ABSTRACT

In August 2005, hurricane Katrina swollen waterlevels to disaster levels close to the city of New Orleans, USA, bursting levees and leading to 80% of the city being flooded. Though an evacuation order was called, 100,000 people were left behind, either unwilling or unable to leave the disaster zone. 1,500 people lost their lives and damage to property was enormous. Even for the 600,000 families who escaped, many were left homeless for months or even years. Over US$7 billion of federal aid was spent on temporary and longer term housing, however, subsequent reports have questioned both the value and the effectiveness of this considerable provision. This is just one of the many disasters that occur worldwide as a result of floods – in spite of the concerted efforts of many individuals and organizations, the fact that such major problems occurred with the post-disaster response in a technically sophisticated and resource rich country indicates that there is considerable room for improvement.

This paper examines the way in which portable and flexible architecture has been used in post-disaster situations, its history in this area and some recent examples. It also investigates how designs implemented for other residential, commercial, industrial, military, medical and entertainment functions have potential to mitigate post-disaster problems, with particular attention to post-flood situations. Attention is given to emergency relief specialist systems and standard products; to reconstruction facilities including enablers and construction systems; and to preparedness opportunities for new shelters and building adaptations, and for the creation of flood resistant architectural design. The potential benefits of utilising mobile and flexible architecture are identified and some recommendations are made for guidelines in selecting the most appropriate systems.
There can be no doubt that the potential of demountable and portable buildings for use in post-disaster situations is perceived as a real area for development by those involved in the architectural design and construction world.


There cannot be an architecture school in the world that has not at some time set its students to design a disaster relief shelter based on the premise that those without housing in a critical post-disaster situation require outside help to replace their destroyed homes. Experienced and respected architects have also devoted time and energy to the creation of new, innovative and sometimes ingenious prototypes for disaster relief situations, including Buckminster Fuller, Alvar Aalto, Future Systems, Renzo Piano and Shigeru Ban. In addition, commercial industrial products of varying degrees of complexity have been produced, tested and in occasionally deployed in post-disaster situations. And yet the scenes that are sought out by the media each time a disaster occurs are remarkably similar - people who are without adequate shelter, in obviously needy circumstances, surrounded by the destruction that was once their own homes. It is therefore clear, even from the selective images of television and the press, that despite the wide-ranging and diverse activity carried out into the problems of shelter after disaster, the relief of human suffering on the ground has yet to be consistently alleviated.

2. ‘Once again, it should be pointed out that a suitable shelter concept to match, in particular, larger-scale emergency measures was not at hand. In addition, the lack of experienced agencies to deal with shelter issues was badly felt... What is needed is a comprehensive shelter strategy with appropriately developed standards, supply methods, specifications for shelter units and industries to make the right products available in time...’ Statement from the United Nations High Commission for Refugees (UNHCR), First International Workshop on Improved Shelter Response and Environment for Refugees, 29 June-1 July 1993, Geneva, part III, p.4 (commenting on shelter aspects of the relief work in Bosnia-Herzegovinia during 1991-2).

The reason for this mismatch between the problems of disaster relief and the proposed solutions is that many designers, and the government and other agencies that lead disaster response, have a fundamental misunderstanding of the circumstances that victims experience in a post-disaster situation. This is based on fundamental misconceptions related to the outsiders’ own experience and not that of the actual victims. Ian Davis, the respected researcher in the field of post-disaster shelter situations has identified these misunderstandings and labelled them as ‘myths’; incorrect yet striking images that have led relief agencies and their agents to gauge their response on seemingly potent concepts that are unfortunately based on an unverified and inaccurate understanding of the actual situation.


Many of these myths surround the response of victims to the disaster in which they are involved, viewpoints often perpetuated if not created, by the media. For example, it is a common and understandable misconception that disaster victims are dazed and helpless, simply waiting for outside aid. It is true there is a short period of shock at their misfortune but very quickly, far more quickly than the authorities can react, they become actively involved in the task of saving lives and property. Another is that people camped out in the wreckage of their home impede reconstruction efforts. In fact these are the first coherent acts of rebuilding property and community, inhabitants staying close to their belongings to protect them and maintain their personal geographical identity.

In order to understand better how these myths have developed and how they influence the capabilities of designers, and others, to respond effectively it is important to understand the nature of the disaster situation. Disaster relief situations can be roughly divided into three types; natural disasters that have as their source a phenomenon such as extreme weather conditions or geological disturbance; wartime or post-war disasters that occur as a by-product of human conflict; refugee situations which may occur as a result of natural or war-time disaster, escape from famine or plague, or migration for economic reasons. It is important, however, to acknowledge that regardless of the cause of a disaster, the severity of the problems it causes are inevitably and inextricably linked with mankind’s ability to respond - UNDRO studies have shown that post-disaster problems are aggravated by human error and lack of foresight and that disaster relief can without doubt be made more effective through systemised planning and management carried out in the event of disaster rather than in response to it.

4. United Nations Disaster Relief Co-ordinator (UNDRO), Shelter After Disaster, Geneva: UN, 1982, pii. Though nearly three decades old, this important document is still in use today and is described by the UN Office for the Coordination of Humanitarian Affairs (OCHA, formerly UNDRO), as a ‘key document on the immediate shelter needs of survivors following disasters’. http://ochaonline.un.org/AboutOCHA/ Organigramme/EmergencyServicesBranchESB/ LogisticsSupportUnit/Guidelinesforshelterassistance/ShelterafterdisasterGuidelinesforassistance/
Much can be learnt from history. After the San Francisco earthquake of 1906, large parts of the city were destroyed by the subsequent fire that levelled 250,000 homes. The authorities response to this disaster is one that is still common today. The people at first helped themselves making rough shelters from whatever materials were to hand or sought shelter with friends and relatives in a better situation. When the authorities responded, it was first with the aid of the military (who by their efficient hierarchical organisation are able to act quickly), establishing tent camps that provided basic shelter but did not respond to other needs. Some tents were replaced with two-roomed, wooden shelters, or ‘cottages’ as they were called by the relief committee, situated in camps outside the city. As the people returned to their own urban property, many of the resourceful inhabitants jacked up their temporary dwellings, placed them on wheels and towed them to the site of their permanent home where some still exist to this day.

This experience still offers a valuable lesson in the way people respond to the problems of the destruction of their homes, their displacement and subsequent requirements. Wherever possible victims prefer to find alternative homes staying close to their social and economic base. When the limited amount of emergency accommodation eventually arrives, if it is of acceptable quality, it becomes a temporary substitute for permanent housing. In some cases this emergency accommodation eventually becomes part of the settled dwelling pattern and continues to be occupied decades later.

Contemporary disasters follow the repetitive pattern of those in history, though each is of course unique in its own way. However, since the Second World War, organised response to disaster has increased dramatically. A vast range of disaster relief agencies have been established by nations, groups of nations, and independent, sometimes international organisations. These groups naturally have different perceptions of their role in disaster relief and are sometimes governed by strict regulations that control the nature of their intervention in a situation. A great deal of money and effort is now available to mitigate the problems of a post-disaster situation and there is no doubt that many have felt the benefits of this international responsibility for human suffering. However, whether the full effectiveness of these resources is being realised is now questioned by independent reports based on careful case studies that have examined the actual events of relief operations. This research has led to a better understanding of the nature of some of the problems and why they continue to reoccur.

In the case of natural disasters, it is clear that certain geographic areas are prone to particular problems, which are repeated at reasonably predictable intervals. People who live in these areas nevertheless unable to or refuse to move to safer areas for economic and social reasons. Day-to-day patterns of existence are more important to most people than the chance that some disaster may occur at an unknown future date, therefore, if a particular location is more suitable to providing a better way of life it will attract and retain inhabitants. This is obviously the case for relatively wealthy cities such as San Francisco, USA and Kobe, Japan that have experienced destructive earthquakes, but is also true in poorer communities such as the Chittagong, Bangladesh, a coastal region that supports port and fishing activities, which in 1992 experienced a typhoon that made ten million people homeless and killed more than 125,000. In Chittagong a key factor in the casualty toll was the methods used in the buildings' construction. Surprisingly, vernacular housing is not generally designed to respond to a disaster situation, unless that disaster is a relatively frequent occurrence. In the post-disaster situation there may be very few shelter alternatives for the victims, because of their inappropriate construction even the buildings that are left undamaged may still pose a risk if re-inhabited. In these cases the value of effective emergency accommodation is in the provision of a practical, usable base, which can be utilised to protect the inhabitants and their property in support of their efforts to rebuild their dwellings and community. Advice on safer methods of construction should be incorporated in a way that will make the buildings less vulnerable to future disaster.

It is clear that there is a place for portable and temporary shelter in disaster relief situations. Of the annual UNHCR budget (US$1.6 billion in 2008) approximately 40% is spent on shelter though this varies from year to year in response to need.

However, it is also clear that many efforts that have been made have fallen far short of expectations, either for logistical reasons (e.g. arrived too late, acquired for use by non-victims) or design reasons (e.g. inappropriate on a functional, economic, or cultural level). The reason for this is that many designs have been donor-led in terms of their requirements - that is, the agency supplying the shelter has decided the parameters for its creation or selection. This is the norm for imported design
solutions, rather than the exception, and yet this problem remains unrecognised by the majority of designers and commissioning agencies. Even if such solutions could be seen to be effective in logistical and functional terms they also raise other, less easily quantifiable issues. The provision of complete imported solutions cannot be seen as an aid to long-term problems as they increase the danger of external aid dependence, and hinder the development of local confidence and economic activity.

8. UNDRO, Shelter After Disaster, pp.24-9. This document concludes that in general: ‘Emergency shelter has more often than not been regarded as a product with design criteria developed by the donor. This approach has consistently failed to satisfy the needs of the surviving families.’

For longer-term refugee settlements, virtually all current design solutions are based on a military type layout that put expediency and perceived efficiency before sensitivity to the inhabitants’ social, cultural and historic living patterns. This type of organisational pattern can in fact hinder peoples’ recovery process by suppressing individuals and local organizations’ desire and ability to begin their own reconstruction.

9. ‘Military organisations seek uniformity and conformity. This concern for order is simply too much to expect from a civilian population stricken by disaster. The period immediately after a disaster is a time when people need to get together and develop collective responses. A military hierarchy of decision-making inhibits this organic social process.’ UNDRO, Shelter After Disaster, p.12.

Even if longer-term camps are a necessity (which is discussed below), organisations that provide expert specialist help to the aid agencies in the provision of such camps naturally put their emphasis on the provision of adequate water and sanitation supplies in the effort to prevent disease. The issue of planning is generally ignored, although it has been established that the introduction of sensitive planning consultation to create places more able to respond to community needs (social, recreational, educational, health) can lead to a much higher acceptance and involvement in operation and management of the settlement by the refugees themselves.

10. ‘Camps are usually designed according to crude engineering principles... the product is imposed on a resistant refugee clientele.’ Dr. Roger Zetter, ‘An Overview of Shelter Provision and Settlement Policy’, unpublished paper presented at UNHCR, First International Workshop on Improved Shelter Response and Environment for Refugees, 29 June - 1 July 1993, Geneva, p.10.

Post-flood Shelter Relief: A Case Study

In August 2005, the close passage of Hurricane Katrina resulted in a tidal flood surge that caused more than 50 breaches in the levee system protecting the North American city of New Orleans, to create perhaps the worst flood disaster in United States history.


Despite being planned many decades before the levee system was still incomplete, and many of the areas that were constructed still collapsed significantly below their design thresholds. As a result of this fundamental failure of an engineering system that was designed to protect the city and its inhabitants from just such an occurrence, eighty percent of the city was flooded up to four and a half metres of water. As Katrina approached, damage from high winds and floods were anticipated, and a mandatory evacuation of the city was ordered on the morning of 28th August with the Hurricane’s peak of devastation occurring the next day. Despite the evacuation order and the emergency displacement of more than a million residents, over 100,000 people were either unable or unwilling to leave and with communications failures and other rescue complications, thousands were forced to find inadequate shelter in the Louisiana Superdome sports stadium or their own often severely damaged homes. More than 1500 people died in the catastrophe and there was significant civil disorder with looting and violence a major problem.

It is in the post-disaster situation that shelter problems become significant as the immediate problem of survival in extreme conditions is replaced by the need to house persons whose own homes have been destroyed or damaged beyond occupation. It is estimated that 600,000 families were displaced in the aftermath of the flood, and despite the high winds of the Hurricane it was primarily flood damage that caused most problems. People were evacuated or found their own route away from the disaster area – the 25,000 people from the Louisiana Superdome relocated to the Houston Astrodome in a fleet of 475 buses, but many more left the city in their own vehicles days before the event. In the early days of September 2005, office buildings, motels and hotels, and even cruise ships were utilised to house the flood refugees. The US federal government allocated $7 billion for temporary and longer-term housing dispersed via the Federal Emergency Management Agency (FEMA), city and state authorities. Red cross emergency housing and trailer parks were set up (though not beginning until the middle of September), mostly remote from work, education and health facilities, although because of infrastructure problems their occupation was delayed, often for many months. Meanwhile, efforts to restore housing areas in the city itself were hampered by uncoordinated efforts, power, water and communications problems. Voucher and rent subsidy programmes allowed people to rent properties, however, these were not available immediately or had restrictions and uncertainties in the way they could be
The more successful shelter programmes were simple, quick and immediate – closely tuned to inhabitants’ desire and ability to help themselves. The Army Corp of Engineers instituted a ‘blue tarp’ programme to put temporary covering on damaged roofs to allow re-habitation and limitation, to some degree, of further damage. Some of the thousands of trailers, instead of being placed in remote rural camps, were deployed adjacent to people’s damaged homes enabling them to both protect their property and also to begin the salvage and rebuilding process. Thousands of people lived in the upstairs portion of their house whilst the downstairs flood damaged area was restored. However, many repairs were slow to be implemented because of the lack of materials and skilled workers. In some cases people have subsequently undertaken preparedness work for any future flood such as raising the property on a new foundation (routinely achieved with timber framed buildings). The city has gradually but progressively been re-inhabited although two years after the flood its population was only half what it had been before.

There has been significant criticism of the poor response both state and federal authorities made in the wake of the Katrina disaster – both to mitigate the emergency situation in the days before and immediately after the event, but also in the longer term. In the short term there was clearly an aversion by many of those in charge to providing shelter close to people’s communities although this has multiple benefits – placing people at the location of the rebuilding effort, maintaining existing social and economic groups. Trailers can be placed adjacent to people’s own houses or where this is not possible on vacant building sites, parking areas and school playgrounds. As rebuilding progresses the trailers can be gradually removed providing a flexible and tuned housing support system. In the longer term, there was clearly insufficient support and aid for householders to rebuild their own lives by providing infrastructural and material support coupled with more flexible financial aid that allowed people to decide their own needs in terms of accommodation or rebuilding.

The experiences of the New Orleans 2005 flood indicate that even in a global superpower with immense resources, disaster relief, if not informed by accurate knowledge of past experience, can be severely impeded. This example provides two principle lessons. First, that emergency relief needs to be applied quickly and as close to the centre of need as possible – preparedness in terms of communications and resources is the key to this. Second, that post-disaster shelter relief should be focused, once the immediate emergency has passed, on providing shelter within existing communities to supporting local rebuilding. For these reasons, there are only limited opportunities for specialised mobile disaster relief structures (for example medical facilities and very short term shelter structures) although there are many mobile building solutions that are primarily designed for longer term functions that can be of service. With this knowledge it is possible to formulate strategic recommendations that could establish a pattern for successful response in post-disaster situations.

When a disaster occurs, the immediate preoccupation of the population is to save life, then property. Suitable shelter can play a major role in preventing further distress, illness and death if it is made available immediately, therefore emergency shelter must be in use by the victims within the first few days of the post-disaster situation if it is to be at all effective. On the ground operatives who understand the local situation and the victims themselves are in the best position to decide the nature, numbers and location of the shelter requirements and also to undertake its deployment, thereby tackling logistical problems in the most immediate and efficient manner and also reducing the feelings of helplessness and despair these people might otherwise experience. The shelter should be capable of supporting the efforts of the victims to rebuild their lives, economic activities and community, so its deployment should not divert resources from these activities. It should therefore be capable of erection speedily with the minimum of effort, and fulfil its function for the duration of the emergency period without further maintenance. It should also have a built in lifespan or be reacquired for reuse elsewhere, which will make it unattractive for diversion by unscrupulous parties for sale or use in non-relief situations. Any permanent components in the shelter’s construction should be capable of recycling into permanent building stock.

The shelter should be designed and built as part of a coordinated disaster preparedness process dedicated to the location in which it is to be deployed. It should be designed with the benefit of local knowledge and, if possible, be constructed with materials of local origin, as part of a process of investment in local industry. Simultaneous with the provision of shelter should be expert advice (from sources acceptable to the recipients) regarding the rebuilding of their property in ways that will reduce or negate the possibility of future disasters. In some situations this may not only relate to building construction methods, but siting and layout. Financial relief aid should then be channelled into these areas to encourage activities that will limit shelter related problems if or when a similar disaster reoccurs. The aims of such a policy in relief operations are to improve the conditions of the inhabitants without eroding their cultural patterns, a positive outcome therefore being the end result of a calamitous event. A temporary mobile shelter should protect the inhabitants from harsh weather conditions. It should establish an area of territory for its inhabitant, either of occupancy or ownership. It should support the activities of social and physical construction. It should provide a physical manifestation of personal identity, privacy...
and security. It should provide an address for the receipt of communication, services and aid. It should support the continuation or establishment of a form of income, either from business or by adjacency to previous or new employment. It should be capable of expansion to accommodate family members. It should have the capacity to store and protect personal property. These requirements may sound comprehensive and complex but it should be remembered that the long term purpose of emergency shelter (to support the reestablishment of the individual in his community) is also a complex issue and should be a key factor in its creation and deployment.

Esoteric and inventive creations for shelter after disaster are interesting to others in the design professions, but of no value whatsoever to refugees and disaster victims. What is required is a clear recognition by the authorities coordinating and funding the response to the disaster of logistical needs, and an understanding of the real situation of the people experiencing the results of the disaster. With some degree of certainty many disasters can even be predicted, if not in time, in place. What is required to mitigate their impact is a knowledgeable preparedness programme in the clearly identified geographic locations where disasters are known to occur, based on dedicated design responses utilising resources that have other uses beyond the emergency relief situation, in particular for the rebuilding programme that inevitably follows.