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Improving Community Resilience using Bamboo Emergency Sheltering in the Face of Disasters

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Abstract: ***Disaster Recovery Planning is a crucial step towards catastrophic events. It encompasses a range of activities, but using a sustainable material for temporary reconstruction is fundamental. Thus, we aim to introduce a practical model to construct bamboo-made sheltering in the case of natural disaster in the north of Iran.***

Keywords: Bamboo, Sheltering, Disaster, Resilience

I. INTRODUCTION

There are always unexpected natural threats which impose a great deal of cost from societal and economical perspectives on local communities. Although local initiatives and officials are working on the subject to boost their capacities to cope with these crises, the impact of natural disasters on the society is still catastrophic.

Since a disaster prone country like Iran is subjected to escalating natural disasters from the myriad of possible threats, being able to manage the risks of these hazards plays an essential role in community resilience. Additionally, it is almost certain that the more extreme weather is a result of climate change, thereby creating further risks to society. Reports show that 31 types of 41 possible natural disasters occurred in Iran such as earthquakes, floods, droughts, landslides, desertification, deforestation, storms. However, the earthquake is a most frequent and serious crisis in this country .

The case in point is an Ardabil earthquake on 28 February 1997 where significant losses imposed on the region. Unfortunately, 100 people were killed, 2,600 injured, 36,000 lost their home, 12,000 houses damaged or destroyed and 160,000 livestock killed .

Likewise, most of the people in the north of Iran live in houses that are extremely vulnerable to natural disasters such as earthquake, and flood. So, occurring natural crises in these areas has significant potential damages to buildings and may come up with enormous amount of dislocations. Therefore, providing a reliable temporary emergency shelter for such situation is a national necessity.

Generally, the governmental and non-governmental organizations (NGO) are responsible for managing crises . However, three main phases of action plan are recommended in this concept,; pre-disaster (prevention and mitigation), during disaster (preparedness and response, and post-disaster (recovery and rebuilding) (Figure 1) . Of course, the response planning plays an essential role in providing resilience towards disastrous events .

Figure 1: Action plan to face with disaster

An important point needs to be considered is that there is a big gap over the course of the relief measures and reconstruction. When residents experience a catastrophic earthquake, they will not be able to tolerate more than a couple of hours after the incidents and they require immediately the basic needs .

Moreover, the context of disaster usually causes intense negative impacts on people, goods, services and/or the environment which reduces the adaptive capability of the affected community to respond . Hence, all initiatives would face difficulties to provide an appropriate space. In fact, they should take into account the resting area, caring the children and elderly people, storing tools to allow affected people to concentrate on their livelihoods-related requirements . In this regard, the notion of temporary housing and sheltering provide great opportunity to ensure the essential services for families in times of crisis.

Of course, disaster relief efforts are the key challenges of survivors in the aftermath of catastrophe. Undauntedly, emergency shelter as a temporary housing not only provides the protection from natural threats, but also tries to maintain health, privacy and the dignity of the survivors. Furthermore, it creates a safe environment for coping with the remained risk of disaster. It also minimizes the environmental impacts until the construction of long-term housing .

In the light of studies, there are many ways represented by scientists to build temporary sheltering, but applying bamboo-made shelter considered as a reliable housing mainly because of its flexibility and resiliency to wind. It also does not have secondary hazards such as falling masonry structures.

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Scholars signify further research are necessary in this issue. The case in point is Sichuan Earthquake in 2008 in China, where more than 100 Bamboo emergency shelter built in the resettlement area. Accordingly, in March 2010, European Union funded a project to establish a Bamboo planning in high risk regions to face with earthquakes. In addition, following the devastating earthquake in Port-au-Prince in January 2010 in Haiti, the World Bamboo Organization formed to facilitate information flow in terms of bamboo. This organization immediately launched a pilot project in this country to initiate a long-term plantation .

It is also important to highlight that there are different species of bamboo with over 250 varieties which are really suitable for construction . Since they have good properties, grow fast, cost lower, consume lesser construction time, insulate better and is available, it is strongly recommended by authors to construct emergency shelters to deal with potential disasters.

Similarly, the Indian Institute of Technology published the suitability of bamboos for structural products because of its mechanical and physical properties .

Although Bamboo has unique properties, but it requires special environmental, supply, logistics and construction considerations. If initiatives did not take into account all of these parameters, there would be delays in response, costing extra money and putting people at risk.

It is also true that authors agreed on building Bamboo housing is a shared responsibility of citizens, voluntary and non- voluntary organizations, and governments , but its application in the North of Iran is an unexplored research area. Thus, this paper seeks to address this gap and we believe that using this type of sheltering not only creates a sustainable resource in the region, it also increases the local community resilience.

II. Material and Methodology

A variety of methods are used to develop the resiliency of community in times of crisis, but having information about the status of victims and building an effective strategies to deal with their potential disasters are crucial for understanding that our existing condition is resilient or needs more attention(s).

In general, the domain of Bamboo emergency shelters should be sited as close as possible to the community. They are intended to facilitate core services such as food, drink, and sleeping and sanitation. However, the temporary shelter must consider the size which depends on the time, needs, logistics constraints, and governments' policy.

Furthermore, the features of privacy and security, cultural appropriateness, ventilation and thermal comfort, environment, cost, and the type of hazards are other features that need to be involved in the design. For example, some structures are suitable for protecting people from the impact of a hurricane, but may not be suitable for occupancy for more than two or three days. On the other hand, a structure that is not appropriate for hurricane might be ideal for long-term occupancy four people who escaped from the flood or volcano.

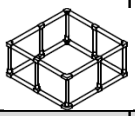
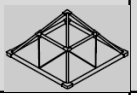
Also, the construction site must be erected on firm ground, easily accessible and well known to people. The proposed model worked out based on three main steps; excavation and earth work, bamboo work, joinery work.

At first, the site excavated to make the area clear. Second, bamboos placed in the position of 7m (each sliced into four parts with regards to table 1). After that, bamboos drilled at connection point to insert a cable and tie (cable would fix the bamboo slices). Next, bamboo mat prepared in appropriate size and tightly secured to the shelter frame to cover the internal wall, ceiling, external wall and roof. Totally, it took only 6 hours to finish up the model which is really important in terms of relieving the victims of disaster (Table 1).

Simply, to build the proposed model implement the following steps:

a) Excavation of the site (height, 20 cm, 6m×6m)
b) Using sandboxes as a foundation
c) Flooring the timber on the sand boxes
d) Constructing a bamboo framework as illustrated in the figures 1, 2, and 3 in which joined with metal joints in modular form.
e) Applying the metal cable in parallel to hold the cork insulator across the wall.
f) Constructing the ceiling as showed in the figure x and placing it on the framework.
g) Placing the canvas insulator over the ceiling for thermal and moist protection.
h) Placing two cables over the ceiling and joining them to the foundation to boost the overall strength of the structure as well as to resist better against the wind.

Table 1: The required materials and their specification

Code	Type	Shape	Material	Number	Time
A	Box (60×40)		Plastic box filled with sand	150	60 min
B	Wall		Bamboo	24	45 min
C	Ceiling		Bamboo	12	30 min
C	Ceiling Insulator		Canvas	36 m^2	30 min
D	Cable		Metal	155 m	45
E	Joint		Metal	25	30 min

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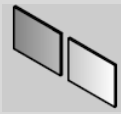
F	Insulator plates 3×3		Cork	8	60 min
F	Timber 3×1		Wood	24	45 min

III. Results and Tables

The results of proposed emergency shelter demonstrated specifically as follows (Figures 2-9):

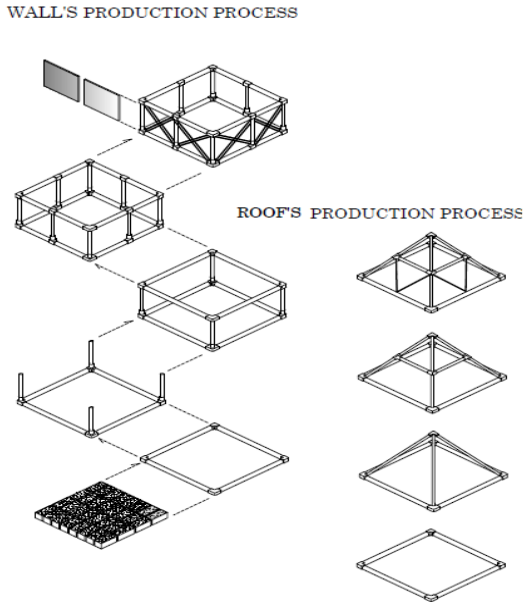


Figure 2: The demonstration of how the roof, and walls should be constructed.

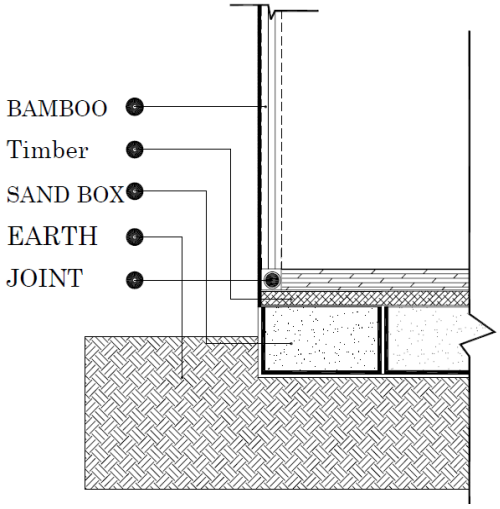


Figure 3: the positions of bamboo, timber, sand boxes, earth, and joints in the proposed model

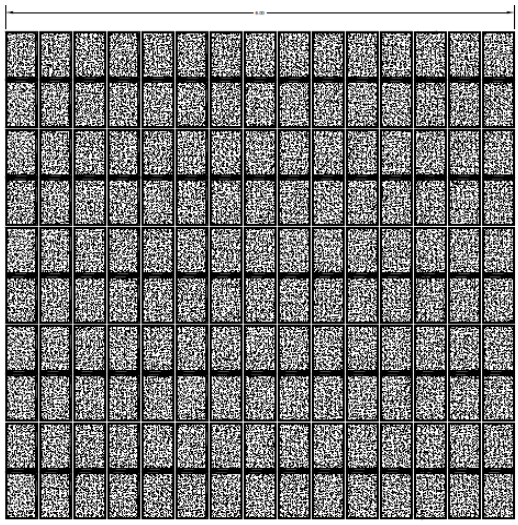


Figure 4: The foundation plan of emergency shelter using sand boxes.

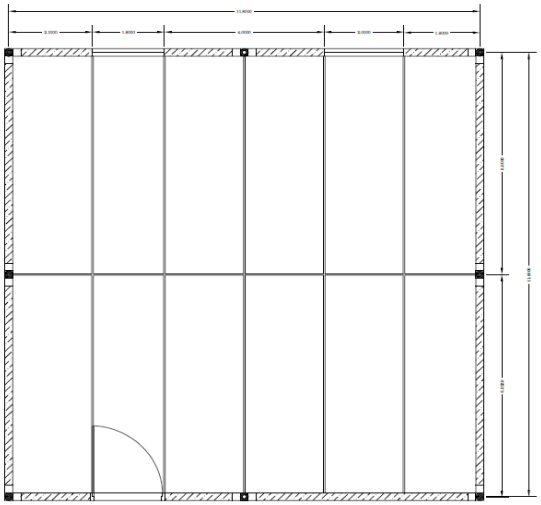


Figure 5: The ground floor plan of emergency shelter using sand boxes.

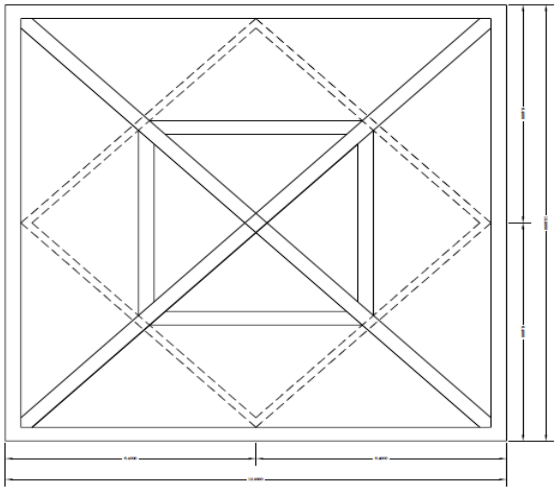


Figure 6: The roof plan of emergency shelter

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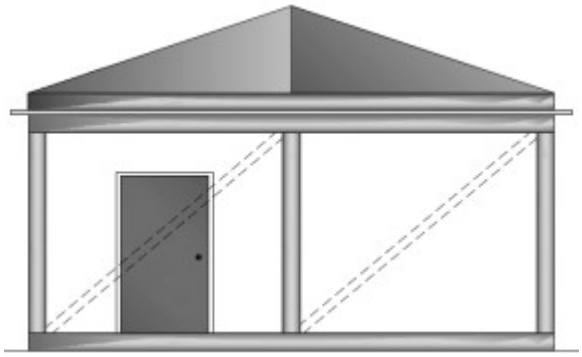

Figure 7: The main elevation of proposed emergency shelter

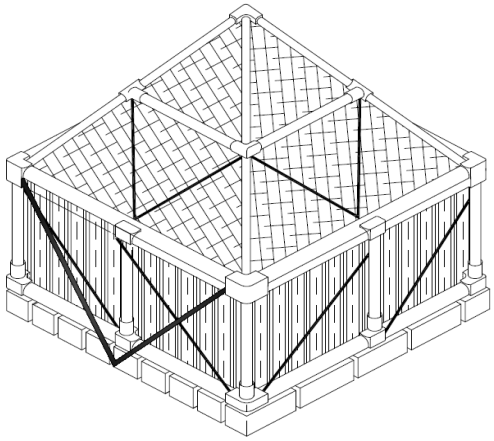

Figure 8: The framework of proposed emergency shelter model using bamboo.

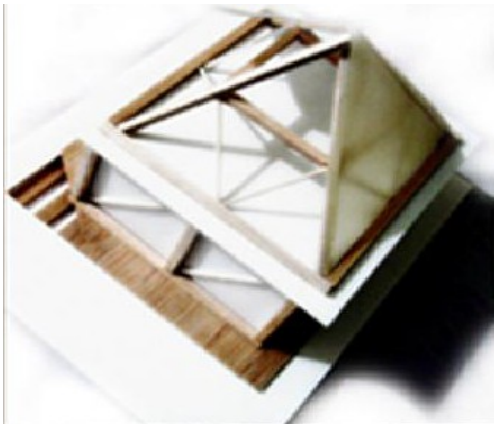

Figure 9: The proposed model of bamboo emergency shelter

IV. Conclusion

The improvement the community resilience is the main impetus for this study, because without temporary sheltering, the society is more vulnerable towards disasters. Additionally, using Bamboo as a sustainable resource is kind of value-creating action plan and it reduces the cost of such housing which really important in developing countries.

I. Acknowledgement

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