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Large outdoor fires and the built environment — Global overview of different approaches to standardization

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Foreword

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 92, *Fire safety*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Large outdoor fires have the potential to negatively impact the built environment.

Examples of such fires are:

— wildland-urban interface (WUI) fires (wildland fires that spread into communities; this type of fire has become a global problem);

NOTE Once a WUI reaches a community, a large urban fire can develop.

— post-earthquake fires (large urban fires that potentially occur after an earthquake);

— tsunami-generated fires (fires potentially generated from tsunamis);

— volcano-generated fires (fires potentially generated from volcanic activity); and

— fires that occur in informal settlements.

This document provides an overview of approaches to standardization for lessening the destruction on the built environment caused by such fire exposure. Evacuation is not included as there are no known approaches to standardization as the present time.

Large outdoor fires and the built environment — Global overview of different approaches to standardization

1 Scope

This document provides a review of global testing methodologies related to the vulnerabilities of buildings from large outdoor fire exposures. It also provides information on land use management practices. Some of the test methods outlined in this document have been developed in the context of building fires and extrapolated to external fire exposures.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
bushfire
unplanned fire in a vegetated area, as opposed to an urban area

Note 1 to entry: Used primarily, but not exclusively, in Australia, New Zealand, and Africa.

Note 2 to entry: It is likely that the term was first used in South Africa and is possibly derived from the Dutch word 'bosch' meaning uncultivated land. In Australia the term was first used in the first half of the 19th century. The term passed into legislation in the first half of the 20th century, first in the Australian Capital Territory (Bushfire Act, 1936), Western Australia (A Bush Fires Act, 1937) and New South Wales (Bush Fires Act, 1949).

Note 3 to entry: Definition adapted from Reference [42].

3.1.2
direct flame contact
flame impinging on building systems and materials

Note 1 to entry: Direct flame contact is one of the three structure ignition pathways, together with firebrands and radiant heat.

Note 2 to entry: The flames can come either from the main wildfire flames, from burning elements and ornamental vegetation surrounding structures, or from adjacent structures.

Note 3 to entry: Definition adapted from Reference [42].

3.1.3
evacuation
dispersal or removal of people from dangerous areas and their arrival at a place of relative safety

Note 1 to entry: Definition taken from Reference [42].

3.1.4
post-earthquake fire
fire which occurs after an earthquake

3.1.5
firebrand
airborne object capable of acting as an ignition source and carried for some distance in an airstream

Note 1 to entry: Firebrands are also sometimes referred to as flying brands or brands.

Note 2 to entry: Firebrands are similar to embers but with a slight distinction: ember refers to any small, hot, carbonaceous particle and when embers have the capability of setting additional fires, they become firebrands.

Note 3 to entry: The aerodynamic properties of firebrands is an important characteristic requiring consideration.

Note 4 to entry: Firebrands or embers can be burning, flaming or smouldering.

Note 5 to entry: Definition adapted from Reference [42].

3.1.7
informal settlement
unplanned settlement or area where housing is not in compliance with current planning and building regulations (unauthorized housing)

[SOURCE: Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997]

3.1.8
large outdoor fire
urban fire, tsunami-generated fire, volcano-generated fire, WUI fire, wildland fire, or informal settlement fire, where the total burnout area is significant

3.1.9
spot fire
fire caused by flying firebrands at a distance from the original fire

3.1.10
tsunami-generated fire
fire caused by tsunami, typically by burning elements contained in the flood waters

3.1.11
urban fire
fire which occurs in an urbanized area

3.1.13
volcano-generated fire
fire caused by volcanic eruption

3.1.14
wildland
land that either has never suffered human intervention or has been allowed to return to its natural state, or that is managed for forestry or ecological purposes

[SOURCE: ISO/TS 19677:2019, 3.2]

3.1.15
wildland fire
fire occurring in peat, forests, scrublands, grasslands or rangelands, either of natural origin or caused by human intervention

Note 1 to entry: Used primarily, but not exclusively, in North America.

[SOURCE: ISO/TS 19677:2019, 3.3, modified — reference to "peat" added and Note 1 to entry added.]

3.1.16
wildland firefighting
suppressive action involving a fire in forests, scrublands, grasslands or rangelands

3.1.17
wildland-urban interface
WUI
area where structures and other human development adjoin or overlap with wildland

[SOURCE: ISO/TS 19677:2019, 3.4]

3.1.18
wildland-urban interface community
WUI community
community where humans and their development meet or intermix with wildland fuel

Note 1 to entry: Definition adapted from Reference [45].

3.1.19
wildland-urban interface fire
WUI fire
wildland fire that has spread into the wildland-urban interface (WUI)

Note 1 to entry: It is also possible for fires to start in the wildland-urban interface (WUI) and spread into the wildland.

3.1.20
wildland-urban interface firefighting
WUI firefighting

suppressive action involving a fire in the wildland-urban interface (WUI) where the action, tactics and equipment used can differ from urban firefighting

4 Ignition scenarios

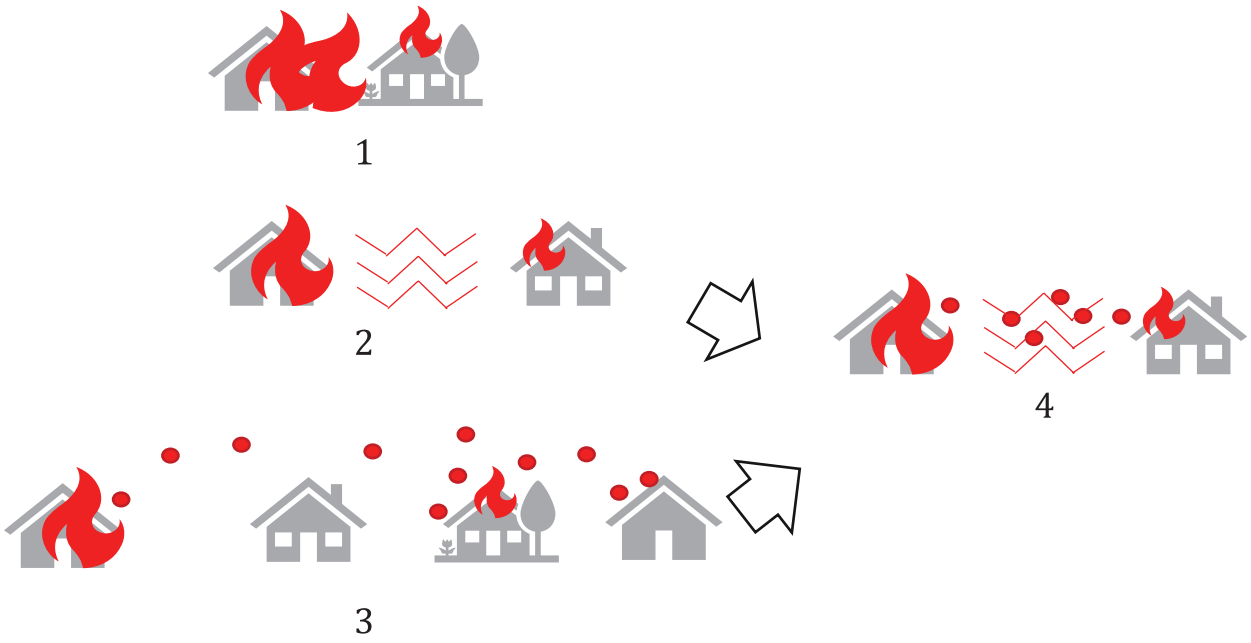
It is important to understand that large outdoor fires involve the interaction of topography, weather, vegetation and structures. Large outdoor fires differ from enclosure fires in several ways; most notably the fire spread processes are not limited to well-defined boundaries, as is the case of traditional building or enclosure fires. Wildland firefighting and WUI firefighting techniques, as well as fire mitigation, also differ in their nature, application and in terms of the distances involved in such situations. At the interface, the interaction of buildings, construction products used, and urbanization rules are also key parameters. Reference [32] gives a good overview of these phenomena. There are three ways in which ignition can occur:

— Direct flame contact — This is the aspect usually managed by fire tests from building regulations.

— Thermal radiation — The probability of ignition depends on the distance and time of exposure. This can occur at distances of tenths of meters.

— Firebrands — The probability of ignition depends on the accumulation. Spot fires can occur at long distances (several hundred meters).

A combination of any of these three points is also possible. Direct flame contact and thermal radiation act in combination as a flame exists and emits thermal radiation. Direct flame contact and firebrands can also act in combination while direct flame contact is likely dominant. Thermal radiation and firebrands can act in combination as shown in Figure 1.



Key

1 direct flame contact
2 thermal radiation
3 firebrands
4 thermal radiation and firebrands

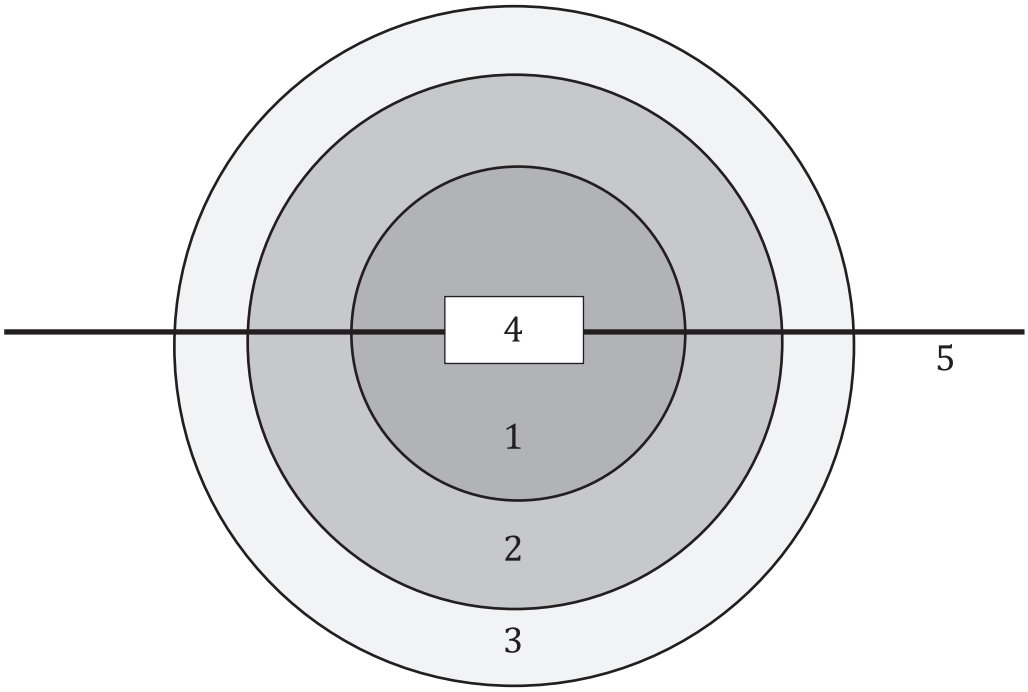
Figure 1 — Fire propagation modes in large outdoor fires (from Reference [32])

5 Regulation principle and strategies

5.1 Japan

The Building Standard Law (BSL) of Japan[25] aims to cover the threat of large urban fires. According to the BSL, there are two major fire tests conducted in Japan in the context of preventing urban fire spread: a roof test and a fire resistance test for exterior walls.

The purpose of the BSL is to safeguard the life, health and property of people by providing minimum standards concerning the site, construction, equipment and use of buildings, and thereby to contribute to the furtherance of the public welfare. To prevent fires from spreading from one building to the next and to minimize the occurrence of urban fires, buildings located in "fire protection zones (FPZs)", "quasi-fire protection zones (QFPZs)", and "cities under Article 22" are required to conform to the BSL. Figure 2 illustrates the basic philosophy of zoning. While no scientific research has yet been carried out to determine the efficacy of these regulations, due at least in part to the regulations, large urban fires are a relatively rare occurrence in Japan today, and are most likely to occur under extreme conditions (in themselves rare), such as those following a major earthquake or in extremely high winds.



Key

1 fire protection zone
2 quasi-fire protection zone
3 city under Article 22
4 station
5 railway

Figure 2 — Zoning concept according to BSL of Japan (from Reference [25])

5.2 California State Building Code (US)

California refers to California Building Code, Title 24, Part 1, Chapter 7A Materials and Construction Methods for Exterior Wildfire Exposure, as well as Chapter 49, Requirements for Wildland-Urban Interface Areas. The following California State Fire Marshal (SFM) Test Standards are described: 12-7A-1,[6] 12-7A-2,[20] 12-7A-3,[18] 12-7A-4,[14] 12-7A-5.[21]

5.3 NFPA 1144, Standard for Reducing Structure Ignition Hazards from Wildland Fire (US)

The National Fire Protection Association (NFPA) published the current edition of NFPA 1144[50] in 2018. This standard can serve as a model for adoption (in total or with amendment) by local building codes. The scope of the document ranges from assessing fire hazard in the structure ignition zone to building design, location and construction. Building components covered include: roof, exterior walls, openings (including windows and doors), chimneys, and accessory structures. Sample qualitative and quantitative hazard assessment methodologies are included in the Annex. In the 2022 revision process this document is to be combined with NFPA 1141[48] and NFPA 1143[49] to form a single document, NFPA 1140.

5.4 International Wildland Urban Interface Code (IWUIC)

The International Code Council (ICC) published the current edition of the IWUIC in 2018.[47] This model ranges in scope from water supply and vehicles access to building construction and fire protection requirements. Appendix sections provide additional information on topics including: vegetation