

Lightweight Folding Shelter Design for Flood Affecteds

Yasir Ali

yasirali199727@gmail.com

CECOS University of IT and Emerging Sciences Peshawar, Pakistan

Dr Aman Ullah

Ph.D. Architecture, Istanbul, Turkiye

Visiting Faculty, Master of Architecture, CECOS University

Corresponding Author: Yasir Ali yasirali199727@gmail.com

Received: 20-01-2026

Revised: 06-02-2026

Accepted: 22-02-2026

Published: 08-03-2026

ABSTRACT

The study investigates the design of the Lightweight Folding Shelter Design for the flood affecteds of Charsadda people. This area is more vibrant towards flood due to its strategic location in this area Kabul and Swat Rivers have been mixed, and the water level goes high as a result the water starts flowing towards the population. The study investigates from the existing data of PDMA and NDMA and local sources.

Keywords: Lightweight folding shelters, flood-affected communities, Charsadda, emergency housing

INTRODUCTION

What is folding shelter design?

The foldable emergency safe haven objectives at imparting instant comfort after screw ups. The safe haven is characterised by an easy assembly and disassembly process, a compact and bendy structure, and an adaptability to hastily converting situations. except from useful resource comfort, the folding safe haven can also make a splendid cheap and smooth addition to the campsite or be used as a transient outdoor structure. The folding shelter additionally modular in layout, which means individuals devices may be joined together to create large dwellings or separate rooms. while blended collectively, the



folding refuge can without difficulty accommodate larger families, as well as supplying privacy during times of disaster.

Project Background

Pakistan is at risk of maximum natural hazards. it's miles at risk of floods, earthquakes throughout all components of the country. in line with the Federal Flood commission of Pakistan has witnessed 28 extremely good disastrous floods in its 75-yr records. the first recorded splendid flood becomes witnessed in 1950, accompanied through 1955, 1956, 1957,

1959, 1973, 1975, 1976, 1977, 1978, 1981, 1983, 1984, 1988, 1992, 1994, 1995 after which every 12 months on account that 2010 — which additionally saw the worst flood in the usa's history. these floods together affected 616,558 rectangular kilometers of land, snatched thirteen,262 treasured human lives and triggered losses really worth over Rs39 billion to the country wide economy. right here are some of the flood records in information that are found 1990 onwards.

Problem Statement

Every year KPK is facing floods, which leads to demolishing the agricultures land and houses, human life and life stocks, while at other hand NDMA has facilities all the effects of the areas all over the time of disasters. However, for the residence NDMA only provides tents for temporary livings. Moreover, as per the KPK cultures people are not like to live in the tents, they move to other area and start staying their which leads to uncertainty of the areas.

Objectives

- Design suitable living environment for the local resident who are affected from flood.
- Proper living shelters for floods and other disasters effects.
- Transportable and folding shelters.
- Lightweight houses to installed/executed quickly.

METHODOLOGY

- Survey and research.
- Case Study (Local, National).
- Site Analysis (Site Assessment).
- Design study in consultation of Supervisor.

SCOPE OF WORK

- Foldable Lightweight House.
- Proposed Zoning and Master Plan Design
- Livestock space.
- Market spaces.
- Basic Health Unit.
- Masjid.

- School.

Note: main focus on folding shelter design.

LITERATURE REVIEW

Background of Floods

2007 KP, Sindh and Baluchistan Floods: -

In 2007, Khyber Pakhtunkhwa, Sindh and coastal area of Baluchistan were badly affected due to monsoon rainfall. Sindh and coastal area of Baluchistan were affected by Cyclone Yemyin in June and then torrential rains in July and August, while Khyber

Pakhtunkhwa was affected by melting glaciers and heavy rainfall in July and August which leads to heavy flood in KP.

Casualties Caused by Flood: Deaths

130 People Died in KP, 815 in Sindh and Baluchistan due to heavy floods.

Displaced

Around 12k plus people lost their homes and were moved out from their own shelter which leads to the homeless situation for them, and homeless people move towards urban area which leads to urban migration, crime issue and kacha abadi.

2010 Pakistan Floods: -

In 2010, like everywhere in Pakistan Khyber Pakhtunkhwa face heavy rainfall in result it is converted to floods which damages many areas across KP. The most affected was rural areas of KP. According to UN experts, 2.7 million people in Khyber Pakhtunkhwa (KP), 5.3 million in Punjab and over 6 million in Sindh have been affected.

Province	Deaths	Injured	Houses Damaged	Population Affected
Balochistan	54	104	75,596	700,000
KP	1,156	1,198	284,990	3,800,000
Punjab	110	262	497,700	6,000,000
Sindh	411	1,235	876,249	7,274,250
AJK	71	87	7,106	200,000

GB	183	60	2,830	100,000
Total	1,985	2,946	1,744,471	18,074,250

As mentioned in the above table that how much KP was affected by 2010 Floods? The ratio of Deaths was highest among all other provinces while injured ratio was 2nd behind Sindh and houses damaged ratio was 3rd behind Sindh and Punjab.

- Damage to Livestock (head of livestock)**

Province	Died in Floods	Indirectly Affected	Sold at Low prices	Animal Sheds Destroyed	Fisheries	Poultry farms/ Birds	Govt. Veterinary	Extension Dept. Field Offices
Punjab	62,765	4,361,000	9,800	10,700	916	459,000	13	17
Sindh	54,064	7,376,115	NK	33,000	NK	NK	9	0
KP	105,042	739,429	NK	NK	23	NK	NK	NK
Balochistan	51,740	1,621,144	NK	NK	NK	NK	NK	NK
AJK	723	228,000	1,900	2,700	NK	NK	NK	NK
Total	274,334	14,325,688	11,700	46,400	939	459,000	13	17

- Field Crops (damage in hectares)**

Provinces	Cotton	Sugarcane	Rice	Maize	Pulses	Fodder Crops	Summer Vegetable	Other	Province Total
Punjab	315,769	64,467	72,086	2,782	50,865	110,565	5,005	14,410	661636
Sindh	99,930	20,072	217,074	0	0	3,934	6,044	7,284	357488
KP	206	41,986	36,542	92,206	6,807	0	8,137	391	191020
Balochistan	0	0	41,455	15	0	4,932	35,722	10,245	92369
AJK	0	0	113	9,474	0	0	1,296	182	11242
Total	415,905	126,525	367,270	104,476	57,673	119,431	56,204	32,513	1,313,755

• **2016 Pakistan Floods: -**

Like as 2010, KP to face floods challenges in 2016 Heavy monsoon rains are common in the region. This led to multiple periods of flooding, landslides, and damage (including loss of life) particularly in Northern Areas. The Swat River overflowed and multiple landslides occurred around Pakistan including in Khyber Pakhtunkhwa, Gilgit-Baltistan, Azad Jammu, and Kashmir.

Month	Type of Disaster	Areas Affected	Deaths	Injuries	Houses Damaged
March - May 2016	Heavy pre-monsoon rains	Punjab, Khyber Pakhtunkhwa, Gilgit Baltistan, Azad Jammu and Kashmir	271	279	2929
June – September 2016	Monsoon rains	Khyber Pakhtunkhwa, Balochistan, Azad Jammu and Kashmir	153	113	1452

KP see a massive disaster in a form of Floods through pre monsoon rains. The ratio shown above is clearly justifying the floods damaged ratio before and during monsoon rains.

Houses Deficiency:

There are over 20 million homeless people in Pakistan. Its estimates around 9% of the total population. Most of them are living in temporary shelter, refugees, slums, or on the street, which leads to create urban sprawl and leads to many urban issues in the region. By use of lightweight shelters for such people it will not only facilitate such people but also the ratio of homeless people will decrease. These shelters will be movable structures so it will also encourage the utilization of land as our population is increasing in urban ratio and rural ratio day by day.

Countrywide Disaster Management Authority

Countrywide disaster management Authority is the lead company at the Federal level to address the whole spectrum of catastrophe control sports. it is the govt arm of the national disaster management commission (NDMC) which has been installed beneath the Chairmanship of the top Minister because the apex policy making body inside the area of disaster management. within the occasion of a catastrophe, all stakeholders consisting of authorities' Ministries/Departments/corporations, militia, INGOs, NGOs, UN companies work through and shape part of the NDMA to conduct one window operations. it is mounted under the national catastrophe control Act – 2010 and features under the supervision of countrywide catastrophe management commission (NDMC) which is headed by the prime Minister of Islamic Republic of Pakistan. NDMA manages the whole catastrophe control Cycle (DMC) which includes Preparedness, Mitigation, threat discount, comfort and Rehabilitation.

Types of Materials Locally Available That Can Be Used:

Sandwich Panels: -

Sandwich panels are constructing material designed to cowl buildings and structures. these panels include two layers that shape the outer shape and make sure form, weather resistance and stress. They include a center that provides thermal and acoustic insulation houses.

Characteristics of Sandwich Panels: -

The maximum essential functions of sandwich panels are their extremely good insulation. The middle



Outer surface which forms a rigid structure

Inner surface provides thermal and acoustics properties

of the plates gives it low thermal conductivity, this is, higher insulation. for that reason, it's far regularly used in the renovation of buildings, both on roofs and facades, and in the creation of business buildings. Sandwich panels are synthetic and installed in no time. For meeting, they're screwed to the shape and, relying on the finish, it is able to be with visible or concealed screws. This makes the development time one of the shortest in comparison to different structures. one of the most essential benefits of sandwich panels as a production detail is the type of shapes and finishes to be had available on the market. There are all types of panels relying on the building for which it's far designed. The finishes vary between rustic and current, and we can locate imitation wooden or imitation tile panels among others.

Size of Sandwich Panels:

The width of the insulation board is usually 1,000 mm (39.37inch) and, in a few models, it's far 1, a hundred and fifty mm (45.27) extensive. The length of the sandwich panel may be adjusted according to the desires of every challenge, the most commonplace dimensions being between 3 and 6 meters, however, in some cases, a most length of as much as 16 meters can be reached. The thicknesses of these panels can range tremendously depending on the final utility, the maximum common values being between forty and one hundred fifty-200 mm thick relying on the application.

Use of Sandwich Panels:

These insulating factors are mainly beneficial chiefly in roofs and facades of industrial buildings that process at low temperatures. due to their lightness, they may be perfect for renovating enclosures. they are additionally effective in the insulation of cold rooms and warehouses, in sports centers and shopping centers and in homes, both new and renovated.

Use of Sandwich Panels in Wall and Facade:

Sandwich panels for wall and facades have been improved for the construction of enclosures in houses, colleges, hospitals, industrial facilities or purchasing centers. Sandwich panels also can be observed for indoors partitions that require insulation. The blessings supplied via those façade panels rely to a big extent on the method of becoming a member of between panels. The fastening device is applied in a tongue-and-groove manner, making sure ok safety, stopping the dissipation of warmth and humidity.

Use of Sandwich Panels in Roof:

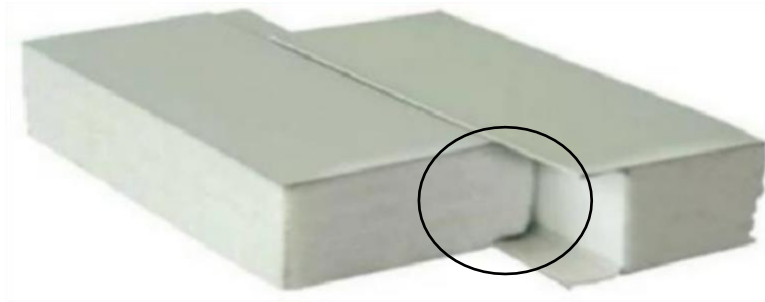
The characteristics of sandwich panels for roofs differ from façade panels in that they will must resist big quantities of snow, rain and different climatic factors. they are constant to the structure with self-drilling screws, to prevent leakage in case of rain and humidity, and are often mixed with sealing joints, which accelerates installation without sacrificing the insulation layer.

Process of Single EPS Sandwich Wall Panel Joint Details

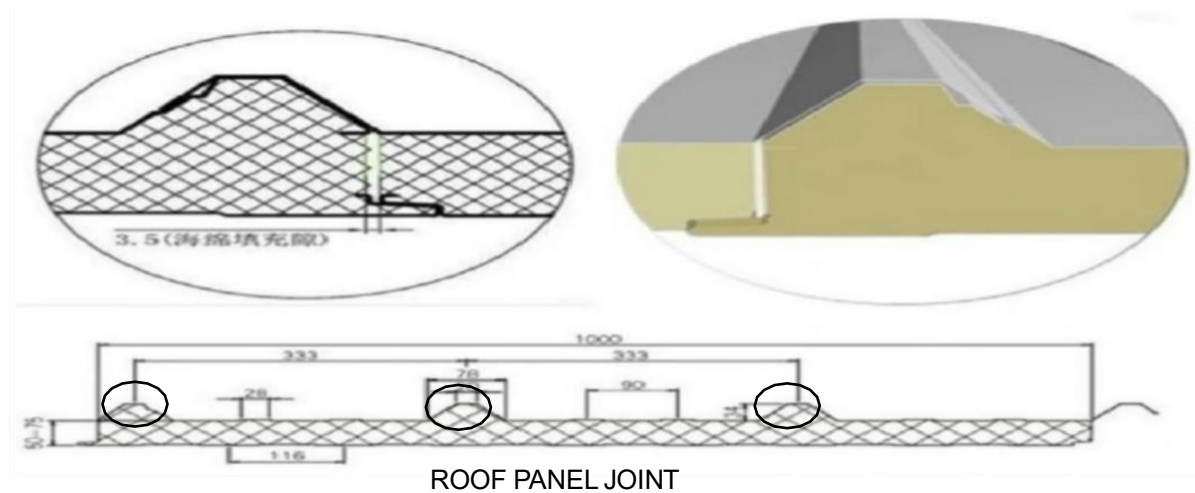


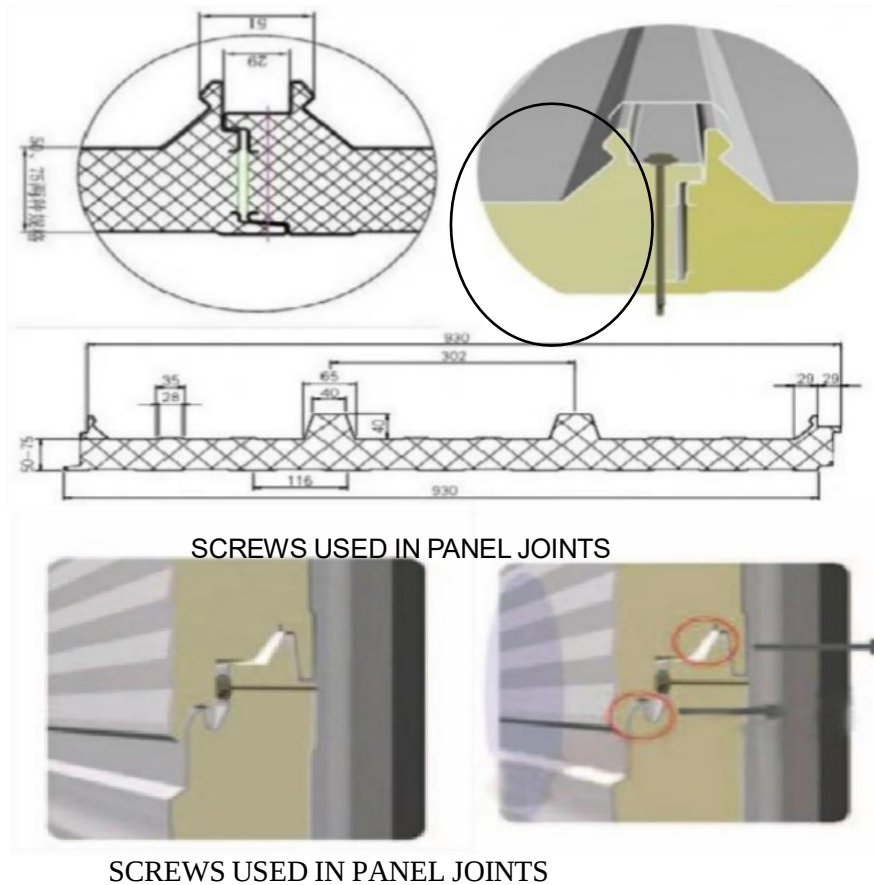
EPS SANDWICH PANEL

JOINING SPACE



Process of Single EPS Sandwich Roof Panel Joint Details





Feature of Sandwich Panels:

Toughness

Sandwich Panel lifespan degrees from 15-twenty years.

Light Weight

The distinguish advantage that cannot simply prevent transportation value, however can also easy for sporting and lifting, and it has the capability of sporting heavy masses.

Inert Capability

It is an inert material that doesn't show up response when contacted with other materials. as an example, water can make metallic rust. but, inside the case of expanded polystyrene sandwich panel, water will comfortably haven't any reaction, so EPS sandwich panel with inert performance. also, sandwich panel with resistance to acid and alkali.

Thermal and Soundproof Insulation

Sandwich Panel convey to some make bigger sound insulation however excellent thermal insulation; sandwich panel ensures users peaceful surroundings.

Value Performance

A sum total of all your expenses from shopping, to delivery, constructing, and retaining are reasonably-priced compared to other building cloth total fees.

Cheap Installation Price

With the usage of sandwich panel, the set-up fees are much less in comparison to different building substances price will come cheap. this is due to it did no longer want any unique equipment earlier than follow sandwich panel to the design region. only screws are wished. this can store price and time.

RESEARCH METHODOLOGY

Site Analysis

Selection of the Site

As we know Pakistan is vernable to the natural disasters especially floods and we have seen it from the last couple of decades it causes a lot of damage to many parts of the country specially KPK in terms of infrastructure, financial aspects and most importantly human life and their houses are affected. The geography of the floods in Pakistan is it starts from the upper region/ north region of the country and then its spreads into the different parts of the country through rivers channels, canals etc. The floods coming from the north region and water from Warsak enter to the Kabul River as a result the water level on that spot increase and due to this water level take the shape of flood water and extended to surrounding areas.

Due to above explanation the flood water overflow and badly hit the near areas of Kabul River which is spreads approx. 8 to 10 km. In order to tackle these things proposed site is selected in the same region away from 5 to 6 km so that the rescue operations can be conducted easily and the peoples can be shifted from the affected areas to safe zones.



PROPOSED SITE FOR LIGHTWEIGHT SHELTER DESIGN

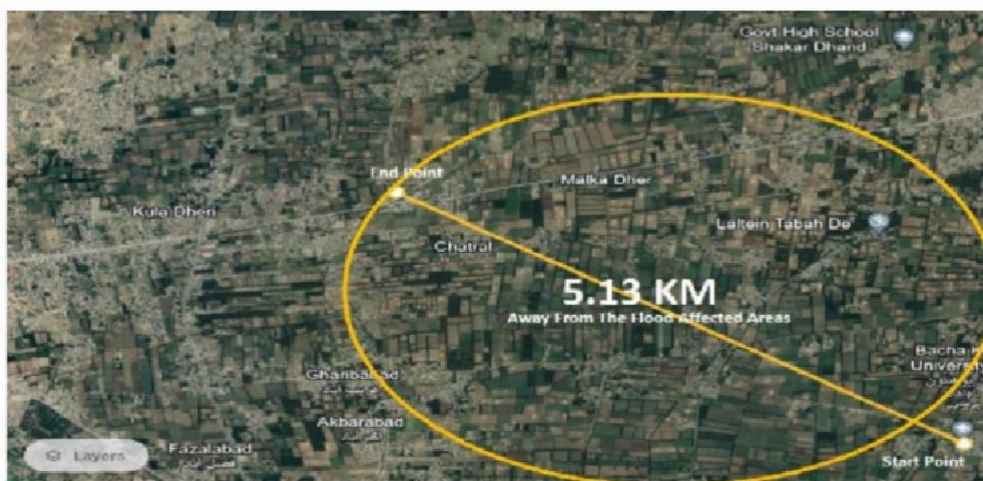
Geographical Analysis



SWAT AND KABUL RIVER INTERSECTION POINT



AREAS AFFECTED BY FLOODS MOSTLY



SITE DISTANCE FROM AFFECTED AREAS

Location:

The site is located in Charsadda near Ghani Khan Road Mardan. The total covered area is 11.41 acres (91.25 Kanals).



Neighborhood Context:

The site is surrounded by agriculture lands, government buildings, judicial complex and some residential areas too.



Judicial Complex



Agriculture Lands



Judiciary Residency



Residential Area

Topography and Vegetation:

Topography is flat a little bit ups down on site is observed but it didn't require any such excavation.



Site Topography

Site Entrance

SWOT ANALYSIS

 STRENGTHS	 WEAKNESSES	 OPPORTUNITIES	 THREATS	
Site is accessible from many routes so that the rescue operation and management can be easily done.	Open Drainage issue leads to bad smell in the site results in environment damage. However, after proper drainage design the issue may be resolved.	The site is close to government building from surrounding which can bring prestige benefits.	No security issues and treads are found as site in near to government buildings with full prove security.	

CASE STUDY

Prefab House EPS Sandwich Panel Foldable Portable Emergency Shelter / After-Disaster Housing, Mobile House China

PRODUCT SPECIFICATIONS

Frame Material	Steel Frame
Insulation Material	EPS Sandwich Panel
Flooring	Laminate Flooring/PVC Carpet
Window	Aluminum Alloy/PVC
High Light	Emergency Disaster Shelter
External Wall	EPS Sandwich Panel
Roof	EPS Sandwich Panel
Door	Steel Security Door
Other Fittings	Toilet, Washbasin, Shower, Kitchen etc.

This EPS Sandwich Panel shelter additionally called “Lotus” residence gives a actual home at low-cost charges and is a totally simplest foldable but flexible” and may be used for multi- purposes. It requires no foundation and is simple and very quick to assemble (30mintegrated) by way of unskilled laborers. (2-three) now not because of mild, however smart!

As a totally built-in solution all Doors, Windows, electrics, etc. are already included. Therefore, carefully choose the materials built-in our houses and make sure that they are recyclable, environment friendly, and do not contain any chemical harming materials.

Quick Detail:

Name	Lotus House	Application	After-disaster housing
Color	Blue, White, Yellow, etc. depend on the customer’s request	Feature	1.rapid deployment 2.safe and durable 3.flexible design
Material	Sandwich Panel and other parts Material	Certificate	CE, ISO, SAA, ETC

Description:

Building Materials

1. Steel Frame
2. Roofing & Ceiling: EPS Sandwich Panel with color bond covering.
3. Wall: EPS Sandwich Panel.
4. Floor: CFC Sheet, PVC Floor covering.
5. Steel step and safety railing for the loft.
6. Door (entrance: double door with cipher lock, others: single door).
7. Window: single glass PVC window, white color, 4'W x 3'H, 2 each.
8. Bathroom: Toilet, Washbasin, Shower.

Applications:

Hotel, House, Office, Shop, etc.

Specifications:

1. 15 mins quickly Portable Emergency Shelter.
2. The shelters can be used attached or detached from the trucks, which means only one truck is required to use several shelters at the same time.
3. They're made to be moved easily and quickly and can be transported by ship, train, truck, air transport, or helicopter.

The benefits of our Lotus House:

1. Cost-effective and Affordable.
2. Spacious and easy to assemble.
3. Multifunctional usage.
4. Green (Environmentally Friendly).
5. Easy to transport and cost-saving in logistic.
6. Mobile with long service lifetime.



Foldable Shelter House



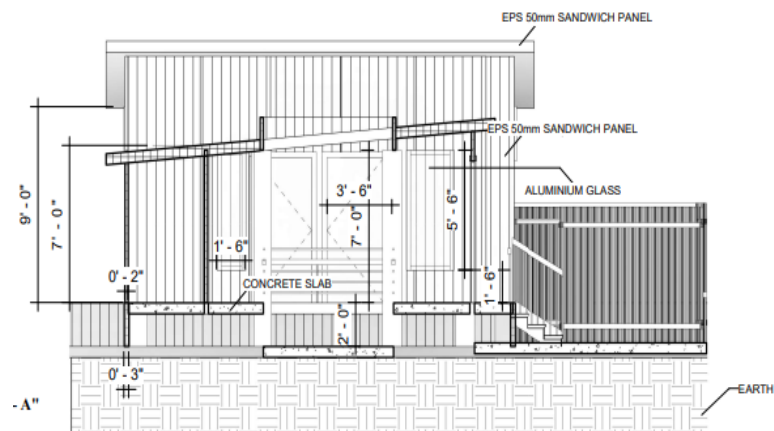
Manufacturer Company

The Working System Details:



ARCHITECTURE DESIGN PROPOSAL AND SOLUTION





LIGHTWEIGHT FOLDING SHELTER DESIGN



FRONT VIEW

SIDE VIEW



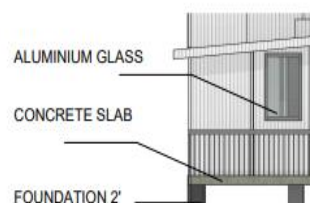
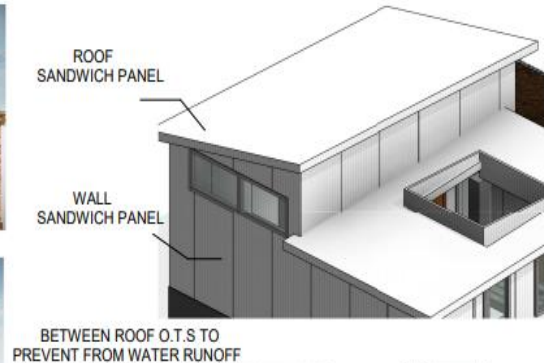
BACK SIDE VIEW

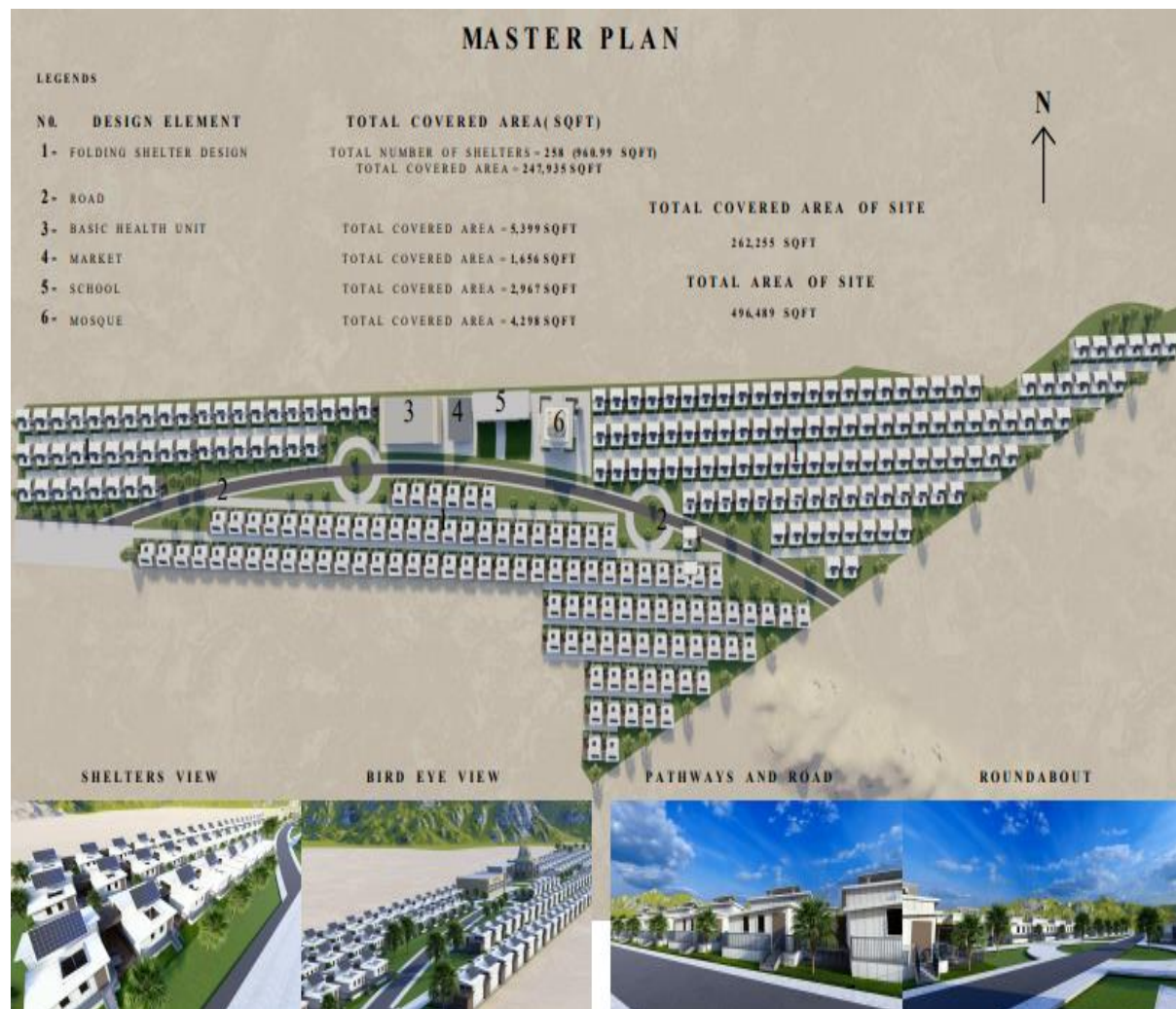
SIDE VIEW



PERSPECTIVE VIEW

LIGHTWEIGHT FOLDING SHELTER STRUCTURE





CONCLUSION

The study investigates the design of the Lightweight Folding Shelter Design for the flood affectees of Charsadda people. This area is more vibrant towards flood due to its strategic location in this area Kabul and Swat Rivers have been mixed, and the water level goes high as a result the water starts flowing towards the population. The study investigates from the existing data of PDMA and NDMA and local sources.