DEVELOPMENT OF A MULTI-CRITERIA MODEL FOR ASSESSING THE BUILDINGS POTENTIAL FOR TEMPORARY USE AS FLOOD TRANSITIONAL SETTLEMENT SHELTERS IN YEMEN

BY

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Dedication

To my family

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All praise and most merciful thanks are due to Almighty Allah for providing me with required time, ability, patience, knowledge and health to achieve this research work.

The grateful Acknowledgments are due to King Fahad University of Petroleum and Minerals (KFUPM) and Hadramout Establishment of Human Development (HEHD) for supporting me with required facilities, resources, housing and financial support.

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Lastly, I have tried to revise mistakes and inaccurate data within the body of this research. I hope my apology is accepted for incorrect data and mistakes that are improvised or beyond my knowledge.

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LIST OF ABBREVIATIONS

AHP	:	Analytical Hierarchy Process
ANP	:	Analytic Network Process
ARP	:	Adaptive Reuse Potential
BAP	:	Building Adaptation Potential
CI	:	Consistency Index
CR	:	Consistency Ratio
DSS	:	Decision Support System
EM-DAT	:	Emergency events Database
GNP	:	Gross National Product
GOs	:	Governmental Organizations
IFRC	:	International Federation of Red Cross and Red Crescent
NGOs	:	Non-GovernmentalOrganizations
MAM	:	Municipal Administration Ministry
MAUT	:	Multi Attribute Utility Theory
MAVT	:	Multi Attributes Value Theory
MC	:	Municipal Council- Hadramout, Yemen
MCDM	:	Multi Criteria Decision-making Method
OUNDRC	:	Office of United Nations Disaster Relief Coordinator
RF	:	Rebuild Fund- Hadramout, Yemen

RI	:	Random Index
SAME	:	Shelter Assessment, Monitoring and Evaluation
SODM	:	Single Objective Decision-making Method
SP	:	Sphere Project
TS	:	Transitional Shelter
UN	:	United Nation
UNCHS	:	United Nation Center for Human Settlements
UNHCR	:	United Nation Higher Commissioner of Refugees

ABSTRACT

Full Name : Ahmed Saeed Mohammed Baharoon

Thesis Title : Development of a Multi-Criteria Model for Assessing the Buildings Potential for Temporary Use as Flood Transitional Settlement Shelters in Yemen

Major Field : Architectural Engineering

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The objectives of this thesis are to develop a model for assessing the potential of buildings for temporary use as transitional shelters; to conduct case studies to demonstrate and verify the applicability of the developed model and to develop guidelines for use by design professionals to facilitate the provision of buildings that could be easily adapted for temporary use. In order to achieve these objectives, literature review and interviews with professional who have worked in the disaster relief and displaced settlement have been conducted. The obtained knowledge and experiences were the foundation to develop a multi criteria model that includes sequential phases to assess the buildings' potential for temporary use. These phases are planning constraints profile, preliminary assessment of building condition, comprehensive assessment of building condition, data analysis and report development. To verify and check the model applicability, the model is applied on two case studies, for buildings that were used as transitional shelters in Hadramout, Yemen during the 2008 flood disaster. The outcome of applying the developed model on these cases presents a variation in the buildings' potential and their capacity. In addition, a set of constraints and recommendations were concluded to optimize the use of these buildings temporarily as transitional shelters. By comparing these results with the case studies records, the outcome of the model is very rational and reflects the actual capability and condition of these buildings. Finally, the research presents a set of guidelines and recommendations for use by design professionals to assess the potential of buildings that could be easily adapted for temporary use.

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ملخص الرسالة

الاسم الكامل: أحمد سعيد محمد باهارون

عنوان الرسالة: تطوير نموذج متعدد الخصائص لتقييم قدرة المباني للاستخدام المؤقت كملاجئ أيواء انتقاليه اثناء الفيضانات في اليمن

التخصص: الهندسة المعمارية

تاريخ الدرجة العلمية: ابريل ٢٠١٣ – جمادى الاولى ١٤٣٤هـ]

تهدف هذه الرسالة الى تطوير نموذج متعدد الخصائص لتقييم قدرة المباني للاستخدام المؤقت كملاجئ سكن انتقاليه، كما تهدف الى تطبيق النموذج على حالات دراسية لغرض التحقق من قابلية تطبيق هذا النموذج، علاوة على ذلك تهدف الدراسة الى استنتاج ارشادات تساعد المختصيين على تطوير الرؤى المستقبلية اللازمة للاستخدام المباني مؤقتا بشكل ايسر. ولتحقيق الاهداف المذكورة انفا، تم البحث في العديد من المراجع والابحاث السابقة ذات العلاقة وتم ايضا اجراء العديد من المقابلات الشخصية مع اشخاص من ذوي الخبرة والتي اكتسبت خبرتهم من خلال العمل ضمن جهود الانقاذ و اسكان النازحين اثناء الكوارث. اعتمد النوذج بشكل جوهري على هذه المعرفة والخبرات المكتبسبة لتطوير نموذج ذو مراحل متسلسلة من اجل تقييم قدرة المباني للاستخدام المؤقت. هذه المراحل هي تحديد القيود والاشتراطات التخطيطية، التقييم الاولي، التقييم الشامل وتحليل وتوثيق النتائج. لغرض التحقق من قابلية تطبيق هذا النموذج، تم تطبيق النموذج على حالتين دراسيتين، حيث ان هذه الحالات هي عبارة عن مباني استخدمت كملاجئ ايواء اثناء احداث كارثة فيضانات ٢٠٠٨ في محافظة حضرموت باليمن. تطبيق النموذج على هذه الحالات اظهر اختلافا ملموسا في قابلية المباني وقدرتها الاستيعابية، كما تم التوصل عبر هذا التقييم الى مجموعة من الاشتراطات والتوصيات والتي تساعد على تحسين اداء المبنى وقدرته اثناء الاستخدام المؤقت. ومن خلال مقارنة النتائج المتحصل عليها من النموذج مع سجلات هذه الحالات، فان نتائج هذا النموذج منطقية ومتلائمة جدا مع القدرة الحقيقية للمباني.

في الختام، تضم هذه الدراسة مجموعة من الارشادات والتوصيات و التي تساعد المختصيين على تطوير الرؤى المستقبلية اللازمة للاستخدام المباني مؤقتا بشكل ايسر.

درجة الماجستير في العلوم
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CHAPTER ONE

INTRODUCTION

This chapter presents an overview of the research problem. A brief background, problem statement, research objectives, scope and limitations, the significance of the study, and research methodology are included in this chapter.

1.1 Background

Settlements are the main form of human being civilization. They supply civilians with the required needs and welfare. Settlements face serious challenges that threaten their survival. Because of global warming and climatic changes around the world, disaster threats are increasing annually and are accounted as one of the major threats that cause massive damages and losses. To avoid such impacts, disaster prevention and resilience are the newly adopted trends to reduce the negative impacts of disasters. Disaster prevention and resilience are based on the preparedness and readiness of the community to deal with crisis (Said, et al., 2011).

Disaster resilience includes pre-event planning, people aid, resettlement, cleaning up, rehabilitation and reconstruction. In fact, transitional settlement is an important process in disaster management initiatives. Disaster circumstances impose many difficulties and challenges on disaster management teams which slow down their response. Evacuation of the displaced people reduces the impacts of crisis and pressure significantly. To settle the

affected people, there are several sequential phases that the displaced have to go through (Quarantelli, 1982). These phases start with the settlement of tents and end by settlement in permanent buildings.

Transitional use of buildings is a potential alternative to settle displaced populations after disasters. Evidences indicate that there are several problems arising from the transitional use of buildings. These problems affect the success of the displaced settlement. The main objective of this research is to develop a useful decision support model that helps decision makers in evaluating the available alternatives of settlement buildings. The developed decision support model incorporates several dimensions, including the impact of the crisis, the required resources to alleviate the impacts and displaced population.

1.2 Statement of the Problem

Natural disasters present major risks that impacts on the built environment and cause massive damages and losses. When a natural disaster occurs, an emergency management team is assigned to manage the crisis. The emergency management team would be working to deal with many challenges such as the difficulty of making the right decisions at the right time, the difficulty of developing solutions, and restriction of resources (Tas, et al., 2010; Teo & Lin, 2011 b).

The first challenge that usually faces the emergency management team is to settle the displaced people in the affected region. To overcome this challenge, there are many issues that have to be considered to find the adequate settlement solution such as period of settlement at transitional shelters, cost, time needed to prepare the shelters, and shelter capacity.

Previous research indicated the availability of several alternatives to solve settlement problems. These alternatives were assessed based on various factors such as cost, time, feasibility, flexibility, and resource availability. Some of these solutions were found to consume and drain all the available resources, such as the massive use of portable units as a transitional settlement solution, which requires the availability of many recourses (Johnson, 2007a; Corsellis & Vitale, 2005; Alam, 2008; DIFD, 2008).

Transitional use of the building is early known as a solution for displaced settlement in vulnerable regions. Adopting the strategy of building re-use was very effective in various cases. However, this strategy has failed to meet the requirements of displaced settlements in other cases. The success of transitional use of buildings refers to the potential of building for adaptive reuse that is based on diverse criteria reflecting the real building capability to achieve the task (Wilkinson, et al., 2009; DIFD, 2008). Therefore, To ensure the efficient use of buildings for the transitional settlement, it is necessary to develop an analytical technique considering all of these requirements and criteria to assess buildings' capabilities. Developing and applying such a tool will support decision makers with technical information to determine the building potential, capacity and required actions for successful use of buildings temporarily as transitional shelters.

1.3 Research Objectives

The objectives of this research are as follows:

1. To develop a model for assessing the potential of buildings for temporary use as a flood transitional settlement shelters in Yemen.
2. To conduct case studies to demonstrate and verify the applicability of the developed model.
3. To develop guidelines that can be used by design professionals to facilitate the provision of buildings that could be easily adapted for temporary use.

1.4 Scope and Limitations

The scope and limitations of this research are as follows:

1. Yemen is the context to apply the developed model.
2. The developed model will be applied on permanent, existing buildings for conducting temporary use as transitional shelters at the flood disaster situation.
3. Region that is vulnerable and treated by flood disasters is the environment to implement the model.
4. The required case studies for verifying the developed model will be obtained from Yemen, Hadramout 2008 flood disaster.
5. Respondents to the questionnaire survey that will be conducted to weigh the model criteria, will be selected from a sample of:
    - Non-Governmental Practitioners: They are specialists and experts who have participated with Non-Governmental Organizations (NGO) in the 2008

Hadramout flood event. NGO practitioners are architects, managers and engineers.

- Governmental Practitioners: These practitioners include architects, managers and engineers of the Rebuild Fund Project (RF) at the Public Works Ministry in Hadramout, Yemen.

1.5 Significance of the Study

The significance of this research stems from the following:

1. Developing pre-disaster solutions for displaced settlement has high priority in the present time due to the increase of natural disasters, especially, flood disasters. In essence, the study aims at providing a reliable temporary use of buildings for transitional settlements.
2. The developed model is composed of sequential phases that apply a reasonable investigative approach to assess the potential of buildings. This approach is developed to gather all the characteristics and the local considerations that have to be incorporated in the assessment process.
3. The developed model, while being derived from the international standards and practices, has the potential to be customized according to the local considerations and priorities for any flood disaster region.

1.6 Research Methodology

This section presents the required research steps to achieve the three objectives of the study.

1.6.1 The First Objective

The first objective is to develop a model for assessing the potential of buildings for temporary use as transitional shelters. This objective will be achieved through conducting the following phases:

Phase 1: Domain Analysis and Description

Phase 1 includes the following research activities:

I. Carrying out a comprehensive literature review for the purposes of:
   - Reviewing previous research related to disaster management, transitional settlement and adaptive reuse of buildings.
   - Reviewing the general criteria that have an influence on the building potential for temporary use as transitional shelters.
   - Reviewing the international standards for shelters.
   - Reviewing previous models developed to assess the building potential.

II. Reviewing two local case studies of temporary use of buildings to discover the actual problems and difficulties faced during displaced settlement.

III. Conducting interviews with the concerned professionals that have previously participated in the relief and rebuild efforts in order to:
   - Assess and customize the obtained criteria.

- Review and revise the requirements of international standards of shelters to suit the needs of local community.

IV. Identifying the relative importance values of the identified criteria (weights) by conducting the following activities:

- Developing a questionnaire survey to assess the building potential criteria.
- Pilot-testing the questionnaire survey through experts to check the criteria statement clarity and understanding.
- Identifying the selection criteria of the respondent sample.
- Distributing and collecting the questionnaire survey.

Phase 2: Model Development

Phase 2 includes the following research activities:

I. Developing the planning constraints profile.

II. Developing the preliminary assessment.

III. Developing a comprehensive assessment checklist.

IV. Developing a methodology for analyzing the weighted criteria and the outcome of the assessment through the developed checklist.

V. Reporting the findings including a statement of the building potential, capacity of the building, constraints of use and recommendations.

1.6.2 The Second Objective

The second objective is to conduct case studies to demonstrate and verify the applicability of the developed model. This objective will be achieved through conducting the following phases:

Phase 1: Review of Actual Flood Disaster' Case Studies

Phase 1 includes the following research activities:

I. Reviewing two actual case studies of temporary use of buildings as transitional shelters for displaced resettlement in Hadramout 2008 flood.

Phase 2: Application of the Developed Model

Phase 2 includes the following research activities:

I. Applying the model on two actual case studies to verify the model applicability.
II. Analyzing the results of the model and the two case studies to provide the explanations for the difficulties and problems.
III. Analyzing the results of case studies.

1.6.3 The Third Objective

The third objective is to develop guidelines for use by design professionals to facilitate the provision of buildings that could be easily adapted for temporary use. This objective will be achieved through incorporating the outcomes of interviews as well as the results of the model application on the case studies. Figure 1.1 illustrates the methodology followed to achieve the objectives of this research.

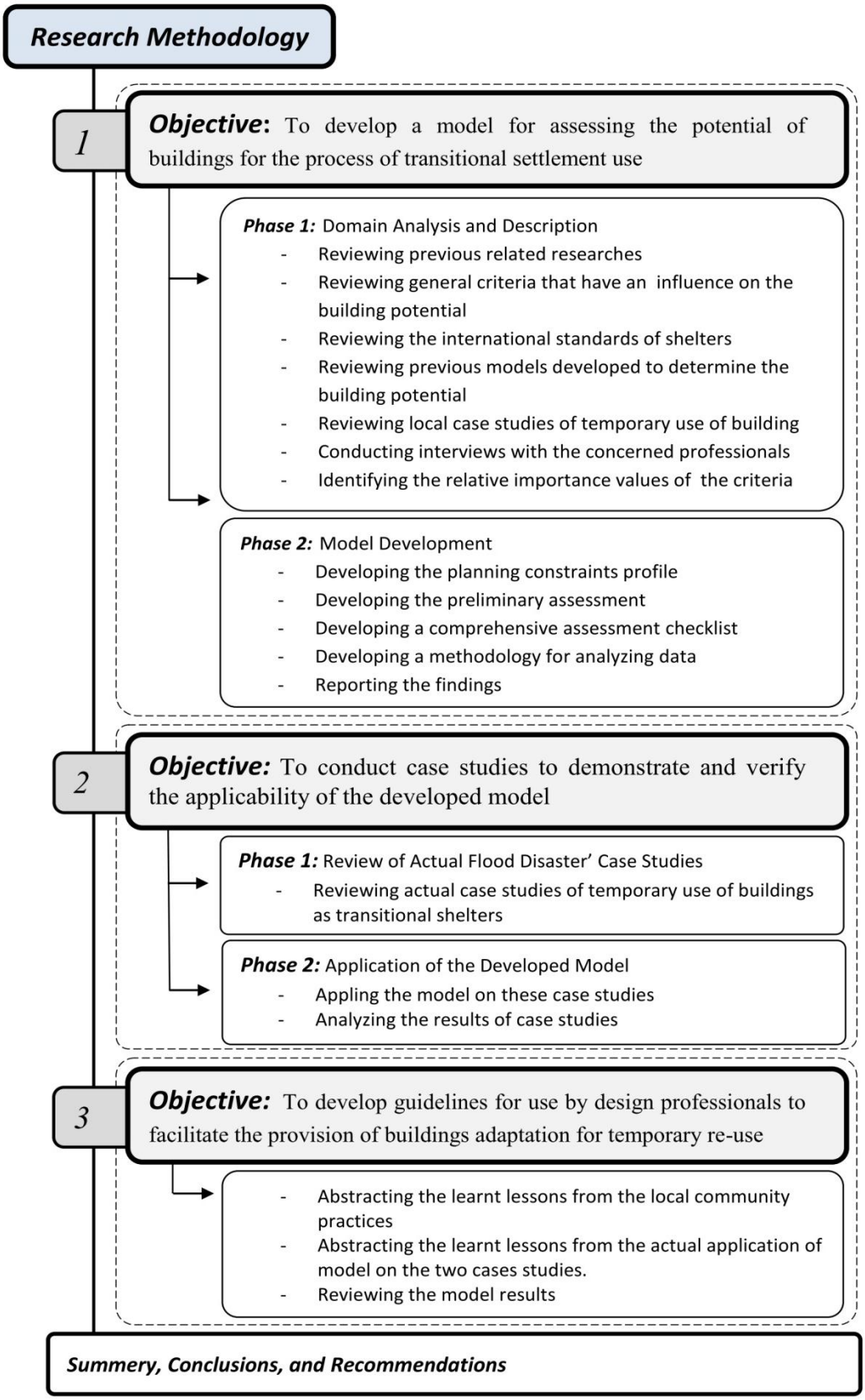

Figure1.1: Research Methodology

1.7 Structure of the Thesis

The thesis is divided into eight chapters as follows:

Chapter One: Introduction

This chapter presents an overview of the research problem. A brief background, problem statement, research objectives, scope and limitations, significance of the study, and research methodology.

Chapter Two: Literature Review

This chapter presents a comprehensive literature review for the purposes of reviewing previous research related to disaster management, transitional settlement and adaptive reuse of buildings. The chapter also reviews previous models developed to determine the building potential for temporary use as transitional shelters, and reviews standards of shelters.

Chapter Three: Local Practice of Resettling the Displaced

This chapter presents the current local practices of displaced settlement during Hadramout 2008 flood disaster. The chapter summarizes the problems, resettlement alternatives and used criteria to evaluate buildings.

Chapter Four: Requirements and Criteria Assessment

This chapter presents the customization of the international standard and basic displaced needs and the criteria weighting.

Chapter Five : Development of the Model

This chapter presents the development of the model through the identification of a multi-phase framework that includes planning constraints profile, preliminary assessment, comprehensive assessment, data analysis, and report development.

Chapter Six: Application of the Developed Model

This chapter presents an application of the model on four actual case studies to verify its applicability. The chapter also presents an analysis of the results of the case studies.

Chapter Seven: Guidelines for the Provision of Transitional Flood Shelters

This chapter presents a number of guidelines and recommendations for use by design professionals to facilitate the provision of buildings that could be easily adapted for temporary use.

Chapter Eight: Conclusions and Recommendations

This chapter presents a set of conclusions and summary that are obtained from the previous chapters and the model results. Also, it presents recommendations for further research.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents a comprehensive literature review for the purposes of reviewing previous research related to disaster management, transitional settlement and adaptive reuse of buildings. The chapter also reviews previous models developed to determine the building potential for temporary use as transitional shelters, and reviews standards of shelters.

2.1 Disaster Management

2.1.1 Definition of the term "Disaster"

"*Disaster is a natural or man-made event that negatively affects life, property, livelihood or industry often resulting in permanent changes to human societies, ecosystems and environment*" (Eshghi & Larson, 2008). Generally, disasters are divided into three types based on the causes of occurrence, which are:

- Natural disasters are caused by natural forces and phenomena such as floods, earthquakes, hurricanes (Eshghi & Larson, 2008; Shaluf, 2007). A natural disaster is defined as "*an event caused by natural forces of nature that often has a significant effect on human populations*" (Conan-Davies, 2003). Disasters constitute one of the main risks that threaten built-up environments and urban communities.

- Man-made disasters are caused by human activities, failure of systems or conflicts such as collapse of bridges, airplane crashes, nuclear leaks, and also wars (Shaluf, 2007; Eshghi & Larson, 2008).
- Hybrid disasters are caused by a combination of natural and man-made actions such as acid rain and deforestation (Shaluf, 2007).

2.1.2 Impacts of Disasters

Disasters have long and short term impacts influencing people, the environment and the natural, economic and technological capital resources of countries (Schneider, 2011; Otero & Martí, 1994). According to the Center for Research on the Epidemiology of Disasters, 399 natural disaster events occurred in 2009. 16,000 people were killed and 220 million were injured around the world (EM-DAT, 2009). The Asian Disaster Reduction Center (ADRC, 2009) indicated that the total expected physical losses were US$50 billion. The alarming statistics have forced governments to consider seriously the development of disaster resilience plans and strategies to resist and avoid the effects disasters (Paton & Johnston, 2006). The impacts of disaster are categorized as follows (Auffret, 2003):

- People impact: disasters such as the death of relatives, injury or even personal financial or physical losses, generally impact on individuals psychologically and emotionally.
- Economic impact: including the cost of damage, recovery and reconstruction expenses, and decrease in the gross national product (GNP).
- Environmental impact**:** including the destruction of agricultural lands.

2.1.3 Disaster Crisis Management

The rapid increase in the rate and risk of disasters has forced governments to develop strategies and plans for managing the impacts of disaster crises (Unlu et al., 2010).

Disaster management is defined as *"the range of activities designed to maintain control over disaster and emergency situations and to provide a framework for helping at-risk persons to avoid or recover from the impact of the disaster.Disaster management deals with situations that occur prior to, during, and after the disaster."* (Schramm & Hansen, 1991). The Office of United Nations Disaster Relief Coordinator (OUNDRC, 1982) classified the nature of efforts conducted during crisis management as efforts conducted (1) during the pre-disaster phase, (2) immediate relief period, (3) rehabilitation period, and (4) reconstruction period. Such classification of efforts acts to support the preparedness of governments and societies to overcome the impact of a crisis. Within these phases, there are five different levels of decision making starting with the political decision level. Thereafter come the strategic level, tactical level, operational level and technical level (Weisaeth, et al., 2002). The following figure indicates the cycle of efforts in the disaster management process (Brown, 1979).

Figure 2.1: Disaster Cycle Management (Brown, 1979)

2.1.4 Post Disaster Housing

Review of the literature indicates the availability and use of multiple synonyms for the term post- disaster settlement to describe the settlement of affected people. These common synonyms are rehabilitation, settlement, reconstruction, housing and rebuild (Corsellis & Vitale, 2005; UNHCR, 2000; Correia & Melbin, 2005; DIFD, 2008). The process of post-disaster settlement is defined as an action that is implemented to reinstate the damaged buildings (UN, 2006; Thanurjan & Seneviratne, 2009).

Johnson (2007) describes it as a process and also as a product. As a process, he defined it as a place that provides people with shelters and services for a limited period of time until they return to permanent houses. As a product, he defined it as a substantial body that is occupied by evacuees after disaster events. Johnson (2007) indicates that the temporary housing is not isolated, but is linked with other processes of the crisis management. It performs as a transitioned step between the emergency shelters and permanent houses (Johnson, 2007). Quarantelli (1982) indicated that the post disaster settlement is divided into four types:

- Emergency shelters:

  Emergency shelters receive the displaced immediately after the disaster. The displaced inhabit emergency shelters for a limited time (days).

- Temporary shelters:

  Temporary shelters have various forms which could be a tent or refuge facility. Evacuees are moved to temporary shelters and get the required services to survive for a period that could extend for weeks.

- Temporary housing:

At this stage of displaced settlement, all the evacuees can carry out their daily activities like they were doing before the disaster. People settle in temporary housing while their permanent houses are being constructed.

- Permanent housing:

  It is the last stage of settlement. People return completely to their normal life.

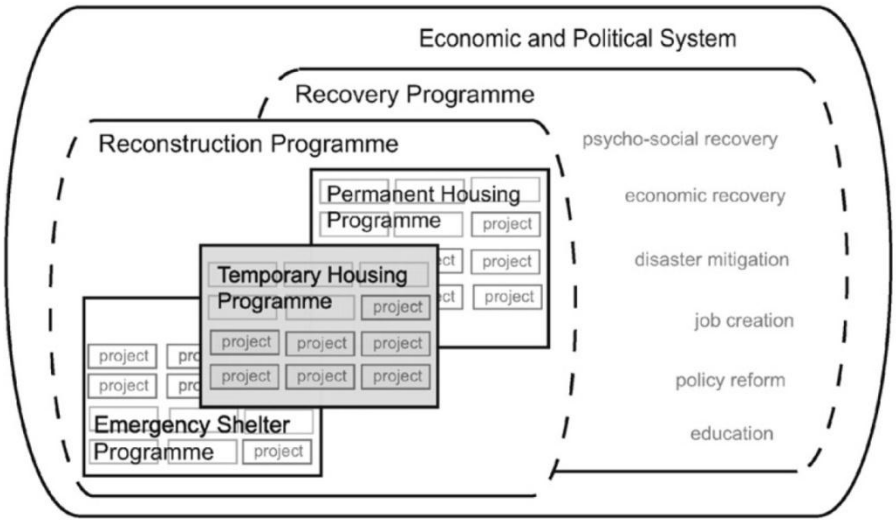

Figure 2.2: Temporary Housing Relations (Johnson, 2007)

To develop the post disaster housing solutions, there are two different approaches that consider disaster size, affected population, time and availability of resources. (Johnson, 2007; Tas et al., 2010).

Top-down is a commonly adopted approach to plan and implement temporary housing projects. This approach considers the managerial and organizational aspects to meet the project objectives. Standards, and technological and technical solutions are applied to provide the speed and simplicity of the implementation process (El-Masri & Kellett, 2001; Johnson, 2007; Davidson et al., 2007)

The other approach is based on the communities' participation and also named bottom-up approach. While the down-top approach disregards this type of participation completely,

bottom-up approach takes into account social considerations, experiences, and the requirements of the affected people. Unlike the down-top approach, this contribution makes the adopted solutions more satisfactory (El-Masri & Kellett, 2001; Johnson, 2007; Davidson et al., 2007).

2.2 Transitional Settlement

2.2.1 Transitional Shelters

Corsellis & Vitale (2005) defined the Transitional Shelter (TS) as a term used to describe the settlement shelters that temporarily receive the displaced population of natural disasters and conflicts. Transitional resettlement is a temporary phase between emergency and permanent housing that extends for months or a year. When the displaced people settle in shelters, emergency aid is given to meet the basic needs of the displaced (Correia & Melbin, 2005; IASC, 2010b).

The United Nations Higher Commissioner of Refugees (UNHCR) pointed out that (Corsellis & Vitale, 2005):

"Shelter must, at a minimum, provide protection from the elements, space to live and store belongings, privacy and emotional security. Shelter is likely to be one of the most important determinants of general living conditions and is often one of the largest items of non-recurring expenditure."

The Sphere Project Handbook (2011) described transitional shelters as a critical post-disaster element of survival that provides people with local security and protection from climate, illness and disease. The United Nations Centre for Human Settlements UNCHS indicates that (Corsellis & Vitale, 2005) :

"Adequate shelter means more than a roof over one's head. It means adequate privacy; adequate space; physical accessibility; adequate security; security of tenure; structural stability and durability; adequate lighting, heating and ventilation; adequate basic infrastructure, such as water-supply, sanitation and waste-management facilities; suitable environmental quality and health-related factors; and adequate and accessible location with regard to work and basic facilities: all of which should be available at an affordable cost."

Therefore, getting an adequate settlement shelter is related to the law of human rights. To satisfy this, many issues have to be considered in the shelter planning and preparing such as legalities of tenure, security, availability of services, materials, facilities and infrastructure, habitability, accessibility and cultural adequacy (Corsellis & Vitale, 2005; Boamah & Kumarasuriyar, 1997).

2.2.2 Human Rights and the Needs of the Displaced

When a disaster occurs, people existing in a vulnerable area lose many things such as property, personal belongings and also lifestyle. They are forced to live in other safe communities with the basics for survival. (Auffret, 2003; Corsellis & Vitale, 2005)

Displaced people have many rights that guarantee their freedom and dignity as human beings. These rights include displacement from the risk area that threatens their life and resettlement in safe locations. In case of disasters or conflicts, people displace to the closest locations internally or regionally to get the basic aid that helps them to survive (Sphere Project, 2011). International Covenants guarantee these rights and encourage governments to support human rights in disasters and conflict situations (OCHA, 2004). Human rights under the disaster situations include (OCHA, 2004):

- Getting a shelter or a refuge
- Getting food and drinking water
- Getting clothes and blankets
- Getting medical care
- Getting away from the risk
- Getting respect without any type of discrimination

Based on these rights, people's needs can be categorized as follows:

- Human survival needs:

  These needs ensure that people survive after disaster events. They include safe location settlement, food aid, epidemic and disease control, and a healthy environment. (OUNDRC, 1982; Sphere Project, 2011)

- Services:

  After settlement in transitional shelters, displaced people return to carry out their regular activities (Quarantelli, 1982). Education, medical care, communication, and transportation are the main required services. (Sphere Project, 2011)

- Social needs :

  During the disaster event, people face many difficulties and become pessimistic. So they need special counseling and contact with people to mitigate the effects of the disaster and inspire them with optimism. (Silove et al., 2006). Social needs include psychological and spiritual counseling.

- Special needs:

  Special needs or services are required for people who have any kind of disability which requires more awareness and care. (Silove et al., 2006).

- Cash grants:

  Financial aid is a part of the aid package for the displaced. It is given for the people who lose their jobs and have no reliable financial resources. This aid is to cover the personal needs of displaced people which are not provided by the aid program (IASC, 2005a).

Without doubt, all of these needs are required for the displaced people, but there are priorities that rank these needs based on importance for human survival (IASC, 2005a). Figure 2.3 shows the priority of these needs.

Figure 2.3: Displaced Needs Priorities (IASC, 2005a)

2.2.3 Shelters Types

Conditions of settlement, location, displaced population and host community are the main factors used to distinguish the settlement shelter types. Transitional settlements are divided into two main options, which are dispersed settlements and grouped settlements; under each of these options, there are three more options (Corsellis & Vitale, 2005; Sphere Project, 2011; IASC, 2005a).

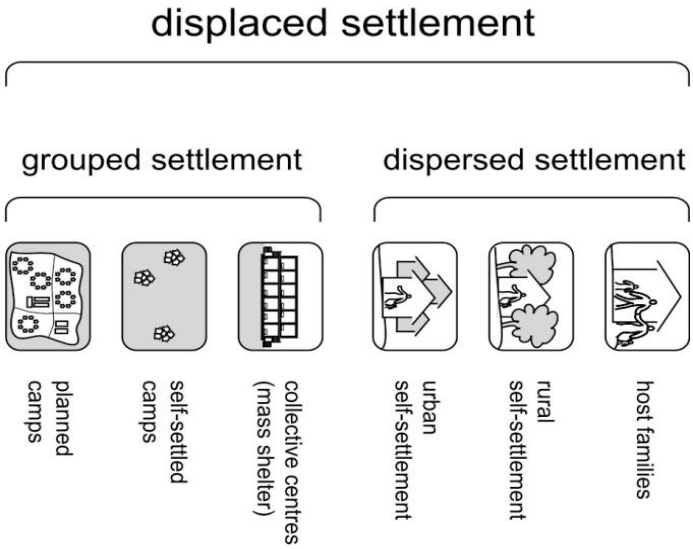

Figure 2.4: Displaced Settlement Options (Corsellis & Vitale, 2005)

Dispersed Settlement:

This type of settlement helps the displaced population to be hosted within a host community and benefit from the existing services and infrastructure. Dispersed shelters give displaced people a chance to return to their normal lives. The main advantage of this type of settlement is that displaced people are safer when integrated with people in the grouped settlement (Corsellis & Vitale, 2005; IASC, 2005a).

The disadvantages of dispersed settlement is that host communities do not interact positively with the displaced, increasing the ethnic and religious discrimination problems between the host and the hosted communities. Besides, most of the host communities refuse to receive a huge displaced population (Corsellis & Vitale, 2005; IASCa, 2005).

The dispersed shelters include three options of settlement:

- Host Families: this option is settling the displaced people within local families' properties. This type of hosting could be in an allocated part of a building or land for

a period of time. In this type of settlement, people can invite their displaced relatives and friends to live with them (Corsellis & Vitale, 2005; IASCa, 2005).

- Rural Self-Settlement: in this option of settlement, the displaced people are settled in public rural locations. At this kind of shelter, the displaced are self-sufficient and they get the required privacy. When the displaced have animal and agricultural lands, this option of settlement would be more suitable (Corsellis & Vitale, 2005; Sphere Project, 2011; IASC, 2005a).
- Urban Self-Settlement: Displaced people settle illegally in unclaimed properties or on unclaimed land. At this type of settlement, and unlike the previous types, the displaced population occupies land and creates slum districts. Urban self-settlement is not preferred because it impacts the city services and infrastructure (Corsellis & Vitale, 2005; Sphere Project, 2011; IASC, 2005a).

Grouped Settlement

Unlike the dispersed settlement, the displaced population is supported by external assistance. The people are settled in collective facilities or on land. The government and the organizations are responsible for managing and providing these people with the required aid. Advantages of grouped settlement are that the displaced shelter can be managed and secured easily and the governments have a clear vision to help the displaced with strict strategies. On the other hand, grouped settlements impose extra burdens on the governments and could affect the community resources (Corsellis & Vitale, 2005; Sphere Project, 2011).

The grouped shelters include three settlement options:

- Grouped in collective centers: this type is known as mass shelters. Displaced people are settled in existing structures. Governments and authorities reuse adaptively some public facilities, schools, community centers and gymnasiums for this purpose. This type of settlement is used especially when the cities' residents are affected. Collective centers are used for a short period until other permanent shelters are constructed (Corsellis & Vitale, 2005; Sphere Project, 2011).
- Grouped in self-settled camps: in this option, the displaced are settled in a camp, which is located on public or state land. A self-settled camp is established immediately after disasters and before the arrival of any organization's aid. It depends on the government's assistance (Corsellis & Vitale, 2005; Sphere Project, 2011; IASCa, 2005).
- Grouped in planned-settled camps: unlike the self-settled, planned-settled camps are to settle displaced people on land that was developed for settlement purposes. The displaced get most of the services and infrastructure that are required to return to a normal life (Corsellis & Vitale, 2005; Sphere Project, 2011).

All dispersed and grouped settlement options present a variation in terms of conditions, services, size and independence. Based on this variation, the advantages and disadvantages can be concluded in table 2.1.

Table 2.1: Advantages and Disadvantages of Transitional Settlement Options (Corsellis & Vitale, 2005)

Dispersed Settlement	Advantages: • Responsive to the displaced needs • Accommodation within an existing community • Good chance to invest and develop the community infrastructure and services • Very cost –effective • Sustainable • Providing displaced family privacy
	Disadvantages: • Impact the host community and environment • Insecurity of the local host community • Social and ethical discrimination between the host and the hosted • Exhaustion of local resource and services • More efforts required to distribute aid • Limited access and speed to deliver assistance • Low displaced population • Hosting period is very limited
Grouped Settlement	Advantages: • Expanding and upgrading the infrastructure • High displaced population • Easy access to deliver aid and services • Good control, management, and monitoring
	Disadvantages: • The initial cost of the settlement is very high • Required extra sources • Infeasibility in future • Independent and isolated community • Less family privacy • Need to pre-displacement planning • Difficulty of displaced working • Difficulty to carry out daily activities

2.2.4 Transitional Shelters Criteria

Transitional settlement shelters have to meet the needs of local communities and the resources of governments (Corsellis & Vitale, 2005). Assessment of the available settlement shelters is an essential action that has to be conducted to find the adequate shelter. This assessment has to consider all restrictions of local communities' needs and

resources of governments. In order to achieve that, Table 2.2 presents briefly a set of criteria that have to be considered when assessing the building potential for use as shelters. These criteria are obtained from literature and actual case studies of displaced settlement.

2.2.4.1 Essential Issues

Before conducting all steps of the assessment, critical issues have to be considered. One of the essential issues is the availability of the building. The used buildings for displaced settlement have to be available or vacant during the disaster and the settlement period (Corsellis & Vitale, 2005). In case of occupied buildings, there is another choice, which is relocating the building function into another building temporarily during the displaced settlement (Correia & Melbin, 2005). If the building availability problem is solved, another problem will arise which is getting the formal agreement of the building owner. Governments have to make any type of compromises to get the owner's agreement, which sometimes includes some compensation (UNHCR, 2000). No doubt, getting the agreement for governmental buildings is much easier than the agreement for private buildings (Bin Saad, 2012; Correia & Melbin, 2005).

The second issue is the building's structural integrity and safety to settle the displaced people. Assessment of building safety is related to the building's structural condition and location. In terms of building structure, the building has to be in a good condition to accommodate the expected function (Correia & Melbin, 2005; Correia & Melbin, 2005; MC, 2006).

Table 2.2: Transitional Shelter Assessment Criteria

Essential Issues	**Safety, Stability**	Structure stability	(Corsellis & Vitale, 2005; Correia & Melbin, 2005)
		Out of risk zone - Distance from risk zone - Elevation over the water surface	(Corsellis & Vitale, 2005; Sphere Project, 2011; Chu & Su, 2012; Liu, et al., 2011; Karim , et al., 1998; Alam, 2008; Xu, et al., 2007; IASC, 2010b; Boamah & Kumarasuriyar , 1997)
	Availability	Availability of building	(Corsellis & Vitale, 2005; Boamah & Kumarasuriyar , 1997)
		Ownership and formal agreement	(Corsellis & Vitale, 2005; Correia & Melbin, 2005; Sphere Project, 2011; Alam, 2008)
Building Characteristics & Suitability	**Structure and design**	Flexibility to remodel the layout of the building to accommodate new required functions	(Corsellis & Vitale, 2005; Correia & Melbin, 2005)
		Availability of functional space units(e.g.number of classes and bathrooms)	(Karim , et al., 1998)
		Number of access points to the building and proximity to the main circulation routes	(Corsellis & Vitale, 2005; Sphere Project, 2011; Chu & Su, 2012; Liu, et al., 2011; Alam, 2008; Xu, et al., 2007; IASC, 2010b)
	Occupancy	Capability of occupying the spaces in the building either partially or fully (occupancy ratio)	(Corsellis & Vitale, 2005; Boamah & Kumarasuriyar , 1997)
		The building's maximum capacity to accommodate displaced population	(Corsellis & Vitale, 2005; Chu & Su, 2012; Boamah & Kumarasuriyar , 1997; Alam, 2008; Xu, et al., 2007)

	Building Systems	The capability of the water supply, sanitary, power supply systems to tolerate the additional demand for services	(Corsellis & Vitale, 2005; Sphere Project, 2011; IASC, 2010b; OCHA, 2004)
		The capability of the ventilation systems to tolerate the additional demand for services	(Corsellis & Vitale, 2005; Sphere Project, 2011; Karim , et al., 1998; IASC, 2010b)
		The capability of the fire protection systems to tolerate the additional demand for services	(Corsellis & Vitale, 2005; Xu, et al., 2007; IASC, 2010b)
	Adaptation Works	Availability of required resources for carrying out the required adaptation works (e.g. money, material, manpower and machine)	(Corsellis & Vitale, 2005; Correia & Melbin, 2005; Sphere Project, 2011; Boamah & Kumarasuriyar , 1997)
		Ease of reverting back the adapted building to its original condition	(Corsellis & Vitale, 2005)
Infrastructure and Public Facilities	**Infrastructure**	The capability of the municipal water supply, sanitary, power supply systems totolerate the additional demand for services	(Corsellis & Vitale, 2005; Correia & Melbin, 2005; Sphere Project, 2011; Liu, et al., 2011; Karim , et al., 1998; Alam, 2008; Xu, et al., 2007; IASC, 2010b)
		Accessibility to the site (e.g. through pathways and roads)	(Corsellis & Vitale, 2005; Sphere Project, 2011; Chu & Su, 2012; Liu, et al., 2011; Alam, 2008; Xu, et al., 2007; IASC, 2010b)
	Public Facilities	Proximity of available public facilities that provide services to the displaced population (e.g. schools, hospitals and recreational)	(Corsellis & Vitale, 2005; Correia & Melbin, 2005; Sphere Project, 2011; Chu & Su, 2012; Liu, et al., 2011; Xu, et al., 2007; Karim , et al., 1998; Alam, 2008)
		Availability of facilities to accommodate the special needs of the displaced population (e.g. the elderly and the handicapped)	(Sphere Project, 2011)
		Ease of establishing temporary support facilities that provide services to the displaced population (e.g. communal cooking, warehouses)	(Corsellis & Vitale, 2005; Sphere Project, 2011)

Community considerations	Attainment of privacy for the host and the displaced families	(Correia & Melbin, 2005; Xu, et al., 2007; IASC, 2010b)
	Impact of the size of the displaced population on the host community (e.g. noise and insecurity)	(Corsellis & Vitale, 2005; Sphere Project, 2011; Liu, et al., 2011; Karim , et al., 1998; Alam, 2008; Xu, et al., 2007; IASC, 2010b; Correia & Melbin, 2005; Chu & Su, 2012; Boamah & Kumarasuriyar , 1997)
	Period for hosting the displaced population	(Corsellis & Vitale, 2005; Correia & Melbin, 2005)
	Social interaction and community support between the host and the displaced populations (e.g. impact of education, religion, ethnic)	(Corsellis & Vitale, 2005; Sphere Project, 2011; Liu, et al., 2011; Karim , et al., 1998; Alam, 2008; Xu, et al., 2007; IASC, 2010b)

At the same time, the building has to be in a safe location which has to be above water level, out of the range of the disaster risk and provided with an adequate drainage system as well as being from any other sources of risk such as fuel or chemical storage and heavy falling debris (Corsellis & Vitale, 2005; Sphere Project, 2011; Chu & Su, 2012; Liu, et al., 2011; Karim , et al., 1998; Xu, et al., 2007; IASC, 2010b; Boamah & Kumarasuriyar , 1997; IFRC, 2011; MC, 2006).

2.2.4.2 Building Characteristics

Building characteristics are one of the main criteria when assessing a building's potential for temporary use as a transitional shelter. Under building characteristics, there are three sub-criteria which influence the assessment process.

- **Building Structure and Design**

This criteria includes three sub-criteria. The first one is flexibility of the building to be remodeled by changing or adding some elements to its layout to accommodate new functions (Corsellis & Vitale, 2005; Correia & Melbin, 2005). Making door openings, creating some partitions, and adding more portable bathroom units are examples of changes. The second sub-criteria is the availability of functional space units. The meaning of functional spaces is spaces that are required in the displaced settlement in a transitional shelter which include empty rooms, bathrooms, open spaces and stores (Karim et al., 1998). The third sub-criteria is the number of access points to the building and the main circulation routes. Availability of the required number of accesses will provide the privacy of displaced people to get in or out of the buildings and will ease the discharging process. (Corsellis & Vitale, 2005; Sphere Project, 2011; Chu & Su, 2012; Liu et al., 2011; Alam, 2008; IASC, 2010b; MC, 2006; UNHCR, 2000).

- **Occupancy**

This criteria includes two sub-criteria related to building occupation. The first sub-criteria is to define the capability of the building to be occupied fully or partially. Sometimes, building's spaces cannot be used for certain reasons such as:

- Spaces include fixed furniture.
- Space area is very small or complex.
- The indoor environment is inadequate for settlement.
- Some spaces are used as stores.

Therefore, if the building has any of the previous conditions, it will be used partially and will limit its capability to accommodate the displaced people (Boamah & Kumarasuriyar , 1997; Corsellis & Vitale, 2005). The second sub-criteria is the capacity of the building to accommodate the displaced population. This issue is one of the most important things in the displaced settlement management. Building capacity size has to be known to estimate the maximum number of displaced that can be accommodated in available spaces (Corsellis & Vitale, 2005; Chu & Su, 2012; Boamah & Kumarasuriyar , 1997; Xu et al., 2007).

- **Building Systems**

To assess the building potential for use as a shelter, the building systems have to accommodate the needs of the displaced, which could be incompatible with the existing systems. Without essential upgrading, deterioration is expected in the building systems (IFRC, 2011; Corsellis & Vitale, 2005). The main required systems in buildings to settle the displaced people are as follows:

- Water supply: Water supply is an essential need for the survival of the displaced; it includes drinking, cooking, and hygienic water supply (IFRC, 2011). The water supply system has to be provided with extra sufficient water sources to meet the excess demand. Besides, displaced people have to get safe and equitable access to a sufficient quantity of water by re-arranging a sufficient number of taps (Sphere Project, 2011; Corsellis & Vitale, 2005).

- Drainage and sanitary: Capability of drainage and sanitary system is essential to provide the displaced with adequate, appropriate and acceptable toilet facilities (Sphere Project, 2011; Corsellis & Vitale, 2005)
- Power: Electricity is required as a safe domestic energy source. It enables the displaced to have household amenities such as lighting, internal heating and cooking and the use of other personal appliances (Sphere Project, 2011; MC, 2006; Corsellis & Vitale, 2005).
- Ventilation: Thermal comfort in covered spaces is essential to accommodate the displaced at transitional shelters. Adequate ventilation, temperature and humidity are the main parameters considered to assess the thermal comfort. (Sphere Project, 2011; IASC, 2010b; IFRC, 2011; Corsellis & Vitale, 2005)
- Fire: To ensure safety of the displaced, there are restrictions and requirements that have to be followed. Fire breaks, fire load, and fire prevention equipment are the main issues considered to ensure the safety at shelters (Sphere Project, 2011; IASC, 2010b; Corsellis & Vitale, 2005).

- **Adaptation Works**

In the case of utilizing a building for temporary use, adaptation works are the expected action to upgrade the incompatible parts of the building. Conducting the adaptation works faces two main concerns. The first one is the availability of the required resources, which are money, labor, time and material. Generally, the available resources are restricted because of the disaster conditions (Corsellis & Vitale, 2005). Therefore, the adaptation works that require skilled labor, specific material, a long time and a lot of money are not preferred (Bin Saad, 2012; Al-Kaff, 2012).

Reinstating the building to its original condition is the second issue that has to be considered in the adaptation works. To return the building to the original function, the adaptation works have to perform a minor upgrading or maintenance for the building systems (Corsellis & Vitale, 2005).

2.2.4.3 Infrastructure and Public Facilities

- **Infrastructure**

Besides the building's capability to settle displaced people in host communities, infrastructure has to be capable of providing the displaced with the required services (Corsellis & Vitale, 2005).

In case of hosting in existing communities, all of the displaced and the hosts must get adequate services such as follows:

- Water, power, sanitary, and waste disposal services have to accommodate the additional needs of the displaced. Therefore, upgrading and providing these services with extra resources are expected to meet that demand (Corsellis & Vitale, 2005) .
- Availability of safe and adequate access to shelters in the disaster situation is an essential issue that has to be considered in the shelter site assessment (Liu, et al., 2011; Corsellis & Vitale, 2005). For transitional shelters, the shelter site has to be accessible by heavy trucks, while other facilities such as public facilities have to be accessible by light vehicles (Sphere Project, 2011). Safety in all-weathers, security, and good lighting are the main characteristics of roads and access points that link shelters with other facilities (Sphere Project, 2011; Liu et al., 2011).

- **Public Facilities**

Shelters have to be linked with other public facilities that are required to provide the displaced with essential services such as follows (Xu et al., 2007; Correia & Melbin, 2005).

- Shelters in host communities rely on the hosting community facilities; public facilities should provide the displaced with basic services within reasonable walking distance. Basic public facilities are such as hospitals, schools, social facilities, places of worship, meeting points, and recreational areas, (Sphere Project, 2011; Karim et al., 1998; Liu et al., 2011; Corsellis & Vitale, 2005).
- Shelters have to be provided with the required equipment and solutions to accommodate for older people, the handicapped and pregnant women (Sphere Project, 2011).
- Shelters have to be provided with support facilities which are required to offer basic aid and services, such as cooking fuel tanks, communal cooking facilities, administrative offices, warehousing, staff accommodation and quarantine areas (Sphere Project, 2011).

2.2.4.4 Community Considerations

- **Privacy of Displaced and Host Communities**

To ensure the suitability of shelters, the local norms, customs and traditions of the host and displaced communities have to be considered (Karim , et al., 1998). The process of shelter assessment and selection has to be carried out in cooperation with the local people; that is to meet the local communities' requirements and priorities (Liu, et al.,

2011). The adequate shelters should ensure the privacy of the families and individuals, and that is done by allocating a separate private space for each family, arranging a sleeping area, providing locking doors, and separating toilet and bathing facilities (Karim et al., 1998; Sphere Project, 2011; IFRC, 2011). Karim et al. (1998) pointed out that disregarding the privacy of the displaced could, together with other economic and psycho-social tensions, lead to serious complications and problems such as the deterioration in marital relationships, sexual harassment and rape.

- **Impact of the Size of the Displaced Population on the Host Community**

In the case of hosting within existing communities, the population size should be low because of many considerations, such as the ratio of the displaced population, availability of shelters and the impact of the displaced on the host community (Corsellis & Vitale, 2005). Increasing the ratio of the displaced in the hosting community has many serious impacts, such as social unrest, insecurity, noise pollution and inconvenience (Xu et al., 2007; Corsellis & Vitale, 2005; OCHA, 2004).

- **Period for Hosting the Displaced Population**

The transitional shelters are used immediately after the disaster and extend for months until the permanent houses become ready. If the displaced are hosted in a community, the hosting period has to be limited to avoid negative psychosocial problems such as depression and social unrest (Corsellis & Vitale, 2005). Bin Saad (2012) indicated that hosting the displaced for a prolonged period leads to a reduction in the support of the local communities and donors. The host communities believe that the prolonged

settlement of displaced people will lead to the creation of slum districts in their neighborhood and they will affect their livelihood (Karim et al., 1998; Bin Saad, 2012).

- **Social Interaction and Community Support**

In most transitional settlement projects, the continuous collaboration of communities, organizations and donors is the main cause of the project's success (Correia & Melbin, 2005; Corsellis & Vitale, 2005). Corsellis and Vitale (2005) indicated that the displaced settlement in the hosting community could cause insecurity and discrimination problems. Therefore, the compatibility of education, religion and ethnicity is essential to ensure the collaboration of communities (OCHA, 2004)

2.2.5 Standard of Shelters

To ensure suitability in transitional shelters, standards were developed to meet the minimum requirement of the settlement by affording humanity and dignity to the displaced (Sphere Project, 2011). These standards include shelter, food items and non-food items standards. Each one of them stipulates adequate conditions, required services per person and the quantities of items that the displaced need to survive (Sphere Project, 2011). Table 2.3 shows the main requirements of standards that are used in the emergency and transitional shelters.

Table 2.3: Shelter Standards Requirement

Requirements	Standard	References
Area		
Minimum surface area	30- 45 m^2 per person	(UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)
Minimum covered area	3.5 m^2 per person excluding cooking facilities	(UNHCR, 2000; OCHA, 2004; Sphere Project, 2011; IFRC, 2011)
Minimum allocated area for	18-25 m^2 per family	(IASC, 2010b)

families (5-7) persons	including bathing and cooking facilities	
Food preparation	100 m^2 per 500 persons	(UNHCR, 2000)
Storage	150 - 200 m^3 per 1,000 persons	(UNHCR, 2000)
Water supply		
Minimum quantity of water	15- 20 Liters per person per day	(UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)
Maximum number of people per tap	200-250 persons per tap	(UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)
Maximum distance to taps	100 m or few minutes' walk	(UNHCR, 2000; OCHA, 2004)
Sanitation		
Maximum people per latrine	10-20 persons (if sex-segregated public toilets) 1 toilet per family (5-10 persons)	(UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)
Maximum people per shower	50 persons	(UNHCR, 2000)
Maximum distance to toilet	50 m	(UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)
Refuse		
Maximum distance form shelters to refuse disposal	Less than 100 m to communal pit	(OCHA, 2004; Sphere Project, 2011)
Maximum People per 100 m^3 communal refuse pit	500 persons	(UNHCR, 2000; OCHA, 2004)
Maximum People per 100 liters refuse container	10 families or 50-persons	(UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)
Lights		
Minimum level of illumination at shelters	40-100 Lux	(MC, 2006)
Supplementary tasks (first aid treatment, checking in, offices)	400 Lux	(MC, 2006)
Emergency lights	Buttery lights are used for 24 hours- 1 lux for shelters, 15 lux for tasks area	(MC, 2006)
Protection from weather condition		
Indoor temperature	15 to 19° C	(UNHCR, 2000)
Ventilation	Comply with building codes	(IASC, 2010b; MC, 2006)
Fire prevention		
Firebreak	In case of camp, 30 m wide is recommended for approximately every 300 m of built-up area.	(UNHCR, 2000)
Fire sources	Eliminating fire, smoking,	(IASCa, 2005; MC, 2006)

	cooking sources	
Fire extinguishers	Provision extinguisher for each risk location	(MC, 2006)

Communal services		
Medical services	1 health center per 1 site or 20,000 persons	(UNHCR, 2000)
Educational services	1 school block per 1 sector or 5,000 persons	(UNHCR, 2000)
Aid distribution	1 point for 5000 persons	(UNHCR, 2000)
Retail store	1 market per 1 site or 20,000 persons	(UNHCR, 2000)
Other requirement		
Public address system		(UNHCR, 2000)
Adequate lighting system		(UNHCR, 2000)
Arrival zones and departure zones whichare separated from accommodation zones		(UNHCR, 2000)
Administrative offices and accommodations taff		(UNHCR, 2000)
Security fencing (depending on circumstances)		(UNHCR, 2000)
Adequate separations and screening are required for privacy purposes		(MC, 2006)

2.3 Adaptive Reuse of Buildings

2.3.1 What Is Adaptive Reuse

Sustainability is a new trend applied in the construction industry since 1960s (Conejos & Langston, 2010). Adaptive reuse of facilities has been developed as one of the building sustainability solutions. Adaptive reuse of buildings is an innovative solution to promote building performance and maintain the asset value (Bullen & Love, 2011; Wilkinson et al., 2009). Bullen and Love (2011) described adaptive reuse as an action that has a significant influence on the facility performance and all other environmental, financial and social aspects. Bullen and Love (2011) pointed out that adaptive reuse is a change process that aims to improve the improperly used items in a proper way for different

functions within the context of the facility. Langston et al., (2008) indicated that adaptive reuse means using the main structural elements in a different way to change the building use. Adaptive reuse of facilities could be " within use or across use adaptation" (Wilkinson et al., 2009). Wilkinson et al., (2009) explained that in the two cases, a building can be adapted by keeping the original function of the building such as, adapting the traditional offices to be newer or open space offices while the other case is changing the function entirely, such as adaptating hotels to be hospitals.

Adaptive reuse includes several processes and levels that are based on the purpose of the adaptation. "Renovation, refurbishment, remodeling, rehabilitation, recycling, and reinstatement" are different terms used to describe the adaptation (Wilkinson et al., 2009). Douglas (2006) indicated that adaptation is *"any work to a building over and above maintenance to change its capacity, function or performance".*

2.3.2 Reasons and Motivations

Adaptive reuse of buildings is an engineering solution for the obsolescence problem of buildings. One of the main reasons for applying the adaptation is that the old buildings are not able to meet the users' improved requirements (Bullen & Love, 2011). The following are the common reasons and motivations to adopt building adaptation as a solution:

- Impact of building obsolescence (Langston et al., 2008).
- Increasing the need for modern applications in the work environment (Compbell, 1996).
- Tendency to create a sustainable building by considering energy and environment issues (Bullen & Love, 2011; Langston et al., 2008; Zhou & Lowe, 2003).

- Demolition has a negative impact on the environment (Bullen & Love, 2011).
- Old buildings have attractive values that are related to location, transportation, architecture style, and social value (Bullen & Love, 2011).
- Adaptive reuse costs less than the demolition and reconstruction of a new building (Bullen & Love, 2011; Langston et al., 2008; Wilkinson et al., 2009).
- The durability of building materials allows for extending the building's life (Bullen & Love, 2011).
- Vacant and redundant buildings (Conejos & Langston, 2010).
- Poor building design and complexity (Langston, et al., 2008).

2.3.3 Benefits and Barriers

Adaptive reuse as mentioned previously is an approach to retain the building performance at a particular level that meets the users' requirements. It is widely implemented in several types of buildings such as heritage, airfield, and educational buildings, offices and industrial facilities (Conejos & Langston, 2010). Evidence indicates that there are many barriers facing the good practice of adaptive reuse. On the other hand, there is also a set of encouraging benefits. Barriers and benefits are briefly listed in table 2.4.

Table 2.4: Barriers and Benefits of Adaptive Reuse of Facilities

Benefits	Sources
• Reduce the impact of obsolete buildings	• (Wilkinson et al., 2009)
• Response to owners & occupants needs	• (Bullen and Love, 2011)
• Meet standards & sustainability requirements	• (Rocha & Sattler, 2009; Bullen and Love, 2011; Wilkinson, James, & Reed, 2009)
• Less cost	• (Campbell,1996; Bullen and Love, 2011;Wilkinson, James, & Reed, 2009)
• Retain building value and	• (Bullen and Love, 2011)

performance. • Consider environmental impact • Provide material conserving • Safer and less disturbance • Provide efficiency and functionality • Less downtime of facility operation	• (Zhou and Lowe,2003; Bullen and Love, 2011) • (Bullen and Love, 2011; Langston et al, 2008; Rocha and Sattler,2009; Wilkinson, James, & Reed, 2009) • (Bullen and Love, 2011; Wilkinson, James, & Reed, 2009) • (Langston et al, 2008;Bullen and Love, 2011) • (Bullen and Love,2011: Wilkinson, James, & Reed, 2009)
Barriers	Sources

2.3.4 Adaptive Reuse Considerations

Adaptive reuse of buildings considers several issues that influence the success of the process (Spector, 2003; Bullen & Love, 2011; Wang et al., 2010; Wang & Zeng, 2010; Conejos & Langston, 2010; Wilkinson et al., 2009). These considerations are sorted into different categories according to their relationship and impact.

Building Characteristic:

Under the main category of building characteristic, there are several criteria that impact the adaptive reuse potential which are as follows:

- Building age and material deterioration (Teo & Lin, 2011)
- Capabilities of building systems have to be considered. (Langston et al., 2008; Wang & Zeng, 2010; Wang et al., 2010; Spector, 2003).
- Aesthetic value such as architectural style and historical value (Wilkinson et al., 2009).

Environmental Considerations:

Environmental considerations include (Spector, 2003; Wang et al., 2010; Wilkinson et al., 2009):

- Energy consumption.
- Material consumption.
- Recycling of existing building material.

Property and Economic:

Under this category, buildings are analyzed as assets. Property and economic considerations include (Spector, 2003; Langston et al., 2008; Wang & Zeng, 2010; Wang et al., 2010; Wilkinson et al., 2009):

- Expected profit.
- Property value.
- Location.
- Budgets & cost of adaptation.
- Community acceptability.
- Accessibility.

Regulation and Standards Requirements:

Compliance with building regulations and standards is a fundamental concern. Because of the adaptive reuse works, building could violate some standard regulations during the modification. Therefore, the adapted building has to be checked again to avoid violations. Architecture, structure, safety and health requirements are the main

restrictions that have to be considered in the adaptation process. (Wang et al., 2010; Langston et al., 2008; Spector, 2003)

Risk:

Risk is another concern considered in the building adaptation. In general, hazardous conditions and materials are examples of potential risk in buildings, which have to be considered carefully (Spector, 2003).

2.3.5 Building Adaptation Scheme

When the building adaptation is approved, an implementation scheme has to be adopted to manage the adaptation. To ensure the success of the entire process, the implementation process has to be executed as a set of sequential actions (Douglas, 2006) . Douglas (2006) indicated that building adaptation is one of the main activities of the tactical level of the facilities management. Building adaptation includes different types and levels of maintenance, renovation and refurbishment. Campbell (1995) suggested an overall approach to manage building upgrading. This approach is as follows (Campbell, 1995):

- Estimating the need.
- Defining the goals.
- Assessing building condition.
- Defining the approach and actions.
- Developing a plan.
- Implementing the plan.

2.3.6 Functional Options of Adapted Buildings

The uncertainty of the needs is the first problem facing the building adaptation process (Ali et al., 2009). To determine the need specifically, the new function after adaptation has to be specified clearly. Needs have to reflect the users' requirements to ensure the success of the adaptation scheme (Huxtable, 1988). Douglas (2006) pointed out that the adaptation options are limited by the building function and condition. Besides, he believed the standards and expectation of owners and users also constitute other constraints for the process. Douglas (2006) pointed out that a building could be adapted to the same function which partially matches the original design or could be adapted to another function which means major modification works. Table 2.5 shows the suggested options.

Table 2.5: Options of Building Adaptation (Douglas, 2006)

Original category	*Existing use*	*Typical new use*
Agricultural	Barn	Single/multiple dwelling; arts/crafts centre; coffee/snack bar; souvenir shop; local museum/gallery/centre
	'Dovecote' or 'Doocot'	
	Threshing mill	
	Cart shed	Parish/community hall; hotel/leisure centre; function room
	Stable	Ditto
	Smithy	
Commercial	Bank	Coffee bar; public house; wine bar; new shop/office; restaurant; flats
	Public house	
	Shop	Ditto
	Office	Ditto
	Pavilion	Ditto
	Hotel	Office
	Corn exchange	Performing arts centre; drama/television studio
	Office block	Hotel; residential
Ecclesiastical	Church	Dwelling/s; arts centre; film theatre; lecture theatre
	Function hall	Community centre; office
	Manse/parsonage house	Restaurant; storage; workshop/garage; multiple flats; nursing/residential home
Industrial	Whiskey bond	Multiple flats; mixed use – shops and offices on ground floor, flats or small businesses on upper floors
	Mill, warehouse	
	Maltings/distillery	
	Railway station	Ditto
	Factory	Performing/fine arts centre; studio theatre; sports centre; offices
	Warehouse	Gallery; office; residential
	Windmill	Dwelling; office
Institutional	School	Community centre; flats
	College	Hotel
	Hospital	Educational facility; flats
	Mental asylum	Sports complex
		Youth/detention centre
		Offices
		Luxury apartments
Residential	Tenement	Improved housing, with modified layouts/facilities
	Townhouse	
	Mansion house	Multiple flats
		Offices
	Medieval castle/tower house	Restaurant and bar
		Holiday accommodation
		Large single dwelling, or multiple apartments

2.3.7 Building Assessment

After defining the needs of building adaptation, the building has to be assessed to investigate the required works to conduct the adaptation. Building assessment is defined as a first step in the building intervention planning process, which has to apply a systematic diagnosis tactic to analyze the building condition (Genre et al., 2000). This diagnosis is carried out by conducting a walk-through tour to assess the building structure and installed elements. The walk-through report has to define the deterioration and physical conditions of building elements (Brandt & Rasmussen, 2002; Genre et al., 2000). A comprehensive checklist and other measuring tools are used to help the specialist to carry out the evaluation (Genre et al., 2000). Baird et al. (1995) pointed out that the evaluator needs to use different techniques to measure the condition of systems correctly. Douglas (2006) indicated that the need to change can affect the level of the assessment, which could include some elements of the building or the entire building. Figure 2.5 shows the influence of change needs on the assessment range.

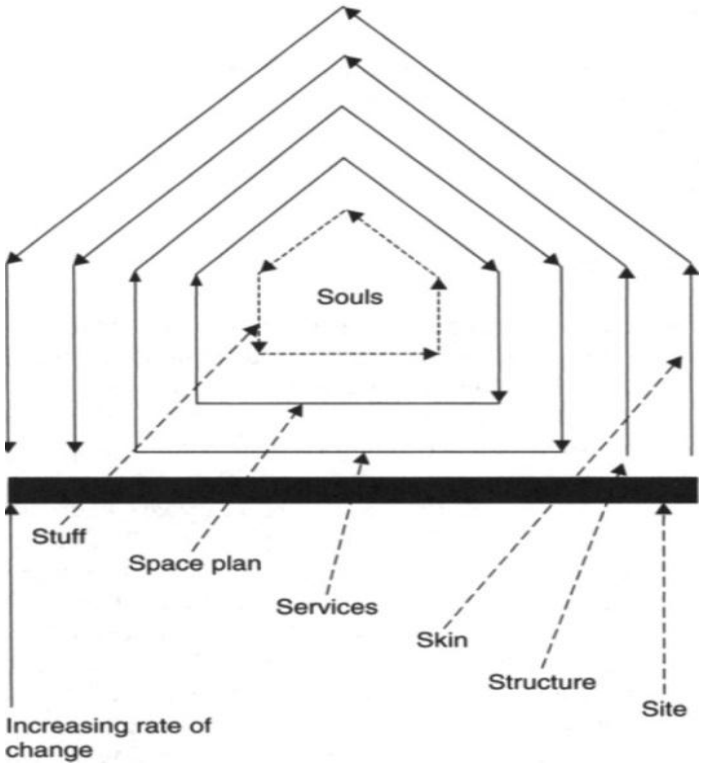

Figure 2.5: Level of Change (Douglas, 2006)

When minor changes are suggested, the assessment action will include only the related systems which are the soul of the building, while the major changes extend the assessment work to cover all elements. Baird et al. (1995) developed a comprehensive checklist of building assessment. The checklist includes six main attributes which are corporate, site, construction, space, internal environment, and building services. Under each attribute , there is a set of factors. Table 2.6 briefly presents these attributes and factors required to assess the condition of a building.

Table 2.6: Attributes Required to Assess Building Condition (Baird et al., 1995)

Attribute	Sub-attribute	Example of items
Corporate	Corporate objectives	- Expected building contribution?
	Serviceability	- Location, adaptability if requirement change
	Image	- Statues, location image, shape, parking, entrance
	Tenure	- National code, local laws, in- house code
	Code compliance	- Land cost, consulting cost
	Initial cost	- Annual income, refurbishment cost
	Life cost	- Energy cost, management cost, insurance
	Operation cost	- Disasters, emergency accommodation
	Security	- Demolition cost
	Disposal	
Site	Access	- Parking availability, ease of locating building
	Built environment	- Current and future level of construction
	Microclimate	- Solar orientation, wind, condition nearby building
	Local services	- Shops, restaurants, personal services
	Site	- Ground condition, space, security
	Conditions	- Ground water, stability of the site
Construction	Structure safety	- Code compliance, stability, age, skeleton statue
	Structure adaptability	- Maximum load on foundation, skeleton and floor
	Overall dimension	- Floor numbers, useful area, floor height
	Shell geometry	- Surfaces, windows,shading, external form
	Structural layout	- Core position, fixed walls, size of modules
	Cladding material	- External finishes, corrosion, leaks, infiltration
	Access	
Space	Major zones	- Core function area, amenities services area
	Type of spaces	- Opened, fixed
	Function	- Offices, stories
	Storage	- Accessories, material, fire protected stories
	Circulation space	- Corridors, potential bottlenecks
	Stairs	- Stairs location, condition, emergency exits
	Finishes and furnishings	- Decor, furniture, equipment
	Social	- Privacy, access between spaces
Interal environment	Air quality	- Overall ventilation, odors, pollutants
	Ventilation	- Natural, mechanical system
	Thermal comfort	- Humidity, air speed, temperature
	Noise	- Sound absorption, exterior and interior noise
	Lighting	- Average illuminance level, surface reflection
	Ambience	- Exterior view, wall appearance
Building services	Flexibility	- Capacity, adjustability
	HVAC	- Type, condition, maintenance
	Electrical services	- Power points, lights, switches, E. generator
	IT	- Phones, networks extension and capacity
	Elevators	- Overall transport capacity
	Water services	- Water supply, hot & cold water, clearness
	Fire protection	- Detectors, extinguishers etc

2.3.8 Adaptation Approaches and Actions

As a result of the assessment process, a technical report is developed to define what the required action is to adapt the building (Genre et al., 2000). Teo & Lin (2011b) developed a map describing all actions of adaptation in Figure 2.6. These actions vary from minor actions such as maintenance to major actions such as restoration. Douglas (2006) defined the relation between the level of intervention and level of the building degradation and obsolescence. If the degradation is less, the intervention level will be minor. The more degradation is observed, the intervention which could reach the core of the building. Figure 2.7 shows this relation graphically. Maintenance is the basic level of intervention which means repairing the defective parts (Douglas, 2006; Mohd-Isa et al., 2011). Refurbishment is of greater scope than maintenance work which is an non-periodical process including major repair works (Ali et al., 2009). Rehabilitation, modernization and renovation are defined as planned actions that aim to improve the old buildings to meet the new standards requirements (Douglas, 2006). Reconstruction is the process of constructing the damaged parts of the building that could not be restored (Douglas, 2006).

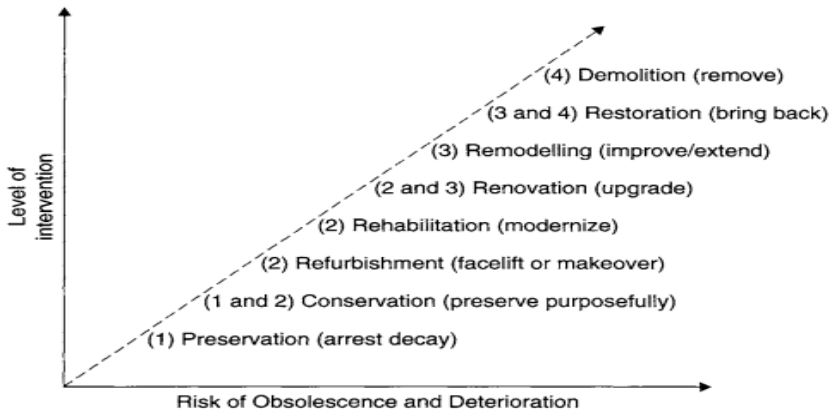

Figure 2.7: Levels of Intervention Action (Douglas, 2006)

2.4 Previous Studies of Adaptive Reuse Potential

Building adaptation was the scope of several research studies that aimed to find a percentage value reflecting the actual building capability for adaptation (Shen & Langston, 2010; Conejos et al., 2012; Wang et al., 2010; Wang & Zeng, 2010; Teo & Lin, 2011) . These research studies concentrated on adaptive reuse as a solution for building redundancy and obsolescence problems. To assess the building adaptation potential, they applied different models based on quantitative analysis methods.

Quantitative analysis is defined as *"a scientific approach to managerial decision making whereby raw data are processed and manipulated resulting in meaningful information"* (Render et al., 2009). This analysis approach uses models as tools to understand and describe the problem. Figure 2.8 shows the sequential steps that are applied to analyze the problem.

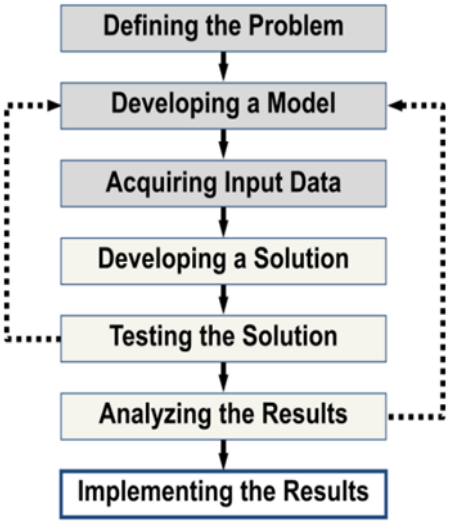

Figure 2.8: Quantitative Analysis Approach Steps (Render et al., 2009)

In case of building adaptation, quantitative analysis was used to develop advanced models to assess the building adaptive reuse potential by applying multi-factor evaluation techniques (Wang et al., 2010; Conejos & Langston, 2010; Wang & Zeng, 2010; Langston et al., 2008).

2.4.1 Multi Criteria Based Models

To make the right decisions, several quantitative and qualitative techniques were developed to help the decision makers. Selecting the proper technique depends on several aspects such as the goal, criteria influence and attributes. Moradi & Akhtarkavan (2008) indicated that the decision analysis is based on three main methods, which are single objective decision-making (SODM) methods, multi criteria decision-making methods MCDM, and decision support systems (DSS).

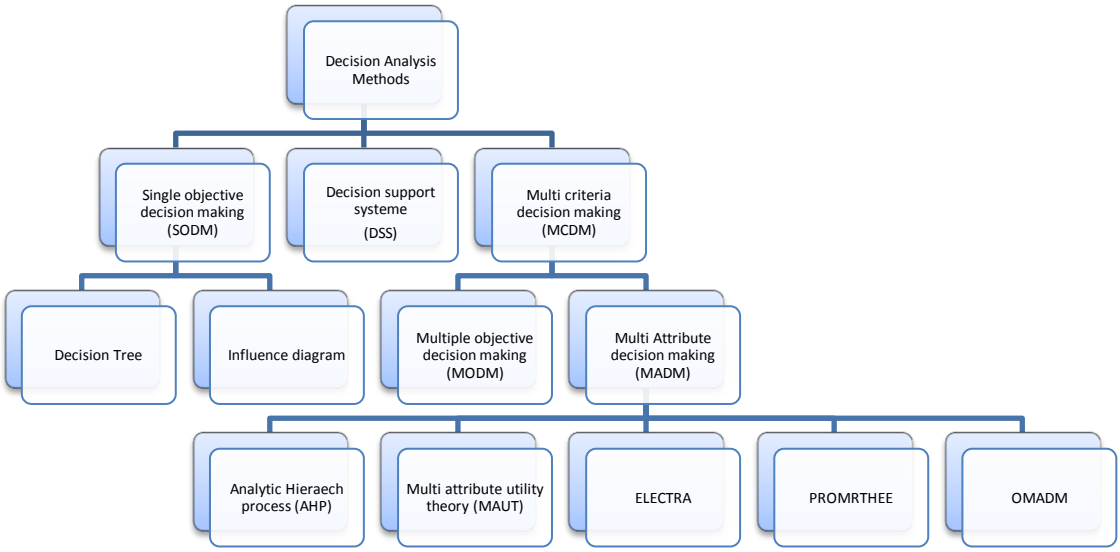

Figure 2.9: Decisions Analysis Methods (Moradi & Akhtarkavan, 2008)

Zhou , et al.(2006 cited Moradi & Akhtarkavan,2008) reviewed 252 studies to find the most used techniques. The following table illustrates the classification of these studies.

Table 2.7: Classification of Decision Analysis Studies (Moradi & Akhtarkavan, 2008)

SODM		**MCDM**					**DSS**	**other**	**TOTAL No.**
DT	ID	MODM	MAUT	AHP	ELECTRE	PROMETTHRE			
41	13	41	48	52	14	10	29	4	252

As shown above, the Analytic Hierarchy Process (AHP) and Multi Attribute Utility Theory (MAUT) are commonly applied in most of the reviewed studies. The following models are the conclusions of previous conducted research studies that applied Analytic Network Process (ANP), AHP, and MAUT to assess the building's adaptation potential.

2.4.1.1 Analytic Hierarchy Process (AHP) Based Model

The AHP method is a quantitative analysis tool for decision making by considering multi-criteria impact (Saaty, 2008). AHP method is used to develop an integrated model to assess the adaptive reuse of Japanese style houses which were constructed in 1900s in Taiwan. This model was developed by Wang et al. (2010). It is based on a multifactors evaluation which considers the Japanese houses' characteristics. The methodology of this model is as follows:

1. Defining and classifying the criteria and sub-criteria of the Japanese houses in hierarchal structure.
2. Calculating the criteria weight by applying the AHP method:

By AHP, decision makers can evaluate the criteria importance and estimate the number of pairwise comparisons by using the following equation.

$$\mathbf{C}\ (\boldsymbol{n}, \mathbf{2}) = \boldsymbol{n}\ (\boldsymbol{n}\text{-}\mathbf{1})/\mathbf{2} \qquad (2.1)$$

According to the pairwise comparisons, the matrix is calculated to estimate the ratio and criteria weight.

3. Using fuzzy theory to compare the criteria performance

Experts are asked to evaluate the criteria by using a defined scale (very poor, poor, fair, good, and very good). Each value of this scale is converted to a numerical value ranged between 0-1.

$$\mathbf{0 \leqq L \leqq M \leqq U \leqq 1} \qquad (2.2)$$

Triangular fuzzy number is adopted in the model. The membership function is as follows:

$$u_A(x) = \begin{cases} \frac{(x-1)}{(m-1)} & l \le x \le m \\ \frac{(x-u)}{(m-u)} & m \le x \le u \\ 0 & \text{otherwise} \end{cases} \qquad (2.3)$$

In the matrix, that is assumed

p = decision makers (evaluators)

m = alternatives considering n criteria.

$$D_{ij}^{(k)} = (l_{ij}^{(k)}, m_{ij}^{(k)}, u_{ij}^{(k)}) \qquad (2.4)$$

Where:

k=1, 2….., p

i=1, 2,…, m

j=1, 2,…,n.

Calculation of triangular numbers and division gives the average of triangular $\overline{D_{ij}}$

$$\overline{D_{ij}} = \frac{1}{p}(D_{ij}^{(1)} + \cdots D_{ij}^{(p)}) = \left(\frac{1}{p}\sum_{k=1}^{p} l_{ij}^{(k)}, \frac{1}{p}\sum_{k=1}^{p} m_{ij}^{(k)}, \frac{1}{p}\sum_{k=1}^{p} u_{ij}^{(k)}\right) \quad (2.5)$$

The following formula is used to ; value of a fuzzy number.

$$X_{ij} = \frac{(l_{ij} + 2m_{ij} + u_{ij})}{4} \quad (2.6)$$

4. Ranking the results by using Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS is sorting the results in a logical way by conducting five steps:

- Normalize the matrix.
- Present the weighted matrix.
- Estimate the negative and positive solutions.
- Measure the interval between negative and positive solutions.
- Calculate the relations of solutions.
- Rank the criteria.

Table 2.8: Criteria and Sub-criteria Weight (Wang et al., 2010)

Goal	Criteria	Sub-criteria		Rank
Evaluation for reuse design of Japanese style houses	Cultural 0.217	Historical value	0.0716	4
		Artistic value	0.0380	12
		Architectural value	0.0625	6
		Identity	0.0449	10
	Functional 0.135	Amenity	0.0284	17
		Spatial Adaptability	0.0743	3
		Route rationality	0.0324	15
	Environmental 0.112	Urban context	0.0269	18
		Scenic improvement	0.0616	7
		Physical condition	0.0235	19
	Conceptual 0.243	Creativity	0.0632	5
		Sustainability and reversibility	0.0795	2
		Harmonious coexistence	0.1004	1
	Economical 0.103	Cost for rehabilitation	0.0456	9
		Cost for maintenance	0.0174	21
		Benefit from reuse	0.0399	11
	Technological 0.101	Structural system	0.0503	8
		Air-conditioning equipment	0.0136	22
		Disaster prevention facility	0.0371	13
	Social 0.089	Citizen welfare	0.0291	16
		Community empowerment	0.0368	14
		Potential beneficial effect for the surrounding	0.0231	20

2.4.1.2 Analytic Network Process (ANP) Model

AHP is the base concept of ANP. It is also an analysis tool for decision making by considering multi-criteria impact without assumption of criteria independence in higher and lower level (Saaty, 1999). Criteria independence is the differentiating factor between AHP and ANP. ANP method is used to develop an integrated model to assess the adaptive reuse of historical buildings. Wang and Zeng (2010) integrated the analytic network process method with fuzzy delphi method to assess the heritage building potential for adaptive reuse. The adopted methodology in this model consists of three phases:

1. Developing the list of respondents:

   To assess and define the weight of criteria, practitioners and experts such as architects, developers, owners, contractors and historians who have the knowledge and experience participate.

Table 2.9: Adopted Factors in the Selection Model (Wang & Zeng, 2010)

Description of reuse selection factors
Potential market; location; physical analysis of the building; architectural and historical evaluation 1. General: a matching process 2. The user: location; What building lends itself to best; evident needs; compatibility of newly introduced uses with existing; subsidizing needs 3. The building: physical condition; space gain and space change; architectural character; future change Building and structural analysis; public interest; site and situation Historic value; cultural and artistic value; technological value; scenic/contextual value and the environmental effect; social value Conditions of integrity and/or authenticity; adequate protection and management system; ecologically and culturally sustainable; increasing public awareness, involvement and support; enhancing the role of communities

2. Fuzzy Delphi method:

   By using fuzzy Delphi method, respondents are asked to evaluate the criteria by using a scale of three points (pessimistic, moderate, and optimistic). The fuzzy method is used to estimate the level of criteria interdependence.

3. Analytic network process

   ANP is applied as follows:

   - Defining the interdependence between the criteria at the equivalent, lower and upper level.
   - Defining arcs and arrows that analyze the network relations between criteria in different levels.
   - Concluding the criteria impact.
   - Comparing the alternatives.
   - Evaluating criteria by using ANP scale (1-9) (Saaty, 1999).
   - Estimating the overall value and priority of each criteria.

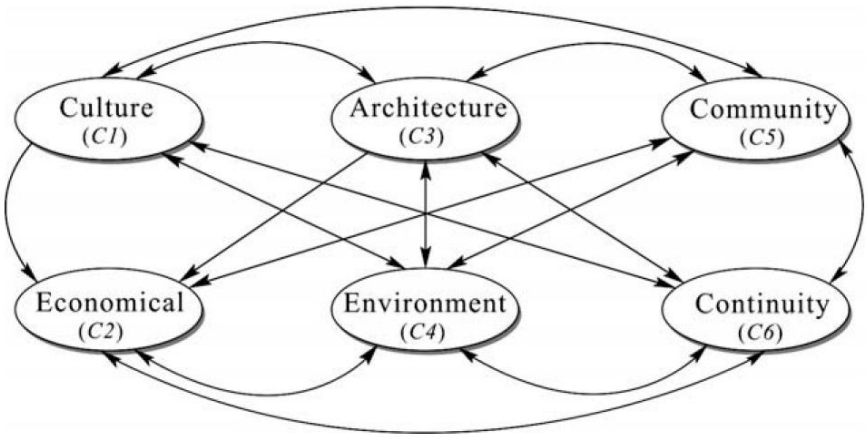

Figure 2.10: Criteria Network Relationship (Wang & Zeng, 2010)

2.4.1.3 Multi Attributes Value Theory (MAVT) Model

MAVT is one of the Multi Attribute Utilities Theory models (Moradi & Akhtarkavan, 2008). It is used to solve problems that have conflicts between objectives (Belton & Stewart, 2002). Teo& Lin (2011) used this theory to define the potential of buildings for adaptive reuse in Singapore. They developed a model based on factors and attributes. These factors are:

- Building occupants' attitude
- Housing obsolescence
- Prospective impacts arising from adaptation
- Urban planning policies
- Building sustainable performance

Under each of these factors, Teo& Lin (2011) identified sets of criteria and attributes that describe all aspects of buildings. According to these factors, criteria, and attributes, Teo& Lin (2011) suggested a BAP assessment framework to develop the MAVT model (figure 2.11).

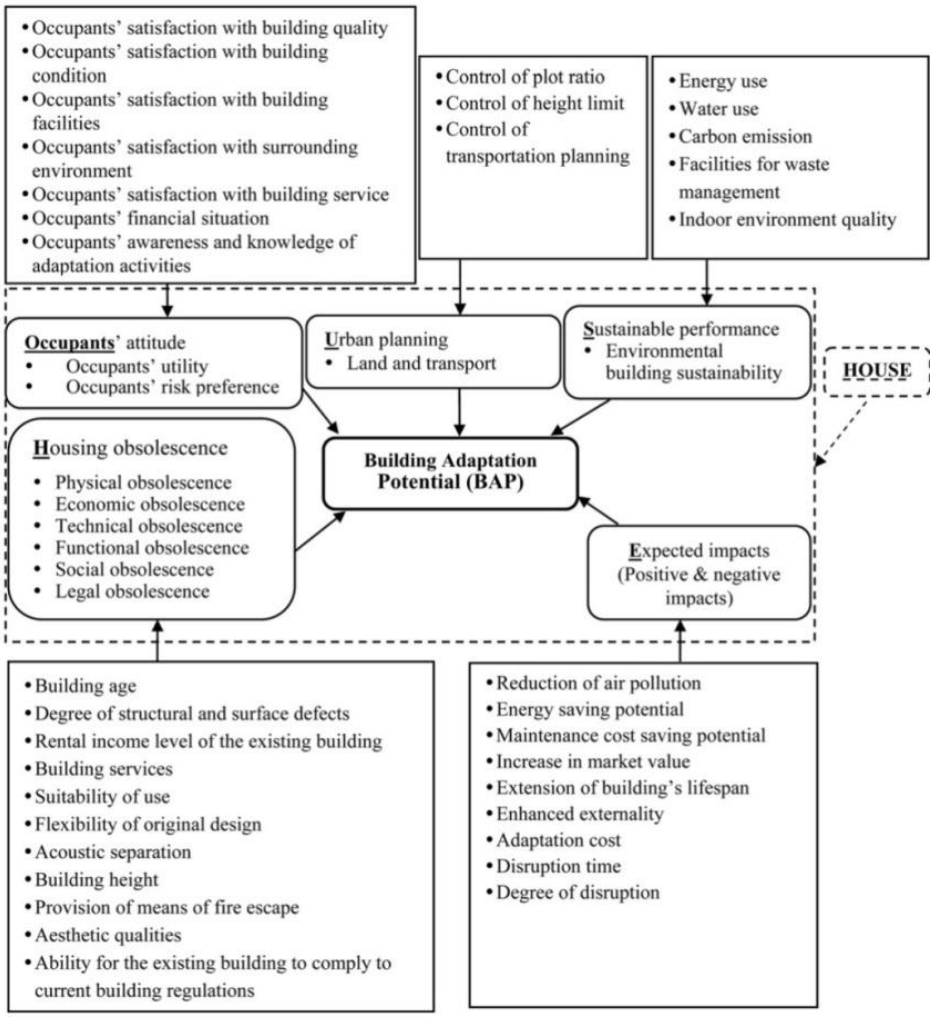

Figure 2.11: BAP Assessment Framework of MAVT Model (Teo & Lin, 2011)

To develop the MAVT model, Teo& Lin (2011) adopted the following methodology:

1. Defining the factors and attributes which had already developed (Figure 2.11)
2. Conducting interviews with experts and practitioners to weigh up the factors and attributes
3. Estimating the weight of attributes by applying the following equation (Teo & Lin, 2011):

$$a = \frac{(-3)(n_1)+(-2)(n_2)+(-1)(n_3)+0(n_4)+1(n_5)+2(n_6)+3(n_7)}{n_1+n_2+n_3+n_4+n_5+n_6+n_7} \quad (2.7)$$

Where: a = mean importance rating of an attribute

n_1, n_2, n_3, n_4, n_5, n_6, n_7 = number of subjects who rated the attributes -3, -2, -1, 0, 1, 2, 3.

Thus,

$$w_i = \frac{a_i}{\sum_{i=1}^{m} |a_i|} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2.8)$$

Where: i = attribute reference, m = numbers of attributes under one criterion

w_i = weight of attribute i, a_i = mean importance rating of attribute i acquired from previous equation

$$w_j = \frac{a_j}{\sum_{j=1}^{n} |a_j|} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(2.9)$$

Where: j = the criterion reference, n = numbers of criteria under one factor

w_j = weight of criterion j, a_j = mean importance rating of criterion j, given by Eq. (2.10).

$$a_j = \frac{\sum_{i=1}^{m} a_i}{m} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2.10)$$

$$w_k = \frac{a_k}{\sum_{k=1}^{p} |a_k|} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(2.11)$$

Where: k = factor reference, w_k = weight of factor k,

p= numbers of factors in the determination of BAP, a_k = mean importance rating of factor k, given by Eq. (2.12).

$$a_k = \frac{\sum_{j=1}^{n} a_j}{n} \quad \text{.....(2.12)}$$

4. Rating the attribute by using summated rating 0-10 scale

5. Aggregating the overall value by using value function :

$$\text{BAP} = \sum_{k=1}^{R} \text{BAP}_k \quad \text{.....(2.13)}$$

Where: BAP = building adaptation potential, BAP_k is given by Eq. (2.14).

$$\text{BAP}_k = w_k \left(w_{k1} \sum_{i=1}^{m} w_{k1i} r_{k1i} + w_{k2} \sum_{j=1}^{n} w_{k2j} r_{k2j} + \cdots + w_{kp} \sum_{h=1}^{o} w_{kph} r_{kph} \right) \times 100 \quad \text{.....(2.14)}$$

Where: BAP_k= building adaptation potential obtained from the w factor

w_k = importance weight of factor k,

wk_p = importance weight of criterion p under factor k

w_{kph} = importance weight of attribute h under criterion p

r_{kph} = rating given to the attribute h under criterion p

Table 2.10 presents the obtained results that are analyzed by using Statistical Package for Social Sciences (SPSS v18.0) software.

Table 2.10: Weights and Rating of BAP Model

Criterion	N (1)	Mean (2)	t (3)	Sig. (2-tailed) (4)	w_i (5)	w_j (6)	w_k (7)
1. Occupants' attitude before adaptation							0.1526
1.1. Occupants' utility						−0.4320	
Occupants' satisfaction with building quality (SBQ)	49	−0.92	−3.881	.000	−0.1592		
Occupants' satisfaction with building condition (SBC)	49	−1.39	−4.940	.000	−0.2405		
Occupants' satisfaction with building facilities (SBF)	49	−0.92	−4.461	.000	−0.1592		
Occupants' satisfaction with surrounding environment (SSE)	49	−1.06	−4.433	.000	−0.1834		
Occupants' satisfaction with building services (SBS)	49	−1.49	−5.570	.000	−0.2578		
1.2 Occupants' risk preference						0.5680	
Occupants' financial situation (OFS)	49	1.41	8.172	.000	0.3092		
Occupants' awareness and knowledge of adaptation activities (OAK)	49	1.37	10.308	.000	0.3004		
Occupants' expectation for value enhancement (OEV)	49	1.78	13.204	.000	0.3904		
2. Housing obsolescence before adaptation							−0.2282
2.1 Physical obsolescence						0.4093	
Building age (BA)	49	2.41	22.136	.000	0.5021		
Degree of structural and surface defects (DSD)	49	2.39	21.273	.000	0.4979		
2.2 Economic obsolescence						−0.0972	
Rental income level for existing building (RIL)	49	−0.57	−2.619	.012	−1.0000		
2.3 Functional obsolescence						−0.1563	
Building services (BS)	49	−1.18	−4.086	.000	−0.4291		
Suitability for use (SU)	49	−1.02	−3.619	.001	−0.3709		
Flexibility of original design (FOD)	49	−0.55	−2.181	.034	−0.2000		
2.4 Technological obsolescence						−0.1103	
Noise separation (NS)	49	−0.69	−3.463	.001	−0.3557		
Building height (BH)	49	−0.35	−1.611	.114	0.0000		
Means of fire escape (MFE)	49	−0.90	−3.701	.001	−0.4639		
2.5 Social obsolescence						−0.1637	
Appearance attractiveness (AA)	49	−0.96	−4.750	.000	−1.0000		
2.6 Legal obsolescence						−0.1603	
The ability of compliance to current building regulations (ACR)	49	−0.94	−3.023	.004	−1.0000		
3. Prospective impacts related to building adaptation							0.0405
3a. Positive impacts after adaptation						0.5117	
Reduction of air pollution in the long run (RAP)	49	1.55	11.324	.000	0.1222		
Electricity saving potential in the long run (ESP)	49	2.43	21.503	.000	0.1916		
Maintenance cost saving in the long run (MCS)	49	2.53	23.975	.000	0.1995		
Increase in market value (IMV)	49	2.31	17.174	.000	0.1822		
Extension of physical life (EPL)	49	2.06	15.277	.000	0.1625		
Enhanced externality (EE)	49	1.80	12.848	.000	0.1420		
3b. Negative impacts during adaptation						−0.4883	
Adaptation cost (AC)	49	−2.27	−20.930	.000	−0.3752		
Inconvenience time (IT)	49	−2.00	−18.330	.000	−0.3306		
Degree of disruption (e.g. dust and noise) (DD)	49	−1.78	−12.623	.000	−0.2942		
4. Urban planning policies							0.0000
4.1 Land and transportation						0.0000	
Control of plot ratio (CPR)	49	−0.43	−1.613	.113	0.0000		
Control of height limit (CHL)	49	−0.35	−1.407	.166	0.0000		
Transportation planning (TP)	49	−0.24	−.960	.342	0.0000		
5. Building sustainability before adaptation							0.5786
5.1 Environmental building sustainability						1.0000	
Electricity consumption (EC)	49	2.08	14.938	.000	0.2838		
Water usage (WU)	49	1.76	11.076	.000	0.2401		
Air pollution (AP)	49	1.55	11.076	.000	0.2115		
Facilities for waste management (FWM)	49	−0.57	−2.263	.028	−0.0778		
Indoor environmental quality (IEQ)	49	−1.37	−8.329	.000	−0.1869		

Note: −3 is strongly negative impact; 0 is no impact; and 3 is strongly positive impact.
The significance level α is set at 0.05.
w_i is the importance weight for the ith attribute.
w_j is the importance weight for the jth criterion.
w_k is the importance weight for the kth factor.

2.4.2 Adaptive Reuse Potential (ARP) Models

Adaptive re-use potential ARP model is developed by Langston et al.(2008). ARP model has a unique method to assess building potential for adaptive reuse. This method is used as a key technique for several research studies to solve the adaptive reuse problems (Shen & Langston, 2010; Conejos et al., 2012). It is based on the concept of a building's useful life. Defined criteria are presented in different types of obsolescence. These types are:

- Physical obsolescence: deterioration, maintenance and physical performance
- Economic obsolescence: cost, property value , location, investor interest
- Functional obsolescence: possible functional change
- Technological obsolescence: devices and application obsolescence
- Social obsolescence: behavioral changes (e.g. aesthetics, religious observance)
- Legal obsolescence: revised safety regulations, building ordinances or environmental controls

This model is implemented in the following steps:

1. Defining of the building's expected physical life and building age in years.
2. Evaluating all types of obsolescence to estimate the useful life of the building

- Physical obsolescence: calculated by using a reduction scale. The maintenance budget is the measure of obsolescence.
    - High maintenance budget = 0% reduction
    - Low maintenance budget = 20% reduction
    - Normal maintenance intensity = 10% reduction

- Economic obsolescence: calculated by using a reduction scale. The location is the measure of obsolescence.

- High population density = 0% reduction
- Low population density = 20% reduction.
- Average population density = 10% reduction.

- Functional obsolescence: calculated by using a reduction scale. The flexibility of a building's design is the measure of obsolescence.
  - Low cost of change work = 0% reduction
  - High cost of change work = 20% reduction
  - Typical cost of change work = 10% reduction
- Technological obsolescence: calculated by using a reduction scale. The operational energy of a building is the measure of obsolescence.
  - Low energy consumption = 0% reduction
  - Intense energy consumption = 20% reduction.
  - Conventional energy consumption = 10% reduction.
- Social obsolescence: calculated by using a reduction scale. The feasibility and external income is the measure of obsolescence.
  - Fully owned and occupied space = 0% reduction
  - Fully rented space = 20% reduction
  - Balanced rent and ownership = 10% reduction.
- Legal obsolescence: calculated by using a reduction scale. The quality of the original design is the measure of obsolescence.
  - High quality = 0% reduction
  - Low quality = 20% reduction
  - Average quality = 10% reduction.

The following equation is used to calculate useful life:

$$\text{Useful life}\,(L_u) = \frac{L_p}{\left(1 + \sum_{i=1}^{6} O_i\right)^{L_p}}, \qquad (2.15)$$

Where:

Lp = physical life (years)

O_1, O_2, O_3, O_4, O_5, O_6 = physical, economic, functional, technical, social, legal obsolescence (% as decimal p.a.).

3. Calculating the building's priority by defining its potential for adaptive reuse as a percentage value. High index means higher potential, while the low index means low potential. This process is the algorithm of the following equations:

$$y = 100 - \frac{x^2}{100}. \qquad (2.16)$$

$$\mathrm{ARP}_{(\text{increasing})} = 100 - \frac{(\mathrm{EL}_u^2/100)}{\mathrm{EL}_u} \times \mathrm{EL}_b, \qquad (2.17)$$

$$\mathrm{ARP}_{(\text{decreasing})} = 100 - \frac{(\mathrm{EL}_u^2/100)}{100 - \mathrm{EL}_u} \times (100 - \mathrm{EL}_b), \qquad (2.18)$$

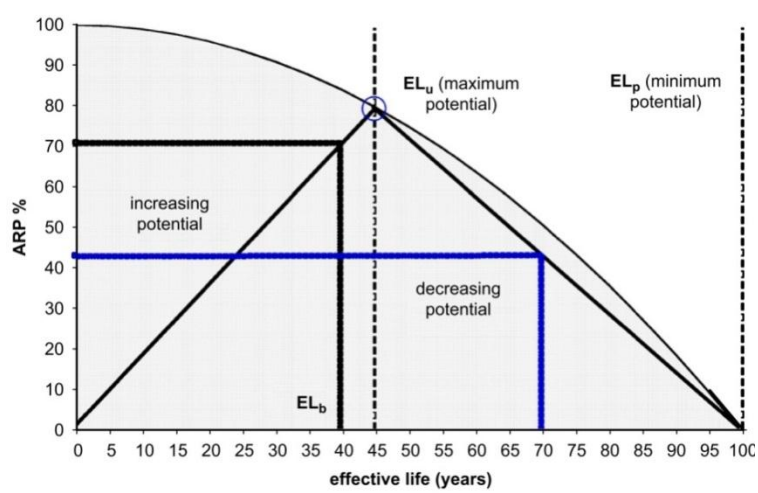

Figure 2.12: ARP Model (Langston, et al., 2008)

2.4.3 QSR Nvivo Analysis Model

Unlike the previous models, Bullen & Love (2011) developed a different model which was analyzed by QSR Nvivo software. This model aimed to assist the decision makers to reuse buildings with explicit consideration of issues that impact the buildings. To understand these issues, Bullen & Love (2011) adopted an interpretative methodology to reach the purpose of the research. This methodology involved conducting 81 interviews with people involved who have the experience and knowledge, such as developers, architects, facilities managers and consultants. Bullen & Love believe conducting interviews is an effective technique to obtain the knowledge that is reached by direct observation and practice. Three types of interviews were conducted to obtain as much information as possible.

Data collected from the conducted interviews was analyzed by using QSR Nvivosoftware. QSR Nvivo software is a version of NUD*IST which was developed to analyze structured and unstructured data. The outcome of the analysis indicated that there are three main criteria that essentially influence the adaptive reuse decision. These criteria are capital investment, asset condition, and regulation. Besides that, the financial issue is the main determinant of the adaptive reuse process. In addition to criteria and determinants, sustainability, and economic and social tenets are important issues that have to be considered in the adaptation of buildings. All of these conclusions are represented in the figure 2.13.

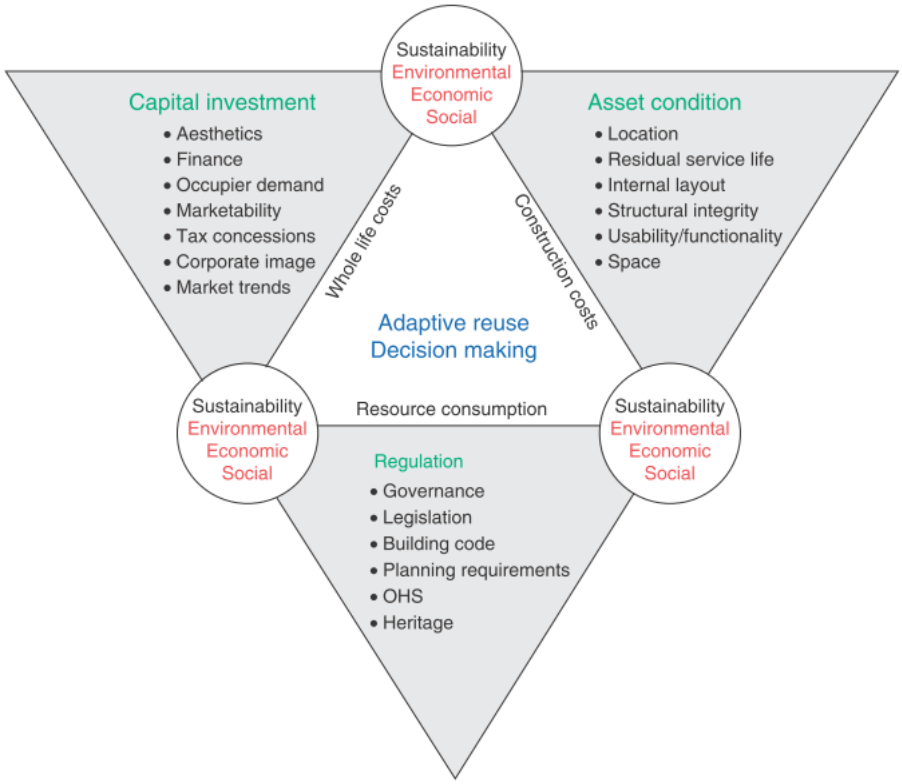

Figure 2.13: QSR Nvivo Model (Bullen & Love, 2011)

2.5 Criteria Weighting by Using AHP

According to the previous research using quantitative analysis to assess a building's potential, Analytical Hierarchy Process AHP is an appropriate technique to assess these criteria. The main reasons to adopt AHP are that it has more flexibility to modify, has inter-relationship and uses different measures for evaluations. To apply AHP, there are four steps that have to be followed to get the weights of the criteria. These steps are as follows (Saaty, 2008; Wu et al., 2007):

- **Defining Criteria and Constructing the Hierarchy**

The defined criteria have to be ranked in a hierarchical structure to define the relationship and level of criteria. At the top of this structure is building potential value as

a goal. The criteria are dispersed over different levels. The first level is the main criteria level, below this level, there are also sub levels that complete the hierarchy structure.

- **Developing AHP Pairwise Comparisons (Matrix)**

The previous structure is used to conduct the pairwise comparisons. Criteria that are on the same level will be assessed together to get the criteria weights. Therefore, a matrix will be developed to assess the main criteria. Then a set of matrices will be developed to assess sub and sub-sub criteria under the main level. Table 2.11 shows the matrix of the main level of criteria as a sample for this process. Appendix I has a questionnaire survey that was developed to assess these criteria.

Table 2.11: Main Criteria Matrix

Main criteria	Building characteristics	Infrastructure and public facilities	Community considerations
Building characteristics	1	X1	X2
Infrastructure and public facilities	1/X1	1	X3
Community considerations	1/X2	1/X3	1

Where: X1, X2,X3= 1,2,3,4,5,6,7,8 or 9 which are the scale value that used to assess criteria

Another way to estimate the number of pairwise comparisons was indicated by Saaty(2008) that it is : pairwise comparisons = n* (n-1)/2 …….(2.19)

Where n= number of criteria

To assess these criteria, a 1 to 9 scale is used to estimate their importance. Each value means a particular level of importance which is as follows:

- 1= Equally Important
- 3= Weakly Important
- 5= Strongly Important
- 7= V. Strongly Important
- 9= Extremely Important

Values 2,4,6,8 mean certain values between the single values. They are disregarded to simplify the assessment process and to help the evaluators to distinguish the variation between the assessment choices.

- **Defining Evaluators Sample**

Criteria importance value is a very crucial component in building potential assessment. Using the accurate value will rationalize the assessment process. In general, criteria weighting is based on people's evaluation of defined criteria. On the other hand, people's evaluations are related to their knowledge, experience and background. Therefore, selecting the sample of respondents has to be based on clear criteria for the adoption of their evaluations.

- **Computing Criteria Importance Values**

To compute criteria importance values, sequential steps have to be conducted which are as follows (Render et al., 2009) :

- Computing the evaluation of criteria by converting matrix numbers to decimal
- Calculating the column totals

- Dividing the matrix numbers by their respective column totals to produce the normalized matrix
- Determining the criteria priorities by computing the average of each row

Table 2.12: Computing Criteria Weights

	Main criteria	Building characteristics A	Infrastructure and public facilities B	Community considerations C
Original matrix	Building characteristics A	1	X1	X2
	Infrastructure and public facilities B	1/X1	1	X3
	Community considerations C	1/X2	1/X3	1
Column total		Column total = 1+(1/X1)+(1/X2)	Column total = X1+1+(1/X3)	Column total = X2+X3+1
Normalized matrix	A	1/col. A total	X1/ col. B total	X2/ col. C total
	B	(1/X1)/ col. A total	1/ col. B total	X3/ col. C total
	C	(1/X2)/ col. A total	(1/X3)/ col. B total	1/ col. C total
Factor evaluation	A	[(1/col. A total)+ (X1/ col. B total)+ (X2/ col. C total)]/3		
	B	[(1/X1)/ col. A total)+(1/ col. B total)+ (X3/ col. C total)]/3		
	C	[(1/X2)/ col. A tota)l+(1/X3)/ col. B total)+(1/ col. C total)]/3		

- Determining the consistency ratio is conducted in five steps, The first step is determining the weighted sum vector. The second step is determining the consistency vector. The third step is computing the consistency index by computing lambda (λ)

  lambda (λ)= consistency vector/ n

  Where n: number of criteria

  The fourth step is computing consistency index which is calculated by

  $$CI=\frac{\lambda-n}{n-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2.20)$$

  The last step is computing the Consistency Ratio CR by the following equation

  $$CR=\frac{CI}{RI} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2.21)$$

  Where:

  CI= consistency index

  RI= Random index

2.6 Discussion

This chapter reviews the previous research about disaster management, transitional shelters and adaptive reuse of buildings, which will simplify the understanding of the research problem. Through disaster management process reviewing, the transitional settlement position can be defined in the disaster management context. Therefore, the research problem can be understood and solved. As mentioned previously, estimating the building potential for temporary reuse as transitional shelter is the main objective of this research, so, the temporary reuse of buildings and transitional settlement research studies were reviewed. As we know, transitional settlement of displaced people includes many

types. The research will concentrate on settlement at host communities in existing buildings while the other types of settlement will be disregarded. The defined criteria of transitional shelters and standards are crucial components to assess a building's potential for temporary reuse. However, the importance and impact of criteria are not defined in the previous studies. So, there is a need to estimate the importance of each one.

On the other hand, assessing the building potential when considering its use as a particular type of shelter requires developing implementation actions. These actions that make buildings suitable for this function in the expected context must be studied. Therefore, the adaptation of buildings has to be applied in a professional way to ensure the success of transitional use. In general, adaptive reuse of the building is performed to improve the building for permanent reuse. However, in case of transitional settlement, adaptation will be applied for temporary reuse as shelter which will add more challenges for the adaptive reuse process to return the building back to its original state. Because of this, there are many aspects which will be added and others which will be disregarded.

In the last section of this chapter, previous studies were reviewed to conclude the advantages and disadvantages from each model. The result of analyzing the models is that the ARP model is unique technique to assess building potential, but it cannot be modified to meet the requirements of temporary reuse, because, it is based on obsolescence as a measurement tool, which is not considered in temporary reuse. Unlike the ARP, MAVT and QSR Nvivo analysis models are flexible. They present the criteria structure and relationship. However, they do not indicate the value and the relative importance of the criteria. On the other hand, AHP Family models have the flexibility to add and modify the structure of criteria and assume the interrelationship. By using AHP

and ANP, importance values and the relationships can be estimated easily on a percentage scale. AHP models are the most suitable technique to assess building potential for temporary use as transitional shelters. However, some research indicates that AHP is a useful technique to evaluate some issues, such as relative value only (Coyle, 2004). AHP has many strengths and weaknesses that have to be pointed out before using it.

Points of weakness:

- AHP is applied by using matrices which limit the options of evaluation (Coyle, 2004).
- The 1-9 scale is a linear scale which could not meet the evaluation options of some cases
- There is zero value in the AHP scale (Ishizaka & Labib , 2009)
- There is ambiguity because of using a verbal scale. Therefore, the evaluators face difficulty in distinguishing between them (Coyle, 2004).

On the other hand, the strengths are (Coyle, 2004):

- AHP is able to rank criteria and alternatives to meet conflicting objectives
- AHP is able to detect inconsistent judgements
- Calculations are easy and do not need a mathematical background

Applying AHP technique will be discussed in more detail in chapter 4 through the model structure.

CHAPTER THREE

LOCAL PRACTICE OF RESETTLING THE DISPLACED

This chapter aims to gain information about the local practice of settling the displaced. To achieve that, interviews were conducted with people who worked in the Hadramout flood event of 2008. Furthermore, two case studies will be reviewed to obtain the major problems and lessons learnt.

3.1 Introduction

The Hadramout Province is one of the twenty-two provinces of the Republic of Yemen. It is the largest province located in the south east of the country. Most Hadramout cities are dispersed between the coastline and the valley directorates (MAM, 2010).

On 24 October 2008, a Tropical Storm (Level 3) hit Eastern Yemen and drenched it with heavy rains. It is counted as one of the worst disasters that has ever been faced in the region. More than 20,000 people lost their homes, while the total number of people affected was more than 700,000. Schools, mosques, clubs and other public premises were used as shelters to settle the displaced people immediately after the disaster. Some of the displaced were unwilling to live with other families in shelters; they preferred to live with their relatives or in camps near their collapsed homes. According to the local authorities, the displaced were scattered in 113 settlement centers around the main cities of the Hadramout which were mainly schools (OMC, 2008). For different reasons, the success of the displaced people's settlements varied in the 113 settlement centers. Some of them

were closed after a short time, while others were used for more than a year (Al-Kaff, 2012; Bin Saad, 2012).

To review the local practice of settling the displaced in buildings, two buildings of the 113 settlement centers were selected as case studies to discover the main problems faced during the temporary use of buildings and the adopted solutions. The variation of location, building characteristics, capacity and settlement situation were considered as criteria for the selection..

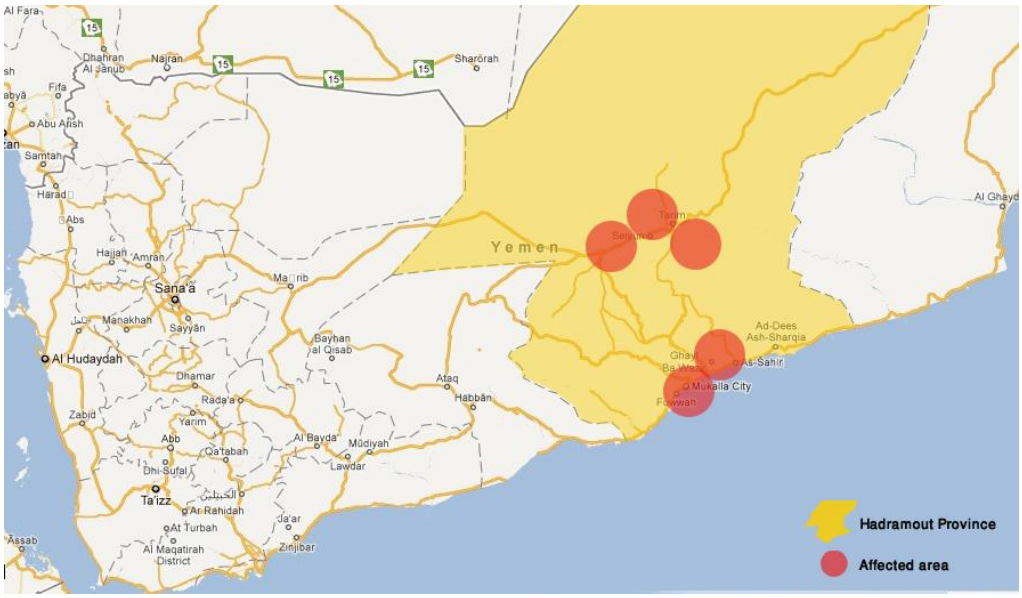

Figure 3.1: Yemen Map

3.1.1 Case Study 1: Ibn Khaldoon School

Ibn Khaldoon School is a newly constructed elementary school located in the downtown area of Mukalla, the capital city of the Hadramout. Ibn Khaldoon School is one of the three schools located in the radius of 120 meters to serve three residential districts. Figure 3.2 shows the location of the school and its surrounding residential districts.

Figure 3.2: Ibn Khaldoon School Location (Google earth, 2012)

Ibn Khaldoon School was established to serve 800 students who reside in the environs of the school. Because of the limited area, the school consists of four floors and a basement floor. It includes 18 classrooms, 14 bathrooms and 14 supporting facilities. As shown in the school layouts (figures 3.3), the ground floor includes the principal's office, a laboratory, an archive room and a cafeteria. The first and upper floors include all classrooms and teachers' offices. The basement floor includes bookstores and a maintenance workshop.

During the last flood disaster event in 2008, many people were displaced and moved from their damaged houses into safe locations. In response to the displacement action, some schools and mosques were used as collective centers to receive people (OMC, 2008). Ibn Khaldoon was selected as a transitional shelter to settle affected people who had resided in the old town of Mukalla. This selection was based on the occupation status of the building, its location and condition. Ibn Khaldoon School is very close to the affected locations and it was under construction in 2008. (Bin Saad, 2012)

More than 350 displaced persons (60 families) were settled in the school for six months, starting from October 2008 to April 2009. Settlement committees faced problems of how to reuse this building and how to assign spaces. Municipal Council members suggested separation between genders to provide privacy and increase the building capacity. Complying with this suggestion, the ground floor was allocated to accommodate young and adult men. It included three main zones which were adult male zone, young male zone and a food distribution area.Young and adult male zones were available for sleeping and eating times only. The upper floors and private spaces on the ground floors were allocated to accommodate all remaining family members like women, girls, and children. By using partitions, each classroom could accommodate 1-3 families based on the families' size. On each floor, bathrooms were allocated to serve the floor occupants only. The small private spaces on the ground and upper floors were used to accommodate families that had special needs such as having old people and pregnant women, while some of these rooms were used to isolate uncooperative families. The basement was used to store medicine, food and non-food items.

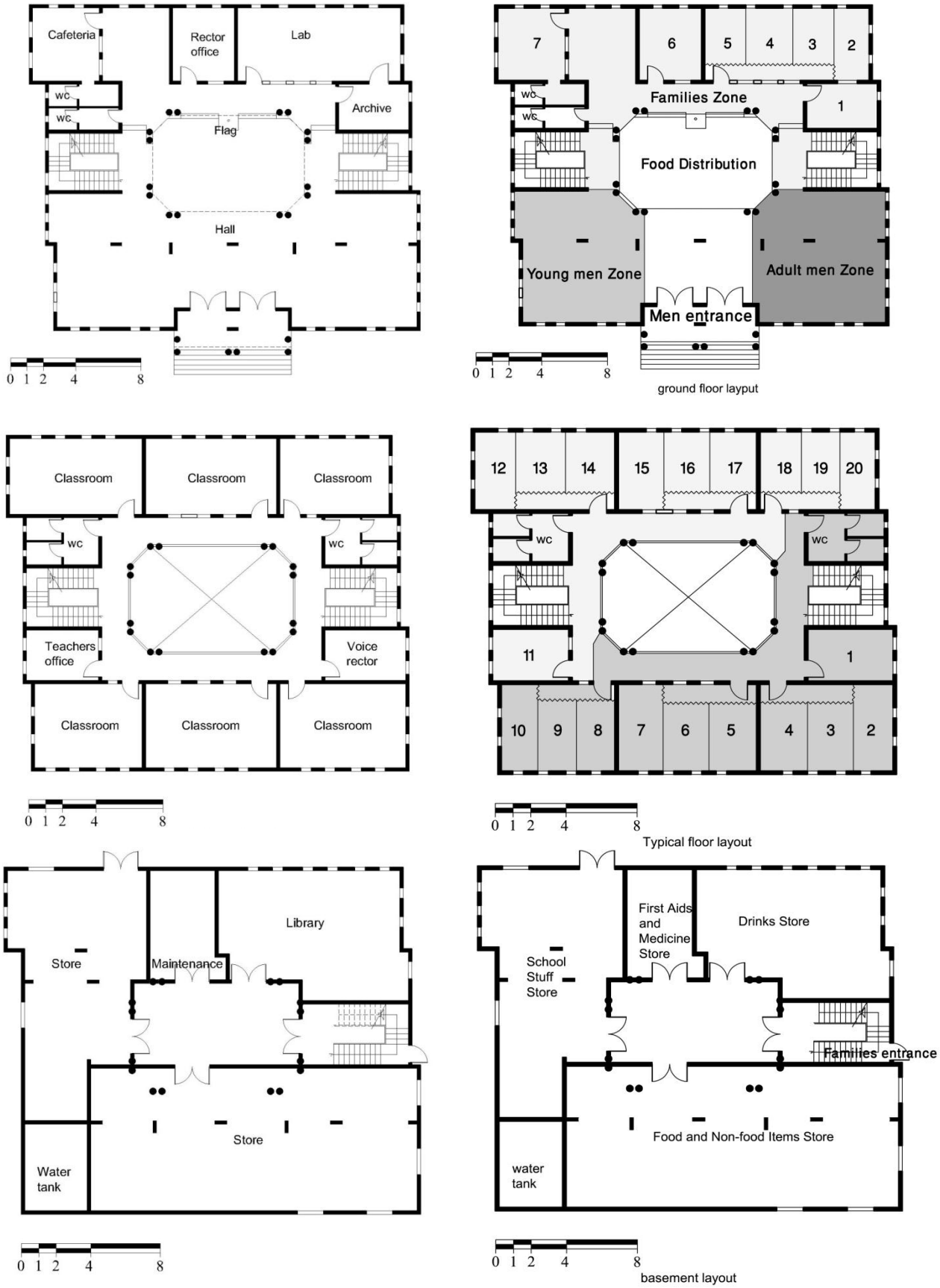

Figure 3.3: Ibn Khaldoon Floors Layouts (Before – After)

Figure 3.4: Ibn Khaldoon School

Figure 3.5: Ibn Khaldoon School- During Settlement (Al-Ayyam Journal, 2009)

3.1.2 Case Study 4: Tarem Secondary School

The Tarem Secondary School is the main school of Tarem Directorate which is one of the largest directorates of the Hadramout valley. It was constructed in 1960's to serve more than 1500 students who reside in Tarem, Thaby and Damoon town. Figure 3.6 shows the location of the school.

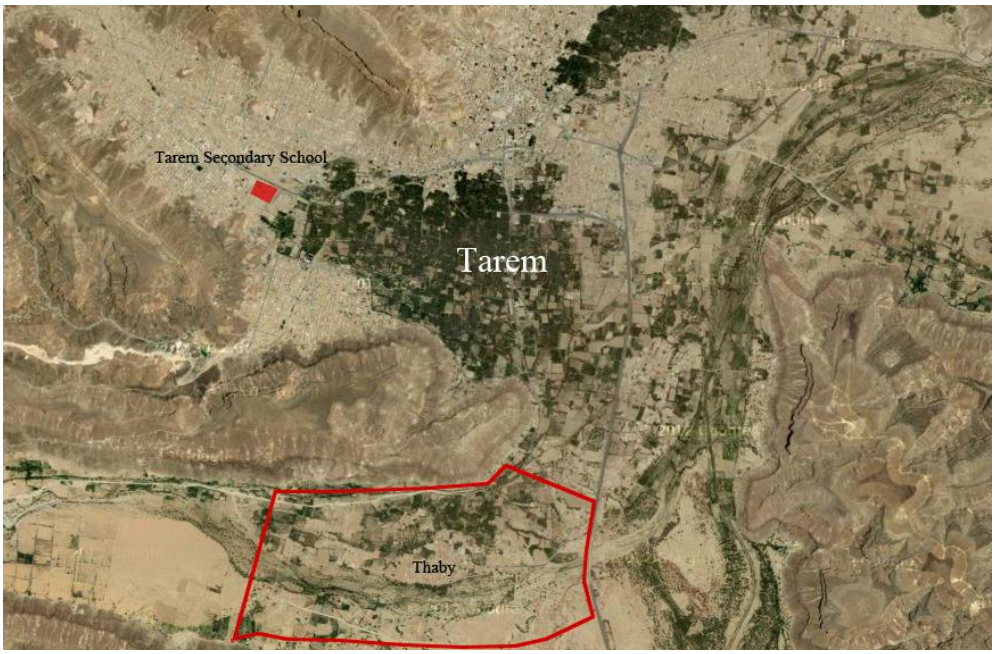

Figure 3.6: Tarem Secondary School and Thaby Village Location (Google earth, 2012)

The Tarem secondary school is located within an educational campus including the school building, mosque, stores and workshops. Based on the school layouts shown in figures 5.13, the two floors of the school include 214 classrooms, 26 bathrooms, 8 offices, 4 laboratories, 3 stores, and the main cafeteria.

During the last flood disaster event in 2008, many people were displaced and moved from their damaged houses in Thaby into safe locations in Tarem. Tarem secondary school was used as a collective center to receive the displaced people. The school

location, design and capacity were the main reasons for selecting it as a transitional shelter to settle the affected residents of Tarem and its suburbs.

More than 1,500 displaced people were settled in the school for four months starting from October 2008 to January 2009. The Municipal Council and NGOs suggested separation between genders to provide privacy and increase the building capacity. Complying with this suggestion, all classrooms and corridors of the ground floor were allocated to accommodate young and adult males. Besides the male accommodation, supporting activities such as storing, cooking, and aid distribution were on the ground floor. To accommodate women, the upper floor classrooms and corridors were opened and allocated for this activity. To provide privacy of the displaced females, the main corridor's windows and stair's doors were covered with curtains. The small spaces in the upper floor were used to provide the elderly and pregnant women with the required care. On each floor, bathrooms were allocated to serve the floor occupants only. The other buildings in the school campus were used as support facilities, such as offices, medicine stores, and store for food and non-food items.

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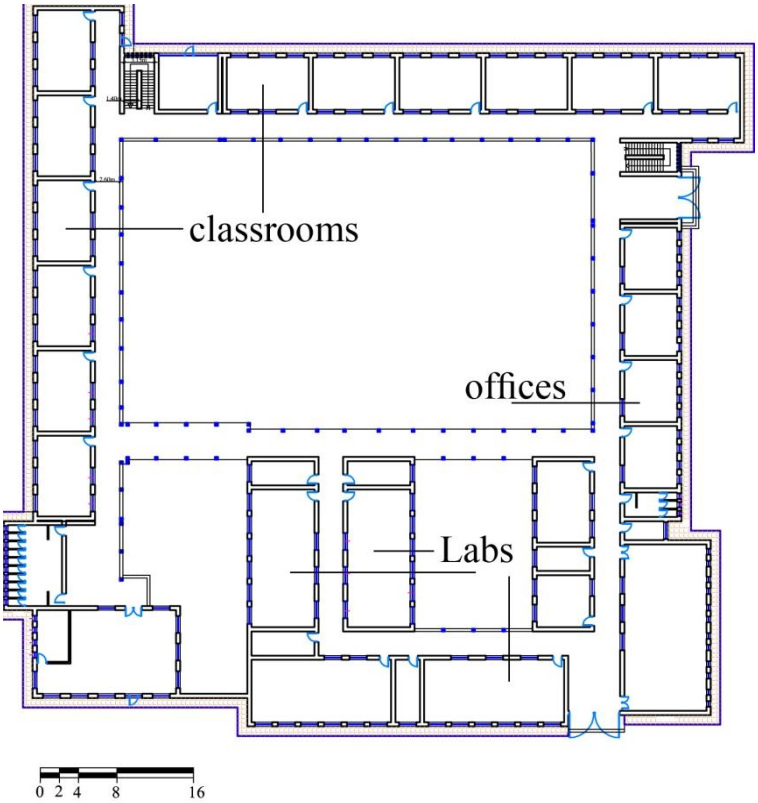


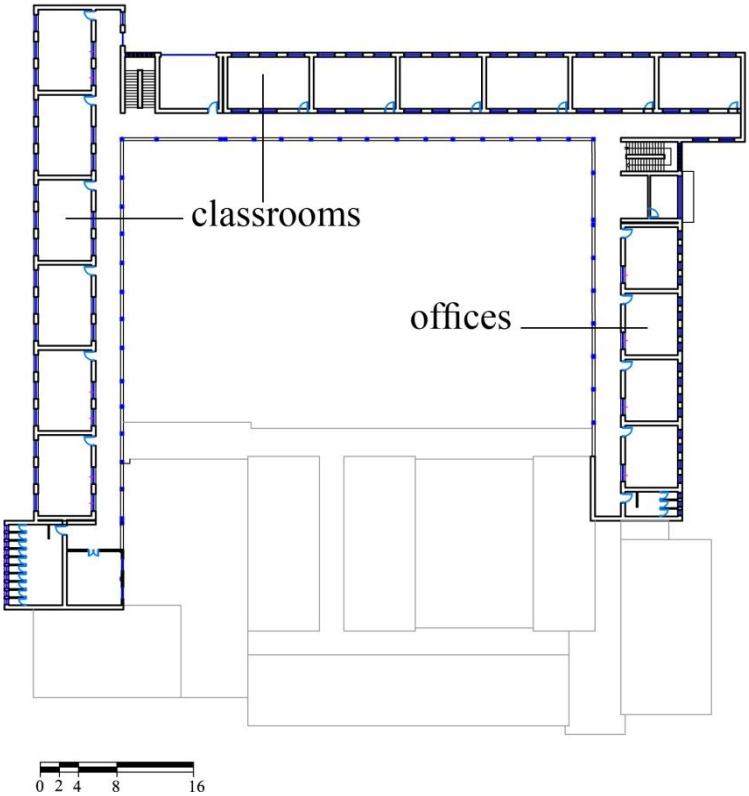
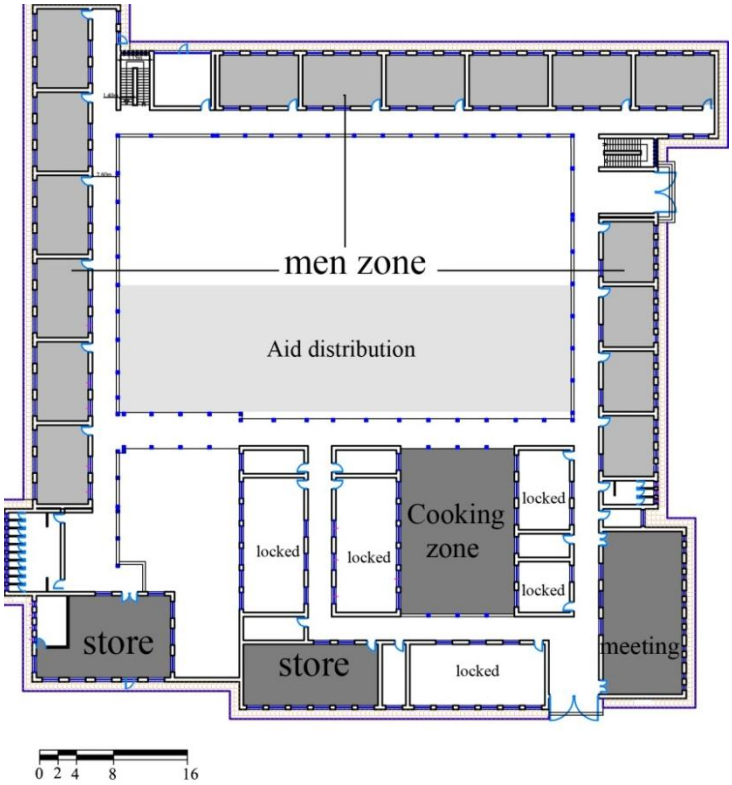


Figure 3.7: Tarem Secondary School – Before



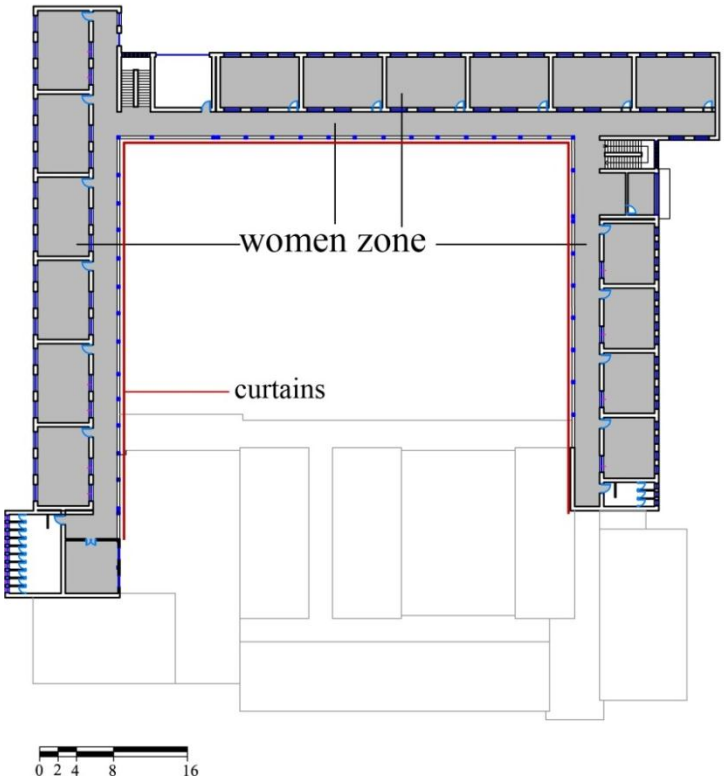


Figure 3.8: Tarem Secondary School – After

Figure 3.9: Tarem Secondary School

Figure 3.10: Tarem Secondary School

In October 2008, Hadramout, Yemen faced one of the worst flood disasters that it has faced in its history. This disaster left massive damage and displaced thousands of people, leaving them homeless (OMC, 2008). The relief and rescue efforts provide specialists with valuable knowledge and experience to deal with disaster events. The resettlement experience created a group of knowledgeable people who have worked at different stages of the crisis management team, starting from rescuing people to rebuilding efforts. To obtain this experience, interviews with those involved were conducted in the Hadramout to investigate the resettlement practice. The goal of these interviews was to consider actions to be taken, assess criteria, study problems, learn lessons, and weigh up advantages and disadvantages.

3.2 Interviews

3.2.1 Interview Methodology

Interviews with those involved are one of two main sources of information that support the research. This is all carried out to provide the research with the actual problems that will enhance the model effectiveness. At this stage of the research, unstructured interviews and open-ended questions are the adopted technique to obtain the knowledge and experience of those involved. Interview questions are divided into 4 parts. Each part aims to discover different types of information at all times and during all circumstances of the event. Interview questions are structured as follows

- Before the event: the purpose of questioning is to investigate the suitability and the readiness of people and governments to face emergencies.

- After the flood: the purpose of questioning is to investigate the impact and the actions
- After resettlement: the purpose of questioning is to investigate the physical condition of building, circumstances, phases and problems of resettlement.
- Resettlement facilities: the purpose of questioning is to investigate the alternatives and assessment criteria.

3.2.2 Personal Information of the Interviewees

Thirteen interviews were conducted individually with those who had worked during the flood disaster event in 2008 in Hadramout, Yemen. Each interview was conducted for about 30 to 60 minutes. Table (3.1) presents the information of the interviewees.

Table 3.1: Interviewees' Information

No.	Name alphabetically	Background	Org.	Position	Time period
1	Abdullah Bin Saad	-	GO***	Resettlement director,MC*	2008-2011
2	Abdullah Sweed	Mechanical	GO***	Resettlement director,MC*	2008-2009
3	Hani Al-Kasimi	Architect	GO**	Assessment Engineer,RF*	2009- 2011
4	Hamed Al-Saqaf)	-	NGO***	Rescue team director	2008-2009
5	Hussain Ali Al-aidaroos	-	NGO***	Rescue team director	2008-2009
6	Lotfi Al Boesy	Architect	GO**	Manager , RF*	2011-2012
7	Maher Bahomeesh	Architect	GO**	Assessment Engineer,RF*	2009- 2011
8	MoeezBafadel	Civil engineer	GO**	Manager , RF*	2009-2011
9	Mohammad Al- Mashgari	-	NGO***	Resettlement director	2008-2009
10	Mohammed Bajsair	Architect	GO**	Assessment Engineer,RF*	2009- 2011
11	Osama Hassan BinYahia	Civil engineer	GO**	Manager , RF*	2008-2011
12	Zain Al-aidaroos	Architect	GO**	Assessment Engineer,RF*	2009- 2011
13	Zain Bin Aqeel	-	NGO***	Rescue team director	2008-2009

*** RF- Rebuild Fund - Public Works Ministry, MC- Municipal Council**
**** GO- Governmental organization**
***** NGO- Non Governmental organization**

3.2.3 Findings of the interviews

The conducted interviews were analyzed to obtain the required knowledge and experiences.. Figure 3.11 explains how interviews were conducted and the expected contribution of local practice in the model development.

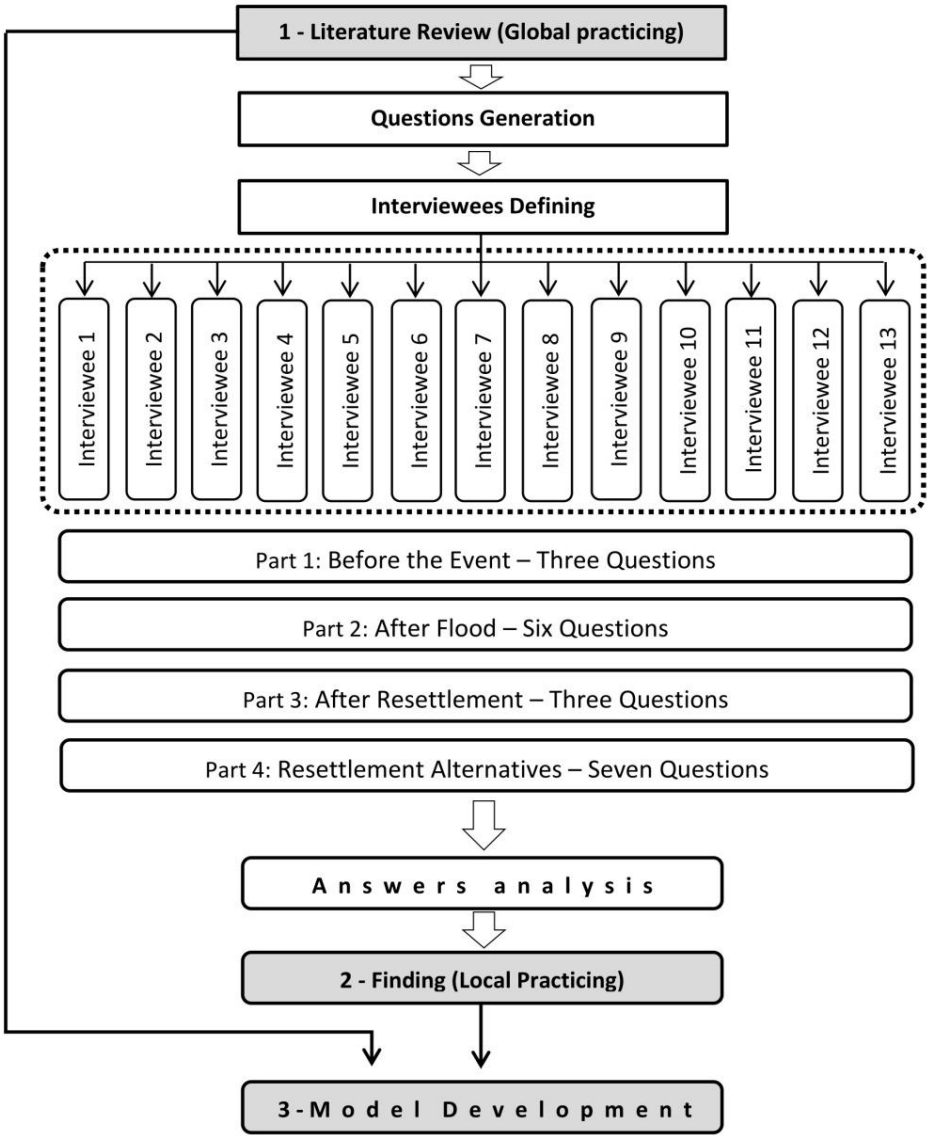


Figure 3.11: Interviews Methodology and Expected Contribution in the Model

3.2.4 Findings of the interviews

The conducted interviews were analyzed to obtain the required knowledge and experiences.. Figure 3.11 explains how interviews were conducted and the expected contribution of local practice in the model development.

According to the interview structure, the analysis of answers follows the same structure to present the findings, which are as follows:

3.2.4.1 Before the Event

- **Preparedness:**

According to most of the interview responses, the government had no plan to manage the disaster event in the scale of the Hadramout flood of 2008. The government's performance and reaction were disorganized and unfocused. The government's reaction became balanced after weeks but still fell behind the non-governmental organizations (Sweed, 2012; Bin Ageel, 2011; Bin Saad, 2012). On the other hand, NGOs were working essentially just to distribute the aid. The 2008 Flood event was the first experience that was managed by their restricted resources and staff (Al-Aidaroos, 2011; Bin Ageel, 2011; Al-Mashgari, 2012).

3.2.4.2 After the Flood

- **Reception of the Displaced in Shelters**

The 2008 Flood caused huge damage to the buildings, varying between partial and entire collapse (OMC, 2008; Bajsair, 2011; Bahomeesh, 2012). When the flood occurred, thousands of people were displaced. In most cities and villages, the displaced went to schools and mosques as refuge and temporary shelters (Sweed, 2012; Bin Yahia, 2012; Bin Ageel, 2011; Al-Aidaroos, 2011). The average number of members of the displaced families who went to the refuge locations was 5-7 persons. Al-Saqaf (2011) indicated that most of the displaced lost all their belongings. Some of them picked up portable essentials or valuable (Sweed, 2012; Al-Aidaroos, 2011; Bin Saad, 2012).

- **Displaced Needs and Available Resources**

The critical needs of the displaced are to help them to survive. Getting an adequate shelter was the main need for all displaced families (Al-Mashgari, 2012; Sweed, 2012). Bin Yahia (2012) mentioned in his interview *"they are looking to get a place that can keep their humanity and dignity, they do not expect to get five star suites"*. Also, getting food and clothes aid is the second priority of the displaced (Bin Yahia, 2012; Sweed, 2012; Bin Saad, 2012; Al-Mashgari, 2012). In some locations, there was a need for medical and special care (Al Boesy, 2012; Al-Aidaroos, 2011; Bin Ageel, 2011).

- **Problems and Difficulties after Flood**

While the displaced were being received in the refuge locations, there were many problems and difficulties that impacted the resettlement process. The major problems were as follows:

1. Absence of Mass Management Skills: most of the NGO staff were not trained to deal with and manage people under these circumstances. That led to the postponement of the resettlement procedure in some locations (Bin Saad, 2012; Al-Mashgari, 2012).
2. Data Problems: most of the participating organizations suffered from both the conflict of and lack of data integrity. Because of the absence of unified leadership and administration, many incidents of cheating and fraud were recorded (Al-Aidaroos, 2011; Al-Kasimi, 2012; Bahomeesh, 2012; Bin Yahia, 2012).
3. Variation of Families: Al-Aidaroos (2011) pointed out that the variation in families' numbers slowed down the resettlement process. Hence, special solutions were found for these families.
4. Shortage of Available Buildings for Temporary Reuse: this is the main problem facing the resettlement of the displaced. There are no predefined buildings for this purpose (Bin Yahia, 2012; Al Boesy, 2012). Sweed (2012) believes that buildings have to be assessed before the disaster to find the solutions and avoid the wastage of time and effort.

3.2.4.3 After Resettlement

- **Resettlement Phases and Periods**

The resettlement of the displaced was achieved in three phases. The first phase was accommodating people in tents and neighbors' houses. This was initiated in the first three days and extended to the first two weeks (Al-Mashgari, 2012; Al-Saqaf, 2011). The second phase was accommodating people in schools as temporary shelters; the period of this phase was 1- 12 months (Bin Yahia, 2012). The last phase was accommodating people in rented apartment buildings (Bin Yahia, 2012). Displaced people stayed in these buildings until their permanent buildings were finished (Al-Mashgari, 2012; Al Boesy, 2012).

- **Problems during Resettlement Period**

All of the interviewees indicated that the settlement of the displaced people in existing buildings caused many problems between the displaced themselves and with the neighbors.

- **Internal Problems:** most of the used buildings did not provide the privacy that is required for all families (Sweed, 2012). Local customs and religious adherences increase the impact of this problem. Absence of privacy causes many social and moral problems between the displaced people (Bin Yahia, 2012). Sweed (2012) noted that, in the second phase of settlement, schools were very crowded and this negatively affected the health and psychological state of the occupants.

- **Neighbors' Problems:** in some recorded incidents, neighbors complained about noise, inconvenience and waste that increased because of the accommodation of the displaced in their neighborhood (Al Boesy, 2012). Al-Mashgari (2012) indicates that the original residents suffered from the irresponsible behavior of the displaced. Consequently, some of the residents were forced to take more precautions to avoid any robbery or violation (Bahomeesh, 2012).
- **Degradation of Building and Public Services:** in terms of the condition of buildings, the entire renovation was required to return the used building to the original condition before the resettlement. The heavy use of the buildings completely damages systems, equipment and finishes (Al-Aidaroos, 2011; Al-Kasimi, 2012; Bahomeesh, 2012; Bajsair, 2011; Bin Yahia, 2012). Furthermore, there was a lot of damage which impacted the public services. Residents complained about sewer pipe blockage, water supply shortage, and unavailability of parking spaces (Al Boesy, 2012; Bin Yahia, 2012).

- Reactions of the Displaced

Getting into a safe place was the aim of the displaced during the disaster. Settling of the displaced people in schools was not a suitable solution, so they were more pessimistic and depressed (Bafadel, 2012). When they were resettled in rented apartments, they got a new chance to return to their daily activities (Bin Yahia, 2012). The following table concludes all of these problems within the criteria structure.

Table 3.2: Problems and Difficulties Facing the Displaced Settlement

Related Category	Shelter	Problems and difficulties	Adopted Solutions
Availability of building			
	- Ibn Khaldoon - Tarem	Unavailability of school buildings for long period	- Redirecting students to other schools - closing the shelters
	- Fuwwah	Unavailability of the formal agreement	- Closing the shelter until getting the formal agreement - Relocating shelters to other buildings.
Building characteristics			
	- Ibn Khaldoon - Tarem	Difficulty to remodel building layouts	- Using curtains - Separating between genders
	- Ibn Khaldoon	Difficulty to isolate the shelter (shelter buildings were not boarded by a fence)	- Reducing the entrances as much as possible
	- Tarem - Fuwwah - Al-Masaken - Ibn Khaldoon -	Unavailability of enough bathrooms	- Allocating the interior bathrooms for women and using the nearest mosques bathrooms for men - Constructing and renovating bathrooms
	- Ibn Khaldoon - Tarem	Very crowded	- Reducing the displaced capacity
	- Tarem - Al-Masaken - Ibn Khaldoon	Deficiency of water and sanitary networks	- Installing new tanks and equipments - Upgrading the existing networks
	- Ibn Khaldoon - Tarem	insufficient number of electrical plugs and switches	- Adding new plugs and switches
	- Tarem - IbnKhaldoon	insufficient ventilation	- Adding and redistributing the

	-		cailing fans
	- IbnKhaldoon	Fire accidents	- Prohibiting all fire-based activities (cooking, smoking, heating)
Infrastructure and public facilities			
	- Ibn Khaldoon - Tarem -	Deficiency of municipal water and sanitary systems	- Increasing the daily hours of water supply - Assigning a team to maintain the existing sanitary networks
	- Ibn Khaldoon - Tarem -	Increasing trash	- Adding new refuse containers - Increasing the disposal shifts
	- Tarem - Ibn Khaldoon -	Unavailability of supporting facilities such as stores, hospitals and kitchens	- Leasing near buildings - Allocating spaces within the shelters - Constructing portable temporary facilities
	- Tarem - Ibn Khaldoon -	Unavailability of facilities or spaces for special needs people	- Allocating spaces for elder, pregnant and handicapped to provide them with required care
	- Tarem	Difficulty to use roads to displace people from the flooded location to the shelters	- using a military helicopter and allocating clear area for landing
Community considerations			
	- Tarem - Ibn Khaldoon - -	Unavailability of personal private spaces to gather husbands and wives	- Leasing furnished apartments to gather families out the shelter
	- Ibn Khaldoon -	Increasing personal problems (divorce …)	- Establishing a committee for counseling and advising

	- Fuwwah - Ibn Khaldoon -	Increasing the social problems between displaced themselves and hosts community	- Enforcing rules - Eliminating people who make problems - Establishing a committee for counseling and advising - Calling Police Dept.
	- Fuwwah -	Refusing displaced settlement by the local community for ethnic reasons	- Relocating the shelter to other location
	- Fuwwah - Al-Masaken - Ibn Khaldoon	Declining the community interacting with displaced after months	- Reducing the displaced population as much as possible - Resettlement of the displaced in leased buildings

3.2.4.4 Building Assessment Factors

After the disaster, the available alternatives were very limited. Reusing of available buildings, portable units and reconstructing new buildings were the options at that time. Adopting the proper solution to settle the displaced is based on several issues, which are as follows:

Sweed (2012) indicated that when they planned to settle people in schools, a set of criteria was defined to select the suitable buildings. These criteria are as follows:

- **Ownership:** public property was preferred over private property for this purpose.
- **Availability:** existing buildings can be reused immediately with minor repair.

- **Out of the risk area:** reused buildings have to be out of the range of flood risk.

- **Building in a good condition:** selected buildings have to be in a good condition to accommodate people and respond to their needs.

- **Number of classrooms and bathrooms:** that gives extra flexibility to increase the number of displaced families settled in the schools.

Bin Yahia (2012) added more criteria that were considered in the selection of rented apartment buildings.

- **Flexibility of the original design:** structure and architecture designs are the pivot of the flexibility assessment. They have to be flexible in order to be able to add or remove some elements that are required for the accommodation of the displaced.

- **Less cost of maintenance and upgrading:** the building condition was assessed with a view to avoid extensive maintenance works. Buildings that have luxury or high quality finishes were excluded.

- **Old and safe:** old buildings are preferred over new buildings to accommodate people. This is to avoid any negative effects on the condition of the new building and the property value. Both old and new buildings are subject to compliance with safety standards and local building regulations.

- **Close to original locations:** to help the displaced to return to their lives and activities, rented buildings have to be as near to the displaced original location as possible.

- **Site and accessibility:** selected buildings have high-density populations, so they require a site with good access to avoid disturbance or inconvenience for neighbors.

As mentioned previously, the three settlement alternatives were assessed. The availability of some buildings encouraged the decision makers to invest in them to settle the displaced. While the unavailability of the work force, time, funds, and material were the factors that persuaded the decision makers to disregard the other two alternatives (Al Boesy, 2012; Bafadel, 2012; Bin Yahia, 2012; Sweed, 2012).

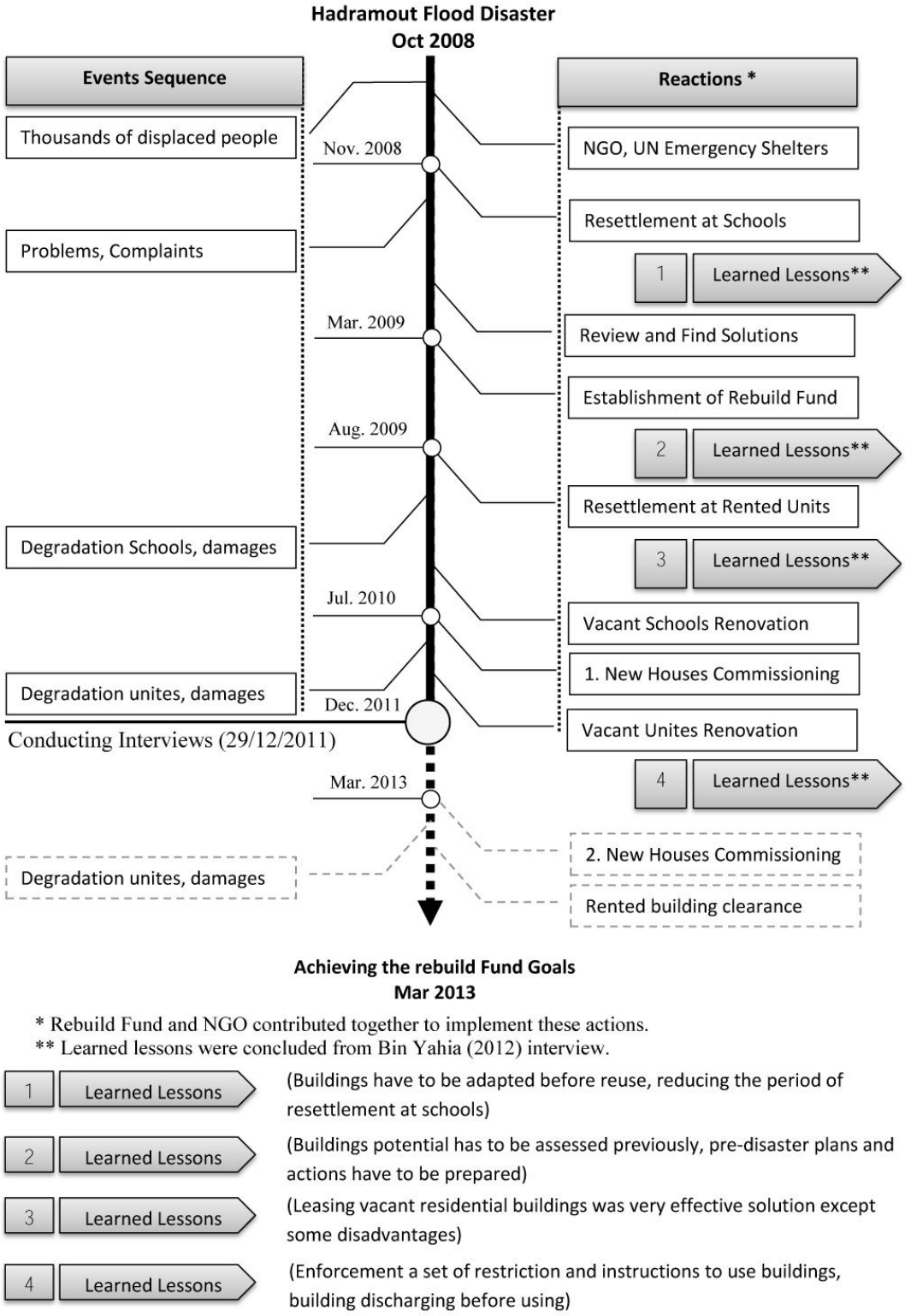


Figure 3.12: Resettlement Events Timeline

CHAPTER FOUR

REQUIREMENTS AND CRITERIA ASSESSMENT

This chapter aims to customize international standards of shelters, the basic needs of the displaced and the criteria importance values. To achieve that, questionnaire surveys were conducted with those who worked in the Hadramout flood event 2008.

4.1 Customizing the Standards and Requirements of Shelters

As mentioned in chapter 2, shelters have to provide the displaced people with a certain level of existence that guarantees their humanity and dignity. Therefore, the UN Higher Commissioner of Refugees leads the effort to develop a standard that defines minimum requirements (Sphere Project, 2011; UNHCR, 2000). This standard is developed to be applicable in any country around the world. In other words, it is expected that the standard could be higher than the local community needs. For that reason, there is a need for local experts to assess these requirements to ensure their suitability to local community needs.

In order to assess the international requirements, five experts were asked to customize them based on their experience gathered from the 2008 Hadramout flood disaster. Table 4.1 shows the personal information of experts. Table 4.2 presents the experts' customization for the basic requirements for the settlement of the displaced and the standard of shelters.

Table 4.1: Experts' Information

N.	Name	Background	Org.	Position	Time period
1	Abdullah Bin Saad	-	GO***	Resettlement director,MC*	2008-2011
2	Abdullah Sweed	Mechanical	GO***	Resettlement director,MC*	2008-2009
3	Hamed Al-Saqaf)	-	NGO***	Rescue team director	2008-2009
4	Maher Bahomeesh	Architect	GO**	Assessment Engineer,RF*	2009- 2011
5	Osama Hassan BinYahia	Civil engineer	GO**	Manager , RF*	2008-2011

* RF- Rebuild Fund - Public Works Ministry, MC- Municipal Council
** GO- Governmental organization
*** NGO- Non Governmental organization

Table 4.2: Customization of the Basic Requirement for Displaced Settlement and Shelter

International requirement (needs & rights)	Customized by expert
Basic requirement priorities (IASC, 2005a): 1. Clothes, blankets 2. Shelter 3. Mattress 4. Windproof 5. Stove 6. Flooring 7. Wall and roof insulation	Basic requirement priorities: 1. Food,clothes, blankets 2. Reuniting families in shelter 3. Mattress 4. Windproof 5. Wall and roof insulation
Cash Grants (IASC, 2005a).	Cash Grants: 2$ for a person per day(food and water excluded)
special needs (Silove, et al., 2006):	Priorities of special needs : (Special cases such as pregnants, older, handicapped)
Minimum covered area: - 3.5 m^2 per person excluding cooking facilities (UNHCR, 2000; OCHA, 2004; Sphere Project, 2011; IFRC, 2011) - 18-25 m2 per family including bathing and cooking facilities (IASC, 2010b)	Minimum covered area: - 2.5 m^2 per person excluding cooking facilities - At least 18 m2 per family (5persons) including bathing and cooking facilities (IASC, 2010b)
Food preparation: 100 m^2 per 500 persons (UNHCR, 2000)	No additional requirement
Storage: 150 - 200 m^3 per 1,000 persons (UNHCR, 2000)	No additional requirement
Minimum quantity of water: 15- 20 Liters per person per day (UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)	Minimum quantity of water: 15- 20 Liters per adult person per day 25- 35 Liters per child per day
Maximum number of people per tap:	No additional requirement

200-250 persons per tap (UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)	
Maximum distance to taps: 100 m or few minutes' walk (UNHCR, 2000; OCHA, 2004)	Maximum distance to taps: 50 m or few minutes' walk
Maximum people per latrine: 10-20 persons (if sex-segregated public toilets) or 1 toilet per family (5-10 persons) (UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)	Maximum people per latrine: 25 persons for male use 15 persons for female use 1 toilet per family (5-7 persons)
Maximum people per shower: 50 persons (UNHCR, 2000)	No additional requirement
Maximum distance to toilet: 50 m (UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)	No additional requirement
Maximum distance form shelters to refuse disposal: Less than 100 m to communal pit (OCHA, 2004; Sphere Project, 2011)	No additional requirement
Maximum People per 100 m^3 communal refuse pit: 500 persons (UNHCR, 2000; OCHA, 2004)	No additional requirement
Maximum People per 100 liters refuse container: 10 families or 50-persons (UNHCR, 2000; OCHA, 2004; Sphere Project, 2011)	No additional requirement
Minimum level of illumination at shelters: 40-100 Lux (MC, 2006)	1 white florescent unit 80 watt
Supplementary tasks (first aid treatment, checking in, offices) : 400 Lux (MC, 2006)	No additional requirement
Emergency lights: Buttery lights are used for 24 hours- 1 lux for shelters, 15 lux for tasks area (MC, 2006)	Not required
Indoor temperature: 15 to 19° C(UNHCR, 2000)	No additional requirement
Ventilation: Comply with building codes (IASC, 2010b; MC, 2006)	1 roof fan per family 1 roof fan per 12.5 m^2
Fire extinguishers: Provision extinguisher for each risk location (MC, 2006)	No additional requirement
Medical services: 1 health center per 1 site or 20,000 persons (UNHCR, 2000)	No additional requirement
Educational services: 1 school block per 1 sector or 5,000 persons (UNHCR, 2000)	No additional requirement
Aid distribution: 1 point for 5000 persons (UNHCR, 2000)	Aid distribution: 1 point for each site
Retail store: 1 market per 1 site or 20,000	Not required

persons (UNHCR, 2000)	
A public address system (UNHCR, 2000)	Not required
Administrative offices and accommodations staff (UNHCR, 2000)	Administrative offices and accommodations staff at each site
Security fencing (depending on circumstances) (UNHCR, 2000)	Security fencing between the shelter and the surrounding neighborhood
Adequate separations and screening are required for privacy purposes (MC, 2006)	Adequate separations and screening are required for privacy purposes(in case of families units or genders zones)

As shown in table 4.2, the local community characteristics obliges the modification of the international standard to meet the special needs of the community. In general, the suggested modifications are lower than the international standard or they add more explanation of the standard requirements.

4.2 Building potential criteria weighting

To weigh the building potential criteria, a set of actions is carried out. These actions are the development of a pairwise comparison questionnaire survey, pilot testing it, distributing and collecting it and analyzing the responses.

- **Development of Pairwise Comparison Questionnaire Survey**

To assess the relative importance of the 19 defined criteria, a set of matrices is developed to assess the criteria while considering the main level, sub level and sub-sub level of criteria. Equation 1 is applied to estimate the number of pairwise comparisons in each level of criteria (Saaty, 2008).

The number of pairwise comparisons = n* (n-1)/2 ……..……. (4.1)

Where n= number of criteria

In the developed questionnaire survey, the respondents were asked to assess the relative importance of the criteria by selecting one of the five verbal terms used in the evaluation scale. The verbal terms used to assess criteria are “Extremely important”, “Very Strongly Important”, “Strongly important”, “Weak important”, and “Equally important”.

Where:

1= Equally Important,

3= Weak Important,

5= Strongly Important,

7= V. Strongly Important,

9= Extremely Important

The developed questionnaire survey is attached in Appendix I

- **Pilot testing the Questionnaire Survey**

For the purposes of testing the criteria statement’s clarity and comprehensibility, the developed questionnaire survey was pilot tested by consulting six respondents in the Hadramout Province. The pilot testing process helped to discover any ambiguous statements, revise them, and estimate the required time to complete the survey form.

- **Distributing and Collecting the Questionnaire Survey**

The building potential criteria were assessed by specialists who were involved in the relief and reconstruction efforts in the Hadramout Flood of 2008. The selection of respondents’ samples was based on the assigned tasks during the disaster, years of

experience and educational background. All of the respondents worked for Non-Governmental Organizations (NGO) and Rebuild Fund (RF), which was established by the Public Works Ministry.

Throughout the Hadramout province, 125 hard copies of the questionnaire survey were distributed in the offices and branches of NGOs and the Rebuild Fund. 82 copies of the questionnaire were received as responses. Twenty-two of these responses were rejected because they were incomplete or filled out by inexperienced persons, leaving sixty responses for the assessment of the criteria. Table 4.3 presents the assessment based on the received responses.

Table 4.3: The Received Responses Assessment

125 Hardcopy of questionnaire survey distributed to Rebuild Fund and Non Governmental Organizations (Al Rafah, Islamic Association and Al-Badiah)		
	- 43	Not received from the RF and NGOs
	- 5	Filled by inexperienced persons
	- 11	Incompleted
	- 6	Filled with a pattern
60 responses are accepted		

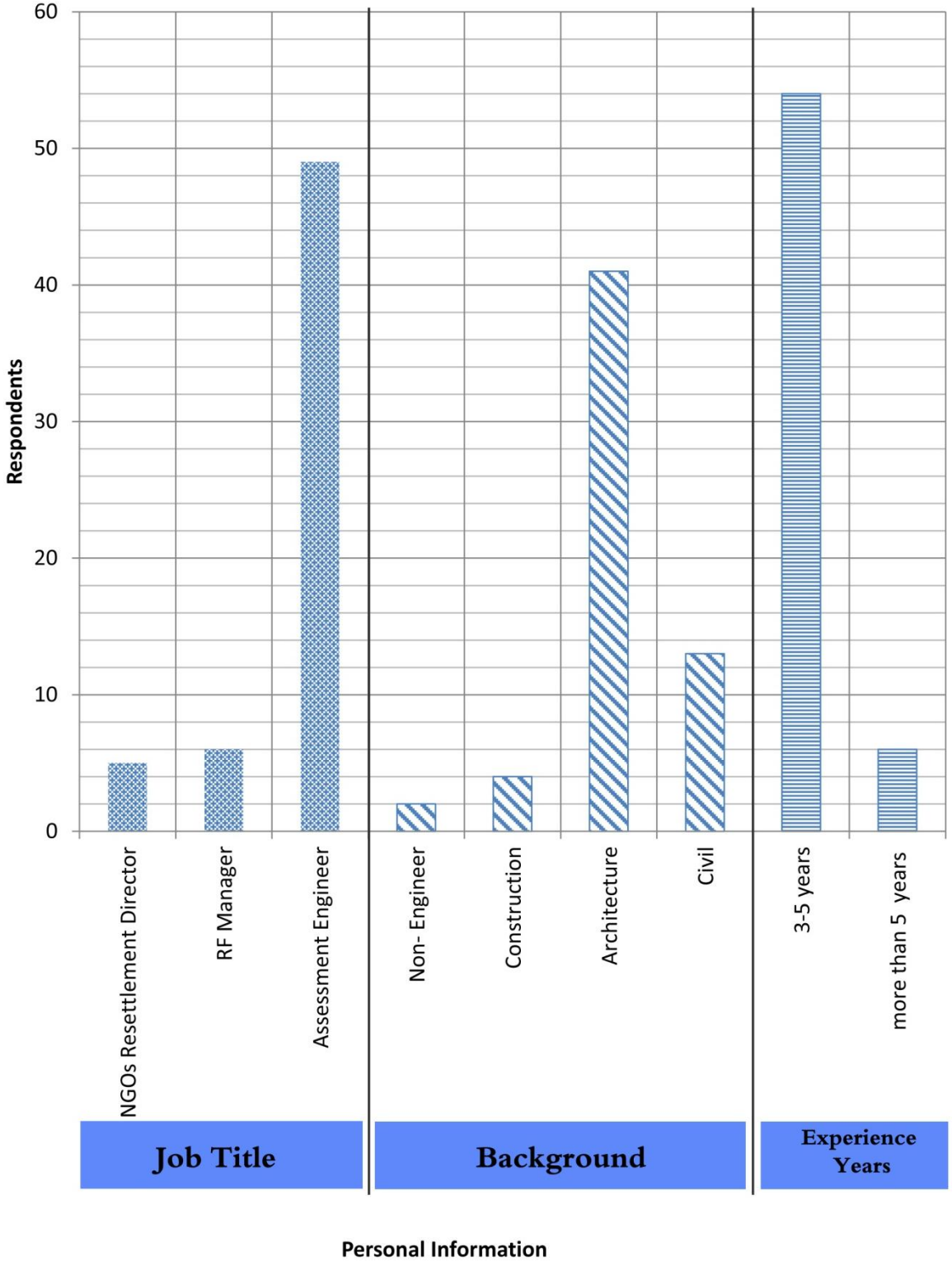
- **Questionnaire Survey Analysis**

According to the personal information fields in the survey, the years of experience indicate that 10 percent of the respondents (6 persons) have more than 10 years experience gained from the 1980s relief projects, while the remaining 90 percent of the respondents (54) have 3 to 5 years experience gained from the relief projects of the recent 2008 flood event.

Regarding the educational background of respondents, about 21 percent of the respondents (13 persons) have a structural engineering background, about 68 percent (41 persons) have an architectural engineering background, about 6 percent (4 persons) have a construction management background, while the remaining 3 percent (2 persons) have no engineering or management background.

The respondents were asked about the job title and assigned tasks during the disaster. The results indicate that about 82 percent of respondents (49 persons) worked as assessment engineers at different sites around the Hadramout directorates, 10 percent (6 persons) worked as branch managers of the Rebuild Fund and NGO's, while the remaining percent (5 persons) worked with NGO's as resettlement directors at collective centers in Mukalla, capital of Hadramout, and Say'un. Figure 4.1 presents the personal information of respondents graphically.

To get the accurate weights of the criteria, the accepted responses were analyzed. All the respondents' judgements were entered into the Expert Choice software to calculate the weights by applying the AHP method. Table 4.4 concludes the local and global relative importance of the criteria.



[Figure 4.1: The Personal Information of Respondents]

Table 4.4: Relative Importance of Building Potential Criteria

Criteria	Ranking			Priority	
	Main	Sub	Sub-sub	Global	Local
Building Characteristics	1			**0.486**	**0.486**
Structure and Design		1		0.165	0.340
Flexibility to remodel the layout			3	0.027	0.164
Availability of functional spaces			1	0.076	0.458
Number of access points			2	0.063	0.378
Occupancy		2		0.117	0.240
Capability of occupying spaces			2	0.029	0.250
Maximum capacity of building			1	0.088	0.750
Building Systems		3		0.110	0.226
Capability of the water supply, sanitary, power supply systems			1	0.063	0.570
Ventilation			2	0.028	0.255
Fire			3	0.019	0.175
Adaptation Works		4		0.094	0.194
Availability of required resources			2	0.022	0.235
Reverting the adapted building to its original condition			1	0.072	0.765
Infrastructure and Public Facilities	3			**0.235**	**0.235**
Infrastructure		1		0.167	0.709
Capability of the municipal water supply, sanitary, power supply systems			1	0.092	0.553
Accessibility to the site			2	0.075	0.447
Public Facilities		2		0.068	0.291
Proximity of available public facilities			2	0.014	0.205
Availability of facilities for special needs people			3	0.005	0.069
Ease of establishing temporary support facilities			1	0.049	0.726
Communities Considerations	2			**0.279**	**0.279**
Attainment of privacy		3		0.032	0.115
Impact of displaced population size		4		0.031	0.113
Hosting period		2		0.070	0.251
Social interaction and community support		1		0.145	0.521
Consistency Ratio = 0.07					

The results of the criteria assessment indicate that the building characteristics have the highest relative importance value with 0.486 as a global priority, while the communities' considerations criteria has the second global priority with 0.279. The infrastructure and public facilities have a lower relative importance with 0.235 as a global priority. This variation between the relative importance values reflects the respondents' opinions about these criteria. They confirmed that the effects of the building characteristics are essential in the assessment of the building. Therefore, assessment and selection of transitional shelters have to be given more importance to building characteristics.

As shown in Table 4.4, the building characteristics and infrastructure and public facilities have two levels of sub criteria, while community considerations have just one level of sub criteria. The results of the building characteristics sub criteria indicate that the building structure and design are the most important issues (0.165) in this group of criteria. The respondents ranked the sub criteria in sequential priorities and they believe that the adequate building for transitional shelters has to have functional spaces as far as possible, an adequate number of access points and a flexible layout allowing for minor modifications. The second sub criteria of building characteristics is building occupancy (0.117). The criteria ranking shows that the building's maximum capacity has to be given more consideration than the occupancy ratio of the spaces in the process of building assessment. The third sub criteria of building characteristics are building systems (0.110). The respondents ranked the sub-criteria of building systems as follows: they believe the adequate building for transitional shelters has to have reliable water, power and sanitary systems in the first

instance, while other systems such as ventilation and fire prevention are low priority requirements. The last sub-criteria of the building characteristics are adaptation works. Despite the importance of the availability of required resources, the respondents believe that the reinstatement of a building to its original condition after the disaster is a critical issue that has to be studied carefully before conducting any adaptation works. The importance values and ranking of sub criteria of the building characteristics are presented in detail in Table 4.4.

In relation to the communities' considerations, the results of the sub-criteria indicate that social interaction and community support have the highest relative importance in this group of criteria. The respondents believe that the community's support is the most important reason for the success of settling the displaced in a host community. The respondents ranked the sub-criteria sequentially as follows: hosting period, attainment of privacy and impact of displaced population size. Although the community's support is very important, the priority of the attainment of privacy conflicts with the local community situation. To explain this judgement, the relation between privacy and the hosting period could be the cause of the incompatibility; the respondents believe that the privacy factor could be discarded to reduce the hosting period.

Lastly, the result of sub-criteria concerning infrastructure and public facilities indicates that the infrastructure has more relative importance than public facilities (0.167, 0.068). The respondents believe that to use a building in an urban location, the municipal systems such as water, power and sanitary systems have to be capable of accommodating the expected additional use with consistency. In addition, they

believe that the availability of safe and adequate access to the shelter sites is the second priority, subsequent to the capability of municipal systems. In relation to public facilities and services, the results indicate that the ease of establishing temporary support facilities is the most important concern. They believe that in order to ensure the success of the settlement of the displaced at a host community, the transitional settlement buildings need to support facilities such as stores, aid distribution centers and field hospitals that could be constructed temporarily in the nearest open area. They also believe that, as a second priority, the building selected to settle the displaced has to be linked with basic services within reasonable walking distance. In general, the result of the infrastructure and public facilities criteria is reasonable and compatible with the expectation obtained from literature and the previous criteria of the building characteristics.

By comparing the obtained weights with the problems and difficulties of the case studies, we can conclude that, there is a considerable correlation of between the criteria weights with these problems. This correlation of weights with problems and difficulties supports the respondents' judgement and confirms the credibility of weights. Table 4.5 shows this comparison between criteria weights and the problems recorded.

Table 4.5: Comparison between Criteria and Problems Records

Weights Percentage values	Criteria of building potential assessment	Difficulties occurrence Number of buildings
50% 25%		1 2 3 4
	Building Characteristics	
	Structure and design	
	Occupancy	
	Building systems	
	Adaptation works	
	Infra. and Public Facilities	
	Infrastructure	
	Public Facilities	
	Communities Considerations	
	Attainment of privacy	
	Impact of displaced pop. Size	
	Hosting period	
	Community interaction	

CHAPTER FIVE

MODEL DEVELOPMENT

This chapter includes the model structure development. The model development is based on previous research studies and experiences gained. The developed model consists of five sequential phases which are required to assess the most important concerns of the temporary use of a building as transitional shelter.

5.1 The Assessment Model of Buildings Potential for Temporary Use

The idea of this model is to develop an assessment tool to measure the relative potential of buildings for temporary use as shelters. The concept of adapting and using buildings temporarily during a disaster was developed by Shelter Project SP in 2005 at the University of Cambridge (Corsellis & Vitale, 2005). Shelter Project provides essential guidelines to help the specialists deal with the problems of transitional settlement of displaced population around the world from the planning phase to the implementation phase. Shelter Assessment, Monitoring, and Evaluation (SAME) is the name of the suggested approach by SP to assess transitional settlement.

The developed model is based essentially on four sources which are the concept of the SAME, international standard of shelters, criteria obtained from the literature review and the local expert customization of the criteria and requirements. The composition of all these components creates a new model adequate for the local community application in Yemen. Figure 5.1 presents the model development process. Although this model was

developed for application in Yemen, the model structure can be used in other communities. Using the model in different context requires re-assessing the criteria weighting and re-customizing the displaced shelter requirements to meet the local community needs.

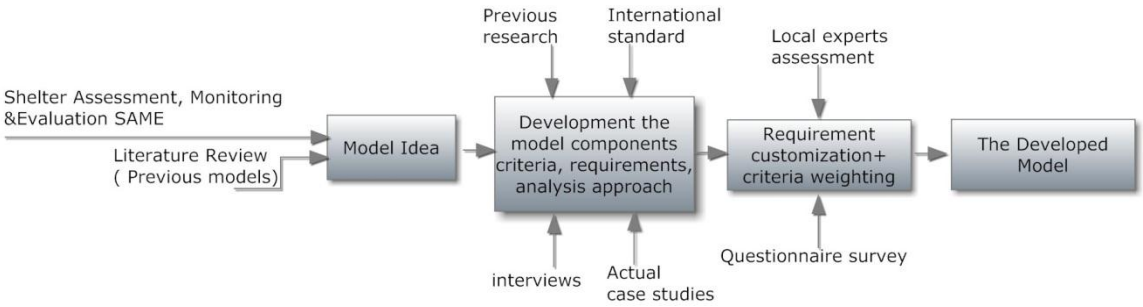


Figure 5.1 : Model Development

This model is developed as a decision support tool to assist the decision makers. It is based fundamentally on the AHP technique to analyze and assess building potential. Applying this model before the disasters will provide the disaster management team with the capability of the available building stock to accommodate the displaced people. This model will assess the potential of buildings for temporary use, their expected capacity, restrictions of use and the adaptation actions required to make them suitable for transitional settlement.

As mentioned previously, the model consists of five sequential phases. The first phase is identifying the planning constraints profile. The importance of this phase is to define the context to apply the model and also define the requirements and standards that have to be reached. The second phase is to assess the building's availability and stability to accommodate the proposed function. The second phase is an overall assessment without going into details. If the building gets the approval of the second phase, buildings can

then be assessed in detail in the third phase. In the third phase, the condition of a building is evaluated by using an assessment checklist. The assessment checklist includes questions related to technical issues that were defined to meet the developed criteria. The fourth phase is analyzing the data that were collected from the previous phases. Finally, the fifth phase is the documentation of the results. Overall assessment value, capacity, constraints, recommendation of adaptation are the main contents of the document.

All of these phases are linked together. The approval of the previous phases is required before progressing to get the next phase. To use and apply this model, a framework has to be followed by a team of specialists to assess the building potential for temporary use as transitional shelters. The assessed building has two possible scenarios. The first scenario is that the building cannot meet the minimum requirement, or the building passed the first phase and has low potential for temporary use, so it will be in a class which includes all buildings that have constraints. The other scenario is that the building passed all phases and has high potential, so it is adequate for temporary use. Figure (5.2) shows the model and its sequential phases.

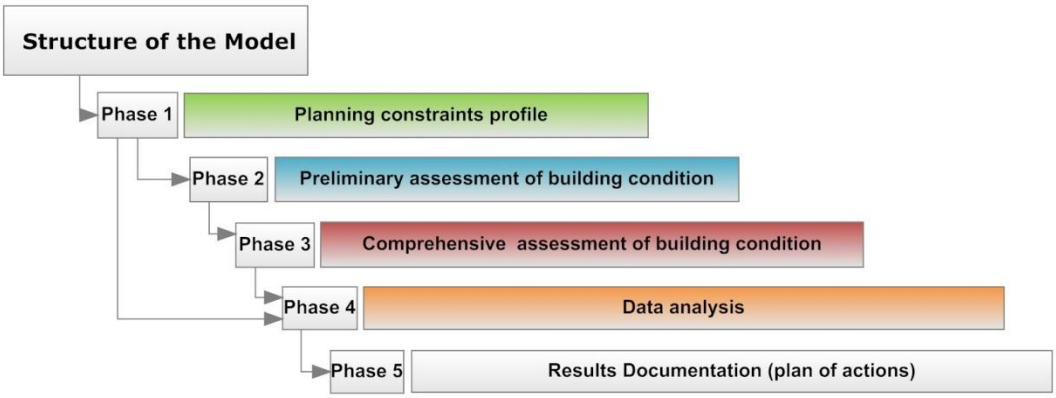


Figure 5.2: The Assessment Model of Buildings Potential for Temporary Use

5.1.1 Phase 1: Planning Constraints Profile

To conduct the assessment process of buildings, the assessment has to be compared with a certain level of requirements, which act as assessment constraints. This profile is obtained from the planning phase of disaster resilience management. Therefore, constraints have to meet the planning goals during the disaster situations. These constraints will be considered at all phases of assessment. Identifying constraints is based on four components, which are as follows (Corsellis & Vitale, 2005):

- **Model Application Context**

This model has to be applied in a particular context which has to consider the following:

- All displaced people have to be settled internally within the affected region. That means the model will be applied in the safest locations in the vulnerable region in Yemen.
- The distance between shelters and the original homes of the displaced has to be as short as possible.
- All selected buildings have to be classified in groups based on their function. That is to define the relative potential of each building within the group.

- **Standards of Shelters and Minimum Requirements of the Displaced People:**

As mentioned previously in chapter 2, the Sphere Project (2011) and UNHCR Handbook standards were developed to provide organizations with the minimum requirements of displaced people in disaster conditions. These requirements were customized by local experts to meet the local community needs in Yemen. Table 5.1 presents all of these requirements.

Table 5.1: Basic Requirement for Displaced Settlement in Shelter in Yemen

1	Basic requirement priorities: 6. Food,clothes, blankets 7. Reuniting families in shelter 8. Mattress 9. Windproof 10. Wall and roof insulation
2	Cash Grants: 2$ for a person per day(food and water excluded)
3	Priorities of special needs : (Special cases such as pregnants, older, handicapped)
4	Minimum covered area: - 2.5 m^2 per person excluding cooking facilities - At least 18 m2 per family (5persons) including bathing and cooking facilities (IASC, 2010b)
5	Food preparation: 100 m^2 per 500 persons
6	Storage: 150 - 200 m^3 per 1,000 persons
7	Minimum quantity of water: 15- 20 Liters per adult person per day 25- 35 Liters per child per day
8	Maximum number of people per tap: 200-250 persons per tap
9	Maximum distance to taps: 50 m or few minutes' walk
10	Maximum people per latrine: 25 persons for male use 15 persons for female use 1 toilet per family (5-7 persons)
11	Maximum people per shower: 50 persons
12	Maximum distance to toilets: 50 m
13	Maximum distance form shelters to refuse disposal: Less than 100 m to communal pit
14	Maximum People per 100 m^3 communal refuse pit: 500 persons
15	Maximum People per 100 liters refuse container: 10 families or 50-persons
16	1 white florescent unit 80 watt
17	Indoor temperature: 15 to 19° C
18	1 roof fan per family 1 roof fan per 12.5 m^2
19	Fire extinguishers: Provision extinguisher for each risk location
20	Medical services: 1 health center per 1 site or 20,000 persons
21	Educational services: 1 school block per 1 sector or 5,000 persons
22	Aid distribution: 1 point for each site
23	Administrative offices and accommodations staff at each site
24	Security fencing between the shelter and the surrounding neighborhood
25	Adequate separations and screening are required for privacy purposes

- **Expected Capacity:**

To manage the effects of the disaster, planners have to think about the expected capacity. (Corsellis & Vitale, 2005). Identifying the expected capacity of the building is impossible before the disaster happens. However, based on the interviews with involved people in relief efforts, they believed the displaced population could be estimated by:

- Estimating the approximate population size of the neighborhood and nearest locations, because displaced people are resettled at the nearest location to their homes (Bin Saad, 2012; Sweed, 2012).
- To save resources, the settlement of the displaced has to be feasible and the number of displaced has to be neither too low nor too high (Al-Kaff, 2012). Al-Kaff (2012) indicated that many settlement centers were closed because the displaced people were fewer than 100 persons, while other centers faced many managerial problems and difficulties because the density of people was very high with over 1500 displaced persons (UNHCR, 2000; Al-Kaff, 2012).

- **Available Resources to Conduct Adaptation Works**

Availability of resources to conduct adaptation works is a very important issue when selecting buildings for temporary use. Therefore, the required resources to adapt the buildings have to be expected. This includes funds, time, manpower, and materials. This constraint serves to exclude buildings that could require a lot of adaptation work to be adequate for temporary use as transitional shelters.

Therefore, the concerned parties that plan for pre-disaster assessment have to develop and customize these requirements to meet the local needs and priorities.

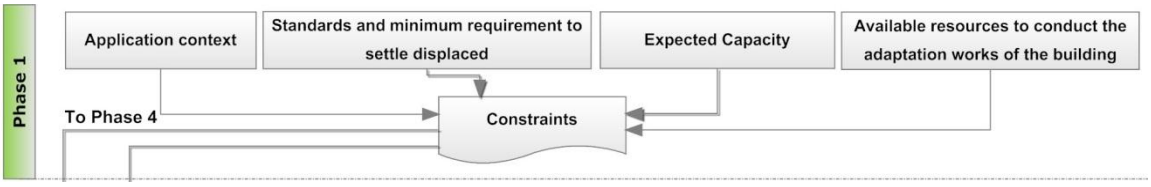


Figure 5.3: Phase 1, Planning Constraints Profile

5.1.2 Phase 2: Preliminary assessment of a building's condition

After identifying the constraints profile, an overall assessment has to be conducted on the available building stock to assess the potential of buildings to accommodate the proposed function. The objective of conducting the preliminary assessment is to exclude buildings that have serious problems or do not meet the essential requirements, and to focus on the competitive alternatives. The considered issues in this phase are the availability of buildings, their stability and the safety of the displaced. Corsellis & Vitale (2005) indicated that this step includes veto criteria which have the power to eliminate any buildings. Therefore, these criteria were excluded from the criteria assessment for the temporary use of a building. All of these issues can be assessed by using simple questions. Figure 5.4 and table 5.2 show how the preliminary assessment is conducted.

Table 5.2: Preliminary Assessment Checklist

Main issues		
Availability	Type of building ownership	- Personal properties - Public properties
	Availability of owner agreement	- Formal agreement of government parties or persons - Informal agreement and commitment
	Building occupation status	- Vacant - Fully or partially occupied
	Ability to relocate the building function in another	- Building function can be relocated in other buildings with extending the work

		building	hours.
Stability		Building structure stability	- In a good condition - New - Renovated - Defected and risky
		Availability of serious defects	- Just finishing defects - Structural elements are defected
Displaced safety	Types of expected risk	- Buildings collapse - Disaster risk	
	Building vulnerability for disaster risk	- The distance from the water body - The lowest point in the site is higher than the water	

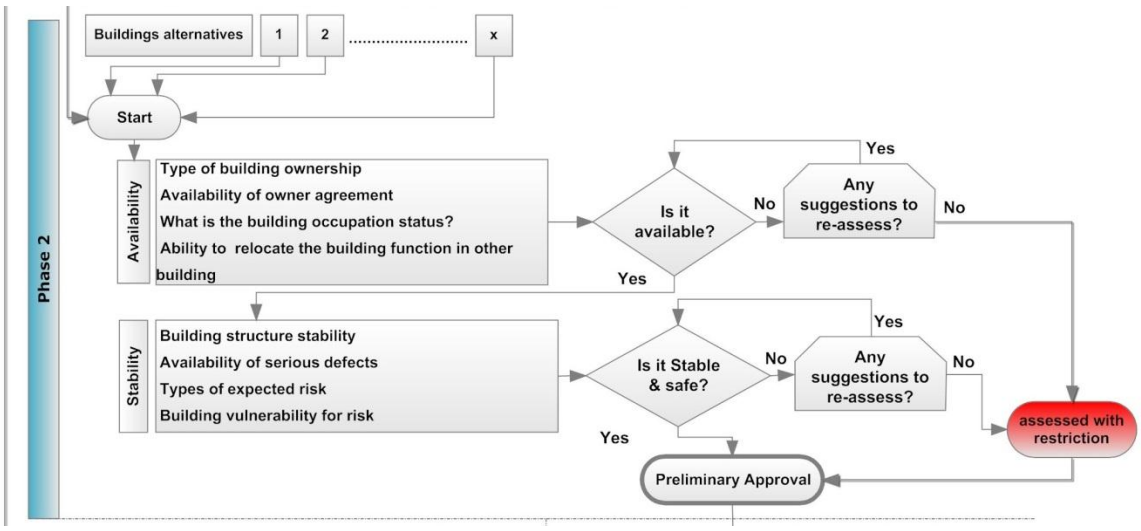


Figure 5.4: Phase 2, Preliminary Assessment of Building Condition

5.1.3 Phase 3: Comprehensive Assessment of the Condition of a Building

The comprehensive assessment is conducted on buildings that get the approval for the second phase of assessment. Unlike the preliminary assessment, the third phase of the assessment goes into the details and it is based on the criteria that were obtained from the previous research and interviews with practitioners. This assessment is conducted by using an assessment checklist which matches the criteria structure and also covers all of

the building systems. The assessment checklist includes a list of key questions that help evaluators to assess buildings. Table 5.3 shows these questions of the assessment checklist. Appendix II is an assessment checklist form that has been developed for use by the evaluator in the walk-through building assessment. Figure 5.5 shows the process of comprehensive assessment a building's condition.

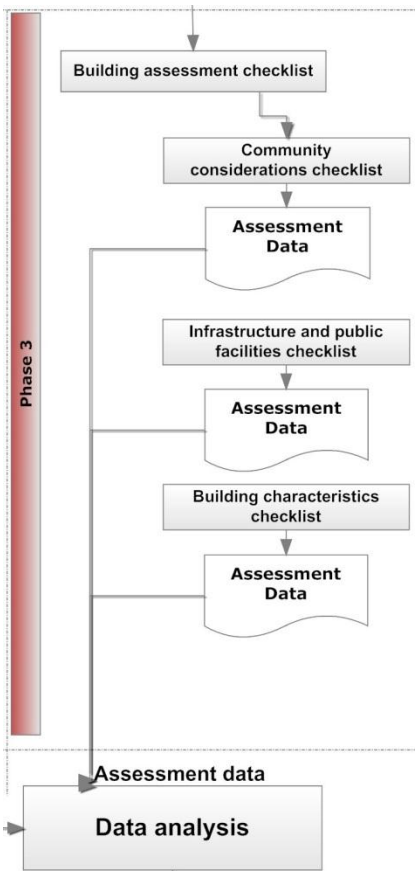


Figure 5.5: Phase 3, Comprehensive Assessment of Building Condition

Table 5.3: Assessment Checklist (Corsellis & Vitale, 2005; IFRC, 2011; Sphere Project, 2011)

Criteria	Questions
Building Characteristics	
Flexibility to remodel building layout	- What is the type of building structure? - Does it allow for adjustment? - What is the level of adaptation works? - How much is the total useful area of floor? - Can the available spaces be remodeled easily?
Availability of functional space units	- How many rooms are available to use? - How many bathrooms are already available to use? - Is there an internal open space for gathering people?
Number of access points to the building and proximity to the main circulation routes	- How many entrances are available to use? - Are they suitable for the settlement use? - Are entrances and routes provided for the handicapped people (ramps, curb cuts, and handrails)? - Are the circulation routes capable to discharge the expected population?
Capability of occupying the spaces in the building either partially or fully	- Are there any expected spaces that will be used as a store? - Are there any spaces that include fixed equipment or furniture? (Labs, laundry)
The building's maximum capacity to accommodate the displaced population	- What is the expected capacity of the building - If some modifications were carried out, can the building accommodate more than the expected capacity? - What is the maximum expected capacity?
The capability of the water supply, sanitary, power supply and gas supply systems to tolerate the additional demand for services	- Is there a need for extra water source (e.g. extra tanks)? - Does the capability of electrical network provide the expected use (e.g. distribution of power sockets, light distribution, AMP and capacity of the new expected appliances) ? - Are the Sanitary pipes capable to tolerate the expected use? - Are building installations and equipments durable to tolerate the heavy use?
The capability of the HVAC systems to tolerate the additional demand for services	- Is the HVAC system capable to provide occupants with the required thermal comfort?
The capability of the	- Does the expected function have more risk than the original

fire protection systems to tolerate the additional demand for services	function? - Does the building condition meet the minimum requirement of fire safety standard? - What is the expected source of fire? - What is the expected fire load?
Availability of required resources for carrying out the required adaptation works	- Do adoption works meet the allocated resources? - Can works be carried out under the disaster and harsh climate conditions?
Reverting the adapted building to its original design	- Are the suggested works leading to permanent modifications on the original layout?
Infrastructure and public facilities	
The capability of the municipal water supply, sanitary, power supply systems	- What is the ratio of displaced population to host community population? - How long is the transitional settlement period? - Are the municipal services in a good condition to tolerate the additional demand for services? - Is there a need to upgrade these services?
Accessibility to the site (e.g. through pathways and roads)	- Is there an open space facility close to the settlement location? - If not, is there a clear area to construct portable temporary facilities? - What are the suggested actions to get these facilities? - What are the accesses conditions? How much is the roads vulnerability to weather conditions?
Public facilities that provide services to the displaced population	- What is the expected distance between the building and the nearest public facilities? - Are they capable to tolerate the additional demand for services?
Availability of facilities to accommodate the special needs	- If the building was not providing the needs of disabled people, is there any other building to settle them?
Ease of establishing temporary support facilities	- Is there an open space facility close to the settlement location? - Is there a clear land to construct portable temporary facilities?
Communities considerations	
Privacy of host and displaced	- Is the allocated area providing the required level of privacy for each family? (e.g. room and bathroom) - Are the community customs and priorities considered? - Is there any expected violation for hosted community privacy? - How much is the separation distance between assessed

	building and closest neighbors' buildings?
Impact of the size of the displaced population	- What is the ratio of the displaced population to the host population? - How much is the separation distance between assessed building and closest neighbors' buildings? - Are there any expected slum spots caused by the displaced settlement at the host community? - Is there any expected inconvenience, risk and insecurity, turbulence that is caused by the displaced settlement at the host community? - Are there any environmental impacts?
Period for hosting	- How long are the displaced people accommodated in transitional shelters?
Social collaborations and community support	- What is the compatibility level of the displaced and the host population (culture, education, religion, ethnic)? - Based on the history of community collaborations in the disaster situation, What is the expected sympathy of community for displaced people?

5.1.4 Phase 4: Data Analysis

In this phase, the collected data is analyzed to get the required information of the building's potential assessment. The main steps of the data analysis process are as follows:

- Computing the building potential value: this is done by multiplying the relative importance of criteria by the assigned percentage value of criteria, which is obtained from the assessment checklist. Table 5.4 presents the relative importance of building potential criteria that were obtained from local experts in Yemen.
- Estimating the expected building capacity.
- Identifying the list of constraints which are obtained from the sub-criteria assessment.
- Concluding the suggested recommendations and actions to adapt the building.
- Developing the building layout for temporary use

Table 5.4: Relative Importance of Building Potential Criteria

Criteria	Ranking			Priority	
	Main	Sub	Sub-sub	Global	Local
Building Characteristics	1			**0.486**	**0.486**
Structure and Design		1		0.165	0.340
Flexibility to remodel the layout			3	0.027	0.164
Availability of functional spaces			1	0.076	0.458
Number of access points			2	0.063	0.378
Occupancy		2		0.117	0.240
Capability of occupying spaces			2	0.029	0.250
Maximum capacity of building			1	0.088	0.750
Building Systems		3		0.110	0.226
Capability of the water supply, sanitary, power supply systems			1	0.063	0.570
Ventilation			2	0.028	0.255
Fire			3	0.019	0.175
Adaptation Works		4		0.094	0.194
Availability of required resources			2	0.022	0.235
Reverting the adapted building to its original condition			1	0.072	0.765
Infrastructure and Public Facilities	3			**0.235**	**0.235**
Infrastructure		1		0.167	0.709
Capability of the municipal water supply, sanitary, power supply systems			1	0.092	0.553
Accessibility to the site			2	0.075	0.447
Public Facilities		2		0.068	0.291
Proximity of available public facilities			2	0.014	0.205
Availability of facilities for special needs people			3	0.005	0.069
Ease of establishing temporary support facilities			1	0.049	0.726
Communities Considerations	2			**0.279**	**0.279**
Attainment of privacy		3		0.032	0.115
Impact of displaced population size		4		0.031	0.113
Hosting period		2		0.070	0.251
Social interaction and community support		1		0.145	0.521
Consistency Ratio = 0.07					

The analyzed data will be used to check the building's suitability with the pre-defined constraints. If the building meets the constraints, it will get the final approval of the assessment process and it will be adequate for temporary use as transitional shelter. Figure 4.6 shows this process of assessment.

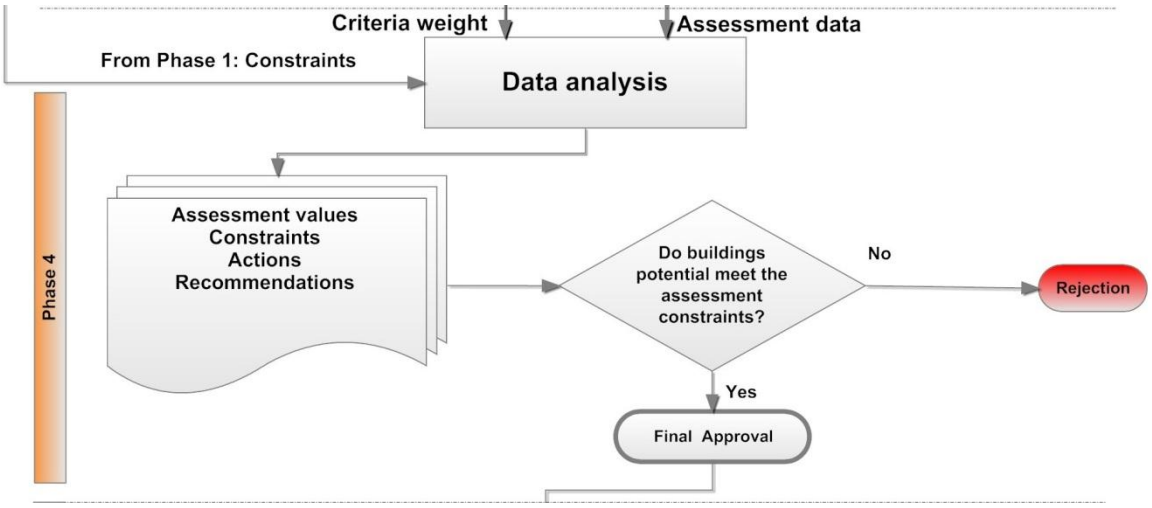


Figure 5.6: Phase 4, Data Analysis

5.1.5 Phase 5: Report Development

Consequent to the assessment process of a building's potential for temporary use, a report has to be prepared to document the assessment results. The report presents the results in a way that allows decision makers to know the actual condition of the available buildings. The report includes a statement that estimates the building potential and other information such as capacity, constraints of use and recommendations to develop the solutions. Figure 4.7 shows this phase of the model.

A variation of potential in different buildings is expected, so, an up-down classification is suggested to rank these buildings. In this classification, buildings that have high relative potential in their group and fully meet the requirements will be in class A. Class B

includes buildings that meet the requirement partially. While buildings that have some use restriction (from phase 2: preliminary assessment) will be in class C. Table 5.5 presents the classification system of buildings.

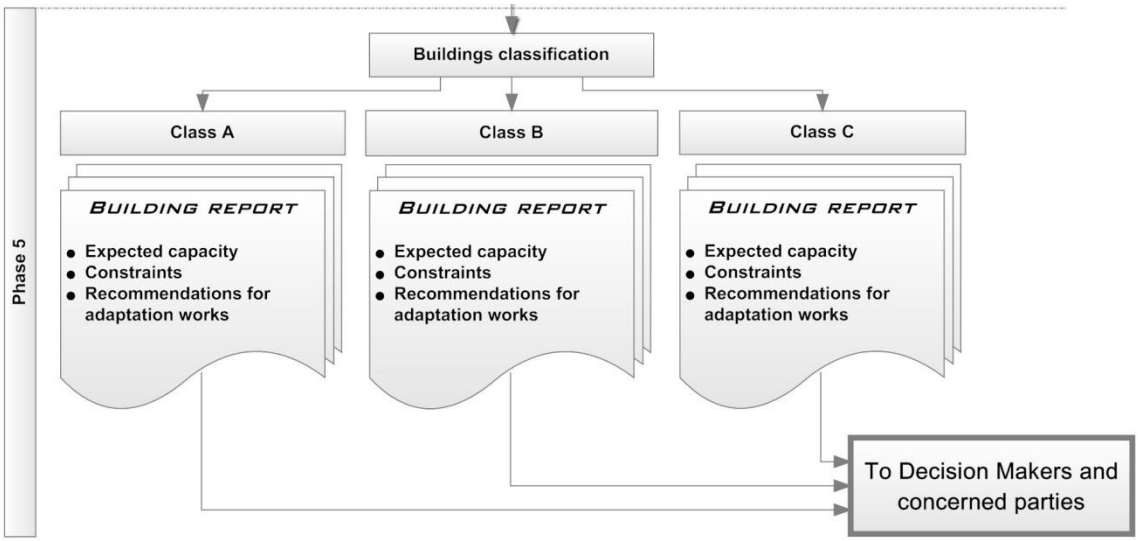


Figure 5.7: Phase 5, Report Development

Table 5.5: Building Classification

Assessment results	Class A	Class B	Class C
Potential value	100-50%	Less than 50%	Less than 50%
Restrictions	Without restriction	Without restriction	With restriction
Constraints	Fully meet	Partially meet	Partially meet
Recommendations	Few	Many	Many

- Note: the classification intervals could be adjusted to be related to the results of the buildings assessment.

5.2 Discussion

This model is an assessment tool that provides the decision maker with significant information. As mentioned previously, the model consists of five sequential phases. The first phase of the model is related to disaster resilience planning and management. The constraints profile reflects the strategy of the needs of governments and communities to manage the expected disaster. Therefore, identifying constraints is a relative issue. Governments have to define constraints according to their resources and priorities. This phase will be the guideline of the assessment process in the next phases. The second phase, as we know, is an overall assessment process to rank the selected buildings. No doubt, this process has to be conducted by specialist engineers who have the experience and knowledge to deal with these buildings and discover their potential.

If buildings get the preliminary approval, a comprehensive assessment has to be carried out to get more details about the buildings' potential. Similar to the preliminary assessment, this phase of assessment has to be done by specialist engineers who are familiar with assessment issues. In the fourth phase, the output of the assessment checklist is analyzed by using AHP technique. In addition, criteria weights and planning constraints are considered in the analysis process.

In this phase, the engineer has to add any test that could help to gain further information. Suggestions about implementation actions are expected in this phase. These suggestions will be a guideline to develop the proper solution for a building in disaster conditions.

The collected data, criteria weights and constraints of planning will be analyzed together to conclude what the building potential for temporary use is. The output of the data

analysis includes a statement that estimates the building potential, capacity, constraints of use, recommendations and proposed layout of the building.

In the fifth phase, the data analysis output documents are to be used in a database or report form. Representing the analysis output will simplify the use of this information in the disaster period. The classification of a building, which was adopted in the building's documentation, is a very important action. Buildings that have A class in each group will be adapted to settle the displaced people. If the number of displaced people is more than the expectation, the other buildings with B and C classes will be used sequentially.

As a result of grouping and classifying the buildings, all assessed buildings will be sorted by the relative potential of the other buildings within their group. Therefore, it is expected that buildings will have the same relative potential values in different groups of buildings. The decision makers have to consider and introduce all the other assessment data such as capacity , adaptation works, and recommendations to select the adequate group of buildings for disaster circumstances .

CHAPTER SIX

MODEL APPLICABILITY TESTING

In this chapter, the developed model will be applied to two case studies to test its applicability. In each case study, the model phases will be applied to the selected buildings and they will be analyzed individually. Then, the settlement history of the buildings will be reviewed to discuss and compare it with the model results. Applying this approach will help to explain the actual problems arising from the case studies.

6.1 Case Studies

6.1.1 Case Study 1: Fuwwah School

Fuwwah School is an elementary school located in the East of Mukalla, the capital city of the Hadramout. The school was constructed in 1960's. It was reconstructed and renovated three times to cater for the society's educational needs. Figure 6.1 shows the location of the school and its surrounding residential districts.

Because of the open site allocated for the school campus, Fuwwah School was designed to be built horizontally in sequential stages. The new additional buildings were constructed separately close to the old building. This type of extension created four individual buildings. During the flood disaster event, the oldest building, which was vacant, was used to settle the displaced people temporarily.

The School location was selected to serve the residential districts of old Fuwwah town. The first constructed school building was established to receive 600 students who resided

in the surroundings of the school. Because of the lack of the renovation and maintenance of this building, some of its spaces had collapsed. As shown in the school layouts (figures 6.2), the remaining spaces of the school include 14 classrooms and 4 stores only, while labs, bathrooms and offices were in the collapsed part.

During the last flood disaster in 2008, many people were displaced from their damaged homes into safe locations. Unlike Mukalla downtown settlement, the local society of Fuwwah ignored the settlement of the affected people in the neighborhood schools for ethnic and social reasons. This action forced the municipal council to find another suitable building which was the original building of the Fuwwah School.

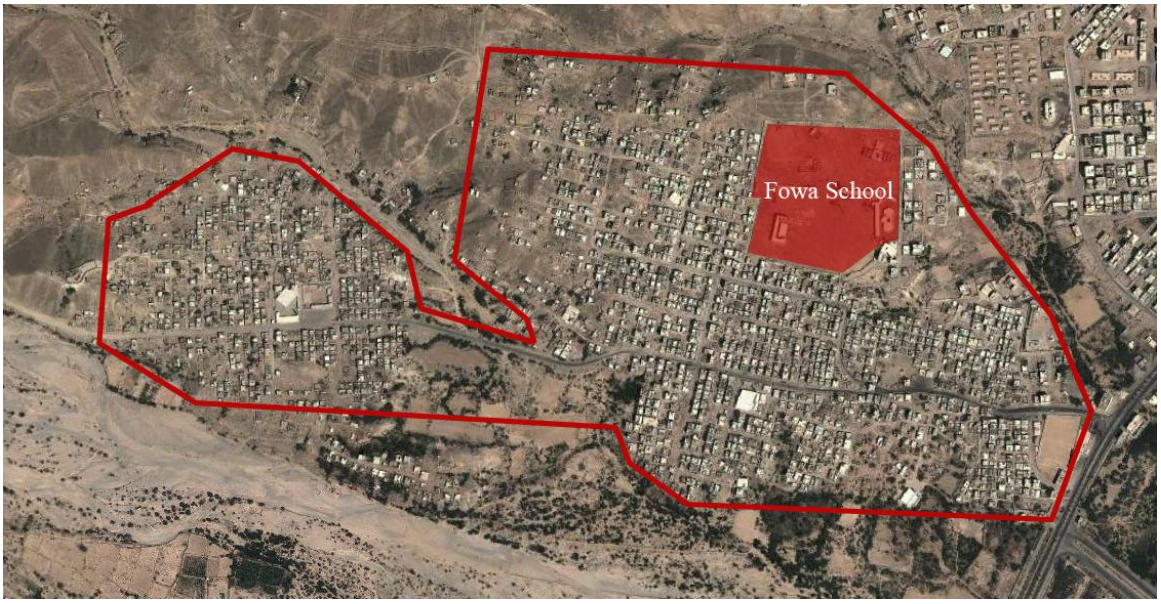


Figure 6.1: Fuwwah School Location (Google Earth, 2012)

The municipal council selection was based on the building's occupation status, its value and importance (Sweed, 2012). The settlement circumstances affected the number of resettled people at Fuwwah School. At the beginning, more than 150 persons were settled in the school. This number fell during the first month. Most displaced families left the school because of the unavailability of basic needs, which led to the closure of the settlement at Fuwwah School after three months.

As mentioned previously, 150 persons (24 families) were settled in the school for three months starting from October 2008 to January 2009. The settlement committee assigned big classrooms for big or related families, while small classrooms were allocated for small families and single women. The condition of the school bathrooms forced the displaced people to use the bathrooms and water tanks of a newly constructed mosque on the site. A temporary tent was set up close to the school to distribute food and non-food aid. Unlike other schools and settlement shelters, there were no supporting facilities in the school such as food, medicine stores and administrative offices.

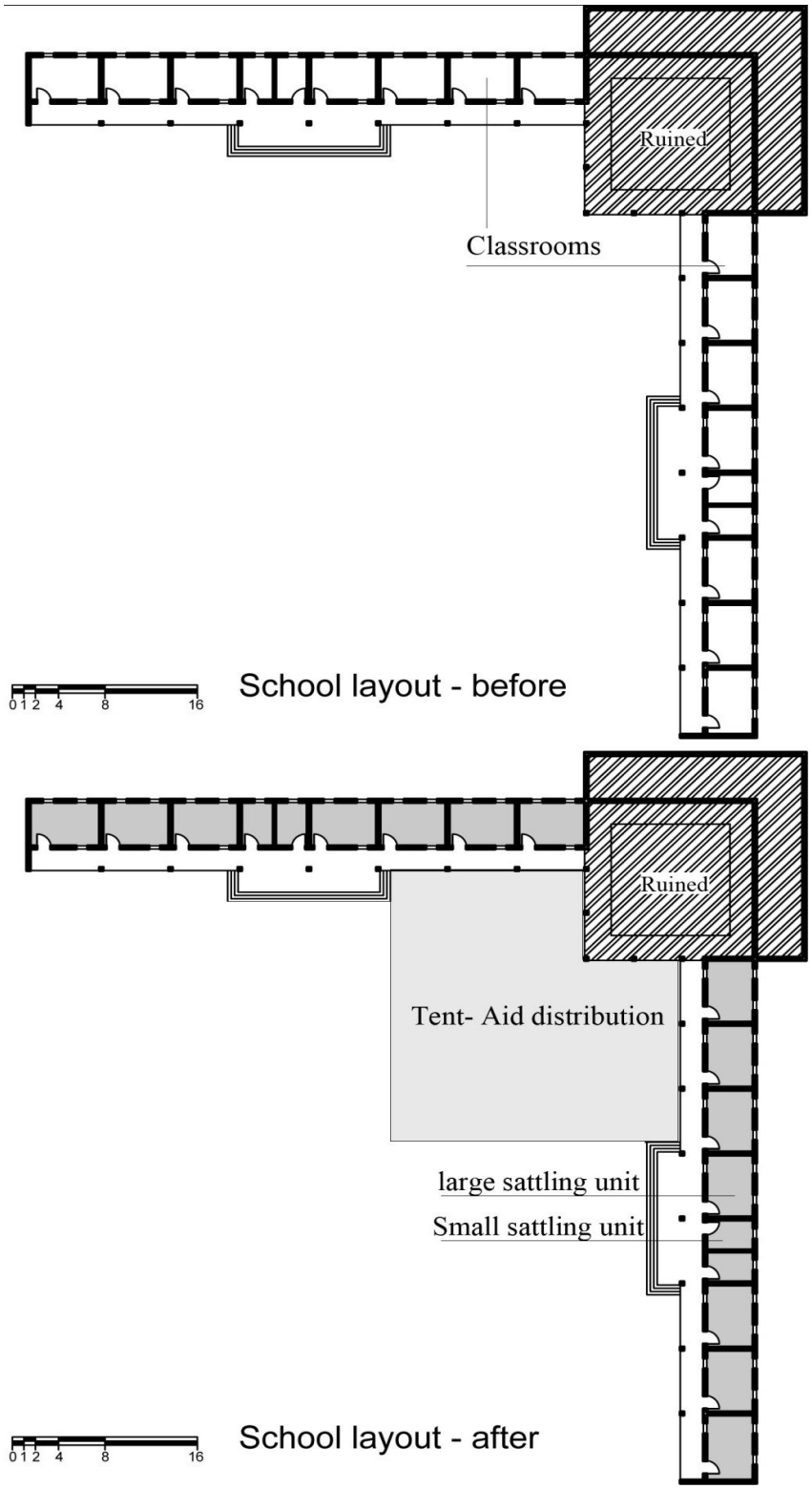


Figure 6.2: Fuwwah School Layouts (Before- After)

Figure 6.3: Fuwwah School during Settlement

Figure 6.4: Fuwwah School during Settlement

6.1.2 Case Study 2: Al-Masaken Apartment Building

Based on the time and condition of the settlement, this case is different from the previous case studies. The settlement at Al-Masaken apartment building came after the settlement at schools. It was an action to improve the settlement conditions and return the displaced to their usual life. Increasing the social problems supports the trend of resettlement of the displaced in more suitable buildings. The Municipal Council and Rebuild Fund decided to find buildings that could provide the displaced with privacy and basic requirements of a normal life.

By considering the number of flats, their condition and the building's capability, the Al-Masaken apartment building was selected with other similar buildings to accommodate the displaced. To legalize the settlement of the displaced at the building, the Municipal Council and Rebuild Fund drew up a leasing contract form between each family and the building owner. Based on the leasing contract, the Rebuild Fund developed the flats' layout by adding bathrooms and some partitions to divide flats and increase their capacity. The original flats were allocated to big families or related families, while the small flats were allocated for small families. Figure 6.5 shows the layout before and after adaptation.

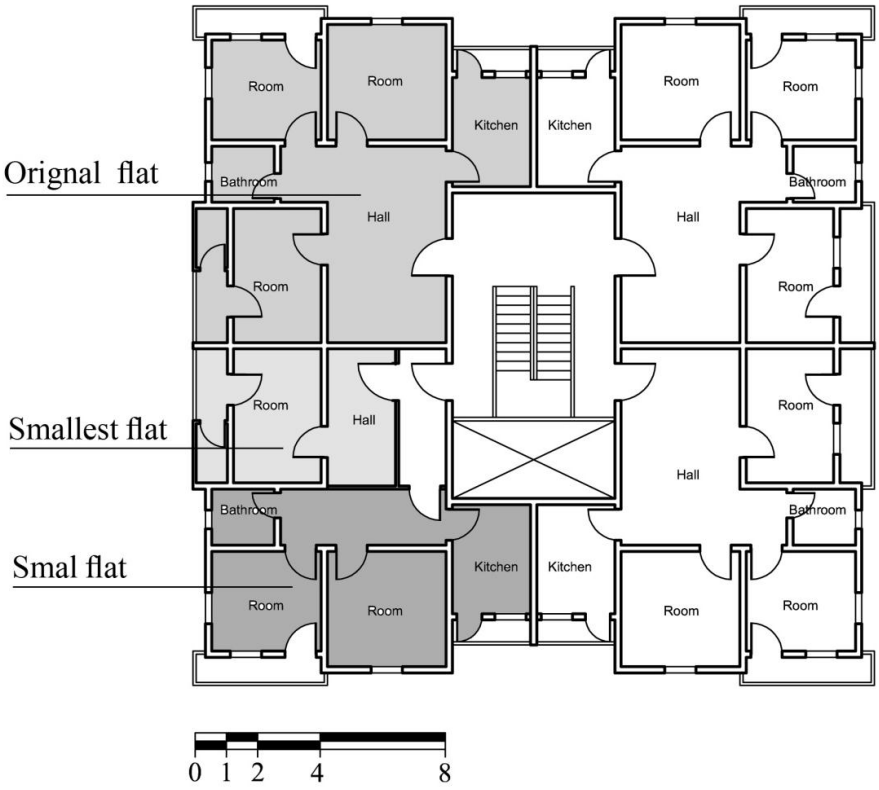


Figure 6.5: Al-Masaken Apartment Building Layout

Figure 6.6 : Al-Masaken Apartment Building during Settlement

6.2 Model Applying

6.3 Applying the Model

To test the model applicability, the two previous case studies will be evaluated by applying the model. The outcome of the model will be compared with evidence and data that were obtained from the studies documentation. To apply the model to the aforementioned case studies, a local technical team was assigned to assess the building's capabilities. The assigned team included four members who had worked in the flood of 2008 and who have the required knowledge to deal with the building assessment procedure. Table 6.1 shows more information about them.

Table 6.1: Assessment Team Information

Name	Engineering background	Missions		Location
		Previous 2008	Current 2012	
Osama Bin Yahiya	Civil Engineer	Technical Manager	Structure, risk, sanitary and infrastructure assessment	Mukalla,
Wazer Hussain	Electrical Engineer	-	Electrical network assessment	Mukalla,
Mohammed Bajsair	Architect	Assessment Engineer	Building design, infrastructure assessment	Mukalla
Zain Al-Aidaroos	Architect	Assessment Engineer	Building design, infrastructure assessment	Mukalla

As mentioned in Chapter 5, the model includes five stages that are: planning constraints profile, preliminary assessment of the building's condition, comprehensive assessment of the building's condition, data analysis and report development. The model stages involve

different concerns relating to the building capability, proposed adaptation, cost and implementation actions. For research purposes, implementation actions, cost and estimation of quantities were excluded to avoid any extra work unrelated to the research objectives.

6.3.1 Planning Constraints Profile

Complying with the planning constraints profile components, the assessment team developed the constraints profile by customizing the international standard and concluding lessons from pervious practices to meet the local community needs. Table 6.2 presents the main constraints to assess the building potential in Yemen.

Table 6.2: Assessment Constraints Profile

Standards of shelters and minimum requirement of displaced people	
Basic requirement priorities:	1. Food,clothes, blankets 2. Reuniting families in shelter 3. Mattress 4. Windproof 5. Wall and roof insulation
Cash Grants:	2$ for a person per day(food and water excluded)
Priorities of special needs :	(Special cases such as pregnants, older, handicapped)
Minimum covered area:	- 2.5 m^2 per person excluding cooking facilities - At least 18 m2 per family (5persons) including bathing and cooking facilities (IASC, 2010b)
Food preparation:	100 m^2 per 500 persons
Storage:	150 - 200 m^3 per 1,000 persons
Minimum quantity of water:	15- 20 Liters per adult person per day 25- 35 Liters per child per day
Maximum number of people per tap:	200-250 persons per tap
Maximum distance to taps:	50 m or few minutes' walk
Maximum people per latrine:	25 persons for male use 15 persons for female use 1 toilet per family (5-7 persons)
Maximum people per shower:	50 persons

Maximum distance to toilets:	50 m
Maximum distance form shelters to refuse disposal:	Less than 100 m to communal pit
Maximum People per 100 m^3 communal refuse pit:	500 persons
Maximum People per 100 liters refuse container:	10 families or 50-persons
Light	1 white florescent unit 80 watt
Indoor temperature:	15 to 19° C
Ventilation	1 roof fan per family 1 roof fan per 12.5 m^2
Fire extinguishers:	Provision extinguisher for each risk location
Medical services:	1 health center per 1 site or 20,000 persons
Educational services:	1 school block per 1 sector or 5,000 persons
Aid distribution:	1 point for each site
Suppot facilities	Administrative offices and accommodations staff at each site
Model Application Context	
	- Displaced people have to be settled internally within the range of the affected region. - The distance between shelters and the displaced houses have to be as less as possible.
Expected capacity	
Displaced capacity in shelter	- To be efficient, capacity at a shelter has to be more than 200persons - To manage a shelter and avoid chaos, capacity at a shelter have to be less than 1000 persons
Settlement period	
Settlement in shelter	- 6 -12 months
Available resources to conduct adaptation works	
Fund	- Limited
Time	- Two weeks available to conduct all adaptation works
Manpower	- Unavailability of skilled labors to conduct all buildings, plumbing, electrical works

6.3.2 Preliminary Assessment of a Building's Condition

To conduct a preliminary assessment of the selected buildings, the assessment team evaluated their availability, stability and safety. Table 6.3 summarizes the preliminary assessment of the buildings. As shown in the table, the Al-Masaken building is preliminarily adequate to use as a shelter. While the Fuwwah School was partially damaged, it could be used as shelter with some restrictions excluding the damaged part of the building. Therefore, a comprehensive assessment is required to estimate the building's potential for temporary use as a shelter.

Table 6.3: Summary of the Preliminary Assessment of the Buildings

	Fuwwah	Al-Masaken
Availability		
Type of building ownership	Public	Private
Availability of owner agreement	Available*	Available*
Building occupation status	Vacant	Vacant
Ability to relocate the building function in another building		
Availability assessment	Available	Available
Stability		
Building structure stability	Stable	Stable
Serious defects	Yes. Some spaces	No
Stability assessment	Stable with restrictions**	Stable
Safety		
Expected risk	Collapse of some spaces	Safe
Building vulnerability for disaster risk	Safe	Safe
Safety assessment	Safe with restrictions**	Safe
Overall assessment	Adequate with restrictions**	Adequate

*To carry out the assessment process, owners' agreement was assumed.
** To use the building as a shelter safely, the collapsed parts will be excluded.

6.3.3 Comprehensive Assessment of a Building's Condition

The comprehensive assessment evaluates buildings by using a checklist that was developed to cover all building aspects. To assess the buildings, the assessment team used the developed checklist form, which is attached as Appendix II, and evaluated each building independently. The following are the assessment checklist forms and proposed layouts of the buildings.

- **Fuwwah School Assessment**

Table 6.4: Assessment Checklist of Fuwwah School

Assessment Checklist of Building Potential for Temporary Use as Transitional Shelter		
1. Building Characteristics & Suitability	2. Infrastructure Services	3. Communities Considerations

Certified Specialist	**Civil- architect- electrical-municipal council member**
Engineer Name	**Osama, Wazer, Mohammed, Zain**
Attached documents: building floor plan	
Used measuring and testing tools:	

General Information

Total building area: 636 m^2
Number of floors: 1 floor
Original function of building: educational - school

1. Building Characteristics & Suitability

1.1 Building Structure and Design

Flexibility to remodel building layout	
Type of structure	Wall bearing
Does it allow for adaptation works?	Yes
What is the level of adaptation works?	altering windows into doors
How much is the total functional area of each floor?	446m^2
Can the available spaces are remodeled easily?	Yes
Sub criteria assessment (percentage value)	100 %
Availability of functional space units	
How many are rooms that already available to use?	18 space
How many are bathrooms that already available to use?	0
Is there an internal open spacefor people gathering?	Yes
Sub criteria assessment (percentage value)	60%
Access points to the building and main circulation routes	
How many are entrances available to use?	Not needed
Are they suitable for the settlement use?	Yes
Are entrances and routs providing the handicapped people (ramps, curb cuts, and handrails?)	Yes
Are the circulation routes capable to discharge the expected population?	Yes
Sub criteria assessment (percentage value) - Adequate Access points and corridors (100%) - Inadequate Access points and corridors (0%)	100%

Recommendations 1.1
What is the suggested layout to settle displaced people? Attach solution drawing
Are there any constraints to use the building? What are they? - Excluding the damaged part of the school
What are the suggested actions and recommendations? - Adding 32 portable WC units in the main corridor - Reunion families and relatives in a room as much as possible - Using partitions to close and divide the main corridor (see figure 5.19) - Altering the internal windows of the rooms into doors

1.2 Occupancy

Capability of occupying the building spaces	
Are there any expected spaces will be used as store?	No. the school is vacant
Are there any spaces that include fixed equipment or furniture? (labs, laundry)	No
Sub criteria assessment (percentage value) - Totally available to use (100%) - Unavailable to use (0%)	100%
Capacity of the building to accommodate displaced population	
What is the expected capacity of the building	32 units*(5-7) persons = 160-224 persons
If some modification were carried out, can building accommodate more than the expected capacity?	NO
If yes, what is the maximum expected capacity?	160-224 persons
Sub criteria assessment (percentage value) - Meet the capacity range or more (100%) = yes - Less than capacity range (0%) = no	100%
Recommendations 1.2	
Are there any suggestions or recommendations?	

1.3 Building Systems

The capability of water supply, sanitary, power supply systems to tolerate the additional demand for services	
With considering the expected capacity and function, please assess the following:	
Is there a need for extra water source (e.g. extra tanks)?	Yes Required 4480 liters per day
Does the capability of electrical network provide the expected use (e.g. distribution of power sockets, lights distribution, AMP and capacity of the new expected appliances) ?	No
Are the Sanitary pipes capable to tolerate the expected use?	No
Are building installation and equipment durable to tolerate the heavy use?	No
Sub criteria assessment (percentage value) - Building system is capable and need miner maintenance (100%)	0%

- Building system is not capable and need major maintenance (0%)	
The capability of the HVAC systems to tolerate the additional demand for services	
With considering the expected capacity and function, please assess the following:	
Is the HVAC system capable to provide occupants with the required thermal comfort?	No
Sub criteria assessment (percentage value) - HVAC system is capable and need miner maintenance (100%) - HVAC system is not capable and need major maintenance (0%)	0%
The capability of the fire protection systems to tolerate the additional demand for services	
With considering the expected capacity and function, please assess the following:	
Does the expected function have more risk than the original function?	Yes
What is the expected source of fire? Cooking gas, cigarettes	
What is the expected fire load? the school roof(wood), personal stuff	
Sub criteria assessment (percentage value) - Fire system is capable and needs miner upgrading (100%) - Fire system is not capable and needs major upgrading (0%)	0%
Recommendations 1.3	
Are there any constraints to use the building systems? What are they? - Prohibiting cooking and smoking in the rooms - Prohibiting using heating appliances - Prohibiting high consuming appliances	
What are the suggested actions and recommendations? - Providing building with required fire extinguishers - Installing sockets (1 socket per family or 5-7 persons) - Installing roof fans - Installing high quality taps - Installing sanitary pipes and linking them with public network - Installing water tanks	

1.4 Adaptation works

Availability of required resources for carrying out the required adaptation works	
With considering the suggested works to make the building ready for displaced settlement and the constraint of available resources, please assess the following:	
Do they meet the allocated resources?	Yes
Can works are carried out under the disaster and harsh climate conditions?	Yes
Sub criteria assessment (percentage value)	50%

- Adaptation works meet the available resources (100%) - Adaptation works do not meet the available resources (0%)	
Reverting the adapted building to its original design	
With considering the suggested works to make the building ready for displaced settlement, please assess the following:	
Are the suggested works leading to permanent modifications on the original layout?	No
Sub criteria assessment (percentage value) - Building can be easily reverted to original function (100%) - Building cannot be easily reverted to original function (0%)	100%

2. Infrastructure and Public Facilities

2.1 Infrastructure

The capability of the municipal water supply, sanitary, power supply systems	
What is the ratio of displaced population to host community population?	2.5 %
Are the municipal services in a good condition to tolerate the additional demand for services?	Yes
Is there a need toupgrade these services?	No
Sub criteria assessment (percentage value) - Municipal services are capable and needs miner upgrading (100%) - Municipal services are not capable and needs major upgrading (0%)	100%
Accessibility to the site (e.g. through pathways and roads)	
How many accessesare available to the building?	-
What is the expected distance between building and nearest main road?	400 m
Are they providing pedestrians, vehicles and disable movement?	Yes
What are the accesses conditions? How much is the roads vulnerability for weather conditions?	Vulnerable
Sub criteria assessment (percentage value) - Accesses are adequate (100%) - Accesses are inadequate (0%)	50%
Recommendations 2.1	
Are there any constraints to use the infrastructure? What are they?	
What are the suggested actions and recommendations? - Covering the footpath in paving stone	

2.2 Public Facilities

Public facilities that provide services to the displaced population	
What is the expected distance between building and	Mosque: in the site - 50 m

nearest public facilities?	Hospital: 2 km Markets: 500 Other schools: 1 km
Are they capable to tolerant the additional demand of services?	Yes
Sub criteria assessment (percentage value) - Public facilities are capable to tolerant (100%) - Public facilities are not capable to tolerant (0%)	100%
Availability of facilities to accommodate the special needs	
If the building was not providing the needsof disable people, is there any other building to settle them?)	yes
Sub criteria assessment (percentage value) - Meet the needs of those people (100%) - Does not meet the needs of those people (0%)	100%
Ease of establishing temporary support facilities	
Is there an open space facility close to the settlement location?	Yes
If not, is there a clear land to construct temporary facilities?	Yes
Sub criteria assessment (percentage value) - Availability of solution to get temporary support facilities (100%) - Unavailability of solution to get temporary support facilities (0%)	100%
Recommendations 2.2	
Are there any constraints for the public facilities? What are they?	
What are the suggested actions and recommendations?	

3. Community Considerations

Privacy of host and displaced	
With considering the expected capacity of displaced settlement, please assess the following:	
Is the allocated area providing the required level of privacy for each family? (e.g. room and bathroom)	Yes
Is there any expected violation for hosted community privacy?	No
How much is the separation distance between assessed building and closest neighbors' buildings?	Approximately 350 m
Sub criteria assessment (percentage value) - Building provides privacy (100%) - Building does not provide privacy (0%)	100%
Impact of the size of the displaced population	
With considering the expected capacity of displaced settlement, please assess the following:	
What is the ratio of displaced population to the host	2.5%

population?	
How much is the separation distance between assessed building and closest neighbors' buildings?	Approximately 350 m
Is there any clear area that would be slum spots by at the host community?	Yes
Is there any expected inconvenience, risk and insecurity, turbulence that caused by displaced settlement at the host community?	No
Is there any environmental impacts?	Yes
Sub criteria assessment (percentage value) - There are no impacts (100%) - There are serious impacts (0%)	80 %
Period for hosting	
How long are displaced people accommodated in transitional shelters?	12 – 16 months
Sub criteria assessment (percentage value) - Meet the constraint of hosting period (100%) - Does not meet the constraint of hosting period (0%)	100 %
Social collaborations and community support	
With considering the expected capacity of the displaced settlement and period of hosting, please assess the following:	
Based on the history of community collaborations in the disaster situation, What is the expected sympathy of community for displaced people?	Cooperative and very sympathetic
Sub criteria assessment (percentage value) - Collaborative community (100%) - Non-collaborative community (0%)	100%
Recommendations 3	
Are there any constraints for the public facilities? What are they? - The community is very sensitive for the cultural, educational and ethnic concerns	
What are the suggested actions and recommendations? - Increasing the times of refuse collecting - To avoid any slum spots, displaced have to be enforced to leave the shelter site after closing the shelter.	

- **Al-MasakenApartment Building Assessment**

Table 6.5: Assessment Checklist of Al-Masaken Apartment Building

Assessment Checklist of Building Potential for Temporary Use as Transitional Shelter		
1. Building Characteristics & Suitability	2. Infrastructure Services	3. Communities Considerations

Certified Specialist	**Civil- architect- electrical-municipal council member**
Engineer Name	**Osama, Wazer, Zain, Zain**
Attached documents: building floors plans	
Used measuring and testing tools:	

General Information

Total building area: 475 m^2
Number of floors: 5 floor
Original function of building: Residential (4 floors)–commercial (ground floor)

1. Building Characteristics & Suitability

1.1 Building Structure and Design

Flexibility to remodel building layout	
Type of structure	Reinforced concrete structure
Does it allow for adaptation works?	Yes
What is the level of adaptation works?	Adding partitions, opening doors
How much is the total functional area of each floor?	420m^2
Can the available spaces are remodeled easily?	Yes
Sub criteria assessment (percentage value)	100 %
Availability of functional space units	
How many are rooms that already available to use?	64 space
How many are bathrooms that already available to use?	16
Is there an internal open spacefor people gathering?	No
Sub criteria assessment (percentage value)	90%
Access points to the building and main circulation routes	
How many are entrances available to use?	1
Are they suitable for the settlement use?	Yes
Are entrances and routs providing the handicapped people (ramps, curb cuts, and handrails?)	No
Are the circulation routes capable to discharge the expected population?	Yes
Sub criteria assessment (percentage value) - Adequate Access points and corridors (100%) - Inadequate Access points and corridors (0%)	90%

Recommendations 1.1
What is the suggested layout to settle displaced people? Attach solution drawing
Are there any constraints to use the building? What are they?
What are the suggested actions and recommendations? - Installing 16 portable WC units in the balconies - Rooms assigning is based on the families size - Reunion families and relatives in close rooms as much as possible - Using partitions to close and divide the main hall in each flat (see figure 5.20)

1.2 Occupancy

Capability of occupying the building spaces	
Are there any expected spaces will be used as store?	No
Are there any spaces that include fixed equipment or furniture? (labs, laundry)	No
Sub criteria assessment (percentage value) - Totally available to use (100%) - Unavailable to use (0%)	100%
Capacity of the building to accommodate displaced population	
What is the expected capacity of the building	32 units (16 units include 2 rooms and 16 units include single room) 16 *(6) persons + 16*(10)= 208- 304 persons
If some modification were carried out, can building accommodate more than the expected capacity?	NO
If yes, what is the maximum expected capacity?	208- 304 persons
Sub criteria assessment (percentage value) - Meet the capacity range or more (100%) = yes - Less than capacity range (0%) = no	100%
Recommendations 1.2	
Are there any suggestions or recommendations?	

1.3 Building Systems

The capability of water supply, sanitary, power supply systems to tolerate the additional demand for services	
With considering the expected capacity and function, please assess the following:	
Is there a need for extra water source (e.g. extra tanks)?	NO Required 5120 liters per day
Does the capability of electrical network provide the expected use (e.g. distribution of power sockets, lights distribution, AMP and capacity of the new expected appliances) ?	Yes

Are the Sanitary pipes capable to tolerate the expected use?	Yes
Are building installation and equipment durable to tolerate the heavy use?	Yes
Sub criteria assessment (percentage value) - Building system is capable and need miner maintenance (100%) - Building system is not capable and need major maintenance (0%)	100%
The capability of the HVAC systems to tolerate the additional demand for services	
With considering the expected capacity and function, please assess the following:	
Is the HVAC system capable to provide occupants with the required thermal comfort?	yes
Sub criteria assessment (percentage value) - HVAC system is capable and need miner maintenance (100%) - HVAC system is not capable and need major maintenance (0%)	100%
The capability of the fire protection systems to tolerate the additional demand for services	
With considering the expected capacity and function, please assess the following:	
Does the expected function have more risk than the original function?	No
What is the expected source of fire? Cooking gas, cigarettes, electrical sparks	
What is the expected fire load? personal stuff	
Sub criteria assessment (percentage value) - Fire system is capable and needs miner upgrading (100%) - Fire system is not capable and needs major upgrading (0%)	0%
Recommendations 1.3	
Are there any constraints to use the building systems? What are they? - Prohibiting using heating appliances - Prohibiting high consuming appliances	
What are the suggested actions and recommendations? - Providing building with required fire extinguishers	

1.4 Adaptation works

Availability of required resources for carrying out the required adaptation works
With considering the suggested works to make the building ready for displaced settlement and the constraint of available resources, please assess the following:

Do they meet the allocated resources?	Yes
Can works are carried out under the disaster and harsh climate conditions?	Yes
Sub criteria assessment (percentage value) - Adaptation works meet the available resources (100%) - Adaptation works do not meet the available resources (0%)	100%
Reverting the adapted building to its original design	
With considering the suggested works to make the building ready for displaced settlement, please assess the following:	
Are the suggested works leading to permanent modifications on the original layout?	No
Sub criteria assessment (percentage value) - Building can be easily reverted to original function (100%) - Building cannot be easily reverted to original function (0%)	100%

2. Infrastructure and Public Facilities

2.1 Infrastructure

The capability of the municipal water supply, sanitary, power supply systems	
What is the ratio of displaced population to host community population?	1 %
Are the municipal services in a good condition to tolerate the additional demand for services?	Yes
Is there a need toupgrade these services?	No
Sub criteria assessment (percentage value) - Municipal services are capable and needs miner upgrading (100%) - Municipal services are not capable and needs major upgrading (0%)	100%
Accessibility to the site (e.g. through pathways and roads)	
How many accessesare available to the building?	On the main road
What is the expected distance between building and nearest main road?	On the main road
Are they providing pedestrians, vehicles and disable movement?	Yes
What are the accesses conditions? How much is the roads vulnerability for weather conditions?	good
Sub criteria assessment (percentage value) - Accesses are adequate (100%)	100%

- Accesses are inadequate (0%)	

2.2 Public Facilities

Public facilities that provide services to the displaced population	
What is the expected distance between building and nearest public facilities?	Mosque: 250 m Hospital: 3 km Markets: 100 m schools: 500 m
Are they capable to tolerant the additional demand of services?	Yes
Sub criteria assessment (percentage value) - Public facilities are capable to tolerant (100%) - Public facilities are not capable to tolerant (0%)	100%
Availability of facilities to accommodate the special needs	
If the building was not providing the needsof disable people, is there any other building to settle them?)	Yes
Sub criteria assessment (percentage value) - Meet the needs of those people (100%) - Does not meet the needs of those people (0%)	100%
Ease of establishing temporary support facilities	
Is there an open space facility close to the settlement location?	No
If not, is there a clear land to construct temporary facilities?	Yes
Sub criteria assessment (percentage value) - Availability of solution to get temporary support facilities (100%) - Unavailability of solution to get temporary support facilities (0%)	100%

3. Community Considerations

Privacy of host and displaced	
With considering the expected capacity of displaced settlement, please assess the following:	
Is the allocated area providing the required level of privacy for each family? (e.g. room and bathroom)	Yes
Is there any expected violation for hosted community privacy?	No
How much is the separation distance between assessed building and closest neighbors' buildings?	Approximately 50 m
Sub criteria assessment (percentage value)	100%

- Building provides privacy (100%) - Building does not provide privacy (0%)	
Impact of the size of the displaced population	
With considering the expected capacity of displaced settlement, please assess the following:	
What is the ratio of displaced population to the host population?	1%
How much is the separation distance between assessed building and closest neighbors' buildings?	Approximately 50 m
Is there any clear area that would be slum spots by at the host community?	No
Is there any expected inconvenience, risk and insecurity, turbulence that caused by displaced settlement at the host community?	No
Is there any environmental impacts?	Yes
Sub criteria assessment (percentage value) - There are no impacts (100%) - There are serious impacts (0%)	90 %
Period for hosting	
How long are displaced people accommodated in transitional shelters?	12 – 16 months
Sub criteria assessment (percentage value) - Meet the constraint of hosting period (100%) - Does not meet the constraint of hosting period (0%)	100 %
Social collaborations and community support	
With considering the expected capacity of displaced settlement and period of hosting, please assess the following:	
Based on the history of community collaborations in the disaster situation, What is the expected sympathy of community for displaced people?	Cooperative
Sub criteria assessment (percentage value) - Collaborative community (100%) - Non-collaborative community (0%)	100%
Recommendations 3	
Are there any constraints for the public facilities? What are they? - The community is very sensitive for the cultural, educational and ethnic concerns	
What are the suggested actions and recommendations? - Increasing the times of refuse collecting	

6.3.4 Data Analysis and Report Development

The collected data were analyzed to get the required information of the buildings' potential assessment. The main steps of data analysis process are as follows:

- Computing the buildings' potential value by multiplying the relative importance of criteria by the assigned percentage value of criteria
- Estimating the expected building capacity
- Identifying the list of constraints which are obtained from the sub-criteria assessment
- Concluding the suggested recommendations and actions to adapt the buildings
- Developing the building layout for temporary use

The following tables show the results of the building analysis

Table 6.6: Buildings Analysis Results

Building 1: Fuwwah School			
1 Building potential assessment	Criteria weighting * Assessment percentage		
Weight flexibility to remodel the layout	0.027	1.00	0.027
Availability of functional spaces	0.076	0.60	0.046
Number of access points	0.063	1.00	0.063
Structure and design	0.165		0.136
Capability of occupying spaces	0.029	1.00	0.029
Maximum capacity of building	0.088	1.00	0.088
Occupancy	0.117		0.117
Capability of the water supply, sanitary, power supply systems	0.063	0.00	0.00
Ventilation	0.028	0.00	0.00
Fire	0.019	0.00	0.00
Building systems	0.110		0.00
Availability of required resources	0.022	0.50	0.011
Reverting the adapted building to its original condition	0.072	1.00	0.072
Adaptation works	0.094		0.083
Building Characteristics	**0.486**		**0.336**

Capability of the municipal water supply, sanitary, power supply systems	0.092	1.00	0.092
Accessibility to the site	0.075	0.50	0.038
Infrastructure	0.167		0.130
Proximity of available public facilities	0.014	1.00	0.014
Availability of facilities for special needs people	0.005	1.00	0.005
Ease of establishing temporary support facilities	0.049	1.00	0.049
Public Facilities	0.068		0.068
Infrastructure and Public Facilities	**0.235**		**0.198**
Attainment of privacy	0.032	1.00	0.032
Impact of displaced population size	0.031	0.80	0.025
Hosting period	0.070	1.00	0.070
Social interaction and community support	0.145	1.00	0.145
Communities Considerations	**0.279**		**0.272**
Building potential value			**0.806**
2 Capacity constraint	160-224	✓	
3 Settlement period constraint	12 – 16	✓	
4 Fund, Time, Manpower constraint	Considered	✓	
5 Constraints and recommendations for use			

- Constraints:
- Excluding the damaged part of the school
- Prohibiting cooking and smoking in the rooms
- Prohibiting using heating appliances
- Prohibiting high consuming appliances
- The community is very sensitive for the cultural, educational and ethnic concerns
- Recommendations:
- Adding 32 portable WC units in the main corridor
- Reunioning families and relatives in a room as much as possible
- Using partitions to close and divide the main corridor (see figure 5.19)
- Altering the internal windows of the rooms into doors
- Providing the building with required fire extinguishers
- Installing sockets (1 socket per family or 5-7 persons)
- Installing roof fans
- Installing high quality taps
- Installing sanitary pipes and linking them with public network
- Installing water tanks
- Covering the footpath in paving stone
- Increasing the times of refuse collecting
- To avoid any slum spots, displaced have to be enforced to leave the shelter site after closing the shelter.

6 layouts of building use

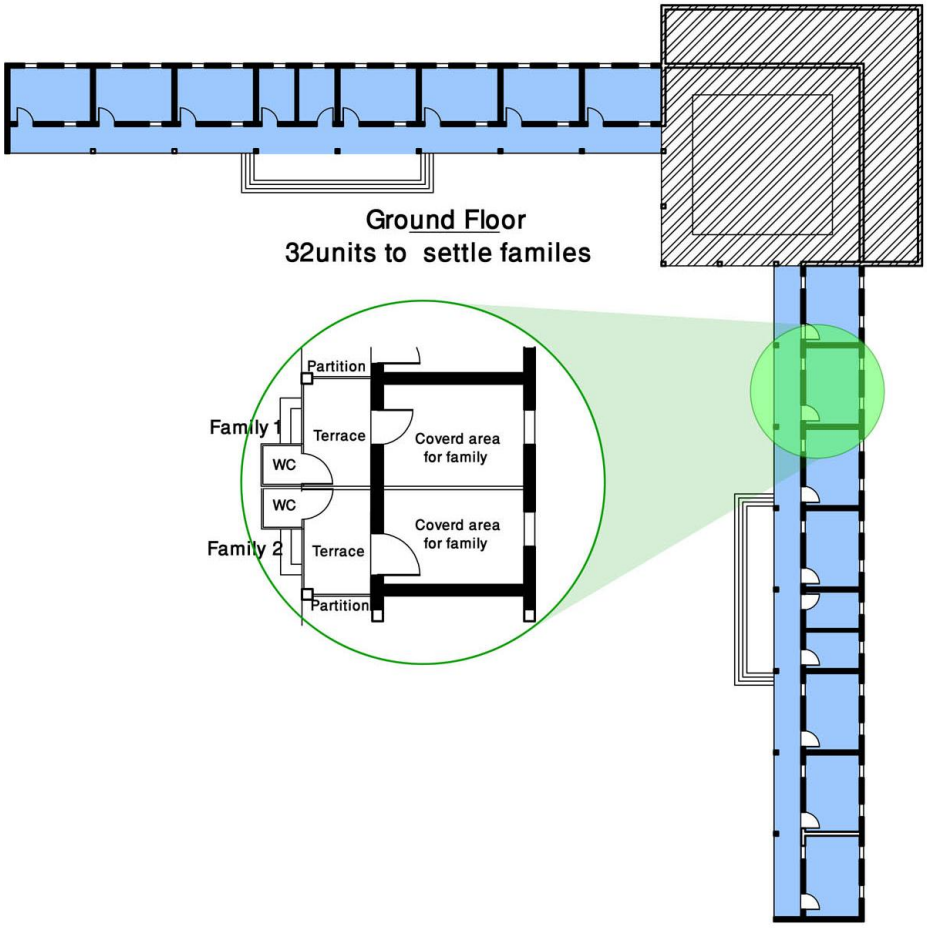


Figure 6.7: The Proposed Layout of FuwwahSchoolShelter

Building 2: Al-Masaken apartment building			
1 Building potential assessment	Criteria weights * Assessment percentage		
Weight flexibility to remodel the layout	0.027	1.00	0.027
Availability of functional spaces	0.076	0.90	0.068
Number of access points	0.063	0.90	0.057
Structure and design	0.165		0.152
Capability of occupying spaces	0.029	1.00	0.029
Maximum capacity of building	0.088	1.00	0.088
Occupancy	0.117		0.117
Capability of the water supply, sanitary, power supply systems	0.063	1.00	0.063
Ventilation	0.028	1.00	0.028
Fire	0.019	0.00	0.000
Building systems	0.110		0.091
Availability of required resources	0.022	1.00	0.022
Reverting the adapted building to its original condition	0.072	1.00	0.072
Adaptation works	0.094		0.094
Building Characteristics	**0.486**		**0.454**
Capability of the municipal water supply, sanitary, power supply systems	0.092	1.00	0.092
Accessibility to the site	0.075	1.00	0.075
Infrastructure	0.167		0.167
Proximity of available public facilities	0.014	1.00	0.014
Availability of facilities for special needs people	0.005	1.00	0.005
Ease of establishing temporary support facilities	0.049	1.00	0.049
Public Facilities	0.068		0.068
Infrastructure and Public Facilities	**0.235**		**0.235**
Attainment of privacy	0.032	1.00	0.032
Impact of displaced population size	0.031	0.90	0.028
Hosting period	0.070	1.00	0.070
Social interaction and community support	0.145	1.00	0.145
Communities Considerations	**0.279**		**0.275**
Building potential value			**0.964**
2 Capacity constraint	208- 304	✓	
3 Settlement period constraint	12-16	✓	
4 Fund, Time, Manpower constraint	Considered	✓	
5 Constraints and recommendations for use			

- Constraints:
  - The community is very sensitive for the cultural, educational and ethnic concerns
- Recommendations:
  - installing 16 portable WC units in the balconies
  - rooms assigning is based on the families size

- Reunioning families and relatives in close rooms as much as possible
- Using partitions to close and divide the main hall in each flat (see figure 5.20)
- Prohibiting using heating appliances
- Prohibiting high consuming appliances
- Increasing the times of refuse collecting

6 layouts of building use

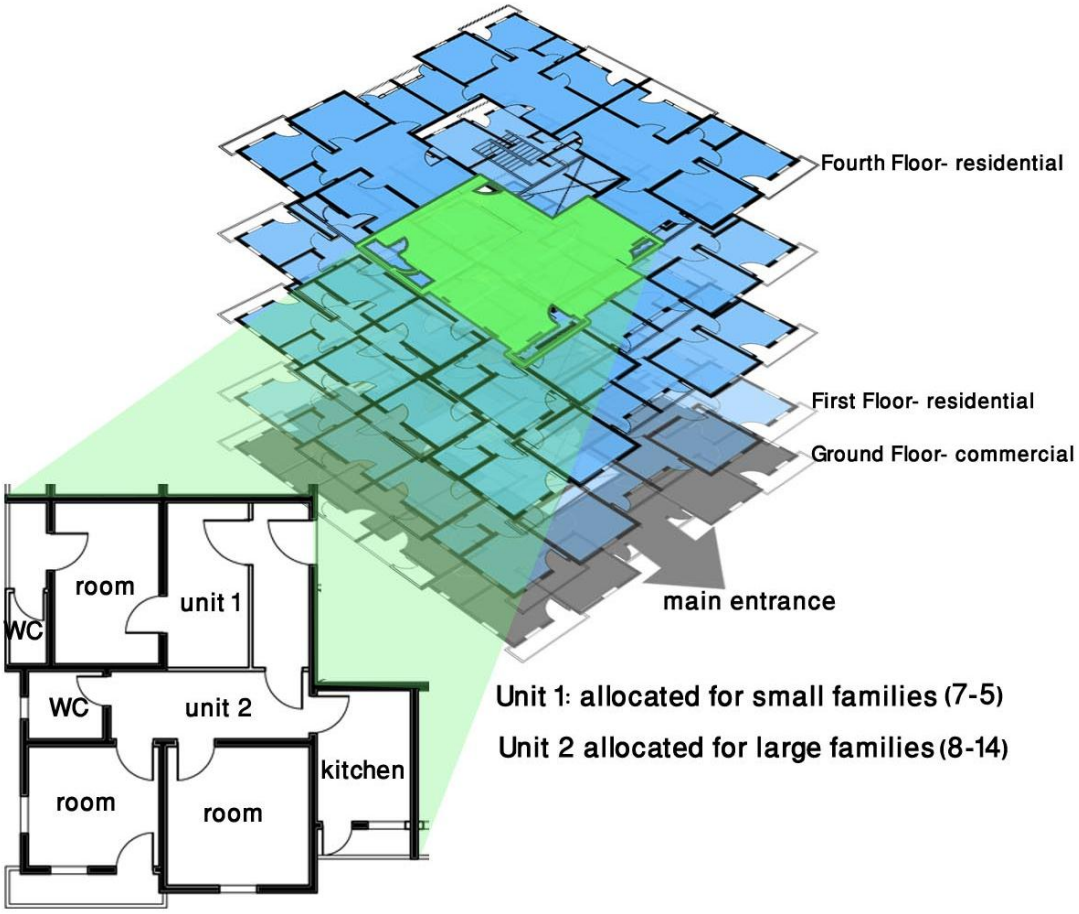


Figure 6.8: The Proposed Layout of Al-MasakenShelter

As shown, the results of the assessment of the buildings indicate that all of the buildings have high potential for temporary use as transitional shelters, while three of them meet fully the constraints of the assessment. Therefore, the buildings' potential variation is used to classify the buildings within an up-down ranking. In this ranking, buildings that have high potential and fully meet the requirements will be in class A, such as the

Almasaken building. While buildings that do not meet some requirement or have lower potential than class B are ranked in class C, such as Fuwwah school.

6.4 Discussion

Applying the model to a set of case studies is to check the model applicability, which helps to discover how it works with the actual cases and evaluate its outcomes. Applying the model is done in five phases which are: preparing the constraints profile, preliminary assessment, comprehensive assessment, data analysis and report development.

In the phase of the preparing of the constraints profile, the assessment team developed a set of constraints to work as a guide for the assessment process. They developed the constraints based on international standards of shelters and the local practice which was learned from the previous relief and rebuild efforts. The assessment team indicates that the customized requirements of the standard satisfy the local displaced community needs. On the other hand, the assessment team faced a problem to estimate the resources constraint. They suggested that the assessment has to be restricted with limited resources which are already available in the disaster location. Therefore, it was based on the available material in the markets and the support of the local donation organizations. Despite the constraints being few, the adopted decisions in this phase were very reasonable and they reflected the local requirements.

In the preliminary assessment phase, the assessment team carried out the required visits to the buildings in Mukalla. They conducted the preliminary assessment by evaluating availability, stability and safety of the buildings. The results show that the Al-Masaken building is initially adequate for temporary use as transitional shelters, while Fuwwah

school is adequate with reservation because of the damaged part. Unlike the building selecting process before applying the model, which is based on the building vacancy essentially, the assessment of buildings covered different aspects and defined new constraints for using these buildings such as the period of building vacancy and damaged parts. Besides that, the assessment team had enough time to negotiate and find fair compensation for the owners.These results are counted as advantages to when applying the model to buildings before use.

In the comprehensive assessment phase, the assessment team evaluated the buildings by using checklist forms. Due to the assessment results, the Al-Masaken building has the highest potential (0.96), while the Fuwwah School got 0.81 as a potential value. The result of the assessment is very reasonable and reflects the actual conditions of the buildings and the community.

Despite the limited application of the model, there are some indicators which can be considered to assess the model's applicability. Based on the buildings and settlement records, Al-Masaken and Fuwwah School faced several problems during the settlement of the displaced. By comparing the buildings' potential assessment and these problems, there is a considerable correlation between the actual buildings' performance during the settlement period and the potential values. This correlation is a supportive indicator for the credibility of the results. Table 6.7 presents the main problems and related statements that were obtained from the model outcome.

Table 6.7: Comparison of the Assessment Results and the Settlement Problems

Related Category	Problems and difficulties	Model assessment (values, constraint, recommendations)
The building availability		
	- Unavailability of the formal agreement	❖ Availability of the building and formal agreement is essential use the buildings.
Problems related building characteristics		
-	- Difficulty to remodel building layouts - Unavailability of enough bathrooms	❖ Using partitions to close and divide the opened area ❖ Adding portable WC units in the main corridor
	- Deficiency of water and sanitary networks	❖ Installing sanitary pipes and linking them with public network ❖ Installing extra water tanks ❖ Installing high quality taps
	- insufficient number of electrical plugs and switches	❖ Installing sockets (1 socket per family or 5-7 persons)
	- insufficient ventilation	❖ Installing roof fans
	- Fire accidents	❖ Prohibiting cooking and smoking in the rooms ❖ Prohibiting using heating appliances ❖ Providing the building with required fire extinguishers
Infrastructure and public facilities		
	- Deficiency of municipal services - Increasing trash	❖ Increasing the times of refuse collecting
Community considerations		
	- Unavailability of personal private spaces to gather husbands and wives - Increasing the social problems - Refusing displaced settlement by the local community for ethnic reasons	❖ Reunioning families and relatives in a room as much as possible ❖ The community is very sensitive for the cultural, educational and ethnic concerns

Based on the assessment and the model application, the assessment team concludes a set of points that have to be considered in the future model application or development:

- In case of the absence of a strategic plan of the country for disaster management, it is difficult to estimate certain constraints, such as the available funding and support.
- Some aspects of the model cannot be assessed individually because they are related to the overall assessment of the location, such as the ratio of the displaced to the local community (related to the accumulative ratio in other shelters).
- In addition, to ensure the objectivity of the model results, the constraints profile has to be developed to assess the exceptional capability of these groups of buildings.
- To ensure the accuracy of the assessment scale, the scale has to be divided into intervals that are described with explanatory notes to help the evaluators select the right values in the assessment forms.

CHAPTER SEVEN

GUIDELINES FOR THE PROVISION OF TRANSITIONAL FLOOD SHELTERS

This chapter presents a number of guidelines for use by professionals to facilitate the provision of buildings that could be easily adapted for temporary use.

These guidelines are derived from the local community practices and the model application on the case studies. Therefore, the complying with these guidelines will help the professionals to overcome the difficulties of the displaced settlement in the future. The following guidelines were developed to be used in Yemen by the concerned professionals to facilitate the provision of buildings that could be easily adapted for temporary use. The developed guidelines are divided into four groups as follows:

7.1 Planning Stage

- To guarantee the accuracy of the model outcome, the government and concerned organizations have to prepare an actual database that reflects the real government preparedness and the region characteristics. This database is the input of the first phase of the model, the database could be reached by conducting the following essential actions:
    - Developing a risk plan for the whole regions of the country in order to define the safest locations for the flood disaster hazards.

- Estimating the population capacity of each region and the expected displaced population during the disaster based on the census and the history of disaster in the region.
- Developing a disaster record to document the previous disaster events and their effect on the built environment. That is to predict and avoid the future disaster impact.
- Estimating the expected available resources during the disaster time. The available resources include the required time to relief people,the time to prepare shelters, manpower, material and fund.

- The government should test the developed multi-criteria model outcome reliability by implementing the recommendation and actions of the model prior to the disaster time on some buildings as an actual practicing for the displacement of people and building adaptation.
- The government has to enact legislation to arrange the process of the temporary reuse of buildings which includes:
  - The agreement procedures.
  - Time of use.
  - Alternative building to relocate the building occupants.
  - Re-use constraints.
  - Condition of the building before and after.
  - The compensation.

- To minimize the adaptation work, building selection has to consider all the assessment results such as potential value, capacity, constraints, and recommendation to select the most proper buildings.
- Based on the predefined classes of building, temporary use of buildings has to start with class A buildings of each group of buildings.
- In case of unavailability of class A buildings, buildings of class B and C will be the available choice to settle the displaced people temporarily. Therefore, there is a need to reassess the class C buildings to find a solution to eliminate the reuse restriction.
- Educational programs should be carried out to prepare the local communities to host the displaced people.
- The government should develop educational programs to train people to live in displacement circumstance. That is to enhance the social solidarity and the community disaster resilience .

7.2 **Designing Stage**

- In order to be used during the disasters as shelters, large public facilities design should consider the displacement settlement requirements.
- Therefore, designers should develop the proper layout solutions to provide the original function essentially and provide the building potential for temporary use as shelters during disasters as a second priority.
- To avoid the major adaptation works in some systems, designers should increase the specification of building systems to accommodate the additional use.

Increasing the systems specification is such as increasing the diameter of sewer pipe, spare conduits and sleeves inside the walls.

- Designers have to consider that the apartment building and horizontal educational building , that have single loaded corridors or long openings to the outside, have a high potential to be reused as family shelter with minor modification works. Therefore, the designers have to develop spaces that could be easily reused.
- Designers have to use essential light weight materials to remodel the spaces. That will minimize the material consumption and the effort to revert the building to its original condition.

7.3 **Adaptation works Stage**

- The developed solutions should reduce the cost of adapting through implementing minor adaptation works.
- To provide for cost efficiency and sustainability, all resources and equipments should be reused and recycled after the temporary use of the buildings.
- Promoting the building system condition after the re-use has to be one of the main goals of the Adaptation works. That will be an attractive issue for the buildings' owners to allow for reuse of their buildings.
- The adaptation works should not include any high technical works because of the unavailability of skilled manpower during the disaster time.

7.4 Assessment works Stage

- In case of the application of the developed multi-criteria model on different countries or communities, some of the model components have to be re-customized to meet the local community needs. These components are the criteria weighting and standard requirement customizing.
- The assessment team should develop the assessment forms and the checklist, which is provided in the appendixes, to meet the actual buildings' conditions.
- The assessment team has to carry out all of the assessment phases and document the results phase by phase to avoid the data missing or redundancy.
- The assessment team has to have the sense to discover the relation and causes of problems through the assessment process.
- In case the conflict or ambiguity, a re-assessment action is required to check the data integrity.
- The assessment team should use and develop the adopted measures in the model to meet the actual buildings' conditions.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary and the conclusions of the study. It also presents a set of recommendation for further research.

8.1 Summary of the Study

The objectives of this thesis are to develop a model for assessing the potential of buildings for temporary use as transitional shelters, to conduct case studies to demonstrate and verify the applicability of the developed model and to develop guidelines for use by design professionals to facilitate the provision of buildings that could be easily adapted for temporary use. In order to achieve these objectives, the research methodology consists of five phases which are as follows:

In the first phase, comprehensive literature review was conducted for the purposes of reviewing previous research related to disaster management, transitional settlement, adaptive reuse of buildings and standards of shelters.Also it was conducted to review previous models developed to determine the building potential. Besides, interviews with the concerned professionals that involved in the relief and rebuild efforts were conducted for the purposes of reviewing the actual problems of settlement and investigating the temporary use criteria. The obtained knowledge and experiences were analyzed to identify the building potential criteria for temporary use as transitional shelters.

In the second phase,the obtained knowledge and criteria from the first phase were used to develop a multi criteria model that includes sequential phases to assess the buildings'

potential for temporary use.The model phases are (1) developing the planning constraints profile, (2) developing the preliminary assessment, (3) developing a comprehensive assessment methodology, (4) developing a methodology for analyzing the weighted criteria and the outcome of the assessment through the developed checklist and (5) reporting the findings including a statement of the building potential, capacity of the building, constraints of use and recommendations.

In the third phase, a set of actual case studies was reviewed. These cases are samples of temporary use of buildings as transitional shelters for displaced resettlement in Hadramout 2008 flood.

In the fourth phase, to verify and check the model applicability, the model is applied on two buildings that were used as transitional shelters in Hadramout, Yemen during the 2008 flood disaster. The results of the model were analyzed and compared with the case studies records.

In the last phase, a set of guidelines and recommendations were presented to be used by design professionals to facilitate the provision of buildings that could be easily adapted for temporary use.

8.2 Conclusions

- In order to meet the local community requirements, the requirements of the international standard of shelters were customized by 5 local experts. The results of customization indicate that the local community requirements are lower than the international requirements.

- The results of the interviews with 13concerned professionals indicate that, during the 2008 flood disaster in Yemen, the building assessment criteria were the ownership of the building, availability of the building, safety, the condition of the building, number of classes and bathrooms, flexibility of the original design, maintenance cost, proximity to the homeland, and accessibility

- Based on the previous research studies and interviews with the 13 professionals, 23 criteria were identified for the assessment of building potential for temporary use as transitional shelters. These criteria are classified under four main categories which are the essential issues, building characteristics, infrastructure & public facilities and community considerations.
- The results of the criteria weighting analysis indicates that the building characteristics category is the highest relative importance value with 0.486 as a global priority; while communities' considerations category has the second global priority with 0.279; and infrastructure and public facilities category has a lower relative importance with 0.235 as a global priority. This variation between the relative importance values reflects the respondent opinions about these criteria.
- The results of building characteristics sub- criteria assessment indicate that:
  - The structure and design criterion has the highest relative importance value with 0.165.
  - The occupancy criterion has the second relative importance value with 0.117.
  - The building systems criterion has the third relative importance value with 0.110.

- The adaptation works criterion has the lowest relative importance value with 0.094.

- The results of communities considerations sub- criteria assessment indicate that:
  - The social interaction and community support criterion has the highest relative importance value with 0.145.
  - The hosting period criterion has the second relative importance value with 0.070.
  - The attainment of privacy criterion has the third relative importance value with 0.032.
  - The impact of displaced population size criterion has the lowest relative importance value with 0.031.
- The results of infrastructure and public facilities sub-criteria assessment indicate that:
  - The infrastructure criterion has the highest relative importance value with 0.167.
  - The public facilities criterion has the second relative importance value with 0.068.
- Based on the results of the weighted criteria and other components, a multi-phase model is developed to assess the building potential for temporary use as shelters. This model is based fundamentally on AHP technique to analyze and assess building potential. This model assesses the buildings potential for temporary use, expected capacity of buildings, restriction of use and the required adaptation actions. The phases of this model are as follows; developing the planning

constraints profile, developing the preliminary assessment, developing a comprehensive assessment methodology, developing a methodology for analyzing the assessment outcome and reporting the findings

- The developed model was applied on two case studies to verify its applicability. The results of applying the developed model indicate that the preliminary assessment indicate that Al-Masaken apartment building is adequate for temporary use in terms of availability, stability and safety. While Fuwwah School can be used with safety and stability restrictions.
- The results of the comprehensive assessment of the building condition present extensive values and data including the buildings potential, capacity, settlement period, compatibility with resources, constraints, recommendations for use and proposed layout of the buildings.
- The results of applying the developed model indicate that Al-Masaken apartment building has 0.96 as a potential value which is the highest potential value compared with the other building. Al-Masaken apartment building is capable to accommodate 302 persons and it is adequate for more than 6 months settlement.
- Fuwwah school has the second potential value which is 0.806 .Fuwwah school is capable to accommodate 224 persons and it is adequate for more than 6 months settlement.
- Based on the learnt lessons from the local practices and the results of application the developed model on case studies, a set of guidelines was developed to be used by design professionals to facilitate the provision of buildings that could be easily adapted for temporary use. These guidelines are divided into four groups which

are planning stage, designing stage, assessment work stage and adaptation work stage guidelines.

8.3 Recommendations for Further Research

Based on the research, a set of recommendations is developed to help concerned parties to apply the model and extend it for further research. These recommendations are as follows:

- It is observed that the assessment team had problems with the measures that were used to assess the buildings' potential. Therefore, it is recommended to conduct further research to define the proper measures to assess the building potential for temporary use a transitional shelter. Developing effective measures will help the assessment team to evaluate building potential accurately and will make the assessment results reasonable.
- It is observed that, there is a need to legislate the action of the temporary use of building as transitional shelter. Developing legislation and policies to arrange this process will keep the rights of all parties and will encourage people to contribute in this social solidarity action.

APPENDIX I

- Questionnaire survey of criteria assessment – English

King Fahd University of Petroleum & Mineral
College of Environmental Design
Architectural Engineering Department

Questionnaire Survey

Development of a Multi-Criteria Model for Assessing the Buildings Potential for Temporary Use as a Flood Transitional Settlement Shelters in Yemen

Prepared by

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February 2012

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Dr.Ismail Mohammad Budaiwi

Dr.Jamal Al-Qawasmi

Dr.JayprakashChadchan

Questionnaire Survey Form

Part 1: Personal Information:

Please fill and select the right fields.

- ***Respondent information***

Name (optional)				
Phone (optional)				
E-mail (optional)				
Background	Architecture	Civil	Management	Other (…..)

- ***Position information***

Position	Manager (governmental /Non-governmental)	
	Assessment engineer	
	Settlement coordinator	
	Rescue team director	
	Other, please specify (……..)	
Experience	Less than 3 years	
	3-5 years	
	More than 5 years	
Location	Coastline cities	
	Valleys cities	
	Other, please specify (……..)	
Type of organization	Governmental organizations	
	Non-Governmental org.	
	Other, please specify (……..)	
Origination Name(optional)		

Part 2: criteria assessment

Please assess the following criteria by using 1-9 scale. The example shows the way to select the right value.

Example:

	Extremely important	V. Strongly Important	Strongly important	Weak important	equally	Weak important	Stronglyimportant	V.Strongly Important	Extremely important	
Criteria	**9**	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	**Criteria**
A			✓							B
A						✓				C

- ***Main criteria assessment***

To assess the building potential for transitional settlement use, the maincategoriesthat have to be consideredinclude:

- Building characteristics & suitability
- Infrastructure and public facilities
- Community considerations

Please, assess the importance of these categories (criteria and sub-criteria) as follows.

Main criteria										
Criteria	**Extremely important**	**V. Strongly Important**	**Strongly important**	**Weak important**	**Equally**	**Weak important**	**Strongly important**	**V. Strongly Important**	**Extremely important**	**Criteria**
	9	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	
Which one of these criteria has more importance?										
Capability of the building structure and systems for adaptation to accommodate another function (e.g. structure, occupancy ratio, building systems)										*Capability of the infrastructure and public facilities to tolerate the additional demand for services (e.g. public networks, public services)*
Capability of the building structure and systems for adaptation to accommodate another function (e.g. structure, occupancy ratio, building systems)										*Willingness of the community to accept accommodating the displaced population (e.g. attainment of privacy, displaced population size, communities background)*
Capability of the infrastructure and public facilities to tolerate the additional demand for services (e.g. public networks, public services)										*Willingness of the community to accept accommodating the displaced population (e.g. attainment of privacy, displaced population size, communities background)*

- ***Sub-Criteria Assessment***

Each value of these criteria is based on sub-criteria that have also influence on the building potential for settlement use. Please, assess the importance and effect of sub-criteria as follows:

Sub-Criteria of Building Characteristics and Suitability										
Sub-Criteria	**Extremely important**	**V. Strongly Important**	**Strongly important**	**Weak important**	**Equally**	**Weak important**	**Strongly important**	**V. Strongly Important**	**Extremely important**	**Sub-Criteria**
	9	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	
Which one of these criteria has more importance?										
Flexibility of the building structure *(e.g. capability to modify and upgrade)*										Building capacity to accommodate the displaced population (e.g. population capacity and ratio of used spaces)
Flexibility of the building structure *(e.g. capability to modify and upgrade)*										*The extent of the adaptation works (e.g. what have to be adapted to use building)*
Flexibility of the building structure *(e.g. capability to modify and upgrade)*										The capability of building systems to *tolerate the additional demand for services*
Building capacity to accommodate the displaced population (e.g. population capacity and ratio of used spaces)										*The extent of the adaptation works (e.g. what have to be adapted to use building)*
Building capacity to accommodate the displaced population (e.g. population capacity and										The capability of building systems to *tolerate the additional demand for services*

ratio of used spaces)										
The extent of the adaptation works (e.g. what have to be adapted to use building)										The capability of building systems to *tolerate the additional demand for services*
Sub-sub-Criteria of the Flexibility of the Building Structure										
	Extremely important	**V. Strongly Important**	**Strongly important**	**Weak important**	**Equally**	**Weak important**	**Strongly important**	**V. Strongly Important**	**Extremely important**	
Sub-sub	**9**	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	*Sub-sub*
Which one of these criteria has more importance?										
Flexibility to add or remove building elements (e.g. interior walls)										Flexibility to remodel the layout the building to accommodate new required functions
Flexibility to add or remove building elements (e.g. interior walls)										Availability of functional space units
Flexibility to add or remove building elements (e.g. interior walls)										Number of access points to the building and proximity to the main circulation routes
Flexibility to remodel the layout the building to accommodate new required functions										Availability of functional space units
Flexibility to remodel the layout the building to accommodate new										Number of access points to the building and proximity to the main

required functions										circulation routes
Availability of functional space units										Number of access points to the building and proximity to the main circulation routes
Sub-Sub-Criteria of the Building Capacity to Accommodate the Displaced Population										
Sub-sub	**9**	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	*Sub-sub*
Capability of occupying the spaces in the building either partially or fully (occupancy ratio)										The building's maximum capacity to accommodate displaced population
Sub-Sub-Criteria of Building Systems										
Sub-sub	**9**	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	*Sub-sub*
The capability of the water supply, sanitary, power supply and gas supply systems to *tolerate the additional demand for services*										The capability of the HVAC systems to *tolerate the additional demand for services*
The capability of the water supply, sanitary, power supply and gas supply systems to *tolerate the additional demand for services*										The capability of the fire protection systems to *tolerate the additional demand for services*
The capability of the HVAC systems to *tolerate the additional demand for services*										The capability of the fire protection systems to *tolerate the additional demand for services*
Sub-Sub-Criteria of the Extent of Adaptation Works										
Availability of required resources for carrying out the required adaptation works (e.g. money, material, manpower and machine)										Ease of reverting back the adapted building to its original design and function

Sub- Criteria of Infrastructure and Public Facilities										
	Extremely important	**V. Strongly Important**	**Strongly important**	**Weak important**	**Equally**	**Weak important**	**Strongly important**	**V. Strongly Important**	**Extremely important**	
Sub-Criteria	**9**	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	**Sub-Criteria**
Capability of the infrastructure to tolerate the additional demand for services										Availability *of the public facilities to tolerate the additional demand for services*
Sub-Sub-Criteria of Infrastructure										
The capability of the municipal water supply, sanitary, power supply systems to *tolerate the additional demand for services*										Accessibility to the site (e.g. through pathways and roads)
Sub-Sub-Criteria of Public Facilities										
Proximity of available public facilities that provide services to the displaced population (e.g. schools, hospitals and recreational)										Availability of facilities to accommodate the special needs of the displaced population (e.g. the elderly and the handicapped)
Proximity of available public facilities that provide services to the displaced population (e.g. schools, hospitals and recreational)										Ease of establishing temporary support facilities that provide services to the displaced population (e.g. communal cooking, warehouses, administration offices, collective area)
Availability of facilities to accommodate the special needs of the displaced population (e.g.										Ease of establishing temporary support facilities that provide services to the displaced

the elderly and the handicapped)										population (e.g. communal cooking, warehouses, administration offices, collective area)
Sub-Criteria of Community Considerations										
	Extremely important	**V. Strongly Important**	**Strongly important**	**Weak important**	**Equally**	**Weak important**	**Strongly important**	**V. Strongly Important**	**Extremely important**	
Sub-Criteria	**9**	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	**Sub-Criteria**
Attainment of privacy for the host and the displaced families										Impact of the size of the displaced population on the host community (e.g. noise and insecurity)
Attainment of privacy for the host and the displaced families										Period for hosting the displaced population
Attainment of privacy for the host and the displaced families										Social interaction and community support between the host and the displaced populations
Impact of the size of the displaced population on the host community (e.g. noise and insecurity)										Period for hosting the displaced population
Impact of the size of the displaced population on the host community (e.g. noise and insecurity)										Social interaction and community support between the host and the displaced populations
Social interaction and community support between the host and the displaced populations										Period for hosting the displaced population

Questionnaire survey of criteria assessment – Arabic

جامعة الملك فهد للبترول المعادن
كلية تصاميم البيئة
قسم الهندسة المعمارية

المسح الاستبياني

لتطوير نموذج متعدد الخصائص لتقييم قدرة المباني للاستخدام المؤقت كملاجئ أيواء انتقاليه اثناء الفيضانات في اليمن

إعداد

أحمد سعيد باهارون

مرشح لنيل درجة الماجستير في الهندسة المعمارية من جامعة الملك فهد للبترول والمعادن

المملكة العربية السعودية

4/8/2013

٢٨ جمادى الأولى، ١٤٣٤

أعد هذا المسح الاستبياني باشراف

د. محمد حسانين

أ.د. عبدالمحسن الحماد

د. اسماعيل بديوي

د. جمال القواسمي

د. جيبريكاش تشادتشان

الأستبيان

الجزء الاول : المعلومات الشخصية

يرجى الاجابة عن الاسئلة التالية بملء الفراغات المناسبة:

- معلومات المقّيم:

الاسم				
الهاتف				
البريد الالكتروني				
مجال التخصص*	مهندس معماري	مهندس مدني	اداري	اخرى(.....)

*حقل اجباري

- الوظيفة والخبره العملية :

الوظيفة *	مديرلمنظمة حكومية او غير حكومية	
	مهندس تقييم ميداني	
	منسق اعادة اسكان المتضريين	
	مسئول فريق انقاذ	
	اخرى، يرجى تحديدها(.....)	
سنوات الخبرة العملية *	أقل من ٣ سنوات	
	٣-٥ سنوات	
	اكثر من ٥ سنوات	
موقع العمل او الوظيفة *	مديريات ساحل حضرموت	
	مديريات وادي حضرموت والصحراء	
	اخرى، يرجى تحديدها(.....)	
جهة العمل *	منظمات حكومية	
	منظمات غير حكومية، مجتمع مدني	
	اخرى، يرجى تحديدها(.....)	
اسم جهة العمل		

*حقل اجباري

الجزء الثاني: تقييم العناصر و الخصائص الرئيسية و الثانوية

ملاحظة هامة : لتسهيل عملية التقييم ، يرجى مراجعة التكوين الهرمي للنموذج قبل تعبئة الاستبيان (مرفق مع الاستبيان)

المثال التالي يوضح طريقة التقييم المطلوبة:

فضلا، قيم اهمية الخصائص الموضحة في جدول المقارنه الثنائية بناء على الأهمية والتأثير مستخدما المقياس ١-٩ . علما ان الارقام تعني التالي:

١= كلا الخاصيتين متساويتين في الاهمية

٣= الخاصية محدودة الاهمية

٥= الخاصية مهمة

٧= الخاصية مهمة جدا

٩= الخاصية مهمة بشكل مطلق

	أهمية مطلقة	مهمة جدا	مهمة	اهمية محدودة	متساوية	اهمية محدودة	مهمة	مهمة جدا	اهمية مطلقة	
الخاصية	٩	٧	٥	٣	١	٣	٥	٧	٩	الخاصية
ب			✓							أ
ج						✓				أ

- ***العناصر الرئيسية***

لتقييم قدرة المباني لغرض الاستخدام المؤقت كملاجئ ايواء، يجب تقييم العديد من العناصر ذات التاثير الاهمية وهي:

- خصائص المبنى وملائمته لمتطلبات الايواء والملاجئ
- قدرة البنية التحتية والمرافق الخدمية العامة ضمن نطاق المبنى
- خصائص واعتباراتالمجتمع

لتقييم قدرة المبنى، يرجى تقييم أهمية العناصر التالية:

العناصر الرئيسية									
العناصر	**اهمية مطلقة**	**مهمة جدا**	**مهمة**	**اهمية محدودة**	**متساوية**	**اهمية محدودة**	**مهمة**	**مهمة جدا**	**أهمية مطلقة**	**العناصر**
	٩	٧	٥	٣	١	٣	٥	٧	٩	
اي من العناصر التالية هو اكثر اهمية؟										
خصائص المبنى وقدرته على الاستيعاب										*قدرة البنية التحية والمباني الخدمية على الاستيعاب*
خصائص المبنى وقدرته على الاستيعاب										*قابلية وقدرة المجتمع المضيف لقبول النازحين*
قدرة البنية التحية والمباني الخدمية على الاستيعاب										*قابلية وقدرة المجتمع المضيف لقبول النازحين*

- ***الخصائص الرئيسية والثانوية***

تضم العناصر السابقة العديد من الخصائص الرئيسية والثانوية والتي تؤثر بشكل جوهري على قدرة المباني للاستخدام المؤقت كملاجئ ايواء انتقاليه اثناء الفيضانات. فضلا، يرجى تقييم الخصائص التالية:

خصائص المبنى وقدرته على الاستيعاب									
الخصائص الرئيسية	**اهمية مطلقة**	**مهمة جدا**	**مهمة**	**اهمية محدودة**	**متساوية**	**اهمية محدودة**	**مهمة**	**مهمة جدا**	**أهمية مطلقة**	**الخصائص الرئيسية**
	٩	٧	٥	٣	١	٣	٥	٧	٩	
اي من الخصائص التالية هي اكثر اهمية؟										
مرونة هيكل المبنى لاعادة الاستخدام (مثال: قابلية التعديل و الاضافة)										قدرةالمبنى الاستيعابية لاسكان النازحين
مرونة هيكل المبنى لاعادة الاستخدام (مثال: قابلية التعديل و الاضافة)										*الاعمال المطلوبة لاعادة استخدام المبنى*
مرونة هيكل المبنى لاعادة الاستخدام (مثال: قابلية التعديل و الاضافة)										قدرة انظمة المبنى *على استيعاب طلب النازحين (ماء،كهرباء،صرف)*
قدرةالمبنى الاستيعابية لاسكان النازحين										*الاعمال المطلوبة لاعادة استخدام المبنى*
قدرةالمبنى الاستيعابية لاسكان النازحين										قدرة انظمة المبنى *على استيعاب طلب*

										النازحين(ماء،كهرباء،صرف)
الاعمال المطلوبة لاعادة استخدام المبنى										قدرة انظمة المبنى *على استيعاب طلب النازحين (ماء،كهرباء،صرف)*

لمرونة هيكل المبنىالخصائص الثانوية										
الخصائص الثانوية	**اهمية مطلقة**	**مهمة جدا**	**مهمة**	**اهمية محدودة**	**متساوية**	**اهمية محدودة**	**مهمة**	**مهمة جدا**	**اهمية مطلقة**	**الخصائص الثانوية**
	٩	٧	٥	٣	١	٣	٥	٧	٩	
اي من الخصائص التالية هي اكثر اهمية؟										
قابلية ومرونه الاضافة اوالازالة لبعض عناصر المبنى (مثال: الجدران الداخلية)										القابلية والمرونه لاعادة تصميم وتوزيع الفضاءات
قابلية ومرونه الاضافة اوالازالة لبعض عناصر المبنى (مثال: الجدران الداخلية)										توفرالفضاءات الوظيفية الملائمة لاسكان النازحين
قابلية ومرونه الاضافة اوالازالة لبعض عناصر المبنى (مثال: الجدران الداخلية)										عدد المداخل وارتباطها مع ممرات الحركة الرئيسية داخل المبنى
القابلية والمرونه لاعادة تصميم وتوزيع الفضاءات										توفرالفضاءات الوظيفية الملائمة لاسكان النازحين
القابلية والمرونه لاعادة تصميم وتوزيع الفضاءات										عدد المداخل وارتباطها مع ممرات الحركة الرئيسية داخل المبنى
توفرالفضاءات الوظيفية الملائمة لاسكان النازحين										عدد المداخل وارتباطها مع ممرات الحركة الرئيسية داخل المبنى

الخصائص الثانوية للقدرة الاستيعابية للمبنى									
	٩	٧	٥	٣	١	٣	٥	٧	٩
نسبة اشغال فضاءات المبنى بشكل كامل او جزئي									العدد الاقصى من النازحين الممكن استيعابهم داخل المبنى

الخصائص الثانوية لقدرة انظمة المبنى									
	٩	٧	٥	٣	١	٣	٥	٧	٩
قدرة انظمة وشبكات المياه، الصرف الصحي، الكهرباء والغاز داخل المبنى *لاستيعاب الطلب*									قدرة انطمة التكيف والتهوية *لاستيعاب طلب و استخدام النازحين*
قدرة انظمة وشبكات المياه، الصرف الصحي، الكهرباء والغاز داخل المبنى *لاستيعاب الطلب*									قدرة انظمة مكافحة الحريق والسلامة
قدرة انطمة التكيف والتهوية *لاستيعاب طلب و استخدام النازحين*									قدرة انظمة مكافحة الحريق والسلامة
الخصائص الثانوية لاعمال إعادة الاستخدام									
	٩	٧	٥	٣	١	٣	٥	٧	٩
توفر الموارد المطلوبة لاجراء اعمال اعادة الاستخدام (مثال: التمويل،المواد،العمالة،المعدات والتجهيزات)									قابلية اعادة المبنى الى حالته السابقة قبل اجراء اي تعديلات

الخصائص الرئيسية للبنية التحتية والمرافق الخدمية									
الخصائص الرئيسية	**اهمية مطلقة**	**مهمة جدا**	**مهمة**	**اهمية محدودة**	**متساوية**	**اهمية محدودة**	**مهمة**	**مهمة جدا**	**اهمية مطلقة**	**الخصائص الرئيسية**
	٩	٧	٥	٣	١	٣	٥	٧	٩	
توفر المرافق العامة *اللازمة وقدرتها على الاستيعاب*										توفر البنية التحتية وقدرتها على *الاستيعاب*

الخصائص الثانوية للبنية التحتية									
سهولة الوصول الى الموقع بواسطة ممرات المشاة والطرق									قدرة الخدمات البلدية *استيعاب الطلب* (مثل امداد المياه،الصرف الصحي، التغذية الكهربائية)
الخصائص الثانوية للمرافق الخدمية العامة									
قرب المرافق الخدمية المتوفرة لخدمة النازحين (مثال:المدارس، المستشفيات، المتنزهات)									توفر المرافق لخدمة الاشخاص ذوي الاحتياجات الخاصة من النازحين (مثال: كبار السن، المعاقين)
قرب المرافق الخدمية المتوفرة لخدمة النازحين (مثال:المدارس، المستشفيات، المتنزهات)									سهولة انشاء مباني دعم وامداد مؤقته (مثال: مطابخ عموميه، مخازن، مكاتب ادارية، ساحات عامة)
توفر المرافق لخدمة الاشخاص ذوي الاحتياجات الخاصة من النازحين (مثال: كبار السن، المعاقين)									سهولة انشاء مباني دعم وامداد مؤقته (مثال: مطابخ عموميه، مخازن، مكاتب ادارية، ساحات عامة)

خصائص و اعتبارات المجتمع									
الخصائص	**اهمية مطلقة**	**مهمة جدا**	**مهمة**	**اهمية محدودة**	**متساوية**	**اهمية محدودة**	**مهمة**	**مهمة جدا**	**أهمية مطلقة**	**الخصائص**
	٩	٧	٥	٣	١	٣	٥	٧	٩	
توفير الخصوصية اللازمة للمجتمع المضيف والنازحين										تاثير الكثافة السكانية النازحة على المجتمع المضيف
توفير الخصوصية اللازمة للمجتمع المضيف والنازحين										فتره استضافة النازحين ضمن المجتمع المضيف
توفير الخصوصية اللازمة للمجتمع المضيف والنازحين										التفاعل والدعم الاجتماعي بين المجتمع المضيف والنازحين
تاثير الكثافة السكانية النازحة على المجتمع المضيف										فتره استضافة النازحين ضمن المجتمع المضيف
تاثير الكثافة السكانية النازحة على المجتمع المضيف										التفاعل والدعم الاجتماعي بين المجتمع المضيف والنازحين
فتره استضافة النازحين ضمن المجتمع المضيف										التفاعل والدعم الاجتماعي بين المجتمع المضيف والنازحين

APPENDIX II

Assessment Checklist of Building Potential for Temporary Use		
1. Building Characteristics & Suitability	2. Infrastructure Services	3. Communities Considerations
Certified Specialist		
Engineer Name		
Attached documents: building floors plans		
Used measuring and testing tools:		

General Information

Total building area:	
Number of floors:	
Original function of building:	

1. Building Characteristics & Suitability

1.1 Building Structure and Design

Flexibility to remodel building layout				
Type of structure	Load bearing wall	Frame structure		
Does it allow for adaptation works?		Yes	NO	
What is the level of adaptation works?	Add doors	Add partitions	Remove walls	
How much is the total functional area of each floor?		……..m^2		
Can the available spaces are remodeled easily?		Yes	NO	
Sub criteria assessment (percentage value)		……%		
Availability of functional space units				
How many are rooms that already available to use?				
How many are bathrooms that already available to use?				
Is there an internal open space for people gathering?		Yes	NO	….m^2
Sub criteria assessment (percentage value)		……%		
Access points to the building and main circulation routes				
How many are entrances available to use?				
Are they suitable for the settlement use?				
Are entrances and routs providing the handicapped people (ramps, curb cuts, and handrails?)		Yes	NO	
Are the circulation routes capable to discharge the expected population?		Yes	NO	
Sub criteria assessment (percentage value) - Adequate Access points and corridors (100%) - Inadequate Access points and corridors (0%)		……%		

Recommendations 1.1
What is the suggested layout to settle displaced people? Attach solution drawing
Are there any constraints to use the building? What are they? …… ……
What are the suggested actions and recommendations? …… …… ……

1.2 Occupancy

Capability of occupying the building spaces		
Are there any expected spaces will be used as store?	Yes	NO
Are there any spaces that include fixed equipment or furniture? (labs, laundry)	Yes	NO
Sub criteria assessment (percentage value) - Totally available to use (100%) - Unavailable to use (0%)	…… …..……%	

Capacity of the building to accommodate displaced population		
What is the expected capacity of the building	……. persons	
If some modification were carried out, can building accommodate more than the expected capacity?	Yes	NO
If yes, what is the maximum expected capacity?	……. persons	
Sub criteria assessment (percentage value) - Meet the capacity range or more (100%) = yes - Less than capacity range (0%) = no	Yes	NO

Recommendations 1.2
Are there any suggestions or recommendations? …… …… …… …… …… …… ……

1.3 Building Systems

The capability of water supply, sanitary, power supply systems to tolerate the additional demand for services		
With considering the expected capacity and function, please assess the following:		
Is there a need for extra water source (e.g. extra tanks)? (Please add your notes in the recommendations' field 1.3)	Yes	No
Does the capability of electrical network provide the expected use (e.g. distribution of power sockets, lights distribution, AMP and capacity of the new expected appliances) ? (Please add your notes in the recommendations' field 1.3)	Yes	No
Are the Sanitary pipes capable to tolerate the expected use? (Please add your notes in the recommendations' field 1.3)	Yes	No
Are building installation and equipment durable to tolerate the heavy use? (Please add your notes in the recommendations' field 1.3)	Yes	No
Sub criteria assessment (percentage value) - Building system is capable and need miner maintenance (100%) - Building system is not capable and need major maintenance (0%)	…… …..……%	

The capability of the HVAC systems to tolerate the additional demand for services		
With considering the expected capacity and function, please assess the following:		
Is the HVAC system capable to provide occupants with the required thermal comfort? (Please add your notes in the recommendations' field 1.3)	Yes	No
Sub criteria assessment (percentage value) - HVAC system is capable and need miner maintenance (100%) - HVAC system is not capable and need major maintenance (0%)	…… …..……%	

The capability of the fire protection systems to tolerate the additional demand for services		
With considering the expected capacity and function, please assess the following:		
Does the expected function have more risk than the original function?	Yes	No
Does the building condition meet the minimum requirement of fire safety standard? (Please add your notes in the recommendations' field 1.3)	Yes	No
What is the expected source of fire? …… …… …… ……		
What is the expected fire load? …… …… ……		
Sub criteria assessment (percentage value) - Fire system is capable and needs miner upgrading (100%) - Fire system is not capable and needs major upgrading (0%)	…… …..……%	

Recommendations 1.3
Are there any constraints to use the building systems? What are they? …… …… …… …… …… …… ……
What are the suggested actions and recommendations? …… …… …… …… …… ……

1.4 Adaptation works

Availability of required resources for carrying out the required adaptation works		
With considering the suggested works to make the building ready for displaced settlement and the constraint of available resources, please assess the following:		
Do they meet the allocated resources? (Please add your notes in the recommendations' field 1.4)	Yes	No
Can works are carried out under the disaster and harsh climate conditions? (Please add your notes in the recommendations' field 1.4)	Yes	No
Sub criteria assessment (percentage value) - Adaptation works meet the available resources (100%) - Adaptation works do not meet the available resources (0%)	…… …..……%	

Reverting the adapted building to its original design		
With considering the suggested works to make the building ready for displaced settlement, please assess the following:		
Are the suggested works leading to permanent modifications on the original layout?	Yes	No
Sub criteria assessment (percentage value) - Building can be easily reverted to original function (100%) - Building cannot be easily reverted to original function (0%)	…… …..……%	

Recommendations 1.4
Are there any constraints to conduct the adaptation works? What are they? …… …… …… ……
What are the suggested actions and recommendations? …… …… ……

2. Infrastructure and Public Facilities

2.1 Infrastructure

The capability of the municipal water supply, sanitary, power supply systems		
What is the ratio of displaced population to host community population?	……%	
How long the transitional settlement period is?		
Are the municipal services in a good condition to tolerate the additional demand for services?	Yes	No
Is there a need toupgrade these services? (Please add your notes in the recommendations' field 2.1)	Yes	No
Sub criteria assessment (percentage value) - Municipal services are capable and needs miner upgrading (100%) - Municipal services are not capable and needs major upgrading (0%)	……%	

Accessibility to the site (e.g. through pathways and roads)		
How many accessesare available to the building?		
What is the expected distance between building and nearest main road?		
Are they providing pedestrians, vehicles and disable movement?	Yes	No
What are the accesses conditions? How much is the roads vulnerability for weather conditions? (Please add your notes in the recommendations' field 2.1)		
Sub criteria assessment (percentage value) - Accesses are adequate (100%) - Accesses are inadequate (0%)	……%	

Recommendations 2.1
Are there any constraints to use the infrastructure? What are they? …… …… …… ……
What are the suggested actions and recommendations? …… …… ……

2.2 Public Facilities

Public facilities that provide services to the displaced population		
What is the expected distance between building and nearest public facilities? (Please, specify the distance to one separately)		
Are they capable to tolerant the additional demand of services? (Please add your notes in the recommendations' field 2.2)	Yes	NO
Sub criteria assessment (percentage value) - Public facilities are capable to tolerant (100%) - Public facilities are not capable to tolerant (0%)	……%	

Availability of facilities to accommodate the special needs		
If the building was not providing the needsof disable people, is there any other building to settle them? (Please add your notes in the recommendations' field 2.2)	Yes	NO
Sub criteria assessment (percentage value) - Meet the needs of those people (100%) - Does not meet the needs of those people (0%)	……%	
Ease of establishing temporary support facilities		
Is there an open space facility close to the settlement location?	Yes	NO
If not, is there a clear land to construct portable temporary facilities? (Please add your notes in the recommendations' field 2.2)	Yes	NO
Sub criteria assessment (percentage value) - Availability of solution to get temporary support facilities (100%) - Unavailability of solution to get temporary support facilities (0%)	……%	

Recommendations 2.2
Are there any constraints for the public facilities? What are they? …… …… …… …… ……

What are the suggested actions and recommendations? …… …… …… …… …… …… ……

3. Community Considerations

Privacy of host and displaced		
With considering the expected capacity of displaced settlement, please assess the following:		
Is the allocated area providing the required level of privacy for each family? (e.g. room and bathroom)	Yes	NO
Are the community customs and priorities considered?	Yes	NO
Is there any expected violation for hosted community privacy? (Please add your notes in the recommendations' field 3)	Yes	NO
How much is the separation distance between assessed building and closest neighbors' buildings?		
Sub criteria assessment (percentage value) - Building provides privacy (100%) - Building does not provide privacy (0%)	……%	
Impact of the size of the displaced population		
With considering the expected capacity of displaced settlement, please assess the following:		
What is the ratio of displaced population to the host population? (note: displaced have to be less than host population)		
How much is the separation distance between assessed building and closest neighbors' buildings?		
Is there any expected slum spots caused by displaced settlement at the host community? (Please add your notes in the recommendations' field 3)	Yes	No
Is there any expected inconvenience, risk and insecurity, turbulence that caused by displaced settlement at the host community? (Please add your notes in the recommendations' field 3)	Yes	No

Is there any environmental impacts? (Please add your notes in the recommendations' field 3)	Yes	No
Sub criteria assessment (percentage value) - There are no impacts (100%) - There are serious impacts (0%)	……%	

Period for hosting	
How long are displaced people accommodated in transitional shelters?	
Sub criteria assessment (percentage value) - Meet the constraint of hosting period (100%) - Does not meet the constraint of hosting period (0%)	……%

Social collaborations and community support	
With considering the expected capacity of displaced settlement and period of hosting, please assess the following:	
What is the compatibility level of the displaced and host population? - Culture - Education - Religion - Ethnic (Please add your notes in the recommendations' field 3)	
Based on the history of community collaborations in the disaster situation, What is the expected sympathy of community for displaced people?	
Sub criteria assessment (percentage value) - Collaborative community (100%) - Non-collaborative community (0%)	……%
Recommendations 3	
Are there any constraints for the public facilities? What are they? …… ……	
What are the suggested actions and recommendations? …… ……	

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