Sustainability Assessment for Temporary Housing Units

Noura Mohamed Ezzaroualy

Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Architecture

Eastern Mediterranean University
February 2021
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

Prof. Dr. Ali Hakan Ulusoy
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science in Architecture.

Prof. Dr. Resmiye Alpar Atun
Chair, Department of Architecture

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Architecture.

Assoc. Prof. Dr. Ercan Hoşkara
Supervisor

Examining Committee

1. Prof. Dr. Sadiye Müjdem Vural

2. Assoc. Prof. Dr. Ercan Hoşkara

3. Assoc. Prof. Dr. Payam Mahasti

ABSTRACT

Natural disasters and wars have been happening in recent years because of various factors, such as cultural, political, economic, etc. The conflict has contributed to a considerable rise in refugee numbers. UNHCR suggests that nearly 62 million people had been displaced from their countries and had to flee to areas they believed would be safer. Around 22 million of these people are refugees. The majority of refugees staying in refugee camps are placed in different countries worldwide, which have a population of more than 250000. While most of these refugee camps offer much-needed services to the refugees, there are numerous problems in many camps.

The critical situation in these camps is that some refugees may continue to live in these places for several years, which may last from five to ten years, and sometimes it may last for decades, these camps gradually turn into small random cities if the camp is not subject to regulation. From this standpoint, this research studies the types of emergency shelters focusing on temporary housing units, which are temporary buildings, to present a proposal to assess these units' sustainability. This thesis aims to propose sustainable temporary housing principles and assessment system to create a new scale to evaluate temporary housing sustainability by using the LEED-H rating system as a base. According to the results, this thesis will evaluate a case in order to test the evaluation system. The evaluation system will be used as a tool for decision-making processes.

Keywords: Shelters, Refugee Camps, temporary housing, sustainability, sustainability evaluation, LEED-H.

ÖZ

Son zamanlarda savaşlar kültürel, politik, ekonomik ve bunun gibi çeşitli faktörler yüzünden vuku bulmaktadır. Bu çatışma hatırı sayılır bir miktarda mülteci artışına sebep olmuştur. UNCHR yaklaşık 62 milyon insanın daha güvende olmak için kendi ülkelerini terk edip başka yerlere gittiği öne sürülmüştür. Bu rakamın 22 milyon kadarını da mülteciler oluşturmaktadır. Mülteci kamplarında kalan mültecilerin çoğunluğu dünya üzerinde değişik ülkelere yerleştirilmiştir. Popülasyonu 250000'ı aşan ve şehre benzeyen kamplar bulunmaktadır. Çoğu mülteci kampları gerekli servisleri sağlasa da kamplarda birçok problem baş göstermektedir.

Bu kamplarla ilgi kritik nokta bazı mültecilerin bu yerlerde beş ile on yıl süreyle hatta bazen on yıllarca yaşamaya devam edecek olmalarıdır, bu kamplar eğer düzene sokulmazlarsa gitgide rastgele küçük şehirlere dönüşeceklerdir. Bu bakımdan, araştırma afet sonrası geçici konaklama ünitelerine odaklanan ve geçici yapılar olan acil durum barınak çeşitleri önergesi ile bu ünitelerin sürdürebilirliğini değerlendirmeyi ele almaktadır. Bu tez sürdürülebilir geçici konaklama prensipleri ve gelişen ülkelerde bu geçici barınak yerlerinin ölçülmesi üzerine LEED-H değerlendirme sistemini temel alarak yeni bir ölçü tasarısı önermeyi hedeflemektedir. Sonuçlara göre, tez değerlendirme sistemini test etmek için bir örneği değerlendirecektir. Değerlendirme sistemi karar verme sürecinde bir araç olarak kullanılacaktır.

Anahtar Kelimeler: Barınaklar, Mülteci Kampları, Geçici barınma, Sürdürebilirlik, Sürdürebilirlik Değerlendirmesi, LEED-H

DEDICATION

I dedicate this work to my family for their unwavering support and inspiration during this Master's journey. Your continuous support and your insightful words were my strength and will always be.

ACKNOWLEDGMENT

With my warmest appreciation. I would like to thank my supervisor Assoc Prof. Dr. Ercan Hoşkara, who this study would hardly be completed without his continuing support and encouragement.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

1.1 Problem Statement

The number of homes affected or lost after disasters are usually high, and relocatin affected people is one of the leading construction steps. Families have to search for temporary shelters immediately after the disaster or conflict and then start the temporary housing phase before permanent housing options identified. It is necessary to provide citizens with minimum conditions to live dignified, privatised, and safe during this process. The substantial-quality post-disaster shelter can provide significant physical, cultural, and economic advantages for users and sustain their environment and family structure. The provision of adequate shelters and the proper arrangement of camps with acceptable layouts include managing to obtain the highest degree of comfort and the feeling of home and belonging in short periods.

Despite all the attempts to provide adequate and integrated shelter immediately after the disaster, many problems appear afterwards. However, since the shelter's primary purpose is to provide comfort and safety for those affected, we must rethink improving quality and enhancing these shelters' sustainability.

1.2 Literature Review

Nowadays, the number of disasters, natural disasters, wars, and political conflicts is continuously increasing. The main impact of such events on the citizens is leaving them shocked, traumatised, and genuinely worried about their family members or

relatives who have lost in the disaster; meanwhile, the loss of their homes and belongings is another tragedy to deal with it. The loss of their homes is one of the most common stressors (Caia et al, 2010). Having a home is a critical need and necessary for people to live in health, security, and comfort. Thus, losing a home means losing dignity, identity, and privacy (Barakat, 2003).

Forcibly displaced people worldwide has risen dramatically in the last decade, with an estimated annual growth of 1.6 million between 2000 and 2014. At the end of 2015, there were 65.3 million displaced people worldwide (UNHCR, 2016). Combined with the continuing environmental problems faced by climate change. As the post-disaster sheltering process begins, also take in consideration that the shelter is not only a roof and room walls but also a lot more than that. Proper space and conditions are necessary; not only buildings or blocks. Some fundamental dynamics should be taken into consideration in the shelter before provide them to victims.

In recent decades several ideas and methods have been developed and introduced. However, some issues continue to remain and prevent more productive and reliable results from being achieved (Kronenburg, 2009). Global developments assess developments in forced migration and status, which increase public perception of continuing crises. Reports analyse trends of the last ten years, which reveal that 79.5 million have displaced since the end of 2019. UNHCR's number has never been this high before. Most temporary housing issues are due to misunderstandings about the situation after a disaster (Kronenburg, 2009).

The issues described above explicitly related to the solutions implemented to structured programs developed by governments, non-governmental organisations, and

international aid agencies. Engineers and technicians who are not in the same environment and not familiar with local conditions, not in the disaster area but a different country, typically produce such solutions. However, the definition of a typical architectural approach may not be acceptable because it lacks the local ecology, environment factors, cultural values, familiar scale variations, and other concerns (UNDRO, 1982).

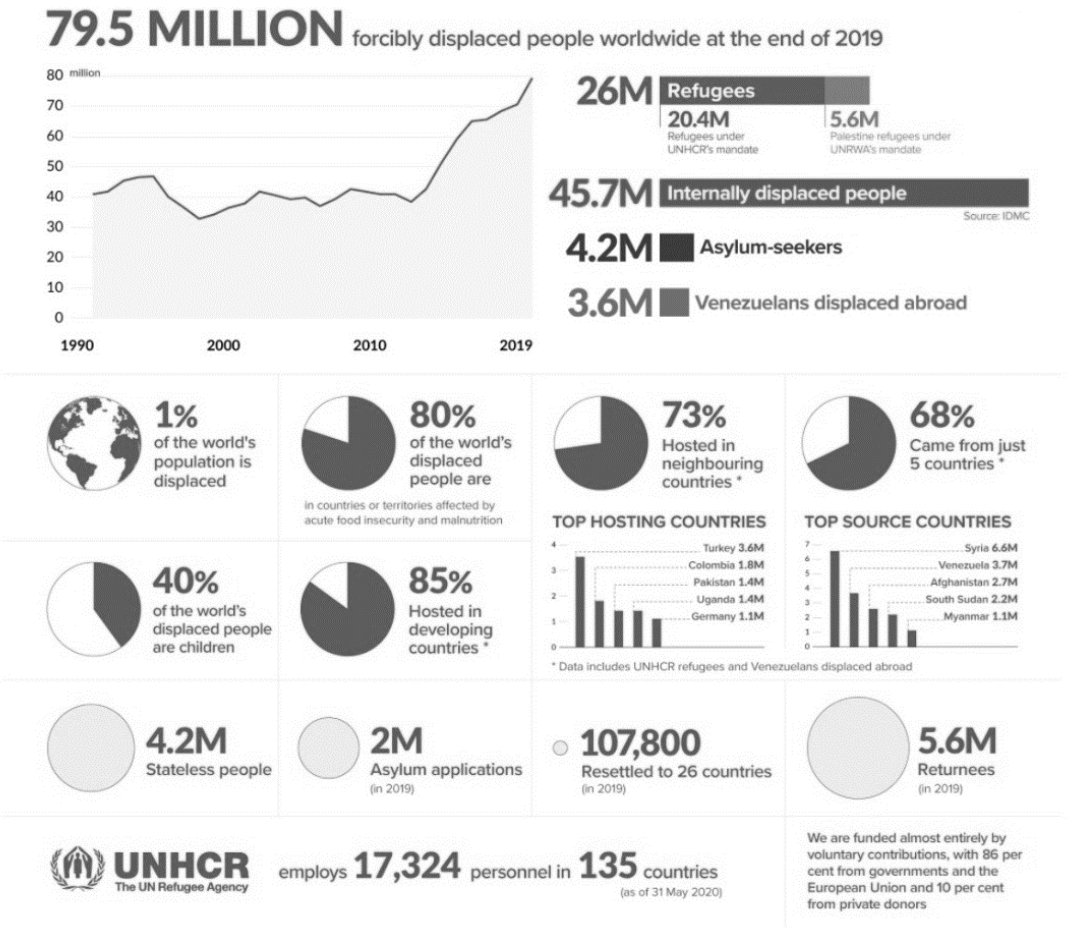

Figure 1: Forced displaced people worldwide. (UNHCR, 2020)

Another significant factor in raising temporary housing issues is a lack of pre-planning. Post-disaster situations are optimal because the need for high pressure and shortage of support contributes to inadequate responses (Johnson, 2008). In the lack of a pre-planned approach, the actions seem to concentrate on immediate needs, but the aim of

producing fast results has not proved to be sufficient in the long term. Although these strategies not meant for long durations, societal challenges and environmental destruction may arise. Moreover, the state of people who are usually local displaced in natural disasters changes this manner from the people who displaced because of conflict and war by being typically assigned in controlled camps in countries outside their region. As a result, those who live in shelter camps are affected by space design and organisation in numerous ways.

Figure 2: Syrian internally displaced people in the Atme camp. (Betteridge, 2015)

Significant focus also required in the design and organisation of refugee shelter in camps. For the past century, architects have innovative projects in emergencies relief environments, such as prefabricated houses, flyaway structures, geodesic domes, wooden houses, igloos and cardboard tubes. These concepts have experimented in a particular personality, but few have been proven effective. For this reason, these designed models have not yet developed for use by final integrated with the production

process. They are not aware of regions and developed solutions, which are not useful for their communities. People frequently adjust or attach shelters to those given by NGOs or governments without complete monitoring or research. Affected communities who do not need any expertise can solve self-developed transitional problems. It is frustrating that the solutions often differ from the needs and do not fit all rising tasks. Concepts of the design should be creative. After a disaster, societies must respond to their urgent needs rather than permanent resiliency concerns. Usually designs fixated on a structure where adjustment must be taken into account. Although prefabricated construction is excellent for emergency use, their negative qualities can attract serious problems when people use them for the long term.

1.3 Research Question

The refugee camps are the first step following disaster emergencies and conflicts. Most of the units used in this situations are prefabricated and have some necessities during construction, design, and transfer, which in some cases fail to function correctly. In many cases some severe problems start to arise in these shelters, mainly because they do not meet the users' comfort and quality of life expectations, in some cases, the temporary phases can last more than it supposed to and for that new principles should be defined. Many foreign and local organisations such as UNHCR, IFRC, etc., are trying to provide these shelters with better services.

However, when the quality level increases, the cost of units and their environmental impact can increase. There must be a balance among the different dimensions; otherwise, the comfort problem's solution will not be sustainable within this context. This thesis focuses on sustainable solutions to these problems and proposes sustainable

temporary housing principles and evaluation systems. According to this, the research questions of this thesis are listed below:

1. What are the most critical problems facing post-disaster temporary housing?
2. What are the principles of sustainable temporary housing?
3. How can the sustainability level of temporary houses be evaluated?

1.4 Aim of the Study

When a disaster occurs, which involves establishing refugee shelters, the shelter is supposed to last for a brief period before the construction or planning of the affected people permanent housing is complete. However, in certain situations, the condition may change, particularly in most cases, when these camps located in countries that suffer from wars or conflict causes several displaced people. In this situation, these camps could last for years or even decades.

This thesis aims to propose the priciples of sustainable temporary housing units and to define credits for evaluation system as a new scale to assess the sustainability level of temporary housing units by using the LEED-H V4 rating system as a base. According to the results, this thesis will use one case study to test the standard LEED-H V4 evaluation system check list. The results of this evaluation system will be used as a tool for decision-making processes.

1.5 Research Methodology

This thesis uses a qualitative method, literature review on relevant topics, including refugee camps, refugee shelters and shelter phases reviewed as a first step. Books, journals, papers and documents provided by UNHCR, CAL EARTH, Oxfam International and others were also included in the literature. the author tried to visit

some refugee camps, but it was very hard due to COVID-19. The case studies' visual analysis based on maps, photographs, and videos displays the camps situations.

1.6 Thesis Layout

In the current chapter of this thesis, the author introduces the general purpose, the goal and the methods utilised throughout the research process.

The second chapter covers temporary housing units in detail: the design, materials, and styles, the problems facing this type of housing, and a review of existing research to develop the relevant understanding of the subject.

The third chapter discusses sustainability in constructing buildings and temporary housing units, sustainable requirements and criteria for buildings and principles for sustainable temporary housing.

The fourth chapter evaluates sustainability and temporary housing units addressing LEED rating system for homes (LEED-H v4) and applying the evaluation system to two case studies and discussing the findings.

The fifth chapter concludes the thesis, addresses the observations of chapters 3 and 4, and then gives recommendations and future investigations. Table 1 shows the structural framework of this thesis.

Table 1: The structural framework of the thesis.

INTRODUCTION			
Problem Statement	Research Question	The Aim	Methodology
THEORETICAL BACKGROUND			
Temporary housing		Temporary housing Units Problems	
Sustainability and sustainable development, sustainability rating systems		LEED for homes to evaluate post-disaster temporary housing units	
FINDINGS AND DISCUSSION			
CONCLUSION			

1.7 Thesis Limitations

To achieve the main objective of this thesis, specific research criteria must be defined. Some statistics regarding the number of refugees worldwide will be addressed, with the reasons for the displacement of people being mentioned, natural causes and wars or political clashes. This thesis's focus will be on housing solutions provided to refugees, specifically temporary housing units that have an average life span and that lasts from five to ten years.

All types of sustainability evaluation systems will be listed, focusing on only one system LEED for homes. This thesis also will try to adapt this system to the requirements of temporary housing units. The evaluation of this research is based on is a proposal from the author to create a new evaluation system suitable for temporary housing units after noticing their increase in numbers worldwide.

1.8 Terminology

1.8.1 Disaster

An event that includes the emergence of the extreme threat of destruction, injury or loss of life or property, including but not restricting itself to typical, human-made or hybrid causes such as fire, flooding, earthquakes, hurricanes, tornadoes, high water, landslides, wind storms, and volcanoes.

Disasters do not happen when risks are not appropriately managed only, but even when there are few to no warnings and no clear explanation of why they occur (Milleti, 2004).

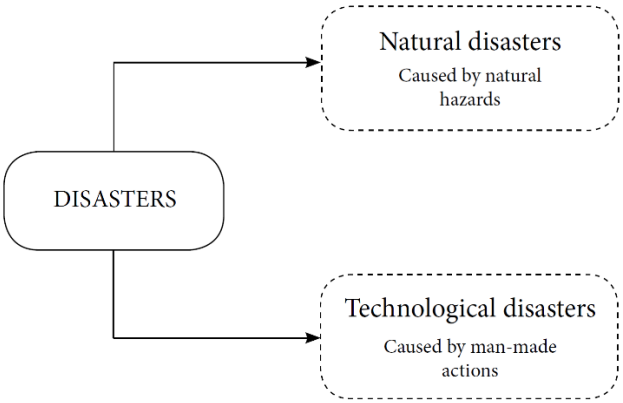

Figure 3: Group of disasters. (Wagemann, 2012)

1.8.2 Refugee

According to UNHCR, refugees are obliged by persecution, conflict, or violence to leave their country. A refugee has a deep fear of discrimination based on a specific social group, nationality, religion, gender, political opinion, or membership. They are most definitely not ready or frightened to return home. War and cultural, tribal, and religious violence contribute to refugees who have left their countries.

1.8.3 Shelter

"Structure affording protection", the word 'shelter' applies to anything from evacuation individuals to stays for a couple of hours in a neighbour's house waiting for a threat to pass. Often, shelter is permitted to live with relatives in another part of the country for a longer time (several years) while waiting for a house in the local community to be reconstructed. In this aspect, protection is the most critical factor in the early stage of a disaster for survivors. It can provide a protected space and shield users from climate and environmental threats.

In (The Sphere Initiative, 2011; Yüksel &Hasirci, 2012; NRC 2014), it can also serve as the household's immediate physical and psychological atmosphere, such as personal protection and care and health. It is also possible to determine that the shelter has considerable psychological and physical importance to protect human dignity and support a household in crisis times. Housing is a cause of common and sometimes extreme concerns compared to sheltering, whether of a temporary or permanent form (Davis, 2015). The inability to satisfy the needs and desires of individuals provokes complaints.

1.8.4 Housing

A house described as a building or shelter for the dwellings of people and animals. The social group living in a house referred to as a family. The household is usually more of a family, but other social classes such as roommates can also constitute households or individuals who are not associated in a rooming house. There are houses with only one family or a similar group, bigger households called townhouses or row houses that include several family houses in the same building.

Chapter 2

TEMPORARY HOUSING UNITS

This chapter first lists the construction phases after disasters and conflicts, then explains the different types of housing used in emergencies and which housing is selected for each specific phase. Secondly, this thesis focuses on one type of units, specifically temporary housing unit, its forms, its durability and the standards for these units. Then highlight the social, economic and environmental problems posed by temporary housing units.

Natural disasters and wars significantly affect the city development and built environment of a population, creating social and economic hardship. Housing forms the heart of a community as it serves the most fundamental need of shelter and allows the accomplishment of other life facets, thus, it has a crucial responsibility in facilitating security and prosperity in every community. There is a lot more to houses than unit with a foundation inside (Johnson, Lizarralde, and Davidson 2006). A house is considered as the essential social step for people to have the impression that they are associated with the community in which they exist and part of it which offers security, anonymity, integrity and social identification to them (Félix, Branco and Feio 2013).

Thus, housing loss means that all of this sense and ideals and housing provided as the first step after any disaster. As it has been stated in the Article "11" of International conference of Economic, Social and Cultural Rights "Every human being has a right

to a live in a level that would be appropriate for himself and his family's health and well-being, including enough food, clothes and houses (OHCHR 1994). Therefore, it is necessary to help the affected by providing them with relief temporary housing to help these affected citizens to reinvigorate their life, work and maintain their privacy before they return to their houses or the new permanent housing and to rehabilitate the houses that have been destroyed and ruined and their facilities generally require a great deal of time.

There are typically two main definitions for all forms of relief housing in a disaster or conflict in these circumstances: housing and shelter (Johnson, 2002). Incompatibility usually exists in disasters or conflict situations when each term could represent whether it should be implemented housing believed to set everyday lives for tasks, such as school, cooking, home activities, etc., while sheltering takes place directly after the disaster, without previously high-level plans, (Johnson, 2006). Secures and critical safety requirements of affected individuals and emergency housing or temporary shelters should be retained and supplied.

However, the term housing has a particular meaning, which offers the necessities, as it brings on the inclusion of higher support get the disadvantaged communities' everyday duties and practices back again. (E.g. food planning, household, socialising, jobs, schools and recreational activities, (Quarantelli, 1995, 2003; Johnson, 2006). It also means that housing technically proceeds housing in early phases of post-disaster and conflicts construction. However, primarily in the post-disaster and post-conflict programming and construction methods, the two phases function in complementary environments and apply different degrees of threat to the cultural social, economic. After listing standard shelter units, this thesis focuses on the second and third stage of

sheltering, knowen as temporary housing. The difference between sheltering and housing interfere together as one stage sometimes, and for that, it will be mentioned in details.

2.1 Construction of Temporary Housing Units after Disasters and Conflicts

The rebuilding mechanism involves housing construction and repairing as a defining aspect of post-conflict strategies to stabilise the social, communities and institutions in a period of return to stability (Johnson, Lizarralde, and Davidson 2006). Construction after conflict and after the disaster lunches from the beginning of the disaster activity before sustainable housing options are given (Hany Abulnour, 2014). The restoration strategy generally faced by tackling the need to move quickly, while also recognising long-term sustainable urban growth issues (Davidson 2006).

Other researches and historical literature on emergency cases were used in this study, all of which require standard programming and techniques to deal with the effects of this destructive activity since natural disasters and wars affect nearly equal most of the populations. There are also several distinctions between temporary housings before or after a crisis (Johnson, 2008).

2.2 Standards for Temporary Housing Units

International humanitarian groups have completed a framework of recommendations developed to strengthen concerned international agencies' humanitarian operations. In any case, methodologies, procedures and recommendations presented in this paper will still need to change to suit the local situation and adapt with the consensus of the stakeholders, donors and actors involved. Guides from humanitarian organisations

such as the Sphere Handbook and UNHCR's principles are two of the most used guides worldwide.

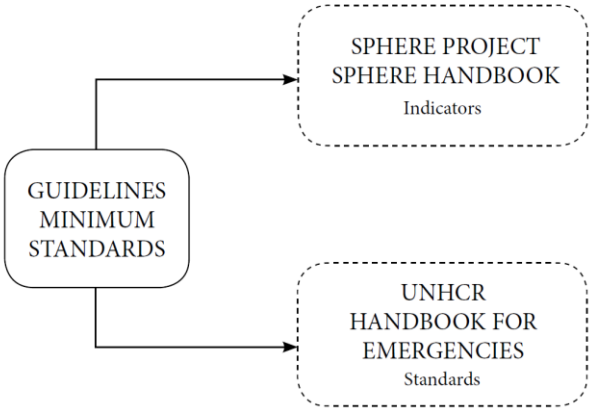

Figure 4: The most used guidelines for sheltering. (Wagemann, 2012).

The Sphere Project started in 1997 with several NGOs and the Red Cross or Red Crescent Organization, and then the Red Cross itself implemented Sphere Project. They have established a set of global humanitarian standards designed to improve the humanitarian responses in disasters. These principles in the Sphere Handbook, the Humanitarian Charter and Basic Standards of Humanitarian Response based on this part of the International Humanitarian Activities (The Sphere Project, 3rd Ed 2011).

The housing guidelines covered in this handbook in the technical chapter. The UNHCR's "Handbook for Emergencies" contains the United Nations' definition for emergency services. Chapter 12 details several facets of the preparation and integration of a camp and collective centres, emphasising mass required intervals. The Sphere Handbook addresses the importance of both quality and quantity and uses the word "standard" in various ways. Standards are generally quantitative in the handbook for emergencies.

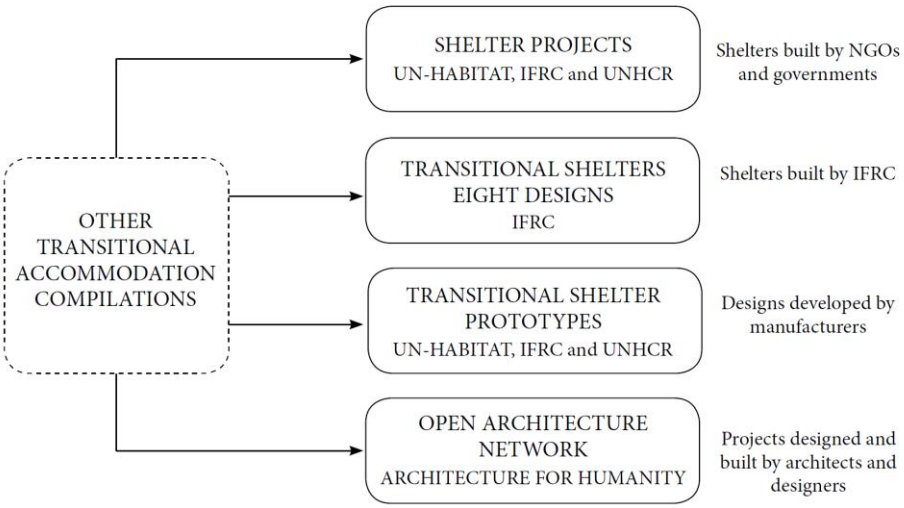

Figure 5: Other transitional housing compilations. (Wagemann, 2012)

Therefore, with the Minimally Significant Variations (MIDs) in the Sphere-Handbook and UNHCR's Handbook, it is easier to compare the recommendations and results.

2.3 Differences of Sheltering and Temporary Housing

If a disaster happens, many supportive, practical strategies and actuates that implement during the disaster, building shelters, rescuing population, providing health care, and construction. This used to track critical methods, define functions, and establish measurable priorities (Sphere Handbook, 2011). These phases may take place at the same time in the construction phase. According to (Corsellis, Tom 2014), the most common acts among people affected by natural disasters are:

- Responding to the disaster, and recovering after a disaster (0-25 days).
- Damage and loss evaluation (15-45 day) estimate the need for recovery, direct and indirect socio-economic impacts.
- Recovery and construction phase, designed to include moving the affected people from emergency shelter to temporary housing, until the permanent housing phase is ready.

- Risk reduction (20 days-continuous) phase to strengthen and increase security, adopting a policy to secure and safeguard, rebuilding and developing master plans and building regulations, taking and adopting policies and regulations that secure and safeguard.

The early relief efforts and funds for disaster recovery developed rapidly, but they tend to lose impact with time, leaving a gap between the initial disaster recovery and associated activities (usually long term and large-scale projects) (Corsellis, Tom 2014). It is necessary to start project development early in the process. It is a complex issue to coordinate the whole process due to the number of various actors involved. Everyone does, including many limited resources used to help the affected community (Global Shelter Cluster, 2017).

In 2006 according to (IASC), the coordination system emerged to fit particular situations by clearly dividing tasks and responsibilities among humanitarian groups. It is co-chaired by the International Red Cross Society (IFRC) and the United Nations High Commissioner for Refugees (UNHCR) when a disaster strikes, the International Federation of Red Cross and Red Crescent Societies (IFRC) is the primary organisation tasked to manage the disaster. Similar to the way that there is a multi-sectorial response in countries like Syria and Iraq. Besides, emergency aid agencies and aid activities in different parts of the world are not all the same, so it is not a simple approach to resolving an unexpected humanitarian crisis. There is still improvement in multilateral partnerships, as the shelter sector still faces challenges. The Review of the International Federation's Shelter Cluster Commitment in 2017 identified several problems still to address.

One of this programme's problems is the lack of continuous care following a disaster, lack of training and transfer of information to other agencies, and the imperfect transmission of this knowledge to the field (Davidson, Sara and PRICE 2011). Because many new operational activities in the shelter sector have different organisations across different disciplines and cultural boundaries, we need to work together to ensure that everything is going and can be. In the construction and recovery of a badly destroyed city, architecture and planning in those areas are crucial. Solutions to the housing problems, which are design too seriously damaged communities must include in the issues.

The architect's role starts with the building's rehabilitation and construction, but it should also extend to thinking about the design and planning of sustainable development in the long term.

2.4 Phases and Types of Sheltering and Temporary Housing Units

In 1995, the disaster sociology pioneer, Enrico Quarantelli, identified relief categorised into four separate phases: Emergency Shelters as the first step in the relief action, Temporary Shelters and Temporary Housing as the next phase and Permanent Housing at the end. In recent years, most aid programs have identified three phases: Tents for emergencies, temporary/transitional housing and permanent housing. Any of the programmes have recently attempted to minimise the process from tents to permanent solutions, extend the first step and begin the long-lasting approach faster. Furthermore, in May 2012, the Shelter Center proposes the transitional solution, all phases in a continuous, which involves three stages of the housing process after a disaster:

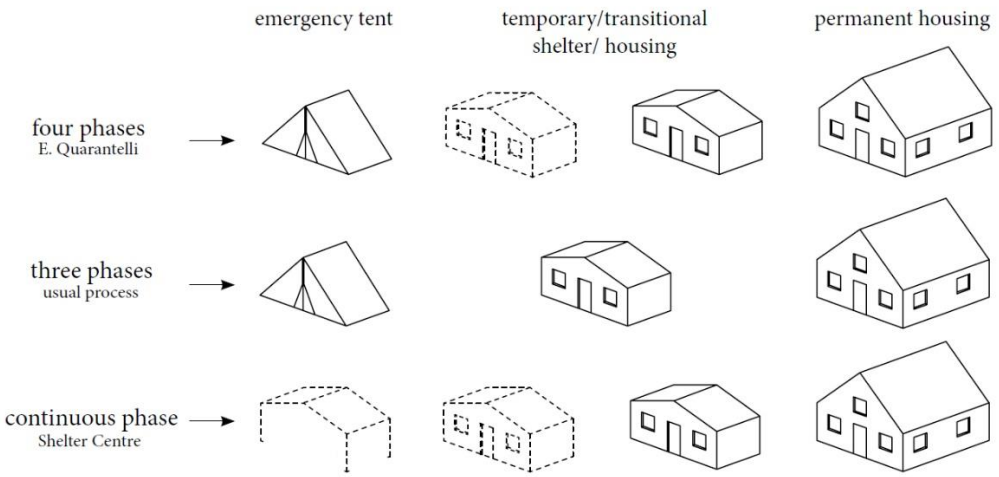

Figure 6: Phases of sheltering and housing after a disaster (Davis, 2012- Quarantelli, 1995- Shelter Centre, 2012).

2.4.1 Emergency Shelters

The emergency shelter serves as the urgent aid and collects the displaced families at the emergency phase immediately after losing their homes and sometimes without prior arrangements. It can be within hours of the disruptive action that forces vulnerable groups to leave their homes or relocated. For example, it could be a property of a family member or friend that they can stay with, a public building, or the site of a gathering like public stadiums, tents and paper partition shelters. This sheltering phase is likely to be very brief (hours to days) and manly focusing on assisting such as food supply and other essential facilities.

The tents are common and useful in disaster and refugee camps due to the advantages listed in table 2. Designers today develop and sell numerous types of tents with different functions and structures around the world. Tents differentiate by shape into four forms: Ridge Tent, Middle Pools with high and low walls, Hoop or Tunnel Tent and Frame Tent.

Ridge Tent: The main structure is a horizontal pole heading through the top of the ridge frame. It may be a single-pole or two sloping bars. This type of tents is the oldest and more conventional style of the tent. The tents may be made of linen or nylon, which make this tent lightweight material shelter.

Figure 7: Ridge Tent, Zaatari camp in Jordan. (2020)

Middle Pole with high and low wall tents: This type of tents usually created from a thick canvas sheet. Technically, it can conceder it as ridge shelter, since it has a horizontal pole in the middle of the tent.

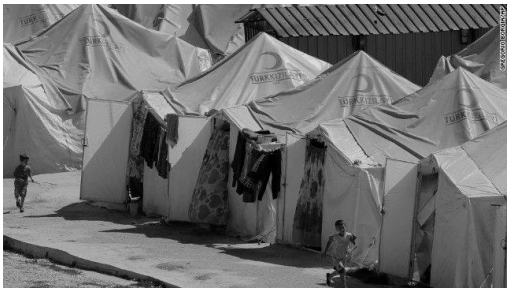

Figure 8: Middle Pole Tent, Syrian Refugees in Turkey. (Edam, 2013).

Tunnel Tent: These tents contain various curved poles, forming a long frame like a tunnel. The pitches are simple and once built; they have plenty of space for the equipment and provide decent headboards in contrast to the dome design.

Figure 9: Tunnel Tent, Kalobeyei Settlement in Northern Kenya. (2015)

Frame Tent: They are fitted with a rigid structure of straight poles with angled joints (usual steel) and can provide much space, including decent headroom, plus stability when right. On the bottom, structure tents appear to take a bit longer than most tents.

Figure 10: Frame Tent. (UNHCR, 2016)

The tent is a lightweight, portable, and easy to carry a shelter, but it does not have sufficient insulation to maintain heat. Therefore it is not ideal for cold weather, and can save the lives of refugees before the shelters can be repaired (IFRC, 2011; Davis& Lambert, 2002).

2.4.2 Temporary Shelters

Temporary shelters always come as the next step in the relief process where the family members transfer and stay in these units in the following days (Johnson 2008). During their stay at emergency shelters, people recovering from disasters have minimum basic

security and supply. However, there would be no trouble due to a shortage of housing. Temporary shelters built to protect people from external threats and maintain a certain level of privacy, these temporary buildings also have the minimum space for each one and space for a family gathering.

When it comes to sheltering, no high arrangements produced that carry regular life tasks, so the people impacted must be obtained for a limited period, not more than a couple of weeks. Their lifespan and resistance focus, however on the form and efficiency of the shelters. Immediately after a catastrophic incident, sheltering and alternatives take place. or sudden displacement. For example, in wars, will go from a few days at the beginning the last for more weeks or even months in some cases, in a situation like this they can have a better temporary housing unit or permanent house (Abulnour 2014). Therefore, the shelter designs should be subject to the cost, lifetime and longevity, speed, resistance, and safety factors balance (IFRC 2013). Furthermore, the appropriate amount of risk regarding the systemic perspective should not be surpassed because these shelters intended to protect their inhabitants rather than place their lives at risk.

In some cases, though, the affected local, and the citizens construct participate in the construction. Many other terminologies have evolved in terms of temporary housing alternatives in response to postwar conflicts and the housing shortage following earthquakes. These terms express various advanced forms of shelter suited to various circumstances, like transitional and prefabricated sheltering units, winter tent shelters, central, and rooftop shelters. However, what makes an advancing, revolutionary, or some other form of shelter is the architecture itself and the more substantial context from which it designed in forms indicated in these advanced shelters (IFRC 2013).

Nevertheless, such terminology of advanced refugees transcends their meaning as it relates to their residents' very basic needs so that they have fully responded to their needs, which means day-to-day activities that attribute to the high qualities features that they offer compared to traditional shelters.

- The Refugee Housing Unit (RHU) is an improved shelter solution developed by IKEA and compiled by Better Shelter, cooperating with Sweden and the United Nations High Commissioner for Refugees (UNHCR). The RHU is made of a steel frame, roof and wall panels, flooring and solar power (phone charger and light). The residence period in these units ranges from one and a half to three years, and the number of its inhabitants ranges from two to four members of one family.

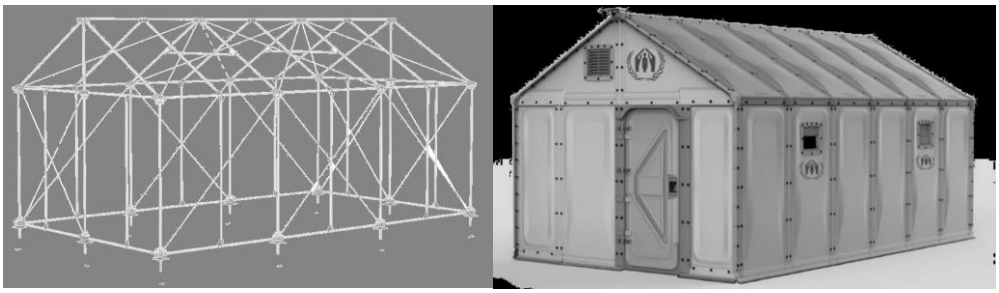

Figure 11: The Refugee Housing Unit (RHU). (UNHCR, 2016)

Figure 12: Better Shelters at a transit camp on the Greek island of Lesbos. (Better Shelter, 2015).

- The emergency shelter project's key goal was to reach the refugee community and new refugees in Ajuong Thok camp using available resources. Forces,

including the area and its population, are key driving factors for the plan as the refugees are from rural areas and have on their shelter coping skills. The region has available a massive forest to help, which transports grass services. Depending on the case, the amount of time would be 1 to 5 years.

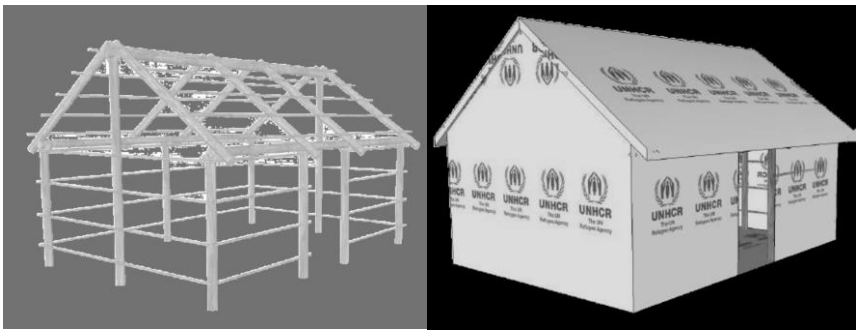

Figure 13: Wooden Gable Frame unit with Different Claddings (UNHCR, 2016)

Figure 14: Ajuong Thok, South Sudan (UNHCR, 2013)

2.4.3 Temporary Housing Units

However, this step considered a temporary step, but it takes place over a longer duration than in the previous stage because higher quality of life features are offered than in the preceding stages, and it allows the displaced families to return their daily life functions. This stage can take a form of a prefabricated unit, a mobile housing, an apartment, a wintering tent, a self-constructed residence, a family member's house, etc.

The housing step could take several months to three years before the rebuilding process finished when the families finally return to their new homes.

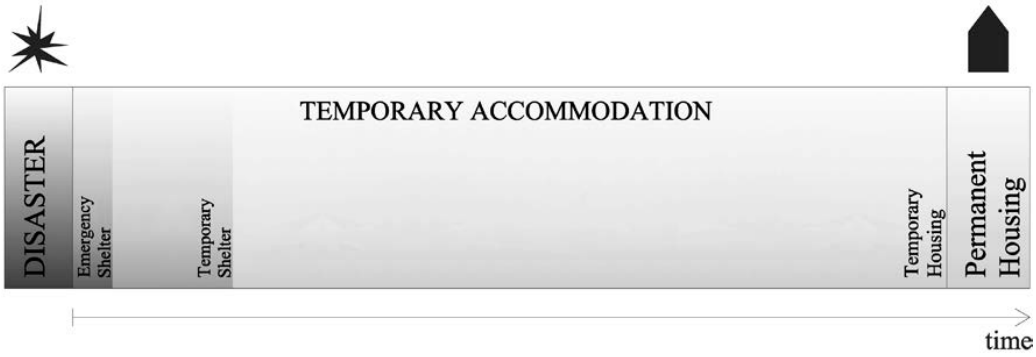

Figure 15: Temporary housing phase in sheltering presses (Johnson 2008).

The word "temporary housing" includes all the kinds of housings that the people will temporarily live in during their journey after a disaster and before they move to their permanent houses (Johnson, 2006). Johnson describes the distinction between temporary housing and temporary housing terminology as temporary housing is a single face that involves temporary housing, other forms of emergencies or temporary shelters, and the Quarantelli sequential process related to post-disaster and post-conflict recovery. These short forms of housing may be any kind of mobile homes, tiny houses, winter tents, and other kind units that is usually not designed only for thses situations, for instance; public centers buildings such as schools or sports centres, factories, abandoned buildings, public services, etc.

Anyhow, these forms and types of units usually obtained by the IDPs (Mooney 2009). For example, in some cases, empty buildings might welcome the affected people and serve as immediate supports and provide them with the right temporary housing (Lizarralde and Davidson, 2006). Besides, there should be a general awareness of the numbers and how long people seek temporary housing. The more temporary housing

is required, and the longer it takes for temporary housing, the more permanent alternative suggested. The temporary housing suited around the same time, the process of supplying temporary housing takes place when executing policies and proposals to permanently reconstruct and regenerate disaster or war effects. Temporary housing is a central part of temporary housing can provide a mid-term housing units for the ones survived the disasters and wars, making them more permanent and enduring alternatives that are not provided by any of the other temporary housing choices (Félix, Branco, and Feio 2013). It is not easy to describe or define temporary housing.

However, it can describe the structures for affected people living in high risk environments (Abulnour 2014). Also described by Johnson as part of the temporary housing phase in affected areas, or as a building form is a temporary usage to receive the impacted families during the recovery process (Johnson 2007). It is also a place where the displaced families can stay safe and re-establish their everyday lives before a permanent remedy can be found.

Temporary housing and housing lead to a rapid solution for the housing crisis after a disaster or war, so it is considered the most critical temporary housing process. It is responsible for helping displaced people regain their everyday lives, allowing them to feel normalcy living before (Johnson, 2007a; Arslan & Cosgun, 2008). Defining this form of housing as a long-term phase and in some circumstances, can exceed a maximum of many years (Abulnour 2014). When the permanent option for housing becomes accessible, this form of housing usually ends. However, in some cases, temporary houses may be converted to permanent where the quality requirements are high and provide.

The importance of temporary housing stemmed from its fundamental role as an immediate solution to recognise and temporarily and concurrently satisfy the people displaced by constructing and constructing their hometowns. That is to add, the time gap when it comes to the first sheltering phase and the final housing phase is filled (Johnson 2006; Lizarralde, and Davidson 2006). The entire rebuilding process will be improved onec the desinged temporary housing is well functioning, as it allows the requisite time to make decisions on the strategy and organise the new structures that would contribute to more viable solutions (Johnson 2008; Félix, Branco & Feio 2013b).

There are three critical elements in a temporary housing and housing proposal: speed and time, consistency and cost. These critical factors are the basic requirements that each specification should review to find a solution to match these key elements to ensure protection, feasibility, reliability, efficiency, speed and other possible factors. According to its specifics, every condition needs to be analysed to create a basis for all the considerations followed by strategic plan adapts the environment and determines the overall vulnerabilities and perspectives.

As the design and building the temporary housing and housing depending on the duration of the conflict or the disaster, the country's status, community values and culture, etc. despite all this, this type of temporary housing would be a big success. A significant step in the entire aftermath of the rebuilding process had it been the earliest stage for the households, both physics and psychology, to restart their life and allow them to prepare the future of the constructions concurrently.

Temporary sheltering and housing are the primary purpose of protecting people from external threats and maintaining a certain privacy level. These temporary buildings also have the minimum space for each one and space for a family gathering. Also, temporary shelters are essential to provide residents with the minimum living conditions until temporary housing and housing arranged and organised. As such facilities are to be easily accessible in the post-disaster period, they are usually smaller and made of lighter materials to make the shipping and the installation more comfortable; however, and according to (Asefi and Sirus 2012), there are two significant forms of shelters in terms of material, usage and construction:

- Shelters with transformable features, using versatile and flexible components, this form of shelters is both lightweight and straightforward to transport and install. The tent is the most commonly used form of temporary housing (UNDRO, 1982; Hamilton, 2012).
- Shelters that only use durable materials for non-transformable components.

Temporary houses will either grouped on or around the afflicted family's property into the 'camps' of mass homes. Where possible temporary residences on or adjacent to the family's property are preferable, this would deter any disruptions for family members and allow them to use existing facilities while preserving the social networks and living close to the former residence.

Nowadays, many kinds of temporary housing are available. However, it is most likely that the term temporary housing applies to prefabricated, ready made and standardised units (Félix,2013). because they are known to use temporary housing typically during a disaster or a conflict, however, the prefabricated have two groups: ready-made and designed kits (Félix, 2013).

- Ready-made units are entirely fabricated housing structures that can to be transported to the location to be fixed in place. Due to the problematic transport method needed to carry this type into the location, this prefab type is not suitable. Thus another strategy is used to make it easy for the transport process to be handled parts that can be installed in the location.
- Supplies Kit units instead of the complicated transport system required for the previous prefab forms, this solution is produced. This style relies on developing small elements that shape the whole unit and is therefore easy to move and install because elements are compact, small and comfortable for the local people to manage.
- Shipping containers and mobile houses Preassembled transportable buildings are shipped to the emergency site and later reused for future disasters. It may be placed on or in settlements on a homeowner's property.
- Temporary units. These are portable, self-sufficient houses, mostly made up of prefabricated parts, constructed in settlements inside and around the disaster-affected regions, provided by states, NGOs and relief organisations. The units may be either separate (detached) or attached. There are kitchens and toilets in several units, or some adjacent unit has a communal toilet.

There could be not enough space available nearby in high-density urban centres where families live in apartments. The whole system of a region should wipe out, and there could be a period before the distributed ecosystem of water and power replaced, and clustering is needed, regardless of the drawbacks. These kinds of temporary shelters can be:

- Adjusted to a permanent house part.

- Recycled for a different purpose.
- Relocated to a permanent location from a temporary site.
- They are reselling, raising money for rehabilitation aid; and recycling for rebuilding.

After disasters, temporary housing continuously used so families can live with dignity before permanent housing has been constructed. The large-scale disasters will result in continuous rebuilding lasting at least months, or even several years due to many affected persons, the facilities' damage, and the immense demand for construction supplies, contractors or même building permit.

Moreover, disagreements over property ownership, urban planning problems, and sufficient funds could interrupt operations, extending even further construction duration. Even if the provider governments and non-governmental organisations follow a strategy of not offering temporary homes, families are always obliged to create a temporary home for themselves. The explanation is that disaster survivors do not want to wait for at least many months to rebuild housing in tents or mass shelters permanently. For example, in Colombia, the government was slower to establish temporary homes after the 1999 earthquakes in Armenia, which favoured an accelerated permanent policy of construction; however, in months, the hillsides were filled with wooden huts constructed temporary housing by the families.

- **One Room Shelter unit,** the structure was planned in compliance with the national shelter requirements, facilities were approved, and labelled city by the National Disaster Management Authority of Pakistan, the lifetime of this unit is ten years.

- The minimum surface area of 25m2.
- Separate the kitchen and bathroom.
- Long standing foundations
- Concrete block structures, stone structures, or cement mortar structures.

Figure 16: One room temporary housing unit. (UNHCR, 2016)

Figure 17: One room temporary unit in Sindh province. (Pakistan, 2010)

- **Earthbag shelter unit,** Earthbag technology includes filling twined bags or tubes of sandy soils, which function as temporary types. The bags are put in courses and tamped to ensure that more robust, well-packed elements are obtained. According to the design, they are then stowed over each other by two barbed wire strands, which build barriers or domes between them. The key benefits of this kind of structure are that it is fundamental and easy to create, not just in terms of materials, but also in terms of the equipment used for its building. Besides, based on some simple scientific principles, the design

method is convenient for people with no building expertise to understand and apply (Khalili & Outram, 2008).

Figure 18: Earthbag unit structure. (Khalili, 2008)

Figure 19: Baninajar Refugee Camp in Iran 1995 (Khalili, 2008)

- **Container sheltering unit,** For emergency services, containers are used as temporary housing before permanent housing is built. During the early period, container housing had smooth wooden floors in the buildings and flatter roofs to prevent occupants' avoidance. This sort of facility provides a temporary place for meeting people, with kitchens, restrooms, and heating equipment (insulation boards and boilers). The containers have some key advantages such as consistency, ergonomics, speed, cost, flexibility. The wall and roof

sandwich panel structure provide full insulation. The double thermal insulation system is added to the walls. It has a maximal width inside room specially built for family use. Single quarters, WC, bathroom and kitchen are included in a single unit.

Figure 20: Container housing unit. (Karmod, 2013)

Figure 21: Containers housing units used in Pakistan flood. (Karmod, 2013)

2.4.4 Permanent Housing

This stage is the finite rebuilding of the house. After the construction process, the affected families move in and live permanently. The permanent housing construction process can take time. It can take a few years, since it directly related to many considerations and conditions, as it involves infrastructure maintenance and the rebuilding process, taking into account the distinct amounts and degrees of destruction

in each district. In some instances, this process's requirement would include constructing and repairing the original houses if permanent houses were not entirely destructed. This process generally guided and financed by the governments, international organizations, banks and NGOs. The construction phase of permanent housing typically takes place gradually when residents live in temporary housing facilities.

In several recent examples, along with the other preceding rebuilding stages, the permanent housing process integrated and resulting in incremental improvement, and changes in earlier housing phases conceived fundamentally for the creation of permanent structures. Based on these historical situations, Quarantelli's theoretical, standard model adopted in post-disaster and after scenarios are the series of stages in supplying housing, temporary housing and permanent housing. Nevertheless, it is not often done for example, often phase of emergency housing may be missed or compromised or combined in one fundamental operation (Hany Abulnour 2014). This typically occurs in conjunction with particular situations and schemes in each situation vary according to the timing and sequencing of disruptive events and their effects. This relies on the funding sources too, and in conflict situations, various factors enforce different principles and tactics could establish an additional layer.

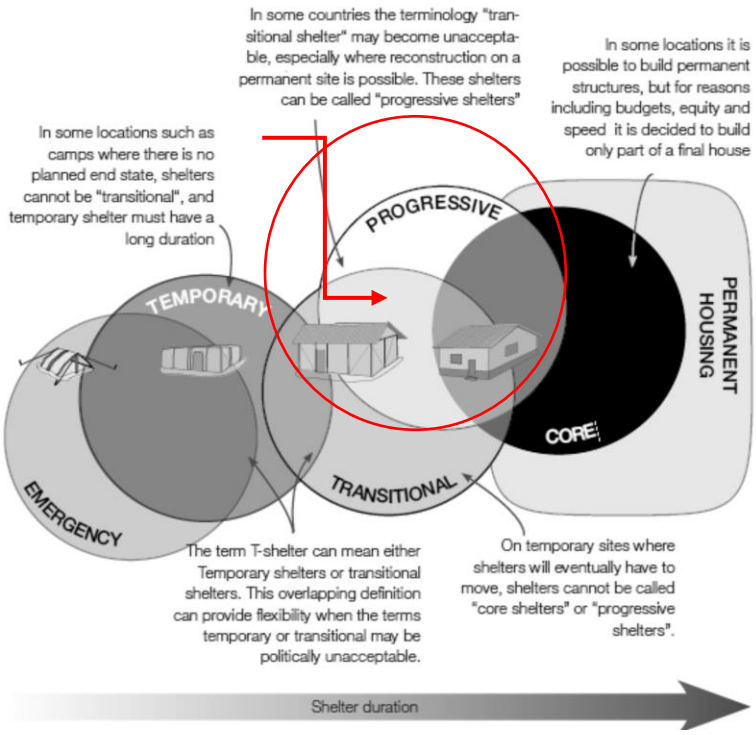

Figure 22: Phases of sheltering. (Abulnour, 2014)

In another instance, the boundaries that define each phase of the process may particularly after the release of advanced housing flaws that cause a rise to sustainable problems and concerns that can lead to construction from one type to another using various building technology and techniques. Besides, the boundaries that define both of these stages of growth may sometimes merge or missed.

Table 2: Sheltering Phases. Developed by author; based on Veenema.et.al, 2015; Forouzandeh.et.al, 2008; Quarantelli, 1991IFRC, 2011; U.S.

Sheltering Phase	Description	Examples
Emergency Shelter (most used is Tent)	• First sheltering step immediately after a disaster. • Used for a short-term period, a night or few days. • Used in local conditions and circumstances. • Flexible set up in the location.	 UNHCR family tent used in Zaatary camp, 2014
T- shelter (Temporary Shelter)	• Used for a mid-term period. • Provide minimum level of comfort. • Follow standards for functions spaces. • Relocating option, and re-used materials.	 T-shelters after Tropical Cyclone Evan. (Fiji, 2012)
Temporary Housing	• Used for an extended period from three to ten years. • Design with basic services such as utilities and plumbing equipment. • Success in providing security and other socio-economic items	 Syrian refugee camp in Turkey. (Komlosi, 2016)
Permanent Housing	• Last phase of sheltering, upgrade and development model of temporary housing • Stable, provide all services and resistant to future disasters	 Permanent Housing units used Flooding, (Colombia 2011)

2.5 Problems of Temporary Housing Units

Temporary housing solutions have, despite their importance, reported many problems and poor outcomes (Félix et al., 2013a). Some of the most frequent concerns relate to the units' design, for instance, the inability to protect against the local environment or culture (Johnson, 2007a) (Gokhale & Gulahane, 2010). These issues also lead to people denying their temporary housing units or leaving them (Félix, 2014; Johnson, 2007a).

Temporary housing has been highly criticised because of concerns related to sustainability, social failure, etc. (Hadafi and Fallahi, 2010), as a large portion of temporary housing projects have traditionally indicated that there have been complications and miscarriages (Hidayat & Egbu, 2010). Because the nature of the units or other structures forms part of misunderstandings concerning inhabitants' needs and misinterpretation its unsustainable and unsatisfactory (Félix, 2013).

Nevertheless, temporary house problems and complications generally arise where the suggested factors do not provide adequate input into the variables of architecture and planning mentioned earlier in the programme. Therefore, it is necessary to know the issues and recognise the causes of temporary housing problems or appropriations so that such strategies and recommendations can be drawn up to prevent or minimise its effect. We have to look at three things, the economy, the environment and culture when discussing sustainable issues. Because the first response to the event is with units manufactured in another region, they must ship them to the effected country so that this step adds transportation to the location.

This method can be very costly since it requires the expenses of shipping and transportation of units, in some cases, the formation of these units can be hard to install, requiring employing professional employees to install them, which can be e expensive. The expected brief duration of use of the units found both of these expenditures large and excessive. Thus, it is a very costly form of housing (UNDRO, 1982, Hadafi and Fallahi, 2010). As a result, temporary housing has often blamed for failing funding from permanent houses (Johnson, 2007a), which negatively impact the overall rebuilding scheme.

2.5.1 Economic Problems

When constructing temporary housing, it can take time and may risk the possibility of success in the ongoing construction process and lead to massive energy loss and materials (Johnson 2006; Johnson 2008). Temporary buildings often cost the same as permanent buildings and still have much shorter live time. They also cost more than permanent ones in some situations (UNDRO, 1982; Hadafi & Fallahi, 2010).

Figure 23: Transporting container shelters to Azraq camp (2014)

Besides the costs of supplying facilities for the site of the units (roads, electricity, water) and in some situations the extra costs of the skilled worker, import material and transportation of units are very high Forces (Philippe, Feio and Branco 2013b). Side along with its lifetime, temporary housing makes it highly costly, since it means this units can only use for short time that makes the expense useless and consequently. In some cases, temporary housing can be significantly unsustainable (Félix, Branco et Feio 2013b; Johnson 2008). This will adversely impact the permanent restoration mechanism if resources spent in temporary housing constitute delays and programme instability (Félix, 2013). In general, a lack of preparation for the potential attitudes towards or further using these systems will lead to unreasonable decisions that trigger tremendous loss of natural resources.

2.5.2 Environmental Problems

The high quantity of energy and material needed to construct temporary units and the lack of alternatives for their use (Félix, Branco and Feio 2013b), are considered environmentally non-suspendable temporary housing. Moreover, they cause waste because of their disposal of units and remains of litter, trash, etc., which require considerable clean-up measures (Donohue, 2012), due to the lack of planned disposal of temporary units following use, which results in negative environmental implications (Félix, Branco, Feio 2013b).

Figure 24: Temporary housing unit modifications. (Saltzman et al., 2010)

Furthermore, inadequate conditions in temporary housing lead to poor health, a prominent factor in housing insufficiency (Severinsen, Chapman 2014) and a harmful impact on the environment. This sort of environmental damage left during the temporary housing phase is often a concern in post-disaster situations since many regions have different sources of waste and pollution, which can be environmentally and humanly harmful and therefore must be handled (Arslan & Cosgun, 2007).

This also refers to waste and central transport infrastructure (Félix et al., 2012). Turkey provided an example after the 1999 earthquake of this sort of scenario. On the town's outskirts, temporary housing units set up where new facilities and utilities had built. The recovery lasted several years, and most residents rehoused in new homes between 2003 and 2005. This caused the government to suspend the TH-Process to withdraw the units subsequently. However, many traces of non-functioning necessary infrastructure on the land (Johnson, 2007a; Johnson, 2007b) reported, and action to demolish infrastructure and clean temporary housing facilities could require significant financial expenditure (Bektas, 2007).

2.5.3 Social and Cultural Problems

Regardless of the community it will serve or culture it will aim to serve, temporary housing units are intended for use around the world. The concept is usually standardised or universal and lacks real needs, environment diversities and cultural differences. As a result, prefabricated clusters create a confidential environment that is not accepted by local citizens (Gulahane, Gokhale 2012), as they focus on mass-production techniques to reduce expense and provide all asked units promptly (Félix, M. Branco, 2012).

This separates the designers from the target audience in terms of culture, which results in unacceptable alternatives that do not fit with the target community's cultural or social background (UNDRO 1982; Félix, M. Branco and Feio 2013). In uncertain circumstances, the immediate need for quick and scalable intervention typically leads to inconvenience and arbitrary preparation that leads to adaptability issues. (Florian, Costas & Kärreman 2019). Local acceptance is a significant factor in the performance of the project. Public involvement in the construction programme can also have a huge impact on the construction phase, since many cases shows that with local or constructive participation by the community helps Community stability as they contribute to significant declines in historical and cultural traditions, leading to unfavourable psychological and social recommendations (Coffey, Trigunarsyah 2012).

One significant aspect in this situation is location. Inadequate temporary housing can in many cases cause of its failure, for that, the affected population could either refuse it or even give it up and therefore, massive loss of money and expenditures could be incurred. Besides, faraway places can cause the affected people social exclusion because they conceded as disadvantaged communities (T. Seneviratne et al. 2011), which will impact the recovery of affected people, as this psychological vulnerability will not consider as a transformative recovery highlighted after disputes and housing solutions. Therefore, all residents have the right to achieve protection in housing and live in appropriate physical conditions with adequate access where possible to necessary facilities and services (Severinsen and Howden-Chapman 2014).

After reaching the end of this chapter and after presenting the problems that the temporary housing units face, it can be seen that these challenges are the biggest impact on the level of sustainability of these units. From this point of view, it can be said that these issues have more complications when not working on addressing them and offering alternatives that help minimize Liabilities caused from the inadequate conditions of these units. And the discussion about sustainability and its connection with temporary housing units opens a new door to discuss sustainability, how it is implemented and measured.

Chapter 3

SUSTAINABILITY AND TEMPORARY HOUSING UNITS

This chapter describes sustainability and sustainable development as and provides a detailed description of approaches for how it applies in the building sector, particularly the construction of temporary housing units. For the second part of this chapter, there are more details about sustainability requirements and buildings' criteria.

Dictionaries commonly define sustainability by multiple outlets as a system capacity to tolerate and preserve itself. This term can be used differently in various disciplines. From the earliest civilisations to present, the conception of sustainability-related in human history to man-dominated ecological systems. A specific community with local growth and development success, accompanied by crises that are either resolved or unresolved, leads to sustainability, leading to a decrease. In ecology, sustainability characterises the capacity to preserve stable, involved and productive ecological environments over time. Examples of productive ecological environments include long-lived and stable lakes and forests (Ashdown, P.L, 2020).

Since the 80s, a more human-sustainable definition used on planet Earth and this contributes to the idea of sustainability, described as follows by the Brundtland Commission (20 March 1987) at the United Nations "sustainability means to satisfy current needs without risking the potential of future generations to meet their own

needs". More recently, the quality of construction of human settlements and by implication, the housing has been taken into account (Choguill, 1999 Ashdown, P.L, 2011).

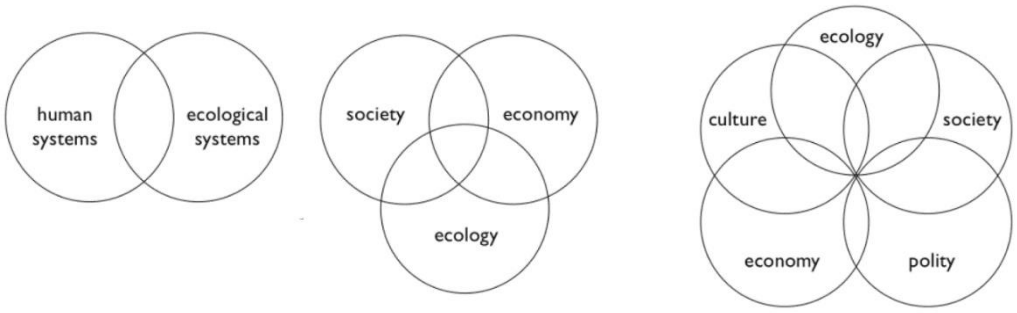

Figure 25: Relationships in sustainable development – environmental, social and economic concerns. (Choguill, 1999; Ashdown, P.L, 2011).

3.1 Sustainability and Sustainable Development

Initially, sustainable development mainly designed as a keyword for macroeconomic development (International Union for the Conservation of Nature and Natural Resources, 1980). It is fascinating that it took the humanity so long to adopt this crucial principle to urban cities, considering the world record concerning urbanisation and the massive expansion of housing developments, and the fact that this same urban centres, from where the greater use of resources occur and most of the waste products pollution, are produced. The uncertainty that follows this transition may be part of the explanation for this noticeable delay.

However, we will achieve the rewards of biodiversity if we can. Start with the idea that human settlements are permanent and then work to resolve housing problems (Pieroni, M.D.; Pigosso, D.C.A.; McAloon, 2018). Various terms and perspectives used to explain the concept of sustainability and Sustainable development. Sustainable

development aims to provide everybody, now and for decades to come, with a better quality of life. Involves achieving four main global targets at the same time:

- Social progress to understand humans needs.
- Environmental efficient protection.
- Responsibility toward natural resource consumption.
- Maintaining high, steady economic growth rate and opportunities.

The core concept of sustainable growth is to focus on the external factors to create a built commodity with optimum internal environmental qualities to reduce the harmful elements of these constructions. Buildings must adapt to the world from the design stage and settlement when facing nature decreases (McDonough, 1992).

After a thorough consultation with architectures, environment and philosophy members, the Hannover Principles published, the primary purpose is that they will adapt to suit the concerns of various countries and regions worldwide so that everybody will find a way to stand and build on the future without compromising the potential to face the challenges on its own. The incorporation of material, moral and ecological aspects of human culture must be a goal. These facets are typically isolated rather than linked by existing technologies, procedures and means. In his book The HANNOVER PRINCIPLES, (McDonough, 2003) mentioned nine main principles to follow in the sustainable design phase, these principals are:

- Focus that society and nature have their rights to live together in a safe supportive, diverse and sustainable environment.
- Accept the interdependence of humans. Depends on the world of nature with vast and varied ramifications across all aspects of life.

- Support spirit-matter relationships. Given the current and changing relations between spiritual and material understanding,
- Take responsibility for the effect on human being, and the right of natural systems.
- Build long-term protected objects. Do not pressure future generations of maintenance needs or regular testing of potential threats because of the irresponsible production of products, procedures, and standards.
- Remove the waste definition. Assess and maximise the entire product and service life cycle to fix the natural systems' condition without waste.
- Trust natural sources of energy. Like a living planet, human designs should benefit from eternal solar income their artistic powers. Efficiently and efficiently, integrate this energy into responsible usage.
- Comprehension of concept limits. No human existence is infinite, and not all issues are overcome by nature. Those that build and prepare should be respectful towards nature.
- The model and mentor should not be avoided or monitored as an annoyance.
- Continuous development by information sharing. Foster transparent and direct dialogue between co-workers, employers, suppliers and consumers to connect environmental and ethical accountability with long-term sustainable concerns and restore an interconnected relationship with natural processes and human activities.

The adaptation to the evolution of our understanding Hanover Principles should be regarded as a living document that aims to transform and create our interdependence with nature.

3.2 Sustainability in the Design of Buildings and Construction

In different human life fields, the word design generally referred to as the "way of doing things or making things" design first steps often based on a particular goal, which ensures that the device or method is most effective, lucrative or aesthetically impressive, etc. These targets may be dramatically polar and can require a change in thinking and a high level of creativity to achieve them. (D. Alexander, 2013). Nature utilises the sun's energy to build interdependent processes in which uncertainty and variety require sustainable growth. In comparison, modern civilisation uses resources to minimise natural complexity in processes. Humanity aims to establish mechanisms of human design that enable us to stay in the natural sense.

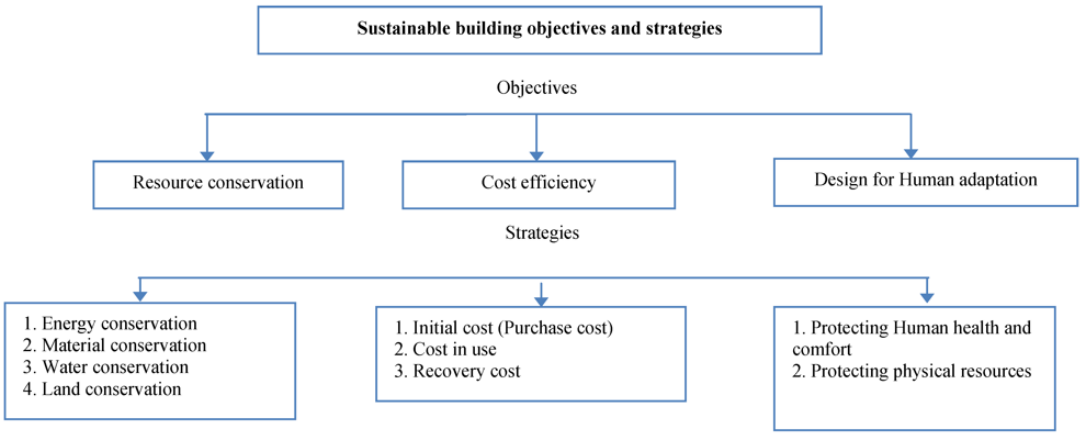

Figure 26: Design of A Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector (Akadiri, P.O 2012).

Further attention is required at nearly any level of the planning, development and installation process. The future of the relationship between humanity and nature cannot be supported by linear systems of logic or short-term strategies explaining ignorant, oblivious, or selfish means. Choosing natural and local material instead of traditional construction has different implications in construction and post-disaster restoration

situations. Post-disaster construction restoration programmes are somewhat different from standard construction projects (D. Alexander, 2013).

The most notable difference between a traditional and post-disaster, construction is the additional dimension of sustainable characteristics and resilience in the construction or rehabilitation phases. The building can be done adequately in a daily scenario. There are still questions about the building's sustainability (with regulations and legislation that apply to typical constructions). In a way, Tolba (Tobla, 1987) has also given us the criterion to judge urban growth and human aspect, conveniently accessible to the housing sector. Housing projects must become commercially efficient, socially reasonable, physically practical and environmentally friendly to be sustainable. Government housing policies must aim at these attractive targets.

However, there is another significant aspect which needs to included carefully. When a country develops, only subsistence will be the first step in the road of improvement. However, no government would like to be frozen in the growth process, mainly when other nations are still well past the early and fundamental stage. Therefore, a dynamic aspect of the description must be defined (Choguill, 1999).

From sustainability of life to anything at higher and more ethical standards, we are continuously mindful that if economic growth takes place within a country or a region, prospects for genuinely sustainable development may be restricted to the citizens of other nations and towns. The nature of that restriction depends upon the willingness of different countries, especially the affluent, to transfer to the poor. In other words, in the development process, a redistribution of opportunities could be required, rather

than only a few economically developing countries, making them all accrued (Diaz-Balteiro, L.; Romero 2004).

3.3 Sustainability of Temporary Housing Units

The critical problems facing new Post-Disaster Housing shelters are environmental adequacy, economic feasibility and cultural acceptability. NGOs, policy-makers, and researchers particularly for restoration have recognised the value of users' awareness to provide cultural sensitivities. The (UNDRO, 1982) in Shelter after Disaster: Guidelines for Assistance; Folder United Nations Disaster Relief Organization argued three-six years ago that local community involvement is the secret to sustainable restoration. The participants who work for the construction of the Post-Disaster Housing shelters also improve the Post-Disaster Housing shelter's flexibility and the project's durability. The local contributions will inspire the affected, support the social bonds, and build unity among those who suffer. There are many ways to measure an emergency shelter programme's effectiveness comfort level of clientele, shelter protection. Nevertheless, the lack of users' involvement often leads to an evident project failure if people do not accept the service Given the current challenges and risks on the field, telling affected communities how to support them is not straightforward (Quarantelli, 2005).

In order to conserve natural resources and to represent local resource management skills, the International organisation of migration (IOM) recommended the selection of cultural materials (that are local material that is already in use in traditional architecture within the current culture), which would therefore minimise the carbon footprint of the shelters. The shelter's overall costs generally include materials,

shipping, building, and staff costs, but exempt facilities expenditures for the camps, which contribute to incorrect comparisons (Barakat, 2003).

Table 3: Sustainability aspects of temporary housing by Author

Sustainability in temporary housing units		
Environmental Sustainability	Social Sustainability	Economic Sustainability

Furthermore, it is necessary to consider waste management costs that arise from the processing of materials (Tumbeva, M.D.; Wang, 2016) Investing in their efficiency seems unavoidable due to the short-lived planned for Post-Disaster Housing shelters, as it could cost more than permanent homes (Félix, D.; Branco, J.M.; Feio, 2003). however, for two reasons: shelters are often kept for much longer than initially planned (UNHCR, 2019), and only the cost is mentioned when the solutions are compared short-sightedly because the maintenance costs are widespread if an adequate shelter can be used for several years (Giustiniani, F.Z. 2011). In potential Post-Disaster Housing strategies as the missing connection between architecture and sustainability, this calls for the more successful implementation of life cycle thinking.

3.3.1 Environmental Sustainability

The environmental advantages are linked to the usage of local materials including timber, cane and soil, the repository's recyclability and durability, the passive heat cooling mechanism, the ability to gain rain and power through solar panels. To determine environmental protection, we must therefore consider all of the environmental implications of various components (e.g., the embodied energy in the materials and transport to site, the operational energy demand, the environmental consequences of rainwater harvesting) (Shelter Centre, 2011).

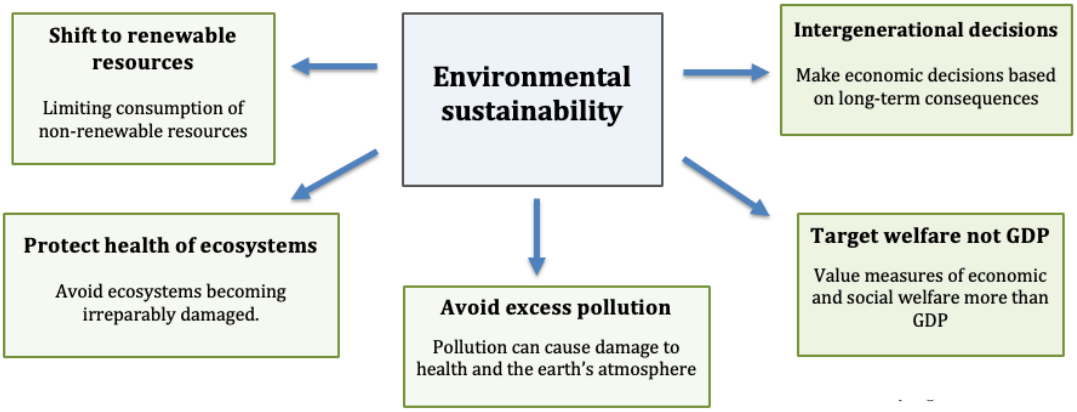

Figure 27: Environmental sustainability, definition and issues (Pettinger 2018).

Some common practises were not seen in the 'novel projects.' These included raising the shelter over a plinth in areas that are vulnerable to flooding and the structure's specifics that can sustain severe wind areas. “Existing solutions” have been through various theory and practical stages, resulting in them being more suited to application requirements in different fields. (McDaniel, 2017) The iterative familiarity of 'current ideas' can be learnt from the novel designs. The use of rescued materials, using onsite materials created by the receivers, and taking such conventional building practises, such as Clissage (the lime-and-earth mixture attach the wood frame to filling) and Amakan, were other constructive ways (woven bamboo wall cladding).

On the other hand, low-carbon methods include asphalt, plastics, stainless steel, nylon and aluminium. An example of such materials is a shelter in the U-dome shelter. It is made up of on-board polypropylene panels linked with nylon fasteners. A further example of concrete used for exterior skin is the Concrete Canvas shelter. Any existing alternatives like the T-shelters in Jordan include evidence of carbon-intensive substrate (World Visio, 2014). Mad basically from a stainless steel frame covered by an

aluminium- and foam isolation-separated double layer of Inverted Box Rib (IBR) (Alshawawreh, 2018).

In some instances, natural resource demand has been higher than that available, and this is the case in the Kenya-Dadaab 2009 project, where mud and scarcity are inherently available. The number of shelters constructed has been reduced by water deficiency. Mud has been suggested for potential ventures from remote areas, but mud blocks would become a less sustainable choice for most shelters. With unplanned mud excavation, trousers have converted into waste pits and mosquito-breeding grounds during rainy seasons (UN-HABITAT; IFRC. Shelter Projects 2009. 2010).

3.3.2 Social Sustainability

It is hard to describe social sustainability since the sector continues to emerge (Corsini, L.; Moultrie, 2019), while in one definition (Missimer, M.; Robert, K.-H.; Broman,2017) is at the same time undefined and hard to limit. However, the concept adopted in this article is the maintenance of current social systems, which take account of historical norms, debate, equality, and engagement in resolving social problems and concerns.

The definition of social sustainability often starts and ends with the other two aspects of environmental and economic sustainability. However, each dimension deals variously with the overlapping variable. A simple example is the resources where local materials and their climate and economic components, serve a social need related to the familiarity. The most frequently defined social advantages of shelters (innovative architecture and solutions) were: the short-term time needed to assemble shelters with the minimal number of staff, efficient use of building services for unqualified users,

use of local and local materials, sustainability and development (Corsini, L.; Moultrie, 2019).

In comparison, some of the "existing solutions," such as Haiti 2010 (UNHCR. Shelter Design Catalogue, 2016) and the Philippines 2012 (UN-HABITAT; UNHCR 2016), were more valued by using local construction methods, providing outside or private areas that were suitable for consumers (i.e. familiar and used in their culture). One of the several shelter examples of one-room construction missing in private facilities is the IKEA refugee-housing unit (UNHCR. Shelter Design Catalogue, 2016).Another similar characteristic between the clusters is the minimal or inadequate shelter (relative to the number of inhabitants needs). A model of its total surface area of 8 metres (Treggiden, K. Designnobis, 2015) is the Post-disaster Provisional Design refuge

Additional disadvantages included complete reliance on local resources available at the site or continuous load on world materials, and short-term strategies are suggested. In 'existing solutions' such as the 2012 Myanmar Coast, which hosts eight family members (Missimer, M.; Robert, K.-H.; Broman, 2017) the construction of traditional shelters were also evident rather than private shelters. Another problem addressed in Ethiopia 2011 was the availability of a shelter design, which the host community recognises but not its users. In Ethiopia, the tukul shelters given to the refugees were not known to the Sudanese who had to live in them for months. In the same scenario, there was another social insufficiency because the livestock taken out of their country by Sudanese refugees could not be stored (IFRC; UN-Habitat, 2011, 2012).

Recent research has also shown that social sustainability components are to reach beyond the sphere of the human sphere and take account in some societies of livestock

and domestic animals (Alshawawreh, 2020). The recognition and awareness of best practices among current refugee projects and the cultural impact on space needs will minimise the space between decision-makers and users. Involving users at the beginning of the shelter designs would guarantee final production's social adequacy, if possible.

3.3.3 Economic Sustainability

It will take time and endanger success in a continuous construction process when building temporary houses and resulting in tremendous energy loss and materials (Johnson 2006; Johnson 2008). Temporary constructions often cost the same as permanent constructions and yet provide a much shorter life span. In some cases, this can be more expinsive than providind permanant housing option (UNDRO, 1982; Hadafi & Fallahi, 2010).

Apart from the expense of providing the site of the units and, in any other cases, the specialist worker's extra costs, import materials and the transport of units are exceedingly high forces (Philippe, Feio and Branco 2013b). Temporary accommodation alongside its lifespan renders it very expensive, as it requires large investments units designed to last for a limited period and thus render the cost unnecessary. In some cases, temporary accommodation will be considerably unsustainable (Félix, Branco and Feio 2013b). The permanent reconstruction process will badly affect ecomonic expended in temporary housing if they represent a significant cause of disruptions and services' volatility (Félix, Branco and Feio 2013b). In general, the inability to plan for or use these structures can lead to irrational actions that cause enormous harm to natural resources.

3.4 Sustainability requirements and criteria for buildings

3.4.1 Site Requirements

• Start by choosing a location that is appropriate for public transit use.

• Full site analysis with limited environmental management.

• To guide design choices, use computer simulations.

• Complete an essential building study to understand techniques that affect the building design in particular.

• Evaluate building adjacency and the relationship between the building and the location.

• In building drawing details, display high-performance design techniques. Complete information help to discourage sketches from being interpreted on-site.

• During the development period, the structural adjustment was suggested, the effect of these improvements on building efficiency could be measured (using computer simulations).

3.4.2 Energy Efficiency

• Assess the use and implementation into building design of green energy technology, whether both now and in the future.

• Use architectural architecture in the energy design of the building. The structure form should enhance the efficiency of the building.

Reduce or eliminate technological and design specifications by integrating passive solar systems as an alternative building resource. To execute this technique, use computer simulations to direct design decisions.

• Test all the features of the devices in case they fail.

3.4.3 Material Efficiency

• Choose a sustainable building and commodity materials, measuring different types like reuse and recycling quality, zero or low-off air pollution gassing, zero or low degree of toxicity.

• Evaluate the environmental preference of all construction materials.

• All modifications must be tested using computer modelling before installation to ensure that the modifications will not reduce the building's design objectives.

• Incorporate requirements explicitly in writing to remove uncertainty. Construction mistakes may trigger on-site interpretations during production.

3.4.4 Water Efficiency

• Eliminate wastewater by the ultra-low-flow toilet, low-flow shower and other water absorption systems.

• Use centralised water delivery re-circulation systems.

• Set up heating systems at point-of-use for more desolate location.

• Using a water balance management system that distributes water to farmers based on the management system details.

• Compare the scenery from the houses individually. Make use of micro irrigation to provide the water required in non-turf areas.

• Using cutting-edge irrigation and self-locking tubing on hoses. Secure and preserve current natural features and ecosystems.

There is a superb choice of low-maintenance plants, and just enough trimmings are needed.

• Construction of dual water plumbing for toilet or greywater recycling schemes for site drainage for reclaimed water.

3.4.5 Occupant Health and Safety

• Avoid indoor microbial pollution by using microbial growth-resistant materials delivers efficient roof and garden drainage Installation of bathrooms with appropriate ventilation.

• Enable proper air-coil ventilation, and other moisture-control systems building Provide adequate ventilation and a system that provides high efficiency and filtration. Ventilation and ventilation systems may benefit indoor air quality by keeping the air hot and keeping it well distributed.

• To enhance indoor air quality, select building materials and indoor finish items with null or small emissions.

• Building Operation and Maintenance.

• Construction shall be ecologically and resource effectively planned, installed, refurbished, operated or reused.

• Introduction construction includes mechanical, electrical and plumbing equipment checking and modification.

• The circuits shall meet the operator's configuration requirements and be observed in the equipment's installation and condition.

• Adequate maintenance guarantees that a building stays built and commissioned.

3.5 Principles for Sustainable Temporary Housing

- Budget, As a regular construction project always comes with the prospect of costs, it should be no surprise that the construction cost affects the minds of customers, project teams and construction companies (Mora E.P., 2007). In typical temporary architecture and any post-disaster facilities situation, it is imperative to define architecture (temporary or permanent) and design the architecture (the client or property manager).

- Process Period, According to "Identifying Temporary" chapter, a strategy must be made to move the victims to a more stable and better condition. The crucial part of the recovery stage is housing construction after the requisite infrastructure is made because it is the real step that can shift from an emergency to a temporary phase. There are many options to reduce construction time, such as manufacturing some shelters in factories while constructing the infrastructure. According to (H. S. Tomkiewicz, 2011) The method most frequently used during wars and conflicts, although in some situations, it is impractical because it is reasonably costly to move these shelters to the conflict zone. In other solutions, we have to depend on victims themselves to build with their own hands or any other materials, but it takes an extended period.

- Time Usage. When we decide how we will upgrade the structures, we can care about durability. The shelters we constructed would last for several years. Second, there should be concern about environmental consequences. It is inevitable but can be handled. Although victims' living comfort is of great importance, the long-term living benefits are also significant because they can choose permanent housing (H. S. Tomkiewicz, 2011).

- Materials. In the construction phase and starting with design, proper material selection plays a vital role. If materials that initially used for this project are poorly selected, the units' performance, the duration of the operational and maintenance phases, and the health and well-being of humans and the environment would be affected. There is a need to incorporate materials, technology, methodologies and considerations to construct sustainable buildings (C. Joustra, 2010).

The emphasis is on understanding just how much of the energy we use makes it into a usable product, such as the air, soil, and water, and the nature of those resources the

user is using. A significant aspect of environmental policy involves the limited use of natural resources. The concept can be interpreted in the "reduction, reuse, recycling" mantra: reduction of consumption, recycling of existing resource (recovery, recycling or recycling) and recycling of waste generated.

- Energy, Energy savings are not very comparable because of variations in dwelling energy intensities. Houses are created with different numbers of inhabitants as they come with different functions and usage. These considerations and their costs should be taken into account in comparisons. (C. Joustra, 2010). On the other hand, it is different from a city due to its sustainable construction material for the temporary scenario, which does not need any infrastructure and services and even it is so far from the location of other buildings. This can be achieved through non-governmental organisations such as charities. In this respect, we will think the only way to supply our buildings in recovery with energy is to reduce the expense of these charities - which can continue for an extended period - and, given the lack of facilities.

- Water, Water reuse has become a big trend for sustainable temporary housing. It is also intrinsically connected to energy. There is a need for energy to pump and transfer water into the construction system. The treatment processes that lead to water complying with appropriate Quality requirements require additional resources. There are inadequate supplies of water for any of the users. Recalculating our current and expected use makes it crucial to identify and adopt sustainable solutions that work for us in the present and future generations (H. S. Tomkiewicz, 2011).. On the one hand, by being more careful about water management, one can improve productivity. The ecosystem benefits from it. Water problems might be lessened if local governments, in conjunction with engineering technologies, adopt strategic water management, such

as adaption to climate change, recycling, or decentralised water reuse. For example, various water usage techniques, such as reuse, recycling, retrieval, green roofing, and native land use, can be placed. Water strategies are also introduced.

- Capacity, Every family is unique and complex, with its estate, the average number of members, and personal issues and needs. Therefore, we should find a suitable architectural solution to the problems facing this family. Disaster managers do not think that information is necessary because of the number of people needing supplies. This may be done in emergencies, but since we transition to a temporary level, which, as we said, can last a long time, it is irrelevant to deal with all families that have the same conditions. One successful way to achieve our goal is to be versatile in resource usage (H. S. Tomkiewicz, 2011).

After defining sustainability and its criteria in this chapter, it is clear that the construction industry has become much more dependent on the movement towards sustainability, which leads us to the need to address the relationship between constructing temporary housing units and sustainability, as this kind of building units lacks the aspects that are often covered by sustainability criteria.

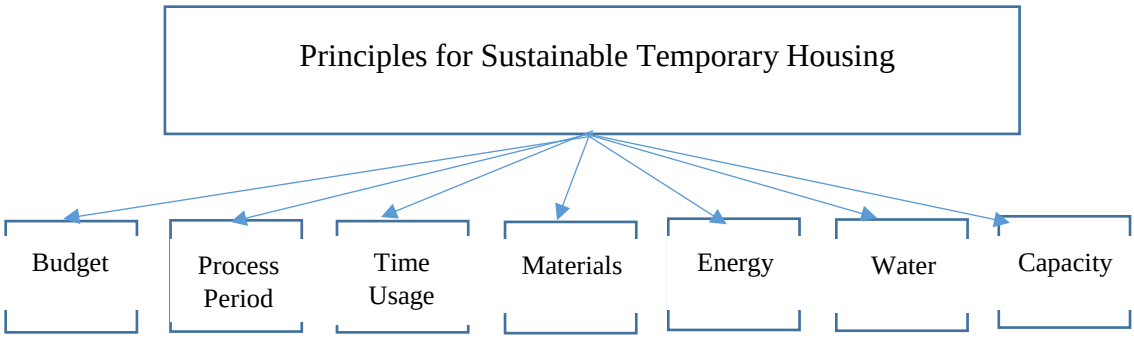

Figure 28: Principles for Sustainable Temporary Housing, by author

Chapter 4

ASSESSMANTS OF SUSTAINABILITY AND TEMPORARY HOUSING UNITS

This chapter is a continuation of the previous chapter regarding sustainability and its standards in construction, but this chapter is divided into two main parts. The first part of the chapter focuses on the types of global systems for evaluating the sustainability of buildings and to narrow the field of research, and this chapter has focused on the most common two evaluating systems, BREAM and LEED. However, this thesis adopting the LEED-H v4 System only, explaining in detail and covering its criteria.

The second section of the chapter is case studies, where the chapter reviews two case studies that use the temporary housing units and their evaluation in the standard LEED-H v4 system to note the deficiencies of this system in evaluating this type of building. After obtaining the evaluation results, these results are discussed to determine the recommendations that can be used to improve the evaluation system for temporary housing units.

For the last decades, several current problems related to climate change has been a significant worldwide concern. By recognising the destructive changes in the climate, governments, scientists, businesses and society accept the collapse of the traditional way of life and the modern way of doing business, with the least amount of damage to nature and the community. The global energy uses of buildings and operations recorded

36% and 39% of energy-related CO2 emissions in 2018, (Global Alliance for Buildings and Construction, 2018) considering the construction sector is the most significant global user of raw materials and energy. Steel is the primary material used in the construction industry, and 3 billion tonnes of raw materials are used globally per year. It creates a significant volume of pollution that is environmentally damaging. These changes require significant building design standards, construction techniques, operation procedures and even the materials used.

In several developing countries, construction standards have been set that cover the life cycle of buildings from architecture through to demolition. Sadly, individual countries were not serious enough about the scope of environment conservation. This subject has only been studied substantially over the past ten years, has allowed the findings to be accomplished in building sustainability, and highlighted the approach to reduce the effect of buildings on the environment. There are much research about building sustainability in different areas of design. But some scientific papers published in 2016-2018 period. Authors review and evaluate some of the multinational sustainability appraisal schemes, such as LEED, BREEAM, Green Star, GBI, Green Label, BEAM Plus, IGBC and CASBEE. The various BSASs are used to test related aspects of green building, but comparing these assessment systems was a challenge (Shan, Hwang, 2018).

4.1 Assessing and Managing Sustainability in Buildings

Sustainability assessment methods can be orientated to different levels of analysis: in the building materials, the building product or the building element, the construction elements of the building or the community, and, finally, the building itself/ the neighbourhood. The team developed three kinds of sustainability assessment systems and tools: these systems and tools address three kinds of goals: sustainability assessment systems identify sustainability support systems determine sustainability assessment tools (Kibert, C.J. 2003).

- Manage building energy efficiency (Performance-Based Design).
- Life-cycle assessment (LCA) systems.
- Sustainable certification and rating systems for buildings.

According to several assessment systems, most of the ratings have been assigned on the following: usage of electricity, materials, water, program management, environmental services and waste. Mathematically, this was obvious when evaluating the most critical effect of these programmes' weighted requirements on buildings' certification ratings. CASBEE (Japan) and IGBC (India) were distinct because these structures are tailored closely to their environmental issues and building specifications (Shan, Hwang 2018).

Likewise, the most common LEED and BREEAM BSAS often compared to local systems focused on a given country (Seinre, Kurnitski 2014). For instance, the main requirements for assessing Green buildings in Estonia have already been identified in a scientific study. In Estonia, the new construction laws have been contrasted with BREEAM and LEED certification schemes. Comparing energy use, indoor environment and facets of transport, the best five new buildings that could apply for sustainable systems certification were studied. However, specific problems, such as construction and car-parking, are not taken into account. The findings show that Estonia's current building laws are not too far from the appraisal criteria of popular BSAS.

Another critical factor in research is the effect of sustainable/green construction technology on reducing greenhouse gas emissions. The study of G-SEED, LEED, BREEAM and CASBEE affecting CO2 emissions showed that the most substantial

outcomes of the ecosystem are those of services and products and energy production and the use of clean energy (Zhikun, Vivian 2018). Even though green building technology can lead to high construction costs and longer construction length, it is still not widely known in the United States.

The most critical factors for green construction technology are lower electricity rates, higher rental and selling rates, higher indoor air quality, credibility, and real estate developers' credibility. Certification of green buildings requires additional time and financial support that rely heavily on the project delivery team's expertise and skills. Trained and experienced in green construction personnel may have more difficulties choosing a better process in constructing a greenhouse. The following scientific issues and research directions/trends for green buildings have been established from the literature review:

- Evaluation of international buildings/systems for environmental assessment.
- The research by international frameworks and local criteria in safe buildings assessment.
- BSAS application for CO2 reduction.
- Key factors stimulating and avoiding the use of sustainable building technologies;
- Selection of the green building project implementation team.

However, in many different BSAS schemes, the building process's sustainability is not differentiated individually, and it is measured as a combination of the different structural, nodal, and usability rating types.

4.2 Sustainability Certification and Rating Systems for Buildings

The environmental effect of buildings is rising and growing (Castro-Lacouture, 2009). Much energy and money wasted throughout the life cycle of a building. Today, sustainability appraisal mechanisms are being used to analyse planning, design, renovation, and building operational management procedures and ensure more effective use of resources and environment conservation (Chau, 2010).

This encourages cost savings and sustainability benefits to both improve the efficiency and marketability of buildings. The cities and its residents absorb the greater part of the energy and have a significant role in implementing sustainability throughout the world (Burnett 2007). Several review papers on the efficacy assessment of energy usage and other metrics have been developed in recent years (Aberg & Henning 2011; Dalla Rosa & Christensen 2011). From an economic standpoint, Burnett tried to assess sustainability. His preference of financial (initial investment, investment gain and project value) economic metrics is of little concern, but their execution alone does not provide a final look of building sustainability.

Another approach to environmental assessment strategies and processes introduced and accepted by the environment only stresses saving energy or improving the efficacy of water consumption, minimising CO2 emissions, improving quality of life or planning and targeted use of services. However, out of the many programmes put into place, only a few systems are commonly accepted and set a precedent for sustainable development. Here are the following five rating tools that will be used in this study, considered as the most common, powerful and technologically advanced rating tool available:

- **BREEAM** (Building Research Establishment's Environmental Assessment Method) is the most significant environmental analysis method for buildings and commonly used in environmental review methodologies. It was developed in the UK in the 1990s and has been used by over 600 environmental authorities as to the building environmental assessment tool (Nguyen, BK 2011):
- **LEED** Green Building Ranking Scale, developed by the US, Leadership in Energy and Environmental Architecture (LEED). A collection of guidelines for environmentally friendly architecture was issued by the Green Building Council (USGBC) in 1998. The LEED organisation has established itself into a more general structure since its establishment in 1998. Through this, the organisation has expanded to include more than 14,000 initiatives in the US and 30 countries spanning 99 billion m^2 of the construction area.
- **CASBEE** was created In Japan in 2001. Four simple CASBEE versions follow the different stages of the construction's Life-cycle (Pre-design, new construction, current buildings and refurbishments).
- **GREEN STAR** is an Australian cooperative construction environment ranking system. The Green Building Council of Australia was at the forefront of the campaign to mark buildings for their environmental effects. The system tackles various environmental concerns while still considering workplace health and efficiency and cost savings.
- **The BEAM Society founded**, HK-BEAM in Hong Kong in 1996. The aim is to promote voluntary efforts for environmental sustainability to be assessed, improved and labelled by buildings.

Table 4: Comparison of the most important green building rating systems in terms of the weights used in the evaluation's main categories. (Berardi, 2011).

Assessment criteria	Green building rating system				
	LEED	IPT	BREEAM	CASBEE	SBTool
Energy efficiency	21,7%	20,0%	8,3%	9,6%	4,0%
Water efficiency	7,3%	20,0%	4,5%	9,1%	4,0%
Indoor environment quality	18,8%	6,0%	12,4%	22,4%	23,0%
Waste and material management	18,8%	20,0%	9,8%	21,1%	12,0%
Eco management	10,1%	0,0%	14,1%	0,0%	10,0%

4.2.1 BREEAM Rating System

BREEAM is exceptional in quantitative results and is also the most innovative tool for constructing sustainability evaluation wordwilde. The approach built with exclusion of previously defined and applied inaccuracies and growing usage accuracy. As it is stated before, it makes sense to discuss the circumstances of this method. (Aberg & Henning 2011; Dalla Rosa & Christensen 2011).

Beyond having various variants available to different buildings categories, BREEAM is very flexible and can apply to a wide range of different buildings. For residential properties, there is the more reliable and affecting method of measuring the sustainability of buildings that looks at the unique features of the building block. Here, the detailed data is customised for the nation example, and the adapted system decides whether the criterion has been met.

Table 5: BREEAM assessment categories by the author.

Categories	Weighting (%)	Credits
Land Use and Ecology	10	10
Transport	8	9
Water	6	9
Energy	19	30
Materials	12,5	12
Health and Wellbeing	15	10
Waste	7,5	7
Pollution	10	13
Management	12	22
Innovation	10	10
Total:	110	132

However, BREEAM 2008 assessment approach does not disclose the function of the evaluation outcome difficulty, which offers an opportunity to determine the sustainability of buildings on any of its inherent characteristics, but the experts need to make an individual judgement by using the various assessment criteria to evaluate how to categorise each building on the sustainability of its inhabitant. Experts' observation of sustainability evaluation and involvement in the process would be relevant since sustainability evaluation comprises specific contextual parameters, whose determination to assess values and importance are prerogatives for experts. A BREEAM method developed to determine building life cycles at all phases (design stage, completed building, in-use and renovation). Since this study's authors are interested in and are trained in, traditional building techniques, their review of the BREEAM 2013 technical manual was deemed critical.

The highest BREEAM rating is tracked by multiplying the impact that each group has with the number of points that have been scored, and the overall rating of assessment is based on the amount of the cumulative scores. (Ustinavičius, 2013) For a lower standard of appraisal, the cost of constructing a BREEAM approved building would be cheaper. Prototypes in remote areas would be far more expensive than those in an urban setting. The selected place could cause the project to be more costly. It could require a five to ten per cent financial expense increase to achieve the best ranking. Sometimes a building becomes certified for an excellent rating, and then it may cost more to finish the rating, or it may cost more to figure out whether the building gets a Very Good rating, but in the end, it is typically only two per cent of the total project value to get a Very Good rating.

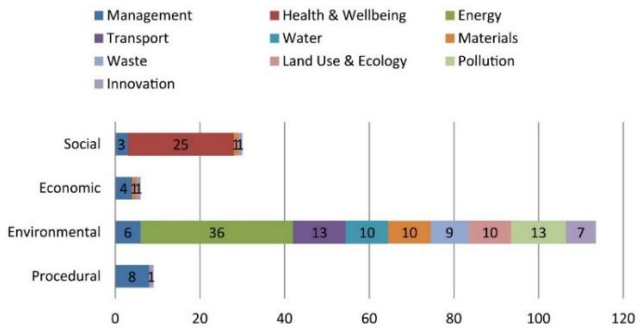

Figure 29: BREEAM credits weighting of Environmental, Social and Economic Pillars, (Wu P, Song Y, Wang, 2017).

4.2.2 LEED Rating System

Both LEED and BREEAM have strategies for all construction life cycles, but the LEED rating system used exclusively for this thesis. LEED system points are given for each applied criteria, scoring points are summarised, and the final cumulative score is determined (Robinson D, 2015). The added expenses - soft costs and greening costs of construction supplies and vehicles - must be considered. Soft costs include planning, commissioning, paperwork and costs of energy modelling. This is between 1.5 and 3.1

per cent of the overall project costs. Greening costs are correlated with the expense of building materials and supplies, but the total average of costs is between 5.0 and 8.0% (Northbridge Environmental Management Consultants, 2003).

The other reports found, based on whether the firm used an in-house LEED project manager or outside consultant, according to Northbridge Environmental Management Consultants 2003 a 2% -3% contribution to overall construction costs and less than 2% of total project spending. LEED certification has been solicited. LEED has identified two critical categories related to building process sustainability: materials and energy, and air quality for indoor applications.

Table 7: LEED assessment categories by the author.

CATEGORİES	WEİGHTİNG (%)	CREDİTS
Sustainable Sites	25,45	28
Water Efficiency	9,09	10
Energy And Atmosphere	33,64	37
Materials And Resources	11,82	13
Indoor Environmental Quality	10,91	12
Regional Priority	3,64	4
Innovation In Design	5,45	6
Total:	100	110

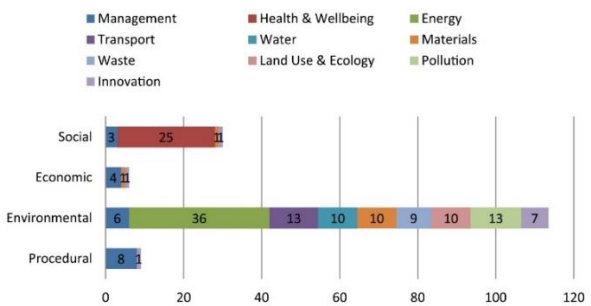

Figure 30: LEED credits weighting of Environmental, Social and Economic Pillars, (Wu P, Song Y, Wang, 2017)

4.2.2.1 EED Rating For Home (LEED-H V4)

The LEED system was developed initially in the US. Leadership in Energy and Environmental Design Green Building Council (USGBC) creates a standard for evaluating new commercial buildings (US Green Building Council, 2005). This initiative has helped identify a standard green building assessment, encourage 'whole architecture,' acknowledge sustainable development leaders, 'foster green competition,' raise understanding of the advantages of sustainable design and profoundly affect the building industry (US Green Building Council, 2005).

Benefits of LEED adoption cover human- and environmental-related systems. The effects of higher efficiency of the indoor environment and improving health and efficiency mainly affect people's lives. Energy and water use processes contribute to a decrease in environmental issues. Today, LEED no longer only applies to modern commercial structures but also applicable to residential structures. USGBC has a policy to green existing buildings (LEED-EB), commercial interiors (LEED-CI), core and shell units (LEED-CS), neighbourhoods (LEED-ND), and housing (LEED-H V4). USGBC launched a one-year test of the LEED-H V4 programme in August 2005. This programme aims to encourage healthy construction practises by home-owners (US Green Building Council, 2005). It requires the building's structure and the building's design, and it is landscaping and interior design.

The initiative strives to recognise those home-owners who have contributed to sustainable construction activities to the best of their capacity. Following the United States. Green Building Council (2005), the objective for LEED-H V4 is to create a useful tool for introducing green building practises to a significant number of new home building marketplace." To introduce the green building practises for a significant

segment of the New Home Marketplace. Homes taking part in the LEED-H V4 scheme will obtain a ranking of approved performance, silver, gold or platinum in

Subjects: house sites, site sustainability, water efficiency, air quality indoor, materials and resources, energy and environment, awareness of home-owners, innovation and design process, etc. Credits in each group are issued, and the LEED-H V4 qualification standard is calculated. Home location credits are focused on the environmental growth of the general site of the building. This involves eliminating urban development and land degradation and emphasising human rather than urban growth. Areas that are environmentally vulnerable or at risk should be avoided, and house construction should not remove resources.

When constructing a house, the home's location should be considered with the new structure, and home construction should begin next to these areas. The location credits are based on the effects on the site of the building. Water sources must be preserved, while environmental pollution and demand for farm chemicals must be reduced, landscaping often needs to cover 50% of the challenging site.

The credit for water efficiency reuses excess water for lawn watering applications, eliminating irrigation systems. Irrigation systems can be used, but automatic controls must be fitted. Reducing the use of indoor water is also essential for the certificate of LEED-H V4. The indoor credits of environmental sustainability focus on air quality steps such as reducing domestic combustion gases. The indoor efficiency credit requires moisture and temperature monitoring, as well as adequate ventilation. Occupants must also be vaccinated from contaminants in kitchens and toilets, air pollutants and other air pollutants.

Material and resources enable people in the house construction sector to develop their houses on the occupant's needs. This approach promotes the sustainable usage reduction of waste activities in framing and other products. This category is also compulsory for geographic and sustainable use of resources and waste reduction. Household awareness is also crucial to LEED-H V4 certification and includes training homes for the LEED-H V4 programme; furniture, machinery and appliances installed; electricity and water conservation, and renewable energy sources. Innovation and construction phase credits will be achieved, in addition to the LEED-H V4 programme, by implementing innovative construction and interior design practises.

4.2.2.2 Using LEED-H V4 system to evaluate Temporary housing units

This thesis aims to focus on a specific method for evaluating the sustainability of the post-disaster temporary housing unit, as these units face a lack of sustainability measuring systems before and following construction and housing of these units. Using the LEED-H V4 rating system is based on the similarities between the standard house and the post-disaster temporary housing units used in emergencies, where the concept of these units comes into the accommodation group, but with other differences includes the period for the use of these units. In this study, the housing units used in emergencies were analysed as temporary housing units with a standardized lifetime of five to ten years which may, if possible, be modified, improved and turned into permanent housing units.

It is well understood that the growing numbers of LEED approved homes was because of the affordable housing market, which has become an essential part of the green movement. Accordingly, about 34% of LEED for homes were affordable homes projects, similar to 2018 LEED in Motion study (USGBC, 2018).

participation in LEED for Homes certification, with the help of different funding agencies Habitat for Humanity has contributed to this rising number of affordable green homes (Habitat for Humanity, 2012). It is getting easier to see green buildings' performance as green buildings' demand continues to rise. According to the US Green Building Council (USGBC), certified buildings used, in total, about 25% less energy and around 11% less water, created about 34% less carbon dioxide and saved over 80 million tonnes of waste (USGBC 2018c).

Many studies have carried out post-occupancy tests to evaluate the effectiveness of accredited LEED buildings (POE). POE "is the process of systematic and rigorous evaluation of the buildings after construction and occupation" (Preiser, Rabinowitz, & White, 1988, p. 3). POEs are crucial to assess if buildings and technology operate as planned, how the buildings meet the users' needs, and how the building's design, efficiency, and health can be changed for each building. As green building POEs can help builders and policymakers understand how to achieve improved outcomes from green building technology, several POEs have assessed LEED-certified buildings' efficiency, particularly for office buildings (Liang et al., 2014; Newsham et al., 2013).

The value of a sustainable home, and that sustainable features such as photovoltaics and geothermal heating systems are one of the most requested after home features. While the number of homes certified by LEED has risen quickly and consumers' awareness of green homes, the assessment of the actual output of LEED homes have been neglected, and there are currently tiny details on the actual results of LEED homes. Given that it is uncertain how an inexpensive LEED house enhances energy production produces an atmosphere that is healthier and more relaxed and improves satisfaction and life quality. At the same time, in use, this thesis aims to conduct a

thorough performance assessment for LEED-certified habitats for temporary housing units in terms of sustainability.

4.3 Case study

A case study using temporary housing units after conflicts were selected to be addressed and evaluated with LEED-H v4 System to assess these units sustainability to cover temporary housing standards units.

4.3.1 Kilis Oncupinar Refugee Camp, Turkey.

In expectation of the fresh influx of people leaving the nearby Syrian region, Turkey has planned two-story container units for refugees in a camp in the south-centre province of Kilis. More than 13,000 people are now based on Kilis Oncupinar refugee camp, built-in 2012. The camp currently has 1,000 container houses in two stories.

Figure 31: Containers housing units Kilis Oncupinar camp, Turkey. (Cimen, 2016).

Since 2012, they have housed Syrians, and after several findings, the second division of the camp was set up for the entire Government, taking into account the everyday activities and relationships with each other. By constructing the new houses, Syrians lived in a society of peace and protection alongside their family members and neighbours. The new housing units were designed with fire-resistant materials. There is also a balcony on the two-story containers.

Figure 32: Kilis Oncupinar camp, Turkey. (Cimen, 2016).

A renewable and low-cost solar receiver and processing system were set up for the new buildings. Electricity will produce for the camp's new portion of the energy supply, according to the idea to set up a two-floor container camp, which will also be the place for a school, three community centres and a market, of Kilis Governor Suleyman Tapsis, who serves more than four years in Kilis. The projects were funded by Qatar and Kuwait as well (Cimen, 2016). According to official information, more than 35,000 Syrian refugees in refugee camps along the frontier in the Kilis Province were given.

4.3.1.1 LEED Home Evaluation For Container Temporary Housing Units

Choosing containers used in the post-disaster temporary housing units is more widespread and has been used in different countries with different weather and climate in several countries. LEED for homes was used to evaluate these housing units' sustainability with future suggestions to enhance the positive aspects evident in this type of construction.

Table 8: LEED-H v4 for Homes prerequisites and credits, Container temporary units evaluation by the author.

Y	?	N			
			Credit	Integrative Process	2

0	0	0	Location and Transportation	15
Y			Prereq Floodplain Avoidance	Required
			PERFORMANCE PATH	
	✓		Credit LEED for Neighborhood Development Location	15
			PRESCRIPTIVE PATH	
	✓		Credit Site Selection	8
	✓		Credit Compact Development	3
✓			Credit Community Resources	2
✓			Credit Access to Transit	2

0	0	0	Sustainable Sites	7
Y			Prereq Construction Activity Pollution Prevention	Required
Y			Prereq No Invasive Plants	Required
✓			Credit Heat Island Reduction	2
✓			Credit Rainwater Management	3
✓			Credit Non-Toxic Pest Control	2

0	0	0	Water Efficiency	12
Y			Prereq Water Metering	Required
			PERFORMANCE PATH	
	✓		Credit Total Water Use	12
			PRESCRIPTIVE PATH	
✓			Credit Indoor Water Use	6
		✓	Credit Outdoor Water Use	4

0	0	0	Energy and Atmosphere	37
Y			Prereq Minimum Energy Performance	Required
Y			Prereq Energy Metering	Required
Y			Prereq Education of the Homeowner, Tenant or Building Manager	Required
	✓		Credit Annual Energy Use	30
	✓		Credit Efficieng Hot Water Distribution	5
		✓	Credit Advanced Utility Tracking	2

0	0	0	Materials and Resources	9
Y			Prereq Certified Tropical Wood	Required
Y			Prereq Durability Management	Required
	✓		Credit Durability Management Verification	1
✓			Credit Environmentally Preferable Products	5
✓			Credit Construction Waste Management	3

0	0	0	Indoor Environmental Quality	18
Y			Prereq Ventilation	Required
Y			Prereq Combustion Venting	Required
Y			Prereq Garage Pollutant Protection	Required
Y			Prereq Radon-Resistant Construction	Required
Y			Prereq Air FIltering	Required
Y			Prereq Environmental Tobacco Smoke	Required
Y			Prereq Compartmentalization	Required
	✓		Credit Enhanced Ventilation	3
	✓		Credit Contaminant Control	2
		✓	Credit Balancing of Heating and Cooling Distribution Systems	3
	✓		Credit Enhanced Compartmentalization	3
	✓		Credit Enhanced Combustion Venting	2
		✓	Credit Enhanced Garage Pollutant Protection	1
		✓	Credit Low Emitting Products	3
		✓	Credit No Environmental Tobacco Smoke	1

0	0	0	Innovation	6
Y			Prereq Preliminary Rating	Required
✓			Credit Innovation	5
	✓		Credit LEED AP Homes	1

0	0	0	Regional Priority	4
		✓	Credit Regional Priority: Specific Credit	1
		✓	Credit Regional Priority: Specific Credit	1
		✓	Credit Regional Priority: Specific Credit	1
		✓	Credit Regional Priority: Specific Credit	1

			TOTALS	Possible Points:	110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

4.4 Findings

The container units used in temporary housing sustainability evaluation have been evaluated in this thesis using LEED for homes criteria as a base to establish a measuring system for temporary housing units in emergencies. The case study met the following categories of LEED-H V4 criteria:

- **Location and Transportation**, the mentioned case study were placed in a safe location, after disasters, which made it possible to set up a refugee camp in the sense of which the government and other organisations have assisted.
- **Sustainable Sites**, temporary housing construction, kept surrounding area safe, as required in the criteria, clearing only the area required to construct the units. The greens that exist often lower the need for chemical pesticides, as will the Earthbag strategy, which is naturally resistant to pests.
- **Water Efficiency,** suppling the site with water, can be complicated, but it can supply water pipes to each unit to control clean and greywater due to the construction steps.
- **Energy and atmosphere,** It can also notice how windows increase the rooms heating process and, on the other hand, it can improve water heating by using solar panels on top of the unit.
- **Materials and resources** usually depend on the family members, but most Earthbag shelters and containers used as temporary housing units in the emergencies have a single bedroom structure, which means they are smaller than the residential average.
- **Indoor air quality**, ventilation and air distribution are supported by the use of natural material and venting. Housing occupants through natural ventilation

methods and minimisation of conventional heating, ventilation and air conditioners are safe from pollutants and carbon monoxide.

- **Innovation and Design Process**, Any conformity was attributed to the designer's decisions.

The building's environmental responsibilities, using a natural construction method often guarantees some sustainability that could endure for decades. However, the building system's underlying sustainability can be complemented and improved by the shelter construction industry members' choices. Selecting the location near existing facilities and green spaces and selecting a sustainable site is especially significant. For air and water heating purposes, photovoltaic systems may also improve the uints construction system's sustainability. Ultimately, the manufacturer gets the ultimate say of how these units are designed, enhancing its sustainability. Therefore, ecological characteristics are possible when Earthbag units are understood in compliance with the designer's decisions.

4.5 Weaknesses of LEED-H V4 Relating to Temporary Housing Units

The use of LEED-H V4 as a rating system for temporary housing units was from the fact that temporary housing units are the closest thing to home, and in the absence of any system to measure their sustainability, choosing LEED-H V4 has been one of the best choices so far.

With the observation of the results presented by the assessment of sustainability in the case studies, it can be said that this system lacks some criteria that may help cover the basics and requirements of temporary housing units. On the other hand, most of the currently existing credits can be applied to these units, but this thesis aims to create a

unique temporary housing system. The criteria have been clarified that may not fit temporary housing units or may not be needed by this system due to their importance in the temporary housing phase. For example, when evaluating temporary housing units, Garage Pollutant Protection and Environmental Tobacco Smoke are not considered essential in the evaluation in temporary housing. Their role in the list is considered meaningless and irrelevant due to the nature of these units' construction.

Also, by comparing the number of points needed by Annual Energy Usage, which were calculated by thirty points, the absence of this factor in the construction of temporary housing units wastes a significant number of points, leading to misunderstanding the evaluating in temporary housing phase.

Table 9: LEED-H v4 for Homes criteria not needed when evaluating temporary housing units by the author.

Y	?	N			
			Credit	Integrative Process	2
0	0	0		**Location and Transportation**	15
Y			Prereq	Floodplain Avoidance	Required
				PERFORMANCE PATH	
			Credit	LEED for Neighborhood Development Location	15
				PRESCRIPTIVE PATH	
			Credit	Site Selection	8
			Credit	Compact Development	3
			Credit	Community Resources	2
			Credit	Access to Transit	2
0	0	0		**Sustainable Sites**	7
Y			Prereq	Construction Activity Pollution Prevention	Required
Y			Prereq	No Invasive Plants	Required
			Credit	Heat Island Reduction	2
			Credit	Rainwater Management	3
			Credit	Non-Toxic Pest Control	2
0	0	0		**Water Efficiency**	12
Y			Prereq	Water Metering	Required
				PERFORMANCE PATH	
			Credit	Total Water Use	12
				PRESCRIPTIVE PATH	
			Credit	Indoor Water Use	6
			Credit	Outdoor Water Use	4
0	0	0		**Energy and Atmosphere**	37
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Energy Metering	Required
Y			Prereq	Education of the Homeowner, Tenant or Building Manager	Required
			Credit	Annual Energy Use	30
			Credit	Efficieng Hot Water Distribution	5
			Credit	Advanced Utility Tracking	2
0	0	0		**Materials and Resources**	9
Y			Prereq	Certified Tropical Wood	Required
Y			Prereq	Durability Management	Required
			Credit	Durability Management Verification	1
			Credit	Environmentally Preferable Products	5
			Credit	Construction Waste Management	3
0	0	0		**Indoor Environmental Quality**	18
Y			Prereq	Ventilation	Required
Y			Prereq	Combustion Venting	Required
Y			Prereq	Garage Pollutant Protection	Required
Y			Prereq	Radon-Resistant Construction	Required
Y			Prereq	Air FIltering	Required
Y			Prereq	Environmental Tobacco Smoke	Required
Y			Prereq	Compartmentalization	Required
			Credit	Enhanced Ventilation	3
			Credit	Contaminant Control	2
			Credit	Balancing of Heating and Cooling Distribution Systems	3
			Credit	Enhanced Compartmentalization	3
			Credit	Enhanced Combustion Venting	2
			Credit	Enhanced Garage Pollutant Protection	1
			Credit	Low Emitting Products	3
			Credit	No Environmental Tobacco Smoke	1
0	0	0		**Innovation**	6
Y			Prereq	Preliminary Rating	Required
✓			Credit	Innovation	5
	✓		Credit	LEED AP Homes	1
0	0	0		**Regional Priority**	4
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
0	0	0		**TOTALS**	Possible Points: 110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

The red credits listed in the criteria are not necessary when evaluating temporary housing units as this temporary housing units don't have a permanent feature.

4.6 Discussion

Once the results of the above LEED-H V4 standard evaluation system have been observed for temporary units, it was noted that there are various weaknesses in the system that could affect these temporary units' sustainability. The above cases have faced some issues with credit earnings due to the fact that they may not comply with the fundamental principles of this system categories, and thus the sustainability level of such units has started to decrease. However, some of the temporary housing units strengths have been excluded from the evaluation method used. It can be said that some of the significant aspects missing in the necessary evaluation LEED-H V4 system are:

- **Social dimensions**, the existing evaluation system used in this thesis does not cover all the social dimensions. Considering the significance of this factor and its role in sustainable development. When using temporary housing units in any emergencies, the social dimension must be included to meet a standard of affordability that ensures the continuity of using these units without the need for improvements to be made by the inhabitants of these units to meet their needs.
- **The use of local materials**. In some instances that use temporary housing structures, the materials used are local resources; other examples are soil and certain forms of timber such as bamboo, which are commonly available in areas without places for this. It should be noted that including this point to the proposed evaluation system might create a difference in the unit sustainability level depending on the local availability of materials on the construction site.
- **The flexibility to choose between different types of housing**, **based on the climate of the region or local materials and local workers.** It is necessary to expand the variety of temporary housing units used, since the circumstances

and materials of construction change due to the region's weather and environment or materials' availability. For some types of units, it does happen that they do fit into some regions but do not fit into others. If a single ready-made housing units model was implemented without considering the previous aspects, it could lead to several problems. It is safer to offer the option of using various types of housing units on the location. Focusing on the value of using the local workforce should be considered before construction starts, as their understanding of the site's features is essential,

- **The future possibility of transporting these housing units to different locations in the future**. Consideration must be given to providing mobility within the evaluation options since most of the temporary housing units used are units that can be easily relocated and moved from one location to the next, improving the benefits of using one design over another. The ease of mobility and the flexibility to reuse these units for different purpose make them valuable. for that, it is essential to add this aspect to the list.
- **Considering the life span of these units.** In the standard LEED-H V4 , the system used to evaluate houses' life span in ordinary housing situations is not measured correctly. Unlike temporary housing units, whose life span may be estimated from five to ten years with the potential to modify or make changes that would make them permanent housing units, Knowing and measuring the life span can reflect an essential improvement in the sustainability level of the housing type used.

Table 10: Comparison between LEED for Homes credits and the proposed credits for the new system by the author.

Credits	LEED-H V4	Proposed Credits for Temporary Housing Units	Reccommondation
Location and Transportation	✓	✓	Some points used in this credit can be added and used in other credits given the priority to impact the credit on the chosen temporary housing unit type.
Sustainable Sites	✓	✓	When choosing the right type of temporary housing units, the design adjustments based on the designer's decisions will increase some of these points.
Water Efficiency	✓	✓	Providing water may be one of the most significant consequences facing temporary housing, but the improvement of efficiency is crucial.
Energy And Atmosphere	✓	✓	Given the size of the temporary housing units and the fact that they do not need to have an hvac system, it is easy to see how this aspect could be improved about the difficulty of improving the point of needing an hvac system.
Materials And Resources	✓	✓	More points must be provided for this credit as it is one of the most critical indicators in the process of building temporary housing units.
Indoor Environmental Quality	✓	✓	Some points can be removed from this credit and added to others, the garage is not a part of the temporary housing units, and it is likely difficult to provide air filters.

Innovation	✓	✓	_
Social Dimensions		✓	Focusing on this credit and giving it appropriate points for its importance in the sustainability of temporary housing units used for various reasons and locations.
The Use Of Local Materials	✓	✓	This credit exists in the leed-h v4 system, but the points given to it can be improved due to the critical role in improving temporary housing units' quality.
Diversity Of The Used Units Types		✓	Offering a variety of housing units enables the potential to achieve the highest points of efficiency by selecting units that suit the environment and location.
Transporting Flexibility Of The Units		✓	The most critical feature of temporary housing units is that most of their forms are easily transferable from one location to another. So it can be added as a credit with the right amount of points.
Units Life Span		✓	Considering the proposed system is for evaluating temporary housing units, its life span is relatively short compared to the traditional residential buildings. Hence, it can be said that some changes can be made to give appropriate points for this credit.

It is possible to suggest some changes to the current evaluation method, as some credits can be deducted from the current list and added to the new proposal form according to what was discussed previously. The proposed system used depends mainly on the existing LEED-H V4 assessment system. The addition of improvements or changes in the appropriations and the housing units' requirements to become more flexible and appropriate to cover the differences in the conditions in which the temporary housing units are used.

Table 11: Current LEED-H v4 credits and the proposed credits for the new system by the author.

LEED-H VE CHECK LIST

0	0	0	**Location and Transportation**		15
Y			Prereq	Floodplain Avoidance	Required
			PERFORMANCE PATH		
			Credit	LEED for Neighborhood Developr	15
			PRESCRIPTIVE PATH		
			Credit	Site Selection	8
			Credit	Compact Development	3
			Credit	Community Resources	2
			Credit	Access to Transit	2
0	0	0	**Sustainable Sites**		7
Y			Prereq	Construction Activity Pollution Pre	Required
Y			Prereq	No Invasive Plants	Required
			Credit	Heat Island Reduction	2
			Credit	Rainwater Management	3
			Credit	Non-Toxic Pest Control	2
0	0	0	**Water Efficiency**		12
Y			Prereq	Water Metering	Required
			PERFORMANCE PATH		
			Credit	Total Water Use	12
			PRESCRIPTIVE PATH		
			Credit	Indoor Water Use	6
			Credit	Outdoor Water Use	4
0	0	0	**Energy and Atmosphere**		37
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Energy Metering	Required
Y			Prereq	Education of the Homeowner, Ten	Required
			Credit	Annual Energy Use	30
			Credit	Efficieng Hot Water Distribution	5
			Credit	Advanced Utility Tracking	2

PROPOSED CREDITS FOR TEMPORARY HOUSING UNITS

0	0	0	**Location and Transportation**		12
Y			Prereq	Floodplain Avoidance	Required
			PERFORMANCE PATH		
			Credit	LEED for Neighborhood Developr	15
			PRESCRIPTIVE PATH		
			Credit	Site Selection	8
			Credit	Community Resources	2
			Credit	Access to Transit	2
0	0	0	**Sustainable Sites**		7
Y			Prereq	Construction Activity Pollution Pre	Required
Y			Prereq	No Invasive Plants	Required
			Credit	Heat Island Reduction	2
			Credit	Rainwater Management	3
			Credit	Non-Toxic Pest Control	2
0	0	0	**Water Efficiency**		12
Y			Prereq	Water Metering	Required
			PERFORMANCE PATH		
			Credit	Total Water Use	10
			PRESCRIPTIVE PATH		
			Credit	Indoor Water Use	6
			Credit	Outdoor Water Use	4
0	0	0	**Energy and Atmosphere**		7
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Energy Metering	Required
			Credit	Efficieng Hot Water Distribution	5
			Credit	Advanced Utility Tracking	2

0	0	0	**Materials and Resources**		**9**
Y			Prereq	Certified Tropical Wood	Required
Y			Prereq	Durability Management	Required
			Credit	Durability Management Verificatio	1
			Credit	Environmentally Preferable Produc	5
			Credit	Construction Waste Management	3

0	0	0	**Indoor Environmental Quality**		**18**
Y			Prereq	Ventilation	Required
Y			Prereq	Combustion Venting	Required
Y			Prereq	Garage Pollutant Protection	Required
Y			Prereq	Radon-Resistant Construction	Required
Y			Prereq	Air FIltering	Required
Y			Prereq	Environmental Tobacco Smoke	Required
Y			Prereq	Compartmentalization	Required
			Credit	Enhanced Ventilation	3
			Credit	Contaminant Control	2
			Credit	Balancing of Heating and Cooling I	3
			Credit	Enhanced Compartmentalization	3
			Credit	Enhanced Combustion Venting	2
			Credit	Enhanced Garage Pollutant Protect	1
			Credit	Low Emitting Products	3
			Credit	No Environmental Tobacco Smoke	1

0	0	0	**Innovation**		**6**
Y			Prereq	Preliminary Rating	Required
✓			Credit	Innovation	5
	✓		Credit	LEED AP Homes	1

0	0	0	**Regional Priority**		**4**
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1

0	0	0	**Materials and Resources**		**14**
Y			Prereq	Certified Tropical Wood	Required
Y			Prereq	Durability Management	Required
			Credit	Durability Management Verificatio	1
			Credit	Environmentally Preferable Produc	5
			Credit	Construction Waste Management	3
			Credit	Local Materials Use	5

0	0	0	**Indoor Environmental Quality**		**12**
Y			Prereq	Ventilation	Required
Y			Prereq	Combustion Venting	Required
			Credit	Enhanced Ventilation	3
			Credit	Contaminant Control	2
			Credit	Balancing of Heating and Cooling I	1
			Credit	Enhanced Compartmentalization	2
			Credit	Enhanced Combustion Venting	1
			Credit	Low Emitting Products	3

0	0	0	**Innovation**		**6**
Y			Prereq	Preliminary Rating	Required
✓			Credit	Innovation	5
	✓		Credit	LEED AP Homes	1

0	0	0	**Regional Priority**		**4**
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1

0	0	0	**Innovation**		6
Y			Prereq	Preliminary Rating	Required
✓			Credit	Innovation	5
	✓		Credit	LEED AP Homes	1

0	0	0	**Regional Priority**		4
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1

0	0	0	**TOTALS**	Possible Points: 0

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

The green credits included in the criteria are what was added by the author as a proposal for the evaluating temporary housing units

0	0	0	**Innovation**		6
Y			Prereq	Preliminary Rating	Required
✓			Credit	Innovation	5
	✓		Credit	LEED AP Homes	1

0	0	0	**Regional Priority**		4
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1

0	0	0	**Units Flixibility**		13
Y			Prereq	Unit type based on location	Required
Y			Prereq	Unit Durability	Required
			Credit	Dismantling and installing	4
			Credit	Reuse for other purposes	4
			Credit	Transporting and relocating	5

0	0	0	**Social and Culture**		18
Y			Prereq	Respect Cultural background	Required
Y			Prereq	Cover Social Needs	Required
			Credit	Single Family Privicy	6
			Credit	Reuse purposes Flexibility	4
			Credit	Transporting Flexibility	4
			Credit	Local workers	4

0	0	0	**Time Managment**		8
			Credit	construction and Importing Duratio	4
			Credit	Life span 5 to 10 years	4

0	0	0	**TOTALS**	Possible Points: 0

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 113

Chapter 5

CONCLUSION

Over the last decades, the world witnessed a rise in the numbers of displaced persons and refugees, both of which have contributed to the massive construction of refugee camps in countries worldwide, both the developed and the developing countries. The variety of locations, climates and other considerations has resulted in developing different temporary housing units using different building systems. The diversity of building systems and the demand for the raw materials used in post-disaster construction and the rise in natural resources and energy use affect the worldwide construction industry.

In this thesis, all sheltering and housing phases were mentioned, but the main focus was on temporary housing units only. This type of housing considered among the residential construction units, but with some differences like the size, material, and mobility of the temporary units. Since there is no assessment system to evaluate its sustainability, this research used global systems for evaluating the sustainability of buildings, specifically the LEED-H V4 system as a base. Propose establishing another evaluation system that covers the credits in temporary housing units that the LEED-H V4 did not cover. A balance is often required in building temporary housing units, specifically in terms of expense, efficiency, durability, cultural appropriateness, and building technologies. In this dynamic situation, which is often further limited by resources and time, sustainability is necessarily a challenge. However, the broader

protection of the affected has a critical role to perform. Therefore, the present options for temporary housing units have become inadequate, and further reconsidering is required. The present needs to combat climate change, and the socioeconomic gains from the more sustainable designs are pushing. One is covering all three foundations of sustainable development, for a more balanced view of the temporary housing unit design.

5.1 Proposed Credits for Evaluating Temporary Housing Units

To achieve this thesis's aim, and after the previous study of all the data presented in each of the chapters of this research, certain changes were then made to the LEED-H V4 assessment system. The criteria that do not apply to the temporary housing units were removed, and the appropriate and necessary criteria were also added. when evaluating these units with the new system, it can have better sustainability levels.

As shown in Table 12, the proposed units have been added to the checklist LEED-H V4 system and the credits proposed was added to the new system for temporary housing specifically.

Table 12: Current LEED-H v4 credits and the proposed credits for the new system in one check list by the author.

Y	?	N			
			Credit	Integrative Process	2
0	**0**	**0**	**Location and Transportation**		**15**
Y			Prereq	Floodplain Avoidance	Required
			PERFORMANCE PATH		
			Credit	LEED for Neighborhood Development Location	15
			PRESCRIPTIVE PATH		
			Credit	Site Selection	8
			Credit	Compact Development	3
			Credit	Community Resources	2
			Credit	Access to Transit	2
0	**0**	**0**	**Sustainable Sites**		**7**
Y			Prereq	Construction Activity Pollution Prevention	Required
Y			Prereq	No Invasive Plants	Required
			Credit	Heat Island Reduction	2
			Credit	Rainwater Management	3
			Credit	Non-Toxic Pest Control	2
0	**0**	**0**	**Water Efficiency**		**12**
Y			Prereq	Water Metering	Required
			PERFORMANCE PATH		
			Credit	Total Water Use	12
			PRESCRIPTIVE PATH		
			Credit	Indoor Water Use	6
			Credit	Outdoor Water Use	4
0	**0**	**0**	**Indoor Environmental Quality**		**18**
Y			Prereq	Ventilation	Required
Y			Prereq	Combustion Venting	Required
Y			Prereq	Garage Pollutant Protection	Required
Y			Prereq	Radon-Resistant Construction	Required
Y			Prereq	Air FIltering	Required
Y			Prereq	Environmental Tobacco Smoke	Required
Y			Prereq	Compartmentalization	Required
			Credit	Enhanced Ventilation	3
			Credit	Contaminant Control	2
			Credit	Balancing of Heating and Cooling Distribution Systems	3
			Credit	Enhanced Compartmentalization	3
			Credit	Enhanced Combustion Venting	2
			Credit	Enhanced Garage Pollutant Protection	1
			Credit	Low Emitting Products	3
			Credit	No Environmental Tobacco Smoke	1
0	**0**	**0**	**Innovation**		**6**
Y			Prereq	Preliminary Rating	Required
			Credit	Innovation	5
			Credit	LEED AP Homes	1
0	**0**	**0**	**Regional Priority**		**4**
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1

0	0	0	**Water Efficiency**		**12**
Y			Prereq	Water Metering	Required
				PERFORMANCE PATH	
			Credit	Total Water Use	12
				PRESCRIPTIVE PATH	
			Credit	Indoor Water Use	6
			Credit	Outdoor Water Use	4

0	0	0	**Energy and Atmosphere**		**37**
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Energy Metering	Required
Y			Prereq	Education of the Homeowner, Tenant or Building Manager	Required
			Credit	Annual Energy Use	30
			Credit	Efficieng Hot Water Distribution	5
			Credit	Advanced Utility Tracking	2

0	0	0	**Materials and Resources**		**14**
Y			Prereq	Certified Tropical Wood	Required
Y			Prereq	Durability Management	Required
			Credit	Durability Management Verification	1
			Credit	Environmentally Preferable Products	5
			Credit	Construction Waste Management	3
			Credit	Local Mterial Use	5

0	0	0	**Units Flixibility**		**13**
Y			Prereq	Unit type based on location	Required
Y			Prereq	Unit Durability	Required
			Credit	Dismantling and installing	4
			Credit	Reuse purposes Flexibility	4
			Credit	Transporting and relocating	5

0	0	0	**Social and Culture**		**18**
Y			Prereq	Respect Cultural background	Required
Y			Prereq	Cover Social Needs	Required
			Credit	Single Family Privicy	6
			Credit	Reuse purposes Flexibility	4
			Credit	Transporting Flexibility	4
			Credit	Local Workers	4

0	0	0	**Time Managment**		**8**
			Credit	construction and Importing Duration	4
			Credit	Life span 5 to 10 years	4

0	0	0	**TOTALS**	Possible Points:	**115**

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

The red credits listed in the criteria are not necessary when evaluating temporary housing units as this temporary housing units don't have a permanent feature.

The green credits included in the criteria are what was added by the author as a proposal for the evaluating temporary housing units

5.2 Principles to Improve Temporary Housing Units Sustainability Levels

Once the criteria can be expounded and presented as a new assessment system for temporary housing units in the LEED V4 measurement system, guidelines can be considered to enhance temporary housing units and their sustainability levels. The awareness of common problems and their background opens up the possibility of addressing certain principles which could improve the performance of temporary housing:

- **Use local resources**

Locally generated resources would be the preferred alternative to imports because these resources will be available locally without shipping costs. Using locally available materials allows local workers to develop projects since the people in the area manage them. Local groups also provide expertise and building skills, and earlier surveys have shown that survivors have given initial solutions to the shelter needs. In addition, the community's constructive engagement may be a valuable method of preserving the sense of pride and society that is important during traumatic experiences.

- **Design with locals**

The units should be designed according to how people use them in that specific location. It is essential to turn the attention onto the production of more flexible and safe alternatives and 'homes' production and not only build shelters. The design needs to be as local as possible. Take advantage of local building needs, materials, and processes. It makes units locally organized and cost-effective.

- **Basic methods of construction**

It should be simpler and quicker as possible for the units to be installed. Simple building systems are chosen to speed up and allow local people to be involved. It also encourages the process of removing after use.

- **Transporting flexibility**

Where there are limited or non-existent local resources and units must be transported, the approach can be focused on small, light elements for transport, especially to locations with limited access and allow this units to be relocated again if needed.

- **Lifespan**

The units must work for the expected duration and require minimum maintenance and consider it is not permanent unit. The material must be durable enough to resist being affected in the environment, such as snow, rain, heat, and extreme high temperatures.

- **Suitable size**

These would suit the needs of the family in terms of space and capacity. These items would be organised according to the family's needs.

- **Comfort level**

Suitable privacy conditions, indoor environment, natural lighting and artificial lighting, ventilation, etc. A wide range of configurations and flexibility in location makes the unit multifunctional and enables transformation and renovation. The units are more easily customised by consumers, making them more connected to their rooms.

- **Reuse and recycling**

Consider potential repair steps just after the end of product life. Reuse and recycling solutions are highly beneficial for temporary housing units.

As a conclusion of this thesis, it is recommended that further researches and studies be performed to improve the sustainability evaluation process and include more points and distribute the correct percentages on the proposed scale for evaluating the sustainability of temporary housing units.

REFERENCES

Aberg, M., & Henning, D. (2011). *Optimisation of a Swedish district heating system with reduced heat demand due to energy efficiency measures in residential buildings*. Energy Policy, 39(12), 7839-7852.

Adnan, N. A., Basarudin, Z., & Che Omar, N. (2014, May). *Variation in hydrological responses estimation simulations due to land use changes. In International conference on civil, biological and environmental engineering (CBEE)*, Istanbul, Turkey (pp. 27-28). after occupancy: example of Duzce, Turkey. Building and Environment 43.

Ahmad, S., Ibrahim, A., Alias, R., Shapee, S. M., Ambak, Z., Zakaria, S. Z., & Mat, A. F. A. (2010, March). *Thermal and electrical characterization of alumina substrate for microelectronic applications*. In AIP Conference Proceedings (Vol. 1217, No. 1, pp. 442-446). American Institute of Physics.

Alexander, D. E. (2013). *Resilience and disaster risk reduction: an etymological journey.* Natural hazards and earth system sciences, 13(11), 2707-2716.

Alshawawreh, L., Pomponi, F., D'Amico, B., Snaddon, S., & Guthrie, P. (2020). *Qualifying the sustainability of novel designs and existing solutions for post-disaster and post-conflict sheltering*. Sustainability, 12(3), 890.

Arslan, H., & Cosgun, N. (2008*). Reuse and recycle potentials of the temporary houses.*

Arslan, Hakan. 2007. *Re-Design, Re-Use and Recycle of Temporary Houses*. Ascona, Switzerland.

Asefi, M., & Sirus, F. A. (2012). *Transformable shelter: Evaluation and new architectural design proposals.* Procedia-Social and Behavioral Sciences, 51, 961-966.

Akadiri, P. O., Chinyio, E. A., & Olomolaiye, P. O. (2012). *Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector*. Buildings, 2(2), 126-152.

Barakat, S. (2003). *Housing reconstruction after conflict and disaster.* Humanitarian Policy Group, Network Papers, 43, 1-40.

Bektaş, E. (2007). *A Post-Disaster Dilemma: Temporary Settlements in Düzce City, Turkey*. In Post-disaster reconstruction: meeting stakeholder interests.

Betteridge, A., & Betteridge, A. (2015, July 10). *SYRIA-CONFLICT*. Retrieved January 20, 2021, from https://devpolicy.org/antipodes-continue-to-fall-short-on-aid-to-syria-20140918/syria-conflict

Birkland, T. A. (2006). *Lessons of disaster: Policy change after catastrophic events.* Georgetown University Press. Building and Environment 42 (1): 400–406. https://doi.org/10.1016/j.buildenv.2005.07.032.

Burnett, K. M., Reeves, G. H., Miller, D. J., Clarke, S., Vance-Borland, K., & Christiansen, K. (2007).

Castro-Lacouture, D., Sefair, J. A., Flórez, L., & Medaglia, A. L. (2009). *Optimization model for the selection of materials using a LEED-based green building rating system in Colombia.* Building and environment, 44(6), 1162-1170.

Chang, Y., Wilkinson, S., Potangaroa, R., & Seville, E. (2010). *Resourcing challenges for post-disaster housing reconstruction: a comparative analysis.* Building Research & Information, 38(3), 247-264.

Caia, G., Ventimiglia, F., & Maass, A. (2010). Container vs. dacha: *The psychological effects of temporary housing characteristics on earthquake survivors. Journal of environmental psychology*, 30(1), 60-66.

Choguill, C. L. (1999). *Community infrastructure for low-income cities: The potential for progressive improvement*. Habitat International, 23(2), 289-301.

Claes, K., Vandenbussche, L., Versele, A., & Klein, R. (2012). *Sustainable planning and construction in the South*. KLIMOS working paper 7.

Cluster, G. S. (2017). Shelter Projects 2015-2016. International Organization for Migration: Dhaka, Bangladesh.

Coffey, V., & Trigunarsyah, B. (2012, April). *Rebuilding housing after a disaster: factors for failure. In Proceedings of eighth Annual International Conference*

of the International Institute for Infrastructure, Renewal and Reconstruction (IIIRR) (pp. 292-300). Kumamoto University.

Corsellis, T., Sweetnam, P., Ahmad, P., Izhar, S., Khan, F., & Rajput, K. (2014). *Evaluation of One Room Shelter Programme for the 2011 floods response in South Sindh, Pakistan.*

Corsini, L., Aranda-Jan, C. B., & Moultrie, J. (2019). *Using digital fabrication tools to provide humanitarian and development aid in low-resource settings*.

Costanza, R., & Daly, H. E. (1992). *Natural capital and sustainable development. Conservation biology*, 6(1), 37-46.

Dalla Rosa, A., & Christensen, J. E. (2011). *Low-energy district heating in energy-efficient building areas.* Energy, 36(12), 6890-6899.

Davidson, C. H., Johnson, C., Lizarralde, G., Dikmen, N., & Sliwinski, A. (2007). *Truths and myths about community participation in post-disaster housing projects.* Habitat international, 31(1), 100-115.

Davidson, S., & Price, G. (2011). *Review of the international Federation's Shelter Cluster commitment. IFRC, Geneva*.

Donohue, C. (2012). *Strategic planning for post-earthquake temporary housing: Best practices.* Humanitarian Aid in Complex deliveries, University of Denver.

Elizabeth Wagemann (2012) *Accommodation, T., & Disaster*, A. CAMBRIDGE. July.

Federation of Red Cross and Red Crescent Societies. http://www.ifrc.org.

Fedoruk, L. E., Cole, R. J., Robinson, J. B., & Cayuela, A. (2015). *Learning from failure: understanding the anticipated–achieved building energy performance gap.* Building Research & Information, 43(6), 750-763.

Félix, D., Branco, J. M., & Feio, A. (2013). *Temporary housing after disasters: A state of the art survey.* Habitat International, 40, 136-141.

Félix, D., Monteiro, D., Branco, J. M., Bologna, R., & Feio, A. (2015). *The role of temporary accommodation buildings for post-disaster housing reconstruction. Journal of Housing and the Built Environment*, 30(4), 683-699.

Félix, Y., Halperin, S., & Thomas, J. C. (2012). *Rational homotopy theory* (Vol. 205). Springer Science & Business Media.

Florian, M., Costas, J., & Kärreman, D. (2019). *Struggling with meaningfulness when context shifts volunteer work in a German refugee shelter. Journal of Management Studies*, 56(3), 589-616.

Giustiniani, F. Z. *Civil-Military Relations in Disaster Contexts 2011*. In International Law in Disaster Scenarios (pp. 187-197). Springer, Cham.

Gulahane, K., & Gokhale, V. A. (2010). *Design criteria for temporary shelters for disaster mitigation in India.* In Participatory design and appropriate technology for disaster reconstruction. Conference proceedings.

Hadafi, F., & Fallahi, A. (2010). *Temporary housing respond to disasters in developing countries-case study: Iran-Ardabil and Lorestan Province Earthquakes*. World Academy of Science, Engineering and Technology, 66(42), 1536-1542.

Hamilton, N. (2012). *Post-disaster shelter: A studio-based response to emergency shelter in natural disaster zones*. Sustainable futures: Architecture and urbanism in the global south, Kampala, Uganda, 2730.

Hany Abulnour, A. (2014). *The post-disaster temporary dwelling: Fundamentals of provision, design and construction*. Hbrc Journal, 10(1), 10-24.

Hidayat, B., & Egbu, C. O. (2010, September). *A literature review of the role of project management in post-disaster reconstruction.* In Procs 26th Annual ARCOM Conference (pp. 1269-1278). Association of Researchers in Construction Management.

Homepage. (n.d.). Retrieved January 2021, from https://karmod.com/en/products/low-cost-housing?gclid=EAIaIQobChMIl869_vDA7gIVz

How BREEAM certification works. (2019, September 05). Retrieved March 03, 2021, from https://www.breeam.com/discover/how-breeam-certification-works/

IFRC. 2013. *Post-Disaster Shelter: Ten Designs*. Vol. 2. Geneva: International

Johnson, C., Lizarralde, G., & Davidson, C. H. (2006). *A systems view of temporary housing projects in post-disaster reconstruction.* Construction management and economics, 24(4), 367-378

Johnson, D. M., & Zlotnick, C. (2006). *A cognitive—behavioral treatment for battered women with PTSD in shelters: Findings from a pilot study. Journal of Traumatic Stress: Official Publication of the International Society for Traumatic Stress Studies,* 19(4), 559-564

Johnson, D. M., Zlotnick, C., & Perez, S. (2008). *The relative contribution of abuse severity and PTSD severity on the psychiatric and social morbidity of battered women in shelters.* Behavior Therapy, 39(3), 232-241.

Joustra, C. (2010). *An integrated building water management model for green building.*

Khalili, N. (2008). *Emergency sandbag shelter and eco-village. Hesperia, CA: Cal-Earth Press.*

Kibert, C. J., Sendzimir, J., & Guy, G. B. (Eds.). (2003). *Construction ecology: nature as a basis for green buildings.* Routledge.

Koukkari, H., & Huovila, P. (2005, January*). Improving the performance of buildings. In Proceedings of the Final Conference of COST Action* C12—Improvement of Building's Structural Quality by New Technologies (pp. 425-430).

Kronenburg, R. H. (2009). *Mobile and flexible architecture: solutions for shelter and rebuilding in post-flood disaster situations*. In blue in architecture 09_ Proceedings_IUAV Digital Library.

LEED .1. (n.d.). Retrieved January 2, 2021, https://www.usgbc.org/leed/1?creative=341456035424&keyword=leed&matchtype=b&network=g&device=c&gclid=EAIaIQobChMInZ7gwaOu7gIVCdZ3Ch2WcwYhEAAYASAAEgKMmPD_BwE

LePine, J. A., Erez, A., & Johnson, D. E. (2002). *The nature and dimensionality of organizational citizenship behavior: a critical review and meta-analysis.* Journal of applied psychology, 87(1), 52.

Ling, P. C. H., Tan, C. S., & Saggaff, A. (2019, September). *Feasibility of ISO shipping container as transitional shelter-a review. In IOP Conference Series: Materials Science and Engineering* (Vol. 620, No. 1, p. 012056). IOP Publishing.

Mcdaniel Jr, M. D. (2017). U.S. Patent No. 9,587,394. Washington, DC: U.S. Patent and Trademark Office.

McDonough, W. F. (2003). 2.15–*Compositional model for the earth's core. Treatise on geochemistry*, 547-568.

McDonough, W. F., Sun, S. S., Ringwood, A. E., Jagoutz, E., & Hofmann, A. W. (1992). *Potassium, rubidium, and cesium in the Earth and Moon and the evolution of the mantle of the Earth.* Geochimica ET Cosmochimica Acta, 56(3), 1001-1012.

Mileti, D. S. (2004). *Disasters by design: A reassessment of natural hazards in the United States.* Washington, DC: Henry.

Missimer, M., Robèrt, K. H., & Broman, G. (2017). *A strategic approach to social sustainability–Part 1: exploring the social system. Journal of Cleaner Production*, 140, 32-41.

Mooney, E. (2009). *When 'temporary' lasts too long*. Forced Migration Review, (33), 64.

Mora, E. P. (2007). *Life cycle, sustainability and the transcendent quality of building materials*. Building and Environment, 42(3), 1329-1334.

Nazir, F. A., Edwards, D. J., Shelbourn, M., Martek, I., Thwala, W. D. D., & El-Gohary, H. (2020). *Comparison of modular and traditional UK housing*

construction: a bibliometric analysis. Journal of Engineering, Design and Technology.

NRC. (2008). The Camp Management Project. Retrieved from https://www.nrc.gov/

NRC. (2014). The Shelter Situation of Refugees from Syria in Neighboring Countries. Retrieved from https://www.nrc.gov/

Pettinger, T., King, P., Hamish, Priyadarshini, D., & Faybillz. (2019, December 09). Environmental sustainability - definition and issues. Retrieved March 01, 2021, from https://www.economicshelp.org/blog/143879/economics/environmental-sustainability-definition-and-issues.

Quality, A., Superadobe, O., & Building, C. (2021). *Air Quality in Oxfam Superadobe Community Building, Zaatari camp.*

Quarantelli, E. L. (2005, September). *Catastrophes are different from disasters: Some implications for crisis planning and managing drawn from Katrina.* In Online forum and essays]–Social Science Research Council.

Seneviratne, T. K. K. S., Amaratunga, R. D. G., & Haigh, R. P. (2011). *Post conflict housing reconstruction: housing needs and expectations of conflict-affected communities.*

Severinsen, C. A., & Howden-Chapman, P. (2014). *The problem and politics of temporary housing. Housing*, Theory and Society, 31(2), 125-147.

Shaw, M., & Sharp, D. (2003). U.S. Patent Application No. 10/096,439.

Shelter centre. (n.d.). Retrieved 2011, from http://sheltercentre.org/

SPHERE HANDBOOK. *Humanitarian Charter and the Minimum Standards in Humanitarian Response. The Sphere Project*, (third Ed.), 2011. 393 p. Available from ittee on Economic Development, Public Buildings, and Emergency Management of the Committee on Transportation and Infrastructure, House of Representatives, One Hundred Thirteenth Congress, first session, October 2, 2013. (2014). Washington: U.S. Government Printing Office.

Tan-Soo, J. S., Adnan, N., Ahmad, I., Pattanayak, S. K., & Vincent, J. R. (2016). *Econometric evidence on forest ecosystem services: deforestation and flooding in Malaysia*. Environmental and resource economics, 63(1), 25-44.

The world's leading sustainability assessment method for master planning projects, infrastructure and buildings. (2020, October 29). Retrieved January 2, 2021, from https://www.breeam.com/

Tolba, M. K. (1987). Guest comment: The ozone agreement—and beyond. Environmental Conservation, 14(4), 287-290.

Tomkiewicz, H. S. (2011). *Barriers to Implementation of Sustainable Construction Practices in the Homebuilding Industry: A Case Study of Rochester*, NY.

Treggiden, K. Designnobis *Proposes Pop-Up Disaster Relief Shelter for Earthquake-Affected Families.*

Tucker, S., Gamage, A., & Wijeyesekera, C. (2014). *Some design aspects of sustainable post-disaster housing. International Journal of Disaster Resilience in the Built Environment.*

Tumbeva, M. D., Wang, Y., Sowar, M. M., Dascanio, A. J., & Thrall, A. P. (2016). *Quilt pattern inspired engineering: Efficient manufacturing of shelter topologies*. Automation in Construction, 63, 57-65.

UNEP, Clark and G. (2007). Evolution of the global sustainable consumption and production policy and the United Nations Environment Programme's (UNEP) supporting activities. Journal of cleaner production, 15(6), 492-498.

Ustinavičius, D. (2013). Personalinė bibliografija Lietuvoje: mokslo sričių ir krypčių apžvalga. Lietuvos mokslų akademijos Vrublevskių biblioteka, 83-94.

Wamsler, C. (2004). *Managing urban risk: perceptions of housing and planning as a tool for reducing disaster risk*. National Emergency Training Center.