Architecture of Emergencies in the Middle East

Proposed Shelter Design Criteria

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To my late father, Abdallah Alshawawreh, and my mother, Sahar Matarneh. You are the reason behind every moment of success. To you I owe it all and to you I dedicate this thesis.

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Declaration

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Research Degree Programmes and that it has not been submitted for any other academic award. The entire work is the candidate's own work. Any views expressed in the dissertation are those of the author.

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Abstract

The number of displaced individuals has been significantly increasing globally during the past decade, reaching over 68 million by end of 2017. The Syrian conflict in the Middle East has attracted more attention to refugee issues, specifically in relation to large forced displacement. While refugee camps are generally considered temporary, reviews of previous case studies feature longer stay periods and permanency. In the sector of humanitarian architecture, specifically in post-disaster sheltering studies, various organisations, academics, and designers have been trying to solve the sheltering issues by proposing shelter designs, but they remain unresolved. Therefore, there has been a need to review and change the desig approach.

The main aim of this research is to introduce transitional shelter design criteria for the Middle East, with a sub-aim of applying the criteria into a proposed design. The main aim was achieved through investigating the current sheltering challenges faced by refugees in the Middle East, exploring the extent of sheltering variables given to refugees around the world, identifying the required design elements based on culture and context, and reviewing the existing shelter guidelines. However, the sub-aim was fulfilled through a trial and error method based on the proposed criteria.

This study adopts a grounded theory methodology, where several field visits were conducted to Syrian refugee camps in Jordan (namely Zaatari and Azraq); using focus group discussions, observatory tours, and participatory design sessions as data collection methods. In addition, existing documents concerning the shelter standards and existing shelters have been used as a fourth data collection method. The gathered data has led to a recommended set of guidelines, which formed the shelter design criteria, and thereby, the proposed design outline.

Culture and context are two elements that have been found to be integral factors in shaping the design preferences of the shelter users. Moreover, the flexibility of the shelter design is found in this research to be fundamental in addressing large-scale shelter design responses. On this basis, it is recommended to have shelter design criteria and a primary, yet flexible, core design for each geographic region - which could be adopted and adapted in cases of disaster. This procedure will not only lead to a better sheltering response but could also save time, which is a crucial element in emergency situations.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

BBC	British Broadcasting Corporation
CAQDAS	Computer-Aided Qualitative Data Analysis Software
CMP	The Camp Management Project
CRED	Centre for Research on the Epidemiology of Disasters
GoJ	Government of Jordan
HRW	Human Rights Watch
IBR	Inverted Box Rib
ICIP	Infrastructure and Camp Improvement Program
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
IFRC	International Federation of Red Cross and Red Crescent Societies
IGO	Intergovernmental Organisation
IOM	International Organization for Migration
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
LCRC	League of the Red Cross Societies
MoPIC	Ministry of Planning and International Cooperation
NGO	Non-Governmental Organisation
NRC	Norwegian Refugee Council
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PD	Participatory Design
RHU	Refugee Housing Unit
SDC	Swiss Agency for Development and Cooperation
SGBV	Sexual and gender-based violence
SIPs	Structural Insulated Panels
UDHR	Universal Declaration of Human rights
UN	United Nations
UNDRO	United Nations Disaster Relief Organization
UN-HABITAT	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
UNISDR	United Nations International Strategy for Disaster Reduction
UNRWA	United Nations Relief and Works Agency

Glossary

1951 Refugee Convention	The main international instrument of refugee law.
Amakan	Woven bamboo wall cladding.
Asylum	The right to be recognized as a refugee and receive legal protection and material assistance.
Asylum Seekers	Someone who fled his country and sought sanctuary in another country through applying for asylum.
Beneficiary	Someone who derives advantage from something. In this research refers to the person who was provided with a shelter.
Clissage	A traditional technique involving woven thin slats of wood.
Collective Centre	Pre-existing buildings that are used as communal settlements for the displaced people in a post-disaster situation.
Conflict	A confrontation between one or more parties due to incompatible interests and could lead into violence if not managed, usually it occurs throughout a large land area.
Disaster	A sudden and tragic event whether natural or man-made that causes high impacts and losses.
Global Shelter	A shelter that was not designed for a specific region or case and believed to serve any post-disaster situation.
Household	A unit of house and its occupants who share their resources, sleep and eat together
Internally Displaced Person	Someone who has been forced to flee his or her home but never crossed an international border.
Mashrabiyyah	Wooden latticework bay window.
One-size-fits-all Shelter	A universal or global shelter that is not specified for a certain culture or context.
Palestine Refugees	‘Persons whose normal place of residence was Palestine during the period 1 June 1946 to 15 May

	1948, and who lost both home and means of livelihood as a result of the 1948 conflict' (UNRWA,2019)
Pre-fabricated Shelters	Shelters that are assembled in a manufacturing site or factory, and then transported to the intended location.
Reconstruction	Rebuilding in a post-disaster situation.
Refugee	A person who is forced to flee their country (crossed an international borders) due to violence or persecution.
Shelter	Habitable covered living space, providing a secure, healthy living environment with privacy and dignity for the groups, families and individuals residing within it (Shelter Centre and IOM, 2012).
Shelter User	Shelter inhabitant.
UN	United Nations is an international organization that was founded in 1945, aims at increasing the economic and political cooperation between its 193 Member States.
UNHCR	United Nations High Commissioner for Refugees is a United Nations programme with the mandate to protect refugees, forcibly displaced communities and stateless people. It is a UN refugee agency.
UNRWA	United Nations Relief and Works Agency was founded in 1949 to contributes to the welfare and human development of Palestine refugees in the Near East.
Vulnerable	Characteristics of a person who does not have the capacity to anticipate, cope with, resist and recover from the impact of an event.

Chapter 1

Introduction

This Chapter introduces the thesis and clarifies the motivation behind the work. It also presents the aim and objectives of the research, the methodology used and the main contribution to knowledge. In the last section, the structure of the thesis is explained and illustrated through a diagram.

1.1 Research overview

The role of architecture has been minimised throughout the years and directed away from the humanitarian sector. However, architecture originated with humanitarian objectives; it was found to fulfil the human needs of having a space to live, to communicate and a space to worship. In fact, the nature of architecture that is based on problem solving is most needed where humanitarian disasters occur.

In a world where the number of natural disasters is significantly increasing and the effect of conflicts is widespread, forcing the displacement of millions of people, there is a need to put more attention and care into the humanitarian response. Despite the efforts in developing the theory of sheltering response, the humanitarian sector is still providing aid based on a 'reaction' approach. This gap between the theory and practice was the key driver of this research towards presenting guidelines for designing shelters in the Middle East – a region that has been suffering from many conflicts for long periods of time.

Post-disaster situations usually involve complex issues, particularly if it includes displacement. Giustiniani (2011) highlights the importance of having a rapid response in post-disaster situations and argues that failure in dealing with such situations could fuel existing tensions and create new conflicts. In addition, the rapid response including shelter is the first step for the affected people to alleviate the post-disaster trauma. A successful shelter design would satisfy the users and empower them to be active again in their communities. This could only be carried out through engaging the users in all design and implementation stages. However, this engagement must be planned and supervised by professionals (i.e. architects, engineers, and skilled labours). In such cases, the significant role of humanitarian workers would be to facilitate the relation between the beneficiaries and the professionals. Additionally, a successful design would allow the residents to turn the shelters into homes, not in a permanency dimension, but instead to provide the ability to feel safe, secure and dignified under a roof.

1.2 Motivation

The main motivation behind the research is the gap between theory and practice in the sector of humanitarian architecture, specifically, in post-disaster shelters. The ongoing Syrian conflict and the influx of refugees from Syria to its neighbouring countries, including Jordan, has been a recent wake-up call towards the good and bad practice of humanitarian response. However, despite the seven decades time difference, the similarity of the sheltering response between the Palestinian and Syrian camps in Jordan that is explored and explained in Chapter 2 highlights this knowledge gap.

During the early days of this research, there were four statements from three different people that clarified the scope of the gap. The first two were said by Kilian Kleinchmidt, a former director of Zaatari camp (i.e. the largest Syrian camp in Jordan), who said, *“We simply wasted too much money because we didn’t think long-term”* (Laub, 2015, para. 10), and added in a different interview, “*In the Middle East, we were building camps: storage facilities for people. But the refugees were building a city*” (Radford, 2015, para. 3). The third saying is from a Syrian refugee in the Zaatari camp, who said, “*In Syria we are killed by bombs, but in Zaatari we die from the cold. The bathrooms and kitchens are crowded and unclean, and there is no privacy or dignity”* (Smith, 2013). Shigeru Ban, a Japanese humanitarian worker, said at the 2014 Ecobuild conference in London “*Architects are not building temporary housing because we are too busy building for the privileged people*” (Pogrebin, 2014, para. 11).

It could be concluded that the sheltering humanitarian response has been short-sighted throughout the years and has lacked long-term planning. Additionally, there appears to be a lot of wasted effort and money, which has resulted in inadequate provision of shelters. The inadequacy is evidenced by the dissatisfaction of the camps’ residents and the lack of privacy and dignity they suffer from. However, the absence of the role of architects in designing shelters and camps is a fault where both architects and humanitarian agencies take part of the responsibility.

1.3 Aim and objectives

The aim of this research is to *propose transitional shelter design criteria for the Middle East* that has a number of suggested guidelines. *Proposing a design outline* that applies the proposed criteria is a sub-aim of the research. To achieve the aim and sub-aim, there was a need to meet the following four objectives:

1. Investigate the challenges of living in Middle Eastern shelters
2. Explore the existing shelters around the world and the extent of applied variables
3. Identify the effect of culture and context of the Middle East on the design elements of the transitional shelter
4. Explore the existing guidelines and adopt the best practice among them

1.4 Research methodology

This study adopts a grounded theory methodology where focus group discussions, observatory tours, documents, and Participatory Design were used. The main aim of proposing transitional shelter design criteria for the Middle East is fulfilled through gathering results from the four previously mentioned data collection methods. However, the sub-aim, which is the design outline, is fulfilled through a trial and error method that is evaluated by the proposed criteria.

1.5 Contribution to the knowledge

This research proposes transitional shelter design criteria for the Middle East that contains 46 guidelines. These guidelines would help in designing an adequate transitional shelter for displaced people in the Middle East. Moreover, the criteria are applied in a shelter design outline that is also proposed in the thesis. However, the research process itself establishes the knowledge needed to identify what is considered as reliable criteria. The culture of the affected people and the context of disaster are found to be integral factors in shaping the shelter design preferences of users. Additionally, the flexibility of the shelter design is found to be fundamental in addressing large-scale shelter design responses, while providing a sense of individuality and therefore belonging.

Throughout the field visits to Zaatrai and Azraq Syrian camps in Jordan, the main challenges that are faced by the residents are highlighted. However, most of the challenges are found to result from the cultural inadequacy of the shelters provided.

Analysing the global shelters of the past decade highlighted the main factors that affect the material costs and size of shelters, along with the most frequently used shelter materials. Throughout the analysis, it was found that there is a lack of structured and holistic documentation. Therefore, a suggested documentation form for shelter projects was also developed and is presented in the thesis.

1.6 Structure of the thesis

The thesis is composed of ten chapters. *Chapter 1* provides an introduction of the research presented, the motivation behind the research, its aim and objectives, the methodology, the contribution to knowledge and the structure of the thesis.

Chapter 2 reviews the background and state-of-the-art of the four main elements that form this thesis; the context, humanitarian emergencies; the region, Middle East; and the two main studied aspects, design criteria (standards and guidelines), and sheltering.

In *Chapter 3*, the adopted methodology and methods of this research are explained. Moreover, an explanation of how they contributed to fulfilling the research objectives, and therefore the aim and sub-aim, is presented.

Chapter 4 discusses the Zaatari camp visit where focus group discussions and observatory tours were held to understand the sheltering approach and the challenges that are faced by its residents. *Chapter 5* discusses the same issues in another camp setting, which is Azraq camp. The field visit to Azraq camp also included focus group discussions and observatory tours.

A review of the global existing shelters that were provided to displaced people in the past decade is presented in *Chapter 6*, with a detailed discussion of the findings being presented in *Chapter 7*.

Chapter 8 presents the Participatory Design experiments that were held in both Zaatari and Azraq Syrian refugee camps, and discusses their findings.

While Chapters 2-8 shape and fulfil the objectives of the research as shown in Figure 1.1, *Chapter 9* gathers the findings and fulfils the aim and sub-aim of the research, i.e. the shelter design criteria for the Middle East and the proposed design outline. Lastly, the conclusion of the research is presented in *Chapter 10*, along with recommendations for future work.

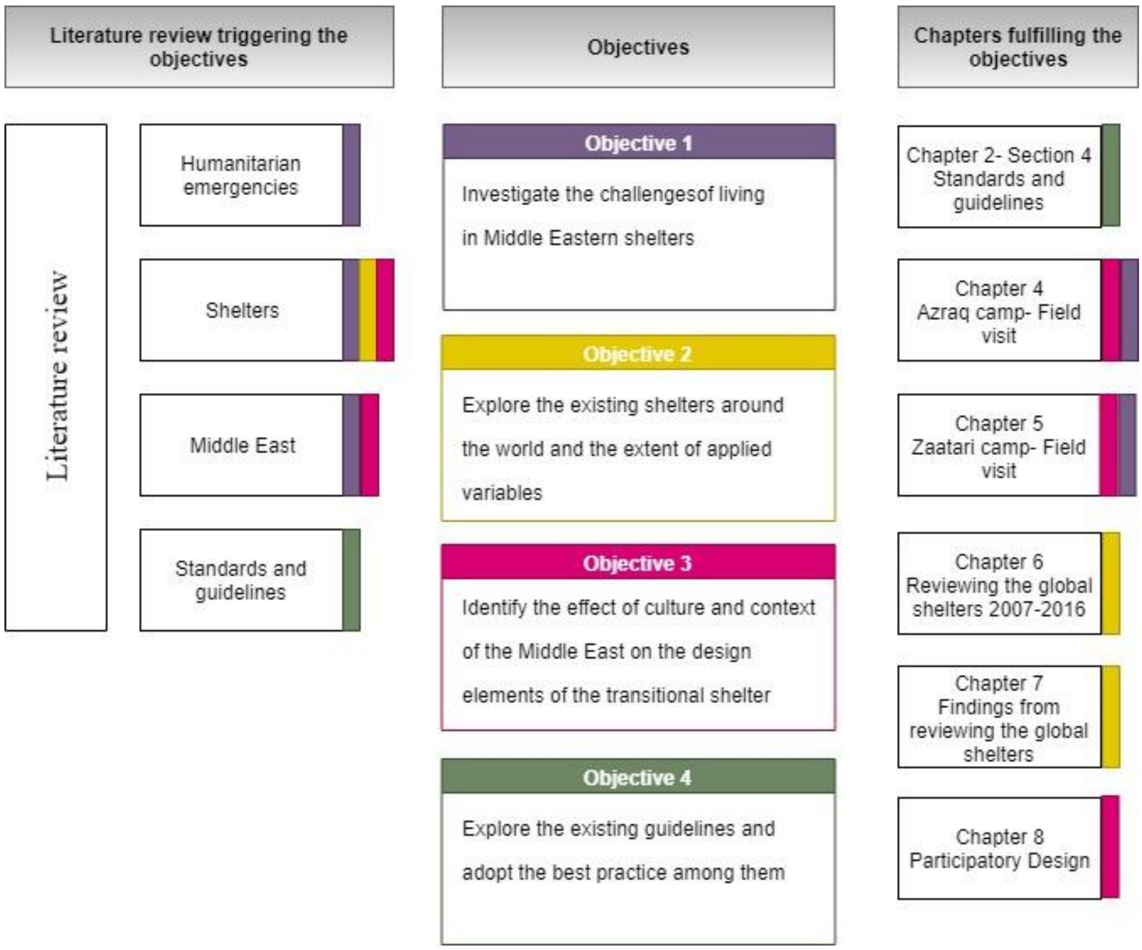


Figure 1.1: A colour coded diagram showing the relation between the literature review sections, the objectives and the chapters that fulfilled the objectives

Chapter 2

Literature review

This chapter reviews the background and state-of-the-art of the four main elements that form this thesis; the context, humanitarian emergencies; the main topic, shelters; the geographic region, Middle East; and the subtopic, standards and guidelines.

2.1 Humanitarian emergencies

Hazard, disaster and emergency are terms that are wrongly used interchangeably to describe the same event (Reed, 2011; Bhandari, 2014). In fact, the hazard describes a potential source of danger that could turn into a disaster event (Bhandari, 2014). UNISDR (2017) defines the hazard as a process, phenomenon or human activity that may lead to various impacts and losses.

The definition of disaster is not agreed globally, Shaluf, Ahmadun and Said (2003) refer that to the various disciplines using the term. The word disaster has a Latin origin that mixes two words, 'dis' which means 'without', and 'astrum' means 'star' and it stands for sudden and tragic events resulting in loss, damage and distress (Bhandari, 2014). Davis and Lambert (2002) clarify that disasters are related to overwhelmed coping capacities. The later disaster definition is also emphasized by the Government Office for Science (2012, p. 13), which defines disaster as "an event which overwhelms the ability of a community or society to cope using its own resources". IFRC (2019b) and UNISDR (2017) agree with the previous definitions and explain that disasters happen when the functioning of a community or a society is disrupted and when the vulnerable people are impacted due to the event. The main six characteristics of disasters can be summarised into sudden, tragic, direct and indirect losses, disrupted functioning of communities/societies, increased vulnerability, and insufficient coping capacity of a community.

The term emergency is defined in Oxford Dictionaries (2019) as "a serious, unexpected, and often dangerous situation requiring immediate action". Bhandari (2014) looks at the term as a combination of the words emerge and urgency, and therefore defines it as a sudden change from what is considered normal or familiar. However, from a humanitarian perspective, UNHCR defines the emergency as: “any situation in which the life, rights or well-being of refugees and other persons of concern to UNHCR will be threatened unless immediate and appropriate action is taken” (UNHCR, 2018c, p. 3). Based on the previous definitions, it is concluded that emergency is a situation that includes four characteristics: it is abnormal, unexpected, rapid, and requires immediate response to alleviate the effect of a disaster.

UNISDR (2017) mentions that emergency and disaster are sometimes used interchangeably while talking about health emergencies or technological and biological hazards, nevertheless, Davis and Lambert (2002) clarify that emergency is the situation emerging in the aftermath of a disaster.

Hence, the main difference between hazard, disaster and emergency could be concluded that while hazard is the ‘potential source of danger’, the disaster is the ‘event’ that causes high impacts and losses, and emergency is the ‘situation’ in the aftermath of that event. Therefore, this thesis researches the architecture in the situation aftermath of a disaster, i.e. in a post-disaster situation.

2.1.1 Types of disaster

There are no agreed groupings of the types of disaster. However, most scholars and humanitarian workers often classify the disasters based on the primary force that causes them. Reed (2011) divides the disasters into four types: Natural, technological, social, and complex disasters and failed states. According to Reed (2011), the natural disasters include three categories: geophysical event with local impact such as volcanoes, hydro-metrological event impacting wider area such as windstorms, and biological event such as epidemic diseases. However, the technological disasters are caused by accidental human-caused failures of facilities or activities, while social disasters are caused by failures of the social order, where there is a collapse in the behaviour of a community. When a complex of failures happens due to a failed governance and weak law application, it would be classified as ‘complex disasters and failed states’. Another grouping is proposed by Vallero and Letcher (2013), they classify the disasters into natural and anthropogenic (i.e. human-origin). In a review study over the various classification of disaster types, it was concluded that despite the variety of disaster types, they can be all covered under natural and man-made disasters (Shaluf, Ahmadun and Said, 2003).

However, in a later article, Shaluf (2007) added a third type into the classification involving hybrid disasters, which is a mix of both disaster causes, i.e. natural and man-made. IFRC (2019a) along with many other organisations use the classification of natural and man-made disasters, some of the organisations refer to the man-made disasters as 'human-made' or as 'technological' such as CRED (Guha-Sapir, 2008) , but they share the definition of man-made disasters. In this research, the term disaster refers to both types; natural and man-made.

Davis and Lambert (2002) argue that despite the common belief about natural disasters being caused by natural forces, the human impact on the environment that affects the frequency and intensity of those events, is usually neglected. In addition, one of the characteristics of disasters is the impact on vulnerable people, who usually live in disaster-prone areas. Therefore, the human preparations and mitigation of impacts affect the degree to which a hazard turns into a disaster. Thomalla *et al.* (2006) suggest a collaboration between the climate change adaptation and disaster risk reduction societies as a way to minimise the vulnerability toward hazards.

Moreover, man-made disasters could also be encouraged by natural forces. It has been found that there is a relation between climate change and conflicts as the former increase the vulnerability of the people and therefore, their dissatisfaction with their governments. The case of Syria is an example, as some literature argued that there is a relation between the droughts, which had affected Syria for the years between 2006-2010, and the ongoing war (Eklund and Thompson, 2017). The droughts forced people to migrate from rural to urban areas and this displacement along with other effects such as food insecurity and unemployment encouraged opposition (Gleick, 2014). Though, other academics disagree as the relation is not proved (Selby *et al.*, 2017).

2.1.2 Disaster criteria

In this thesis, and due to the availability of data, the number of disaster events are adopted from two sources:

- Centre for Research on the Epidemiology of Disasters (CRED): involves statistical numbers of natural disaster events.
- Swiss-Re institute - Sigma reports: involves statistical numbers of natural and man-made disasters.

CRED and Sigma have different methods for counting natural disasters, i.e. the criteria used to categorise hazardous events as natural disasters. Below are the criteria for both sources with a comparison that is illustrated in Table 2.1.

The criteria of CRED include all natural disasters that conformed to one of these conditions (EM-DAT, 2018):

- Loss of life involving a minimum number of 10 people.
- A minimum number of 100 people were affected.
- A state of emergency had been announced.
- A request for international assistance had been made.

While the Swiss-Re institute- Sigma counts the disasters in their records if they resulted in (Sigma, personal communication):

- Loss of life or missing of 20 people or more.
- A minimum number of 50 people were injured.
- A minimum number of 2,000 people were made homeless
- If the financial losses exceeded a certain amount (the amount differs from one year to another).

Table 2.1: Comparison between CRED and Sigma criteria for counting the disasters

Criteria	**CRED**	**Sigma**
Loss of people	10 or more	20 or more
Affected people	100 or more	-
Injured people	-	50 or more
Homeless people	-	2,000 or more
Announcing a state of emergency	Yes	-
Requesting international assistance	Yes	-
Financial losses	-	Yes

Natural disasters have become highly destructive and costlier over the years, and it is predicted that it will continue to increase due to the global warming and the rise in average global temperature (NOAA and Arndt *et al* as cited in Patel and Hastak (2013)).

2.1.3 Statistics

According to Sigma reports that were published between 2008 and 2017, the total number of disaster events that happened during 2007-2016 were 3,208 of which 1,652 were natural disasters and 1,556 man-made. However, the number of man-made disasters was higher than the number of natural disasters during 2007, but the relation between the two disaster types differed during the following years. Notably, the number of man-made disasters had decreased throughout the past decade to reach its lowest number during 2016 (136 events), while the number of natural disasters had increased to reach its highest during 2015 (198 events) as clarified in Table 2.2 and Figure 2.1.

Table 2.2: Number of disasters worldwide 2007-2016-
Numbers from Swiss Re- Sigma reports (2008-2017)

Type of disaster	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2007-2016
Natural	142	137	133	167	175	168	150	191	198	191	1652
Man-made	193	174	155	137	150	150	158	148	155	136	1556
Total number	335	311	288	304	325	318	308	339	353	327	3208

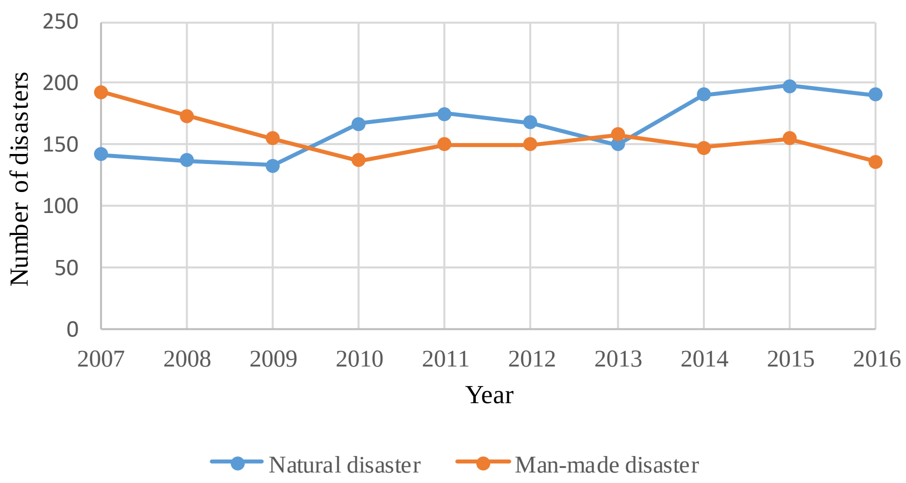


Figure 2.1: Comparing disasters numbers during 2007-2016
(Source- Swiss Re-Sigma reports, 2008-2017)

The total number of disaster events that occurred during 2009 had the lowest recorded figure; 288 disaster, while the highest recorded figure of disaster events was during 2015 with 353 disasters. Despite the equivalent number of man-made disasters in the two years, i.e. 155 events.

2.1.4 Refugees

In 1951, the United Nations established an international refugee law regarding the status of refugees and their rights. It aimed at resettling the Second World War refugees during a three-year period, with the intention of disbanding the law thereafter. However, the law remained active and an assisting protocol was added to the convention in 1967 that expanded its scope (Sharma, 2015). In total, about 145 state parties ratified the 1951 convention around the world. The convention defines the term ‘refugee’, states the rights of the displaced, and sets the obligations to protect them (UNHCR, 2019f). The USA for UNHCR (a non-profit organisation established by American citizens to support the work of UNHCR), defines the refugee as a person who is forced to flee their country, i.e. crossed an international border, due to violence, war or persecution (USA for UNHCR, 2018).

During 2017, the number of forcibly displaced people was approximately 68.5 million, exceeding the figure of the previous year by 2.9 million people. This number includes refugees, internally displaced people (IDPs) and asylum seekers. Out of the 68.5 million, there are more than 25.4 million refugees, 40 million IDPs, and 3.1 million asylum seekers. However, only 19.9 million of the refugees are registered within the mandate of UNHCR, while the other 5.4 million are the Palestinian refugees registered within the United Nations Relief and Works Agency (UNRWA) (UNHCR, 2018a).

In the ‘Figures at a glance’ platform (UNHCR, 2018a), it is stated that 57% of the worldwide refugees come from three countries; 6.3 million from Syria, 2.6 million from Afghanistan, and 2.4 million from South Sudan. This figure provides indications on the catastrophic disasters that happened in these countries and where most refugees come from, however, two mistakes were spotted in this figure. Firstly, the stated numbers of refugees in the three countries form 57% of the UNHCR refugees not the world’s refugees (i.e. 57% from the 19.9 million refugees not the 25.4 million refugees). Secondly, the number of registered Syrian refugees has never reached 6.3 million according to the records of UNHCR (2019e), as until January 2019, the number reached 5.7 million refugees and this is the highest number of Syrian refugees since the beginning of the war.

Nevertheless, the Syrian conflict which erupted in 2011 is currently the top source of refugees in the world and was described by the UN high commissioner for human rights as the worst man-made disaster since world-war II (Siegel, 2017). More recently, the Rohingyas, who are the stateless Muslim minority in Myanmar, have escaped the latest violence in Myanmar that was initiated in August 2017, and sought refuge in Bangladesh (UNHCR, 2018d). Till the end of 2018, there have been over 906,000 registered Rohingya refugees in Bangladesh, about 738,000 of them, have arrived after the violence during August 2017 (UNHCR, 2019d). Other major disasters had also occurred during the past decade and caused major displacements, such as the disasters in Iraq, Sudan, South Sudan, Burundi, Ukraine, Central African Republic, Yemen, and the Democratic Republic of the Congo (UNHCR, 2018b).

Most of the refugees are hosted in the developing countries (Devictor and Do, 2016); around 85% according to UNHCR (2018b). One of the reasons could be the geographic proximity of those countries to the origin of refugees. Figure 2.2 shows the concentration of refugees around the world including the main 10 countries of asylum. Since 2014, Turkey has been hosting the greatest number of refugees around the world due to the influx of Syrian refugees (63% of the Syrian refugees live in Turkey). Considering the economic perspective, amongst the 10 main hosting countries, there is only one high-income country, i.e. Germany, two low-income sub-Saharans countries, namely Ethiopia and Uganda, and the other seven countries are middle-income (UNHCR, 2018b).

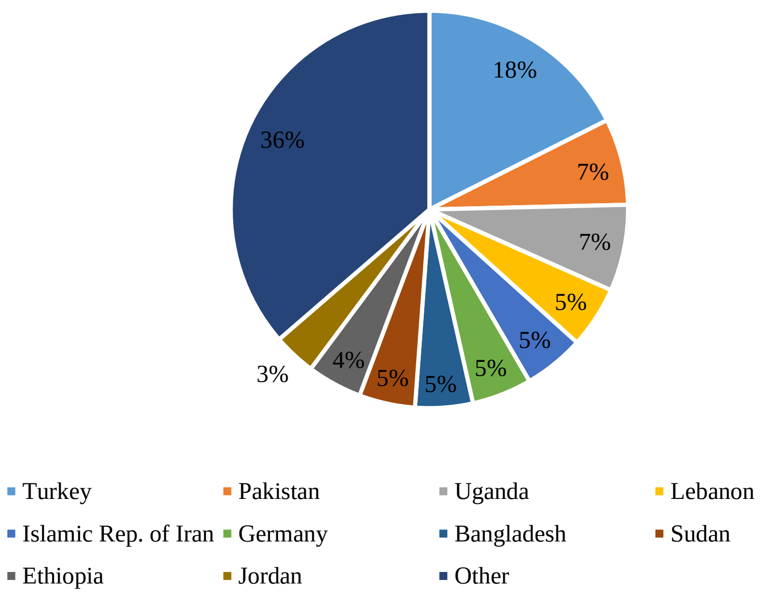


Figure 2.2: Main countries of asylum for refugees (UNHCR, 2018b)

Another significant perspective to consider is the relevance of the hosted number of refugees to the national population size of the hosting countries. In this regard, and within the UNHCR records, Lebanon hosts the largest number of refugees compared to its population, followed by Jordan and then Turkey. If the Palestinian refugees who are under the mandate of UNRWA are included in the statistics, then Jordan is first as third of the population are refugees and Lebanon is in second place with refugees making up a quarter of its population (i.e. 1 in 4) (UNHCR, 2018b). In terms of regions, until the end of 2017, sub-Saharan Africa was hosting a third of the world's refugees. A major increase in the 2017 Africa refugee numbers came from South Sudan where more than a million-refugees fled foremost to Uganda and Sudan (UNHCR, 2018b). These statistics are based on the formal numbers of refugees who are registered within the records of UNHCR or UNRWA. However, the real numbers usually exceed the registered numbers. In October

2015, the Government of Jordan (GoJ) estimated the number of Syrians in Jordan as 1.4 million, when at that same time, only 630,000 Syrian were registered as refugees under the mandate of UNHCR in Jordan (MoPIC, 2016).

The top four hosting countries in the Middle East (i.e. Tukey, Lebanon, Islamic Republic of Iran, and Jordan) have different responses to the 1951 convention. Turkey and the Islamic Republic of Iran are state parties of the convention (UNHCR, 2015a), however, Turkey retains a geographic limitation to refugees fleeing from events that occurred in Europe (HRW, 2019). On contrary, Jordan and Lebanon did not sign the convention, but both countries take part in the international human rights instruments that cover the rights of refugees. The fear of permanently settling the Palestinian refugees in Jordan and Lebanon, and causing the loss of their ‘right of return’ is argued by Evans-Barns (2009) as the reason behind the refusal of these countries to sign the convention. Sharma (2015) argues that the convention offered assistance only to the people who were displaced in Europe and excluded other types of refugees in other parts of the world such as the stateless people, or those in humanitarian crisis. Sharma (2015) adds that if the framework of the convention was not amended, specifically its language and implications, the scope of assistance will continue to be selective and limited.

Concerning the number of years that refugees stay in exile or in camps, there are differing views. A commonly quoted statistic is 17 years for the average number of years that refugees stay in camps. It was cited in the Australian Broadcasting Corporation (McIntyre, 2008), in an interview with UNHCR’s goodwill ambassador (BBC Radio 4, 2016), and in academic papers such as Chamma and Arroyo (2016). Others quoted the same number of years (i.e. 17) for the average years of staying in exile, including the UNHCR (Edwards, 2014) and the King of Jordan in an interview with Euronews (2015).

The source of this statistic is either unmentioned or referred to UNHCR. White (2015) explained that the origin of this number goes back to a UNHCR (2006) document that cites the statistic from another internal document, that is UNHCR (2004). The 2004 document states the following: “It is estimated that the average of major refugee situations, protracted or not, has increased from nine years in 1993 to 17 years at the end of 2003” (UNHCR, 2004, p. 2). As seen from the statement, it does not refer to camps and it talks about the refugee situations in 2003, which is approximately12 years behind 2015, when the use of the statistic became a trend. White (2015) also argues that the number is clearly an estimate, and is not inclusive. It limits the cases to the ones under the mandate of UNHCR (excluding the Palestinian situation under the mandate of

UNRWA) and limiting the figure to cases in the developing countries, and to cases that have more than 25,000 refugees.

Another study by the World Bank (Devictor and Do, 2016) states that the average duration of exile is 21.2 years. This number is for the 6.6 million refugee who are in protracted situations of over five years and registered within the UNHCR records. The criteria of UNHCR in terms of protracted refugee situations are to have a minimum of 25,000 refugees from the same nationality who are displaced for at least five consecutive years in a developing country (UNHCR, 2006). Referring again to the argument of White (2015), it is hard to do an estimation as cases vary in context and cannot be gathered in one statistic. White adds in an interview with BBC Sound (2016) that despite the belief that such memorable statistic would get positive attention to refugee issues, it does not help the humanitarian sector in the long run as countries will be cautious in receiving refugees.

2.1.5 Summary

It is concluded in this section that while hazard is a potential source of danger, disaster is the event that causes high impacts and losses, and emergency is the situation in the aftermath of that disaster. Therefore, this research is investigating the architecture in post-disaster situations. The term disaster in this research refers to both natural and man-made disasters. However, the statistics of disaster events differ from one source to another. This difference in the reported disaster statistics may be attributed to the absence of an agreed definition of disasters, their criteria, and their types. In this research, the natural disaster statistics were taken from two sources: CRED and Sigma, while the numbers of man-made disasters were only sourced from Sigma. It could be noted that the total number of natural disasters that happened during 2007-2016 had increased throughout the years while the number of man-made events had decreased.

There are 68.5 million forcibly displaced people around the world, of which 25.4 million are refugees (19.9 million under the mandate of UNHCR and 5.4 million are Palestinians under the mandate of UNRWA). The Middle Eastern countries have been leading providers in hosting refugees, due to its proximity to the refugee origins. The Syrian conflict as an example is considered as the worst man-made disaster since world-war II. Four out of the top ten hosting countries in the world are Middle Eastern (i.e. Tukey, Lebanon, Islamic Republic of Iran and Jordan), with Jordan being number one in the world in terms of refugee numbers relevance to its national population size (i.e. 1 in 3).

It was noted that the UNHCR statistics exclude the Palestinian refugees who are under the mandate of UNRWA. However, UNHCR publishes the statistics claiming that they are worldwide statistics. This research recommends moving the responsibility of publishing the formal international refugee statistics from the UNHCR to the UN, as the UN is an Intergovernmental Organisation (IGO) who has both the UNHCR and UNRWA under its umbrella.

In terms of the period for refugees staying in exile, there is no evidence behind the usually cited average of 17 years. Moreover, it is hard to carry out an estimation as cases vary in context and cannot be gathered in one statistic. Despite the good intentions behind such statistics to get people's attention, they are likely to be unhelpful in the long run.

This section triggered the shape of the first objective in this thesis, that is**:** *to investigate the challenges of living in the Middle Eastern aid shelters*. This objective is fulfilled in Chapter 4 and Chapter 5.

2.2 Shelters

In Maslow's (1943) hierarchy of needs pyramid, shelter is amongst the physiological needs that is placed at the base of the pyramid. Maslow claims that a person cannot achieve the psychological needs (safety, belonging and love) or the self-fulfilment needs (esteem and self-actualization) without fulfilling the basic needs (physiological and safety) (Maslow, 1943). Hence, the importance of shelters to humans exceeds the direct known benefits and becomes a stepping-stone to fulfil other human needs (McLeod, 2007). Article 25 of the Universal Declaration of Human rights is the "right to an adequate standard of living" which includes the right to live in adequate housing (UDHR, 1948). More recently, it has been reinforced that the provision of post-disaster sheltering has no separate legal treatment than the right of adequate housing (Global Shelter Cluster, 2018). UNHCR (2016) identifies the shelter as a human right and therefore priorities its provision in post-disaster situations. However, the benefits of human rights to post-disaster sheltering response go beyond the shelter provision, it also acknowledges the entitlements of shelter users. Carver (2011) clarifies that these entitlements involve two essential rights, the provision of shelter based on needs, and the protection of the other human rights. The latter is supposed to prevent the provision of shelters to be part of a trade-off overtaking other human rights, such as the right of movement or employment. Unfortunately, despite these agreed entitlements, they are not always applied, specifically in camps where the right of work or right of movement is not provided in many cases.

Generally, the Emergency Shelter Cluster is globally chaired between UNHCR and IFRC, with UNHCR leading in conflicts that results in having refugees and IDPs, while IFRC leads in natural disaster situations (Shelter Centre and IOM, 2012). The phrase ‘shelter after disaster’ according to Burnell and Sanderson (2011) means a temporary structure that is not a tent nor a permanent structure, usually has a life span of 3-5 years, and is wide enough to include reconstruction and sometimes resettlement (when it involves vulnerable people at risk). However, these temporary structures are not always preferred, specifically in the aftermath of natural disasters. Decision makers generally prefer to direct the fund and effort into the reconstruction phase rather than on relief sheltering. Davis (2011) presents a statement that he has received through advice in 1972 and adopted through his 40 years of experience, “relief is the enemy of recovery”. Davis (2011) argues that we must minimise the relief response to maximise the recovery. This argument is valid to a certain extent; however, previous cases prove that such an approach may have major issues. The post-earthquakes’ shelter response in Ardabil and Lorestan Province-Iran is an example of a similar thinking. Nevertheless, due to unexpected events, the reconstruction process was delayed, resulting in thousands of people living in emergency tents for up to two years, remaining unprotected from the harsh weather (Hadafi and Fallahi, 2010). The later study also argues that if people were consulted on how they prefer to deal with the emergency, they might have chosen a different approach, and therefore the adverse effects would have been lessened. Moreover, land rights in post-disaster situations usually take two to fifteen years to be resolved and this affects the reconstruction of damaged homes (Shelter Centre and IOM, 2012). Therefore, providing shelters in the initial stages after disasters is critical to ensure adequate levels of safety, security, protection and community health (Sphere Project, 2011; UNHCR, 2016).

IFRC and OCHA (2015) have presented several views on the neglect over the shelter sector. Some refer that to the institution’s failure in developing their understanding of the shelter sector, others refer it to the costly commitment. In addition, the rapid need to respond in post-disaster situation, limits the possible sheltering options. Davis (2011) analysed the post-disaster shelter response during the years 1972-2011 and he has found that agencies had more focus on shelters during 2007-2011 compared to previous years. Additionally, Albadra, Coley and Hart (2018) has found a significant increase in the published academic papers regarding shelters since 2012 onwards, which may refer to the role of the recent disasters in raising awareness.

In the global movement to urgently transfer into a more sustainable way of living, the humanitarian sector has been given insufficient attention. In the past, it was seen as an indulgence to consider the environment in post-disaster responses, due to the significant size of the affected population and the crisis intensity. The human impact on the environment is amongst the usually-neglected drivers of natural disasters (Ramboll and Save the Children, 2017). Similar thinking approach was also presented by scholars, such as Davis and Lambert (2002) and Tucker, Gamage and Wijeyesekera (2014).

The environmental impact of the shelters has been highlighted as a clear knowledge gap by Ramboll and Save the Children (2017), and the need to be further researched is amongst their recommendations. The same gap was highlighted by Albadra, Coley and Hart (2018) as their literature survey showed that in the past 38 years, only 60 academic papers have been published regarding ‘emergency or temporary shelters’, and only nine of them addressed the life cycle sustainability or environmental impacts of shelters. However, the latest edition of the Sphere handbook regarding the minimum standards in humanitarian response has increased the focus on considering the sustainability aspect while providing shelters (Sphere Association, 2018).

Kelman *et al.* (2011) points out to the role of external funding in determining the timelines of post-disaster shelter and settlements support, and clarifies how the aid is driven by the interest of media in the disaster. However, Kelman *et al.* (2011) believe that the aforementioned reality will not change, and therefore, the humanitarian sector shall take advantage of the short timeline of media interest to maximise the shelter support. Johnson (2007) highlight some of the main challenges that face post-disaster shelters, such as high costs, delivery delays, remote and adverse locations, and poor designs.

2.2.1 Sheltering options

The affected communities in post-disaster situations involve both displaced and non-displaced population; therefore, the sheltering options would be different. Non-displaced population have six reconstruction options: occupancy with no legal status, house tenant, apartment tenant, land tenant, apartment owner-occupier, and house owner-occupier (Shelter Centre and IOM, 2012). On the other hand, displaced people have different six settlement options. They either live with a host family, in urban self-settlement that is informally used, in rural self-settlement where they create a settlement on collectively owned rural land, in collective centres settlement that involve using existing large buildings, in self-settled camps, or in planned camps (Shelter Centre and IOM, 2012). The last two options are the focus of this research, as they involve the provision of new shelters.

There are five common sheltering solutions, according to UNHCR (2019a), they are: tents, plastic sheeting, shelter kits, prefabricated shelters, and rental subsidies. Table 2.3 shows the pros and cons of each solution according to UNHCR (2019a). It is important to understand the available options before deciding the type of response. However, there are some assumptions that will not be always true, such as assuming that prefabricated shelters are long lasting made of reusable materials, or always insensitive to the culture.

Table 2.3: Possible sheltering solutions (UNHCR, 2019a)

Shelter solution	Pros	Cons
Family tent	- Traditional (familiar) - Lightweight - Large production capacities - Can be winterised	- Canvas rots - Inflexible - Draughty - Unable to withstand extreme weather - Difficult to heat - Short duration
Plastic sheeting	- Important component in relief aid - UV-resistant - Heavy duty - Lightweight - Flexible - Large production capacities	- Needs a frame material. If not provided then wood would be collected for the support structure, which could harm the environment if not planned
Shelter kit (materials and tools)	- Use of local materials - Familiar and culturally appropriate	- Require time - Require training
Prefabricated shelters	- Permanent or semi-permanent - Easy to maintain - long-lasting - Valuable and reusable materials	- High cost - Require time for shipping - Transport challenges - Inflexibility - Insensitive to cultural norms - Difficult to cool
Rental subsidies	- Provide sense of independence - Encourage integration - Influx of income to the host community	- Hard to monitor the quality of shelters - Possibility of rent inflation - Need for upgrade and repair

Despite the current variety of shelter responses, there is a need for improvement. Kelman *et al.* (2011) suggest to enhance the links between practice and research to achieve better shelter responses. Moreover, the role of architects in post-disaster sheltering and reconstruction according to Kelly and Caldwell (2014) does not involve building the physical shelters, but instead increasing the capacity of people in order to build and reconstruct their own communities, by adopting the 'shelter as a process' approach.

Davis (1978) emphasized the importance of considering the shelter as a process. Additionally, he underlined the importance of analysing the traditional housing and the accompanying social and cultural patterns before designing shelters. Today, about forty years later, organisations are still calling to adopt that approach, as the misunderstanding still exists. The benefits of considering the shelter as a process involve decreasing the sense of passivity upon beneficiaries. Furthermore, there is an ongoing debate between the urgent need of having stockpiled and rapid-deployed shelters (such as the prefabricated shelters) and the ‘shelter as a process’ approach (such as using shelter kits). Ramboll and Save the children (2017) concludes that a hybrid approach would be more efficient, i.e. having a stockpiled rapid shelter that could be adapted by the residents using basic materials.

2.2.2 Camps

The definition of camps could differ based on the context. USA for UNHCR (2019, para. 2) defines the refugee camp as “a temporary accommodation for people who have been forced to flee their home because of violence and persecution”. They are constructed while crises unfold for people fleeing for their lives’. The temporary accommodation in this definition refers to the camp including the land and what is being built over it. In this research, the interest in camps comes out of the interest in the shelters that are built over the land of the camp. The terms camp and settlement are usually used interchangeably, however, there are five parameters that differentiate them from each other. Camps have less freedom of movement, depend more on aid assistance, their mode of governance is more restrictive, they have temporary status despite the actual length of stay and are more dense than settlements (Schmidt, 2009).

The camps could be ‘planned’ where a government or an agency is responsible for the planning, or self-settled (informal camps), which are independent and organised by the displaced people themselves. Collective centres and transit and return centres are sometimes considered under the umbrella of camps (NRC/CMP, 2008; UNHCR, 2014). Unfortunately, limitations are usually forced on the rights and freedom of the camps’ inhabitants, which breaks the human rights codes. Approximately 40% of the world’s refugees live in camps, most probable as no other choice is available for them, while the rest of the refugees live within host communities (UNHCR, 2014).

There is an old debate over the necessity of setting up camps and its ethical existence. However, there is a wide agreement on considering the camps as a last possible choice. The UNHCR try to avoid the establishment of camps, but at the same time, the safety and protection of the refugees are prioritised. Therefore, camps are still an accepted option when alternatives are absent (UNHCR, 2014). UNHCR (2014) explains that in some cases, the host government insist on having the refugees in camps for managerial or security reasons. Moreover, governments believe that if refugees were settled within the communities, they would be encouraged to stay longer and never leave. Additionally, the camps could help the UNHCR and other organisations in defining the needs of the refugees and therefore provide better assistance.

On the contrary, the camps increase the dependency of refugees on external aid and weaken their abilities. It could have a bad influence on the environment and in some cases increase sexual and gender-based violence (SGBV), child protection concerns and human trafficking. At the same time, security is not always guaranteed in camps (UNHCR, 2014). Camps usually include similarity, repetitiveness and modularity due to the unified distributed shelters, the ordered layout and the hierarchical plan (Dalal, 2017). Dalal (2017) adds that camps are 'suddenly painted with white, over which the big turquoise signage of UNHCR has been placed', referring to the ignorance over the rich various cultures of the residents and their variant backgrounds.

The 3rd issue of the Forced Migration Review published a debate in regard to the establishment of camps. Crisp and Jacobsen (1998) on one side presented three main arguments that explain the need of having the camp option, they are: 1) host governments are whom insist on camps, 2) there is a lack of evidence on the better success of self-settlement over camps, and 3) camps are unavoidable. They clarified that the focus should go beyond the existence of camps into exploring the ways to provide the best possible conditions to the residents of camps. Black (1998) replied to Crisp and Jacobsen arguments by agreeing on the host governments preference of camps but adding a responsibility on the international agencies of promoting the camps. He also argued that successful self-settlements exist such as Art Hansen's work in northwest Zambia and Walter Kok's work in eastern Sudan. He added that their success is the evidence of their superiority over camps.

Castillo, Chamma and Komlosi (2016) describe the self-settled camps as examples of the transitory architecture. They argue that the refugees would have better satisfying levels if they have the ability to change and personalise their self-settlement camp, and they would use less materials. The study considers the self-settled camps as learning opportunities for the architects and limit their role to only help the residents in considering the macro scale of the whole camp. At the same time, the organisations shall be helping in managing the collaboration between the residents and the involved workers. However, camps are still considered as a less preferred solution, but they remain the focus of the media, aid distribution and research, while the self-settlements are not getting the needed support to succeed.

2.2.3 Shelter terminologies

There are no agreed terminologies regarding sheltering, and the existing terms are usually misused. UNDRO (1982) suggests eight phases of shelter provision: tents, imported designs and units, standard designs incorporating indigenous materials, temporary housing, the distribution of materials, core housing, hazard-resistant housing, and accelerating reconstruction of permanent housing. Thirteen years later, Quarantelli (2005) proposed a different shelter categorisation which included four stages: emergency sheltering, temporary sheltering, temporary housing and permanent housing. He distinguished between emergency and temporary shelters (mainly in the behavioural aspects), and between sheltering and housing, where in housing, the users resume their household routine, while they do not in shelters. Distinction is also made between temporary and permanent housing, where in the latter, the users return to their original houses or new houses within their community.

Barakat (2003) proposed different definitions for shelter and housing. He defines the shelter as a structure intended for temporary use despite the actual length of stay. Housing instead provides either a permanent solution or a solution that hosts the affected communities until they can rebuild their own homes. In the Shelter Design Catalogue produced by UNHCR (2016), they categorised the shelters into: global, emergency, transitional, and durable. The inclusion of global shelters amongst the categories is questioned as ‘global’ refer to the geographic location while the other categories refer to shelter duration. This confusion could be seen inside the same document when the case studies were distributed between the categories in circles of intersection; global shelters were excluded.

The International Federation of Red Cross and Red Crescent Societies (IFRC) suggested five shelter duration levels before achieving the permanent housing. They call the levels as ‘approaches’ instead of the typical ‘response phases’. The approaches, which mainly depend on the context of each case, are: emergency shelter, temporary shelter, transitional shelter, progressive shelters, and core shelters (IFRC, 2013).

Emergency shelter refers to the first rapid response given immediately after a disaster with a short-term life span. It could be basic material kit, a tent or a collective centre.

Temporary shelter is a response that prioritise time and low cost. It has limited but yet longer life span compared to the emergency shelter, and it has no planned end-state, such as shelters in camps. Transitional shelter is the third possible approach in the IFRC (2013) categorisation. It differs from the temporary shelter that its materials could be upgraded or reused in future permanent houses and could be relocated into permanent locations. Both temporary and transitional shelters can be called as T-shelters as an added flexibility for an enhanced political acceptance. Progressive shelters have the same characteristics of the transitional shelters, but they are built on permanent locations and could be later upgraded to a more permanent status. The tore shelter is part of a permanent shelter that provides the needed safety and privacy and due to various reasons is not completed to be a full house (IFRC, 2013). IFRC (2013) adds that deciding which term to use depend on the expected life-span, the used materials, the site and the local politics. Figure 2.3 shows the relation between the types depending on the shelter duration.

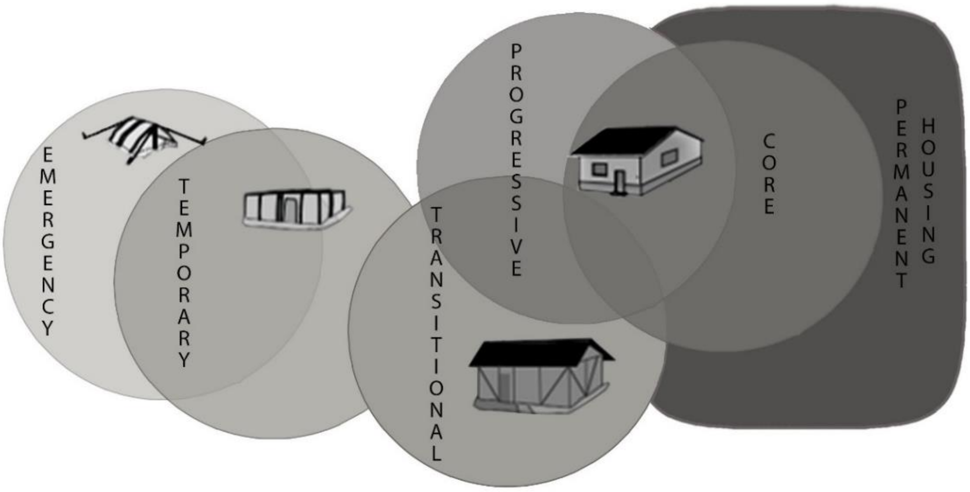


Figure 2.3: Shelter duration (IFRC, 2013)

In addition to the confusion in the phases' terminologies, the general term used to refer to the sheltering response is not agreed on, but the terms 'emergency shelters' and 'temporary shelters' are commonly used between scholars. However, since the previous two terms are used to describe specific approaches/phases in some categorizations including the IFRC (IFRC, 2013), and since the word disaster refers in this research to both natural and man-made disasters, the term 'post-disaster shelter' is used throughout the research to describe the shelter responses in the aftermath of disasters.

Transitional shelters

The transitional shelter approach is explored in various documents such as Corsellis and Vitale (2005), IFRC (2013) and Sphere Project (2011). However, Shelter Centre and IOM

(2012) explains the approach in more details. They clarify that the transitional shelter is an incremental process that provides sheltering to the affected families while they are seeking to maintain other recovery options. Corsellis and Vitale (2005) defines the implementation period of the transitional shelter as the period between the disaster and achieving durable solution. The approach has five characteristics: upgradability, reusability, ability to be relocated, ability to be resold and recyclability.

The transitional shelter supports the gradual adding of materials and elements to the initial shelter response in order to reach a durable solution, while the multi-phased approach provide separated responses (i.e. emergency, temporary, and/or permanent) (Shelter Centre and IOM, 2012). IFRC (2013) proposes the approach amongst five other shelter approaches (Figure 2.3), which can be considered as a contradiction to what Shelter Centre and IOM (2012) propose. Shelter Centre and IOM (2012) state clearly that responding with an emergency shelter, followed by a transitional shelter to reach the goal of reconstruction is not considered as ‘transitional shelter process’. According to Shelter Centre and IOM (2012), transitional shelter and reconstruction should go parallel to each other. The ten principles of transitional shelters are: to assess situation, involve community, develop strategy, reduce vulnerability, agree standards, maximise choice, buy time, incremental process, plan site, and reconstruction (Shelter Centre and IOM, 2012). Hence, the concept of transitional shelter is usually misused. Most shelter designs claim to fall under this category, which is not right in most cases. Such a misattribution is due to two major misconceptions: (1) it is usually thought that transitional shelter is a product while it is an incremental process, and (2) it is mistakenly used to describe approaches to permanent construction. Prefabricated shelters as an example, are not transitional shelters, as they are usually imported and do not involve beneficiaries during the designing and building process. In addition, incrementalism is not fulfilled (Shelter Centre and IOM, 2012). Despite being the choice for most aid agencies, transitional shelters are criticized for few reasons, i.e. it becomes permanent in many cases, it consumes a lot of resources, and that it spends the money and political will on short-term solution that do not address the long-term problem (Burnell and Sanderson, 2011). These critics could be valid if the implementation was wrongly applied, but not true if the principles of transitional shelters were carefully fulfilled.

During the review of case studies, this research will use the classification of the cases as originally documented. However, the proposed shelter design criteria and design outline will be focusing on the transitional shelter, and the ten principles presented by Shelter Centre and IOM (2012) whenever the scope of this research allow.

2.2.4 Social, environmental, and economic aspects in shelter designing

The main issues that current post-disaster shelters suffer from are cultural inadequacy and lack of sustainability in terms of environmental impacts and economic viability (Félix, Branco and Feio, 2013). The recognition of the importance of users' participation in order to have culturally sensitive designs has been acknowledged by NGOs, policy makers and scholars, specifically in reconstruction. Thirty-seven years ago, the UNDRO (1982) concluded that the key to success in reconstruction is the local community's participation. The case study of Al-burjan village in Lebanon is an example, where the main lesson learnt was that reconstruction must be culturally rooted (El-Masri and Kellett, 2001). Cronin and Guthrie (2011) show through analysing the case of the new society in Pune, where people were relocated from a flood-affected slum, how a strong partnership between the support organisation and the affected community could overcome the incidental obstacles that face most projects through their implementation. Cronin and Guthrie (2011) clarify that the organisation's bottom-up approach made the relocation possible as they believed in the capabilities of the poor people in addressing their needs, propose solutions, plan and implement the strategies with the help of the organisation. Barakat and Zyck (2011) proposed a 'hybrid approach' in reconstruction that combines the 'owner driven' and the 'contractor driven' existing approaches used in Southern Lebanon. The purpose was to ensure the structural integrity of the house through constructing the foundation and the frame by a contractor, while at the same time, support the local ownership by allowing the owners to design the layout.

Mistakes have also been made in designing shelters. Some organisations, researchers, companies, and professionals assume that their knowledge is sufficient for designing shelters despite the culture and needs of users. The case of the 2010 floods in Leh- India is an example. Prefabricated shelters were distributed to the affected people by two organisations, 550 shelters of which 100 were bamboo shelters. Both types were not accepted by the users, as they were not suitable for the extreme winters they have. In addition, the bamboo shelters had low lighting and ventilation, which prevented the users from lighting fires to warm up. The shelters also were lightweight, which made the users doubt their stability in cases of strong winds. The affected people did not occupy the shelters and built instead their own traditional mud-block houses whenever and wherever possible. Moreover, the prefabricated shelters were expensive, costing around $7000 per shelter. These factors gave the case the description of 'a costly error and a lost opportunity'. A lot of opportunities and benefits to the local economy could have been achieved and the capacity of users could have been built, if the money and effort were properly spent (Sphere India, 2011; Global Shelter Cluster, 2018).

The cultural inadequacy in designing shelters does not only result in uncomfortable living conditions, but also causes serious social problems within the communities such as violence and crime. However, little is known about how and when to apply the principles of participation in designing post-disaster shelters. Participation from early stages provides better and more satisfying design results. It also empowers the affected population and allows them to be active again in the society, instead of the typical image of being passive help-receivers. Unfortunately, recent literature has neglected this dimension (Davidson *et al.*, 2007). In addition, superficial participation has to be avoided, while the complexity of the community, their needs and power sources should be understood during the participation process in order to make a positive change (Al-Nammari, 2013). Sharma explains that despite the frequent talk about the locally driven approach in designing shelters, it remains elusive due to the distance between the planning and designing location and the implementation sites. She suggests moving all decisions and planning to where the users live as a way to localise the shelter process (Global Shelter Cluster, 2018). When designing shelters, the future usage after the initial purpose or period ends, shall be considered. Planning the reuse and design flexibility are two elements that could ease both the customisation of the beneficiaries and the adaptation when shelters are reused (Félix, Branco and Feio, 2013), in turn benefitting sheltering sustainability.

A study on 20 shelter solutions by Escamilla and Habert (2015) concluded that cost and environmental impact do not necessarily affect the technical performance of shelters and that sustainable shelter solutions can be produced using either global or local construction materials. Global materials will most likely provide better technical performance while the local materials will likely lower both costs and environmental impact. Celentano *et al.* (2018) found the source of material supply, whether local or global as the main factor affecting the speed in the scale of construction technology. They noticed that using local materials decreases the cost but increases the construction time, while the use of industrialised materials does the opposite. Therefore, they suggest using local materials with a small input of industrialised materials to increase the speed with no noticeable impact on costs. However, when focusing on the shelter unit, they found that the roof's complexity is the main factor affecting the speed and not the source of materials.

Shelter Centre and IOM (2012) recommends the selection of culturally appropriate materials, as it will help protecting the natural resources. It is believed that it reflects the local expertise in resource management, and consequently, will reduce the shelters carbon footprint through minimising the energy consumption and pollution. According to Yi and Yang (2014), applying sustainability principles leads to resilience and robustness of post-disaster structures and shall be considered during the whole reconstruction process. Minimising the wasted materials during manufacturing will also reduce the cost of shelters (Tumbeva *et al.*, 2016).

The shelter's total cost usually includes the expenses of materials, transportation, construction work and the workforce. In the camp context, the money paid for the infrastructure must also be considered while calculating the costs. The intended short lifespan of post-disaster shelters makes the investment in their quality appear inefficient as it could result in them costing more than permanent housings (Félix, Branco and Feio, 2013). This however generally proves untrue for two reasons: shelters stay in their place, and are occupied, for much longer than what was initially predicted, and considering only the initial costs when comparing solutions is short-sighted, as the operational costs differ widely when a well-designed shelter is used for a long time. Arslan (2007) recommends the consideration of re-using and recycling the materials of temporary shelters or transforming them into permanent housing as a way to save money, protect the environment and conserve resources. This calls for a greater adoption of life cycle thinking as the missing link between designing shelter and sustainability.

2.2.5 Shelter typologies

Scholarly classification of shelters is diverse. Albadra, Coley and Hart. (2018) categorised the shelters in terms of their manufacturing approach or location into 'transportable shelters' and 'built on-site shelters'. They clarify that transportable shelters include any shelter that is manufactured off-site and then shipped to the intended location. This category covers both basic shelters such as tents, and more developed flat-packed solutions. Conversely, the built on-site shelters are usually constructed using locally available materials and, in most cases, the beneficiaries are provided with tool kits and training to build their own shelters. A similar categorisation was done by Felix, Branco and Feio (2013). They grouped the shelters based on their readiness level into 'ready-made units' and 'kit supplies'. The ready-made ones are fully constructed in a factory environment and transported to the location as one unit. They may be divided into separate but somewhat large parts to be assembled on site. Kit supplies instead solve the problem of heavy transport systems by producing smaller elements that can be erected by local people on-site. The issue with the previous two categorisations is twofold. Firstly, there will be a confusion in when to consider the parts as a ready-shelter that is divided into pieces (transportable) or parts of a kit (built on-site). Secondly, the applicability of the shelters is unconsidered, as many good ideas could be inapplicable in post-disaster situations.

Quaglia, Dascanio, and Thrall (2014) analysed the existing US military solutions in order to present their origami-inspired proposals for what they call 'rapidly deployable shelters'. They categorised the military shelters depending on the walls characteristics into 'non-expandable rigid wall shelters', 'expandable rigid wall shelters', and 'soft wall shelters'. Considering the military shelter solutions as equivalent to post-disaster shelters is a delusive perspective, as the two situations have different context and needs.

In this research, shelters have been classified according to their historical application into innovations and existing shelters. Innovations are defined in this research as shelter designs that were developed by corporates or researchers but not necessarily ever used. While existing shelters are instead applied in the field in post-disaster situations. The innovations will be reviewed and discussed in the following section, while the existing shelters will have a thorough analysis in Chapters 6 and 7.

2.2.6 Shelter innovations

The attempts to design shelter solutions by corporates or researchers usually prioritise the transportability and rapid deployment of the shelters. They rarely consider the social and cultural factors or the visual, acoustic and thermal performance (Fosas *et al.*, 2018).This section reviews eleven shelter innovations and investigates them against the three sustainable dimensions (social, environmental and economic), with advantages and disadvantages noted for each dimension. Table 2.5 illustrate the comparison. However, a second table with full details is provided in Appendix A.

It is hard to classify the environmental sustainability in terms of absolute pros and cons, as the paths leading to it differ in each country or sector (Goodland, 1995). Additionally, the environmental sustainability must be evaluated if needed to be measured. This could be done through the use of environmental impact assessment tools, such as Life Cycle Assessment (LCA). However, within the scope of this review, the categorisation has been clustered by considering the local or natural materials as pros. This choice boils down to their lower reliance on fossil fuels, the lack of energy and carbon-intensive supply chains, and less use of transportation. There remain however instances where a categorisation would be misleading. This is the case of using perlite in the Tentative Concept design, for example, which is on the one hand a natural material and, on the other, a possible cause of rhinitis and pneumonia (Maxim *et al.*, 2014).

The economic sustainability of the innovations was evaluated after calculating the average material costs for the studied existing shelters in Chapter 7 ($1250). It was noted that the maximum material costs was for a project in Iraq 2015-2016 with $5,500 (Global Shelter Cluster, 2017). These two costs along with their average ($3,375) formed the criteria in Table 2.4 that is used for evaluating the cost of shelters in Table 2.5.

Table 2.4: Cost classification adopted in this research

Materials Costs	<$1,250	$1,250-$3,375	$3,375-$5,500	>$5,500
Description	Below average	Above average	Within existing range	Unaffordable

The designs with assigned shelter types do not always show the specifications of that type. Most of the innovations were considered as global shelters or as one-size-fits-all solutions, which is recognised as a wrong approach for it neglects the social context and cultural needs (Barakat, 2003; UNHCR, 2016). Additionally, innovations were transportable; in most cases, they were flat packed, but other techniques were also used, such as being stackable, foldable, or disassembled into smaller parts (Appendix A).

Social dimension

The common social positive points between some designs are the short time needed to assemble the shelters by a minimum number of workers, the ease of deployment that allows unskilled beneficiaries to take part in the construction, and the possibility of adding local materials. The most common issues under the social dimension are the one-room approach that most designs have and the lack of a private toilet and a private kitchen. TranShel (Figure 2.4(a)), is amongst the many shelter examples of the one-room designs that also lack private facilities (World shelters, 2018). The small or insufficient shelter area (compared to the number of residents and/or their needs) is another common issue between designs. The Tentative Concept post-disaster shelter which is shown in Figure 2.4(b) is an example of the small size issue with its 8 m^2 overall area (Treggiden, 2015).

Table 2.5: Shelter innovations comparison

	Shelter solution	**Social sustainability**		**Environmental sustainability**		**Economic sustainability**	
		Pros	**Cons**	**Pros**	**Cons**	**Pros**	**Cons**
1	Conrad Gargett's	- Flexible - No mechanical fixings	- Does not consider SN - No private T&K	- Use of wood	- Use of plastic		'Unknown cost'
2	Exo stackable shelter	- Easily deployed - No tools needed - Can attach multi units	- Does not consider SN - No private T&K	- Use of wood - LED light display - Recyclable	- Use of Aluminium - Steel in floor		Unaffordable
3	U-dome	- Easily deployed - Can incorporate LM	- Does not consider SN - Small size - No private T&K	- Compatible to RES	- Use of plastic - Use of Nylon		Above average
4	TranShel	- Easily deployed - Expandable - Possibility of LM	- Does not consider SN - Small size & low height - No private T&K	- Reusable & recyclable - No off gassing - Possibility of LM	- Use of plastic		Above average
5	Concrete Canvas shelter	- Various sizes - Easily deployed	- Does not consider SN - No private T&K	- Durable - Covered by earth	- Use of concrete & plastic - Vehicle needed		Unaffordable
6	The Liina Transitional Modular Shelter	- Easily deployed - Various rooms - Private K	- Does not consider SN - Small size - No private T	- Use of wood - Insulated panels - Durable	- Use of Nylon		'Unknown cost'
7	The Pallet House	- Easily deployed - Adaptable - LM (P)	- Depends on the availability of materials - No private T&K	- Use of wood - Wood/straw roof (P) - Possibility of LM	- CS roof (P)	Below average (Basic material)	
8	Life shelter	- Easily deployed - Durable - Adaptable- LM (P)	- Does not consider SN - Small size - No private T&K	- Stone wool insulation - Durable - Reusable	- Stone wool insulation - Use of steel - Cement cladding roof	Below average (For large quantities)	
9	Rapid Deployment Module (RDM)	- Easily deployed - Integrated floor	- Does not consider SN - Small size - No private T&K	- Passive techniques - Reuse shipping box - Durable	- Unknown walls materials - Questionable TC		Unaffordable
10	Tentative Concept	- Raised floor	- Small size - No private T&K	- Use of fibreglass - Use of textile with Pe - Collects water on roof	- No TC - Use of Pe		'Unknown cost'
11	Hex house	- Sufficient size - Various rooms - Can attach multi units - Private T&K	- Does not consider SN	- Durable - RES, Biogas toilet and rainwater harvesting - Use of foam insulation	- Use of steel		Unaffordable

T-Toilet/ K-Kitchen/ SN-Social Needs/ M-Materials/ L-Local/ G-Global/ RES-Renewable Energy Sources/ TC-Thermal Comfort/ P-possible/ Pe-Perlite/ CS-Corrugated Sheets

The main lesson learnt from the shelter cases about the social dimension would be that one-room designs do not fulfil the social needs. Giving the possibility of adding an internal fabric division to that room does not meet the need for proper walls. Additionally, the toilet/shower and the kitchen are not considered during the designing phase. Not providing private facilities leads to many social, health and psychological problems. Adding those private facilities at a later stage usually results in further time delays and incurs higher resources and costs. The size of the shelter shall be suitable to the number of space users, their age and gender. Providing one size shelter does not respond to diverse family needs, the context and culture of beneficiaries. Using materials that are familiar or accepted to the users, as well as maintainable, are important elements to consider. The main recommendation to fulfil the social aspect in any shelter design would be to engage the beneficiaries from early design stages. That would help in providing a more satisfying shelter, which responds to their own cultural needs and at the same time enhances their sense of belonging to their shelters.

(a) (b)

Figure 2.4: Shelters with social inadequacy: a) TranShel (World shelters, 2018), b) Tentative Concept post-disaster shelter (Treggiden, 2015)

Environmental dimension

In the environmental dimension, the main positive characteristics are related to the use of natural materials such as wood, possibility of using local materials, use of insulation, the reusability and durability of the shelter, using passive cooling and heating techniques, the ability to collect rainwater and the provision of electricity through solar panels. However, bad practice has included the use of carbon-intensive materials such as concrete, plastic, steel, nylon, and aluminium. The U-dome shelter shown in Figure 2.5(a) is an example of a shelter made of such materials. It consists of corrugated polypropylene panels, which are connected by nylon fasteners (Engineering Review International, 2009; designboom, 2018). The Concrete Canvas shelter (Figure 2.5(b)) is another example where concrete was used for the outer skin (Concrete Canvas, 2018a).

It was found that all renewable energy applications are positive additions to any shelter design. Albeit, it must be understood that these renewable sources cannot be the only energy providers as they depend on weather conditions, which are unpredictable. In addition, those applications are only cost effective if the long term is considered, while in most cases, the duration of the situation is unknown, and budget is limited. Using natural materials like wood, bamboo, thatch, mud and other bio-based or recyclable materials could reduce environmental impacts, but this can only be explicitly analysed through, for instance, Life Cycle Assessment (LCA) and evidence, rather than the designer's beliefs, which is generally, what drives design choices. Tucker, Gamage and Wijeyesekera (2014) indicate that the recent rise in using the environmental impact assessment tools have encouraged the use of the traditional and greener materials. In general, the use of local materials is preferable but also prefabrication could in some cases save time, cost, and provide the necessary thermal comfort. Whatever is the selected approach, designing a shelter that can withstand the local weather conditions is a priority, especially in areas prone to natural disasters. The lifespan of the shelters and their reusability/recyclability options shall be considered while evaluating alternative designs to have a more realistic understanding of their values.

(a) (b)

Figure 2.5: Shelters with environmental inadequacy: a) U-dome transitional shelter (designboom, 2018), b) Concrete Canvas shelter (Concrete Canvas, 2018)

Economic dimension

The unrealistic cost that most designs have exceeds what is usually considered affordable for shelters by UNHCR, IFRC and their partners. This difference is clearly noted by comparing the cost of the innovations with the average material cost of the studied existing solutions that is presented in Chapter 7, i.e. $1,250. Figure 2.6(a) shows the Hex House, a shelter designed by Architects for Society. In the Dezeen online magazine, the cost per unit was denoted as $15,000-$20,000 (McKnight, 2016), while in the Hex House website, it is mentioned as $55,000-$60,000 (Hex House, 2018). Another design with an expensive cost is the Rapid Deployment Module (Figure 2.6(b)) (Maxey, 2013), with unit costs around $15,000-$18,000 (VisibleGood, 2018). It is vital to understand that the goal of a reduced shelter cost is not only to save money but most importantly to help more people within a fixed budget. Usually the shelter project beneficiaries are much fewer than the affected people who need help. Therefore, the principal purpose is to give the best shelter quality at the lowest possible cost to help the maximum possible number of people in need. Kelman *et al.* (2011) discuss the trade-off that usually happens due to fund limitations between the number of beneficiaries and the quality of the provided assistance.

(a) (b)

Figure 2.6: Shelters with economical inadequacy: a) Hex House shelter (Hex House, 2018), b) Rapid Deployment Module (Maxey, 2013; Images Courtesy of RDM and Fast Company)

2.2.7 Summary

The provision of shelters in post-disaster situations is among the human rights that shall be given without overtaking other rights. However, in many refugee cases, particularly in camps, there are breakthroughs in these codes. Additionally, there is an ongoing argument regarding post-disaster shelters, with relief being considered by some humanitarian workers as a burden in the way of recovery. Nevertheless, in most cases, the provision of shelters is unavoidable as the reconstruction process is complicated and requires time. Generally, there is a neglect over the shelter sector, despite the recent enhanced attention. The external funding and interest of the media are two correlated key drivers effecting the sheltering response and the amount of support that is given in post-disaster situations.

Displaced people have different options of shelter responses from non-displaced people, as the former would be in need for settlement options while the latter would need reconstruction. Moreover, there are variant sheltering solutions that could be offered. This research is focusing on the displaced people who are in self-settled or planned camps and are provided with a shelter solution. Generally, camps are less preferred among other settlement options; however, in some cases they are unavoidable.

The term ‘post-disaster shelter’ is used throughout the research to describe the shelter responses in the aftermath of disasters. However, in this research, the focus is on the shelter responses that are beyond the survival basic aid of tent or plastic sheeting. For the past forty years, scholars and humanitarian workers have been supporting the approach of considering the shelter as a process. However, this is still not widely adopted. The gap between the theory and the implementation may be a result of the lack of guidance, the constraints of time and need for training. However, recent studies have recommended adopting a hybrid approach, i.e. having a stockpiled rapid shelter that could be adapted by the residents using basic materials. The transitional shelter adopts the approach as it involves the principle of incremental process. However, the concept of transitional shelters is usually misunderstood and misused.

In this research, the reviewed shelters have been classified according to their historical application into innovations and existing shelters. Innovations are defined as shelter designs that were developed by researchers, companies or professionals but not necessarily ever used. While existing shelters are instead applied in post-disaster situations. While the existing shelters will be reviewed in Chapters 6 and 7, this section included a review of eleven shelter innovations against the three pillars of sustainability.

Generally, the humanitarian sector is still lagging in sustainability, and the impact of the aid shelters on the environment is highlighted as a knowledge gap in recent studies. Considering the shelters as products or one-size-fits-all solutions and providing one-room designs, were the common wrong approaches in the social dimension. In terms of environment, it is recommended to adopt a hybrid approach in choosing the shelter materials, where global materials will most likely provide better technical performance in shorter time, while the local materials will likely lower both costs and environmental impact. However, the materials should be chosen based on evidence such as using environmental impact assessment tools. For the economic dimension, the innovative shelters have unrealistically high cost. Additionally, adopting life cycle thinking could make the provided shelters serve as an investment to the countries.

This section had a rich input to the research, and helped in shaping three objectives: Objective 1, *to investigate the challenges of living in Middle Eastern aid shelters*, which is fulfilled throughout the work reported in Chapter 4 and Chapter 5. Objective 2 *to explore the existing shelters around the world and the extent of applied variables,* which is fulfilled throughout the work reported in Chapter 6 and Chapter 7. Finally, objective 3, *to identify the effect of culture and context of the Middle East on the design elements of the transitional shelter*. This objective is fulfilled in chapters 4, 5 and 8.

2.3 Middle East

The Middle East is a transcontinental region. Towards the beginning of the 20th century, the term 'Middle East' replaced the previously used term of 'Near East'. The map in Figure 2.7 shows the Middle East boundaries (Halavaara, 2016). The Middle East boundaries are centred on Western Asia with few countries that are fully or partially located in Europe such as Cyprus and Turkey, or in North Africa such as Egypt. The countries that are mostly considered as Middle Eastern, include: Bahrain, Cyprus, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, historic Palestine (i.e. present-day Israel and the Palestinian occupied territory of West Bank and Gaza), Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen.

Figure 2.7: The boundaries of the Middle East (Halavaara, 2016)

Most of the Middle Eastern countries have hot desert climate based on the Köppen climate classification shown in Figure 2.8, which means it has hot and arid climate with intense sunshine for most of the year. The warm Mediterranean climate (i.e. hot and dry summers and mild rainy winters) is covering parts of the North-West Middle Eastern countries, while cold semi-arid climate (i.e. warm to hot dry summers and cold winters) covers the majority of Iran. However, Turkey has various types of climates in different areas (Wikimedia, 2019).

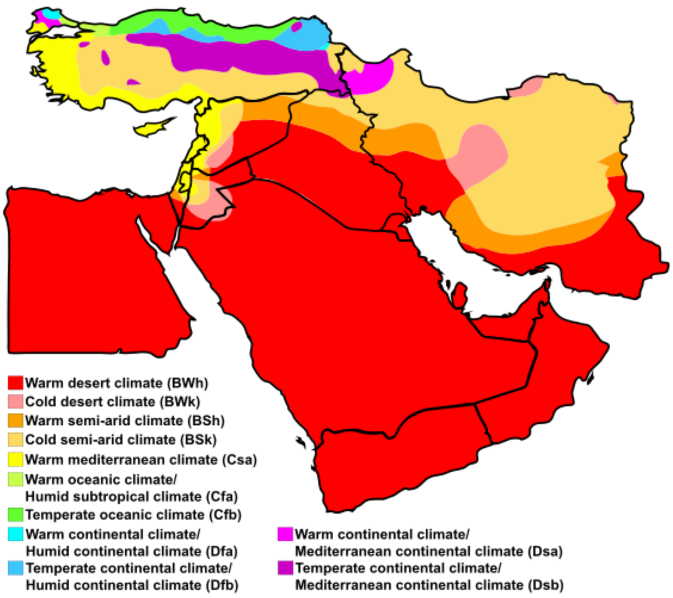


Figure 2.8: Middle East map of Köppen climate classification (Wikimedia, 2019)

Arabs are the largest ethnic group in the Middle East followed by Turks, and Islam is the most common religion followed by Christianity. People in the Middle East work in agriculture, animal husbandry and in towns and cities. Additionally, there are still a minor percentage of nomads. The tribal structure is common between Middle Easterners, where the tribe is a group of families with the same ancestor from the patrilineal descendants. The members of a tribe usually live in adjacent homes and there is a head of the tribe that is recognised as a leader. The tribes have commonly known rules such as blood feud, hospitality and sanctuary, and common concepts such as honour and nobility. These rules and concepts are more intense in the nomads and become less significant going through semi-nomads to the semi-sedentary and the sedentary cultivators (Patai, 1952).

The Middle East had faced three major conflicts that caused influx of refugees from the sources to their neighbouring countries. The wars in Palestine during 1948 and 1967, the invasion of Iraq that led to a war in 2003, and more recently, the ongoing Syrian civil war that was erupted in 2011.

2.3.1 Building typologies in the Middle East

The nomadic camp usually has number of tents with a significant distance between them for an enhanced privacy. On contrary, the villages have houses that are close to each other with narrow pathways. The main construction materials used are stone for the mountainous areas, mud or adobe on plains, reed in the marshes, and palm leaves and fronds in the deep south (Patai, 1952).

The family is the focal position in the culture of the Middle Easterners. The role of the family unit has managed to survive among all the strata of societies including the urban population. As aforementioned, the family is patrilineal, extended and usually headed by an elderly male member. The family membership comprises of all the sons including those married and their families, and the unmarried daughters. In the nomadic culture, the family live in nearby tents that form a cluster, while in the villages and towns, they either live in one building or in several buildings with a shared courtyard (Patai, 1952).

The traditional Arab homes have a clear structure. The form and spaces were generated from the traditions and culture. Although there are differences between regions, there is a common architecture language between all Arab houses that responded to the common religious needs and the climate. The Arab houses are described as introverted, where the family life looks into the indoor courtyard instead of the outside. The main elements are the entrance, courtyard, reception area with a wind catcher, sitting area with a Mashrabiyyah (wooden lattice-work bay window) that is located between two courtyards (El-Shorbagy, 2007). The privacy of the family is an essential element that affects the design of the houses and clearly separates the space into public, semi-public, and private spaces. It has plain external walls to discourage strangers from looking toward the house and to protect from the harsh weather conditions (El-Shorbagy, 2007).

The entrance opens into the courtyard or into a blank wall and then into the courtyard for an enhanced privacy. The courtyard is an essential feature of all traditional Arab houses as it responds to the necessity of privacy, while at the same time achieves a better level of thermal comfort. Additionally, the courtyard acts as an intermediary space between the entrance and the reception area. The reception is a covered outdoor area that is opened into the paved courtyard and has a Mashrabiyyah to the other planted courtyard. During the 12th century when the Mamluks ruled the area, some features had changed such as covering the courtyard and having the reception in a separated hall. Hence, the wind catcher was introduced as an alternative to the courtyard ventilation. The uniqueness of the Arab house comes from the elements that responded to the people's traditions, culture and environment and succeeded in fulfilling their needs (El-Shorbagy, 2007).

Building typologies in Syria

Syria is located on the eastern coast of the Mediterranean Sea and shares borders with Turkey to the north, Iraq to the east, Jordan to the south and Lebanon and historic

Palestine to the east. Arabs are the majority of the population, Arabic is the main spoken language and Islam is the main faith (CORPUS Levant, 2004).

Syria has a diversity in the building types, but the main differences are between the two common lifestyles; nomadic and sedentary. Nomadics, usually called Bedouins, constantly migrate as tribes searching for pastures and water, therefore, they live in tents. The sedentary lifestyle on the other hand live in cities or countryside. The city-houses are mainly built with stone and have various typologies. However, the city-house does usually consist of a courtyard with surrounding rooms. The house in the country has a courtyard that is more used as a garden, where rooms are on one side and walls surround the other sides. The internal space of the country-house is divided into two parts, one for the inhabitants and the other for the animals. Generally, there are seven main types of dwellings: tents, the basic house, the house with a Riwaq (i.e. covered gallery), the house with a Liwan (i.e. outdoor distributor), the rural house with courtyard, the urban house with a courtyard and the Lebanese house (CORPUS Levant, 2004).

Tents are used by the Nomadics. The large tent has two areas, one for men and another for women, and there is a section for guests usually separated by felt, cloth, or supply bags. The small tents are used for all life activities, including cooking, and storing. The tent is square or rectangle, made from woven wool, fixed by ropes and stakes. Three generations usually live in these tents (CORPUS Levant, 2004). The basic unit, which could be found in the rural areas, consists of two aligned living units that are opened into an exterior area, and can be used as a leisure space or for animals. The house with a Riwaq is found in some villages in the south of Syria. It consists of several rooms that are connected through a covered gallery in the front elevation, called ‘Riwaq’. In the north of Damascus, a rural type of house consists of two rooms and a distributor outdoor space in between called ‘Liwan’ (CORPUS Levant, 2004).

One example of the rural house with courtyard is a single unit of 4 m x 4 m covered with a cupola and replicated around a courtyard. Generally, they are divided into day sections (separated rooms for men and women), bedroom section, kitchen, service rooms, traditional oven room, and area for animals. Another example found on the outskirts of Aleppo, is where the whole house takes the shape of a mud cupola. In present times, reinforced concrete became used and roofs became flat and covered with wood, plants and earth. One of the reasons behind the decrease in using mud is the lack of craftsmen, though the thermal insulation and acoustic of the traditional mud buildings are much better than the modern reinforced concrete houses. The limited number of openings is what distinguishes this type (CORPUS Levant, 2004).

The most common typology in Syria is the traditional courtyard house that is also common in other Mediterranean countries. Several rooms surround and open into an inner courtyard. In medium and large houses, a water fountain is located in the centre of the courtyard. Few long and high openings are located on the external walls (CORPUS Levant, 2004). The seventh and last typology is the Lebanese house and as obvious from the name, it has a strong presence in Lebanon. It consists of a main indoor hall that is surrounded by rooms. The front rooms have triple arch windows. The balcony is present in this type and it overlooks the garden or the street. This type is the most modern middle-class type in Syria, though the houses in Syria are very modest compared to the houses in Lebanon (CORPUS Levant, 2004).

2.3.2 Jordan

Jordan is the heart of the Arab East, located on the East Bank of the Jordan River. It shares borders with historic Palestine on the west, Syria on the north, Iraq in the Northeast, Saudi Arabia on the south, and is bordered by the Gulf of Aqaba from the South-West. Jordan has an area of 89,342 km^2 and is divided into 12 governorates. Arabs are the majority of the population, Arabic is the main language and Islam is the official religion. The population of Jordan is approximately ten million (Aljazi, 2018).

Throughout the many conflicts that have happened and are still happening in the Middle East, Jordan has managed to provide support and help by hosting refugees from neighbourhood countries. As a result of this strategy, Jordan is now the top hosting country of refugees in the world in relevance to ratio of the national population size (UNHCR, 2018b). Two major refugee influxes have led to camps establishment in Jordan: Palestinians and Syrians. The Palestinian camps were established after the 1948 and the 1967 wars, which according to UNRWA (2018) resulted in forced displacement of approximately five and a half million registered refugees. Jordan hosts about 40% of the Palestinian refugees (more than two million) (UNRWA, 2018), of which 370,000 are hosted in the ten recognised UNRWA camps (UNRWA, 2016).

More recently, when the Syrian civil war started in 2011, the Syrians fled the war to their neighbouring countries including Jordan. Approximately, 1.3 million Syrians are hosted in Jordan; only 672,000 refugees are registered under the mandate of UNHCR. The UNHCR along with the Jordanian authorities provided camps for about 20% of the registered Syrian refugees, while the rest live within the host community. There are five Syrian refugee camps in Jordan: Zaatari, Azraq, Emirati Jordan Camp (EJC), King Abdullah Park (KAP) and Cyber City (Protection Working Group, 2016), with Zaatari and Azraq being the two largest camps. Zaatari camp was established in July 2012 with tents being the provided shelter. However, during the years, the tents were replaced with prefabricated shelters. Azraq camp is a purpose-built camp that was opened in April 2014 and has steel T-shelters hosting the refugees. The majority of Syrian refugees in Jordan originated from Dara'a city (48%), followed by Homs with 19%, Aleppo 10%, Rural Damascus 9%, and Damascus 8%. The Syrian refugees have been in Jordan for an average of 4.6 years, with only 2% returnees (Tiltnes, Zhang and Pedersen, 2019). Jordan faces some major economic challenges, including poverty, unemployment, and general government budget deficit (Aljazi, 2018). Additionally, Jordan is considered the second 'water-poorest' country in the world. The influx of Syrian refugees has increased the average water demand in Jordan by 21%, which led to water crisis (Petra, 2015). While the Palestinian camps in Jordan will be reviewed in the following section, the Syrian camps will be discussed in detail throughout Chapter 4 and Chapter 5.

2.3.3 Palestinian camps in Jordan

The 1948 and 1976 wars in Palestine forced millions of Palestinians out of their land, seeking refuge in neighbouring Lebanon, Syria, and Jordan. UNRWA (2019b) defines the Palestinian refugees as "persons whose normal place of residence was Palestine during the period 1 June 1946 to 15 May 1948, and who lost both home and means of livelihood as a result of the 1948 conflict". This definition includes 750,000 Palestinians and the descendants of their males. Today, UNRWA has 5.4 million registered Palestinian refugees, of which are more than two million in Jordan.

Approximately, 18% of the Palestinian refugees in Jordan are hosted in ten recognised camps (UNRWA, 2016). There are three other camps (i.e. Prince Hasan, Sukhneh and Madaba) that are only recognised and managed by the Jordanian government as they were not initiated as camps, but instead the Palestinian refugees gathered and concentrated in them (Palestinian Return Centre, 2018). The Palestinian camp is defined by UNRWA (2019b) as "a plot of land placed at the disposal of UNRWA by the host government to accommodate Palestine refugees and set up facilities to cater to their needs". As aforementioned in the first section of this chapter, Jordan is not a signatory of the 1951 convention. However, the Palestinian refugees in Jordan, excluding the refugees who were displaced from Gaza in 1967, were granted the Jordanian citizenship, without interfering with their ‘right of return’ (Alnsour and Meaton, 2014).

The first displacement following the 1948 war was relatively unregulated (Rueff and Viaro, 2010). Until December 1949, three international organisations were providing aid to the Palestinian refugees: the International Committee of the Red Cross (ICRC), the League of the Red Cross Societies (LRCS) and the American Friends Service Committee (AFSC). In May 1950, UNRWA was established to face the Palestinian refugee case, operating in five areas: Gaza strip, West Bank, Jordan, Syria, and Lebanon (Bocco, 2010). Four Palestinian camps were established in Jordan following the 1948 displacement. The first camp was Zarqa, which was set up by the ICRC in 1949. The three other camps Irbid, Jabal el-Hussein and Amman New camp (Wihdat) were established by UNRWA in 1951, 1952, and 1955 respectively (WebGaza, 2006). The Jordanian government has rented private and public land to be used by UNRWA, which in turn set up the camps over the land, distributed tents to the refugees and built communal facilities. During the 1950s, the tents were replaced with structures that are more permanent. The replacement of the tents involved giving each family of up to five members, a plot of 80 m^2-100 m^2, over which a 12 m^2 ‘core unit’ is built. The unit consisted of one room with sanitary services that has concrete and block walls, and asbestos roofing. The refugees do not own the given plot, but have the permission to use it as a residence (Rueff and Viaro, 2010). The needs of the refugees increased with time and the families started to extend. Therefore, the refugees added extensions of mud and concrete rooms to the original core unit. Despite the prohibition of the vertical expansion, the refugees built extra floors when their plots were fully built. This unplanned expansion resulted in having irregular shaped multi-level houses with narrow pathways and dead-end alleys (Rueff and Viaro, 2010).

During the war in 1967, more Palestinians were displaced. In order to accommodate the new refugee influx in Jordan, UNRWA established six new camps: al-Baqa’a, Husn, Jerash, Marka, Souf, and Talbieh (Palestinian Return Centre, 2018). Initially, the refugees were hosted in tents that were replaced afterwards with prefabricated shelters. Gradually, the refugees self-built shelters that are more durable, and the camps ended up with fully occupied plots with attached housing (Rueff and Viaro, 2010). According to UNRWA (2019a), the Palestinian camps are amongst the world’s densest urban environments, where in many cases are considered life-threatening to its residents. A study that has been done by Alnsour and Meaton (2014) at al-Baqa’a camp in Jordan, found that despite the severe spatial overcrowding, the houses have reasonable size of 90 m^2-150 m^2, accommodating an average family size of 6.4 members. However, the quality of the buildings was very poor, both structurally and aesthetically. The range of used materials included cement, iron, stone, galvanised metal, bricks, concrete, and sand.

Jerash camp, which hosts refugees from Gaza city, has one of the poorest infrastructure camps in Jordan. The major issues in the camp are overcrowding, ‘stinky’ sewage system Figure 2.9(a) (SDC, 2018), and the poor housing conditions (Palestinian Return Centre, 2018). Palestinian Return Centre (2018) interviewed a resident of Jerash camp that shared his experience. He said that when they first arrived in Jordan, they lived in tents for a year until they were replaced with core units. He was one of a twelve-member family who shared the one-room unit, while the whole neighbourhood shared the toilet. The water had to be collected from a communal water tap. However, during the 1980s, the houses became connected to the water system and the residents were allowed to replace the asbestos roofs with concrete if they are financially capable. The corrugated sheet roofs were sources of thermal discomfort during both summer and winter. Moreover, the noise of the rain hitting the roof deprives the residents from sleeping, and the smoke of burning the wood for heating affects the health of the residents and causes fire. During 2017, about 65% of the roofs in Jerash camp were made out of asbestos and corrugated sheets (Figure 2.9(b) (UNRWA, 2013)).

(a) (b)

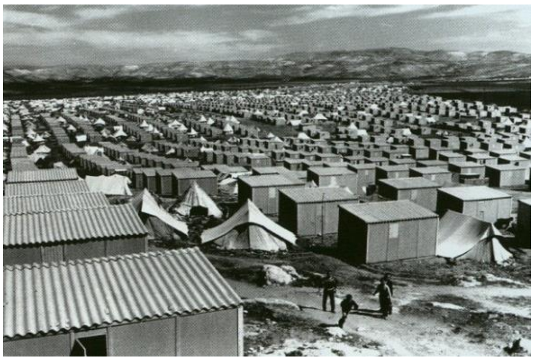
Figure 2.9: a) Wastewater surface runoff in Jerash camp (SDC, 2018), b) A view over Jarash camp during 2013 that shows the corrugated sheets roofing- photo by Ahmad Abu Sitteh-UNRWA (UNRWA, 2013)

Figure 2.10 shows the evolvement of al-Baqa’a camp in Jordan, where Figure 2.10(a) shows a photo from UNRWA archieves to the camp during 1970 when the refugees were hosted in tents (Ma’an News Agency, 2015), Figure 2.10(b) shows the provision of the pre-fabricated shelters (Palestine in Arabic, 2019), Figure 2.10(c) is a general view of the camp during the 1970s when there were a combination of tents and prefabricated shelters (Body on the line, 2009), and Figure 2.10(d) shows a recent photo of the camp where the corrugated sheets are still used in many houses (Selbi, 2015).

(a)

(b)

(c)



(d)

Figure 2.10: The evolution of al-Beqaa camp in Jordan: a) The provision of tents- photo from UNRWA Archives/AFP (Ma'an News Agency, 2015) b) The replacement of tents in the camp with prefabricated units during the 1970s (Palestine in Arabic, 2019), c) A general view of al-Baqa'a camp during the 1970s (Body on the line, 2009), d) A recent photo of the camp by Majd Selbi (Selbi, 2015)

Rueff and Viaro (2010) suggest three main reasons behind the poor conditions of the Palestinian camps: the temporary status of the refugees that did not allow the planning of rehousing the refugees, the restrictions on construction and extensions that were forced by the host governments, and the isolation of the camps. Therefore, Rueff and Viaro (2010) suggested that the host governments shall provide flexibility in terms of extensions, provide heavy infrastructure, allow mobility and encourage the social integration of the refugees. In terms of housing, engaging the refugees in designing and implementing low-cost housing solutions were suggested.

However, the Palestinian camps form a unique politicised case that differentiates it from other refugee camps cases. That is, the temporary status of the camps was always emphasised by the refugees, the hosting governments and by the UNRWA, due to its relation to the Palestinians 'right of return'. Therefore, the enhancement of the physical structure and infrastructure of the camps was for a long time refused and seen as a step towards permanency (Alnsour and Meaton, 2014), or what is commonly referred to as settlement or 'tawteen' (Misselwitz and Hanafi, 2010).

This was the case until 2004, when the Geneva Conference was held. The conference clearly differentiated between two rights of the Palestinian refugees: ‘the right to live in improved living conditions’ and ‘the right of return’. In addition, it highlighted three major concerns in the Palestinian camps that needed to be improved: the overcrowding, poor environmental and sanitary conditions, and the lack of recreational spaces (Misselwitz and Hanafi, 2010). The Geneva Conference triggered UNRWA to launch a new program during 2006, called the Infrastructure and Camp Improvement Program (ICIP). The program marked a change in UNRWA’s response strategy as it introduced the provision of sustainable development instead of the previously provided relief. However, the program faced many challenges from its early stages, both financially (i.e. poorly funded) and socially (i.e. misunderstood) (Misselwitz and Hanafi, 2010).

2.3.4 Summary

The Middle East is a transcontinental region. It includes Bahrain, Cyprus, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, historic Palestine, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen. Most of the countries have hot desert climate. The largest ethnic group in the Middle East are Arabs, and Islam is the most common religion. The tribal structure is common between Middle Easterners, where people of the same tribe live close to each other and share commonly known rules and concepts. The family is extended and is the focal position in the culture, which is usually headed by an elderly male member.

The tradition and culture of the Arabs alongside the environment of their region effected the form and spaces of their traditional houses. However, the privacy was the key element that effected the design of the houses. The houses are introverted where the family life looks into an indoor courtyard instead of the outside, as the courtyard feature succeeded in fulfilling both the privacy needs as well as the thermal comfort. In Syria, such as many other Mediterranean countries, the common building typology is the traditional courtyard house. It consists of several rooms that surround and open into an inner courtyard. Only few long and high openings are located on the external wall. While the city houses are built with stone, the rural houses used to be built with mud, but in present times, reinforced concrete replaced the mud.

Two major refugee influxes in the Middle East have led to establishing camps in Jordan, i.e. Palestinians and Syrians. Tents were distributed to the refugees in the ten Palestinian camps. However, in the first four camps that were set up following the 1948 war, the tents were replaced with core unit structures of concrete and block walls and asbestos roofing. While in the other six camps, built following the 1967 war, the tents were replaced with prefabricated shelters, and later with self-built durable shelters. Today, more than 70 years later, the camps are still functioning and have transformed into life-threatening dense areas. This unplanned expansion of the shelters resulted in having irregular shaped multi-level houses with narrow pathways and dead-end alleys. The shelters suffer from spatial overcrowding, poor structures, poor aesthetic views and poor sewage systems. The temporary status of the refugees, the restrictions on construction, and the isolation of the camps are suggested causes of the poor conditions of the camp.

More recently, five Syrian camps were established in Jordan for Syrians. The two largest camps are Zaatari and Azraq. Zaatari camp was established in July 2012. Tents were distributed to the camp's newcomers and with time, they were replaced with prefabricated shelters. Azraq camp is a purpose-built camp that was opened in April 2014, where rows of steel T-shelters were built to host the refugees.

This section has helped shape the first and third thesis objectives. The first: *to investigate the challenges of living in the Middle Eastern aid shelters*. This objective is fulfilled in Chapter 4 and Chapter 5. The third objective is *to identify the effect of the Middle Eastern culture and context on the design elements of the transitional shelter*. This objective is fulfilled throughout the work of chapters 4, 5 and 8.

2.4 Standards and guidelines

There are no agreed standards for designing shelters. However, there are some documents that have recommended shelter design guidelines, such as 'section A' of IFRC (2013) where it involves some recommendations for designing shelters. Another document is the Transitional Shelter Guidelines (Shelter Centre and IOM, 2012), where one of the sections is dedicated to design. The 'Transitional Shelter Guidelines' document clarifies a lot of the misconceptions in regard to transitional shelters, while at the same time, explains and specifies the technical details of shelters. Additionally, IFRC produced a document for shelter kits (IFRC, 2009) that provides guidelines on how to use the IFRC shelter kit (i.e. two tarpaulin pieces and a tool kit). However, these documents among others, mention the Sphere handbook as their major reference. Moreover, most of the aid agencies, organisations and other entities who are involved in the humanitarian sector and shelter designing refer to the Sphere guidelines. Therefore, the guidelines of Sphere will be discussed further in this section.

2.4.1 Sphere Handbook

The Sphere was first published in 1998 and was revised in 4 following editions that were published in 2000, 2004, 2011 and recently in 2018. It contains the humanitarian charter and minimum standards in humanitarian response. One of the key drivers for the changes in the 2018 edition is cited as the evolving operating contexts. Sphere (2018) describes this driver as the need to consider the “urbanisation” of the world instead of the previously assumed “rural and camp-based contexts”. The changes that responded to this driver among other drivers made the 2018 edition more generalised. Despite the importance of having a holistic and consistent global approach in post-disaster situations, there is also a need to specify standards and guidelines for particular cases as the practicality and applicability of the standards differ depending on the culture of the users and the context of the situation.

Sphere Association (2018) consists of four foundation chapters and four technical chapters. The structure of the technical chapters consists of standards, key actions, key indicators and guidance notes. One of the four technical chapters in the Sphere handbook covers the minimum standards with regard to the 'shelter and settlement’ responses. This review has analysed the ‘shelter and settlement’ chapter in both Sphere Project (2011) and the Sphere Association (2018) to be able to extract guidelines for designing transitional shelters in its micro scale (i.e. not including the urban scale).

The ‘shelter and settlement’ chapter consists of seven standards: planning, location and settlement planning, living space household items, technical assistance, security of tenure, and environmental sustainability (Sphere Association, 2018). In the ‘planning’ standard, the integration of the community was encouraged, in particular the minorities and people who may face barriers in accessing the shelters. The provision of adequate drainage facilities is needed to avoid the water ingress to the dwellings and services. An appropriate sewage system is not mentioned in the ‘shelter and settlement’ chapter but instead is advised in the ‘water supply, sanitation and hygiene promotion’ chapter (Sphere Association, 2018). The second standard concerning the ‘location and settlement planning’ has many suggestions that cover the site selection (Sphere Association, 2018). However, there are uncontrolled limitations in site selection such as the preference of the governments and the availability of land. Crisp and Jacobsen (1998) had previously presented this argument more than twenty years ago. Therefore, in many cases the site is imposed on humanitarian workers and not chosen. The fourth key action in the second standard covers the importance of having sufficient space for all functions, including the planning for 'shared resources'. The provision of 'communal cooking facilities' is given as an example (Sphere Association, 2018). However, assuming that all cultures would accept communal kitchens has been proved wrong through many previous cases including the Syrian camps in Jordan (Alshawawreh, Smith and Wood, 2017).

In the same standard, indicators regarding the land area are stated, such as the 45 m^2 per person in camp-type settlement, and the 30 m^2 when services are provided outside the settlement. In addition, the ratio between the covered space and the plot size is recommended to be as low as 1:2 or 1:3, while 1:4 or 1:5 are preferred. For fire safety, a firebreak of 30 metres should be inserted after every 300 metres of built-up areas in camp settings. The space between every two shelters shall be as minimum as two metres and preferred to be twice the height of the shelter (Sphere Association, 2018). However, these considerations must be fulfilled in an urban scale throughout the settlement planning.

The significant importance of protecting the privacy and dignity of the households in temporary settlements is assured in various locations throughout the handbook. This includes the guidance regarding having the shelter opening facing towards a common or screened area, and not towards the entrance of another shelter. Moreover, the needs, preferences and habits of various age, gender and disability groups are to be considered (Sphere Association, 2018).

The third standard in the shelter and settlement chapter is regarding the 'living space'. This is the most related standard to the micro scale of shelters in camps and settlements. It affirms the importance of providing a sufficient space for the diverse needs of the household. Respecting the culture and the lifestyle of users is highlighted, including the provision of separations between genders and age groups. Additionally, the shelter shall provide physical security, dignity, privacy and weather protection. The provision of a suitable amount of lighting, ventilation and thermal comfort are among the key actions of the standard. The standard also recommends the use of culturally acceptable and environmentally sustainable shelter solutions, materials and construction techniques (Sphere Association, 2018).

The most used and quoted recommendation in Sphere has always been the one regarding the minimum living space per person, i.e. 3.5 m^2. However the origin of that number has no scientific basis according to Kennedy and Parrack (2013). The recommended 3.5 m^2 space per person is originally part of a booklet that was published by the World Health Organisation in 1971, and it was based on the need of air ventilation without any other considerations. However, it was adopted by Sphere since its first edition. In the 2018 edition, the 3.5 m^2 recommendation continued to be present, but with an additional statement that recommends an area of 4.5 m^2 to 5.5 m^2 per person in cold climates, in cases where cooking, bathing and/or sanitation are included (Sphere Association, 2018). Linking the decision of providing indoor or outdoor facilities to the climate neglects the cultural aspect. There are regions with cold climates around the world where its people do not accept indoor facilities, and other warm climate locations where using outdoor toilets interfere with the culture and privacy of the people. Nevertheless, the Sphere handbook also suggests considering the culture and the social norms while planning the minimum living space. Another numeric minimum standard is presented in the same section with regard to the floor-to-ceiling height; Sphere recommends 2 m or 2.6 m depending on the climate, where the latter is for hot climates.

For hot and dry climates, which is the most common weather in the Middle East (based on the Köppen climate classification shown previously in Figure 2.8), it is recommended to use heavy construction materials, or lightweight materials with insulation. Additionally, areas that are shaded and ventilated are recommended to be added to the shelters. Gaps shall be avoided between the internal flooring and the external walling, to prevent the ingress of dust and insects. Moreover, the location of openings and partitions must maximise the internal living space and the adjacent external areas if applicable. It is recommended to include open public household spaces for socialising.

The shelter structure is preferred to align with the local or national building codes where applicable, as they are assumed to "reflect the local housing culture, climatic conditions, resources building and maintenance capacities, accessibility and affordability". In terms of materials, if the local materials are adequate and their sourcing will not affect the local economy, workforce, or the environment, then they are advised to be used. However, in case of using unfamiliar materials, the impacts must be considered. The use of multiple sourced materials is to be encouraged after conducting market and environmental impact assessments. The materials along with the construction methods must enable the residents to maintain, adapt, or upgrade the shelter by using safe, familiar, available and affordable tools where appropriate. The quick availability of materials would accelerate the process of construction and allow the affected people to self-build the shelters. Moreover, the engagement of the affected people is important in both designing and construction.

There are three standards that are mentioned in the 2011 edition but are removed in the 2018 edition, and there is one standard that is only introduced in the 2018 edition. In the third standard of Sphere Project (2011, p. 259) (i.e. covered living space), the following is stated “Response plans agreed with local authorities or others should ensure that temporary or transitional shelters are not allowed to become default permanent housing”, this sentence ensures the importance of the temporary status of the shelters. This sentence is not included in the new edition of Sphere Association (2018). However, this guideline is adopted in this research as most hosting governments prohibit the permanency of shelters. The two other guidelines that are not included in the 2018 edition are regarding the deconstruction possibility and reusability. They are mentioned in the first standard ‘strategic planning’ of the Sphere Project (2011) under the ‘transitional shelter’ guidance note. Sphere Project (2011, p. 252) states that “Post-disaster shelter solutions that can be reused in part or in whole in more permanent structures, or relocated from temporary to permanent locations, can promote the transition by affected populations to more durable shelter”. However, in Sphere Association (2018), this guidance note is not presented, and the only mention of transitional shelters is in Appendix 4 of the ‘Shelter and Settlement chapter’ as one of the assistance options. This difference refers to the change in the structure between the two editions; however, these two guidelines are adopted in the final criteria of this research. Moreover, the ‘the multiple exit routes’ guideline is only presented in the 2018 edition. This guideline is mentioned in the Sphere Project (2011) as a guideline for collective centres, however, only in the Sphere Association (2018), it became a general guideline.

2.4.2 Summary

The Sphere handbook is probably the most important reference for humanitarian standards. However, the standards are much generalised. They cover all types of humanitarian responses, mixes all scenarios together, and does not specify the guidelines depending on the geographic location or the culture. In many cases, the handbook is found to be confusing and therefore hard to implement. Additionally, the ‘shelter and settlement assessment checklist’ that is presented in Appendix 1 of the ‘Shelter and Settlement chapter’ in Sphere Association (2018), would be good for collecting information in a post-disaster situation. However, the relation between the results of the assessment and the standards are not clarified. One of the aims behind reviewing the Sphere booklet in this research is to extract guidelines that could be an addition or a confirmation to the findings of other chapters. However, the extraction was not an easy task. The shift in the focus of Sphere Association (2018) towards the urban context, resulted in having some differences compared to the Sphere Project (2011). Table 2.6 shows the extracted guidelines from both editions and what is adopted from them in the final criteria presented in Chapter 9.

Table 2.6: A table showing the extracted guidelines from Sphere Project (2011) and Sphere Association (2018), along with the adopted guidelines from both editions into the final criteria of this research

Themes		**Guidelines**	**Sphere**		**Adopted**
			2011	**2018**	
Pre-design		No permanent materials or construction details allowed	✓	×	✓
		Users participation from early design stages	✓	✓	✓
		Assess the climatic conditions for all seasons	✓	✓	✓
		Align with existing typical housing approach	✓	✓	✓
Materials		Locally sourced or purchased materials	✓	✓	✓
Shelter solutions		Local or familiar construction build techniques	✓	✓	✓
		Can be built by users i.e. Not dependent on specialist equipment	✓	✓	✓
		A construction system with overall good thermal performance	✓	✓	✓
		Construction system which protects from the environment and is well-sealed	✓	✓	✓
		Environmentally friendly	✓	✓	✓
		Adequate provision for surface drainage and guttering	✓	✓	✓
		Adequate sewage system	✓	✓	✓
Design elements	Openings	A suitable private screened and shaded outdoor area	✓	✓	✓
		Adequate lighting and ventilation	✓	✓	✓
		Weather protected openings	✓	✓	✓
		External opening location shall help in providing thermal comfort	✓	✓	✓
		Maximise inner space usage through openings and divisions	✓	✓	✓
	Interior	A minimum covered floor area of 3.5 m^2 per person that increases in cold climates or urban settings to reach 4.5 m^2 to 5.5 m^2 (including the cooking space and bathing)	✓	✓	×
		Ensure multiple exit routes	×	✓	×
		Possibility of adding internal divisions	✓	✓	✓
		Provision of different genders/ age groups spaces	✓	✓	✓
		Adequate space to undertake these activities: sleeping/ washing and dressing/ care of infants/ children and the ill or infirm/ storage of food/ water/ house-hold possessions and other key assets/ cooking and eating indoors when required/ and the common gathering of the household members	✓	✓	×
		Ground floor raised and insulated underneath	✓	✓	✓
		Minimum height of 2 m to 2.6 m—depending on the climate (the warmer climate, the higher ceiling)	✓	✓	✓
Safety	Accessibility	Have safe access to all users, especially users with special needs	✓	✓	✓
	Fire-separation	Avoid close proximity between shelters	✓	✓	✓
Future of the design		Maintainable by users/ easily adaptable using locally available tools and materials	✓	✓	✓
		Possibility of future expansion or adding a second floor	✓	✓	✓
		Can be deconstructed for possible relocation	✓	×	✓
		Reusable in whole or part in future permanent structures	✓	×	✓

There are three guidelines from the two reviewed Sphere handbooks (i.e. 2011 and 2018 editions) that are not adopted in the suggested criteria of this research. They are the minimum covered floor area per person, i.e. 3.5 m^2 (suggested in both editions) and the 4.5 m^2 - 5.5 m^2 (suggested by the 2018 edition), the multiple exit routes, and the list of activities that need to be undertaken in the shelter. As aforementioned, the recommended minimum floor area per person of Sphere is not based on a valid evidence, and that is the reason it was discarded. The second discarded guideline is the 'multiple exit routes', that is presented in the Sphere Association (2018). The preference of having multiple entrances depends on the culture. Multiple exit routes could be seen as a necessity in flood prone areas, as the residents could escape from the second exit in case of flood. While in other cultures, the second exit could be considered as weakening to the security, or as a waste of space. Therefore, it will not be adopted in this research. The third discarded guideline is the list of daily activities that require spaces inside the shelter. The reason behind discarding this guideline refers to its unspecific nature. These activities are very general and do not reflect the culture. This section contributed in shaping and fulfilling the fourth thesis objective that is *to explore the existing guidelines and adopt the good practice among them*.

2.5 Conclusion

The number of disaster-affected people have been raised in the previous years and have reached 68.5 million during 2017, of which 22.5 million are refugees. Approximately, 85% of the refugees are hosted in developing countries, which do not have enough resources nor infrastructure to host the influx of refugees. Therefore, the role of the aid agencies in sharing the responsibility is significant. Moreover, four out of the top ten hosting countries of refugees in the world are Middle Eastern. Which evidence the need of further research on the situation of refugees in this region.

This review chapter provided evidence of the important role of shelter provision in post-disaster situations. However, the existing shelters continue to be unsatisfactory to their residents. The lack of agreed terminologies, lack of agreed approaches and the confusion in the theory and guidelines are some of the possible reasons behind the inadequacy of the provided shelters. However, the transitional shelter approach that adopts an incremental process method is a preferred solution, but due to wrong implementations, this approach is sometimes criticised. The innovative shelters that have been designed by various companies and researchers are not adopted nor applied in real post-disaster situations. This could refer to the cultural inadequacy, environmental inconsideration, and unrealistic high cost. However, exploring the existing shelters that were applied in real case scenarios would provide better information concerning the good and bad practice.

The Middle East has a unique building typology that reflects the traditions and culture of the people and the environment. To be able to design adequate shelters for the Middle East, there is a need to understand these building typologies and the drivers behind them. Jordan was chosen in this study to further research its camps. This is due to the role of Jordan as the top hosting country for refugees in the world, in relevance to the ratio to national population size. There were approximately 64 years between the establishment of the two main refugee camps in Jordan, i.e. Palestinian and Syrian camps. However, the similarity of the sheltering response between the Palestinian and Syrian camps in Jordan, despite the many issues of the former camps, highlights a significant gap in the sheltering response and in the theory that was developed over these 64 years.

In terms of the existing standards and guidelines, they are much generalised, which could be one of the reasons behind its lack of implementation. This literature review evidenced the need for specified guidelines for the various regions, cultures and shelter approach. The following Chapter 3 will explain the methodology that was used to fulfil the objectives of this research.

Chapter 3

Methodology

This Chapter discusses the purpose of the research, and explains the relationship between the adopted philosophical stance, the research methodology, research strategy, data collection methods and data analysis methods. Towards the end of the chapter, the quality and rigour of the research along with the research ethics will be discussed.

3.1 Purpose of the research

Research projects are commonly divided into three main categories according to their purpose: exploratory, descriptive and explanatory. Exploratory studies are used to understand the nature and scope of the research problem. The focus of the exploratory studies has a degree of flexibility, which allows it to become gradually narrower throughout the research timeframe (Saunders, Lewis and Thornhill, 2009). Exploratory studies usually aim at creating hypothesis instead of testing them. This type of research is interested in dealing with people who are knowledgeable about a certain topic. The resulted data of this category is usually qualitative (Sue and Ritter, 2012; Gray, 2013). Descriptive studies aim at describing the characteristics of population based on the collected data of the research. Therefore, it is guided by research questions rather than hypothesis (Sue and Ritter, 2012). Saunders, Lewis and Thornhill (2009) explain that the descriptive research is usually an extension to exploratory or explanatory research. While, explanatory studies aim at explaining phenomena and predicting the accompanying possible future scenarios (Sue and Ritter, 2012). This category of studies analyses and makes relationships between various variables of the research (Saunders, Lewis and Thornhill, 2009).

Moreover, some scholars suggest a fourth category, interpretive studies, which is focused on people’s experiences and how they view them (Gray, 2013). However, the same research study could span into two or all categories, i.e. have more than one purpose (Saunders, Lewis and Thornhill, 2009; Sue and Ritter, 2012).

The work of this research fits in two categories. It is *exploratory* in the parts that are concerned with understanding the situation in the Middle Eastern camps and in the existing shelters around the world (the literature and the focus groups). However, it is also *explanatory* where it analyses the findings and makes relationships between the needs of the people and the guidelines, which are presented by all the used methods.

3.2 Philosophical stance

The natural science and the social science are two different realities that require different methods to research. Natural science is concerned with consistencies in the data, while social science is asserted with the actions of the individuals (Gray, 2013). This research is a *social science research*.

3.2.1 Approaches to the relationship between theory and research

Theory is defined as “an explanatory scheme comprising a set of concepts related to each other through logical patterns of connectivity” (Schwandt as cited in Mills *et al*. (2014, p. 7)). The relation between theory and research is arguable between researchers. The more traditional relation is called ‘deductive’ theory, in which the researcher depends on the known theories to conclude a certain hypothesis to be tested. It is noted that theory could be the literature that has been collected about a certain topic (Bryman, 2016). The stages of deductive process are theory, hypothesis, operationalize, testing, examine outcomes, and finally modify the theory if necessary (Gray, 2013). The opposite approach to deductive is the ‘inductive’ theory, in which theory is a result of research and is concluded from observations (Bryman, 2016). The inductive theory aims at finding relationships after analysing the collected data (Gray, 2013). Nevertheless, inductive process (building theory) is likely to entail a degree of deduction (testing theory), and in some research, there is a need to go back and forth between data and theory and this strategy is called ‘iterative’. Therefore, the deduction and induction theories are not sharply defined as usually presented (Bryman, 2016).

In this research, an *inductive strategy* is used, despite the degree of deduction that comes from the literature review, which is considered unavoidable in most research projects. The collected data through the methods formed the aimed shelter design criteria, which is the ‘theory’ outcome of this research.

3.2.2 Research paradigms

Ontology, epistemology, and axiology are three research paradigms that aim to understand the phenomena from different perspectives. The ontology is concerned with the nature reality, while epistemology concerns about the theory of knowledge and what is or shall be considered as acceptable knowledge in any field of study (Bryman, 2016). Axiology, is the theory of value, it is related to what is being valued in a research by the researcher (Saunders, Lewis and Thornhill, 2009). Gray (2013) differentiates between ontological and epistemological considerations by what each tries to understand, as the former is concerned with 'what is?', the latter is concerned with 'what it means to know?'. Gray (2013) argues that the western thought is divided into two ontological traditions; the ontology of becoming, where it emphasises on the absence of reality, and the ontology of being, where the reality is seen as being composed of clear entities with identifiable properties.

The three common positions of epistemology are objectivism, constructivism, and subjectivism. While objectivism supports the detachment of the feelings and values of the researcher from the research. Constructivism, believes that the truth and meaning results from the interaction between the subject and the world, i.e. meaning is constructed not discovered. In contrast, subjectivism, believes that the subject imposes the meaning on the object (Gray, 2013). Gray (2013) clarify the relationship between the epistemology, theoretical perspectives, methodology and methods (Figure 3.1).

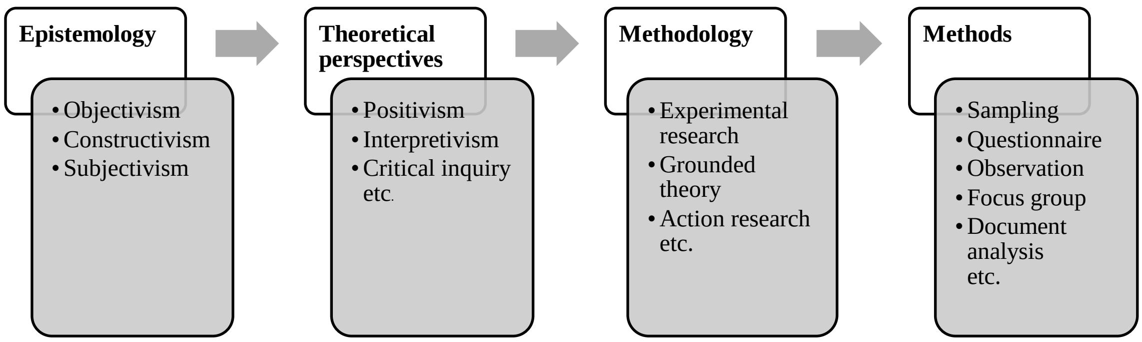


Figure 3.1: Relationship between epistemology, theoretical perspectives, methodology and research methods, adapted from (Crotty, 1998)

This research is categorised under the *constructivism* epistemology and the accompanying *being* ontology. This refers to the nature of research, which depends on studying the interaction between the residents of the camps and their shelters. This interaction is affected by their culture, believes and individual needs, which gives the constructed meaning of the research. This research focuses on the human value and the right to live with dignity in displacement situations. These values connect the researcher to the research and forms the axiological paradigm.

3.2.3 Theoretical perspectives

There are many theoretical perspectives. However, it is argued that positivism and interpretivism are from the most influential perspectives. Positivism is usually linked to objectivism and is based on a being ontology. Its main argument is that "reality exists external to the researcher and must be investigated through the rigorous process of scientific inquiry" (Gray, 2013, p. 20). Interpretivism is a theoretical perspective that is linked to constructivism and is also based on a being ontology. It is an anti-positivist stance that looks at the interpretations of the social world through the lenses of culture and history (Crotty, 1998).

In this research, *interpretivism* is the theoretical perspective that led to the chosen methodology. The chosen approach in interpretivism is the *symbolic interactionism*, which has three principles: people actions depend on their interpretation of the meaning of the object, meanings emerge from social interaction, and meanings are handled and modified by the interactive process that is used by people in dealing with a phenomenon. This means that meanings are not fixed but instead are revised with experience (Gray, 2013). This is how this research is conducted. It depends on how the Syrian refugees interacted with their shelters in the camp. Their interaction was translated into amendments, and their amendments were interpreted by the researcher based on the culture and believes of the camps' residents.

3.3 Research methodology: Grounded theory

Corbin and Strauss (2008, p. 2) define the methodology as "a way of thinking about and studying social phenomena". The used methodology of this research is the *grounded theory*, which according to Corbin and Strauss (2008) has the purpose of building theory from data. There are three main genres: traditional, evolved and constructivist. Aligning with the epistemology of this research, the grounded theory methodology of this research is the *constructivist*. The constructivist grounded theorists "do not assume that theory emerges from data; rather they believe researchers construct the analysis of the data and thus the categories and core category that eventually makes up a grounded theory" (Mills *et al.*, 2014, p. 6). The role of the researcher in the constructivist grounded theory is acknowledged, and his histories and theories are not separated from the research, however, they must be dealt with required scrutiny (Mills *et al.*, 2014).

Grounded theory has four tools: theoretical sampling, coding, theoretical saturation and constant comparison. Theoretical sampling is an ongoing process of data collection for generating theory. It is "concerned with the refinement of the theoretical categories that emerge in the course of analysing data that have been collected, rather than boosting sample size" (Charmaz as cited in Bryman (2016, p. 411)). Coding is the key process of grounded theory in which the data is broken into components that are ready for the comparison. The key concept of theoretical saturation is to stop sampling when a category has been saturated with data. The constant comparison aims at keeping a connection between data and conceptualisation. However, this connection is more implicit than explicit (Bryman, 2016).

The used tools in the grounded theory produce sequential outcomes. The first results are concepts, which come from coding. When these concepts are elaborated through comparisons, they are called categories and the aspects of each category are properties. Moreover, the initial relationships between the concepts are called hypothesis in the grounded theory. Finally, the main outcome is the theory itself (Bryman, 2016). The theory is defined as a set of well-developed categories that are related through statements to form a theoretical framework. This framework explains a phenomenon (Strauss and Corbin, 1998). The key concepts of grounded theory, which are applied in this research are regarding the use of multi methods for data collection and the use of small sampling (when saturated) rather than one method and techniques with larger sampling.

3.4 Research strategy

The research strategy is the orientation to the conduct of social research. The main two strategies in research are quantitative and qualitative. The traditional difference between the two is that quantitative involve measurements, while qualitative emphasizes words. In a quantitative project, there is a need to understand the factors that influence the outcome. While qualitative projects are usually exploratory, as there is a need to explore when a theory is unknown (Creswell, 2009).

However, the distinction between the two strategies is controversial. Some scholars consider the distinguish as helpful and necessary, while others consider the difference as useless or false. Moreover, many researchers differentiate between the strategies on deeper levels based on their approach to the relationship between theory and research, and their epistemological and ontological foundations. The main differences are illustrated in Table 3.1 (Bryman, 2016). The differences between the two strategies are not always clear in the methods. In addition, the two strategies could be combined in one research. This combination is called mixed-methods.

Table 3.1: Differences between the quantitative and qualitative research strategies (Bryman, 2016)

	Quantitative	**Qualitative**
Approach to the relationship between theory and research	Deductive	Inductive
Epistemological orientation	Natural science- Positivism	Interpretivism
Ontological orientation	Objectivism	Constructivism

This research has a *qualitative strategy*. The field visits including the focus group discussion, the observatory tours and the Participator Design (PD) experiments. These three methods along with 'documents' are the used qualitative methods. However, the comparisons that were made to the documents are considered as quantitative. The confined quantitative input to the research is not big enough to consider the strategy as mixed methods.

The qualitative research has nine common characteristics (Creswell, 2009), Table 3.2 shows the characteristics and how they were fulfilled in this research.

Table 3.2: The fulfilment of the qualitative research characteristics

Qualitative research characteristics (Creswell, 2009)	**How they were fulfilled in the research**
The natural setting	The researcher collected data from the field (camps)
The researcher is the key instrument	The researcher collected the data by herself, instead of depending on tools such as questionnaires
The use of multiple sources of data	Multi-methods were used
Inductive data analysis	The collected data were organised in themes to contribute to the final criteria
Participants' meaning	The perspective of the participants shaped the research
Emergent design	There was a flexibility in adding and using the methods
Theoretical lens	There was an emphasis on the social aspect
Interpretive	The collected data were interpreted by the researcher to form the themes and guidelines of the criteria
Holistic account	Many aspects of the shelter design were explored

3.5 Data collection methods

The research methods are not considered as neutral tools due to the dependency on how the social scientists perceive the connection between various social realities and how they are examined. However, they also do not depend on the intellectual preferences of the scientists (Bryman, 2016). The grounded theory methodology is usually fulfilled through qualitative research strategies (Bryman, 2016). Interviews are among the commonly used methods in the grounded theory among other methods such as documents, literature and elicited material such as questionnaires and surveys (Mills *et al.*, 2014).

This research used four main methods for collecting the data; each method will be briefly discussed here. However, for an enhanced understanding and connectivity between the method and the analysis, the details of the data collection will be presented throughout the next chapters wherever fitted.

3.5.1 Focus group

Focus group is a form of group interview, where the moderator conducts the interview with a group of people. In the focus group context, these people (participants) are known to be involved in a certain situation and they are asked to talk about their involvement in that situation. Therefore, the questions of the focus group are concentrated on a particular topic and involve a degree of interaction between the participants (Bryman, 2016). The focus group method was used in two camp settings (i.e. Zaatari camp and Azraq camp). Each camp involved one focus group session, where pre-structured questions were asked (Appendix B). The researcher moderated the sessions, recorded the discussions, transcribed the recordings, and translated the transcriptions from Arabic (the participants' spoken language) into English. More details concerning the reasons behind choosing this method and the data collection are presented in Chapter 4 for the Zaatari camp visit and in Chapter 5 for the Azraq camp visit.

3.5.2 Observatory tours

To ensure the accuracy of the data collection through the focus group, complimentary observatory tours have been held in both camps (i.e. Zaatari and Azraq camps). The tours included walking between the shelters, entering two to three shelters in each camp (with the permission of the inhabitants), and documenting the observations through visual data (photographs) and notes taking. More details about the data collection through the observatory tours are presented in Chapter 4 for the Zaatari camp visit and in Chapter 5 for the Azraq camp visit.

3.5.3 Documents

Documents could be used as a source of data in research. The main characteristic of this method is that documents are not produced by the researchers nor upon their request. Instead, these documents are already published, and the social researchers are analysing them as they are presented. The documents could be personal (such as letters and diaries), official (whether from state documents or from private sources), mass-media outputs (such as newspapers and magazines), or virtual documents (such as websites and social media) (Bryman, 2016).

This method is used twice in this research with documents deriving from private sources. The Sphere guidelines that were analysed in the literature review, Chapter 2, has produced one of the four main input for the final criteria. Two editions of the handbook were analysed and compared to extract the shelter design guidelines. The second position in this research that used this method is the documents of the existing shelters that were produced by organisations and gathered shelter cases from around the world. More details about the data collection is explained in Chapter 6 where the existing shelters' data is analysed.

3.5.4 Participatory Design

Participatory Design (PD), also called 'cooperative design' and 'co-design', has been proposed since the 1970's as a method to fulfil the concept of designing 'with the people' not 'for the people'. Roth (1999) considered PD as one manifestation of the participatory research that is described as a human-centred design research, in order to seek better and successful solutions. Carroll (2006, p. 7) defines PD as "the direct inclusion of users within a development team, such that they actively help in setting design goals and planning prototypes".

The closest familiar method to PD is the experimental design. Experiments are unusual in sociology; however, they still could be used in social research. The experimental design research could be differentiated based on the setting where they are conducted. They are divided into laboratory experiment (conducted in a contrived setting) and field experiment (real-life setting). The PD experiment that is conducted in this research occurred in real-life setting, i.e. inside the camps, therefore, it is considered as a *field experiment*. The details of the PD experiments that were held in both Zaatari and Azraq camps are discussed in Chapter 8.

3.6 Data analysis methods

The grounded theory, as aforementioned, has four tools: theoretical sampling, coding, theoretical saturation and constant comparison. While theoretical sampling is related to the data collection, the other three tools are related to data analysis. Coding is the key process of grounded theory, which is used to break the collected data into components that are ready for the constant comparisons. The theoretical saturation is used for both collecting data and analysing it. The saturation in coding means that the extracted categories are representative of the data and there is no need for further revisions of the data. The constant comparison is the fourth tool and aims at keeping a connection between data and conceptualisation. The first results that come from coding are called concepts. When these concepts are elaborated through comparisons, they are called categories and the aspects of each category are the properties (Bryman, 2016).

The data that are collected in this research are analysed (coded) in ways that formed different concepts within each method. However, the various interpreted outcome from the methods were being compared and categorised under the same ‘themes’. The language used for framing the ‘guidelines’ of the criteria, were unified to ease this comparison, and therefore gather the findings. While thematic coding was used for analysing the field visits (i.e. focus group discussions and observatory tours) and the PD sessions, qualitative content analysis was used for the documents. However, both methods include coding.

3.6.1 Thematic coding

Thematic coding is one way of qualitative analysis where common themes link certain pieces of text or images from the data, and therefore establish a framework of thematic ideas (Gibbs, 2012). Thematic coding was used for the field visits and for the PD sessions in two different ways. In the field visits to Zaatari and Azraq camps, the transcribed discussions were inserted into the NVivo software, along with the photos and notes of the observatory tours. NVivo is a computer-aided qualitative data analysis software (CAQDAS) that eases the process of coding and retrieving data (Bryman, 2016). Figure 3.2 illustrates a screenshot of the analysis file from the Nvivo software, where thematic coding structure is used. The same tool was used for the data resulted from the field visit to Azraq camp, as seen in the files shown on the left side of Figure 3.2.

There are three stages of coding according to Strauss and Corbin (1998) approach of grounded theory: open coding, axial coding and selective coding. Open coding is when the text is read reflectively and broke down into concepts that are then, grouped into categories. Axial coding is when the categories are developed and connected. Lastly, selective coding is when a ‘core category’ is developed. The core category is the central issue that integrate other categories (Bryman, 2016). The open and axial coding of the field visits data, were undertaken using the NVivo software. However, the selective coding was manually done and constantly modified until the final version of framework from the Zaatari camp visit is presented in Chapter 4- Table 4.3, and from the Azraq camp visit is presented in Chapter 5- Table 5.4. The two tables were merged together in Chapter 9 when the comparison between the frameworks of the various methods were presented in Table 9.1.

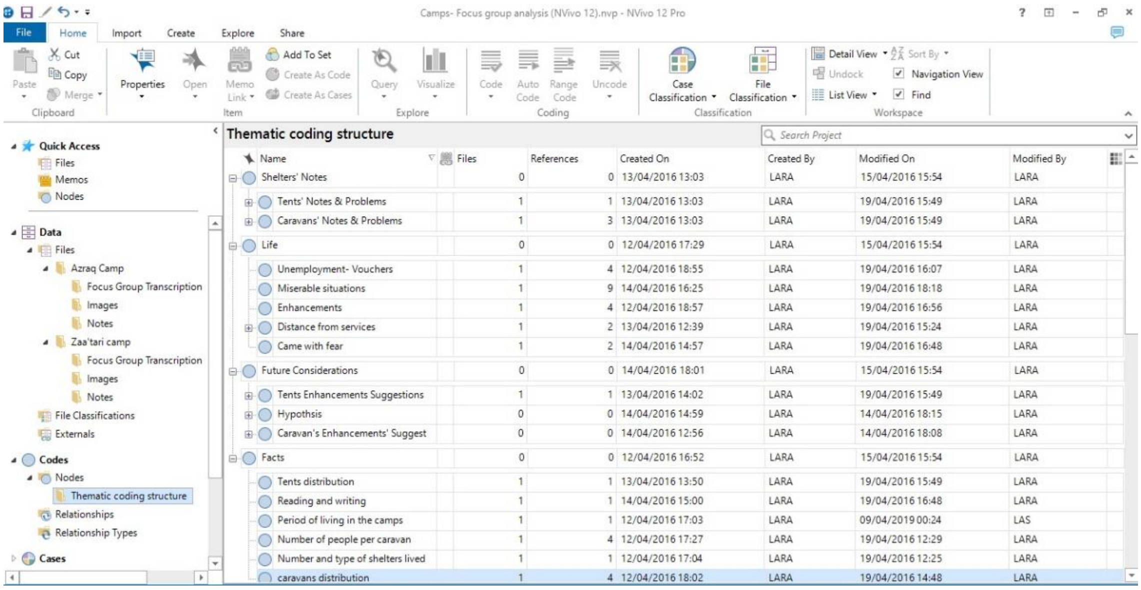


Figure 3.2: The thematic coding structure of the Zaatari focus group discussions and observatory tours (NVivo)

Regarding the PD sessions, the collected data were in the form of 3D mock-ups that were designed by participants from both Zaatari and Azraq camps. The mock-ups were transformed into 2D plans by the researcher and comparisons were made to extract findings. While the details of the analysis are presented in Chapter 8, the presence of the thematic coding was in coding the findings of the comparisons. The resulted framework is presented in Table 8.2.

3.6.2 Qualitative content analysis

Qualitative content analysis is a method used to give meaning to qualitative data by extracting categories from the content into a coding frame. This data analysis method is systematic, flexible and reduces the amount of data (Schreier, 2013). Qualitative content analysis is usually used for analysing documents (Bryman, 2016). In this research, this method was used twice with the two data collection set of documents (i.e. Sphere handbooks and the shelter projects). The documents went through ‘intensive reading’ to be able to extract initial categories and subcategories; followed by rounds of 'revising and expanding', until the preliminary coding frames from the Sphere handbooks and the shelter projects were formed. However, towards the end of the research, all the preliminary coding frames from the documents (i.e. Sphere handbooks and shelter projects) along with the other two sources of analysis (i.e. field visits and PD sessions), were compared to unify the wording of the categories (called themes) and subcategories (called guidelines). This procedure of unifying the coding framework offered the possibility of gathering the findings of the different data collection methods into one final framework that fulfils the aim of this research (i.e. the proposed shelter design criteria).

3.7 Quality and rigour

The quality of the grounded theory depends on the demonstrated rigour level by the researcher. This rigour level depends on the ability of the researcher to conduct the research, the philosophical and methodological alignment and the right application of the methodology and chosen methods (Mills *et al.*, 2014). Charmaz (2006) suggests four elements to evaluate the grounded theory: credibility, originality, resonance and usefulness. The 'credibility' element is enhanced through the familiarity with the context, collecting the right amount of data, comparing the results and observations. She also considers the relation between the data, the outcome categories, and the researcher arguments as a way of evaluation. The 'originality' questions the addition of the study to the current concepts and practices. While 'resonance' is concerned with ensuring that the findings represent the experience of the participants and is meaningful to them. The last element is the 'usefulness', and it covers the contributions and impact of the findings.

This research tackled the credibility element through choosing methods that represent an actual case of refugees, which is the Syrian refugees in Jordan. The field visits to the camps aim at having a thorough understanding of the situation. The data from the focus groups is supported by observatory tours in order to increase the credibility of the participants' views, while at the same time, provide a visual proof (photographs) of the findings. Moreover, the PD approach provides an insight on how the residents of the camps would approach the shelter design. This is crucial, as the findings would reveal the priorities of the residents in terms of shelter designing, which they may not be able to express through words. The results from the various methods are extracted in a unified framework (the themes of the criteria), which facilitated their comparison.

The originality of the research comes from the specificity in what it covers. Having shelter criteria for a specific geographic location is not presented in the current literature. In addition, the methods used to form the criteria were never presented in forming the current worldwide shelter standards and guidelines. In terms of resonance, the research claims that the findings represent the shelter needs of the studied Syrian refugees. The sub-aim of this research (i.e. proposing a shelter outline for the Middle East) has the purpose of ensuring the applicability of the criteria. However, only when the shelter is prototyped, tested, and experienced by the refugees, we could ensure the resonance of the findings. This discussion is presented in Chapter 10 as part of the suggested future work. Finally, the usefulness of the criteria is explained through the contributions of this research that are presented in Chapter 1.

3.8 Research ethics consideration

Creswell (2009) emphasizes the importance to anticipate the ethical issues that could arise throughout the research. He adds that these ethical issues must be considered during all the research stages. In this research, the identified problem was chosen to be of significance to the affected people. The study empowers the participants by considering their views as the main source of data and prioritise them over the documented data. Moreover, the aim of this research was clarified to the participants using simple words throughout the field visits.

During the data collection, many ethical considerations were predicted and dealt with. The context of the camps forces a level of sensitivity. The researcher will access the camps with the help of registered organisations. Attention must be paid for the way that the researcher dresses during the field visits, talks and behaves while communicating with the residents. It is important to engage with the participants and make them comfortable in expressing their views to a person who will listen and respect all opinions. Moreover, written consent forms are not to be presented to the participants due to the sensitivity of the situation inside the camps and the participants' preference to be unidentified. However, the participants will be verbally informed with the content of the consent form. They will be introduced to the researcher background, aim of study, and aim of the visit. They also will be informed about their freedom to leave the setting at any time and for any reason. In addition, the participants have to be told that the discussions are recorded and that no photos of faces will be taken. During the data analysis and interpretation, proper tools are chosen to analyse the data to ensure the accuracy of the information. Finally, throughout the writing of this thesis, inclusive language must be used, and the various views must be respected and presented. Moreover, the results have to be presented exactly as they will be found, without any falsifying to fulfil specific goals.

3.9 Summary

This chapter clarified the complex effects on the research methods and analysis as many variables are involved. The following list summarises the adopted research routes. Figure 3.3 shows the relation between the epistemology, theoretical perspective, methodology, and data collection methods of the research.

- The purpose of this research is both exploratory and explanatory
- It adopts an inductive approach to the relation between theory and research
- A constructivism epistemology is adopted
- A being ontology is adopted
- The theoretical perspective is interpretivism, specifically, symbolic interactionism
- Constructed grounded methodology is used
- The data are collected through the following methods: focus group, observation, documents analysis, and Participatory Design.

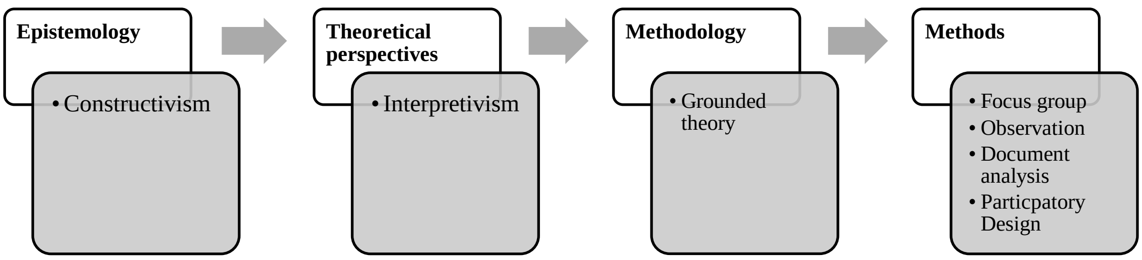


Figure 3.3: The relationship between the adopted research routes

Chapter 4

Zaatari camp- A field visit

To understand the current sheltering approach in Jordan and the issues about supporting very large groups of refugees, a field visit was conducted to the Zaatari Syrian camp. This chapter reviews the background of the camp and discusses the findings of the focus group discussions and observatory tours that were undertaken during the visit.

4.1 General information

In July 2012, the need to host the refugee influx triggered UNHCR and the Jordanian government to set up the Zaatari camp located in Mafraq governorate, about 13 kilometres away from the Syrian border in northern Jordan. The camp was set up in nine days on a land that is owned by the Jordanian armed forces (USA for UNHCR, 2017). The Jordanian government provides the security within the camp and on its entry gates. As shown in Figure 4.1 (The New York Times, 2019), the west of the camp was set up first and with time, it evolved to enclose approximately 5.3 km^2 of land (UNHCR, 2018e) that are surrounded by a ring road of 8.3 km (Ledwith, 2014).

The universal guidance direct towards having a maximum of 20,000 refugees in any camp setting (UNHCR, 2019b), with a surface area of 45 square metres per person (Sphere Association, 2018). Zaatari camp reached its peak during April 2013 with more than 200,000 residents, which equals ten times the recommended maximum number of residents who used to live in less than half of the recommended surface area. Moreover, the number of dwellings reached its maximum during March of the same year with more than 26,000 dwellings. Consequently, in April 2014, the Jordanian government closed the unofficial border crossings in Daraa (Ledwith, 2014) and opened the Azraq camp. Since June 2014, the number of residents in Zaatari camp became less than 85,000, and decreased gradually with time, reaching approximately 79,000 residents in January 2019 (UNHCR, 2019e). This number still exceeds the recommendations for the maximum number of residents per camp but fulfils the minimum surface area per person.

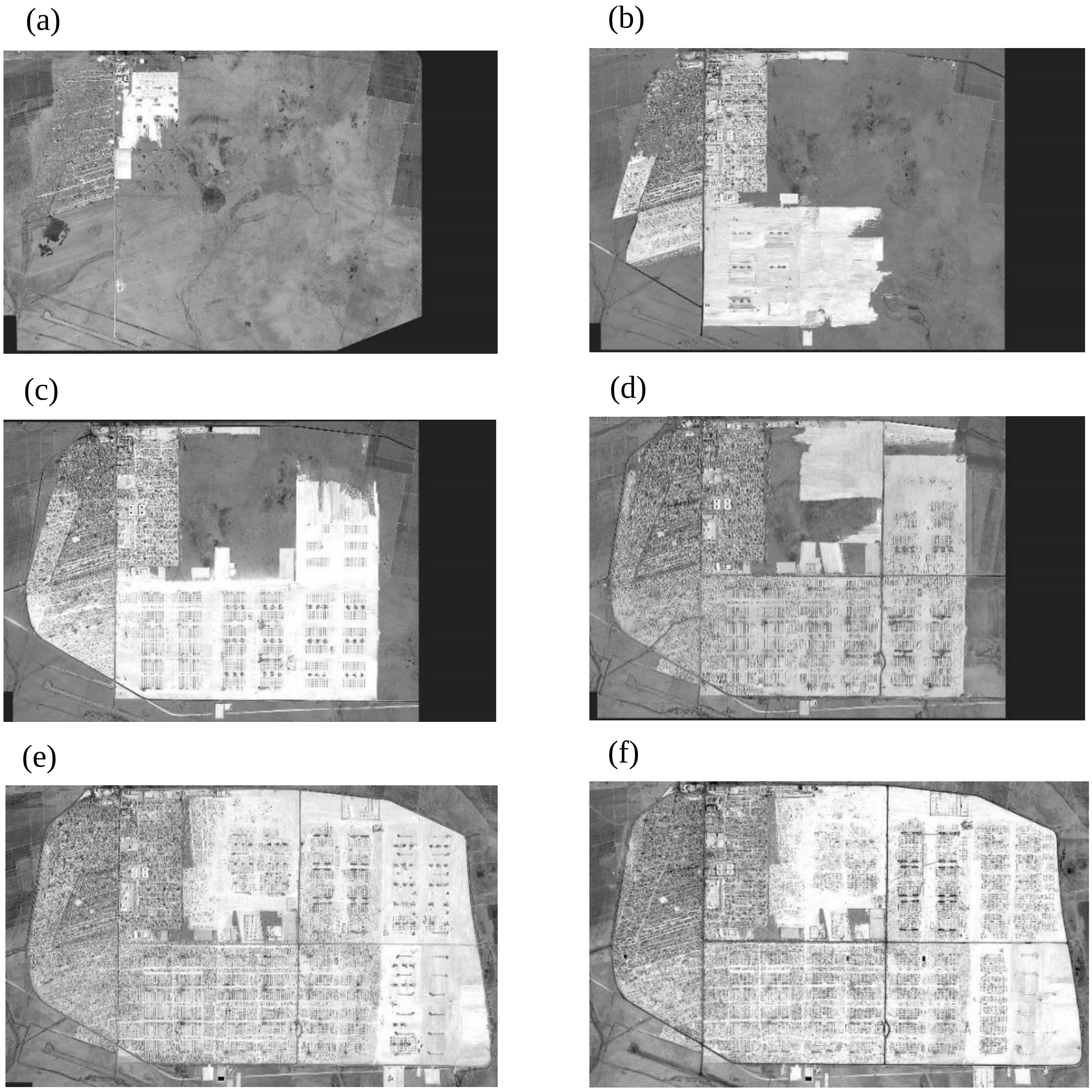


Figure 4.1: Satellite images of Zaatari camp that shows the evolvement of the camp- retrieved from CNES 2013, Distribution Astrium Service, Spot Image, DigitalGlobe (The New York Times, 2019): a) During September 2012 hosting 2400 shelters, b) During November 2012

Zaatari camp is divided into 12 districts. Each district has number of blocks with multi streets. The first sheltering response in the camp was tents. However, the tents were not suitable for the winter season as they were prone to flooding (REACH, 2014a; Gatter, 2018). The winter season of 2013 was very hard on the camp’s residents as heavy rainstorm and snowstorm hit the country. Tents were flooded and families were moved to their relatives’ shelters, to mosques or to emergency shelters while others were relocated to other camps (Gavlak, 2013; Maayeh, 2015). The residents of the camp attacked the aid workers in 2013 out of frustration when their tents swept away. The residents were afraid that the storm would kill their children and elderly due to the cold (Gavlak, 2013). During November of the same year, another storm hit the camp and forced hundreds to leave their tents, being hosted with relatives or neighbours (IRIN, 2013). Figure 4.2(a) shows the interior of a tent following the rainstorm, while Figure 4.2(b) shows a resident with reduced mobility passing through the muddy pathway.

(a) (b)

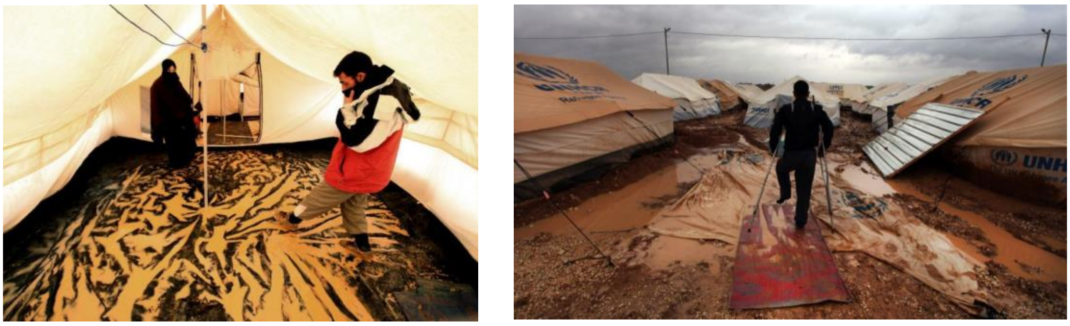


Figure 4.2: Photo of Zaatari camp during the winter of 2013- photos by Mohammad Hannon- Associate Press (Gavlak, 2013): a) The inside of a tent after the flooding, b) A resident with reduced mobility walking through the muddy pathways

During 2015, a snowstorm hit the region, and while three people passed away in Lebanon, the storm had fewer effects on the Syrians in the Jordanian camps, as only 1,800 families were living in tents at that time. However, about 20 tents flooded, and their residents were relocated into emergency accommodations (Maayeh, 2015).

The records of weather in Jordan (represented by Amman due to the availability of information) during the first six years of the Zaatari camp lifetime (July 2012-July 2018) show that the lowest temperature was -7.5^{o}C in December 5, 2015, and the highest was +42^{o}C in August 3, 2015 (Weather Spark, 2019). Which made 2015 a tough year for the camp's residents during both seasons of summer and winter.

The introduction of prefabricated shelters (known locally as caravans) in Zaatari camp was during the first few months of the camp's opening. About 350 prefabricated shelters were reported to be in the camp during October 2012 (Daily News Egypt, 2012). Figure 4.3 shows the process of supplying the shelters (Mullen, 2013; USA for UNHCR, 2017). However, only when the weather storms hit the camp, the tents replacement process was accelerated. Towards the end of 2015, most of the tents were replaced with prefabricated shelters that were donated by various organisations and countries (REACH, 2014a).

(a) (b)

Figure 4.3: Prefabricated shelter at Zaatari camp: a) The supply of a prefabricated shelter - photo by Mohammed Hannon/AP (Mullen, 2013), b) Residents moving the shelters on a self-made carts- photo by Hesna Al Ghaoul/UNHCR (USA for UNHCR, 2017)

The dimensions of the prefabricated shelters vary around the camp. The two images in Figure 4.3 show an example of this difference as (a) could be estimated to have the dimensions of 5 m x 2.5 m, while (b) have the dimensions of 4 m x 2.5 m. This difference goes back to the different shelter donors. The responsible organisations (i.e. UNHCR and NRC) explained that they were initially accepting all shelter donations, as the priority was to replace the tents and provide robust shelters to more residents. However, after some time, they started following the Sphere Project (2011) guideline of providing an area of 3.5 m^2 per person. The prefabricated shelters are made from 40 mm sandwich panels. The outer skin of the panels is 0.35 mm steel sheets, the inner skin is either steel or timber, and the insulation in between is polyurethane (Albadra, Coley and Hart, 2018).

In a report published by NRC (2012), they evaluated the prefabricated shelters as being 'satisfactory', following a visit to one of the manufacturing companies in Jordan that were producing 2,500 shelters at that time. Albeit, the evaluation criteria are not mentioned. In a survey by Albadra, Coley and Hart (2018), they found that 48% of the residents are unsatisfied with the thermal comfort of their shelters during winter and 73% are unsatisfied during summer. In the same study, the indoor temperature during September reached 40^{o}C, while during winter, the indoor temperature dropped to less than zero with very high concentration of CO_2 that reached 2700 ppm. The high concentration of CO_2 refers to the range of activities that are held inside the shelter, specifically in winter, including the use of gas heaters and smoking (Albadra, Coley and Hart, 2018).

The camp has evolved into a city that has its own facilities, such as schools, hospitals, mosques and others. In addition, the residents opened various types of shops within the camp as small self-owned businesses. Figure 4.4 shows an aerial view of the camp.

Figure 4.4: An aerial photo of Zaatari camp (United States Government Work, 2013)

4.2 Field visit information

In the literature review (Chapter 2), the need for understanding the challenges that the residents of the Middle Eastern camps face in their daily lives was highlighted. Specifically, while living in the post-disaster shelters. Therefore, there was a need to conduct field visits to Middle Eastern camps.

Zaatari camp was visited in January 2016 with the assistance of Save the Children International staff. The visit included observatory tours and focus group discussions with some of the camp's residents. The photos that were taken during the tours in the camp supported the focus group outcome and formed a visual evidence of the findings. Therefore, the photos that are presented in this chapter were taken by the researcher, unless denoted differently. The information in the following sections describe the situation at the time of the visit and do not include the latest changes. The gathered information was grouped in four categories: participants information, shelters information, general conditions, and future considerations (Figure 4.5).

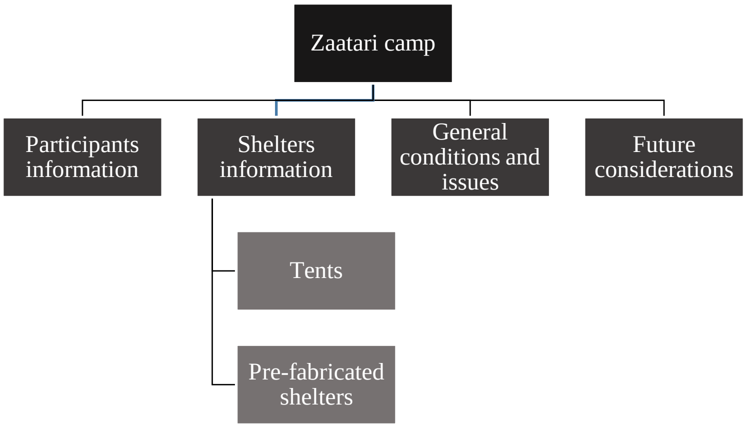


Figure 4.5: Zaatari camp- Categories of the collected information

4.3 Data collection methods

The situation of camps is generally very challenging and complicated. In Zaatari camp specifically, the residents are overwhelmed with the number of government representatives, celebrities, journalists, researchers, and others who visit the camp, talk to them, and take photos of them. At the same period of the visit, these concerns were raised and led to a very strict policies in accessing the camp and taking photos. The researcher gained access to the camp through Save the Children International organisation. However, the sensitivity of the situation and of the people was very restricting and directed the visit's decisions.

The focus group method was chosen in this study as it allows an in-depth understanding of the situation adds a human dimension and discovers how different people think and feel towards the same issue. This was in favour of the sensitive situation of the camp, where people feel more comfortable in talking within groups of familiar faces, rather than in isolation. Additionally, focus groups save time and cost compared to interview of same sample size.

Convenience sampling was used for the focus group. The organisation sent invitations to the residents who are already registered in their records. They were mothers who frequently attend the support sessions that are provided by the organisation. Men in the camp usually do not attend the organisations gatherings, and therefore, they had no presence in the focus group. The convenience sampling approach had an additional benefit in the camp's context as the participants had already signed consents with the organisation. Hence, they did not have to sign specific consents for the focus group nor were asked to identify themselves. However, the participants were verbally informed about the main points that a consent cover. These precautions were taken to prevent any misunderstanding that might have impeded the purpose of the focus group. Giving the participants an opportunity to trust the researcher and feel safe to share their experience and opinions knowing that they are not identified.

An invitation was sent by the organisation to all the 'mothers' group', where 28 participants showed up on the time. At the beginning of the session, the researcher introduced herself and the purpose of the focus group. The participants were aware that they could leave at any time; therefore, three of them had left during the session for personal commitments, which reduced the number of the participants to 25. The number is relatively large compared to a typical focus group, but the sensitivity of the camp situation played a role in having such a large group, as selecting the participants would make the other 'mothers' think that they were excluded or discriminated against. However, the moderator (i.e. the researcher) along with the helpers from Save the Children, were able to manage the group. The duration of the discussion was 63 minutes; it was recorded and notes were written. The participants were comfortable in sharing their views and experiences, and they had valuable discussions with each other that enriched the outcome.

The participants were asked pre-structured questions (Appendix B). The questions were divided into three groups: general information (engagement questions), shelter's evaluation (exploration questions), and hypotheses (future scenarios). The first group of questions covered some general information related to the camp. These questions were aimed at engaging the participants with the topic. The second group comprised exploratory questions that aimed at having an in-depth understanding of the situation in the camp and the challenges that are faced by its residents. The third group were future scenarios that covered some hypothesis and aimed at discovering the expected responses of participants in certain situations. The audio recordings were transcribed in Arabic (the language of the participants), and then translated into English. The translated transcription was inserted into the NVivo software for coding and analysing. The resulted themes and subthemes are listed and explained in the following sections.

4.4 Participants information

Some general information about the participants and their personal experience was gathered at the start of the session, including:

- The amount of time they had spent in the camp
- The number and type of shelters that they inhabited
- The distribution of the pre-fabricated shelters
- The location of the shelters
- The number of people who share the same shelter
- Their literacy skills

The focus group discussion was held at Save the Children's kindergarten at Zaatari camp. The participants replied on the question about the length of their stay in the camp, where 25 participants out of the 28 had stayed for a period between 30 months and 36 months. The other three respondents had stayed between more than 18 months and less than 30 months. They all had the experience of living in the two types of shelters that had been utilised in the camp including tents and the pre-fabricated shelters. The maximum period that any of them had lived in a tent was 12 months, before being housed in a pre-fabricated shelter. The pre-fabricated shelters were donated to the UNHCR by various agencies and individuals, both private and public. As a result, the quality of the provided shelters varied depending on the donor. The participants included individuals from a family of ten who were living together in one shelter. Although they have received a second shelter due to the large family size, but they preferred to utilise it for the kitchen and the toilet, ended up living in one shelter.

The location of the tent inside the camp was a choice of the residents. Initially, the support agencies used to erect the tents for them, but they noticed that once they leave, the refugees would move them to another plot that is adjacent to their relatives and neighbours, trying to reconstruct the housing layouts of their previous community. The agencies then changed their strategy by only distributing the tents without erecting them. The same process happened with the pre-fabricated shelters, where the residents had the choice of moving the shelters. However, during late 2015, the movement of the shelters became prohibited. The prohibition of shelters movement was adopted for organizing purposes and to minimise the problems related to the shelters' proximity.

Some of the participants did not receive their pre-fabricated shelters directly from the agencies, but instead they bought them from other previous residents who had left the camp. Previously, the ownership status of the shelters was not clear, but later on it was clarified that the shelters belong to the camp not to the resident. Some of the respondents mentioned that lately there was an announcement to distribute pre-fabricated shelters to whoever did not receive one previously from the agencies. Surprisingly, some of the families who bought their shelters preferred not to register for a new one, thinking that new arrivals would need them more.

On another level, the respondents were asked about their literacy skills, when they all agreed on their ability to read and write. This gives an indication about their awareness level and explains what most of the humanitarian workers in Zaatari say about the high expectations, standards and skills of the refugees, compared to other refugees around the world. The high expectations and demand from the refugees had forced agencies and organisations to enhance the level of the aid (Betts, Bloom and Weaver, 2015b).

4.5 Shelters information

When the camp was opened in July 2012, the UNHCR provided 70,000 emergency tents to families in Zaatari camp. However, due to the climatic extremes in Jordan and specifically in the northern desert where the camp is located, the agencies found the urge to replace the tents with more dignified and protective pre-fabricated shelters (Touaibia, 2015). This section discusses the main issues that have been faced by the participants in the two types of shelters they have occupied, i.e. tents and prefabricated shelters.

4.5.1 Tents

Tents were the first sheltering response to the refugee crisis and provided the primary need for shelter. Throughout the discussion with the participants, the primary issues regarding tents were mentioned, they are:

- Recognising the tents
- Heating
- Key issues related to the use of tents
- The modifications made to tents
- Returning the tents

Recognizing their tents

As all the tents had the same visual appearance and design, it was confusing for the camp's residents to recognise their allocated tent. To reduce this confusion, refugees wrote the owner's name on the external tent fabric.

Heating

On their initial arrival, the refugees had no appliances to provide heating during the winter season. Therefore, they used to collect papers and cardboard from around the camp and burn them to feel warm. Shortly afterwards they started selling their food vouchers to buy firewood. The participants did not find the tents protective from the weather elements, and they were in a continuous fear of burning the tents.

Key issues related to the use of tents

The participants were asked about the main problems they used to face when they were living in the tents; their answers were mainly around the entrance of rats and mice to the shelters, the issues of mud and dust, theft incidents, privacy concerns, lack of security and safety, being prone to the weather elements, health concerns and flammability concerns. The details of these issues are summarised in Table 4.1.

Table 4.1: Major challenges related to tents

Challenge	**Notes from the participants**
Rats and mice	An initial and ongoing problem for refugees is the existence of rats and mice in the camp area. Despite that, the pre-fabricated shelters did not prevent rats from entering the shelters, but the raised floor level provided some screening.
Mud and dust	Due to the lack of ground paving in the camp, the soil and dust used to turn into mud during winter. Additionally, following each dust storm, the dust used to enter the inside of the tent leading to respiratory problems.
Theft	Due to the tent's lack of security, the occupants constantly experienced theft incidents.

Challenge	Notes from the participants
Privacy	Whilst tents can provide some form of privacy, they were not sufficient to address the cultural and religious needs of the residents as was expressed by one of the participants by saying: *"We could not get our head scarfs off back then, even inside our own tents"*.
Safety and security	1. The security in the tent was a major concern to the participants, especially for the female-headed households. One of the participants, who lives alone with her kids, described how a man who was unknown to her, used to come to her tent in the middle of the night and stare at her. After several incidents, her neighbours offered assistance by guarding her tent. 2. All respondents mentioned that they used to shower inside the tents because they found no safety when using the outdoor public showers.
Weather elements	The rainwater was able to penetrate into the inside of the tents.
Health problems	1. The acts of burning papers and using firewood to set a fire inside the tents were exposing the residents to toxic fumes. These affected the health of the residents and caused many respiratory issues. Children were the most affected. 2. The low hygiene level was the main concern. The communal improper toilets and kitchens exposed the residents to major health problems.
Flammability	Flammability of the tents was a key issue for the respondents. The spread of flame and the close proximity of the tents sometimes resulted in a whole street of tents being destroyed by fire. As one of the participants described the situation: *"The tents used to burn. In our block, we used to extinguish the fire in one and when we go to the next, we find it burning as well"*. They did not know the real causes of fire but some of them suggested the following: • It was intentionally caused. • It happened accidentally while some inhabitants were trying to warm themselves by making a small fire and then lost control over it and burned their tent • The use of electric heaters and gas cylinders • The electric wires in the streets that were exposed to the rainwater

Modifications made to tents

It was hard for the tent inhabitants to make improvements to their tents, but some of them had made some trials. Since the communal toilet and the kitchen were the major problems, the camp's residents tried to find a space inside the tent for those two main functions. One of the participants explained how her family have dealt with the tent. They have closed one of the two openings in the tent's canvas, in order to hang their belongings next to it. They put their kitchen tools in a cardboard box next to the closed opening and added a cover to prevent insects and rats from entering the box. Following that, they decided to stop using the communal toilets, as it was uncomforting and lacked security; therefore, they made a hole in the ground inside the tent to be used as a toilet and covered it. The rest of the participants agreed that they all used to shower inside their tents, specifically during the last period of living in the tents as safety concerns had raised.

Returning the tents

The policies regarding the ownership of the tents have changed throughout the period that the residents occupied the camp. Some of the residents who decided to leave the camp and go back to Syria managed to take their tents in order to re-erect them in Syria. Other former residents have sold their tents to the newcomers before leaving the camp. When the prefabricated shelters arrived at the camp to replace the tents, the residents were asked to hand the tents back before receiving the new shelters.

4.5.2 Pre-fabricated shelters

The participants were asked whether they found the shelters to be satisfactory or not. Initially, the camp residents stated that they were happy about the shelters. However, as the discussions continued and the focus group appeared to be more comfortable to talk about the challenges they face, a number of factors and problems were identified. The main challenges that the residents faced in their camp life following the relocation to pre-fabricated shelters were related to:

- Recognising the pre-fabricated shelters
- Weather protection
- Heating
- Key issues related to the use of pre-fabricated shelters
- Amendments to fit the culture
- Distribution of space
- Maintenance
- Accessibility
- Kitchens
- Toilets
- Water
- Electricity

Recognizing the pre-fabricated shelters

The participants described how they have adapted to the camp conditions with time and memorised the camp's layout, as they have been living in it for four years. However, in the beginning of their stay in the camp, they used to get lost. Nowadays, they can identify landmarks in the camp to recognise areas, such as a specific shop or a mosque. However, the camp became organised afterwards and is divided into districts, blocks, and streets.

Weather protection

As an attempt to seal the shelters, the camp's residents add canvas, wood and anything they can afford or find, over the roofs. Figure 4.6 shows two examples of roof covering. Despite the efforts that were made to cover the roofs, wind storms blow away most of the added roof materials. This would lead to further sourcing of materials. The additional canvas linings that were added over the roof do not prevent the shelters from leaking. Albeit, this varies between the shelters due to the quality variance, as stated previously. Therefore, the occupants did not experience the same degree of challenges.

(a) (b)

Figure 4.6: Shelters inside the Zaatari camp: a) A shelter with canvas covering the roof, b) A shelter with an extension made out of corrugated sheets walls and canvas roof.

Heating

When asked about the situation during the season of winter, some of the participants stated that despite the leakage, the gas heaters that were distributed to them were able to warm the inside of the shelters. Other participants insisted that the use of heaters was insufficient. This discrepancy in opinions may indicate the varying quality of shelters, ability to source additional linings, and the variance of expectations. The main concern is regarding the safety of using the gas heaters inside the shelters without proper ventilation.

Key issues related to the use of pre-fabricated shelter

This section discusses the main problems faced by the users inside their pre-fabricated shelters; the main points are summarized in Table 4.2 and detailed afterwards.

Table 4.2: Main problems related to pre-fabricated shelters

Main challenge	Notes
Rats	They enter the inside of the shelters
Leakage	The walls and roofs are not sealed properly
Flammability	The shelters raise flammability concerns
Privacy	Lack of privacy
Health problems	The shelters caused respiratory problems, flu and pneumonia
Ventilation	The ventilation level is affected by the insensitivity of the design towards the culture
Proximity to adjacent shelters	There is no minimum distance between the shelters. In some cases, the shelters are adjoined

One of the major issues that the camp's residents face is the access of rats to the inside of the shelters. Since the policies in Zaatari allowed its residents to do amendments to the shelters and allowed the entrance of some materials to the camp, the residents adjusted their shelters to minimise the rats' entrance. They removed the wooden floors and replaced them with concrete, as the rats used to chew through the wooden floors (Figure 4.7(a)). Additionally, some of the residents filled the outdoor space between the raised shelters and the ground, either by pouring concrete or by filling it with earth, as Figure 4.7 shows in both (b) and (c). However, in some cases, the rats manage to get through the concrete floors, possibly due to improperly cured concrete.

(a) (b) (c)

Figure 4.7: Zaatari camp floor adjustments: a) A concrete floor replacing the wooden floor, b) A street view showing how the residents filled the underneath of the shelters with earth, c) A shelter's raised floor being filled with earth

The pre-fabricated shelters have leakage issues. The shelters leak air, water and dust, mainly due to the improperly sealed joints. The participants raised the aforementioned quality difference between the shelters when they were talking about the leakage issue, as some shelters leak more than others. Some of the participants explained the suffering of having water leakage as it led to frequent mould smells and damp wooden-floors. One participant said, *"They gave me a caravan (pre-fabricated shelter), but it is better if they didn't..., the water leaks, other than the bad smell. Most of the times, we open the windows to breath due to the bad smell, you know the smell of the (wet) wood and Formica, it hurts us"*. The participants added that the residents who live in shelters that leak from both roof and walls, suffer more than those living in shelters that leak only through the roof.

All the participants agreed on experiencing the shelter leakage problem. While some participants thought that they could solve the issue, others mentioned that the addition of the canvas, wood and other materials over the roofs and behind the walls, does not prevent the leakage, specifically at the joints as shown in Figure 4.8. During the leakage discussion, the participants mentioned the self-built toilets and kitchens that they added next to their shelters. These remain roofless until the owners can afford buying canvas to cover them. Vulnerable families are unable to prioritize such items, despite the tangible improvements that could be added to their living conditions.

(a) (b) (c)

Figure 4.8: Pre-fabricated shelters at Zaatari camp: a), b) Improperly sealed roof-wall junction at one of the shelters, c) Wood and corrugated sheet fixed inside a shelter to seal the wall.

In terms of security, the participants feel secured inside the pre-fabricated shelters, as the doors are lockable. Conversely, the participants do not feel safe outside their shelters, specifically at night. Moreover, the participants have flammability concerns toward the pre-fabricated shelters; they fear causing fires inside the shelters while cooking, or while burning wood during winter. However, the privacy remained as a major concern in the pre-fabricated shelters, though to a lesser extent than living in tents. One of the participants responded to the privacy question by saying: *"there is nothing called privacy* *in the camp"*. This is due to the proximity of shelters to each other (Figure 4.9). Most of the camp's residents had built extensions next to their main shelters, such as courtyard, toilet, kitchen, and/or family living room. These extensions vanished the distance between the shelters and interfered with the residents' privacy. The participants complained about the absence of sound insulation, as it caused many fights within the camp.

Figure 4.9: An example of the proximity of shelters

Health problems in the camp vary and have numerous causes. Respiratory diseases are amongst the most common illnesses in the camp, due to a key factor involving leakage of rainwater over the wooden interior (Figure 4.10). According to the participants, their children used to have continuous flu, notably before getting the heaters. One of the participants shared her experience regarding her children's continuous illness; the doctor warned her that if heating were not provided to her children, they would be in danger of developing Pneumonia. This then led to diet and food issues as the family sold the food-vouchers they have received from the organizations to afford the heating necessities.

(a) (b)

Figure 4.10: The interior of the pre-fabricated shelters: a) wooden floor, b) Wooden walls and floor

With regard to ventilation, when the participants were asked about the window's size, they agreed on its suitability. On the contrary, when they were asked about the situation during the season of summer, they indicated that they suffer from the indoor heat. During the observatory tours that were made throughout the camp, it was noted that the ventilation inside the shelters is affected by the privacy element due to the unconcerned shelter design. The residents tend to cover the sole window of the shelter, whether from the inside or the outside, as keeping the privacy of the homes is a necessity; both culturally and religiously (Figure 4.11(a) and (b)). Other cases have relocated their shelters, and/or the self-built extensions in a way that makes the windows overlook the courtyards they made, so the privacy could be still preserved. Figure 4.11(c) shows a case where the residents have self-built an extension opposite to the window, benefitting from the location to protect the interior of the shelter from being exposed to the public areas.

(a) (b) (c)

Figure 4.11: Windows of the pre-fabricated shelters: a) A window that is fully covered from the outside, b) A window that is half covered from the outside, c) A window that is located opposite to a self-built extension

Concerning the proximity to adjacent shelters, the participants indicated that in some 'blocks', the shelters are directly adjacent to each other (Figure 4.12), while in other 'blocks' there is a short space between the shelters; from one to three metres. One participant said, *"In my case, the caravan next to me is overlapping with my toilet by a metre and a half, can you understand? If there were any argument between them, sometimes we go out of our place,….my husband sometimes starts knocking on the wall so they would understand that we can hear them and that they have to stop"*.

Figure 4.12: An example of the adjacent shelters

Amendments to fit the culture

The focus group participants agreed on considering the design of the shelters as inappropriate to their cultural and religious background. Responding to the cultural inappropriateness, the camp's residents made some amendments to their shelters in order to cope and adapt to the life in the camp. The major amendment was in response to the communal kitchens and toilets that were provided in the camp. The residents needed their own facilities, from both cultural and privacy/security perspectives. Therefore, they self-built private facilities next to their original shelters, by enclosing spaces using corrugated sheets for the walls and canvas for the roof—whenever they can afford buying the materials.

Some of the large families (>six members) who received two shelters, have extended their space by enclosing an area in between the two shelters with corrugated sheets. The importance of this additional area comes from using it as a reception for guests and as a room for family gatherings. The shelters miss the social spaces; and this is a big challenge according to the residents. Figure 4.13(a) shows an example of a self-built family sitting room that was enclosed between two pre-fabricated shelters, while Figure 4.13(b) illustrates a street view to another example of shelter's extensions.

(a) (b)

Figure 4.13: Shelters' extensions: a) A family sitting room that was formed by enclosing the space between two shelters, b) A street view over a shelter's self-built extensions

As aforementioned in Chapter 2, the courtyard is an important feature in the building typology of Syria; therefore, the residents enclosed adjacent spaces to their shelters to be used as private outdoor courtyards. According to the participants, the private outdoor areas gave them the opportunity to move freely and comfortably in and out of their shelters without being exposed to the public. One participant shared her view on the advantages of the self-built courtyard, by saying *"… when you go out, no one sees you whether you are wearing a head cover or not"*. The courtyard offers an enhanced privacy and at the same time strengthen the family relations (CORPUS Levant, 2004).

Figure 4.14(a) (Dathan and Wilkes, 2016) shows a top view of the camp where the self-built courtyards can be easily spotted and compared to the traditional Syrian urban house that is illustrated in Figure 4.14(b). The courtyard shown in Figure 4.14(c) has a self-built water fountain that makes the courtyard similar to the courtyards of the traditional Syrian houses shown in Figure 4.14(d) (ARCHNET, 2019). This comparison of the layout of the shelters, along with the aforementioned preference of refugees in living next to their relatives and neighbours in the camp, clarifies how refugees try to recall the environment of their previous houses.

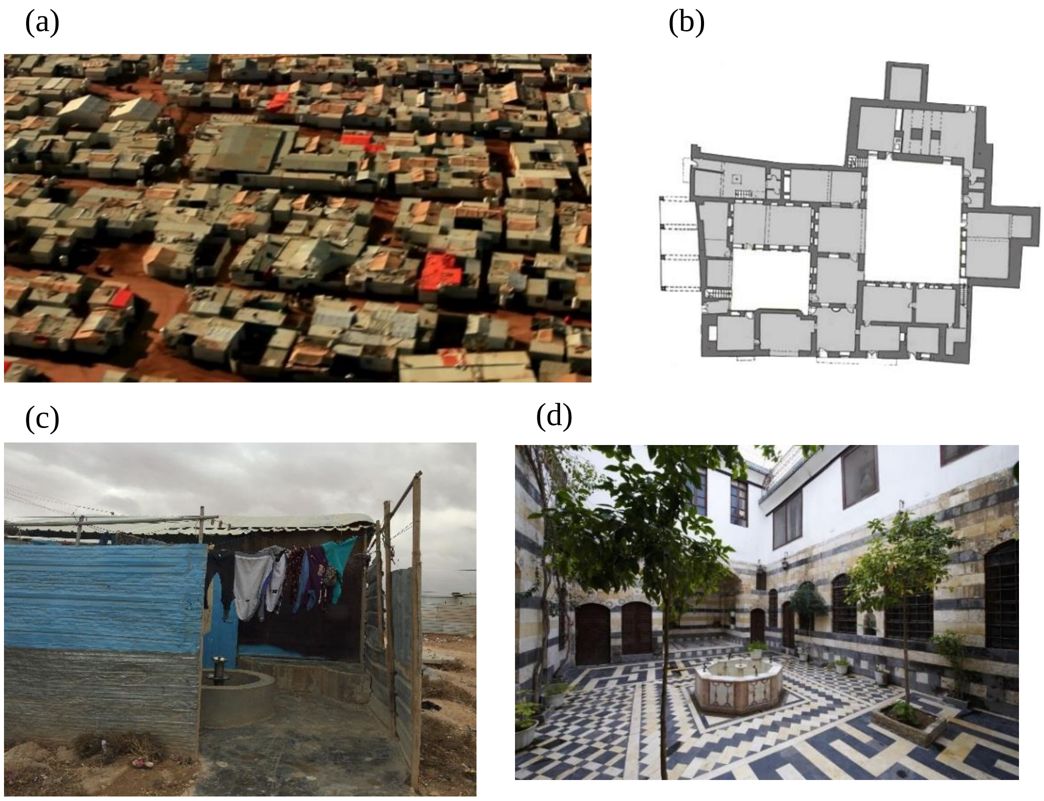


Figure 4.14: A comparison between the traditional Syrian house and the self-built courtyards at Zaatrai camp: a) Top view of Zaatari camp (Dathan and Wilkes, 2016), b) A traditional Syrian urban house (CORPUS levant,2004), c) A self-built water fountain in Zaatari camp, d) Traditional Syrian courtyard-Sibai House- photo by Matjaz Kacicnik (ARCHNET, 2019)

The original floor material of the pre-fabricated shelters is wood as shown in Figure 4.10. However, for many reasons including the problem of rats chewing through the wooden floors, and the unfamiliarity of the wooden floors have led the residents to replace the existing floors with concrete. The residents also poured concrete floors for the courtyards and extensions they have built. The main advantage of using concrete floors is their ability to be washed, as this is the typical way of cleaning floors according to the residents.

Many innovations came out of the camp, including handmade handcarts (Figure 4.15(a)) and donkey carts (Figure 4.15(b)), which are made out of recycled materials. They are used to move and/or sell goods. Additionally, the residents started breeding birds in their shelters as shown in Figure 4.15(c). The main shopping street was opened by the residents and is called "Shams-Elysées" inspired by the name of the famous avenue in Paris "Champs-Elysées", as Sham means Syria in Arabic (Figure 4.15(d)).

Figure 4.15: Shelters innovations: a) Handcart, b) The Shams-Élysées street, where residents move by walking, bicycles, and handcarts, c) Birds cage, d) Shams-Élysées shopping street

Distribution of space

The pre-fabricated shelter consists of one room. The large families, who have received two shelters, were able to allocate a shelter for a private kitchen and toilet/shower. Figure 4.16 shows an example of a shelter that is specified as a kitchen and toilet/shower. Figure 4.16(c) raises a hygiene concern as a result of the proximity of food and cooking to the toilet. The families who received one shelter, have self-built private facilities next to their original shelters, as will be discussed later.

(a) (b) (c)

Figure 4.16: Private facilities allocated in a pre-fabricated shelter: a) A toilet/shower inside a shelter, b) A private kitchen in a shelter, c) A short partition dividing the kitchen from the toilet inside a shelter

Maintenance

When the focus group participants were asked about the maintenance strategy, they complained about the absent services. One of the participants has received a shelter with a door that cannot be locked, and despite her official complaints, she found no response. The participants agreed that this year and for once, they had received twenty Jordanian Dinars (JDs), which approximately equals twenty-eight dollars, for maintenance purposes, including buying a canvas to seal the roof. Some of the participants have directly received canvas in previous years as part of winterisation projects, but not all of them agreed on receiving the canvas aid. The reason behind their different experiences may refer to their various arrival time to the camp. Additionally, the participants were asked if the given twenty JDs were enough to fulfil their maintenance needs. Approximately 93% of the participants thought that they were insufficient.

Accessibility

Concerning accessibility, the participants thought that the low-levelled floor of the shelter makes it accessible. They added that residents with disabilities are provided with a steel ramp to be attach to the doors of their shelters. A twofold problem could be extracted from their response; first, the shelters are not accessible without the ramps, and second, people with reduced mobility such as elderly are not provided with ramps.

Kitchens

When the camp was first established, communal kitchens were provided to its residents. Every street of the camp (approximately a hundred families according to the participants) were sharing two to three kitchens. The residents faced many problems in using the communal kitchens including its opening times. The kitchens used to be opened from nine o'clock in the morning until three o'clock in the evening, which made cooking impossible for the female workers. According to the participants, each kitchen had four stoves that were shared by approximately forty families. The participants also mentioned that the gas cylinders used to run out every two days, which used to lead to kitchen closure until the cylinders are replaced. Moreover, the communal kitchens initiated many social problems such as fights among the users. The long walk to reach the closest kitchen to the residents was another burden.

Following the complaints and problems that accompanied the communal kitchens, the aid organisations distributed material kits to self-build private kitchens. The kits included corrugated sheets, wood, and screws. Nevertheless, many residents sold their kits to fulfil other urgent necessities. As aforementioned, some of the families who have received two shelters were able to specify one of their shelters to allocate their private kitchen and toilet/shower. The other families built their private kitchens whenever they were able to afford the needed materials. They enclosed a space next to their shelters with corrugated sheets, and covered it with canvas as shown in Figure 4.17(a) and (b), or with corrugated sheets as shown in Figure 4.17(c). The canvas is not a durable material, which creates a continuous need of sourcing new canvas pieces whenever the old ones are ruined.

Figure 4.17: Examples of self-built kitchens

The shelves of the kitchens were made out of the wood that have been removed from the original floors. This can be verified by comparing the wood that is used for the shelf in Figure 4.17(d) and the previously discussed wooden floor in Figure 4.10. Other furniture pieces were also made out of the removed wooden floors.

Toilets/showers

In terms of toilets/showers in the camp, there were two phases, the first one was when the residents were using the planned communal toilets/showers, and phase two is the current situation with the self-built ad hoc private facilities.

<u>Communal toilets/showers</u>

When the camp was initiated, the residents of the camp were provided with communal toilets. According to some of the participants, about hundred shelters in each street were sharing two bathrooms dedicated to each gender, and each bathroom had twelve toilets. Another participant had a different experience as the residents of the street she lives in used to share two females' bathrooms, and two males' bathrooms, where each bathroom had four toilets and four showers. In terms of distance, some of the residents who live in a certain district had to walk around four streets to arrive at the nearest bathroom.

There were major problems with the communal toilets that forced the residents to search for alternative solution and ultimately self-build their own toilets. The key problems included safety, long queues, embarrassment, and hygiene. These are discussed individually below:

- Safety was an issue in using the communal toilets, especially if they needed to use them at night, when there is no electricity.
- In the communal toilets, people were standing in long queues to wait their turn to use the toilet. That was hard and inhuman especially for kids and pregnant women. A participant shared her experience by saying: *"I was pregnant, and you know how pregnant women go more frequently to the bathroom. When there were a lot of people in the queue, most of the times (I couldn't wait)"*, she continued: *"At night, if I wanted to go to the bathroom at 2am: where there is no electricity and I am holding the water bottle, it was almost like going to a horror movie"*.
- The participants mentioned how uncomfortable and embarrassing it was to use the communal toilets as they must carry the water bottle with them

and walk in front of everyone in the street. They felt embarrassed that everyone know that they were going to use the toilet, a participant said, *"I swear, I was stopping myself from going"*. Another participant commented: *"We have feelings!"*, referring to the embarrassment they felt.

- Since the toilets/showers were not safe enough and had long queues, the participants said that they were showering less than usual—which caused many hygienic problems.

<u>Private or self-built toilets/showers</u>

The residents introduced an alternative to the communal formal toilets after living in the camp for a certain time. As aforementioned in the kitchen section, the families who have two shelters, had the option to allocate a private kitchen and a toilet in one of them, while the rest of the families have self-built their private toilets by enclosing a space next to the original shelter with corrugated sheets. The self-built toilet was kept roofless until the family members could afford a piece of canvas as shown in Figure 4.18(a) and (b). The main problem in the private toilets and kitchens is the lack of a proper sewerage system. The residents dig ditches in the ground or use pipes to discharge the wastewater (black and grey) to outside pits (Figure 4.18(c)). The ditches from different households create network of surface runoff, following the direction of the slope as illustrated in Figure 4.18(d) and (e). This situation leaves the Zaatari residents exposed to contamination.

Figure 4.18: Facilities: a) Outdoor facility with a nearby pit, b) Canvas roof over a toilet, c) Wastewater ditch and pit, d) Network of surface runoff wastewater, e) Surface runoff wastewater, f) Concrete tank to be installed

The main discharge methods of wastewater according to an assessment made by REACH (2014b) are clarified below:

- Storage at household level (pit, barrel, tank)- 8%
- Surface run off (ditch or throwing on the ground)- 29%
- Connection to drainage network or tank of WASH block- 36%

During the visit, some concrete tanks were noted around the camp that were yet to be installed for wastewater disposal, as part of a planned project to establish a sewage system in the camp. (Figure 4.18(f)). According to UNHCR (2015c), part of the wastewater is being treated through a plant, which is collected and transported by sewerage trucks.

Water

At the time of the visit, the water used to be delivered by a truck, which fills the water storage tanks that are located in front of the shelters. The tanks were being filled every three days (Figure 4.19). The participants had different experiences in terms of the tanks' ownership. Some of the residents had communal tanks, while the others had private tanks. Nevertheless, the participants agreed that their daily share of water equals thirty-five litres per person. The participants argued that this amount of water is not enough for their needs and sometimes they tend to buy extra amount of water from private water companies—if they could afford that.

Figure 4.19: A street view that shows the water tanks

Electricity

When the camp was initially opened, there was no electricity. However, at the time of the visit, the electricity had been supplied for thirteen hours per day, from three o'clock in the morning until four o'clock in the evening. According to the participants, the hours of supplied electricity are sometimes interrupted; some of the participants think that the discontinuity of supply aims at preventing the residents from using the electric heaters, as its usage was prohibited by the agencies.

The introduction of electricity in the camp made the daily life of the residents much easier. According to the participants, the advantages of electricity such as having a source of light at night, and the opportunity of using electric devices, have turned the shelters into habitable places. Figure 4.20 shows some of the captured electric devices inside the visited shelters.

(a) (b) (c)

Figure 4.20: Electricity at Zaatari camp: a) Light bulb that is connected to electricity by the residents, b) Electric fan, c) Television

4.6 General conditions and issues

Throughout the focus group discussions, there were some general topics that were discussed by the participants with regard to their personal experience, they could be summarised as follow:

- The arrival experiences
- The unemployment challenges
- The large distance from services and ways of transportation
- Individual incidents
- The continuous enhancements

One of the participants remembered the fear they had felt before arriving at the camp. She clarified that once they arrived at the tent, she and her family had slept for a long time because of the many sleepless nights they had spent before arriving at the camp. The unstable situation in Syria and the continuous airstrikes caused enormous fear and made the Syrians question their survival possibilities. Therefore, the peace and safety they found in the camp when they arrived was appreciated.

In terms of work opportunities, finding a job inside or outside the camp is not an easy task for the residents. If the male residents wanted to work inside the camp, they would be given the job of collecting the bins. Each resident worker has a turn of collection every six weeks and would be paid thirty JDs (equals forty-two dollars) each rotation. However, the thirty JDs are a very small amount of money considering the needs and the amendments they wished to make to their shelters. However, some of the camp's residents managed finding a job outside the camp, mostly with low salaries as the refugees' right of work was not obtained at that time, and therefore were prone to exploitation.

The aid agencies distribute various vouchers to the camps' residents. They get monthly vouchers for the food and occasionally some other vouchers. The challenge is when the residents sell their food vouchers in order to fulfil other urgent needs, such as making the private toilet, sourcing the roof materials or buying heaters. This led some residents to starve. Additionally, the unemployment affects the residents' social life. The participants shared their stories with regard to fights and stress that happens between the family members as they spend a lot of time together in one room. One participant said, *"When the man stays at home, he keeps arguing with his wife"*.

The walking distance to the major services inside the camp differs depending on the location of the shelters. Among the participants, the maximum time anyone has to walk is an hour, which is the distance to the NRC distribution office each way. Other residents walk the same distance to reach the shopping mall, where they can use their vouchers to buy their needs. Moreover, some of the participants walk half an hour from their shelters to arrive at the kindergartens area. Free buses were introduced to the camp at the beginning of 2015. However, they do not reach the areas of where the NRC or the hospital are located. Two buses serve the camp and operate in the route between the main gate of the camp, the youth centres and the shopping mall. The participants complained that the buses are always full of young men who want to go to the youth centres, leaving no space for the women and children coming from the shops holding bags of home essentials. The women prefer not to get into a crowded bus as standing in buses may expose them to bumping into other people or to harassment. Alternatively, the women hire a car on their way back to their shelters (similar to shared taxis) by giving the driver some of the goods from their shopping bags. Since the buses depart from the main gate, the residents who live in far areas suffer the most. A participant, who lives in block number eleven, walks around an hour to arrive to the main gate where the buses stop, and most of the times, she fails in securing a place in the first arrived bus. She argues that the main gate is not much closer to her shelter than the shopping mall itself.

The participants shared some stories that happened with them or with other residents they know. One of the participants lost her ten-month-old daughter when a small amount of hot water spilled over her; she was severely burned and passed away after two days. It could be argued that the one-room design and the primitive ways of heating the water could be behind this incident. Another participant talked about the many tragic cases in the camp that she knows. She said that whenever she visits them, she goes back to her shelter appreciating more the good health of her kids and the living conditions she has. She added that her family was able to sell some of their food vouchers to fulfil urgent needs, but other families could not secure their needs as they constantly have insufficient amount of food.

One of the stories was about a twenty-one years old man who fell on his back from a third-floor building while working outside the camp. The young man, who was the breadwinner of his nine-member family, got a movement disability and needed a bed to lay onto as he could not lay on the ground. The family could not afford buying a bed; therefore, his old father created a bed by filling water bottles with crushed stones, covering them with wood plates, and then putting over a mattress. The father's invention worked as a bed, but since the shelter has a wooden floor, the movement of people inside the shelter shake the bottles, which hurts the back of the young man and starts shouting out of pain. Based on this story, it could be noted that the provision of proper sets of bedding and proper construction materials would lessen the suffering of the patient.

Another shared story was about an accident where the water truck fell over a child while he was playing in the street. Sadly, his leg was crushed. One of the aid organizations sent him to a hospital outside the camp for an urgent surgery. The learnt lesson of this story is the riskiness behind the absence of safe children playgrounds, whether inside the shelters such as courtyards, or separate communal areas.

The participants agreed on the continuous enhancements of the camp, specifically the infrastructure. In addition, the participants showed their appreciation towards the newly opened streets, the rearrangement plan of the shelters that aims at leaving firebreaks between the shelters, and the formal sewerage system plan that they have started implementing. The participants expressed their gratitude towards Jordan for hosting them.

4.7 Future considerations

As part of the focus group discussions, the participants were asked questions related to some possible future scenarios. They were asked about their suggestions to generally enhance the experience of living in both the tents and the prefabricated shelters. Additionally, they were given two hypothetical scenarios with related questions.

Suggested enhancement for the tents

According to the participants, the main challenge that the camp residents faced whilst living in the tents was the roof and the water leakage. Therefore, when they were asked about their suggestions to enhance the tents, they said that if they were given corrugated sheets for the roof while living in the tents, it would make a big difference.

Suggested enhancements for the pre-fabricated shelters

With regard to their current life in the pre-fabricated shelters, the main concern was the long distance to the services (i.e. shopping mall). The camp has a new policy that prevents the residents from relocating their shelters. However, the services are not equally distributed between the zones (districts). One of the participants stated that the district she lives in does not have a kindergarten or a school. Therefore, the distribution of services could enhance the quality of the life inside the camp. Moreover, the participants complained about the close proximity of the shelters. Enforcing a minimum distance between the shelters would increase the privacy and the safety in cases of fire.

Hypothetical scenarios

Participants were asked about their opinion on the following two hypothetical scenarios.

<u>Ability to assemble from a box</u>

The participants were asked *"If you were given the shelter in a box (pre-fabricated pieces) with instructions on how to assemble it, would you or a family member be able to do so?"*. They all agreed on their ability to self-build. Some participants mentioned that when the camp was initially opened, the agencies distributed material kits to build small kitchens (prior to having the communal kitchens), and they have succeeded in building them.

<u>A return package- deconstruction route</u>

The second scenario was "*If hopefully peace is back to Syria, and if your shelters had the ability to be deconstructed and reconstructed again, do you feel that this feature would ease your return to your country?"*. They all agreed that it would facilitate the return as most of their homes in Syria have been demolished, and if returned, they would need a shelter until they can rebuild their houses.

4.8 Summary of findings

Zaatari camp was established in July 2012, and since then has expanded quickly to enclose the current area of 5.3 km^2. The number of residents in Zaatari camp reached as high as 200,000 residents, but the number decreased gradually to reach 79,000 residents by January 2019. Tents were distributed to the camp's newcomers and with time, they were replaced with prefabricated shelters. The harsh winters accelerated the process of replacing the tents. The prefabricated shelters have various dimensions due to their various donors. However, none of them fulfils the recommended 3.5 m^2 per person of the Sphere handbook. They are made of 40 mm sandwich panels, where the outer skin is made of steel, the insulation is polyurethane, and the inner skin is either steel or timber. The floors are made of wood.

The field visit to the camp that included focus group discussions and observatory tours, revealed the main concerns and challenges that were faced by the residents when they used to live in tents. Proper floors and enhanced roofs could make big difference to the life in tents. Moreover, the privacy, security, and using protective and fire-retardant tent materials could be areas of further research.

The pre-fabricated shelter on the other hand, had some major issues that were highlighted by the residents and could be solved with a better design. Firstly, a protective and accessible floor that is made out of familiar materials is missed and needed. Additionally, a properly sealed shelter that is made out of fire-retardant materials could enhance the quality of life inside the shelters. In terms of the shelter layout design, small changes would provide a more dignified shelter, such as having private facilities, outdoor private area, larger indoor area, internal dividers, and proper openings. These changes along with well-planned infrastructure and services of the camp would limit the possibilities of turning the camp into a slum city. The unplanned extensions that are made by the residents are worrying, as the urban scale of the camp is not considered. However, the extensions are a result of the insufficient space of the shelter, therefore, revising the strategy of distributing the shelters while considering the cultural restrictions is proposed. An additional major finding is the priority of having private facilities over bigger sleeping areas. This was clarified through the decision that was made by the large families (who were given two shelters), to specify one of the shelters for private facilities, while living and sleeping in the other. The main shelter design guidelines that are extracted from the field visit to Zaatari camp are listed in Table 4.3.

Table 4.3: Suggested transitional shelter design guidelines- extracted from the Zaatari camp field visit

Themes		**Guidelines**
Pre-design		• No permanent materials or construction details allowed • Shelters shall be recognizable from each other- not identical
Materials		• Use non-flammable materials
Shelter solutions		• Can be built by users i.e. Not dependent on specialist equipment • Construction system which protects from the environment and is well-sealed • Adequate provision for surface drainage and guttering • Adequate sewage system
Design elements	**Openings**	• A suitable private screened and shaded outdoor area • Adequate natural lighting and ventilation • Windows protect the residents' privacy • Lockable doors and windows
	Interior	• An increased indoor space that respects the gender separation • Possibility of adding internal divisions • Provision of different genders/ age groups spaces • Main space needs: outdoor courtyard/ reception for socialising/ family sitting room/ 2-3 bedrooms/ private kitchen/ private toilet and shower • Ground floor raised, insulated underneath and washable
Safety	**Accessibility**	• Have safe access to all users, specifically users with reduced mobility
	Fire-separation	• Avoid close proximity between shelters
Future of the design		• Maintainable by users/ easily adaptable using locally available tools and materials • Possibility of future expansion or adding a second floor • Can be deconstructed for possible relocation

The hypothetical scenarios that were presented to the participants concerning the self-build and deconstruction of shelters, have delivered positive response by the camp residents. This provides an opportunity for further investigation towards the alternative possibilities of designing, distributing, and transporting the shelters.

One of the key lessons to draw from the field visit is the need to improve the shelter form, construction type, layout, function and critically concerning the cultural aspects. Additionally, the services, health and hygiene elements are worrying in relation to the consequential effects of internal heaters, cookers and self-built toilets. Chapter 5 would present the findings of a similar field visit that had been held to Azraq camp in Jordan.

Chapter 5

Azraq camp- A field visit

To understand the current sheltering approach in Jordan and the issues about supporting very large groups of refugees, a field visit was conducted to the Azraq Syrian camp. This chapter reviews the background of the camp and discusses the findings of the focus group discussions and observatory tours that were undertaken during the visit.

5.1 General information

Azraq camp is the second largest Syrian Refugee camp in Jordan in terms of number of residents. It is located 80 kilometres southeast of Zaatari camp and 90 kilometres away from the Syrian borders. In contrary to Zaatari camp, which was originally named after the 'Zaatari' nearby Jordanian village, Azraq camp is located in an isolated area. The camp was purpose-built and designed to take account of lessons that are learnt from Zaatari camp. It was opened in April 2014 due to the increasing number of refugees in Jordan. Azraq camp has a village-based approach, which was cited as a way to provide a sense of ownership and community. It was designed to have six villages, albeit, when the camp was initially opened, only villages three and six were used (UNHCR, 2019c), while villages five and two were opened in later stages (Figure 5.1).

Azraq camp was planned to have 13,500 T-shelter units (IFRC, UN-Habitat and UNHCR, 2014). However, until January 2019, the number of used shelters were less than 9,000 (UNHCR, 2019c). The camp has the potential capacity of accommodating 120,000 to 130,000 refugees in its total area of 14.7 km^2 (UNHCR, 2019c). According to the UNHCR statistics, the camp reached its peak during July 2014 with approximately 55,000 residents, despite its maximum current capacity of hosting only 50,000. Nevertheless, since June 2018, the number of residents stabilised at about 40,000 residents (UNHCR, 2019e). This number still equals twice the recommended maximum number of residents in any camp settlement (i.e. 20,000) (UNHCR, 2019b).

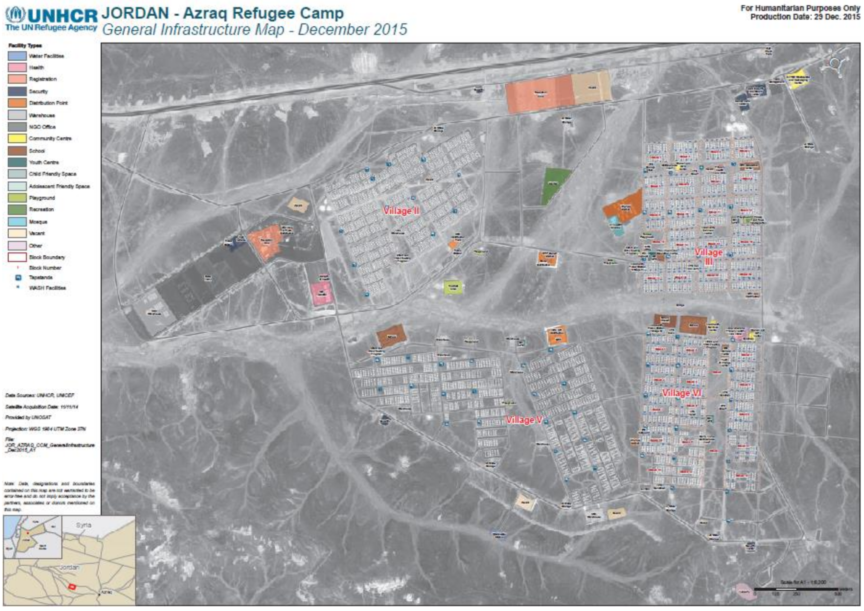


Figure 5.1: Azraq camp general infrastructure map (UNHCR, 2015)

Similar to Zaatari camp, Azraq camp has a grid system, where rows of white shelters make up the streets. However, in contrast to Zaatari camp, the 'base camp' that contains the NGO offices in Azraq camp are distant from the shelters; it is ten-minutes away by driving to the nearest village. Gatter (2018) argues that the emptiness of Azraq, the unoccupied shelters that separate the villages and the abundance of space are intentional and intended to limit the movement of the refugees, which makes demonstrations and undesired gatherings harder to occur. Figure 5.2(a) shows a general view of the shelters at Azraq camp (Dunmore and Chen, 2015).

The design of the shelters was claimed to be a reaction to the issues that were found in the prefabricated shelters of Zaatari camp. The Shelters are called T-shelters, which is a term used to describe both of temporary and transitional shelters, and usually the term is used to offer an enhanced political acceptance due to its flexibility (IFRC, 2013). The T-shelter of Azraq camp has an interlocking steel structure, covered by 10 mm-15 mm of Aluminium foam insulation, and has external and internal Inverted Box Rib (IBR) metal cladding and flashing. The interior of the shelter includes an additional roofing layer of plastic sheeting. In terms of floor, concrete was poured over a metal rebar, which made the structure permanent, despite the original relocatable design. In fact, the ability of the shelter to be dismantled and re-used was cited as a strength in the Shelter Projects 2013-2014 book (IFRC, UN-Habitat and UNHCR, 2014), which is not true in the actual implemented design. Additionally, adjustable footings were used to level the structure. Figure 5.2(b) shows a diagram of the T-shelter components (UNHCR, 2015b). Moreover, the originally designed porch, was cancelled during the implementation stage due to cost and time constraints (IFRC, UN-Habitat and UNHCR, 2014).

(a) (b)

Figure 5.2: Azraq camp: a) A general view of the camp- photo by Herwig, b) Main diagram of the T-shelter design with the possibility of adding a porch (UNHCR, 2015)

When the T-shelter was first implemented, the highlighted drawbacks included the inability of the IBR to be sealed-off and the high amount of heat gain (IFRC, UN-Habitat and UNHCR, 2014). REACH (2015) found that approximately 90% of the residents are unsatisfied of the indoor temperature of their shelters during the summer season, while 45% are unsatisfied during the winter season. Additionally, Albadra, Coley and Hart (2018) who had approximate results in their survey with regard to the thermal comfort, argue that the better satisfaction level in winter, despite the freezing shelters at night, goes back to the thermal adaptation opportunities such as gas heaters and layers of cloths and blankets. The spot measurement that was done by Albadra, Coley and Hart (2018) in summer recorded a surface roof temperature that was as high as 46^{o}C. In the same study, and similar to Zaatari camp, the indoor CO_2 levels were found to be significantly high during the winter season.

For safety and security concerns, Jordan has closed its western borders with Syria during mid-2013 and its eastern borders during mid-2014. However, thousands of Syrians fled the war and gathered in the no man’s land between Jordan and Syria; called the ‘berm’ (Staton, 2016). Two settlements were initiated in the berm; Rukban and Hadalat. The conditions in the berm are described as ‘horrible’; people are unable to move due to the lack of safety and money, and their status is not clear, as they are not IDPs nor refugees. Moreover, gangs are controlling the settlements, and infections are spread. During March 2016, the pressure from the international aid agencies on the Jordanian government resulted in making a deal of hosting some of the Syrians from the berm in village five of Azraq camp. This deal had a condition of fencing-in the village, which resulted in a ‘camp-within-a-camp’ situation. The residents of village five are under continuous observation, and they are not allowed to leave the village. They have their own ‘small’ shop, food distribution centres, and ‘tented’ schools. After some time, the residents who prove to pose no danger, could be relocated to other villages inside the camp (Gulf News, 2016; Staton, 2016). Nevertheless, village five filled-up quicker than anticipated, which led to the opening of village two. In the beginning, village two hosted large number of Syrians who came from the berm in large communal shelters, following the same ‘camp-within-a-camp’ approach. However, with time, it transformed into a ‘normal’ village, leaving village five as the only fenced-in village inside the camp

The absence of electricity was cited as the primary need to the Azraq camp residents, according to REACH (2015) assessment. However, in May 2017, a solar plant that was funded by IKEA along with a power network that was funded by the Saudi Fund for Development, were able to connect the shelters in villages three and six to electricity (Figure 5.3). The other two villages, two and five, were provided with electricity towards the end of November 2018. Hence, Azraq camp became the first refugee camp in the world that is fully operated by renewable energy (UNHCR, 2017).

Figure 5.3: The solar plant at Azraq camp- photo by IKEA Foundation/ Vingaland AB (UNHCR, 2017)

Regarding the type of aid, six months after the opening of Azraq camp, the aid transformed from food distribution into cash assistance. This transformation allowed the residents to shop from the two operating shops (Stablein, 2018). However, the continuous demand from the residents to open their own shops inside the camp, has led to the opening of 250 shops in the market areas inside the camp. These shops are 50% owned by the residents and the other 50% are owned by the local community (UNHCR, 2019c).

5.2 Field visit information

Azraq camp was visited in January 2016 with the assistance of ‘Save the Children International’ staff. The purpose of the visit was to understand the challenges that are faced by the residents. Additionally, the visit showed the difference between a camp with rapid deployment of tents such as Zaatari camp, and a purpose-built and pre-planned camp such as Azraq. The visit included focus group discussions and observatory tours with some of the camp’s residents. The photos that were taken during the tours in the camp supported the focus group outcome and provided a visual evidence of the findings.

Therefore, the photos that are presented in this chapter were taken by the researcher, unless denoted differently. The information presented in the followed sections describes the situation at the time of the visit and do not include the latest changes. The gathered information was grouped into four categories: participants information, shelters information, general conditions, and future considerations (Figure 5.4).

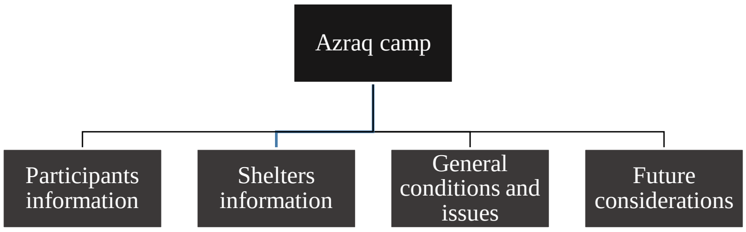


Figure 5.4: Azraq camp- Categories of the collected information

5.3 Data collection method

The need to understand the challenges that are faced by the residents at the Middle Eastern camps were highlighted in the literature review (Chapter 2). The time element and the huge influx of refugees that arrived in Jordan at the beginning of the war in Syria, has played a big role in setting Zaatari camp. However, there was a need to conduct a field visit to the purpose-built Azraq camp, as it presents a different scenario where lessons from Zaatari camp were claimed to be learnt.

As aforementioned in Chapter 4, the sensitivity in researching camps and dealing with their residents, usually force limitations on conducting field-based research. In fact, the situation in Azraq camp, specifically at the time of the visit was of a concern. The strict policies that were forced by both the Jordanian government and UNHCR, absence of electricity, remote location and lack of working opportunities are some of the reasons behind the tensions that were felt during the visit.

The focus group method was again chosen in Azraq camp for the same reasons that were mentioned in Chapter 4, including the flexibility and convenience it offers to the participants. The researcher had access to the Azraq camp through Save the Children International organisation who applied for the researcher's governmental approval to access the camp. Convenience sampling was used for the focus group as the participants were invited by the organisation; randomly from their records. The participants were females, as men at Azraq camp do not usually attend the gatherings of the organisations. The precautions of not signing consents for the focus group, not identifying the participants, and not taking photos of them, were most beneficial at Azraq camp. The participants were clearly stressed from living in the camp with its strict policies. Their unhappiness was clearly expressed by their responses. Notably, due to the precautions, the participants felt safe in sharing their stories and opinions towards the camp.

At the beginning of the session, the researcher introduced herself and the purpose of the focus group. The participants were aware that they could leave at any time. The participants were asked pre-structured and open-ended questions that provided the desired flexibility in the session. The questions were the same as those asked to the residents at Zaatari camp, with the exception of the questions that are related to tents. The questionnaire which is attached in Appendix B, is divided into three groups: general information (engagement questions), shelter's evaluation (exploration questions), and hypotheses (future scenarios). The first group of questions covered some general information with regard to the camp. They aimed at engaging the participants with the topic. The second group with exploratory questions aimed at having an in-depth understanding of the camp situation and the challenges that are faced by its residents. The third group were future scenarios that covered some hypothesis and aimed at knowing the participants' expected responses in certain situations.

Nine participants were in the focus group session, which had a duration of 42 minutes. The discussions were recorded, and notes were written. The researcher recorded the discussions, transcribed the transcription into Arabic (the language of the participants), and then translated it into English. The translated transcription was inserted into the NVivo software for coding and analysing. The resulted themes and subthemes are listed and explained in this chapter.

5.4 Participants information

Towards the beginning of the focus group session, some general information was gathered from the participants, they included:

- The amount of time they had spent in the camp
- The dimensions of the provided shelters
- The location of the shelter
- The number of people who share the same shelter
- Their literacy skills

The focus group discussions were held at the offices of Save the Children inside the Azraq camp, where the nine female participants were gathered.

- One-third of the respondents had been living in the camp for more than eighteen months—noting that at the time of the focus group, the camp had been opened for only twenty months.
- Two-third of the respondents had been living in the camp for more than twelve months and less than eighteen months.

Since Azraq camp was purpose-built, the T-shelters were constructed prior to the residents' arrival. One of the focus group participants experienced living in both Zaatari and Azraq camp. She stayed in Zaatari for a month but could not cope with the quality of life; therefore, she decided to go back to Syria. However, when the situation became worse in Syria, she decided to seek asylum again in Jordan, but this time she was given a shelter at Azraq camp.

The dimensions of the distributed T-shelter are 4 m x 6 m, which provides an area of 24 m^2. Each shelter serves a family of six members or less, while families of more than six members receive two shelters. The participants mentioned that during the first months of the camp's opening, the families of six members used to receive two shelters as well, but afterwards they changed the policy to include only families of more than six members. Nevertheless, it was argued that receiving two shelters is not of a big benefit as the mattresses and tools are given for only one of the them.

The responsible agency for allocating shelters to the families is UNHCR. When the Syrians arrive at the camp, the UNHCR gives them one of the shelters that are documented as vacant in their computerized system. The families have to occupy the given shelters first before applying for relocation if desired. The T-shelters are fixed in the ground; therefore, the families cannot move the shelters, but they can ask for relocation into another vacant shelter. According to the participants at the time of the discussion, it was hard to find a vacant shelter as villages three and six were the only opened villages in the camp. Additionally, there are families who reside in the camp and receive shelters, but afterwards, they illegally escape the camp. Their shelters remain registered in the UNHCR records as occupied until a significant amount of time passes without them returning into the camp. One of the participants arrived at the camp accompanying her family and other seven families of relatives. They asked the UNHCR office to locate them next to each other, but their shelters were scattered around the camp. It took them a significant amount of time until they were able to relocate and gather in one street. Another participant said that her family is not interested in relocation, as the shelters around the camp are of the same quality.

On another note, the participants were asked about their literacy skills, and they all confirmed their ability to read and write. The high percentage of literate and skilled people among the camp's residents, if properly dealt with, could contribute in building the camp and at the same time benefit the host community. It also provides the agencies with a wider range and shapes of possible aid to implement.

5.5 Shelters information

According to the focus group participants, the main challenges that are faced by the residents while living in the T-shelters are:

- Recognising the shelters
- Amendments to fit the culture
- Weather protection
- Warming and cooling the shelter
- Problems with the T-shelters
- Distribution of space
- Maintenance
- Accessibility
- Kitchen
- The porch
- Toilets
- Water
- Electricity

Recognizing the shelters

Azraq camp is organized in terms of planning. The zones are divided into villages, blocks, streets, and numbered shelters. As aforementioned, only villages three and six were open at the time of the visit—while villages two and five opened in later stages. Figure 5.5(a) shows the plan of village three, which contains 20 blocks. Approximately, each block includes 96-192 shelters. The plan of village six that is shown in Figure 5.5(b), contains 15 blocks, where most of them include 168-180 shelters, except block number 15 that has the least number of shelters; 48. According to the siteplan, each three shelters share the use of one communal bathroom unit that consists of a toilet and a shower. The address details are usually written over the walls of the communal unit as seen in Figure 5.5(c).

(a) (b) (c)

Figure 5.5: Azraq camp: a) A site plan of village three, b) A site plan of village six, c) A toilet unit with a block and street numbers written over its wall

Amendments to fit the culture

Although the policies in the Azraq camp prevent amending the shelters, but the residents managed to do some necessary changes. The lack of privacy is one of the major concerns in the camp. Therefore, the residents reacted by removing the plastic sheeting from the inside of the T-shelter and using it as an external partition between each two shelters such as Figure 5.6(a), or fencing an area in front of their shelters such as Figure 5.6(b), for the purpose of enclosing a private outdoor space.

A participant explained the necessity of the outdoor private area by saying: "*…in those opened caravans, people can see you clearly from the outside, even when you are inside the shelter*. She added, *"My husband enclosed two metres next to the caravan. He brought steel bars, dug them into the ground, and covered the space in between with canvas*".

(a) (b)

Figure 5.6: An alternative use of the internal-roof plastic sheeting: a) The plastic sheeting enclosing the two metres firebreak, b) The plastic sheeting used as a fence to enclose a private area in front of a shelter.

Weather protection

The participants stated that the shelters are not protective from the weather elements, specifically in summer, as the heat inside the shelter is unbearable to them. Moreover, the participants complained about the water leakage during rainfall. Although the shelters are provided with a second internal roof of plastic sheeting, the residents considered them useless during rainfall and therefore, the sheeting was removed and reused outdoor as aforementioned. A participant described the situation by saying: "*In summer we look like fried chicken, and in winter we freeze*".

Additionally, dust ingress is one of the biggest challenges that were faced in the shelters. During dusty days, the participants said that nothing could prevent the dust ingress. The interior of the shelters along with their belongings become yellowish (covered with dust). The ventilation pipes, which are located on the gables of the shelter (Figure 5.7), are a major source of dust ingress, and therefore the residents block them with plastic bags.

Figure 5.7: Blocked ventilation pipes to limit the dust ingress

Warming and cooling the shelter

To warm up the interior of the shelter during the winter season, the agencies distributed gas heaters to the residents. However, during the summer season, the residents have no means of cooling. The participants commented mockingly that they use cardboards as hand fans, if they were fortunate in sourcing them. Some of the shelters include a corner in its interior design with a sole small window located behind the corner. According to the participants, this corner blocks the light and air that could come from the window. Therefore, some of the residents removed the corner, but others considered it as a benefit to enclose a shower area. All the participants stated that they shower inside their shelters and do not use the communal outdoor ones.

Problems with the T-shelter

The major challenges that were discussed between the participants in regard to the life inside the shelters are summarized in Table 5.1 and discussed further afterwards.

Table 5.1: Main challenges related to T- shelters

Challenge	Notes from the participants
Contradictions with culture	The shelter consists of one room, and its interior is exposed to the outside
Safety and security	The shelters are safe, but not outdoors where the bathrooms are located
Harmful edges	The edges of the corrugated sheets were reported as harmful by the residents
Flammability	The residents have flammability concerns regarding the shelters
Distance between shelters	Two meters distance between the shelters
Ventilation	There is only one window in the shelter and overlooks public areas
Leakage	Walls and roofs are not properly sealed
Mud	The earth around the camp turns into mud when it rains/ No paved pathways
Privacy	The shelter is exposed to the public/ No private outdoor areas
Health problems	Various health issues, mainly affecting the children

The shelter consists of a basic design involving a one-room plan. The original design included partitioning wires to allow the addition of fabric room dividers, but they were never installed. The residents indicated that it is not acceptable culturally nor religiously to have different ages and genders sleeping in the same room. Therefore, they erected their own dividers using sheets or blankets as and when required. The participants argued that one-room shelters could only be acceptable for families with infants or very young children, but it cannot be acceptable for the families with older children. A participant said that her brother (age 20) and her sister (age 24) both live in her parents' one-room shelter, which is extremely unacceptable according to them. Another participant shared her case, saying, "*We are six people living in one caravan (shelter), and I have a seven-grade son (12 years old). If I want to change my clothes, I ask them (my children) to go out of the shelter until I finish*". Other personal stories were shared by the participants and reinforced the same problem of lacking personal spaces, i.e. one-room shelter for the whole family.

According to the participants, the inside of the shelter is safe as it has a lockable door. However, the main hardship occurs when they go outside to the toilets. They try to share the toilets only with their relatives, but they do not have control over that all the time. A participant said, "*Yesterday a new family came to our street, it freaked us out. I swear we stayed worried until they surrendered and went away (left the shelter)*". This attitude toward newcomers initiate social problems such as bullying.

Other stories included the injuries caused from the sharp edges of the overlapped internal metal cladding sheets. Whenever the residents tidy their mattresses or wipe the walls of the shelters, their hands bleed. Throughout the discussion, one of the participants showed her newly wounded hand and said, "*This is the proof*" (Figure 5.8).

Figure 5.8: A junction between two steel sheets in the wall and the plastic sheeting roof

The participants expressed their concerns regarding the flammability of the shelters. The close proximity of the shelters is also concerning the aid agencies; therefore, they refused to add kitchens in the separative two-metres between the shelters. Despite the fulfilment of the Sphere Project (2011) standard by having two-metres firebreak, this distance is not enough in terms of both flammability and privacy, as the sounds from the neighbouring shelters can be clearly heard inside the shelters (Figure 5.9).

Figure 5.9: A photo shows the two metres spacing in between shelters

The shelters have only one small window for ventilation (Figure 5.10(a)). The problem gets worse when residents close their windows and shade them using fabrics because they directly overlook public areas or overlook the windows of their neighbours, and therefore interfere with their privacy. Additionally, as aforementioned, the ventilation pipes are blocked with plastic bags by the residents to limit the dust ingress (Figure 5.7). The extreme weather during the summer season, the defects of the shelter design and materials, and the small window size increase the occupants' dissatisfaction. Some residents made openings in the walls as shown in Figure 5.10(b), but these are hard to seal during winter.

(a) (b)

Figure 5.10: Azraq camp ventilation openings: a) The small window in the T-shelter, b) An opening opened in the wall by the residents

The joints between the walls and the roof are not well sealed and were found to be leaking both water and dust. Residents prefer flat roofs rather than pitched roofs, as they think they are easier to be sealed and more familiar. Due to the camp's strict policies on making changes to the shelters, the residents cannot change the roof. According to the participants, the maintenance team did not respond to their complaints due to lack of fund. They believe that the roofs need to be completely replaced and this would cost a lot of money. The plastic sheeting secondary roofs aim at minimise the leakage, but as aforementioned, the residents found them useless and decided to take them off and reuse them outside (Figure 5.11).

(a) (b)

Figure 5.11: The plastic sheeting: a) The plastic sheeting roof inside one of the shelters, b) The plastic sheeting used as external dividers

When it rains, all the soil and dust in the camp turn into mud. According to the participants, the journey to the communal toilets sunk their shoes and clothes into the mud. They spend a lot of time cleaning after each journey to the toilet, which is very inconvenient. The privacy problem within the shelters is primarily associated with the windows. The shelters face either the public areas or the windows of the neighbours. Both cases force the residents to shut down their windows from afternoon onwards.

There are some facts that caused health issues to the residents of the camp, specifically to the children. The main facts are discussed in Table 5.2.

Table 5.2: Main causes of health issues in Azraq camp

Causes of health issues	**Notes**
Working kids	Some of the kids in the camp work as delivery boys using hand carriages. They deliver between the shopping mall and the shelters, and in return, they get an item from the goods. The child labour causes many health problems due to the weight of the carriages, the walked distance and being exposed to the harsh weather for a long time.
Showering inside the shelter	The residents shower inside their shelters, despite that shelters are not designed to have internal showers nor is there space provision. This causes respiratory problems particularly among children. A participant shared her son's experience saying: "*My son is 17 years old, he had asthma when he was younger and since we came here it started again. He has an endless flue, and I always feel that his chest is not alright, he can't breathe well*". She argues the unpracticality of kicking him out of the shelter whenever someone showers or cooks inside.
Cooking inside the shelter	As a result of the absence of kitchens, the camps' residents cook inside their shelters, which spreads respiratory problems between the residents. One participant shared her son's problem, *"I have a kid who has allergy, in an early stage of Asthma. Whenever I fry something in the caravan (shelter), the smell (steam) makes him start coughing. The cough stays until I take him to the doctor for an Oxygen inhaler"*. She added, *"My husband applied for a second caravan (to use it as a kitchen), but they asked for a medical report. He tried to get the report, but the doctor refused, saying that they are not allowed to give any medical reports"*. She still cooks inside.
Long distance to get to school	Getting to the school needs approximately half an hour of walking for the children who live next to the security area in village six. The participants think that the long distance affected the children and they have lost weight.
Getting water problems	The residents fill up bottles or containers of water from the water taps. There is long distance to reach the closest tap and children are the primary water carriers. Most of the children in the camp have back pain due to this chore. In addition to the effect on their growth. A participant shared a child's story who got sprain from carrying the water. Another participant said, "*My kid sometimes tells me: "Mom, let's go back to Syria under the airstrikes, it is better than holding those water bottles""*.

Causes of health issues	Notes
Coming back from hospital	One of the challenges that were discussed by the participants happens when they have a health emergency case. The ambulance takes them out of their shelters to the hospital but does not return them back when they finish; even if it was late at night. The hospital is located far from the shelters. They mentioned a story about a pregnant woman who lost her baby while walking back to her shelter from the hospital. That woman left the camp and went back to Syria.

Distribution of space

The participants divide the inner space of the shelter by some of their belongings, such as blankets or sheets. They cannot keep the space divided as sometimes they need to use the whole space, or they need to use the dividers (their belongings). They also enclose certain areas in the shelter for specific purposes such as cooking, showering or dressing corner (Figure 5.12).

(a) (b)

Figure 5.12: Dividing the interior of the shelters: a) A curtain enclosing a dressing area, b) Blankets enclosing a dressing area

Maintenance

Concerning maintenance, there is a team who has the responsibility of maintaining the shelters. However, the residents must report the problem they are facing to CARE organization; the responsible NGO for the maintenance. Following the reporting procedure, a staff member must visit the shelter for inspection and propose his recommendations to the organisation. The participants argued that the maintenance strategy is not effective, though, it did get better in recent days prior to the field visit.

One participant shared her experience when she, along her family, first arrived at their shelter. The window was glassless, and she explained, "*We waited for fourteen months until they came and put glass over our window; we spent last winter with a glassless* *window*". She was discussing with another participant who faced the same challenge, on how they managed the winter season with the glassless window. One of them used nylon to temporarily seal the window, while the other used cardboards. The participants clarified that prior to the last dust storm that hit the camp, the maintenance team fixed all the glassless windows. When the participants were asked about the reason behind the glassless windows, they replied that they either were broken by previous residents or from the unbearable summer heat. They added that now the agencies repair the previously inhabited shelters prior to hosting new families. However, the maintenance team do not solve the common aforementioned issues such as leakage and sharp edges.

Accessibility

Residents with reduced mobility face two main obstacles in the camp according to the participants, the raised threshold of the toilets (Figure 5.13(a)), and the trenches of wastewater that go along the streets (Figure 5.13(b)). A recent story was shared about a 70 years old man who fell on the ground when he was trying to cross over the trench opposite to his shelter.

(a)

(b)

Figure 5.13: Reasons of reduced accessibility, a) The toilets raised threshold, b) Trenches of wastewater

Kitchens

The residents were not provided with private or communal kitchens. They were given some kitchen tools to be used inside their shelters. The tools included a stove and a gas cylinder as shown in Figure 5.14. Cooking inside the shelters is one of the major reasons behind the respiratory problems faced by the residents.

Figure 5.14: A Kitchen inside a shelter

The Porch

The original design of the T-shelter included a porch, but it was not implemented when the camp was built due to cost and time constraints as mentioned in Chapter 2. However, at the time of the field visit, a small extension was being added to the front of the existing shelters compensating the porch, and was hoped to be used for cooking (Figure 5.15). The participants expressed their disappointment over the location of the extension, as it is not located in one of the shelter sides as they requested. According to the participants, the extension in front of the shelter has a small size (i.e. 0.8 metre width), exposes the residents to the outside, and makes no difference concerning the cooking smell and stem. The residents argued that the side would provide better level of privacy and would give them larger area for cooking. However, as aforementioned, the agencies refused using the sides for cooking, as they are concerned about fire hazards.

(a) (b)

Figure 5.15: The new extension of the T-shelter

Toilets

The toilets are communal in Azraq camp. Each street has twelve shelters and four-bathroom units, where each unit has a toilet and a shower (Figure 5.16). Usually, every three families share the facilities of a unit. Nevertheless, this distribution system is not always practical. Thus, in some streets, the use of the bathroom units is based on gender (i.e. separated units for females and males). The residents had ceased the usage of the communal showers due to safety concerns and preferred to shower in their own shelters using buckets of water. However, the shelters are not designed to have internal showers nor is their space provision. The communal facilities cause many hardships to the residents; the main challenges are listed in Table 5.3.

(a) (b) (c)

Figure 5.16: The facilities unit: a) A street view of two units, b) The toilet, c) The unused shower

Table 5.3: Main challenges in using the communal facilities

Challenge	Notes
Walking in winter	In winter, the residents find it hard to reach the unit as the soil in the ground turns into mud, in particular the family who is living the farthest from their unit.
Security and safety	It is not safe to use the communal units, especially for children and women at night. A participant shared her experience of using the toilet at night by saying: *"If we want to take my little daughter to the toilet, both I and her father should accompany her,"* she explained that her daughter needs her help in using the toilet, while her husband stands outside for protection. Another participant said, *"For me, if my husband didn't come with me to the toilet and stood outside, I won't dare to use the toilets"*, explaining that it is far from their shelter and it is not comfortable to go in front of the people on the street.
Distance	Going in winter to the toilet is hard, especially for children due to the distance and the harsh weather. The distance increases the safety concerns.
Hygiene	The toilets are not hygienic due to the large number of users, specifically the toilets that are shared based on the gender as more people use them. A participant said describing the situation, *"no one will clean for someone else, and therefore if it became dirty, it will remain dirty"*.

Water

Water taps are distributed around the camp, as shown in Figure 5.17(a), and are piped from the primary main water tanks located on the camp edge (Figure 5.17(b)). There is approximately one tap for every three blocks. The taps operate for five hours in the morning and five hours in the evening. The residents fill up bottles or containers for their daily usage. There is no limit for the amount of water they can take, but the closest tap to any shelter would still be distant. Children are the primary water carriers, which means holding up to 20 litres per day according to the residents. This is exposing the children to many health issues as discussed earlier.

(a) (b)

Figure 5.17: Water at Azraq camp: a) A water tap, b) Main water tanks

Electricity

At the time of the visit, the only source for electricity at the Azraq camp was the solar lantern. Every shelter has one to two lanterns that could charge mobile phones but no other devices (Figure 5.18). Thus, the lanterns do not compensate the role of electricity. During the winter season, specifically when it rains or when it is foggy, the lanterns do not charge, and the camp's residents remain in the darkness. According to the participants, the lanterns work for five hours as maximum, which means that they sleep at seven in the evening. The lack of electricity is one of the main hardships that are faced by the residents. Children suffer the most, as they must stay inside the shelters after darkness where there are no light or entertainment sources. However, as discussed at the beginning of the chapter, a solar plant and power network were implemented in the camp during 2017, sixteen months following the field visit.

(a) (b)

Figure 5.18: Electricity at Azraq camp: a) Solar lantern, b) Solar module

5.6 General conditions and issues

Throughout the discussions, the participants shared some general stories from the camp. Some of the stories were about the long distance to reach the services, while other stories were about being forced to stay in the camp, due to the lack of other alternatives, and about the Syrians who actually left the camp and went back to Syria.

There is a significant distance between the shelters and the services in the camp. Some participants walk approximately an hour each way to arrive at the only shopping mall of the camp where they can use the distributed vouchers. There are no buses in Azraq camp, but lately people with hand carriages were given the permission to work in the camp. They carry the groceries from the shopping mall to the resident shelters and are paid with items from the carried grocery bags. Unfortunately, according to the participants, all the workers are children, aged fourteen and below.

The agencies distribute daily free bread to the residents, but one of the family members has to go to the distribution office next to the shopping mall (distant from the shelters) to receive the bread. Men and children are the ones who are responsible for this chore. A participant said that some days, her husband refuse to go and receive the bread as he thinks that the distributed bread do not worth the hour of walking each way. The walking distance and standing in ques to receive bread was found humiliating by the residents.

According to the participants, all the schools are located in village six and none is located in village three (the villages that were opened at the time of the visit). The walking distance to the schools differ depending on the location of the shelter. For the children who live in block one at village three, it could be an hour of walking. This distance is worrying to the parents in terms of both security and health aspects. These worries led to an increase in the number of 'out of school' children. A participant said, "*In summer, I am forced to not send my kids to school; it is far away and the weather is so hot. When my son comes back, he always has headache. He says, "I have a headache, it is so hot", and in winter, he tells me: "mom I can't reach the school, it is far away*". On the other hand, security is a major concern. Participants mentioned that they could not let their first or second grade children go to school by themselves due to the distance.

The participants agreed that living in the camp is not satisfying, but there are no other choices for them. They are accepting the conditions of the camp only for their children. Living in the camp is safer than living in Syria, they explained. The participants also mentioned that many Syrians have left the camp and preferred to go back to Syria, as they could not handle the hard life and.

5.7 Future considerations

The Participants in Azraq camp had responded to the same questions that were asked in Zaatari camp, which tackled the possible future scenarios. They were asked to express their opinion on how the experience of living in the T-shelters could be enhanced. They also responded to two hypothetical scenarios as discussed below.

T-shelters enhancements suggestions

The roof is the main element that the participants agreed on its unsuitability. They complained about the improperly sealed pitched roof, and they are unable to fix or seal them. The participants prefer flat roofs, as according to them, they are easier to maintain. Additionally, the participants wish if cement and blocks are allowed in the camp, as they would be able to build proper homes. However, this amendment is unacceptable in a hosting country where the temporary status of the camp is a priority. At the same time, their preference clarifies what types of familiar materials they prefer and gives an indication on the expectations they have. Moreover, electricity is a priority for them and its provision would make a big difference to their lives.

Hypothetical scenarios

Participants were asked about their opinion on these two hypothetical scenarios:

Ability to assemble from a box

They were asked "*If you were given the shelter in a box (pre-fabricated pieces) with instructions on how to assemble it, would you or a family member be able to do so?*". They all agreed on their ability to self-build. In fact, the residents expressed their preference to this approach, as they believe that the shelters would be of higher quality than the current T-shelters. They added that some of the first arrivals to the camp in village three have participated in building the shelters of blocks numbered six, five and two.

A return package- deconstruction route

The second scenario was "*If hopefully peace is back to Syria, and if your shelters had the ability to be deconstructed and reconstructed again, do you feel that this feature would ease your return to your country?*". About 56% of the participants indicated their preference to take their shelters with them back in Syria, so they can live in them until they rebuild their homes. However, the effect of the strict policy in Azraq camp was clear on the participants' behaviour during the discussion. In this question, despite the description of the scenario, some of the participants could not separate the scenario from their current situation and thought that they are being offered to take the T-shelters with them, while others could not imagine the scenario, as their own homes are not demolished. However, one of the participants explained her rejection to take the shelter back to Syria by saying: "*...if we went there (to Syria) and stayed in our caravans (shelters), we would be lazy in rebuilding our homes. But if we stayed in the street (homeless), we would be forced to rebuild, we would rebuild our homes in two days*".

5.8 Summary of findings

Azraq camp is a purpose-built camp that was opened in April 2014 due to the increasing number of Syrian refugees entering Jordan. It is designed to have six villages in an area of 14.7 km^2. However, at the time of the visit, only two villages were occupied, while two others became in use during later stages. The peak number of residents in the camp reached 55,000, but it decreased gradually and stabilised since June 2018 at 40,000 residents. Rows of white T-shelters make up the camp, where each shelter has an area of 24 m^2. The shelter has an interlocking steel structure, covered by aluminium foam insulation and has external and internal IBR metal cladding. The interior of the shelter includes an additional roofing layer of plastic sheeting, while the floor is made of concrete.

The field visit that included focus group discussions and observatory tours with some residents from the camp have highlighted the main issues that are faced by the residents, both in the macro level of the camp as well as in the micro scale of the T-shelters. One of the learnt lessons from Zaatari pre-fabricated shelters and was applied in the Azraq T-shelters is the use of concrete instead of wooden floors. However, the drawbacks of the T-shelters are very similar to those faced in the prefabricated shelters of Zaatari camp. The T-shelters were not properly sealed, and the pitched roof prevented the residents from adding fabric and materials, such as what the residents at Zaatari camp have done. Additionally, the layout of the T-shelter has the same issues of the prefabricated shelters of Zaatari camp, such as the absence of private facilities, outdoor private area, internal dividers, and proper openings. In fact, the interior of the T-shelter was harder to be divided as the layout is closer to a square than a rectangle. The stricter policies in Azraq camp have prohibited the residents from making changes to the shelters, which increased the level of stress and dissatisfaction between the residents. The concerns regarding the accessibility of the shelters and flammability of the materials were also alarming inside the Azraq camp. The sharp edges of the overlapped steel sheets have raised another health concern. The materials among all shelter elements have to pose no harm to the residents.

The lack of electricity and direct water channels were of major concern to the residents during the visit. However, in May 2017, Azraq camp became the first refugee camp that is powered by renewable energy. During the second visit to the camp in December 2017, a significant difference was noted by the researcher in terms of the situation inside the camp, the acceptance between the residents and the general lifestyle. The introduction of electricity did not only affect the quality of life at Azraq, but also had positive psychological effect on the residents. The main shelter design guidelines that could be extracted from the field visit are summarised in Table 5.4.

Table 5.4: Suggested transitional shelter design guidelines- extracted from the Azraq camp field visit

Themes	Guidelines
Pre-design	• No permanent materials or construction details allowed • Shelters shall be recognizable from each other- not identical
Materials	• Safe materials- ex. no sharp edges • Use non-flammable materials
Shelter solutions	• Can be built by users i.e. Not dependent on specialist equipment • Construction system which protects from the environment and is well-sealed • Adequate provision for surface drainage and guttering • Adequate sewage system

<table>
<tr><th colspan="2">Themes</th><th>Guidelines</th></tr>
<tr><td rowspan="2">Design elements</td><td>Openings</td><td>• A suitable private screened and shaded outdoor area
• Adequate natural lighting and ventilation
• Windows protect the residents’ privacy
• Lockable doors and windows</td></tr>
<tr><td>Interior</td><td>• An increased indoor space that respects the gender separation
• Possibility of adding internal divisions
• Provision of different genders/ age groups spaces
• Main space needs: outdoor courtyard/ reception for socialising/ family sitting room/ 2-3 bedrooms/ private kitchen/ private toilet and shower
• Ground floor raised, insulated underneath and washable
• Flat roof is preferred over the pitched roof for ease of maintenance and usability</td></tr>
<tr><td rowspan="2">Safety</td><td>Accessibility</td><td>• Have safe access to all users, specifically users with reduced mobility</td></tr>
<tr><td>Fire-separation</td><td>• Avoid close proximity between shelters</td></tr>
<tr><td colspan="2">Future of the design</td><td>• Maintainable by users/ easily adaptable using locally available tools and materials
• Possibility of future expansion or adding a second floor
• Can be deconstructed for possible relocation</td></tr>
</table>

The positive responses by the residents with regard to the two hypothetical scenarios concerning the self-build and deconstruction of shelters, assure the possibility and acceptance of using alternative approaches in designing, distributing, and transporting the shelters. The next chapter, numbered 6, will discuss and analyse the global post-disaster shelters that were provided during the past decade (2007-2016).

Chapter 6

Global shelters 2007-2016

This chapter reviews the global shelters provided after disasters; whether natural or man-made. The purpose of this review is to identify the range of sheltering types that are used in disasters and compare them in terms of their material costs, shelter size, and construction materials. The chapter also discusses the shelter drivers and the beneficiaries' needs.

6.1 Introduction

This work extract and understand the commonalities, bespoke issues, challenges, and lessons learnt from the existing shelters that have been provided to people in post-disaster situations. It focuses on the most recent decade (2007-2016). This period was chosen for three reasons:

- To have a wide variety of projects with different contexts to compare (e.g. location, time, type of disaster, culture, beneficiaries needs and policy factors)
- There are more detailed information compared to previous decades
- The cost information and technical details and solutions are more related to the current period.

It is noteworthy that due to the wide range of case studies, geographic locations, type of projects, and degree of documentation available, comparisons may be restricted or limited. However, towards the end of the chapter, a suggested documentation form is illustrated that contains the must-known information about any shelter project.

6.2 Data collection method

The provided support to disaster-affected people can differ from one case to another. This chapter primarily discusses the shelters that were provided as ready-built units, or as materials with recommended designs. Emergency shelters such as tents and permanent shelters were excluded from the scope of this study.

Reducing the effect of disasters and its impact can be aided by minimising the vulnerabilities. Studying past examples can improve strategies for post-disaster aid actions, therefore improving outcomes (including quality of life, sustainability, function, and operation).

The main documents reviewed for this study comprise six shelter projects reports that were published by the Global Shelter Cluster (2008, 2009, 2010, 2011-2012, 2013-2014, 2015-2016) (UN-Habitat, 2008; UN-Habitat and IFRC, 2010; IFRC, UN-Habitat and UNHCR, 2012, 2013, 2014; Global Shelter Cluster, 2017). These reports have illustrated and discussed both good and bad practices amongst the projects. Other documents are also reviewed such as 'Post-disaster shelter: Ten designs' by the International Federation of Red Cross and Red Crescent Societies (IFRC, 2013) and the 'Shelter Design Catalogue' by UNHCR (2016).

For the purposes of this study, whilst the review covers a full decade, the study summates shelter projects every two years. The analysis of their material costs, shelter size, and materials used is presented throughout the various tables and figures. The case studies in this chapter have an alphabetical reference to assist in referring to them. Figure 6.1 shows all the cases on the world map, while their portfolio of photos is provided in the followed four next pages. All tables shown throughout the chapter include image reference, disaster type, case study 'countries', year, number of shelters built and expected lifetime in years.

Material tables also have an added column entry 'main project' that refers to the shelter type. The material fields are divided into four main shelter parts: frame and/or walls, roof, floor and foundation. For grouping the materials in the comparison tables, wood was used as a generic term that included all materials related to wood including bamboo—even though bamboo is technically a grass. The notation (B) can be found in the tables wherever bamboo was used. This review depended on the available information in the reports. The field in the tables were left empty when information could not be sourced.

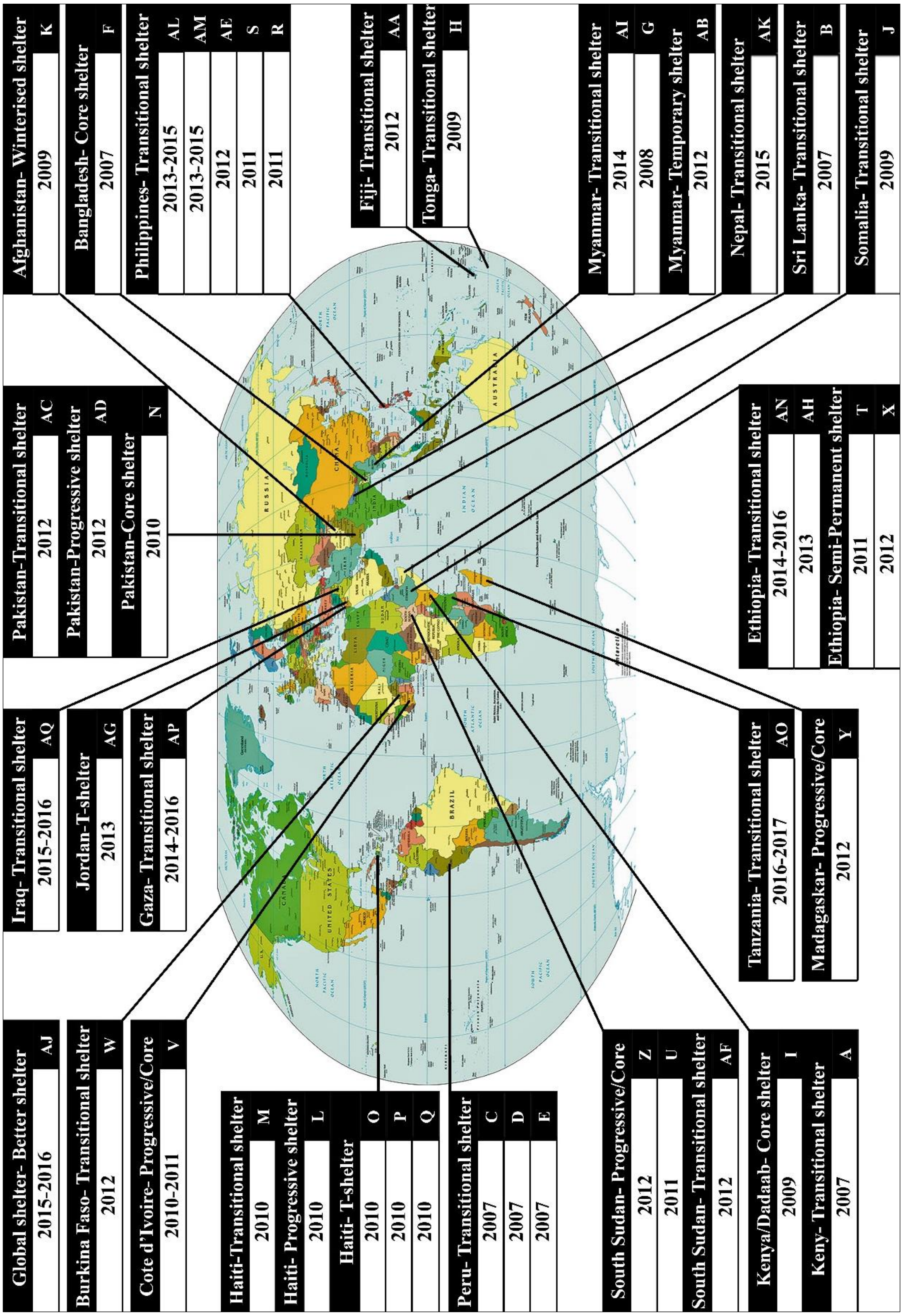


Figure 6.1: Case studies 2007-2016 on the world map

Kenya 2007
Transitional shelter
Joana Cameiro in (UN-Habitat, 2008)

Sri Lanka 2007
Core shelter
Jake Zarios in (UN-Habitat, 2008)

Peru 2007
Transitional shelter
Predes in (UN-(UN-Habitat, 2008)

Peru 2007
Transitional shelter
Eddie Argenal in (UN-Habitat, 2008)

Peru 2007
Transitional shelter
LeGrand Malany in (UN-Habitat, 2008)

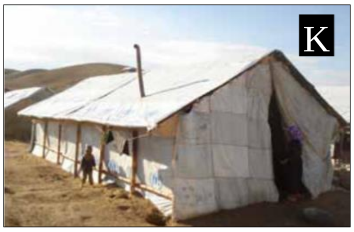
Bangladesh 2008
Core shelter
Xavier Génot, IFRC in (UN-Habitat and IFRC, 2010)

Myanmar 2008
Transitional shelter
Veronica Wijaya- in (IFRC, UN-Habitat and UNHCR, 2012)

Tonga 2009
Transitional shelter
Kathleen Walsh in (IFRC, UN-Habitat and UNHCR, 2012)

Kenya-Dadaab 2009
Core shelter
Jake zarins in (UN-Habitat and IFRC, 2010)

Somalia 2009
Transitional shelter
Jozeph Ashmore, (UN-Habitat and IFRC, 2010)



Afghanistan 2009
Winterised shelter
Shaun Scales in (IFRC, 2013)

Haiti 2010
Progressive shelter
Sandra Tapia in (IFRC, UN-Habitat and UNHCR, 2012)

Haiti 2009
Transitional shelter
Shaun Scales- NRC in (IFRC, UN-Habitat and UNHCR, 2012)

Pakistan 2010
Core shelter
Kpakpo in (IFRC, UN-Habitat and UNHCR, 2012)

Haiti 2010
T-shelter
(IFRC, 2013)

Haiti 2010
T-shelter
(IFRC, 2013)

Haiti 2010
T-shelter
(IFRC, 2013)

Philippines 2011
Transitional shelter
(IFRC, 2013)

Philippines 2011
Transitional shelter
(IFRC, 2013)

Ethiopia 2011
Semi-permanent
Demissew Bizuwerk- IOM in (IFRC, UN-Habitat and UNHCR, 2013)

South Sudan 2011
Progressive shelter
Fernando Murillo in (IFRC, UN-Habitat and UNHCR, 2013)

Cote d'Ivoire 2010-2011
Progressive shelter
Yao Albert Konan/ (IFRC, UN-Habitat and UNHCR, 2013)

Burkina Faso 2012
Temporary shelter
Christian Jepsen in (IFRC, UN-Habitat and UNHCR, 2013)

Ethiopia 2012
Semi-permanent shelter
Joseph Ashmore (IFRC, UN-Habitat and UNHCR, 2013)

Madagascar 2012
Progressive shelter
CRS in (IFRC, UN-Habitat and UNHCR, 2013)

South Sudan 2012
Progressive shelter
Fernando Murillo (IFRC, UN-Habitat and UNHCR, 2013)

Fiji 2012
Transitional shelter
Habitat for Humanity Fiji in (IFRC, UN-Habitat and UNHCR, 2014)

Myanmar 2012
Temporary shelter
UNHCR in (IFRC, UN-Habitat and UNHCR, 2014)

Pakistan 2012
Transitional shelter
FE Altamash/CRS in (IFRC, UN-Habitat and UNHCR, 2014)

Pakistan 2012
Progressive shelter
ACTED in (IFRC, UN-Habitat and UNHCR, 2014)

Philippines 2012
Transitional shelter
CRS in (IFRC, UN-Habitat and UNHCR, 2014)

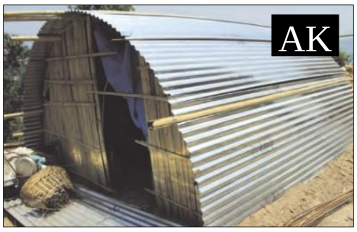
South Sudan 2012
Transitional shelter
UNHCR in (IFRC, UN-Habitat and UNHCR, 2014)

Jordan 2013
T- shelter
Ru'a Al-Abweh in (UNHCR, 2016)

Ethiopia 2013
Transitional shelter
(UNHCR, 2016)

Myanmar 2014
Transitional shelter
(UNHCR, 2016)

Better shelter 2015-2016
Global shelter
(UNHCR, 2016)



Nepal 2015
Transitional shelter
Adesh Tripathee in (Global Shelter Cluster, 2017)

Philippines 2013-2015
Transitional shelter
Dave Hodgkin in (Global Shelter Cluster, 2017)

Philippines 2013-2015
Transitional shelter
World Vision in (Global Shelter Cluster, 2017)

Ethiopia 2014-2016
Transitional shelter
Chiara Vaccaro in (Global Shelter Cluster, 2017)

Tanzania 2016-2017
Transitional shelterTom Corcoran in (Global Shelter Cluster,

Gaza 2014-2016
Transitional shelter
CRS staff in (Global Shelter Cluster, 2017)

Iraq 2015-2016
Transitional shelter
Alan Miran in (Global Shelter Cluster, 2017)

Different terminologies with the same meaning were utilised throughout the comparison. This is because of the geographic terminologies used for recording in the original documentation, such as the use of Typhoon, Cyclone, and Hurricanes. Sheltering types' terminologies also were set depending on the original documentation, as the decision refers to a mix of contextual factors, including the local glossary of terms (IFRC, 2013). The acronyms used for describing the disaster types are mentioned in Table 6.1.

Table 6.1: List of acronyms used throughout the chapter

C- Conflict	NF- Natural Flood	GS- Global Shelter
NTs- Natural Tsunami	NT- Natural Typhoon	NE- Natural Earthquake
NC- Natural Cyclone	GS- Global Shelter	

6.3 Global shelter case studies 2007-2008

According to a report published by Swiss Re, there were 142 natural disasters and 193 man-made disasters during 2007 (Swiss Re- Sigma, 2008), and about 137 natural disaster and 174 man-made during 2008 (Swiss Re- Sigma, 2009). But according to a report published by CRED, there were about 414 natural disasters during 2007 (Scheuren *et al.*, 2008), and 354 events during 2008 (Rodriguez *et al.*, 2009). The shelter projects in the years 2007-2008 were not fully documented. The information is insufficient, yet it could aid in providing preliminary indicators.

There are seven cases in this section located in five different countries, six of them were applied in 2007 and a case in 2008. Information is cited from documents published by organizations that work with sheltering response. Kenya 2007 (A), Sri Lanka 2007 (B), and the three projects in Peru 2007 (C, D, E) were documented in UN-Habitat (2008). The data for the Peru project 2007 (D) was also stated in UN-Habitat and IFRC (2010), besides the Bangladesh project 2007 (F). While Myanmar 2008 (G) shelters' details were taken from IFRC, UN-Habitat and UNHCR (2012). The cases studied during 2007-2008 are displayed below in Figure 6.2.

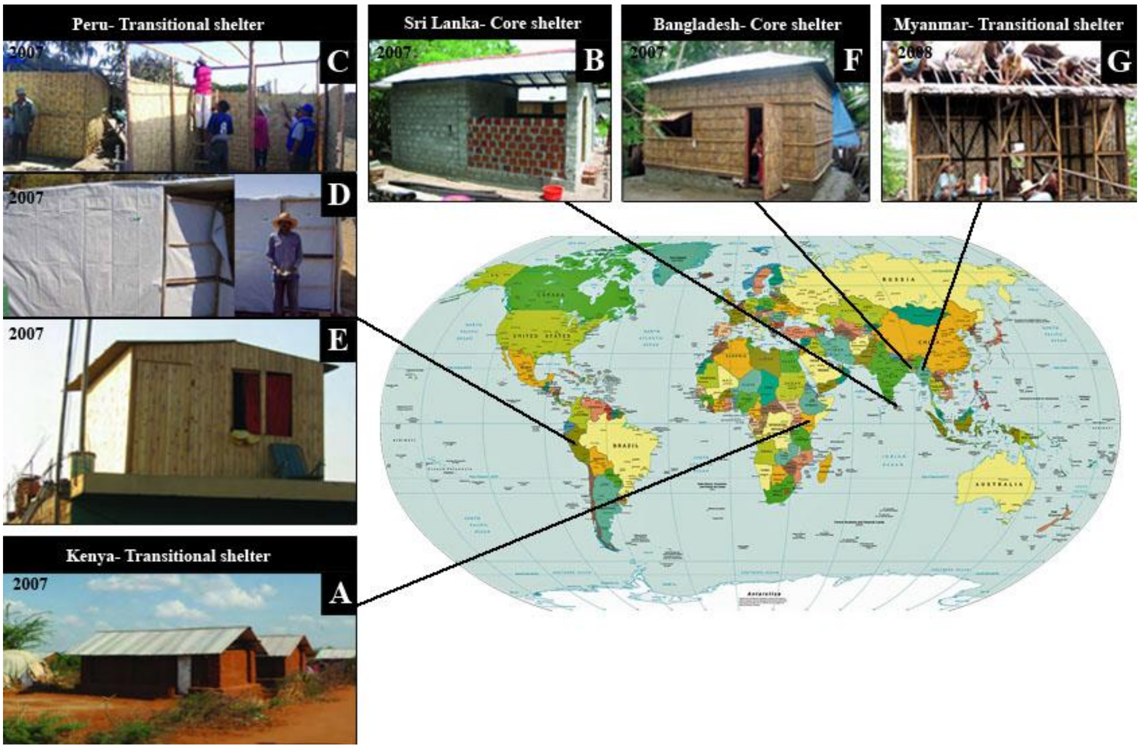


Figure 6.2: Case studies 2007-2008 on the world map

6.3.1 Cost comparison 2007-2008

A comparison between the material costs is displayed in Table 6.2. However, not all the projects had documented costs. Additionally, for some projects such as Myanmar (G), only the total project cost was recorded. For the two projects that have their material costs documented (i.e. Bangladesh and Kenya), they differed significantly.

Table 6.2: Material costs comparison table 2007-2008

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Materials cost per shelter in US Dollars						
						0-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750
A	NF	Kenya	2007	500	_							
B	C	Sri Lanka	2007	213	_	Unkown						
C	NE	Peru	2007	726	_	Unkown						
D	NE	Peru	2007	706	_	Unkown						
E	NE	Peru	2007	1900	_	Unkown						
F	NC	Bangladesh	2007	1250	_							
G	NC	Myanmar	2008	850	_			*				

* Project cost

In Bangladesh, the shelter consisted of a core unit that was designed to be wind-resistant and was built over a mud plinth to provide protection from flooding (Figure 6.3). The material costs were $1,600 for each of the built 1,250 shelter. This project was the second most built shelter within these years after Peru (E). The relatively good standards of the shelter may have increased the costs. Some of the drawbacks that were cited included the lack of good timber and delivery delays, which may also have an impact on the costs. However, the used woven bamboo was locally sourced (UN-Habitat and IFRC, 2010).

Figure 6.3: Bangladesh project 2008- photo by Xavier Génot, IFRC (UN-Habitat and IFRC, 2010)

The Kenya shelter project (A), was implemented at Ifo camp, located inside the Dadaab compound. In 2007, the camp had 173,000 Somali occupants. The government in Kenya refused to encourage any permanent structure. The primary construction material was mud bricks that were made by the beneficiaries. This may have led to the shelter's lower costs (Figure 6.4). The costs ranged from \$440 to \$480 depending on the source of soil- whether from inside or outside the camp (UN-Habitat, 2008). Although the material costs are only known for two projects, the significant cost difference as shown in Figure 6.5, illustrates how responses in emergencies can differ widely, even during the same year.

Figure 6.4: Kenya project 2007- photo by Joana Cameiro (UN-Habitat, 2008)

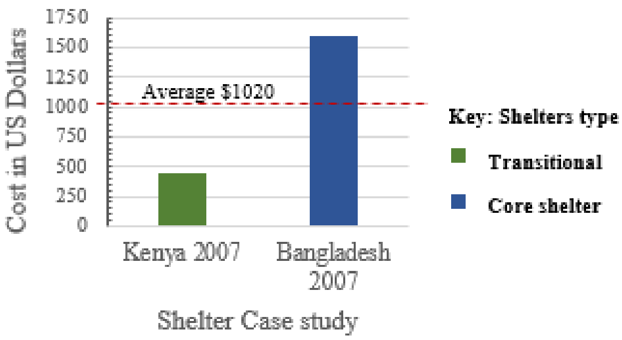


Figure 6.5: Material costs comparison 2007-2008

6.3.2 Size comparison 2007-2008

In contrary to the cost, the sizes of the shelters' projects were documented and were within the same range. The smallest size was 9 m^2 and the largest was 18.6 m^2. A comparison between the sizes of the 2007-2008 studied projects is displayed in Table 6.3.

The projects' size has a similar range. One of the three Peru projects studied (labelled C), has the smallest shelter of 9 m^2. The project aimed at encouraging the community to build shelters directly after the earthquake, which occurred in 2007. The materials were distributed to the beneficiaries and they self-built the shelters. Although the bamboo mats are not officially considered a construction material, the climate allows the residents to live in bamboo structures as building semi-permanent structures from bamboo is traditional in the coastal regions of Peru (Figure 6.6) (UN-Habitat, 2008).

Table 6.3: Size comparison table 2007-2008

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Size-m^2	
						15=>	16-20
A	NF	Kenya	2007	500	_		■
B	C	Sri Lanka	2007	213	_		■
C	NE	Peru	2007	726	_	■	
D	NE	Peru	2007	706	_		■
E	NE	Peru	2007	1900	_		■
F	NC	Bangladesh	2007	1250	_	■	
G	NC	Myanmar	2008	850	_	■	

Figure 6.6: Peru project 2007- photo by Predes (UN-Habitat, 2008)

All the projects discussed in this section were established after natural disasters except the Sri Lanka project (B), which was built after a civil conflict (Figure 6.7). It has the largest sized shelter amongst those studied in this section, with an area of 18.6 m^2. This ‘core shelter’ was smaller than the semi-permanent shelter that had been previously distributed in Sri Lanka. This may mean that their original houses were relatively large. This change in the shelter approach was taken due to the adaptability and expandability of the new design (UN-Habitat, 2008). The project targeted some of the displaced families from Karukamunai district who found their houses destroyed upon returning to their village. The 213 households who received the core shelters were eligible for support after demonstrating proof of owning the land and loss of house (UN-Habitat, 2008).

Figure 6.7: Sri Lanka shelter 2007-
photo by Jake Zarios (UN-Habitat, 2008)

The availability of land is one of the most challenging issues in humanitarian responses. In Bangladesh, the shelter's size was reduced to 15 m^2 due to the limited availability of land (UN-Habitat and IFRC, 2010). The average size of the 2007-2008 studied projects is 16 m^2 (Figure 6.8).

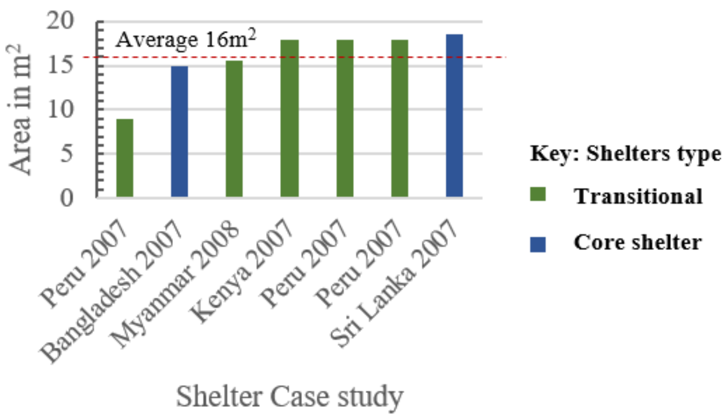


Figure 6.8: Size comparison 2007-2008

6.3.2 Materials comparison 2007-2008

Table 6.4 shows the known materials for the studied projects in 2007-2008.

Table 6.4: Materials comparison table 2007-2008

Image	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Frame and/or walls							Roof			Floor		Foundation
							Wood	Steel	Concrete	Brick	Grass	Corrugated metal sheets	Plastic sheeting	Corrugated metal sheets	Corrugated cement panel	Steel	Mud plinth	Concrete	Concrete
A	NF	Kenya	2007	Transitional	500	_	■			■		■							
B	C	Sri Lanka	2007	Core shelter	213	_	■	■		■			■	■					
C	NE	Peru	2007	Transitional	726	_	*B												
D	NE	Peru	2007	Transitional	706	_	■				■		■					■	
E	NE	Peru	2007	Transitional	1900	_	■								■				
F	NC	Bangladesh	2007	Core shelter	1250	_	*B			■						■	■		■
G	NC	Myanmar	2008	Transitional	850	_	*B												■

It was difficult to source detailed information about the material used for each construction element, specifically for the floor and the foundation. Where the foundation materials utilised were known, such as the cases of Bangladesh and Myanmar, concrete was used. Both projects were established after two separate cyclones that hit the countries. One of the reasons behind using concrete foundations was aligned to the need for stability to resist cyclones.

The shelter in Bangladesh (F) was built on a mud plinth, anchored to the soil by eight reinforced concrete columns with five feet deep foundations. The design had a base of six course bricks over a plinth. The walls were made of woven bamboo, which was believed to be cost effective, environmentally friendly and could be repaired. In addition, the design offered the possibility of expanding the shelter in all directions (UN-Habitat and IFRC, 2010). Myanmar shelter (G), included sustainable materials of bamboo and palm (Figure 6.9). Crude oil was used to preserve the wood, while concrete was only used for the foundation (IFRC, UN-Habitat and UNHCR, 2012). Figure 6.10 is for Peru project (E), where a prefabrication approach was chosen. The roof was made with corrugated cement panels and the floor used pre-existing concrete slabs (UN-Habitat, 2008). In Peru transitional shelter (D), a simple design was used as shown in Figure 6.11. The frame was made out of timber poles and was covered by plastic sheeting with woven reed mats on top of it. For the floor, a soil-cement mix was chosen.

Figure 6.9: Myanmar transitional shelter 2008- photo by Veronica Wijaya- UN-Habitat (IFRC, UN-Habitat and UNHCR, 2012)

Figure 6.10: Peru Transitional shelter 2007- photo by LeGrand Malany (UN-Habitat, 2008)

Figure 6.11: Peru transitional shelter 2007- photo by Eddie Argenal (UN-Habitat, 2008)

6.4 Global shelter case studies 2009-2010

During 2009, 288 disaster events occurred according to Swiss Re- Sigma (2010), consisting of 133 natural and 155 man-made events. While according to Rodriguez, Donner and Trainor (2018), the total number of natural disasters was significantly higher at 335. During 2010 the number of disasters increased to 304, 167 events were natural and the remaining 137 were man-made (Swiss Re- Sigma, 2011). Once more, the number of natural disasters in 2010 was recorded differently by Guha- Sapir *et al.* (2011) with a total number of 385 disaster events. The documentation of the projects during the years 2009-2010 showed a significant enhancement compared to previous years. The studied cases of this section are illustrated in Figure 6.12 in relation to their countries.

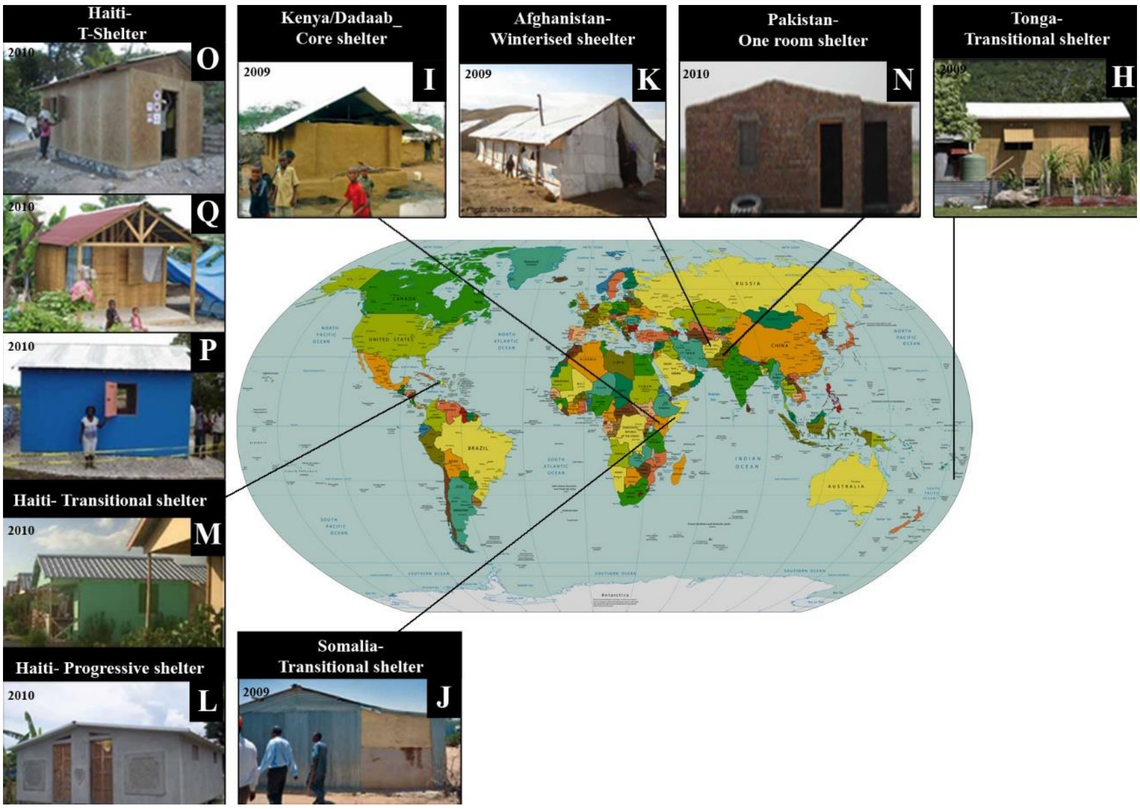


Figure 6.12: Case studies 2009-2010 on the world map

The reviewed projects in this section include, Tonga 2009 (H), Haiti 2010 (L, M) and Pakistan 2010 (N), and their data was taken from IFRC, UN-Habitat and UNHCR (2012). The data of Kenya-Dadaab 2009 (I) and Somalia 2009 (J), were taken from UN-Habitat and IFRC (2010). Afghanistan 2009 (K) and Haiti 2010 (O, P, Q) taken from IFRC (2013).

6.4.1 Cost comparison 2009-2010

Comparing the material costs for the studied projects during 2009-2010, shows a wide variety of costs, ranging from $264 to $4,350. This is shown in Table 6.5.

Table 6.5: Material costs comparison table 2009-2010

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	**Materials cost per shelter in US Dollars**																	
						0-250	**251-500**	**501-750**	**751-1000**	**1001-1250**	**1251-1500**	**1501-1750**	**1751-2000**	**2001-2250**	**2251-2500**	**2501-2750**	**2751-3000**	**3001-3250**	**3251-3500**	**3501-3750**	**3751-4000**	**4001-4250**	**4251-4500**
H	NTs	Tonga	2009	74	_																		■
I	C	Kenya-Dadaab	2009	up to 3500 PY	_		■																
J	C	Somalia	2009	634	_			■															
K	C	Afghanistan	2009	380	1		■																
L	NE	Haiti	2010	3960	_										■								
M	NE	Haiti	2010	1356	_							■											
N	NF	Pakistan	2010	175	_			■															
O	NE	Haiti	2010	2000	3 to 5							■											
P	NE	Haiti	2010	4471	5 to 10											■							
Q	NE	Haiti	2010	1050	3 to 5							■											

A clear outlier in the material costs was for Tonga's project (H) shown in Figure 6.13. It has material costs of $4,350. Whilst the number of built shelters in Tonga was considerably less than other sites, which may have affected the economies of scale, a key factor for the increased costs could be the remoteness of location. The entire shelter was built in a remote island, flat packed and then shipped to the site (IFRC, UN-Habitat and UNHCR, 2012). However, the design was of a high standard in order to resist future cyclones. (IFRC, UN-Habitat and UNHCR, 2012).

Figure 6.13: Tonga project 2009- photo by Kathleen Walsh (IFRC, UN-HABITAT and UNHCR, 2012)

Haiti 2010 (P) also had a cost that is considered high in comparison to the rest of the projects in this section, costing 2,580 CHF (IFRC, 2013), equivalent to $2519 (US) at the time of writing this section in September, 2017. This project served 4,471 households according to the IFRC (2013), the highest number in this section. The design is considered durable with a lifespan of five to ten years. To resist future flood effects, the first floor was raised (Figure 6.14). The higher specifications compared to other shelters may be the main reason behind the high cost (IFRC, 2013).

Figure 6.14: Haiti project 2010- (IFRC, 2013)

The second largest project in terms of beneficiaries was Haiti (L), with 3,960 shelters (Figure 6.15). The material costs of the 18 m^2 shelter was $2,400. Other shelter sizes of 36 m^2 and 54 m^2 were also supplied for larger families (IFRC, UN-Habitat and UNHCR, 2012). The shelter had two stages, a preliminary structure of steel frame involving tarpaulin, and a more permanent external skin layer involving cement cladding. The main reason for the higher cost was the use of the mortar cladding (IFRC, UN-Habitat and UNHCR, 2012).

Figure 6.15: Haiti project 2010- photo by Sandra Tapia (IFRC, UN-HABITAT and UNHCR, 2012)

The Afghanistan shelter (K) is classified as a winterised shelter. It had the lowest material costs of 270CHF, equivalent to $264 at the time of this review in September 2017. The shelter was constructed to act as a shell (Figure 6.16). Each shelter included a tent that was erected inside a structure of bamboo pole frames, while walls and roofs were made from plastic sheeting. Plywood sheets were used for the roof truss bracing (IFRC, 2013).

The low cost reflects the simplicity of the shelter design, construction approach, the used materials, and the self-build by beneficiaries.

Figure 6.16: Afghanistan project 2009- photo by Shaun Scales (IFRC, 2013)

Project (I) is was applied in Dadaab- Kenya (Figure 6.17). It is a continuation of previous years' shelter projects where about 3,500 shelters were being built annually. The material costs were low compared to other projects at approximately $480 per shelter. Beneficiaries made their own mud blocks and the traditional used technique helped lower the cost. However, the unplanned mud excavation resulted in having holes that became refuse pits or mosquito-breeding sites (UN-Habitat and IFRC, 2010).

Figure 6.17: Kenya-Dadaab project 2009- photo by Jake zarins (UN-Habitat and IFRC, 2010)

The variation in the projects' costs and the wide variety of the shelters types is shown in Figure 6.18. It is noted that Haiti's five studied projects used different terminologies to describe the shelter types; progressive, transitional and T-shelter. The average cost of the projects' materials was $1,610 as shown in Figure 6.19. Three out of the five Haiti projects have costs that are close to the average for that period. No relation between the material costs and the shelter types can be seen. However, the remoteness factor and material specifications for Tonga suggest an influence on cost.

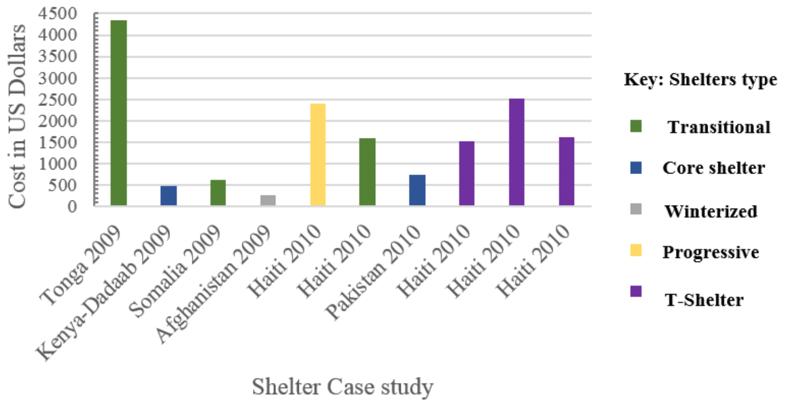


Figure 6.18: Material costs comparison 2009-2010- Chronological order

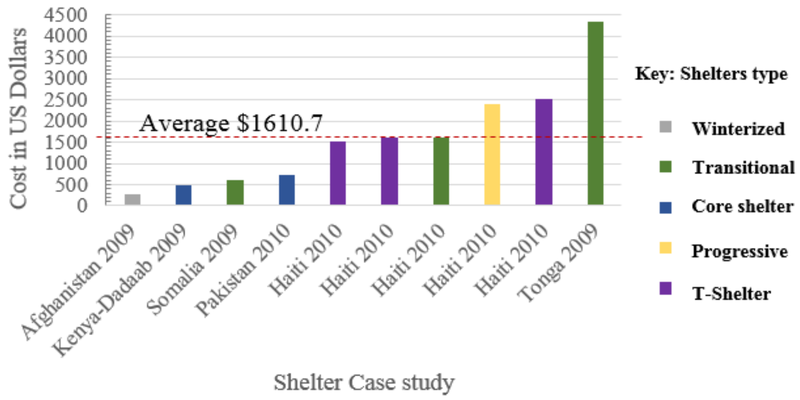


Figure 6.19: Material costs comparison 2009-2010- Ascending order

6.4.2 Size comparison 2009-2010

The Afghanistan shelter (K) stands out with the largest size of 39 m^2, despite its lowest cost. However, as previously mentioned in the cost discussion, the shelter was only a shell for a tent, which may have provided more flexibility in terms of size. The Haiti shelter (Q) has the second largest shelter size in this category, with a size of 27 m^2. The 6.7 m^2-covered porch has increased the total area of the shelter. Clissage—a traditional technique of woven wood, was used for the walls as shown in Figure 6.20. The use of clissage has reduced the overall wall thickness and the dependency on other non-local materials. This may have enhanced the ability to form a larger shelter volume and space compared to other shelter. During 2009 and 2010, the smallest studied shelter was in the Somalia project (J) due to funding limitations. However, the shelters also had structural defects (Figure 6.25).

Figure 6.20: Haiti shelter 2010- (IFRC, 2013)

Figure 6.21 shows that there is no relation between the size and the year of the project. It also shows that shelters of the same type have approximate size range. All projects other than Afghanistan have sizes that relatively close to the average size of 22.4 m^2 (Figure 6.22). The size comparison between the projects that are studied for the years 2009-2010 can be seen in Table 6.6. The shelter sizes vary between 16 m^2 to 39 m^2.

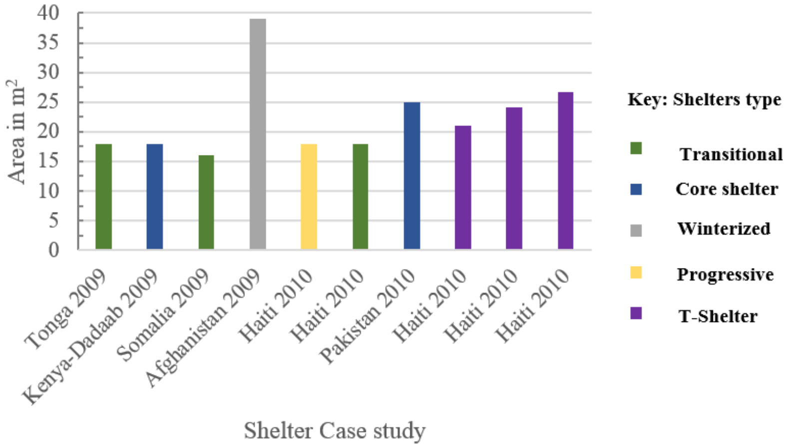


Figure 6.21: Size comparison 2009-2010- Chronological order

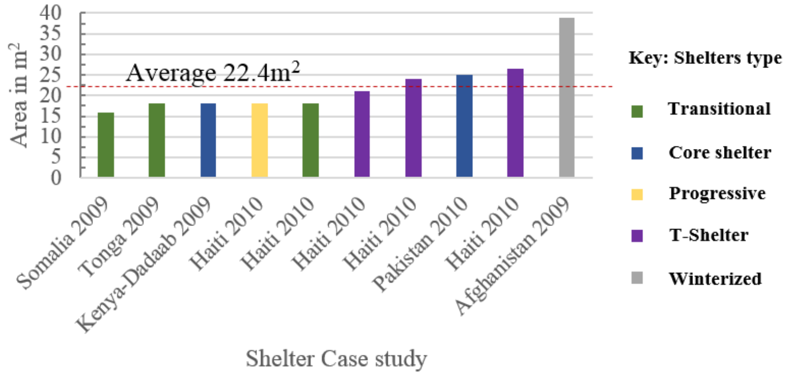


Figure 6.22: Size comparison 2009-2010- Ascending order

Table 6.6: Size comparison table 2009-2010

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size - m^2					
						15=>	16-20	21-25	26-30	31-35	36-40
H	NTs	Tonga	2009	74	_		■				
I	C	Kenya-Dadaab	2009	up to 3500 PY	_		■				
J	C	Somalia	2009	634	_		■				
K	C	Afghanistan	2009	380	1						■
L	NE	Haiti	2010	3960	_		■				
M	NE	Haiti	2010	1356	_		■				
N	NF	Pakistan	2010	175	_			■			
O	NE	Haiti	2010	2000	3 to 5			■			
P	NE	Haiti	2010	4471	5 to 10			■			
Q	NE	Haiti	2010	1050	3 to 5				■		

6.4.3 Materials comparison 2009-2010

The projects reviewed for the years 2009-2010 have better documentation in terms of the used materials. Table 6.7 shows a comparison of shelters in terms of materials. For the frames and or/walls, wood is the most predominantly used material. This may reflect its lightweight mass, availability, and affordability. Plastic sheeting was also used in some projects due to the significant lower cost, ease of transport and providing some weather protection. Wood was the most commonly used material for the roof, mainly as a support to another material. A range of metal sheets, corrugated metal sheets, ceramic and plastic sheeting were used in some projects. The floor materials varied between wood and concrete with one case that had a compacted earth floor. In the cases reviewed, foundations were the least documented element. Of those foundations that were documented, concrete foundations were the most common.

Table 6.7: Materials comparison table 2009-2010

Image	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Frame and/or walls							Roof						Floor			Foundation		
							Wood	Steel	Concrete	Mud	Brick	Corrugated metal sheets	Plastic sheeting	Corrugated metal sheets	Corrugated bituminous	Wood	Steel	Metal sheet	Plastic sheeting	Concrete	Wood	Compacted earth	Concrete	Stone	Wood
H	NTs	Tonga	2009	Transitional	74	_	■																■		
I	C	Kenya-Dadaab	2009	Core shelter	up to 3500 PY	_	■			■				■											
J	C	Somalia	2009	Transitional	634	_	■					■		■		■				■					
K	C	Afghanistan	2009	Winterised	380	1	*B						■			■			■			■			
L	NE	Haiti	2010	Progressive	3960	_		■	■				■	■							■		■		
M	NE	Haiti	2010	Transitional	1356	_										■				■					
N	NF	Pakistan	2010	Core shelter	175	_			■		■		■			*B							■		
O	NE	Haiti	2010	T-shelters	2000	3 to 5	■									■		■		■			■	■	
P	NE	Haiti	2010	T-shelters	4471	5 to 10	■									■		■			■		■		
Q	NE	Haiti	2010	T-shelters	1050	3 to 5	■								■				■	■			■		■

The shelter of Tonga 2009 (H) was flat packed in the capital and shipped to Niuatoputapu. Wood was chosen for the walls and concrete for the footings. No information of the shelter's floor and roof was provided (Figure 6.13) (IFRC, UN-Habitat and UNHCR, 2012). The Haiti 2010 shelter (P) had a timber and plywood frame (Figure 6.14). According to (IFRC, 2013), the timber frame was believed to withstand high winds and seismic events. While the shelter built in Haiti 2010 (L), had a galvanised steel frame, timber sub framing, steel roof, and concrete foundations. Tarpaulin was used in the beginning, and then cement cladding was added for the durable solution as shown in Figure 6.15. Most of the construction materials were purchased locally except the steel frames and part of the roof. In order to minimise the damage of future floods, the shelters were raised from the floor. Deeper foundations were used in higher-risk areas (IFRC, UN-Habitat and UNHCR, 2012).

Referring to UN-Habitat and IFRC (2010), self-made mud blocks and timber and corrugated iron roof were used for the shelter in Kenya-Dadaab 2009 (I) (Figure 6.17). The shelters in Pakistan 2010 (N) were part of a pilot project (Figure 6.23). Brick or concrete burnt blocks and cement mortar were used for the walls. Wooden girders were used for roofs and concrete for foundations (IFRC, UN-Habitat and UNHCR, 2012).

Figure 6.23: Pakistan core shelter 2010- photo by Kpakpo (IFRC, UN-Habitat and UNHCR, 2012)

The transitional shelter project in Haiti 2010 (M) had a raised cement plinth to reduce water and vermin ingress and an extra space was provided by the front veranda. The frame's material could be assumed through images as being made of timber (Figure 6.24) (IFRC, UN-Habitat and UNHCR, 2012).

Figure 6.24: Haiti transitional shelter 2010- photo by Shaun Scales-NRC (IFRC, UN-Habitat and UNHCR, 2012)

The Somalia shelter (J) is the smallest shelter amongst the 2009-2010 studied cases. The shelter was made of timber and corrugated iron (Figure 6.25). The aim of the shelter project was to enhance the living conditions for the displaced families in Hargeisa-Somalia. According to UN-Habitat and IFRC (2010), the design was inspired by previous shelters that were locally built by low-income community. The shelter's internal thermal comfort was found to be less hot compared to the 'Tukul' shelters that were previously self-built in the camp. Dust penetration was cited as a main concern. Simple post foundations were used in order to make relocation simpler. The cited criticism involved the thin and loose timber roofing and that termite infestation could have been reduced if the walls were raised above the ground level.

Figure 6.25: Somalia transitional shelter 2009- photo by Jozeph Ashmore (UN-Habitat and IFRC, 2010)

Shelter (O) in Haiti used a timber frame and a stone foundation that raised the shelter above the ground level as shown in Figure 6.26. The recommendations from IFRC (2013) included the decrease of the roof's overhang as in case of hurricanes, roof failures usually occur due to wind pressure and suction on the overhangs, via a leverage effect. To minimise the level of maintenance and extend the life span of the shelter, the local population was encouraged to apply preservative to the timber. However, if pre-treated timber was used, it could have provided a more robust result.

Figure 6.26: Haiti T-shelter 2010- (IFRC, 2013)

6.5 Global shelter case studies 2011-2012

The number of recorded natural disasters in 2011, excluding the biological disasters, were 332 (Guha-Sapir *et al.*, 2012), and 310 in 2012 (CRED CRUNCH, 2013). However, as discussed in chapter 2, the criteria used for counting the disasters differ from one source to another. According to Swiss Re- Sigma (2012), the total number of disasters had a significant increase in 2011 to reach 325, of which 175 were natural and 150 man-made. While in 2012, the number of disasters decreased to 318 events, of which 168 were natural and 150 man-made disasters (Swiss Re- Sigma, 2013). This section discusses the shelters that were built during the years 2011-2012. Figure 6.27 illustrates the cases that are studied in this section in relation to the countries they were implemented.

The ‘Shelter projects 2011-2012’ was the data source for South Sudan 2011 (U), Cote d’Ivoir 2010-2011 (V), Ethiopia 2011(T), Ethiopia 2012 (X), Burkina Faso 2012 (W), Madagascar 2012 (Y), South Sudan 2012 (Z) (IFRC, UN-Habitat and UNHCR, 2013). The detailed information for the projects in Philippines 2011 (S) and Philippines 2011(R), were sourced from the document ‘Post-disaster shelter: Ten designs’ written by IFRC (2013). From the ‘Shelter projects 2013-2014’, the following projects were studied: Fiji 2012 (AA), Myanmar 2012 (AB), Pakistan 2012 (AC), Pakistan 2012 (AD), Philippines 2012 (AE), and South Sudan 2012 (AF) (IFRC, UN-Habitat and UNHCR, 2014).

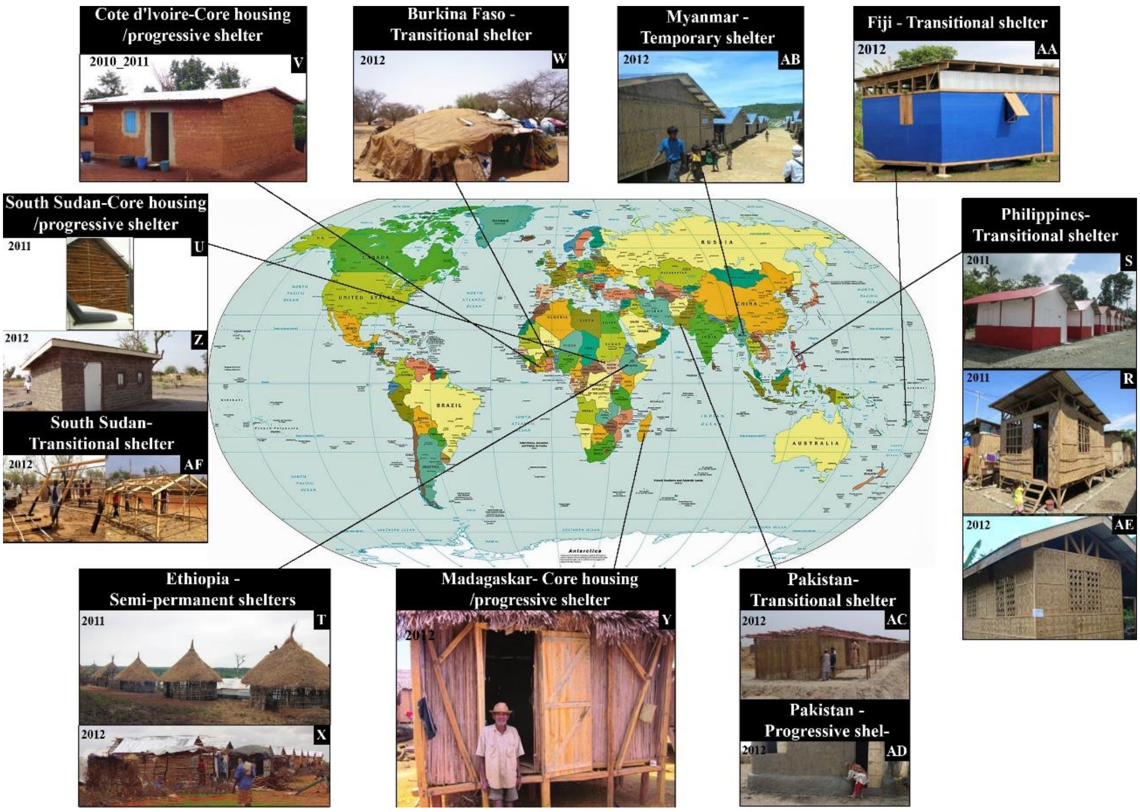


Figure 6.27: Case studies 2011-2012 on the world map

6.5.1 Cost comparison 2011-2012

During 2011 and 2012, the range of material costs varied between $128 and $1,800. Comparisons of material costs are shown in Table 6.8.

Table 6.8: Material costs comparison table 2011-2012[1]

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Materials cost per shelter in US Dollars							
						0-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750	1751-2000
R	NC	Philippines	2011	1823	5		■						
S	NT	Philippines	2011	250	5							■	
T	C	Ethiopia	2011	2175	_			■	■				
U	C	South Sudan	2011	6800	_		■	■					
V	C	Côte d'Ivoire	2010-2011	1341	_			■					
W	C	Burkina Faso	2012	1000	_	■							
X	C	Ethiopia	2012	7127	_			■					
Y	NC	Madagascar	2012	598	_	■							
Z	C	South Sudan	2012	1500	_				■	■			
AA	NC	Fiji	2012	254	_								■
AB	C	Myanmar	2012	2843*8	_			■					
AC	NF	Pakistan	2012	5167	_		■						
AD	NF	Pakistan	2012	1000	_		■						
AE	NT	Philippines	2012	4139	_		■						
AF	C	South Sudan	2012	3747	_		■						

Three of the studied projects were implemented in the Philippines, all of which were responding to the situation, post the 2010 cyclone. Two of the shelter types were built in 2011 (S) and (R), as shown in Figure 6.28 and Figure 6.29 respectively. The two projects have the same expected lifetime of five years. However, there was a significant difference in their material costs, which may be linked to the differences in the used materials.

Figure 6.28: Philippines shelter- Transitional shelter 2011- (IFRC, 2013)

[1] The shelters built in Myanmar were 8-unit shelters, so the number of shelters built were stated as (2843*8).

Both projects used corrugated metal roofs and concrete foundations but they have different building envelope materials. Additionally, the (S) shelter has concrete columns and includes a private bathroom (IFRC, 2013).

Figure 6.29: Philippines shelter- Transitional shelter 2011- (IFRC, 2013)

The project in Fiji was implemented after the tropical cyclone Evan that hit the area. The materials of the shelter cost about $1,800. This shelter has the most expensive materials between the projects that were studied in the years 2011-2012. The average material costs for the projects in this section is approximately $637 (Figure 6.34), which makes the material costs of Fiji equals triple the average (IFRC, UN-Habitat and UNHCR, 2014). Two of the possible reasons for this significant increase in cost may be the remoteness, (similar to Tonga 2009) with the need of importing timber, and the higher specifications of the structure in order to withstand severe cyclonic wind loads (Figure 6.30).

Figure 6.30: Fiji shelter 2012- photo by Habitat for Humanity Fiji (IFRC, UN-Habitat and UNHCR, 2014)

Due to the conflicts in Mali, affected people moved to neighbouring countries including Burkina Faso. In the beginning, support organisations tried to distribute the all-weather emergency tents, but people refused to occupy them. According to IFRC, UN-Habitat and UNHCR (2013), it was commonly believed between beneficiaries that those tents would not be sufficient to protect them from the extreme weather conditions.

The beneficiaries, who were originally from the Tuareg population in Mali, were used to living in traditional tents next to their mud brick houses. This project provided them with shelters that were similar to their traditional tent and cultures but with some differences in used materials (Figure 6.31). The cost of the shelter materials was $240, which is close to one-third of the average ($637). The use of traditional lightweight materials maybe the main reason behind the shelter's low cost (IFRC, UN-Habitat and UNHCR, 2013).

Figure 6.31: Burkina Faso temporary shelter 2012- photo by Christian Jepsen (IFRC, UN-Habitat and UNHCR, 2013)

During the years 1977 to 2012, Madagascar has experienced approximately 46 natural disasters. The project mentioned in this section was built in 2012, after two tropical storms (Giovanna and Irina). This project has the lowest material costs amongst the ones studied for the years of 2011-2012; $128 (IFRC, UN-Habitat and UNHCR, 2013). The shelter design was an adaptation of the traditional houses involving a wooden frame with thatch or corrugated sheeted roofs. Reasons behind the low cost may include the budgetary constraints, and that most of the materials were sourced locally by the beneficiaries themselves (Figure 6.32) (IFRC, UN-Habitat and UNHCR, 2013).

Figure 6.32: Madagascar shelter 2012- photo by CRS (IFRC, UN-Habitat and UNHCR, 2013)

Figure 6.33 shows that there is no association between the year of the project and the material costs involved. The costs variation has more alignment with the design, materials and the geographic location. Remote areas, hard to reach areas, and lack of sufficient locally produced materials for shelter construction appear to be some of the factors behind an increased material costs. The average material cost per shelter for 2011-2012 was $637 (Figure 6.34), with $778 in 2011 and $566 in 2012. This may relate to the raise in the number of implemented projects during 2012 with less material costs.

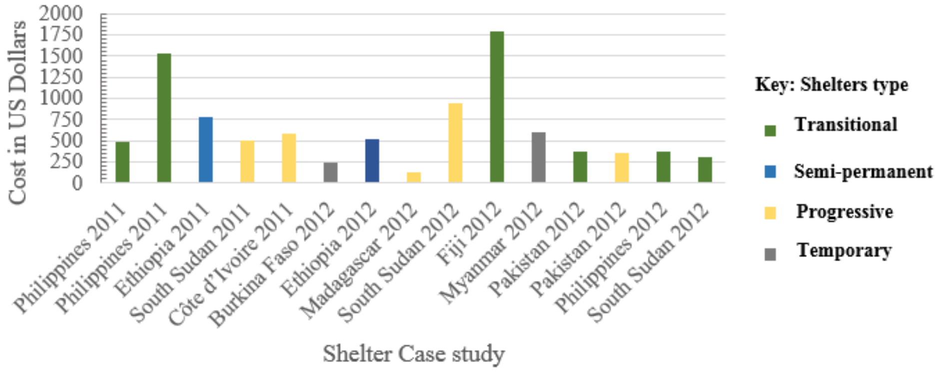


Figure 6.33: Material costs comparison 2011-2012- Chronological order

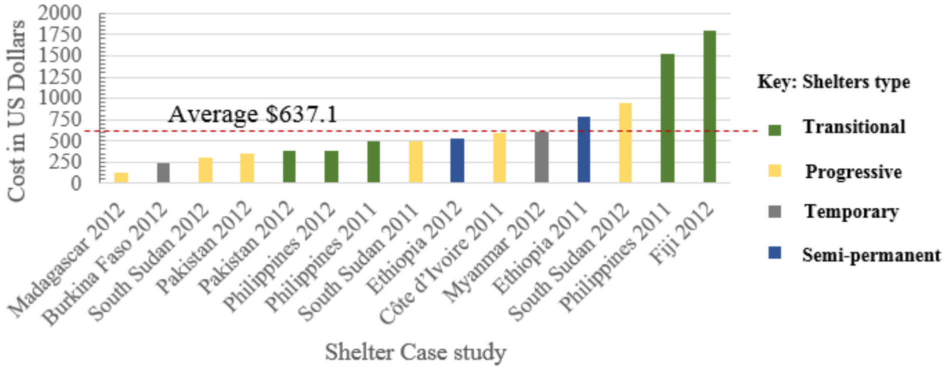


Figure 6.34: Material costs comparison 2011-2012- Ascending order

6.5.2 Size comparison 2011-2012

The 15 projects studied in the years 2011 and 2012, had a very wide range of sizes from 12 m^2 to 38 m^2. A size comparison between the projects studied in the 2011-2012 section is illustrated in Table 6.9. A noticeable outlier is the shelter with the largest size in this section in Cote d'Ivoire (V)—also called Ivory Coast. The shelter has a size of 38 m^2, built in a familiar design to users using local materials (Figure 6.35). The relatively large size may reflect the typical local design size and the use of locally produced mud blocks. Lowering construction costs using the beneficiaries' labour may also have contributed to the size factor (IFRC, UN-Habitat and UNHCR, 2013). The second largest shelter is the Philippines (S), but as mentioned previously in the cost comparison discussion, this project has a high material cost. The Madgascar project (Y) has the smallest shelter size (12 m^2) compared to other cases implemented during the same period. This may be due to the budgetary constraints that limited the project as mentioned in IFRC, UN-Habitat and UNHCR (2013).

Table 6.9: Size comparison table 2011-2012

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size- m^2					
						15=>	16-20	21-25	26-30	31-35	36-40
R	NC	Philippines	2011	1823	5		■				
S	NT	Philippines	2011	250	5				■		
T	C	Ethiopia	2011	2175	_	■	■	■			
U	C	South Sudan	2011	6800	_		■	■			
V	C	Côte d'Ivoire	2010-2011	1341	_						■
W	C	Burkina Faso	2012	1000	_			■			
X	C	Ethiopia	2012	7127	_			■			
Y	NC	Madagascar	2012	598	_	■					
Z	C	South Sudan	2012	1500	_		■	■			
AA	NC	Fiji	2012	254	_			■			
AB	C	Myanmar	2012	2843*8	_		■				
AC	NF	Pakistan	2012	5167	_			■			
AD	NF	Pakistan	2012	1000	_		■				
AE	NT	Philippines	2012	4139	_		■	■			
AF	C	South Sudan	2012	3747	_	■					

Figure 6.35: Cote d'Ivoire shelter 2010-2011- photo by Yao Albert Konan (IFRC, UN-Habitat and UNHCR, 2013)

In October 2011, about 54,000 Sudanese fled to Ethiopia due to conflicts. The shelter design was similar to what is already used by the host community (Tukuls) and its materials were locally available (Figure 6.36). These shelters were not familiar to the refugees and therefore did not fulfil their needs. There are three categories of shelters' sizes (10 m^2, 14 m^2 and 21 m^2) with costs of \$640, \$800, \$920, respectively. The shelters with varied sizes were distributed to families depending on their number (<2, 3-4, 6-8 persons) respectively. According to IFRC, UN-Habitat and UNHCR (2013), the shelters were cost-effective and more durable than tents.

Figure 6.36: Ethiopia shelters 2011- photo by Demissew Bizuwerk- IOM (IFRC, UN-Habitat and UNHCR, 2013)

The unit size for the shelters that were constructed in South Sudan (AF), was 15 m^2. The shelter was designed to accommodate families of three members or more. It also had the flexibility for future expansion. The gable walls and the roof section were prefabricated; the small size of the shelter may encourage the prefabrication approach (Figure 6.37).

Figure 6.37: South Sudan shelter 2012- photo by UNHCR (IFRC, UN-Habitat and UNHCR, 2014)

Figure 6.38 shows that shelters in the same country have approximately similar sizes; this may be aligned to family size and cultural need. The average size of the shelters studied was about 20 m^2. The sizes range between 12 m^2 to 38 m^2— can be similarly expressed as 60% to 190% when compared to the average shelter size. This difference indicates a big gap between the shelters' sizes (Figure 6.39).

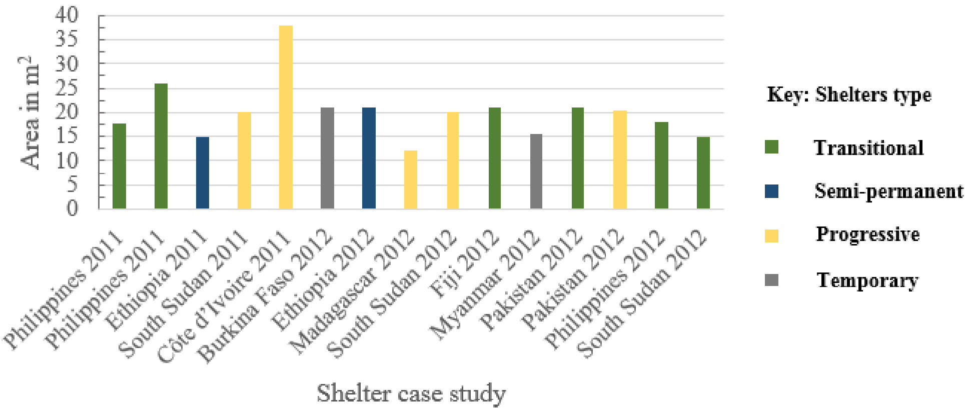


Figure 6.38: Size comparison 2011-2012- Chronological order

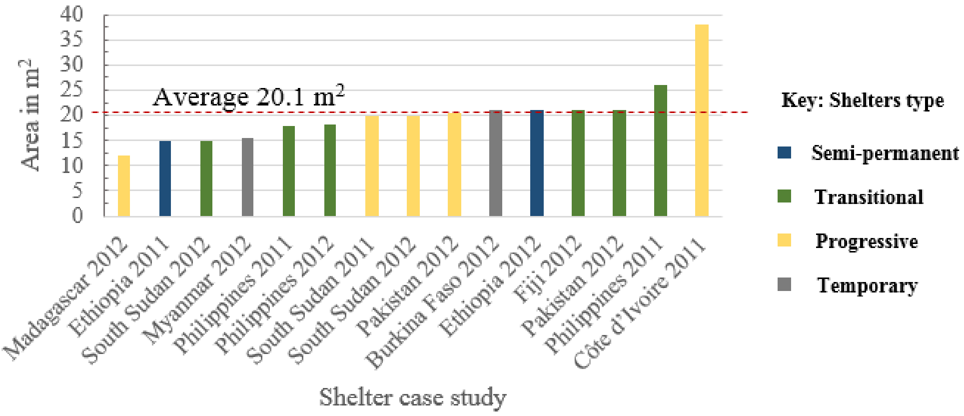


Figure 6.39: Size comparison 2011-2012- Ascending order

6.5.3 Materials comparison 2011-2012

A comparison of the various materials used for building the shelters is illustrated in Table 6.10. The Philippines shelter (S) has reinforced concrete columns, half height masonry walls, and timber for the rest of the walls. The floor was made of concrete while timber was used for the roof with metal on the sides (Figure 6.28). The materials chosen for the (S) shelter maybe one of the reasons behind the high cost, compared to the (R) shelter. The (R) shelter used locally available materials; exterior walls from Amakan (woven panels of bamboo or palm leave), floors and roof frames from coconut wood, and floor from plywood (Figure 6.29) (IFRC, 2013).

The design of the shelter provided for the Tuareg population in Burkina Faso (W) was similar to their traditional tent but with two plastic sheets and nine woven straw mats, instead of the tanned animal-skin (Figure 6.31). Mats were used for the walls and it gave them the flexibility of changing the location of the door depending on the direction of the wind (IFRC, UN-Habitat and UNHCR, 2013). The beneficiaries of the Cote d'Ivoire project (V) contributed in building the shelters. They were given brick moulds and other needed tools to produce the mud blocks (Figure 6.35). There were no information in regard to the materials of the floors and foundations (IFRC, UN-Habitat and UNHCR, 2013). The Shelters in South Sudan (AF) had a tarpaulin roof, and according to (IFRC, UN-Habitat and UNHCR, 2014), they were not protective from the sun and corrugated sheets were planned to replace the tarpaulins. Prefabricated timber was used for the end wall and roof sections, while bamboo was used in between the walls (Figure 6.37). The shelters in Ethiopia (T) as shown in Figure 6.36, had a timber and bamboo frame with a thatch roof that was plastered with mud whenever possible.

Table 6.10: Materials comparison table 2011-2012

Image	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Frame and/or walls							Roof						Floor				Foundation			
							Wood	Concrete	Masonry	Mud	Plastic	Mat	Plastic sheeting	Corrugated metal sheets	Wood	Steel	Plastic sheeting	Mud plaster	Thatch	Concrete	Wood	Mud plinth	Compacted earth	Steel reinforcement	Concrete	Stone	Wood
R	NC	Philippines	2011	Transitional shelters	1823	5	■ *B						■	■							■			■	■		
S	NT	Philippines	2011	Transitional shelters	250	5	■	■	■						■	■				■				■	■		
T	C	Ethiopia	2011	Semi-permanent shelters	2175	–	■ *B												■								
U	C	South Sudan	2011	Progressive shelter	6800	–	■ *B			■			■						■								
V	C	Côte d'Ivoire	2010-2011	Progressive Shelter	1341	–				■				■	■												
W	C	Burkina Faso	2012	Temporary shelter	1000	–	■				■	■					■										
X	C	Ethiopia	2012	Semi-permanent shelters	7127	–	■ *B							■			■								■		
Y	NC	Madagascar	2012	Progressive shelters	598	–	■							■	■				■							■	■
Z	C	South Sudan	2012	Progressive shelter	1500	–				■				■	■												
AA	NC	Fiji	2012	Transitional shelter	254	–	■						■	■									■		■		
AB	C	Myanmar	2012	Temporary shelter	2843*8	–	■ *B							■	■	■					■ *B						
AC	NF	Pakistan	2012	Transitional shelters.	5167	–	■ *B			■												■				■	
AD	NF	Pakistan	2012	Progressive Shelters	1000	–	■ *B			■					■ *B		■	■									
AE	NT	Philippines	2012	Transitional shelters	4139	–	■						■	■											■	■	
AF	C	South Sudan	2012	Transitional shelters	3747	–	■ *B						■	■			■										

6.6 Global shelter case studies 2013-2014

During 2013, approximately 308 disaster events occurred, 150 of them were natural disasters and 158 were man-made (Swiss Re-Sigma, 2014). In 2014 the total number of disasters increased by 10% than the previous year to reach 339 disaster. The main raise was in the number of natural disasters, which had increased by 27% to reach 191 disaster while the man-made disasters were 148 event with a decrease of 6% from 2013 (Swiss Re-Sigma, 2016). CRED documents recorded 330 natural disaster during 2013 excluding the biological disasters (Guha-sapir, Hoyois and Below, 2014) and 324 during 2014 (Guha-Sapir, Hoyois and Below, 2015).

Two cases from 2013 and a case from 2014 are studied in this section. These are Ethiopia 2013 (AH), Jordan 2013 (AG) and Myanmar 2014 (AI) with data taken from the shelter design catalogue (UNHCR, 2016). Jordan's data was also taken from the shelter projects 2013-2014 document (IFRC, UN-Habitat and UNHCR, 2014). The three cases, which were included in the study, were implemented as results of man-made conflicts. The three cases were the only projects that aligned with the criteria of choosing the cases in this research—provided as ready-built units, or as materials with recommended designs, excluding tents and permanent housing. The locations of the projects are shown below in Figure 6.40.

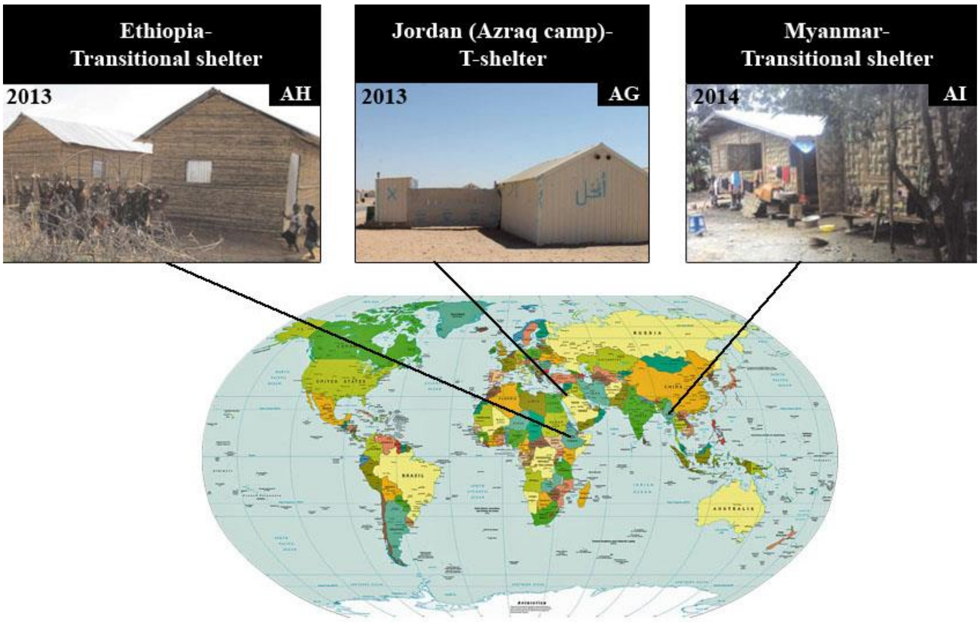


Figure 6.40: Case studies 2013-2014 on the world map

6.6.1 Cost comparison 2013-2014

Comparing the three cases (Table 6.11) shows that the material costs of the shelters in Ethiopia and Myanmar projects are approximately of the same range. While Jordan's T-shelters in Azraq camp have two significantly different costs. According to shelter projects 2013-2014, the material costs of the T-shelter in Jordan (AG) is $1340 (IFRC, UN-Habitat and UNHCR, 2014), while in the shelter design catalogue, the material costs of the same shelter is stated as $2374 (UNHCR, 2016). The Azraq camp shelters consist of interlocking steel structures, which were produced off-site in a factory and transported to the site (Figure 6.41). The use of steel as the only material and the remoteness of the camp inside Jordan may have resulted in the higher cost.

Table 6.11: Material costs comparison 2013-2014

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Cost per shelter / household in US Dollars									
						0-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750	1751-2000	2001-2250	2251-2500
AG	C	Jordan	2013	13500	2-4y						■				■ *
AH	C	Ethiopia	2013	_	2-4y		■								
AI	C	Myanmar	2014		2-4y	■									

* Refers to the material costs as stated in the shelter design catalogue document (UNHCR, 2016)

Figure 6.41: Azraq- Jordan T-shelter 2013- photo by Ru'a Al-Abweh (UNHCR, 2016)

Both shelters, in Myanmar (Figure 6.42) and in Ethiopia (Figure 6.43), were built with materials that are widely available or produced locally; this is amongst the reasons behind the acceptable cost of the shelters compared to Jordan's shelter. The cost of the Myanmar shelter (AI) was $454, it could host two families due to its twin design, which makes the cost $227 per family. The shelter is elevated from the ground and traditional construction methods were used to ease the maintenance (UNHCR, 2016). The twin-shelter system may be the reason behind the cheaper shelter's materials. The cost of Ethiopia's shelter (AH) was $448. The compact bamboo shelter has one door and two windows, which provide good ventilation in the hot climate. It has a corrugated iron sheet roof that is protective from the rain. Additionally, an internal partition is provided for enhanced privacy (UNHCR, 2016).

Figure 6.42: Myanmar transitional shelter 2014- (UNHCR, 2016)

Figure 6.43: Ethiopia transitional shelter 2013- (UNHCR, 2016)

The shelters in both Ethiopia and Myanmar are transitional while Jordan's shelter is a T-shelter (i.e. temporary or transitional). The average cost for the three projects as shown in Figure 6.44 is \$685. Noticeably, Jordan's project has raised the average.

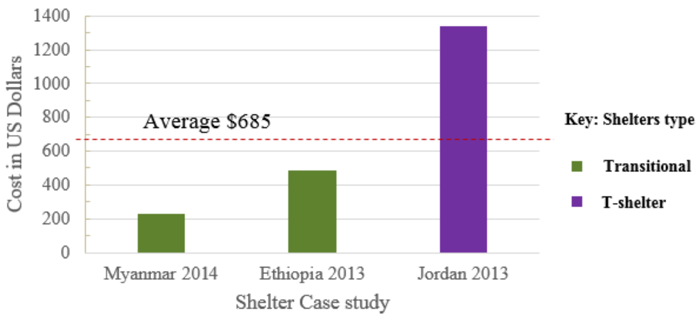


Figure 6.44: Cost comparison 2013-2014

6.6.2 Size comparison 2013-2014

The sizes of the three shelter projects range between 18 m^2 and 24 m^2. Size comparisons can be seen in Table 6.12 and Figure 6.45. Jordan's shelter was the largest (24 m^2), followed by Ethiopia (21 m^2) and Myanmar (18 m^2) per family. The small variation in sizes (shown in Figure 6.45) did not align with the significant difference in cost. Materials, type of build and location are likely to have been the primary influential factors.

Table 6.12: Size comparison table 2013-2014

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size- m^2		
						15=>	16-20	21-25
AG	C	Jordan	2013	13500	2-4y			
AH	C	Ethiopia	2013	_	2-4y			
AI	C	Myanmar	2014		2-4y			

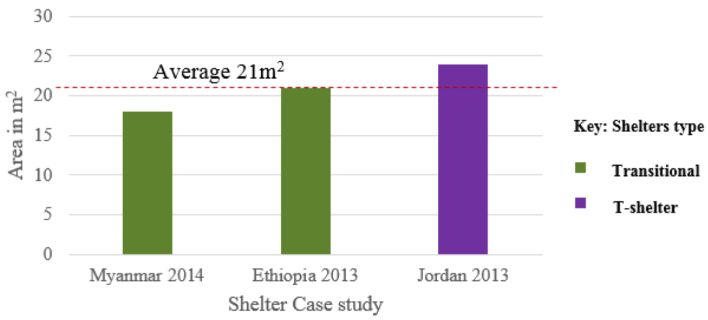


Figure 6.45: Size comparison 2013-2014

6.6.3 Materials comparison 2013-2014

A comparison in terms of the materials used in the three shelters studied in this section is shown in Table 6.13. Ethiopia's shelter (AH) had a basic design consisting of a wooden structure, bamboo wattle support structure, and a corrugated iron sheet roof. In cases where the cladding was not satisfying, residents used plastic sheeting or clothes to cover the walls. Bamboo mats was an optional cladding that was not included in the design, with the purpose of protecting the shelter from water and dust penetration (UNHCR, 2016).

The Myanmar shelter (AI) also had a timber frame structure and bamboo mat for the walls and floor. The roof was made of corrugated galvanised iron, and footings were made of concrete and raised above the ground (UNHCR, 2016). For the Jordan's project (AG), the main structural material in the T-shelter design is steel. The walls consist of two layers of Inverted Box Rib with aluminium foam insulation in between. A plastic sheeting was provided as an internal roof (IFRC, UN-Habitat and UNHCR, 2014).

Table 6.13: Materials comparison table 2013-2014

Image	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Frame and/or walls			Roof			Floor		Foundation
							Wood	Steel	Insulation	Corrugated metal sheets	Wood	Plastic sheeting	Wood	Concrete	Concrete
AG	C	Jordan	2013	T-shelters	13500	2-4y									
AH	C	Ethiopia	2013	Transitional	_	2-4y	*B								
AI	C	Myanmar	2014	Transitional		2-4y	*B						*B		

6.7 Global shelter case studies 2015-2016

During 2015, 353 disaster events occurred around the world with 155 man-made disasters and 198 natural disaster, the ever recorded in one year (Swiss Re-Sigma, 2016). In 2016, the total number decreased to 327 disaster events, of which 191 were natural disasters and 136 man-made (Swiss Re- Sigma, 2017). According to Guha-Sapir *et al.* (2016), there were 395 registered natural disaster in 2015 which was decreased during 2016 to 342 natural disaster.

The following cases were cited from the 'shelter projects 2015-2016' document: Nepal 2015 (AK), Philippines 2013-2015 (AL), Philippines 2013-2015 (AM), Ethiopia 2014-2016 (AN), Tanzania 2016-2017 (AO), Gaza 2014-2016 (AP) and Iraq 2015-2016 (AQ) (Global Shelter Cluster, 2017). The information regarding the Better Shelter project 2015-2016 (AJ) was taken from its official website (Bettershelter, 2017) and the shelter design catalogue (UNHCR, 2016). Figure 6.46 shows the location of the cases on the world map.

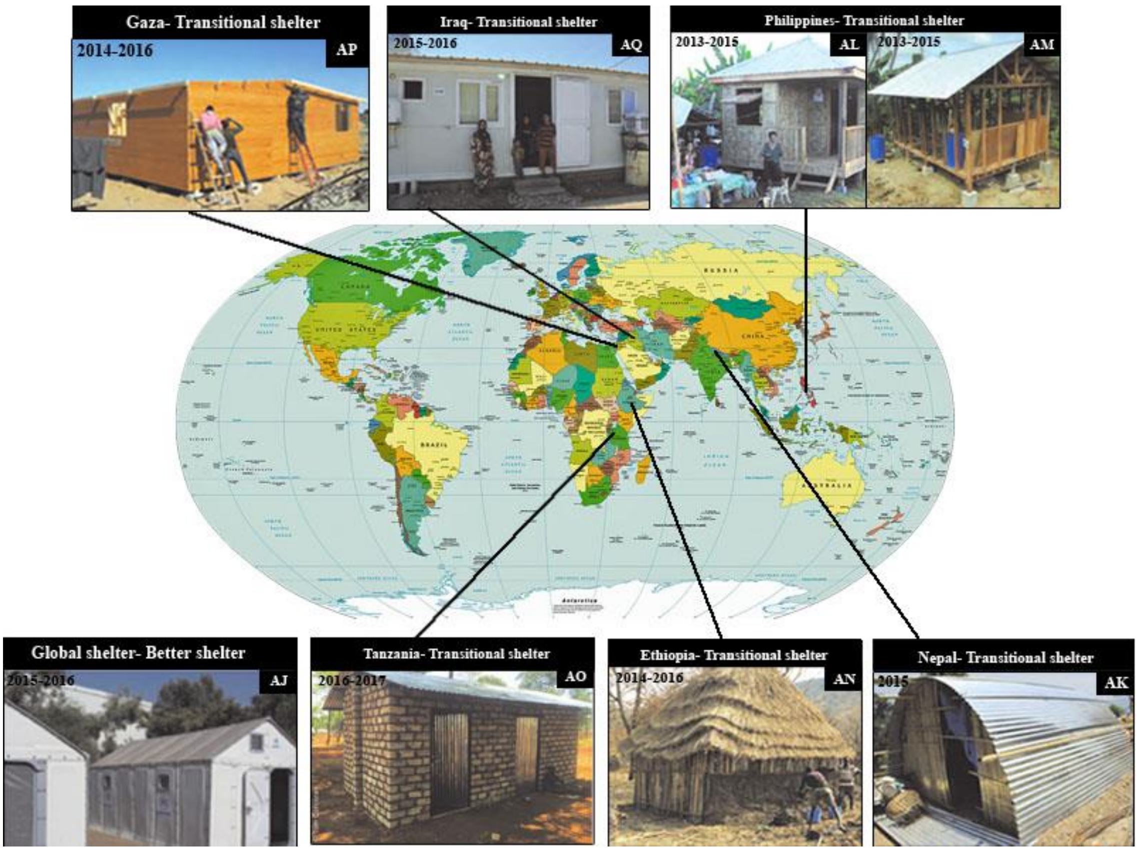


Figure 6.46: Case studies 2015-2016 on the world map

6.7.1 Cost comparison 2015-2016

The projects studied in this section have a wide range of material costs as shown in Table 6.14. The material costs range from $200 to $5,500. Some of the stated materials' price include labour and/or transport and some of them do not. This is due to the lack of a unified reporting form.

Table 6.14: Material costs comparison table 2015-2016

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Materials cost per shelter in US Dollars																		
						0-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750	1751-2000	2001-2250	2251-2500	2501-2750	2751-3000	3001-3250	3251-3500	3501-3750	3751-4000	4001-4250	4251-4500	4500<
AJ	GS	Better shelter	2015-2016	6870	1.5-3					■														
AK	NE	Nepal	2015	5065	_	■																		
AL	NT	Philippines	2013-2015	3500	3-5y					■	■	■	■											
AM	NT	Philippines	2013-2015	885	_														■					
AN	C	Ethiopia	2014-2016	835	_			■																
AO	C	Tanzania	2016-2017	7552	_		■																	
AP	C	Gaza	2014-2016	470	5																			■
AQ	C	Iraq	2015-2016	1406	_																			■

The Nepal project (Figure 6.47) had the lowest material costs of $200. The responsible organisation provided the beneficiaries with shelter kits combined with a training on how to erect a suitable shelter with the supplied materials. They were provided with a design but not forced to follow it. The materials were procured locally and the shelters were built by the beneficiaries themselves (Global Shelter Cluster, 2017).

Figure 6.47: Nepal transitional shelter 2015- photo by Adesh Tripathee in (Global Shelter Cluster, 2017)

Iraq's prefabricated shelter shown in Figure 6.48 has the most expensive materials amongst all the studied shelters in this chapter, of $5,500. The materials were locally procured but originally imported from neighbouring countries, which may have led to the high cost. Additionally, the higher quality of the prefabricated shelter, fittings and finishing compared to others, may be other reasons for this increased cost. One of the documented weaknesses mentioned that a flexible design could better meet the beneficiaries' needs (Global Shelter Cluster, 2017).

Figure 6.48: Iraq transitional shelter 2015-2016-
photo by Alan Miran in (Global Shelter Cluster, 2017)

In Gaza, a shelter project was implemented and served 470 households—the least number of beneficiaries amongst the projects in this section. Beneficiaries were families with houses that were completely destroyed throughout the war and had enough rubble-free area on their lands for the new shelters. This shelter allowed them to stay in their original neighbourhood, with the possibility of rebuilding their demolished houses (Figure 6.49) (Global Shelter Cluster, 2017). The shelter's material cost of $4,600 is the second highest material cost in this section. The shelter was made of timber, since most of other building materials were embargoed. The reasons behind the high material cost, may involve the higher build quality and design, the siege situation in Gaza which also resulted in procurement delays, and the higher specifications compared to other shelters (Global Shelter Cluster, 2017).

Figure 6.49: Gaza transitional shelter 2014-2016-
photo by CRS staff in (Global Shelter Cluster, 2017)

The Philippines project (AL) was implemented as a response to typhoon Haiyan. It used 'Debris to Shelter' approach to support people who had their houses completely destroyed or located in the coastal 'No Build Zone' and therefore, had to relocate. A million tree were salvaged, and its timber was used as the main construction material. While no sufficient evidence was found behind the cost variation of $1190-$1860, the change in the source of timber after using all the fallen coconut trees may have increased the material costs (Figure 6.50) (Global Shelter Cluster, 2017).

The other Philippines project (AM) in this section was also built in the same period following Typhoon Haiyan (Figure 6.51). The material cost was $3,500 per shelter, which is relatively expensive compared to the other projects in this section. No stated reason is given for the higher cost, but the materials high demand, the harsh climatic conditions, and the shortage in supply of good quality materials, may be some of the contributing factors (Global Shelter Cluster, 2017).

Figure 6.50: Philippines transitional shelter 2013-2015-
photo by Dave Hodgkin in (Global Shelter Cluster, 2017)

Figure 6.51: Philippines transitional shelter 2013-2015-
photo by World Vision in (Global Shelter Cluster, 2017)

The variety of the material costs for the projects built during 2015 and 2016 are shown in Figure 6.52—although some of the projects started or finished before or after those years. It is obvious that there is no relation between the year of the project, the shelter type and the cost (Global Shelter Cluster, 2017). Figure 6.53 shows a comparison between the material costs in an ascending order, where a clear gap between the projects is noticed. The average material cost is approximately $2,184.

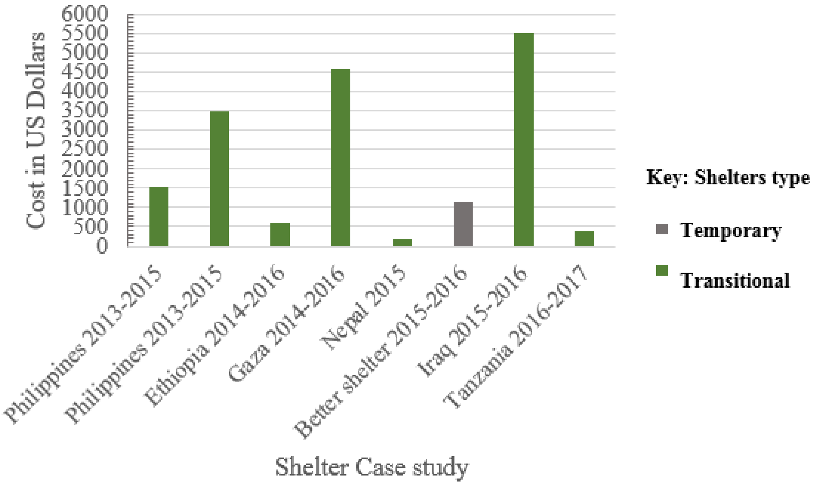


Figure 6.52: Material cost comparison 2015-2016- Chronological order

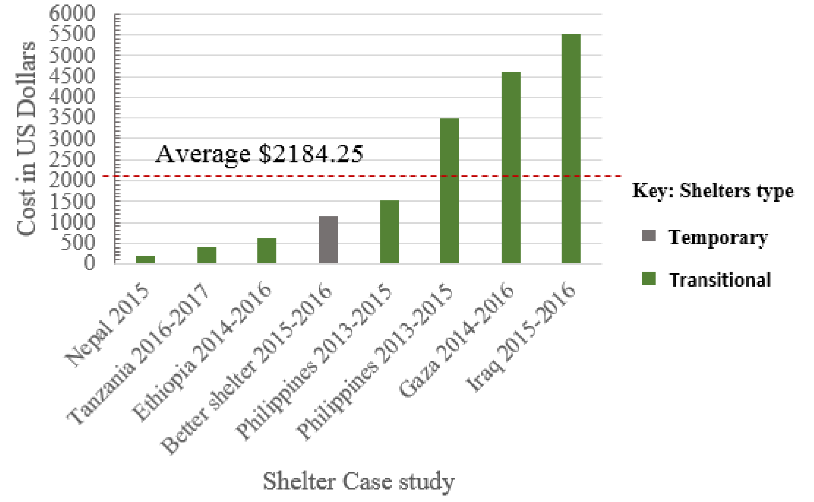


Figure 6.53: Material cost comparison 2015-2016- Ascending order

6.7.2 Size comparison 2015-2016

In contrast to the cost, most of the studied shelters' sizes are within the range of 16.7 m^2 to 25 m^2. The only outlier is the project in Gaza. A comparison between the different shelters' sizes is shown below in Table 6.15. According to Global Shelter Cluster (2017), prior to the project, some of the affected people in Gaza refused to receive steel prefabricated shelters that were distributed by some agencies. One of the reasons was their small size (Global Shelter Cluster, 2017). Gaza shelter (AP), which has an area of 62 m^2, has an L-shape outline that contains a bedroom, a kitchen, and a bathroom. The community was involved in the design stage (Global Shelter Cluster, 2017).

Iraq's shelter (AQ) has an area of 22.5 m^2, which is close to the average size of this section, i.e. 24.7 m^2 as Figure 6.55 shows. The size is not proportional with the cost, as the material costs of the Iraq shelter were the most expensive amongst the cases analysed in this section (Global Shelter Cluster, 2017). Nepal shelter (AK) which has the lowest cost amongst the cases studied during 2015 and 2016, has also the smallest size (16.7 m^2). The project distributed shelter kits and provided a suggested design. About 93% of households used the materials to build transitional shelters; 30% of them followed the suggested design, whilst the other 63% did not. The residents also used salvaged materials to meet their needs (Global Shelter Cluster, 2017).

Table 6.15: Size comparison table 2015-2016

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size per room/ family- m^2								
						15=>	16-20	21-25	26-30	31-35	36-40	41-45	46-50	50<
AJ	GS	Better shelter	2015-2016	6870	1.5-3		■							
AK	NE	Nepal	2015	5065	_		■							
AL	NT	Philippines	2013-2015	3500	3-5y			■						
AM	NT	Philippines	2013-2015	885	_		■							
AN	C	Ethiopia	2014-2016	835	_		■							
AO	C	Tanzania	2016-2017	7552	_		■							
AP	C	Gaza	2014-2016	470	5									■
AQ	C	Iraq	2015-2016	1406	_			■						

Figure 6.54 shows a size comparison of the shelters that were built during 2015-2016. It can be noted that there is no clear relation between the year, the shelter type, and its size. With the exception of Gaza's shelter, the size of the seven other shelters was between 17.5 m^2 and 24 m^2. The average size of the shelters that were built in the years 2015-2016 is 24.7 m^2, which would be 19.4 m^2 if the Gaza project was not included (Figure 6.55).

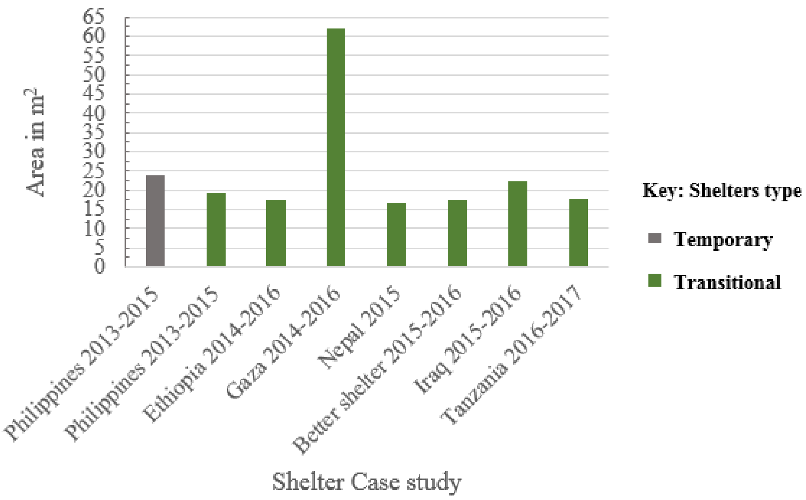


Figure 6.54: Size comparison 2015-2016

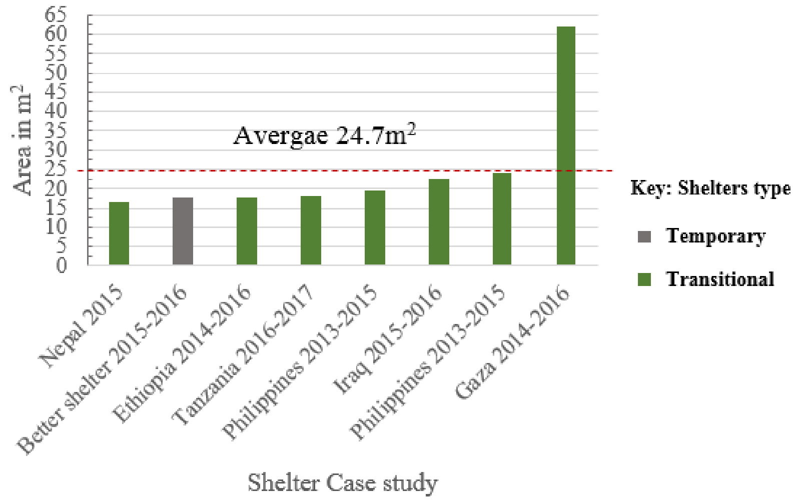


Figure 6.55: Size comparison 2015-2016- Ascending order

6.7.3 Materials comparison 2015-2016

Ranges of materials were used in the studied projects. However, the lack of information on the floor materials and the foundations is noted. A comparison between the materials used in each case can be found in Table 6.16.

Table 6.16: Materials comparison table 2015-2016

Image	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Frame and/or walls							Roof						Floor			Foundation
							wood	Steel	Mud	Brick	Corrugated metal sheets	Polymer plastic	Insulation	Corrugated metal sheets	Wood	Steel	Polymer plastic	Insulation	Thatch	Plastic flooring	Fiberglass	Wood	Concrete
AJ	GS	Better shelter	2015-2016	Temporary	6870	1.5-3		■				■	■				■			■			
AK	NE	Nepal	2015	Transitional	5065	_		■			■			■									
AL	NT	Philippines	2013-2015	Transitional	3500	3-5y	■				■												
AM	NT	Philippines	2013-2015	Transitional	885	_	■				■												
AN	C	Ethiopia	2014-2016	Transitional	835	_	■ *B		■						■				■				
AO	C	Tanzania	2016-2017	Transitional	7552	_				■				■									
AP	C	Gaza	2014-2016	Transitional	470	5	■							■								■	■
AQ	C	Iraq	2015-2016	Tarnsitional	1406	_		■					■	■		■		■			■	■	

For the frames and walls, the most common materials were wood, corrugated metal sheets and steel. Among the three aforementioned materials, corrugated metal sheets roofs were the most commonly used. Wood, polymer plastic and thatch were also used separately in different projects. Some projects did not provide information about the roof.

The shelter in Tanzania (AO) shown in Figure 6.56 was made out of bricks produced by the community members. The shelter had a size of 18 m^2, designed for the average family size of five members. A duplex shelter that has two doors and a partition in between was given to smaller families. The material costs were typically \$395.

Figure 6.56: Tanzania transitional shelter 2016-2017- photo by Tom Corcoran in (Global Shelter Cluster, 2017)

The shelter in Ethiopia (AN) used traditional techniques and the beneficiaries were involved in the building process (Figure 6.57). According to the shelter projects 2015-2016, the shelter had a size of 17.6 m^2 and the material costs were approximately \$604. It used treated eucalyptus posts; bamboo split bracings, mud plaster, and sloped grass roof on top of eucalyptus rafters and purlins. The door was made out of eucalyptus pole frames and corrugated iron sheet (Global Shelter Cluster, 2017).

Figure 6.57: Ethiopia transitional shelter 2014-2016- photo by Chiara Jasna Vaccaro in (Global Shelter Cluster, 2017)

The 'Better Shelter' is an enterprise based in Sweden that has partnerships with UNHCR and IKEA. They designed a shelter that is called Refugee Housing Unit (AJ). The shelter has an area of 17.5 m^2 with material costs of \$1,150 (UNHCR, 2016). Figure 6.58 shows the shelter which has a galvanised steel frame while the roof and the walls are made of recyclable polymer plastic panels (Bettershelter, 2017). The main structure is made of steel. The walls, roofs, and internal partitions were made of PU insulated sandwich panels. The flooring was composed of plywood sheets except for the bathroom, which was made of fibreglass. Many concerns were raised about the Refugee Housing Unit (known as the IKEA shelter), which forced UNHCR to stop distributing the remaining 10,000 shelter out of the 15,000 they originally bought. The concerns were regarding the shelter's vulnerability to fire, issues with the internal metal-tube frame, ventilation, and rigidity. In addition, it has no groundsheet and is inaccessible to wheelchair due to its raised door. However, a new enhanced version of the shelter is in the design stage (Fairs, 2017).

Figure 6.58: Refugee Housing Unit 2015-2016-
(UNHCR, 2016)

6.8 Conclusion

This chapter focused on the sheltering response during the past decade, from 2007 to 2016. The chosen 43 cases were shelters that are not tents nor permanent housing. They were distributed by the support organisations as ready designs or material kits with suggested designs. For this study, projects for every two years were grouped together for analysis. Material costs, shelter size and used materials were compared through tables and figures. Due to the wide range of case studies, geographic locations, type of projects and available documentation, the comparisons may have been limited, but they identified the range of adopted approaches. In terms of material costs and shelter size, only 38 cases had recorded data out of the 43 cases that were analysed in this chapter. Following the cost analysis, the ten main factors that affect the shelter material costs were identified as:

- **Availability of funding**
- **Quality and durability** of construction materials.
- **The simplicity** or complexity of shelter design
- **Location,** specifically remoteness of sites, increase the cost.
- **Community participation** during the design and implementation can both save money and achieve higher satisfaction levels between users.
- **Source of materials**, as local and locally available materials are generally cheaper than the imported ones.
- **Scale of shelter need** affects the total material costs

- **Construction methods** involving local traditional construction approaches were found to be less costly versus prefabrication.
- **Socio-political conditions** can force certain boundary conditions on materials, cost, longevity, and quality of the built shelters.
- **Productivity and efficiency**, as delayed procurement and delivery raise the cost.

While some of these aspects are uncontrollable such as the available funding or the scale of the needed shelters, others can be controlled. Considering these aspects in the decision-making process can minimise the total shelter cost. Moreover, the same analysis was undertaken in terms of shelter size and eight aspects were found influential, they are:

- **Availability of funding** determines the possible shelter size.
- **Existing habitat approach**—the size of the users' original houses.
- **The shelter's design**—simple designs reduce costs and enable funding to be directed towards a larger more practical shelter size.
- **Source of materials**, where the use of local materials can save money that can be redirected into a bigger shelter.
- **Number of beneficiaries per shelter** influences the size and design.
- **Scale of shelter need** in relation to economy of scale versus the size.
- **Status and available land**, as the available land affects the shelter size.
- **Construction methods**— the self-built shelters provide size flexibility, while the shelter size is influenced by the transportation method in cases of prefabrication.

Table 6.17 shows a comparison between the aspects that affect the material costs and shelter size. As shown, there are five common factors: availability of funding, shelter's design, source of materials, construction methods, and scale of shelter needs.

Table 6.17: Aspects affecting material costs and shelter size

Aspects	**Material costs**	**Shelter size**
Availability of funding	✓	✓
Quality and durability	✓	
The shelter design	✓	✓
Location	✓	
Community participation	✓	
Source of materials	✓	✓
Construction methods	✓	✓
Socio-political conditions	✓	
Productivity and efficiency	✓	

Aspects	Material costs	Shelter size
Scale of shelter need	✓	✓
Existing habitat approach		✓
Number, age, and gender of beneficiaries in the shelter		✓
Status and availability of land		✓

Regarding materials, bamboo and/or thatch shelters with mud plaster, is an efficient low-cost construction. It has been widely used in shelter designs for regions where such materials are locally available, such as the Philippines and Ethiopia. Additionally, woven split bamboo mats were widely used. Moreover, Tukul shelters and wattle and daub were used; however, the high indoor temperature in such methods was a concern.

Locally sourced wood and plywood sheets are among the most used materials for shelters, while the mud blocks are becoming second for its efficiency. However, the use of mud must be planned as the resulted holes usually become refuse pits or mosquito-breeding sites. Additionally, corrugated sheets are often used in the zones where no local temporary materials can be found. Tarpaulins were also popular for walls, mainly for insulation. Corrugated sheets were often used for roofs due to its strength, light weight, affordability, ease of fixing, and channelled drainage. Wood or/and bamboo are the second most used materials for roofing, whether as primary materials or as supporters to other materials. Tarpaulins were also used for roofing, especially in cases that involved rapid responses, but it is noticeably not protective against the harsh weather conditions. For shelter floors, many projects did not indicate the flooring material. It could refer to either lack of documentation or absence of floors. The materials mentioned were wood, concrete and compacted earth. Raised floors or building over a plinth is a technique that was used in areas prone to flooding. The foundation information was also undocumented; however, concrete and stone were among the documented foundation materials.

The justification behind choosing the shelter type is not addressed in the documentation of the projects. This gap was also highlighted by Ramboll and Save the Children (2017), as they recommend publishing the rationale behind the shelter responses in the future 'Shelter Projects' documents, and to develop summary sheets on typical responses. Moreover, during the review, a lot of missing information formed obstacles against deeper comparisons and findings. Therefore, the typical documentation cover page of the 'Shelter Projects' was adapted and edited with extra recommended fields. The proposed form is presented in the next two pages. The findings of this chapter are further analysed, compared, and discussed in the following chapter, numbered 7.

(Geographical Zone) (Disaster type)

CASE STUDY NAME

KEYWORDS:

PROJECT LOCATION	
CRISIS	
TOTAL HOUSES DAMAGED	
TOTAL PEOPLE	
BENEFICIARIES	
PROJECT OUTPUTS	
OTHER OUTPUT	

MAP

PROJECT DESCRIPTION

SHELTER RESPONSE *(WITH JUSTIFICATION)*

PROJECT TIMELINE

STRENGTHS	WEAKNESSES

(Geographical Zone) (Disaster type)

SHELTER SIZE

SHELTER DENSITY

MAXIMUM NUMBER OF BENEFICIARIES PER SHELTER

COST PER SHELTER → MATERIALS COST
LABOUR COST
TRANSPORTATION COST
MANAGEMENT COST
TOTAL PROJECT COST

SPEED OF CONSTRUCTION

EXPECTED LIFETIME

SANITARY *(INCLUDED IN THE DESIGN? PRIVATE OR COMMUNAL? IF COMMUNAL- MIXED OR SEPARATED GENDER)*

KITCHEN *(PRIVATE OR COMMUNAL)*

DRAINAGE

MATERIALS USED → FOUNDATIONS
FRAME
WALLS
FLOOR
ROOF

SOURCE OF MATERIALS

CONSTRUCTION TECHNIQUES

LABOUR SKILLS *(HIGHLY SKILLED WORKERS OR BUILT BY STAKEHOLDERS)*

ABILITY TO RESIST FUTURE NATURAL DISASTERS *(IF APPLICABLE)*

Chapter 7

Findings from reviewing the global shelters

This Chapter will analyse the results of the previous chapter (Chapter 6) which reviewed the shelter projects during (2007-2016). The number of shelter case studies assessed in the previous chapter is 43, only 38 of them included specific data and information regarding cost and size. These 38 cases will be analysed and compared in this chapter.

7.1 Introduction

As mentioned in chapter 2, in the period between 2008 and 2017, the total number of disaster events was 3,208 of which 1,652 were natural disasters and 1,556 man-made. Despite the importance of identifying the number of disasters, they do not give indications on the numbers of affected people. As an example, the Syrian war may be counted as one man-made disaster, but it was described by the U.N. High Commissioner for Human Rights, as the worst man-made disaster since world war II (Siegel, 2017). The tables in this chapter adopt the same format used in Chapter 6 and the same acronyms are being used as shown in Table 7.1.

Table 7.1: List of acronyms used throughout the chapter

C- Conflict	NF- Natural Flood	GS- Global Shelter
NTs- Natural Tsunami	NT- Natural Typhoon	NE- Natural Earthquake
NC- Natural Cyclone	GS- Global Shelter	

7.2 Cost analysis

Table 7.2 shows the material costs of all the 38 shelters. There are 11 case studies, which had costs under the range of $251-$500, six of them were built after conflicts, and the remaining five were built after natural disasters. This suggests that there is no clear relation between the cost and the disaster type. In addition, no direct relation was found between the cost and the shelter type as the shelters involved various construction types.

Table 7.2: Material costs comparison table 2007-2016

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Materials cost per shelter in US Dollars																		
						0-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750	1751-2000	2001-2250	2251-2500	2501-2750	2751-3000	3001-3250	3251-3500	3501-3750	3751-4000	4001-4250	4251-4500	4500<
A	NF	Kenya	2007	500	_		■																	
F	NC	Bangladesh	2007	1250	_							■												
H	NT	Tonga	2009	74	_																		■	
I	C	Kenya-Dadaab	2009	up to 3500 PY	_		■																	
J	C	Somalia	2009	634	_			■																
K	C	Afghanistan	2009	380	1		■																	
L	NE	Haiti	2010	3960	_										■									
M	NE	Haiti	2010	1356	_							■												
N	NF	Pakistan	2010	175	_			■																
O	NE	Haiti	2010	2000	3 to 5							■												
P	NE	Haiti	2010	4471	5 to 10											■								
Q	NE	Haiti	2010	1050	3 to 5							■												
R	NC	Philippines	2011	1823	5		■																	
S	NT	Philippines	2011	250	5							■												
T	C	Ethiopia	2011	2175	_			■	■															
U	C	South Sudan	2011	6800	_		■	■																
V	C	Côte d'Ivoire	2010-2011	1341	_			■																
W	C	Burkina Faso	2012	1000	_	■																		
X	C	Ethiopia	2012	7127	_			■																
Y	NC	Madagascar	2012	598	_	■																		
Z	C	South Sudan	2012	1500	_				■	■														
AA	NC	Fiji	2012	254	_								■											
AB	C	Myanmar	2012	2843*8	_			■																
AC	NF	Pakistan	2012	5167	_		■																	
AD	NF	Pakistan	2012	1000	_		■																	
AE	NT	Philippines	2012	4139	_		■																	
AF	C	South Sudan	2012	3747	_		■																	
AG	C	Jordan	2013	13500	2-4y						■				*									
AH	C	Ethiopia	2013	_	2-4y		■																	
AI	C	Myanmar	2014		2-4y	■																		
AJ	Global shelter	Better shelter	2015-2016	6870	1.5-3					■														
AK	NE	Nepal	2015	5065	_	■																		
AL	NT	Philippines	2013-2015	3500	3-5y					■	■	■	■											
AM	NT	Philippines	2013-2015	885	_														■					
AN	C	Ethiopia	2014-2016	835	_			■																
AO	C	Tanzania	2016-2017	7552	_		■																	
AP	C	Gaza	2014-2016	470	5																			■
AQ	C	Iraq	2015-2016	1406	_																			■

Excluding the two post-conflict cases that did not disclose the number of built shelters, and the global case of 'Better shelter' case, the total number of built shelters within this study include 54,816 post-conflict shelters in 16 case studies, and 37,517 post-natural disaster shelters in 19 cases studies.

Figure 7.1 illustrates material costs comparison between all the cases that are reviewed in the previous chapter, while Figure 7.2 shows the cases in cost ascending order. Despite the unequal studied samples, and the higher number of natural disasters during the last decade compared to man-made disasters as aforementioned in chapter 2; the number of built shelters after conflicts were noticeably higher than those in post natural-disaster situations. The reason could refer to the socio-political factors, including the media coverage as discussed in Chapter 2 referring to Kelman *et al.* (2011). Conversely, the study conducted by Rodella-Boitreaud and Wagner (2011), says that donors respond to natural disasters more than they respond to conflicts. The study also found that donors' interests in countries, is the main factor affecting the aid distributions. However, it can be noted that there is no direct relation between the material costs and the year they were built. Most of the shelters with higher material costs are transitional shelters; however, the transitional shelters appear in all cost ranges. The average material costs between all the studied projects was $1,243.

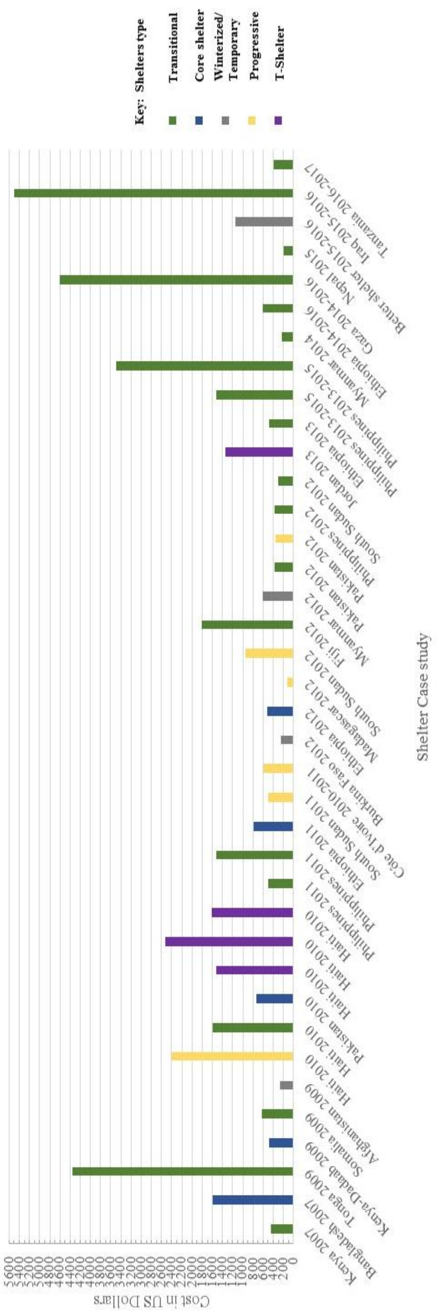


Figure 7.1: Material costs comparison 2007-2016- Chronological order

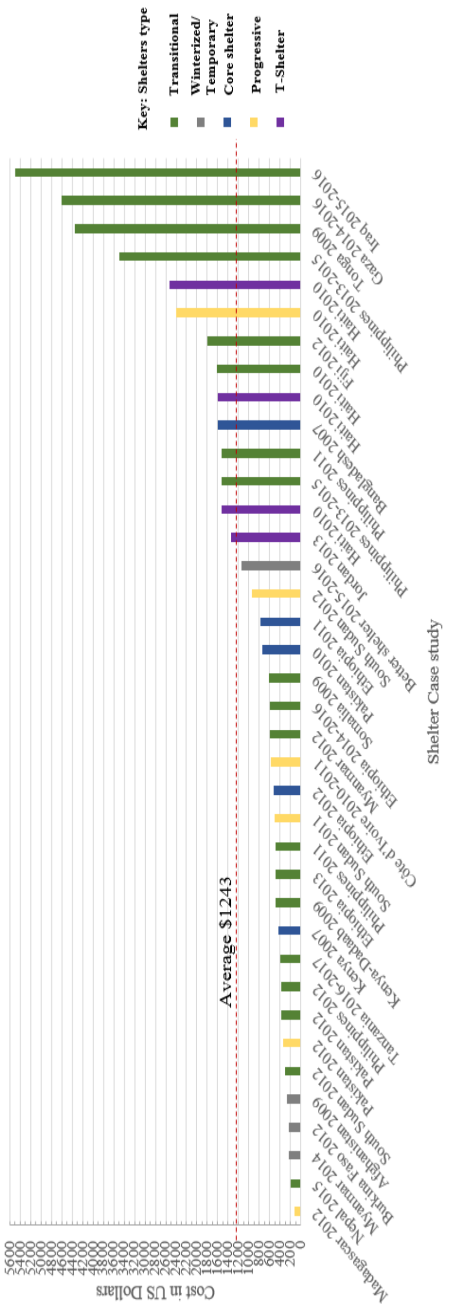


Figure 7.2: Material costs comparison 2007-2016- Ascending order

7.3 Size analysis

In contrary to the wide gap found between the projects' material costs, the projects' shelter size has a distinct grouping from 15 m^2 to 25 m^2. Approximately 50% of the shelter projects have a size within the range of 16-20 m^2 as shown in Table 7.3.

Table 7.3: Shelter size comparison table 2007-2016

Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size per room/family- m^2								
						15=>	16-20	21-25	26-30	31-35	36-40	41-45	46-50	50<
A	NF	Kenya	2007	500	_		■							
F	NC	Bangladesh	2007	1250	_	■								
H	NT	Tonga	2009	74	_		■							
I	C	Kenya-Dadaab	2009	up to 3500 PY	_		■							
J	C	Somalia	2009	634	_		■							
K	C	Afghanistan	2009	380	1						■			
L	NE	Haiti	2010	3960	_		■							
M	NE	Haiti	2010	1356	_		■							
N	NF	Pakistan	2010	175	_			■						
O	NE	Haiti	2010	2000	3 to 5			■						
P	NE	Haiti	2010	4471	5 to 10			■						
Q	NE	Haiti	2010	1050	3 to 5				■					
R	NC	Philippines	2011	1823	5		■							
S	NT	Philippines	2011	250	5				■					
T	C	Ethiopia	2011	2175	_	■								
U	C	South Sudan	2011	6800	_		■							
V	C	Côte d'Ivoire	2010-2011	1341	_						■			
W	C	Burkina Faso	2012	1000	_			■						
X	C	Ethiopia	2012	7127	_			■						
Y	NC	Madagascar	2012	598	_	■								
Z	C	South Sudan	2012	1500	_		■							
AA	NC	Fiji	2012	254	_			■						
AB	C	Myanmar	2012	2843*8	_		■							
AC	NF	Pakistan	2012	5167	_			■						
AD	NF	Pakistan	2012	1000	_		■							
AE	NT	Philippines	2012	4139	_		■							
AF	C	South Sudan	2012	3747	_	■								
AG	C	Jordan	2013	13500	2-4y			■						
AH	C	Ethiopia	2013	_	2-4y			■						
AI	C	Myanmar	2014		2-4y		■							
AJ	Global shelter	Better shelter	2015-2016	6870	1.5-3		■							
AK	NE	Nepal	2015	5065	_		■							
AL	NT	Philippines	2013-2015	3500	3-5y			■						
AM	NT	Philippines	2013-2015	885	_		■							
AN	C	Ethiopia	2014-2016	835	_		■							
AO	C	Tanzania	2016-2017	7552	_		■							
AP	C	Gaza	2014-2016	470	5									■
AQ	C	Iraq	2015-2016	1406	_			■						

The three outliers in terms of shelters size were built after conflicts and had served smaller numbers of beneficiaries. These projects were Afghanistan and Cote d'Ivoire with a size range between 36 m^2 and 40 m^2, and Gaza with a size of more than 50 m^2. Figure 7.3 shows that there is no obvious relation between the shelter size, the year when it was built, and the shelter type. More transitional shelters appear to have been built during the last third of the decade than previous years. However, the 'Shelter Projects' reports mention in their introductions that flexibility in terminology helped the implementation of the projects. This may indicate that the more frequent use of the term ‘transitional’ has nothing to do with the construction type.

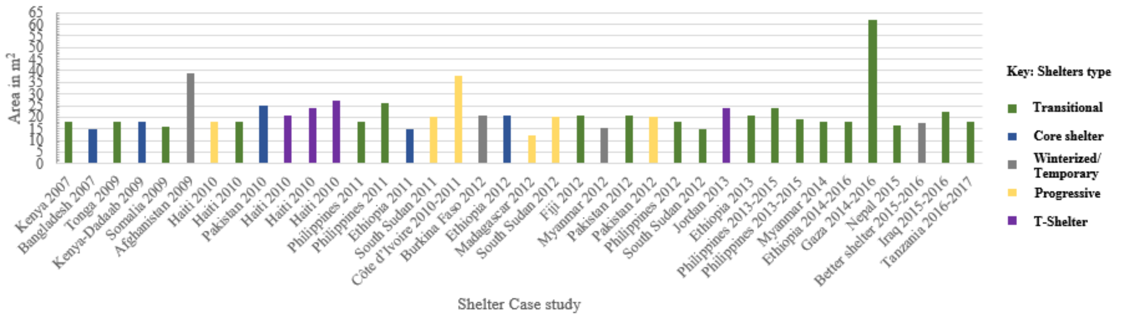


Figure 7.3: Shelter size comparison 2007-2016- Chronological order`

Figure 7.4 shows that the average size of the studied shelters was 21.6 m^2. According to the Sphere Project (2011), it is recommended to provide an area of 3.5 m^2/person as a minimum personal space in sheltering response. The average fulfils the sphere recommendation for families of six members and below, but around two-thirds of the projects have shelter size below this ‘recommended’ average. In addition, the shelters’ facilities, users’ needs and culture, and the number of household members differ between cases. One of the most common challenges faced by beneficiaries is the one size shelter as it fails to meet the needs of individuals.

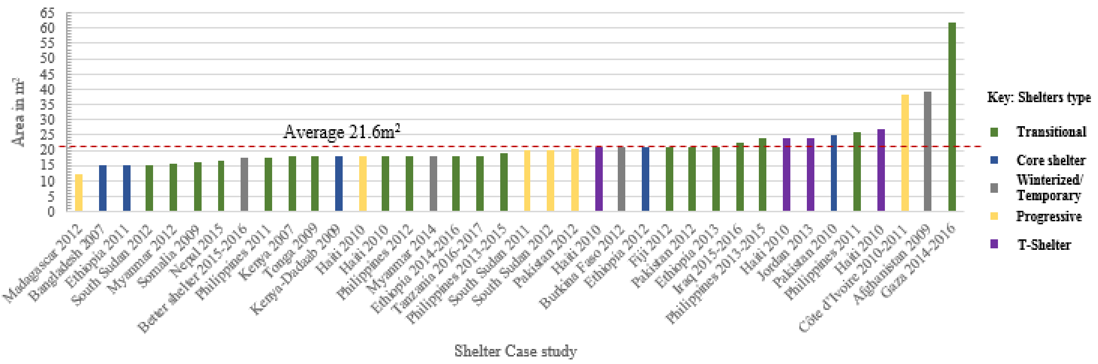


Figure 7.4: Shelter size comparison 2007-2016- Ascending order

7.4 Materials analysis

In addressing conflict events and displacement of people, the authorities appear in many cases to have a focus on temporary solutions, while avoiding any element that could encourage permanency. Such socio-political aspects may explain the limitations on using permanent materials such as concrete. Table 7.4 shows a comparison between the 38 shelters studied in terms of the materials used. This analysis investigated four areas of the shelter involving: a) frame and/or walls, b) roof, c) floor and d) foundations.

Table 7.4: Materials comparison table 2007-2016

Number	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Frame and/or walls												Roof										Floor						Foundation			
							Wood	Steel	Concrete	Masonry	Mud	Brick	Plastic	Corrugated metal sheets	Polymer plastic	Insulation	Mat	Plastic sheeting	Corrugated metal sheets	Corrugated bituminous	Wood	Steel	Metal sheet	Plastic sheeting	Polymer plastic	Insulation	Mud plaster	Thatch	Plastic flooring	Fiberglass	Concrete	Wood	Mud Plinth	Compacted earch	Steel reinforcement	Concrete	Stone	Wood
A	NF	Kenya	2007	Transitional	500	_	■					■		■																								
F	NC	Bangladesh	2007	Core shelter	1250	_	*B					■										■											■			■		
H	NT	Tonga	2009	Transitional	74	_	■																															
I	C	Kenya-Dadaab	2009	Core shelter	up to 3500 PY	_	■				■								■																			
J	C	Somalia	2009	Transitional	634	_	■							■					■		■										■							
K	C	Afghanistan	2009	Winterised	380	1	*B											■			■			■										■				
L	NE	Haiti	2010	Progressive	3960	_		■	■									■	■													■				■		
M	NE	Haiti	2010	Transitional	1356	_															■										■							
N	NF	Pakistan	2010	Core shelter	175	_			■			■						■			*B															■		
O	NE	Haiti	2010	T-shelters	2000	3 to 5	■														■		■								■					■	■	
P	NE	Haiti	2010	T-shelters	4471	5 to 10	■														■		■									■				■		
Q	NE	Haiti	2010	T-shelters	1050	3 to 5	■													■				■							■					■		■
R	NC	Philippines	2011	Transitional shelters	1823	5	*B											■	■													■			■	■		
S	NT	Philippines	2011	Transitional shelters	250	5	■		■	■											■	■									■				■	■		
T	C	Ethiopia	2011	Semi-permanent shelters	2175	_	*B																					■										
U	C	South Sudan	2011	Progressive shelter	6800	_	*B				■							■										■										
V	C	Côte d'Ivoire	2010-2011	Progressive Shelter	1341	_					■								■		■																	
W	C	Burkina Faso	2012	Temporary shelter	1000	_	■						■				■							■														
X	C	Ethiopia	2012	Semi-permanent shelters	7127	_	*B												■					■												■		
Y	NC	Madagascar	2012	Progressive shelters	598	_	■												■		■							■									■	■
Z	C	South Sudan	2012	Progressive shelter	1500	_					■								■		■																	
AA	NC	Fiji	2012	Transitional shelter	254	_	■											■	■															■		■		
AB	C	Myanmar	2012	Temporary shelter	2843*8	_	*B												■		■	■										*B						
AC	NF	Pakistan	2012	Transitional shelters.	5167	_	*B				■																						■				■	
AD	NF	Pakistan	2012	Progressive Shelters	1000	_	*B				■										*B			■			■											
AE	NT	Philippines	2012	Transitional shelters	4139	_	■											■	■																	■	■	
AF	C	South Sudan	2012	Transitional shelters	3747	_	*B											■	■					■														
AG	C	Jordan	2013	T-shelters	13500	2-4y		■								■			■					■							■							
AH	C	Ethiopia	2013	Transitional shelter	_	2-4y	*B												■		■																	
AI	C	Myanmar	2014	Transitional shelter		2-4y	*B												■													*B				■		
AJ	GS	Better shelter	2015-2016	Temporary	6870	1.5-3		■							■	■									■				■									
AK	NE	Nepal	2015	Transitional	5065	_		■						■																								
AL	NT	Philippines	2013-2015	Transitional	3500	3-5y	■							■																								
AM	NT	Philippines	2013-2015	Transitional	885	_	■							■																								
AN	C	Ethiopia	2014-2016	Transitional	835	_	■				■			■							■							■										
AO	C	Tanzania	2016-2017	Transitional	7552	_						■							■																			
AP	C	Gaza	2014-2016	Transitional	470	5	■												■													■				■		
AQ	C	Iraq	2015-2016	Tamsitional	1406	_		■								■			■							■				■		■						

The most frequent used materials and the number of projects that involved them, out of the 38 case studies are as follow. For the walls/ frames, wood and/or bamboo were the most frequent used material with (16) cases -around 42% of the total cases. Tarpaulin was second (eight), Mud (seven), and Corrugated sheets (six). Steel also was from the frequent materials used with five cases using steel for their walls/frames. For the roof structure, 18 cases (47%) used corrugated metal sheets. wood/bamboo roofs (14) plastic sheeting (seven), thatch (four) and steel (three). Many projects did not indicate the flooring material. It may not be documented or that those projects did not include flooring in them. The most used floor material was wood, used in seven cases. Concrete was the second most used floor material with six cases. Although concrete is considered as a permanent material, in some cases, it was accepted to be used for floors due to the impracticality of other available materials. Foundations also lacked documentation. The cases, which predominantly mentioned the foundations, included, concrete (13 cases) and stone (four cases). Steel reinforcement and wood were used in other projects.

7.5 Discussion

Due to the variation in the type of data, available and restrictive details of construction information and costs reported in numerous documents, the results and analysis are presented as indicative. Nevertheless, having compared the 38 key case studies with most information does provide a useful knowledge base for analysis. Table 7.5 shows a summary of average material costs and shelter size for each pair of years and the number of studied cases. The studied cases number in 2011-2012 were the highest; the only reason is that more projects in those years fit within the utilised criteria, i.e. non-tent and non-permanent shelters with ready or suggested designs from the aid providers.

The lowest average shelter size is observed for 2007-2008 years period; however, the average material costs is not the least. Referring to this period’s projects, the key reasons behind the smaller shelter size include land availability, remoteness, funding, and materials’ availability. The highest average material costs and the largest average shelter size was in the years 2015-2016. Planned projects like Gaza and Iraq increased these averages, as they were both built after conflicts, and had served smaller population numbers compared to other projects.

Table 7.5: summary of average material costs and shelter size

Years	Material costs		Shelter size	
	Number of cases	**Average material costs per shelter in US Dollar**	**Number of cases**	**Average size per room/family-m2**
2007-2008	2	$1020	7	16m^2
2009-2010	10	$1610.7	10	22.4m^2
2011-2012	15	$637.1	15	20.1m^2
2013-2014	3	$685	3	21m^2
2015-2016	8	$2184.3	8	24.7m^2

Figure 7.5 shows the minimum and maximum material costs for the studied projects in every pair of years. The projects in 2015-2016 have the widest range, as Gaza and Iraq projects had higher material costs compared to other projects during the same range of years. Another significant variation in projects material costs was during the years 2009-2010, caused by the wide material costs difference between Afghanistan project (K) and Tonga project (H). The rest of years had projects with material costs that are relatively close to each other.

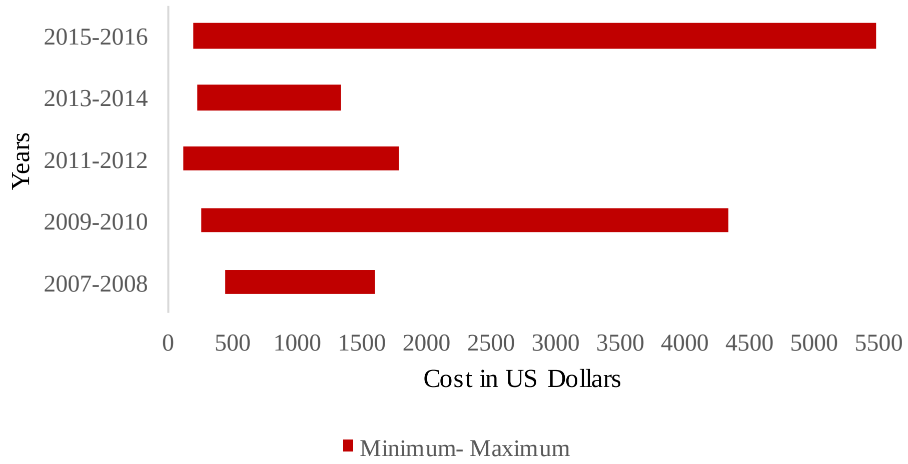


Figure 7.5: Minimum and maximum shelters' material costs per two years duration

Figure 7.6 shows the frequency of various material costs. About six projects had material costs around $500, while three projects had material costs around $1500. Two cluster areas for costs were observed, one at $500 and second at $1500. The difference between the average material cost ($1,243) and the most common material cost ($500) shows the funding disparities between different humanitarian responses. Figure 7.6 also shows the sporadic and significant higher shelters material costs.

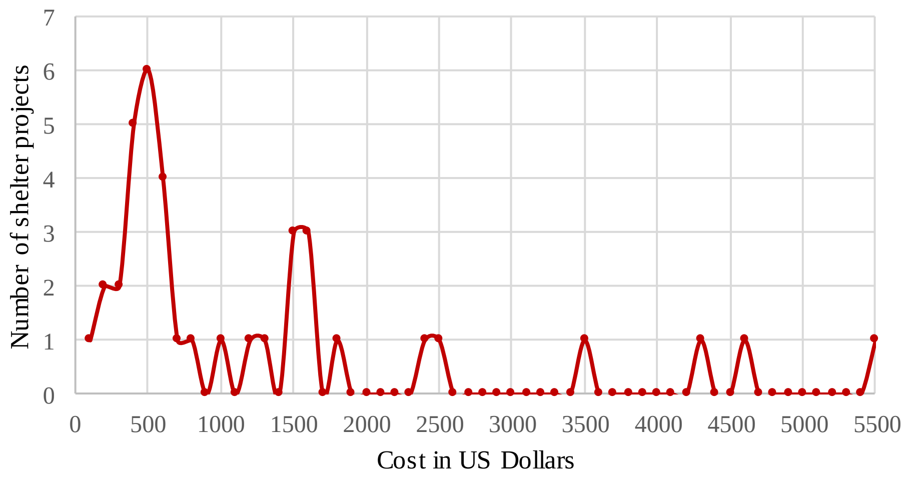


Figure 7.6: Comparing number of shelters at different costs

The minimum and maximum shelter size in each pair of years during the studied decade is shown in Figure 7.7. The years 2015-2016 have the widest gap in size, as Gaza shelter had the largest size of all studied projects throughout the decade. It is noticeable that the smallest shelter size in these two years is relatively large compared to other projects studied in other years.

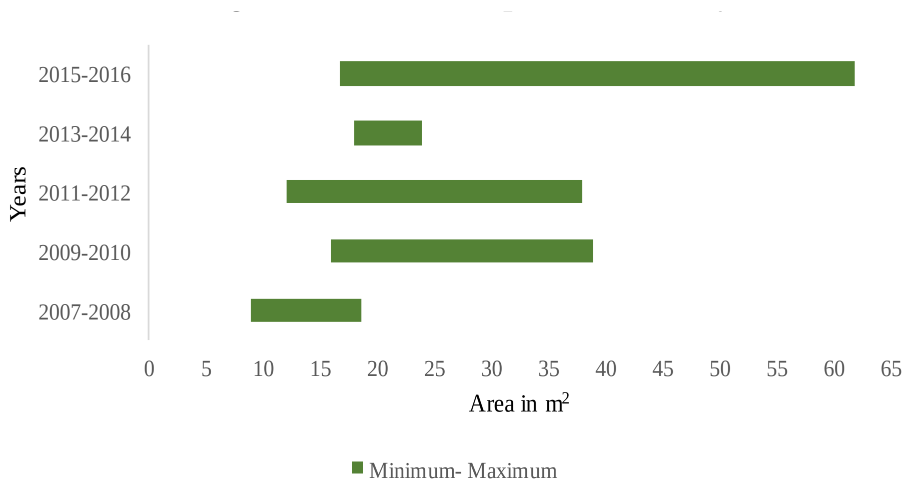


Figure 7.7: Minimum and maximum shelters' size per two years duration

The smallest gap was found in the projects studied during 2013-2014. This may be due to that only three studied projects were included during this period (where information was provided) but could also be due to the shelter type as all three were T-shelters. Figure 7.8 shows the most frequent shelter size. There are 11 case studies with size of approximately 18 m^2 and 6 cases of 21 m^2. The most common shelter size (18 m^2) is close to the average shelter size (21.6 m^2). Though the number of cases with high shelter size is limited, the difference between them and the most common size is significant.

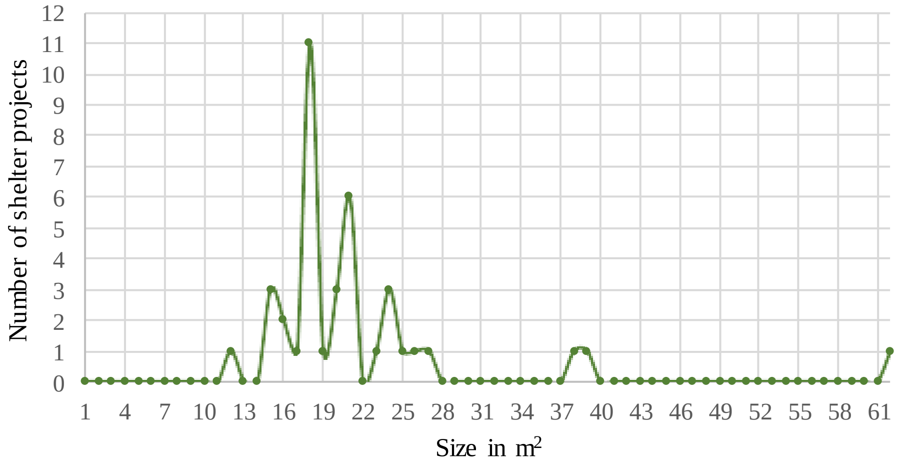


Figure 7.8: Most frequent shelter size

Out of the 38 studied cases, there are 18 cases that were built after conflicts, 19 after natural disasters and 1 global shelter, which is the Refugee Housing Unit by Better Shelter. The number of built shelters in each case differs widely; the lowest was the Tonga project with 74 shelters, and the highest was in Jordan with 13,500 shelters. The number of families that are hosted in those shelters were counted and Myanmar project was found to serve the highest number of families with its 2,843 shelters. Each shelter of the Myanmar project hosted eight families in separate rooms, resulting in a total 'equivalent' household unit of 22,744. Among the 38 shelter projects, only 12 projects have announced their expected life span; Haiti (P) has the maximum announced lifespan of 5-10 years (with maintenance), while Afghanistan (K) has the minimum with 1 year lifespan.

Regrouping shelters

It was noted that the terminologies used for the shelter types do not have unified standards. As previously mentioned in Chapter 2, various terminologies for shelter types were suggested by different sources. The review within this chapter and the previous chapter, clarify the absence of unified criteria for the shelter types. An experiment of regrouping the studied shelters was done based on the shelter specifications and used materials. The main purpose of the regrouping was to see if relations can be found between material cost, shelter size, and the used materials. Appendix C shows the images of the projects distributed in the six new groups with comparative tables of material cost, shelter size, and used materials. The groups were emergency shelters, temporary shelters, transitional shelters (woven bamboo/wood walls), transitional shelters (shelters with hard surface materials), T-shelters, and core shelters. It was found that the range of material cost, shelter size, and used material were narrowed for some of the new groups but not all of them, as the shelter type is not the only element affecting them.

Group 1- Emergency shelters involved five projects: Peru (D), Somalia (J), Afghanistan (K), Burkina Faso (W), Ethiopia (X), and Nepal (AK). It was noted that they all have material costs that were less than \$750 and size between 16 m^2 to 25 m^2 except for the Afghanistan project (K). No identified patterns were found in the used materials. The second group was for the Temporary shelters. It included four projects; Ethiopia (T), Madagascar (Y), Pakistan (AC), and Ethiopia (AN) and they all had material costs under \$1,000 and size below 25m2. Wood, mud, and thatch were the most commonly used materials.

Transitional shelters were divided into two groups, Group 3- transitional shelter (woven bamboo/wood walls) and Group 4- transitional shelters (harder surface materials). The Transitional shelters made of woven bamboo and/or wooden walls was the third grouping. It involved eleven cases: Peru (C), Bangladesh (F), Myanmar (G), Haiti (Q), Philippines (R), South Sudan (U), Myanmar (AB), Philippines (AE), Ethiopia (AH), Myanmar (AI), and Philippines (AL). Only two-thirds of the 9 cases with known material costs were within the range of \$251- \$750. All shelter sizes were under 30 m^2, with the majority falling within the range of 16 m^2 to 20 m^2. Group 4 has 11 projects: Kenya (A), Peru (E), Tonga (H), Kenya (I), Haiti (M), Haiti (O), Haiti (P), Philippines (S), Fiji (AA), South Sudan (AF), and Philippines (AM). No pattern was found in their costs but seven out of the eleven cases had a shelter size in the range of 16 m^2 to 20 m^2. All cases except Haiti (M) used wood for the frame and/or walls.

The T-shelters formed the fifth Group, it included: Jordan (AG), Refugee Housing Unit by Better Shelter (AJ), Gaza (AP), and Iraq (AQ). All cases had a pre-fabrication approach and were built in the Middle East, except the Refugee Housing Unit that is considered as a global shelter and was used in different countries including Middle Eastern. There was no significant pattern in the material costs except that both Iraq and Gaza have relatively expensive materials. The shelter size range between 16 m^2 to 25 m^2 except for Gaza project which has a large size of 62 m^2. No pattern was found in the used materials. The sixth and final group was for the Core shelters. It included projects with permanent materials such as blocks and concrete. There are seven cases in this group including Sri Lanka (B), Haiti (L), Pakistan (N), Cote d'Ivoire (V), South Sudan (Z), Pakistan (AD), and Tanzania (AO). No pattern was found in the used materials nor in their cost. The size ranged between 16 m^2 and 25 m^2 except for Cote d'Ivoire, which had size of 38 m^2. The regrouping may not be able to explain the differences in material costs, shelter size and used materials, as they also depend on other factors besides the shelter type. However, the regrouping highlighted the gap in the misused shelter terminologies.

7.6 Conclusions

This chapter analyses the material costs, shelter size and used materials in the shelters that were distributed in during the decade 2007-2016. The average material costs for all the studied cases was about \$1,250, although the most common material cost was approximately \$500. The difference between the average and most common material costs clarifies the funding disparities of the humanitarian responses. Most of the shelters with higher material costs are transitional shelters. However, the transitional shelters also appear in all cost ranges. In addition, more transitional shelters were built during the last third of the decade, which does not necessary mean complying with its specifications.

The gap between the average shelter size (21.6 m^2) and the most common size (18 m^2), is relatively small. However, about two-thirds of the studied projects have shelter size below the average. According to the Sphere Project (2011), it is recommended to provide an area of 3.5 m^2 per person as a minimum covered space in sheltering response. If it was assumed that each shelter hosts a family of five, then both the average and the common sizes would fulfil the guideline. However, as aforementioned in Chapter 2, the origin of the 3.5 m^2 is not valid (Kennedy and Parrack, 2013), and the needs of users differ between cultures. In addition, the shelter facilities, user needs, and the number of family members living together differ between projects. One of the main drawbacks that was repeated in most projects is the ‘one size shelter’ approach, as they lack the needed flexibility. The key reasons behind the cheaper and/or smaller shelters included the shelter type, land availability, remoteness, funding, material availability, and socio-political norms

The most commonly used materials were wood for the walls and framework, corrugated sheets for the roof and concrete for the floors and foundations. In post-conflict shelter response, permanent materials are prohibited. This may explain the choice of materials in the post-conflict projects. Local and locally available materials are preferred to be used wherever they can be accommodated in the shelter design. These materials are often familiar to users, could be self-maintained, environmentally friendly and cheaper than other global materials. Self-built approach minimises the cost of the shelter project. Therefore, it is recommended to design prefabricated parts that can be constructed on site by beneficiaries. If a hybrid approach was adopted for future shelter designs, whereby local materials can also be used with prefabricated sections, this would allow for a more standardised response, but with the added benefit of local sourcing and self-building. Generally, no relation was found between the material costs, shelter size, used materials, the year it was built, the cause of the displacement, or the shelter type.

The shelter types and the originally documented categorisations were found to be misleading, as similar shelters in different projects have different categorisation. Therefore, a regrouping experiment has been made for the studied projects depending on their characteristics. This experiment narrowed down the range of material costs, shelter size and used materials in each group but patterns were not always found due to the other factors that affect the shelter design. Having unified criteria for categorising shelter types would make the shelters design process, evaluation, and reporting rigorous.

Less than one-third of the shelters had documented lifespan expectancy. Knowing the expected lifespan would allow accurate shelter comparisons. However, this key factor does not appear to have any specific focus within documentation and reviews. The main guidelines that were extracted from the case studies are shown in Table 7.6. The following Chapter 8, will describe a Participatory Design experiment.

Table 7.6: Main guidelines extracted from reviewing the shelters around the world

Themes		**Guidelines**
Pre-design		• No permanent materials or construction details allowed • Aim for a simple shelter design • Users participation from early design stages • Align with existing typical housing approach • Flexible design
Materials		• Locally sourced or purchased materials • Materials made by users- ex. Bricks, woven bamboo • Lightweight materials (to reduce the need for lifting equipment) • Materials which are easy to transport • Materials which are resilient to possible natural disasters and environmental conditions
Shelter solutions		• Local or familiar construction build techniques • Can be built by users i.e. Not dependent on specialist equipment • Construction system that is protective and well-sealed • Environmentally friendly
Design elements	**Openings**	• A suitable private screened and shaded outdoor area • Adequate natural lighting and ventilation
	Interior	• The possibility of adding internal divisions • Ground floor raised, insulated underneath and washable
Future of the design		• Durable • Maintainable by users/ easily adaptable using locally available tools and materials • The possibility of future expansion or adding a second floor • Can be deconstructed for possible relocation

Chapter 8

Participatory Design experiment

This chapter discusses a Participatory Design experiment that was held in Jordan, specifically in Zaatari and Azraq camps. Experimental results were illustrated in the form of 3D mock-ups that were transformed into 2D plans. Comparisons between the plans were made in order to extract findings and guidelines to take forward to the shelter criteria and design stage.

8.1 Introduction

Community participation in post-disaster situations has received more attention in recent years, but it has not yet been implemented widely. Earlier projects have had end users involved in the building process or post sheltering feedback, but rarely during the design phase. Most cases discussed in the recent Shelter Projects 2015-2016 book, highlighted the lack of community engagement as a weakness. This gap involved the absence of users' involvement such as the case of Gaza project, or the lack of staff training on how to plan community involvement such as the case of Tanzania project. Other cases had lack of funds, safety, space or other influencing factors that affected the ability to engage the communities in the shelter design and construction (Global Shelter Cluster, 2017).

Concerning the Zaatari and Azraq Syrian camps in Jordan, previous reports and articles have highlighted significant issues with their shelters. ACTED (2017) discusses the poor conditions and rapid degradation of the prefabricated shelters in Zaatari camp. The Shelter Projects 2013-2014 book includes an assessment of the T-shelters of the Azraq camp, where the main weaknesses included the incapability of the used Inverted Box Rib (IBR) corrugated sheets to be sealed efficiently, which resulted in gaining heat. Additionally, the poor design of the T-shelters raised many privacy concerns (IFRC, UN-Habitat and UNHCR, 2014). Moreover, Albadra, Coley and Hart (2018) highlights the issues regarding the thermal performance and privacy in both Zaatari and Azraq camps.

In this research, specifically in Chapters 4 and 5, the main challenges that faced the residents in Zaatari and Azraq camps were presented. While in Chapters 6 and 7, the analysis of the case studies emphasized on the lack of user involvement in designing the shelters. As a response to these findings along with the literature review that triggered the fourth objective of this research, a second round of field visits took place at the same camps in Jordan, i.e. Zaatari and Azraq camps. During the visits, some of the residents participated in designing refugee shelters through a Participatory Design (PD) method.

The evidence of previous studies using PD as a research method is limited. However, the method was adopted by Architecture Sans Frontieres UK who carried out workshops around the world aimed at building communities using PD. Their work in Los Pinos and Kenya are two examples (Frediani, French and Ferrera, 2011; Frediani *et al.*, 2013). In the Los Pinos case, a two-week workshop was undertaken in the municipalities of Quito and Mejìa (Ecuador) to explore options for Los Pinos future upgrading. The 'dwelling' was one of the aspects they explored through different phases: diagnosis phase, dreaming exercises and then consolidating the findings. The dreaming phase included 'dreaming through drawing' and 'dreaming through modelling'. The latter indicated that modelling was a more accessible tool to the residents than drawing. The participants were given a kit of several room sizes and were asked to select rooms and build their own dream house (Frediani *et al.*, 2013). The 'dwelling' approach in the case of Kenya workshop was almost similar to that of Los Pinos. Frediani *et al.* (2011) described the four stages that was undertaken: 'Diagnosis through walking and talking', 'Dreaming through drawing', 'Dreaming through modelling', and 'Dreaming through typologies'. Despite that the given kit of room sizes in both cases (Los Pinos and Kenya) are claimed to be a result of the drawing exercises; the ready modelled rooms limits the choice of the participants and hence the use of their potential and creativity.

According to Sanders *et al.* (2010), the main challenge with PD is to find suitable techniques that are easy to use for non-professionals and allow them to add their unique input. The latter study organises the PD tools and techniques through a three-dimensional framework containing the form, purpose, and the context. Additionally, Sanders *et al.* (2010) recommends various variables that are used to determine the three previously-mentioned dimensions.

This chapter will analyse and discuss a PD experiment that was held in Jordan, specifically in Zaatari and Azraq Syrian camps. By applying the framework of Sanders *et al.* (2010), the present study chose the form of 3D mock-ups, in order to fill the purpose of generating design ideas and understanding the refugees' current experience. Information was gathered through face-to-face working groups. The selection of participants, their involvement and the techniques used were limited because of the many challenges that are usually present in the refugee camps and the sensitivity of the situation.

8.2 Data collection method

Visits to both Azraq and Zaatari camps in Jordan have been arranged during December 2017 and January 2018 respectively. The visits included four PD sessions that were held with 43 participants. Three of the sessions involved nine groups, where each group produced a 3D mock-up (one of the groups could not complete the mock-up), and the fourth session included one group that produced a 2D plan instead of the 3D mock-up. The participants included women, men and children providing a range of users input.

Each session started with a five-minute introduction about the researcher's background, purpose of the field visit, and an explanation of the experiment. The participants were informed that the discussions would be recorded and that photos of their work would be taken during the experiment. The participants have raised no objection to the approach. Each group was informed that the duration of the session was to be between 60 to 90 minutes, and they were made aware of their freedom to leave at any time and for any reason. Following the introduction, ten minutes of discussion followed. The participants were asked questions to initiate the discussions and prepare them for the experiment. The questions were as follows:

- Before arriving at the camp, what did you expect your shelter to be like?
- What are the main challenges you face while living in the shelters?

The aim when asking the aforementioned questions was to provoke the minds of the participants to answer the final question:

- What are the activities that you engage in and require space inside your shelters?

The answers to the last question were written in lists for everyone to see during the experiment. Following the discussion, they were asked to split up into groups of 4-6 participants depending on the session's overall number. The purpose was to design 3D mock-ups and/or plans for shelters that reflect their culture, beliefs and functional preferences. Each group was given a set of prepared materials in a scale of 1:25, which are listed below and shown in Figure 8.1:

- A baseboard with a drawn layout of the given land, framed layouts of the surrounding shelters (two metres in distance), and the main street. The dimensions of the land plot are 7.5 m x 4.8 m (considering that each shelter serves six people with a minimum area of 6 m^2 per person),

- Cardboards of different lengths and a ‘scaled dimension’ height of 2.8 m. The cardboard lengths were marked by a smooth slice every 1.2 m to help the participants and the researcher in estimating areas,
- Materials cut in the shape of doors (0.9 m x 1.8 m) and windows; small (0.5 m x 0.5 m) and big (1 m x 1 m),
- Other cardboard and EVA foam (soft polymer) pieces,
- A pack of putty removable adhesive, i.e. blue tack,
- Scissors,
- Markers.

The participants were asked to consider the outlined plot on the board (Figure 8.1) as a real piece of land that was given to them to build their own shelter. The provision of simple materials was hoped to ease and facilitate the interaction of the participants. Additionally, the participants were informed that the cardboards are sliced every 1.2 metre, so they can understand and have a feeling of the room sizes that they are creating.

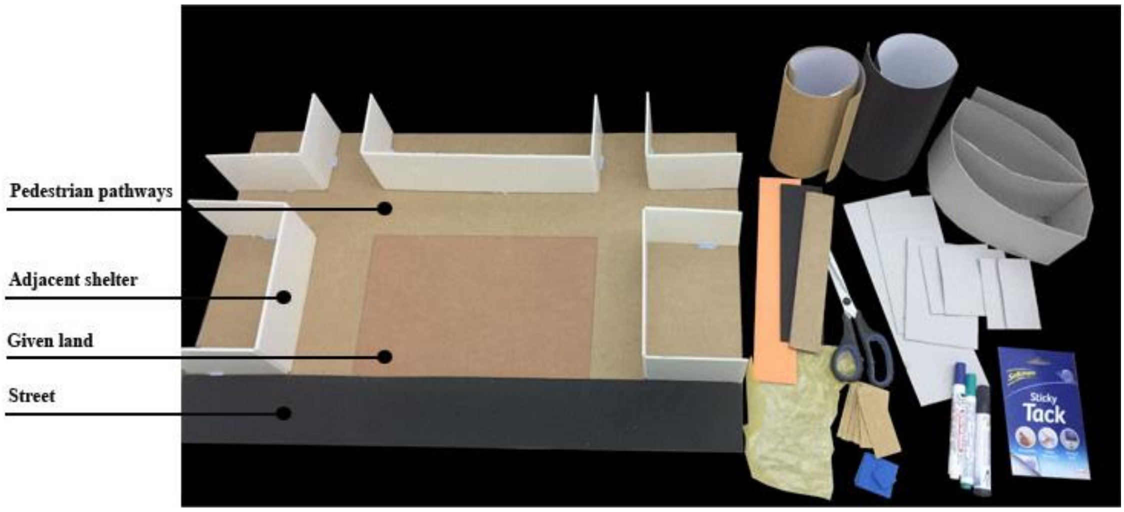


Figure 8.1: The toolkit of materials distributed to each group during the experiment

The 3D outputs were then transformed into 2D plans by the researcher during the analysis stage. However, some edits were made to the plans, as the mock-up dimensions were not accurate. Moreover, the doors were not drawn on the 2D plans since the type of doors were not discussed with the participants, but their location is indicated as openings. The plans were colour coded according to the level of privacy; i.e. blue for the public areas, red for the semi-private areas, green for the private areas and yellow for the facilities. The colours assist in clarifying the use and circulation (movement between rooms).

As the participants had no previous design experience, the resultant 3D mock-ups and plans are not 'ready designs'. Instead, they are used to identify the residents' priorities, desired use of space and the functional needs. The aim of these analyses and outcomes is to use the results to influence the future proposed designs.

To conclude, the stages of the experiment are:

- Discussions with participants about their spatial needs.
- The participants modelling shelters by using distributed kits.
- Transferring the models into 2D drawings.
- Comparing the drawings and identifying patterns to take forward.

8.3 Experiment at Azraq camp

The visit to Azraq camp was held in December 2017. A team from 'PLAN international' organisation accompanied the researcher, invited the participants and hosted the sessions in their offices. Two sessions were held; the first session involved 14 female participants who produced three different 3D mock-ups. An unplanned second session with a group of five male participants followed, where they shared their own perspectives by drawing the plan of their preferred shelter. Three 3D mock-ups and a 2D plan were produced as a result of the sessions held at Azraq camp.

8.3.1 Session 1

After the introduction, a discussion with the participants followed. Some participants expressed that their initial expectation before arriving to Jordan was to be hosted in city flats instead of the camp shelters. The situation in the camp was shocking to them, specifically the shared toilets and showers. They all agreed that safety was their main concern at the beginning, but after spending some time in the camp, they started looking after enhancements.

The participants also mentioned that families who own two shelters (i.e. larger families) have a more dignified life, as they can specify a space for sleeping and another for sitting and eating. According to them, families who own one shelter have complicated lives, as all family members do all their daily activities at the same space. The 14 female participants summarised their spatial needs into the following:

- Three bedrooms (separating age and gender groups)
- House garden

- Private courtyard
- Kids room (for playing and studying)
- Reception
- Family sitting room
- Storage area
- Kitchen
- Separate spaces for the toilet and the shower

They also mentioned two other needs according to their current experience:

- A private water tank, as they have communal outdoor water taps.
- A continuous floor that links between their shelters; referring to the fact that the shelters are fixed in the ground, and when a large family has given two shelters, the area in between remains floorless.

At the end of the discussion, the participants expressed their objection to the provision of poorly constructed shelters of connected steel sheets. They complained that the steel hurts their hands, provides no sound insulation, and has rusting issues. Following the discussion, the experiment has started by dividing the participants into three groups of 4-6 members each and the material supplies were distributed. The researcher was available to help whenever needed throughout the experiment.

Group number 1

Group 1 decided to have their entrance at the street side of the shelter, with a large shading element identifying the entrance along with some trees. The entrance to the design is through a private courtyard that gives access to the reception room, which in turn, leads into the family sitting room. Two bedrooms and a kitchen get access through the family sitting room. The toilet has an access through one of the bedrooms, and the shower can be accessed through the toilet.

The participants clarified that they prefer large family sitting rooms compared to larger bedrooms, as this reflected their original homes. In their initial design, the reception and the family sitting room were merged into one big room, but towards the end of the session, they decided to separate them by a wall to protect the privacy of the family when they greet guests. This group prefers to have a second floor with internal stairs and a flat roof.

Figure 8.2 shows photos of the 3D mock-up during the work and on completion. Three big windows and one small window were used. One of the big windows was in one of the bedrooms overlooking the courtyard. The other two were located in the kitchen and the reception overlooking the rear of neighbouring shelters. The small window was in the toilet overlooking the street. All windows were located as high as possible to limit the visibility from outside. In addition, the participants mentioned the importance of fencing the shelters for an enhance privacy. Some rooms were left windowless; this is assumed an oversight, as there were conversations about how important the openings are to the participants.

(a) (b) (c)

Figure 8.2: Azraq camp- group 1: a) During the experiment, b) Final mock-up, c) Final mock-up

In Figure 8.3 the 3D mock-up was turned into a zoning diagram of the spaces and then to a plan. It can be noted that the rooms' sizes in the plan are different from those in the diagram. This is to accommodate the door openings at the same positions that were identified by the participants. The function and position of the rooms were prioritised over their size. The circulation inside the shelter starts with the public areas that are accessible by guests, and then to the family sitting room, which is a semi-private area. The family sitting room is the access point to the other rooms such as the two bedrooms and the kitchen, and finally to the private areas. The toilet in this design in inaccessible to the guests as it can only be accessed through one of the bedrooms.

(a) (b)

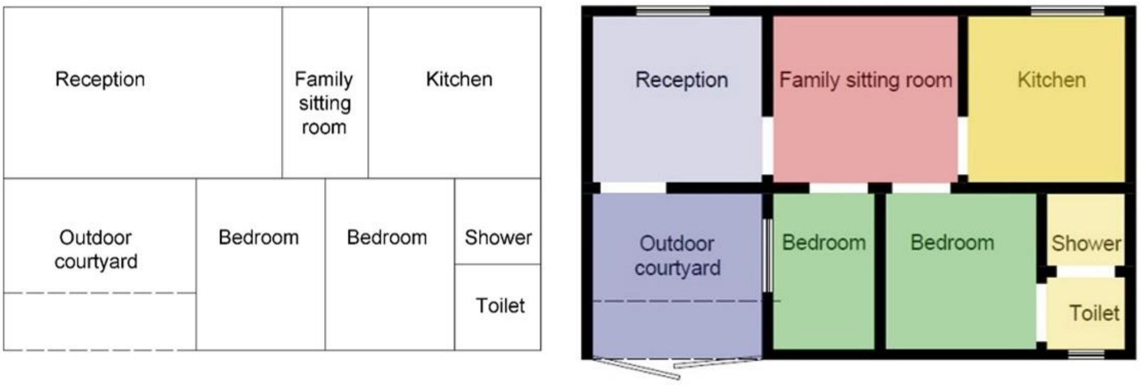


Figure 8.3: Azraq camp- Group 1: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

Group number 2

The second group also suggested an entrance that leads to an open courtyard, from where the family sitting room, the children's bedroom, the kitchen and the toilet can be accessed. The group added a wall partition in the family sitting room in the final stages of the design when they discovered that they forgot to allocate a bedroom for the parents (Figure 8.4).The participants were keen to have a garden; they drew flowers and trees around their shelter. Moreover, the preferences to have a flat roof and future vertical expansion were symbolised by the addition of stairs in the design.

(a) (b) (c)

Figure 8.4: Azraq camp- group 2: a) During the experiment, b) Final mock-up, c) Final mock-up

Figure 8.5 shows a zoning diagram and a plan that represent the 3D mock-up. This group considered the public outdoor courtyard as the core access to the other rooms. The semi-private area, i.e. the family sitting room, has access to one of the private areas (the parents' bedroom). In terms of windows, three large windows were allocated in the three main rooms, and two small windows were placed in the two facility rooms (Figure 8.5).

(a) (b)

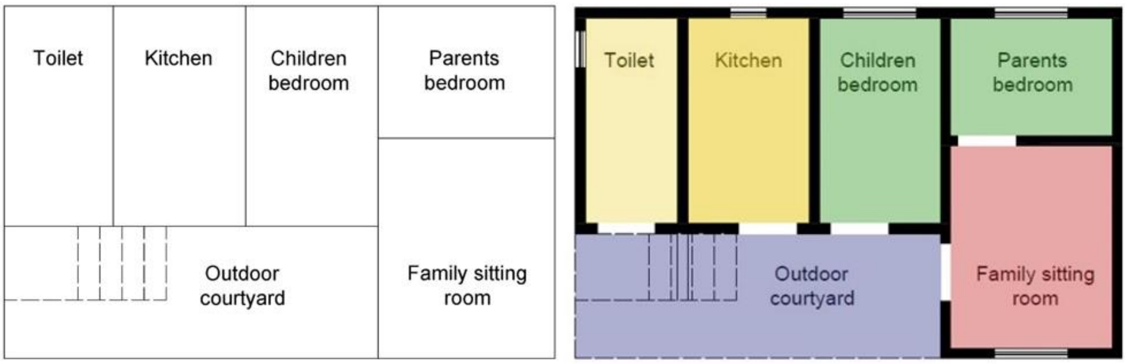


Figure 8.5: Azraq camp- Group 2: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

Group number 3

This group has an entrance from the street side that opens into a private courtyard. A large canopy with a grape tree and a water fountain were chosen to shape and decorate the courtyard. These features reflect the traditional Syrian homes. The courtyard has a door that leads to the family sitting room providing access to the two bedrooms. While the reception, toilet, shower and the kitchen can be accessed directly from the outdoor courtyard. The participants did not consider the indoor-outdoor transition as a problem. Figure 8.6 shows the 3D mock-up during and on completion of the work.

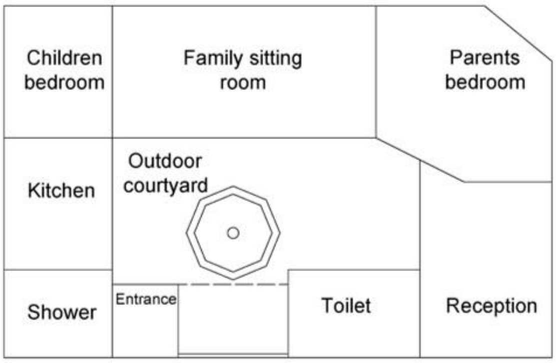
(a)

(b)

Figure 8.6: Azraq camp- group 3: a) During the experiment, b) Final mock-up

A zoning diagram and a plan were extracted from the 3D mock-up (Figure 8.7). Three big windows were allocated in the design, two highly located windows in the family sitting room and the parents' room overlooking the rear neighbouring shelters, and a third window was located in the parents' room looking towards the family sitting room. Two other small windows were used; one in the kitchen and another in the reception. The toilet was positioned next to the reception to make it accessible to the guests while at the same time limiting their movement inside the shelter.

(a)



(b)

Figure 8.7: Azraq camp- Group 3: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

The location of the courtyard is at the core of the shelter, providing access to the public areas, semi-private area, and the facilities. Additionally, there is a clear transition between privacies, from a public area (the courtyard) to a semi-private area (the family sitting room) and then to the private areas (the bedrooms). It is assumed that the oblique walls and the windowless rooms were an oversight.

8.3.2 Session 2

In the camps, it is culturally unacceptable to gather the males and the females in the same room, therefore, following the females' session, a second session had commenced including five male participants. Due to a logistical problem, the participants drew a 2D plan as opposed to the 3D mock up, to represent their shelter preferences.

Male group

The male participants mentioned issues in relation to the current shelters' distribution system. They believed that the criteria should depend on the age and gender of the family members, not on the number of household members. They gave examples of current cases in the camp where adults live in the same room as their parents, which is unacceptable in their opinion. According to the participants, a minimum of three rooms should be provided to any family with adults from both genders.

The participants agreed that the main functions of the shelter in their point of view are the same as those mentioned in the first session (Section 8.3.1). However, the male participants did not agree with the 3D mock-up designs that were produced by the females. Their comments were mainly about the need of an indoor core space that distributes between the rooms, contrary to the indoor-outdoor transition that was presented by the females in groups 2 and 3. Moreover, the windows that overlook the neighbouring shelters were considered unacceptable to the males. Positioning the windows on a high level did not remove their privacy concerns.

Figure 8.8 shows the proposed plan of the participants. The plan had unrealistic dimensions, as it was not drawn to scale. The main points that were discussed by the participants while drawing the plan were the need of a family sitting area to act as a core access point to all other functions, and the need of having two doors to the shelter; one for the family and one for the guests.

(a) (b)

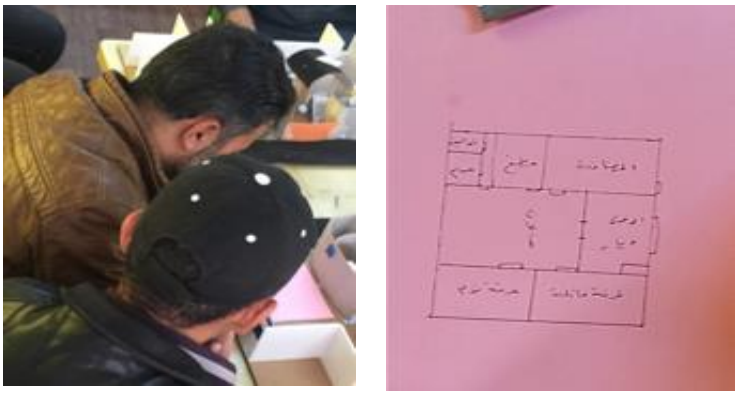


Figure 8.8: Azraq camp- Male group: a) The group while drawing, b) The plan drawn by the male group

Figure 8.9(a) shows the zoning diagram, while Figure 8.9(b) illustrate the males proposed plan fitted into the same dimensions that were given to the other groups (7.5 m x 4.8 m). Notably, the size of the courtyard in the edited plan was decreased in order to fit the inner access of the reception. The group did not distribute the windows, but their refusal was made clear towards having windows that overlook the neighbours or public areas—which is unavoidable in their plan. In addition, the privacy was the main concern when allocating the various functions. The public areas are accessible from the street side and the semi-private area (the family sitting room) is the core access point to all rooms.

(a) (b)

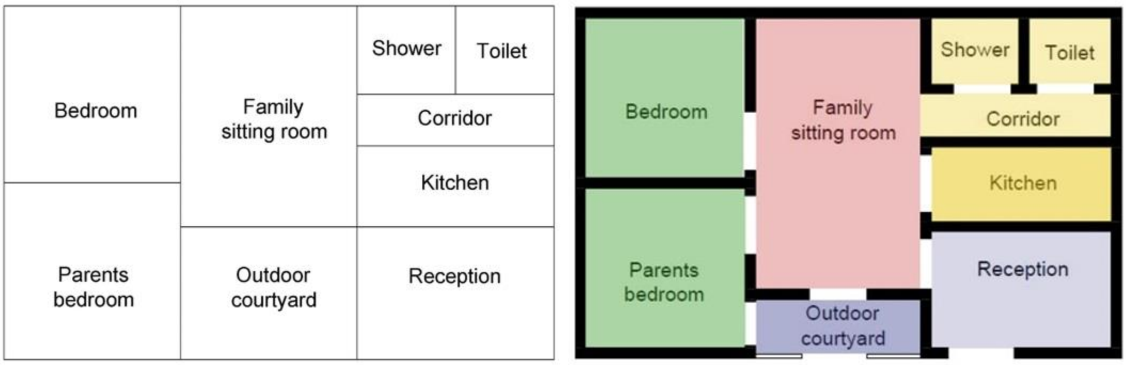


Figure 8.9: Azraq camp- Male group: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

8.4 Experiment at Zaatari camp

Zaatari camp is the second camp that was chosen to carry out the experiment. The field visit was held in January 2018. The visit and the meetings were organised by 'Save the Children Jordan'. Two sessions were held, the first session included 12 female participants, all of whom work as teachers in one of the camps' schools and the second session was with 12 male students, with ages range from 13 to 15 years old.

8.4.1 Session 1

There were 12 female participants in this session, who were divided into three groups for the 3D mock-ups stage. During the discussion, the participants recalled the time they had spent in the tents before moving to the prefabricated shelters. Some of them lived in tents for days and others for more than two years. When the residents moved into the prefabricated shelters, they faced the challenge of fitting all their daily activities into the one-room designed shelter. Some of the families bought a second shelter when they were able to afford it, so they can have a more dignified lifestyle.

The participants considered the outdoor private areas as more important than the shelters themselves. This refers to the high levels of heat inside the shelters during the summer season. Additionally, the participants considered the outdoor space as a safe zone for their children to play instead of the camp's streets, which are filled with possible hazards. The more flexible policy at Zaatari camp compared to Azraq camp, provided the residents with the ability to modify their shelters and self-build additional spaces over time. The participants summarised their spatial needs as the following:

- Three bedrooms
- Kitchen
- Family sitting area
- Reception
- Separate spaces for the toilet and the shower
- An outdoor private area that children can play in
- A private garden
- An outdoor fence

Group number 1

The entrance in this design can be accessed through the main street. It opens to the family sitting room where you can access the garden, the reception, the kitchen, the toilet, and one of the bedrooms. While the second bedroom can be accessed through the kitchen. Figure 8.10 shows the 3D mock-up during and after completion. It is not ideal to have a bedroom that is accessed via a kitchen, but it is assumed that it was proposed after recognising the missing door of the bedroom. However, it is not a favourable circulation scenario. Three big windows were allocated in the design, two of them in one of the bedrooms overlooking the neighbouring shelters, and the third one is in the reception overlooking the street. Two other small windows were allocated in the toilet and in the shower. Some windows and doors were missed in the design as an oversight due to the participants' lack of design experience.

(a) (b)

Figure 8.10: Zaatari camp- Females- Group 1: a) During the experiment, b) Final mock-up

The circulation of this design is unique, when compared to previous designs. The entrance of the shelter is through a semi-private area (family sitting room) that gives access to other functions including the public areas (reception and the courtyard). The participants did not insert a door for the kitchen. However, the researcher added the door in the 2D plan. Regarding the roof, when the participants were asked, they preferred a flat roof (Figure 8.11).

(a) (b)

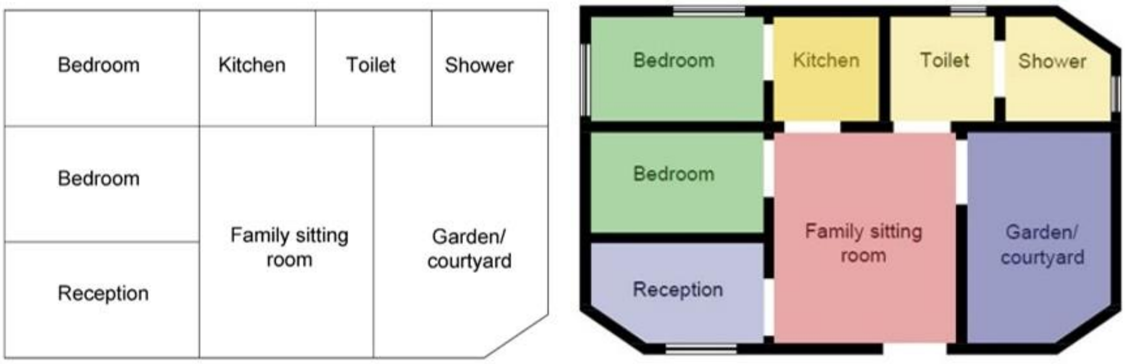


Figure 8.11: Zaatari camp- Females- Group 1: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

Group number 2

This group chose their entrance to be on the corner between the street and the left side of the shelter, presumably for an enhanced privacy. The first accessed space is an indoor garden/courtyard that is surrounded by walls. Through the courtyard, you can enter either the reception or the family sitting room that acts as the primary access point to the rest of the rooms, i.e. two bedrooms, kitchen, and a toilet that leads to the shower (Figure 8.12).

(a) (b)

Figure 8.12: Zaatari camp- Females- Group 2: a) During the experiment, b) Final mock-up

Figure 8.13 shows the zoning diagram and the plan. A very clear circulation can be spotted, where it starts with a public area, leading to another public area from one side and to a semi-private area from another side. There is an access through the semi-private area to the facilities and the private areas. The family sitting room is once again acting as the core space. This group preferred to have a pitched roof when asked. The participants mentioned that they prefer to allocate two windows for each room, one towards the outside and one facing the family sitting room. The purpose of having two windows is to have airflow and thereby, natural ventilation. The participants applied this technique twice: in one of the bedrooms and in the kitchen. The family sitting room has two windows, one overlooking a bedroom and the second towards the courtyard. The other bedroom and the reception have large windows towards the back and the left sides. The design also has two small windows; allocated in the toilet and the shower.

(a) (b)

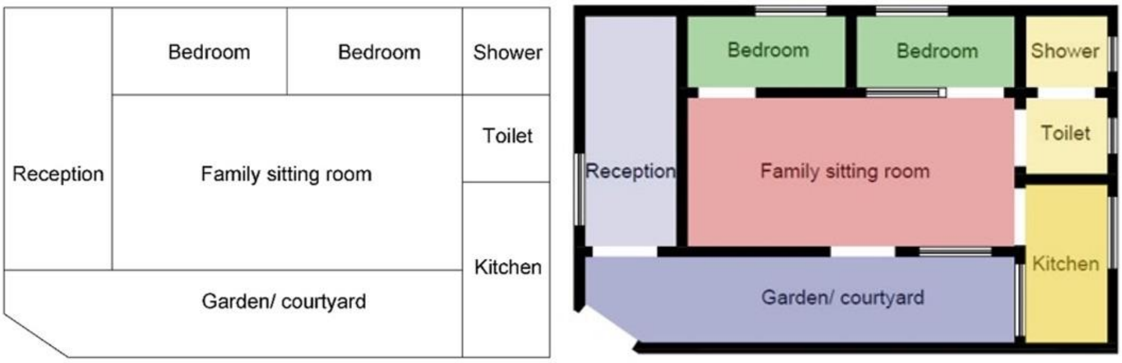


Figure 8.13: Zaatari camp- Females- Group 2: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

Group number 3

Figure 8.14 shows the 3D mock-up of group 3, both during the experiment and on completion. The four participants of group 3, decided to locate the access of the shelter at one of the sides instead of the main street (off-street access). The main door of the shelter opens into a private garden/courtyard and it have access to a small room that has an unidentified function. However, it is assumed to be a toilet for guests or a storage area.

(a) (b)

Figure 8.14: Zaatari camp- Females- Group 3: a) During the experiment, b) Final mock-up
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

The courtyard is the main entrance to the shelter and leads to the family sitting area. Similar to the other designs, the sitting area acts as the core access point to the other rooms; two bedrooms, kitchen and a toilet with a shower as shown in Figure 8.15. The entrance is accessed through a public area that leads to a semi-private area, which leads on to the facilities and the private rooms. As aforementioned, a small room is located next to the public area that could be a toilet. If that was the case, then the purpose would be to limit the movement of guests, in order to protect the privacy of the family.

Three large windows were allocated in this design; two in the family sitting room where one is overlooking the courtyard and the other is overlooking one of the bedrooms. The third window is in the second bedroom and overlooking the neighbouring shelter. Six smaller windows are inserted; four located in the four facility rooms, while the other two are in one of the bedrooms, overlooking the street and courtyard. When asked, this group preferred to have a pitched roof.

(a) (b)

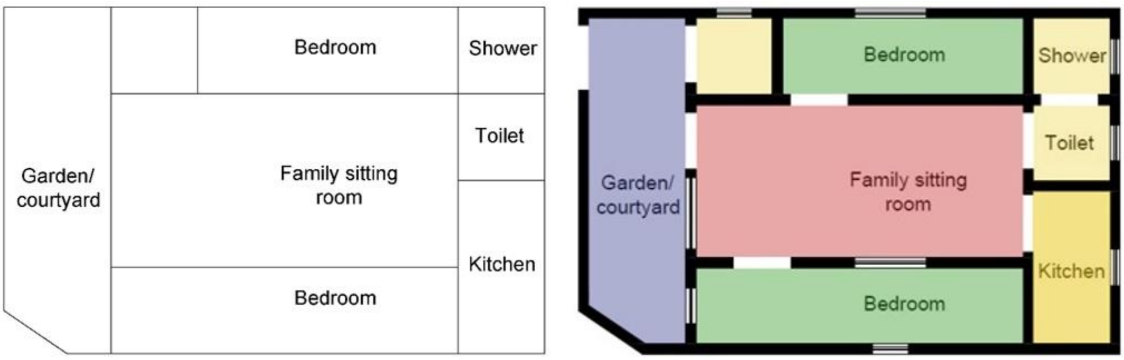


Figure 8.15: Zaatari camp- Females- Group 3: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

8.4.2 Session 2

The second session comprised of 12 teenage boys, ranging between 14 to 16 years old. The boys were divided into three groups of four participants each. In the first part of the session that included the discussion, the participants said that living in tents was expected to them prior to their arrival, therefore they were not shocked. Additionally, they mentioned the amendments that were made by their families to their current shelters, including the self-built private toilets and kitchens, the concrete floors, and the enclosed spaces used as private courtyards. The 12 boys summarised their spatial needs as:

- Three bedrooms
- A studying area (table and chairs)
- A playing area
- Kitchen
- Separate spaces for the toilet and the shower
- Reception
- Family sitting room
- Veranda (outdoor private area/garden)

Group number 1

The entrance in this design was accessed directly from the street. A small entrance takes you into the sitting area where all other functions surround it; two bedrooms, studying room, reception, kitchen, toilet and a shower (Figure 8.16). Since the participants were young students, they specified an area for studying, which was not introduced previously. The group prioritised having bigger shelter size over having a courtyard, but they allocated some greenery next to the entrance.

(a) (b)

Figure 8.16: Zaatari camp- Teenage boys- Group 1: a) During the experiment, b) Final mock-up

The shelter has four large windows; two in the reception, one in a bedroom and one in the studying room. Three small windows were allocated in the facilities rooms (none facing the main road). One of the bedrooms did not allow for a window, however, this is assumed an oversight. This group preferred the mono-pitched roof. Figure 8.17 shows the zoning diagram and the plan. Similar to the design of the first group in the first session (Figure 8.11), the present group has a semi-private area that allows access to all other activity areas including the public (i.e. entrance and reception).

(a) (b)

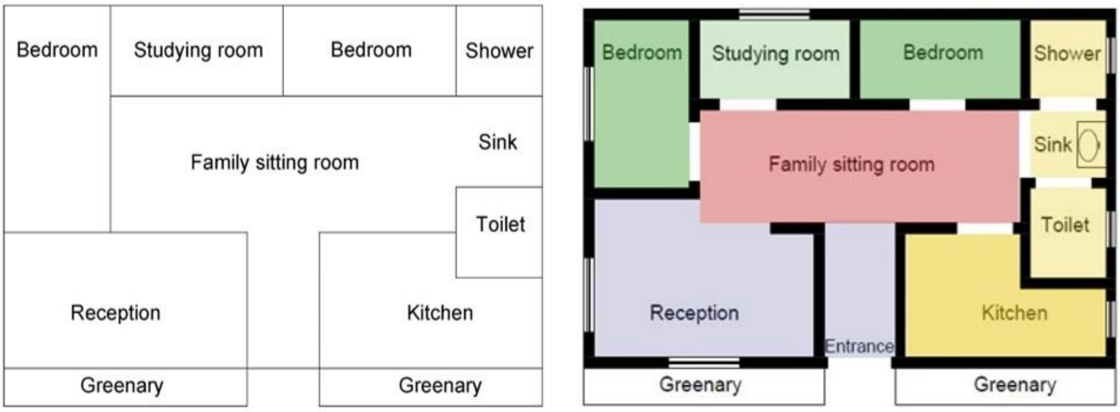


Figure 8.17: Zaatari camp- Teenage boys- Group 1: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

Group number 2

Due to time constraints, this group was not able to complete their work as they had school commitments. Therefore, their work was not analysed. However, their initial work shown in Figure 8.18 shows a similar approach of having a middle area that works as the centre point of the shelter, allowing access to other areas. When asked, they preferred to have a mono-pitched roof.

(a) (b)

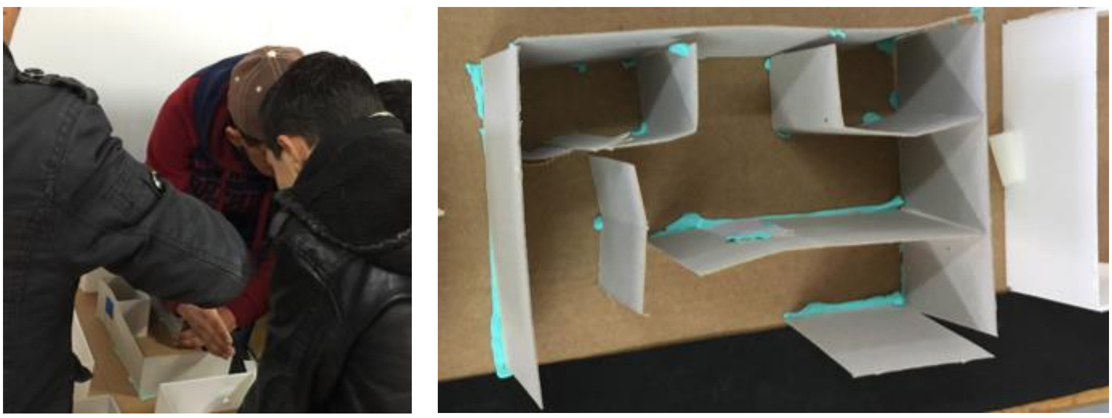
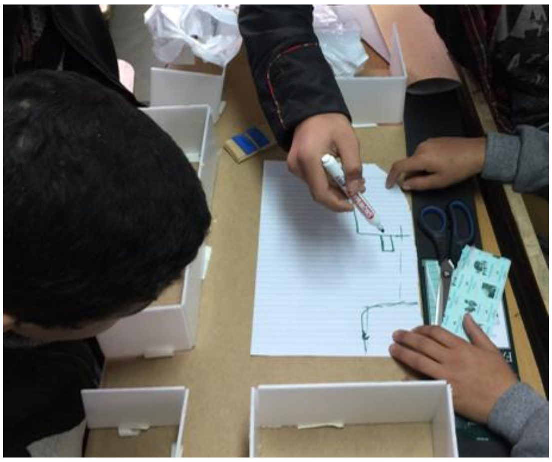


Figure 8.18: Zaatari camp- Teenage boys- Group 2: a) During the experiment, b) Final mock-up

Group number 3

The shelter design of this group also included a direct entrance from the main street. The entrance opens into a corridor that has access to all other functions (Figure 8.19). The design has three bedrooms: the parents, boys and the girls. A reception, kitchen, toilet and a shower are also identified in the design. Figure 8.20 shows the zoning diagram and the plan representing the design. Four large windows were allocated in their shelter; three for the bedrooms and one in the reception room. The toilet, shower and the kitchen had a small window each. This group preferred a pitched roof.

(a) (b)



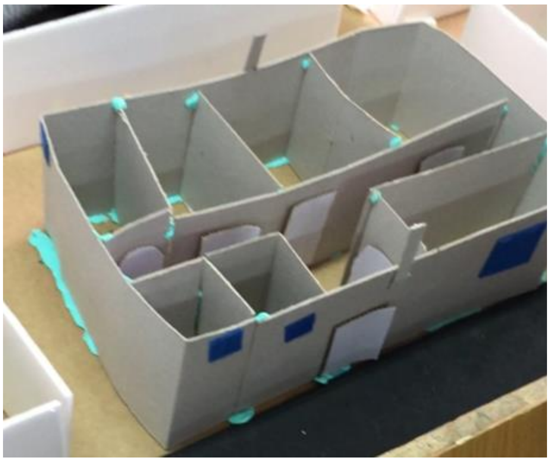
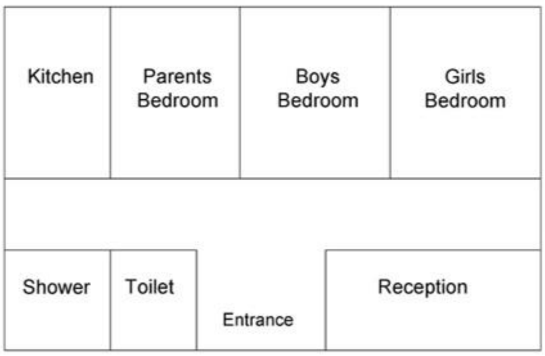


Figure 8.19: Zaatari camp- Teenage boys- Group 3: a) During the experiment, b) Final mock-up

The entrance of the shelter in this design is considered public as it leads to all rooms including the reception. The zones were organised depending on the function/privacy level, where the facilities are located in one corner and the bedrooms are next to each other. However, the corridor is a lost space, despite that it was originally planned to be a family sitting area, but the identified space was limited. This design does not include a courtyard as the participants prioritised having a third bedroom (Figure 8.20).

(a) (b)



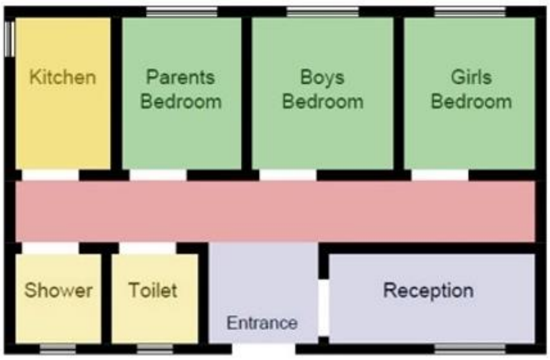


Figure 8.20: Zaatari camp- Teenage boys- Group 3: a) Zoning of spaces, b) Plan with openings
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

8.5 Discussion

Common trends were identified with regard to the needed functions inside the shelter. They included an outdoor courtyard, a reception, a family sitting room, two bedrooms, kitchen, toilet and a shower. Some designs had extra functions such as an additional room or less functions, such as no courtyard or no reception. The shelter designs made by the Azraq camp participants, do not have clear differences from the designs of the Zaatari camp participants. The only specific design difference between the shelter designs produced in both camps is the proposed material for enclosing the private courtyard. At Azraq camp, the participants chose light materials to separate the courtyards from the public surrounding, while at Zaatari camp, solid walls are used to surround them. This behaviour may refer to the safety experience in the camp at the time of the experiment.

When comparing the different designs, some clear differences were found between the plans that were designed by male and female participants. Figure 8.21 and Figure 8.22 show the commonalities between the plans made by the same gender. The primary design differences were observed when comparing the courtyard size, the number and position of the shelter's entrances, the size and position of windows, and the number of rooms inside each shelter. In addition, the relation between the rooms (physical location) differed between the designs depending on the gender of participants, such as the relation between toilet and shower, toilet and reception, and courtyard and reception.

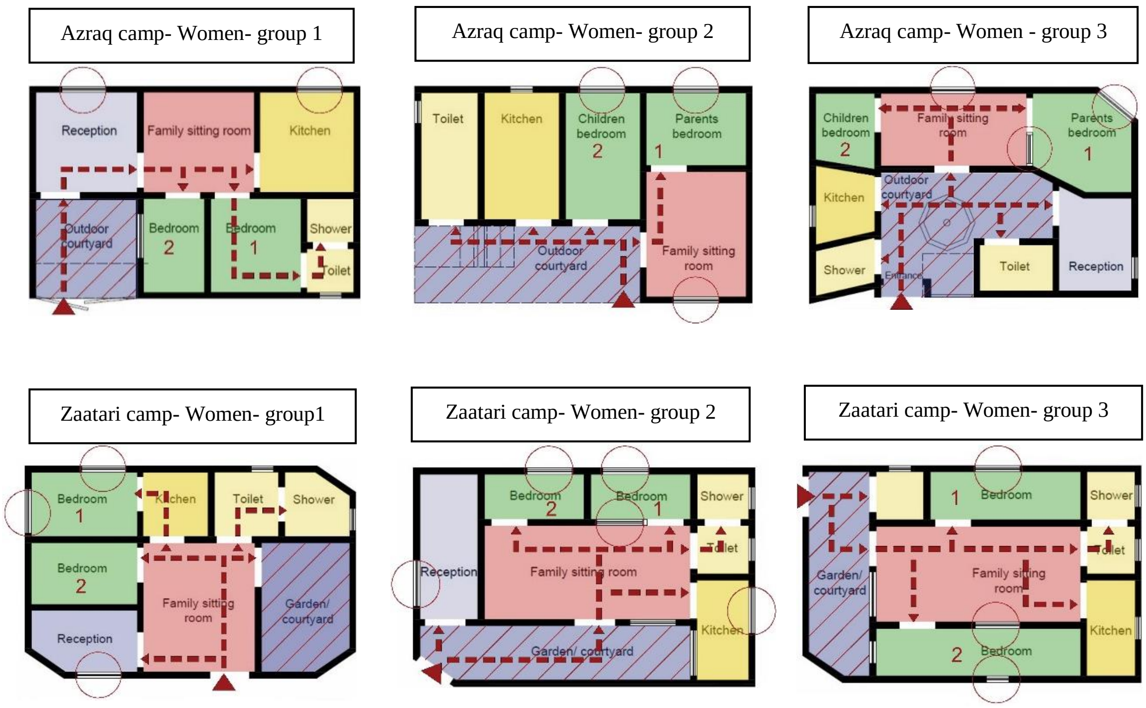


Figure 8.21: Females plans in both Azraq and Zaatari camps
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

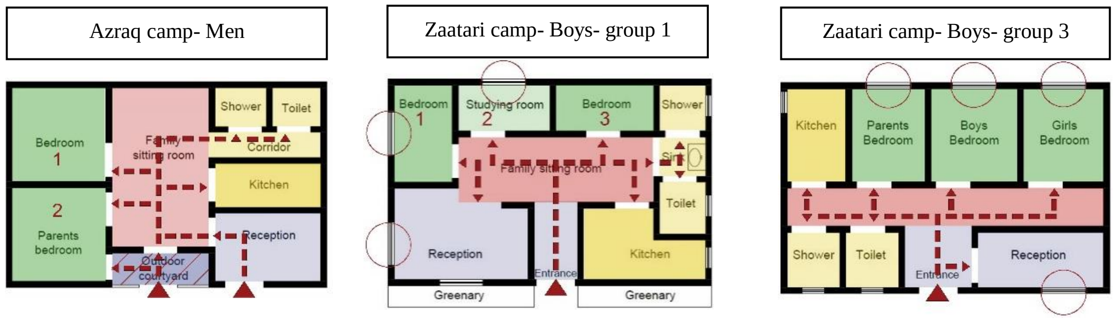


Figure 8.22: Males plans in both Azraq and Zaatari camps
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

The size of the courtyard was a major difference. Female participants designed larger courtyards as this was identified as a priority area to them. Male participants preferred to have larger indoor spaces; therefore, they designed smaller courtyards or dispensed them. It is assumed that this difference is a result of the higher freedom of movement for males within the camps in comparison to the female residents who spend a considerable amount of time inside the shelter, thus, would be the primary users of this space. Another difference is the number and position of entrances, with male participants preferring two entrances, i.e. one for the family and a separate entrance for guests, augmenting the privacy of the shelter. On contrary, most female participants located one main entrance through the courtyard, with some groups having multiple secondary entrances. The three male groups designed entrances directly from the street into the middle of the shelter, while females designed indirect entrances (off street) to provide extra privacy.

Female participants inserted high-level windows and recommended outdoor solid fences for enhanced privacy. The group of male teenagers did not include windows in some of the rooms, while the adult men (whom did not position the windows in their plan) stated their refusal of having windows that overlook the streets or the neighbours.

Although all groups stated in the discussions that they prefer the toilet and the shower to be separated, some female groups did not prioritise this in their design due to the space limitations, contrary to the male groups. Moreover, the male participants did not consider the distance between the toilet and the reception area. However, some of the female groups positioned them side by side to limit the movement and prevent the guests from entering the private areas of the shelter. Figure 8.23 shows two bubble diagrams representing the designs of the two genders and compare them in terms of room functions and their average areas.

The relation between the courtyard and the reception in terms of their location was also approached differently. While the female participants located the main entrance through the courtyard where guests can enter, the teenage boys did not allocate courtyards in their designs, and the adult men positioned a separate outdoor entrance to the reception room.

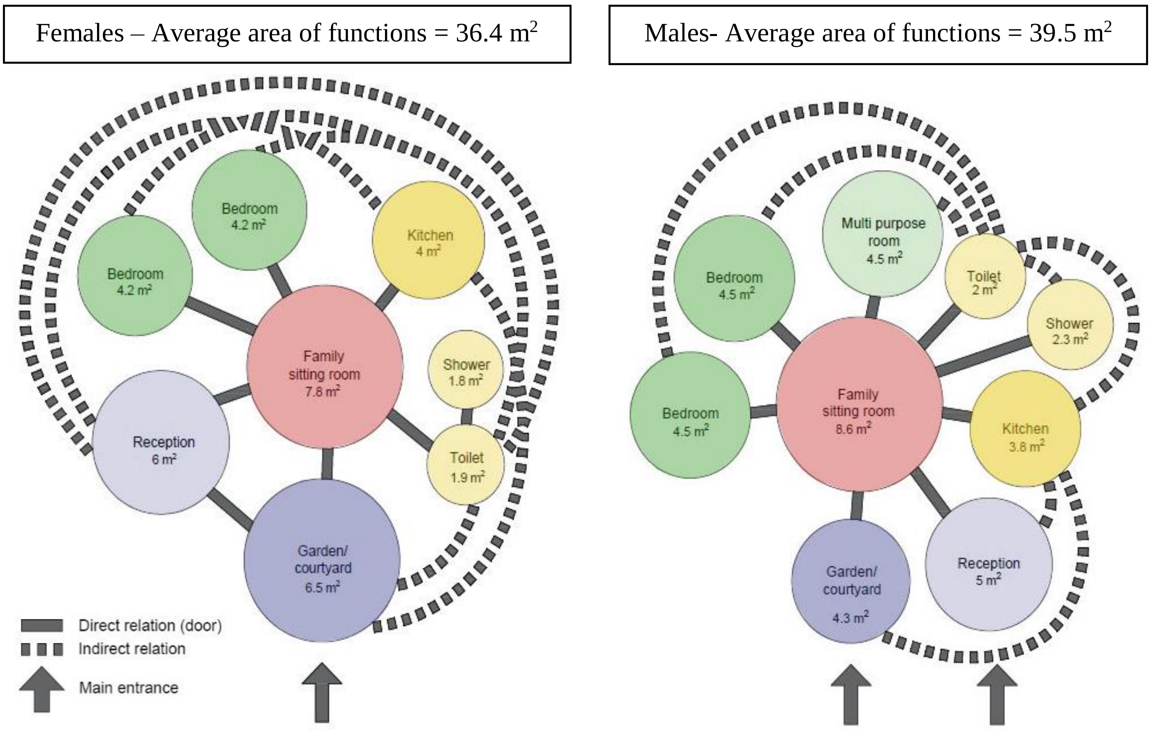


Figure 8.23: Bubble diagrams representing the groups' plans in terms of their gender

Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

The total sum of the average room sizes in the female and male designs were 36.4 m^2 and 39.5 m^2 respectively. Considering that the original given land plot in the kit was 36 m^2; the males exceeded the available usage space. Table 8.1 compares the sizes of the rooms according to female and male groups. The primary observed differences are the larger courtyard in the females' designs, and the larger family sitting room in the males' designs.

Table 8.1: A comparison between the different genders' designs in terms of room sizes

Gender	Courtyard	Reception	Family sitting room	Bedroom	Kitchen	Toilet	Shower
Females	Garden/ courtyard 6.5 m^2	Reception 6 m^2	Family sitting room 7.8 m^2	Bedroom 4.2 m^2	Kitchen 4 m^2	Toilet 1.9 m^2	Shower 1.8 m^2
Males	Garden/ courtyard 4.3 m^2	Reception 5 m^2	Family sitting room 8.6 m^2	Bedroom 4.5 m^2	Kitchen 3.8 m^2	Toilet 2 m^2	Shower 2.3 m^2

8.6 Summary of findings

The purpose of the conducted Participatory Design experiment was not to have ready-made designs to take forward, but to understand how the residents would approach the shelter design and to identify their priorities and needs based on their culture and context. This study shows the importance of early engagement with users at the design stage. This engagement leads to shelter designs that meet the needs of the residents, while empowering them by valuing their voice. Each design had its own identity, but at the same time, there were commonalities stemming from the culture and beliefs of the whole community. Moreover, there were clear differences between male and female designs in terms of layout, space requirements and functional needs. However, the diversity of the participants enriched the outcomes, which is hoped at leading to future inclusive designs.

The participants were unable to include all their desired rooms that were mentioned during the discussions. The limited area (i.e. 36 m^2) that was given to each group in the experiment required the participants to prioritise what rooms to include. However, the primary request of the participants was to consider the age and gender of residents while distributing the shelters in cases of new arrivals in the camps. This request can also be read as the need to design multi shelter sizes for the various family requirements. Moreover, the culture and privacy were the main two factors that affected the participants' decisions. The movement between 'public', 'semi-private' and 'private' areas within the shelter was of a big concern to protect the privacy of the family members.

The outdoor private courtyard/garden is very important to the residents, especially females and young children. For the courtyard, the participants chose the position of entrances, shading elements, plants and other features based on their previous homes. Inside the plot plan, the family sitting area acts as a core access point to other rooms. Windows are preferred to overlook private areas; if not possible, high-level windows with a solid fence, surrounding the shelter was preferred. They also preferred inner windows in rooms facing towards the sitting area to allow for natural ventilation.

One tangible outcome was the participants' desire to give their shelters an identity by adding their own modifications. This clarifies the importance of providing a degree of flexibility in the shelter design as it creates more individuality and a sense of belonging. The contribution of this work towards the transitional shelter criteria, which is the aim of this thesis, is illustrated in Table 8.2, where a list of the extracted shelter design guidelines are presented. The following Chapter 9 would gather the findings of the previous chapter, to fulfil the aim and sub aim of this research.

Table 8.2: Guidelines extracted from the Participatory Design sessions

Themes		**Guidelines**
Pre-design		• Design various shelter sizes • Users participation from early design stages • Shelters shall be recognizable from each other- not identical • Flexible design
Materials		• Locally sourced or purchased materials • Safe materials- e.g. no sharp edges
Design elements	**Openings**	• A suitable private screened and shaded outdoor area • Openings shall protect the residents' privacy
	Interior	• A minimum covered floor area of 6 m^2 per person • Indirect main access for the shelter to enhance privacy (off street) • Provision of spaces for different genders/ age groups • Households of 4-6 people space needs include: An outdoor courtyard/ reception for socialising/ Family sitting room/ 2-3 bedrooms/ Private kitchen/ private toilet and shower (preferable separated) • Family sitting area gives core access to other shelter functions • Circulation from public to semi-private to private areas • Flat roof is preferred for ease of maintenance and usability
Future of the design		• The possibility of future expansion or adding a second floor

Chapter 9

Criteria and shelter design outline

This chapter will gather the findings of previous chapters to form the aimed transitional shelter design criteria. The major developed design concepts and the reasons behind discarding or modifying them will be presented, along with the final proposed design outline. Towards the end of the chapter, some construction materials will be discussed as possible options for the shelter design, to be further researched and tested in the future.

9.1 Introduction

The results that were presented in previous chapters are the stepping-stones toward forming the transitional shelter design criteria, which is the aim of this research. The purpose of proposing the criteria is to direct future shelter designs in the Middle East toward a more dignifying outcome. This could be done by considering the guidelines of the criteria during the shelter design process, or to evaluate existing and future shelter designs. It is understood that shelters will not always be able to fulfil all the guidelines due to other challenging factors such as time, budget, location, and policies. However, it is important to be aware of what the shelters lack and consider future fulfilment as part of the adopted incremental process approach. Additionally, individual cases may have unique needs and specific requirements and conditions that should be prioritised over the proposed guidelines. This is the main reason behind choosing the word “guidelines” to describe the outcome, instead of the commonly used word “standards”.

A design outline is also proposed in this chapter as a direct application of the criteria’s guidelines. The proposed design is not meant to be the only application of the criteria but instead, it is a result of the researcher’s own interpretation of that knowledge. Different researchers, designers and humanitarian workers could use the same set of guidelines to design different shelters for the same region. In addition, it could be used as an inspiration and a reference to propose similar criteria to other regions around the world.

9.2 Methodology

The criteria were formed by gathering the suggested shelter design guidelines that were presented in previous chapters into a list. There are four previously mentioned sets of guidelines in this thesis that were extracted from various sources; from the Sphere handbooks (Chapter 2), the field visits to Zaatari and Azraq camps (Jointly in Chapters 4 and 5), reviewing the previous global shelters (Chapter 7), and from the Participatory Design (PD) sessions that were held in Zaatari and Azraq camps (Chapter 8). In cases of contradictions over the same guideline, priority was given to the guideline that has been extracted from the field visits, whether from the focus group discussions or the PD sessions, as they had better represent the culture of the people and the local context.

In this chapter, only the major design concepts are discussed, while many minor ideas have been done in between. However, all the concepts were beneficial as they clarified the challenges and limitations that usually surround the shelter design. The sequence of the concepts is what led to the final proposed design outline.

As discussed in the literature review (Chapter 2), this research supports the incremental process approach. This means that no definite final design is proposed, instead suggestions that could save time and efforts during future possible disaster events are proposed. This approach was translated through proposing a flexible outline and various possible materials that may need to be amended according to the context.

9.3 Criteria development

As aforementioned, the criteria gathered the four previously presented sets of guidelines. The first set is extracted from the Sphere handbooks and was presented in Chapter 2. The main challenge that faces the Sphere users is its generalised standards. The second set of standards is a merge of the guidelines that were concluded in Chapters 4 and 5. These guidelines represent the field visits to Zaatari and Azraq camps in Jordan. They were mainly focused on the design elements and the future of the design. In Chapter 7, another set of guidelines was introduced after analysing 43 existing shelter cases from around the world in the past decade. The main added guidelines were about the pre-design considerations and materials specifications. A deeper analysis on the culture and design preferences of the Middle Eastern refugees was needed. These guidelines were extracted from the PD sessions that were held with participants from Zaatari and Azraq camps. The sessions enriched the criteria with many guidelines, specifically about the interior aspect.

Collectively, the criteria have 46 guidelines that are spread around six main themes: pre-design, materials, shelter solutions, design elements, safety, and future of the design. The themes, ‘design elements’ and ‘safety’ have been further subdivided into openings and interior, accessibility and fire separation, respectively (Table 9.1). The structure of the criteria includes four columns representing each method (sphere/ focus group discussions/ case studies/ PD sessions). The guidelines have checkmark symbols that are inserted under the method/s that suggested or supported them.

9.3.1 Pre-design

The ‘pre-design’ theme has eight guidelines as outlined in Table 9.1. In most cases, the temporary status of the camps and shelters is a crucial condition for the hosting governments and countries, which is the reason behind the *prohibition of permanent materials and techniques*. A *simple design* has many benefits including the reduced cost, better use of space and ability to be built and maintained by users. In addition, a shelter design that has multi-variant size options responds to the needs of different families and allows a fairer way of distributing areas. *User participation during the early design stages* was highlighted many times during the research. Although it was not directly mentioned during the focus groups discussions, the participants in Azraq camp referred to the male residents who helped in constructing some of the shelters, as a paid job.

The assessment of the climatic conditions for shelter location is very important to provide the optimal thermal comfort, ventilation, and protection. Although the literature review chapter touched on the general climatic conditions of the Middle East and Jordan, the consideration of this element in the design would require an in-depth analysis, which is not the purpose of this study. However, it could be an area of further research building on the shelter design criteria within this thesis. *Aligning with the existing housing types*, specifically in the original countries is important as communities have different needs in terms of size, location, functions and space relations. Both Sphere and the previous case studies emphasised on this guideline. The importance of having *non-identical shelters* and providing *flexibility* in the design have been introduced during the research. Both elements respect the individual needs and preferences of households.

9.3.2 Materials

Locally sourced or purchased materials and *self-made materials* could reduce the cost, support the local market and empower the beneficiaries. In addition, when the materials are familiar and acceptable to the users, they will be able to fix them whenever needed. The used materials must be *safe, with no sharp edges.* The residents of Azraq camp highlighted this concern, as the sharp edges of the steel sheets that form the walls of the T-shelters were harmful. The materials should also be *lightweight, easily transported* and *non-flammable***.** In areas that are prone to natural disasters, the chosen materials *must be resilient to future possible disasters.*

9.3.3 Shelter solutions

The construction techniques must be *familiar* to the users and *could be self-built* if possible**.** The *good thermal performance* **o**f the shelter is crucial to the inhabitants and could not be reached if the structure was not protective and well sealed. The whole building process must be *environmentally friendly,* and the use of natural resources must be planned to minimise the adverse impact. Additionally, *adequate drainage, guttering and sewage systems* should be provided.

9.3.4 Design elements- Openings

The provision of private outdoor areas is a main cultural element in designing shelters in the Middle East, specifically for the Syrians. It should also provide shaded areas, possibly by plants or roof overhangs. The openings must provide *adequate natural lighting, adequate ventilation* and *protection from the weather conditions*, to limit the undesired thermal loss. The *openings should not affect the privacy* of the residents. It is preferable if the windows open into the private outdoor area, or otherwise be located at a high level. Internal windows or openings can be added to encourage airflow. The *location of the openings can affect the thermal performance* of the shelter. In hot-dry climates, they must avoid the direction of the prevailing wind, while in cold climates the direction must minimise the airflow. The location of openings must *maximise the available space*. For security and privacy reasons, the *openings shall be lockable*.

9.3.5 Design elements- Interior

As mentioned in the literature review chapter, the Sphere Project (2011) suggests a minimum area of 3.5 m^2 per person. More recently, this has been updated and revised in the Sphere Association (2018) to be 4.5 m^2 - 5.5 m^2 per person in cold climates where the services are indoor. Cultural norms in the Middle East force the use of more space regardless of the weather. From visits to camps, discussions with refugees and the research undertaken, if a set space per person is required for specifications, it is recommended that this should be a *minimum area of 6 m^2 per person.* This area is a result of estimating the areas of the needed functions. However, using a fixed numeric approach based on the number of people per shelter does not consider the age, gender of residents and the cultural norms of the region. The suggested 6 m^2 is only an indication and a replacement of the current suggested 3.5 m^2 of the Sphere.

During the PD sessions, some participants had the preference of *having indirect access to the shelters (off street),* as this provides better privacy to the shelter. Additionally, it was noted that having the *possibility of adding internal divisions* is important. This provides each household with the opportunity to adapt and use the space in the best way that serves their needs. Providing *separate spaces for residents of different gender and age* is a priority in designing shelters.

The main spaces that the PD participants agreed on their need are:

- *An outdoor courtyard*
- A *reception* room for guests
- *Family sitting room* for family gatherings.
- *2-3 bedrooms* depending on the household members' age, gender and number.
- *Private kitchen, toilet and shower*, where the toilet and shower are preferred to be separated from each other.

Other suggested spaces were a studying room and a storage. The outdoor private courtyard could be used for family gathering, receiving guests, washing clothes, preparing food, playing area for children, gardening, and keeping animals such as chickens or birds.

The *family sitting area is the core access* to all other functions inside the shelter. The circulation of the shelter shall depend on the privacy levels: areas that can be accessed by guests (public areas), areas that are used by all family members (semi private areas) and finally, the bedrooms (private areas). The *floor shall be raised* to protect the shelter from water ingress and create an airflow if possible. Additionally, it must be *insulated* to limit the heat loss, and to be *washable* as suggested by the focus groups participants. A *minimum height of two metres* shall be generally provided for shelters (recommendations for hot climates to reach the minimum of 2.6 m). Regarding the roof, most of the participants in the field visits, preferred the *flat roof* compared to the pitched roof for ease of maintenance, usability, and possibility of future expansion.

9.3.6 Safety- Accessibility

All users shall be able to *access their shelters safely*, including people with reduced mobility.

9.3.7 Safety- Fire separation

The *fire separation* can be designed-in through the camp planning. The field visits have shown that the dissatisfaction of the residents towards the area of the shelter, often lead to unplanned extensions, thus reducing the fire separation distance.

9.3.8 Future of the design

The research found that shelters must be *durable* due to the potential long usage period. In addition, the research suggests the consideration of future shelter usage in cases where the residents move out. The Sphere Project (2011), does not consider the durability of the shelter but instead considers the shelter as a temporary response until a more durable solution is obtained. The shelter shall have the possibility of being *maintained by the users*, which means using local materials and tools. This is important as in most cases, the maintenance of the shelters is not included in the plans of the aid providers. Moreover, the limited timeline and budget of the projects force the residents to be self-sufficient when the aid stops. The shelters in most cases are intended to be temporary, but existing cases show that people stay for much longer periods. In such cases, the households expand their shelters without considering the planning of the whole camp or area. *Planning for possible future expansion* or adding a second floor is important to avoid future challenges such as flammability, overcrowding and poor sanitation.

During the discussions with the Syrian refugees in the visited Jordanian camps, people intimated their willingness to go back to their country if safety was guaranteed. However, they expressed their concerns regarding the place they would inhabit when they return, as many homes are demolished or inhabitable. In such cases, if the shelters they ‘temporarily’ reside can be *deconstructed*, transported and reconstructed in their original countries, this could provide important habitation as they rebuild their original homes and communities. In cases where the original house is destroyed, then residents could *reuse the shelter* as a core unit, build additional rooms and utilise materials that are more permanent. This is how this research consider the application of the incremental shelter approach.

Table 9.1: The proposed transitional shelter design criteria for the Middle East

No.	Themes		No.	Guidelines	Suggested by: Sphere	Focus group	Case studies	PD sessions
1	Pre-design		1.1	No permanent materials or construction details allowed	✓	✓	✓	
			1.2	Aim for a simple shelter design			✓	
			1.3	Design various shelter sizes				✓
			1.4	Users participation from early design stages	✓		✓	✓
			1.5	Assess the climatic conditions for all seasons	✓			
			1.6	Align with existing typical housing approach	✓		✓	
			1.7	Shelters shall be recognizable from each other- not identical		✓		✓
			1.8	Flexible design			✓	✓
2	Materials		2.1	Locally sourced or purchased materials	✓		✓	✓
			2.2	Materials made by users- e.g. Bricks, woven bamboo			✓	
			2.3	Safe materials- e.g. no sharp edges		✓		✓
			2.4	Use non-flammable materials		✓		
			2.5	Lightweight materials (to reduce the need of lifting equipment)			✓	
			2.6	Materials which are easy to transport			✓	
			2.7	Materials which are resilient to possible natural disasters and environmental conditions			✓	
3	Shelter solutions		3.1	Local or familiar construction build techniques	✓		✓	
			3.2	Can be built by users i.e. Not dependent on specialist equipment	✓	✓	✓	
			3.3	A construction system with overall good thermal performance	✓			
			3.4	Construction system that is protective from the environment and is well-sealed	✓	✓	✓	
			3.5	Environmentally friendly	✓		✓	
			3.6	Adequate provision for surface drainage and guttering	✓	✓		
			3.7	Adequate sewage system	✓	✓		
4	Design elements	Openings	4.1	A suitable private screened and shaded outdoor area	✓	✓	✓	✓
			4.2	Adequate natural lighting and ventilation	✓	✓	✓	
			4.3	Weather protected openings	✓			
			4.4	Openings shall protect the residents' privacy		✓		✓
			4.5	External opening location shall help in providing thermal comfort	✓			
			4.6	Maximise inner space usage through openings and divisions	✓			
			4.7	Lockable doors and windows		✓		
		Interior	4.8	A minimum covered floor area of 6m2 per person		✓		✓
			4.9	Indirect main access for the shelter to enhance the privacy (off street)				✓
			4.10	Possibility of adding internal divisions	✓	✓	✓	
			4.11	Provision of space for different genders/ age groups	✓	✓		✓
			4.12	Households of 4-6 people space needs include: An outdoor courtyard/ reception for socialising/ Family sitting room/ 2-3 bedrooms/ Private kitchen/ private toilet and shower (preferable separated)		✓		✓
			4.13	Family sitting area gives core access to other shelter functions				✓
			4.14	Circulation from public to semi-private to private areas				✓
			4.15	Ground floor is raised, insulated underneath and washable	✓	✓	✓	
			4.16	Minimum height of 2-2.6m—depending on the climate (the warmer climate, the higher ceiling)	✓			
			4.17	Flat roof is preferred for ease of maintenance and usability		✓		✓
5	Safety	Accessibility	5.1	Have safe access to all users, especially users with special needs	✓	✓		
		Fire-separation	5.2	Avoid close proximity between shelters	✓	✓		
6	Future of the design		6.1	Durable			✓	
			6.2	Maintainable by users/ easily adaptable using locally available tools and materials	✓	✓	✓	
			6.3	Possibility of future expansion or adding a second floor	✓	✓	✓	✓
			6.4	Can be deconstructed for possible relocation	✓	✓	✓	
			6.5	Reusable in whole or part in future permanent structures	✓			

9.4 Design outline

The design concepts translated the main ideas that were extracted from the field studies (Chapters 4, 5 and 8) and the analysed case studies (Chapters 6 and 7). The previously proposed criteria in Table 9.1 were used to evaluate and compare the different suggested concepts in Table 9.2.

The average material costs per shelter that was calculated and suggested in Chapter 7 equal $1,250. Designs with similar material costs are preferred but is seen as difficult to achieve. The main reason is that most of the local and familiar materials in the Middle East are considered permanent and therefore prohibited to be used in camps. The use of global materials is more expensive than using locally sourced materials, despite their benefit of increasing the speed of construction. However, the proposed design should consider reducing the overall project cost by using lightweight materials that would lower the transportation cost, and by limiting the use of construction equipment and specialised labourers through adopting a self-build approach.

The average shelter size of the 43 cases that were analysed in Chapters 6 and 7 was 21.6 m^2. If this area hosts a family of six members (the common limit number of residents per shelter), it will provide an area of 3.6 m^2 per person. This number aligns with the Sphere Project (2011) recommendation for the minimum covered area per person of 3.5 m^2. However, as discussed earlier, this study recommends an area of 6 m^2 as a replacement of the 3.5 m^2 Sphere recommendation. Additionally, this research recommends providing shelters based on the gender and age of the residents, not only their number.

The use of shipping containers for distributing the material kits must be considered as their dimensions may limit the dimensions of the chosen materials, specifically the height. The dimensions of the containers that are provided by World Class Shipping (2012) were taken as a reference in this research. The World Class Shipping have containers with a length of 13.6 m, width of 2.4 m, and height of 2.7 m. The container’s door has a width of 2.3 m and a height of 2.6 m. These dimensions suggest that wall heights must be below 2.7 m and preferably below 2.6 m, if they are to be transported upright.

The outline of the final proposed design is a result several previous design concepts that were generated. However, only the major concepts will be discussed in the next section. The priorities that were utilised in the early design concepts included the consideration of designing multi shelter sizes, movability of the shelter, and flexibility of the design.

9.4.1 Shelter design process

Concept 1- The initial thought was to design a ‘U’ shape shelter to be able to use the space in the middle as a private courtyard as shown in Figure 9.1. The shelter design includes a main bedroom, a family sitting room with a partition, a toilet, a kitchen, and a courtyard. The partition in the sitting room is added to enhance the privacy of the family members when guests are received. Another benefit of the partition is to allow the family sitting room to turn into a second bedroom at night. This shelter can serve a family with up to five members, i.e. parents and three children or three adults of the same gender. On the left side of the shelter, there is a specified space for future set of stairs to access the roof or upper level if needed.

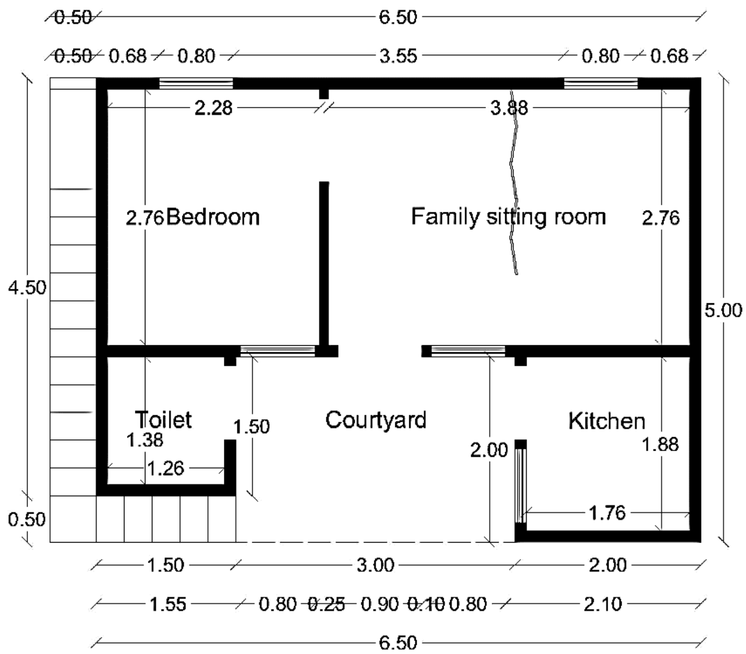


Figure 9.1: First shelter design concept

The indoor area is around 25.8 m^2 and since it serves five family members, it provides an area of 5.2 m^2 per person. The main limitations in this design are:

- It did not align with the deconstruction and transportability guidelines that are numbered 6.4 and 2.6 in Table 9.1.
- It has only one separate bedroom. Turning the family sitting room into a bedroom at night is not an ideal solution but still acceptable.

The next concept focussed on designing for the deconstruction and transportability factors, i.e. how to ship the shelter in a container and allow the users to construct and deconstruct the shelters by themselves.

Concept 2- This concept presents the idea of fitting the rooms inside each other. The main benefit of this method is the ability to fit more shelters into one container, in order to minimise the needed space and therefore, the associated cost. The design shown in Figure 9.2 has the same number of rooms as the previous design concept. It has two external doors, one from the courtyard towards the family sitting room and one from the courtyard towards the kitchen. A specified space for a potential future built stair is found on the left side of the shelter. The shelter can serve a family of five members, i.e. parents and three children or three adults of the same gender. The total covered area of the shelter is 27.4 m^2, providing an area of 5.5 m^2 per person. Every room is smaller than its adjacent room and so is their floors and roofs, for the purpose of fitting the rooms inside each other.

Figure 9.2(a) shows the suggested plan while Figure 9.2(b) illustrates a top view of how the rooms can be fitted inside each other. The kitchen cannot be fully fitted due to its position on a different direction. The alternative solution was to include only the floor of the kitchen inside the unit with the other rooms, while panels would be used for its walls and would be pre-packed within the shelter module to be erected on site.

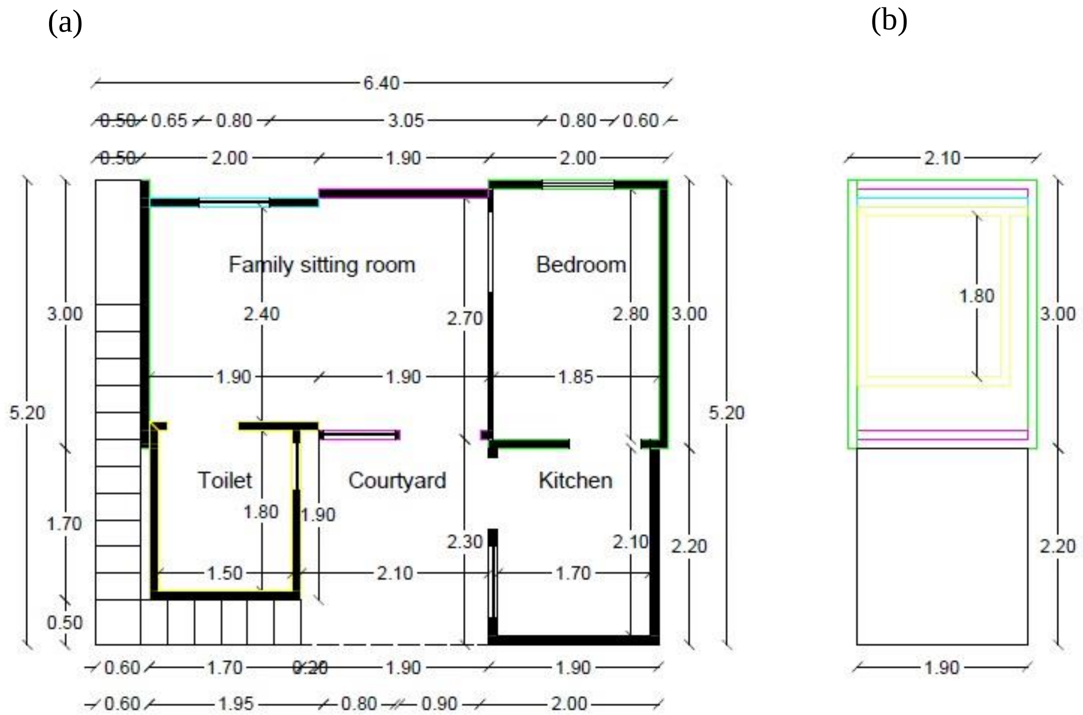


Figure 9.2: a) Second shelter design trial, b) A demonstration top view of how the rooms can fit inside each other

A 3D sketch of the concept is illustrated in Figure 9.3, while Figure 9.4 illustrates a 3D coloured model of the same concept. They show the relations between the rooms including the floors. One of the main limitations in this design is the height reduction. Despite the 2.4 m height of the bedroom (green room in Figure 9.4), the height reduction led to having a toilet with a height of 1.8 m (yellow room in Figure 9.4) and kitchen wall panels with a height of 1.6 m. This height is less than the recommended minimum height for shelters as guideline 4.16 states in Table 9.1. A suggested solution was to have an expansion to the walls that holds a clearstory fitted within the roof, but it was discarded due to its unpracticality.

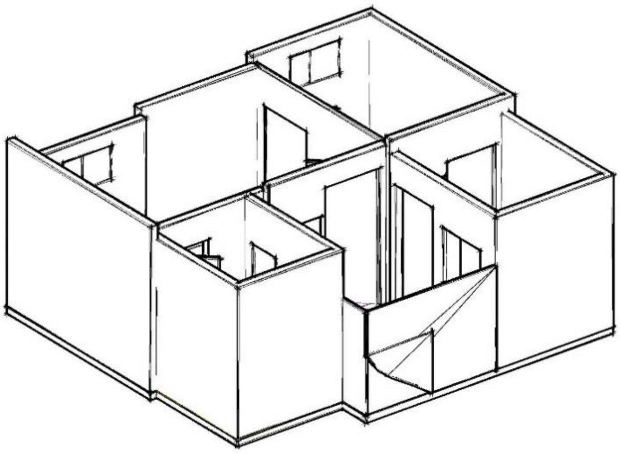


Figure 9.3: A sketch model that clarifies concept 2

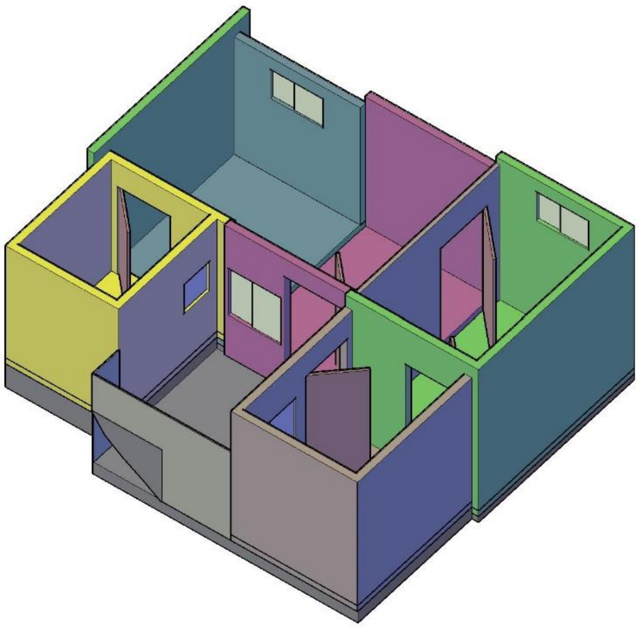


Figure 9.4: A 3D model of concept 2

Another setback for the design is the height difference between the rooms. It makes the shelter inaccessible to people with reduced mobility, which is against the guideline 5.1 in Table 9.1. The concept of having a ready built unit that other rooms can be pulled out from was excluded after this design, due to:

- Difficulties regarding the connections between floors, walls and roofs
- The unpracticality of the decreased height between the rooms, which makes the shelter inaccessible. Moreover, additional panels have to be added in order to extend the wall heights, which complicates the design
- The need to install wheels or slide rails to pull-out the rooms may be difficult to function with dust and stones, leading to reduced durability and impaired function of future deconstruction
- The design is not flexible, and the users cannot amend or expand it

A simpler shelter was the aim for the next trials.

Concept 3- This design aimed at having a built-in pod that has a pre-fitted toilet and part of the kitchen including hob and sink. Panels were suggested for the rest of the walls. If the panels were equally sized, then they could fulfil the flexibility guideline (numbered 1.8 in Table 9.1). In this concept, the users can organise the panels in the way that responds best to their needs and to the shelter's surroundings. This includes the panels with openings, which enhances the users' privacy. Figure 9.5 shows the first possible outline for this concept.

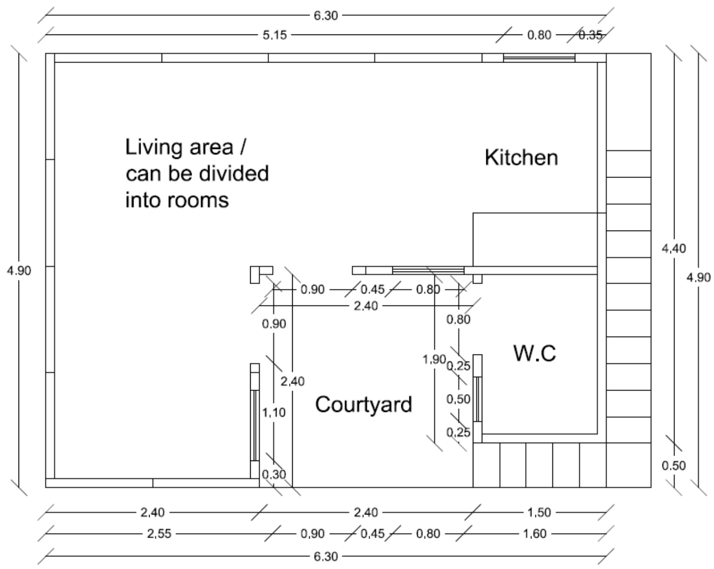


Figure 9.5: Third shelter design trial

An open plan space was suggested, allowing the users to divide the space in response to their individual needs. A space for a potential future built stair is provided on the right side of the shelter. The shelter can host a family of four members with a covered area of 25.3 m^2, which gives a personal area of 6.3 m^2.

Figure 9.6 shows the panels that would be used for the shelter without the toilet-kitchen pod, which is pre-fitted. The design uses 16 panels, 14 of them are equally sized with the dimensions (1.2 m x 2.4 m) while the other two panels could not be standardised with the other panels, their dimensions are (1.4 m x 2.4 m) and (1.7 m x 2.4 m).

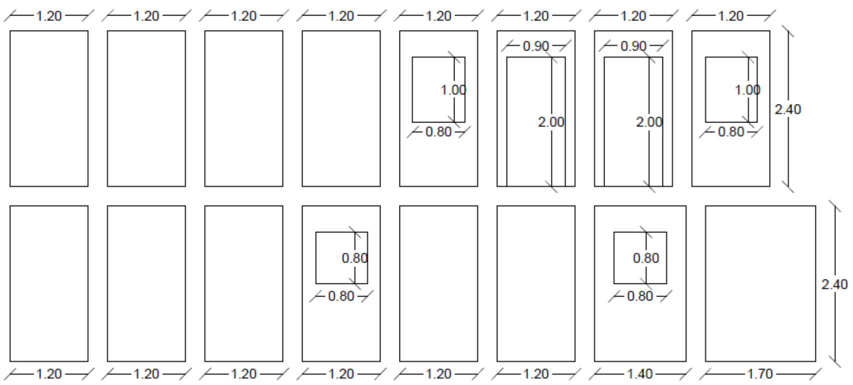


Figure 9.6: Third shelter design trial- Panels arrangements

Figure 9.7 and Figure 9.8 show some possible ways of arranging the panels in 2D and 3D respectively. The size and location of the courtyard and the position of the doors and windows differ between the outline options.

Figure 9.7: Third shelter design trial- Different possible outlines using the same *panes*

Figure 9.8: Third shelter design trial- 3D demonstrations of the different possible outlines

The main issues with this design were:

- The shared wall between the kitchen and the toilet results in having insufficient space for the kitchen needs.
- The panels are not standardised as two panels are of different sizes.
- Undesirable open plan shelter.

Concept 4- In this proposal, the pod dimensions were changed, and the panels were standardised. The flexibility and ease of use are the main benefits of this design. The shelter could be distributed in two sizes depending on the household needs. The concept's plans are shown in Figure 9.9, while the 3D sketches are illustrated in Figure 9.10. The standardised panels feature respects the different needs of the families, allow future expansion, and at the same time standardise the construction system.

(a) (b)

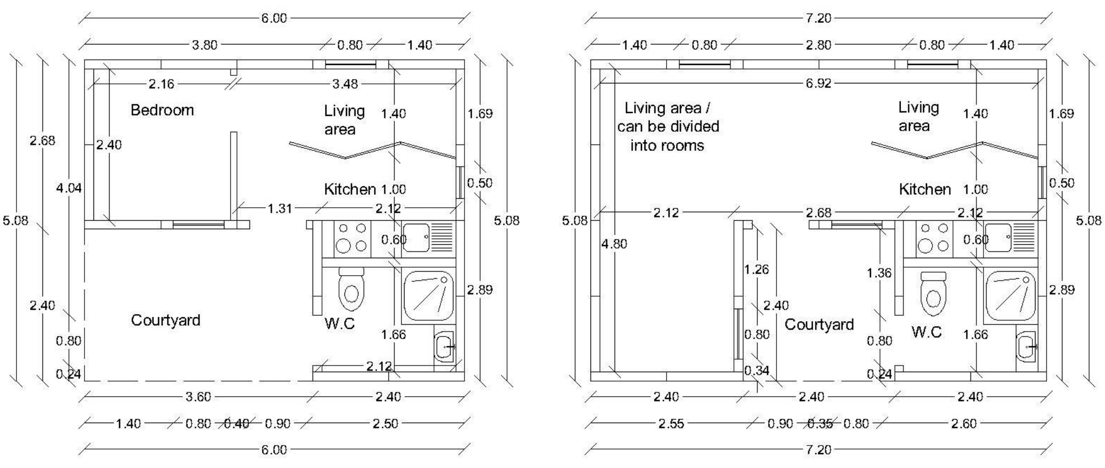


Figure 9.9: Fourth shelter design trial: a) Basic plan for a family of three, b) Extended plan for a family of five

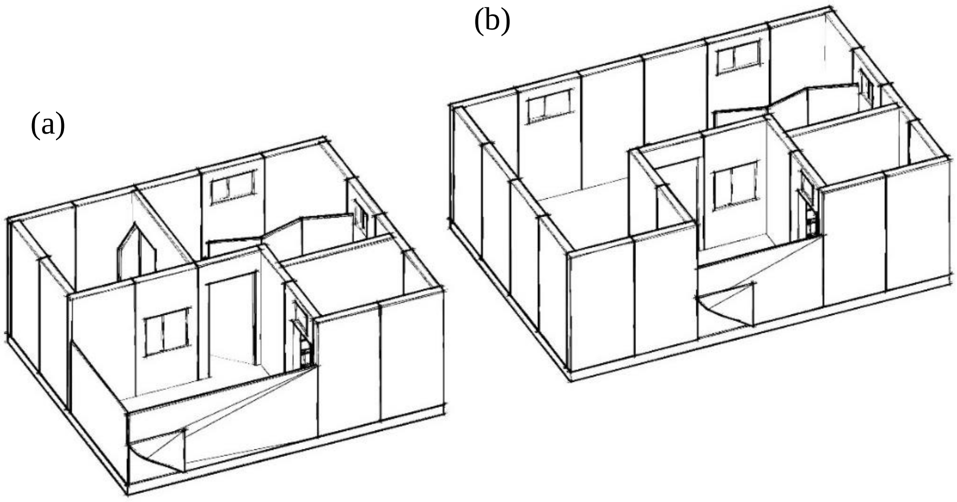


Figure 9.10: 3D sketches illustrating concept 4: a) Basic plan, b) Extended plan

The basic plan in Figure 9.9(a) and Figure 9.10(a) can serve a family of three, i.e. parents and a child or three adults. The total area is 21.8 m^2, which offers a space of 7.3 m^2 per person. The extended plan in Figure 9.9(b) and Figure 9.10(b) can serve a family of five, i.e. parents and three children or adults of the same gender. It has a covered space of 30.8 m^2, providing an area of 6.2 m^2 per person. Figure 9.11 below shows the panels arrangements in concept 4.

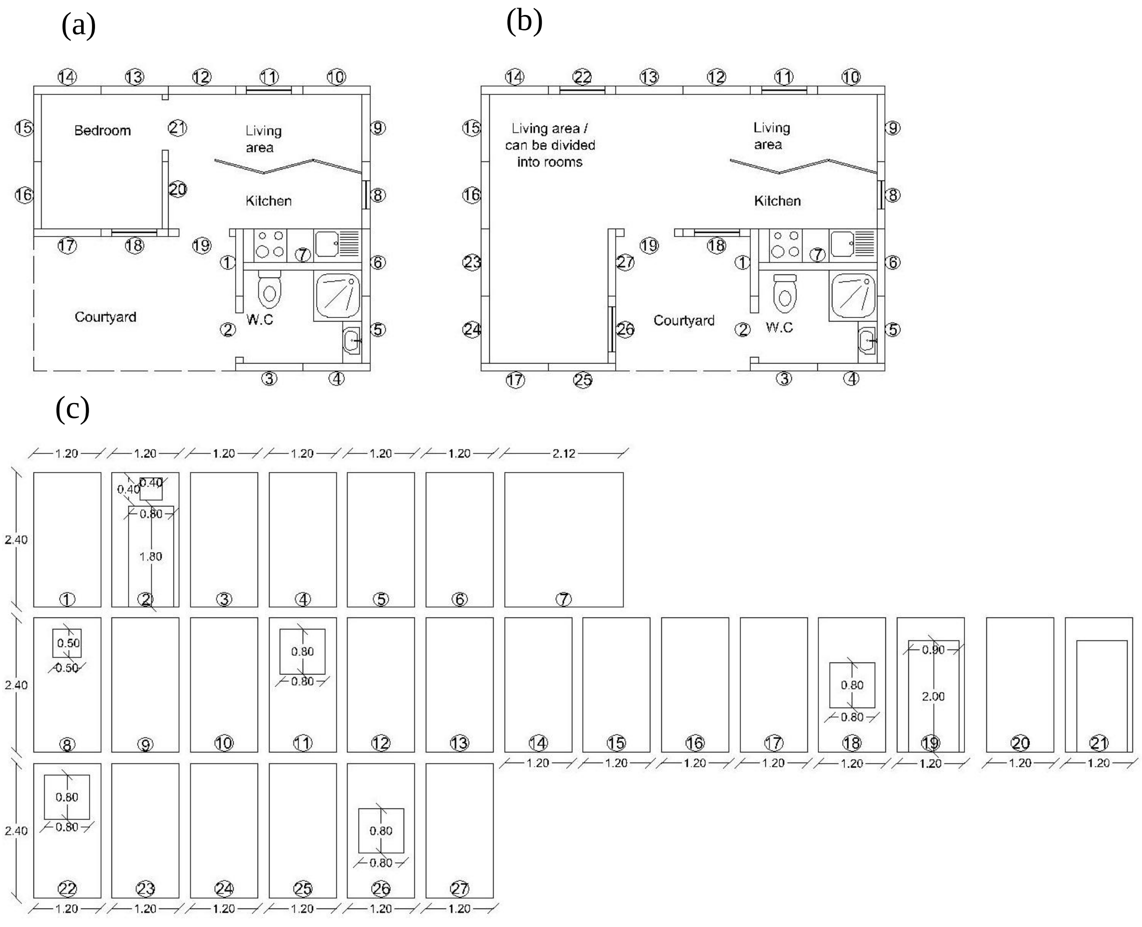


Figure 9.11: Concept 4- Panels arrangements: a) Basic plan with numbered panels, b) Extended plan with numbered panels, c) Numbered panels for both plans

The basic design in Figure 9.11(a) will require 21 panels, of which seven panels are built-in with the toilet-kitchen pod. The larger size in Figure 9.11(b) needs the addition of six panels, resulting in 27 panels (excluding the internal panels, which should be located by the residents).

This design has the following main challenges:

- The undesirable open plan
- The kitchen area is not enclosed and must be divided by a partition, which limits the use of space.

Concept 5- In this outline, the toilet-kitchen pod is set horizontally (Figure 9.12). It has the same advantages of the earlier two designs of the partially standardised panels and the flexibility of the design. However, it also solves the previous concern regarding the kitchen area as it has a separate space in this design. As with the previous designs, the living room can be used at night as a bedroom, while the courtyard can be used as a reception. The guests in this design will not have access to the toilet as it is within the private zone.

The basic plan (Figure 9.12(a)) can serve a family of four, i.e. parents and two children or adults of the same gender. The total area is 24.9 m^2, which gives a space of 6.2 m^2 per person. The extended plan (Figure 9.12(b)) can serve a family of five, i.e. parents and three children or adults of the same gender. The area of the extended plan equals 27.8 m^2, which provides an area of 5.6 m^2 per person.

(a) (b)

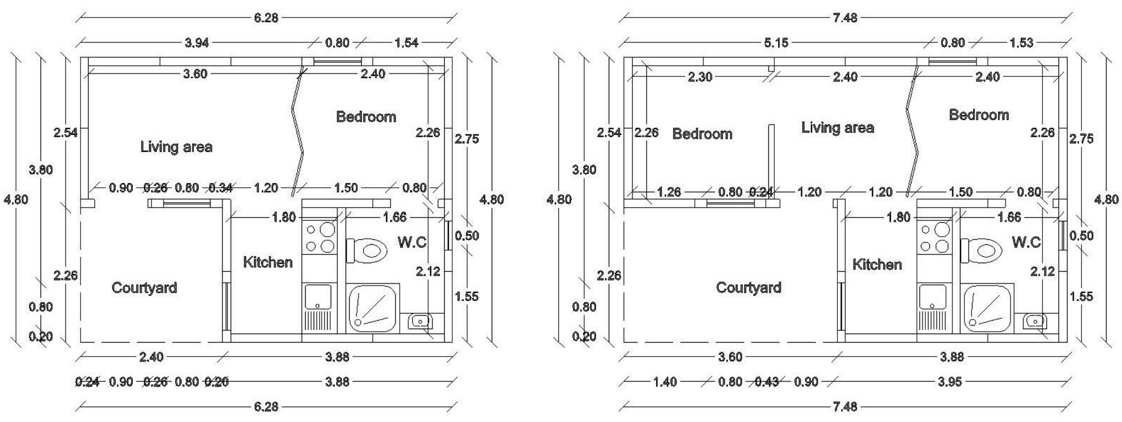


Figure 9.12: Fifth shelter design concept: a) Basic plan for a family of four, b) Extended plan for a family of five

Figure 9.13 shows the panels arrangements. The numbers (1-10) are the needed panels for the kitchen-toilet pod. The second line (11-21) are the needed panels for the completion of the main shelter, while the panels (22-24) are the added panels for the extended design. Sketches of concept 5 are illustrated in Figure 9.14, where (a) is the basic shelter and (b) is the extended shelter.

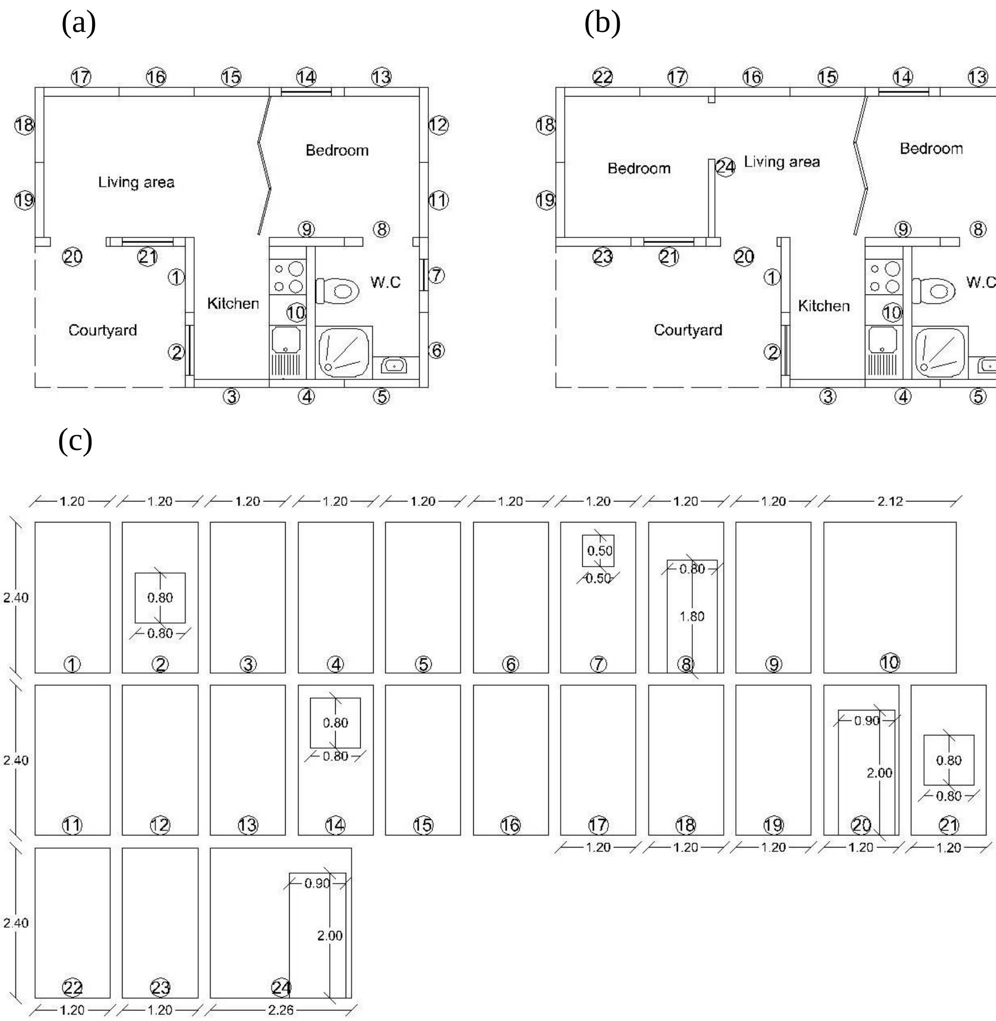


Figure 9.13: Concept 5- Panels arrangements: a) Basic plan with numbered panels, b) extended plan with numbered panels, c) Numbered panels for both plans

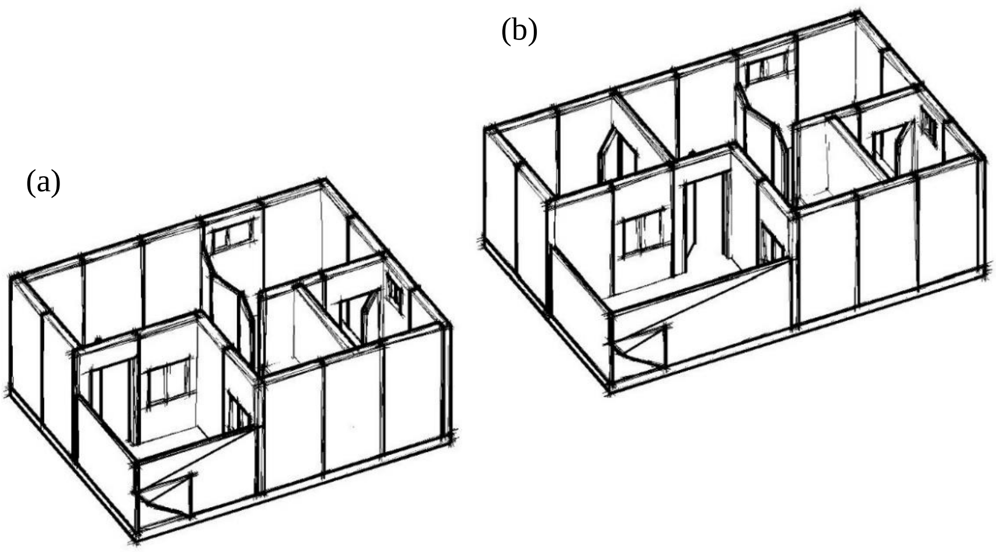


Figure 9.14: 3D sketches representing concept 5

The main disadvantages of this design are:

- The undesirable open space
- The position of the toilet, as it can only be accessed through the bedroom

The aim for the next design is to solve the open space issue by providing a divided interior. It shall also solve the challenge of the toilet's location. Providing a toilet that could be accessed from the outside is a positive alternative, as it would offer access to guests. The PD participants considered the outdoor toilet as a preferred option, considering the hygiene perspective.

9.4.2 Final design outline

The outline of this design is composed of a toilet-kitchen pod, a bedroom, a family living room that can be multi-used (as a dining area, bedroom, and reception), and a courtyard which can be multi-used (as a family gathering area, reception, laundry area, playground for children and as a garden).

Figure 9.15 illustrate the basic outline that is suitable for a family of four members, parents and two adults of the same gender or two children, which provides an area of 6.3 m^2 per person. As shown in Figure 9.17(a), the design consists of 25 panels of the same size (1.2 m^2 x 2.4 m^2) including the eight panels that form the fixed pod (i.e. kitchen-toilet). The courtyard has an area of 6.1 m^2.

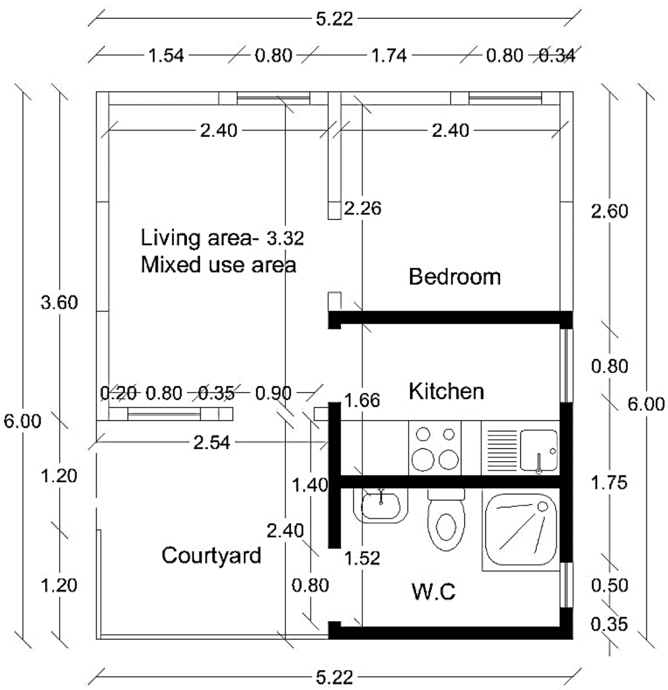


Figure 9.15: Final shelter outline proposal- basic plan for a family of four

The outline could be expanded for a larger family of six members by adding seven extra panels of the same size, i.e. 1.2 m^2 x 2.4 m^2. Figure 9.16 and Figure 9.17(b) show the extended design outline. The added panels form an extra bedroom that could be divided into two rooms if needed (by adding two more panels in the middle). This outline has a larger courtyard of 12.2 m^2 to serve the larger family needs. The outline provides an area per person of 5.7 m^2, which is less than the recommended 6 m^2 (guideline 4.8 in Table 9.1). However, it provides the necessary division between genders and age groups, which is a priority according to the findings of this research (guideline 4.11 in Table 9.1). This design clarifies the previously argued opinion about providing the area depending on the needs not on the number of residents. However, in both sizes, the privacy could be enhanced by providing extra panels or pieces of canvas to surround the courtyard.

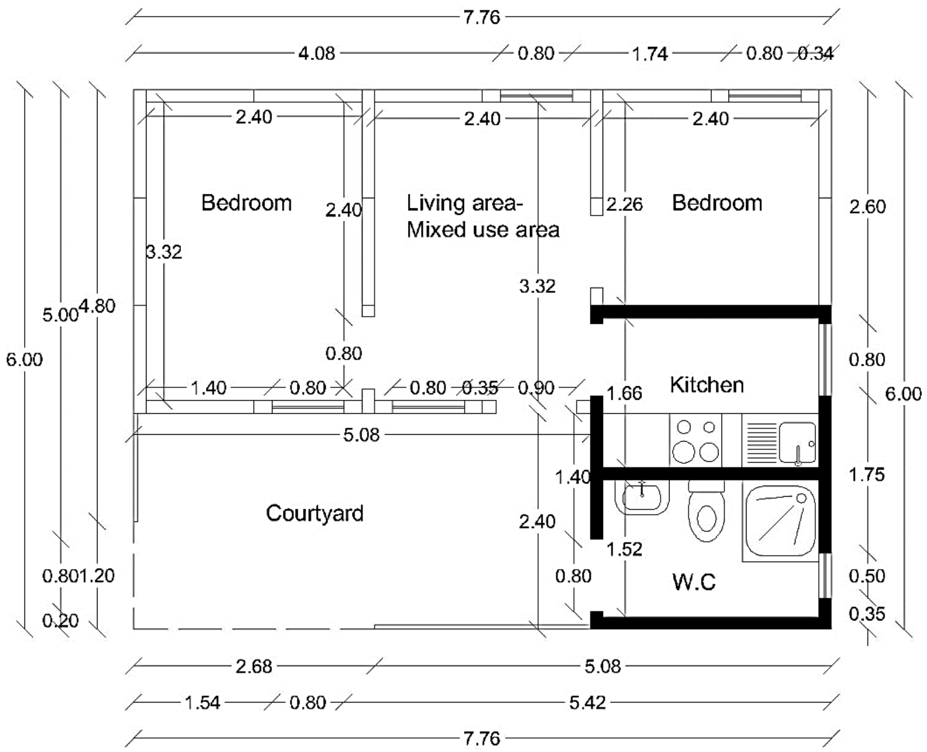


Figure 9.16: Final shelter outline proposal- basic plan for a family of six

Figure 9.17(c) shows the panels arrangement, where the first row are the panels needed for the kitchen-toilet pod, the second row are the panels that form the basic shelter, and the third row are the seven extra panels that expands the shelter.

To understand the circulation of the suggested design, the two shelter sizes have been colour coded in Figure 9.18. The private courtyard is a public area (can be accessed by guests), the toilet can be accessed from the courtyard and the family sitting room (living area) is the access point to other rooms. The access to the courtyard from the street is determined by the position of the fabric. However, in the design, the entrance to the courtyard is suggested to be from the side of the shelter (off street), for an enhanced privacy. Figure 9.19, illustrates the two designs in the form of 3D sketches.

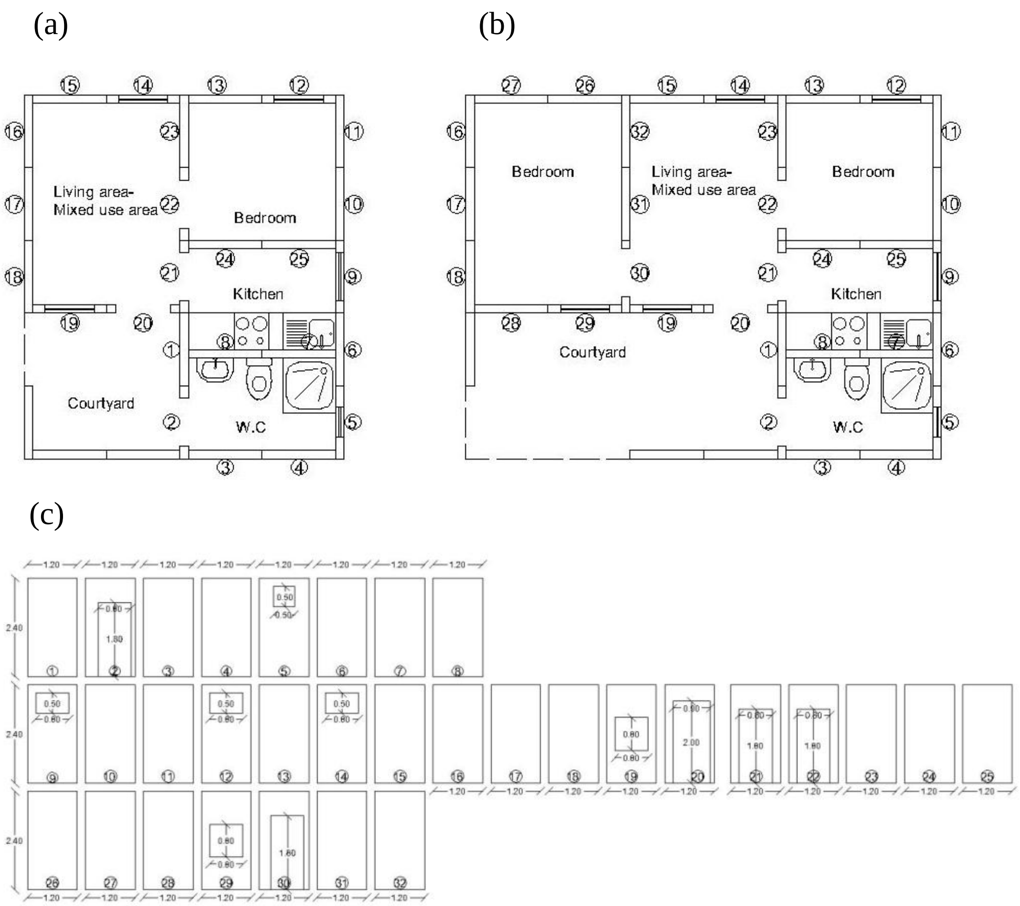


Figure 9.17: Final outline proposal- panels arrangements

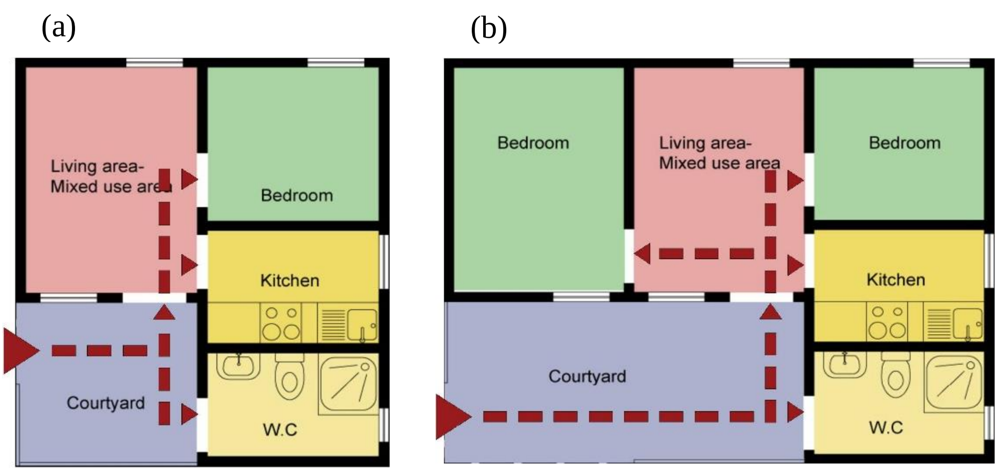


Figure 9.18: The two shelter sizes colour coded depending on privacy level
Key: Blue- Public areas/ Red- Semi-private areas/ Green- Private areas/ Yellow- Facilities

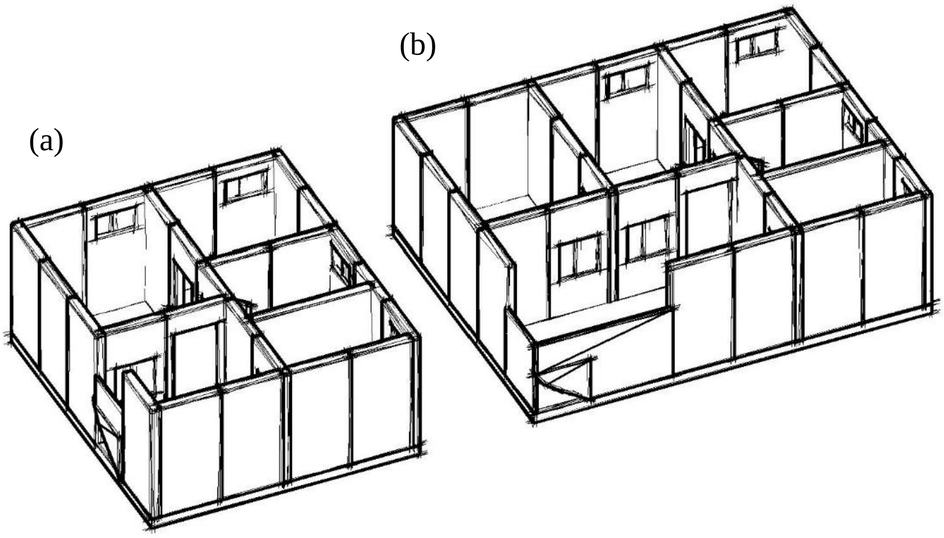


Figure 9.19: 3D sketches representing the final proposal

9.5 Discussion

This chapter gathered the information from the previous chapters and linked them together to propose transitional shelter design criteria for the Middle East, which is the aim of this research. The chapter also discussed the main concept trials that led to the final proposed shelter outline. Panels were suggested for the walls to fulfil the flexibility guideline and to offer the ability of deconstruction. The final suggested concept has two shelter sizes to fulfil the needs of different families. The interior of the shelter is divided into rooms for an enhanced privacy. Additionally, the shelter outline provides a private courtyard and an outdoor toilet that opens into the courtyard to make it accessible for guests. The family sitting room can be turned into a bedroom at night to maximise its usage. In terms of ventilation, some of the windows are directed toward the private courtyard as preferred, while the other windows are positioned higher up for enhanced privacy. The materials are beyond the scope of this research; however, some proposed materials are presented in Appendix D, as a stepping-stone for future research.

Table 9.2 illustrates a comparison between the five discarded concept trials and the final proposed concept against the suggested criteria. The table shows that 32 guidelines out of the 46 were fulfilled by the final proposal; the other 14 guidelines are related to elements that are beyond the scope of this study, i.e. materials and technical details. The criteria aim at providing guidance for designers and researchers to be able to understand the needs of refugees in the Middle Eastern, and therefore design a satisfying shelter outcome. The proposed shelter outline is considered as a practical application to the criteria. However, as aforementioned, various designers could interpret the criteria differently. The next chapter, numbered 10, will conclude the research.

Table 9.2: Shelter concepts against the proposed design criteria for the Middle East

No.	Themes		No.	Guidelines	Shelter concept: Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Final concept	Notes
1	Pre-design		1.1	No permanent materials or construction details allowed						✓	
			1.2	Aim for a simple shelter design	✓	×	✓	✓	✓	✓	
			1.3	Design various shelter sizes	×	×	×	✓	✓	✓	
			1.4	Users participation from early design stages	×	×	×	×	×	✓	
			1.5	Assess the climatic conditions for all seasons	✓	✓	✓	✓	✓	✓	In literature review
			1.6	Align with existing typical housing approach	✓	✓	×	×	×	✓	C3, C4, C5- open plans
			1.7	Shelters shall be recognizable from each other- not identical	×	×	✓	✓	✓	✓	
			1.8	Flexible design	×	×	✓	✓	✓	✓	
2	Materials		2.1	Locally sourced or purchased materials							
			2.2	Materials made by users- e.g. Bricks, woven bamboo							
			2.3	Safe materials- e.g. no sharp edges			✓	✓	✓	✓	C3, C4, C5, C6- Panels
			2.4	Use non-flammable materials							
			2.5	Lightweight materials (to reduce the need of lifting equipment)			✓	✓	✓	✓	C3, C4, C5, C6- Panels
			2.6	Materials which are easy to transport	×	✓	✓	✓	✓	✓	C3, C4, C5, C6- Panels
			2.7	Materials which are resilient to possible natural disasters and environmental conditions							
3	Shelter solutions		3.1	Local or familiar construction build techniques		×	✓	✓	✓	✓	
			3.2	Can be built by users i.e. Not dependent on specialist equipment		✓	✓	✓	✓	✓	
			3.3	A construction system with overall good thermal performance							
			3.4	Construction system which protects from the environment and is well-sealed							
			3.5	Environmentally friendly							
			3.6	Adequate provision for surface drainage and guttering							
			3.7	Adequate sewage system							
4	Design elements	Openings	4.1	A suitable private screened and shaded outdoor area	✓	✓	✓	✓	✓	✓	
			4.2	Adequate natural lighting and ventilation	✓	✓	✓	✓	✓	✓	
			4.3	Weather protected openings							
			4.4	Openings shall protect the residents' privacy	✓	✓	✓	✓	✓	✓	Depends also on shelters relations
			4.5	External opening location shall help in providing thermal comfort							Depends on the context
			4.6	Maximise inner space usage through openings and divisions	✓	✓	✓	✓	✓	✓	
			4.7	Lockable doors and windows	✓	✓	✓	✓	✓	✓	Depends on provision
		Interior	4.8	A minimum covered floor area around $6m^2$ per person	×	×	✓	✓	✓	✓	C5 and final outline- provide less than $6m^2$ for the extended plan
			4.9	Indirect main access for the shelter to enhance the privacy (off street)	✓	✓	✓	✓	✓	✓	Through the courtyards
			4.10	Possibility of adding internal divisions	✓	✓	✓	✓	✓	✓	
			4.11	Provision of space different genders/ age groups spaces	✓	✓	×	×	×	✓	C3, C4, C5- only if divided by internal divisions
			4.12	Households of 4-6 people space needs include: An outdoor courtyard/ reception for socialising/ Family sitting room/ 2-3 bedrooms/ Private kitchen/ private toilet and shower (preferable separated)	✓	✓	✓	✓	✓	✓	Courtyards and family sitting rooms can host guests
			4.13	Family sitting area gives core access to other shelter functions	×	✓	×	×	×	✓	C3, C4, C5- Core function not clear as they are open plans
			4.14	Circulation from public to semi-private to private areas	✓	✓	×	×	×	✓	C3, C4, C5- Circulation not clear as they are open plans C5- toilet within private areas.
			4.15	Ground floor is raised, insulated underneath and washable							
			4.16	Minimum height of 2-2.6m—depending on the climate (the warmer climate, the higher ceiling)		×				✓	C2- Toilet height is $1.8m^2$
			4.17	Flat roof is preferred over the pitched roof for ease of maintenance and usability		✓	✓	✓	✓	✓	
5	Safety	Accessibility	5.1	Have safe access to all users, especially users with special needs	✓	×	✓	✓	✓	✓	C2- Has inner steps
		Fire-separation	5.2	Avoid close proximity between shelters							Depends on context
6	Future of the design		6.1	Durable						✓	Suggested materials are durable
			6.2	Maintainable by users/ easily adaptable using locally available tools and materials		×					
			6.3	Possibility of future expansion or adding a second floor	✓	×	✓	✓	✓	✓	C2 has stairs, but expansion is not practical
			6.4	Can be deconstructed for possible relocation		✓	✓	✓	✓	✓	
			6.5	Reusable in whole or part in future permanent structures		✓	✓	✓	✓	✓	

Chapter 10

Discussion and conclusion

This chapter concludes this thesis by discussing and summarising the findings, reflecting on the research objectives and presenting the potential applications of the work. This research has brought together several key strands, which has been possible through the field visits to camps, and discussions with camp residents. The research has faced limitations that will be discussed along with recommendations for future work.

10.1 Discussion

Within the sector of humanitarian architecture, this research contributed to the post-disaster sheltering studies. However, the sector is not yet able to provide adequate shelters to the affected populations. The research link this shortage to the lack of agreed foundation knowledge in terms of terminologies, approaches, and guidelines, which also aligns with what Felix, Branco and Feio (2013) have presented. Despite the lack of agreement on shelter standards, the main adopted existing reference is Sphere Association (2018). However, most of its guidelines are not implemented in the existing shelters and shelter innovations. These shelters are classified as unsatisfactory, due to the cultural inadequacy, technical defects, environmental inconsideration, and budget constraints. This research examined the standards of Sphere, and found that the lack of implementation may go back to its general standards and lack of consideration to the geographic location and various cultural needs. The proposed criteria of this research differ from Sphere by being specified to a certain geographic region (i.e. Middle East) and by considering the culture of the users through a bottom-up approach. However, this research also built on the knowledge of Sphere, and considered its guidelines in forming the proposed criteria.

The Middle East, as a geographic region, has a rich and unique building typology that reflects the common culture and values of the people and responds to the environment. However, these typologies along with the culture and values were not considered while providing shelters to the Palestinian refugees about seventy years ago, nor while sheltering the Syrian refugees six years ago. Therefore, the recommendations within this study suggest the need to specify shelter design guidelines for the various regions, cultures, and shelter approaches.

The shelters in Zaatari and Azraq Syrian camps in Jordan has been previously studied by Albadra, Coley and Hart (2018), who focused on the thermal inadequacy of the shelters. Other studies on the camps were conducted by organisations such as ACTED (2017), REACH (2014a) and REACH (2015) who assessed the camps in different stages and highlighted some of the shelters drawbacks. However, the used methods and the way of interpreting the data differ between these previous studies and this research, which adopts the user perspectives and their cultural needs. The key lessons that were learned from the camps were concerning the need to improve the shelter form, construction type, layout, and function. These improvements must align with the cultural needs and values of the society and population they serve. Additionally, the services, health, and hygiene elements are worrying in relation to the consequential effects of internal heaters, cookers, and toilets/showers. Concerns about lack of accessibility and flammability do also exist. The infrastructure found in both camps, despite the differences, have been a main source of contamination and discomfort, specifically for the children. Moreover, the findings regarding the innovations made by the Syrian refugees in their shelters, show continuity to what Betts, Bloom and Weaver (2015b, 2015a) have presented.

During this study, five aspects were found to affect both the material costs and size of designing shelters around the world: the *available funding, shelter design, source of materials, construction method* and *scale of shelter need*. However, the cost of shelters is also affected by the quality and durability of the shelter, location, community participation in construction and sourcing materials, socio-political conditions, and productivity and efficiency in terms of time. There is no fixed preferred cost for shelters, but the calculated $1,250 average material costs of existing shelters can give an indication for what is considered typical for post-disaster shelters. The principal purpose shall be to give the best shelter quality at the lowest possible cost to help the maximum possible number of people in need. The size also has other effecting aspects, such as the existing habitat approach, number, age, and gender of beneficiaries in the shelter, and status and availability of land. The average shelter size among the cases studied was 21.6 m^2. However, the most common size was 18 m^2, which refers to the providers' assumption that each shelter serves a family of five members with an area of 3.5 m^2 per person as Sphere recommends. Nevertheless, the origin of the 3.5 m^2 is not valid, families have various sizes, and the needs of users differ between cases and cultures. This research suggests a minimum area of 6 m^2 per person as a replacement to the 3.5 m^2, based on area estimations of the needed functions. This suggestion was presented in this research prior the release of the 2018 edition of the Sphere handbook, in which a suggestion of 4.5 m^2 - 5.5 m^2 is added under the condition of having the shelter in cold climates where indoor facilities are included. However, this research also argues that there should not be a fixed numeric approach for the size of the shelter that is based only on the number of household members. The size of the shelter should also take into consideration the age, gender and cultural norms of the residents.

The most commonly used materials for the existing shelters are wood for the walls and framework, corrugated sheets for the roof and concrete for the floors and the foundations. Local or locally available materials are preferred to be used wherever they can be accommodated in the shelter design. This aligns to local people's familiarity with using the materials and ability to maintain them. In addition, local materials are often more environmentally friendly and cheaper than global materials. However, using global materials could save time and provide better technical performance. Therefore, blending local and imported materials can optimise cost, speed, technical performance and sustainability of shelter provision. This finding shows continuity to the study of Escamilla and Habert (2015) which highlighted the benefits of both local and global materials. Due to the lack of shelter projects' documentation, this research proposes a documentation form to be used for future projects. It adopts the 'Shelter Projects' cover page and adapts it to include the missing required information. The unified holistic documentation would allow future research to make accurate comparisons and, therefore, save time and efforts while providing a pre-emptive design framework, which could lead to better future shelters.

The engagement of the affected population in designing their shelters leads to shelter designs that meet the needs of the residents, while empowering them by valuing their voice. Moreover, people with different gender and age ranges have dissimilar needs and therefore the engagement must be inclusive to all segments of society. During the PD experiment, the participants notably approached the design in the same way the building typology of the Middle East was initiated, as discussed in Chapter 2. The culture and privacy were found to be the main factors that affected the participants' decisions. Additionally, the movement between 'public', 'semi-private' and 'private' areas within the shelter was of significant concern to protect the privacy of the family members. This similarity evidenced that design solutions could be found in the vernacular architecture of any region. However, one major finding in the PD experiment was the importance of providing a degree of flexibility in the design as it creates more individuality and a sense of belonging. Failure to address the needs of the users in the designs would encourage people to make unplanned changes. This could lower the quality of the shelters and at the same time impact the urban scale. Unplanned changes cause the evolvement of the settlement or the camp to be unstructured zones with inadequate additions, which could transform them into future slums.

These findings formed the transitional shelter design criteria for the Middle East along with a proposed design outline that were presented in Chapter 9. The uniqueness of the proposed criteria and shelter design of this research is that they overcame the cultural inadequacy that is present in the current guidelines and shelter designs. This was achieved by adopting bottom-up research methods that considered the users as the main source of data. Additionally, an important element of the proposed design is the use of panelised walls, as they achieve the flexibility and movability guidelines. The main purpose of the criteria is to provide guidance and assistance for the designers and researchers to be able to understand the needs of the Middle Eastern refugees and therefore design adequate and satisfying post-disaster shelters.

10.2 Reflecting on the research objectives

This research argues for the importance of changing the shelter designing approach through producing more specific criteria, for each region or country. The aim of this research was to produce transitional shelter design criteria for the Middle East followed by a proposed design outline. Four objectives were assigned to fulfil the aim and sub-aim of this research. The objectives were met throughout the four methods utilised as discussed below.

10.2.1 Objective 1

The first objective was to *investigate the challenges of living in Middle Eastern shelters*. This objective was triggered by the first three sections of the literature review, i.e. humanitarian emergencies, shelters, and the Middle East. The statistics of the humanitarian emergencies in the Middle East along with the shelter review and comparisons of the Palestinian and Syrian camps in Jordan fuelled the first objective. The field visits to the Zaatari and Azraq Syrian camps that were analysed in Chapters 4 and 5 aimed at meeting this objective. Communicating with the users and observing the shelters and the human behaviours enriched the outcome of this research and provided information that is more reliable. It was found that many of the challenges faced in the camps were mostly due to the cultural inadequacy of the shelters and the absence of flexibility in their designs. Additionally, the improper infrastructure (e.g. sewage issues, lack of utilities and lighting) was considered as a source of contamination and hardship for the residents of the camps. The lack of residents' engagement and considering them as passive help-receivers have increased the challenges. However, the residents were often amending the shelters to fulfil their own current needs without considering the technical performance of the shelters or the public interest in the bigger scale of the camp. The multiplication of self-built changes to shelters require oversight to prevent camps evolving into slums.

10.2.2 Objective 2

The second objective was to *explore the existing shelters around the world and the extent of applied variables*. This objective was suggested in the 'shelters' section of the literature review. The existing shelter responses are a primary source of knowledge and reference in relation to good and bad practice. Therefore, the global shelters that were reviewed and compared in Chapters 6 and 7, aimed at fulfilling this objective. There is a clear lack of shelter projects' documentation, despite the gradual enhancement throughout the years. However, from the available information, it was found that there was no relationship between the material costs, shelter size, used materials, type of shelter, the cause of displacement or the year in which it was built. Moreover, the justification of the shelter choices was never published. The no-relation finding is evidence of the continuing fragmented approaches to shelter and humanitarian emergency responses, which are also influenced by media and politics. As Kelman *et al.* (2011) argue, this is unchangeable and the humanitarian sector has to take advantage of the short-term interest of the media.

10.2.3 Objective 3

The third objective was about *identifying the effect of culture and context of the Middle East on the design elements of the transitional shelter*. This objective was suggested by the literature review and by reviewing the existing shelters in the Middle East and around the world. The effect of culture and context were highlighted through the field visits to the Zaatari and Azraq camps in Jordan that are analysed in Chapters 4, 5, and 8. While the first set of visits identified some of the aspects throughout the self-built amendments, the PD sessions in the second series of camp visits were the main source of information that met this objective. As described in Chapter 8, the purpose of the PD experiments was not to have ready-made designs, but instead to understand the effect of the culture and context on the shelter design choices of the residents. Each design from the participants had its own identity, but at the same time, there were many commonalities stemming from the culture and beliefs of the whole community, such as the privacy, which was the main driver of the design choices. However, there were clear differences between male and female designs in terms of layout, space requirements and functional needs, which emphasises the importance of engaging all members of the community to produce inclusive shelter designs. In conclusion, it was found that the PD approach could lead to an improved shelter design, function, identity and, importantly, belonging.

10.2.4 Objective 4

Exploring the existing guidelines and adopt the good practice among them was the fourth objective of this research. This objective was suggested and fulfilled throughout the literature review in the standards and guidelines section. It was found that, although there are no mandatory standards for designing shelters, most of the humanitarian sector refer to the Sphere handbook and its standards. However, the handbook is much generalised, covering a wide range of sectors and responses. The gap between the existing standards and the lack of application is argued in this research to refer to the generalised and unpractical standards. Moreover, the presentation of the standards as long swathes of text without having summarised lists of specific guidelines that are easy to follow is another reason behind the fragmented shelter approach. This is evidenced by having the Sphere recommendation of 3.5 m^2 minimum area per person as the most cited guideline among the approximate 500 pages of Sphere (despite its lack of evidence). Hence, having clear and specified guidelines would facilitate their application.

10.3 Implications of the research

The implications of this research could be divided into three levels: the design outline, the criteria and the used methods. Firstly, the design outline that is proposed for the Middle East, could be prototyped to host displaced people in post-disaster situations, where the users extend the shelter through an incremental process. Secondly, the proposed criteria for designing transitional shelters in the Middle East, could be interpreted differently by various designers to propose new shelter designs. Lastly, the methods that were used to understand the situation and design preferences of the Syrian refugees, i.e. focus group discussions, observatory tours and PD experiments, could be held in other regions or even other Middle Eastern contexts. The findings of these methods could be added to the general findings from the Sphere guidelines and the global case studies to form more specific and practical criteria for other specified regions or cases.

10.4 Limitations and further study

In the used methods, some limitations affected the outcome of this research. The conducted field visits to the camps, which included three of the used methods (i.e. focus group discussions, observatory tours and PD), were limited by the ability to access the camps and by the sensitivity of the situation inside them.

The limited ability to access the camps is twofold; the geographic distance between Jordan where the studied camps are located and Scotland where the research is conducted, and the difficulties in gaining permission to access the camps. These limitations led to having relatively small samples in each method in a restricted time frame. The research responded to the limitations by using a grounded theory methodology, which focuses on using multi methods with ‘saturated sampling’. The use of the multi-methods enhanced the understanding of shelters. However, future research could include longitudinal studies, where a series of visits are conducted throughout a significant period to better understand the behavioural interaction with the spaces inside the camps.

The sensitivity of the situation inside the camps also forced limitations on the sample number and their demographic structure, which could bring into question the representativeness of the sample. However, during the first visits, the focus group method was chosen to overcome this issue, and the observatory tours were held to support the findings of the focus groups. While in the second set of visits, when the Participatory Design (PD) sessions were held, the different age and gender of the participants added useful insights and findings. Future research could include organised series of PD sessions involving participants with various demographic characteristics.

Moreover, considering the Syrian case as representative of the whole Middle East region was chosen due to the ongoing war and the existence of the case. The analysis of the Palestinian camps in Jordan that was presented in Chapter 2, and the common findings between both of the Palestinian and Syrian camps, support and validate the results. However, this could be questioned, as there are other factors and sub-thematic areas to consider, such as Arabs and non-Arabs or Levant and Gulf. The Middle East region could also be studied based on the countries, cities or rural areas. Therefore, future research could cover other areas in the Middle East using other approaches. As mentioned in the implications section, future work could also include applying the same methods to other regions around the world and form specific shelter criteria that respects their cultural and environmental differences.

The desktop research of the global case studies lacked information that could help provide a more detailed analysis. The suggested documentation form is a result of what this research found to be missing in the current shelter documents. However, future work could include in-depth research on how to document the shelter projects in a way that allows an efficient comparative analysis, such as Life Cycle Assessment (LCA), Life Cycle Cost (LCC) or cultural-based comparatives.

The period of this research did not allow a more detailed development of the design. Therefore, the directions for possible future work include researching and assigning materials. The proposed materials in Appendix D could be the starting point of this research; however, a detailed research on possible and available materials shall be conducted along with the technical details. Additionally, the acoustics of the shelter has to be considered, as the importance of this aspect was highlighted in Chapter 4. Nevertheless, prototyping the proposed shelter design, and conducting the required tests and assessments, would guide and validate the design. Moreover, the cost of the shelter was not calculated, as the design is not finalised. Therefore, the possible future work, which would develop the details of the design, has to consider the LCC of the shelter.

10.5 Epilogue

The rapid increase in the number of displaced people around the world is significant and alarming. It is impossible for the humanitarian sector to control the causes of natural or man-made events which cause displacement. However, they do have the opportunity to develop better pre-emptive shelter approaches. There is a significant increase in the number of displaced people living in urban areas, nevertheless, establishing camps and settlements are sometimes inevitable. Therefore, the undesirable solution of providing shelters or shelter materials cannot be avoided.

There is a need for more collaboration between humanitarian and non-humanitarian workers in the shelter sector. This need for developing the links between practice and research was also presented by Kelman *et al.* (2011) as a way for improving the shelter response. The challenges in the shelter sector are long-standing, and therefore, most of the arguments in the sector are repetitive. There are conceptual arguments such as ‘relief is the enemy of recovery’, and ‘do we really need shelters?’, or about the ethical existence of camps and if they must be organised or self-settled. Other arguments covered the choices of shelters, such as the suitability of the incremental process approach and the use of local or global materials. However, the failure in overcoming these arguments is preventing the shelter sector from developing. Thus, there is an urgent need to revise the current shelter designing approaches, more specifically the standards and guidelines that direct the designs.

This research demonstrated that, while every post-disaster case has its own significance to meet humanitarian needs, there are some common requirements with respect to the geographical region and culture. Therefore, new specified shelter design criteria for each region is suggested to be proposed, supported by a bottom-up approach, where the users are engaged in forming the guidelines to achieve the required cultural adequacy. Moreover, in post-disaster sheltering, the role of architects is to support the affected people to construct their shelters and their communities in a way that fulfil their needs, while the role of the humanitarian workers is to facilitate this collaboration between the architects and the shelter users.

The world today is talking about 'encouraging' the refugees to go back to their countries, specifically the Syrians and Rohingyas. However, both Syria and Myanmar are still unsafe for these returnees and the 'encouragement' is unethical as it pushes people toward dangerous situations. However, generally, refugees would love to go back to their countries when it is safe and when they would have a roof to house them. Since many homes were demolished by the conflicts, the flexibility of the aid shelters and their ability to be deconstructed and rebuilt, would be the real 'encouragement' for return.

To summarise this research, the shelter sector needs to step back from the current approach and change their perspective towards the affected people, their potential skills and shelter needs. Only when we stop looking at the displaced people as numbers and start respecting their individuality, we would be qualified to provide adequate humanitarian response.

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Appendices

Appendix A

Shelter innovations comparison- Extended table

Table A.1: Comparison between the shelter innovations

	Shelter solution (shelter type)	Application	Transportation	Social sustainability		Environmental sustainability		Economic sustainability		References	Notes
				Pros	Cons	Pros	Cons	Pros	Cons		
1	Conrad Gargett's By Conrad Gargett Riddel firm (Emergency shelter)	Only prototyped	Flat packed- Can be disassembled and reassembled with ease	- Flexibility in positioning the shingles and therefore the openings - No mechanical fixings	- One room design- - Does not consider social needs as it is a global shelter - No toilet or kitchen provision	- Frame is made of a grid of intersecting plywood - Some cladding shingles made of plywood	- Some cladding shingles made of translucent plastic and clear plastic		Unknown cost	(Furuto, 2013; Conrad Gargett, 2018)	
2	Exo stackable shelter By Michael McDaniel (Transitional shelter)	Reaction produced around 50 Exos total, most were for testing purposes.	Stackable	- Easily deployed in two minutes by four people - Units can be attached to each other - No tools or heavy machinery needed.	- Does not consider social needs as it is a global shelter - One room design - No toilet or kitchen provision	- Use of wood - Some units come with an LED light display for unlocking and locking the door. - Recyclable	- Aircraft-grade aluminium - Flooring is made of heavy-duty steel tubing and Birchwood		Shelter cost $5,000-$6,000 (Unaffordable)	(Kessler, 2015; McDaniel, 2017; FIBONACCISTONE, 2018)	closed in April 2016 due to funding issues
3	U-dome (Transitional shelter)	- Two U-Domes were assembled in Sacramento- California - Some shelters were distributed at River Haven - Distributed at the Arcata Night Shelter	Flat packed	- Easily deployed - Can incorporate local materials	- Does not consider social needs as it is a global shelter - One room design - Small size (18m^2) proposed for a family of five members - No toilet or kitchen provision	- Off-grid energy sources compatible but not included	- 5 mm thick corrugated polypropylene panels connected with nylon fasteners		Basic shelter cost $2,495- added accessories can be purchased. (Above average)	(World Shelters, 2009, 2018b; designboom, 2018)	Other shelters have been designed by the same company; World Shelter, such as (TShel2/ Green Dome/ / Q-Shelter)
4	TranShel (Transitional shelter)	- Produced a shelter for display at the Shelter Consortium meeting in Geneva (May 2009)	Flat packed	- Easily deployed, can be erected by four adults - Expandable, adaptable to form a core house using local materials - Panels provide ready attachments interior for using local materials	- Does not consider social needs as it is a global shelter - One room design - Small size (18m2) and a wall height of 1.8m for a family of five members - No toilet or kitchen provision	- Reusable - Material has no off-gassing - Recyclable - Possibility of adding local materials	- Frameless hard-panel structures of panels made from corrugated polypropylene		Shelter cost $2,965-$2,360 (Above average)	(World shelters, 2018; World Shelters, 2018a)	

	Shelter solution (shelter type)	Application	Transportation	Social sustainability		Environmental sustainability		Economic sustainability		References	Notes
				Pros	Cons	Pros	Cons	Pros	Cons		
5	Concrete Canvas shelter (Transitional shelter)	- Most projects were military shelters and were sent for tests (US military, Swedish military, Dutch military and United Arab Emirates military)	Foldable and inflatable	- Has two sizes to meet various family's needs (25m2 or 50m2) - Easily deployed, ready in 24 hours	- Does not consider social needs as it is a global shelter - One room design - No toilet or kitchen provision	- Durable- design life of over 10 years - Covered by sand or earth fill, which will give protection, thermal mass and insulation.	- Thin walled concrete structures - Water requirement - Use of plastic - The 50m2 shelter needs a vehicle or winch to unfold prior to inflation - Demolished for its end life		Shelter cost $23,000 to $30,000 (Unaffordable)	(Howard, 2013; Concrete Canvas, 2018a, 2018b)	Medium to long-term operations
6	The Liina Transitional Modular Shelter (Transitional shelter)	Was only prototyped for experiment	Flat packed	- Easily deployed- Can be assembled in six hours by two adults - The interior is divided into different spaces - A private kitchen is provided	- The space subdivision is not responding to the cultural needs (Designed for Ararat region in Turkey but considered as a global shelter) - Small size (18m^2) for a family of 4-5people - No toilet provisions	- Built of plywood and laminated veneer lumber panels - Durable- lifespan of around 5 years - Wood fibre insulation -Covered by a canopy	- Nylon straps (liina) are used		Unknown cost	(Meinhold, 2011; Archdaily, 2018)	
7	The Pallet House (Transitional shelter)	Some prototypes were built for various exhibitions	Could be disassembled	- Easily deployed - No skilled workers needed - Adaptable - Possibility of adding local materials as cladding	- Depends on the availability of materials in the location. - Small basic unit of 18m^2, and requires 80 pallets - No toilet or kitchen provision, but it can be added as it is a technique not a design	- Made of wooden shipping palettes covered by local materials using wattle & daub technique - Wood or straw roof (p) - Possibility of LM	- An option of using corrugated sheets as a roof cover	Materials cost around $500- palettes only (for a shelter of 18m^2) (Below average)		(I-BEAM, 2018)	
8	Life shelter (Transitional shelter)	Hundreds of Syrian refugees has been living in the shelters (Northern Iraq)	Flat packed	- Easily deployed- Can be assembled by 2 people in 3-4 hours without tools - Adaptable as it is a modular design - Can integrate local materials - Durable- expected life span of 15+ years	- Does not consider social needs as it is a global shelter - One room design - Small size (18m^2) - No toilet or kitchen provision	- Stone wool insulation - Durable- Has a life span of 15+ years. - Reusable for permanent housing	- Panels and end-walls made of Stone wool insulation boards reinforced with steel - Galvanised steel floor frame - Cement cladding roof	For large quantities order, the price start from $790- excluding taxes (Below average)		(Lifeshelter, 2018; Real Relief, 2018)	

	Shelter solution (shelter type)	Application	Transportation	Social sustainability		Environmental sustainability		Economic sustainability		References	Notes
				Pros	Cons	Pros	Cons	Pros	Cons		
9	Rapid Deployment Module (RDM) (Semi-permanent shelter)	- Used few times as medical facilities and other functions. - BP bought 26 shelters and used in Mexico - Some shelters were provided to Moore Oklahoma - Trials to distribute them as refugee shelters	Flat packed	- Easily deployed- Can be assembled by 2 people in 25 minutes - Integrated floor structure that makes the shelter sets slightly off the ground	- Does not consider social needs as it is a global shelter - One room design - Small size ($12m^2$) - No toilet or kitchen provision (although some shelters had an addition of toilet and shower)	- Lightweight roof is vented, and the shade fly provides passive cooling and heating. - Reuse shipping box as the base structure - Durable- Expected lifespan of 10 years	- Materials used for walls are not mentioned- only that they are hard walls and could double up as white boards. - The roof is made from vented fabric roof and its weather protective level is questioned despite the weather-protection claims		Shelter cost $15,000-$18,000 (Unaffordable)	(Maxey, 2013; Williams, 2013; VisibleGood, 2018)	
10	Tentative Concept (Post-disaster shelter)	Not known application	Flat packed	- Has a floor that is raised above the floor	- Small size ($8m^2$)- Can hosts two adult and two children (very tight area per person) - No toilet or kitchen provision	- Use of fibreglass shells - Use of textile that is quilted and contains insulated perlite in between - Roof water-collection - Recyclable decks floor	- Tough fabric walls are not enough to maintain a thermal comfort. - The textile is quilted and contains insulated perlite in between		Unknown cost	(Treggiden, 2015; DESIGNNOBIS, 2018)	Though the perlite is a natural material, it is a possible cause of rhinitis and pneumonia
11	Hex house (Shelter (not specified))	Prototyped- But no known application	Flat packed	- Sufficient size ($47m^2$) - Various rooms - Private toilet and kitchen provision	- Does not consider social needs, as it is a global shelter (the porch and openings locations may interfere with the privacy requirements of some cultures).	- Durable- Has a life span of 15y-20y - It includes rainwater-harvesting systems. - Includes underground water storage tanks - Rooftop solar panels - Use of foam insulation	- Use of steel SIPs		Shelter cost $15,000-$20,000 and on a different source $55,000-$60,000 (Unaffordable)	(McKnight, 2016; Hex House, 2018)	
12	Weaving a home (Tent)	Not applied	Foldable	- Culturally acceptable as it is inspired by the Bedouin tents	- Short-term solution- It can only replace the rapid used tent - No toilet or kitchen provision	- Solar-powered skin that absorbs sunlight, convert it into usable electricity and store it in a battery kept underneath the tent. - Roofs are equipped with a water storage tank.	- Plastic members threaded into a cloth		Unknown cost	(Douglass-Jaimes, 2015; Abeer Seikaly, 2019)	

Appendix B

Focus group list of questions

Location

Date

Number of respondents and their gender

Section A: General Information (Engagement questions)

1. How many years have you been in Zaatari/Azraq camp?
   A) 3.5y-2.5y B) 2.5y-1.5y C) 0.5y-1.5y
   D) 0.5>y
2. How many types of shelters have you lived in since arriving to Zaatari/Azraq camp? What are they? How long did you stay in each type?
3. Do you have the ability to read and write?
4. What was/is the approximate area provided per person in each shelter? Alternatively, how many people were housed in each shelter?
5. What is the distance (firebreak) between the shelters?
6. Where were/are the bathroom and kitchen located? Are they communal? If yes for how many families?
7. How do you recognize your own shelter from the others?
8. Did you choose the plot where your shelter is located?
9. Is there a strategy for the shelters' maintenance? If yes, how?
10. Are the shelters accessible for people with reduced mobility? If not, what are the issues?

Section B: Shelters' Evaluation (Exploration questions)

(Questions 1-5 were only asked for Zaatari camp participants, as they are inapplicable to Azraq camp context)

1. Was the first shelter satisfying? Did you face obstacles? What were they?
2. Was the location of the shelter suitable for you (inside the camp)?

3. During the extreme weather conditions in summer and winter, was the first shelter protective? Any experience?
4. When you had the first shelter, did you do any amendments to fulfil your needs?
5. What did you do with the old shelters after having new ones?
6. Are you satisfied with the current shelters?
7. Is the location of your current shelter suitable for you (inside the camp)?
8. During the extreme weather in summer and winter, are your current shelters protective? Any experience?
9. Do the current shelters respect your cultural and religious background?
10. Did/ does the shelters make you feel secured?
11. Did/does the shelters gave you the privacy needed?
12. How do you access water? Is it available all the time? If not, for how long?
13. Is the electricity available all the time? If not, for how long?
14. Do you find any troubles with the ventilation in the current shelter?
15. Do you use any type of appliances foe heating or cooling? If yes, what do you use?
16. Having the current shelters, did you do any amendments to them?

Section C: Hypothetical scenarios (Exit questions)

1. If you can change things in the first shelter, what will they be? (only in Zaatari)
2 If you can change things in your current shelter, what will they be?
3. If you had the option of having a shelter that is built by you with instructions on how to do so, will you or someone who shares you the same shelter be able to do that?
4. In the case of having your home country safe again: Is having a shelter here that is designed in a way that can be deconstructed, taken back with you and reconstruct it in your country as a temporary shelter (to live in until you rebuild your homes), will encourage you to go back?

Appendix C

Re-grouping the case studies

The regrouping of the case studies depended on their specifications. The groups are:

Group 1. Emergency shelters- Cases with simple design and materials aimed at saving lives, they have short lifetime. Figure C.1 shows the photos of the regrouped projects in the emergency shelters, Table C.1 illustrated the cost comparison, Table C.2 illustrates the size comparison, and Table C.3 illustrates the materials comparison.

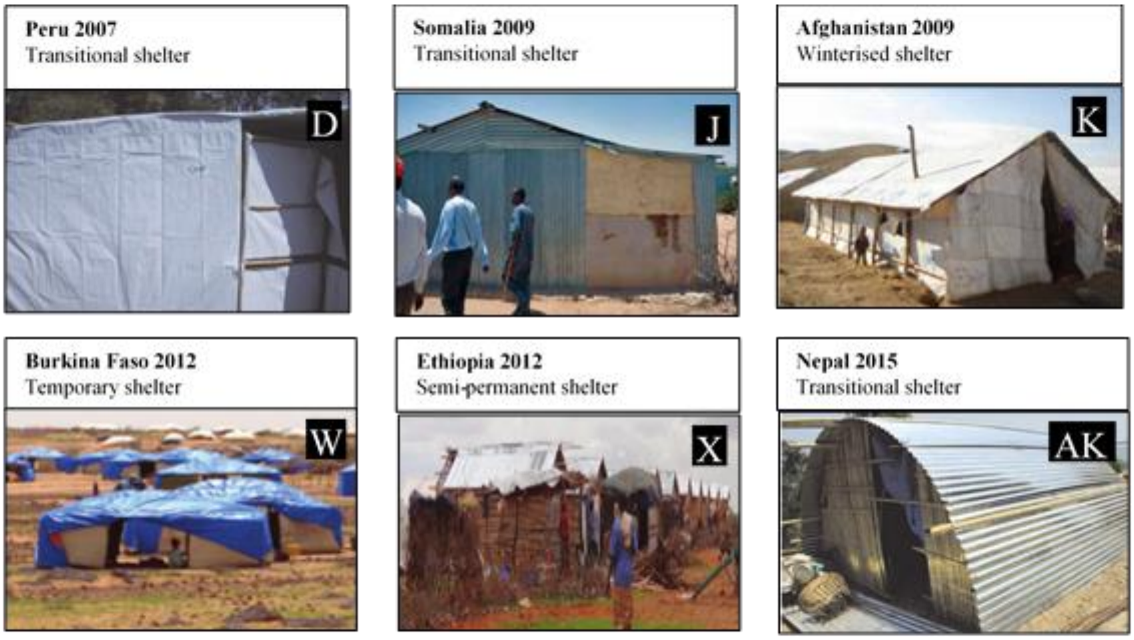


Figure C.1: Group 1- Photos of emergency shelters

Table C.1: Group 1- Cost comparison of emergency shelters

Cost comparison- shelters re-grouped as Emergency shelters								
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	**Materials cost in US Dollars**		
						0-250	**251-500**	**501-750**
J	C	Somalia	2009	634	_			■
K	C	Afghanistan	2009	380	1		■	
W	C	Burkina Faso	2012	1000	_	■		
X	C	Ethiopia	2012	7127	_			■
AK	NE	Nepal	2015	5065	_	■		

Table C.2: Group 1- Size comparison of emergency shelters

Size comparison- shelters re-grouped as Emergency shelters											
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size - m^2					
						15=>	16-20	21-25	26-30	31-35	36-40
D	NE	Peru	2007	706	_		■				
J	C	Somalia	2009	634	_		■				
K	C	Afghanistan	2009	380	1						■
W	C	Burkina Faso	2012	1000	_			■			
X	C	Ethiopia	2012	7127	_			■			
AK	NE	Nepal	2015	5065	_		■				

Table C.3: Group 1- Materials comparison of emergency shelters

Materials comparison- shelters re-grouped as Emergency shelters																			
Number	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Frame and /or walls							Roof			Floor		Foundation
							Wood	Steel	Plastic	Corrugated metal sheets	Grass	Mat	Plastic sheeting	Corrugated metal sheets	Wood	Plastic sheeting	Concrete	Compacted earch	Concrete
D	NE	Peru	2007	Transitional	706	_	■				■		■				■		
J	C	Somalia	2009	Transitional	634	_	■			■				■	■		■		
K	C	Afghanistan	2009	Winterised	380	1	*B						■		■	■		■	
W	C	Burkina Faso	2012	Temporary shelter	1000	_	■		■			■				■			
X	C	Ethiopia	2012	Semi-permanent shelters	7127	_	*B							■		■			■
AK	NE	Nepal	2015	Transitional	5065	_		■		■									

Group 2. Temporary shelters- Shelters built with local materials, with no planned end state. Figure C.2 shows the photos of the regrouped projects in the temporary shelters.

Figure C.2: Group 2- Photos of temporary shelters

Table C.4 illustrated the cost comparison, Table C.5 illustrates the size comparison, and Table C.6 illustrates the materials comparison.

Table C.4: Group 2- Cost comparison of temporary shelters

Cost comparison- shelters re-grouped as Temporary shelters									
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	**Materials cost in US Dollars**			
						0-250	**251-500**	**501-750**	**751-1000**
T	C	Ethiopia	2011	2175	_				
Y	NC	Madagascar	2012	598	_				
AC	NF	Pakistan	2012	5167	_				
AN	C	Ethiopia	2014-2016	835	_				

Table C.5: Group 2- Size comparison of temporary shelters

Size comparison- shelters re-grouped as Temporary shelters								
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size - m^2		
						15=>	**16-20**	**21-25**
T	C	Ethiopia	2011	2175	_			
Y	NC	Madagascar	2012	598	_			
AC	NF	Pakistan	2012	5167	_			
AN	C	Ethiopia	2014-2016	835	_			

Table C.6: Group 2- Materials comparison of temporary shelters

Materials comparison- shelters re-grouped as Temporary shelters																	
Number	**Disaster Type**	**Case study**	**Year**	**Main Project**	**No. built**	**Expected lifetime in years**	**Frame and/or walls**			**Roof**			**Floor**		**Foundation**		
							Wood	**Mud**	**Corrugated metal sheets**	**Corrugated metal sheets**	**Wood**	**Thatch**	**Mud Plinth**	**Compacted earch**	**Stone**	**Wood**	
T	C	Ethiopia	2011	Semi-permanent shelters	2175	_	*B										
Y	NC	Madagascar	2012	Progressive shelters	598	_											
AC	NF	Pakistan	2012	Transitional shelters.	5167	_	*B										
AN	C	Ethiopia	2014-2016	Transitional	835	_											

Group 3. Transitional shelters (1)- Shelters with woven bamboo/wood walls. Figure C.3 shows the photos of the regrouped projects in the transitional shelters (1), Table C.7 illustrated the cost comparison, Table C.8 illustrates the size comparison, and Table C.9 illustrates the materials comparison.

Figure C.3: Group 3- Photos of transitional shelters (1)

Table C.7: Group 3- Cost comparison of transitional shelters (1)

Cost comparison- shelters re-grouped as Transitional shelters (shelters with woven bamboo/wood walls)						Materials cost in US Dollars							
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	0-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750	1751-2000
F	NC	Bangladesh	2007	1250	_							■	
Q	NE	Haiti	2010	1050	3 to 5							■	
R	NC	Philippines	2011	1823	5		■						
U	C	South Sudan	2011	6800	_		■	■					
AB	C	Myanmar	2012	2843*8	_			■					
AE	NT	Philippines	2012	4139	_		■						
AH	C	Ethiopia	2013	_	2-4y		■						
AI	C	Myanmar	2014		2-4y		■						
AL	NT	Philippines	2013-2015	3500	3-5y					■	■	■	■

Table C.8: Group 3- Size comparison of transitional shelters (1)

Size comparison- shelters re-grouped as Transitional shelters (shelters with woven bamboo/wood walls)						Shelter size - m^2			
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	15=>	16-20	21-25	26-30
C	NE	Peru	2007	726	_	■			
F	NC	Bangladesh	2007	1250	_	■			
G	NC	Myanmar	2008	850	_	■			
Q	NE	Haiti	2010	1050	3 to 5				■
R	NC	Philippines	2011	1823	5		■		
U	C	South Sudan	2011	6800	_		■		
AB	C	Myanmar	2012	2843*8	_		■		
AE	NT	Philippines	2012	4139	_		■		
AH	C	Ethiopia	2013	_	2-4y			■	
AI	C	Myanmar	2014		2-4y		■		
AL	NT	Philippines	2013-2015	3500	3-5y			■	

Table C.9: Group 3- Materials comparison of transitional shelters (1)

Materials comparison- shelters re-grouped as Transitional shelters (shelters with woven bamboo/wood walls)							Frame and/or walls					Roof						Floor			Foundation			
Number	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Wood	Mud	Brick	Corrugated	sheeting	Corrugated	Corrugated	Wood	Steel	Plastic	Thatch	Concrete	Wood	Mud Plinth	Steel	Concrete	Stone	Wood
C	NE	Peru	2007	Transitional	726	_	*B																	
F	NC	Bangladesh	2007	Core shelter	1250	_	*B		■						■					■		■		
G	NC	Myanmar	2008	Transitional	850	_	*B																	
Q	NE	Haiti	2010	T-shelters	1050	3 to 5	■						■			■		■				■		■
R	NC	Philippines	2011	Transitional shelters	1823	5	*B				■	■							■		■	■		
U	C	South Sudan	2011	Progressive shelter	6800	_	*B	■			■						■							
AB	C	Myanmar	2012	Temporary shelter	2843*8	_	*B					■		■	■				*B					
AE	NT	Philippines	2012	Transitional shelters	4139	_	■				■	■										■	■	
AH	C	Ethiopia	2013	Transitional shelter	_	2-4y	*B					■		■										
AI	C	Myanmar	2014	Transitional shelter		2-4y	*B					■							*B			■		
AL	NT	Philippines	2013-2015	Transitional	3500	3-5y	■			■												■		

Group 4. Transitional shelters (2)- Shelters with hard surface materials. Shelters with woven bamboo/wood walls. Figure C.4 shows the photos of the regrouped projects in the transitional shelters (2), Table C.10 illustrated the cost comparison, Table C.11 illustrates the size comparison, and Table C.12 illustrates the materials comparison.

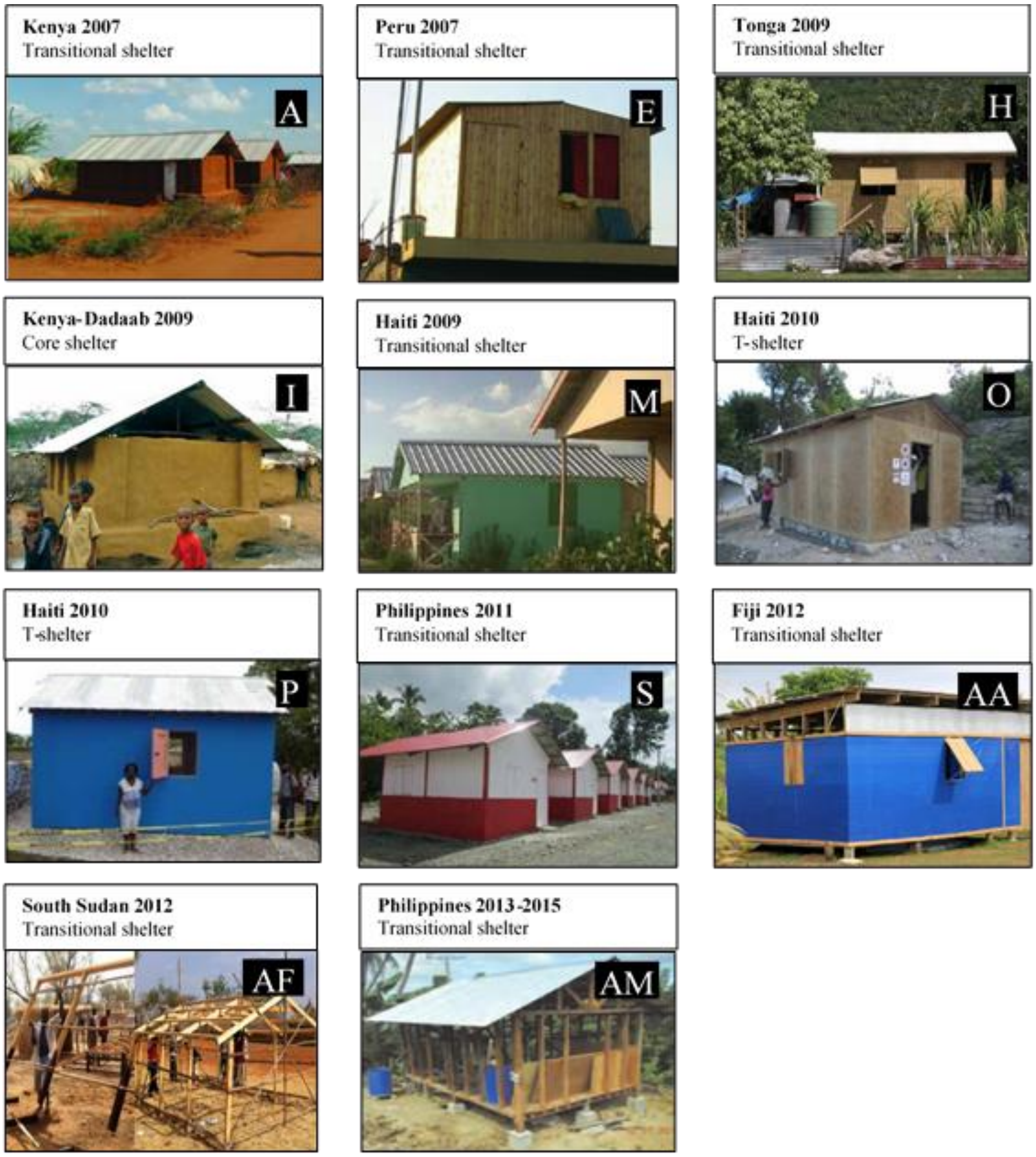


Figure C.4: Group 4- Photos of transitional shelters (2)

Table C.10: Group 4- Cost comparison of transitional shelters (2)

Cost comparison- shelters re-grouped as Transitional shelters (shelters with harder surface materials)																							
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	**Materials cost in US Dollars**																	
						0-250	**251-500**	**501-750**	**751-1000**	**1001-1250**	**1251-1500**	**1501-1750**	**1751-2000**	**2001-2250**	**2251-2500**	**2501-2750**	**2751-3000**	**3001-3250**	**3251-3500**	**3501-3750**	**3751-4000**	**4001-4250**	**4251-4500**
A	NF	Kenya	2007	500	_		■																
H	NT	Tonga	2009	74	_																		■
I	C	Kenya-Dadaab	2009	up to	_		■																
M	NE	Haiti	2010	1356	_							■											
O	NE	Haiti	2010	2000	3 to 5							■											
P	NE	Haiti	2010	4471	5 to 10											■							
S	NT	Philippines	2011	250	5							■											
AA	NC	Fiji	2012	254	_								■										
AF	C	South Sudan	2012	3747	_		■																
AM	NT	Philippines	2013-2015	885	_														■				

Table C.11: Group 4- Size comparison of transitional shelters (2)

Size comparison- shelters re-grouped as Transitional shelters (shelters with harder surface materials)									
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size - m^2			
						15=>	**16-20**	**21-25**	**26-30**
A	NF	Kenya	2007	500	_		■		
E	NE	Peru	2007	1900	_		■		
H	NT	Tonga	2009	74	_		■		
I	C	Kenya-Dadaab	2009	up to	_		■		
M	NE	Haiti	2010	1356	_		■		
O	NE	Haiti	2010	2000	3 to 5			■	
P	NE	Haiti	2010	4471	5 to 10		■		
S	NT	Philippines	2011	250	5				■
AA	NC	Fiji	2012	254	_			■	
AF	C	South Sudan	2012	3747	_	■			
AM	NT	Philippines	2013-2015	885	_		■		

Table C.12: Group 4- Materials comparison of transitional shelters (2)

Materials comparison- shelters re-grouped as Transitional shelters (shelters with harder surface materialss)																								
							Frame and/or walls							**Roof**					**Floor**			**Foundation**		
Number	**Disaster Type**	**Case study**	**Year**	**Main Project**	**No. built**	**Expected lifetime in years**	**Wood**	**Concrete**	**Masonry**	**Mud**	**Brick**	**Corrugated metal sheets**	**Plastic sheeting**	**Corrugated metal sheets**	**Corrugated cement**	**Wood**	**Steel**	**Metal sheet**	**Concrete**	**Wood**	**Compacted earch**	**Steel reinforcement**	**Concrete**	**Stone**
A	NF	Kenya	2007	Transitional	500	_	■				■	■												
E	NE	Peru	2007	Transitional	1900	_	■								■									
H	NT	Tonga	2009	Transitional	74	_	■																	
I	C	Kenya-Dadaab	2009	Core shelter	up to 3500 PY	_	■			■				■										
M	NE	Haiti	2010	Transitional	1356	_										■			■					
O	NE	Haiti	2010	T-shelters	2000	3 to 5	■									■		■	■				■	■
P	NE	Haiti	2010	T-shelters	4471	5 to 10	■									■		■		■			■	
S	NT	Philippines	2011	Transitional shelters	250	5	■	■	■							■	■		■			■	■	
AA	NC	Fiji	2012	Transitional shelter	254	_	■						■	■							■		■	
AM	NT	Philippines	2013-2015	Transitional	885	_	■					■												

Group 5. T-shelters- Shelters that can be described as both temporary and transitional, mainly prefabricated. Figure C.5 shows the photos of the regrouped projects in the T-shelters, Table C.13 illustrated the cost comparison, Table C.14 illustrates the size comparison, and Table C.15 illustrates the materials comparison.

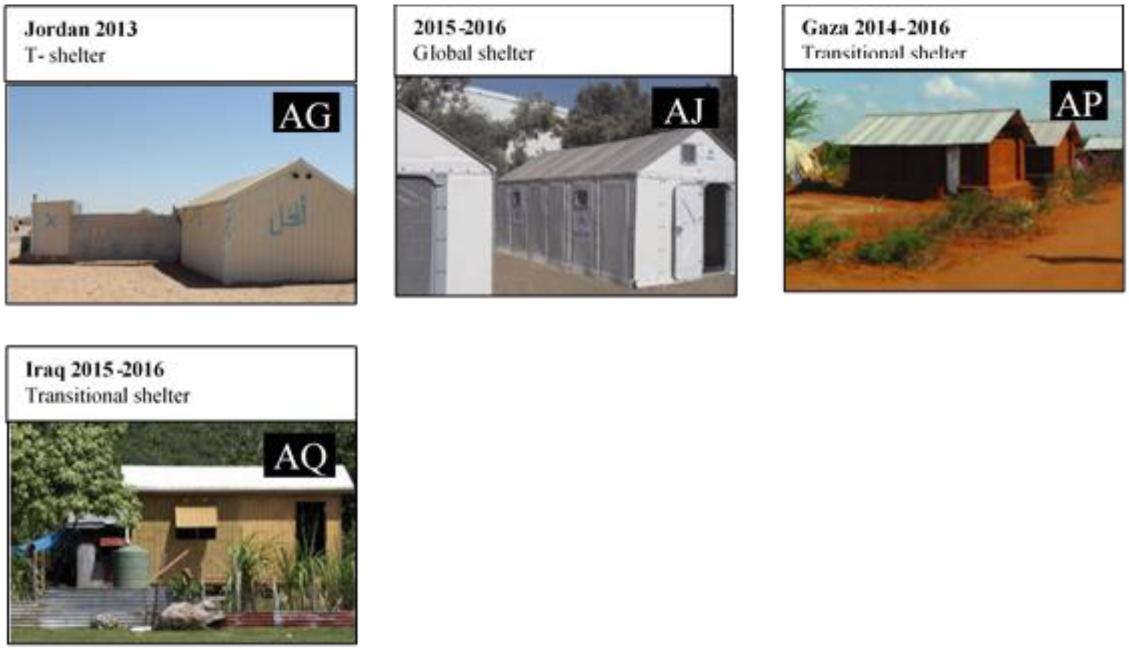


Figure C.5: Group 5- Photos of T-shelters

Table C.13: Group 5- Cost comparison of T-shelters

Cost comparison- shelters re-grouped as T-shelters																							
						Materials cost in US Dollars																	
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	0-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750	1751-2000	2001-2250	2251-2500	2501-2750	2751-3000	3001-3250	3251-3500	3501-3750	3751-4000	4001-4250	4251-4500	4500<
AG	C	Jordan	2013	13500	2-4y						■													
AJ	Global shelter	Better shelter	2015-2016	6870	1.5-3					■														
AP	C	Gaza	2014-2016	470	5																			■
AQ	C	Iraq	2015-2016	1406	_																			■

Table C.14: Group 5- Size comparison of T-shelters

Size comparison- shelters re-grouped as T-shelters														
						Shelter size per room/family- m^2								
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	15=>	16-20	21-25	26-30	31-35	36-40	41-45	46-50	50<
AG	C	Jordan	2013	13500	2-4y			■						
AJ	Global shelter	Better shelter	2015-2016	6870	1.5-3		■							
AP	C	Gaza	2014-2016	470	5									■
AQ	C	Iraq	2015-2016	1406	_			■						

Table C.15: Group 5- Materials comparison of T-shelters

Materials comparison- shelters re-grouped as T-shelters																			
							Frame and /or walls				Roof				Floor				Foundation
Number	Disaster Type	Case study	Year	Main Project	No. built	Expected lifetime in years	Wood	Steel	Polymer plastic	Insulation	Corrugated metal sheets	Plastic sheeting	Polymer plastic	Insulation	Plastic flooring	Fiberglass	Concrete	Wood	Concrete
AG	C	Jordan	2013	T-shelters	13500	2-4y		■		■	■	■					■		
AJ	GS	Better shelter	2015-2016	Temporary	6870	1.5-3		■	■	■			■		■				
AP	C	Gaza	2014-2016	Transitional	470	5	■				■							■	■
AQ	C	Iraq	2015-2016	Tarnsitional	1406	_		■		■	■			■		■		■	

Group 6. Core shelters- shelters that were built with materials that are considered permanent. Figure C.6 shows the photos of the regrouped projects in the core shelters, Table C.16 illustrated the cost comparison, Table C.17 illustrates the size comparison, and Table C.18 illustrates the materials comparison.

Sri Lanka 2007
Core shelter

Haiti 2010
Progressive shelter

Pakistan 2010
Core shelter

Cote d'Ivoire 2010- 2011
Progressive shelter

South Sudan 2012
Progressive shelter

Pakistan 2012
Progressive shelter

Tanzania 2016-2017
Transitional shelter

Figure C.6: Group 6- Photos of core shelters

Table C.16: Group 6- Cost comparison of core shelters

Cost comparison- shelters re-grouped as core shelters															
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	**Materials cost in US Dollars**									
						0-250	**251-500**	**501-750**	**751-1000**	**1001-1250**	**1251-1500**	**1501-1750**	**1751-2000**	**2001-2250**	**2251-2500**
L	NE	Haiti	2010	3960	_										■
N	NF	Pakistan	2010	175	_			■							
V	C	Côte d'Ivoire	2010-2011	1341	_			■							
Z	C	South Sudan	2012	1500	_				■	■					
AD	NF	Pakistan	2012	1000	_		■								
AO	C	Tanzania	2016-2017	7552	_		■								

Table C.17: Group 6- Size comparison of core shelters

Size comparison- shelters re-grouped as core shelters											
Image	Disaster Type	Case study	Year	No. built	Expected lifetime in years	Shelter size- m^2					
						15=>	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**
B	C	Sri Lanka	2007	213	_		■				
L	NE	Haiti	2010	3960	_		■				
N	NF	Pakistan	2010	175	_			■			
V	C	Côte d'Ivoire	2010-2011	1341	_						■
Z	C	South Sudan	2012	1500	_		■				
AD	NF	Pakistan	2012	1000	_		■				
AO	C	Tanzania	2016-2017	7552	_		■				

Table C.18: Group 6- Materials comparison of core shelters

Materials comparison- shelters re-grouped as core shelters																		
Number	**Disaster Type**	**Case study**	**Year**	**Main Project**	**No. built**	**Expected lifetime in years**	**Frame and /or walls**						**Roof**				**Floor**	**Foundation**
							Wood	**Steel**	**Concrete**	**Mud**	**Brick**	**Plastic sheeting**	**Corrugated metal sheets**	**Wood**	**Plastic sheeting**	**Mud plaster**	**Wood**	**Concrete**
B	C	Sri Lanka	2007	Core shelter	213	_	■	■			■	■	■					
L	NE	Haiti	2010	Progressive	3960	_		■	■			■	■				■	■
N	NF	Pakistan	2010	Core shelter	175	_			■		■	■		■ *B				■
V	C	Côte d'Ivoire	2010-2011	Progressive Shelter	1341	_				■			■	■				
Z	C	South Sudan	2012	Progressive shelter	1500	_				■			■	■				
AD	NF	Pakistan	2012	Progressive Shelters	1000	_	■ *B			■				■ *B	■	■		
AO	C	Tanzania	2016-2017	Transitional	7552	_					■		■					

Appendix D

Possible materials

In Chapters 6 and 7 where the previous existing case studies were analysed, the most common materials that were used for the shelter's elements were listed. In terms of walls and frames, wood and/or bamboo were the most used materials. Tarpaulin was also commonly used, preferably as an addition to the main materials but not as a stand-alone material. Corrugated sheets were used but not preferred, as they are unfriendly to the environment, overheat the interior, and may lead to injuries when handled and installed. Mud and mud blocks were used in previous cases, but they cannot be used in this design as they contradict with the temporary and movability guidelines, numbered 1.1 and 6.4 respectively in the criteria (Table 9.1). In the same analysis, the most common used materials for the roof were corrugated sheets, wood and/or bamboo, plastic sheeting, thatch and steel. For the floors, wood or concrete were mostly used, while concrete and stone were used for the foundations.

As clarified earlier, this research does not consider the shelter as a product, but instead as an incremental process. The panelised walls that were chosen in the outline section align with this approach in terms of layout. For materials, the context of the disaster is the main driver in choosing the suitable materials. This section discusses the potential materials for the walls, floor and roof, while it gives some recommendations on possible materials to be considered.

According to Escamilla and Habert (2015), sustainable shelter solutions can be produced using either global or local construction materials. Global materials are most likely to provide better technical performance whereas the local materials are likely to lower both costs and environmental impact. In this design, the preliminary preference in terms of materials is the use of natural and local materials. However, there are few considerations regarding the use of natural materials, such as avoiding the overconsumption of the resources, and the priority of using durable materials. The use of wood appeared as a preferred material due to its sustainability and its ability to be easily removed, but the unavailability of wood in most of the Middle Eastern countries could be a limitation.

Walls

From the design outline section, panels were chosen for the walls to provide the required flexibility and adaptability to address the movability guidelines in the suggested criteria (numbered 1.8 and 6.4 respectively in Table 9.1). They also help fulfil other guidelines such as the design of various shelter sizes, the ease of transportation, and ease of maintenance, i.e. guidelines 1.3, 2.6, and 6.2 respectively in Table 9.1.

Sandwich panel structures usually have two outer skins of a strong and high-density material and a core of a low-density insulation material. One of the most common structures which have a sandwich panel approach are the Structural Insulated Panels (SIPs) (Yang, Li and Du, 2012). SIPs are engineered composite load-bearing panels, which are pre-fabricated and can be used for walls, floors (with adequate support), and roofs components. As a sandwich panel, one of the benefits is that the structural support is incorporated with the insulation as one system (Kermani, 2006).

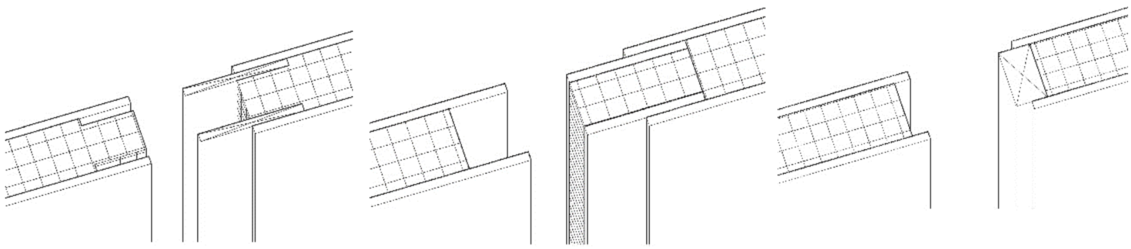
The most common core materials which have been used in SIPs include Polystyrene (PS) such as Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS), Polyurethanes (PUR) foam, or Polyisocyanurate (PIR) (Panjehpour *et al.*, 2012; Pullen, 2017). Although, following the recent Grenfell Tower fire in London and concerns regarding cyanide gas when burning it is recommended that PIR is avoided. PUR has higher R-value than the PS insulation (the measure of resistance to heat flow through a given thickness of material). However, a thicker PS in a SIP will achieve the same U-value of a PUR core. The availability of the insulation material and its cost may be the main factor in choosing the insulation. For the outer structural skin for SIPs, some of the common used materials are: metal, fibre cement, cement, calcium silicate, gypsum and oriented strand board (OSB) (Panjehpour *et al.*, 2012). There are two fabrication techniques used in SIPs, either an industrial adhesive on a pre-cut foam core that is pressed between the facing panels, or injection where foam is injected between the facings.

SIPs have many benefits, such as the high strength-to-weight ratio, good thermal performance, low environmental impact, and the benefits related to its prefabrication such as ease of erection, lightweight, alignment to self-build and saving time. The long-term use is also a benefit as long as it is protected from degradation (Rungthonkit and Yang, 2009; Yang, Li and Du, 2012; Ahmed, 2018). Another benefit of SIPs that is crucial for the proposed design is the possibility of deconstruction.

OSB is a very common used material for structural skins for its cost efficiency (Panjehpour *et al.*, 2012). Additionally, OSB is usually available in large panel sizes (Ahmed, 2018). The drawbacks of OSB are the potential of being flammable, insect penetrable and moisture penetration (Panjehpour *et al.*, 2012).

For the outer walls, this research suggests *SIPs of OSB skin and PUR (injected) or PS (glued) insulation*, while for the internal walls, *any solid partition with a good quality could be used*, whether OSB boards, wooden panels or one of the innovative materials such as ECOR panels that are made out of waste fibre, water, and heat (ECOR, 2019).

In order to connect any two SIPs together (panel-to-panel joints), there are three common methods: OSB thin spline, mini-SIP spline or dimensional lumber spline (Figure D.1). Nevertheless, The tests that were carried out at the university of Birmingham, showed that the *panels with dimensional lumber spline connections* are the stiffest and provide highest design loading capacity (Rungthonkit and Yang, 2009).



(a) OSB thin spline (b) Mini-SIP spline (c) Dimensional lumber spline

Figure D.1: Typical panel-to-panel joints

The panels are usually fixed together by nails or screws. To keep the movability of the panels, screws are proposed to be used on at least one side of each panel as illustrated in Figure D.2. This would ease future deconstruction and re-use of the panels.

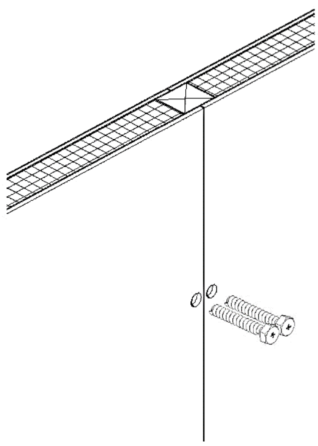


Figure D.2: Panel-to-panel connection

For the corners, screws can also be used, but the research suggests producing *cam lock nuts and cam screws connection system*. There is a patented connection system with a similar concept called TorpedoCSIS (Brown, 2016), which could be scaled to be used for the SIPs panels. Figure D.3 illustrates the possible detail. The benefits of using this connection system is the ease of future deconstruction and the ability to be used by unskilled people using simple tools.

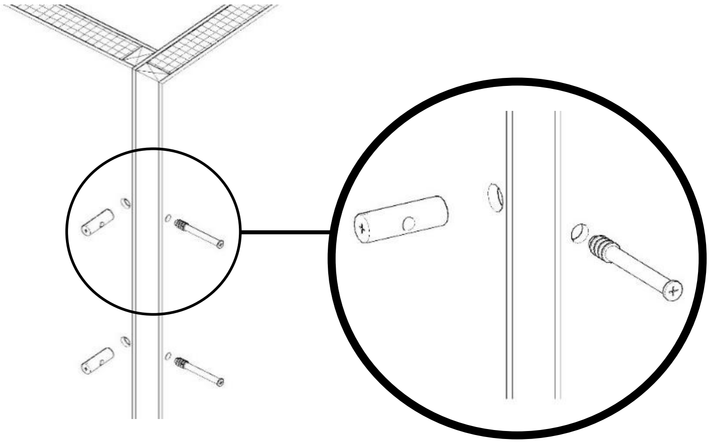


Figure D.3: Cam lock nuts and cam screws connection detail

Cladding

As described in Chapter 2, the temperature levels vary widely between summer and winter in the Middle East. To avoid the overheating of the shelter, it is proposed to utilise a cavity external wall system, and an outer skin with thermal mass properties. However, to minimise the weight of the transported material, to ease the construction and deconstruction, and to engage the users in the building process, this study proposes using on-site materials such as sand, earth, and small stones for the outer leaf core material. A suggested approach to address these features is using a fabric bag cladding system that is delivered to site as pre-rolled fabric. The cladding lining can then be opened and filled with local materials (Figure D.4).

The fabric bag would be anchored to the SIPs via standard offset clips, which are able to withstand lateral wind forces and provide tieback support for the facade. Depending on the outer facing of the fabric bag, coatings could be applied. It also may need to be plastered to protect the bags from corrosion. One possible solution would be the plaster invention of Nader Khalili, which uses 85% earth and 15% cement plaster (CalEarth, 2018). There are major challenges in this type of cladding, such as the anchoring details, specifically for the areas between the windows and the roof. The method that has to be adopted to compact the earth is also of a concern, since the bags are installed vertically. Taking lessons from the earth bags used in “CalEarth” founded by Nader Khalili

(CalEarth, 2018), the bags shall be with a rigid texture as the gravel or earth will depend exclusively on the bag to maintain its shape. It is challenging to apply this cladding, but it is possible with further research.

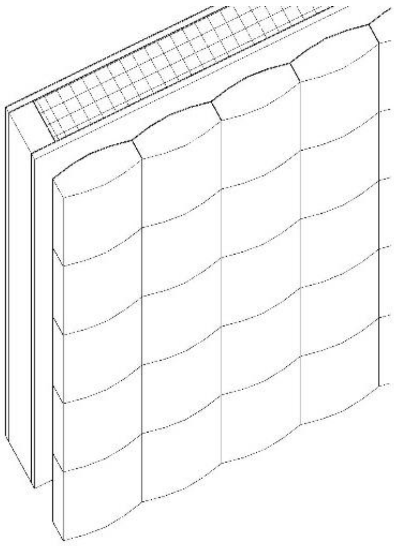


Figure D.4: Fabric bags as exterior cladding

Another option would be wrapping the SIPs with a breather membrane, which prevents moisture penetration but permits air. *Fabric bags, breather membrane, or a combination of both* would be the options for the cladding. Prototyping the shelter and the use of environmental impact assessment tools will examine the applicability and the practicality of the options.

Roof

The roof is the most complex element in the shelter scale, and it is the main factor that affects the speed of construction considering the scale of the shelter (Celentano *et al.*, 2018). It is hard to provide a roof that is protective, temporary, has a low cost, lightweight, rapidly installed and friendly to the environment at the same time. As such, a compromise approach is suggested.

As mentioned in chapter 7, approximately 47% of the studied projects used corrugated sheets as a roofing material. The second most used roofing material was wood/bamboo roofs with a percentage of 37%. Using the corrugated sheets for roofs is not a preferred solution due to many factors: they are prone to corrosion, transfer heat, cannot be fully sealed, have sharp edges and are not suitable in cyclone prone areas as they may cause serious injuries when blown away. In this study, the corrugated sheet roof is excluded from the possible options. Although it is still a choice when funds are limited, and local natural alternatives are not available. A timber-based roof is suggested in this study.

Panelised SIPs could be used as they could be deconstructed and reused and have good thermal performance. However, the cost is the main limitation of using SIPs. Moreover, during summer, the wooden roof whether SIPs or others, cannot provide the required thermal performance, thus, an added separative material is needed.

In this research, a canopy is suggested to be added over the panelised roof with an air gap in between. To do this, spacers must be added underneath the canopy to allow air circulation. This method can provide shading and limit the amount of heat gained by the roof and therefore the heat transferred to the interior. Scavino (2014) proposed a similar solution as an addition to the existing prefabricated shelters in Zaatari camp, but it was not adopted by the aid providers. The study examined two options for the shade net; agricultural fabric and Polyester, while suggesting other three option; perforated Polyethylene, tarpaulin and PVC. For the spacers, the study proposed tires, concrete blocks or steel spacers. *Wooden panels and a canopy with an air gap in between* are suggested for the roof to be further researched. The spacers could be sourced from the surrounding environment.

Floor

As previously mentioned in Chapter 7, most of the studied cases did not indicate the flooring material. However, of those mentioned, around 18% used wood and 16% used concrete. Both wood and concrete are not preferable to be used. Wooden floors are not familiar in the Middle Eastern culture as floors are often washed with water. While concrete, is a permanent material that is not allowed by many local authorities.

Innovative materials are to be looked at for the flooring system. One option is the bead manufacturing floor system which consists of small pellets of plastic which expands when heated due to the gas it contains, ending up with a product of 98% air and 2% of polystyrene (Energystore, 2018). Another innovation is an emergency floor designed by Good Works Studio (2019). This is a floor made of interlocking recyclable expanded Polypropylene foam pieces (EPP). It can be inserted directly on the ground, or elevated over pallets or sandbags. A fund by USAID from 2015-2018 was given to the designers to do further testing on the material (USAID, 2018). The ease of erection and deconstruction, the affordable cost, and the existing prototyping in existing emergency shelters are advantages of the Emergency Floor. In this research, the *Emergency Floor* is suggested for the flooring solution to be examined.

Foundations

Many existing cases among the ones studied in Chapter 7, did not indicate the foundation materials. However, around 43% of the studied cases in this research used concrete for the foundation, which is considered as an undesired permanent material. In many Middle Eastern locations, foundations are not required for stability purposes, but they are needed for other reasons, such as elevating the shelter to limit the possibility of moisture penetration during heavy rain showers and reducing access to rats and insects.

One choice to be used could be the wooden pallets, which usually are available in the sites after transporting food and non-food items. Another option could be the gabion cages that are internally covered with fabric and filled with earth. Both pallets and gabion cages options are theoretically possible, but the foundation must be technically fit with the chosen floor material. Prototyping and examining the options would clarify the most suitable foundation, whether among the mentioned options or others.

Summary of possible materials

Materials are beyond the scope of this research, but there were recommendations that need to be further researched, prototyped and examined. The suggested materials included SIPs of OSB skin and PUR insulation for external walls, while the internal walls could be OSB boards, wooden panels, or one of the innovative new materials. For the cladding, fabric bags, breather membrane, or a combination of both would be options to be tested. Wooden panels (probably SIPs) and a canopy with an air gap in between is suggested for the roof to be further researched. Interlocking recyclable EPP are suggested for the floor. Pallets and gabion cages are two options for the foundation to be further studied. These options provide a system that can be easily transported, has a lightweight and can be self-built. The outer skin facilitates the use of local materials and provides coolth and warmth. Additionally, the system fulfils the main priority in the design, which is the ability to be deconstructed and transported for reuse in other location.