Building Research & Information (September–October 2004) **32**(5), 368–378

Spon Press
Taylor & Francis Group

Design of humanitarian tents for use in cold climates

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Extreme climatic risks pose significant challenges to displaced populations that often lack adequate shelter. Contemporary policy documents concerning emergency shelter reveal that the scope of shelter-associated risk is much wider than simply exposure to the elements and includes a significant social dimension. However, disparity exists between implicitly accepted risks described in aid agency literature and field practice. Experience in recent disaster assistance programmes in Kosovo and Afghanistan illustrates how ill equipped the aid community is to deal with cold weather affecting transitional settlements. A review of the environmental risks associated with living in tented accommodation in cold climates reveals the difficulty of providing thermal comfort and fire safety in both heated and unheated tents. In addition, social surveys and field trials with displaced populations in Afghanistan illustrate that shelter is used, perceived and valued differently according to the ethnic and cultural background of occupants, and that these are also factors that impact on the risks they bear. Several design recommendations and guides for the use of cold climate relief tents are made, whilst acknowledging that the provision of alternative, longer-term shelter provision during the phase of emergency response is nearly always preferable.

Keywords: cold-climate shelter, disaster response, humanitarian aid, insulated shelter, risk, shelter policy, shelter, SPHERE standards, tents, transitional settlement

Les risques climatiques extrêmes sont des défis importants pour les populations déplacées qui souvent manquent d'abri. Des documents actuels consacrés aux abris d'urgence révèlent que l'ampleur des risques associés aux abris est beaucoup plus importante que la simple exposition aux éléments et comprend une dimension sociale significative. Toutefois, il existe des disparités entre des risques acceptés implicitement décrits dans la littérature des agences d'aide et la réalité sur le terrain. L'expérience acquise dans le cadre de récents programmes d'aide mis en œuvre au Kosovo et en Afghanistan illustre combien les services d'aide sont mal équipés pour résoudre les problèmes posés par le froid et qui affectent les camps de transition. Une revue des risques environnementaux associés à la vie sous des tentes dans les climats froids révèle la difficulté à fournir un confort thermique et la sécurité en cas d'incendie dans les tentes qu'elles soient chauffées ou non. De plus, des études sociales et des essais en grandeur réelle conduits en Afghanistan sur des populations déplacées montrent que l'abri est utilisé, perçu et apprécié différemment en fonction du contexte ethnique et culturel des occupants et que ces derniers sont en eux-mêmes des facteurs qui ont une influence sur les risques qu'ils encourent. L'auteur fait plusieurs recommandations et donne des orientations quant à la conception des tentes de secours à utiliser sous les climats froids, tout en reconnaissant que la mise en place d'autres dispositions pour la fourniture d'abris de plus longue durée pendant la phase de la réponse d'urgence est presque toujours préférable.

Mots clés: abris pour climats froids, réaction aux catastrophes, aide humanitaire, abris isolés, risques, politiques relatives aux abris, abris, normes SPHERE, tentes, camps de transition.

Building Research & Information ISSN 0961-3218 print/ISSN 1466-4321 online
http://www.tandf.co.uk/journals
DOI: 10.1080/0961321042000220990

Introduction: humanitarian shelter in context

The number of refugees and internally displaced persons (IDPs) resulting from conflict has risen dramatically over the past 20 years. In 2002, 20 million forced migrants, including both refugees and IDPs in 82 countries world wide, were listed as 'of concern' to the United Nations High Commissioner for Refugees (UNHCR, 2002).

Fuelled by increasing mass media interest in conflict and disasters, foreign participation in the relief of human suffering has also risen, and a new trend of international humanism has emerged (Ignatieff, 1998). The last decade has witnessed humanitarian interventions on an unprecedented scale. Examples include Kuwait and Northern Iraq in 1991/92, Somalia in 1993, Bosnia and Croatia in 1994, Rwanda and the Democratic Republic of Congo in 1994/95, Kosovo in 1999, and Afghanistan from 1995 to the present day.

Of these examples, four have involved provision of significant quantities of tents in cold climates by the international community. Agency policy concerning the provision of emergency shelter in cold climates, however, continues to be ambiguous. Whilst it is acknowledged that shelter using local materials and construction techniques is, in nearly all circumstances, the preferred solution to the shelter requirements of displaced people, vast numbers of tents continue to be supplied to displaced persons during emergency phases of humanitarian relief operations. In Iraq in 2003, for example, the UNHCR purchased 100 000 tents as part of contingency preparedness (A. Marinkovic, Supply and Transport Section, UNHCR, personal communication, 2003[1]).

UNHCR estimates there are currently nearly 6 million displaced persons living in camp settlements world wide. Of these, 3 million are in cold climates, of which the majority continues to live in tents and other similarly 'temporary' accommodation (UNHCR, 2002). Whilst the provision of tents during an initial response might be justified for the suppliers of shelter due to environmental, logistical and political constraints typically manifest during emergency phases, displaced people often have a different view of their use beyond this phase. This is much harder to justify when compared with the risks associated with long-term occupation of such accommodation (Ashmore, 2002). This is a problem experienced in all climates.

In Marratane refugee camp, Northern Mozambique, in 2001, for example, tents were supplied to a small caseload of refugees who were relocated from camps in the capital, Maputo. The cost of supplying the tents was US$500 per unit. The tents, however, were virtually uninhabitable in the heat and humidity of Nampula province, and within two months, the vast majority of the 1500 refugees had built their own informal houses from locally available materials and with their own resources. Later, housing was upgraded by building an adobe house based upon vernacular construction with a steel sheet roof and with a larger internal floor area (Manfield, 2002). The unit cost of the upgraded housing was nearly half the cost of a tent. This example illustrates the fact that aid agencies often provide tents when other shelter solutions and other settlement options could be implemented in preference to tents without impacting significantly upon the short-term health and security risks borne by displaced persons.

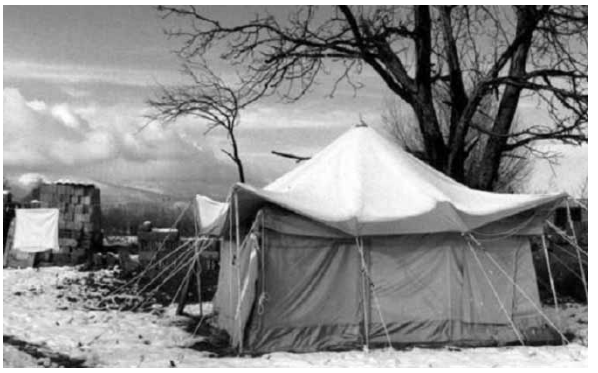

Figure 1 Standard UNHCR centre pole tent in Prelip, Western Kosovo
Source: L. Meredith-Vula, 1999.

Figure 1 shows tents in use in Kosovo and the former Yugoslav Republic of Macedonia in 1999 and 2000.

The paper begins with a characterization of shelter and the problem of providing shelter in humanitarian response before focusing upon the specific environmental challenges of inhabiting tents. It then discusses research undertaken to improve tent design before discussing its importance in the wider political arena of humanitarian relief.

Characterization of humanitarian shelter

There is a wide range of risks associated with human inhabitation of shelter and housing. However, specific considerations exist that impact on occupation of shelter in the context of humanitarian assistance.

Some risks are direct, such as poor occupant health resulting from poor-quality shelter. Other risks are indirect and complex, such as the effect of shelter provision upon the dignity of occupants. It is necessary, therefore, first to understand what is considered to be the full range of shelter considerations within a humanitarian context in order that risk can be also be described fully.

There is consensus among the major aid agencies concerning the primary role of shelter, which can be summarized as ensuring health and well-being, security

against violence and dignity (Medecins sans Frontieres, 1997; UNHCR, 1999; Lambert and Davis, 2002). The scope of shelter, however, can be viewed as being broader than this. The Sphere Minimum Standards in Disaster Response[2] (International Federation of the Red Cross, 2003), which is a consensus document that describes minimum standards to assist disaster-affected populations, carries a detailed characterization of shelter assistance within humanitarian relief. From this description, it is possible to identify the component parts of shelter that should be provided during an initial response. Although this description is not meant to be a formal definition, it provides a series of benchmarks or targets, which are further supported by the majority of actors within the international humanitarian community. For the purposes of this analysis, humanitarian shelter considerations are split in to two categories: environmental and health considerations, and social and livelihood considerations.

Table 1 shows that the scope of humanitarian shelter can extend well beyond simple protection from the elements. It situates shelter in a wider social and political context, beyond risk being perceived as purely physical in nature. This reflects not only the requirements for the design of accommodation, but also the wider social implications associated with settlement and services. These social requirements reflect the responsibilities of other actors involved in the support of settlement, such as the government hosting the refugees, known as the host government, the humanitarian donor organizations, humanitarian agencies, and others responsible for the external support in providing relief to displaced populations, the international community and, of course, the responsibilities of the occupant. Finally, Table 1 indicates that shelter can impact upon the economic and legal aspects of settling displaced people.

Range of shelter-related risks

How does the actual field practice of using tents in grouped settlement fulfil the social and political needs

Table 1 Humanitarian shelter considerations (adapted from International Federation of the Red Cross, 2003)

	Shelter considerations for displaced populations
Environmental and health	
Space	people should have adequate space (at least 3.5 m^2 per person)
Accessibility	physical access is maintained to the shelter
Security	provision of 'security' and protection from harassment and other threats to physical safety and well-being
Structural hazard protection	protection from structural hazards
Durability	should be durable
Lighting	adequate artificial lighting is provided in the shelter and within the settlement
Ventilation	provision of suitable ventilation
Drainage	provision of site drainage
Durability	suitably durable
Local environmental impact	minimizes the long-term adverse impact on the environment
Habitable	habitable and provides protection from the cold, damp, heat, rain and wind
Energy	energy or fuel is provided for cooking, heating and lighting
Health	provision of protection from shelter-related threats to health, such as suitable physical protection from disease vectors, and the provision of living environments that do not cause psychosocial ill-health
Social and livelihood	
Dignity	promotion of 'peace and dignity'
Family and community life	support of 'family and community life' and communal coping strategies
Host community	maintaining a 'minimal impact on the host community'
Privacy	provision of adequate privacy
Self-sufficiency/self-management	supports 'self-sufficiency and self-management' and involves all stakeholders, including women, in the planning and decision-making process of shelter provision
Adaptable potential	should enable affected households incrementally to transition from emergency to durable shelter solutions within a reasonably limited period and with regard to the constraints on acquiring the additional resources necessary
Expression of cultural identity	construction and building materials used must appropriately enable the expression of cultural identity and the diversity of housing
Land tenure	security of 'land and building ownership and usage' is considered
Services	access to schooling, childcare, healthcare, refuse disposal and emergency services
Storage	means to store food and other household goods
Water	provision of safe drinking water
Sanitation	provision of access to sanitation and washing facilities
Natural resources	provision of sustainable access to natural and common resources
Employment	should consider affordable access to employment options
Affordability	should be affordable by the occupants themselves

described above? Examples from field practice and research illustrate implied and explicit shelter-related risks.

Literature review

There is very little literature available that quantifies exactly how shelter provided to displaced populations impacts upon their quality of life and the risk they bear (Corsellis, 2001). The quantitative data that exist are almost exclusively limited to health profile and mortality and morbidity statistics compiled by medical agencies. Not only are the results of such material difficult to attribute in any direct manner to the standard of shelter provision, but also such data do not address the social impacts of shelter provision upon risk. It is even difficult to link shelter with direct environmental risk in humanitarian contexts. In Maslack Camp, Afghanistan, in 2002, for example, 20 people were reported to have died of cold in a single night. The UN and several other agencies commissioned an internal investigation to discover the primary causes of the deaths. The report concluded that it was difficult to establish that the 15–20% rise in the diagnosis and incidence rate of acute respiratory infections (ARIs) (J. Ashmore, Researcher at Shelterproject, personal communication, 2003) were explicitly caused by poor shelter (UNAMA, 2002), yet the international media as well as individuals among aid agencies were unanimous in their conclusion that poor shelter and inadequate heating were the primary causes of the fatalities (Harding, 2002). This blurring of the line between what is perceived to be shelter and responsibilities in other sectors might have led to insufficient agency understanding and quantification of shelter-related risk.

Other literature includes guidelines and standards that govern the selection and use of emergency shelter. These include publications by UNHCR, Medecins sans Frontieres, Sphere and Shelterproject.[3] However, these are limited in size and scope. Aid agencies also produce 'grey' literature in the form of assessment and situation reports, which have included material on the performance of emergency shelter programmes, although this material tends to be anecdotal and, again, limited in scope.

Industry provides virtually no technical literature on this subject-matter, nor does it currently contribute in any meaningful way to product development or the quantification of environmental risk associated with living in humanitarian tents. Few tent and shelter manufacturers undertake shelter product design according to published environmental performance specifications. Fewer still undertake independent technical research or field-based studies to inform the design of tents they supply for emergency shelter assistance programmes (J. Davidson, Winterhaven, personal communication, 2003). Although technical standards such as those published by the International Standard Organisation exist, these standards are limited to fire safety, the structural strength of fabrics, the specification of supporting structures and the durability of materials for tents. Environmental performance indicators for internal environments and qualitative guidance relating to the use and inhabitation of such accommodation are clearly lacking.

These information gaps have hampered the ability to assess adequately the risks to which tent occupants are exposed and hence provide. This is partly because the locations in which displaced populations are often situated are inaccessible to the research community. Undertaking work that is perceived to be 'academic' during an emergency relief operation is also often seen as politically unacceptable in the initial phases.

Therefore, the majority part of this paper is supported by the field experience of the authors from their involvement with relief operations in cold climates including Kosovo, Macedonia, Albania (Corsellis, 2001) and Afghanistan (Ashmore *et al.*, 2003) rather than from the existing literature.

Environmental and health risks

Living for prolonged periods in canvas tents poses significant environmental risks to occupants. These range from difficulties in achieving thermal comfort to providing physical security and fire safety.

Lack of shelter can have a major impact upon occupant health and nutritional status, particularly in cold climates or where there are daily extremes of temperature (UNHCR, 1999). Specifically, poor shelter can lead to ARIs among occupants. The incidence of ARIs is a major cause of morbidity and mortality world wide, but displaced populations living in tented accommodation in cold climates are especially at risk (Medecins sans Frontieres, 1997). Among other factors, the provision of thermal comfortable conditions inside a shelter is important to avoid ARIs. To comprehend how tents impact upon the thermal comfort of occupants, it is necessary to understand how heat is lost from a tent as opposed to buildings.

Mechanisms of heat loss from a tent

Figure 2 shows the four main mechanisms of heat loss from tented environments. Heat is lost by conduction from the air to the tent fabric; from the air inside the tent to the ground; by air infiltrating from the internal environment to the external environment; and through radiation to the sky and to the surrounding external environment. The first three mechanisms of heat loss are discussed below.

Thermal conduction through the tent fabric

Canvas has an inherently low thermal resistance and so the rate of heat lost from tents through conduction to

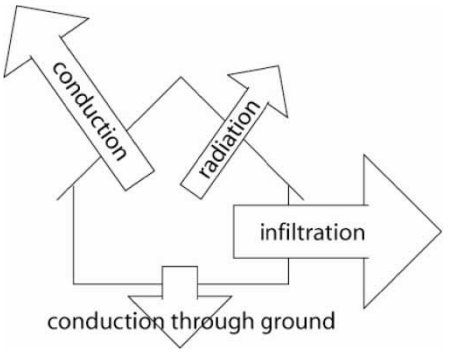

Figure 2 Mechanisms of heat loss from a tent: overview diagram
Source: Shelterproject (2003a).

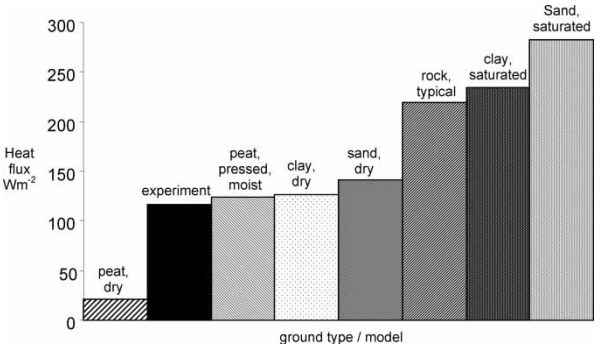

Figure 3 Heat flux from a human body to the ground at a test site in Cambridge, UK, and predicted heat flux for a range other soil types
Source: Youlton (2003).

the outside air is high relative to buildings. Even if all presently possible additional measures were employed to increase the insulation of standard canvas tents, such as using heavier gauge canvas, adding a cotton liner and a double fly-sheet, the global conductance of the tent remains nearly 50 times greater than an insulated brick cavity wall (Manfield, 2000c).

Infiltration losses from a tent

The majority of heat energy in tented environments is stored in the air. Most tents, however, are inherently leaky structures as the fabric construction is often full of gaps at junctions between sections of material. Furthermore, canvas fabric is air-permeable, all of which leads to heat lost by hot air leaving the tent, known as infiltration. Infiltration heat losses predictably rise in windy conditions. However, the rise is steepest over low wind speeds between 0 and 5 m/s, which are manifest in the majority environments (Grisaffi, 2003).

Heat losses to the ground

Heat losses through conduction from occupants directly to the ground can also significantly affect thermal comfort. This problem is further compounded by the fact that ground insulation is rarely available or provided by agencies to displaced persons occupying tents (Neumann, 2000, pers. comm.). When ground insulation is distributed, it is usually limited to a plastic sheet and a blanket, which have small thermal resistances. When coupled with the fact that thermal capacity of the earth is high, large amounts of heat from the internal air can be lost to the ground in cold weather.

Heat is also lost by conduction directly from occupants where in contact with the ground. This is significant given that occupants in many displaced camps often spend a lot of time in sedentary sitting positions during the day and lying on the ground asleep at night. Tests undertaken in a UK winter climate indicate this form of heat loss can account for 70% of total body heat loss when a person lies on peat soil with two layers of clothes on a blanket and a plastic sheet. The percentage heat loss is likely to be higher than this in climates with lower ground temperatures, such as in Southern Afghanistan, and on wet, dense soil conditions. Figure 3 shows empirical results with predicted results generated from an effusivity model (Youlton, 2003).

Other factors affecting thermal comfort

Aside from high rates of heat loss, several other factors affect thermal comfort in humanitarian tents. These include the availability of fuel for heating, the amount of thermal mass in tent construction and the provision of non-structural shelter such as clothing and bedding.

Fuel availability

The high rate of heat loss from tents means that a large heat source is required to maintain thermally comfortable conditions in cold climates, and that the heater must run continuously during a heating season (Manfield, 2000b). However, fuel is often in short supply, as markets are often disrupted in areas in which displaced populations are located. The fuel demand of a displaced population also often exceeds that which local markets can supply in normal market conditions. These factors make the supply of fuel an expensive activity for both the displaced and the international community. Whilst it is not uncommon for agencies to distribute some fuel to displaced people living in tents in cold climates, they rarely can find sufficient funding to meet and sustain all fuel requirements, even during the emergency phases of a response. In such conditions, occupants invariably tend to forgo the facilities of heating and lighting fuel in order to maintain sufficient fuel to cook, which clearly impacts upon thermal comfort. A knock-on effect of a restricted ability to provide lighting for living environments and shared facilities is an adverse impact upon social and occupancy patterns at night.

This can, for example, reduce the ability for camp occupants to access sanitation facilities safely.

Thermal mass

Tents have negligible thermal mass, which means there is no potential to store heat passively from either solar gains during the day or from internal heating for later use in colder periods of the day or night. This means these tents heat up and cool down very quickly and require more fuel use and more complex fuel management to provide thermally comfortable conditions.

Other non-structural shelter provision

Poor access to fuel for heating means greater reliance is placed upon other non-structural shelter provision to provide thermal comfort to tent occupants, such as personal insulation, which includes clothing and bedding. Bedding, however, is usually limited to two blankets per person and sometimes a foam mattress (International Federation of the Red Cross, 2003). Furthermore, the distribution of clothing is by no means standard practice in all humanitarian contexts (Manfield, 2000b).

Fire safety, security and occupant health in tented environments

In addition to the effects of poor thermal comfort, ARIs are also caused by inhaling indoor air pollution (Warwick and Doig, 2003). In a humanitarian context, this typically includes inhaling smoke from burning fuel for heating and cooking, from inhaling tobacco smoke as well as other pollutants resulting from living in overcrowded tented environments (Medecins sans Frontieres, 1997). These phenomena all have direct links to shelter provision.

Whilst it might be unrealistic to expect standard relief tents to conform to European standards for fire safety and occupant health, it is noteworthy that there are no alternative standards or guidance commonly accepted by agencies for the support of cooking and heating inside tents. It is often the case that tent occupants are left to their own devices to find solutions for cooking and heating. In camps in Southern and Western Afghanistan in 2002, many families undertook cooking with open fires inside tents using solid fuel, such as coal or wood, without formal agency support (Ashmore, 2002). This dramatically reduced both fire safety and occupant health, as occupants were often unable to avoid exposure to and inhalation of smoke and fumes. Figure 4 shows a displaced family cooking over an open fire in a humanitarian tent in Kandahar, Southern Afghanistan.

Whilst the health risks associated with cooking over an open fire indoors are significant, they do not diminish appreciably when stoves are provided. This is especially true when stoves are distributed to tent occupants without a pipe to exhaust combustion gases, known as a flue pipe. Additionally, stoves can also be easily knocked over, especially when tents are densely occupied.

Figure 4 Open fire cooking in tents in an internally displaced persons' camp near Kandahar, Southern Afghanistan
Source: J. Ashmore, 2003.

When stoves are distributed with flues, the risk of inhaling harmful gases can be reduced, although the fire risk remains. The flue must pass through the canvas roof of the tent, which is a flammable material. Often, a metal manifold is employed to reduce the chance of canvas ignition by preventing the tent fabric coming into direct contact with the hot flue. This strategy, however, has proved not to be fail-safe, as tents supplied with flues to families in Kosovo in 1999 still caught fire as the temperature of the flue pipe was so high that the manifold was of little benefit (Clarke, 2003). Furthermore, tents move differentially from installed stovepipes in even small winds, which can cause the pipe to contort or break, further compromising fire safety.

The distribution of flues with stoves does not, however, significantly reduce environmental health risk if occupants are unfamiliar with the use of such equipment. Figure 5 shows a family in Kosovo capping

Figure 5 Displaced Kosovars capping a stove to reduce heat loss from the tent and exposing themselves to risks of inhaling noxious gases
Source: W. Schellenberg, 1999.

their stove flue to reduce infiltration heat losses from the stove unit, but increasing the risk of occupants inhaling noxious waste gases.

As well as fire risk, it is also noteworthy that standard tents are often found to be too small for typical family sizes by agencies undertaking shelter assistance programmes in the field. Most tents typically have a floor plan area of 12–16 m^2, which can provide shelter for two to four people if the Sphere indicator of 3.5 m^2 per person is applied (International Federation of the Red Cross, 2003). In the majority of humanitarian contexts, however, family groupings are larger than four persons. This can prove to be an acute problem, particularly in camp settlements, because displaced families are often unwilling to separate in to smaller groupings. The result can be overcrowding and inadequate space for sleeping, for living and for storage of belongs, including food, all of which adversely impacts upon occupant health. Dense living also reduces privacy among the family group, the effects of which are discussed below.

Tents cannot always provide a suitably secure living environment and cannot significantly reduce the potential for physical attack or theft from outside threats. The structural stability and durability of canvas tents are also inherently limited and are particularly vulnerable to failure in weak soil conditions, where pegs and guy ropes come loose, or where tents are located on exposed sites with high winds and snow (Manfield, 2001). Figure 6 shows the failure of a family tent due to snow loading in Kosovo in 1999.

The structural safety of tents can also be compromised because canvas degrades rapidly when exposed to moisture, ultraviolet light and movement in the wind from human use. Tents consistently occupied as homes for prolonged periods beyond an emergency phase rarely stay intact for longer than 12 months without significant adaptation and remedial repair work. Canvas tents distributed by the UNHCR in Benin in 1999 decayed in ultraviolet light within eight months (W. Neumann, Senior Physical Planner, UNHCR, personal communication, 2000). Similar ultraviolet degradation rates were noted by Ashmore in camps in the Gash Barka region of Eritrea in 2002, whilst the same tents rotted within ten months in camps in Northern Mozambique in 2002 due to a combination of local humidity and exposure to ultraviolet light (Manfield, 2002).

Figure 6 Tent failure in Prelip, Western Kosovo
Source: W. Schellenberg, 1999.

In summary, the current humanitarian tent is not suitable for prolonged occupation and carries significant environmental risks for even short-term occupation in severely cold climates. The next section describes an attempt to redress these risks through the design of an insulated tent liner by improving the thermal environment inside a tent.

Insulating the standard tent

Over the past five years, a multidisciplinary team from Shelterproject has worked in partnership with humanitarian organizations and manufacturers to improve the design of standard cold climate shelters supplied to displaced persons in emergencies. Works that have contributed to the knowledge of insulating tents over this period include Manfield and Corsellis (1999), Crawford (2000, 2003), Battilana (2001), Grisaffi (2003), Gutteridge (2002), Youlton (2003) and Clarke (2003). In addition, it builds upon Ashmore's shelter fieldwork in Afghanistan with the International Committee of the Red Cross in 2002 and 2003 (Ashmore *et al.*, 2003).

An insulation material was selected for liner prototype construction that was made from a composite of polyester wadding and moisture-permeable spun-bonded polymers. The material choice was informed by environmental criteria, such as thermal resistance, moisture permeability, durability and flammability, and logistical criteria such as cost, volume and the supply lead time for large quantities of material (Shelterproject, 2003). The prototype was then tested in several cold climate environmental chambers in the UK and in field trials in real environments in the UK and Switzerland. Finally, social and environmental field tests were also conducted with displaced families in Afghanistan, including post-occupancy surveys to quantify satisfaction and thermal comfort within both existing canvas tents and tents fitted with liners.

Results from the research indicate that adding a liner to a heated humanitarian tent can reduce total heat lost by up to 50%. The reduction in heat lost through air infiltration is the most significant. Further, liners reduce thermal asymmetry between conductive, convective and radiant environments, which also improves

Figure 7 Liner inside a standard UNHCR ridge tent in field trials in an internally displaced persons' camp in Kandahar, Southern Afghanistan
Source: J. Ashmore, 2003.

the thermal comfort for occupants, independent of the effect upon air temperature. Liners reduce the fuel requirement for heating and so fire safety can be dramatically improved. Liners also significantly lower the rate of heat loss in windy environments. Finally, feedback from surveys in Afghanistan towards the addition of insulation to tents was generally positive. It was noted that insulation was valued highly when compared with other household and personal items, notably blankets, and that the tested liner was worth the equivalent of 20–30 blankets.

These tests, however, represent only an indicator of social and technical performance and also identified were several drawbacks associated with the liners used in the tents.

Social surveys conducted with 180 families in camps in Herat, Afghanistan, in 2002 indicated that satisfaction relating to tents was strongly linked to the ethnic and cultural background of the occupants surveyed. Those from poor, rural or nomadic backgrounds were most satisfied with the tents and liners as shelter; other groups were less so and felt more at risk. Additionally, survey results also indicated that occupant control of ventilation was not always undertaken intuitively by all tent occupants and that certain ethnic groups within the camp were at greater risk as a result. This questions the use of liners in tents as a global shelter solution if occupants cannot always be relied upon to ventilate their insulated tent safely. The tendency for displaced Afghans was to reduce ventilation inside tents in severely cold conditions, even if this meant greater exposure to other health risks, such as inhaling noxious fumes and gases. In other words, the risk that certain displaced ethnic groups might suffocate themselves by inadequately ventilating through a lack of experience or intuition might prove too great for supporting agencies to bear (Ashmore, 2003).

Liners also present challenges for moisture management. It is harder for moisture produced inside tents from cooking and respiration to be removed from the internal tent environment when a liner is used, as the environment is better sealed against air infiltration. Whilst a well-sealed environment is more thermally efficient, a build up of undispersed moisture in a tent can lead to fungal growth and a lowering of thermal comfort, the effects of which have been discussed previously. The liners tested were moisture permeable and able to disperse moisture adequately as shown in tests undertaken in a UK winter climate. It is not clear, however, whether it is possible to develop a material suitable for a shelter system that can adequately disperse moisture in all humanitarian contexts and in all climatic conditions (Shelterproject, 2003a).

Parallel tests of several liners with various thermal resistivities indicate that liners must be very bulky to remove the need for internal heating inside tents in the coldest climates in which humanitarian assistance is currently provided. For example, a liner must be several times the volume of the tent itself to provide comfortable conditions where no heater is employed and situated in an environment with an external air temperature below -5°C. Given the typical logistical constraints in relief operations, agencies have indicated that this volume is not feasible for transportation and that a realistic liner product must, therefore, compromise upon the thermal performance specification. This indicates that it is unlikely that tent liners will remove altogether the need for heating tents in cold climate humanitarian contexts.

Liners cannot reduce body heat loss to the ground and this remains a primary concern for occupants. Personal insulation, therefore, is a higher priority for the displaced to achieve thermally comfortable conditions. Further, it is difficult for cold climate tents to adapt to provide comfortable environments in periods when the climate is not cold. All climates vary during daily and seasonal cycles, and the extent to which a tent design is tailored to the average or worst-case conditions is still under debate. Shelter should aim to ensure survival against extremes of climate. However, it should also cope with average temperatures. For example, air temperatures in camps in Western Afghanistan fall to below -10°C for a few nights each year whilst reaching over 30°C during the summer months. The ideal tent liner would provide thermally comfortable conditions in both extremes of climate. However, it is not clear whether a single product can achieve this goal. This problem also raises a more general question of the technical humanitarian definition of a 'cold climate', both in terms of a design air temperature and the period for which a climate is deemed to be cold. In the same manner, the definition of 'thermally comfortable' conditions might also be challenged as Western models, values and understanding

for thermal comfort have limited applicability in the context of humanitarian relief.

Finally, the insulation materials most appropriate and affordable for humanitarian relief are all plastic-based products that carry a fire risk. Although the tested liner did not increase the fire risk, as it has a similar flammability to that of canvas, the fire risk associated with living in a tent with a liner therefore remains a significant hazard.

Social and livelihood risk

As well as environmental and health risks, there are social and livelihood risks associated with living in tents. These risks are inherently harder to quantify, yet case study evidence from Afghanistan and elsewhere suggests that displaced people themselves often view such factors as having a greater impact upon their quality of life than the environmental influences discussed above.

Tents pose significant problems for privacy. Canvas fabric is a poor acoustic insulator and in dense camps where tents are in close proximity to each other social tensions can rise as occupants have a limited ability to conduct family activities in private. Lack of privacy was noted as having a direct impact upon the quality of life in camps in Goma, Congo, in 1994. Families were unable to have conversations in private to resolve personal problems, resulting in many leaving the camp to find privacy, which exposed them to further security risk in an insecure region. Agency social workers also attributed the rise in violence among the population to dense settlement and tented accommodation (Challinder, 1998). In cold weather, the lack of space inside accommodation means that more time is spent outdoors. In camps in the former Yugoslav Republic of Macedonia in 1999, a lack of space to prepare meals inside family accommodation meant that displaced people were forced to queue for long periods outdoors in cold weather to receive rations and meals from communal kitchens, which affected the incidence of ARIs.

Tents present a limited potential for self-sufficiency and self-management of shelter resources. This is in part because displaced persons are rarely consulted about the suitability of tents as shelter (Corsellis, 2001). The lack of occupant participation in the selection of shelter often means that tent occupants are less willing to assume ownership and responsibility for seeking longer-term shelter and settlement solutions independently (Ashmore *et al.*, 2003).

Tents are prefabricated solutions that often have a limited potential for subsequential adaptation and integration with local or vernacular housing models. This also inhibits the ability of tent occupants to meet their own shelter needs over the medium to long term. In Eritrea in 2001, for example, displaced persons in the Gash Barka region were provided with standard canvas tents but quickly moved independently to adapt their new tents to resemble traditional *hudno* dwellings by using the canvas as a covering instead of earth and stone. However, the canvas fabric was rapidly punctured by the wooden structures and in many cases began to leak after a few months, leading to the additional distribution of plastic sheeting before the rainy season (Ashmore *et al.*, 2003).

Most displaced persons living in tented camps are not from nomadic backgrounds and have little or no experience of prolonged occupation of such accommodation (Manfield, 2001). This inhibits the opportunity for the expression of cultural identity (Medecins sans Frontieres, 1997) and also impacts directly upon the ability of occupants to control and adapt their living environment. For example, a significant proportion of the Kosovan occupants of Stenkovac camp in the former Yugoslav Republic of Macedonia in 1999 were from urban areas and had little experience of living outdoors and no experience of living in tents. Most were unaware of adaptive measures necessary to improve the environmental performance of their tents, such as digging drainage ditches around the site to cope with storm water runoff and digging in the sides of their tents to reduce wind driven heat losses at ground level. Such basic adaptive measures were eventually learnt after several months, although such periods can become critical in severely cold weather (Manfield, 2001).

Imported tents are rarely affordable to occupants themselves. Maintaining a tent is often practically and economically difficult and adds to the financial burdens of an already economically insecure population. Maintenance considerations, such as purchasing materials to undertake repairs or buying heating fuel in the winter months, also impact upon the extent to which ownership of shelter resources are assumed by displaced persons and, hence, their willingness to participate in meeting their own needs (Harrell-Bond, 1998). Economic autonomy is often cited as the key issue by developmental agencies when resettlement and integration becomes the only lasting durable solution for the displaced. However, tents are often insufficient not only to meet needs for physical security and occupant safety, but also for the secure storage of goods and equipment necessary to maintain livelihoods.

Whilst developmental shelter models cite durability as a key aim, this is by no means so explicit in the characterization of humanitarian shelter. This is largely because secure tenure of property is virtually never attainable for displaced persons living in emergency shelter (UNHCR, 1999) despite the fact that durable shelter might be required and financially preferable in the majority of emergencies regardless of the anticipated length of occupation. In such cases, high shelter risk over the short term is often traded for longer-term

lower risk if displaced settlement and shelter can be relocated to more suitable sites and accommodation at a later date (Babister and Kelman, 2002). However, there is little attempt by agencies to quantify the short-term environmental risk associated with the provision of non-durable shelter, with the result that a displaced population is exposed to long-term and life-threatening risk if subsequent relocation is not achieved.

Conclusion

It has been established that shelter-related risk is linked to social, logistical and political phenomena and well as to environmental concerns. A technical analysis of the performance of humanitarian tents in both controlled conditions and in field programmes demonstrates that it is very difficult for tents to meet occupant requirements for thermal comfort in extremes weather conditions, particularly in cold climates. Recent research undertaken to insulate tents using liners made from standardized plastic products indicated that improvements in thermal comfort in tents could be achieved, but that their scope of use, and the ability to reduce overall environmental risk for occupants, remained limited.

These drawbacks indicate that whilst an insulated liner can have a significant effect upon improving thermal comfort inside a tent, it can only play a part of a wider and more holistic strategy for shelter provision to displaced people in cold climates. This is particularly the case in extremely cold whether and where there is no agency-supported heating and cooking provision. Liners and shelter insulation packages should, therefore, be viewed as an option or a component part of a flexible shelter kit to be tailored to the specific climatic, environmental and social demands of each emergency. Building upon this analysis, Figure 8 shows the range of existing mechanisms available both to tent occupants and supporting agencies to provide thermal comfort. The role and priority of shelter insulation is also described within this framework.

Tents remain, and are likely to remain for some time, a key resource available to humanitarian agencies when providing a fast and visible response to the perceived shelter needs of displaced people. Furthermore, tents undoubtedly have played their part in disaster assistance where the risk of long-term occupation can be discounted. This being the case, continued efforts to improve the design and environmental performance of tents for use within the widest range of climatic conditions are still very much required, especially given that the design of standard tents, such as those used by the UN and the Red Cross, have changed very little from the 19th century European military tent models upon which they were originally based.

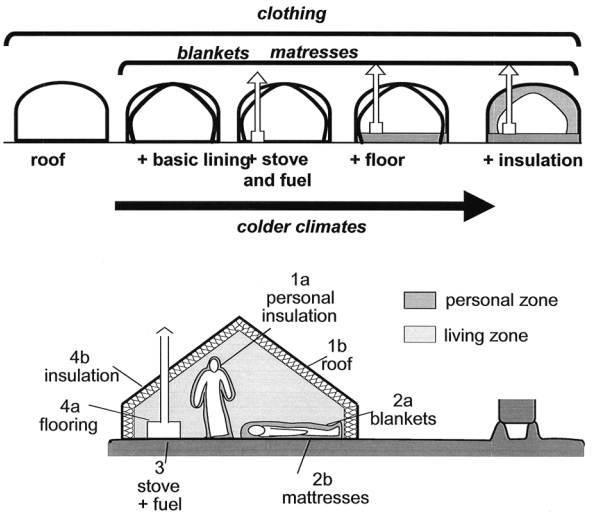

Figure 8 Mechanisms available to provide thermal comfort within a tented environment
Source: Shelterproject (2003b).

The heart of the problem is not the technical specification of equipment but rather a general lack of understanding of the social impact that occupation of such temporary accommodation has upon a displaced population and how this can affect innate coping mechanisms. Evidence from field practice illustrates how and where the use of tents has impacted upon both the social behaviour and the livelihood concerns of displaced populations. However, it is extremely difficult to make direct linkages and harder still to distil such anecdotal evidence into guidance for field practice or improvements for the design of equipment.

The focus of future research should be upon how to identify mechanisms to involve displaced persons themselves in meeting their own shelter needs at an early stage of disaster assistance. This needs to be undertaken in a manner that can inform the design of assistance programmes that respond to the social and livelihood requirements of displaced people without compromising safety, programme budgets or assistance timeframes. The design work described here has highlighted that one such mechanism is to examine the methodologies for surveying displaced populations to understand better the part that tents and shelter play in displaced settlement and, critically, where this differs from the understanding of those responsible for providing shelter.

It is well documented that more that for any other sector, the delivery of effective humanitarian shelter is a developmental activity requiring a developmental understanding. The fact that such an understanding is rarely applied to shelter in a humanitarian context is largely because the policy decisions undertaken in emergency phases are politically difficult and expensive

to alter in later phases of assistance. Despite these barriers, continued efforts should be made to advocate, among the policy-makers in humanitarian agencies, the UN and donor governments, the need to avoid the use of tents and to support more durable shelter solutions for displaced persons during emergency phases.

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Endnotes

[1]The present paper draws on interviews and informal conversations with a number of senior field practitioners including staff from the UNHCR (W. Neumann, Senior Physical Planner, 2000; W. Schellenberg, Consultant Physical Planner, 2000; and A. Marinkovic) and the US Government Department of Disaster Assistance (C. Setchell, Urban Disaster and Shelter Specialist, Office for Foreign Disaster Assistance, 2003.

[2]The Sphere Project is the organization responsible for defining Minimum Standards in Disaster Response. The first edition of *SPHERE* was published in 1997 and has been revised twice following peer reviews and consultations with disaster-affected populations as well as hundreds of locally based and international humanitarian organizations.

[3]Shelterproject is a 'not-for-profit' group consisting of physical planners, shelter specialists and social scientists based at the University of Cambridge who are working to consolidate expertise in responding to the transitional settlement and shelter needs of populations affected by conflict and natural disasters.