Better Shelter

Designing and testing for fire safety in humanitarian settlements

Why is fire protection in humanitarian settlements important?

Why fire safety is important

- Overcrowded temporary structures
- Unsafe cooking and heating appliances or open fires.
- Inability to provide constant childhood supervision

Fire prevention and control initiatives are particularly important in camp settings since displaced persons are more vulnerable to burn injuries than non-displaced.

Source: Kazeroonia, Y et al., 'Fires in refugee and displaced persons settlements: the current situation and opportunities to improve fire prevention and control', Burns, 2016 August; 42(5): 1036–1046. doi:10.1016/j.burns.2015.11.008

A growing concern of fire in humanitarian settlements

Humanitarian camp fires 1990-2015

- **131** incidents in 31 countries (36 unintentional/ 26 intentional/ 43 unknown cause/ 26 cause not mentioned)
- **487** deaths
- **790** burn injuries
- **50,509** shelters destroyed
- **382,486** individuals displaced

Reported number of fires in camp settlements indicates a growing challenged to be addressed.

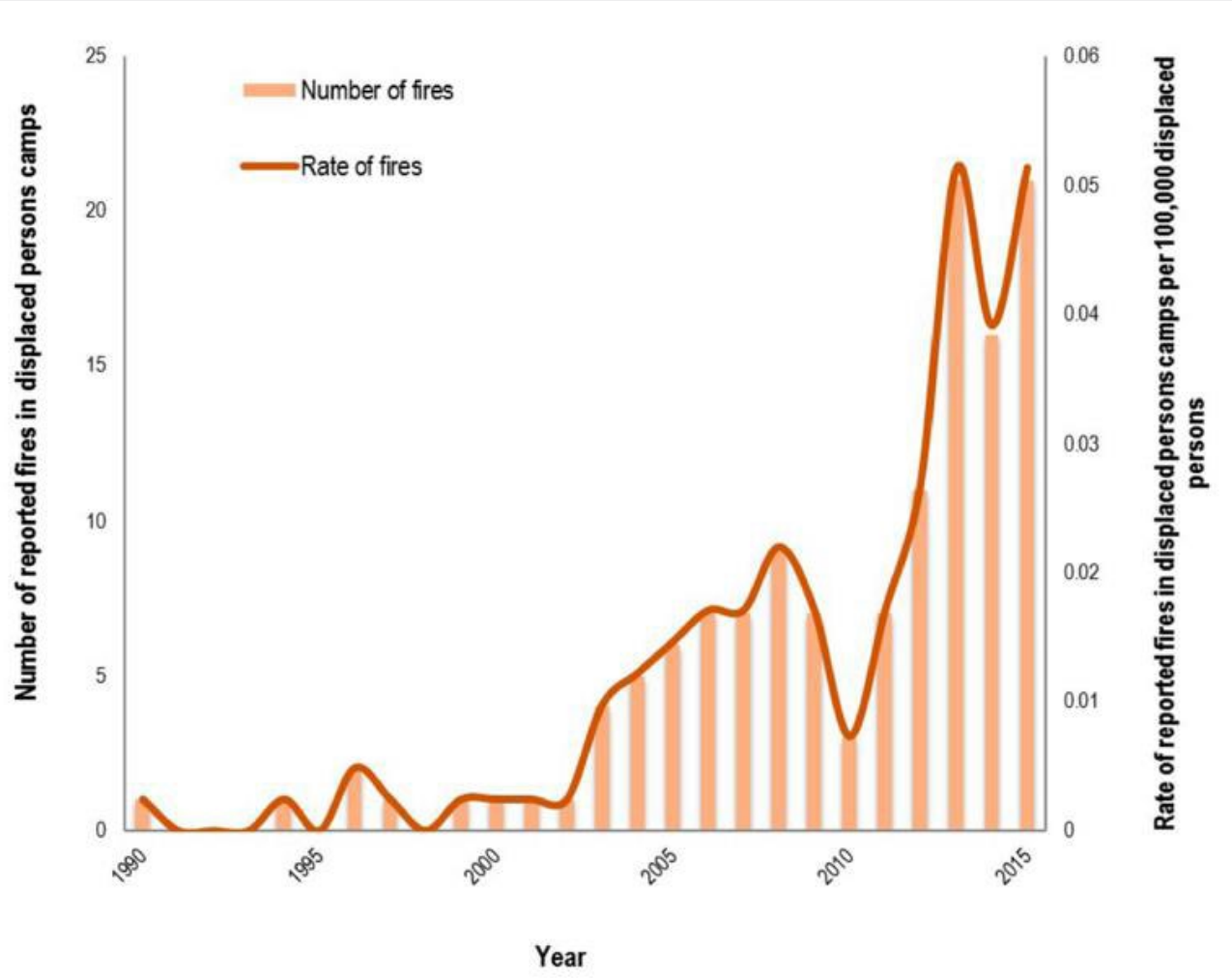


Figure 3.
Number and rate of fires in displaced persons settlements worldwide since 1990.

Source: Kazeroonia, Y et al., 'Fires in refugee and displaced persons settlements: the current situation and opportunities to improve fire prevention and control', Burns, 2016 August; 42(5): 1036–1046. doi:10.1016/j.burns.2015.11.008

The three components of fire safety in humanitarian settlements

Settlement and camp planning

- Fire breaks
- Distance between shelters (no flammable material between shelters)
- Secure cooking facilities
- Trained fire wards
- Fire extinguishers

Use and behaviour

- Sufficient distance between walls-ceiling and stove-heater
- Secure stove/heater
- Limited flammable material stored inside shelter
- No open fires close to, or inside the shelter
- No smoking inside the shelter
- Maintain sufficient ventilation
- Refueling of stove outside of the shelter
- General fire awareness

Shelter material and design

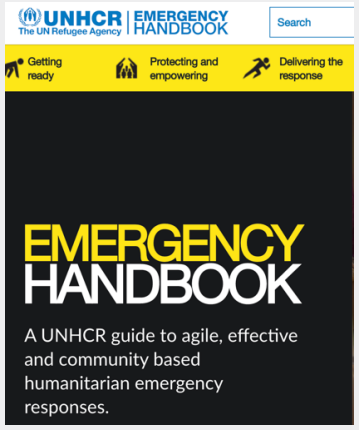
- Secure exit of chimney
- Sufficient ventilation
- Fire retardant materials

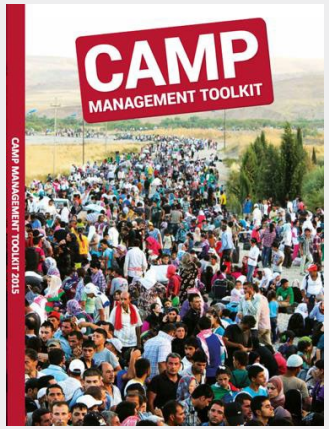
Fire safety depends on the design of the camp, the behaviour of the residents as well as the shelter material and design.

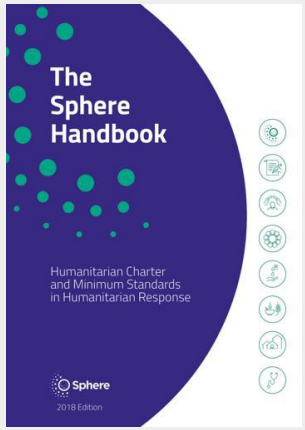
Standards and guidelines

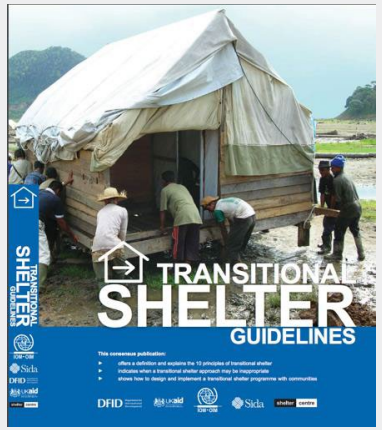
- Guidelines on fire safety from leading humanitarian organizations are most often aligned (but contradictions are not uncommon)
- There are no (national) standards that apply to (all) refugee/ IDP situations
- Unclear when the different guidelines apply –across geography and agency
- Humanitarian guidelines are in general non-specific with regards to shelter structure requirements/codes and provide little information to specify what materials or fire classifications are –or are not –permitted

The most acknowledged humanitarian guidelines provide recommendation on fire safety – but these are partly overlapping, partly contradictory, and do not include standards on fire safety in building materials and design.









How we define and test fire safety

The fire behavior of a shelter is determined by the design and materials –and equally important –the objects inside the shelter that contribute to the fire (matrasses, furniture, clothes etc.) and the outside environment (wind)

We evaluate the structure in a full-scale fire scenario test. The test includes one complete shelter with a typical interior for a family of five people

The test method is developed in collaboration with UNHCR DPSM and the Research Institute of Sweden (RiSe)

Evaluation is based on

- Safe escape time
- Safe distance between units
- In addition, any combustible material in the Better Shelter are tested and classified against international standards.

The only way to test real life fire behaviour is through full scale scenario fire tests of a furnished shelter.

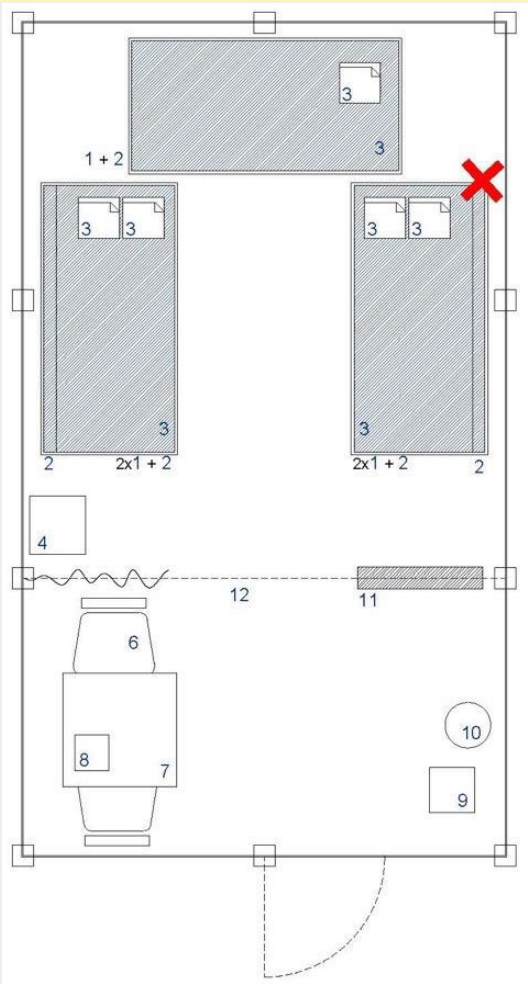
Research institute of Sweden (RiSe) formally know as StatensProvningsanstalt(SP).

Scenario testing is more realistic and demands more of the test object

Better Shelter, UNHCR DPSM, together with the Research Institute of Sweden (RiSe) set a scenario test standard to test shelters in full scale.

- Mimics a realistic scenario of a shelter in a settlement, furnished with flammable items inside: matrasses, plastic furniture, textiles, food items etc.
- Controlled environment (indoor)
- Repeatable test with reoccurring results

Measurements done	
Indoors	**Outdoors**
Gas measurement (CO, CO2, O2)	Temperature
Temperature	Heat radiation
Heat radiation	Heat release rate
Visual checks (video recording)	Visual checks (video recording)



The *required* safe escape time is the time required to safely escape a shelter in the event of a fire

Alert

Alerting time – the time required before people are aware of a fire should be minimum 30 seconds (daytime) (section 3.2.2)

Prepare

Preparation time – the minimum time needed to prepare before leaving the room should be minimum 60 seconds (section 3.2.3)

Evacuate

Evacuation time – the minimum time needed for evacuation can be determined by mathematical calculation (section 3.2.4)

The required safe escape time is important to determine for any shelter structure as it informs how much time is required for people to safely flee in the event of fire. Total required escape time for the Better Shelter is:

30 + 60 + 11 = minimum 101 seconds ≈ 2 minutes

Sources: Swedish building code BFS2013:12 BBRAD 3 section 3.2 RiSereport 7P01256

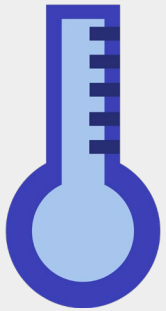
The safe escape time is the duration given residents to safely escape in the event of fire

The safe escape time for the Relief Housing Unit (RHU) is **2 minutes and 20 seconds** based on the following criteria:

Smoke layer level

Visibility

Heat radiation



Temperature

Air toxicity

Sources: Swedish building code BFS2013:12 BBRAD 3 section 3.2 RiSereport 7P01256

Safe distance between shelter units

When structures catch fire, there is a risk that the fire spreads to a neighbouring structure.

- Flying burning particles e.g. with thatch roofs
- Collapsing structures
- Heat radiation

With light weight structures (non brick/concrete) in refugee camp situations, heat radiation –that is the heat emitted from a shelter on fire –Is the factor that determines the spread of fire from shelter to shelter.

Sources: RiSereport 7P01129

Safe distance between shelter units is the recommended minimum fire spread from one unit to another

Measurement of heat radiation.

Determination of safe distance in a no-wind case.

Determination of sensitivity.

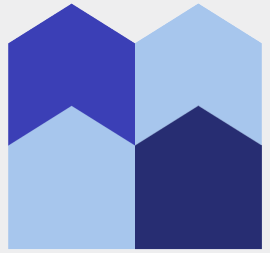
Ignitability of material.

Determination of safe distance in a windy case.

Sources: RiSereport 7P01129

Safe distance between shelter units

Table 6 – Required safety distance at varying windspeeds	
Wind Speed (m/s)	**Safety distances between units (m)**
0	2
2	3
5	4
10	5



Safety distances between units (m)

The exact results are limited to shelter units with the same components and materials as the fire scenario setup (shelter and decoration) –however they give a ”best estimate” for the most common contexts. In situations where the interiors of the shelters will be significantly different (much more, or much less flammable materials) a new test can be conducted to provide more exact advice.

Sources: RiSereport 7P01129

Heater options

Heater options ranked by risk:

1. Electric heater
2. Kerosene/ diesel/ oil heater
3. Wood heater
4. Open fire

More risk

If an option with more risk is selected, more risk mitigations are needed.

Summary and conclusions

The fire behaviour of a shelter is determined by the design and materials –and equally important –the objects inside the shelter that contribute to the fire (matrasses, furniture, clothes etc.) and the outside environment (wind).

Fire safety depends on the

- Design of the camp
- The behaviour of the residents
- The shelter material and design

The only way to test real life fire behaviour is through full scale scenario fire tests of a furnished shelter.

- **Safe escape time** –the amount of time required for residents to safely escape in the event of fire. The safe escape time of the RHU is **2 minutes and 20 seconds**
- **Safe distance between shelter units** –the recommended minimum distance to prevent spread between units. The safe distance of the RHU is 5 meters

Contact

Better Shelter

| www.bettershelter.org

Miguel Acebrón García de Eulate

Technical Support Manager

miguel.eulate@bettershelter.org

+46 702 99 18 24