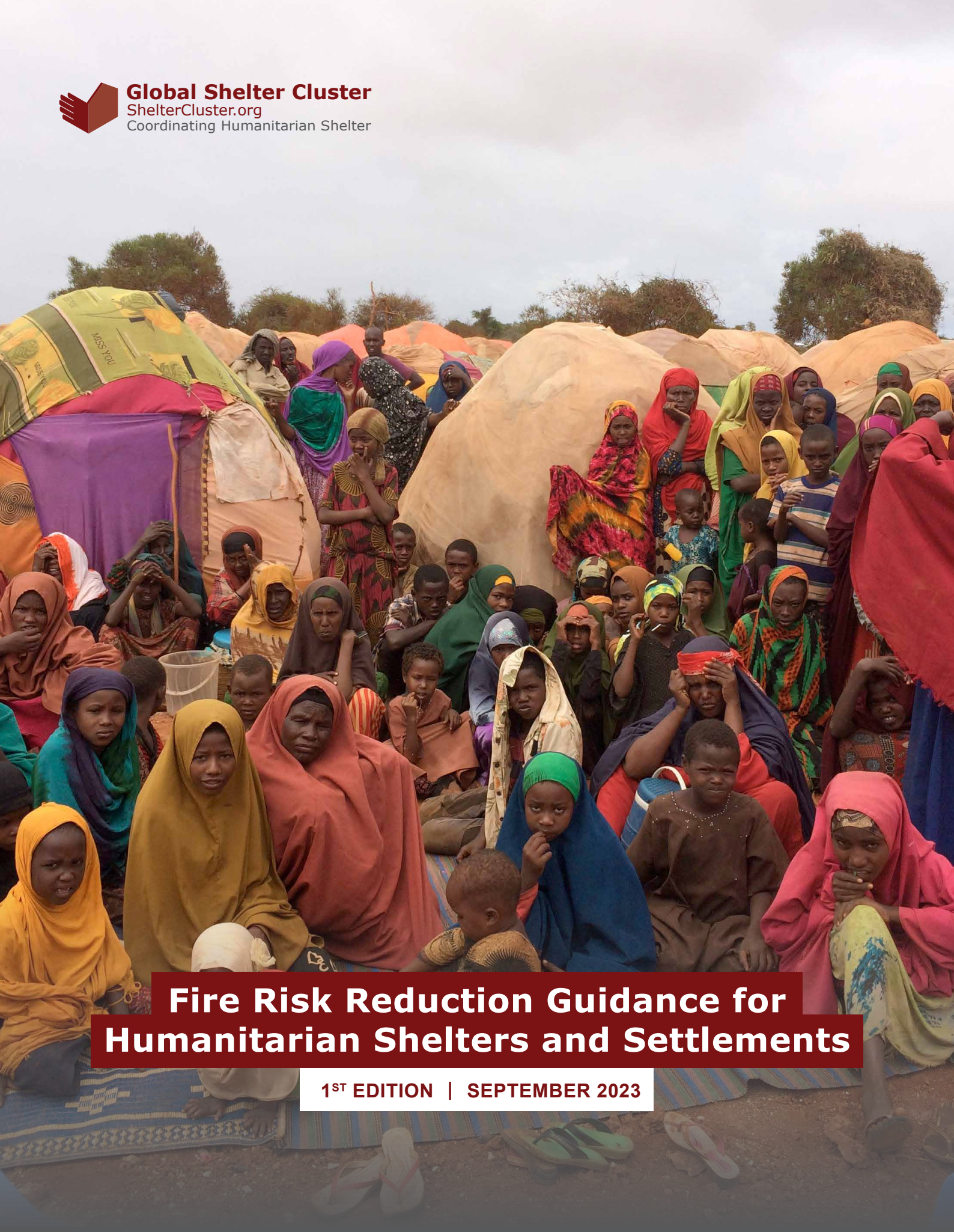
Global Shelter Cluster
ShelterCluster.org
Coordinating Humanitarian Shelter



Fire Risk Reduction Guidance for Humanitarian Shelters and Settlements

1ST EDITION | SEPTEMBER 2023

www.sheltercluster.org

Settlement adaptation and fire risk. Bangladesh

© Paul Chamberlain

CONTENTS

ACKNOWLEDGEMENTS

Development of this document was generously funded by USAID-Bureau of Humanitarian Assistance and the UK Foreign Commonwealth & Development Office and sponsored through the Global Shelter Cluster.

Sincere thanks go to the many colleagues who gave their time at different stages of the project and were so open with their reflections, comments, and analysis. This report draws together and builds upon the work established by many who have committed professional knowledge and experience to humanitarian assistance.

AUTHORS

Kindling: www.kindlingsafety.org

Danielle Antonellis, Helen Underhill, Antonio Cicione, Sandra Vaiciulyte, Sam Stevens

© Danielle Antonellis, Bangalore, India

1 Introduction

The research report associated with this guidance document, The State of Fire Safety in Humanitarian Shelter and Settlements, highlights the significant challenges presented by the lack of available data, knowledge, and research on fire in humanitarian settings, making it challenging to understand and address the problem. This guidance document acts as a form of education and capacity building for use across the sector and sits as a standalone resource, supplementary to the research report.

Reflective of the contextual nature of fire and the incredible diversity of global humanitarian settings, this extended guidance serves Introductiontwo key purposes:

CAPACITY BUILDING
provide baseline of **technical fire risk and safety knowledge** that should be required for all humanitarian actors.

GENERALIZED GUIDANCE
information and discussion points for dialogue among humanitarian professionals and **initial recommendations**.

The extended guidance is necessary because efforts to tackle fire in humanitarian settings are relatively recent and significant knowledge gaps have been identified. The sector does not have the data, evidence, or research to issue or implement comprehensive fire risk reduction and safety guidance that can be reliably considered to meet the complexities of the problem across the range of contexts in which it would be applied. Instead, this approach begins the capacity building process by laying the foundation of required fire science and engineering knowledge that individuals can draw on in their practice[1].

To create comprehensive guidance, a holistic approach to fire safety is needed that brings together four key areas of knowledge[2] (technical, operational, experiential, contextual) and connect to three stages of the fire cycle as experienced in humanitarian settings (before, during, after) (***Figure 1***).

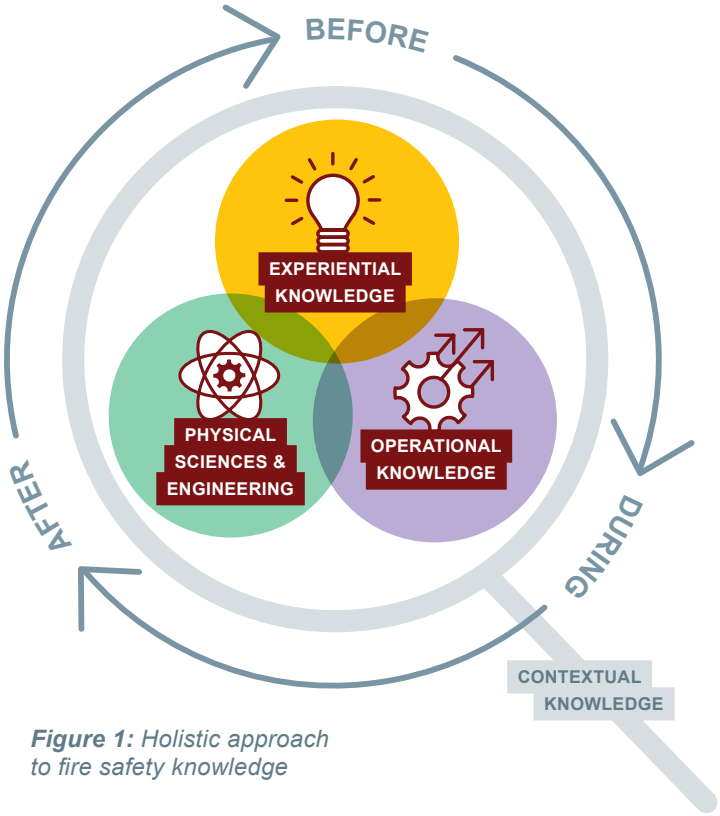


Figure 1: *Holistic approach to fire safety knowledge*

For example, country-level data and analysis are needed that consider the technical aspects of preparedness and how 'before fire' activities connect to how people experience fire risk and therefore the adaptation they may make to a shelter. Similarly, some knowledge exists of operational response during a fire, but in limited contexts, and there is little connection to how what is done during a response shapes recovery efforts or how the response was experienced by residents during and after the fire.

Presenting guidance based on one area of knowledge and one context may lead to unintended consequences where recommendations are implemented as a 'quick-fix' without appropriate expertise or understanding. In the context of fire, the unintended consequences of such interventions can be devastating.

1.1 WORKING WITH THE GUIDANCE

To meet the first purpose, ***Section 2*** of this guidance introduces fire risk from an engineering perspective and aims to bring the social and technical underpinnings of fire risk specific to humanitarian settings together. In the absence of any more detailed knowledge or training in fire safety, it aims to broadly cover the main fire engineering science principles and should be considered required baseline knowledge for fire safety in humanitarian settings.

[1] A reference list is available within the accompanying research report: The State of Fire Safety in Shelters and Settlements. The report includes an overview of country specific Fire Risk Assessments and published technical research that is particularly relevant to humanitarian settings (such as those emerging from the IRIS-FIRE project).

[2] **Technical:** e.g., fire safety engineering, fire science. **Operational:** e.g., fire response, preparedness delivery; **Experiential:** e.g., 'lived' experiences and accounts; **Contextual:** local / national social, political, economic, cultural factors, data on fire incidents and recovery.

The remainder of the document provides detailed context and recommendations for fire safety. It is important to note that the recommendations are not prescriptive, since there is no one-size-fits-all solution for fire safety, and data, evidence, contextual knowledge, experiential knowledge and evaluations of other possible and tested solutions are lacking. This document aims to prompt dialogue about how to best develop and institutionalize guidance in the sector and will hopefully inspire the creation of a cyclical fire safety guidance or standards development process led by a diverse committee overseeing a public participation process. This Community of Practice would create a reference for decision-making in relation to fire risk in humanitarian settings, and act as a reference for other standards which may integrate its component parts (i.e., fire safety considerations).

The State of Fire Safety in Humanitarian Shelter and Settlements report concluded that fire currently falls between the cracks across the sector: fire is seen as ‘everyone’s and therefore no-one‘s responsibility’. This initial guidance, therefore, is intentionally cross-disciplinary and cross-sectoral and is the first step to bring all humanitarians up to speed with basic fire risk and fire safety principles that could be further built upon by different actors.

1.2 FUTURE GUIDANCE AND TOOLKITS

A commitment to future iterations of the guidance would:

- ✓ Draw on an expanded data set of fire incidences, interdisciplinary analysis of fire risk and safety in different shelter and settlement types, and evidence and evaluations of programs in a range of contexts.
- ✓ Be created through committee: draw on different technical, operational, experiential, and contextual knowledges through interdisciplinary collaboration to underpin all recommendations.
- ✓ Support actors within the sector to create contextualised solutions.
- ✓ Be supported by a range of capacity building and education, communication and engagement activities, resources and programs.

Electric wires in tented settlement, Lebanon

© Photovoice activity with settlement resident via Helen Undernill

2

A Fire Engineering Overview

This section introduces the social and technical underpinnings of fire risk specific to humanitarian settings that are the baseline knowledge required for those working within the humanitarian sector. It lays the foundations for understanding how fire risk emerges and the basic principles that underpin fire safety and response in humanitarian settings. It draws together key learning from course curriculum, textbooks, journal articles, fire safety materials and emerging research such as IRIS-FIRE (University of Edinburgh and University of Stellenbosch). This chapter should, therefore, be engaged with as form of education that aims to build capacity within the sector.

First, fire basics are introduced, conceptualizing what fire is and the reasons why fire is dangerous to people. Then, the stages of fire are discussed and applied to humanitarian settings. A distinction is made between fire within a single shelter or building and on a settlement scale. Diverse settlement typologies and infrastructure types are explored in relation to fire risk emergence.

2.1 FIRE BASICS

THE FIRE TRIANGLE

Fire, or combustion, is the heat-releasing reaction between a combustible material and oxygen. Flaming is the visible effect of combustion, in which hot fuel gases and oxygen react releasing light and heat. Though other forms of combustion exist, such as smouldering of solid fuels, in many contexts the terms ‘fire’ and ‘flame’ might be used interchangeably.

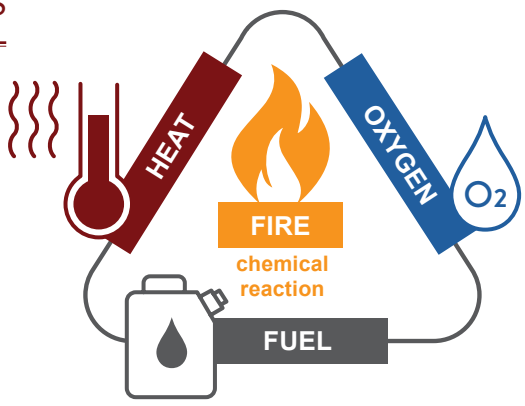


Figure 2: *Combustion Triangle*

The fire triangle is a widely used tool when introducing the topic of fire safety and response. For the combustion process to occur, fuel, oxygen and heat need to be present. Without any one of these components, combustion cannot occur. These three components are known as the combustion or fire triangle, which is visually depicted in ***Figure 2***.

WHY ARE FIRES DANGEROUS TO PEOPLE?

Fire and smoke can be deadly. The main determinant of survival in fire is an occupant's time to incapacitation, meaning occupants are no longer capable of self-survival because of exposure to fire and its effects (i.e., exposure to heat, toxic gases, etc.).

Fire fatalities are mostly attributed to inhalation of smoke or toxic gases. Carbon monoxide, for example, is one of the gases released during combustion. When combined with hemoglobin in the blood, it forms carboxyhemoglobin which results in toxic asphyxia. Once carboxyhemoglobin levels reach 50% in the blood, death is imminent. Smoke inhalation typically damages the body by asphyxiation (lack of oxygen), but it can also cause chemical or thermal radiation, and chemical asphyxiation. Burns are also a prevalent cause of injuries and depending on their extent and location, burns can be fatal.

Once an occupant becomes incapacitated in a fire, conditions can become fatal within seconds. The fire hazards affecting escape capabilities typically occur in the following sequence:

1. Smoke obscuration reduces visibility.
2. Smoke starts to irritate the respiratory tract causing pain and making it difficult to breath; the smoke irritates eyes causing a further reduction in vision.
3. Toxic combustion gases cause asphyxiation leading to loss of consciousness.
4. Severe skin and respiratory tract pain and burns due to exposure to heat.

Therefore, the main determinant of survival in fire is the time required by occupants to leave areas where they could be exposed to fire and its effects. Two key questions to evaluate fire risk are therefore: *(1) How long before a fire or its effects spread beyond its area of origin and put occupants at risk to its effects (e.g., low visibility, exposure to heat or smoke)?, and (2) How much time will it take occupants to reach a place of safety, remote from the fire and its effects?*

These questions underpin a type of fire engineering analysis called an ASET vs. RSET analysis, where:

- ✓ The 'available safe egress time' (ASET) is the amount of time available before a fire or its effects spread beyond its area of origin and put occupants at risk to its effects (e.g., low visibility, exposure to heat or smoke)
- ✓ The 'required safe egress time' (RSET) is the amount of time that occupants take to reach a place of safety, remote from the fire and its effects.

The goal is to have the ASET be greater than the RSET by as much a safety factor as possible, meaning people have sufficient time to safely escape.

2.2 STAGES OF FIRE

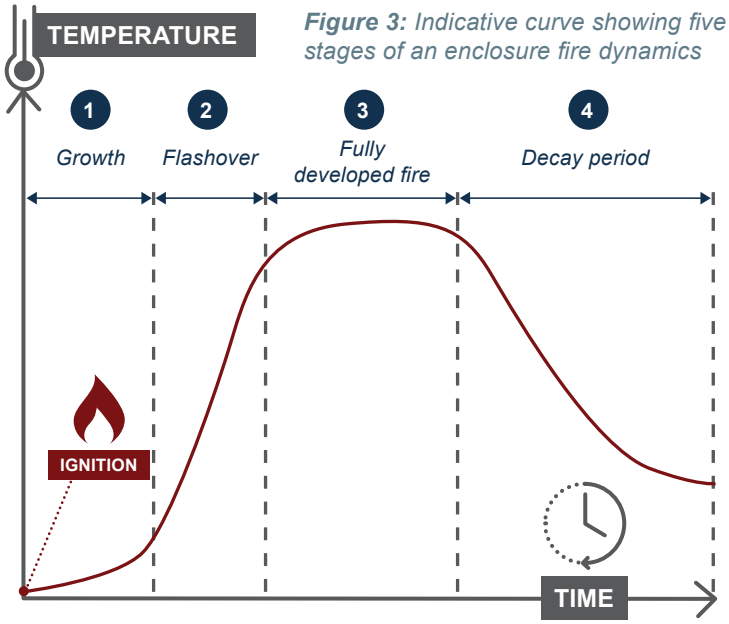


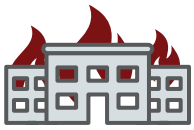
Figure 3: *Indicative curve showing five stages of an enclosure fire dynamics*

The development of a fire in an indoor environment, such as a room or building, can be influenced by various factors such as the size of the enclosure, ventilation conditions, fuel sources, and the availability of oxygen.

Enclosure fire development can be divided into five stages: ignition, growth, flashover, fully developed and decay. Figure 3 shows these stages as a standard curve on a time-temperature graph. This curve remains the same if temperature is replaced by heat release rate on the y-axis, i.e., the rate at which energy, in the form of heat, is released during the combustion of an object.

Similar to fire in an indoor environment, a fire in an open environment will be initiated through an ignition and then undergo a growth period. But fire grows and spreads differently in an outdoor environment than in an enclosure because outside fires have access to a continuous supply of oxygen, and usually to a larger fuel supply. Topography and weather, especially wind, can also significantly influence fire behavior, including the speed, intensity, and direction of fire spread.

In humanitarian settings, both enclosure fires and outdoor fires occur, e.g.,



SHELTER OR BUILDING FIRES (warehouses, hospitals, etc.)**:** individual shelter or building has an interior fire.

SETTLEMENT FIRES: outdoor fire with multiple shelters or buildings involved. Large settlement fires in camp and camp-like setting may form a fire front similar to a wildfire.

WILDLAND FIRES: an uncontrolled fire that burns vegetation.

While many fires in humanitarian settings originate in shelters, once a fire begins to interact with adjacent shelters, combustibles, etc., the fire can be considered an outdoor fire.

Ignition and the modes of heat transfer are discussed in *Sections 2.2.1* and *2.2.2*.

Refer to *Section 2.2.3* for more information on how enclosure fires tend to then go through the stages of early fire growth, flashover, fully developed, decay, and sometimes, collapse, if not contained or extinguished.

Refer to *Section 2.2.4* for more information on how outdoor fires spread as a function of the fuel readily available / accessible to it, and discussion on how these fires may then decay, if not contained or extinguished.

IGNITION

Ignition is the first instance of combustion (i.e., a chemical reaction that takes place when a substance rapidly reacts with oxygen, releasing light and heat in the process). A combustible material ignites when it is heated to its ignition temperature. For less dense materials, such as foams and synthetics, the time to ignition is typically faster compared to other, denser materials such as wood. However, there are other material properties that also influence the time to ignition such as: moisture content, ignition temperature of the material, and the thickness and conductivity of the material.

Ignition can either be spontaneous or piloted (presence of flame or spark). Remembering that materials have different ignition temperatures depending on their physical properties, spontaneous ignition is a phenomenon that takes place once a material's surface reaches a certain temperature that causes the material to ignite spontaneously, without the presence of a flame or spark. For spontaneous ignition, the surface temperature of a solid material should typically exceed 500°C. However, if a flame or spark is present, this acts as a piloted source, and some solid materials can ignite at a surface temperature of 250°C. The presence of a piloted source increases the ignition risk significantly because it (a) lowers the surface temperature required for ignition of the combustible material to take place, and (b) in some cases, it also provides the heat source, e.g., candle flame.

Humanitarian settlements have numerous ignition risks, such as unsafe methods for cooking, heating, and lighting, overloaded electrical connections, incorrectly wired electrics, and old/non-compliant electrical devices. Open flames are common in humanitarian settlements and are often used for cooking (gas stove, three stone fires, etc.) and lighting (e.g., candles, kerosene lamps). Open flames can serve as a piloted ignition source and are therefore a significant fire hazard, particularly in overcrowded or densely populated conditions. Open flames also present a heat source that can easily interact with combustible materials, bringing all three elements of the combustion triangle (heat, fuel, and oxygen) together, leading to unwanted ignition.

Figure 4: *Photographs of unsafe electrical systems in a marketplace in Hargeisa, Somaliland; in an informal settlement in Cape Town, South Africa; self-settled refugee camp in Beirut, Lebanon*

Electrical fires are a leading cause of fires globally. Electricity is also a significant fire hazard in humanitarian settlements. Fire ignitions can arise from electrical faults, short circuits, and overloading associated with formal electrical infrastructure, formal or informal (often illegal) connections and distribution and connected appliances. ***Figure 4*** shows examples of overloaded, unsafe electrical connections in Somaliland, South Africa, and Lebanon. In the small diameter, poorly insulated cables are directly above a stack of mattresses, which are highly combustible, therefore presenting a possible ignition scenario with potential for a significant fire.

Furthermore, the presence of such cables limits access for responding fire services in that (a) fire trucks cannot pass under the low-hanging cables, and (b) electrical supplies to an area must be switched off before extinguishing a fire with water because water is conductive and can cause electrocution if in contact with electricity.

MODES OF HEAT TRANSFER

Once a combustible material has been ignited and combustion is sustained, the fire can grow if there are sufficient combustible materials and oxygen available. This is known as the growth stage. There are three modes of fire spread during this early stage namely radiation, convection, and conduction, as depicted in ***Figure 5***.

THERMAL RADIATION refers to the transfer of heat through electromagnetic waves, which can pass through transparent liquids, solids or through a vacuum. Radiation is typically the main heat transfer mechanism from a flame to the surface of a combustible.

CONVECTION refers to heat transfer from a fluid (gas or liquid) to another body (solid or fluid), or to the transportation of energy by heat-driven movement of the fluid.

CONDUCTION refers to heat transfer through a solid material. Heat transfer through a solid will always be from the surface with the higher temperature to the surface with a lower temperature.

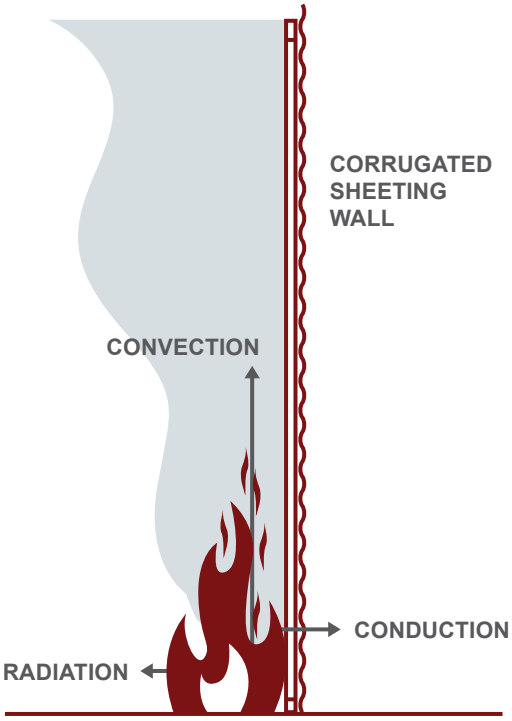


Figure 5: *Modes of heat transfer*

ENCLOSURE FIRES

1 *Early Fire Growth*

Typically, during the early stages of fire growth, the enclosure fire is fuel-controlled, implying that there is sufficient oxygen supply for complete combustion to occur. During the growth stage, hot combustion gases are released and since these gases are hotter than the surrounding environment, and thus less dense, they start to rise. If the fire is inside an enclosure, hot gases will rise and accumulate at the ceiling/roof level. This accumulation of hot gases at ceiling level is known as the hot layer. As more and more hot gases accumulate, the temperature of the hot layer increases.

2 *Flashover*

In the case of sufficient fuel and openings inside an enclosure which is sufficiently durable (i.e., enclosure stays intact), a fire may then progress to flashover. Flashover is reached when the hot surfaces of the enclosure and the hot combustion gases cause all the combustible materials in the shelter to ignite nearly simultaneously. Flashover typically occurs at a hot gas layer temperature of 500-600°C, which corresponds with radiation to floor level of approximately 15-20 kW/m2. Once an enclosure experiences flashover, firefighters cannot enter and people inside the shelter cannot survive, as the heat is beyond living conditions. At this stage, flames form outside the shelter openings because of insufficient oxygen inside the shelter.

Fire experiments with structures typical of informal settlements in Cape Town, South Africa, have shown that internal lining materials such as cardboard can significantly decrease the time to flashover. For example, in the experiment with timber clad timber structures depicted in ***Figure 6***, flame spread occurred rapidly over the vertically lined cardboard, and released substantial heat, allowing the hot layer to reach the temperature required for flashover within 12 seconds after the cardboard lining ignited. This finding has been further demonstrated in numerous full-scale experiments and with computer models. Such a rapid flashover onset is extremely dangerous and there is not enough time to evacuate, particularly if ignition occurs when occupants are asleep.

Figure 6: *Timber plank wall and corrugated steel sheet roof shelter experiment conducted by the University of Stellenbosch*

Not all enclosures will reach flashover, however. This can be explained through an example comparing fire experiments of an enclosure built with non-combustible (corrugated steel) walls and roof to an enclosure with combustible (plastic sheeting) walls and roof (***Figure 7***).

The enclosure with non-combustible walls experienced typical enclosure fire behavior as discussed above, i.e., ignition, growth, and flashover, which was instantly followed by flaming from the openings. In contrast, the plastic sheeting roof in the other experiment melted soon after ignition, allowing hot gases to escape and a relatively symmetric fire plume[3] to develop. The enclosure did not remain intact, and flashover did not occur.

Figure 7: *Photographs of fire experiments: (left) non-combustible enclosure experiment by University of Stellenbosch and (right) combustible enclosure tested by MOAS*

[3] Symmetric fire plume refers to free burning of a circular source in still air, whereas asymmetric fire plumes refers to changing in boundary conditions from wall restrictions or the ambient wind, for example.

3 *Fully Developed Fire*

After flashover, an enclosure fire typically enters the fully developed stage of fire development. During this stage, the heat release rate[4] and temperatures are at their highest. Once an enclosure enters the fully developed stage, the fire typically becomes ventilation-controlled, which means there is insufficient oxygen entering the enclosure (through openings) for complete combustion to occur. Some of these unburnt gases start to accumulate within the enclosure and as they start to leave the shelter through openings such as windows and doors. These unburnt gases ignite when they come into contact with oxygen outside the enclosure, resulting in flames emerging from openings. For closely spaced structures, flames ejecting from openings and impinging on their neighboring shelters can cause the fire to spread to adjacent structures. This can trigger a transition from a building fire to an outdoor fire; refer to *Section 2.2.3*.

4 *Decay and Collapse*

This stage, which marks the gradual decrease in temperature and intensity of the fire, can vary depending on the materials used in the construction of the shelter and the circumstances surrounding the fire. In steel-clad or other non-combustible clad shelters, the decay stage typically occurs when the fire transitions from being ventilation-controlled to fuel-controlled. This change is triggered when the available combustibles within the shelter become depleted, and the fire can no longer sustain its fully developed stage. As a result, the temperature and intensity of the fire decreases.

However, the decay stage may not always follow the conventional pattern in some humanitarian shelters, particularly those constructed using combustible materials. These materials can include tents, bamboo, thatch, wood, plastic, and other similar materials. In these instances, the shelter may experience a collapse before the fire reaches the ventilation-controlled stage due to the burning and weakening of the structural elements.

Moreover, the exterior of the shelter may burn through, creating additional openings in the structure. This development can inadvertently result in a range of possible outcomes. At one end of the spectrum a hotter, more intense fire might occur since more oxygen can get to the fuel more efficiently. Conversely, new openings might create such a well-ventilated fire that much of the heat can escape the shelter resulting in a fire that is cooler but lasts for longer. This transient behavior of the fire poses a significant challenge for occupants and emergency responders, as it may lead to unpredictable outcomes and increased risks.

OUTDOOR FIRES

Fire engineering research and practice related to fire in outdoor environments is an emerging area of interest. There are many lessons and insights to be gained from wildfires, especially those affecting communities in the wildland urban interface (WUI), and urban conflagrations that have affected cities across the globe.

Fires in humanitarian settings often evolve into large conflagrations spreading to dozens, hundreds or sometimes thousands of shelters and buildings. Understanding outdoor fire spread, including between shelters / buildings, is therefore critical to develop fire safety systems to minimize fire spread.

While many fires in humanitarian settings originate in shelters, once a fire begins to interact with adjacent shelters, combustibles, etc., the fire can be considered an outdoor fire. Understanding ignition of shelters and combustibles exposed to exterior fire is fundamental to understanding how fire spreads across settlements.

[4] Heat release rate is the amount of energy, in the form of heat, released during combustion of an object. The amount and type of fuel (combustible materials) will significantly affect the heat release rate of a fire.

A common question posed regarding fire in humanitarian shelters is, what is the minimum distance required between shelters to prevent fire spread? The answer to this question is: *it depends*.

Fire spread is a complex phenomenon that can be better understood by focusing on the driving mechanisms of fire spread. Based on research into wildfires, WUI, and informal settlements, there is strong evidence that the primary mechanisms of fire spread in outdoor environments are:

1 | Radiation

2 | Flame impingement

3 | Branding/spotting via embers (i.e., brands)

Figure 8 shows key insights regarding these mechanisms of fire spread specific to informal settlement dwelling in Cape Town, South Africa (which are typically made from a timber frame clad with steel sheets or timber planks). As shown, the minimum spacing between shelters to avoid ignition from flame impingement or radiation ranges from 2m to over 5m, depending on construction materials, opening sizes and locations, shelter contents, and wind conditions. However, firebrands can be carried long distances, much further than 5m, and cause remote spot fires.

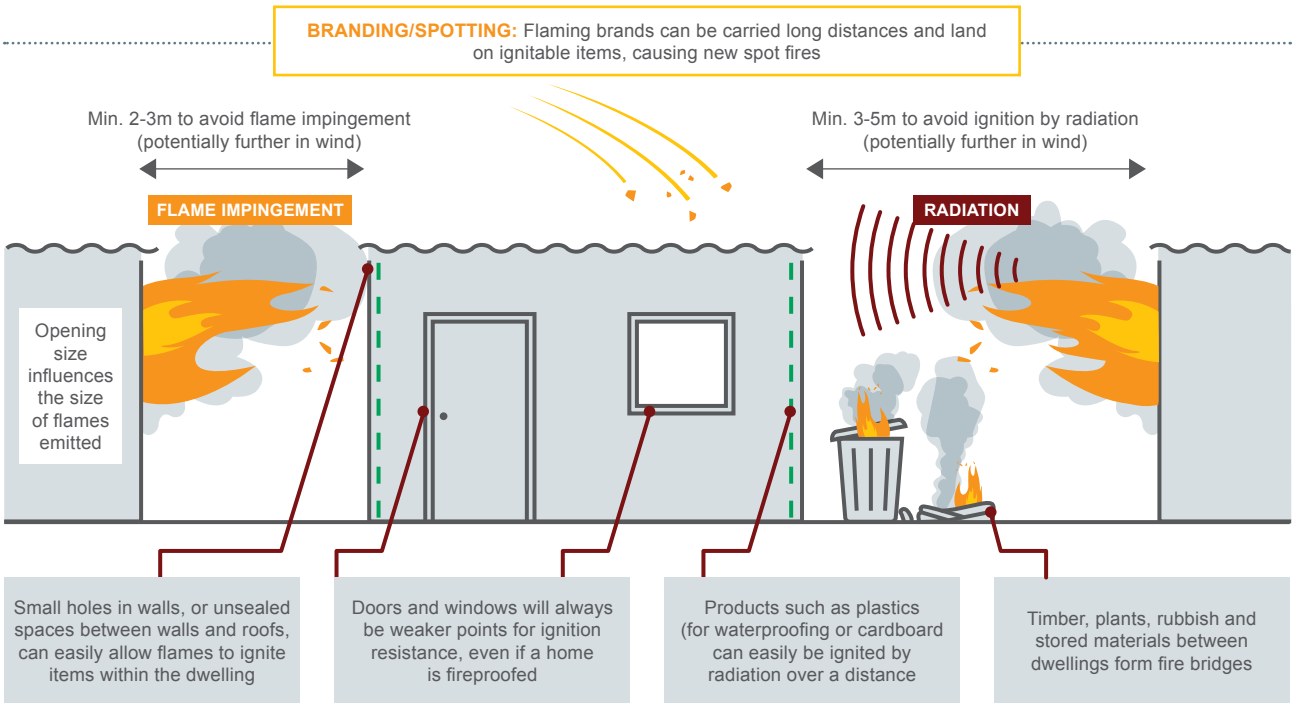


Figure 8: *Mechanisms of fire spread between informal settlement dwellings in Cape Town, South Africa, produced by Stellenbosch University*

RADIATION

Radiation refers to the transfer of heat through electromagnetic waves, meaning fire can spread via radiation without any direct contact between materials or with flames.

It is common practice to calculate radiation between adjacent buildings for regulated building fire safety design, where prescriptive minimum separation distances are not achieved. Based on the results of calculations, fire resistant façade construction may be required, or the number, location, and size of openings may be controlled, to prevent a fire from spreading between buildings.

To evaluate radiation, it is helpful to consider a burning item and a target item because fire spreads only when certain conditions are met based on the relationship between heat emitted by a burning item and the ignition vulnerability of the target item, often referred to as an emitter and receiver in radiation calculations.

In other words, determining if a fire can spread from one shelter to another requires evaluation of:

✓ *Heat emitted from the burning shelter:*

The heat emitted from the burning shelter depends on the materials of construction, the fuel load in the burning shelter (i.e., shelter contents), and ventilation conditions. In the Cape Town informal settlement research previously mentioned, it was found that timber-clad dwellings exposed neighboring structures to heat fluxes[5] 10-20% higher than steel-clad dwellings, with the same interior fuel loading. Additionally, the timber structures emit high heat flu xes in all directions due to combustion of the external facades whereas the high heat fluxes from the steel structures are mostly constrained to the region around the openings (windows and doors) where external flames occur. This demonstrates the importance of considering the contribution of combustible construction materials to fire spread.

Shelters emit heat through thermal radiation from one or more of three sources, as depicted in ***Figure 9:*** (1) the heat of the hot gasses inside the shelter, (2) the heat from the flames ejecting from the openings in the shelter, and (3) the thermal radiation from the burning roof and walls. This means that, all else being equal, a shelter with combustible roof and walls (e.g., timber) typically represents a higher fire spread risk than shelters with non-combustible construction materials because the amount of emitted thermal radiation is higher in the former than the latter. For example, for the steel-clad shelters, thermal radiation from the steel sheets is negligible compared to hot gases inside shelters and the flames ejecting from openings and can broadly be ignored.

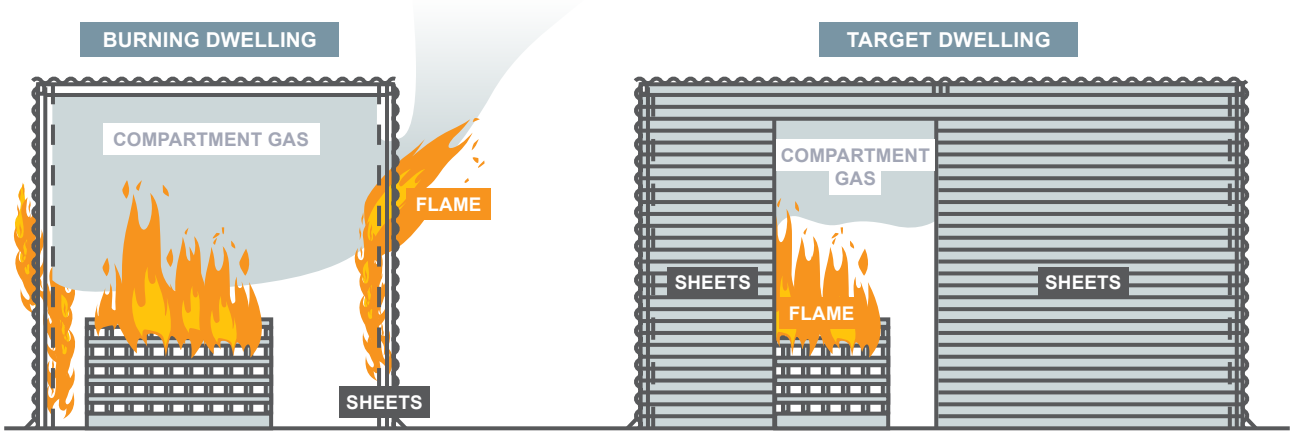


Figure 9: *Heat transfer from non-combustible shelter, produced by Stellenbosch University*

Shelter contents greatly influence the heat release rate and therefore radiative heat emitted. Shelter contents are highly contextual, influenced by factors such as availability of resources (financial resources and affordable options in the marketplace); individual, household, and cultural preferences and needs; humanitarian distributions. It is common for a large percentage of non-food items (NFIs) distributed in humanitarian settings to be plastic and petroleum based, which are highly combustible, contributing significantly to fuel loads in humanitarian shelters.

Ventilation conditions contribute to enclosure fire dynamics as well as the interaction of fire with adjacent (i.e., target) shelters; e.g., flames can project through openings, or react to changing ventilation conditions as a structure collapses.

[5] Heat transfer per unit area

In the case of a shelter with exterior roof and wall materials that melt at a relatively low temperature, the exterior will melt quickly after fire ignition, allowing hot gases to escape and a relatively symmetric fire plume to develop. Fire in this type of shelter will not eject flames from the windows, thereby reducing the radiative heat emitted from the shelter. This fire will behave like an outdoor fire. Only the burning fuel (furniture inside the shelter, etc.) will emit thermal radiation towards adjacent shelters. The amount and type of fuel (the fuel load) thus become extremely important as this determines the amount of thermal radiation emitted.

✓ *Heat received by the target shelter from its burning neighbor*

The heat received by the target shelter depends on the heat emitted by the burning shelter and the separation between the shelters (distance and geometric relationship). The closer a heat source (burning shelter) is to a combustible material (adjacent shelter), the greater the transfer of energy in the form of heat. There is a square root relationship between separation distance and radiant heat transfer. This means that halving the separation distance does not result in a doubling of the radiant heat transfer, but rather increases it by a factor of four. The time to ignition of a combustible material exposed to a fire hazard is therefore approximately exponentially proportional to the separation distance between the target shelter and source shelter.

Wind forces can result in flames tilting in the direction of combustible materials, increasing radiation due to the shortened separation distance between the hazard (the flame) and the target (the combustibles) and thus exponentially decreasing the time to ignition (and the fire spread risk). Wind can also increase the probability of flame impingement. As a result, wind-driven fires can spread more rapidly, complicating firefighting efforts and increasing the potential for widespread damage.

A similar effect is observed with fire spreading uphill. The flame tilt contributes to the speed of fire spread, and therefore understanding the topography of the settlement is important.

✓ *Heat required by materials of construction of the target shelter for ignition to occur*

A combustible material ignites when it is heated to its ignition temperature. As this temperature differs between materials, the exterior material (and interior lining material if exposed through gaps or openings) used for shelter construction will play a substantial role in the ignition vulnerability of a shelter.

If non-combustible external and internal wall materials are not an option, choosing external and internal wall materials with high ignition temperatures is important, as is keeping the distance between shelters as large as possible.

FLAME IMPINGEMENT

Flame impingement refers to the phenomenon where a flame directly contacts a solid surface. It occurs when a flame comes into close proximity with a surface and transfers heat and energy to that surface. The impinging flame can cause various effects, depending on the intensity and duration of the exposure, including ignition of the materials it is in contact with.

Flame length is indicative of the amount of heat and energy being released by the fire. Longer flames have a larger surface area and emit more radiant heat. This heat can preheat nearby fuels, making them more susceptible to ignition and facilitating the rapid spread of fire. Therefore, longer flame lengths correspond to more vigorous and fast-spreading fires.

An outdoor fire typically spreads via radiation and flame impingement when there are combustible materials in close proximity (see ***Figure 10***).

As discussed in *Section 2.2.3*, a building fire may transition to an outdoor fire if flames eject from openings and impinge on neighboring structures. As an outdoor settlement fire progresses, fire may be both inside and outside, in a complex series of interactions. Understanding how specific types of shelters behave in fire can be a strong indicator for settlement scale fire spread. Identifying the primary mechanism(s) of fire spread in a particular area can help to develop mitigation measures and fire response strategies.

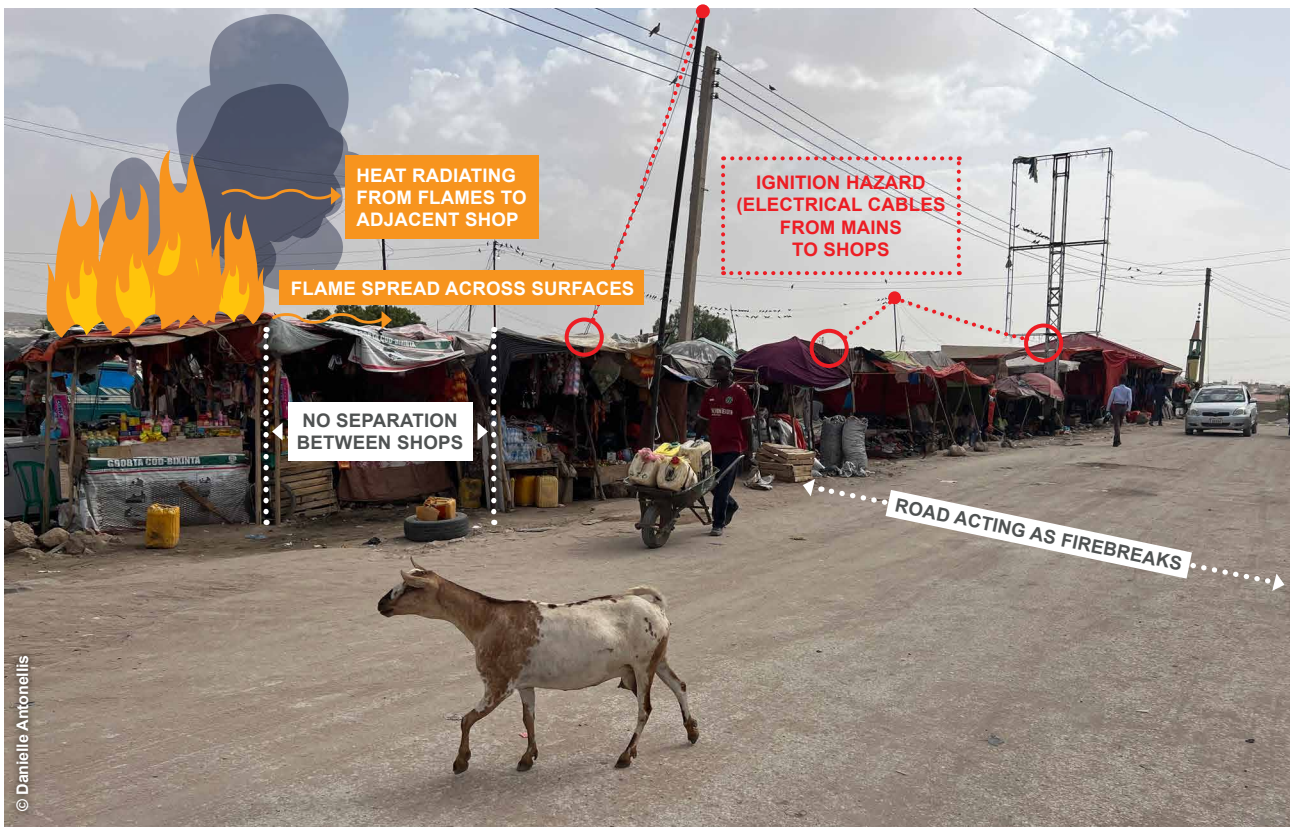


Figure 10: *Mock-up of fire scenario for outdoor market stalls; Hargeisa, Somaliland*

FIREBRANDING/SPOTTING

Evidence from wildfire incidents indicate firebrands can cause spot fires several hundred meters, and even kilometers away from a fire. The process of fire spread through firebrands in humanitarian settlements is similar to that of wildland fires, with the same three sub-processes: generation, dispersion, and ignition. Though fire spread through firebranding has been noted in humanitarian settlements, there is a lack of robust scientific evidence which quantifies the phenomenon, particularly as it relates to the three sub-processes.

The generation process involves the thermal decomposition of solid combustibles (usually natural and wood-type fuels) in a fire, resulting in the detachment of fragmented pieces from the main body that become firebrands. These firebrands can be lofted into the ambient airflow by convection or carried by the wind. The dispersion process involves the transportation of the firebrands downwind as they receive aerodynamic forces and eventually land. The distance that a firebrand can travel is influenced by the wind speed, the fire

size, and the size and density of the material. The ignition process involves the landing of the firebrand, or accumulation of multiple brands, on a combustible material sufficient to cause its ignition. The probability of ignition depends on the material's thermal properties, such as the ignition temperature, as well as the duration of contact with the firebrand and its properties.

When burning materials such as wood and other combustibles release firebrands that are lifted by the ambient airflow and transported downwind these firebrands can land on adjacent or even remote structures, igniting them and causing the fire to spread. Spotting refers to fire spread via firebrands to remote areas away from the site of fire origin. This phenomenon may be responsible for conditions often confused with arson as people observe 'multiple fires' occurring at the same time and infer the only explanation is intentional ignition at multiple locations, when this is, in fact, common behavior observed in outdoor fires when firebrands are present.

Factors that influence the transport of firebrands include wind speed and direction, fire size, buoyancy[6], and the size and density of the material, as mentioned before. Wind speed and direction play a crucial role in the spread of firebrands. The faster the wind, the farther the firebrands can travel. The size and density of the material also determine the distance that firebrands can travel. Lighter and smaller materials such as leaves and twigs can travel longer distances than heavier materials such as logs.

DECAY

In the absence of intervention, a fire will eventually reach the decay phase (i.e., burnout), once the available fuel is consumed.

2.3 FIRE RISK EMERGENCE

Like other disaster risks, fire risk emerges from the intersection of two opposing forces: vulnerability and a hazard, creating pressure and thus disaster risk. A study of fire risk emergence in informal settlements in Cape Town, South Africa and Dhaka, Bangladesh established the main factors: structurally constrained conditions, multitude of ignition sources and conditions that support fire spread, limited infrastructure and institutional capacity to respond to fires, fire services response are generally not fit for purpose for informal settlements, the dichotomy between temporality of settlement in theory and their permanence in practice creates tension between informal settlement residents and the formal systems.

A conceptual illustration of fire risk emergence in a planned camp is shown in ***Figure 11***. The dark red arrow represents unmanaged fire risk emergence as the result of fire safety not being well institutionalized into humanitarian systems to set up and manage camps. For instance, where fire risk is not considered through a Needs Assessment, and then not within a Shelter and Settlements Plan, and then not Site Selection (and so forth…) the fire risk cascades further through the system. Not only does this represent missed opportunities for fire risk reduction, but humanitarian programming itself creating fire problems – i.e., fire risk as an unintended consequence.

While it is not possible to eliminate the risk of fire, and fire risk emergence is an inherent part of a settlement's development, it can be managed and minimized. The light red arrow represents fire risk informed humanitarian action – the creation of fire risks is avoided where possible and fire safety principles are an integral part of fire safety throughout camp's evolution.

[6] Buoyancy refers to the upward force exerted on hot gases and flames due to density differences between hot gases and surrounding air

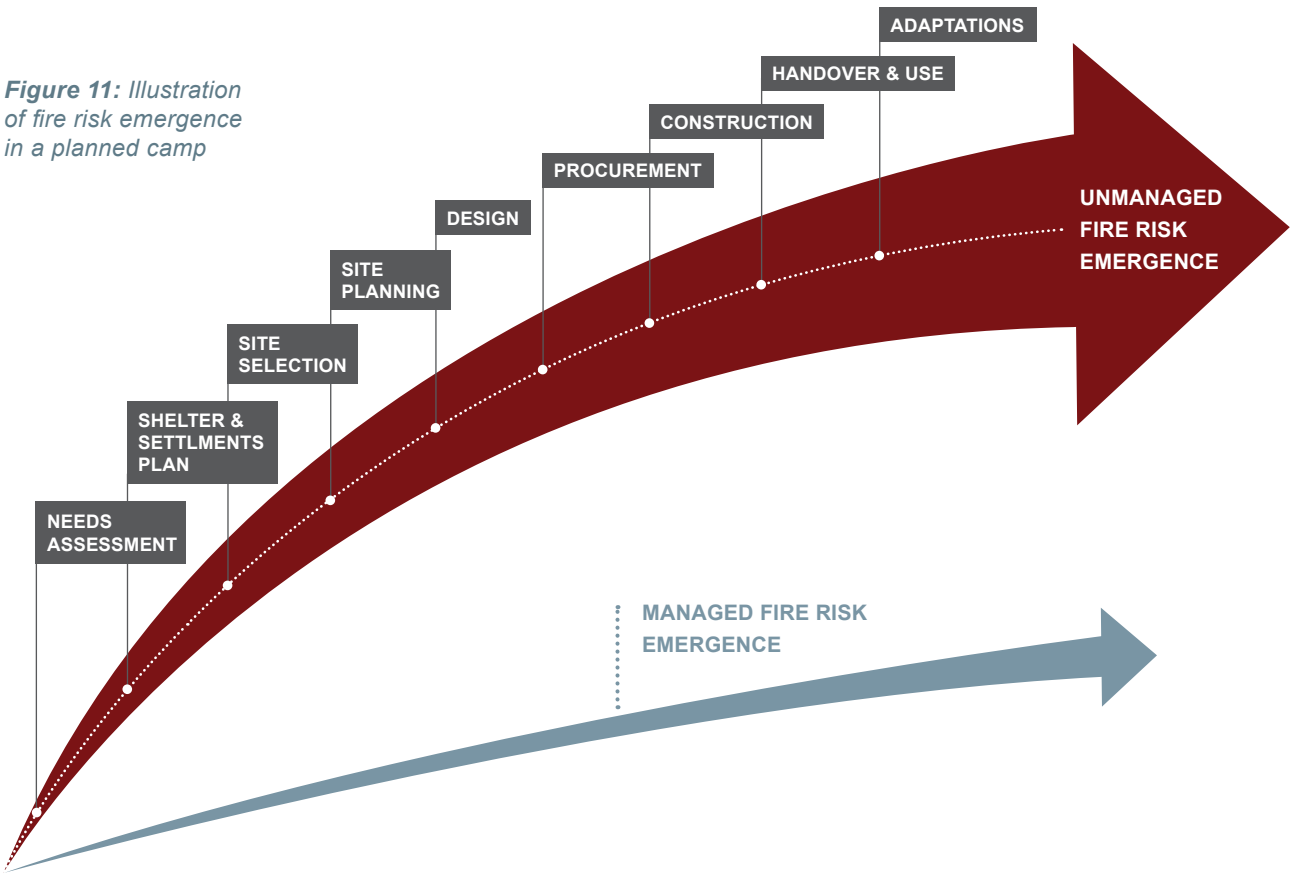


Figure 11: *Illustration of fire risk emergence in a planned camp*

SETTLEMENT TYPOLOGIES

In humanitarian contexts, the specific ways fire risk emerges are contextual, however there are patterns which shed light on the nature of fire risk emergence. These patterns tend to cluster around settlement types, which are generally characterized by their physical environments and the degree or nature of involvement, support, or management from external parties, such as local authorities and humanitarian agencies.

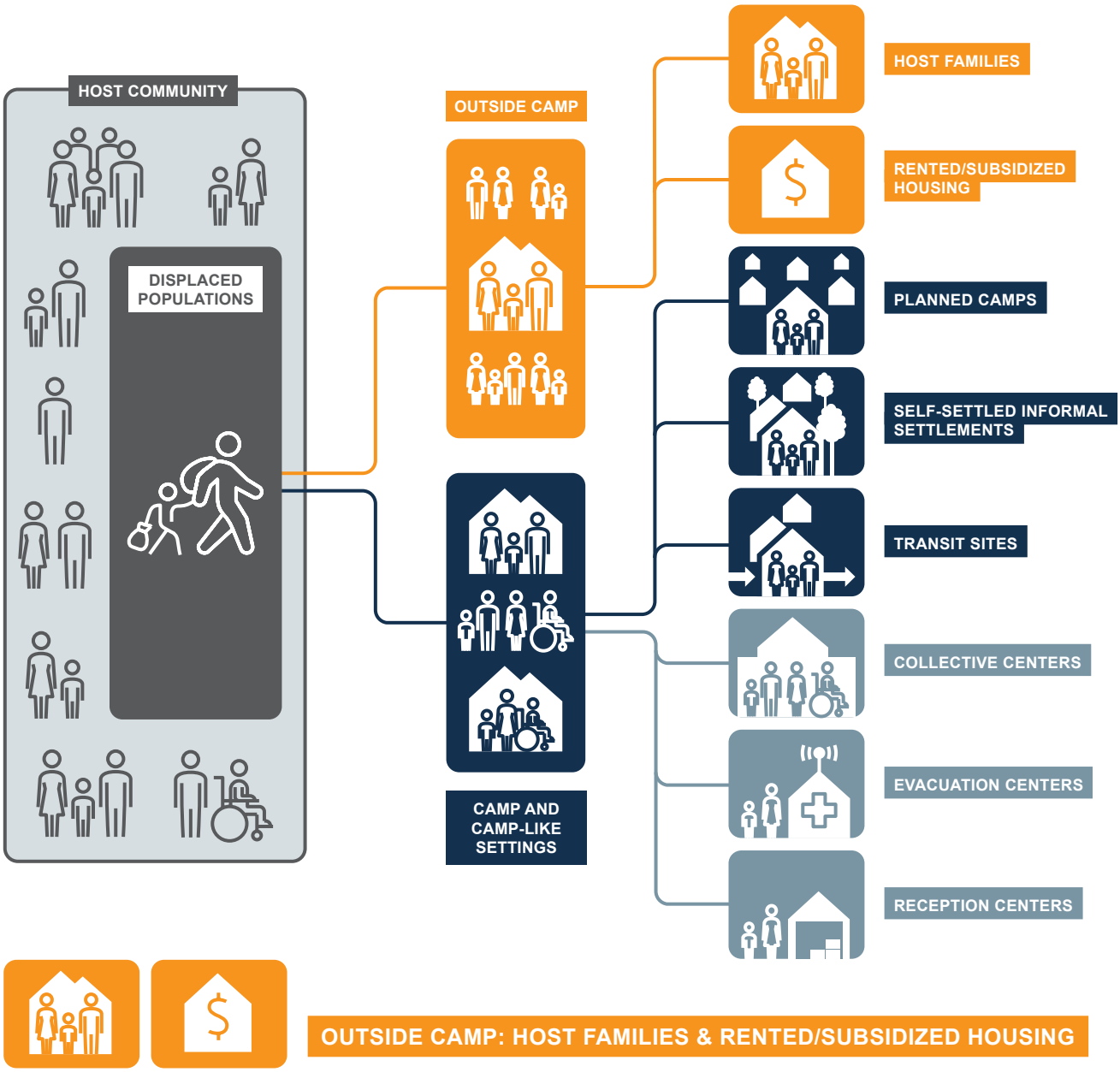
This section presents observations from this research, viewed through the lens of settlement types as defined by the Minimum Standards for Camp Management (2021), illustrated in ***Figure 12***.

While there is limited research on fire safety in informal settlements, interview participants from the humanitarian sector primarily discussed their experiences with fire in planned camps. This does not imply that other settings, such as rented/subsidized housing, collective centers, or in the context of the Türkiye earthquake response in 2023 ‘container cities’, are not considered. However, current knowledge and practice within the sector tend to focus on tented camps or settlements.

It is not possible to describe all possible fire scenarios in each settlement type (more research and data on fire incidents is needed), but it is important to acknowledge the diversity. For example, there are stark differences in fire risk and fire safety for a displaced family renting an apartment in a modern building with appropriate building fire safety and fire risk management systems, compared to a displaced family staying with a host family in a small makeshift dwelling within a long-standing demographically diverse, congested informal settlement that has no formal fire safety systems and lacks coordinated fire risk reduction, or in subsidized housing (such as ‘sub-standard buildings’).

The following subsections incorporate insights from existing literature and professional knowledge of those working to connect fire safety engineering to the humanitarian and development sectors to address fire safety more systematically.

Figure 12: *Settlement types in Minimum Standards for Camp Management (Minimum Standards for Camp Management, 2021: 19)*



According to the Minimum Standards for Camp Management (2021), p. 7:

"Outside camp or area (sometime called neighbourhood) approaches apply to designated geographical areas and can take place in urban, peri-urban or rural settings. Activities are delivered by a mobile team with adaptable skills and profiles. Their work focuses on setting up a centre to deliver site management services to people living in the entire community, both host and displaced. Accommodation can include rented premises and spontaneous settlements. They are most frequently used in dispersed and hard-to-reach displacement settings. They have short lifespans as they are used for evolving emergency situations and should be closely aligned with national structures."

Fire safety in ‘outside camp’ settings are largely a function of housing type (which is very diverse across the globe), housing quality, occupant characteristics and vulnerabilities, and the strengths/weaknesses/gaps of local regulatory systems before and/or during the response. Therefore, fire risk profiles and appropriate fire safety systems for single detached homes where host families may live, can be vastly different than apartments in high-rise buildings. Where housing is formal and broadly compliant to local building fire safety regulations, focus should be on maintaining fire safety systems and addressing fire risks that emerge as the evolving shelter needs of displaced persons adds pressure on the housing system. Common issues include overcrowded conditions, reliance on alternative energy sources and use of buildings for shelter not designed for this purpose, or not fully constructed.

Additional fire safety systems may be needed to address these emergent issues, as well as educational programming to support displaced persons in adapting to their new living conditions, which may be significantly different than what they are used to. For example, someone who is used to cooking over an open fire may introduce their methods and style of cooking in a high rise building that otherwise relied on electric cookers. This would not only increase the risk of ignition, but it could also put the displaced person and their neighbors at significant risk as they may not understand how to safely respond to a fire in the building.

Fire risk will increase more significantly in environments where fire emergency response infrastructure and resources are limited, and where local housing stock is already stressed and/or not achieving a minimum level of safety (e.g., commensurate to the local building regulations).

Mechanisms to improve fire safety through humanitarian action may be limited due to the distributed nature of housing, limited authority, high costs to address systematic housing issues, and other factors. However, mechanisms like cash for rent are often connected to assessments of housing and living conditions, and these could be utilized to assure minimum standards are achieved. Fire safety can be integrated into these types of assessments and minimum safety standards could be a prerequisite for distributing cash for rent. Minimum safety standards could include:

- ✓ Minimum number, capacity, and separation of exits.
- ✓ A maximum occupant load factor (persons/sqm) to avoid over-occupancy.
- ✓ Evacuation planning for people who require assistance to escape in the event of a fire (e.g., persons with disabilities, children, elderly persons).
- ✓ Review of energy usage and provision of NFIs and educational programming, as needed.

EMERGENCY EVACUATION CENTERS

According to the Minimum Standards for Camp Management (2021), p.7:

“Emergency evacuation centers are set up to provide appropriate temporary shelter for persons fleeing a specific and immediate threat, such as natural hazards like cyclones, fires, and flooding. Schools, sports arenas and religious or civic buildings are often used. They should be prepared and planned for in advance of disaster events where and when possible and they need to ensure accessible shelter or keep preparation for reasonable accommodation. Central authorities need to plan for the number of people per night, along with the estimated population flow.”

While emergency evacuation centers may be preparedness assets that are planned for in advance of an emergency, it is possible, and even likely, any building fire safety strategy, installed fire safety systems, and fire management procedures for normal use will not readily accommodate the emergency mode use for shelter and other functions (indoor cooking, internal partitions or shelters, storage, etc.), regardless of whether the building complies with local building fire safety regulations.

Fire safety strategies for emergency use need to be developed, ideally as a preparedness measure before the center is needed during an emergency. A fire strategy should include an overview of the building (e.g., construction materials and methods, size, layout, infrastructure connections, access roads, siting to adjacent buildings); current fire safety strategy, systems, and procedures for normal use, including facilities to support firefighting, search and rescue by the fire services; actual and/or anticipated changes to the physical building and its use (e.g., expected activities); new and/or increasing fire hazards; number, demographics, characteristics, and vulnerabilities of occupants; etc.

A fire risk analysis consistent with international good practices for building fire safety and grounded to the specific social and humanitarian context should be carried out to assess the new fire risk profile and to identify fire safety measures needed to address these risks. This strategy may include physical changes to the building, internal layout, the introduction of new fire safety systems or equipment; it should almost certainly include fire safety messaging and educational programming to inform occupants of the risks in their environment and how they can protect themselves during a fire incident.

COLLECTIVE CENTERS

According to the Minimum Standards for Camp Management (2021), p.6:

"Displaced people may find accommodation in existing public buildings and community facilities, for example schools, factories, barracks, community centres, town halls, gymnasiums, hotels, warehouses, disused factories and unfinished buildings. These were likely not constructed as accommodation. They are often used when displacement occurs in or to an urban setting. Similar to a camp, a collective centre is meant only as temporary or transit accommodation. Levels of assistance vary from full to differing levels of self-reliance, and collective centre management can play a strong role in coordinating services."

One could draw parallels between collective centers and emergency evacuation centers in that both are buildings designed and constructed for a purpose other than accommodation, but they are adapted for this purpose (and possibly others) in response to a humanitarian crisis.

It seems likely, however, that collective centers would more often present significant fire risks that are not well understood, mitigated, or managed, compared to emergency evacuation shelters due to factors such as:

- ✓ Unlike some emergency evacuation centers, collective centers are almost never allocated or planned for as part of preparedness efforts.
- ✓ Collective centers are more likely to be set up in a wider variety of building types, or even in non-buildings (e.g., collective centers set up in underground train stations), which are likely less adaptable to safely function as accommodation for large groups of people, and may introduce fire hazards and/or vulnerabilities that are otherwise unrelated to sheltering. With the train station example, also consider how

much more complex the challenges with fire detection, alarm, and evacuation from an underground train station that is accommodating people who are sleeping (not alert) and likely unfamiliar with the facility.

- Fire safety systems and infrastructure that is normally relied upon to maintain fire safety of the buildings, facilities, and infrastructure in their normal use may not be available or appropriate. For example, smoke control systems are common life safety systems in tunnels and connected train stations to achieve safe evacuation. These systems need to be well maintained and regularly tested, and they are designed specifically for the conditions expected with the normal functionality of the station.
- The fire services and other emergency responders may not have awareness of the changing risk profile of the settlements and the residents.
- Collective centers are more likely to include buildings, facilities, and infrastructure that is ill-maintained or may even be poorly constructed, which may mean poorer electrical systems, less maintained evacuation routes or fire safety systems, etc.

Selection of buildings, facilities, and infrastructure for collective centers is often made by communities and local authorities, meaning humanitarian agencies often do not have the opportunity to select buildings which will more easily achieve minimum standards. However, guidance for site selection can be communicated to local decision makers early in a humanitarian response as part of initial engagement around needs assessments and the development of a shelter and settlement plan. These engagements may serve as an intervention point to interject considerations for site selection thereby avoiding the creation of some fire risks and promoting effective fire risk management.

Each collective center will have its own set of unique challenges and opportunities with regards to fire safety. Similarly to emergency evacuation centers, collective centers need to be surveyed and fire risks and existing fire safety systems analyzed to enable the development of a fire safety strategy that is achievable for humanitarian sheltering in that particular context.

PLANNED CAMPS

According to the Minimum Standards for Camp Management (2021), p.5:

"Planned camps can be located in urban or rural locations. They are places where displaced populations live in purposely constructed sites and have a dedicated management team. Services in planned camps can include water supply, food distribution, non-food item distribution, education and health care, from humanitarian agencies or existing municipal infrastructure. These services are typically only for the people living on the site."

Fire safety in planned camps presents both unique challenges and opportunities. With a dedicated management team and purpose-built infrastructure, there is a greater degree of control and influence by humanitarian agencies and local authorities to ensure fire risk reduction measures are fit for purpose and implemented. However, the temporary and often rapidly evolving nature of these camps can also introduce significant fire hazards and vulnerabilities.

There are ways to reduce fire risks at every stage of a planned camp's lifecycle, but the sooner in a camp's lifecycle that humanitarian programming becomes fire-informed, the more opportunities there are to avoid and minimize fire risk emergence. For example, considerations like spacing between shelters and the

location of fire breaks are made during site planning and it is incredibly difficult to implement change in these areas once a camp is built and functioning. As opportunities to reduce risk are missed through the camp's lifecycle, risk is allowed to emerge and compound.

Other key considerations include potential for use of fire-resistant or noncombustible construction materials, and the availability of fire suppression equipment such as extinguishers and fire blankets. Additionally, the camp's infrastructure should be designed to minimize fire risks, with proper electrical installations, safe cooking facilities, and appropriate waste management systems in place.

Fire safety education is also crucial in planned camps. This involves providing training for both camp residents and staff, covering topics such as fire prevention, safe cooking practices, and appropriate responses in the event of a fire. Regular fire drills and evacuation exercises can help ensure that all camp inhabitants are familiar with the camp's fire safety procedures and escape routes.

Collaboration with local authorities and emergency responders is another essential aspect of fire safety in planned camps. By maintaining strong lines of communication and sharing information about the camp's fire risks and safety measures, humanitarian agencies can better coordinate with local emergency services in the event of a fire.

PRESSED FOR TIME IN SOUTH SUDAN

In South Sudan, one of the world's most severe refugee crises has led to the establishment of numerous planned camps, providing shelter for the displaced population fleeing conflict and violence. However, fire safety in these camps has been a significant challenge, as evidenced by reports from organizations such as UNHCR and Médecins Sans Frontières (MSF). (UNHCR, n.d.) (Doctors Without Borders, 2015)

Due to the urgency of the situation many South Sudanese camps were set up rapidly, sometimes resulting in inadequate spacing between shelters and the use of combustible construction materials. These factors, combined with the lack of proper fire safety measures, have contributed to the rapid spread of fires in some instances, endangering the lives and well-being of camp residents.

RECEPTION AND TRANSIT CENTRES

According to the Minimum Standards for Camp Management (2021), p.6:

"Reception and transit centres may be needed at the start of an emergency as temporary accommodation before people are transferred to a suitable, safe, longer-term location, or at the end of an operation as a staging point of return. They are, therefore, usually either intermediate or short term and may also host returnees. Transit centres typically also provide more services to the population and only indirectly engage in community participation activities and decision-making."

Reception and transit centres play a crucial role in managing the flow of displaced persons during emergencies, ensuring their safety and well-being during the initial stages of displacement or as they prepare to return to their homes. These centres can be found in various locations, such as border crossings, urban areas, or near camps, and can provide a range of services like shelter, food, water, sanitation, healthcare, and registration.

Fire safety in reception and transit centres is of importance, as the temporary and often crowded nature of these facilities can lead to an increased risk of fires. As these centres are intended for short-term use, the infrastructure and services provided may not be as robust as those found in planned camps or other

longer-term settlements. It is crucial to develop and implement fire safety strategies that address the unique challenges and risks posed by the transient nature of these centres.

Well-designed educational messaging campaigns can help communicate fire risks and key fire safety information to people who are not familiar with the site. However, generalized messaging and sensitization resources cannot be implemented without contextualization or regarded as ensuring knowledge and understanding. It is important to conduct and draw from thorough risk assessments and adapt existing fire safety measures to the specific conditions and challenges posed by these facilities. This may include providing fire-resistant building materials and structures, ensuring adequate fire detection and alarm systems, and educating occupants on fire safety procedures and evacuation plans. Additionally, coordination with local fire services and emergency responders is needed to ensure a timely and effective response in case of a fire incident.

WHEN A PIPELINE BECOMES A BOTTLENECK

The Moria Reception and Identification Centre on Lesvos Island, Greece, was originally designed for approximately 2,000 to 3,000 people. It was intended to help register and accommodate migrating asylum seekers along their journey to the EU – for short stays only. However, changing border policies and increasing migration slowed down the pipeline. In 2016, the EU-Türkiye deal put migration from Moria into Europe at a standstill. New arrivals were required to stay on the islands pending return to Türkiye unless they successfully applied for asylum in Greece.

By September 2020, between 12,000 and 13,000 refugees were staying at Moria in the main camp as well as the surrounding “Olive Grove” informal settlements, leading to severe overcrowding and substandard living conditions. The lack of adequate fire safety measures, combined with the overcrowding and the makeshift nature of the facility, contributed to a series of devastating fires that destroyed the entire camp, displacing almost 13,000 asylum seekers (ACAPS, 2021).

SELF-SETTLED INFORMAL SETTLEMENTS

According to the Minimum Standards for Camp Management (2021), p.5:

“Displaced groups, often family or related groups, may self-settle in urban or rural sites on their own. These types of camp-like settings are typically independent of assistance for some time and may exist without receiving any external or formal humanitarian support. Self-settled camps are often situated on privately owned land. They are characterized by limited or no negotiations with the local population or private owners over use or access. In some cases, a camp management agency may operate nearby and learn about the displaced persons’ needs and try to bring them into the management structure so they can receive assistance.”

Informal settlements typically emerge without prior planning or preparation. Due to their spontaneous nature and lack of formal organization, these settlements often lack proper infrastructure, basic services, and fire safety measures. The informal nature of these settlements means that they may not have the same level of access to emergency services and other assistance as other types of camps or settlements. Similar to collective centers, informal settlements may present significant fire risks that are not well understood, mitigated, or managed. Some factors contributing to these risks may include:

- ✓ The lack of formal organization and infrastructure, leading to potential overcrowding, inadequate housing conditions, and limited access to essential services, all of which can exacerbate fire hazards.

- The possibility that informal settlements are located on privately owned land, which can lead to complex legal and ownership issues that may hinder the implementation of fire safety measures.

Ultimately, addressing fire safety in informal settlements requires a comprehensive, community-driven approach. By working closely with local communities, implementing targeted fire safety measures, and strengthening coordination with local emergency services, it is possible to mitigate the risks associated with fires in these vulnerable settings.

To address fire safety in informal settlements, it is essential to conduct thorough risk assessments and implement context-specific fire safety measures. This may include:

- Engaging with the local community: Collaborating with local leaders and community members can help identify the specific risks and vulnerabilities of the settlement and develop tailored fire safety strategies. This could involve creating community-based fire brigades, conducting regular fire safety trainings, and raising awareness of fire hazards and preventive measures.
- Implementing fire safety infrastructure accompanied by appropriate training: Exploring appropriateness of basic fire safety measures, such as fire extinguishers, and ensuring accessible fire escape routes, can significantly reduce the risk of fires and improve the overall safety of the settlement.
- Improving living conditions: Addressing overcrowding and inadequate housing conditions can help reduce fire risks. This may involve providing better quality building materials or advocating for improved land use planning and zoning policies to ensure a safer living environment.
- Providing access to essential services: Ensuring that residents of informal settlements have access to clean water, sanitation facilities, and energy sources can help minimize fire hazards and improve overall living conditions. This may involve working with local authorities and service providers to extend or improve access to these services.
- Strengthening coordination and communication with local emergency services: Establishing relationships and communication channels with local fire departments and emergency responders can help ensure a timely and effective response in case of a fire incident. This may include regular coordination meetings, joint training exercises, and sharing of information about the settlement's fire risk profile.

INFRASTRUCTURE

The literature and engagement with humanitarians as part of this research revealed that when fire in humanitarian settings is considered, it is primarily focused on shelter, and spatial relationships between shelters.

Outside humanitarian settings, there are well established relationships between fire and the following types of physical infrastructure but there is limited (if any) evidence exploring how these infrastructure systems may trigger fire risk emergence or enable fire safety in humanitarian settings:

- Electrical infrastructure (re: ignition risk)
- Water infrastructure (re: firefighting response)
- Road infrastructure (re: firefighting response)

- ✔ Waste management (re: fuel load management)
- ✔ Communications systems (re: alarm systems and emergency telecommunications).

Fires that destroy shelters, camps or supporting facilities such as warehouses with humanitarian supplies can have wider impacts on humanitarian agencies' ability to aid affected populations. But warehousing of humanitarian goods is also seldom discussed with regards to fire. This may be a critical gap responsible for significant financial losses and disruptions to humanitarian programming. Critically, questions have been raised regarding potential poor fire risk management of warehouses due to the storage of large quantities of combustible goods and often unlabeled hazardous materials. The goods stored in warehouses may change over time, demonstrating the importance of a well-documented and managed logistics systems that enable fire informed decision making (e.g., to determine which materials can and cannot be stored together) and effective communication of hazards in real time (e.g., to inform safe and strategic fire response decisions during an incident).

Finally, there is even less discussion within the humanitarian sector on fire in relation to social infrastructure (e.g., schools, health centers, marketplaces) in terms of:

1. the opportunities social infrastructure presents to support and facilitate the reduction of fire risk and consequences in humanitarian settings.
2. the risk fire poses to social infrastructure and what it represents (e.g., health, livelihoods, education).

FIRE IN SOMALILAND MARKETPLACE

On the eve of Ramadan 2022, a fire started at Waheen Market in Hargeisa, Somaliland, one of the largest marketplaces in the Horn of Africa and the sole livelihood source for many displaced persons.

The fire destroyed almost the entire market. Early reports estimated the fire to have caused a financial loss of ~$1.2 Billion USD and widespread exacerbation of vulnerabilities (compounding also with drought conditions).

Figure 13: *Image of the Waheen Market in Hargeisa, Somaliland after the April 2022 fire*

© Bruce Spires

3

Fire Safety Information & Recommendations

This section provides information and recommendations on key fire safety issues in humanitarian settings. The issues have been compiled based on the findings of technical and qualitative research and reflect gaps in current understanding and areas which urgently require further research and/or collaborative development.

Broadly, the findings here can be grouped under the following categories, aligned with the International Fire Safety Standards: Common Principles (available at: https://ifsscoalition.wordpress.com/the-standards/).

1 **Socio-technical context** refers to who, how and why different people experience, interact with, and are affected by fire. However, social, economic, political, and environmental factors play a big role in influencing this context. In this guidance, this category includes environment & seasonality; settlement types; social infrastructure; culture; relationship with fire; gender, disability & inclusion; and daily living.

2 **Fire Safety Education** refers to education, communication and engagement activities that must be considered for fire safety to be embedded within the humanitarian sector. Fire safety education must be considered at the humanitarian sector and community levels.

3 **Prevention** refers to measures that can be taken to reduce the likelihood of a fire occurring (i.e., prevent ignition). In this guidance, this category includes means of cooking, heating, and lighting; electricity; and individual habits and practices.

4 **Detection and Warning** refers to systems and processes that are in place to detect the presence of a fire and alert the appropriate parties. The goal of warning systems is to quickly identify the presence of a fire and initiate an appropriate response. In this guidance, this category includes fire detection and alarm.

5 **Evacuation** refers to systems and processes that are in place to support the safe escape of people in potential danger in the event of a fire. In this guidance it includes evacuation routes, human behaviour, fire safety education, and evacuation management.

6 **Minimize fire growth** (shelter/building scale) refers to measures to minimize the growth and spread of fire within a shelter or building, and to minimize the risk of fire spread from a shelter or building to adjacent combustibles, shelters, or buildings. In this guidance, this category includes materials of construction, shelter contents, compartmentation, and localized fire response systems (household level).

7 **Minimize fire spread** (on a settlement scale) refers to systems and measures to limit or minimize the spread of fire between structures and across settlements. In this guidance, this category includes materials of construction, separation distances between structures, fire resistance of separating elements, and fire breaks.

8 **Firefighting, search and rescue** refers to systems, resources, and procedures to enable effective firefighting (including fire containment and extinguishment), search and rescue efforts by first responders, whether at the community level, municipal level, or something in between (e.g., humanitarian agency responders). Measures taken ahead of a fire incident to improve capacities and capabilities for effective firefighting, search and rescue are a form of preparedness, whereas actions taken during a fire incident make up response. In this guidance, this category includes incident command, emergency telecommunications, emergency vehicle access, water access, firefighting resources and training, and first aid and ambulatory service.

9 **Post-fire** refers to the systems, processes, and resources dedicated to treat and support fire victims, understand the cause and effect of the fire incident, collect, store, and share relevant data about the fire incident, and to capture learning from the fire to enable safer reconstruction locally and development of safer humanitarian shelter and settlements more broadly. It is possible some of the activities categorized as post-fire may begin while the fire is still burning, e.g., burn treatment. In this guidance, this category includes healthcare for physical injuries including burns, mental healthcare, fire investigation, fire incident reporting, and building back safer.

1 | SOCIO-TECHNICAL CONTEXT

CULTURAL AND SOCIAL DIMENSIONS

Social and cultural norms shape fire risk. For example, expectations around behavior can result in some people feeling more responsible for fighting a fire, even without appropriate equipment, or mean that others are more likely to be close to a fire when it starts but not have the knowledge to respond. In many humanitarian settings, residents balance different risks and focus on the immediate need or concern, such as preferring to padlock the door closed at night for increased security.

Different cultures may have different beliefs and practices related to fire. Some cultures have traditional fire-keeping practices, such as using open fires for cooking or heating, which may increase the risk of fire. In some cultures, fire is viewed as an element of the natural world that should be respected, while in other contexts it is a tool to be used and controlled.

Understanding that there are a multitude of culturally situated attitudes towards fire can help practitioners contextualize fire safety messaging and interventions.

RECOMMENDATIONS AND ACTIONS

- ✓ Work with community leaders to establish patterns of fire incidences in a specific context: map when and where fires are most likely to start and how. For example: in some contexts, fires are reported to occur more often at weekends or during national holidays. Draw on these findings in the design and implementation of a fire safety plan and within education, communication and engagement activities.
- ✓ Discuss with communities the needs, concerns and demands that residents manage e.g., security concerns lead people to use padlocks on doors, which can delay escape.
- ✓ Install sliding latches, include the use of key hooks by doors and encourage ‘grab bags’ containing identity documents to prevent occupants from returning to a burning shelter.
- ✓ Ensure education, communication and engagement activities are fully inclusive (e.g., held at various times of day, with a diverse range of participants). Focus on communities exploring their understanding of fire risk and establishing actions they can take to reduce risk in their context.
- ✓ Norms associated with religious dress may place additional pressures on women during a night-time evacuation, causing delay. Sensitivity is needed to address these safety concerns.

It is important to acknowledge the diverse and complex sociocultural relationships people have with fire. These relationships often shape people’s values, beliefs, and attitudes towards fire, and will influence their perception of fire risk. Fire has played a central role in mythology, religion, and spirituality for thousands of years. Cultural or religious beliefs about fire can be deeply rooted in a community’s identity and should be respected.

GENDER, DISABILITY AND INCLUSION

Gender continues to be interpreted narrowly to focus on the difference between women and girls, and men and boys. Gendered social norms can still place many women and girls more at risk because of cooking related fires, and younger, able-bodied men may be expected to respond to fires without appropriate equipment.

However, a more expansive interpretation of gender is necessary to ensure fire safety is inclusive. This would consider various intersecting social identities including disabilities, age, ethnic background, religion, social status, sexual orientation or gender identification.

A more complex gendered approach is generally recognized to be an aspect of fire risk that should inform humanitarian practice. This is required to ensure any mainstreaming of fire safety within the sector is fully inclusive.

RECOMMENDATIONS AND ACTIONS

- ✓ Understand how homogenized and stereotyped practices can increase fire risk for different people and limit the overall capacity of a community to respond to a fire. Women can and do respond to fire incidents.
- ✓ Gendered social norms impact access to knowledge: e.g., when education programmes of fire safety and response are targeted towards men, fire risk is increased for all residents; men can feel culturally required to fight a fire without the appropriate resources, while women, children, the elderly and people with disabilities are often left alone in settlements without the advice of how to safely evacuate or respond.
- ✓ There are many other aspects of a person's identity that can lead to social exclusion (e.g., disability, age, ethnic group, sexuality) and increase their vulnerability. Community fire safety should be inclusive of all people within discussions of fire prevention, response and evacuation.
- ✓ Address fire safety with children through targeted and specific child-friendly education activities: focus on enabling children to identify fire risk (including in their own play) and problem solve approaches to reducing risk in their environment. Embed a household learning approach where children explore fire safety with their households.
- ✓ More work is needed to understand the ways different communities and residents (globally and within a settlement) might behave before, during and after a fire. This work will be critical to ensuring inclusive, contextualized (and therefore appropriate) support and programming.
- ✓ Inclusive education, communication and engagement about fire safety is crucial in any setting. However, in multicultural settings, it is important to consider language barriers and cultural differences that may impact the effectiveness of fire safety messaging. It is critical to engage with local communities to ensure materials and approaches are relevant to the specific context. Programs must be culturally and linguistically appropriate to ensure that fire safety education is inclusive of all members of the community.

© Helen Underhill

Engaging residents through games and problem solving fire safety education, Lebanon

2 FIRE SAFETY EDUCATION

HUMANITARIAN SECTOR EDUCATION

Unless their role specifically focuses on fire safety, humanitarians do not routinely receive training on the issue of fire safety, either in relation to agency buildings and resources or specific to reducing risk within the range of humanitarian settings.

Investment is needed to systematically review and document the content and practices of current education, communication and engagement activities aimed at staff and contractors within the sector. This will establish gaps, areas of expertise, common assumptions and misconceptions which can materialize within humanitarian programming and lead to unintended consequences.

RECOMMENDATIONS AND ACTIONS

- ✓ Volunteers (or anyone working on site) must have access to contextualized fire safety training to ensure fire safe practices within agency buildings.
- ✓ Investment is needed to embed understanding of fire safety for the range of professionals working across the sector within and supporting humanitarian assistance.
- ✓ Knowledge of fire risk emergence, socio-technical issues, prevention, mitigation and response are all necessary and apply to working within agency buildings and in humanitarian settlements.
- ✓ Fire incidents should be recorded alongside the completion of fire investigations. Education and training for humanitarian professionals should engage with existing investigations and reports.

COMMUNITY EDUCATION

People living in humanitarian settings generally understand how fires start in their immediate surroundings, but knowledge of prevention is much less secure or widespread. Unsafe practices related to the treatment of burns continue in many contexts.

Community fire safety education aimed at people living in humanitarian settings is generally delivered through 'sensitization' and messaging (such as posters). When fire education has been delivered through face-to-face sessions, these have been because of 'champions' driving initiatives to draw on the expertise of fire safety professionals to deliver knowledge and information.

People learn and retain knowledge in different ways. They also have different needs. Therefore, fire safety education activities must be contextualized to ensure effective engagement, as a minimum in terms of:

- ✓ how fires start, grow and spread in the setting in which they live
- ✓ how to prevent fires in their environment
- ✓ how to raise and alarm and evacuate
- ✓ when and how to respond
- ✓ when not to respond or attempt to fight a fire.

RECOMMENDATIONS AND ACTIONS

- ✓ Evaluate content and practices of current fire and burns related education, communication and engagement (ECE) activities: assess the relevance and applicability of sensitization resources by engaging with communities to understand how they interpret and respond to different learning methods.
- ✓ Ensure activities are underpinned by trauma-informed education practice. Know the context before delivering ECE programs and adapt according to the community's experiences. Community-led pedagogies are key.
- ✓ Develop knowledge with communities through active engagement: collaborative problem solving embeds contextualization.
- ✓ Inclusive fire safety education is essential: programs must be culturally and linguistically appropriate, they must be delivered at different times and in different spaces to ensure everyone in the community has the opportunity to participate.
- ✓ Investment is needed to explore the possibilities offered by mobile technologies in the design and delivery of fire safety education.
- ✓ Establish processes for monitoring and evaluating fire safety education initiatives that go beyond recording attendance: embed evaluation into the design and revisit settlements to explore the wider impacts of fire safety education - for example, on incidences and treatment of burns.
- ✓ Address fire safety with children through targeted and specific child-friendly education activities: focus on enabling children to identify fire risk (including in their own play) and problem solve approaches to reducing risk in their environment.

OPEN FLAME COOKING, HEATING AND LIGHTING

The use of open flames for cooking, heating, and lighting in humanitarian settings presents significant ignition risks. Determining the safest option among available cooking and heating methods is complex and requires consideration of the probability and severity of a fire occurring. For example, Liquified Petroleum Gas (LPG) stoves can leak, presenting fire and explosion risks, while open flames, such as three-stone fires, and other forms of cooking equipment, can easily interact with combustible materials, increasing fire hazards.

TO MITIGATE COOKING RISKS:

- ✓ Consider the potential for outdoor cooking spaces, including communal cooking spaces, if socially appropriate and safe.
- ✓ Establish a designated area with non-combustible barriers (e.g., cement, mud, lime plaster) and ensure adequate spacing between cooking spaces and the rest of the shelter.
- ✓ Assess affected communities' cooking behaviors, awareness of related fire risks, and preparedness to respond to uncontrolled cooking fires.
- ✓ Design and deliver cooking fire safety education activities, including practical sessions for mitigating the risks of and responding to different types of cooking fires.
- ✓ All fuel-burning equipment should be vented to the outside to avoid carbon monoxide (CO) poisoning. Combustible materials should not be in contact with the chimney, and non-combustible materials should surround the openings (where the chimney exits via shelter walls or ceiling). Regularly clean and inspect heating equipment, including chimneys.

TO MITIGATE RISKS ASSOCIATED WITH HEATING AND LIGHTING:

- ✓ Select safer options such as LED lanterns instead of candles or kerosene lamps.
- ✓ If candles or kerosene lamps must be used, ensure they are placed in secure, non-combustible holders and kept away from any flammable materials.
- ✓ Educate residents on the safe use of candles and other open flame sources, and the importance of never leaving them unattended.
- ✓ Place candles in jars with sand or similar non-combustible materials and keep anything that can burn at least 30.5 cm away from candles in jars.
- ✓ Ensure electric space heaters have an auto shut-off feature if it tips over.

Design and deliver educational activities to build understanding about the different types of fire and assure communities know when and where to use different firefighting techniques and equipment to avoid unintended consequences – e.g., putting water on an oil fire could exacerbate the fire.

ELECTRICITY

Electrical fires present a complex challenge in humanitarian settings. They may be caused by various factors, including electrical overload, damaged cords or wiring, improper use of electrical equipment, low quality electrical equipment, and low-quality electrical connections.

Formal electrical connections are more prominent in 'outside camp settings' than 'camp and camp-like settings'. Informal connections to the electricity grid are otherwise common as individuals or households without formal connections resort to accessing electricity themselves if it is physically possible. These connections can overload the electrical system and increase the risk of fire.

Enabling access to safe and reliable energy sources, including electricity, should be a priority with humanitarian assistance. Addressing this issue requires thoughtful discussions and exploration of possible solutions that consider the financial constraints of residents while prioritizing fire safety.

TO MITIGATE ELECTRICAL RISKS:

- ✓ Regularly assess and maintain electrical infrastructure, ensuring it is in good working condition.
- ✓ Provide technical assistance and support to residents for safely (and legally) connecting to the grid.
- ✓ Provide information on the process and requirements for connecting to the grid.
- ✓ Connect residents with local electricians and other local experts.
- ✓ Work with residents around electrical fire education, including the proper use and maintenance of electrical equipment and infrastructure. For example, the risks of (1) plugging in too many devices into a single outlet, (2) using high-wattage appliances on weak circuits, or extension cords that are not rated for the electrical load, (3) using electrical equipment not designed for the voltage or frequency of the local electrical system.
- ✓ Create awareness campaigns that inform residents on the dangers of illegal and overloaded connections.
- ✓ Offer alternative solutions for cooking, heating, and lighting where safe electrical connections are not achieved, thus alleviating the pressure on unsafe or overloaded connections.

Electrical infrastructure can directly contribute to the risk of electrical fires. For instance, the proximity of combustible shelter materials or stored items loads to electrical wires or equipment can increase the risk of fire if a spark or short circuit occurs. To minimize the risk of fire, the layout and placement of combustible materials in relation to electrical systems should be considered. This may involve maintaining a minimum clearance of 1 meter (3.3 feet) between electrical equipment and combustible materials.

Consider the impact of intermittent electrical loads (common in regions with load shedding) as they can increase fire risk due to power surges. Ensuring electrical system maintenance and providing surge protection devices can help mitigate these risks.

Note other networked energy systems that should be assessed for fire risk, such as informal plastic pipe gas networks (observed in informal settlements in Bangladesh), which introduce significant fire and explosion hazards.

© Paul Chamberlain

Man walking away from fire in distance. Bangladesh

4 | FIRE DETECTION AND ALARM

The sooner people become aware of a fire, the sooner they can act – to escape, fight the fire, notify others of the danger, notify emergency responders, or take other protective actions. Early warning is therefore the goal of fire detection and alarm systems.

Fire detection may be manual or automatic. Manual detection refers to a person noticing a fire, typically triggered by environmental cues such as visible flames, smoke, heat, or noises, whereas automatic detection refers to a device that automatically detects fire or its effects (e.g., smoke, light, heat).

Communications systems to alert or notify people of a fire may also be manual or automatic. Manual alarm refers to people directly communicating that there is a fire incident. This may be via shouting, calling, texting, using a loudspeaker, etc., whereas automatic alarm systems trigger a visual and/or audio cue upon fire detection. It is also possible for automatic SMS messages to be sent via automatic alarm systems. Apps like WhatsApp are common platforms for communications between affected populations and between humanitarian practitioners, and there is evidence these types of messaging apps are widely used in fire emergencies in humanitarian settlements.

Effective fire detection and communication systems are based on several key principles. The design of fire detection and alarm systems for humanitarian settlements should be community-specific and the types of detectors and means of notification should be appropriate for the common fire scenarios in that settlement as well as environmental conditions. False alarms can erode trust in fire detection and alarm devices and lead to complacency in responding to real fire incidents. This can be mitigated through education, regular testing, and maintenance of devices, as well as selection of devices that are not sensitive to the environment (e.g., bugs, smoke from cooking indoors).

More robust, integrated fire detection and alarm systems may be needed for high-risk buildings, such as healthcare facilities, schools, and community centres.

In situations where integrated fire alarm systems cannot be installed, battery-powered detectors/alarms are a more accessible option. These types of fire detection and alarm systems have been piloted/implemented in South African informal settlements with varying success, and in Bangladesh with limited success (barriers included environmental challenges). This is a promising area for further research and development. Where automatic detectors/alarms are used, placing the appropriate type of alarm (e.g., those used to detect smoke, versus flame, versus heat, etc.) in appropriate locations (e.g., near sleeping areas or cooking areas) is critical, as well as ensuring that they are properly maintained and tested. Clear and concise instructions on what to do in the event of a fire are needed, and it is also important to ensure that people are aware of these systems and know how to use them effectively.

In camp and camp-like settings, manual methods for fire detection and alarm are typically relied upon. A community-based fire watch may be a suitable option, which involves community members taking turns monitoring for signs of fire, especially during high-risk times such as night-time or when cooking or heating activities are in progress. By fostering a sense of responsibility within the community, this approach not only helps raise awareness of fire risks but also contributes to the overall safety of the settlement.

The community can be notified of a fire emergency via an audible warning. These can be simple manual alerting devices such as whistles, bells, or improvised air horns. Specific signals can be designated for different types of emergencies, with residents informed of the nature of the incident and trained on how to respond. This approach requires community members to be well-trained on the proper use of these signalling devices and on the appropriate response actions to take in case of a fire.

5 | EVACUATION

Evacuation refers to systems and processes that are in place to support the safe escape of people from potential danger to fire and its effects. A shelter fire may become fully developed or lead to flashover in less than one minute, meaning evacuation from shelters should be priority.

INTERNATIONAL GOOD PRACTICE

Local regulations and international codes and standards such as the International Building Code or the Life Safety Code from the National Fire Protection Association (NFPA 101) should be referenced for the design or for evaluation of evacuation systems within formal buildings. Implementing these international good practices should be the goal for social infrastructure buildings (healthcare facilities, schools, community buildings, etc.), collective centres, emergency evacuation centres, and the various types of housing used outside camp and camp-like settings. Where this is not achievable, or requirements are inappropriate, more contextualized strategies and guidance will need to be developed.

In substandard buildings, camp and camp-like settings, a more performance-based approach will need to be taken to evaluate and design evacuation systems, and the most critical criteria is time.

EVACUATION PROCESS (individual level)

The evacuation process (at the individual level) is often simplified and can be divided into four stages:

1. Time before awareness, after the fire ignition, that it takes for the individual to realize or be informed that something might be wrong (pre-awareness)
2. Time between awareness that something might be wrong until a decision on whether or not to evacuate is made (pre-decision)
3. Time between the evacuation decision and when purposive evacuation movement to safety begins (protective action)
4. Time period when movement to safety begins and ends (travel)

Various individual, social and environmental factors can influence the timing associated with these stages (e.g., shortening or lengthening the time spent in a particular stage). Factors that lengthen the time spent in each stage can in turn, increase the likelihood and time that individuals are exposed to harmful conditions from the fire, leading to injuries or deaths.

EVACUATION SYSTEM DESIGN

The 'required safe egress time' (RSET) is the amount of time that occupants take to reach a place of safety, remote from the fire and its effects, also taking into account the initial time that it takes for the detection of the fire and occupants to be made aware. The 'available safe egress time' (ASET) is the amount of time available before a fire or its effects spread beyond its area of origin (i.e. from the first ignition) and put occupants at risk to its effects (e.g., low visibility, exposure to heat or smoke). The goal is to have the ASET be greater than the RSET. This is referred to as an ASET vs. RSET analysis in the fire engineering community, and it is the basis of evacuation time analysis. Note this type of analysis is not appropriate for a small building or shelter that is a single compartment.

However, it can be utilized for larger buildings, and to analyse evacuation on a settlement scale. In fact, a critical assumption that underpins building fire safety design is fundamentally inappropriate in camp and camp-like settings. That is, occupants are typically considered to be in a place of relative safety once they exit from a building to open air. This is not the case in congested settlements with a risk of fire spread between shelters and buildings.

Evacuation in these settings is complex. External means of escape also need to be considered because fires in humanitarian settlements are often large external fires that could block external escape routes or affect people during their escape. Multiple escape routes (ideally three) need to be well-defined and properly maintained as well as points of refuge within or, ideally outside, settlements.

People living in humanitarian settings cannot simply act as passive agents that follow instructions in the event of an emergency like most building fires. They need to be equipped to assess changing fire risk during an actual fire and make dynamic decisions to take protective actions as the fire incident evolves.

SHELTER LEVEL ESCAPE PLANNING

Escape planning is also critical for smaller buildings and shelters. Common issues competing with evacuation at the shelter level include the desire for privacy and security, to retrieve belongings, or protect the shelter. There have been reports of informal settlement residents in Kenya and South Africa intentionally weakening the sides of their dwelling to be able to evacuate from a fire whilst retaining the security of sleeping with a locked door in a non-fire situation. This highlights the dangers associated with standard door locking practices and how people must balance their needs, e.g., security needs with the additional risk of having a delayed or compromised evacuation. The possible addition of other access doors may also interact with fire behaviour – more ventilation to the fire can increase fire severity.

In Lebanon, 'go-bags' have been used to store valuables like identification cards, so residents can quickly grab their most essential belongings and focus on escape.

DECISION MAKING AND HUMAN BEHAVIOUR

The decision to evacuate (or not) itself is highly complex, and research into decision making and human behaviour in humanitarian settings is severely lacking. Families being separated and searching for one another before beginning their escape is just one example of why people do not begin their evacuation immediately upon becoming aware of a fire. If occupants elect to collect and carry property, particularly heavier and bulkier items, this will slow their own evacuation as well as potentially obstruct evacuation and access routes. Additionally, there is no guarantee that individuals even decide to evacuate; they may instead choose to stay in place and attempt to fight the fire.

Human behaviour is led by human psychology, such as motivations, emotions, in relation to the environmental stimuli, depending on a range of factors including building or settlement characteristics, occupant characteristics, fire behaviour and fire intervention effects.

OCCUPANT CHARACTERISTICS

There are many individual vulnerabilities and conditions that can affect life safety in a fire, and it is important to understand these risks to prevent injury or death. Most commonly, people who are asleep when the fire event occurs are considered to be at greatest risk as they may not be aware of the danger until it is too late. Smoke and toxic gases can quickly overcome a person, making it difficult to escape in time. This risk is particularly high for people who have consumed alcohol or drugs before going to sleep, those with a disability / mobility difficulties, people who are deaf or hard of hearing may not be able to hear fire alarms, while people who are blind or visually impaired may have difficulty navigating escape routes.

Occupant characteristics that typically inform building evacuation design include number and distribution of occupants; alert/asleep; familiar and trained or unfamiliar; physical ability; cognitive ability; independent evacuation versus need for assisted evacuation.

RECOMMENDATIONS AND ACTIONS

- ✓ Conducting a comprehensive risk assessment to identify fire hazards, evacuation routes, and the specific needs and vulnerabilities of the community.
- ✓ Evaluate the adequacy of existing evacuation plans, procedures (including fire detection, alarm, and communications more generally), and infrastructure.
- ✓ Identify potential challenges to evacuation, such as limited access routes, lack of awareness or understanding of evacuation procedures, and cultural or linguistic barriers.
- ✓ Considering international and local building codes when designing means of escape in buildings and in settlements, including route widths and lengths, to accommodate the settlement's population.
- ✓ In humanitarian settings, where space is often limited, it is important to maximize the width of escape routes as much as possible, while also taking into consideration other factors such as fire spread separation and accessibility for people with disabilities.
- ✓ Consider the need for multiple evacuation routes.
- ✓ Involve community in mapping and exercising evacuation routes in case of an emergency.
- ✓ Work closely with planners and authorities to ensure evacuation routes remain unobstructed and clearly marked whenever possible.
- ✓ It is important to remember that humanitarian settings are dynamic, which means that the layout and the physical structure of the community can change frequently, so it is important to continuously monitor, maintain and adapt the escape routes.
- ✓ The provision of safe assembly points outside the settlement should be established for residents to gather in case of evacuation, also considering the space that might be required if residents choose to carry larger belongings with them, so these do not obstruct further evacuation or firefighting efforts.
- ✓ Where possible, emergency lighting and signage should be installed to guide residents to exits in the event of a power outage or hours of darkness. Where emergency lighting is not provided or it does not achieve a minimum of 0.1 foot-candles (1.1 lux) along the path of egress, consider alternative lighting solutions such as solar-powered lights or portable emergency lights.
- ✓ Regular fire drills and evacuation training should be conducted to ensure residents are familiar with escape routes and procedures.
- ✓ Avoid using locks that require a key, as they can slow down the exit process during an emergency. Instead, use thumb turns or other types of locks that can be easily opened with minimal effort.
- ✓ Consult resources like the SFPE Human Behaviour in Fire guidance book or engaging with a specialist in human behaviour in fire to address community-specific issues.

6 | MINIMIZE SHELTER/BUILDING FIRE SEVERITY

The use of combustible construction materials in humanitarian settlements can pose significant fire risks, as they ignite easily and contribute to the rapid spread of fire. The dangers of combustible materials are particularly concerning in densely populated settlements, where fires can quickly escalate and result in significant loss of life and property.

Minimizing the potential size of a fire at shelter scale in turn reduces the immediate risk to life, provides more time for intervention, and delays or even prevents the fire spreading beyond the shelter where the fire originated.

COMBUSTIBLE MATERIALS OF CONSTRUCTION

The use of highly combustible materials, such as thatch, bamboo, or plastics, can increase the risk of fire and the rate at which it spreads. Opting for non-combustible construction materials like concrete, brick, or metal can considerably reduce the risk of fire and limit its spread. However, even non-combustible construction can pose significant danger in the event of a fire if the interior is lined with combustible materials.

INTERNAL LINING MATERIALS

Studies have highlighted potential risks associated with the use of combustible lining materials (typically used for insulation during the winter or summer) and the importance of considering the fire safety implications of these materials when designing, constructing, and adapting shelters and buildings. Combustible materials can increase the early spread and growth rate of a fire, as they provide a highly combustible fuel for the fire to consume, creating a more intense and rapidly spreading fire. They may also contribute to a reduction in the time take to reach a phenomenon known as flashover, which occurs when all combustibles in a shelter ignite in rapid succession. A common description of flashover is the transition from ‘something in a room is on fire’ to ‘the entire room is on fire’. Flashover is therefore the absolute end of tenable conditions for life safety in the room and will result in severe injury or death if these have not already occurred.

The rapid combustion of lining materials can also incur a short period of intense flaming outside of open windows and doors which can contribute to rapid fire spread to other shelters. Using non-combustible materials for internal lining, such as ceramic wool, can help reduce the risk of fire spread and intensity.

Residents may install their own insulation materials, so conducting regular fire safety inspections of the shelters is essential to identify and address any potential emergent hazards related to internal lining materials. Additionally, providing fire safety education and awareness to residents, including information on the dangers of combustible materials and the importance of proper maintenance and use of internal lining materials, is crucial. Collaboration with local fire departments can help provide fire safety training and develop a response plan for fires.

SHELTER CONTENTS

The amount and type of fuel present within the shelter (i.e., shelter contents) is another critical aspect affecting fire growth and spread, as more fuel typically results in higher total energy released during a fire, potentially leading to a more severe fires and increased cumulative heat exposure to neighboring structures.

Highly combustible materials like wool, polyurethane foam, straw, or wood can increase the risk of ignition and the rate at which fire spreads and grows.

Shelter contents are highly contextual, influenced by factors such as availability of resources (finances and affordable options in the marketplace); individual, household, and cultural preferences and needs; humanitarian distributions.

VENTILATION

Ventilation via small gaps and other openings such as doors and windows directly affect fire behaviour and development. Ventilation is directly related to a number of critical fire behaviours in buildings. Most notably, it affects how hot smoke and gases build up in a room or shelter, which determines how fast flashover will occur. After flashover, the rate of thermal energy released by the fire is controlled by the rate at which oxygen can get into the shelter, which is dependent on the size and shape of openings. A shelter with very large openings and defects may be so well ventilated that hot gases do not accumulate to the degree required to cause flashover (known as fuel-controlled). However, it is far more common for shelters to reach flashover (at least where structural integrity is maintained over a sufficiently long period of time for the hot gases to accumulate), in which case marginal increases in ventilation will result in a more efficient, hotter fire, thus known as ventilation-controlled.

COMPARTMENTATION

Research has found that compartmentation can provide occupants with sufficient time to evacuate the building and allow firefighters to contain and extinguish the fire effectively.

Compartmentation is most relevant to larger buildings in humanitarian settings, such as social infrastructure (e.g., healthcare facilities, large schools), warehouses, or outside camps and camp-like settings (e.g., rented apartments). However, one pilot study in tented refugee camps in Lebanon introduced a fire resisting barrier (fire wall in this case) in the middle of a large tent dividing it for two separate families – essentially dividing the tent into two compartments. This was shown to contain the fire to one side of the tent for more than ten minutes, and it is hypothesized that it will slow the spread of fire through the settlement as well. In the context of humanitarian settlements, some specific measures can be applied to enhance compartmentation. Using fire-resistant materials for walls and doors can help contain fires within specific compartments, reducing the risk of spread to adjacent areas. Additionally, ensuring that windows and doors are properly designed and installed can prevent the spread of fire and smoke between compartments.

In resource-limited settings, it is essential to consider alternative, locally available materials that offer some level of fire resistance. This may include using mud, lime plaster, or other non-combustible materials as coatings for walls or roofs.

7 | MINIMIZE FIRE SPREAD

In humanitarian settlements, maintaining appropriate separation between structures, enhancing fire resistance of separating elements, and incorporating fire breaks are essential to minimize the risk of fire spread. It is crucial to consider the size and arrangement of shelters, as well as the materials used in their construction, to develop an effective fire safety plan.

TO MINIMIZE FIRE SPREAD RISKS IN HUMANITARIAN SETTINGS:

- ✓ Use non-combustible construction materials, where possible. In particular, eliminate exposed combustible materials on the exterior of shelters, or protect them with non-combustible coverings.
- ✓ Maximize separation distance between shelters to reduce the likelihood of fire spread. Increase this distance when shelters are constructed from combustible materials and where large openings are present. Consider that even marginal increases in separation distance (even an extra 20-30cm) can make a significant contribution to reducing fire spread risk.
- ✓ Ensure that openings between shelters and fire breaks are clear of any combustibles. Locate openings (doors and windows) where they do not immediately face, or are at least a reasonable separation distance from, neighbouring structures.
- ✓ Use fire-resistant materials for separating elements when possible, considering the potential impact on evacuation routes and the importance of proper construction and installation. Materials such as concrete, brick, metal, or gypsum board can be used to slow the spread of fire.
- ✓ Develop community awareness programs on maintaining safe distances between shelters, proper storage of combustible materials, and the use of fire-resistant separating elements. Educate residents on the importance of adhering to recommended separation distances and maintaining clear fire breaks for increased safety.

- ✓ Collaborate with local authorities and fire safety experts to ensure compliance with relevant fire safety standards and best practices. Regularly review and update fire risk assessments to account for changes in the shelters or the surrounding environment.

- ✓ To minimize the risk of fire spread via firebrands, it is essential to incorporate fire safety measures that specifically address exposure to this risk. Using non-combustible construction materials (especially for the roof and at the joints between roofs and walls), ensuring clear openings between shelters and fire breaks, and developing community awareness programs on the risk of firebrands (and the importance of keeping roofs clear of combustibles, for example) can help to reduce the risk of fire spread through firebrands.

SEPARATION DISTANCES

Separation distances between structures are vital in reducing the risk of fire spread. The Sphere Handbook recommends a minimum of 2 times the height of the shelter separation between shelters, while experimental research on South African informal dwellings, constructed from steel cladding, timber crib fuel load, and a single door and window opening, suggests that a 3-meter separation may be necessary. Factors that influence these distances include the combustibility of cladding materials, internal lining materials, and the size and location of openings (especially areas where openings are facing each other), such as windows and doors, roofs, wind conditions, etc. Larger openings can increase thermal radiation and therefore larger separation distances may be required. When it is not practically achievable to maintain separation distances between every shelter, multiple shelters can be clustered together, and separation can be provided between these larger clusters.

SEPARATING ELEMENT

In cases where separation between shelters is not possible, the use of a separating element may be proposed as an alternative option to reduce the risk of fire spread. Fire-resistant materials, such as concrete, brickwork, and gypsum board can be used to separate structures in cases where maintaining appropriate separation distances is not possible. They may be used strategically in the construction of shelters or communal structures, or integrated into site planning (e.g., a row of toilet blocks could be built of fire resisting materials and placed strategically to slow the spread of fire in the settlement.

Several considerations should be taken into account when using fire-resistant separating elements. These include the potential impact on evacuation routes, as well as the importance of proper construction and installation to ensure their effectiveness. If not constructed properly, gaps or openings can allow flames and heat to pass through, negating the purpose of the separating element. Regular inspections and maintenance of fire-resisting elements are crucial to ensure their effectiveness in case of a fire. Note both minimum separation distances and the use of fire resisting elements are not as effective for firebrand prevention or for radiation from multiple shelters.

FIRE BREAKS

In addition to shelter-to-shelter separation, fire breaks are strategically designed open spaces or physical barriers to further slow or stop the risk of fire spread (i.e., to ‘contain’ it). Sphere Handbook recommends a 30-meter fire break between shelter blocks. The effectiveness of firebreaks depends on factors such as their width, materials used, and maintenance. Fire breaks are critical to provide additional protection in the case of larger fires, although firebrands can still jump across them.

Affected community fighting fire in Dadaab, Kenya. Communities are almost always the first responders to fires in informal settlements and the settlements of displaced communities. Where the host country's fire services do respond, their response if often not timely or effective due to delays in communication, limited fire response infrastructure (roads, water, etc.), and other factors.

8 FIREFIGHTING, SEARCH, AND RESCUE

COMMUNITY RESPONSE

A common approach to fire safety in humanitarian settings is to equip affected populations with fire extinguishers, buckets for water or sand, fire blankets, or other equipment such as beaters and hooks (wildfire response tools). Sensitivity is required around distribution of any kit. Community buy-in and ownership is critical to assure kit if available and used as intended.

Unfortunately, these distributions are rarely accompanied by messaging or training beyond how to operate the equipment. Understandings and acknowledgement of the limited effectiveness and safe application of these tools in humanitarian settings is severely lacking, which leads to expectations that these tools should be used in response to all types and sizes of fire. This can put communities in danger.

For example, while fire extinguishers can serve as a valuable tool for combating fires during the early stages as they are portable and user-friendly, it is crucial to recognize their intended use and limitations. Fire extinguishers can help to extinguish a fire confined to a small area if:

- ✓ The fire is not growing, and the room is not filled with smoke.
- ✓ The operator knows how to use the fire extinguisher.
- ✓ It is within easy reach, in working order, and fully charged.
- ✓ The operator has a clear escape route that will not be blocked by fire.
- ✓ The operator understands the limitations of the fire extinguisher.
- ✓ Fire extinguisher is large enough to put out the fire.

- ✓ Fire extinguisher carries label of independent testing laboratory.
- ✓ Children should not be trained to use fire extinguishers – they should be trained to get out and stay out if there is a fire.

It is not safe to stand within 1.8 meters of a fully involved shelter fire (typical recommended distance for fire extinguisher use), let alone a larger fire that has spread to several shelters, especially without appropriate personal protective equipment. Communities need to be trained to assess fire danger, so they can make dynamic decisions about their response, as fires in humanitarian settings can grow and change quickly. However, if trained, equipped, and supported appropriately, community fire response teams can become an integral part of formal fire response mechanisms responding to large fire incidents (fully developed shelter fire and beyond).

WATER ACCESS

Firefighting in humanitarian settlements relies on access to water as it directly impacts the effectiveness of emergency response efforts. However, the limited water resources in these settings can pose significant challenges, making it essential to explore alternative firefighting methods while considering their risks and limitations. Adhering to guidance from sources such as the Construction Good Practice Standards (2021), The Sphere Handbook (2018), and Minimum Standards for Camp Management (2021 Edition) can help in addressing these challenges.

In humanitarian settlements where water hydrant systems are often unfeasible due to limited resources, alternative firefighting methods, such as fire extinguishers, sand, or other fire-suppressing materials, may be employed. The Sphere Handbook (2018) emphasizes the importance of providing adequate water supplies for firefighting, while the Construction Good Practice Standards (2021) highlight the need to consider the specific context when selecting firefighting equipment.

These alternatives can pose additional risks and may not be as effective as water-based firefighting methods in certain situations. The risks and limitations of different firefighting methods should be assessed and the most appropriate option for the specific context should be selected. This approach aligns with international codes, such as the International Fire Code (IFC), which emphasizes the importance of providing appropriate firefighting equipment based on the potential hazards and available resources.

High-risk areas within the settlement should be prioritized to optimize the allocation of limited resources for firefighting. Alternative locally available firefighting resources remain an option where water access is limited. For example, water sources such as rivers, lakes, or ponds could be used and rainwater harvesting systems can be established to collect and store water for emergency use. Gravity fed water tanks can be installed for firefighting purposes.

Water access for firefighting purposes can be secured through collaborating with WASH and local authorities, and other organizations can help secure funding and resources. These relationships can be used to develop and implement a comprehensive plan for emergency response, enhancing the overall effectiveness of these efforts. Training and educating community members on how to use alternative firefighting methods effectively and safely can empower residents to take appropriate action during emergencies.

The emergency response plan should be regularly reviewed and updated to account for changes in water access and availability. Water access for firefighting purposes should be continuously monitored and assessed to identify areas that need improvement and guide necessary modifications.

EMERGENCY VEHICLE ACCESS

Ensuring adequate access for emergency vehicles such as fire trucks and ambulances is crucial for effective firefighting and rescue operations. The challenge lies in navigating narrow streets and tightly packed homes, particularly in crowded settlements. To address these challenges, the design and infrastructure of humanitarian settlements should be prioritized with the focus on emergency access for firefighting and rescue purposes, in line with humanitarian guidelines. The guidelines emphasize the need for proper planning and coordination between various stakeholders, including local authorities, humanitarian organizations, and community members and include the following recommendations:

- ✓ Ensure that emergency services have access to at least 75% of the shelters within a settlement (Sphere Handbook, 2018).
- ✓ Design access routes that can accommodate vehicles and equipment required for emergency response (Construction Good Practice Standards, 2021).
- ✓ Consider alternative access options such as smaller vehicles or hand-carried equipment but weigh up the risks and limitations of different access options and choose the most appropriate option for the specific context (Minimum Standards for Camp Management, 2021 Edition).
- ✓ Collaborate with local authorities and other organizations to develop and implement a comprehensive plan for emergency response and evacuation (International Fire Code, IFC).

Additional recommendations could include:

- ✓ Invest in infrastructure, such as fire lanes and providing access for emergency vehicles, ensuring that emergency responders can effectively reach the affected areas.
- ✓ Remove physical barriers that may impede access for firefighting and rescue purposes, such as narrow streets or tightly packed homes, is also a critical aspect of this process.
- ✓ Continuously monitor and assess access for firefighting and rescue purposes to identify areas that need improvement and guide necessary modifications.

Addressing the challenges of emergency access in humanitarian settlements requires a multifaceted approach that includes collaboration with local authorities, investment in infrastructure, and community education, all the while adhering to the guidance from relevant humanitarian and international standards. By carefully considering the risks and limitations of different access options and taking proactive steps to improve access and preparedness, humanitarian practitioners can enhance the effectiveness of firefighting and rescue operations in these challenging environments.

INCIDENT COMMAND SYSTEM

The Incident Command Systems (ICS) is an approach to incident management that defines roles and responsibilities to be assumed by responders and the standard operating procedures to be used in the management and direction of emergency incidents.

ICS was developed in the 1970s to address confusion derived from different terminology, organizational structure, and operating procedures between various response agencies at the incident or field level, and to coordinate and handle competing resource demands and to establish consistent resource priorities at the agency or coordination level. It is an all-hazards approach, providing a progressive, scalable, and flexible, yet standardized, system of command, control, and organization.

ICS has been adopted by emergency services across the world over the past 50 years. It has been piloted in the refugee camps in Cox's Bazar, Bangladesh as part of a wider program training and equipping refugee fire response teams.

Here are a few reasons why ICS can be beneficial for humanitarian settings:

- ✓ **CLEAR COMMAND STRUCTURE:** ICS establishes a clear hierarchy of command, with designated roles and responsibilities for each position. This helps in coordinating various response activities and ensures effective communication and decision-making during the incident.

- ✓ **SCALABILITY:** fires in camps and camp-like settings can quickly escalate and require a multi-agency response involving different organizations (which will vary in each context), such as humanitarian agencies, fire services, medical personnel, and security forces. ICS is designed to handle incidents of varying complexity and can be scaled up or down as needed to accommodate the scope of the incident.

- ✓ **COORDINATION AND COMMUNICATION:** ICS emphasizes effective communication and coordination among different response entities. During a fire in a camp or camp-like setting, there may be a need to coordinate activities such as evacuation, firefighting, medical assistance, logistics, and security. ICS provides a common language, standardized procedures, and established communication channels to ensure all relevant stakeholders are informed and working together towards a common goal.

- ✓ **RESOURCE MANAGEMENT:** With the implementation of ICS, resource management becomes more efficient. The system helps identify resource needs, allocate resources appropriately, and track resource utilization. This is crucial in fire response, where there may be limited resources, and their effective deployment can make a significant difference in saving lives and mitigating the impact of the incident.

- ✓ **DOCUMENTATION AND ACCOUNTABILITY:** ICS promotes documentation of incident-related information, including actions taken, decisions made, and resources used. This documentation aids in post-incident analysis, improvement of response strategies, and accountability for the actions taken during the incident.

It is important to note that while ICS provides a valuable framework, there are unique challenges within humanitarian settlement fires that should also be considered when implementing an incident command system. These include, but are not limited to: the vulnerable population, immediate socio-political context (e.g. relationship with host communities, local fire services), language barriers, and cultural considerations, Adaptations and considerations specific to humanitarian contexts may be necessary to ensure the ICS can ensure an inclusive and effective response.

EMERGENCY COMMUNICATIONS

During a fire, various types of emergency communications can be useful to ensure effective and efficient response efforts. There are a range of communication channels and methods to consider in consultation with local communities and relevant agencies responsible for fire response in humanitarian settings where they can be adapted and applied in a contextually appropriate way:

- **EMERGENCY NOTIFICATION SYSTEMS:** Implementing an emergency notification system within the settlement can be crucial. This system can include loudspeakers, sirens, or other audible devices to quickly alert the settlement residents about the fire and provide instructions for evacuation or other necessary actions.

- **MOBILE PHONE ALERTS:** Utilizing mobile phone networks to send emergency alerts and notifications can be highly effective, especially if the residents have access to mobile phones. Sending text messages or utilizing emergency alert apps can help disseminate critical information quickly.

- **RADIO COMMUNICATION:** Establishing a reliable radio communication system among response teams, camp management, security personnel, and other key actors is essential. Radios allow for real-time communication, coordination, and dissemination of instructions or updates across different teams involved in the response.

- **INTERPRETERS AND TRANSLATORS:** Camps and camp-like settings often consist of diverse populations with different languages and cultural backgrounds. It's crucial to have trained interpreters and translators available to ensure effective communication with the affected individuals. These individuals can facilitate communication between responders, camp management, and residents, ensuring instructions and safety information are clearly understood.

- **COMMUNITY ENGAGEMENT AND OUTREACH:** Establishing community engagement and outreach programs within the humanitarian settings can help foster trust, build relationships, and facilitate effective communication during emergencies. These programs can involve community leaders, volunteers, or cultural mediators who can help disseminate information, address concerns, and encourage active participation in emergency response communication efforts.

- **VISUAL COMMUNICATION:** In situations where language barriers exist, visual communication methods can be valuable. This can include using clear signage, symbols, pictograms, or visual aids to convey important safety information and instructions.

- **SOCIAL MEDIA AND ONLINE PLATFORMS:** Utilizing social media platforms, online messaging apps, or dedicated websites can help disseminate information and updates about the fire response efforts to a wider audience. This approach can be particularly useful in reaching out to external stakeholders, such as humanitarian organizations, government agencies, or volunteers who may offer support.

It is essential to ensure that communication methods are accessible, inclusive, and culturally sensitive to the specific needs of the local population (including host communities). Providing information in multiple languages and utilizing community members or cultural mediators can help overcome language and cultural barriers, ensuring that critical information reaches everyone effectively. Embedding opportunities for settlement residents to participate in the design and delivery of these emergency communication efforts will contribute to the success of the approach.

FIRST AID & AMBULATORY SERVICE

Providing first aid and ambulatory services in a humanitarian settlement requires a comprehensive approach that takes into account the unique challenges and needs of the population. Here are some ways these services can be provided:

- **FIRST AID TRAINING:** Train residents, staff, and volunteers in basic first aid techniques. This empowers individuals to provide immediate assistance during emergencies and minor injuries. Conduct regular first aid training sessions and refreshers to ensure the knowledge and skills are maintained. Include first aid treatment of burn injuries in this training.
- **MOBILE MEDICAL TEAMS:** Deploy mobile medical teams that can move within the camp to provide on-site first aid and medical assistance. These teams can consist of healthcare professionals, paramedics, and trained volunteers who can respond quickly to medical emergencies and provide initial treatment.
- **AMBULANCE SERVICES:** Establish ambulance services within the camp to transport injured or critically ill individuals to nearby hospitals or healthcare facilities. Ambulances should be equipped with basic medical equipment and staffed by trained medical personnel.
- **REFERRAL SYSTEM:** Develop a referral system to ensure that individuals with more severe injuries or medical conditions receive the necessary specialized care. This involves establishing partnerships with nearby hospitals or healthcare facilities to provide secondary or tertiary medical services, especially for more advanced burn treatment.

Monguno stadium camp fire

9 | POST-FIRE

FIRE INVESTIGATION

Fire investigation is the process of determining the origin, cause, and circumstances of a fire. Although retrospective, the process enables the understanding of the specific fire dynamics and allows for implementing preventive measures to avoid future incidents. In humanitarian settings, fire investigations can be challenging. A forensic fire investigator is unlikely to be available to lead the investigation, and basic principles of fire investigation like preserving the scene of the fire will be nearly impossible because recovery will begin immediately.

While there is significant information available on how to carry out fire investigations which could be contextualized to humanitarian settings, investigations are highly reliant on the investigator's experience and expert judgment. It is therefore recommended that fire investigations are not prioritized at this time unless a local expert is available.

There may be opportunities, however, for researchers to review available evidence of a fire incident and to study the fire's behavior, human responses, etc. Therefore, collecting and documenting relevant information, such as photographs, videos, and maps of the fire can be useful.

INCIDENT REPORTING

Accurate and timely reporting helps identify patterns, track trends, and develop effective strategies to prevent future fires. Although incident reporting can be challenging in humanitarian contexts due to limited resources and communication infrastructure, it is vital to establish a reporting system to document fire incidents and

take appropriate actions to prevent similar occurrences. This proactive approach can contribute to a safer environment for vulnerable populations, reducing the risk of fires and their devastating consequences.

To ensure effective incident reporting in humanitarian settings, consider the following key components:

- ✓ Develop a concise protocol that includes necessary information, ensuring timely and consistent reporting of all fire incidents.
- ✓ Provide training on incident reporting, teaching staff and community members how to collect and document relevant information about fire incidents.
- ✓ Create a standardized form that captures essential information, such as the date, time, location, cause, and severity of the fire, as well as any injuries or fatalities.
- ✓ Gather and analyze data on fire incidents (and near misses) to identify patterns and trends, using this information to develop effective prevention strategies.
- ✓ Distribute incident reports and prevention strategies among relevant authorities, humanitarian organizations, and affected communities to increase awareness and improve fire safety.
- ✓ Treat all incident reports with confidentiality, avoiding the sharing of personal information without consent.
- ✓ Regularly assess the effectiveness of prevention strategies and incident reporting systems, making necessary adjustments to enhance their efficacy.

HEALTHCARE: PHYSICAL HEALTH

Fire safety and the management of fire risk are crucial considerations in humanitarian settings, particularly when it comes to healthcare and physical health. In humanitarian settings, harmful practices related to the treatment of burns persist (for example, the application of toothpaste), often due to a lack of understanding of basic first aid. It is essential to address this knowledge gap to respond to burns and injuries. By examining the accessibility, adequacy, and appropriateness of existing healthcare services, areas for improvement could be identified and effective measures to enhance fire safety and minimize the impact of fire-related incidents implemented.

RECOMMENDATIONS TO ADDRESS THE CHALLENGES:

- ✓ Evaluate the current provision for responding to burns and injuries, ensuring adequate healthcare infrastructure, well-equipped healthcare centers, and trained healthcare professionals to provide timely and appropriate treatment for burn victims. Regularly assess capacity and accessibility of healthcare facilities, addressing any deficiencies, and establish mechanisms for improvement.
- ✓ Prioritize comprehensive first aid training programs within humanitarian settlements, educating community members, healthcare workers, and volunteers on how to respond effectively to burns and other fire-related injuries. Additionally, conduct awareness campaigns and community engagement initiatives to disseminate information about basic first aid practices.

HEALTHCARE: MENTAL HEALTH

Fire incidents, whether resulting in loss of life, (life-changing) injury, property or livelihoods, can have significant impact on the emotional and mental wellbeing of those affected. Although humanitarian agencies coordinate an immediate response through the provision of emergency shelters and NFIs to support households in their recovery, emotional and mental health support is missing within the current approach to recovery after fire. Settlement residents report trauma to be one of the most significant and long-lasting impacts which can shape their ability to recover in other ways (such as engaging in work). Mental health support during recovery is, therefore, an urgent need to be considered across the broader humanitarian sector.

RECOMMENDATIONS TO ADDRESS THESE CHALLENGES:

- ✓ Evaluate current post-fire recovery programs through a focus on emotional and mental health: establish what provisions are currently made to support emotional and mental health of affected populations and engage with trained healthcare professionals to assess the appropriateness of response.
- ✓ Engage with settlement residents and communities to understand what forms of support are contextually appropriate and offer relevant support.
- ✓ Ensure approaches to fire education, communication and engagement are trauma informed. Engage with education professionals and communities to create materials and resources that protect emotional and mental wellbeing, whilst ensuring appropriate prevention messaging.

BUILDING BACK SAFER

Building back better and safer is a concept that emphasizes the importance of rebuilding after a disaster or conflict in a way that not only addresses the immediate needs, but also addresses pre-existing vulnerabilities and inequalities. In the context of fire safety in humanitarian settings, this concept can be applied by ensuring that the rebuilding process considers the specific fire risks and vulnerabilities that were present before the disaster or conflict. This includes conducting a comprehensive risk assessment to identify the specific fire hazards and vulnerabilities present in the community and incorporating fire safety measures into the rebuilding process. For example, this could include:

- ✓ incorporating fire-resistant shelter/building materials,
- ✓ designing shelters and other spaces that promote good natural ventilation and lighting,
- ✓ ensuring that emergency exits, and fire escapes are easily accessible.

In addition, it is also important to ensure that the community is involved in the rebuilding process, and that they are provided with education and training on fire safety. This can include:

- ✓ engaging with communities on how to recognize fire hazards through community centered education,
- ✓ how to prevent fires from happening,
- ✓ how to respond in case of a fire.

By building back better and safer, it can help to reduce the risk of fire in the future and promote a safer and more resilient community.

© Photovoice activity with settlement resident via Helen Underhill, Lebanon

Child reaching for electric wires and identifying tyres as evacuation risk

4

Conclusions and next steps

Fire risk emergence in humanitarian settings is complex. A baseline technical understanding of fire science and engineering will benefit those working within the humanitarian sector to ensure they consider the before, during and after dimensions of a fire incident.

Improvements to fire safety in the range of shelter and settlement types require holistic approaches based on evidence, evaluation, and contextualization. The current gaps in research and data are such that this guidance is a first version and signals the beginning of a conversation that should be taken up across the sector and developed further through:

- ✓ An expanded data set of fire incidences and near misses, interdisciplinary analysis of fire risk and safety in different shelter and settlement types, and evidence and evaluations of programs in a range of contexts.
- ✓ Engagement with different technical, operational, experiential, and contextual knowledges through an interdisciplinary committee.

The continued development of the guidance is necessary to support actors within the sector to create contextualised solutions and to the development of capacity building and education, communication and engagement activities, resources, and programs.

Global Shelter Cluster
ShelterCluster.org
Coordinating Humanitarian Shelter

www.sheltercluster.org

© Danielle Antonellis / Informal Settlement. Mumbai, India