)
Tensei Mizukami (National Institute for Land and Infrastructure Management, Japan)
Hirokazu Murohoshi (IIBH, Japan)
Tomohiro Naruse (National Institute for Land and Infrastructure Management, Japan)
Kyriakos Papaioannou (Aristotle University, Greece)
Elsa Pastor (Universitat Politècnica de Catalunya-Barcelona Tech, Spain)
John Roberts (LRI Engineering, Canada)
Enrico Ronchi (Lund University, Sweden)
Yichul Shin (Fire Insurers Laboratories of Korea, Korea)
Benoit Smerecki (AFNOR, France)
Joseph Su (National Research Council, Canada)
Junichi Suzuki (National Institute for Land and Infrastructure Management, Japan)
Manuela Tancogne-Dejean (ATILH, France)
Yongho Yoo (Korea Institute of Civil Engineering and Building Technology, Korea)
Hans van de Weÿgert (IFC, UK)
Colleen Wade (BRANZ, New Zealand)
Elizabeth Weckman (University of Waterloo, Canada)
Jürgen Weise (Halfkann Kirchner, Germany)
Hideki Yoshioka (National Institute for Land and Infrastructure Management, Japan)

2. Summary and Next Steps

A total of 35 global experts participated, representing Canada, France, Germany, Greece, Italy, Japan, Korea, New Zealand, Spain, Sweden, United Kingdom, and USA. The workshop was organized to further explore the justification of activities in ISO TC92 for this topic, and how to properly align it in the organization of TC92. Presenters were asked to highlight gaps and specific standards needs in their regions.

Manzello (NIST, ISO TC92 TG03 convener, USA) kicked-off the workshop and presented the TG03 roadmap that was sent to all TC92 members on December, 2017 (3-month open comment period until March, 2018). Again, this roadmap motivated the need for the workshop. As part of the opening presentation, Manzello discussed the newly approved

International Association for Fire Safety Science (IAFSS) permanent working group on Large Outdoor Fires and the Built Environment [1] and also presented the recent paper he developed for the International FORUM of Fire Research Directors [2], on Wildland-Urban Interface (WUI) fires, a part of Large Outdoor Fires and the Built Environment. The IAFSS working group is bringing the full depth of knowledge of the entire IAFSS community to the large outdoor fire problem. Mr. Daniel Gorham (IBHS, USA) presented an overview of USA codes and standards focused on WUI fires. Mr. Gorham discussed some specific IBHS research, with firebrand ignition being a need to address current gaps in USA codes and standards.

Dr. Paolo Intini (Lund University, Sweden/Polytechnic University of Bari, Italy) presented an overview of WUI codes and standards across multiple continents. Gaps and inconsistencies in global WUI codes and standards were the focus of his presentation. Dr. Elsa Pastor (Universitat Politècnica de Catalunya, Spain) presented an overview of the WUI situation in Spain, highlighting current standards and codes shortcomings in Spain. Dr. Hideki Yoshioka (NILIM, Japan) presented an overview of the large outdoor fire and the built environment situation in Japan. His presentation focused on large urban fires, common in Japan, and another component to the large outdoor fire and the built environment problem. Dr. Greg Baker (Olsson Fire & Risk, New Zealand) presented remotely (unable to come) and provided an overview of bushfire standards and codes in the Oceania region.

Manzello (NIST, ISO TC92 TG03 Convener, USA) closed the workshop and indicated a special section will be developed for the journal *Fire Technology*, as presenters will prepare papers. Finally, the audience was queried for new suggestions for potential Work Items (WI) in the event a new Working Group is formed under ISO TC92 on this topic. The current TG03 roadmap, that was presented, has many potential WI, and TG03 will prioritize these.

3. Acknowledgments

The support of the Netherlands Standardization Institute, known as NEN, is greatly appreciated as the local host for the ISO TC92 meetings. In particular, SLM would like to thank Dr. Rob Kotte of NEN for his support in setting up this workshop at the Westcord Hotel in Delft. Dr. Enrico Ronchi (Lund University, Sweden), Dr. Mohamad El Houssami (Plastics Europe, France), and Dr. Nourredine Bénichou (NRC, Canada) are appreciated for volunteering as the organizing committee on behalf of TG03.

References

[1] S.L. Manzello, S. McAllister, and S. Suzuki, Large Outdoor Fires and the Built Environment: Objectives and Goals of Permanent IAFSS Working Group, *Fire Technology*, 54:579-581, 2018.

[2] S.L. Manzello, K. Almand, E. Guillaume, S. Vallerent, S. Hameury, and T. Hakkarainen, FORUM Position Paper, The Growing Global Wildland Urban Interface (WUI) Fire Dilemma: Priority Needs for Research, *Fire Safety Journal*, 100:64-66, 2018.

Appendix A: List of Presentations Delivered at the Workshop

Large Outdoor Fires and the Built Environment

ISO TC 92 Task Group 3

Dr. Samuel L. Manzello, Leader
Fire Research Division
National Institute of Standards and Technology (NIST), USA
Invited Guest Researcher
Building Research Institute (BRI), Japan
National Research Institute of Fire and Disaster (NRIFD), Japan
samuelm@nist.gov

Committee member	AFNOR	France	A - Industry and commerce	M.	El Houssami, Mohamad
Committee member	AFNOR	France	F - Standards application	M.	Guillaume, Eric
Committee member	AFNOR	France	A - Industry and commerce	M.	Parisse, Dominique
Committee member	ANSI	United States	A - Industry and commerce	Dr	Fahy, Rita
Committee member	ANSI	United States	A - Industry and commerce	Mr	Gorham, Daniel
Committee member	ASI	Austria	F - Standards application	Mr.	Eisenbeiss, Arthur
Committee member	JISC	Japan	B - Government	Dr	Himoto, Keisuke
Committee member	JISC	Japan	B - Government	Dr	Kagiya, Koji
Committee member	JISC	Japan	G - Non-governmental organization (NGO)	Mr	Murohoshi, Hirokazu
Committee member	JISC	Japan	B - Government	Ph. D.	Yoshioka, Hideki
Committee member	NEN	Netherlands	A - Industry and commerce	Mr	Both, C.
Committee member	NEN	Netherlands	A - Industry and commerce	Mr.	Weghorst, R.
Committee member	SCC	Canada	B - Government	Dr.	Benichou, Noureddine
Committee member	SCC	Canada	E - Academic and research bodies	Mr	Garis, Len
Committee member	SCC	Canada	A - Industry and commerce	Ms	van Zeeland, Ineke
Committee member	SCC	Canada	E - Academic and research bodies	Prof.	Weckman, Elizabeth
Committee member	SIS	Sweden	A - Industry and commerce	Mr	Albinsson, David
Committee member	SIS	Sweden	A - Industry and commerce	Ms	Ekström, Karin
Committee member	SIS	Sweden	A - Industry and commerce	Mr	Ronchi, Enrico
Document monitor	DIN	Germany	-	Mr Dipl.-Ing.	Brunner, Jens
Document monitor	JISC	Japan	-	Ms	Suzuki, Takako
Document monitor	SIS	Sweden	-	Ms	Ekström, Karin
Document monitor	SIS	Sweden	-	Mrs	Odlén, Viveka
Technical programme manager	ISO	-	-	Dr	Rossi, Anna Caterina

ISO TC 92
Task Group 3

Current Roster

Global Standardization Roadmap for ISO TC92

Charged as TG Leader to Develop:
Global Standardization Needs Roadmap for
Large Outdoor Fires and the Built Environment

Balloted December 2017; Closed March 2018

No negative comments

Roadmap was put in presentation format to be easily digested!

ISO

Document: ISO/TC 92/ N 1222

Date: 18 December 2017

Secretariat of ISO/TC 92
Fire Safety

BSI – United Kingdom, Bernd Borchert
bernd.borchert@bsigroup.com

ISO/TC 92/TG 3 - presentation

Dear Member,

ISO/TC 92/TG 3 - Large Outdoor Fires and the Built Environment – has prepared the attached presentation and asks members of ISO/TC 92 for any comments.

Please submit any comments you might have to the Secretary (bernd.borchert@bsigroup.com) by

02 March 2018

the latest.

Kind Regards,

Bernd Borchert
Secretary to ISO/TC 92

Roadmap

Large Outdoor Fires and the Built Environment

- Wildfires that spread into communities, known as Wildland-Urban Interface (WUI) fires have destroyed communities throughout the world
- Large outdoor fires that pose risk to built environment are urban fires in Japan

2014 Chile Fires

2016 Itoigawa City Fire

1995 Kobe Earthquake

1976 Sakata Fire

2015 Southern California Fires

Large Outdoor Fires and the Built Environment

- WUI fire problem important in Canada, France, Portugal, Spain, Italy, and Greece, Chile, Argentina, Brazil, and Australia
- USA:
  - An average of 75,000 wildland fires consumes a total of 7 million acres of forest land on average each year
  - Roughly, 2-3% of these fires spread into adjacent urban areas, resulting in an average loss of approximately 3000 homes
  - Seven of the fifteen largest U.S. fire loss incidents in this period were WUI fires, with an average property value dollar loss of $1.4 billion – does not include recent California fires
  - Concurrently, the U.S. WUI areas continue to grow; at least 46 million structures are located in these areas comprising over 70,000 communities and affecting 120 million people

Large Outdoor Fires and the Built Environment

- British Columbia (Canada)

Provincial Statistics - 2017

Fire Season Comparison (to September 27,2017)

	Fires	Human	Lightning	Hectares	Cost	Cost/Ha
2017	1,255	486	767	1,212,469	$545,428,380	$449.85
2016	1,050	564	486	100,366	$129,000,000	$1,285.30
2015	1,858	617	1,137	280,605	$277,100,000	$987.51
2014	1,481	664	817	369,168	$297,900,000	$806.95
2013	1,861	564	1,297	18,298	$122,200,000	$6,678.33
2012	1,649	708	941	102,122	$133,600,000	$1,308.24
2011	653	444	209	12,604	$53,500,000	$4,244.68
2010	1,672	680	992	337,149	$212,200,000	$629.40
2009	3,064	881	2,183	247,419	$382,100,000	$1,544.34
2008	2,023	848	1,175	13,240	$81,154,492	$6,129.49
10 Year Average (2007-2016)	1,692	666	1,026	151,041	-	-

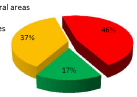
Large Outdoor Fires and the Built Environment

- Portugal:
  - In 2017, burned area above 530kha (compared to the previous maximum of 430kha in 2003), with >110 fatalities, hundreds of houses destroyed, and more than ten industrial, commercial, and service areas affected
- Spain:
  - An average of 12,500 fires consumes a total of 90.000 ha on average per year (2007-2016)
  - Compared to the last decade, a decrease is observed in number of fires (41% reduction) and burnt surface (33%)
  - However, the number of large fires (> 500 ha) is increasing, being responsible of the 37% of burnt area in average (period 2007-2016)
  - Spain has 1,1 million hectares of WUI (more than 4% of the total forested area)
  - 90% of developments at the WUI do not have a self-protection plan (although such plans are required by the Spanish current regulations)
  - Social aspects: there is a general lack of awareness at community level

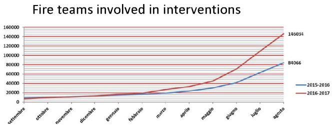
Large Outdoor Fires and the Built Environment

- Italy:
  - Wildfires are a large issue in Italy
  - 2016/2017 showed significant increase
  - 50,000 ha burnt in summer 2017 alone
  - Over 220,000 interventions (including all means) in 2016/2017 (vs 130,000 in 2015/2016)

Yellow: Agricultural areas
Red: Bush fires
Green: Forest fires



Fire teams involved in interventions



Canadair interventions, summer 2017

All data from AIB, Antincendi boschivi

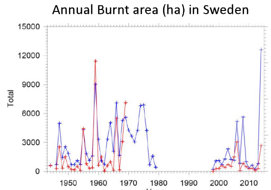
Large Outdoor Fires and the Built Environment

- France:
  - In metropolitan France, there are 16 million hectares (ha) of forest, i.e. 30 per cent of French territory
  - The area of combustible zones increased by 20 per cent between 1975 and 2007 as a result, notably, of relinquishing of agricultural land
  - Woodlands in southern France are potentially highly combustible because of the types of trees and the climate
  - 6,000 French municipalities are classed as "at risk from wildfire", i.e. one municipality out of six
  - Three-quarters of the French municipalities that have experienced fires are in the southern half of the country
  - In 2008, with 2,781 wildfires, France ranked 8th amongst European countries most affected by wildfires
  - Each year, on average, there are 4,000 outbreaks of fire and 24,000 ha of forest are burned in metropolitan France
  - The number of fires is tending to stagnate, while the areas burned are reducing as a result of early intervention, of the monitoring tools used by the firefighting and rescue services and of forest management
  - Less than 2 per cent of fires spread over an area greater than 100 ha
  - 90 per cent human in origin for those fires for which the cause is known, fires generally have harmful effects on ecosystems and are a hazard for structures within or close to the risk area
  - The regions at risk from wildfire are expected to extend significantly towards the regions of northern France by 2040 as a result of the climate change predicted by climatologists

Large Outdoor Fires and the Built Environment

- Sweden:
  - Wildfires in Sweden are not common or widespread, but the wildfires can be severe
  - High risk of more frequent large fires due to the projected drier summer in the future , especially in Southern Sweden

Annual Burnt area (ha) in Sweden



Västmanland fire in 2014 was the largest wildfire in recent decades in Sweden [area of 138 km^2, 70 properties damaged/destroyed, 1 death, evacuation of 1000+ people, total estimated cost of 1 billion SEK]

Large Outdoor Fires and the Built Environment

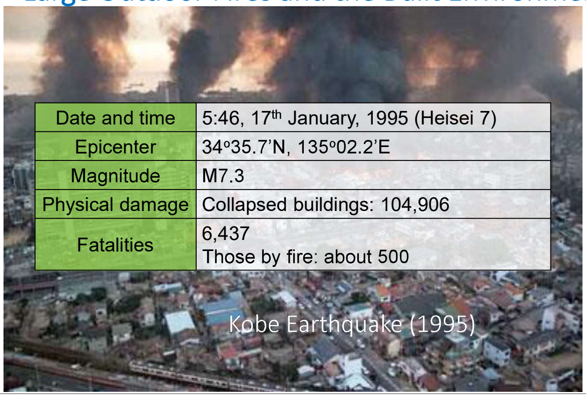
Itoigawa City Fire (May 19, 2017)

Largest urban fire in Japan since 1976 (not caused by earthquake)

Importance of understanding firebrand exposure

147 structures were damaged by fire
with 120 of 147 destroyed

Large Outdoor Fires and the Built Environment



Date and time	5:46, 17th January, 1995 (Heisei 7)
Epicenter	34°35.7'N, 135°02.2'E
Magnitude	M7.3
Physical damage	Collapsed buildings: 104,906
Fatalities	6,437 Those by fire: about 500

Large Outdoor Fires and the Built Environment

Damage by Fire - Kobe Earthquake

Number of ignitions				Building area burnt
building	vehicle	others	total	
２６９件	９件	１５件	２９３件	８３５，８５８㎡

Urban area of about 62ha

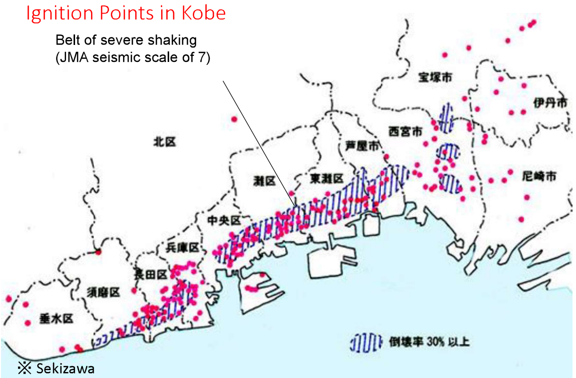
用途等 / 焼損区分	Hyogo Prefecture	Other prefectures			total
		住家	非住家		
			公共建物	その他	
Totally burnt	７，０３５棟	１棟	０棟	０棟	７，０３６棟
半焼	８９棟	５棟	０棟	２棟	９６棟
部分焼	３１３棟	８棟	２棟	１０棟	３３３棟
ぼや	９７棟	６棟	１棟	５棟	１０９棟
合計	７，５３４棟	２０棟	３棟	１７棟	７，５７４棟

※兵庫県の住家・非住家の別については不明

※ 消防庁確定報

Large Outdoor Fires and the Built Environment

Ignition Points in Kobe



※ Sekizawa

Large Outdoor Fires and the Built Environment

- Large outdoor fires present a risk to the built environment
- Wildfires that spread into communities, referred to as Wildland-Urban Interface (WUI) fires
- WUI fires are a growing problem in fire safety science
- Another example are large urban fires, including those that have occurred after earthquakes
- May involve multi-risk emergencies: forest fire, urban fire, toxic smoke dispersion, industrial disasters due to cascade effects (e.g. hydrocarbon fires and explosions)
- Complexity increased due to the fire effects on critical infrastructure: road networks, electrical facilities, power lines and systems

Large Outdoor Fires and the Built Environment

- Over the past several decades, fire safety science research has spent a great deal of effort 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
- Fire spread in large outdoor fires is very complex, involving the interaction of topography, weather, vegetation, and structures
- At the same time, common characteristics between fire spread in WUI fires and urban fires have not been fully exploited
- Once a wildland fire reaches a community and ignites structures, structure-structure fire spread can occur under similar mechanisms as in urban fire spread

Large Outdoor Fires and the Built Environment

- Our task: Propose global standardization needs roadmap for this topic to ISO TC92

Large Outdoor Fires and the Built Environment

- Recent ASTM workshop looked at WUI codes and standards issues
- Finding: current WUI codes/standards not adequate

NIST Special Publication 1198

Summary of Workshop on Structure Ignition in Wildland-Urban Interface (WUI) Fires

Sponsored by ASTM International E05 Committee

Samuel L. Manzello
Stephen L. Quarles

This publication is available free of charge from: http://dx.doi.org/10.6028/NIST.SP.1198

ASTM INTERNATIONAL Standards Worldwide

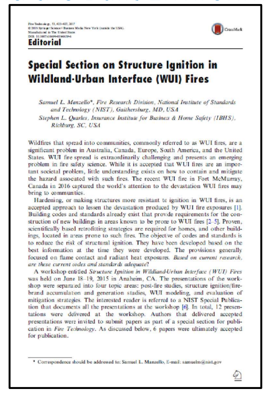
NIST National Institute of Standards and Technology U.S. Department of Commerce

Large Outdoor Fires and the Built Environment

Recent ASTM workshop looked at WUI codes and standards issues

Special Issue Published

March, 2017 Fire Technology



Editorial

Special Section on Structure Ignition in Wildland-Urban Interface (WUI) Fires

Samuel L. Manzello, Fire Research Division, National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA*
Stephen L. Quarles, Insurance Institute for Business & Home Safety (IBHS), Richburg, SC, USA

Wildfires that spread into communities, commonly referred to as WUI fires, are a significant problem in Australia, Canada, Europe, South America, and the United States. WUI fire spread is extraordinarily challenging and presents an emerging problem in fire safety science. While it is accepted that WUI fires are an important societal problem, little understanding exists on how to contain and mitigate the hazard associated with such fires. The recent WUI fire in Fort McMurray, Canada in 2016 captured the world's attention to the devastation WUI fires may bring to communities.

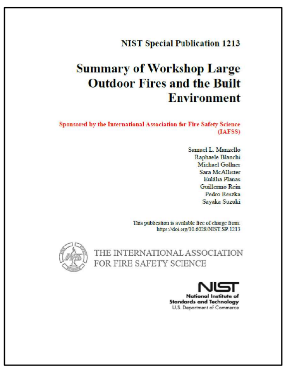
Hardening, or making structures more resistant to ignition in WUI fires, is an accepted approach to lessen the devastation produced by WUI fire exposures [1]. Building codes and standards already exist that provide requirements for the construction of new buildings in areas known to be prone to WUI fires [2–5]. Proven, scientifically based retrofitting strategies are required for homes, and other buildings, located in areas prone to such fires. The objective of codes and standards is to reduce the risk of structural ignition. They have been developed based on the best information at the time they were developed. The provisions generally focused on flame contact and radiant heat exposures. *Based on current research, are these current codes and standards adequate?*

A workshop entitled *Structure Ignition in Wildland-Urban Interface (WUI) Fires* was held on June 18–19, 2015 in Anaheim, CA. The presentations of the workshop were separated into four topic areas: post-fire studies, structure ignition/firebrand accumulation and generation studies, WUI modeling, and evaluation of mitigation strategies. The interested reader is referred to a NIST Special Publication that documents all the presentations at the workshop [6]. In total, 12 presentations were delivered at the workshop. Authors that delivered accepted presentations were invited to submit papers as part of a special section for publication in *Fire Technology*. As discussed below, 6 papers were ultimately accepted for publication.

* Correspondence should be addressed to: Samuel L. Manzello, E-mail: samuelm@nist.gov

Large Outdoor Fires and the Built Environment

- Recent IAFSS workshop – look at problem from global perspective



NIST Special Publication 1213

Summary of Workshop Large Outdoor Fires and the Built Environment

Sponsored by the International Association for Fire Safety Science (IAFSS)

Samuel L. Manzello
Raphaele Blanchi
Michael Gollner
Sara McAllister
Eulàlia Planas
Guillermo Rein
Pedro Reszka
Sayaka Suzuki

This publication is available free of charge from: https://doi.org/10.6028/NIST.SP.1213

THE INTERNATIONAL ASSOCIATION FOR FIRE SAFETY SCIENCE

NIST National Institute of Standards and Technology U.S. Department of Commerce

Large Outdoor Fires and the Built Environment

Key thoughts

As this problem encompasses so many areas, why not develop entire new structure for ISO TC92 to properly address it?

ISO TC92 SC5: Large Outdoor Fires and the Built Environment

WG1: More Ignition Resistant Communities

Develop representative standard test methods indicative of the exposures

WG2: Evacuation, Emergency Management

Develop effective emergency management strategies for communities exposed to large outdoor fires

WG3: Large Outdoor Firefighting

Develop global overview of various tactics that are used, as well as the various personal protective equipment (PPE)

WG4: Environmental Issues

Environmental issues related to both suppressing large outdoor fires, as well the exposure to products of combustion from these fires

The Following Slides Have Specific Suggestions

Large Outdoor Fires and the Built Environment

Workshop – Delft 2018

Global Overview of Current Large Outdoor Fire Standards

- WUI fire standards
- Urban fire standards – methods to mitigate structure to structure spread
  - Once WUI fire reaches communities – urban fire problem
- Invite several key speakers
- Document presentations in joint ISO/NIST Special Publication
- Publish Special Issue in one of the main fire journals

Large Outdoor Fires and the Built Environment

Workshop – Delft 2018

Global Overview of Current Large Outdoor Firefighting Methods and Equipment

- In collaboration with ISO TC92 task group 02 (firefighting)
  - In the case of wildland-urban interface (WUI) fires, wildland firefighters are well versed in tactics to deal with the wildland fires, and structural firefighters are well versed in tactics to deal with traditional structure fires
  - At the WUI there are great challenges as the wildland fire spreads into the community
  - ISO/NIST Special Publication on a global overview of various methods that are used, as well as the various personal protective equipment (PPE)
  - The PPE are quite different between wildland and structural firefighting
  - Obviously, TC92 would not suggest any changes to the various tactics or PPE used, but such a document would be useful for the fire safety science research community, in general, to grasp the nature of the challenges faced by firefighters, especially in the WUI
  - It would hopefully result in more engagement in the global fire safety science research community to the challenges faced by firefighters in a broad sense

Large Outdoor Fires and the Built Environment

Future Suggestions for SC5: WG1 to WG4

If no SC5, work items as a Working Group under ISO TC92?

Large Outdoor Fires and the Built Environment

- Standardized real scale combustibility tests such as burning rate, flame geometry of residential vegetation and artificial fuels
  - Flammability of ornamental fuels has been studied analytically in laboratories giving comparative data among species but there is poor information about real burning characteristics
  - Structural fuels impact and interaction at WUI is even less understood than natural fuels
  - Standardized real scale vulnerability tests of building systems
  - Tested at real scale under a standardized protocol
  - Harmonization on firebrand testing/assessment
  - Ignitions from isolated 'pockets' of fire – spewing, flaming liquid from tanks
- WUI standard definition and classification
  - There are several definitions and classifications around the world that should be gathered, compared, and adapted to the different realities according to an harmonized system

Large Outdoor Fires and the Built Environment

Roadmap for developments in incident modelling

- Different modelling components to be improved (with new data and sub-models)
  - Human response modelling (e.g. evacuation decision, etc.)
  - Fire modelling (e.g. smoke and firebrand spread, impact of vegetation management, etc.)
  - Pedestrian modelling (e.g. representation of behavioural itineraries, etc.)
  - Traffic modelling (e.g. sub-model for driving in smoke, transport mode choice, etc.)
  - Smoke transport
- General modelling gaps for all modelling components
  - Expand the importing of real data from sensors/reports, etc.
  - Tool for the assessment of required level of refinement/granularity (from simple to refined)
  - Integration/coupling of modelling components
  - Modelling emergency response intervention
  - Addressing real-time application issues vs use for evacuation planning

Large Outdoor Fires and the Built Environment

Roadmap for developments in risk modelling

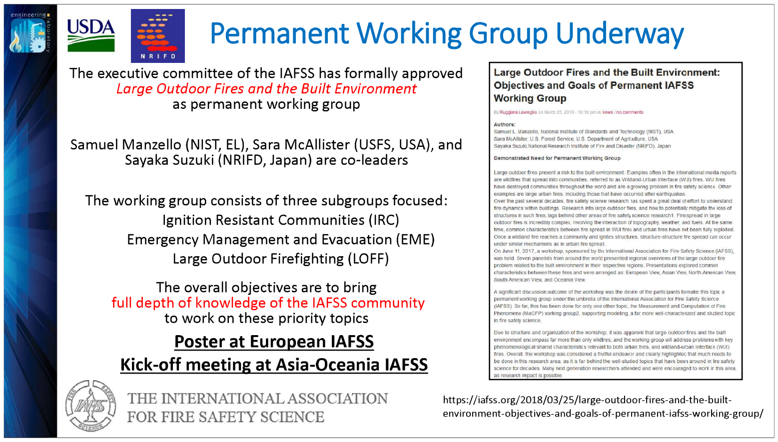
Other modelling efforts:

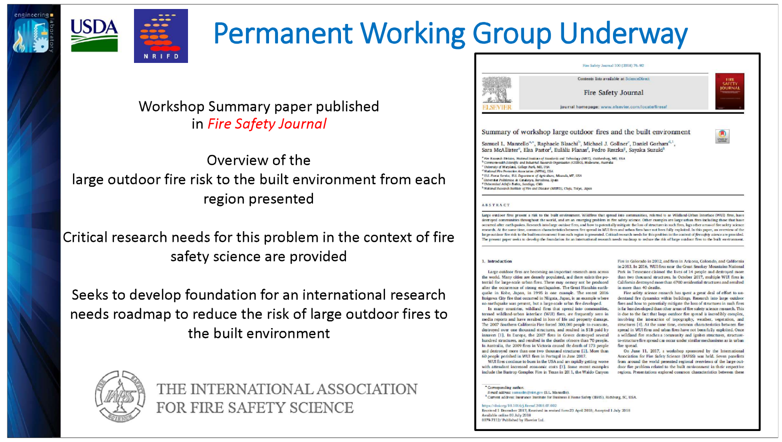
- Risk Indexes for WUI developments
  - Indexes which might help to discriminate high/low risk WUI developments, according to urban planning (population type and density, vulnerable elements, etc.), to the ease/difficulty of fire fighting deployment (accessibility, fire hydrants availability, etc.) to the expected wildfire intensity in the surroundings (driven by characteristic slope, wind, and fuels)
- Risk indexes for WUI homes/lots (micro-scale)
  - Indexes or protocols which might help to discriminate defensible/indefensible lots or homes
  - Indexes and protocols which might help to identify inherently safe homes/spaces to be used as shelters

Large Outdoor Fires and the Built Environment

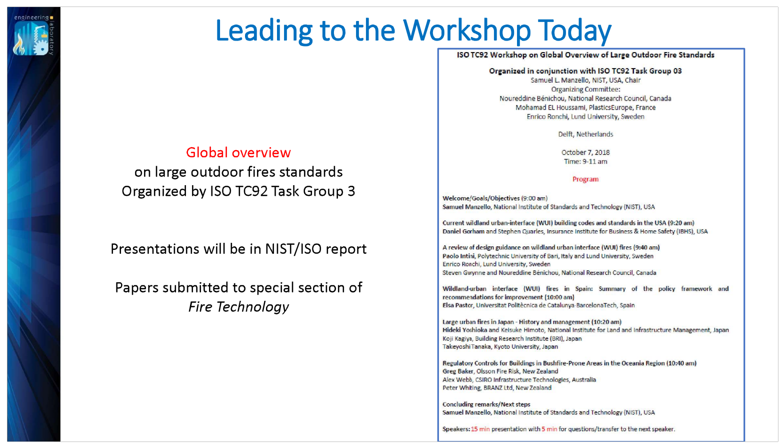
- Japan
  - Simulation tool exits for predicting the large-scale fire spread
  - It would be interesting to compile the information on simulation technique both for urban and WUI fire
  - Japan developing a risk-based method for verifying fire safety of a building from spreading fires
  - This method verifies the equivalency of fire safety level required by the building standard law of Japan, and is possibly be included in the revision of the law and legislative decree which will take place within a few years
  - This could be one example of fire safety evaluation from large outdoor fires

Some Updates


engineering laboratory
USDA
NRIFD
Permanent Working Group Underway
The executive committee of the IAFSS has formally approved
Large Outdoor Fires and the Built Environment
as permanent working group
Samuel Manzello (NIST, EL), Sara McAllister (USFS, USA), and Sayaka Suzuki (NRIFD, Japan) are co-leaders
The working group consists of three subgroups focused:
Ignition Resistant Communities (IRC)
Emergency Management and Evacuation (EME)
Large Outdoor Firefighting (LOFF)
The overall objectives are to bring
full depth of knowledge of the IAFSS community
to work on these priority topics
Poster at European IAFSS
Kick-off meeting at Asia-Oceania IAFSS
Large Outdoor Fires and the Built Environment: Objectives and Goals of Permanent IAFSS Working Group
By Ruggiero Lovreglio on March 25, 2018 - 10:10 pm in News / no comments
Authors:
Samuel L. Manzello, National Institute of Standards and Technology (NIST), USA
Sara McAllister, U.S. Forest Service, U.S. Department of Agriculture, USA
Sayaka Suzuki, National Research Institute of Fire and Disaster (NRIFD), Japan
Demonstrated Need for Permanent Working Group
THE INTERNATIONAL ASSOCIATION FOR FIRE SAFETY SCIENCE
https://iafss.org/2018/03/25/large-outdoor-fires-and-the-built-environment-objectives-and-goals-of-permanent-iafss-working-group/


engineering laboratory
USDA
NRIFD
Permanent Working Group Underway
Workshop Summary paper published
in Fire Safety Journal
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
Seeks to develop foundation for an international research needs roadmap to reduce the risk of large outdoor fires to the built environment
THE INTERNATIONAL ASSOCIATION FOR FIRE SAFETY SCIENCE
Fire Safety Journal
Summary of workshop large outdoor fires and the built environment


engineering laboratory
International FORUM of Fire Research Directors
The growing global
wildland-urban interface (WUI) fire dilemma:
Priority Needs for Research
Fire Safety Journal
FORUM position paper


engineering laboratory
Leading to the Workshop Today
Global overview
on large outdoor fires standards
Organized by ISO TC92 Task Group 3
Presentations will be in NIST/ISO report
Papers submitted to special section of
Fire Technology
ISO TC92 Workshop on Global Overview of Large Outdoor Fire Standards
Organized in conjunction with ISO TC92 Task Group 03
Samuel L. Manzello, NIST, USA, Chair
Organizing Committee:
Noureddine Bénichou, National Research Council, Canada
Mohamad EL Houssami, PlasticsEurope, France
Enrico Ronchi, Lund University, Sweden
Delft, Netherlands
October 7, 2018
Time: 9-11 am
Program
Welcome/Goals/Objectives (9:00 am)
Samuel Manzello, National Institute of Standards and Technology (NIST), USA
Current wildland urban-interface (WUI) building codes and standards in the USA (9:20 am)
Daniel Gorham and Stephen Quarles, Insurance Institute for Business & Home Safety (IBHS), USA
A review of design guidance on wildland urban interface (WUI) fires (9:40 am)
Paolo Intini, Polytechnic University of Bari, Italy and Lund University, Sweden
Enrico Ronchi, Lund University, Sweden
Steven Gwynne and Noureddine Bénichou, National Research Council, Canada
Wildland-urban interface (WUI) fires in Spain: Summary of the policy framework and recommendations for improvement (10:00 am)
Elsa Pastor, Universitat Politècnica de Catalunya-BarcelonaTech, Spain
Large urban fires in Japan - History and management (10:20 am)
Hideki Yoshioka and Keisuke Himoto, National Institute for Land and Infrastructure Management, Japan
Koji Kagiya, Building Research Institute (BRI), Japan
Takeyoshi Tanaka, Kyoto University, Japan
Regulatory Controls for Buildings in Bushfire-Prone Areas in the Oceania Region (10:40 am)
Greg Baker, Olsson Fire Risk, New Zealand
Alex Webb, CSIRO Infrastructure Technologies, Australia
Peter Whiting, BRANZ Ltd, New Zealand
Concluding remarks/Next steps
Samuel Manzello, National Institute of Standards and Technology (NIST), USA
Speakers: 15 min presentation with 5 min for questions/transfer to the next speaker.

Current Wildland-Urban Interface (WUI) Building Codes and Standards in the USA

ISO TC92 Workshop on Global Overview of Large Outdoor Fire Standards
Sunday October 7, 2018

Daniel Gorham and Stephen Quarles

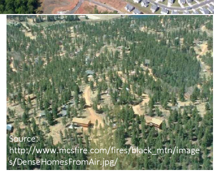
Outline

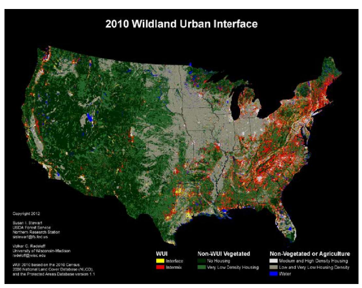
- Defining the WUI
- Building ignition mechanisms
- Building codes & standards
  - Standard test methods
  - Opportunities for improvements

Wildland-Urban Interface/Intermix

Interface

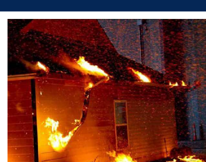
Intermix





Building Ignition Mechanisms

- Firebrands
  - Direct
  - Indirect
- Radiation
- Direct Flame Contact



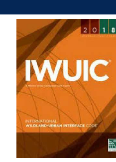
Building Codes & Standards

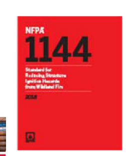
ICC International Wildland-Urban Interface Code (IWUIC)

NFPA 1144, Standard for Reducing Structure Ignition Hazard from Wildland Fire

California Building Code Chapter 7A, Materials and Construction Methods for Exterior Wildfire Exposure

ASTM standards maintained by E05.14 Subcommittee on External Fires



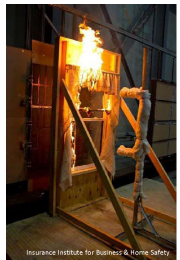


Ignition-Resistant Classification (IRC) Requirements

Roof covering

Protection of eaves

Exterior wall

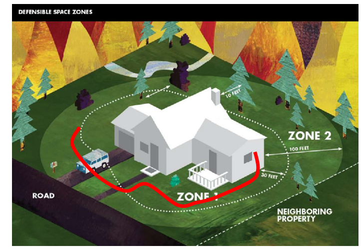


Defensible Space

Noncombustible, 0-5 ft

Zone 1, 5-30 ft

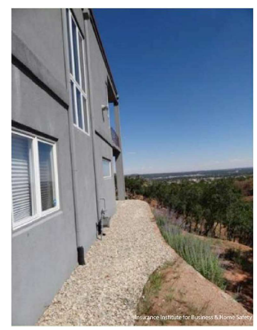
Zone 2, 30-100 ft



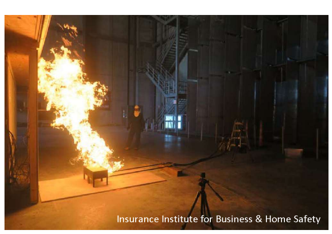
A Coupled Approach

Vegetation management & Building materials

Noncombustible Zone



Evaluation of 5-ft distance



Standard Test Methods for Combustible Decking

ASTM E-2726 Standard Test Method for Evaluating the Fire-Test-Response of Deck Structures to Burning Brands

ASTM E-2632* Standard Test Method for Evaluating the Under-Deck Fire Test Response of Deck Materials

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

* Mandatory in California for walking surface

Deck – firebrands

Under-deck fires

Summary

- WUI definition should include building/population density and home-to-home ignition risk
- Local building codes referencing/including WUI requirements & reference standards
- Opportunities for improvement:
  - Implement/require noncombustible zone
  - Firebrand and under-fire exposure to decks

Questions?

ISO TC92 Workshop on Global Overview of Large Outdoor Fire Standards
Delft – 2018.10.07

A review of design guidance on wildland urban interface fires

Paolo Intini, Ph.D.
Post-Doctoral Research Fellow

Polytechnic University of Bari, Italy

Review of design guidance on Wildland Urban Interface fires

OVERVIEW:

1. *DOCUMENTS REVIEWED*
2. *METHODS USED FOR THE REVIEW*
3. *PRESENTATION OF RESULTS*
4. *CONCLUSIONS*

Based on the **report** by:

Paolo Intini
Polytechnic University of Bari
Lund University
Enrico Ronchi
Lund University
Steven Gwynne
NRC Canada
Noureddine Bénichou
NRC Canada

Project: "Design Guidance on wildland urban interface (WUI) fires"
Sponsor: NRC Canada

Review of design guidance on Wildland Urban Interface fires

FOCUS OF THE REVIEW OF EXISTING DOCUMENTS:
(DEDICATED TO **WUI AREAS** OR CONSIDERING THEM)

- DEFINITION OF **RISK AREAS, SEVERITY CLASSES**
- INFLUENCE OF **LAND** AND **ENVIRONMENTAL FACTORS**
- **BUILDING** AND **FIRE PROTECTION REQUIREMENTS**
- **RESOURCES** AND **ACCESS**

MAIN AIM:
PROVIDING A RATIONAL BASIS FOR:
- **DEVELOPMENT OF NOVEL STANDARDS FOR WUI**/ GUIDELINES
- **UPDATE OF EXISTING STANDARDS ON WUI**/ GUIDELINES
- **PROVIDE INPUT TO ONGOING NRC GUIDANCE GENERATION**

1. DOCUMENTS REVIEWED

1. DOCUMENTS REVIEWED

UNITED STATES

- **NFPA Codes** (1141, 1142, 1143, 1144) **S (C)**
- **California Fire Code** (2016), Chapter 49: Requirements for Wildland-Urban Interface Fire Areas **S (S)**
- Implementation Guidelines for Executive Order 13728 **WUI Federal Risk Management** (2016) **S (C)**
- **Firewise** toolkit (NFPA, 2016) **G (C)**
- Other **State-related documents** (Colorado, Florida, Oregon) **G (S)**

LEGEND: S = Standard/Code/Regulation, G = Guidelines/Recommendations, (C) = applicable at the country-level, (S) = applicable at the State-level, (L) = applicable at the regional/local level.

1. DOCUMENTS REVIEWED

CANADA

Fire Smart Guidebook for Community Protection (Alberta Government, 2013)
G (S/L)

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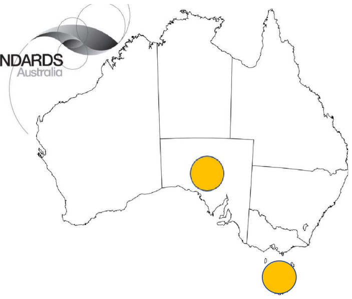
1. DOCUMENTS REVIEWED



AUSTRALIA

- **Construction of buildings in bushfire-prone areas** (Australian Standard, 2009) — S (C)
- Guidelines of the States of South Australia (Government of South Australia, 2017) and Tasmania (Government of Tasmania, 2005) — G (S)

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1. DOCUMENTS REVIEWED

NEW ZEALAND

- **Fire Emergency New Zealand Act** (Fire and Emergency New Zealand, 2017) — S (C)
- **New Zealand Building Code**, Extract: Clauses C1-C6, A3 (2012) — S (C)
- Guidelines from Fire and Emergency New Zealand — G (C)

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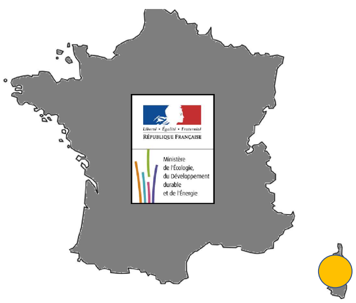

FRANCE

- Code Forestier (**Forest Code**) (2017) — S (C)
- Risques d'incendies de foret. Guide méthodologique (Risk for forest fires. Methodological guidance) (2002) — G (C)
- Guidelines and Plan to Prevent Predictable Fires (Département de la Haute-Corse, 2013) — G (L)

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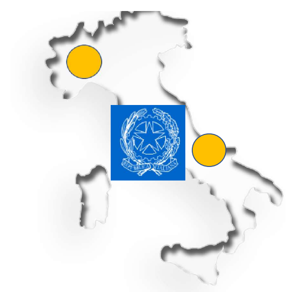
1. DOCUMENTS REVIEWED



ITALY

- "Legge quadro in materia di incendi boschivi" (**Framework law concerning wildfires**) (2000) — S (C)
- **Recommendations for fires and interface fires** (Presidency of Ministry Council, 2017). — S (C)
- Regional Guidelines (Molise, Piemonte) — G (L)

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1. DOCUMENTS REVIEWED

OTHER INTERNATIONAL DOCUMENTS

- **International Wildland-Urban Interface Code** (International Code Council, 2015). — S (I)
- Council Regulation (EEC) No 2158/92 of 23 July 1992 (European Commission, 1992); — S (I)
- EC 2152/2003 (**Forest Focus**) (European Council, 2003). — S (I)

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2. METHODS USED FOR THE REVIEW

CONSISTENT TEMPLATE FOR EACH STANDARD/MAIN DOCUMENT/GROUP OF SIMILAR GUIDELINES

VARIABLES CONSIDERED

MACRO-CATEGORY	1st LEVEL VARIABLE	8: from A to G
SUB-CATEGORY	2nd LEVEL VARIABLE	e.g. B.1, B.2, etc.
SUB-CATEGORY	3rd LEVEL VARIABLE	e.g. B.2.1, B.2,2, etc.

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2. METHODS USED FOR THE REVIEW

VARIABLES IN THE TEMPLATE

- MACRO-CATEGORY: A. HAZARD
- SUB-CATEGORY: A.1 DEFINITIONS
  How hazard and risk zones are identified and classified
- SUB-CATEGORY:
  - A.1.1 DESTINATION (definition of WUI, risk areas)
  - A.1.2 SEVERITY CLASS (definition of risk severity classes and thresholds)

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2. METHODS USED FOR THE REVIEW

VARIABLES IN THE TEMPLATE

- MACRO-CATEGORY: B. LAND
- SUB-CATEGORY:
  - B.1 VEGETATION
    Measures adopted for vegetation surrounding structures
  - B.2 TOPOGRAPHY/ TERRAIN
    Procedures for including topography/terrain in risk classes
- SUB-CATEGORY:
  - B.1.1 DEFENSIBLE SPACE
  - B.1.2 CLEARANCE BETWEEN/FROM VEGETATION
  - B.1.3 MAINTENANCE

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2. METHODS USED FOR THE REVIEW

VARIABLES IN THE TEMPLATE

- MACRO-CATEGORY: C. BUILDING CONSTRUCTION
- SUB-CATEGORY / SUB-CATEGORY:
  - C.1 GENERAL REQUIREMENTS for buildings and materials
    - C.1.1 CLASSES OF IGNITION RESISTANCE
    - C.1.2 FEATURES OF IGNITION-RESISTANT MATERIALS
    - C.1.3 BUILDING SEPARATION
  - C.2 ROOF
    - C.2.1 COVERING
    - C.2.2 VALLEY FLASHINGS
    - C.2.3 EAVES
    - C.2.4 GUTTERS
  - C.3 WALLS/ EXTERNAL COVERINGS
    - C.3.1 EXTERIOR WALLS
    - C.3.2 WALL COVERINGS
  - C.4 WINDOWS/ EXTERNAL DOORS
    - C.4.1 EXTERIOR GLAZING
    - C.3.2 EXTERNAL DOORS
    - C.4.3 VENTS + OTHER OPENINGS
  - C.5 DECKS/ DETACHMENTS
    - C.5.1 DECKS AND OTHER ATTACHMENTS
    - C.5.2 DETACHED STRUCTURES
  - C.6 FLOORS/ INTERIORS
    - C.6.1 FLOOR
    - C.6.2 UNDER-FLOOR
    - C.6.3 OTHER INTERIORS

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2. METHODS USED FOR THE REVIEW

VARIABLES IN THE TEMPLATE

- MACRO-CATEGORY: D. RESOURCES
- SUB-CATEGORY:
  - D.1 UTILITIES
    - D.1.1 WATER SUPPLY
    - D.1.2 OTHER UTILITIES
  - D.2 FIREFIGHTERS
  - D.3 PLANNING
    - D.3.1 FIRE PROTECTION PLANS
    - D.3.2 OTHER PLANS REQUIRED/ SUGGESTED
  - D.4 OUTREACH

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2. METHODS USED FOR THE REVIEW

VARIABLES IN THE TEMPLATE

- MACRO-CATEGORY: E. FIRE PROTECTION MEASURES
- SUB-CATEGORY:
  - E.1 MEASURES FOR WATER SOURCES
  - E.2 MEASURES FOR BUILDINGS
- SUB-CATEGORY:
  - E.2.1 SPRINKLERS
  - E.2.2 MANUAL PROTECTION SYSTEMS
  - E.2.3 WARNING SYSTEM
  - E.2.4 SPARK ARRESTERS
  - E.2.5 COMBUSTIBLE MATERIALS
  - E.2.6 PRIVATE SHELTERS

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2. METHODS USED FOR THE REVIEW

VARIABLES IN THE TEMPLATE

- MACRO-CATEGORY: F. ENVIRONMENT
- SUB-CATEGORY:
  - F.1 WEATHER (influence of weather on procedures/measures)
  - F.2 FIRE HISTORY (influence of fire history on procedures/measures)
- SUB-CATEGORY

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2. METHODS USED FOR THE REVIEW

VARIABLES IN THE TEMPLATE

- **MACRO-CATEGORY** — G. ACCESS
- **SUB-CATEGORY** — G.1 ROADS: Fire safety requirements for road access to structures
- **SUB-CATEGORY**
  - G.1.1 TYPE/NUMBER OF ACCESS ROADS
  - G.1.2 ROAD STANDARDS
  - G.1.3 ROAD MARKINGS
  - G.1.4 VEGETATION CLEARING

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3. PRESENTATION OF RESULTS

A. HAZARD

SUB-CATEGORY	USA	USA (CALIFORNIA)	CANADA	AUSTRALIA	NEW ZEALAND	FRANCE	ITALY	EU	ICC
DESTINATION	X	X	X	X	X	X	X	X	X
SEVERITY CLASSES	X	X	X	X	X	X	X	X	X

X = element present in the standards/guidelines reviewed, x = partially considered (e.g. in a qualitative way, or only some aspects)

COMMENTS:
- Definitions of wildfire risk and hazard levels based in all documents (except NZ) on topography, vegetation and environment.
- Different levels of refinement in the Methods for identifying and classifying severity in WUI areas (e.g. methods based on partial ratings or on fire history, such as EU standards).

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3. PRESENTATION OF RESULTS

B. LAND

SUB-CATEGORY	USA	USA (CALIFORNIA)	CANADA	AUSTRALIA	NEW ZEALAND	FRANCE	ITALY	EU	ICC
VEGETATION	X	X	X	X	x	X	X		X
TOPOGRAPHY /TERRAIN	X	X	X	X		X	X		X

X = element present in the standards/guidelines reviewed, x = partially considered (e.g. in a qualitative way, or only some aspects)

COMMENTS:
- Concept of defensible space present in all documents reviewed (except EU standards)
- Topographic and terrain factors generally affect definitions of risk areas, defensible space and position between houses and slopes.

ISO TC92 Workshop: «Global Overview of Large Outdoor Fire Standards» – Delft – 2018.10.07 Paolo Intini

3. PRESENTATION OF RESULTS

C. BUILDING CONSTRUCTION

SUB-CATEGORY	USA	USA (CALIFORNIA)	CANADA	AUSTRALIA	NEW ZEALAND	FRANCE	ITALY	EU	ICC
GENERAL REQUIREMENTS	X	x		X	X		x		X
ROOF (covering, eaves, gutters, valley flashings)	X	X (no gutters, also valley flashings)	X	X (also valley flashings)	X (no gutters)	X	X (no gutters)	X (no gutters)	X (also valley flashings)
WALLS/EXTERNAL COVERINGS	X	X (also wall coverings)	X	X	X	X (also wall coverings)			X
WINDOWS, DOORS, VENTS	X	X	X (no doors)	X		x (only vents)			X
DECKS/ DETACHMENTS	X (also detach-ments)	X	X	X (also detach-ments)		x (only detach-ments)			X (also detach-ments)
UNDER-FLOORS	X	X	X	X (also floors/interiors)	x (only floors/interiors)				X

X = element present in the standards/guidelines reviewed, x = partially considered (e.g. in a qualitative way, or only some aspects)

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3. PRESENTATION OF RESULTS

D. RESOURCES

SUB-CATEGORY	USA	USA (CALIFORNIA)	CANADA	AUSTRALIA	NEW ZEALAND	FRANCE	ITALY	EU	ICC
WATER SUPPLY	X		x	X	x (also other utilities: evacuation routes)	x			X
FIREFIGHTERS	x		x		x	x	x		
PLANNING	X	x (no plans other than fire protection)	X	x		x (no plans other than fire protection)	x	x	x
OUTREACH	**Variable, depending on the type of document** (i.e. standards, guidelines, local/statewide application)								

X = element present in the standards/guidelines reviewed, x = partially considered (e.g. in a qualitative way, or only some aspects)

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3. PRESENTATION OF RESULTS

E. FIRE PROTECTION MEASURES

SUB-CATEGORY	USA	USA (CALIFORNIA)	CANADA	AUSTRALIA	NEW ZEALAND	FRANCE	ITALY	EU	ICC
FOR WATER SOURCES	X			X					X
FOR BUILDINGS	X	x (only combustible materials)	X	x (only private shelters)	X		x (only combustible materials/ private shelters)		X

X = element present in the standards/guidelines reviewed, x = partially considered (e.g. in a qualitative way, or only some aspects)

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3. PRESENTATION OF RESULTS

F. ENVIRONMENT

SUB-CATEGORY	USA	USA (CALIFORNIA)	CANADA	AUSTRALIA	NEW ZEALAND	FRANCE	ITALY	EU	ICC
WEATHER	X	X		X		X			X
FIRE HISTORY	X		X			X		X	X

X = element present in the standards/guidelines reviewed, x = partially considered (e.g. in a qualitative way, or only some aspects)

COMMENTS:
- Effects of weather and fire history are generally considered for defining risk areas, severity zones or fire protection plans.

3. PRESENTATION OF RESULTS

G. ACCESS

SUB-CATEGORY	USA	USA (CALIFORNIA)	CANADA	AUSTRALIA	NEW ZEALAND	FRANCE	ITALY	EU	ICC
ROADS (type/number of roads, standards, markings, vegetation)	X (also markings)	(in the general Fire Code)	X	X	X (no type/number of roads required, also markings)	X	X (no type/ number of roads required)		X (also markings)

X = element present in the standards/guidelines reviewed, x = partially considered (e.g. in a qualitative way, or only some aspects)

4. CONCLUSIONS

COMMON INDICATIONS/REQUIREMENTS:

- Each of the standards/guidelines reviewed provide definitions of **risk areas (based on topography, vegetation, environment) and severity classes** for these areas;
- Most of the documents include some indications about the **influence of land factors** (i.e. vegetation, terrain, topography), including definitions of **defensible space**.
- Most of the documents include some indications/requirements for **buildings** and **access**.

DIFFERENCES/LACK OF INDICATIONS/REQUIREMENTS:

- Requirements/indications about **resources** (especially water sources, firefighters) and about **fire protection measures** (for water sources) are scarce or lacking in several documents reviewed;
- The consideration of **environmental factors** (weather/fire history) lacks in several documents;
- Different methods were highlighted for defining **severity classes** and different aspects of **building requirements** are treated in different documents (some of them are more complete).

ISO TC92 Workshop on Global Overview of Large Outdoor Fire Standards
Delft – 2018.10.07

THANK YOU FOR THE ATTENTION

Paolo Intini, Ph.D.
Post-Doctoral Research Fellow

Polytechnic University of Bari, Italy

Wildland-urban interface fires in Spain

Summary of the policy framework and recommendations for improvement

Dr. Elsa Pastor

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH
Centre for Technological Risk Studies

Delft, October 2018

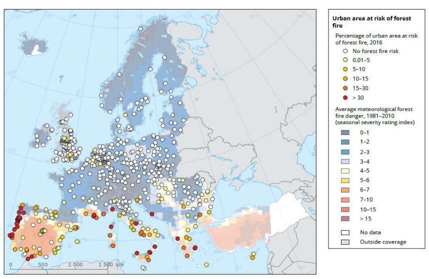
OUTLINE

- WUI fires in Southern Europe
- WUI fire management in Spain
  - Overview of the problem
  - Spanish regulatory structure
  - Overview of complience
- Needs and Opportunities

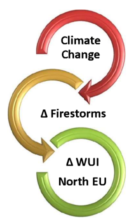
Source: David Caballero

WUI FIRES IN SOUTHERN EUROPE

- Europe has many areas in which forest fires seriously affect urban and rural communities



Populated areas (urban) at risk of forest fire in 2016.
Source: European Climate Adaptation Platform



WUI FIRES IN SOUTHERN EUROPE

- Recent WUI fire events in Southern Europe
  - Madeira Island (Portugal, 2016)
  - Valencia (Spain, 2016)
  - Rognac-Vitrolles (France, 2016)
  - Pedrógão Grande (Portugal, 2017)
  - Ophelia winds wildfires (Spain & Portugal, 2017)
  - Attica (Greece, 2018)

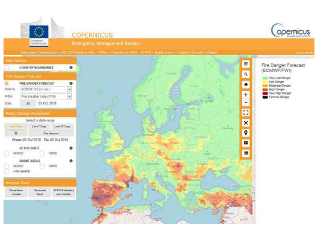
EU wildfire impact in 2017

- *1.2 Million ha burnt*
- *127 people killed*
- *9.8 billion €*

Before and after Mati fire (Yellow line is a zone of fire entrapement) *Source: David Caballero*

WUI FIRES IN SOUTHERN EUROPE

- EU does not hold a common overall strategy for fighting fires, but some efforts are slowly being devoted…
  - To create new polices covering WUI areas
  - Harmonization through EU member states

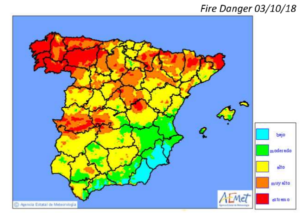


- Current status of policies vary between EU countries
- Poor level of compliance (legal obligations fall ultimately on owners)

WUI FIRE MANAGEMENT IN SPAIN – Problem Overview

- 12,500 forest fires per year on average during the last decade
- 1.1 million hectares of WUI (more than 4% of the total forested area)
- Massive influx of visitors at the WUI during fire season

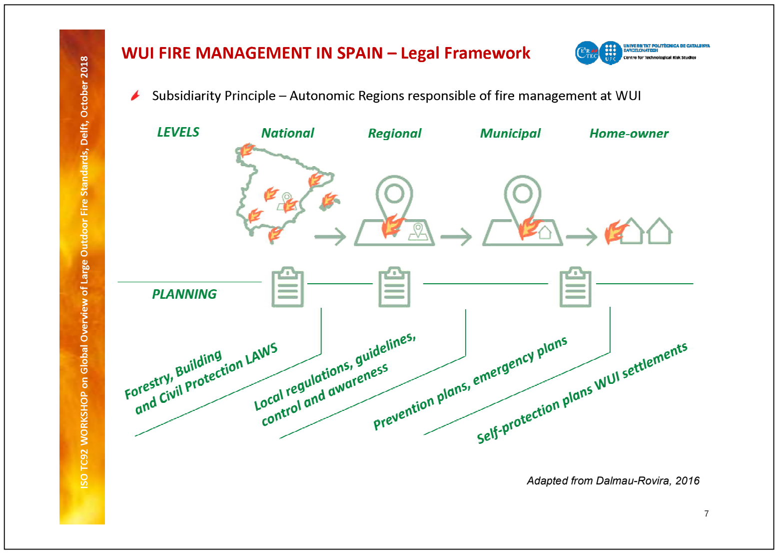
Fire Danger 03/10/18

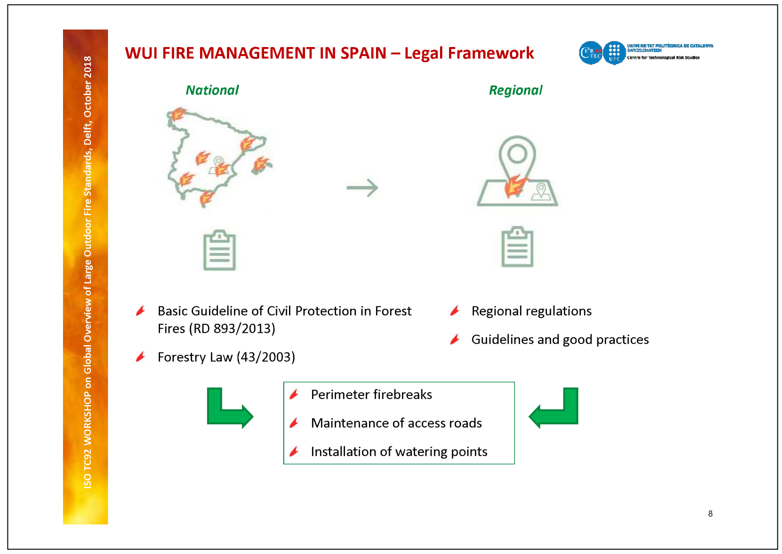


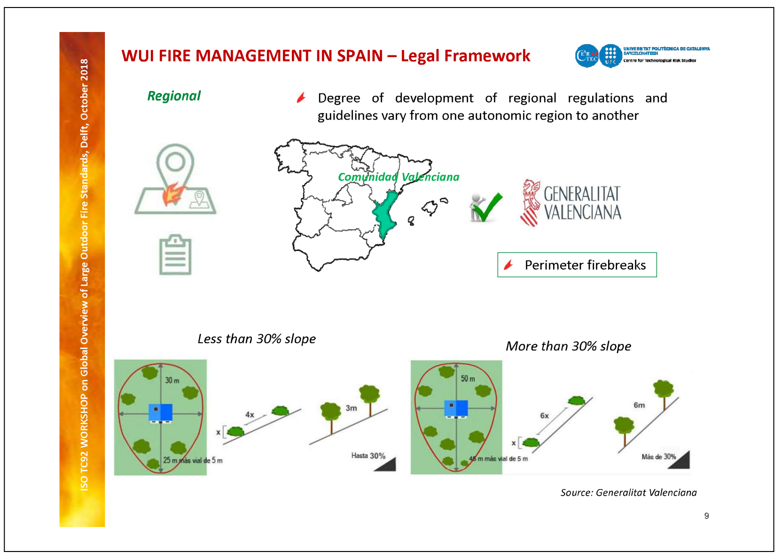
- WUI types
  - Scattered houses in alegal/illegal urbanized areas
  - Isolated houses in wildlands
  - Dense housing in touristic areas

Constructive materials: bricks and concrete

Home losses due to openings


ISO TC92 WORKSHOP on Global Overview of Large Outdoor Fire Standards, Delft, October 2018
WUI FIRE MANAGEMENT IN SPAIN – Legal Framework
Subsidiarity Principle – Autonomic Regions responsible of fire management at WUI
LEVELS
National
Regional
Municipal
Home-owner
PLANNING
Forestry, Building and Civil Protection LAWS
Local regulations, guidelines, control and awareness
Prevention plans, emergency plans
Self-protection plans WUI settlements
Adapted from Dalmau-Rovira, 2016
7


ISO TC92 WORKSHOP on Global Overview of Large Outdoor Fire Standards, Delft, October 2018
WUI FIRE MANAGEMENT IN SPAIN – Legal Framework
National
Regional
Basic Guideline of Civil Protection in Forest Fires (RD 893/2013)
Forestry Law (43/2003)
Regional regulations
Guidelines and good practices
Perimeter firebreaks
Maintenance of access roads
Installation of watering points
8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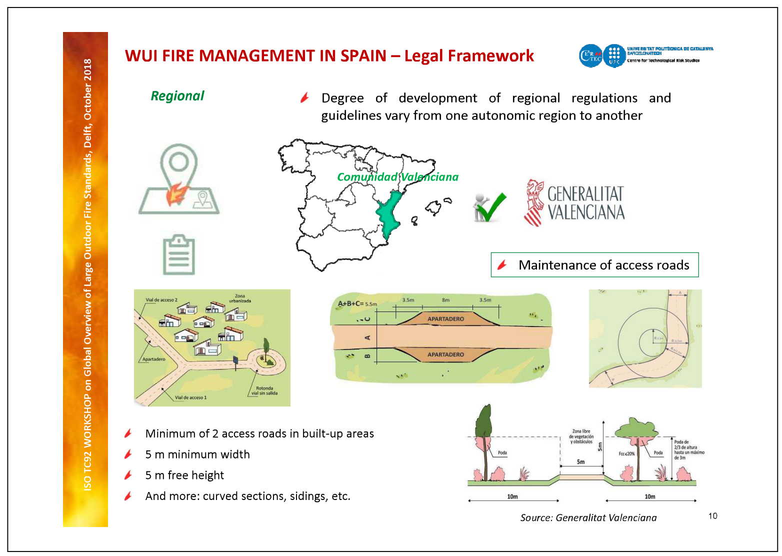
WUI FIRE MANAGEMENT IN SPAIN – Legal Framework
Regional
Degree of development of regional regulations and guidelines vary from one autonomic region to another
Comunidad Valenciana
GENERALITAT VALENCIANA
Perimeter firebreaks
Less than 30% slope
More than 30% slope
30 m
25 m más vial de 5 m
4x
3m
Hasta 30%
50 m
45 m más vial de 5 m
6x
6m
Más de 30%
Source: Generalitat Valenciana
9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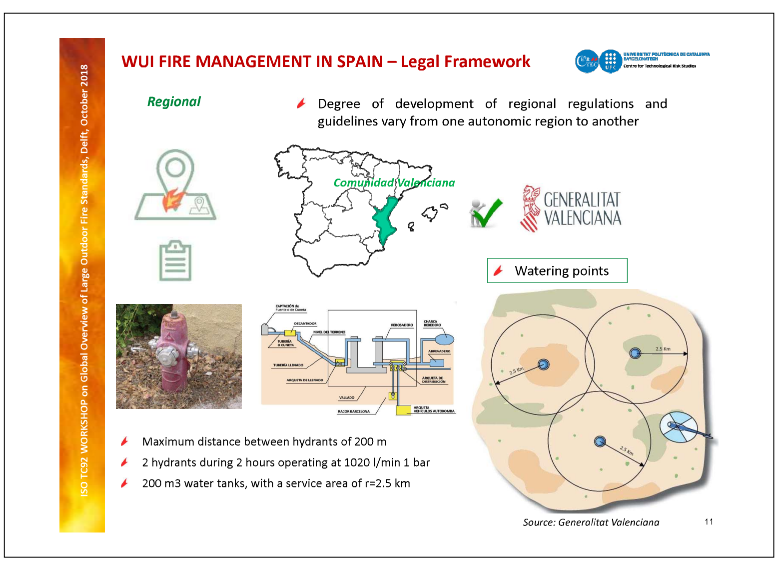
WUI FIRE MANAGEMENT IN SPAIN – Legal Framework
Regional
Degree of development of regional regulations and guidelines vary from one autonomic region to another
Comunidad Valenciana
GENERALITAT VALENCIANA
Maintenance of access roads
APARTADERO
Minimum of 2 access roads in built-up areas
5 m minimum width
5 m free height
And more: curved sections, sidings, etc.
Source: Generalitat Valenciana
10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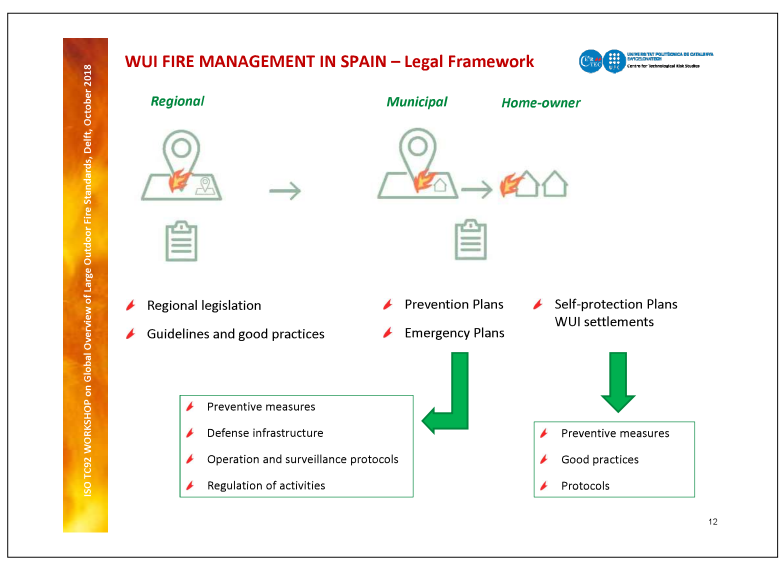
WUI FIRE MANAGEMENT IN SPAIN – Legal Framework
Regional
Degree of development of regional regulations and guidelines vary from one autonomic region to another
Comunidad Valenciana
GENERALITAT VALENCIANA
Watering points
Maximum distance between hydrants of 200 m
2 hydrants during 2 hours operating at 1020 l/min 1 bar
200 m3 water tanks, with a service area of r=2.5 km
Source: Generalitat Valenciana
11


ISO TC92 WORKSHOP on Global Overview of Large Outdoor Fire Standards, Delft, October 2018
WUI FIRE MANAGEMENT IN SPAIN – Legal Framework
Regional
Municipal
Home-owner
Regional legislation
Guidelines and good practices
Prevention Plans
Emergency Plans
Self-protection Plans WUI settlements
Preventive measures
Defense infrastructure
Operation and surveillance protocols
Regulation of activities
Preventive measures
Good practices
Protocols
12

WUI FIRE MANAGEMENT IN SPAIN – Legal Framework

National · *Regional* · *Municipal* · *Home-owner*

- Spanish Building Code?
- Guidelines and recommendations

Need of a technical code for WUI areas

- Sheltering capacity of European structures?

GENERALITAT VALENCIANA

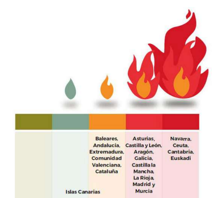
- Double glazing
- Ornamental vegetation at 3 m
- Using of non combustible material
- Cleen roofs
- Spark arrestors in barbecues

WUI FIRE MANAGEMENT IN SPAIN – Complience

- Although Spain has legislation and high losses every year, the degree of compliance is low.
  - Small towns: limited resources
  - Large towns: limited interest

Resources → ← *Risk culture*

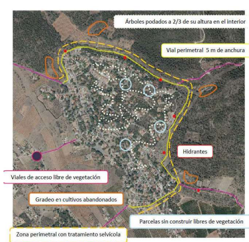
- Asturias, Galicia, Cantabria, Euskadi and the provinces of León and Zamora have the 52% of the fires in Spain, but their fire management plans are deficient or very deficient (*Greenpeace, 2018*)



Source: Greenpeace, 2018

NEEDS AND OPPORTUNITIES

- Some of the regulations provided in the Spanish law are clearly insufficient, both qualitative and quantitatively, particularly the **design of perimeter firebreaks.**
- There is a clear need of a technical code for building and defense against forest fires in the WUI, to regulate, among others, the **shelter capacity of typical Mediterranean houses**.



Source: Generalitat Valenciana

NEEDS AND OPPORTUNITIES

- There is no regulation pointing at the installation, maintenance and defense of **LPG tanks in the WUI**. Negligence and regulatory gaps allow **close exposure to flames** from nearby fuels.

Benitatxell, València, Spain (2016) Source: David Caballero

Neos Voutzas-Mati, Greece (2018) Source: David Caballero

PBD Virtual Lab WUIVIEW · Humanitarian Aid and Civil Protection · UPC · PAU COSTA FOUNDATION · RISE · MINES Alès

Thanks for your attention!

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ISO TC92 workshop on
“Global Overview of Large Outdoor Fire Standards”
Organized in conjunction with ISO TC92 Task Group 03
7 October 2018 – Delft, Nederland

“Large urban fires” in Japan - History and management -

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

[1] Senior Researcher, NILIM, Japan
[2] Chief Researcher, BRI, Japan
[3] Professor Emeritus, Kyoto University, Japan

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”.
- Summary

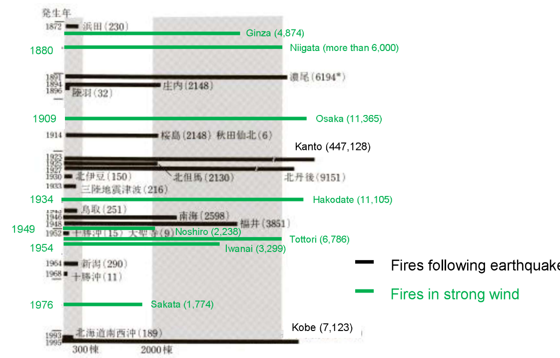
Urban Conflagrations in Edo Period

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

※ wikipedia

Meireki Fire (1657)

Major Urban Fires after Meiji Period



* Tohoku (747,175m² by post-tsunami fire)

No. burnt buildings

Kanto Earthquake (1923)

Sakata Fire (1976)

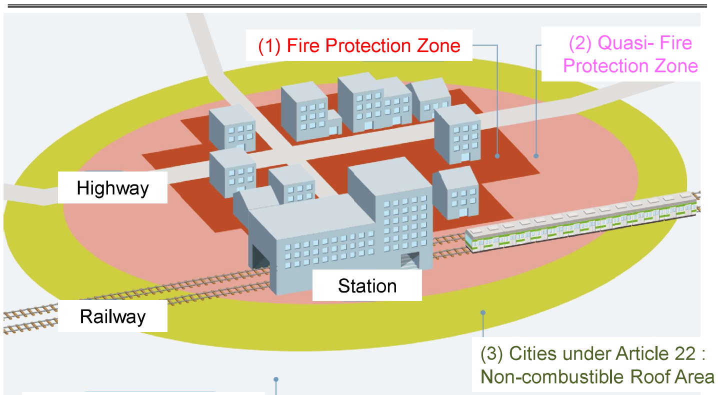
Kobe Earthquake (1995)

Tohoku Earthquake (2011)

Itoigawa Fire (2016)

Standard Regulations on "large urban fires"

Concept of Zoning regulated by City Planning Act



(1) Fire protection zone

- According to Article 61 of BSL (Building Standard Law),
  - buildings which have "three or more stories" or "whose total floor area exceeds 100 sq m" shall be "fire-resistive buildings".
  - other buildings shall be either "fire-resistive buildings" or "quasi-fire-resistive buildings".

(2) Quasi-fire protection zone

- According to Article 62 of BSL (Building Standard Law),
  - buildings which have “four or more stories” or “whose total floor area exceeds 1,500 sq m” shall be “fire-resistive buildings”.
  - buildings “whose total floor area exceeds 500 sq m but does not exceed 1,500 sq m” shall be “quasi-fire-resistive buildings”.
  - buildings which have “three stories” be “quasi-fire-resistive buildings”.

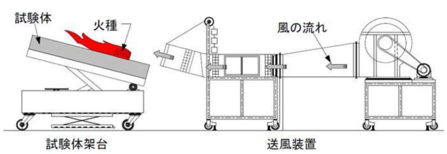
(3) Cities under Article 22 of BSL “Non-combustible Roof Area”

According to Article 22 of BSL (Building Standard Law),

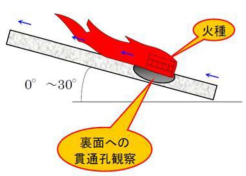
- The construction of roofs of buildings shall conform to technical criteria specified by Cabinet Order, according to the construction and the category of use of the building concerning the performance necessary for a roof to prevent the occurrence of a fire in the building caused by burning brands assumed to accompany a normal fire.

Roof test 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)

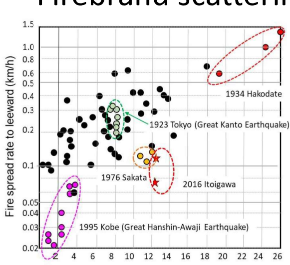


Roof test in Japan Different Brands used for Each Zone

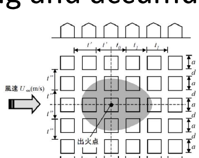
- Fire protection zone, and Quasi-fire protection zone (Article 63 of BSL)
  - Crib: 80 x 80 x 60 mm,
  - Made by lumbers: 19 x 19 x 80 mm.
- Non-combustible Roof Area (Article 22 of BSL)
  - Lumber: 40 x 40 x 40 mm.
  - Identical with “Brand B” in ISO 12468-1.
- Same criteria for two zones:
  - Fire propagation (not reaching to the edge of specimen)
  - Integrity (no flame at reverse side)
  - Deficit (no through-hole larger than 10 mm x 10 mm)

Research Activities 1940-1960’s

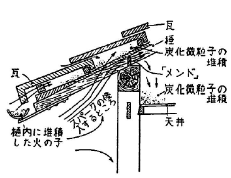
- Fire spread rate due to wind speed
- Firebrand scattering and accumulation behavior



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



A formula of fire spread rate (Hamada 1951)

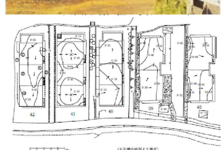


Accumulation of firebrand in a traditional Japanese wooden roof structure (Kamei 1960)

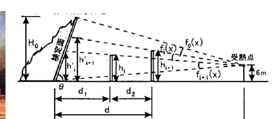
Research Activities 1980-2000’s

- Comprehensive countermeasures against city fires

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



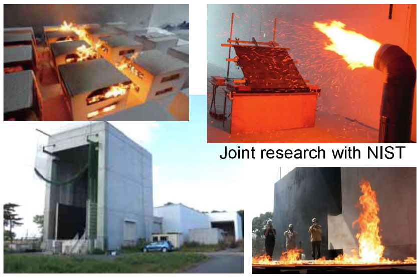
Housing complex fire test in Saganoseki (1979)



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



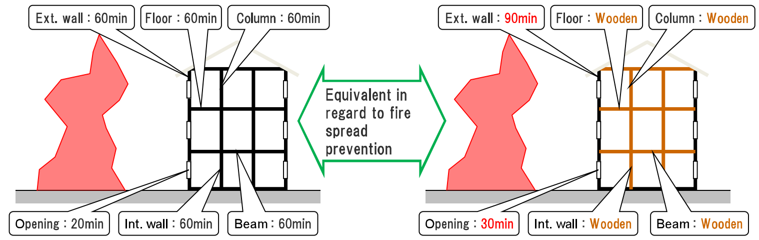
Fire Research Wind Tunnel Facility (FRWTF) in BRI

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

Integrated technology development project (2016-2020)

Limitation of the Current Regulationx

- Uniform requirement for all the main building members including columns, beams, walls, floors, etc.
  - Uniform requirement diminishes flexibility of building design
  - Wooden members may be used as long as the entire building maintains safety equivalent to the current regulation?



Current regulation
Uniform requirement for all main members

Possible alternative regulation
Focused requirement for exterior members

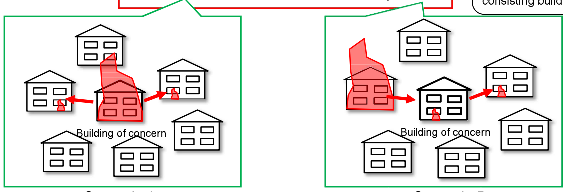
Integrated technology development project (2016-2020)

Equivalency to the Current Regulation

- Risk-based evaluation method
  - Fire safety performance of a building in regard to fire spread prevention under two fire scenarios
  - Alternative regulation will be acceptable if the risk R is smaller than that of the current regulation R_0

Evaluation of equivalency : $\frac{R}{R_0} \leq 1$

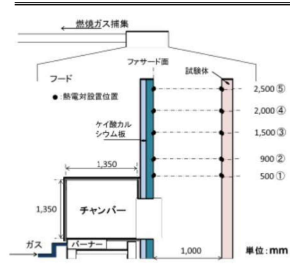
Performance of a building in regard to fire spread prevention determined by performance of consisting building members



Scenario A
Occurrence of fire spread by internal fire

Scenario B
Occurrence of fire spread by external fire

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

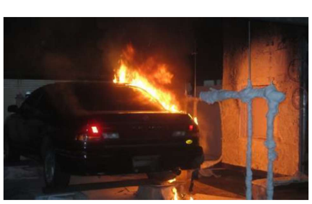


1 m distance.
Plywood façade, as adjacent building.
600 kW, for first ten minutes.
1,200 kW, after ten minutes.

No fire spread
for first ten minutes.

Fire spread
soon after ten minutes.

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.

Summary

- "Large urban fires" have overlapped area 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 int'l standardization work on "large outdoor fires and the built environment" could make a contribution to mitigating the loss caused by those large fires.

Olsson Fire & Risk

CONSULTING ENGINEERS

ISO TC92 WORKSHOP ON GLOBAL OVERVIEW OF LARGE OUTDOOR FIRE STANDARDS
SUNDAY 7TH OCTOBER 2018

Olsson Fire & Risk
CONSULTING ENGINEERS

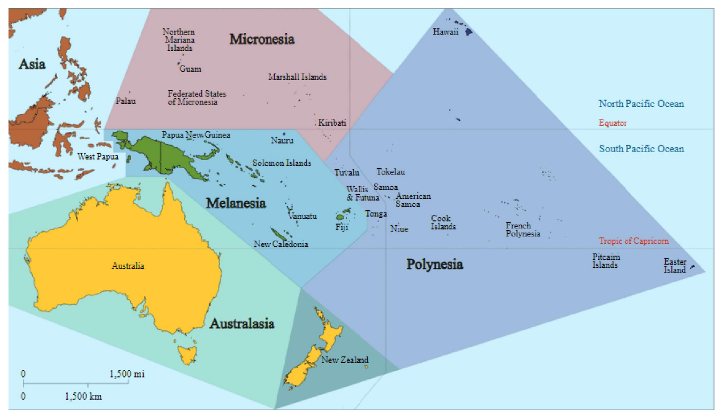
REGULATORY CONTROLS FOR BUSHFIRE-PRONE AREAS IN THE OCEANIA REGION

GREG BAKER
ALEX WEBB
PETER WHITING

Olsson Fire & Risk
CONSULTING ENGINEERS

INTRODUCTION – REGIONAL INFORMATION

- Oceania has four geographical regions – Melanesia, Micronesia, Polynesia and Australasia
- 14 independent countries & 14 dependent territories
- Combined population 40 M – Australia = 24 M, Pitcairn Island = 47
- Combined land area 8.6 M km² – Australia = 7.7 M km², Wake Island = 2 km²



Source - https://en.wikipedia.org/wiki/Oceania#/media/File:Oceania_UN_Geoscheme_Regions.svg

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INTRODUCTION – BUSHFIRES IN OCEANIA

- Bushfires most prevalent in Australia
- 1995-2007 – approx. 50,000 bushfires annually on average
- In New Zealand 1991-2007 – approx. 3,000 bushfires annually on average
- In Australia annually – average 50 million km² burnt
- In New Zealand – average 60 km² burnt

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INTRODUCTION – BUSHFIRES IN OCEANIA

- Table shows the four worst bushfires in Australia in the last 80 years approx.
- In New Zealand the largest bushfire over the same period affected 130 km² (Taupo – 1946)

Bushfires with most severe impact in Australia since 1939

(Source of data -https://www.munichre.com/australia/australia-natural-hazards/bushfires/economic-impacts/significant-bushfires-australia/index.html**)**

Name	State	Date	Burnt area (km²)	Fatalities	Homes destroyed	Overall losses (A$B)
Black Saturday Fire	VIC	2009	4,500	173	2,000	1.07
Ash Wednesday Fire	VIC/SA	1983	5,200	75	2,400	0.335
Tasmanian Black Tuesday Fires	TAS	1967	2,600	62	1,400	0.035
Black Friday Fire	VIC	1939	20,000	700	71	

RESEARCH

- First scientific house-by-house research occurred after Beaumaris fire (VIC) in 1944
- Results not promulgated until Ash Wednesday fire (VIC/SA) 1983
- Larger studies were triggered – 455 houses studies Mt Macedon and 1148 houses Otway Ranges
- These latter studies formed basis for first Australian standards published in 1991

REGULATORY CONTROLS

- Australia and New Zealand have similar building regulatory regimes – performance-based
- NZ has no regulatory controls specific to bushfires
- Australia in contrast has very specific requirements
- Australia's National Construction Code has performance provisions to mitigate impact on buildings in bushfire-prone areas
- Hierarchy of objectives, functional statements and performance requirements directly address bushfire risk

BUSHFIRE STANDARDS – AS 3959

- AS 3959 is primary standard
- Contains method to determine Bushfire Attack Level (BAL) for individual buildings
- BAL is measure of severity of buildings potential exposure to ember attack, radiant heat and direct flame contact
- AS 3959 has six BALs – BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ
- The BAL for the particular building then determines the required construction

BUSHFIRE ATTACK LEVEL

- BAL is a function of four factors – fire danger index, vegetation type classification, distance from building site to vegetation, slope of land under vegetation
- These four factors in combination determine the BAL – tabular method (simple) or calculation (detailed)

VEGETATION TYPE CLASSIFICATION

- Seven vegetation classifications
- Group A Forest, Group B Woodland, Group C Shrubland, Group D Scrub, Group E Malle/Mulga, Group F Rainforest, Group G Grassland

BUSHFIRE STANDARDS – TEST STANDARDS

- AS 3959 contains prescriptive construction requirements for different BALs
- Other option is to test construction system
- AS 1530.8.1 provides a method to determine performance of external construction element when exposed to **radiant heat, burning embers** and **burning debris**
- Laboratory simulation for BAL-12.5 to BAL-40 of actual bushfire attack

AS 1530.8.1 – RADIANT HEAT TEST PROFILES

- Construction exposed to a radiant heat profile
- Profile simulates passage of bushfire front
- Profile includes rapid heating phase, constant peak for 2 minutes and slow decay period
- Total radiant exposure lasts 10 minutes
- Radiating steel panel typically used
- Specimen moved progressively away from radiating panel during 10-minute exposure period

BURNING EMBERS, BURNING DEBRIS

- Burning embers considered as pilot ignition source on vertical and underside exposed horizontal surfaces – small gas flame
- Burning debris on upper surface of horizontal surfaces simulated by pre-ignited timber cribs

AS 1530.8.2 - BAL-FZ

- The second test standard called up by AS 3959 is AS 1530.8.1
- Deals with BAL-FZ
- Test duration 90 minutes
- Standard fire resistance test of specimen for 30 minutes
- Specimen then removed from furnace and monitored for 60 minutes to ensure specimen is self-defending

BUSHFIRE-RESISTING TIMBER

- Bushfire-resisting timber deemed to be acceptable to withstand up to BAL-29
- Can be achieved:
  - Inherent properties of timber
  - Impregnation with fire-retardant chemicals
  - Application of fire-retardant coating or substrate
- Cone calorimeter testing (plus accelerated weathering where timber altered)

Olsson Fire & Risk
CONSULTING ENGINEERS

THANK YOU FOR YOUR ATTENTION