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TRANSITIONAL ACCOMMODATION AFTER DISASTER
Short term solutions for long term necessities

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This thesis has not less than 20,000 words and not more than 30,000 words in length, exclusive of tables, footnotes, bibliography, and appendices

"This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text."

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Abstract

This research focuses on transitional accommodation provided after a disaster, a key phase in the disaster recovery process.

The increasing frequency of natural disasters in recent decades and the media coverage of these events have raised global interest for developing emergency and temporary solutions. However, most proposals have tended to develop universal prototypes centred on the short-term product and not on the long-term process. The lack of architectural and institutional memory leads to proposals emerging after every disaster that ignore the chance to learn from past experiences.

This document begins by studying the impact of disasters in the past 50 years and the definitions of temporary accommodation, and then analyses historical experiences in temporary shelter during the past century. The research concludes with a comparison of different solutions developed in the past decade by universities, architects, designers, and engineers, manufacturers, NGOs, and governments.

Keywords: temporary accommodation, transitional shelter, temporary shelter, temporary housing, disaster recovery.

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INTRODUCTION

The frequency of natural disasters has increased in the last five decades, and the cost in human lives, homelessness, and economic disruption has gone up with it. The reasons for this trend include the increasing urban populations in hazardous areas, inequalities that expose vulnerable people to risks, and lack of planning.

After a disaster, housing is one of the main factors that can help to re-establish normalcy in such a chaotic situation.[1] Therefore, architects can play an important role in the recovery process, by designing housing solutions and helping to rebuild devastated communities. Nevertheless, architects have been absent following the latest catastrophes, and they have not been protagonists in shaping policies nor developing disaster prevention, mitigation, and recovery strategies.[2] The examples of innovative and effective practices are few, and most of these stay only in some pages of architecture and design journals.

Enrico Quarantelli, a pioneer in the sociology of disaster, distinguishes between four phases of disaster relief: emergency shelter, temporary shelter, temporary housing and permanent housing.[3] This research is centred on the transitional accommodation (shelter and housing),[4] because it is a key phase in the disaster recovery process: they are an essential transition from immediate relief to permanent housing. In addition, this phase has been criticised because when the transition is not well planned and developed, long-term recovery is debilitated. Nevertheless, in several cases, it is the only solution available to shelter affected communities, and therefore an important phase to analyse.

Throughout the past century, architects have projected ingenious emergency relief shelters, such as prefabs, inflatables, geodesic domes, igloos and cardboard tubes, among others. These proposals have been widely published in journals and awarded design competitions, but few have become more than prototypes.

In practice, these prototypical solutions have been generally more expensive and frequently rejected by users because they do not suit cultural and climatic conditions. They tend to develop universal solutions of shelter whereas the needs are local. In addition, people often adapt or attach rooms to the shelters given by NGOs or governments without regulation or design. Furthermore, other transitional solutions are developed by affected communities following their particular criteria without professional supervision. Therefore, it is common for solutions given not to fit with the needs, while informal construction and growing processes increase the risk from future disaster events.

Why is there a mismatch between the designs developed by architects and designers and the solutions given in the field? Why have architects not had a clear role or

have had very little presence in the recovery process after disasters? What are the real needs of temporary accommodation after disasters?

It is argued here that most designs have been focused on shelter as a product rather than on the problem of giving accommodation to a population which needs to rebuild their lives. In addition, projects have been developed with an innovative, technical and aesthetical approach, centred in abstract concepts rather than the needs of communities.

After a disaster several requirements must be met, and one of the major conflicts identified in the field is the gap between short-term necessities and long-term requirements. Usually, designs tend to be fixed on ideal solutions where flexibility must be adopted. For example, some prefabricated systems are welcomed for their quickness to solve the problem of shelter, but when they are used longer than planned and people try to modify the shape, design problems arise because they are not designed to grow or to add rooms.

As Cassidy Johnson points out:

> "*The 'best-fit' solution for temporary accommodation must consider two specific elements: the potential of the particular community's human and financial resources; and the possibility of the temporary accommodation strategy to assist in the mid to long-term recovery after the disaster."*[5]

The main research objective of this thesis is to analyse the differences and similarities of temporary accommodation developed by designers, manufacturers, NGOs and governments. The analysis will contribute to understanding the mismatch between them, and to find opportunities for improvement.

Secondary objectives are:

- To map designs developed in the last ten years, in order to have a panoramic vision of solutions available.
- To understand the role of transitional accommodation in the past century as relief after a disaster and different approaches that diverse actors have applied.
- To identify opportunities of improvements in order to define new approaches.

The research is divided into four chapters (Fig.1): first a general description of disasters, followed by an explanation of the process of recovery and temporary accommodation, then an analysis of the

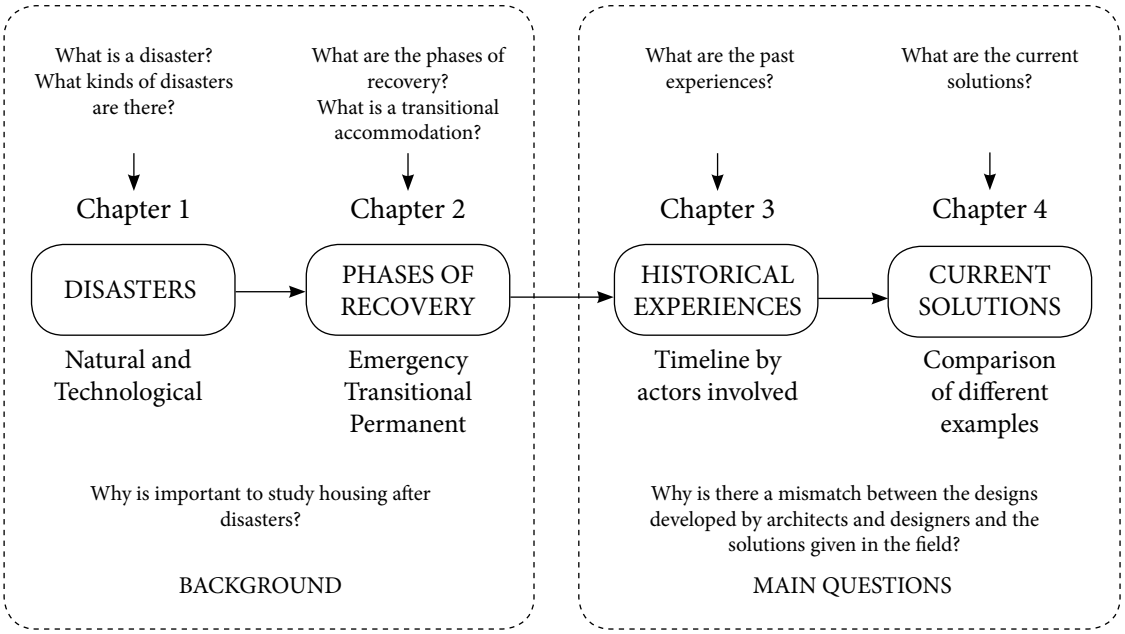


Fig.1. Thesis chapters.
Source: Author.

solutions that diverse actors have developed in the last century, and finally, a comparison of solutions designed in the past decade.

The first chapter seeks to explain in general terms, the impact that disasters have had in the latest 50 years, in order to find a tendency and to answer why it is important to study housing after disasters.

The second chapter explains the most common phases developed after a disaster: relief, recovery and reconstruction. Then, it defines what a temporary accommodation is and why it is a crucial phase in the post-disaster process.

The third chapter presents a historical view on past experiences of transitional accommodation designed and developed in the past century. The aim is to understand how much has been learned from these experiences. The chapter is divided into five parts: solutions by architects, NGOs and governments, manufacturers, universities and self-building. Although in some cases the distinction is blurred, these categories were created because they pursue different objectives, therefore their approaches have been different as well.

The fourth and final chapter is a compilation and comparison of different solutions developed in the past decade. Using the same categories defined in the third chapter, the analysis compares temporary accommodation but separates NGOs from governments, because in some cases they have worked more independently. In addition, self-built solutions are only included as examples and not in the comparison. While in the third chapter, some post-war cases were selected and presented due to their overall importance, the fourth chapter compares only shelters after natural disasters, since discussions of social or other political implications that shelters may have under those circumstances are outside the scope of this thesis.

The methodology used for answering the main questions comprises description and comparison. First, the descriptions are given for: disaster, the phases of recovery, temporary accommodation and historical cases. And second, a comparison amongst current solutions is offered.

The methods used for the comparison include data gathering, selection and analysis (qualitative and quantitative). Data was gathered through diverse sources including websites, journals, and books. Then, a selection of cases was identified based on the most exhibited, the most awarded, and the most built. In addition, the cases for which the most complete information was found were incorporated. With the selected cases, a table with data was defined for key parameters such as square meters, costs, materials,

construction time, and dimensions, among others. Finally, with the information gathered, graphs and drawings were produced in order to compare the cases quantitatively and morphologically. An analysis of the settlements or infrastructure incorporated to the temporary solutions was not done in this thesis, though this is a possible direction for future research using the information compiled.

From the comparisons it was possible to make some conclusions about the reasons for the mismatch between the proposed solutions and the real problems of disaster relief. On the one hand, designs are based on the experience of designers rather than the needs of actual victims. On the other hand, architects and manufacturers try to innovate with new materials, shapes and building technologies, while they should try to use local materials, involve community in the process and to use customisable and culturally based design.

I. DISASTERS, IMPACT AND VULNERABILITY

I. DISASTERS, VULNERABILITY AND IMPACT

There are different approaches and definitions of a disaster, depending on what discipline is studying it. In addition, although not every researcher agrees, there is a general consensus in dividing them between natural and man-made disasters, in relation to their causes. This division has been useful for measuring the impact of some hazards and to define the most damaging in terms of people affected, homelessness, and costs. The lack of capacity to cope with and recover from a hazard is defined as vulnerability. Ending a cycle of vulnerability requires important efforts, in which building codes, planning and design are crucial.

In the last fifty years around 160 million people became homeless due to natural disasters.[1] Although most of those affected were in the developing world, recent catastrophes have shown that the developed world is also vulnerable to these climatic and geological hazards. These events have left immense numbers of people without shelter, and therefore some questions have arisen about the role and the transcendence of having an adequate roof to cope with them.

1.1 What is a disaster? Definitions

A disaster is widely understood as a sudden event that generates great damage, loss and destruction, and disrupts life having negative consequences for the human societies and environment affected.

This situation usually *"overwhelms local capacity, necessitating a request to a national or international level for external assistance."*[2]

From different disciplines it is possible to find diverse approaches to a disaster definition, among which two are the most widespread. The first is the social–cultural approach,[3] which characterizes disasters as an unexpected disruption of a social system. The second is the hazards perspective[4], which is based on the impact of events such as earthquakes, tornadoes, floods, etc. The first approach is commonly used by sociologists and the second by geographers and other geophysical scientists. Although the hazards approach may be a concern with social systems and other issues, the focus is primarily in the processes associated with the target agent.

Other recent definitions are based on the crossing point between an extreme event (hazard) and vulnerable human population with the general consensus that disasters are *"social in nature"* [5] because a disaster happens when a group of people are involved.

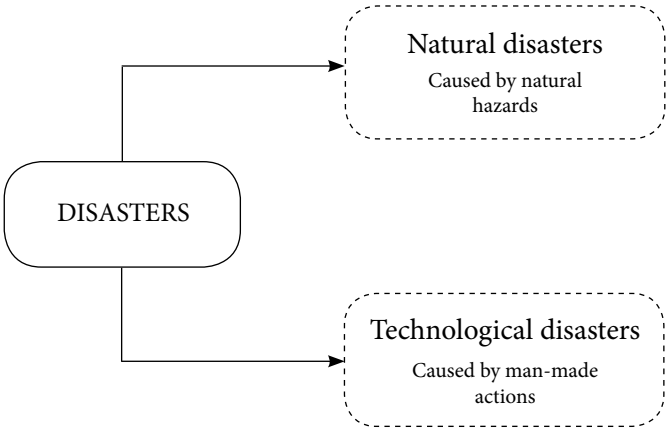


Fig.2. Group of disasters.
Source: Author.

1.2 Groups of disasters

Disaster will be considered in this research as a result of a combination of exposure to a hazard, the condition of vulnerability and the lack of capacity of human populations to cope with the negative consequences. Therefore, there are some conditions that favour a disaster (risks, vulnerability); some causes (hazards, extreme situations such as great natural events); some consequences (social and environmental consequences, impact) and a situation post-disaster (short and long term recovery)

$$\frac{\text{Hazard} + \text{Vulnerability}}{\text{Capacity}} = \text{Disaster}$$ [6]

Although not all disaster researchers agree, disasters are often divided in two groups, those related to events in the natural environment, such as earthquakes, floods, storms and so forth, and others related to manmade actions, such as technological and wartime incidents.

To delineate the area of study, this chapter will be based on the natural hazard approach. On the one hand, disasters provoked by war or civil conflicts have socio-political implications that will not be covered here and, on the other hand, disasters from natural hazards are considered here as part of a cycle of environmental processes.

The division between man-made and natural disasters (Fig.2), although in some cases blurred, has been useful to define the impact of each disaster in terms of loss of life, injury and other negative effects on human population, such as destruction of assets and infrastructure. Nevertheless, it has always been difficult to get qualitative information from post-disaster situations such as mental and social well-being, social and economic disruption, environmental degradation, and other important disruptions that occur after a disaster.

Natural disasters

Natural disasters are caused by natural hazards like earthquakes, floods, droughts and cyclones. While natural disasters share common features such as urgency and uncertainty, there is an artificial sense of unfamiliarity with these events. This is artificial because the risks from natural hazards should not been separated from "*normal*" life.[7]

Throughout human history there are examples of recurrent events that became disasters in different countries, showing that such events have been familiar to humanity from its beginning.

Nº of natural and technological disasters 1960-2011 worldwide

GROUP	Nº	AFFECTED	HOMELESS	DAMAGE USD
Natural	11,282	6,545,325,950	161,451,103	2,224,440,155
Technological	6,903	25,440,521	1,089,317	25,400,359
TOTAL	18,185	6,570,766,471	162,540,420	2,249,840,514

Fig.3. Nº of natural and technological disasters 1960-2011 worldwide.
Source: EM-DAT.

A well-known example is the history of Mount Vesuvius and the city of Pompeii where the population around the volcano has rebuilt their homes as many times as the volcano has erupted, showing that finally they have accepted the hazard as part of their life.[8]

It is a fact that the Earth is in constant evolution, and our efforts should be directed to cope with these changes, through planning and reducing risky built environments.

Although natural disasters are *"non-routine events"*[9] for the society, they are caused by natural cycles of the earth, tied to human interventions in the environment. Some researchers separate "natural phenomena" from "natural disaster".[10] Natural phenomena are occurrences in nature that can be periodical or extraordinary, predicable or unpredictable. They are interdependent and do not always have to result in a disaster. A natural disaster then, is an event produced by a correlation between a natural phenomenon and certain socio-economic and physically vulnerable conditions.[11]

The combination of some factors determines the potential exposure of humans to particular types of natural hazards. In other words "*Disasters are a complex mix of natural hazards and human action.*"[12]

Human activities can modify physical and biological events. For example, deforestation can contribute to flooding downstream or new building techniques can be inadequate to withstand zones exposed to frequent earthquakes. At the same time, social, economic and political processes are often modified by disasters, making some people more vulnerable to future extreme events.[13]

Therefore, architecture, planning and urbanism have a role to play in pre-disaster and post-disaster situations. In pre-disaster, this role occurs through preparedness, better building codes, improvement of the built environment, and development of settlements coping with future hazards. And in post-disaster, it is through solutions that include the long term process in their design, which means preparedness for future natural phenomena.

Man-made or technological disasters

Technological or man-made disasters are caused by man-made actions, such as wartime incidents. They can be intentional or accidental, such as destruction caused during wars, terrorist actions, chemical incidents, and so forth.

Natural disasters 1960-2011 worldwide

SUBGROUP	TYPE	Nº	%	AFFECTED	HOMELESS	DAMAGE USD
Geophysical	Earthquake	954	8.54	168,370,550	22,663,935	730,852,074 ←
	Volcano	187	1.66	5,231,865	355,790	2,940,348
	Mass mov. dry	46	0.41	27,109	3,981	203,800
Metereological	Storm	3,121	27.66	876,423,403	50,958,889	796,225,545 ←
Hydrological	Flood	3,750	33.32	3,295,628,900	83,062,528	483,418,078 ←
	Mass. mov wet	551	4.88	13,684,910	4,222,888	8,429,998
Climatological	Extreme tº	400	3.62	96,565,887	14,340	62,973,419
	Drought	570	5.05	2,059,800,303	20,000	90,134,906
	Wildfire	347	3.08	5,910,667	145,752	49,032,055
Biological	Epidemic	1,247	11.05	23,680,156	0	7
	Insect infestation	82	0.73	2,200	0	230,215
TOTAL		11,282	100.00	6,545,325,950	161,451,103	2,224,440,155

Fig.4. Nº of natural disasters by subgroup 1960-2011. worldwide. Source: EM-DAT.

The unpredictability of such events makes it difficult to include them in disaster recovery planning,[14] and usually they have political implications that will not be analysed in this research.

Figure 3 shows a comparison of the impact between natural and technological disasters in the past 50 years. The impact is measured by the number of affected people, homelessness, and damage in economic terms. Although natural disasters, such as earthquakes and floods, have had a large impact in recent years, some man-made events have been more destructive in past decades due to violent conflicts, such as the First and the Second World Wars. Table given in figure 3 shows that in the last 50 years, natural disasters have had a higher impact than technological, confirming the perception that during last decades, natural hazards have caused substantial devastation in the built environment.

1.3 The impact of great natural disasters and their increase

The cost in human lives has been used historically to measure a disaster's impact.[15] Nevertheless, a new measure has been used in recent decades in cities and developed countries: the costs of building and infrastructure loss.[16] The significant investment they represent and the impact they have had in the economy are now essential to understanding the effects of disasters.

Due to the complexity involved in natural disasters and the lack of information in some cases, it is difficult to get accurate information and statistics. Nevertheless, humanitarian actions at the national and international levels require data for making decisions, for disaster preparedness and for mapping vulnerabilities. It is for that reason that some organisations have created extensive databases to understand and to measure the impact of each event in human environments. One of the most used and respected in the area is the EM-DAT, International Disaster Database.[17] In the EM-DAT database it is possible to get information on disasters since 1900 until today. The database is updated daily, and is accessible on the internet without cost.

The EM-DAT database divides natural disasters into five subgroups, and eleven types. The five subgroups are: geophysical, meteorological, hydrological, climatological, and biological. Table in figure 4 offers an analysis of each type of natural disaster for the

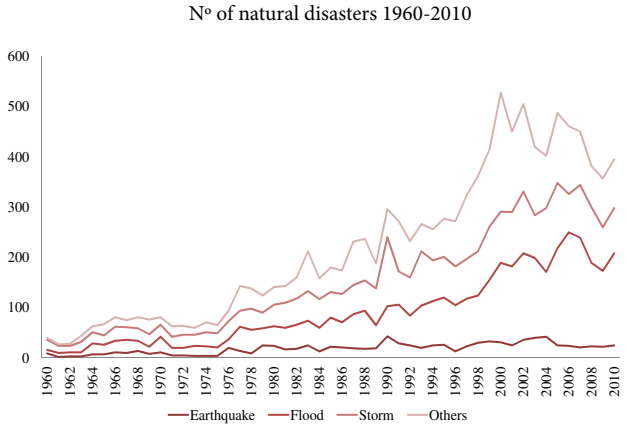


Fig.5. Nº of natural disasters 1960-2010.
Source: EM-DAT.

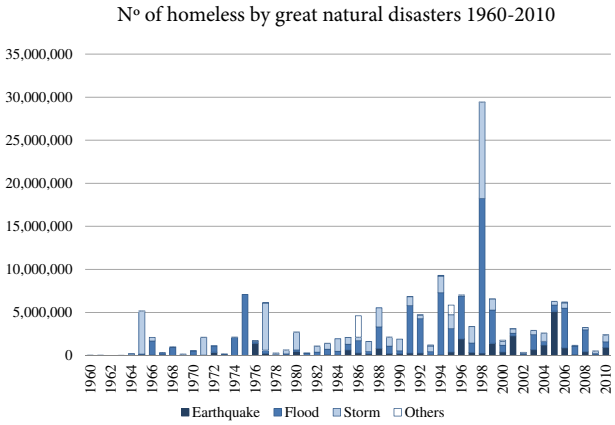


Fig.6. Nº of homeless by great natural disasters 1960-2010.
Source: EM-DAT.

past 50 years. It can be seen that earthquakes, storms, and floods have had the highest impact in human environments due to the number of people affected, homelessness, and damage in terms of costs. For that reason, these three types are commonly called "great natural disasters".

Although the three great natural disasters share the magnitude of impact, they are very different in terms of frequency and characteristics. Figure 4 shows that although earthquakes are less frequent in number than storms and floods, they have had a big impact on housing losses and damage in the economy. Earthquakes are the second highest in comparison with other types of disaster. Floods, meanwhile, in the past 50 years have affected almost four times more people than storms, although the frequency between them is relatively similar. In addition, floods and storms account for more than 60% of all disasters in the last half century.

During the nineties, research in global climate change suggested an increase in the frequency of some natural events such as storms and floods, as a result of the warming of the atmosphere. Nowadays, it is a fact that the number of natural hazard events, especially meteorological and hydrological events such as floods, have increased in the past five decades, as shown in Figure 5. The frequency of storm events has increased approximately 350% since 1960 and flood events by 2,500% in the past 50 years. Although earthquakes have not increased at the same rate, their damage in terms of resources (USD) in the last 20 years is four times greater than 30 years ago.[18]

The substantial increase in frequency of some natural disasters, the cost in human lives, homelessness, and economic disruption has gone up for several reasons, many of which are still the subject of debate. Some researchers suggest that it is related to a rising frequency of natural phenomena (e.g. global warming, climate change, destruction of the ecological balance by man); an increase in world's population living in vulnerable areas; and economic conditions that favour a tendency to use cheap design and materials.[19] Unregulated construction and lack of building supervision systems add to these factors.

Graph given in Figure 6 shows that the number of people made homeless by great disasters differs from the clear increase in the number of natural events.

On the one hand, while some years show a major impact in housing due to storms, such as the years 1965, 1977 and 1998, the most damaging type of natural disaster in terms of shelter in the last 50 years has been floods, with a peak in 1998 with 17,000,000 people homeless. On the other hand, while earthquakes have shown a similar behaviour during the past 50 years, the impact

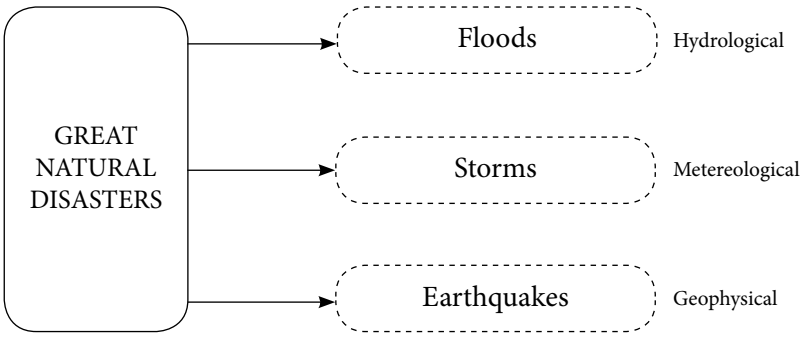


Fig.7. Three great natural disasters.

has been different, with an increase in homelessness in 1976, 1996, 2001 and 2005.

These divergences between the increase in frequency of natural disasters and the impact on housing losses can be explained by the differences in human settlements affected by these disasters: if they are urban or rural, if they have adequate building codes or not, and if they are prepared to cope with these events or not.

Recent natural phenomena, despite some of them occurring with lower intensity than some historical cases, have become major disasters because they have caused much more damage than before, e.g. the Hurricane Katrina in New Orleans in 2005 and the Earthquake in Haiti in 2010. To understand each type of great disaster, here follows a short definition of each of them.

Floods

Most floods have a repetitive behaviour, therefore they are "known risks". While some floods are more difficult to predict, such as tsunamis, it is nevertheless known that a coastal area is at risk of having that event. Although in some places floods are an important component of agricultural and ecological systems, it is necessary to separate the beneficial floods from destructive ones, and to define ways to control them. The damage generated does not come only from the water itself, but other health hazards such as contamination by chemical leaks, fuels and other pollutants. During recent decades floods around the world have been more damaging and costly, and they have affected both developing countries and developed and wealthy countries (US, Europe and Australia). [20]

Storms

Storms, tropical cyclones, hurricanes and typhoons, although seasonal, are highly unpredictable, because they are related to global atmospheric levels such as the ocean temperature. Current global climate changes have led to the idea that in a warmer world the frequency of hurricanes will increase and with greater intensity.[21] In addition, their direction, speed and growth dynamics are still not completely understood, making it difficult to have effective warnings. Although people have long lived in coastal zones, after the establishment of a world market, the number of urban settlements in coastal areas has risen. In recent decades, tourism and export-oriented industries have attracted more people to these zones. Currently more than half of the world's population lives in coastal areas and this fraction is expected to rise in the coming decades. As a result of spatial processes coastal urbanization has increased coastal erosion, amplifying the risk of being affected by a disaster.[22]

Fig.8. Natural hazard zones worldwide.
Source: Architect Magazine.

Earthquakes

Earthquakes are part of a natural geological process. Although they are unpredictable, it is possible to map some areas with high probabilities of facing an earthquake and to identify zones at risk. For example, urban areas within "the Ring of Fire", the edges of the pacific plate are the most likely to suffer a disaster after an earthquake due to their levels of seismic activity and the density of urban development. [23] In some cases, where an earthquake impacts in coastal zones, a tsunami can be a secondary effect of the earthquake, raising the risk of being affected by a natural event. Seismic risk is based on: hazard or ground shaking potential, exposure depending on buildings and infrastructures, quality of construction, and density of development in the area affected. [24]

In an earthquake the characteristics of buildings and structures have a higher influence on vulnerability. The possibility of adapting building design and city planning, taking into account past earthquakes can help to limit the impacts of a new quake. The impact of earthquakes, on the one hand, is related to the intensity of the seism, but on the other hand, the season and the time of the day. It is different in cold conditions, where trapped people have fewer chances to survive, or during the night, when people are sleeping and more exposed to a falling wall.
The quality of the buildings it is also important in this natural event, and usually low income populations have fewer chances of having a good design and better materials, thus being more vulnerable.

These three natural phenomena, as well as all other natural events share unpredictability as a general characteristic. Nevertheless, it is possible to identify zones with higher probabilities of facing these disasters, because they are known hazards, and therefore, to geographically map vulnerable zones. The map in Figure 8 shows that many countries are subject to multiple hazards. However, geography is not the only factor that determines vulnerability. Densely populated urban areas have a higher potential of having more casualties and homeless people. Nevertheless, several countries have managed to design strong building codes and safer settlements, to face periodical and multiple hazards. It is necessary to learn from these examples.

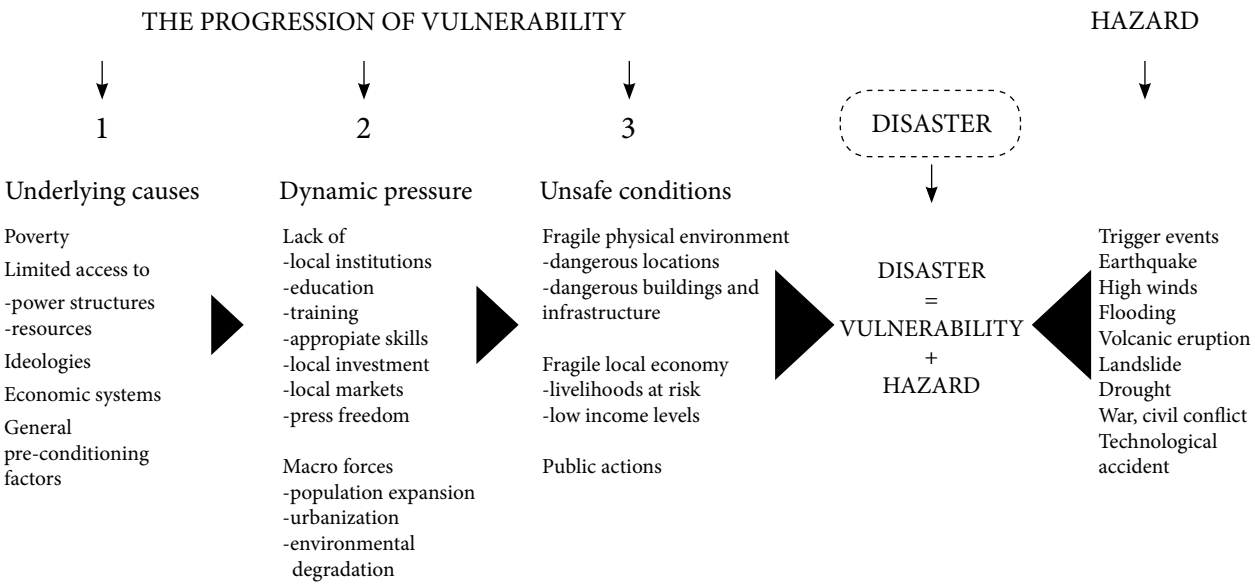


Fig.9. Progression of vulnerability.
Source: UNDRO-DMTP.

1.4 Vulnerability to disaster

Although there is not a unique definition of "vulnerability", disaster response agencies from the nineties onward (International Decade for Natural Disaster Reduction IDNDR), have been using the concept of vulnerability to analyse processes that lead to disasters, and to identify future responses.[25] The three main views about vulnerability and resulting strategies (not exclusive) are: vulnerability as a result of natural hazards and risk, vulnerability related to economic issues, and vulnerability due to socio-economic and political structures.[26] Despite different views, vulnerability to natural hazards is broadly defined as *"the characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard."* [27]

Natural disasters are related to the occurrence of natural events and the vulnerability conditions of a population that allow disasters to occur. The conditions are always different, consequently diverse populations have different levels of vulnerability. Although no country is entirely safe, as the recent devastation in the United States and Japan has shown, developing countries and low income populations are usually those most exposed to disasters due to *"their inability to limit the impact of hazards."* [28]

In the past century, urbanization in hazardous areas has increased vulnerability of large amounts of the population (Fig.9). Currently around 3.3 billion people live in urban areas, 1 billion live in slums, and 80% of urban dwellers are in cities of the developing world.[29]

Many cities and industrial centres in hazardous areas have developed due to the attraction of large populations to live and work there. Therefore, the number of people vulnerable is likely to rise, due to a combination of urbanization, inadequate buildings and settlements, and natural events. In addition, disasters have a big impact on urban places because they cause major disruptions in their complex and interdependent environmental, economic, and social systems.[30]

In general, low income populations suffer more than rich ones in extreme events, because higher income groups have more capacity to protect themselves or come through the disaster. First, rich people are less affected than the poor because good design and engineering (costly, in general) often can minimise such events. Second, rich people can live in a hazardous canyon or hillside voluntarily, seeking to have better views, while poor people have fewer choices and settle in these areas due to the urban growth. Third, the consequences for the rich are less severe than for the poor because the possessions of the rich are usually insured, and they can find easily an alternative

secure shelter while the poor frequently have their entire capital in their home at the site of the disaster.[31] Therefore, after a disaster, low-income populations face a more difficult situation, which magnifies the crisis they had before the event. Then, although post-disaster response should help everyone in need, there is an emphasis in giving solutions to less advantaged people, and also to the poorest countries.

Natural hazards have always been part of history, as noted previously, and people living in hazard-prone areas have used their knowledge and technologies to deal with extreme events. Although strategies to cope with these natural phenomena have been part of the tradition, new processes in cultural, demographic, political and global-economics have changed this picture.[32] In addition, the process of recovery and rebuilding requires long term planning to diminish the risks from future disasters in vulnerable zones.

II. DISASTER RECOVERY PROCESS AND TRANSITIONAL ACCOMMODATION

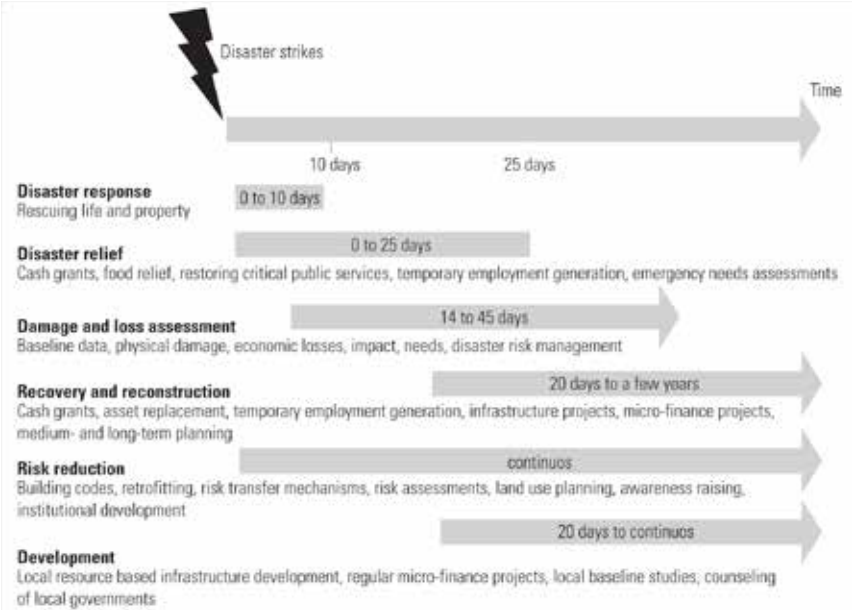


Fig.10.Post-earthquake activities.
Source: World Bank/ GFDRR.

II. DISASTER RECOVERY PROCESS AND TRANSITIONAL ACCOMMODATION

Immediately after a disaster, communities, NGOs and governments, respond with a process that goes from relief to recovery, with the aim of going back to normality. Therefore, the humanitarian response covers from a few days or weeks to many months and even years, depending on the case. The responses generally include water supply and sanitation, health, food, non-food items, shelter and settlements.

This thesis, and specifically this chapter, focuses on sheltering, which is necessary to provide security, protection from the climate, personal safety, and human dignity.[1] The research is centred specifically on temporary accommodation, the phase of the process that is between emergency solutions and permanent buildings. Temporary shelter and housing are generally used when populations are unable to rebuild and/or to use their original dwellings in the mid-term.

These solutions can be temporary and transitional: temporary in usage and location, and a transition to a more durable shelter. There are several options in terms of building system, place and process, and they have their advantages and pitfalls. Therefore, in each event, it is necessary to evaluate which solution is adequate, in order to achieve short, medium, and long term needs.

2.1 The process of recovery

Sheltering activities after a disaster are recognised as a continuous process; nevertheless, governments, humanitarian organisations, and donors, tend to divide their interventions into phases[2]. This is done in order to: track the process, identify term goals and define roles. These phases usually overlap, but the division helps to clarify the progression of the recovery.

The most common post-disaster activities[3] are (Fig.10):

- Disaster response and disaster relief (0-25 days) with the goal of stabilising the situation;
- Damage and loss assessment (15-45 days) with the goal of measuring direct and indirect socio-economic effects to estimate need for recovery;
- Recovery and reconstruction (20 days-years) include moving the population from emergency shelters to transitional housing until the permanent is feasible and affected regions return to normality;
- Risk reduction and development (20 days-continuous) phase to rebuild with better standards, developing master plans and building regulations, taking policy decisions.

In the early phases after a disaster, the implementation of relief programs is developed rapidly, but when the emergency disappears, the efforts tend to lose intensity, leaving a gap between the relief and recovery (usually long term and large-scale projects).

Fig.11.Example of coordination mechanism involved in the response to a disaster. Source: Shelter Centre.

To shorten this gap, it is necessary to start long-term projects early in the process.[4]

The coordination of the whole process is a complex issue due to the number of actors involved in the response (Fig.11). For that reason, a collaborative culture is essential *"to counteract the tendency of organisations and institutions to think and act autonomously, without consideration of their wider role or impact in the wider response."*[5] While government's role is to coordinate to support its citizens, the role of humanitarian organisations is to coordinate to meet their humanitarian mandates.[6]

In the year 2006 there emerged a global coordination system of response after disasters with a *"cluster approach",* in order to organise the division of activities and to clarify roles and responsibilities in the humanitarian community. The Shelter Cluster is co-chaired by the IFRC (International Federation of Red Cross) and the UNHCR (United Nations High Commissioner for Refugees). The IFRC is the convener in disaster situations and UNHCR leads in conflicts.[7]
This approach is applied in countries with humanitarian crises where the needs have a scale and complexity that justify a multi-sectorial response with the involvement of different humanitarian actors.[8]

Although the cluster partnership and agreements among NGOs have been beneficial to enhance the response and the public recognition of the shelter sector as a whole, there are still challenges to face. The "Review of the International Federation´s Shelter Cluster Commitment"[9] in 2011, identified some problems to solve. Among them: the lack of continuity in the field (shelter teams do not stay long enough after an emergency), the lack of training of the coordinators (due to lack of funding and secure positions to retain senior coordinators) and problems of communication and transfer of information.

Because the shelter sector is *"a relatively new specialisation within humanitarian assistance"*[10], the different organisations involved still need time to work together across disciplines and cultural boundaries. Among the disciplines involved in reconstruction and recovery, architecture and planning can play an important role. The design of housing solutions, public buildings and infrastructure to devastated communities, with higher standards than before and with the aim of reducing future vulnerabilities, must be part of the challenges. The architect's role can begin with the rehabilitation and reconstruction phases, but the work should be extended to planning sustainable development for the long term, considering the efficient use of resources, economical and technical factors, and social implications.

2.2 The role of shelter as relief after disaters

After a disaster, housing is one of the main factors that can help to re-establish normality in such a chaotic situation.[11] The consensus is that shelter *"is likely to be one of the most important determinants of general living conditions"*.[12] In that sense, a shelter is not only a secure roof but a covered living space that gives privacy, dignity, and is adequate for the community in need.[13]

Housing recovery is critical to carrying out normal activities and to re-establishing a routine. When affected communities get housing solutions associated with infrastructure, they can start to motivate the economy again, find jobs, open businesses and begin the process of re-development. However, communities are complex networks of social systems that require a multidimensional perspective[14] in order to give them adequate support.

In the year 1978 during the International Conference on Disasters and the Small Dwelling[15] the problem of inadequate housing solutions after disasters was discussed by a group of researchers in the field:

> *"Too often, housing is examined simply as an artifact- a design or a structure- rather than as an end-product of a very complicated process."*[16]

Thirty years after this conference, agencies, NGOs and governments are still trying to find a way to address this complex process.

In that conference, the disaster relief specialist Frederick Cuny pointed out some failures in the relief process that still today are being repeated in giving shelter after a disaster.

a) The lack of comprehension on the problem of simplifying the process and meeting foreign definitions of house, without including participation from victims.
b) To try to transfer lessons from one disaster to another.
c) The lack of understanding of different types of disasters and responses needed.
d) The lack of comprehension of disasters in the context of development.
e) The lack of cooperation between relief organisations, resulting in different disaster policies, inequitable distribution of materials, resources, and quality of houses.
f) The lack of incorporation of financing, land tenure and land use issues in the relief and reconstruction process.
g) Finally, the inadequacy of the programme evaluations of agencies and NGOs, which should include the alleviation of short-term problems and the meeting of long-term needs. [17]

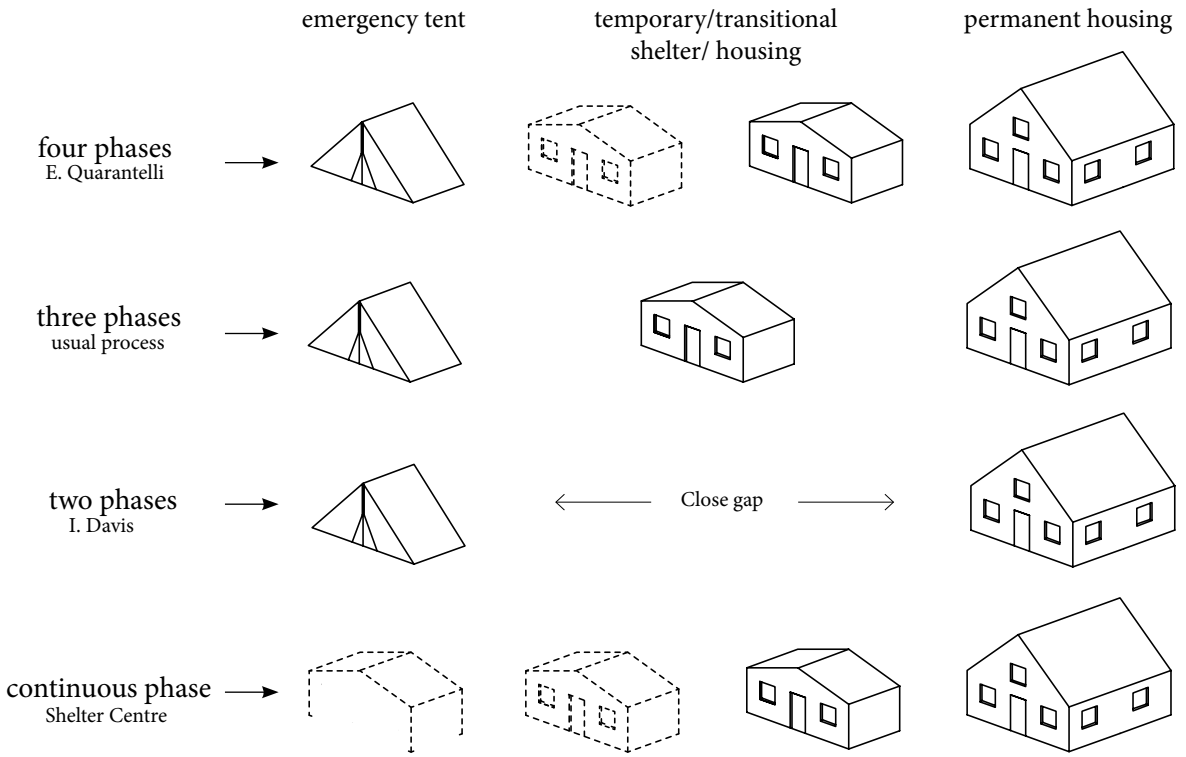


Fig.12.Phases of sheltering and housing after a disaster. Source: Author (see image credits for references).

While some of these problems have decreased progressively due to more coordinated work amongst NGOs, agencies, and governments, others are still today being repeated after disasters. For example, the cooperation between agencies has been improved with the creation of the shelter cluster, and although foreign prototypes are still being deployed, there is more awareness in including affected population in the decisions. However, the lack of funding for the reconstruction, the complex issue of land tenure, and the difficulties of meeting long-term needs are still main issues to address.

2.3 Phases of sheltering and housing after a disaster

There is not unique approach in relation to the processes and phases of sheltering after disasters as can be seen above in the scheme (Fig.12).

Enrico Quarantelli, pioneer in the sociology of disasters, defined in 1995 the relief organized in four phases distinguishing: emergency shelter, temporary shelter, temporary housing and permanent housing.[18] Most aid programs in recent years define three stages: emergency (tents), temporary/transitional (shelters/ housing) and permanent housing. Recently, some programs are trying to reduce the process to only two stages going from tents directly to permanent solutions, extending the first stage and beginning the durable solution earlier. Moreover, the "transitional approach" presented in May 2012 by the Shelter Centre comprises all the stages in a continuous "incremental process."[19]

The most common approach comprises three phases in the housing process after a disaster:

Phase 1, relief/emergency. After every disaster a quick response is fundamental for protecting the people affected from the environment and to generate a first secure place to sleep. The most common solutions are sheltering in community buildings (such as schools and sport centres) and family tents.

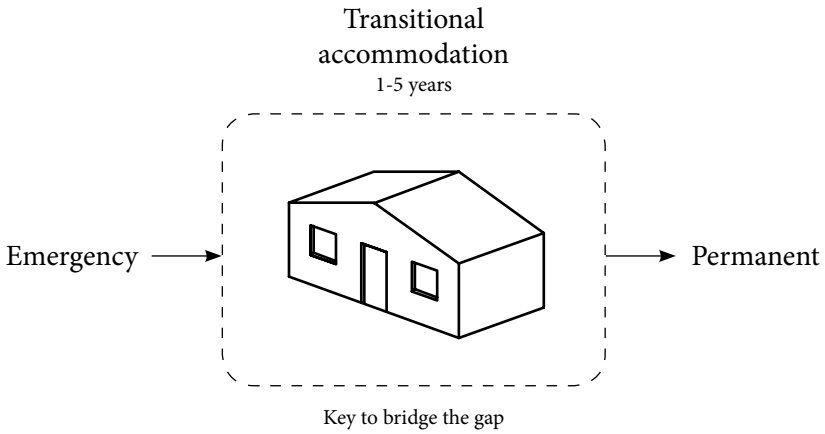


Fig.13. The intermediate phase.
Source: Author.

Phase 2, recovery/transition. Some specialists call this phase the recovery, the process that ensures the affected population a support between emergency sheltering and durable solutions. In this phase, the temporary/transitional shelter is essential as a solution between immediate relief and permanent

Phase 3, development/permanent. It is the final stage of the process, generally considered the final goal, where families have a permanent and secure solution and can reside there for an indefinite amount of time. This can be in a rebuilt house or in a new permanent housing and settlement. The durable solution is dependent on financial resources and the level of destruction of the pre-disaster buildings, and differs from one country and event to another. In some cases, the permanent housing is driven primarily by the governments, while in others, by the market.

The three phases approach has pros and cons, and not always constitutes a linear process. For example, in the emergency phase, the costs of tents are not only related to the price of fabric and poles, but the transportation costs to get to devastated places, which sometimes increases the prices of tents by three to four times. In addition, the life span of a tent -depending on the climate conditions- it is usually shorter than one year, which is insufficient time to build permanent houses.

On the other hand, the permanent phase, generally takes place some years after the event, therefore, quality temporary/transitional accommodation is needed to fill the gap. Moreover, temporary solutions are commonly used longer than expected, and eventually become part of the permanent housing.

The reason for concentrating research and efforts in the intermediate phase (Fig.13) is due to the complexity of a long process that is usually slow, and leaves large groups of people living in inadequate conditions for an extended period of time. In most cases (except some specific experiences) permanent housing is a difficult phase to achieve due to diverse factors e.g. lack on funds, lack of land rights, lack of time for developing projects while solving problems of infrastructure, etc.

Because it is difficult to get sustainable and permanent solutions in the mid-term, better transitional housing is seen as an achievable step in the long-term process of reconstruction. This concept has been assumed by governments and humanitarian organisations, which in recent years are gradually thinking of emergency shelters as a basis for a long-term solution, and have encouraged some architects and manufacturers to explore evolutionary or incremental prototypes that develop into permanent homes and can be the foundation for future settlements. [20]

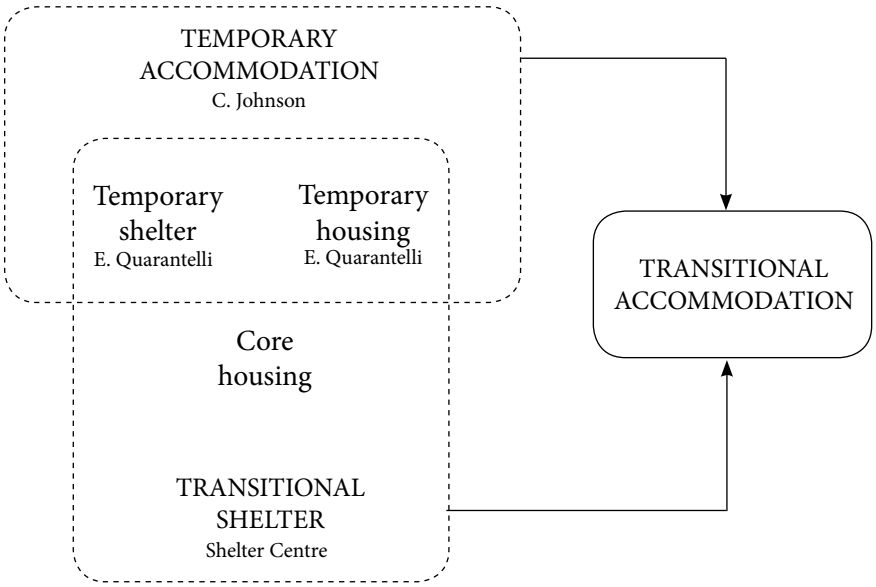


Fig.14. Transitional accommodation terminology.
Source: Author.

Experts agree that for reducing vulnerabilities, and strengthening resilience it is necessary to include risk management assessments in development plans.[21] To achieve permanent, resistant and secure housing, there must be a connection between humanitarian aid and development communities. While the first supports the relief and recovery after a disaster, the second is concentrated on improving quality of life. They should be considered as part of a complete process, therefore their plans should be tied, in order to strengthen resilience, optimise resources, and not duplicate efforts.

2.4 Temporary and transitional Accommodation

There is not universally agreed terminology for the accommodation solutions between emergency and permanent housing. The terms *temporary* and *transitional* are used to refer to both the process and the building solution, nevertheless, some conceptual differences can be found between them. In addition, *shelter*, *housing* and *accommodation* are frequently used interchangeably.

While E. Quarantelly utilises the term *temporary shelter*, comprising self-built shelters, improved tents and mobile homes, and *temporary housing*, usually dwellings with industrialised and standardised design. C. Johnson uses the term *temporary accommodation* comprising all types of temporary lodgings after a disaster.[22]

In the "*Transitional Shelter Guidelines*"[23] launched in May 2012 by the Shelter Centre, it is pointed out that *transitional shelter* has become a common term used since the 2004 Indian Ocean tsunami to describe post-disaster responses. It is stated there that the term has been used to name a variety of approaches such as prefab structures, semi-permanent shelters and core housing, among others.

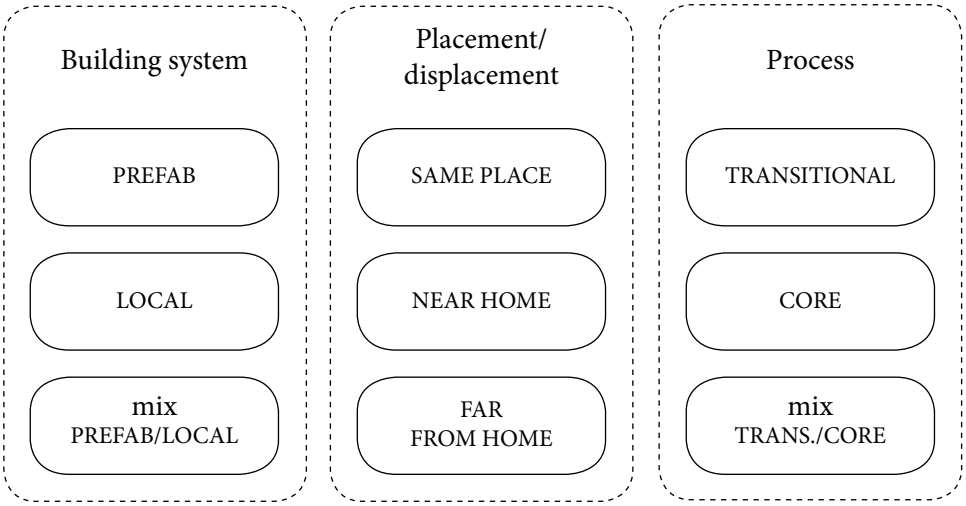


Fig.15. Transitional accommodation options.
Source: Author.

However, some of them do not fulfil the definition of transitional shelter according to that publication, which is:

> *"an incremental process which supports the shelter of families affected by conflicts and disasters, as they seek to maintain alternative options for their recovery."*[24]

Moreover, the shelter should have the potential to be: upgraded, reused, relocated, resold, and recycled. [25]

This research agrees that future approaches should follow the concepts set by the Shelter Centre, where the relief and development is seen as a continuous and incremental process. Nevertheless, in order to study past experiences and a higher number of cases, the concept of *transitional accommodation* was adopted (Fig.14). Accommodation, because it is a broader term that includes shelter and housing, and transitional, because implies both a temporary building and a transition between two phases.

A transitional accommodation (shelter or housing), then, is defined here as a bigger and stronger solution than a tent and an achievable step in the recovery process. It is usually designed to last more than one year and to serve as a transition to a permanent house through different processes. In this phase families begin to resume their activities in a temporary construction that can go from deployable, inflatable, mobile and prefabricated high tech alternatives to the use of local building materials and local labour. The place where the transitional solution is set can go from the same plot of the damaged house to a complete new settlement in a different city/town/village.

Finally, the process from transition to a permanent solution can be done through a transitional solution (disposable or reusable), core housing or a mix between these two options. (Fig.15)

Prefab vs. local

On the one hand, after every disaster decisions must be taken fast, but experience has demonstrated that instant housing solutions are frequently inappropriate in terms of technology, habits and lifestyles.[26] While completely "foreign" projects have not always had the acceptance of the communities, they tend to be fast solutions when already available, but more expensive due to transportation costs. In addition, using the same prototype as a massive solution, it generates large settlements with undifferentiated housing types without considering individual needs. On the other hand, it is always preferable that the transitional accommodation reflects local construction techniques, designs and cultural preferences.[27] Transitional shelter and housing with reference to previous building types

can contribute to decrease psychological trauma and ensure cultural continuity.[28] Furthermore, buildings with local materials tend to be more adequate for the culture and their parts easier to replace and improve, therefore making them easier to fit in an incremental plan. Nevertheless, this kind of solution tends to also be slower to build and more complex to manage in terms of availability (not enough local materials to cover the necessities, and the increase of prices due to market pressures). Therefore, there is no single correct solution, and because it is a complex issue, it is useful to compare and learn from past experiences. Rather than replicating solutions immediately after the disaster, each new situation should be evaluated individually.

Placement vs. displacement

The transitional solution can be set: a) in the same place or plot of the destroyed or damaged house, b) near to it or c) far from it. Experts agreed that it is better to avoid displacement because remaining at home or near to it helps to maintain social networks, to recover livelihoods and to prevent problems of land tenure.[29] Nevertheless, when displacement is inevitable, e.g., to avoid risks due to physical hazards, the duration and distance from the original place should be the minimum possible and the relocation must be voluntarily.[30]
From past experiences, six options for displaced populations and six options for non-displaced populations have been categorised by UN/OCHA.[31] Displaced options are: 1) Host families: sheltering with families or friends 2) Urban self-settlement: informal occupation 3) Rural self-settlement: in collectively owned rural lands 4) Collective centres: mass shelters usually in pre-existing structures 5) Self-settled camps: independent from governments and aid agencies 6) Planned camps: accommodation on purpose-built sites with services provided.

Non-displaced options are: 1) Occupancy with no legal status: without permission, 2) House tenant: rented formally or informally, 3) Apartment tenant: rented formally or informally, 4) Land tenant: house is owned, land is rented, 5) Apartment owner-occupier: apartment is owned, formally or informally, 6) House owner-occupier: house and land is formally or informally owned.

A transitional solution can be used by displaced and non-displaced communities with different objectives. While non-displaced populations can use transitional shelters as a basic starter home to be upgraded, expanded or replaced, displaced populations can use them during the recovery and then disassemble and reuse them when able to return home or resettled in new locations. In addition, transitional buildings can be used as adjacent or adjoining shelter. [32]

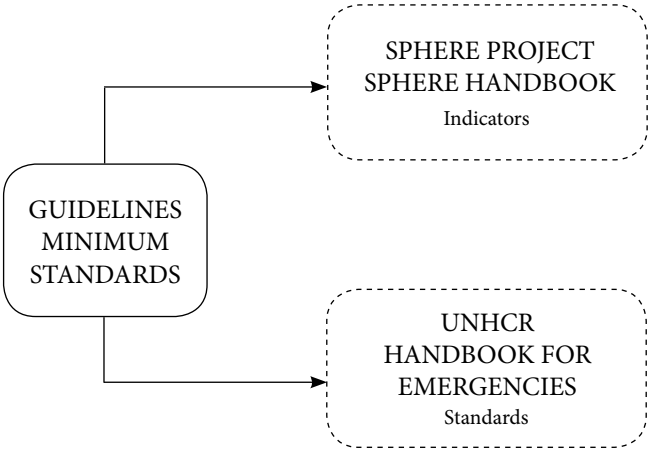


Fig.16. The most used guidelines.
Source: Author.

Transitional vs. core housing

In relation to the process from transitional to permanent, two main types of transitional accommodation have been developed in recent years: a) transitional and b) core/starter housing.

The first one has been extensively used lately because it is considered part of a sequential process, and avoids land tenure problems. The objective of this type is to erect a solution with building materials that can be disposable or reused later to build and improve the permanent house, or used as a secondary house to rent, used as shop, etc.

In the second case, the core or starter housing, the objective is to build a small more resistant shelter that can be expanded incrementally into a larger and more permanent house over the years. It is a transitional solution that progressively becomes a permanent and durable house. This solution in earthquake prone areas can give a central safe space useful to protect families from another seism.[33]

An intermediate solution between these two is a transitional building that can be used as a base for a future house but that is also possible to relocate.

Minimum standards

International relief organisations have agreed on a group of standards that provide minimum guidelines for the humanitarian response, allowing the possibility of monitoring and evaluating the projects. Nevertheless, every situation is unique, therefore, the guidelines given require always adjustment to local circumstances, and the agreement of stakeholders, donors and actors involved. The Sphere Handbook and UNHCR standards are two of the most used global guidelines (Fig.16).

The Sphere Project was initiated in 1997 by a group of NGOs, the Red Cross, and the Red Crescent Movement. They developed a set of universal minimum standards with the objective of improving the humanitarian response in disaster and conflict situations. These standards are comprised in the "Sphere Handbook, The Humanitarian Charter and Minimum Standards in Humanitarian Response".[34] In this Handbook, the guidelines for transitional accommodation are defined in the technical Chapter: Minimum Standards in Shelter, Settlement and Non-Food Items.

The UNHCR (United Nations High Commissioner for Refugees) defines the standards in the "*Handbook for Emergencies*".[35] Chapter 12 of this handbook includes site selection, planning, and shelter, with an emphasis on planned camps and collective centres. [36]

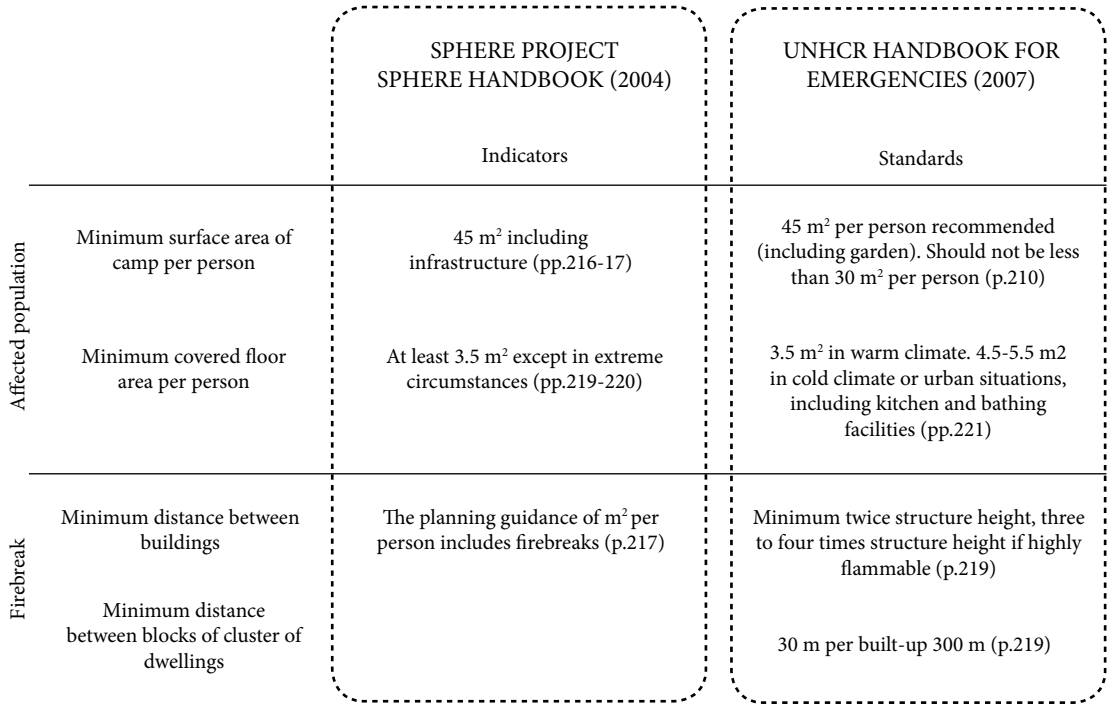


Fig.17.Comparison of Sphere indicators and UNHCR standards.
Source: Author. Shelter Centre/ UNOCHA.

These two handbooks use the term 'standard' in different ways.[37] In the Sphere Handbook, standards are qualitative and universally applicable, while indicators are qualitative or quantitative tools for measuring the applied standards.[38] In the Handbook for Emergencies, standards are usually quantitative.[39] Therefore, to make comparisons between guidelines, it is easier to use indicators with Sphere Handbook and standards with UNHCR's Handbook. Despite these differences in terms, they agreed in several points, such as the minimum surface area of camp per person (45 m^2) or covered floor (3.5 m^2) (Fig.17).

Advantages and disadvantages of transitional accommodation. (Fig. 18)

The potential advantages of using transitional accommodation solutions include: [40]

Costs: They are a similar to tents but have a longer life-span, therefore if built with durable materials can last until the reconstruction phase, maximising the humanitarian organisations response.

Materials: If they are built with local materials can enhance the local economy, in addition, materials can be prepared and distributed as kits, easier for families to transport and convenient for logistics chains. Moreover, adequate and durable materials can be used as part of permanent reconstruction or to allow the shelter to be upgraded.

Building tools and techniques: They are usually built using rapid construction methods and simple tools, which are easier for unskilled workers. Furthermore, with technical supervision and inspection, resistant building principles and techniques can be introduced, as well as sustainable improvements in methods and skills reducing future risks.

Flexibility: Can be used by displaced and non-displaced groups. If developed with the affected communities can include factors such as family size, location, culture, available materials, etc. In addition, they can be disassembled and relocated, giving the opportunity to delay decisions on land rights or tenure until governments can make a resolution.

The risks involved in using transitional accommodation solutions include: [41]

Land tenure issues: When land issues cannot be solved, affected families live indefinitely as occupants, bringing new problems.

Long term: Usually aid organizations do not have the capacity of supporting beyond transitional shelter due to scarcity of resources, therefore, being difficult to

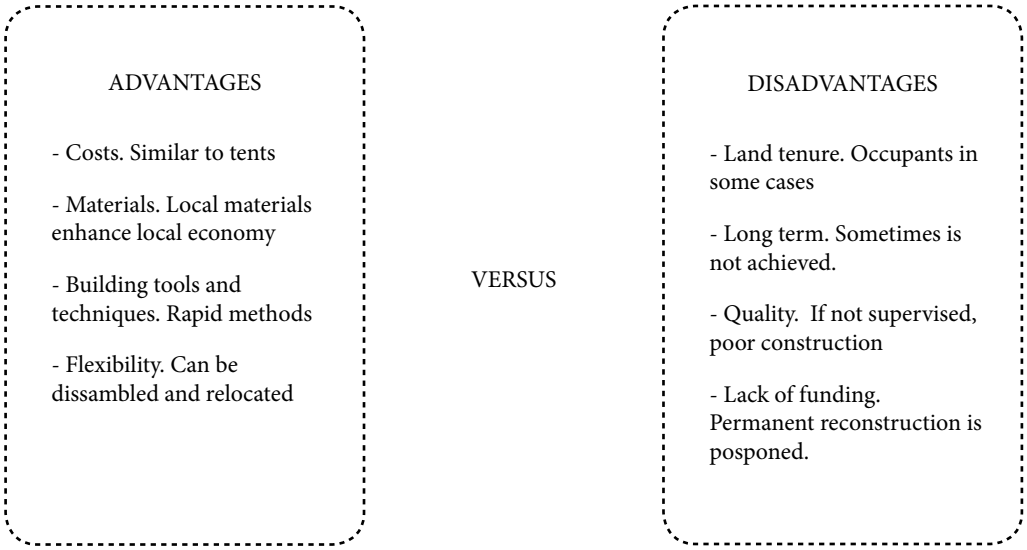


Fig.18. Advantages and disadvantages of transitional. accommodation. Source:Author.

complete the process.

Quality: Sometimes, the constructions are poor or unsafe as result of unskilled voluntary workers or lack of technical capacity in the field.

Market: Due to the high demand of materials, the prices tend to increase and sometimes that results in shelters built to sub-standard quality.

Lack of funding: To concentrate resources on temporary accommodation without considering long-term effects have meant that permanent reconstruction in many cases is postponed. [42]

Other difficulties that arise when the transition lasts longer than planned, is that settlements become a permanent solution with a lack of infrastructure and services, and inadequate transport connection. In some cases, the transitional solution is an improvement to the prior conditions, especially for low income populations. It is difficult to re-settle them if the permanent solution does not meet their requirements or expectations, and is not already available. Other problems are related to living conditions in some settlements, camps (housing) or parks (trailers) due to crime and violence, and the disruption of prior social networks, having negative consequences on the psychological health of inhabitants.[43] As a result, communities begin the process of reconstruction around temporary solutions which become more permanent, affecting the expansion and development of the cities.

Finally, when the transition is not well planned, the long-term housing recovery can be debilitated. Nevertheless, the accommodation after disasters must be understood as a process rather than a product, as Fred Cuny said 30 years ago.[44] Even though transitional buildings can be simple structures "that offer appropriate and flexible shelter over the period of reconstruction"[45] their possibility of being re-locatable, reused, upgraded, or sold, gives a variety of alternatives for recovery in the long term.

A problem with current solutions, especially those developed by architects and manufacturers, as will be seen later in the thesis, is that some of them repeat the same patterns of historical experiences. During the past century, several alternatives of transitional accommodation were developed, resulting in good and bad experiences. From those practices it is possible to learn, in order to guide future solutions, without "reinventing the wheel" after every event. What is needed is building disciplinary and institutional memory in order to have a cumulative development and better results.

III. TRANSITIONAL ACCOMMODATION IN THE LAST CENTURY

III. TRANSITIONAL ACCOMMODATION IN THE LAST CENTURY

The interest in post-disaster emergency housing has risen in the last ten years due to an increase in the frequency of natural disasters, their impact in urban areas, as well as media coverage of these events and their dissemination. However, transitional accommodations, especially prefabricated systems, have been developed since the early twentieth century. Several of them have been designed by leading figures in architecture and have given way to technological and construction innovations. Although there are successful and unsuccessful historical cases from which to learn, currently some past patterns are being repeated without considering these experiences, therefore focusing on the urgency of solving the problem.

This chapter is divided in four sections in order to examine cases of transitional accommodation developed over the twentieth century by the different actors involved. This chapter addresses how architects and designers, aid organisations, governments and communities affected by disasters have followed a parallel development with some collaborative cases. The objective of this analysis is to have an overview of the solutions developed in order to learn from the past and inform future proposals. Finally, a timeline of the post-disaster transitional accommodations developed in the last century has been drawn in order to see the development process on this topic.

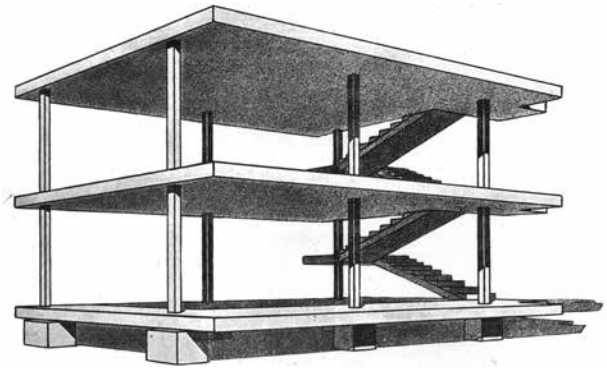


Fig.19.The Domino House. Le Corbusier, 1914.
Source: Boesiger W., Girsberger H.

3.1 Architects and designers

Architects have been involved in transitional shelter since the San Francisco Earthquake in 1906 in the United States of America. Post-disaster emergency housing has been diverse, these include prefab, mobile, tensile, portable, inflatable, infill, among others. Some architects have had a real impact in the field, while others have had an influence in the discipline with experimental and speculative approaches. In both cases, they have caused a development in the architecture discipline, through innovative solutions.

The housing crisis generated by the First and the Second World War, was a fertile field for architects to design and test some of their ideas. An example of this is the "Domino house" (Fig.19), designed in **1914 by Le Corbusier**. This design anticipated the demand for rebuilding the devastation produced by the First World War.[1] His idea was to reduce the elements to the minimum in order to facilitate mass production and the use of standardised elements.[2] The proposal consisted in a two open floor plan, with concrete slabs supported by reinforced concrete columns.[3] This scheme had the aim to give users complete freedom to divide the interiors, a revolutionary idea that defined a completely new method of construction.[4]

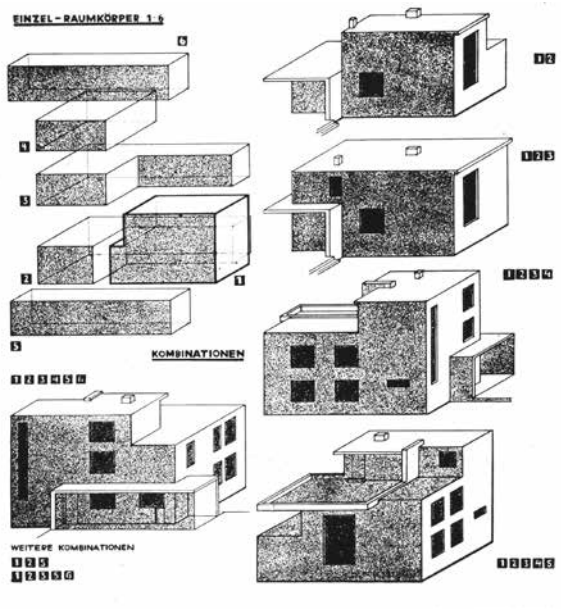


Fig.20. Baukasten im Großen. Walter Gropius, 1922. Source: Probst H., Schadlich C.

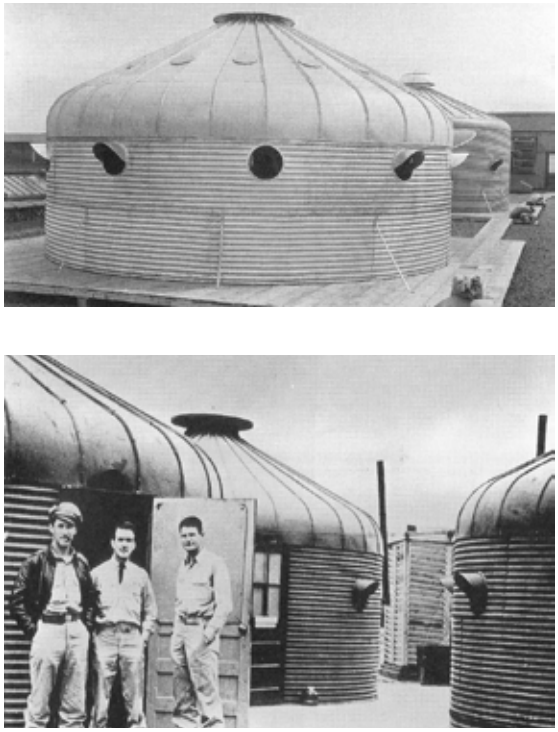


Fig.21. Dymaxion Deployment Unit (DDU). Buckminster. Fuller, 1942. Source: Pawley.

Even though the Maison Domino, was not transitional in essence but a core house for future modifications, it was a pioneer in using the concepts of mass housing and prefabrication, which would later be adopted in post-disaster solutions. Following the ideas of industrialisation, **Walter Gropius and Adolf Meyer** developed a system called *Baukasten im Großen*[5] (big building blocks). The system allowed diverse housing solutions by combining standarised components,[6] based on the concept of children's building blocks[7] (Fig. 20).

In 1931, a competition called *"The Wachsende Haus"* (the growing house) was organised by the German government in order to generate ideas for encouraging the development of the peripheral urban settlement.[8] The design had to be an expandable house with a core of 25 square meters, not exceeding RM 2,500.[9] Some eminent architects such as Gropius, Mendelsohn, Max and Bruno Taut were called to answer the same task than the competitors with the objective of incorporating the results in the Berlin Summer exhibition in 1932.[10] The aim of the competition was to offer flexible houses, adaptable to economic conditions and to constant changes in family structures.[11] The proposal of Walter Gropius was the most acclaimed in the exhibition, and a debate was developed on the principle of growth, self-help and building systems.[12]

In the United States, **Buckminster Fuller** was a pioneer in producing mass housing easy to transport, prefabricated, and economically efficient.[13] Around 1940 he developed the design of temporary housing called Dymaxion Deployment Unit or DDU (Fig.21). The first production orders of the DDU were from Europe, to be produced in a military and civilian form before the United States entered in the Second World War.[14] They were produced by Butler Manufacturing, a company of mass-produced grain bins, between 1940 and 1944, and acquired in thousands to be used by the United States military and for domestic purposes.[15] The shape of the housing units were based on the grain bin, with a higher and a more curved roof, helping to keep their low-cost, fast and demountable concept.[16] In addition to the emergency shelter, Buckminster Fuller later developed his well-known geodesic domes, a concept that has been used extensively as a solution to build rapid deployable shelters. As an example of his influence nowadays, The Buckminster Fuller Institute designed in 2005 a geodesic emergency tent (Dymax) for the NGO called World Shelters, for being used after Hurricane Katrina, in New Orleans.[17]

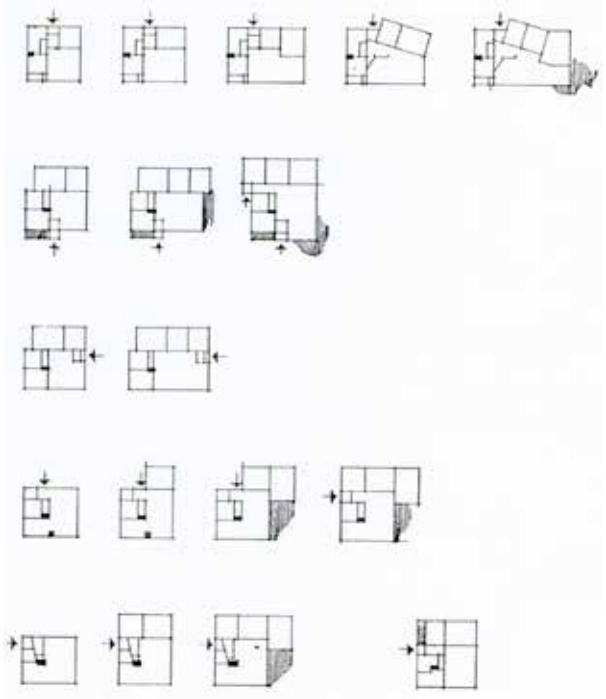


Fig.22. AA System House, diverse configurations. Alvar Aalto, 1940. Source: Pallasmaa J. and Sato T.

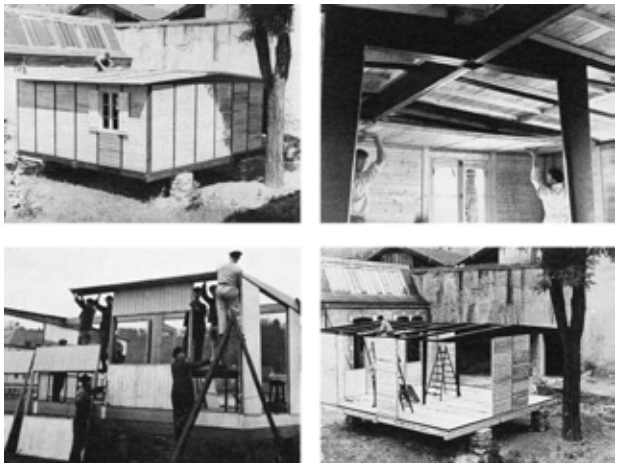


Fig.23. Assembly process of a 6x6 house in Nancy, France. Jean Prouvé, around 1945. Source: Allegret L. and Vaudou V.

During the Second World War, **Alvar Aalto** chaired the Office for the Reconstruction of Finland, with the aim of doing research and designing efficient self-build housing.[18] His idea for solving the housing shortage was based on a flexible standardisation of a type house, questioning the mass production as an effective solution.[19] Therefore, he decided to follow the concept of a basic cell which could grow and evolve through the time, rather than a fixed instantaneous solution. In that sense, he followed the idea of designing core housing that could be adaptable to the user's needs adding more parts. The called AA type houses, which he designed before the war,[20] presented several possible combinations providing flexibility and variation (Fig.22). Nevertheless, the manufacturer built only the most demanded houses by the market, and the idea of flexibility was never really introduced.[21]

Jean Prouvé, was a specialist in prefabrication, who designed and built dismountable houses (pavillon démontable) for the refugees in Lorraine, France, around 1945 (Fig.23).[22] He developed a system of dismountable houses with a metallic central structure and modular timber panels. The concept was based in single meter units (3,4,6,8,9,12…) that allowed the reuse of partitions and prefabricated panels on different types of houses (6x6 m,6x9 m, 8x8 m, etc.)[23] His aim was to build temporary shelters by two people in one day, but due to lack of funding and shortage of materials only some houses were built.[24] Following the concept of a dismountable shelter, in 1956 he developed a prototype called "maison-des-jours-meilleurs" for the Association Les Compagnons d'Emmaüs (Abbé Pierre).[25] The core with kitchen and bathroom was too revolutionary for the time and only some prototypes were built, although other architects celebrated the project, such as Le Corbusier. His designs were influencial, and remain visited until this day, e.g. the Gallery Patrick Seguin in Paris has built and exhibited prototypes of these houses in the latest years, in different cities.[26]

During the sixties, several innovative proposals for shelters were developed by well-known architecture groups such as Archigram in the U.K and the Metabolists in Japan. Although most of them were not designed for emergency situations, they innovated on concepts such as minimum living spaces, mass housing, units and cells, and transient habitats. Some designers criticised the gap between what was offered by architects and what was required, such as Arthur Quarmby in 1974 in "*The Plastics Architect*".[27] In the eighties, some architects designed innovative solutions for disaster shelters, such as the firm Future Systems from the UK, and their design for an air-deliverable shelter in 1985.[28] The project received the attention from the architectural press, but not from the UN for being a clearly inappropriate response.[29]

Fig.24. Bird's eye view of Sandbag Shelter prototypes in Iran. Nader Khalili, 1994. Source:Aga Khan Dev. Network Website.

Fig.25.Paper Log Houses in Kobe Japan. Shigeru Ban, 1995. Source: Architecture for Humanity.

The Iranian architect **Nader Khalili** in 1984 created a system for building lunar colonies for NASA, called sandbag or "superadobe".[30] The temporary housing system made from sandbags was tested in 1991 and developed by Cal-Earth (The California Institute of Earth Art and Architecture). It was used in Iran in 1995 to house Iraqi refugees under the supervision of UNDP (Fig.24).[31] The 15 shelters built in Iran were published by NASA, and winners of awards from the United Nations and the Aga Khan Award in 2004, among others distinctions.[32] The "superadobe system" consists of long tubes of fabric sandbag filled with earth and barbed wire in between the fabric tubes.[33] Although cheap and easy to build, the "superadobe" system was not used extensively because of its unpopularity with the refugees, who disliked the circular space.[34] Nevertheless, the system is still being studied and used, with different shapes and in different locations,[35] because it has several advantages. Some of the advantages of this system are that it can be constructed with on-site materials (earth, sand, rubble) and does not require specific skills. Although Nader Khalili died in 2008, the Cal-Earth team is currently active and responded to the 2010 earthquake in Haiti with the project Haiti One. [36]

Another architect involved in post-disaster transitional solutions since the nineties is **Shigeru Ban**, known for his buildings made from paper tubes. Ban, a Japanese architect, designed and built 21 temporary shelters for the Great Hanshin Earthquake that struck Kobe in 1995 (Fig.25).[37] He saw that several professions were engaged in humanitarian activities but there was a lack of architects in the field, therefore, he began to work as a consultant for the UNHCR.[38] The shelters in Kobe were built using paper tubes and plastic beer-bottles crates loaded with sandbags.[39] These temporary solutions were published in several journals of architecture and he became an iconic architect in the relief after disasters. After Kobe, he built paper log houses and paper emergency shelters in Rwanda (1999), Turkey (2000), India (2001) and Haiti (2011).[40] Because paper log is not always available into affected areas, it proved to be a difficult system to replicate on a large scale.[41] For that reason, Ban has developed solutions with other materials, such as shipping containers, which he used for temporary buildings after the earthquake in Japan, 2011.[42]

In the past 15 years, several architects and some architecture schools have been involved with the problem of transitional and permanent housing after disasters.

An example of this increasing interest is the creation of several organisations working on this issue, such as of Architecture Sans Frontières International founded in 2007[43] (ASF-France in 1979). In 1999 Cameron Sinclair founded **Architecture for Humanity**, a non-profit design services firm that seeks architecture and design solutions to humanitarian problems.[44] This organisation launched a competition for designing transitional shelter in Kosovo after being war-torn. More than 200 architects sent their proposals,[45] and although the selected projects were not built, the competition generated a huge impact in the media and many of the entrants continued working in the field. Sinclair became then a reference for young architects who felt that architecture was trivialised by contemporary practices and they saw in the humanitarian field an alternative to change the role of architects.

As it can be seen, repeatedly architects during the last century were over enthusiastic with the idea of using new technologies and mass housing production. In most cases the costs of prefabricated buildings were higher than the available resources, therefore other local solutions and the market have guided the reconstruction process. The distance between the imaginative projects and the real needs is repeated until today. This gap is probably one of the reasons why architects have not had an important role in the recovery process, except for some few and specific examples.

Fig.26. Shacks in S. Francisco. Union of Carpenters and Army Corps, 1906. Source: The Western Neighborhood Project.

3.2 Aid organisations, agencies and governments

The organised disaster relief deployed by agencies and NGOs, in conjunction with governments, has its first examples in the early years of the twentieth century. The impact of natural disasters in urban areas, along with the First and the Second World Wars created a cycle of continuous emergency in the housing stock in the last century.

The **San Francisco earthquake in 1906** is known as one of the most significant earthquakes recorded of all time, and as the beginning of organised relief in modern times. **The Army Corps of Engineers** played a fundamental role and nascent agencies such as the American Red Cross (founded in 1881) broadened its relief operations to give shelter solutions.[46] Due to the level of devastation, a large group of people was displaced and several temporary housing camps were built in public parks. Many of the housing strategies employed in this event were adopted later as standard process of relief, such as micro-credit and small wooden cottages.[47] The 5,610 cottages or "shacks" built had an area between 13 and 37 square meters.[48] The temporary shacks were built by the Union of Carpenters (Fig.26), and were designed by the Army Corps to be transported later to a final location, which could be a rebuilt building or a new house.[49] Some shacks were used as starter house and others were joined to create a bigger house.

Fig.27. Demountable wooden houses. American Friends Service Committee, 1917. Source: Architecture for Humanity.

Fig.28. Houses for Britain. The US Federal Public Housing Authority, 1945. Source: Library of Congress.

Nowadays, there are still 14 of these shelters in San Francisco,[50] showing that a temporary housing sometimes has a longer life than planned.

During the First World War, several demountable wooden houses (Fig. 27) were built in France and other locations by volunteers of the **American Friends Service Committee** (AFSC), which was founded in 1917 to assist civilian victims of War.[51] The temporary wooden houses or "barracks", known by the French as "*maisons demonstables*", were precedent for building temporary structures.[52] Their parts were prefabricated plywood panels with a roof of a red tile or tarpaper.[53] The demountable wooden houses had two rooms and were placed at an appropriate distance among them to avoid overcrowding.[54] These houses were set on the same site of the destroyed building or in a "*cité*" adjacent to the devastated village. It is not known how these "*cités*" influenced the growth of the villages,[55] but it is possible to infer they had some role in the tendencies of grown

The destruction after the Second World War was even greater than the First World War, leaving millions of people displaced and homeless, therefore emergency shelter was a priority. With the exception of some organisations created before, the war marked the rise of most non-governmental organisations (NGOs such as United Nations), government agencies (such as USAID), humanitarian aid organisations (such as International Rescue Committee, CARE, Oxfam) and religious organisations (such as Catholic Relief Services).[56] They were focused specifically in short-term shelter needs, while governments were in charge of long-term reconstruction. From this moment, NGOs began to play an important role in providing emergency shelter in civil conflicts and natural disasters worldwide.

When the Second World War ended in 1945, the **US Federal Public Housing Authority** sent 30,000 prefabricated temporary emergency houses to Great Britain (Fig.28).[57] The emergency family dwellings had 24 square meters, two bedrooms, living room, kitchen and bathroom. The houses shipped were under a lend-lease program to alleviate the housing shortage due to bombings in Great Britain.[58]

In the late sixties and early seventies crises such as civil wars, tropical cyclones, flooding, and large scale earthquakes led to immense numbers of displaced populations, and therefore an increase in humanitarian organisations working in the field.[59] In addition, the subsequent media attention of these events raised the question of what role should be played by the humanitarian sector.[60] The World Bank and other organisations developed several initiatives to help low income populations, through temporary and permanent

Fig.29.Oxfam Polyurethane Emergency House. Lice, Turkey, 1975. Source: Davis/ Fig.30. Oxfam Polyurethane Emergency House-Making Unit in operation. Lice, Turkey, 1975. Source: Architecture for Humanity.

Fig.31. Polyurethane Igloo shelters in Nicaragua. West German Red Cross and Bayer AG, 1973. Source: Davis I.

houses. Several prefabricated solutions were adopted by aid agencies in response to natural disasters, but they were criticized for being inappropriate in terms of culture, climate and cost.[61] One of these solutions was the hexagonal polyurethane shelters built by **Oxfam** during the seventies.[62] Those shelters were built with polystyrene and polyurethane to create a hexagonal plan of 6.5 square meters and were designed for future expansion, joining other similar units. The shelter was used in India in 1970 and after the earthquake in Turkey in 1974 (Figs. 29 and 30). In Turkey, the units arrived two months after the disaster, when around 1,500 permanent houses had been built for the same affected communities,[63] having a minor impact in the recovery.

Another well-known and criticised case was the inflatable polyurethane foam dome produced by **BayerAG** in cooperation with the **German Red Cross**. [64] The dome was built in Turkey in 1970 and 1975 (Fig. 31), in Peru in 1970, and in Nicaragua after the earthquake of 1972.[65] The domes (also called igloos) had a maximum height of 3 meters, an area of 18 square meters approx., and they were intended to last six months. Most of these shelters were rejected by the community and some of them were used as material for improving self-built houses. Moreover, the choice of an extremely combustible building material was not appropriate for a culture that uses open fire.[66] The domes seemed to follow local vernacular building, but the design did not considerate sizes of families or patterns of living. In addition, they were built away from the damaged buildings, therefore underused by the affected communities.

In Nicaragua after the earthquake in 1972, the United States government participated in the relief, through the donation of money to build temporary wooden houses from locally produced timber and corrugated iron sheeting.[67] But the houses were not used because they were remotely sited, without enough infrastructures, such as water supply, sanitation or road access.[68] The lack of transportation to reach central markets determined the underuse of the shelters, because victims of disaster were not able to purchase cheap food nor have access to their source of livelihood.[69] One year after de disaster, only 35% of the houses were occupied, although when some services were provided, the occupancy increased. [70]

The Oxfam shelters, the Red Cross domes and the US wooden huts were underused due to several reasons, among them the location of the units, often away from transportation routes, and cultural rejection of unusual forms.[71] Although these were not the only solutions given by these organisations, the repeated failure in giving adequate housing solutions led these organisations to rethink their approach.

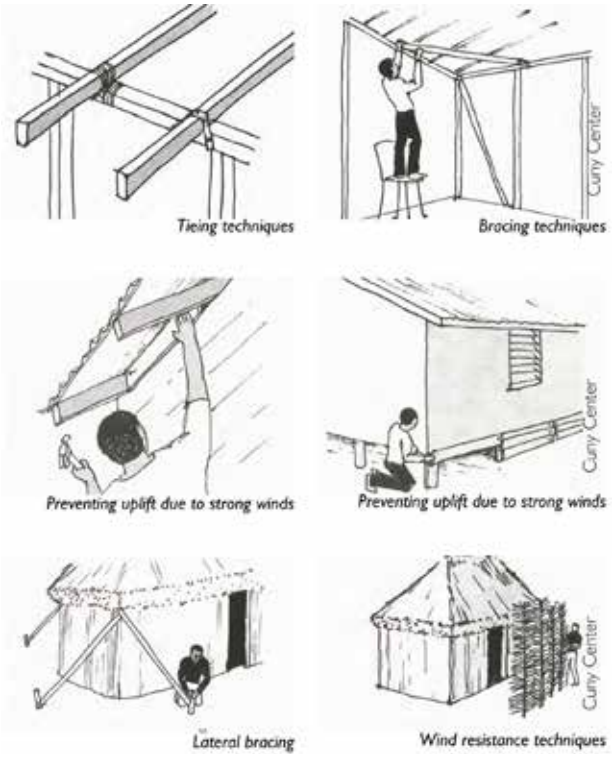


Fig.32. Graphic guidelines to build houses, after the cyclone Isaac in Tonga, 1982. Source: UN-HABITAT.

After these experiences, it became clear that *"badly designed shelter and settlement programmes could cause more harm than good."*[72] Later, an International Conference on Disaster Area Housing was held in Istambul, Turkey in 1977 to discuss about this problem.[73] The conclusions were that usually temporary shelter does not contribute positively to post-disaster housing, which promotes sub-standard living conditions and obstructs longer term reconstruction.[74] In addition, it was concluded that post-disaster housing must be considered as part of the normal housing process, through the inclusion of locally produced shapes and with local materials.[75] Although in the conference it was agreed that the options should explore how to improve the support of such housing, imported and prefabricated houses are used today, probably because they still seem to be the faster way to solve the emergency.

By the end of the seventies, several different agencies entered in the field for the first time. Consequently, overall coordination and technical guidance was necessary and "lead agencies" from the UN began their work. [76] The approach was based in guidelines of minimum standards, such as square meters, that helped to set a universal base from which their performances could be measured, but with the risk of not incorporating local adaptation.[77]

In the early eighties, due to the increasing number of long-term refugees some of them due to civil conflicts, the shelter sector started to pay attention to the political impact the settlements could generate.[78] In addition, agencies began to work with an approach based in assisting affected populations through building materials and programmes in housing education. These programmes were aimed to improve local building skills and to raise awareness on how to build safer houses as well as to reduce risks from future disasters. With this objective, pictographs and illustrated information booklets were used extensively, e.g in the 1982 **Cyclone in Tonga** (Fig. 32) and the **Hurricane in Haiti in 1982**. However, a lack of analysis of the results during the following years made difficult to know the real impact these strategies had in the field. [79]

The knowledge acquired through best practices and minimum standards in the sector became the Sphere Project in 1997. The product of the project was The Sphere Handbook, Humanitarian Charter and Minimum Standards in Humanitarian Response.[80] This handbook is an internationally renowned set of common principles and universal minimum standards for humanitarian response. However, these standards have been criticised by some field professionals for being difficult to translate to the particularities of each case.

Fig.33 Transitional shelters in Batticaloa, Sri Lanka, 2004. Shelters were called "microwave ovens" due to their building material. Source: Agostino Pacciani.

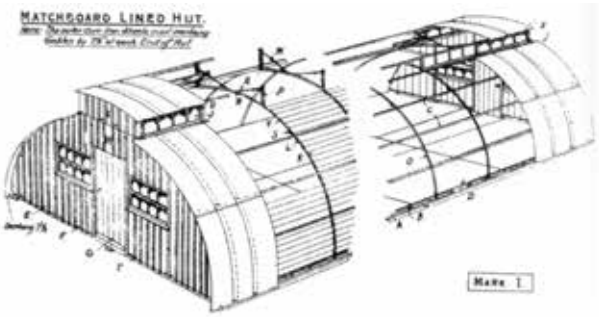


Fig.34. The Nissen Portable Bow Hut, 1917. Source: Kronenburg R.

3.3 Manufacturers

In the past decades, due to a high rate of urbanisation and an increase in the population in hazardous areas, the impact of disasters in terms of homelessness and displacement has been extensive. The large number of emergency, temporary and permanent housing solutions needed, brought prefabricated solutions again to the field. The need of shelter has meant that some new aid organisations without technical expertise have built inappropriate solutions, concerned in quantity rather quality (Fig. 33). Currently it is possible to see diverse alternatives such as metal and wooden frame structures, plastic panels and timber panel houses, among others. In addition, great natural disasters have affected developed countries such as the United States, Japan, Italy and New Zealand, were the solutions differ from the developing world. These countries´ governments have taken the main role in the relief process.

Although the work of the NGOs and agencies has had an important impact after disasters, there are still some complexities to solve in practice. As Frederick Cuny, an American disaster relief specialist and engineer pointed out *"little accumulated wisdom was incorporated into the basic response pattern of the agencies"*.[81] The staff turnover and lack of learning from past experiences is still a problem, as it was discussed in the SHELTER MEETING 12a, organised by Shelter Centre in Geneva, Switzerland and held in May 2012.[82].

The need for housing after disasters in the last century has been seen by the industry as an opportunity to develop new products. The industrialisation played an important role in the solutions given, through prefabrication, new materials and cutting-edge technology. The products developed by manufacturers have been bought by users, by governments and NGOs. The objective of manufacturers is to bring new products to the market seeking profit, therefore most of their products were designed for developed countries, especially after the First World War. Nevertheless, in the past ten years, the industry has found in developing countries, a chance for opening the market to new places. The problem with industrialised solutions in developing countries is that most of them are not culturally based, having a negative impact, and in some cases, rejection from the people affected.

A temporary shelter designed during the First World War that was extensively used by soldiers and later as temporary housing for families was the **Nissen hut** (Fig. 34). Although this prototype was used by the army, it is included here because it was marketed by Nissen Buildings Ltd. The Hut was designed by an officer of the Canadian Engineers, Peter Norman Nissen in 1916.[83] The design was a success due to its simple form, economical use of materials, interchangeable parts, portability, easy to manufacture and easy erection.

Fig.35. Emergency Nissen Huts. London, 1944-45. Source: Vale B.

Fig.36. Quonset huts for students (veterans) in Michigan State University, USA, 1947. Source: Michigan State University.

By 1917 at least 20,000 Nissen huts were in use.[84] Each hut was manufactured with a small number of components: a semi-circular roof made from pieces of corrugated iron, a floor of wooden panels resting on longitudinal sleepers, and two ends, one of them with a door and two windows.[85] The building had 8.2 m. long and 4.9 width and could be erected in four hours by four people using a single spanner.[86] Later, the semi-circular shape was used by Nissen-Petren Ltd. to develop the Nissen-Petren houses, an adaptation of the hut to a mass housing in the UK.[87] The Nissen hut reappeared as emergency housing during the Second World War in London (Fig. 35).

Similar huts were developed later, such as **Romney hut in the UK and Quonset hut in the United States**. Most of them were used during war time as shelter for soldiers and after-war as transitional accommodation for veterans, families and students.

The **Quonset hut** was designed and manufactured by the George A. Fuller construction company, using the Nissen Hut as a reference.[88] The original version was called the T-Rib Quonset Hut and built circa 1941.[89] The standard dimensions of the Hut were 4.9 m. of width and 10.9 m. of length.[90] The hut maintained the semi-circular shape but included some changes such as the inclusion of insulation and wallboards of Masonite® in the interior.[91] The quality and efficiency of the Quonset Hut, allowed its reuse after-war as temporary housing (Fig.36), becoming later in an American icon.

Although the **Nissen, Romney and Quonset huts** were built in large numbers during wartime, they were not used more massively as housing, despite their low cost and durability. The reason might be their curved shape: they look as a non-conventional house; rectangular furniture was difficult to use inside; to insert windows in the curved wall was a complex task; and their actual usable space was less than other types of buildings. However, there are some examples of modified huts that solved this problem such as the Quonset Redesign, which included vertical sidewalls of 1.2 m. high under the curved roof. [92] Despite these modifications another reason for discouraging the use of these huts was the possible associations with the war-time, *"looking back to the war rather than forward to the peace"*.[93]

In North America, another industrialised system was utilised to fulfil the need for housing: the mobile home. The first examples came from the 1919, with the Aerocar built by an aeroplane manufacturer. Nevertheless, the **Airstream Clipper** built in 1936 by Wally Byam was famous for being more ambitious: it included a bath, a dressing room, a kitchen and beds, but was still expensive for most people to buy.[94]

Fig.37 Temporary housing for married veterans of WWII. North Carolina State College, 1946. Source: North Carolina State University Libraries.

Arcon

Uni-seco

Tarran

Aluminium

Fig.38. The four "official" temporary bungalows. Arcon, Uniseco, tarran and Aluminium. Source: Vale B.

However, during the Second World War, bomber factories required a large number of workers, who found in trailer homes an affordable and quickly available housing.[95] In few years the mobile home turned to be a popular form of unsubsidised affordable housing in North America.[96] The industry then, found an interesting market to develop this type of industrialised house.[97] The travel trailers, mobile homes (later called manufactured homes) satisfied the need for housing, due to their affordability and availability.

After the Second World War, the government of the United States bought trailer homes for war veterans and their families (Fig. 37). In the fifties, this **"mobile home"** was massively used, and the industry began to produce variations of the unit, such as extra-long and multilevel, becoming mobile dwellings rather than trailers used as dwellings.[98] In addition, they were popular due to the fact that they did not have the problem of land tenancy, because a place to park the mobile house could be rented for a low price. The availability of these low-cost housing and the concept of transient behind them, encouraged their use as transitional housing in the United States, even with their social connotations (the stigma of the trailer slums).[99] Due to their quick availability, trailers and mobile houses have been used after disasters as a common temporary shelter for families in the United States, such as floods in Oregon in 1948 and Kansas in 1951,[100] the earthquake in Loma Prieta in 1989,[101] and Hurricane Katrina in 2004. Although they are intended to be temporary, they have evolved into a more complete housing unit. They have increased in size and have been used as a starter house, once settled in a more definitive place more rooms can be added.

In the UK the prefabrication had an impact in the construction of permanent and temporary houses. The search for alternatives to traditional forms of construction was crucial, because it detonated ways of saving skilled labour and using materials efficiently.[102] In the UK some 156,623 temporary bungalows were built under the **Temporary Housing Programme** to meet the post-war housing shortage.[103] The Ministry of Works presented in 1944 an experimental prototype commonly called the "Portal Bungalow" which was never used.[104] However, manufacturers were asked to design and build bungalows based in that prototype.[105] From various types produced under the programme, four were the most important in terms of quantity (Fig. 38): the Arcon (38,859 houses), the Uni-Seco (28,999 houses), the Tarran (19,014 houses) and the Aluminium (54,500 houses).[106] They were designed to last 10-15 years, but around 43% of the prefabs built, were still in use in 1995 under the arrangements of the Programme.[107]

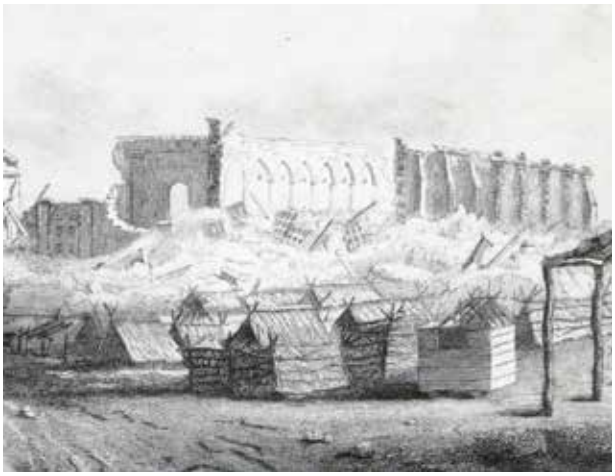


Fig.39. Drawings of temporary huts. Concepción, Chile, 1835. Source: Keynes R.

3.4 Self-built shelters

After every disaster manufacturers have seen an opportunity for introducing new prefabricated housing systems. There is no doubt that a structure demountable, transportable, and easy to erect is perceived in these situations as a chance for easy development. Nevertheless, this kind of solutions, tend to be more adequate in developed countries, where prefabricated building technology is a common system. During the sixties and seventies, low cost housing in developed and developing countries was used for exploring and testing industrialised solutions.[108] Due to bad experiences with industrialised systems in developing countries, they found radical opposition.[109] This opposition was clearly stated by Ian Davis, pointing out that using prefabricated emergency shelters (except for tents) is costly and a waste of funds for developing countries, and therefore should be avoided.[110] Nevertheless, later studies have shown that low technology prefabrication in small scale has advantages to low-income communities and self-help builders. [111]

Displaced and non-displaced communities seek quick ways to get a shelter after a disaster, and usually do not wait until formal assistance begins (which sometimes comes late). However, self-relief without specialised supervision tends to increase risks for future disasters, beginning a new cycle of vulnerability. The relief after disaster, without architects involved, has been probably the most massive way of reconstruction. Nevertheless, there are not enough records of these solutions, excepting for initiatives developed by some organisations in the developing world such as self-help and mutual-aid housing. The most applied schemes under these self-help ideas are those based in upgrading, loans and core houses. Most of these schemes are conceived as transitional phase to reach the permanent solution.

Ian Davis in "Shelter After Disaster"[112] examines some historic experiences on disaster response. The first images in his book are drawings of temporary huts built after the **earthquake in Concepción, Chile in 1835.** These drawings were done by the expedition artist during the scientific voyage that Charles Darwin did to Chile.[113] They are probably the first careful records of a shelter after a disaster (Fig. 39). The community organised a mutual assistance, where the higher classes helped the lower, through setting people to build huts and temporary dwellings. Consequently,

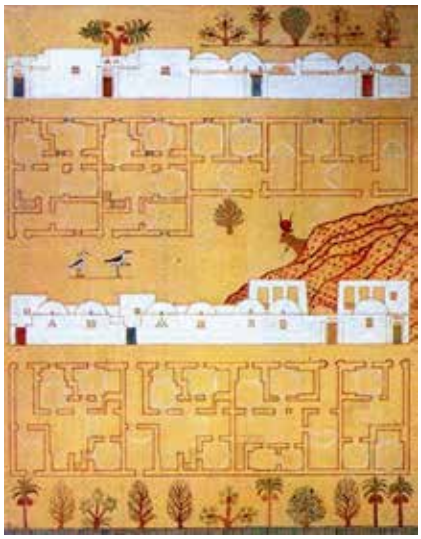


Fig.40. Plan of New Gourna Village Egypt, Hassan Fathy, 1946. Source: Architecture for Humanity.

Fig. 41 Aquatic architecture. House boats in Shanghai's Soochow Crew. Source: Rudofsky B.

after a few days everyone had a shelter. [114]
The repeated failure of renowned architects in designing transitional and permanent housing after the First and the Second World War generated disillusionment in some professionals. This disappointment triggered a debate within the discipline and a self-help housing movement.[115] The movement argued that homeowners had successfully built their own houses for generations without any support.[116] One of the experiments near to this movement was driven by **Hassan Fathy in Egypt** in the thirties, through a mud-brick building village called New Gourna (Fig. 40). [117] The project failed because villagers did not want to participate in the process of design, because they knew they would be resettled and they also expected to receive finished products. [118] The critique from architects was that the village did not fulfil the desire of residents for modern living.[119] However, the experiment left a legacy and it influenced some architects working in popular housing in the developing world.

In the fifties Charles Abrams and Otto Koenigsberger developed in Ghana the roof-loan scheme, as part of a United Nations mission.[120] In this program, families who built themselves the foundations and walls received loans to buy the roof, doors and windows. [121] Later the "core-housing system" was developed, in which organisations built one room that usually had basic services and families could expand it through time.[122] Otto Koenigsberger realised that successful systems of mass-produced and prefabricated housing in Western countries were not ideal in the Third World.[123] He understood that in those countries, labour costs were low while the cost of transporting imported houses was high.[124] But the aided self-help also encountered some difficulties: it was successful in rural areas where people used to build their own houses, but not in towns where they had jobs and could not find time off for house building.[125]

John F.Turner, a British architect launched a self-help rebuilding programme in Arequipa, Peru after the earthquake in 1958.[126] In this programme, people were able to design and build their own houses.[127] They received support for financing them, while the programme negotiated the loans from the Inter American Bank.[128] The "aided self-help" was a precedent for "sites-and-services" where plots, roads, water, and sewage, were provided and the communities could build their own houses. [129]

In 1964 **Bernard Rudolfsky**, following this interest in self-built solutions, presented an exhibition and a publication about vernacular architecture called "Architecture without architects". The aim was to re-appreciate the philosophy and know-how of the "anonymous builders" (Fig. 41). [130] He wanted to learn from the wisdom of "primitive" solutions,

Fig.42. Pictographs to educate communities in Guatemala. Oxfam and World Neighbors,1976. Source: UN-HABITAT.

which anticipated the later technology systems, such as prefabrication, flexible and movable structures, air conditioning, light control elevators, subterranean towns, among others.[131]

Following the idea of self-help, the Christian organisation **Habitat for Humanity** was founded in 1968 in the United States by Millard and Linda Fuller.[132] In 1973 they developed their first project in Zaire (Democratic Republic of the Congo), and in 1976 they formed Habitat for Humanity International.[133] Their concept was different from other self-help programmes because they relied on volunteer work, donated materials and money, and building with the help of homeowner families.[134] Advocates of this program found advantages in involving volunteers instead of forcing family wage earners to give up paid work in order to build their houses.[135] However, there are criticisms on the cost-effectiveness of this concept, due to the high costs paid by foreigner volunteers (travelling and subsisting), and the slow process of rebuilding difficult large-scale projects.[136] In addition, the supported families had to show the capacity to pay for their home and the need for housing,[137] a challenging factor for low-income families or homeless people.

The sites-and-services and self-help models changed the approach from institutional support to self-reliance. Athough this approach has had many successes, it has also encountered some pitfalls such as the tendency to relocate communities, difficulties to assist people without formal land tenure, and the emphasis on quantity rather than quality.[138] Later, the tendency was moved to upgrading slums, an agreement where governments and organisations gave land tenure and some infrastructure, and squatters improved their own houses.[139]

Since the seventies onwards, the concept of self-help found its place in disaster relief, and poor communities were seen as a resource.[140] The **World Bank** was founded in 1944 as International Bank for Reconstruction and Development (IBRD) *"as facilitator of post-war reconstruction and development"*.[141] In 1972 it launched initiatives for slum-improvement that later gave way to the concept of upgrading.[142] The sites-and-services and self-help models changed the line from institutional support to self-reliance.

The role of designers in this self-build model was questioned, and they were relegated as trainers rather than designers.[143] **Frederick Cuny** tried to make the connection between disaster and development, through training families to build safer houses in Nicaragua after the earthquake in 1972.[144] In 1976, he worked with Oxfam and World Neighbors after the earthquake in Guatemala to educate communities with "pictographs"

(Fig. 42).[145] The concept was to provide roofing and materials for the families so they could later use them to build permanent houses.[146]

It is known that the industrial sector with prefabricated prototypes has had a minor role in the relief of developing countries and that self-built solutions have been stronger in the reconstruction after disasters, with or without external support.

In developing countries, the majority of the rebuilding process is done by the people affected using their own resources. Nevertheless, bad quality reconstruction without proper technical supervision has left houses and families more vulnerable for future disasters.[147] The humanitarian sector has recognised this challenge and is currently giving importance to training for people to be able to transfer skills, communicate good practices and to get communities participating in the designing and building. The problem found in this system is the difficulty of replicating and building at a large scale with good quality, due to a lack of specialists in the field able to supervise the complete process.

Fig.43. Prototype of A-frame housing in Guatemala. Intertect and Carnegie-Mellon University, 1976. Source: Davis I.

Fig.44. Prototype of A-frame housing in Bangladesh. Intertect and Carnegie-Mellon University, 1976. Source: Davis I.

3.5 Universities

In the developed world, it is very common for almost every architecture school to run a studio, seminar or workshop to teach how to design a disaster relief shelter. Moreover, students' competitions of emergency and transitional solutions are frequent. The premise is that the homeless communities after a disaster require outside aid to replace their destroyed homes.[148] There are good examples of initiatives, student groups and architecture courses that are rethinking ways of responding to disasters with a wider perspective. Furthermore, through a volunteering system, university students have played a role in rebuilding after disasters, giving their time in the immediate aftermath as well as building for communities affected in the medium term.

Although recent competitions organised by Habitat for Humanity have caused significant repercussion in the media, design competitions for emergency and transitional shelters are not new. In 1975, the International Union of Architects held an international student competition where *"many ingenious (but widely impractical) ideas emerged."*[149] Most of the designs relied on advanced technology rather than cultural issues, using materials such as fiberglass, sprayed concrete and plastic among others. Only one design used indigenous materials and local building skills with western expertise.[150] The winners project was a prototype developed by Cuny's organization, **Intertect, and Carnegie-Mellon University** (Figs. 43 and 44) under the direction of Professor Hartkopf and Charles Goodspeed.[151]The low-technology project was built with a bamboo A- frame and relied on indigenous materials and building skills, but using western expertise.[152] The system was tested in Guatemala after the earthquake in 1976 and in Bangladesh refugee camps.[153] The multi-family shelters used in Bangladesh were designed using bamboo poles, palm thatch, matting and jute rope.[154] The floors were raised against flooding, and alternative models were designed considering the numbers of families.[155] The problem with this system was that the design reduced the indoor space and the extension of the shelter was difficult due to the A shape.[156] In addition, the manuals designed in the US were too detailed for volunteers to follow and work teams preferred to be trained verbally, slowing down the rate of construction and making it impossible for a large scale production.[157]

In the past 30 years, some universities have included disaster recovery as part of a more coordinated group or course. Some examples are the MIT, Portland State University, University of Texas at Austin, and Oxford Brookes.

Fig.45. Demountable shelter prototype developed by students. Liverpool John Moores University, Centre for Architecture, 1993. Source: Kronenburg R.

At the Massachusetts Institute of Technology (MIT), the Special Interest Group in Urban Settlement (SIGUS),[158] established in 1984, focuses on service, participation and non-traditional client groups in both developing and developed countries, including post-disaster situations.

Another example, called Basic Initiative[159] was co-founded in 1985 by Sergio Palleroni[160] at the University of Washington. Currently is a collaboration of faculty and students from Portland State University and the University of Texas at Austin. Its focus is in designing and planning to improve local conditions. The initiative has developed some projects after disasters, including the Katrina Recovery Project and Houses for Haiti. In addition, it's teaching approach for designing and building, gives students skills through practical work for real clients and experience with community development.

In the UK, the School of Architecture at Oxford Brookes University holds research groups in the topic as part of the Oxford Institute for Sustainable Development (OISD)[161] and the Centre for Development and Emergency Practice (CENDEP).[162] Since 1991 it offers postgraduate studies related with shelter after disasters, humanitarian action, development and emergency practice. Although the emphasis is not in design but an interdisciplinary approach, students have developed some prototypes for recent disasters.

There is a large number of transitional accommodation designs developed by architecture and engineering students during the past decades (Fig. 45), because it is a recurrent topic, especially when a disaster strikes. Nevertheless, there are not enough records of the shelters developed. Most of them have appeared in university news and journals, but the majority do not include detailed information. On the one hand, they have been only experimental processes, and in students' competitions where utopic and futuristic prototypes predominate, with some exceptions. On the other hand, they have not been used and therefore, have not had an impact in the field. Nevertheless, in the past years, due to the media coverage of disasters and internet access, projects developed by student have been seen more frequent. Some of these projects were included in the following chapter due to fact that they have been developed over the past ten years.

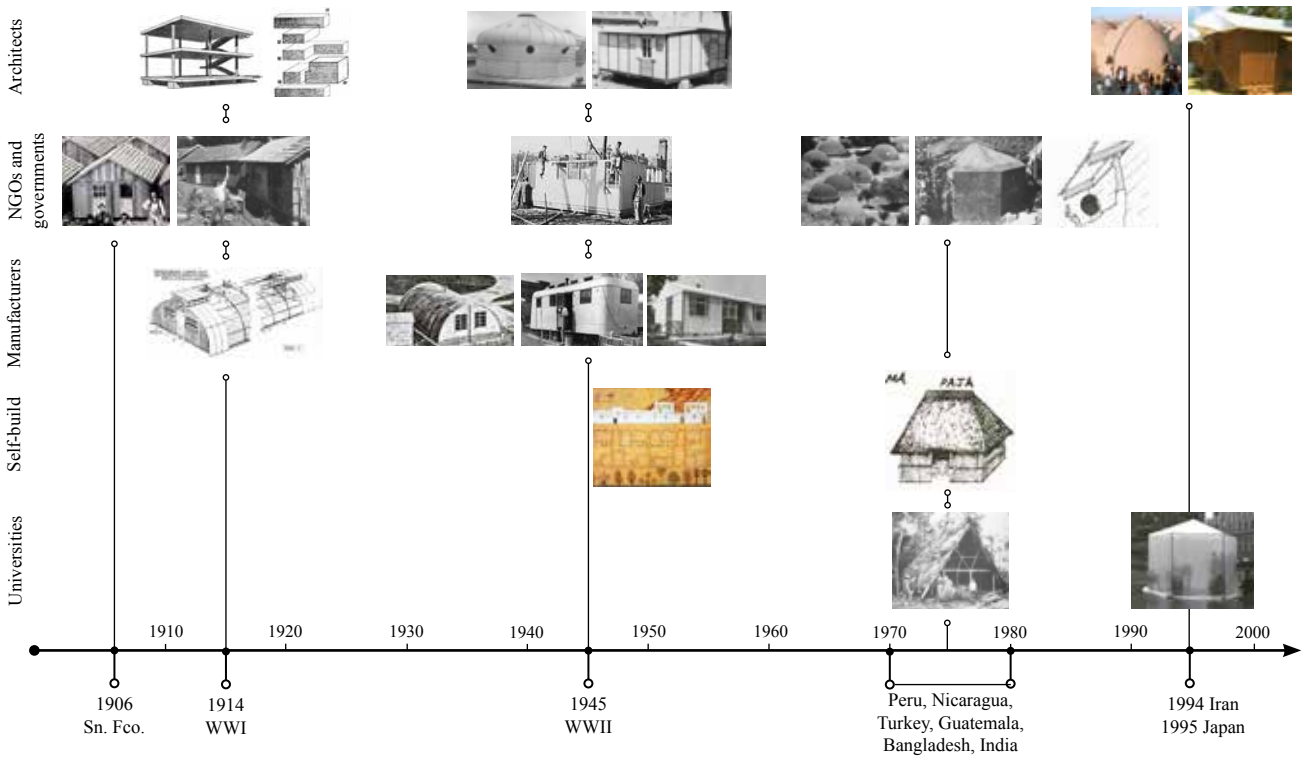


Fig.46. Disaster timeline and responses by group.
Source: Author. See Image Credits.

3.6 A century of innovative explorations

This chapter shows that giving shelter after disaster is a topic that has inspired architects and engineers since the early years of the twentieth century (Fig. 46). Most known and recorded examples are from the First and the Second World War due to the extensive damage they generated in several countries. The need for reconstruction has attracted innovators and manufacturers to the field, but most prototypes have been experimental without a real impact in the field.

Probably most transitional accommodations built for disaster relief have been developed by anonymous (or not renowned) designers and delivered by governments and NGOs in large scale operations. Buildings designed for disaster reliefs are coded in terms of economic, logistical, and material efficiencies, and therefore, sometimes are less innovative that other topics (or less appealing) in terms of design. Nevertheless, prominent architects have been involved in this field, especially after the First and the Second World War, where the shortage of housing pushed forward the construction industry. Unfortunately, designers have been constantly blamed for giving ingenious solutions that do not work. Criticisms have pointed out that

> *"Emergency housing is often seen by designers, architects and engineers, and in some cases, the relief agencies, as an opportunity for generating innovative designs impossible to implement"* [163]

Apart from the groups presented separately here, solutions can be divided according to their approach: high-tech or less technological. The manufacturing industry found a new market in post-disaster shelters, and an opportunity of giving massive housing solutions through prefabrication. At the same time, some architects engaged with the illusion of the development of a housing industry parallel to cars and aircrafts, tried to innovate with sophisticated pieces and assemblage systems. On the other hand, other architects, and NGOs disillusioned by the inappropriate solution to post disaster housing (mainly that the technology created was for developing countries), tried to develop low tech approaches, most of them related with self-built and participatory projects.

Both approaches have their advantages and disadvantages, but history has shown that before developing new experimental innovations, it is essential to review what has been previously done in the field. Most prototypes that are currently being explored were somehow done before, or have past precedents. There are important lessons to learn from them, not only in terms of shape, structure and materials, but in social acceptance and implementation.

IV. CURRENT PROJECTS AND PROTOTYPES

IV. CURRENT PROJECTS AND PROTOTYPES

Although each disaster is different and unique, it is possible to learn from past experiences in order to understand what it is replicable and what it is not. The previous chapter shows an historical review of some experimental projects, key solutions and experiences in the field. The current chapter aims to map solutions available in the past ten years, ranging from some experimental prototypes, to solutions used extensively. This catalogue of examples can contribute to build a panorama of the work done by different sectors involved in giving transitional accommodation after a disaster.

The question of why there is a mismatch between the designs developed by architects and designers and the solutions given in the field, is explored here by comparing examples. The analysis is developed through objective parameters such as square meters and cost, to learn from current solutions what the opportunities for improvement are.

This chapter uses similar categories to those used in the third chapter, but NGOs are separated from governments, because their work on shelters, in the past decade, has been more independent. Self-built solutions are only included as examples and not in the comparison, because there is no global solution possible to analyse nor was it not possible to get accurate information for making a comparison. The reason for maintaining these categories is because each of them is driven by different objectives and therefore it is easier to see how they follow some patterns. In general, the objectives of each category are:

a) Universities and studio courses. To teach their students by design-built prototypes, to innovate through new approaches, materials and techniques, and to get more recognition.
b) Architects, designers and engineers. To seek innovative and appealing designs.
c) Manufacturers. To enter into the market and to gain profits.
d) NGOs and Agencies. To solve an international humanitarian problem.
e) Governments. To solve a national problem, to avoid social-political conflicts and to recover normality in the country.
f) Self-made builders. To solve their shelter problem promptly.

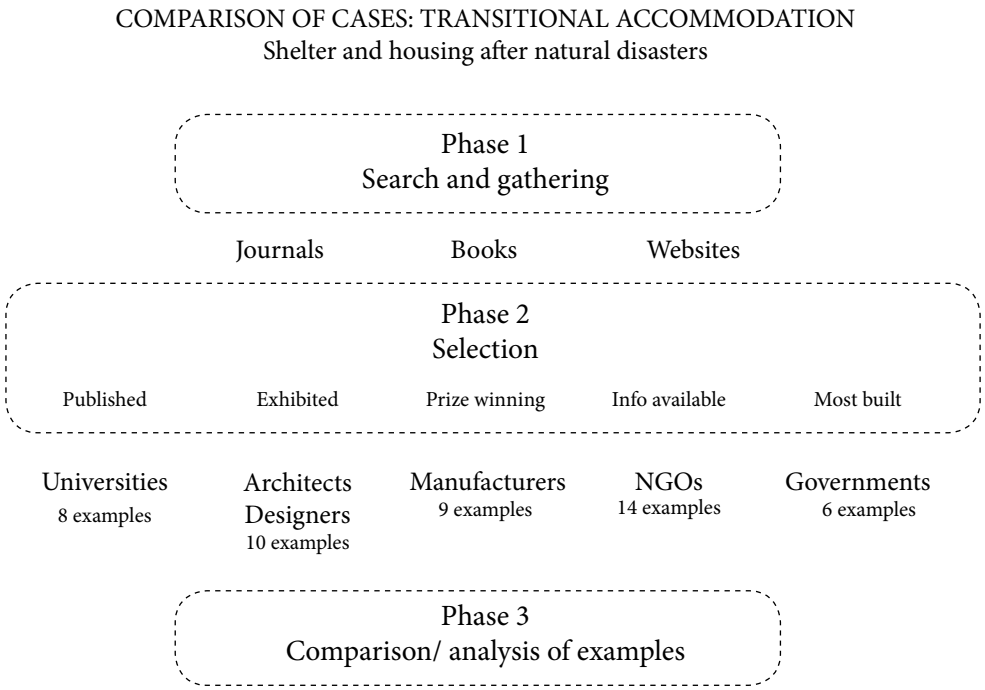


Fig.47. Methodology process.
Source: Author.

4.1 Methodology and selection of cases

The methodology includes gathering, selection and analysis (quantitative and qualitative) of the examples (Fig. 47).

Gathering

The gathering field of transitional accommodation examples designed and implemented in the last ten years was obtained through diverse data sources (websites, journals, and books). This collection distinguishes innovative shelters in different countries affected by disasters, and includes a database to analyse their technical aspects and how they fit (or not) with the local culture and climate. The search was open to diverse geographic areas and types of disaster in order to find solutions from developing and developed countries and from a wide range of events. Nevertheless, due to the large impact of some disasters, several examples are from the same place, e.g. Haiti in 2010, and Indonesia in 2005. In the third chapter, some post-war cases were presented, due to their historical significance. However, only shelters after natural disaster are compared in this chapter, because it was not intended to discuss in this thesis social or other political implications that shelters may have under those circumstances. In addition, the search did not look for information about camps and settlements but for units, materials, costs, performance, life span, square meters, in order to focus the attention on housing. The collection set a database to analyse their technical aspects, in order to make comparisons between cases, identifying gaps between them, classifying materials and techniques.

The criteria used were:

- First, to search in scientific journals through databases such as Science Direct, Web of Knowledge, Web of Science, Scopus, in order to get recent information supported by editorial committees and peer reviews.
- Second, to search in databases not included in scientific databases but known in design fields, such as Avery Index (Architectural Periodicals).
- Third, to search in respected and architectural websites: such as archdaily.com and openarchitecturenetwork.org (architecture for humanity)
- Fourth, to search in University websites, in Departments of Architecture and Engineering, looking for laboratories, projects and thesis.
- Fifth, to search in Agencies, NGOs and aid organisations websites.
- Sixth, to search in websites of architects firms in order to find more information about specific projects found.
- Finally, in books and journals of architecture and humanitarian relief.

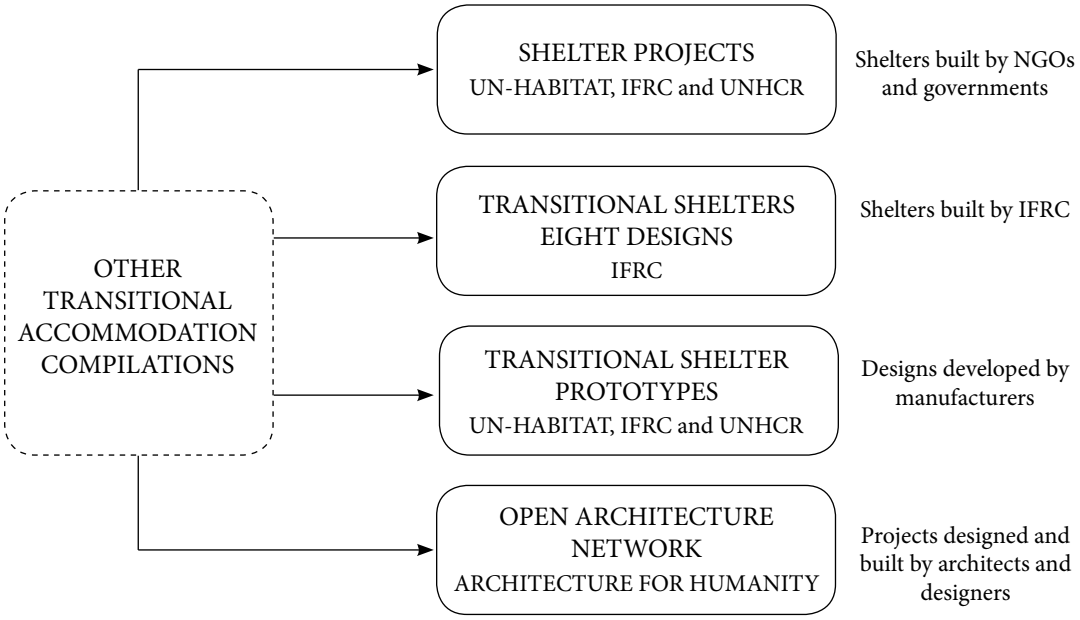


Fig.48. Other transitional accommodation compilations
Source: Author

Through the process of searching, other compilations were found (Fig. 48):

- UNHABITAT, IFRC and UNHCR. Shelter Projects 2008, Shelter Projects 2009 and Shelter Projects 2010. Around 100 case studies of post disaster and post conflict shelter built in the past 100 years.
- IFRC. Transitional Shelters. Eight Designs. 2011. A compilation of tried and tested transitional shelter designs deployed by IFRC.
- SHELTER CENTRE. Transitional Shelter Prototypes. November 2009. A compilation of six transitional shelter prototype designs developed by manufacturers in collaboration with the humanitarian community.
- ARCHITECTURE FOR HUMANITY/ Worldchanging/ Open Architecture Network. An on-line network, which gives open source access to design solutions by architects, designers and builders. The information is a range of projects built and un-built, competition projects presented and winners.

These compilations were useful due to the completeness of their information. They present solutions from their specific area focused in NGOs, manufacturers and architects solutions, but they are not compared transversally, a study that is developed in this research.

Selection

With the information gathered, a second phase was to select cases with the following criteria:

- Architects and universities: the most built, published, exhibited and prize winning examples.
- Manufacturers: the most documented cases and/or prototypes built by manufacturers specialised in the area.
- NGOs, aid agencies and governments: the most documented cases and the most built prototypes.
- Self-built: Some available pictures. Due to the lack of information in this group, only some pictures were selected as examples.

In addition, the cases from whom the most complete information was found were incorporated into their corresponding group.

It is certainly possible to find more examples of transitional accommodation to compare. The examples presented here are a selection that presents a comprehensive view, made during the nine months time-frame of the research.

Ultimately, 53 cases were selected: 8 are designs by Universities, 10 by architects, 9 by manufacturers, 14 by NGOs, 6 by governments, and 6 self-made (Fig. xx). Some of them, although were designed more than ten

years ago, were included in the comparison because they have been used or exhibited recently, they are currently available in the market or they were used in recent disasters.

Selected cases from NGOs have been probably designed by architects or engineers working for the organization, but they were included in the NGOs category due to they have not been published in books, websites or journals related with the discipline, therefore, are in general not known by architecture researchers.

The majority of the information used for the comparison was gathered through the Internet, and some data were asked directly to manufacturers, when was not available online. Most of manufacturers had as a policy do not send information to privates (a research student, in this case), but only to humanitarian organisations. Therefore there is some information lacking in some parts of the comparison. In addition, it was easier to find full information from transitional accommodation developed by NGOs and agencies, than any other category. Therefore, in the comparison there are more cases in that group.

4.2 Comparison of prototypes

With the cases selected, was developed a table with data including: number of units built, dimensions, time used to build, building team, square meters, costs, materials, lifespan (the data with full information can be found in Appendices). In addition, several graphs and drawings were produced, in order to compare the selected cases quantitatively and morphologically, with the aim to understand why the designs developed by architects have been widely recognised, published and awarded, but not used.

The question is: are universities, designers and manufacturers giving adequate solutions?

Universities

Digitally Fab.
2008

Seed
2009

Flatpack
2010

Mediagua UDD
2010

Viv. Eme. Progres.
2010

Recover
2010

Architects, designers, engineers

Future Shack
2001

Hexayurt
2002

Pallet House
2004

Concrete Canvas
2005

DH1
2006

Graph
2009

Manufacturers

Intershelter
1993-

Icopod
2002

Global Village
2004

Liteyurt
2006

TS200
2009

Transhomes
2009

NGOs, Agencies

U-Dome
1977-

Mediagua UTPCH
1997-

Steel Frame Vietnam
2004

Ecoshell
2005

Steel Frame Indonesia
2005

Timber Frame Peru
2007

Timber-Bamboo Peru
2007

Governments

FEMA Trailers USA
2005

Prefab China
2008

M.A.P Wooden Cabins Italy
2009

C.A.S.E. Buildings Italy
2009

Self-made

India
2001

Bangladesh
2007

Indonesia
2009

Indonesia
2009

Haiti
2010

Fig.49. Transitional accommodation examples selected, organised by group.
Source: Diverse, see Image Credits.

Liina
2011

Shelter Project
2011

Red housing
2009

Softhouse
2010

Casa Elemental
2010

Shipping container
2011

Mark III
2009

Habihut
2010

MK5
2010

Bamboo Frame Indon.
2009

Timber Frame Indonesia
2009

Transhell
2009

Timber Frame Pakistan
2010

Steel Frame Haiti
2010

Series 1100 Haiti
2010

Tshel2
2011

Timber House Chile
2010

Kasetsu Jutaku Japan
2011

Haiti
2010

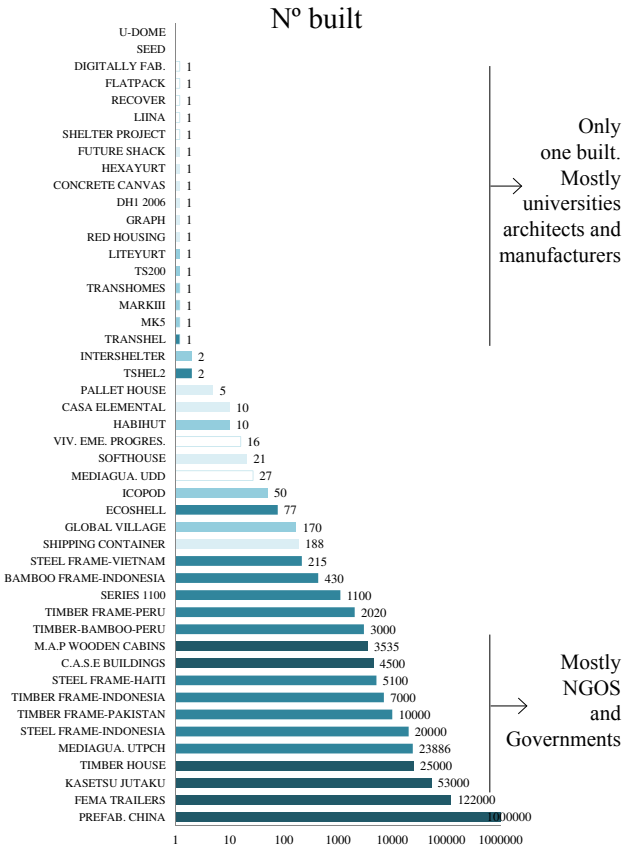


Fig.50. Nº of accommodations built by example. Bar graph in logarithmic scale. Source: Author

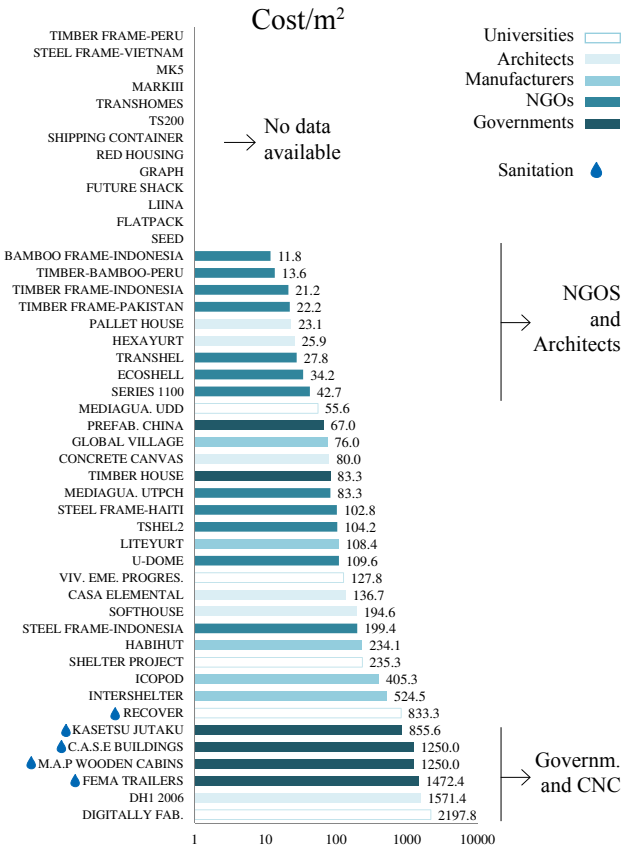


Fig.51. Cost/ square meters by example. Bar graph in logarithmic scale. Source: Author

Number built

The number of solutions built and used in the field (Fig. 50) shows that most cases developed by universities, architects and manufacturers have been more experimental and they have not had a real influence in sheltering after disasters in comparison with NGOs and Governments accommodations. While most experimental examples range from 1 to 188 shelters, NGOs and governments from 215 to 1,000,000 houses built. Some cases have been designed in the last two years, but others ten years ago or more, and they have not been used more massively during the last decade.
Why some of them have being built in large numbers while some others do not? It is an economical issue? The reasons for these differences can be explained by several factors; among them the lack of achieving some standards, high costs or complex shapes, as will be seen in the following comparisons.

Costs

The examples were compared by costs per square meter, in order to get a ratio easier to compare than the final cost. From most NGOs was possible to get this information, but almost one half of architects and manufacturers do not include this data in their projects on their websites and publications. That indicates that for architects, the costs are not fundamental in this kind of projects, whereas for donors and NGOS it is a central point.

The graph given in figure 51 shows that the most expensive solutions coincidentally used digital fabrication as design-building process (design in CAD software and pieces cut by CNC machinery). They were developed by a university team and a designer, and both are based in a set of pieces that can be cut on a machine and assembled in place without using nails. This technology it is supposed to be more efficient, but in costs it is still not competitive with other shelter solutions.

The majority of governmental solutions are among the most expensive cases, above 850 USD per square meters, which could be explained by the quality of the houses (Italy), the technology used (FEMA trailers), or the cost of materials and products in the country (Japan). In addition, these cases include toilets, and therefore have more costs associated with that facility.

The graph showed that a comparison of costs is in general fictitious, because building a house in Indonesia is not the same as building it in the USA, due to labour costs, transportation, among other factors. Moreover, the materials involved and facilities can increase the costs. A comparison using the same prototype in different countries after disasters could be more realistic, but this comprehensive study intends to compare different cases in diverse countries.

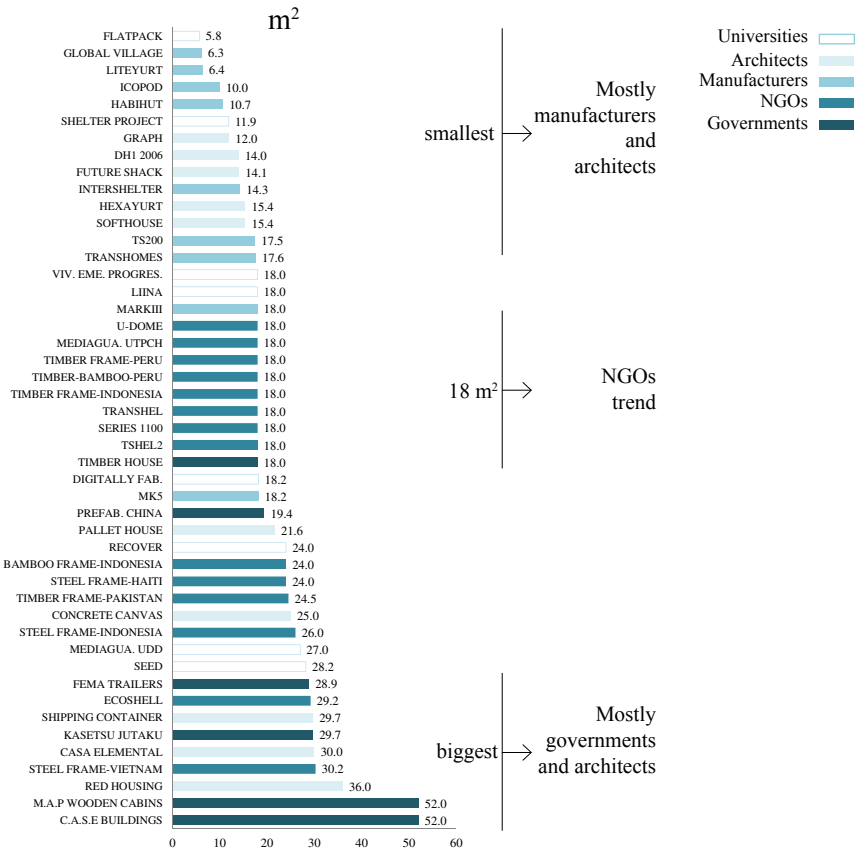


Fig.52. Square meters by example
Source: Author

Square meters

Figure 52 shows a comparison of areas of shelters from minor to mayor values, from which it is possible to identify some patterns:

1. Most NGO and agency solutions tend to have a similar area of 18 m². None of them have less that this area covered, and other NGO solutions range from 24 to 30 m². That could be explained by the usage of current standards and indicators in the humanitarian sector. Specifically, Sphere standards recommends that the minimum covered floor area per person should be 3.5 m² while UNHCR recommends 4.5-5.5 m² in urban or cold situations.[1] Considering that information, it is possible that most NGOs focus on giving solutions to families from 4 to 5 people (18 m²/4.5=4 and 18m²/3.5=5.1), in order to fulfil the minimum standards.
2. Most manufacturers have designed shelters of 18 m² or less. That could mean that some of them consider the Sphere and UNHCR standards, while some others do not intend to build for families of 4-6 people. In that sense, some manufacturers could be designing without fulfilling the requirements used in the field by the humanitarian sector. In addition, the objective of manufacturers is to gain profit; it is possible that smaller solutions are cheaper (information that will be discussed in the following pages). Nevertheless, if they do not reach the minimum standards, they have lower probability of being used in the field. Architect's solutions can be found in both extremes in the graphic: between 14-15.42 m² and between 23.2-30 m². The area covered by these prototypes seems to be a result of other concerns, such as materials, shape and morphology, more than the number of people who need to be sheltered.
3. Governments lodgings presented in figure 52 tend to be among the biggest, excepting cases in Chile and China. These data could distort the information, due to the differences between more and less prosperous countries.

Another issue considered, was to distinguish accommodations that include sanitation, because they should increase the size of the housing. The bar graph in figure 52 shows that effectively most shelters with facilities are among the largest, with exception of two projects developed by architects. Among the largest cases, four are housing solutions given by governments, showing that facilities are an important issue in these countries (USA, Japan, and Italy). Nevertheless, including kitchen and toilets is not always an adequate solution, because some cultures do not have them inside the house. In addition, when doing so, there are some other implications to consider; such as the infrastructure needed, something that it is not always available, especially in temporary solutions.

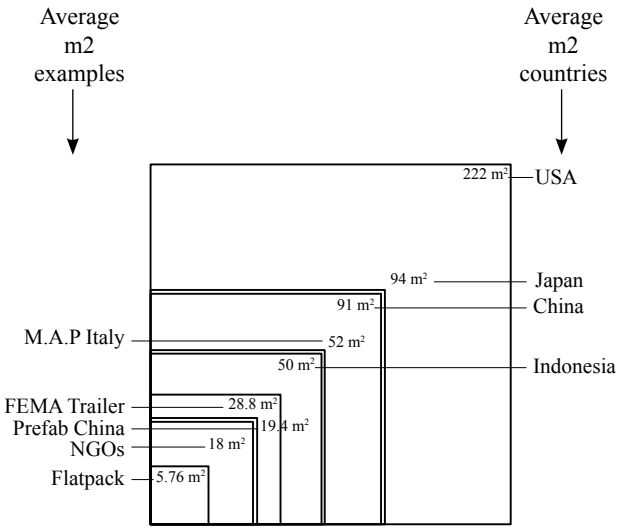


Fig.53. Average square meters of housing per country, compared with some examples. Source: Author

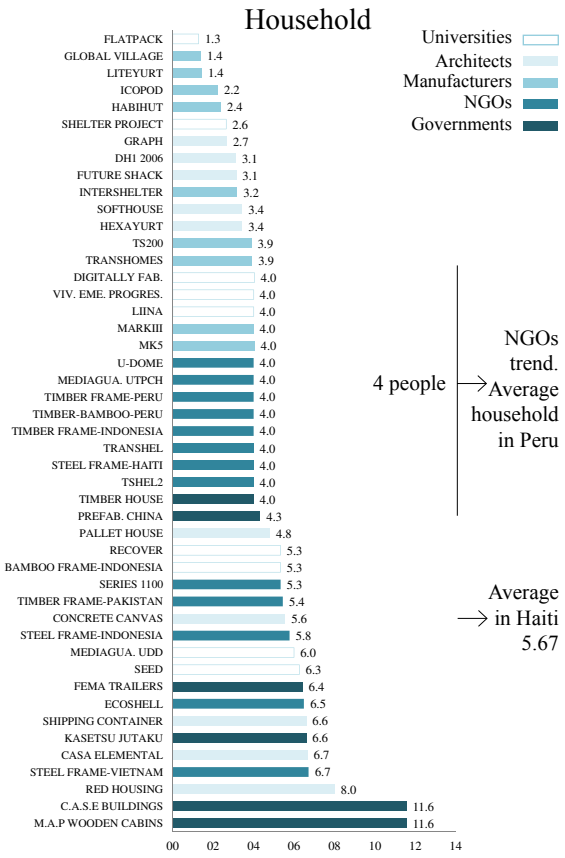


Fig.54. Capacity of people sheltered by example. Square meters/ 4.5 square meters (UNHCR indicator). Source: Author

The division between developed and developing countries was not defined in the comparison of examples. Nevertheless, information about average housing square meters in different countries was included and considered relevant for the analysis. Average areas do not always reveal standard square meters used by low income population (the most common target of transitional solutions). Nevertheless, these areas can be used to compare expected housing dimensions in each country.

Figure 53 shows the differences between the average square meters of housing per country and the cases selected in the analysis:

• In the USA, the average is 222 m^2, while a standard FEMA Trailer is around 28.87 m^2. The average is around seven times the transitional solution.

• In Indonesia, the average approx. 50 m^2, while transitional solutions given by IFRC are between 18 and 26 m^2. Therefore, the transitional solutions seem to have a reasonable area in relation with the average.

• In China the average is 91 m^2, and the prefabricated solution given by the government is 19.44 m^2. Therefore, the average is almost five times the transitional accommodation.

As can be seen, ideal values do not fit in every country, such as the dimension of a standard transitional house of 18 m^2. Nevertheless, international organisations have general patterns in order to have a unified action plan and to evaluate their own performance. Architects and manufacturers should consider this information by country when designing a solution for shelter.

Households

Besides area dimensions, households and family sizes are important to develop a design for shelter after a disaster. Figure 54 shows the number of people each temporary solution can shelter, under the UNHCR standards in urban areas (4,5m^2/person). That information is compared to average household in different countries. A household can be either one person or more living together *"who make common provision for food and other essentials for living."* [4]

Similar to average square meters, there are differences in how many people live in a house in each country. In the USA, Japan, Italy and China average households are between 2.47 and 2.88,[5] while in less developed countries the size of household tends to be greater, such as 3.5 in Chile,[6] 4 in Peru[7] and 5.67 in Haiti.[8]

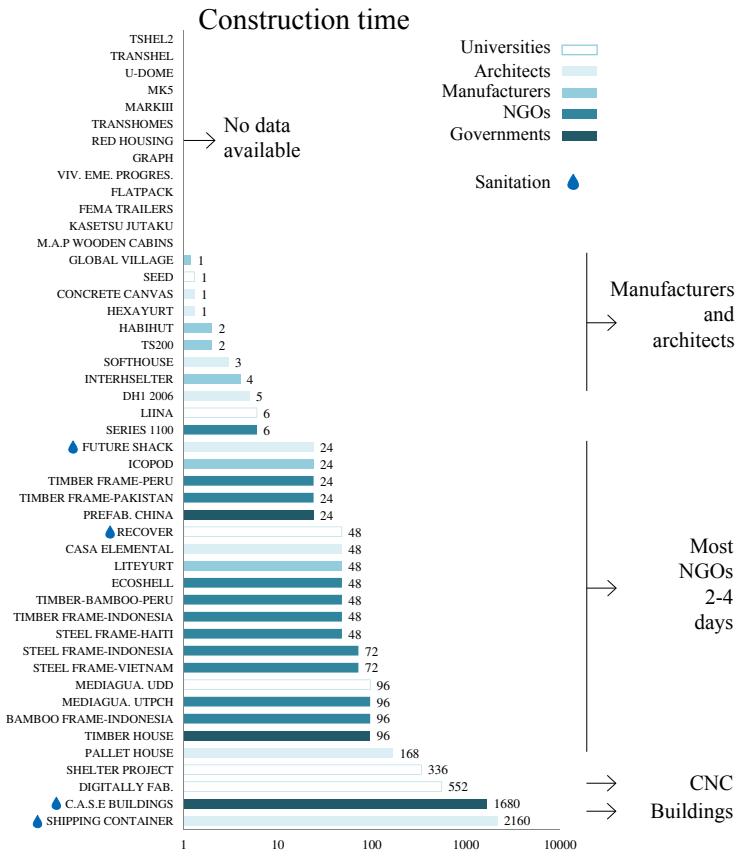


Fig.55. Construction time by example. Bar graph in logarithmic scale. Source: Author

Considering that most solutions in developing countries should shelter at least 4 people, all accommodations under that minimum, are inadequate for them. As it can be seen in figure 54, most cases with less than 4 are manufacturers and architects buildings, showing that they are not incorporating these important standards when designing, while NGOs show a clear tendency to follow a minimum standard.

Construction time

One of the important issues in the relief after a disaster is the rapidness of deploying, building and setting a transitional housing.

In figure 55 it can be seen that most NGOs solutions need between 48 and 72 hours (2-3 days), while most architect's and universities solutions are concentrated in the extremes between 1-6 hours and 168-2,160 hours (7-90 days).

The cases that need more time for being built coincide in two characteristics: they are part of multi-story building and have sanitation included. These features could explain the reason why they need more building time: facilities have infrastructure associated and the dwellings cannot be used until the whole building is finished.

The third slowest in terms of assembly, with 552 hours (23 days) needed to be finished, is the prototype *Digitally Fabricated* developed by MIT. This shows that surprisingly that technology is still less efficient in these types of constructions, where most simple prefabricated panels need less time to give a shelter, such as *UTPCH* with 96 hours (4 days).

Another trend that shows this graph in combination with the number of solutions built, is that the fastest cases, which need less than 1 day for being built (between 1-6 hours) have been in general fewer solutions (1-21 shelters built), with exception of *Series 1100* (1100 built) and *Global Village* (170 built).

From this information, it can be inferred that while some manufacturers, architects and universities are concentrated in designing fast solutions similar in time deployment to tents, NGOs tend to use a slower building technique (probably more local), but still fast in terms of shelter provision (2-4 days).

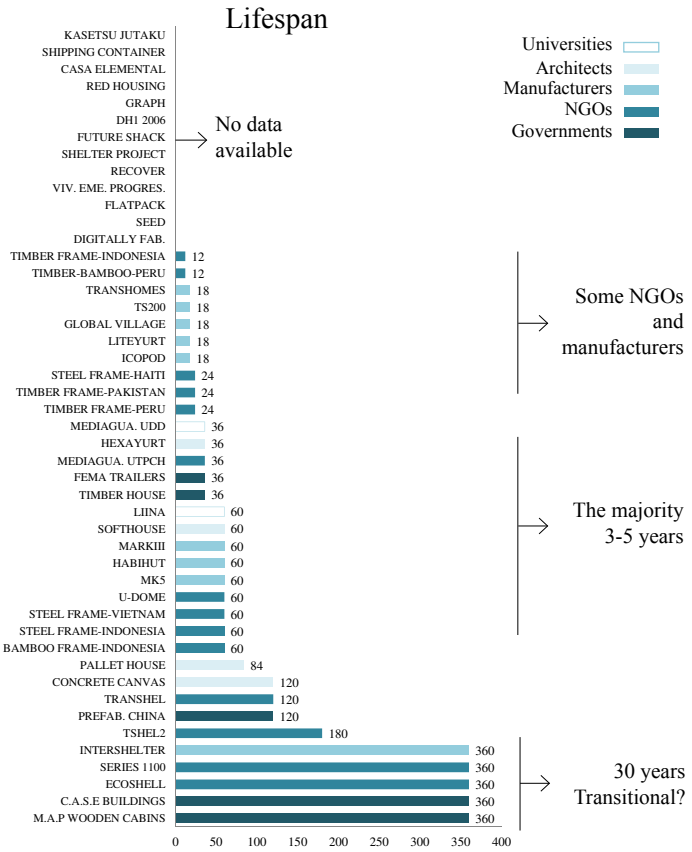


Fig.56. Expected lifespan by example
Source: Author

Lifespan

Although all cases are intended to be transitional, there are several differences among them in terms of building durability. Some of them are not designed to be disassembled and reused while others are designed for being easily dismountable. Currently there is no agreed indicator or standard on housing durability, because materials and local considerations differ from one region to another. For example, wood is considered a durable material in developed countries but not in most developing regions, or a temporary house in some places is built with cardboard and plastic whereas in others with bamboo or mud.[9]

In figure 56 it can be seen that there is not a clear tendency in NGO solutions, but most of them are between 24 and 60 months of lifespan (2-5 years), which seems to be a reasonable time for a transitional housing.

Some NGOs, one manufacturer and one government offer solutions with a life expectancy of 360 months (30 years). Even though they are still temporary and not intended to last "forever" like a permanent house, they are intended to be more durable than standard transitional housings. If each case is analysed more in detail, it could be possible to understand the reasons for the large lifespan of some of them. For example, the government of Italy developed these projects as transitional solutions, with the aim of using these houses later for rent (students, new families, etc.) when affected families move back to their original locations.[10] Therefore, the buildings are temporary and transitional for displaced families affected by the earthquake, but less temporary in terms of the building life.

The two least durable cases are designed by NGOs, and they share some similarities in the materials used, such as a frame and natural fibre matting (bamboo and fibre). Nevertheless, they are intended to be used as material for upgrading the permanent solution, and therefore, extend their life.

Most designs by manufacturers have a life expectancy of 18 months (1.5 years), which is a minimum for a transitional phase, and sometimes is extended longer. The main problem is that they are mostly built with plastic panels as walls that cannot be used later in a future house or as a part of an upgradable accommodation, diminishing the lifespan of the solution.

Therefore, the lifespan comparison shows mainly three types of solutions: a) the lasting ones, based in a transitional situation with a more permanent building, b) the transitional housing, between 2-5 years with the possibility of extending their life as a permanent building once upgraded, and c) the temporary buildings, which are disposable after their usage, although the material can sometimes be recyclable.

Shapes

In addition to the quantitative analysis, a comparison of shapes was done, in order to seek similarities and patterns in terms of morphology. The plans were drawn at the same scale including the entrance and indicating if they have sanitation included inside the building.
The plans show that there have been several attempts to explore different morphologies, such as rectangles, squares, crosses, circles, pentagons, hexagons and decagons.

From the comparison it can be easily inferred that the shape most used has been the rectangular area with the entrance in one of the long sides followed by the same shape but with the entrance in the short side.

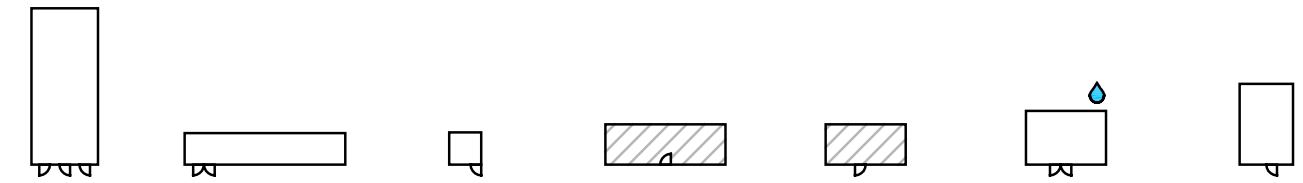
Most of the experimental cases, with shapes other than rectangles, can be seen in projects designed by architects and manufacturers. Most of the pentagonal, hexagonal and decagonal examples have those shapes for maximising the material and due to their building technique.[11] The majority of these non-rectangular shapes are built with a series of panels, without a frame, following a geodesic geometry in the line of Buckminster Fuller's domes, using contiguous triangles to build the shelter.

The problem with these shapes is that they are usually not accepted by affected people due to diverse factors, among them: they have no relation to the local type of construction, they cannot be upgraded or accommodate added rooms, and finally furniture such as beds and shelves do not fit well in such geometry.

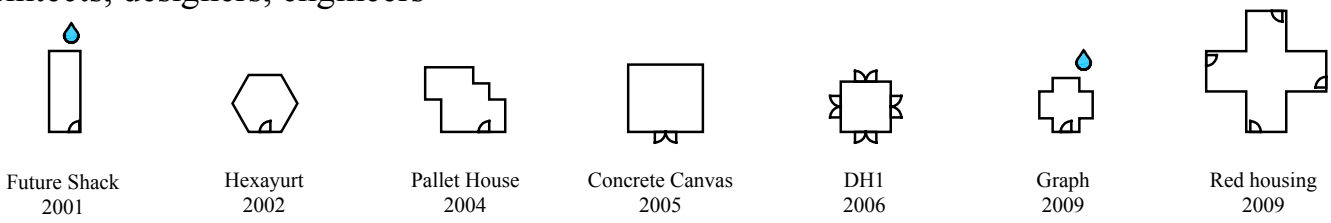
In addition to the shapes, the number built is included in the comparison, in order to see if there is a relation between the form and the preferred models.

Due to the large difference among cases built, a logarithmic scale was used (1-10-100-1000). As can be seen in figure 57 in the following page, the non-rectangular shapes have not been extensively used in the last decade, and just three of them are in the range of 10-100 shelters built. The reasons behind these differences are several, and the shape cannot be the only factor that influences the selection of a housing type. Factors such as cost, material, conservative local tastes and even fixed contracts between organisations and industries could explain the usage of a specific model.

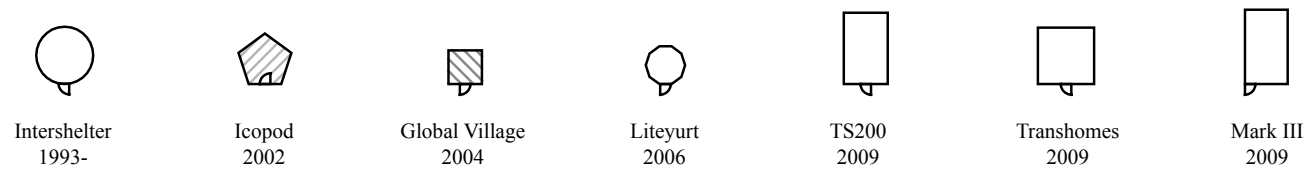
Universities



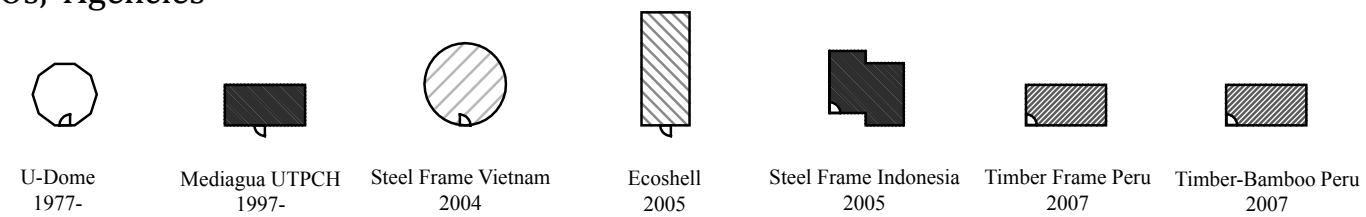
Architects, designers, engineers



Manufacturers



NGOs, Agencies



Governments

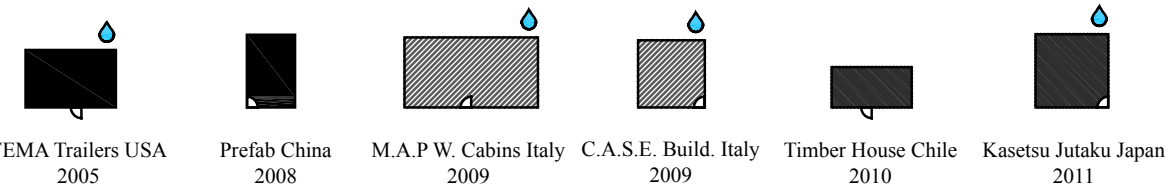
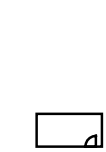
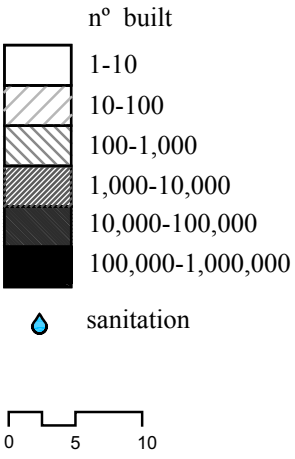


Fig.57. Plans of the examples and number built
Source: Author



Shelter Project
2011



Softhouse
2010

Casa Elemental
2010

Shipping container
2011

Habihut
2010

MK5
2010

Bamboo Fr. Indon.
2009

Timber Fr. Indon.
2009

Transhell
2009

Timber Fr. Pakistan
2010

Steel Frame Haiti
2010

Series 1100 Haiti
2010

Tshel2
2011

4.3 Trends and patterns

The data shown and comparisons done here, show that universities, architects and manufacturers need to understand the problem of transitional accommodation better. While their designs are innovative in terms of materials and speed of deployment, most of them do not consider important aspects such as minimum standards, number of family members and costs.

Numbers

In relation to the number of shelters built within selected cases, it can be seen there are three kinds of projects: a) the examples built but not relevant in the field, therefore not implemented, b) examples built as prototypes in small numbers and c) examples built and implemented in large numbers.

Hence, a question arose: Why some of them have been applied and some others do not? Although how governments and humanitarian agencies select specific types of shelters was not studied here, the comparison among cases suggests that issues such as cost, square meters, shape and adaptability in most built shelters have followed similar criteria.

However, is the number of cases built directly related with the success of a project? Evidence suggests that it is not. Some cases used extensively have not been necessarily successful. For example, FEMA trailers in the USA after the Hurricane Katrina were built in large numbers, but many of them were toxic and brought social and economic problems.[12] In contrast, in the past some prototypes not used in the field pushed the boundaries of the design and building technology. For example, the Domino House or Jean Prouve's prefab proposals were not used in large numbers, but they had an impact in the architecture and the development of modern technologies.

The relation between number of units built and innovative projects can be seen in areas different from architecture. Using the automobile market as an example, each year companies show their cutting-edge inventions and launch new models. The objective is not to enter directly into the market, but to show and to learn from cutting edge technologies, in order to push the limits of innovation. Therefore, those designs are usually far from reality and current needs. Nevertheless, at the same time, car's companies produce every year more "traditional" models to fulfil market necessities, and those are built in large number.

Could architecture use a similar strategy? Some can argue yes, but if so, it should follow two parallel paths: a) the experimental one with the objective of having repercussions in the future, and b) a more realistic one with the aim of solving the immediate needs. Currently, architectural practice is not doing either of them in the

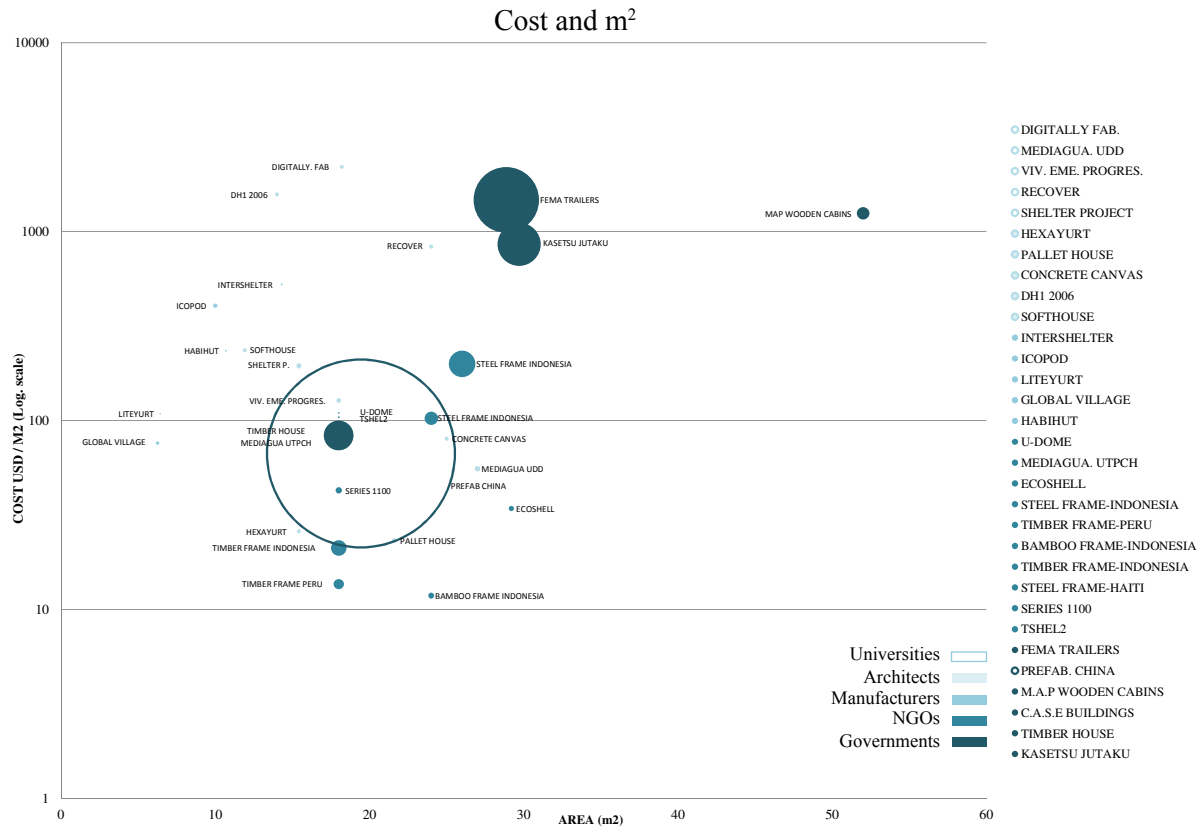


Fig.58. Cost (logarithmic scale)/ square meter by example. Circle size represents n[a] buit. Source: Author

humanitarian field. On the one hand, most innovations are not being introduced, even years after building a first prototype, and on the other hand, in real responses architects have not had a clear nor important role.

Cost

The comparison demonstrates that there are great differences in costs among cases, but there are many factors that influence their prices, such as materials, amenities, building techniques and country. Therefore, costs were compared with other relevant information in order to see some patterns and trends.

Graph given in figure 58 compares information of: cost by square meter, area (m^2) and number of shelters built (size of the circle). As can be seen, budgets and square meters in developed countries (USA, Japan and Italy) are significantly higher that the costs used for temporary shelters in China and Chile. In addition, these shelters are the largest, and moreover have toilets inside, which increases the costs with a supposed better quality.

Among the most expensive cases but with a smaller area than government's shelters are two projects (by a university and a designer) that coincidentally utilises the same building technology (CNC), showing that in terms of cost efficiency they are still not competitive.

The trend in most NGOs, and especially in those examples most built, is to have an area around 18 m^2 and with costs between 12 and 50 USD per m^2, with exception of the cases *Steel Frame Indonesia* and *Steel Frame Haiti*. Both cases are built with steel,[13] a material more expensive than timber or bamboo, and probably imported, which means more transportation, which would explain the higher costs of these examples.

In the graph it is also possible to see that most projects by universities, manufacturers and architects are among the smallest, as was discussed before. In addition, their costs are higher than the majority of NGO shelters. Therefore, these prototypes should have less chance of being implemented.

There are some exceptions to this tendency of designs done by architects with a bigger area than the standard built by NGOs and competitive costs: the *Pallet House* and *Concrete Canvas*.

Initial prototypes of the *Pallet House* were done in 1999, and it has been exhibited extensively during the last decade, while *Concrete Canvas* was invented in 2004 and has received several awards. Then, why have they not been used? Some reasons could be: they have new and not accepted morphologies and materials not easy to build in the field.

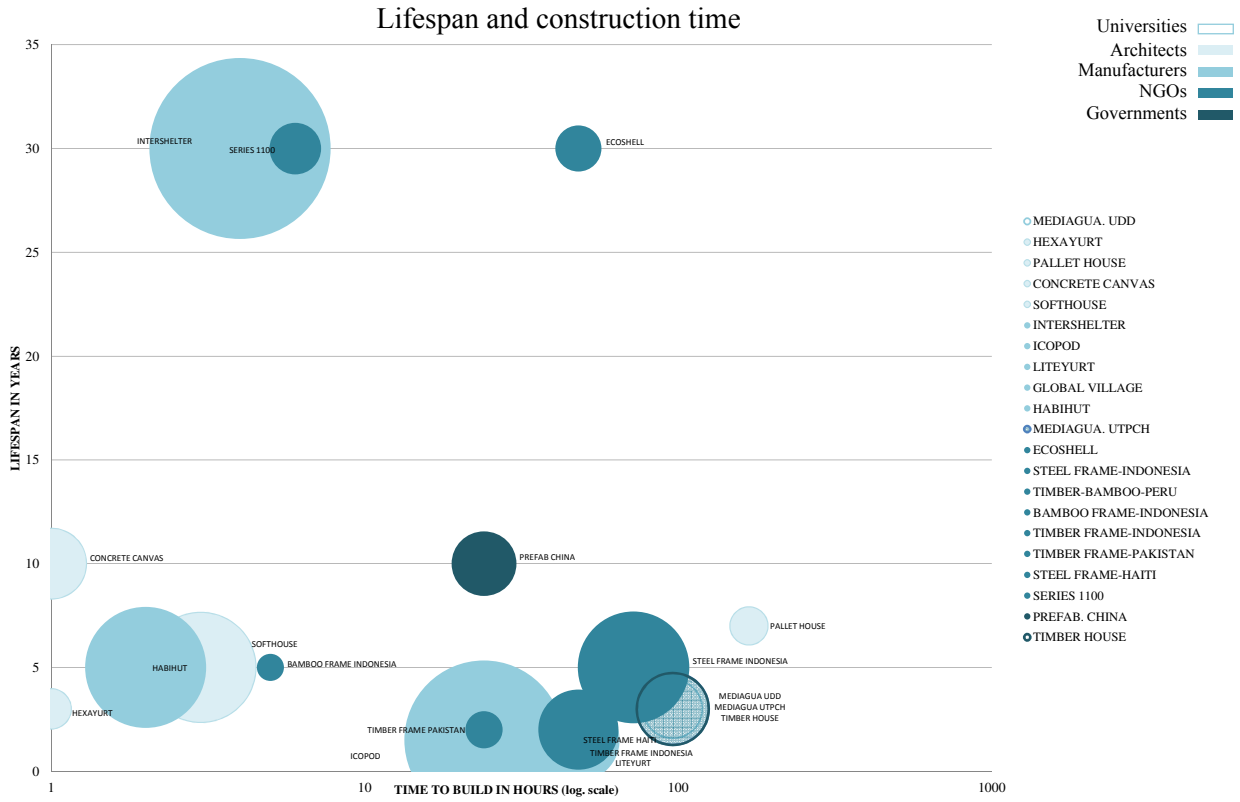


Fig.59. Expected lifespan/ construction time. Circle size represents cost. Source: Author

There are other reasons that could help to understand why they have not being used. On the one hand, in relation with *Pallet House* a) pallets are not always available after a disaster, in the amount needed to replicate the shelter in large numbers and b) some pallets have wood treatments that are toxic to humans, and therefore not suitable to use as material.[14] On the other hand, in relation with *Concrete Canvas* a) to build this shelter requires water, a scarce resource in some post-disaster situations and b) the morphology of the shelter seems unconventional, do not have windows, and is difficult for adding rooms, and c) the shelter is not easily transportable and the material is not reusable.

Lifespan and construction time

This evaluation of lifespan, time to build and costs has fewer cases than the previous comparison, due to lack of information. Data was found from one university and 21 out of 47 examples from the other groups. Nevertheless, the exercise of comparing information was done anyway in order to find trends. In figure 59 the size of the circle represents the cost/m^2.

In terms of efficiency, the fastest cases to build should have a shorter lifespan, but projects compared do not follow this logic. While to building a *Pallet House* takes around 7 days (168 hours) to last 7 years, a *Concrete Canvas* shelter is deployed in only one hour, to last around 10 years. Therefore, the graph shows there is no defined correlation between time to build and lifespan. In addition, if the lifespan is around 5 years, the difference between 3 and 7 days of construction is probably negligible. However, most cases concentrated in less than 5 hours are from architects and manufacturers, showing that they are more interested in fastest building techniques than governments and NGOs.

Around the 80% of cases compared have a lifespan between 1 and 5 years, while only 3 cases go far beyond, with an expected life of 30 years.

Among cases with 30 years of lifespan there is not a clear pattern. It could be inferred they have similar materials,but do not: *Ecoshell* is built with concrete and rebar,[15] *Intershelter* with fiberglass-composite mixture and a gel coat[16] (the most expensive solution in the graph), and *Series 1100* with metal frame and plastic fabric. While the first it is not designed for being dis-assembled or reused, the second and the third have a more flexible design, which allows for transporting the shelter. In terms of building form, *Ecoshell* and *Intershelter* are domes, a shape more difficult to use as a core house for adding new rooms. On the other hand, *Series 1100* has a rectangular shape and a frame that allows future expansions, and for that reason includes the idea of a long recovery process in the shelter design.

Fig.60. Polyurethane Igloo shelters in Nicaragua. West German Cross and Bayer AG, 1973. Source: Davis I.

Fig.61. Ecoshell domes adapted by users, 2008 Source: Ikaputra

Historical

With the historical review of cases built and designed in the past century and the compilation of current designs, a question arose: What have we learned from historical experiences? Moreover, is it possible to find similarities, differences and opportunities for improving future designs?

From time to time manufacturers and architects have proposed solutions, similar to unsuccessful past experiences based in rapid construction and resistant structures to face hazards such as earthquakes and storms. In terms of structural resistance, constructions such as domes are highly recommendable, and therefore have been widely accepted by the engineering community. However, when domes are analysed by their social acceptance and local relationship with traditional building techniques, they frequently receive criticism.

As an example, it is possible to compare the *Ecoshell* (Domes For The World) used in Indonesia in 2006 with the *Polyurethane Igloo Shelter* (West German Red Cross and Bayer AG) used in Nicaragua in 1973. Although they were built with different materials, they faced similar problems, such as the difficulty of being upgraded and adapted to local ways of life (Figs.60 and 61). In both, residents tried to adapt their domes to a more familiar image of home, and in addition, to cover windows and doors from the rain, with extensions.

Evaluations of *Ecoshell* in Indonesia show that users found difficulties in changing and adapting the domes to their necessities.[17] Apart from the importation of building techniques and a not traditional shape for them, the lack of flexibility for future additions and improvements it is considered the main problem.

This example shows there is a lack of institutional memory in the field and little information is transferred. Historical cases and current available designs should be studied before developing a new project. Sometimes the problem is simplified through imitations of vernacular shapes using new technologies. But, if other factors are not considered, the results are designs without sensibility to local realities. In addition, adaptability to future extensions appears to be an important issue to consider when designing. If the solution can be part of a continuous process, analysis in adaptation, social acceptance and risk plans should be done.

CONCLUSIONS

Between 2005 and 2010 approximately 19,800,000 people became homeless[1] due to an increase in natural disasters. Unfortunately, risks for future disasters have increased due to informal building and lack of expert supervision in the process of reconstruction. NGOs and relief agencies have pointed out that there is a lack of professionals in the field, and governments usually do not have the capacity to control or supervise the full process.

Relief after disaster is usually organised in three main phases: emergency shelter, transitional accommodation and permanent housing. This thesis is focused on the transitional accommodation, the intermediate phase, because it is a key stage in the process of recovery and solutions given have been criticised for transplanting foreign architecture without considering the characteristics of place (people's involvement, culture, climate, and landscape).

History shows that architects, manufacturers and NGOs have designed ingenious relief shelters, such as prefabs, inflatables, mobile, tensile, geodesic domes and cardboard tubes among others. These proposals have been published and exhibited, but few have been used and many of them have been inadequate for local communities. In addition, competitions for designing shelter after disasters have appeared massively during the last decade, but most interesting and appealing designs have not been built, or only some prototypes have been used. Architects that question the effectiveness of competitions, say that although designs presented develop great ideas, they do not understand local conditions. On the other hand, architects that defend their existence say they help to raise awareness of disaster sites.[2]

It is possible to argue that architects and designers are called upon to innovate, imagine and project a better world, while culturally people tend to stabilise and maintain traditional ways.[3] Therefore, there is a permanent conflict between innovative designs, the projects developed by the humanitarian organisations and the solutions expected by communities.

The reasons for the mismatch between the proposed solutions and the real problems of disaster relief are several. However, the main factor is a misunderstanding on the situation, with designs based on the designer experience rather than actual victims.[4] Ian Davis, author of the book "Shelter after disaster" and a respected researcher in post-disaster, has labeled these misunderstandings as "myths".[5] These myths have been perpetuated and supported by the media, such as that the victims wait for external aid *"dazed and helpless*".[6] Nevertheless, after a short period of shock, affected communities can actively get involved in the reconstruction, and therefore, influence designers'

response to the situation. Furthermore, the number of permanent and transitional homes built informally through self-recovery is usually far larger than those built formally through aid programmes.[7]

The right answers to the wrong questions

Evidence presented here shows that architectural practices as well as manufacturers' products have been ingenuous when designing for post-disaster housing. Cheap, light and portable paper tubes shelters by Shigeru Ban and cheap, solid and spacious sand-bag shelters by Nader Khalili could be examples of good designs, but without more repercussion in the humanitarian relief[8] with few cases built even though widely published. In addition, several architects still embrace technological and even utopic ideas based in the machine age which have been published everywhere, but have had little resonance for aid workers who are more focused in planning and policies.[9]

Then, why have these innovative solutions been widely published but have not been used? It is argued here that this is because they are trying to answer the wrong questions.

Universities, architects and manufacturers intend to push the boundaries of development through innovation, with short assembly times, new materials, shapes and building technologies. Nevertheless, as it was seen in the comparison of cases, only few of these prototypes and projects have been implemented. Most projects by universities, architects and manufacturers are trying to design a shelter easy and fast to build, mainly prefabricated, transportable, and globally replicable, with a lifespan of 2-5 years, with recyclable materials or environmentally friendly.

However, after a disaster the question to answer is different: How to design a shelter easy and fast to build, mainly with local materials, following the agreed standards, with community involved in the design, upgradable, resistant to local hazards, easy to add rooms, customisable and culturally acceptable? If the innovations are excellent prototypes to show cutting edge technologies but are too far from focusing in the right questions, they will not have an impact in housing after a disaster.

Unfortunately, in general architects and designers have been more interested in generating academic debates about innovative prototypes, publishing and exhibiting their projects, but not solving the real problem, with exception of some cases. Nevertheless, in latest years, some architects have brought to the discussion the role of architects into the process of relief, recovery and development after disasters. Books, such as "*Beyond Shelter. Architecture and*

Human Dignity" by Marie J. Aquilino, "*Design Like You Give a Damn*" by Architecture for Humanity, and "*Expanding Architecture. Design as Activism*" by Bryan Bell and Katie Wakeford, among others, are initiatives that change current perspectives over the architect's influence in the society. There is no a clear "humanitarian design movement" because priorities and interest are diverse, but there might be some common thoughts between an architect who builds a transitional shelter in Peru and another architect who builds a school for a low income community in the Himalayas.

Architectural education

In a world with an increasing frequency and impact of natural disasters, architecture schools have a role to play by giving students exposure to and experience with this problem. Although some architecture students have created and led organizations with a significant impact after disasters, there is still uncommon to find this topic in architecture curricula.
The issues in the humanitarian field are complex, due to political, economic and social implications that design could have. Nevertheless, most simple aspects, such as to calculate costs of a prototype for a house after disaster, where resources are scarce, are uncommon issues taught in a studio. Finally young architects learn about costs in the practice, and therefore their projects come from naïveté, and are difficult to apply or utopic.

The global solution.

Architects and manufacturers have been trying to find a universal solution to solve the problem of transitional accommodation in a world scale. Although prefabricated shelter systems are not recommended by UNHCR due to their high costs, long shipping time, extensive production time, assembly problems and lack of cultural ground, architects have continued to design prefab solutions, because they seem to be the quickest way to give a solution of shelter.
But, it is there a global solution? In terms of design that shelter does not exist, because every case is different, and it would be impossible to find only one shape or material which fits everywhere.

The 'best-fit' solution, then, must be more than a technical and fast system and must include different aspects of the relief rather than only giving a shelter. The transitional solution should be included in a process where the relief, rehabilitation and development are part of an integral plan.[10] Then, the best solution should consider two elements: the financial and human resources, and the mid to long-term.[11]

To understand particular disasters, it is necessary to have information and resources prior to the event, or

to have easy access to them.[12] Preparedness aims are vital to ensure a well-shaped post-disaster assessment, but preparedness is a difficult task to achieve, even though most disasters occur in disaster prone areas. In prone areas, such as seismic zones and coastal areas, it is possible to have a preparedness planning, but most local governments are still failing in this point.

Community participation

Some architects having understood the failures in massive housing solutions, have developed projects based in community participation. These projects, although probably less published and less known than some star-architects designs, have had a large impact in the development of affected communities. Participative reconstruction is usually more successful than massive and top-down experiences promoted by some humanitarian organisations without social participation.[13]

When fast solutions are needed, vernacular building technologies and local knowledge are considered inefficient, even though in many cases experience that community has on the land and the natural phenomenon can be crucial for a reconstruction plan. Some reasons for not including a participatory process could be: a) usually it takes more time, b) there is a tendency to evaluate the success of a program by the number of houses built, not by acceptance and involvement of communities, and c) in some cases it is easier to import materials and technical expertise rather than using local opportunities.

Progressive solutions

> *"We have now learnt that when a progressive and incremental process of housing and reconstruction is denied to the poor, the burden of investment all at once often pushes people back into the insecurity from which they emerged."*[14]

Transitional, as it was said in this thesis, should be understood not only as temporary solution, but a bridge between the phases of the reconstruction process. A sustainable future for transitional accommodation it is based on strategic planning and design, which include their future use and transformation.

As C. Johnson points out:

> *"The most economically, socially and environmentally sustainable forms of reuse are: rental of temporary housing to low-income residents, reuse as new community buildings, and units acting as core for permanent housing.*"[15]

Although incremental core house programs have been developed by international organisations since the 70s, they have not always been successful. One reason for failure in these projects has been the lack of quality in self-built expansions. Nevertheless, agencies are currently conscious that they need to incorporate relief in the process of development, and therefore they are trying to tie transitional solutions with long-term projects, including incremental or progressive housing programs as a way to reach this goal.

The comparison showed that some NGOs and manufacturers have built shelters based in frames that can be moved later into a different location and their walls can be upgraded with more permanent materials. In contrast, most temporary housing prototypes designed by architects and manufacturers have been unsustainable because adaptation or transformation are usually not considered. The fixed and complete imported solutions bring raise some long-term problems: they increase the danger of foreign aid dependence; hinder local confidence and economic growth.[16]

After the 2010 earthquake in Haiti, the Shelter Cluster recognised there was a need for transitional shelters and semi-permanent solutions, such as progressive housing.[17] The Shelter Cluster identifies as good practice progressive solutions that can be upgraded to a permanent house, if they ensure a better construction quality.[18] If there is no planning and supervision on the whole process, and the transitional accommodations do not have high quality, the society affected goes into a persistent cycle of vulnerability. Finally, transitional shelters adapted without regulation and other informal solutions developed by people affected can increase the risk from future disasters. There is therefore, an opportunity of developing designs with more comprehension of the progressive and incremental aspect of the transitional solutions.

The construction of permanent houses as a process that begins with the simplest shelter is not a new idea, and therefore, should not be a concept difficult to introduce. In the developing world housing has always been an incremental process, because people do not build their houses at one time.[19] They used to adding rooms and facilities through the years, and once they have the budget to improve their houses, they build again.

Sustainable recovery

International organizations, agencies and donors have invested large amounts of money and efforts in reconstruction following disasters in the last few decades. With the increase of money used in relief, the attention has turned to building sustainable disaster reduction with the objective of reducing repetitive

investment.[20] This recovery requires focusing not only in rebuilding infrastructure and housing but in addressing economic, political and social needs, also. The implementation of such recovery implies sometimes profound changes in public and private activities including mitigation for future extreme events, and therefore, it must be conceived as a long term process.[21]

At a global level, a sustainable development should reduce the risks faced by vulnerable people exposed to natural hazards. In the World Summit on Sustainable Development in Johannesburg 2002 (informally known as Rio+10), some agreements were reached as linking disaster risk reduction and sustainable development.[22] One of these agreements related to this thesis is the Millenium Goal "Cities without slums".[23] The commitment of this goal was to improve the lives of slum dwellers by 2020, and to mitigate the risks of earthquake, flood, landslide, storms and epidemic disease in Least Development Countries.[24] In Rio+20, developed in June 2012, global concerns about disasters were discussed and some organisations made new commitments, such as: enhancing emergency preparedness capacities and systems for stronger national resilience (United Nations Office for the Coordination of Humanitarian Affairs, UNOCHA); resilient cities and nations collaborative platform, to reduce disaster risk (United Nations International Strategy for Disaster Reduction, UNISDR); urban resilience to the impacts of natural and human-made crises and post-crisis rehabilitation (UN Habitat). Therefore, there is a global concern to diminishing the impact of hazards and to use the resources on disaster response and humanitarian assistance in development and risk reduction.

Further investigation

Due to the duration of this MPhil and the complex topic of giving appropriate transitional accommodation after disasters, several questions that arose during the research were not answered and that could be part of a future and more extensive investigation.

If is not possible to design a global solution, what kind of proposals should be developed that can have a real impact? Is it possible to propose a pallet of design suggestions and alternatives? Is it possible to design a shelter that includes general interests, technical solutions and a better relation with the culture and society of affected places?

Further research should seek to understand how temporary accommodation can consider future transformations a) to suit local needs b) to make a connection between temporary and permanent housing and c) to serve as mass housing solution. To understand

tendencies and find patterns which can later inform future proposals, it would be necessary to analyse how past solutions have been adapted by users and to track the process of transition. Questions such as: what have people done with their shelters? How have they done that? and what were their aspirations?, should be studied. Moreover, there are some non-quantitative aspects that should be investigated, such as: a) likeability (what users like), b) usability (how shelters are used), c) appropriateness (social, cultural, political, economic), d) durability (how well they have lasted) c) process of delivery and building (fast, slow) d) involvement (community involved or not) c) grouping and settlements (public, semi-public and private spaces)

Finally, during the research, immense amount of information, several guidelines, and a large number of reports were found. But professionals sent to field do not have time to read all of them. Moreover, most organisations do not have people doing research on past programmes that have finished, because they have to focus in current events. Therefore, some complementary work should be done, and researchers available in universities could help to track the process and give objective feedback to NGOs and governments, in what is an opportunity for collaboration.

FOOTNOTES

Introduction

1 JOHNSON, Cassidy. Strategies for the Reuse of Temporary Housing. Workshop Paper, Holcim Forum for Sustainable Construction, Urban Transformations. Shanghai, Tongju University, April 18-21, 2007, p. 323. Available from <http://www.holcimfoundation.org/default.aspx?tabid=46>

2 AQUILINO, Marie J. Preface. In her: Beyond Shelter. Architecture and Human Dignity. Metropolis Books, 2011, p.7.

3 QUARANTELLI, E.L. Patterns of Shelter and Housing in US Disasters. Disaster Prevention and Management, 4(3):43-53, 1995.

4 JOHNSON, Cassidy. Strategies for the Reuse of Temporary Housing. p. 323.

5 JOHNSON Cassidy. What's the big deal about temporary housing? Planning Considerations for Temporary Accommodation after Disasters: Example of the 1999 Turkish Earthquakes. Conference: Improving Post-Disaster Reconstruction in Developing Countries. Montreal, Universite de Montreal, IF Research Group, i-Rec information & research for reconstruction, 2002, p.2. Available from <http://www.grif.umontreal.ca/pages/papersmenu.html>

Chapter I

1 EM-DAT. The International Disaster Database. Centre for Research on the Epidemiology of Disasters-CRED. Available from <http://www.emdat.be> Created Oct-21-2011.

2 GUHA-SAPIR, D., VOS, F., BELOW, R., with PONSERRE, S. Annual Disaster Statistical Review 2010: The Numbers and Trends. Brussels, CRED, 2011, p.7. Available from <http://www.cred.be/sites/default/files/ADSR_2010.pdf>

3 PERRY, Ronald W. What Is a Disaster?. In: RODRÍGUEZ, Havidán, QUARANTELLI, Enrico L., DYNES, Russell R. Handbook of Disaster Research. Springer, 2007. Chapter 1, p.5.

4 Ibid. p.8.

5 Ibid. p.9.

6 WISNER, Ben, BLAIKIE, Piers, CANNON, Terry and DAVIS Ian. At Risk. Natural Hazards, People's Vulnerability and Disasters. London, Routledge, (2nd Ed.) 2004. 471 p.

7 Ibid. p.4.

8 COMERIO, Mary. Disaster Hits Home: New Policy for Urban Housing Recovery. Berkeley, Calif., London, University of California Press, 1998, p.2.

9 PERRY, Ronald W. What Is a Disaster?, p.8.

10 MASKREY, Andrew, ROMERO, Gilberto. Como Entender los Desastres Naturales. In: MASKREY, Andrew. Los Desastres No Son Naturales. LA RED, Red de Estudios Sociales en Prevención de Desastres en América Latina, 1993, pp 6-7. Available from <http://www.desenredando.org/public/libros>

11 Ibid.

12 WISNER, Ben, et. al. At Risk. p.5.

13 Ibid. p.7.

14 MCDONALD, Roxanna. Introduction to Natural and Man-Made Disasters and their Effects on Buildings. Great Britain, Architectural Press, 2003, pp. 6-7.

15 COMERIO, Mary. Disaster Hits Home: New Policy for Urban Housing Recovery. Berkeley, Calif., London, University of California Press, 1998, p.20

16 Ibid.

17 The Emergency Events Database EM-DAT maintains essential data on the occurrence and effects in the world from 1900 to present, compiled from various sources (UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies). The EM-DAT has been maintained by the WHO Collaborating Centre for Research on the Epidemiology of Disasters (CRED) since 1988 and the objective is to serve the purposes of humanitarian action at national and international levels. The information is accessible on line in: http://www.emdat.be/. In this website is possible to obtain information relative of disasters.

18 EM-DAT. Available from <http://www.emdat.be> Created Nov-08-2011.

19 MCDONALD, Roxanna. Introduction to Natural… p.2

20 Australia 1990; Missisipi 1993; Rhine 1993; England 1998 and 2000; Eastern and Central Europe 1997, 1998, 1999, 2000 and 2002.

21 WISNER, Ben, et. al. At Risk. p.246.

22 Ibid. p.243. See the 1999 Hangzhou Declaration of representatives of large coastal cities.

23 MCDONALD, Roxanna. Introduction to Natural… p.7

24 Ibid.

25 HEIJMANS, Annelies. From Vulnerability to Empowerment. In: Mapping vulnerability. Disasters, Development and People. BANKOFF, Greg, FRERKS, Georg, HILHORST Dorothea. London, Earthscan, 2004. Chapter 8, p.1.

26 Ibid. p.3.

27 WISNER, Ben, et. al. At Risk. p.11

28 MCDONALD, Roxanna. Introduction to Natural… p.4

29 NCR and SHELTER CENTER. Urban Shelter Guidelines. Assistance in Urban Areas to Populations Affected by Humanitarian Crises. Launch Edition, 2010, pp.8-9. Available from <http://sheltercentre.org/sites/default/files/urban_guidelines_submission_23-11-10_compressed.pdf>

30 BIRCH, Eugenie and WACHTER, Susan. Rebuilding Urban Places After Disaster. Lessons from Hurricane Katrina. Philadelphia, University of Pennsylvania Press, 2006, p.1

31 WISNER, Ben, et. al. At Risk. pp.13-14.

32 HEIJMANS, Annelies. From Vulnerability to Empowerment. Chapter 8, p.6.

Chapter II

1 SPHERE HANDBOOK. Humanitarian Charter and the Minimum Standards in Humanitarian Response. The Sphere Project, (3rd Ed.), 2011, p.244. Available from <http://www.sphereproject.org/handbook/>

2 CORSELLIS, Tom. Literature Review for Shelter after Disaster. Geneva, Shelter Centre, FP Innovations and Royal Roads University, 2011, p. vi. Available from <http://sheltercentre.org/library/literature-review-shelter-after-disaster>

3 THE WORLD BANK , GFDRR. Earthquake Reconstruction. Knowledge Notes. Washington D.C., Nov. 2011, pp.3-5. Available from: <http://www.gfdrr.org/gfdrr/node/1023>

4 Ibid. pp.10

5 CORSELLIS, Tom and VITALE, Antonella. Transitional Settlement and Reconstruction after Natural Disasters. Geneva, Shelter Centre and Department for International Development, United Nations Office for the Coordination of Humanitarian Affairs, 2008, p.8. Available from <http://sheltercentre.org/library/transitional-settlement-and-reconstruction-after-natural-disasters-field-edition>

6 Ibid.

7 SHELTER CLUSTER. Available from <https://www.sheltercluster.org/AboutUs/Pages/TheShelterCluster.aspx>

8 INTER-AGENCY STANDING COMMITTEE (IASC). Guidance Note on Using the Cluster Approach to Strengthen Humanitarian Response. Nov. 2006, p.2. Available from <https://www.sheltercluster.org/AboutUs/Pages/TheClusterApproach.aspx>

9 DAVIDSON, Sara and PRICE, Gill. Review of the International Federation´s Shelter Cluster Commitment. Shelter Cluster, August 2011, p. 6. Available from <https://www.sheltercluster.org/AboutUs/Pages/ClusterEvaluations.aspx>

10 Ibid.

11 JOHNSON, Cassidy. Strategies for the Reuse of Temporary Housing. Workshop Paper, Holcim Forum for Sustainable Construction, Urban Transformations. Shanghai, Tongju University, April 18-21, 2007, p. 323. Available from <http://www.holcimfoundation.org/default.aspx?tabid=46>

12 UNHCR. Handbook for Emergencies. Geneva, UNHCR (3rd Ed.) 2007, p.220. Available from <http://www.unhcr.org/472af2972.html>

13 ASHMORE, Joseph et al. Diversity and Adaptation of Shelters in Transition Settlements for IDPs in Afghanistan. In: Disasters, 27(4): 273–287, 2003, (p.274). Available from <http://josephashmore.org/publications/FI274Ashmore.pdf>

14 PEACOCK, Walter G., DASH, Nicole, and ZHANG, Yang. Sheltering and Housing Recovery Following Disaster. In: RODRÍGUEZ, Havidán, QUARANTELLI, Enrico L., DYNES, Russell R. Handbook of Disaster Research. Springer, 2007, pp. 258-259. Available from <http://www.springerlink.com/content/x26555115j122170>

15 It was the first conference in the topic convened by Oxfam, the International Disasters Institute and the Disasters and Settlements Unit of Oxford Polytechnic (Today Oxford Brookes), held in Oxford, UK.

16 CUNY, Frederick. Disasters and the Small Dwelling: The State of the Art. In: DAVIS, Ian. Disasters and the Small Dwelling. Oxford, Pergamon Press, 1981, p.3.

17 Ibid.

18 QUARANTELLI, E.L. Patterns of Shelter and Housing in US Disasters. Disaster Prevention and Management, 4(3):43-53, 1995.

19 SHELTER CENTRE. Transitional Shelter Guidelines. Geneva, May 2012, p.3. Available from <http://sheltercentre.org/sites/default/files/20120522_tsg_onlinedoc_0.pdf>

20 LANG HO, Cathy. Safe Haven. Disasters and War Have Left Millions Homeless Around the World. Can Architects Help?. Architecture (11):80-83, Nov. 2002, (p. 82)

21 UN-ISDR. Towards a Post-2015 Framework for Disaster Risk Reduction. p.2. Available from <http://www.preventionweb.net/files/25129_towardsapost2015frameworkfordisaste.pdf>

22 JOHNSON Cassidy. What's the big deal about temporary housing? Planning Considerations for Temporary Accommodation after Disasters: Example of the 1999 Turkish Earthquakes. Conference: Improving Post-Disaster Reconstruction in Developing Countries. Montreal, Universite de Montreal, IF Research Group, i-Rec information & research for reconstruction, 2002, p.4. Available from <http://www.grif.umontreal.ca/pages/papersmenu.html>

23 SHELTER CENTRE. Transitional Shelter Guidelines. Geneva, May 2012, p.2. Available from <http://sheltercentre.org/sites/default/files/20120522_tsg_onlinedoc_0.pdf>

24 Ibid.

25 Ibid.

26 HAMDI, Nabeel. Foreword. In: LYONS, Michael, SCHILDERMAN, Theo, BOANO, Camillo. Building Back Better. Delivering People Centred Housing Reconstruction at Scale. Practical Action, London South Bank University, and International Federation of Red Cross and Red Crescent Societies, 2010, pp. IX-XI.

27 IFRC. Transitional Shelters. Eight Designs. Geneva, 2011, p.4. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

28 JIN, Shauna. Transitional Relief Housing for Tsunami Victims of Tamil Nadu, India. Thesis (Bachelor of Science) Cambridge, Mass., Massachusetts Institute of Technology, Department of Mechanical Engineering, 2006, p. 3.

29 CORSELLIS, Tom and VITALE, Antonella. Transitional Settlement and Reconstruction after Natural Disasters. p.20.

30 Ibid.

31 Ibid. pp. 88, 114-126.

32 SPHERE HANDBOOK. Humanitarian Charter and the Minimum Standards in Humanitarian Response. The Sphere Project, (3rd Ed.), 2011, p.252. Available from <http://www.sphereproject.org/handbook/>

33 INTERTECT. Emergency Shelter Strategies That Accelerate Housing Reconstruction. USA, 1992. Available from <http://sheltercentre.org/library/emergency-shelter-strategies-accelerate-housing-production>

34 SPHERE HANDBOOK. Humanitarian Charter and the Minimum Standards in Humanitarian Response. The Sphere Project, (3rd Ed.), 2011. 393 p. Available from <http://www.sphereproject.org/handbook/>

35 UNHCR. Handbook for Emergencies. Geneva, UNHCR (3rd Ed.) 2007. 582 p. Available from <http://www.unhcr.org/472af2972.html>

36 CORSELLIS, Tom and VITALE, Antonella. Transitional Settlement and Reconstruction after Natural Disasters. p.27.

37 Ibid. 25-27.

38 Ibid.

39 Ibid.

40 Ibid. pp. 148-150.

41 Ibid. p.150.

42 JOHNSON Cassidy. What's the big deal about temporary housing? p. 11.

43 PEACOCK, Walter G., et al. Sheltering and Housing Recovery Following Disaster. pp.263-264.

44 CUNY, Frederick. Disasters and the Small Dwelling. p.3.

45 COLLINS, Sam, CORSELLIS, Tom and VITALE, Antonella. Case Study Nº 5. Transitional Shelter: Understanding Shelter from the Emergency Reconstruction and Beyond. ALNAP Innovations Case Studies series (Active Learning Network for Accountability and Performance in Humanitarian Action), Pp.1-15, (p.1). Available from <http://www.alnap.org/pool/files/innovationcasestudyno5-shelter.pdf>

Chapter III

1 BOESIGER, Willy and GIRSBERGER Hans. Le Corbusier 1910-65. London, Thames and Hudson, 1967, p.24

2 Ibid.

3 Ibid.

4 Ibid.

5 HERBERT Gilbert. The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsman. Cambridge, Mass., MIT, 1984, p.42.

6 BERGDOLL, Barry and CHRISTENSEN, Peter. Home Delivery: Fabricating the Modern Dwelling. New York, Basel, Museum of Modern Art, Birkhäuser, 2008, p.56.

7 HERBERT Gilbert. The Dream of the Factory-Made House. p.42.

8 Ibid. p.138.

9 Ibid. p.139.

10 Ibid.

11 BAUHAUS SUMMER SCHOOL 2010. Home is everywhere. 21-30 July 2010, Dessau, Germany. Available from <http://www.bauhaus-dessau.de/index.php?Home-is-Everywhere-4>

12 HERBERT Gilbert. The Dream of the Factory-Made House. pp. 140, 146.

13 PAWLEY, Martin. Buckminster Fuller. London, Trefoil, 1990, p.13.

14 Ibid. p.95.

15 KRONENBURG, Robert. Houses in Motion: Genesis, History and Developments of the Portable Building. London, Academy Editions, 1995, p.45.

16 PAWLEY, Martin. Buckminster Fuller. p.95.

17 AUDEFROY, Joël. Vivienda y Ayuda Humanitaria. Los Antecedentes de las Acciones Frente a los Desastres. TRACE (56): 76-87, Dec. 2009 (p. 78). http://www.cemca.org.mx/trace/TRACE_56/Audefroy_T56.pdf

18 PALLASMAA, Juhani, and SATO, Tomoko. Alvar Aalto Through the Eyes of Shigeru Ban. London, Black Dog Publishing, 2007, p.153.

19 Ibid. p.98.

20 BERGDOLL, Barry and CHRISTENSEN, Peter. Home Delivery. p.28.

21 ALVAR AALTO. Available from <http://file.alvaraalto.fi/search.php?id=584>

22 GUIDOT, Raymond, GUIHEUX, Alain, PIANO Renzo. Jean Prouve: Constructeur. Paris, Editions du Centre Pompidou, 1990, pp.76-77.

23 ALLÉGRET, Laurence, VAUDOU, Valérie. Jean Prouvé et Paris. Paris, Pavillon de l'Arsenal, Picard, 2001, pp.136-137.

24 GALLERY PATRICK SEGUIN. 20th Century Furniture & Architecture. Jean Prouve/ Charlotte Perriand/ Pierre Jeanneret/ Le Corbusier/ Jean Royere. Available from <http://www.patrickseguin.com/en/designers/jean-prouve/architecture>

25 ALLÉGRET, Laurence, VAUDOU, Valérie. Jean Prouvé et Paris. pp.136-137.

26 GALLERY PATRICK SEGUIN.

27 KRONENBURG, Robert. Houses in Motion. p.139.

28 Ibid. p.138.

29 Ibid.

30 LANG HO, Cathy. Safe Haven. Disasters and War Have Left Millions Homeless Around the World. Can Architects Help?. Architecture (11):80-83, Nov. 2002, (p.81).

31 ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. Architecture Responses to Humanitarian Crises. London, Thames & Hudson, 2006, pp.103-104.

32 CALIFORNIA INSTITUTE OF EARTH ART AND ARCHITECTURE. Available from <http://calearth.org>

33 ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. p.112.

34 ARCHITECTURAL REVIEW. Sandbag Refuge. A System for Housing Displaced and Poor People is Made of Universally Available Materials. Architectural Review, 217(1295):72-73, 2005, (p.73).

35 Ibid.

36 ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. 2. Building Change From the Ground Up. New York, Abrams, 2012, p.325; and CALIFORNIA INSTITUTE OF EARTH ART AND ARCHITECTURE. Available from <http://calearth.org>

37 ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. p.103.

38 POLLOCK, Naomi. Ban-Aid. The Japanese Legend Discusses Architect´S Duty to Good. Architectural Record, 196: 90-93, Oct. 2008, (p. 90).

39 Ibid.

40 SHIGERU BAN ARCHITECTS. Available from <http://www.shigerubanarchitects.com>

41 ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. p.103.

42 SHIGERU BAN ARCHITECTS. Available from <http://www.shigerubanarchitects.com>

43 ASF INTERNATIONAL. Experiences and case studies in the commitment of architecture, construction, urbanism and the conservation of historical heritages to Human Development. January 2010. Available from <http://www.asfint.org/IMG/pdf/ASF-Int_Portfolio_2010-02.pdf>

44 ARCHITECTURE FOR HUMANITY. Available from <http://architectureforhumanity.org>

45 OPEN ARCHITECTURE NETWORK. Transitional Housing Competition, 1999. Available from <http://openarchitecturenetwork.org/node/373>

46 AMERICAN RED CROSS. Museum-Explore our History. The San Francisco Earthquake of 1906 and the Red Cross Response. Available from <http://www.redcross.org/museum/history/sanfranquake.asp>

47 STOHR, Kate. 100 Years of Humanitarian Design. In: ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. Architecture Responses to Humanitarian Crises. London, Thames & Hudson, 2006, p.33.

48 Ibid. p.33-34.

49 Ibid.

50 THE WESTERN NEIGHBORHOODS PROJECT. A Nonprofit Organization to Preserve and Share the History and Culture of the Neighbourhoods in Western San Francisco. Available from < http://www.outsidelands.org/index.php >

51AMERICAN FRIENDS SERVICE COMMITTEE. AFSC History. Available from <http://afsc.org/afsc-history>

52 SLAVITT, Lesley. Reconstruction and World War I: Internationalism and the Idea of the Expert. Thesis (M.S.), New York, Columbia University, Graduate School of Architecture, Planning, and Preservation , 1994, Chapter VII. Available from <http://net.lib.byu.edu/estu/wwi/comment/slavitt.htm>

53 Ibid.

54 Ibid.

55 Ibid.

56 STOHR, Kate. 100 Years of Humanitarian Design. pp. 39-40.

57 Ibid. p.40.

58 LIBRARY OF CONGRESS. Houses for Britain. Prints and Photographs Online Catalog (PPOC). Available from <http://www.loc.gov/pictures/item/owi2001043255/PP>

59 UN-HABITAT. Historical Case Studies. Overview. In: UN-HABITAT. Shelter Projects 2008. p.84. Available from <http://www.sheltercasestudies.org/>

60 SHELTER PROJECT. Report on the Transitional Settlement Sector. Cambridge, University of Cambridge, 2003, pp.8,14. Available from <http://sheltercentre.org/sites/default/files/shelterproject_sectorReport.pdf>

61 Ibid.

62 DAVIS, Ian. Shelter after Disaster. Guidelines for Assistance. New York, UNDRO, 1982, pp. 27,30.

63 DAVIS, Ian. Emergency Shelter. In: The role of technology in international disaster assistance. Proceedings of the Committee on International Disaster Assistance Workshop. Washington D.C., The National Research Council, 1977, p.26.

64 DAVIS, Ian. Shelter after Disaster. pp. 27-29.

65 Ibid.

66 KRONENBURG, Robert. Houses in Motion. p.99.

67 DAVIS, Ian. Shelter after Disaster. p. 31.

68 UN-HABITAT and IFRC. Historical Case Studies. Nicaragua-1972-Earthquake-Overview In: UN-HABITAT and IFRC. Shelter Projects 2009, p.106. Available from <http://www.sheltercasestudies.org/>

69 DAVIS, Ian. Shelter after Disaster. p.31.

70 Ibid.

71 DAVIS, Ian. Emergency Shelter. Disasters. The International Journal of Disaster Studies and Practice. 1(1): 23-40, March 1977, (p.32).

72 UN-HABITAT. Historical Case Studies. Overview. p.84.

73 RESSLEI, Everett M., INTERTECT. The International Conference on Disaster Area Housing. Disasters, 2(1):29-30, 1978, (p.29).

74 Ibid.

75 Ibid.

76 UN-HABITAT. Historical Case Studies. Overview. p.84.

77 Ibid.

78 Ibid. p.85.

79 UN-HABITAT. Historical Case Studies, Tonga-1982-Cyclone Isaac. In: UN-HABITAT. Shelter Projects 2008, p.102. Available from <http://www.sheltercasestudies.org/>

80 SPHERE HANDBOOK. Humanitarian Charter and the Minimum Standards in Humanitarian Response. The Sphere Project, (3rd Ed.), 2011. 393 p. Available from <http://www.sphereproject.org/handbook/>

81 CUNY Frederick. Disasters and Development. Dallas, Intertect Press, 2nd ed., 1994, p.19.

82 SHELTER CENTRE. Shelter Meeting, 24-25 May 2012, Geneva. Available from <http://www.sheltercentre.org/meeting/shelter-meeting-12a>

83 KRONENBURG, Robert. Houses in Motion. p.59.

84 Ibid.

85 Ibid.

86 Ibid.

87 RADIO NATIONAL. By design. Nissen-Petren Houses. October, 2007. Available from <http://www.abc.net.au/radionational/programs/bydesign/nissen-petren-houses/3226138>

88 BERGDOLL, Barry and CHRISTENSEN, Peter. Home Delivery. p.76.

89 CHIEI Chris. How the Hut Came to Be. In: CHIEI Chris and DECKER Julie. Quonset. Metal Living for a Modern Age. Princeton Architectural Press, 2005, pp. 1-30. Extracts available from <http://www.quonsethuts.org/book/chapter1.htm>

90 BERGDOLL, Barry and CHRISTENSEN, Peter. Home Delivery. pp.76,78.

91 CHIEI Chris. How the Hut Came to Be. pp. 1-30.

92 QUONSETHUTS. Available from <http://www.quonsethuts.org/huts/index.htm>

93 VALE, Brenda. Prefabs: a History of the UK Temporary Housing Programme. London, Spon, 1995, p.136.

94 KRONENBURG, Robert. Houses in Motion. pp.75,76

95 KRONENBURG, Robert. Houses in Motion. p.76

96 STOHR, Kate. 100 Years of Humanitarian Design. p.37-38.

97 BURNS, Carol J. A Manufactured Housing Studio: Home/On the Highway. Journal of Architectural Education. 55 (1): 51-57, Sept. 2001, (p.53). Available from <http://onlinelibrary.wiley.com/doi/10.1162/104648801753168819/pdf>

98 BURNS, Carol J. A Manufactured Housing Studio (p.54).

99 DRUDY J. Margaret. Mobile Homes. The Unrecognized Revolution in American Housing. New York, Praeger Publishers, 1972, p.15.

100 KRONENBURG, Robert. Houses in Motion. p.76

101 COMERIO, Mary. Disaster Hits Home: New Policy for Urban Housing Recovery. Berkeley, Calif., London, University of California Press, 1998, p.69.

102 BULLOCK Nicholas. Building the Post-War World. Modern Architecture and Reconstruction in Britain. London, Routledge, 2002, p. 174.

103 VALE, Brenda. Prefabs., p.1.

104 Ibid. p.2.

105 Ibid.

106 Ibid.

107 Ibid. p.1.

108 DAVIDSON, Colin, LIZARRALDE Gonzalo, JOHNSON Cassidy. Myths and realities of prefabrication for post disaster reconstruction. IREC, 2008. 14 p. Available from <http://sheltercentre.org/sites/default/files/IREC_MythsAndRealitiesOfPrefabricationForPostDisasterReconstruction.pdf>

109 Ibid.

110 DAVIS, Ian. Shelter after Disaster. p.34.

111 DAVIDSON, Colin, et al. Myths and realities ... 14 p.

112DAVIS, Ian. Shelter after Disaster. 82 p.

113 Ibid. p. vi.

114 KEYNES, Richard D. The Beagle Record: Selections from the Original Pictorial Records and Written Accounts of the Voyage of H.M.S. Beagle. Cambridge, Cambridge University Press, 1979, pp. 256-257.

115 STOHR, Kate. 100 Years of Humanitarian Design. pp. 42.

116 Ibid.

117 Ibid.

118 Ibid. p. 43.

119 Ibid.

120 Ibid. p. 44.

121 Ibid.

122 Ibid.

123 KOENIGSBERGER, Otto. Third World Housing Policies since the 1950s. Habitat International, 10 (3):27-32, 1986, (p. 30).

124 Ibid. (pp.29-30).

125 Ibid. (p. 30).

126 STOHR, Kate. 100 Years of Humanitarian Design. p. 44

127 Ibid.

128 Ibid.

129 KOENIGSBERGER, Otto. Third World Housing … (p. 30).

130 RUDOFSKY, Bernard. Architecture Without Architects: a Short Introduction to Non-Pedigreed Architecture. London, Academy Editions, 1964. Preface.

131 Ibid.

132 STOHR, Kate. 100 Years of Humanitarian Design. p. 44

133 Ibid.

134 HABITAT FOR HUMANITY INTERNATIONAL. Available from <http://www.habitat.org/how/factsheet.aspx>

135 STOHR, Kate. 100 Years of Humanitarian Design. p. 44

136 CHALK, Philip. Jimmy Carter's Favorite Charity. A Wildly Expensive Way to Help Small Numbers of the Non-Poor. The Weekly Standard. New York, 10(37), Jun. 13, 2005. Available from <http://www.weeklystandard.com/Content/Protected/Articles/000/000/005/687hgyza.asp>

137 Ibid.

138 STOHR, Kate. 100 Years of Humanitarian Design. p. 45

139 KOENIGSBERGER, Otto. Third World Housing … (p. 31).

140 STOHR, Kate. 100 Years of Humanitarian Design. p. 44

141THE WORLD BANK. Available from <http://www.worldbank.org>

142 STOHR, Kate. 100 Years of Humanitarian Design. p. 45

143 Ibid.

144 Ibid. pp. 45,47.

145 Ibid. pp. 47.

146 Ibid.

147 SHELTER CENTRE. Shelter Meeting, 24-25 May 2012, Geneva. Available from <http://www.sheltercentre.org/meeting/shelter-meeting-12a>

148 KRONENBURG, Robert. Houses in Motion. p.95

149 DAVIS, Ian. Emergency Shelter. Disasters. The International Journal of Disaster Studies and Practice. 1(1): 23-40, March 1977, (p.24).

150 Ibid.

151 Ibid. (pp.24-25).

152 Ibid.

153 DAVIS, Ian. Emergency Shelter. In: The role of technology in international disaster assistance. Proceedings of the Committee on International Disaster Assistance Workshop. Washington D.C., The National Research Council, 1977, p. 24.

154 UN-HABITAT. Historical Case Studies. Bangladesh-1975-Conflict-People displaced. In: UN-HABITAT. Shelter Projects 2008, p.92. Available from <http://www.sheltercasestudies.org/>

155 Ibid. p.93.

156 Ibid. p.91.

157 Ibid.

158 SIGUS. Special Interest Group in Urban Massachussetts Institute of Technology, School of Architecture and Planning. Available from <http://web.mit.edu/sigus/www/NEW/index.html>

159 BASIC INITIATIVE. Building Sustainable Communities. Portland State University and University of Texas at Austin, School of Architecture. Available from <http://www.basicinitiative.org> and <www.basicinitiative.com>

160 PALLERONI LEITE DESIGN PARTNERSHIP. Portland, Oregon, USA. Available from <http://pl-dp.com>

161 OISD. Oxford Institute for Sustainable Development. Oxford Brookes University, UK.

162 CENDEP. Centre for Development and Emergency Practice. Oxford Brookes University, UK. Available from <http://oisd.brookes.ac.uk/architecture/cendep/index.html>

163 KREIMER Alcira. Emergency, Temporary and Permanent Housing after Disasters in Developing Countries, as quoted in: KRONENBURG, Robert. Houses in Motion: Genesis, History and Developments of the Portable Building. London, Academy Editions, 1995, p.138.

Chapter IV

1 CORSELLIS, Tom and VITALE, Antonella. Transitional Settlement and Reconstruction after Natural Disasters. Geneva, Shelter Centre and Department for International Development, United Nations Office for the Coordination of Humanitarian Affairs, 2008, p. 26. Available from <http://sheltercentre.org/library/transitional-settlement-and-reconstruction-after-natural-disasters-field-edition>

2 US CENSUS BUREAU. Median and Average Square Feet of Floor Area in New Single-Family Houses. 2010 Census Data. Available from <http://www.census.gov/const/C25Ann/sftotalmedavgsqft.pdf>

3 NATIONAL BUREAU OF STATISTICS OF CHINA. China Statistical Yearbook 2011. China Statistic Press, 2011. Available from <http://www.stats.gov.cn/tjsj/ndsj/2011/indexeh.htm>

4 UN. Principles and Recommendations for Population and Housing Censuses. New York, United Nations (Revision 2), 2008, p.100. Available from <http://unstats.un.org/unsd/demographic/sources/census/docs/P&R_Rev2.pdf>

5 a) US CENSUS BUREAU. Median and Average Square Feet of Floor Area in New Single-Family Houses. 2010 Census Data. Available from <http://www.census.gov/const/C25Ann/sftotalmedavgsqft.pdf>

b) NATIONAL BUREAU OF STATISTICS OF CHINA. China Statistical Yearbook 2011. China Statistic Press, 2011. Available from <http://www.stats.gov.cn/tjsj/ndsj/2011/indexeh.htm>

c) JAPAN STATISTICS BUREAU. The Basic Complete Tabulation on Population and Households of the 2010 Population Census of Japan. Available from <http://www.stat.go.jp/english/data/kokusei/2010/basic1/pdf/summary.pdf>

d) UN. Trends in Europe and North America 2001. NY, UN Economic

Commission for Europe, 2001, p.74.

6 INSTITUTO NACIONAL DE ESTADÍSTICAS. Censo 2002, Síntesis de Resultados. Chile, INE, 2002. 50 p. Available from <http://www.ine.cl/cd2002/sintesiscensal.pdf>

7 INSTITUTO NACIONAL DE ESTADÍSTICA E INFORMÁTICA. Peru: Promedio de miembros del hogar y edad promedio del jefe de hogar, 2005, 2007, 2009 y 2010. INEI-Encuesta Nacional de Hogares: 2005,2007,2009 and 2010. Available from <http://www.inei.gob.pe/perucifrasHTM/inf-soc/cuadro.asp?cod=10004&name=ho07&ext=gif>

8 INSTITUT HAÏTIEN DE STATISTIQUE ET D'INFORMATIQUE. Enquête sur les Conditions se Vie en Haïti, 2003. Available from <http://www.ihsi.ht/pdf/ecvh/ECVHVolumeI/logement.pdf>

9 UN-HABITAT. State of the World's Cities 2006/7. Malta, Gutenberg Press, 2006, p.39. Available from <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=2101>

10 UN-HABITAT and IFRC. B.13.Italy-2009-Earthquake. In: UN-HABITAT and IFRC. Shelter Projects 2009, p.65. Available from <http://www.sheltercasestudies.org/>

11 Some of these examples: a) THE HABIHUT. Available from <http://www.thehabihut.com/products_01.html> b) HEXAYURT. Available from <http://hexayurt.com> c) WORLD SHELTERS. U-DOME. Available from <http://worldshelters.org/shelters/u-dome>

12 FEMA, USA. Fema's Response to Allegations of Suppressed or Influenced Formaldehyde Reports. Release Number:

FNF-08-009, Jan. 28, 2008. Available from <http://www.fema.gov/news-release/femas-response-allegations-suppressed-or-influenced-formaldehyde-reports>; BRUNKER, Mike. CDC Tests Confirm FEMA Trailers are Toxic. Agency to Relocate Gulf Coast Residents Because of Formaldehyde Fumes. NBC NEWS, Feb. 14, 2008. Available from <http://www.msnbc.msn.com/id/23168160/ns/us_news-life/t/cdc-tests-confirm-fema-trailers-are-toxic/#.UA477KA2SzJ>; HSU Spencer S. Toxicity in FEMA Trailers Blamed on Cheap Materials, Low Construction Standards. The Washington Post, July 3, 2008. Available from <http://www.washingtonpost.com/wp-dyn/content/article/2008/07/02/AR2008070202800.html>

13 IFRC. Transitional Shelters. Eight Designs. Geneva, 2011, pp.57,69. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

14 Pallets are often treated with chemicals for protecting the wood from insects, termites and decay. Some chemicals are not recommended for being recycled in buildings such as EHB immunisation and CCA preservatives. In 2002, the U.S. Environmental Protection Agency (EPA) announce that Chromated copper arsenate (CCA) treated wood can no longer be manufactured for deck, patios, picnic tables, playgrounds, walkways, landscaping timbers of fencing, due to its toxicity. BEYOND PESTICIDES. Chromated Copper Arsenate (CCA) Treated Wood. In: BEYOND PESTICIDES, 23 (1):18-21 2003. Available from <http://www.beyondpesticides.org/infoservices/pesticidesandyou/spring%2003/cca%20factsheet.pdf>; Nevertheless, there are pallet with other treatments such as Heat Treatment and Chemical Fumigation with methyl bromide, and there are even some pallets who are not treated.

15 DOMES FOR THE WORLD. The Dome, The Ecoshell. Available from <http://www.dftw.org/topics/domes>

16 INTERSHELTER. The Intershelter (tm) Dome. Available from <http://www.intershelter.com/dome.php>

17 IKAPUTRA. People Response to Localize the Imported Culture. Study Case: the Dome House in the Rural Culture Post Javanese Earthquake 2006. In the 14th World Conference on Earthquake Engineering. Beijing, Oct. 12-17, 2008; RACHMAMARCILLIA, Syam, OHNO, Ryuzo. Importance of Social Space in Self-built and Donated Post Disaster Housing after Java Earthquake 2006. In the ASEAN Conference on Environment-Behaviour Studies (AcE-Bs), 2011. Centre for Environment-Behaviour Studies. Malaysia, Faculty of Architecture, Planning and Surveying (FAPS), UiTM. Available from <http://fspu.uitm.edu.my/cebs/images/stories/cebs/av3n7jan2012c3.pdf>

Conclusions

1 EM-DAT. The International Disaster Database. Centre for Research on the Epidemiology of Disasters-CRED. Available from <http://www.emdat.be> Created: Nov-08-2011

2 DRUEDING, Meghan. Picking Up the Pieces in Disaster Zones All Over The World, Architects Help Rebuild Communities. AiA Magazine, 15 (1):37-48, Jan.-Feb. 2011, (p.46). Available from <www.residentialarchitect.com> and <http://mydigimag.rrd.com/publication/?i=61176>

3 BOANO, Camillo. Building Relevance. Six Points on Post-Disaster Practice (A Provocative Untimely Manifesto?) Presentation IFRC and CENDEP at Oxford Brookes University, 18 Aug. 2009. Available from: <http://architecture.brookes.ac.uk/research/cendep/media/CBoano%20DPU.pdf>

4 KRONENBURG, Robert. Houses in Motion: Genesis, History and Developments of the Portable Building. London, Academy Editions, 1995, p.95

5 Ibid.

6 Ibid. p.96

7 STEPHENSON, Maggie. Senior Technical Advisor at UN-HABITAT. In conference: Geospatial Tools and Information Needs in Post-Disaster Recovery Workshop. Organised by Remote Sensing for Built Environment Disasters and Development (REBUILDD). Cambridge, University of Cambridge, Sidney Sussex College, March 29-30, 2012.

8 STERLING, Bruce. Do-Bad Architecture. Architectural Record, 196:86-89, Oct. 2008, (p.87).

9 STOHR, Kate. 100 Years of Humanitarian Design. In:ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. Architecture Responses to Humanitarian Crises. London, Thames & Hudson, 2006, pp. 34

10 JOHNSON Cassidy. What's the big deal about temporary housing? Planning Considerations for Temporary Accommodation after Disasters: Example of the 1999 Turkish Earthquakes. Conference: Improving Post-Disaster Reconstruction in Developing Countries. Montreal, Universite de Montreal, IF Research Group, i-Rec information & research for reconstruction, 2002, p.2. Available from <http://www.grif.umontreal.ca/pages/papersmenu.html>

11 Ibid.

12 Ibid.

13 AUDEFROY, Joël. Vivienda y Ayuda Humanitaria. Los Antecedentes de las Acciones Frente a los Desastres. TRACE (56): 76-87, Dec. 2009 (p. 76)

14 HAMDI, Nabeel. Foreword. In: LYONS, Michael, SCHILDERMAN, Theo, BOANO, Camillo. Building Back Better. Delivering People Centred Housing Reconstruction at Scale. Practical Action, London South Bank University, and International Federation of Red Cross and Red Crescent Societies, 2010, p. IX.

15 JOHNSON, Cassidy. Strategies for the Reuse of Temporary Housing. Workshop Paper, Holcim Forum for Sustainable Construction, Urban Transformations. Shanghai, Tongju University, April 18-21, 2007, p. 323. Available from <http://www.holcimfoundation.org/default.aspx?tabid=46>

16 KRONENBURG, Robert. Houses in Motion. p.99

17 IASC (Inter-Agency Standing Commitee). Shelter & CCCM Needs Analysis & Response Strategy. Haiti, 2012, p.12. Available from <http://sheltercentre.org/sites/default/files/shelter__cccm_needs_analysis__response_strategy_-_haiti_2012.pdf>

18 Ibid. p.14.

19 Regional Director for Asia, CHF International (Interview with NPR on Rebuilding Haiti, February 28, 2010.). SIGUS/ MIT. Is Incremental a Good Strategy for Haiti and Chile? Exhibit panel, UN World Urban Forum-Rio de Janeiro, 22-26 March 2010. Available from <http://web.mit.edu/incrementalhousing/WUF-Rio/ninePanelExhibit.html>

20 WISNER, Ben, BLAIKIE, Piers, CANNON, Terry and DAVIS Ian. At Risk. Natural Hazards, People's Vulnerability and Disasters. London, Routledge, (2nd Ed.) 2004, p.350.

21 Ibid. p.359.

22 Ibid. p.349.

23Ibid. p.350

24 Ibid.

BIBLIOGRAPHY

Books Articles and Reports

ALLÉGRET, Laurence and VAUDOU, Valérie. Jean Prouvé et Paris. Paris, Pavillon de l'Arsenal, Picard, 2001. 367 p. MASKREY, Andrew and ROMERO, Gilberto. Como Entender los Desastres Naturales. In: MASKREY, Andrew. Los Desastres No Son Naturales. LA RED, Red de Estudios Sociales en Prevención de Desastres en América Latina, 1993. 137 p. Available from <http://www.desenredando.org/public/libros>

AQUILINO, Marie J. Preface. In her: Beyond Shelter. Architecture and Human Dignity. Metropolis Books, 2011. 304 p.

ARCHITECTURAL REVIEW. Sandbag Refuge. A System for Housing Displaced and Poor People is Made of Universally Available Materials. Architectural Review, 217(1295):72-73, 2005.

ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. 2. Building Change From the Ground Up. New York, Abrams, 2012. 335 p.

ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. Architecture Responses to Humanitarian Crises. London, Thames & Hudson, 2006. 333 p.

ARCHITECTURE SANS FRONTIÈRES INTERNATIONAL INTERNATIONAL. Experiences and Case Studies in the Commitment of Architecture, Construction, Urbanism and the Conservation of Historical Heritages to Human Development. Paris, 2010. Available from <http://www.asfint.org/IMG/pdf/ASF-Int_Portfolio_2010-02.pdf>

ASHMORE, Joseph et al. Diversity and Adaptation of Shelters in Transition Settlements for IDPs in Afghanistan. In: Disasters, 27(4): 273–287, 2003. Available from <http://josephashmore.org/publications/FI274Ashmore.pdf>

AUDEFROY, Joël. Vivienda y Ayuda Humanitaria. Los Antecedentes de las Acciones Frente a los Desastres. TRACE (56): 76-87, Dec. 2009. Available from <http://www.cemca.org.mx/trace/TRACE_56/Audefroy_T56.pdf>

BERGDOLL, Barry and CHRISTENSEN, Peter. Home Delivery: Fabricating the Modern Dwelling. New York, Basel, Museum of Modern Art, Birkhäuser, 2008. 247 p.

BIRCH, Eugenie and WACHTER, Susan. Rebuilding Urban Places After Disaster. Lessons from Hurricane Katrina. Philadelphia, University of Pennsylvania Press, 2006. 375 p.

BOANO, Camillo. Building Relevance. Six Points on Post-Disaster Practice (A Provocative Untimely Manifesto?) Presentation IFRC and CENDEP at Oxford Brookes University, 18 Aug. 2009. Available from: <http://architecture.brookes.ac.uk/research/cendep/media/CBoano%20DPU.pdf>

BOESIGER, Willy and GIRSBERGER Hans. Le Corbusier 1910-65. London, Thames and Hudson, 1967. 351 p.

BRUNKER, Mike. CDC Tests Confirm FEMA Trailers are Toxic. Agency to Relocate Gulf Coast Residents Because of Formaldehyde Fumes. NBC NEWS, Feb. 14, 2008. Available from <http://www.msnbc.msn.com/id/23168160/ns/us_news-life/t/cdc-tests-confirm-fema-trailers-are-toxic/#.UA477KA2SzJ>

BULLOCK, Nicholas. Building the Post-War World. Modern Architecture and Reconstruction in Britain. London, Routledge, 2002. 287 p.

BURNS, Carol J. A Manufactured Housing Studio: Home/On the Highway. Journal of Architectural Education. 55 (1): 51-57, Sept. 2001. Available from <http://onlinelibrary.wiley.com/doi/10.1162/104648801753168819/pdf>

CHALK, Philip. Jimmy Carter's Favorite Charity. A Wildly Expensive Way to Help Small Numbers of the Non-Poor. The Weekly Standard. New York, 10(37), Jun. 13, 2005. Available from <http://www.weeklystandard.com/Content/Protected/Articles/000/000/005/687hgyza.asp>

CHIEI, Chris. How the Hut Came to Be. In: CHIEI Chris and DECKER Julie. Quonset. Metal Living for a Modern Age. Princeton Architectural Press, 2005, pp. 1-30. Extracts available from <http://www.quonsethuts.org/book/chapter1.htm>

COLLINS, Sam, CORSELLIS, Tom and VITALE, Antonella. Case Study Nº 5. Transitional Shelter: Understanding Shelter from the Emergency Reconstruction and Beyond. ALNAP Innovations Case Studies series (Active Learning Network for Accountability and Performance in Humanitarian Action), Pp.1-15. Available from <http://www.alnap.org/pool/files/innovationcasestudyno5-shelter.pdf>

COMERIO, Mary. Disaster Hits Home: New Policy for Urban Housing Recovery. Berkeley, Calif., London, University of California Press, 1998, 300 p.

CORSELLIS, Tom and VITALE, Antonella. Transitional Settlement and Reconstruction after Natural Disasters. Geneva, Shelter Centre and Department for International Development, United Nations Office for the Coordination of Humanitarian Affairs, 2008. 324 p. Available from <http://sheltercentre.org/library/transitional-settlement-and-reconstruction-after-natural-disasters-field-edition>

CORSELLIS, Tom. Literature Review for Shelter after Disaster. Geneva, Shelter Centre, FP Innovations and Royal Roads University, 2011. 111 pp. Available from <http://www.recoveryplatform.org/assets/publication/lr_for_sad_sheltercentre.pdf> and from <http://sheltercentre.org/library/literature-review-shelter-after-disaster>

CUNY Frederick. Disasters and Development. Dallas, Intertect Press, 2nd ed., 1994.

CUNY, Frederick. Disasters and the Small Dwelling: The State of the Art. In: DAVIS, Ian. Disasters and the Small Dwelling. Oxford, Pergamon Press, 1981. 220 p.

DAVIDSON, Colin, LIZARRALDE Gonzalo, JOHNSON Cassidy. Myths and realities of prefabrication for post disaster reconstruction. IREC, 2008. 14 p. Available from <http://sheltercentre.org/sites/default/files/IREC_sAndRealitiesOfPrefabricationForPostDisasterReconstruction.pdf>

DAVIDSON, Sara and PRICE, Gill. Review of the International Federation´s Shelter Cluster Commitment. Shelter Cluster, August 2011. 81 p. Available from <https://www.sheltercluster.org/AboutUs/Pages/Cluster-Evaluations.aspx>

DAVIS, Ian. Emergency Shelter. Disasters. The International Journal of Disaster Studies and Practice. 1(1): 23-40, March 1977.

DAVIS, Ian. Emergency Shelter. In: The role of technology in international disaster assistance. Proceedings of the Committee on International Disaster Assistance Workshop. Washington D.C., The National Research Council, 1977, pp. 17-35.

DAVIS, Ian. Shelter after Disaster. Guidelines for Assistance. New York, UNDRO, 1982, 82 p.

DAVIS Ian. What is the Vision for Sheltering and Housing in Haiti? Summary Observations of Reconstruction Progress following the Haiti Earthquake of January 12th 2010. Jan. 2012.

DRUDY J. Margaret. Mobile Homes. The Unrecognized Revolution in American Housing. New York, Praeger Publishers, 1972, 234 p.

DRUEDING, Meghan. Picking Up the Pieces in Disaster Zones All Over The World, Architects Help Rebuild Communities. AiA Magazine, 15 (1): 37-48, Jan.-Feb. 2011. Available from <www.residentialarchitect.com> and <http://mydigimag.rrd.com/publication/?i=61176>

D'URZO, Sandra. News from the teardrop island. In: AQUILINO, Marie. Beyond Shelter. Architecture and Human Dignity. Metropilis Books, 2011. Pp 52-63.

FEMA, USA. Fema's Response to Allegations of Suppressed or Influenced Formaldehyde Reports. Release Number:

FNF-08-009, Jan. 28, 2008. Available from <http://www.fema.gov/news-release/femas-response-allegations-suppressed-or-influenced-formaldehyde-reports>

GUHA-SAPIR, D., VOS, F., BELOW, R., with PONSERRE, S. Annual Disaster Statistical Review 2010: The Numbers and Trends. Brussels, CRED, 2011. 42 p. Available from <http://www.cred.be/sites/default/files/ADSR_2010.pdf>

GUIDOT, Raymond, GUIHEUX, Alain, PIANO Renzo. Jean Prouve: Constructeur. Paris, Editions du Centre Pompidou, 1990. 247p.

HAMDI, Nabeel. Foreword. In: LYONS, Michael, SCHILDERMAN, Theo, BOANO, Camillo. Building Back Better. Delivering People Centred Housing Reconstruction at Scale. Practical Action, London South Bank University, and International Federation of Red Cross and Red Crescent Societies, 2010, pp. IX-XI.

HEIJMANS, Annelies. From Vulnerability to Empowerment. In: Mapping vulnerability. Disasters, Development and People. BANKOFF, Greg, FRERKS, Georg, HILHORST Dorothea. London, Earthscan, 2004. Chapter 8, pp. 115-127.

HERBERT Gilbert. The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsman. Cambridge, Mass., MIT, 1984. 407 p.

HSU Spencer S. Toxicity in FEMA Trailers Blamed on Cheap Materials, Low Construction Standards. The Washington Post, July 3, 2008. Available from <http://www.washingtonpost.com/wp-dyn/content/article/2008/07/02/AR2008070202800.html>

IASC. Guidance Note on Using the Cluster Approach to Strengthen Humanitarian Response. Nov. 2006. 15 p. Available from <https://www.sheltercluster.org/AboutUs/Pages/TheClusterApproach.aspx>

IASC. Shelter & CCCM Needs Analysis & Response Strategy. Haiti, 2012. 20 p. Available from <http://sheltercentre.org/sites/default/files/shelter__cccm_needs_analysis__response_strategy_-_haiti_2012.pdf>

IFRC. Transitional Shelters. Eight Designs. Geneva, 2011. 96 p. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

IKAPUTRA. People Response to Localize the Imported Culture. Study Case: the Dome House in the Rural Culture Post Javanese Earthquake 2006. In the 14th World Conference on Earthquake Engineering. Beijing, Oct. 12-17, 2008.

INTERTECT. Emergency Shelter Strategies That Accelerate Housing Reconstruction. USA, 1992. Available from <http://sheltercentre.org/library/emergency-shelter-strategies-accelerate-housing-production>

JIN, Shauna. Transitional Relief Housing for Tsunami Victims of Tamil Nadu, India. Thesis (Bachelor of Science) Cambridge, Mass., Massachusetts Institute of Technology, Department of Mechanical Engineering, 2006.

JOHNSON Cassidy. What's the big deal about temporary housing? Planning Considerations for Temporary Accommodation after Disasters: Example of the 1999 Turkish Earthquakes. Conference: Improving Post-Disaster Reconstruction in Developing Countries. Montreal, Universite de Montreal, IF Research Group, i-Rec information & research for reconstruction, 2002. 18p. Available from <http://www.grif.umontreal.ca/pages/papersmenu.html>

JOHNSON, Cassidy. Strategies for the Reuse of Temporary Housing. Workshop Paper, Holcim Forum for Sustainable Construction, Urban Transformations. Shanghai, Tongju University, April 18-21, 2007, pp. 323-331. Available from <http://www.holcimfoundation.org/default.aspx?tabid=463>

KEYNES, Richard D. The Beagle Record: Selections from the Original Pictorial Records and Written Accounts of the Voyage of H.M.S. Beagle. Cambridge, Cambridge University Press, 1979. 409 p.

KOENIGSBERGER, Otto, Third World Housing Policies since the 1950s. Habitat International, 10 (3):27-32, 1986.

KRONENBURG, Robert. Houses in Motion: Genesis, History and Developments of the Portable Building. London, Academy Editions, 1995.144 p.

LANG HO, Cathy. Safe Haven. Disasters and War Have Left Millions Homeless Around the World. Can Architects Help?. Architecture (11):80-83, Nov. 2002.

LYONS, Michael, SCHILDERMAN, Theo, BOANO, Camillo. Building Back Better. Delivering People Centred Housing Reconstruction at Scale. Practical Action, London South Bank University, and International Federation of Red Cross and Red Crescent Societies, 2010. 375 p.

MCDONALD, Roxanna. Introduction to Natural and Man-Made Disasters and their Effects on Buildings. Great Britain, Architectural Press, 2003. 240 p.

NCR and SHELTER CENTER. Urban Shelter Guidelines. Assistance in Urban Areas to Populations Affected by Humanitarian Crises. Launch Edition, 2010. 165 p. Available from <http://sheltercentre.org/sites/default/files/urban_guidelines_submission_23-11-10_compressed.pdf>

PALLASMAA, Juhani and SATO, Tomoko. Alvar Aalto Through the Eyes of Shigeru Ban. London, Black Dog Publishing, 2007. 271 p.

PAWLEY, Martin. Buckminster Fuller. London, Trefoil, 1990. 192 p.

PEACOCK, Walter G., DASH, Nicole, and ZHANG, Yang. Sheltering and Housing Recovery Following Disaster. In: RODRÍGUEZ, Havidán, QUARANTELLI, Enrico L., DYNES, Russell R. Handbook of Disaster Research. Springer, 2007. Chapter 15, pp.258-274. Available from <http://www.springerlink.com/content/x26555115j122170>

PERRY, Ronald W. What Is a Disaster?. In: RODRÍGUEZ, Havidán, QUARANTELLI, Enrico L., DYNES, Russell R. Handbook of Disaster Research. Springer, 2007. Chapter 1, pp. 1-15.

POLLOCK, Naomi. Ban-Aid. The Japanese Legend Discusses Architect´S Duty to Good. Architectural Record, 196: 90-93, Oct. 2008.

QUARANTELLI, E.L. Patterns of Shelter and Housing in US Disasters. Disaster Prevention and Management, 4(3):43-53, 1995.

RACHMAMARCILLIA, Syam, OHNO, Ryuzo. Importance of Social Space in Self-built and Donated Post Disaster Housing after Java Earthquake 2006. In the ASEAN Conference on Environment-Behaviour Studies (AcE-Bs), 2011. Centre for Environment-Behaviour Studies. Malaysia, Faculty of Architecture, Planning and Surveying (FAPS), UiTM. Available from <http://fspu.uitm.edu.my/cebs/images/stories/cebs/av3n7jan2012c3.pdf>

RESSLEI, Everett M., INTERTECT. The International Conference on Disaster Area Housing. Disasters, 2(1):29-30, 1978.

RUDOFSKY, Bernard. Architecture Without Architects: a Short Introduction to Non-Pedigreed Architecture. London, Academy Editions, 1964. Preface.

SHELTER CENTRE. Transitional Shelter Guidelines. Geneva, May 2012. 216 p. Available from <http://sheltercentre.org/sites/default/files/20120522_tsg_onlinedoc_0.pdf>

SHELTER PROJECT. Report on the Transitional Settlement Sector. Cambridge, University of Cambridge, 2003. 87 pp. Available from <http://sheltercentre.org/sites/default/files/shelterproject_sectorReport.pdf>

SIGUS/ MIT. Is Incremental a Good Strategy for Haiti and Chile? Exhibit panel, UN World Urban Forum- Rio de Janeiro, 22-26 March 2010. Available from <http://web.mit.edu/incrementalhousing/WUF-Rio/ninePanelExhibit.html>

SLAVITT, Lesley. Reconstruction and World War I: Internationalism and the Idea of the Expert. Thesis (M.S.), New York, Columbia University, Graduate School of Architecture, Planning, and Preservation , 1994. Available from <http://net.lib.byu.edu/estu/wwi/comment/slavitt.htm>

SPHERE HANDBOOK. Humanitarian Charter and the Minimum Standards in Humanitarian Response. The Sphere Project, (3rd Ed.), 2011. 393 p. Available from <http://www.sphereproject.org/handbook/>

STEPHENSON, Maggie. Senior Technical Advisor at UN-HABITAT. In conference: Geospatial Tools and Information Needs in Post-Disaster Recovery Workshop. Organised by Remote Sensing for Built Environment Disasters and Development (REBUILDD). Cambridge, University of Cambridge, Sidney Sussex College, March 29-30, 2012.

STERLING, Bruce. Do-Bad Architecture. Architectural Record, 196:86-89, Oct. 2008.

STOHR, Kate. 100 Years of Humanitarian Design. In: ARCHITECTURE FOR HUMANITY. Design Like You Give a Damn. Architecture Responses to Humanitarian Crises. London, Thames & Hudson, 2006, pp.32-55.

THE WORLD BANK , GFDRR. Earthquake Reconstruction. Knowledge Notes. Washington D.C., Nov. 2011. 82 p. Available from: <http://www.gfdrr.org/gfdrr/node/1023> and <www.worldbank.org>

UN. Principles and Recommendations for Population and Housing Censuses. New York, United Nations (Revision 2),2008. 420 p. Available from <http://unstats.un.org/unsd/demographic/sources/census/docs/P&R_Rev2.pdf> PAGE 100

UN-HABITAT and IFRC. Shelter Projects 2009. Published in 2010.122 p. Available from <http://www.sheltercasestudies.org/>

UN-HABITAT, UNHCR and IFRC. Shelter Projects 2010. Published in 2012. 118 p. Available from <http://www.sheltercasestudies.org/>

UN-HABITAT. Shelter Projects 2008.109 p. Available from <http://www.sheltercasestudies.org/>

UN-HABITAT. State of the World's Cities 2006/7. Malta, Gutenberg Press, 2006. 204 p. Available from <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=2101>

UNHCR. Handbook for Emergencies. Geneva, UNHCR (3rd Ed.) 2007. 582 p. Available from <http://www.unhcr.org/472af2972.html>

UN-ISDR. Towards a Post-2015 Framework for Disaster Risk Reduction. 10 p. Available from <http://www.preventionweb.net/files/25129_towardsapost2015frameworkfordisaste.pdf>

US CENSUS BUREAU. Median and Average Square Feet of Floor Area in New Single-Family Houses. 2010 Census Data. Available from <http://www.census.gov/const/C25Ann/sftotalmedavgsqft.pdf>

VALE, Brenda. Prefabs: a History of the UK Temporary Housing Programme. London, Spon, 1995. 192 p.

WISNER, Ben, BLAIKIE, Piers, CANNON, Terry and DAVIS Ian. At Risk. Natural Hazards, People's Vulnerability and Disasters. London, Routledge, (2nd Ed.) 2004. 471 p.

Websites

ALVAR AALTO. Available from <http://file.alvaraalto.fi/search.php?id=584>

AMERICAN FRIENDS SERVICE COMMITTEE. Available from <http://afsc.org >

AMERICAN RED CROSS. Available from <http://www.redcross.org >

AMERICAN RED CROSS. Available from <http://www.redcross.org>

ARCHITECTURE FOR HUMANITY. Available from <http://architectureforhumanity.org>

ARCHITECTURE SANS FRONTIERES INTERNATIONAL. Available from <http://www.asfint.org>

BASIC INITIATIVE. Building Sustainable Communities. Portland State University and University of Texas at Austin, School of Architecture. Available from <http://www.basicinitiative.org> and <www.basicinitiative.com>

BAUHAUS SUMMER SCHOOL 2010. Home is everywhere. 21-30 July 2010, Dessau, Germany. Available from <http://www.bauhaus-dessau.de/index.php?Home-is-Everywhere-4>

CALIFORNIA INSTITUTE OF EARTH ART AND ARCHITECTURE. Available from <http://calearth.org>

CENDEP. Centre for Development and Emergency Practice. Oxford Brookes University, UK. Available from <http://oisd.brookes.ac.uk/architecture/cendep/index.html>

DOMES FOR THE WORLD. The Dome, The Ecoshell. Available from <http://www.dftw.org/topics/domes>

EM-DAT. The International Disaster Database. Centre for Research on the Epidemiology of Disasters-CRED. Available from <http://www.emdat.be>

GALLERY PATRICK SEGUIN. 20th Century Furniture & Architecture. Jean Prouve/ Charlotte Perriand/ Pierre Jeanneret/ Le Corbusier/ Jean Royere. Available from <http://www.patrickseguin.com/en/designers/jean-prouve/architecture>

HABITAT FOR HUMANITY INTERNATIONAL. Available from <http://www.habitat.org >

HEXAYURT. Available from <http://hexayurt.com>

INCREMENTAL HOUSING MIT. Available from <web.mit.edu/incrementalhousing>

INSTITUTO NACIONAL DE ESTADÍSTICA E INFORMÁTICA. Peru: Promedio de miembros del hogar y edad promedio del jefe de hogar, 2005, 2007, 2009 y 2010. INEI-Encuesta Nacional de Hogares: 2005,2007,2009 and 2010. Available from <http://www.inei.gob.pe/perucifrasHTM/inf-soc/cuadro.asp?cod=10004&name=ho07&ext=gif>

INTERSHELTER. The Intershelter (tm) Dome. Available from <http://www.intershelter.com/dome.php>

LIBRARY OF CONGRESS. Houses for Britain. Prints and Photographs Online Catalog (PPOC). Available from <http://www.loc.gov/pictures/item/owi2001043255/PP>

NATIONAL BUREAU OF STATISTICS OF CHINA. China Statistical Yearbook 2011. China Statistic Press, 2011. Available from <http://www.stats.gov.cn/tjsj/ndsj/2011/indexeh.htm>

OISD. Oxford Institute for Sustainable Development. Oxford Brookes University, UK. http://oisd.brookes.ac.uk>

OPEN ARCHITECTURE NETWORK. Available from <http://openarchitecturenetwork.org >

PALLERONI LEITE DESIGN PARTNERSHIP. Portland, Oregon, USA. Available from <http://pl-dp.com>

QUONSETHUTS. Available from <http://www.quonsethuts.org>

RADIO NATIONAL. By design. Nissen-Petren Houses. October, 2007. Available from <http://www.abc.net.au/radionational/programs/bydesign/nissen-petren-houses/3226138>

RECOVERY PLATFORM. Available from <http://www.recoveryplatform.org>

SHELTER CENTRE. Available from <http://www.sheltercentre.org >

SHELTER CLUSTER. Available from <https://www.sheltercluster.org/AboutUs/Pages/TheShelterCluster.aspx>

SHIGERU BAN ARCHITECTS. Available from <http://www.shigerubanarchitects.com>

SIGUS. Special Interest Group in Urban Massachussetts Institute of Technology, School of Architecture and Planning. Available from <http://web.mit.edu/sigus/www/NEW/index.html>

SPHERE PROJECT. Available from <http://www.sphereproject.org/about>

THE CALIFORNIA INSTITUTE OF EARTH ART AND ARCHITECTURE. Available from <http://calearth.org>

THE HABIHUT. Available from <http://www.thehabihut.com/products_01.html>

THE WESTERN NEIGHBORHOODS PROJECT. A Nonprofit Organization to Preserve and Share the History and Culture of the Neighbourhoods in Western San Francisco. Available from < http://www.outsidelands.org/index.php >

THE WORLD BANK. Available from <http://www.worldbank.org>

WORLD SHELTERS. U-DOME. Available from <http://worldshelters.org/shelters/u-dome>

IMAGE CREDITS

1 and 2. Author.

3,4,5,6. Author. With data from: EM-DAT. The International Disaster Database. Centre for Research on the Epidemiology of Disasters-CRED. Available from <http://www.emdat.be> Visited Oct. 21, 2011.

7. Author.

8. WILLS Eric, GREENBLATT Alan. Architecture to rescue. Sites at Risk. How prepared are various global hot spots for impending natural disasters? Architect Magazine, Sept. 8, 2011. Available from <http://www.architectmagazine.com/planning/sites-at-risk.aspx> and <http://imgs.ebuild.com/Architect/architectureWorldMapNEW.swf> Modified by the author.

9. UNDRO-DMTP. An Overview of Disaster Management. Disaster Management Training Programme. 2nd Edition, 1992, p. 15. Modified by the author. Available from <http://www.crid.or.cr/digitalizacion/pdf/eng/doc6764/doc6764.htm> Modified by the author.

10. THE WORLD BANK , GFDRR. Earthquake Reconstruction. Knowledge Notes. Washington D.C., Nov. 2011, p.3. Available from: <http://www.gfdrr.org/gfdrr/node/1023> and <www.worldbank.org>

11. CORSELLIS, Tom and VITALE, Antonella. Transitional Settlement and Reconstruction after Natural Disasters. Geneva, Shelter Centre and Department for International Development, United Nations Office for the Coordination of Humanitarian Affairs, 2008, p. 10. Available from <http://sheltercentre.org/library/transitional-settlement-and-reconstruction-after-natural-disasters-field-edition>

12. Author. With sources: DAVIS Ian. What is the Vision for Sheltering and Housing in Haiti? Summary Observations of Reconstruction Progress following the Haiti Earthquake of January 12th 2010. Jan. 2012, p.16; QUARANTELLI, E.L. Patterns of Shelter and Housing in US Disasters. Disaster Prevention and Management, 4(3):43-53, 1995; SHELTER CENTRE. Transitional Shelter Guidelines. Geneva, May 2012, p.3. Available from <http://sheltercentre.org/sites/default/files/20120522_tsg_onlinedoc_0.pdf>

13,14,15,16. Author.

17. CORSELLIS, Tom and VITALE, Antonella. Transitional Settlement and Reconstruction after Natural Disasters. Geneva, Shelter Centre and Department for International Development, United Nations Office for the Coordination of Humanitarian Affairs, 2008, pp. 25-27. Available from <http://sheltercentre.org/library/transitional-settlement-and-reconstruction-after-natural-disasters-field-edition> Modified by the author.

18. Author.

19. BOESIGER, Willy and GIRSBERGER Hans. Le Corbusier 1910-65. London, Thames and Hudson, 1967, p.24.

20. PROBST H., SCHADLICH C. Walter Gropius: Der Architekt und Theoretiker. (vol.1).Berlin, 1985, p.95

21. PAWLEY, Martin. Buckminster Fuller. London, Trefoil, 1990, pp.96-97.

22. PALLASMAA, Juhani and SATO, Tomoko. Alvar Aalto Through the Eyes of Shigeru Ban. London, Black Dog Publishing, 2007, p.157.

23. ALLÉGRET, Laurence, VAUDOU, Valérie. Jean Prouvé et Paris. Paris, Pavillon de l'Arsenal, Picard, 2001, p. 136.

24. AGA KHAN DEVELOPMENT NETWORK WEBSITE. Aga Khan Award for Architecture. Awards 2002-2004. Available from <http://www.akdn.org/akaa_award9_awards_detail3.asp>

25. ARCHITECTURE FOR HUMANITY. Design like you give a damn. Architecture responses to humanitarian crises. London, Thames & Hudson, 2006, p.102.

26. THE WESTERN NEIGHBORHOODS PROJECT. A Nonprofit Organization to Preserve and Share the History and Culture of the Neighbourhoods in Western San Francisco. Available from <http://www.outsidelands.org/maps/shacks.php>

27. ARCHITECTURE FOR HUMANITY. Design like you give a damn. Architecture responses to humanitarian crises. London, Thames & Hudson, 2006, p.34.

28. LIBRARY OF CONGRESS. Prints and Photographs Division, Washington, D.C. Farm Security Administration/Office of War Information, Black-and-White Negatives, Reproduction Number: LC-USW3-057341-C (b&w film neg.) Available from <http://www.loc.gov/pictures/item/owi2001043255/PP>

29. DAVIS, Ian. Emergency Shelter. In: The role of technology in international disaster assistance. Proceedings of the Committee on International Disaster Assistance Workshop. Washington D.C., The National Research Council, 1977, p. 26.

30. ARCHITECTURE FOR HUMANITY. Design like you give a damn. Architecture responses to humanitarian crises. London, Thames & Hudson, 2006, p.47

31. DAVIS, Ian. Emergency Shelter. In: The role of technology in international disaster assistance. Proceedings of the Committee on International Disaster Assistance Workshop. Washington D.C., The National Research Council, 1977, p. 27.

32. UN-HABITAT. Historical Case Studies. Tonga-1982-Cyclone Isaac. In: UN-HABITAT. Shelter Projects 2008, p.104. Available from <http://www.sheltercasestudies.org/>

33. Courtesy of Agostino Pacciani. Found in: D'URZO, Sandra. News from the teardrop island. In: Beyond Shelter. Architecture and Human Dignity. Metropolis Books, 2011, p. 61.

34. KRONENBURG, Robert. Houses in Motion: Genesis, History and Developments of the Portable Building. London, Academy Editions, 1995, p.58.

35. VALE, Brenda. Prefabs: a History of the UK Temporary Housing Programme. London, Spon, 1995, p.134.

36. MICHIGAN STATE UNIVERSITY. Archives & Historical Collections. Available from <http://msuarchives.wordpress.com/2012/07/09/quonset-village>

37. NORTH CAROLINA STATE UNIVERSITY LIBRARIES. Raleigh, North Carolina. University Archives Photograph Collection. Available from < <http://historicalstate.lib.ncsu.edu/catalog?f[classification_facet][]=Vetville%2C+Trailwood%2C+and+Westhaven>

38. VALE, Brenda. Prefabs: a History of the UK Temporary Housing Programme. London, Spon, 1995, pp. 4,10,14,19

39. KEYNES, Richard D. The Beagle Record: Selections from the Original Pictorial Records and Written Accounts of the Voyage of H.M.S. Beagle. Cambridge, Cambridge University Press, 1979, p.255.

40. ARCHITECTURE FOR HUMANITY. Design like you give a damn. Architecture responses to humanitarian crises. London, Thames & Hudson, 2006, p.43.

41. RUDOFSKY, Bernard. Architecture Without Architects: a Short Introduction to Non-Pedigreed Architecture. London, Academy Editions, 1964.

42. UN-HABITAT. Historical Case Studies. Bangladesh-1975-Conflict-People displaced. In: UN-HABITAT. Shelter Projects 2008, p.93. Available from <http://www.sheltercasestudies.org/>

43. DAVIS, Ian. Emergency Shelter. In: The role of technology in international disaster assistance. Proceedings of the Committee on International Disaster Assistance Workshop. Washington D.C., The National Research Council, 1977, p. 24.

44. DAVIS, Ian. Emergency Shelter. Disasters. The International Journal of Disaster Studies and Practice. 1(1): 23-40, March 1977, (p. 25).

45. KRONENBURG, Robert. Houses in Motion: Genesis, History and Developments of the Portable Building. London, Academy Editions, 1995, p.123.

46. Author. Same image credits from 19 until 45.

47 and 48. Author.

49. Transitional accommodation examples selected, organised by group.

49. UNIVERSITIES:

- Digitally Fabricated Housing for New Orleans. MIT. Source: SAAS Larry. Digitally Fabricated Building Delivery through Kits. FAB6: The Sixth International Fab Lab Forum and Symposium on Digital Fabrication. August 15-20, 2010, Amsterdam. Available from <http://cba.mit.edu/events/10.08.FAB6/Sass.pdf>

- Seed. Clemson University. Source: ARCHDAILY. SEED, an emergent housing solution for the Caribbean Region. 21 Jan. 2010. Available from <http://www.archdaily.com/47267/seed-an-emergent-housing-solution-for-the-caribbean-region>

- Flatpack shelter. Cal-Poly. Source: ARENS Robert M., SALIKLIS, Edmond. Versioning. Design and Fabrication of a Flat Pack Emergency Shelter, p. 1. The BTES Conference, 2011. CONVERGENCE AND CONFLUENCE. August 4-7, 2011, Toronto, Ontario, Canada.

- Media agua. UDD. Pastorelli, Giuliano. Diseño de Media Agua/ Universidad del Desarrollo. 10 Mar. 2010. Available from <http://www.plataformaarquitectura.cl/2010/03/10/diseno-de-media-agua-universidad-del-desarrollo>

- Vivienda Emergencia Progresiva. PUC. CORTES, Macarena. Emergency and Reconstruction: the will of the real. School of Architecture, Catholic University of Chile. In: Chile 8.8. Catalog of the Chilean Pavilion. 12th International Architecture Exhibition Venice Biennale, 2010 p.116.

- Recover -Breathehouse. University of Virginia. Source: HUGHES C.J. In Haiti, Archive houses aim to curb disease through design. In Architectural Record, 12th Jan. 2011. Available from < http://archrecord.construction.com/news/2011/01/110112haiti_archive_houses.asp>

- Liina. Aalto University. Source: ARCHDAILY. Liina Transitional Shelter/ Aalto Unievrsity Wood Program. 11th Oct.2011. Available from <http://www.archdaily.com/174909/liina-transitional-shelter-aalto-university-wood-program>

- Shelter project. MICA. OPEN ARCHITECTURE NETWORK. MICA Shelter Project. Maryland Institute College of Art. Available from <http://openarchitecturenetwork.org/projects/mica_shelter_project>

49.ARCHITECTS, DESIGNERS, ENGINEERS

- Future shack. Godsell. RICHARDSON Phyllis. XS Green: Big ideas, small buildings. London, Thames&Hudson, 2007, p.8.

- Hexayurt. Gupta. STAR-TIDES. Sharing to accelerate research. Transformative innovation for development and emergency support. Hexayurt Project. Available from <http://star-tides.net/resource/hexayurt-project-build-field-transitional-sheltering-10-total-cost-tents>

- Pallet house. I-beam. I-BEAMDESIGN. Prototype built for Prince Charles Royal Gardens in conjunction with IBM, The Financial Times and Earth Awards. London UK, 2010. Available from <http://www.i-beamdesign.com/projects/refugee/refugee.html>

- Concrete canvas. Crawford, Brewin. Source: CONCRETE CANVAS. Rapid Concrete Infrastructure. Available from <http://www.concretecanvas.co.uk>

- DH1 2006. Fleishman. Source: WORTHAM Jenna. Slideshow: Instant Housing and Designing for Disaster. 22nd Oct. 2007. WIRED. Available from <http://www.wired.com/culture/lifestyle/multimedia/2007/10/gallery_instant_housing?slide=9&slideView=4>

- Graph. Rintala Eggersson. Source: SAIEH Nico. Crossing NOW Exhibition in Beijung by Pasi Aalto. Available from <http://www.archdaily.com/24283/crossing-now-exhibition-in-beijing-by-pasi-aalto>

- Red housing. OBRA. Source: ARCHDAILY. Red+Housing/ OBRA Architects. 04 Jul. 2009. Available from <http://www.archdaily.com/27744/redhousing-obra-architects>

- Softhouse. L. Combs, R. Leon, NOMA, M. Parsons, D. Zoric, J. Pak. Source: Open Architecture Network. Haiti SOFTHOUSE. Available from <http://openarchitecturenetwork.org/projects/dlygad2_haitisofthouse>

- Casa elemental Tecnopanel. Elemental. Source: BASULTO, David. Casa ELEMENTAL Tecnopanel, una alternativa eficiente a la vivienda de emergencia. 28th Mar. 2010. Available from <http://www.plataformaarquitectura.cl/2010/03/28/casa-de-emergencia-vivienda-elemental-tecnopanel-mediagua-terremoto>

- Shipping container houses. Shigeru Ban. Source: Pollock, Naomi R. Container Housing, Shigeru Ban Architects, Onagawa, Miyagi Prefecture, Japan. Building for Social Change. Architectural Record, March 2012. Available from <http://archrecord.construction.com/features/humanitarianDesign/Japan/Container-Housing.asp>

49. MANUFACTURERS

-Intershelter, Envirodome. INTERSHELTER. Photo of US Geological Survey Research Station “Alaska Northern Region” courtesy of Mr. Frank Urban. Available from <http://www.intershelter.com/index.php>

- Icopod. Folded homes. Source: FOLDED HOMES. Pods. Icosa Village Pods. Available from <http://foldedhomes.com/pods.html>

- Liteyurt. Folded homes. Source: FOLDED HOMES. Liteyurts. Available from <http://foldedhomes.com/FAQs/faq_sc_qa.html#sc_liteyurts>

- Global village. Ferrara. GLOBAL VILLAGE SHELTERS. Available from < http://www.gvshelters.com>

- TS200. Losberger-Nunatak Systems. Source: TRANSITIONAL SHELTER. Available from <http://www.transitionalshelter.org/www.transitionalshelter.org/TS200.html>

- Transhomes. NRS international. Source: NRS International. TransHome Transformable Shelter. Available from <http://www.nrs-international.com/products/tents/transhome-%C2%AE.aspx>

- MarkIII. Evenshelter. Source: EVENPRODUCTS. Evenshelter. Available from <http://evenproducts.co.uk/index.php/transitional-shelter-meeting-in-geneva>

- Habihut. Source: THE HABIHUT. Habihut Unit. Available from <http://www.thehabihut.com/pdfs/HabiHutBrochure_051111.pdf>

- MK5. Maddel international. MADDEL INTERNATIONAL. Shelter MK5. Available from <http://www.maddelinternational.com/index.php?option=com_content&view=article&id=77&Itemid=77>

49. NGOs

- U-dome. World Shelters. Source: WORLD SHELTERS. U-DOME. Available from <http://worldshelters.org/shelters/u-dome>

- Mediagua. Un Techo Para Chile. VICTORENO Felipe. Estudio del comportamiento térmico de la vivienda de emergencia o “mediagua”. Internship report. Universidad Católica de Chile, 2008, p.48. Available from <http://www.untechoparachile.cl/cis/investigaciones/tesis/vivienda.html>

- Steel frame-Vietnam. IFRC. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p. 69. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Ecoshell. Domes for the World. Source: MONOLITHIC. Monolithic Ecoshell in Indonesia. Available from <http://www.monolithic.com/stories/monolithic-ecoshells/photos#0>

- Steel frame-Indonesia. IFRC. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p.63. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Timber frame-Peru. IFRC/ CHF. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p.45. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Timber-Bamboo-Peru. IFRC/ CHF. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p.51. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Bamboo frame-Indonesia. IFRC. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p.27. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Timber frame-Indonesia. IFRC. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p.33. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Transhel. World Shelters. Source: WORLDSHELTERS. Transhel being assembled at the Shelter Centre in Geneva. Available from < http://worldshelters.org/photo-galleries/transhel-in-geneva

- Timber frame-Pakistan. IFRC. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p.39. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Steel frame-Haiti. IFRC. Source: IFRC. Transitional Shelters. Eight designs. Geneva, 2011, p.57. Available from <http://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf>

- Series 1100. Worldwide Shelters. Source: SHELTER CENTRE. Meeting: Transitional Shelter Day 10a. Available from < http://sheltercentre.org/meeting/material/worldwide-shelters-series-1100-transitional-shelter>

- Tshel2. World Shelters. Source: WORLDSHELTERS. TShel2 in Haiti. Available from <http://worldshelters.org/shelters/tshel2>

49. GOVERNMENTS

- FEMA trailers. USA. Source: KATRINA DESTRUCTION. Hurricane Katrina Editorial and Stock Image Archives. The Ingalls-Wright Emergency Group Site (EGS) in Pascagoula, Miss. Available from <http://www.katrinadestruction.com/images/v/fema+trailers>

- Prefab. China. Source: GZWENCHUANG MADE IN CHINA.COM. Guangzhou Wenchuang Steel Structures Co., Ltd. prefabricated House (Sichuan Wolong Project). Available from <http://gzwenchuang.en.made-in-china.com/product/VbXxIvHPrBhM/China-Prefabricated-House-Sichuan-Wolong-Project-.html>

- M.A.P wooden cabins. Italy. PROTEZIONE CIVILE. Presidenza del Consiglio dei Ministri Dipartimento della Protezione Civile. Comunicazione e media. Foto e video, Emergenze, Terremoto Abruzzo. Inaugurazione Map Goriano Sicoli, Castel di Ieri e Castelvecchio Subequo, 19 dicembre 2009. Map di Castelvecchio Subequo, Foto (12). Available from <http://www.protezionecivile.gov.it/jcms/it/view_gal.wp?facetNode_1=f1_1&prevPage=multimedia&numelem=11&facetNode_3=f1_1_1&facetNode_2=f4_5_2&contentId=GAL7433#top-media

- C.A.S.E buildings. Italy. PROTEZIONE CIVILE. Presidenza del Consiglio dei Ministri Dipartimento della Protezione Civile. Comunicazione e media. Foto e video, Emergenze, Terremoto Abruzzo. Consegna dei MAP a Preturo, 14 gennaio 2010. Un modulo abitativo prima dell'inaugurazione, Foto (9). Available from <http://www.protezionecivile.gov.it/jcms/it/view_gal.wp?facetNode_1=f1_1&prevPage=multimedia&numelem=3&facetNode_3=f1_1_1&facetNode_2=f4_5_2&contentId=GAL7149#top-media>

- Timber house. Chile. Source: VALENZUELA Nicolas. ¿Olvidó Chile la Reconstrucción? Las razones para la Consulta Nacional. 20 Feb. 2012. Available from <http://www.cauquenino.com/html/vamos-en-ayuda-de-cauquenes-y-su-provincia-categorias-79/2133-iolvido-chile-la-reconstruccion-las-razones-para-la-consulta-nacional.html>

- Kasetsu Jutaku. Japan. HOUSE OF JAPAN. Securing Land for Housing. 02 May 2011. Available from <http://www.houseofjapan.com/local/securing-land-for-housing>

49. SELF-BUILT

- India. Source: CONSERVATIONTECH. Building Conservation technology. Unesco mission to Gujarat Inda, for the conservation of earthquake -damaged cultural properties. Photographs Randolph Langenbach, 2001. Available from <http://www.conservationtech.com/india-unesco/unesco-report.htm>

- Bangladesh. Source: UN-HABITAT and IFRC. Natural Disasters Bangladesh- 2007-Cyclone Sidr. In: UN-HABITAT and IFRC. Shelter Projects 2009, p.45. Available from <http://www.sheltercasestudies.org>

- Indonesia. Source: Bob McKerrow. West Sumatra earthquake: Early Recovery. Available from <http://bobmckerrow.blogspot.co.uk/2009/10/west-sumatra-earthquake-early-recovery.html>

- Haiti. Source: Shelters That Don't Shelter the Needy. 15 March 2012. Photo by Fritznelson Fortuné. Available from <http://www.ayitikaleje.org/haiti-grassroots-watch-engli>

- Haiti. Source: UN-HABITAT, UNHCR and IFRC. Haiti – 2010-Earthquake- Overview continued. In: UN-HABITAT, UNHCR and IFRC. Shelter Projects 2010, p.15 (photo by Joseph Ashmore). Available from <http://www.sheltercasestudies.org/>

50,51,52,53,54,55,56,57,58,59. Author.

60. DAVIS, Ian. Emergency Shelter. In: The role of technology in international disaster assistance. Proceedings of the Committee on International Disaster Assistance Workshop. Washington D.C., The National Research Council, 1977, p. 27.

61. IKAPUTRA. People Response to Localize the Imported Culture. Study Case: the Dome House in the Rural Culture Post Javanese Earthquake 2006. Conference Paper. The 14th World Conference on Earthquake Engineering, October 12-17, 2008, Beijing, China.

APPENDICES

CATEGORY	NAME	COUNTRY DESIGNED	YEAR DESIG.	YEAR BUILT	COUNTRY BUILT/TARGET	Nº BUILT	DISASTER TYPE	LENGTH (M)	WIDTH (M)	HIGH (M)
UNIVERSITY	DIGITALLY FABRICATED HOUSING FOR NEW ORLEANS. MIT	USA, Cambridge, Massachussets	2008	2008	Hurric. New Orleans, USA (2004) but built in NY as exhibition (2008)	1	Hurricane Katrina	11.63	4.98	6.10
UNIVERSITY	SEED. CLEMSON	USA, Clemson, South Carolina.	2009	2009	Caribbean Region	0	Hurricanes and earthquakes	12.03	2.35	2.39
UNIVERSITY	FLATPACK SHELTER. CAL-POLY	USA, California	2010	2010	not used yet for disasters	1	general	2.40	2.40	2.40
UNIVERSITY	MEDIA AGUA. UDD	Chile, Santiago	2010	2010	Chile (2010)	27	earthquake	9.00	3.00	3.00
UNIVERSITY	VIVIENDA EMERGENCIA PROGRESIVA (VEP). PUC	Chile, Santiago	2010	2010	Chile (2010)	16	earthquake	6.00	3.00	
UNIVERSITY	RECOVER -BREATHEHOUSE. U. VIRGINIA	USA, Virginia and UK, Wales	2010	2010	Katrina, USA (2005)/ Haiti, (2010)	1	HURRICANES/Earthquakes	6.00	4.00	
UNIVERSITY	LIINA. AALTO UNIV.	Finland	2011	2011	Not used yet for disasters. Cold climate crisis ; Ararat region on the borders of Turkey, Iran, Armenia and Azerbaijan	1	Earthquakes and in cold climate crisis	6.00	4.00	n/a
UNIVERSITY	SHELTER PROJECT. MICA	USA, Maryland	2011	2011	General, katrina, haiti. Not Used yet.	1	general (Tsunami, earthquake and hurricanes	4.88	2.44	
ARCH./DES./ENG.	FUTURE SHACK. GODSELL	Australia, Melbourne	2001	2001	not used yet for disasters	1	general	6.01	2.35	2.39
ARCH./DES./ENG.	HEXAYURT. GUPTA	USA	2002	2010	Haiti (2010)	1	general	n/a	n/a	n/a
ARCH./DES./ENG.	PALLET HOUSE. I-BEAM	USA, N.Y	1999-2004	2004	Not Used yet for disasters.	5	general Kosovo, then Sri Lanka	6.00	4.80	n/a
ARCH./DES./ENG.	CONCRETE CANVAS. CRAWFORD BREWIN	UK	2005	2005	not used yet for disasters	1	general	5.60	5.00	2.45
ARCH./DES./ENG.	DH1 2006. FLEISHMAN	USA, Los Angeles	2006	not used	not used yet for disasters	1	general	3.74	3.74	n/a
ARCH./DES./ENG.	GRAPH. RINTALA EGGERSSON	Norway	2009		not used yet for disasters (China)	1	Earthquake	4.00	4.00	2.70
ARCH./DES./ENG.	RED HOUSING. OBRA	USA/ China	2009		not used yet for disasters (China)	1	Earthquake	9.00	9.00	n/a
ARCH./DES./ENG.	SOFTHOUSE. LEON	USA, N.Y, and Haiti	2010	2010	Jacmel, Haiti (2010)	21	Earthquakes, tropical storms and hurricane conditions	n/a	n/a	n/a
ARCH./DES./ENG.	CASA ELEMENTAL TECNOPANEL. ELEMENTAL	Chile, Santiago	2010	not used	Constitucion, Chile (2010)	10	Tsunami and earthquake	6.10	4.88	3.50
ARCH./DES./ENG.	SHIPPING CONTAINER HOUSES. BAN	Japan	2011	2011	Japan (2011)	188	Earthquake	6.01	4.70	2.31
MANUFACTURERS	INTERSHELTER	USA, Alaska	1993	2010, 2011	Haiti (2010) / Japan (2011)	2	general (Tsunami, earthquake and hurricanes)	4.27	4.27	2.74
MANUFACTURERS	ICOPOD. FOLDED HOMES	USA, Oregon	2002	2005	Pakistan (2005) icosa village	50	earthquake	3.75	3.94	n/a
MANUFACTURERS	LITEYURT. FOLDED HOMES	USA, Oregon	2006	2006	not used yet	1	general	2.95	2.95	2.67
MANUFACTURERS	GLOBAL VILLAGE. FERRARA	USA	2004	2005-2010	Grenada and Afghanistan (2005), Haiti (2010)	70+100	general (Tsunami, earthquake and hurricanes	2.50	2.50	2.44

CONSTRUCT. (HRS)	BUILDING TEAM	M2	COST USD	COST/M 2	SPHERE 3.5m2/pers.	UNHCR 4.5m2/pers.	MATERIALS	LIFESPAN (Months)
552	n/a	18.20	40,000.00	2,197.80	5.20	4.04	Plywood. 5000 individual elements for structure or decoration. Tools used (1), mallets for hammering panels(2), clamps to hold assembled panels in place (3), and crow bars to align parts (4). Miscellaneous tools ranged from hand held routers used to release tools parts from the plywood skeletons and wood glue guns.	n/a
1	n/a	28.20	n/a	n/a	8.06	6.27	Refurbished Shipping Containers (40´)	n/a
n/a	n/a	5.76	n/a	n/a	1.65	1.28	plywood as a surrogate for a composite material of kenaf fiber and recycled polypropylene	n/a
96	4	27.00	1,500.00	55.56	7.71	6.00	wooden panels and wooden pilotis	36
n/a	n/a	18.00	2,300.00	127.78	5.14	4.00	wooden panels	n/a
48	n/a	24.00	20,000.00	833.33	6.86	5.33	Prefabricated panelized building envelope. Prefabricated exterior wall frames can be sided with locally sourced materials, such as bamboo, recycled or regional wood or locally manufactured metal	n/a
6	2	18.00			5.14	4.00	Structurally insulated panels (SIP) of plywood with a Kerto LVL (laminated veneer lumber) wood frame and filled with VITAL wood fiber insulation. Nylon straps and waterproof canvas, an exterior membrane of standard polymer with rubber fastening clips. Windows: Frosted and unfrosted polycarbonate to prevent shatter during transportation.	60
336	n/a	11.90	2,800.00	235.29	3.40	2.64	2” galvanized square tube framing system. The floor system breaks down into oversized pallets. The facades can vary, depending on the aesthetic of a community and what materials are available	n/a
24	n/a	14.12			4.03	3.14	Refurbished Shipping Containers	n/a
1	3	15.42	400.00	25.94	4.41	3.43	Permanent use: Thermax HD (Dow) or Plywood	36
168	5	21.60	500.00	23.15	6.17	4.80	100 recycled pallets	84.00
1	2	25.00	2,000.00	80.00	7.14	5.56	Concrete Canvas (CC) is a flexible cement impregnated fabric that hardens on hydration to form a thin, durable water proof and fire proof concrete layer.	120
5	n/a	14.00	22,000.00	1,571.43	4.00	3.11	3/4" Finland Birch/ (phenolic resin coated) solid birch plywood . The plywood is cut into 276 panels or parts of 28 types	n/a
n/a	n/a	12.00	n/a	n/a	3.43	2.67	n/a	n/a
n/a	n/a	36.00	n/a	n/a	10.29	8.00	bamboo plywood, red fabric	n/a
3	4	15.42	3,000.00	194.55	4.41	3.43	Structural steel frame that receives high performance fabric	60
48	3	30.00	4,100.00	136.67	8.57	6.67	OSB Panels with Expanded Polystyrene (EPS) foam insulation panels. Windows of polycarbonate.	n/a
2160	n/a	29.70	n/a	n/a	8.49	6.60	Refurbished Shipping Containers, 2 or 3 of 20' . 188 apartments (in building blocks)	n/a
4	2	14.30	7,500.00	524.48	4.09	3.18	aerospace composite panels. Fiberglass + gel coat	360
24	4	10.00	4,053.00	405.30	2.86	2.22	polypropylene extruded plastic sheets	18
48	2	6.43	697.00	108.40	1.84	1.43	polypropylene extruded plastic sheets	18
0	2	6.25	475.00	76.00	1.79	1.39	White 13mm polypropylene (PP) profile extruded sheet and polypropylene extrusions. 13mm PP is UV resistant	18

CATEGORY	NAME	COUNTRY DESIGNED	YEAR DESIG.	YEAR BUILT	COUNTRY BUILT/TARGET	Nº BUILT	DISASTER TYPE	LENGTH (M)	WIDTH (M)	HIGH (M)
MANUFACTURERS	TS200. LOSBERGER-NUNATAK SYSTEMS	Germany, France	2009	2009	not used yet for disasters	1	general (Tsunami, earthquake and hurricanes)	5.30	3.30	2.70
MANUFACTURERS	TRANSHOMES. NRS INTERNATIONAL	Pakistan/Dubai?	2009	2009	not used yet for disasters	1	general (Tsunami, earthquake and hurricanes)	4.20	4.20	4.20
MANUFACTURERS	MARKIII. EVENSHELTER	United Kingdom, Worcestershire	2009	2009	not used yet for disasters	1	general (Tsunami, earthquake and hurricanes)	5.53	3.20	2.96
MANUFACTURERS	HABIHUT. HABIHUT	USA, Montana	2010	2011	Haiti (2011) 10 built?	10	Tsunami, earthquake and hurricanes	4.06	3.52	3.76
MANUFACTURERS	MK5. MADDEL INTERNATIONAL	Australia, Queensland	2010	2010	not used yet for disasters	1	general (Tsunami, earthquake and hurricanes)	4.77	3.82	2.65
NGOs	U-Dome, WORLD SHELTERS	California, USA	1977	2008	Biennale Milano, Italy (2008) -exhibited	n/a	general (Tsunami, earthquake and hurricanes)	4.80	4.80	3.60
NGOs	MEDIAGUA. UN TECHO PARA CHILE	Chile, Santiago	1997	2010	Chile (2010)	23886	earthquake-tsunami	6.00	3.00	3.00
NGOs	STEEL FRAME-VIETNAM. IFRC	Vietnam	2004	2004	Vietnam (2004)	215	Typhoons and floods	8.40	3.60	n/a
NGOs	ECOSHELL. DOMES FOR THE WORLD	USA, Texas	2005	2006	Indonesia (2006) AND HAITI (2010) NO?	77	Tsunami, earthquake and hurricanes	6.10	6.10	n/a
NGOs	STEEL FRAME-INDONESIA. IFRC	n/a	2004	2005	Indonesia, Aceh (2005)	20000	Tsunami (2004)	4.57*2	2.825 *2	n/a
NGOs	TIMBER FRAME-PERU. IFRC/ CHF	Peru	2007	n/a	Peru (2007)	2020	Earthquake	6.00	3.00	n/a
NGOs	TIMBER-BAMBOO-PERU. IFRC/ CHF	Peru	2007	2007	Peru, Ica Province (2007)	3000	Earthquake	6.00	3.00	n/a
NGOs	BAMBOO FRAME-INDONESIA. IFRC	Netherlands/ Indonesia (vernacular)	2009	2009	Indonesia, West Java (2009)	430	Earthquake	6.00	4.00	n/a
NGOs	TIMBER FRAME-INDONESIA. IFRC	Indonesia	2009	2009	Indonesia, Sumatra, Padang (2009)	7000	Earthquake	4.50	4.00	n/a
NGOs	TRANSHEL. WORLD SHELTERS	USA, California, Arcata	2009	2009	n/a	1	general (Tsunami, earthquake and hurricanes)	6.00	3.00	1.80
NGOs	TIMBER FRAME-PAKISTAN. IFRC	Pakistan	2010	2010	Pakistan – Khyber Pakhtunkhwa and Gilgit-Baltistan (Northern Areas) (2010)	10000	Flood	5.70	4.30	n/a
NGOs	STEEL FRAME-HAITI. IFRC	Spain	2010	2010	Haiti (2010)	5100	Earthquake	6.00	3.00	4.60

CONSTRUCT. (HRS)	BUILDING TEAM	M2	COST USD	COST/M 2	SPHERE 3.5m2/pers.	UNHCR 4.5m2/pers.	MATERIALS	LIFESPAN (Months)
2	3	17.50	n/a	n/a	5.00	3.89	Aluminium frame, Laminated Polyethylene Extruded PE, and Polycotton	18
n/a	4	17.64	n/a	n/a	5.04	3.92	Mild & Stainless steel frame. Walls of Polyethylene Plastic Sheet. Insulation of Space Blanket. Ground Sheet: Polyethylene Plastic Sheet As Per IFRC Standards	18
n/a	n/a	18.00	n/a	n/a	5.14	4.00	Metallic frame . Sun-reflective UVresistant woven HDPE tarpaulin	60
2	3	10.68	2,500.00	234.08	3.05	2.37	UV resistant polypropylene copolymer panels	60
n/a	n/a	18.20	n/a	n/a	5.20	4.04	Frameless/ 8mm Polypropylene random co-polymer twin walled flute board. Floor is fitted woven textile.	60
n/a	n/a	18.00	1,972.50	109.58	5.14	4.00	Flame retardant 5 mm thick corrugated polypropylene panels connected with nylon fasteners. Aluminium frame door	60
96	4	18.00	1,500.00	83.33	5.14	4.00	wooden panels and wooden pilotis	36
72	6	30.24	n/a	n/a	8.64	6.72	Galvanised steel frame and zincalume corrugated roof sheeting, walls of Plywood and timber studs// Concrete, blocks, plywood and roofing: sourced locally. Steel frame: procured nationally	60
48	6	29.20	1,000.00	34.25	8.34	6.49	Unishell/ ecoshell: 2 or 3 inches of concrete and rebar. Inflatable fabric , Airform gives the dome shape.	360
72	5	26.00	5,185.00	199.42	7.43	5.78	Galvanised steel frame, steel sheet roofing, Radiata Pine/Douglas Fir or equivalent treated timber planks, steel foundation plates and anchors, door fixtures, nails, bolts and screws// Steel frames were manufactured regionally. The roof sheeting and timber imported internaTIONALLY	60
24	4	18.00	n/a	n/a	5.14	4.00	Bolaina (Bolayna) Timber frame with timber cladding and corrugated metal sheet roofing// All materials sourced locally and produced in local fabrication workshops	24
48	4	18.00	245.00	13.61	5.14	4.00	Eucalyptus wood poles, bamboo matting, plastic sheeting, wire and nails, concrete slab// Mats and wood locally available, plastic sheeting imported, staples and staple guns imported	12
96	4	24.00	284.00	11.83	6.86	5.33	Bamboo (Dendroclamus Asper and Gigantochloa Apus) frame and bamboo matting walls with concrete foundations and terracotta roof tiles // MATERIALS locally procured	60
48	5	18.00	381.00	21.17	5.14	4.00	Timber frame, palm fibre roof, concrete bucket foundations and palm matting wall panels// MATERIALS locally procured	12
n/a	2	18.00	500.00	27.78	5.14	4.00	Flame-retardant Uvresistant corrugated polypropylene hard-panels (frameless)	120
24	4	24.51	544.00	22.20	7.00	5.45	Timber frame, corrugated steel sheet roofing and plastic sheeting (bricks and roof insulation locally sourced by homeowners)// Timber: local. Roof sheeting: internationally and locally procured	24
48	n/a	18.00	1,850.00	102.78	5.14	4.00	Galvanised steel frame, timber studs, plastic sheeting walls, corrugated steel roof sheeting, concrete foundations, bolts, screws and nails// Steel frame: imported, Other materials: sourced locally	24

CATEGORY	NAME	COUNTRY DESIGNED	YEAR DESIG.	YEAR BUILT	COUNTRY BUILT/TARGET	Nº BUILT	DISASTER TYPE	LENGTH (M)	WIDTH (M)	HIGH (M)
NGOs	SERIES 1100. WORLDWIDE SHELTERS	USA, Maryland	2010	2010	Haiti, Jacmel (2010)	1100	earthquake and storms	6.00	3.00	n/a
NGOs	TSHEL2. WORLD SHELTERS	USA, Indiana	2010	2011	Haití (2011)	2	general (Tsunami, earthquake and hurricanes)	4.88	2.44	n/a
GOVERNMENTS	FEMA trailers. USA	USA	n/a	2005	Katrina (2005)	122000	Huricane	6.76	4.27	n/a
GOVERNMENTS	PREFAB. CHINA	China	n/a	2008	Sichuan (2008)	1000000	Earthquake	5.40	3.60	n/a
GOVERNMENTS	M.A.P WOODEN CABINS. ITALY	Italy	2009	2009	L'Aquila (2009)	3535	Earthquake	10.00	5.20	n/a
GOVERNMENTS	C.A.S.E BUILDINGS. ITALY	Italy	2009	2009	L'Aquila (2009)/ 185 buildigns / 4500 apartments	4500	Earthquake	5.00	5.00	n/a
GOVERNMENTS	TIMBER HOUSE. CHILE	Chile	1997	2010	Concepcion-Talca-Santiago, Chile (2010)	25000	Earthquake	6.00	3.00	n/a
GOVERNMENTS	KASETSU JUTAKU. JAPAN	n/a	2011	2011	Japan (2011)	53000	Earthquake and Tsunami	5.45	5.45	n/a

CONSTRUCT. (HRS)	BUILDING TEAM	M2	COST USD	COST/M 2	SPHERE 3.5m2/pers.	UNHCR 4.5m2/pers.	MATERIALS	LIFESPAN (Months)
6	6	24.01	1,025.00	42.69	6.86	5.34	Metal-framed tent-like structures and polyester/cotton UV and mildew resistant fabric	360
n/a	6	18.00	2,500.00	104.17	5.14	4.00	Galvanized steel frame with telescopic legs, Flame retardant, UV-resistant 5mm corrugated polypropylene, plus six concrete footings (not included in the price)	180
0	0	28.87	42,500.00	1,472.36	8.25	6.41	aluminium-plastic panels, metal frame	36
24	6	19.44	1,302.00	66.98	5.55	4.32	steel sandwich panels or made of light-weight steel and plywood kit sets, expandable polystyrene (EPS) sandwich prefab boards.	120
n/a	n/a	52.00	65,416.00	1,250.00	14.86	11.56	timber framed prefabricated panels	360
1680	n/a	52.00	73,600.00	1,250.00	14.86	11.56	prefabricated panels, metal frame	360
96	4	18.00	1,500.00	83.33	5.14	4.00	wooden panels and wooden pilotis	36
n/a	n/a	29.70	25,410.00	855.56	8.49	6.60	prefabricated panels, metal frame	n/a