

SUSTAINABILITY IN DESIGN OF EMERGENCY SHELTERS: A CASE STUDY OF INNOVATIVE EMERGENCY SHELTER DESIGN FOR INTERNALLY DISPLACED PERSONS, SHEIKH SHEHZAD CAMP-MARDAN, KHYBER PAKHTUNKHWA, PAKISTAN

Mir Wali Shah

Assistant Professor, Department of Architecture
Hazara University Mansehra, Khyber Pakhtunkhwa, Pakistan
Email address: mwshah@gmail.com

Iftikhar Ali (Corresponding author)

Assistant Professor, Department of Architecture
Hazara University Mansehra, Khyber Pakhtunkhwa, Pakistan
Email address: iashah54@gmail.com

Azmat Ali Khan

Lecturer, Department of Architecture
University of Engineering and Technology, Abbottabad Campus, Khyber Pakhtunkhwa, Pakistan
Email address: aliazmat01@gmail.com

ABSTRACT

Pakistan has been impacted challenging by man-made disasters as well as natural disasters such as earthquakes, floods, cyclones, and draughts. Internally displaced persons as a result of conflict zones are one example of man-made disasters. In the province of Khyber Pakhtunkhwa, it stretches from Waziristan to the Swat Valley. Food, hard climatic conditions, shelter, and a healthy atmosphere were all pressing concerns for these individuals. The most difficult aspect was fitting it into the newly occupied spaces. This work focuses on the rehabilitation of these people from Swat Valley in the urban context of Mardan, where the summer temperature can reach 52 degrees Celsius. The most significant concern, given the extreme climatic conditions, is not only the availability of shelters but also the thermal comfortability of these designated shelters for IDPs. The occupants' psychological needs were left unmet by a need for self-sufficient and thermally comfortable accommodation. To present a sustainable, innovative, and cost-effective solution to deal with the problem of shelters and thermal comfortability at the same time, an exploratory and experimental approach was used in this article. For this study, microclimatic issues such as temperature, humidity management, and wind use are discussed. The results of the experiment suggest that using locally available materials following social and cultural trends, the prototype innovative shelters might be made climate-responsive and cost-effective.

Keywords: Emergency shelters, Thermal comfortability, Communities resettlement, Internally displaced persons, Innovation, Sustainability.

INTRODUCTION

Due to the phenomena of terrorism in its different forms and manifestations, the world's peace is at risk. It has altered the world's socioeconomic and political landscape. Pakistan is one of the countries that is doing a good job of fighting terrorism, but it has suffered a lot of losses in terms of its economy, social conditions, and political systems as a result. Terrorism primarily poses a threat to the entire country's law and order situation, as well as a flagrant violation of basic human rights, infrastructure damage, and a halt to short-term economic activities.

GROUND REALITIES OF THE IDPS

If we look at the historical context, the Swat is well renowned for its natural beauty, eco-tourism, cradle of civilization, and Buddhist heritage archaeological remnants. However, since 2007, this picturesque valley in Northern Pakistan has endured significant law and order issues as a result of terrorism. People were made victims of prosecution carried out by various non-state actors. However, the Pak Army's military operation against the insurgents was eventually successful. As a result of increasing the radius of its activities to include the surrounding districts of Dir, Shangla, Buner, and Chitral, three million people have been displaced from their homes.

Residents of the neighborhood were compelled to flee the red zone during a Pak Army military action for their safety. A panic-like situation develops, resulting in the largest-ever mass displacement of the whole population. The people were lodged in a variety of short-term housing camps. The Sheikh Shehzad camp, located in the Mardan area, is the largest camp for these IDPs. To accommodate the swat families, a tent village was erected. Daily, the IDPs were physically and psychologically challenging. Physically, they would have to deal with issues such as food, housing, and privacy, as well as psychologically dealing with the harsh weather conditions of Mardan, as they were from a very different climate. And they must contend with sweltering temperatures of up to 52 degrees Celsius during June and July when warm air flows. Figures, 1 & 2 showing the Migration from Swat and Settlement in Sheikh Shehzad Camp.



Figure.1. Migration of Masses from Swat to Mardan and Peshawar District affected by war on Terror, in 2009



Figure.2. Internally displaced persons from Swat in Sheikh Shehzad Camp, Mardan

On the western side of the main road leading to Charsadda, the camp was roughly three kilometers from Mardan's main city. W Hundreds of thousands of people were crammed into a small space. These displaced persons were also lodged in government schools, colleges, and other public buildings. Those who could afford rental housing sought shelter in surrounding locations, while others received assistance in finding lodging with close friends or relatives.

Figures 3 and 4 show the Sheikh Shehzad camp's main entrance with buses and vehicles laden with luggage and household items.



Figure.3. People entering the camp



Figure.4. Trucks brimming with household goods

A SUSTAINABLE APPROACH TOWARDS EMERGENCY RESPONSIVE SHELTERS

The challenge is to supply necessities to the masses, as well as to accommodate and provide emergency shelter to all those who have fled from their homes to Sheikh Shehzad camp. Local communities, governmental and non-governmental agencies, and international non-governmental organizations all played a key role in making it achievable. Professionals such as architects, environmentalists, engineers, and social workers were also there to actively participate in the event. Thermal conformability in shelters is the only sustainable answer for the survival of affected people when it comes to preventing heat and providing shelter against extremely harsh climates. This goal includes the placement of emergency responsive shelters at Sheikh Shehzad Camp Mardan. (Figure.5)



Figure.5. Initial planning of Camp



Figure.6. First experiences on Tent

EXPERIMENTS FOR A NEW TYPE OF EMERGENCY SHELTER

To construct a single-family shelter with weatherproofing features that would withstand the camp's harsh weather, architects and engineers began testing prototypes for energy-efficient shelters. With the use of sketches, preliminary work on creating the design of shelters is done. Then, with the

support of the community, a modest tent was chosen to include the desired design. Bamboos, plastic bags, plastic bottles, rope, dirt, and wooden sticks were all employed in this experiment. The tent and all of the above-mentioned materials are given at the selected place as shown in Figure 6.

Intervention in the microclimate (Test-01)

Due to the climatic conditions in Mardan, the tent's layout was retained in a pyramid shape, with a 4-inch thick insulating layer. It was made up of empty disposable plastic bottles that were connected with a rope and covered with a layer of compacted wooden sticks (wooden chicks) to fill in the gaps between the bottles. After that, it was left to be observed. The temperature readings were taken with thermometers during the day's peak hours. The experiment revealed no effectiveness in microclimatic impacts after receiving simultaneous readings.

Readings of Test-I:

TENT#1: Plastic Bottles with Mud Plaster		
S.NO	TIME	Temperature
1	11:00 AM	33 °C
2	12:00 PM	35 °C
3	01:00 PM	37 °C
4	02:00 PM	38 °C
5	03:00 PM	35 °C
6	04:00 PM	38 °C

DAY-1: June 17, 2009

TENT#1: Plastic Bottles with Mud Plaster		
S.NO	TIME	Temperature
1	12:00 PM	39 °C
2	01:00 PM	41 °C
3	02:00 PM	43 °C
4	03:00 PM	42 °C

DAY-1: June 18, 2009

TENT#1: Plastic Bottles with Mud Plaster		
S.NO	TIME	Temperature
1	11:00 PM	39 °C
2	12:00 PM	41 °C
3	03:00 PM	44 °C

DAY-1: June 21, 2009

Figure.7. Tent-I under construction



Intervention in the microclimate (Test-02)

Following the initial experiment, various changes were recommended, which were integrated into the design of a prototype shelter that would be utilized as a second kind.

To strengthen the tent and sustain the overload on the top of tents, a bamboo frame structure of roughly eight inches was built all around the current tent, dully supported by bamboo planks. The core layer consisted of a compressed layer of wooden sticks known as a chick that was placed with a supporting layer of polythene sheet serving as a waterproof membrane. As a super-insulated coating of one inch, chicken wire mesh packed with a mortar of lime and mud was set down on the roof of the tent, followed by whitewashing as a sun rays reflective coating. Following the experiment in June, observations were made using various temperature and precipitation readings. This time,

the experiment was successful, with a significant reduction in the temperature difference of 12 °C to 15 °C when compared to Test-01, as well as other tents and shelters in the camp.

Readings of Test-02: Practical Approach



Figure.8: Tent-02 During construction Stage



Figure.9: Tent-02 Completed



Figure.10: Tent-01 and Tent-02 Images



Figure.11: Tent-02 in Use of family

TENT#02: Mud Plaster on Chick + Bamboo		
S.NO	TIME	Temperature
1	11:00 AM	32 °C
2	12:00 PM	32.5 °C
3	01:00 PM	34 °C
4	02:00 PM	35.5 °C
5	03:00 PM	33 °C
6	04:00 PM	33.5 °C

DAY-1: June 17, 2009

TENT#02: Mud Plaster on Chick + Bamboo		
S.NO	TIME	Temperature
1	12:00 PM	33 °C
2	01:00 PM	34 °C
3	02:00 PM	35 °C
4	03:00 PM	35.5 °C

DAY-02: June 18, 2009

TENT#II: Mud Plaster on Chick + Bamboo		
S.NO	TIME	Temperature
1	11:00 PM	34.5 °C
2	12:00 PM	36.5 °C
3	03:00 PM	38 °C

DAY-03: June 21, 2009

TENT#1: Karavan School + Mud Plaster		
S.NO	TIME	Temperature
1	11:00 PM	32 °C
2	12:00 PM	34 °C
3	03:00 PM	35.5 °C

DAY-04: June 23, 2009

Overall Reading and Observations: Temperature difference

TENT#III: Green Shade on Tent		
S.NO	TIME	Temperature
1	11:00 AM	35 °C
2	12:00 PM	35 °C
3	01:00 PM	37 °C
4	02:00 PM	36.5 °C
5	03:00 PM	34.5 °C
6	04:00 PM	40 °C

Day-01: June 17, 2009

TENT#IV: Green Shade on Canopy		
S.NO	TIME	Temperature
1	11:00 AM	37 °C
2	12:00 PM	39.5 °C
3	01:00 PM	40 °C
4	02:00 PM	41.5 °C
5	03:00 PM	41 °C
6	04:00 PM	42 °C

Day-01: June 17, 2009

TENT#V: School tent without plaster		
S.NO	TIME	Temperature
1	11:00 PM	39 °C
2	12:00 PM	44 °C
3	03:00 PM	47 °C

Day-04: June 23, 2009

TENT#V: Karavan School + Mud Plaster		
S.NO	TIME	Temperature
1	11:00 AM	34 °C
2	12:00 PM	35.5 °C
3	01:00 PM	36 °C
4	02:00 PM	39.5 °C
5	03:00 PM	40. °C
6	04:00 PM	39 °C

Day-05: June 28, 2009

TENT# VI: SPARC Office Tent		
S.NO	TIME	Temperature
1	11:00 AM	44 °C
2	12:00 PM	46 °C
3	01:00 PM	47 °C
4	02:00 PM	49 °C
5	03:00 PM	49.5 °C
6	04:00 PM	47 °C

Day-5: June 28, 2009

TENT#VI: Karavan Office in Camp		
S.NO	TIME	Temperature
1	11:00 AM	35 °C
2	12:00 PM	37 °C
3	01:00 PM	38.5 °C
4	02:00 PM	40.5 °C
5	03:00 PM	41.5 °C
6	04:00 PM	40 °C

Day-5: June 28, 2009

Cost-Effectiveness Factor

S.No	Items	Sizes/Quantities	Cost in Rs.	Total
1	Bamboo	155FT/237 FT	2127	70 - 80\$ Approx.
2	Chick	240 FT ²	880	
3	Plastic	240 FT ²	320	
4	Chicken Mesh	240 FT ²	300	
5	Mud	5 bags	100	
6	Lime	2 bags	200	
7	Nails	1 KG	250	
8	Labor	2 Persons	1000	
				5177 Pak-Rupees

DISCUSSIONS

Temperature readings were taken throughout the peak hours of the day from June 17th to June 29th, 2009, and the temperature difference was determined to be around 12 to 15 degrees (Centigrade). This is significantly less than the other Camp shelters. On the first day, readings were taken at various intervals between 11 a.m. and 4 p.m. on June 17, 2009, in four distinct shelters constructed using various materials and methods, with a temperature differential of 9 degrees (Centigrade). On the second day, readings were taken at four intervals during peak hours, from 12 p.m. to 3 p.m. It can be seen from the data that the temperature difference is just 7 degrees this time (Centigrade). Readings taken on different days show some change in temperature inside the shelter; however, multiple readings were taken inside the proto-type shelter to determine a constant temperature differential, which was found to be 12 degrees (Centigrade) from the surrounding environment.

CONCLUSIONS

The goal of this study is to figure out how to construct thermally suitable emergency responding shelters for the rehabilitation of internally displaced persons (IDPs) in a city like Mardan, where the climate is harsh and temperatures regularly exceed 52 degrees. The necessity for a self-sufficient, energy-efficient shelter was felt in this situation to meet human basic needs. By examining the rapidly rising social and economic difficulties, this article also emphasizes the significance of displaced communities. This can only be accomplished by redesigning, restructuring, and reinventing the current profiles of community settlements in rural and urban areas. The authors emphasize the effective application of indigenous technology, such as the use of locally available sustainable materials, improved construction processes, and workmanship, which not only makes the shelter energy-efficient but also cost-effective. Communities' active participation in their re-settlement encourages them to battle natural disasters such as earthquakes, floods, and man-made wars.

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