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THE HOUSING DESIGN FOR DISASTER RELIEF IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

Thepphavong Xaykosy (a)*, Bundit Chulasai (b)
*Corresponding author

(a) Department of Architecture, Faculty of Architecture, Chulalongkorn University, 254 phayathai Rd, Wangmai, Khet Pathum Wan, Bangkok, Thailand, x.thepphavong@mail.com
(b) Department of Architecture, Faculty of Architecture, Chulalongkorn University, Bangkok 10330 Thailand, bunditchulasai@yahoo.com

Abstract

The research offers a house for disaster victims in the Lao People's Democratic Republic that can respond as emergency shelters, temporary shelters, and permanent residences at the same time. To build a house for victims, according to previous studies, form, materials, and labours are the 3 most significant points that have an impact on the house for victims. The proposed house is a one-story rectangular building with lean-to metal sheet roof; the house size is 3.00 x 6.00 meters. Cold rolled steel placed on the precast column is selected to be the main structure. The exterior floor is built by the reinforced concrete, while a steel structure topped with a layer of fibre-cement board is proposed to be an elevated interior floor. A steel frame lining with a fibre-cement board is also be used on the wall. When applied the proposal to the area. It took 24 days to complete. During that time, heavy rain occurred almost every day. If the area has good weather conditions, the house can be able to be completed within 7 days. The total budget was 2,327 USD which was separated into 1,660 USD for material and 660 USD for 2 labour. Regarding the survey, there are several problems. Therefore, the suggestions have been adapted to improve the house design to be more suitable for disaster victims.

Keywords: House, disaster, victims, form, materials, labours.

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1. Introduction

In the past, the house was built by family member and neighbours in whit everybody could joint to collaborate in this process by contributing as labours, providing tools, and materials (Oliver, 1969). The construction mostly used natural materials including wood as the principal material for construction. The building could represent locality and adaptation to be compatible with the environment (Oranratmanee, 2009). Currently, the natural materials wood is due to the wood price expensive. Also, the style of house is different from the past.

Nowadays, the global environment change occurred due to natural factors or from human actions (Prakhammintara, 2012). It resulted in physical problems or disasters throughout the world, such as earthquakes, tsunamis, floods, and other disasters, causing both direct and indirect effects on humans, which is harmful to life and shelter. The Lao People's Democratic Republic is one of the countries where has encountered many natural disasters such as floods, droughts, landslides, storms, and typhoons for many years. In 1970 - 2012, there were a total of 33 recorded events, especially floods that affected nearly 9 million people, causing more economic losses 400 million US dollars (Henderson, 2018). In the year 2018, there were 10 provinces affected by floods from all 18 provinces (UN Office for the Coordination of Humanitarian Affairs., & UN Country Teamin Laos. 2018). When a disaster occurred, the houses of the victims damaged and must be evacuated to other areas that were not affected by the disasters (Figure 1). The government, therefore, has to provide public areas to the victims after the Natural disasters passed (Asian Disaster Preparedness Centre, 2011). When people returned to their house, they found that the houses were badly damaged which requires a long period of reconstruction. It has been clear that the Government of the Lao People's Democratic Republic has the desire to promote the construction of housing to help disaster victims.

Figure 01. Natural disasters in the Lao People's Democratic Republic in 2018
Source: United Nations in Lao PDR

2. Problem Statement

The shortage of housing during the disaster in the Lao PDR.

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3. Research Questions

- What is the most suitable house model for disaster victims in the Lao PDR?

4. Purpose of the Study

The research is to offer a house for disaster victims in the Lao PDR.

5. Research Methods

- Explore the area by observing and recording small house styles, materials that are available in the area in Vientiane capital, Lao PDR.
- Collect data from reports, theses, research papers and various documents related to the design and construction of houses. Analyse the data obtained from the collection to be used to determine the criteria in design and construction.
- Design and plan construction using concepts and methods from data analysis.
- Build the trial of the construction of the house, which has been constructed in Vientiane, Lao People's Democratic Republic. During the process, it documents the steps of construction by observing, taking notes and recording images.
- Evaluate and analyse data obtained from construction.
- Improved from the problems encountered during construction and development to present a home model for disaster victims.

6. Findings

The concept of shelter for disaster victims is divided into 3 types (Figure 2) Emergency shelter, Temporary housing and Permanent residence (Johnson, 2007). Emergency shelter is a place for victims to live temporarily when they cannot live in their previous residence, temporary housing is a shelter in which the victims could use normal daily life but it is a short-term accommodation, permanent residence is a return to an existing residence that has lived before a disaster or a newly built residence (Wolfe-Murray, 2015).

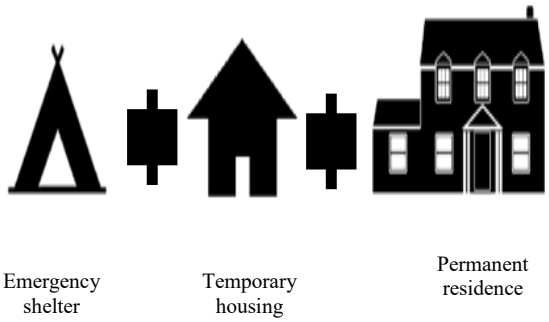

Figure 02. Concept of shelter for disaster victims Source: Johnson (2007)

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Form the concept of shelter for disaster victims, the government of Lao People's Democratic Republic, they had a limited budget. Therefore, the researcher will design a house that can respond to all types by using design specification such as emergency shelter that requires fast construction, temporary shelters have to meet human basic need and permanent residence can be extended later (Figure 3).

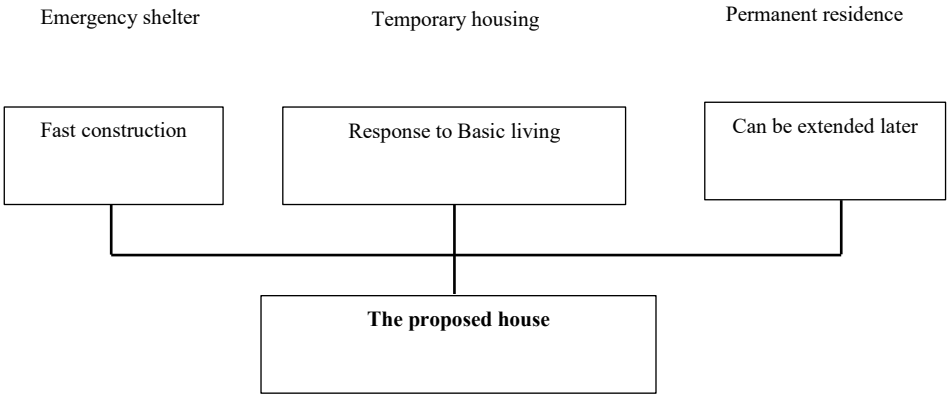

Figure 03. Specification for housing

Based on previous studies, there are 3 types of victims, to help them after a disaster. Those studies found that the design should require 3 factors such as form, materials, and labours. Moreover, the building design must be simple, adaptable and firm. Local construction method and light-weight material should also be used in the house, as a result of self-help construction and using less labour (Figure 4).

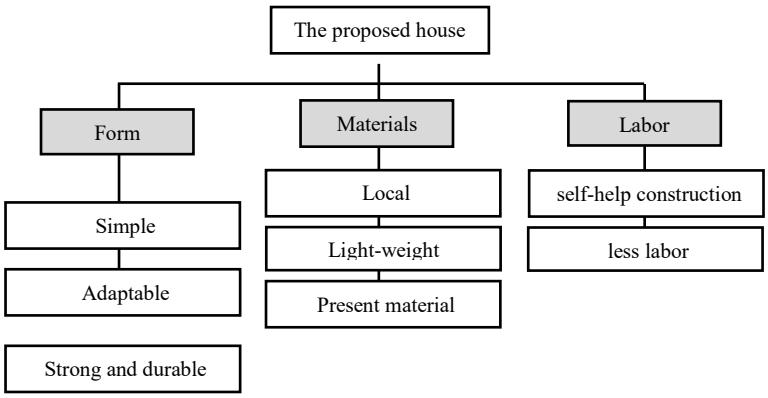

Figure 04. The supported factor of victim house.

There are 5 case studies that explore disaster victim houses such as in Thailand, Vietnam, Haiti, and the Philippines (Figure 5).

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(a) Thailand 2012 (b) Thailand 2013 (c) Vietnam 2004

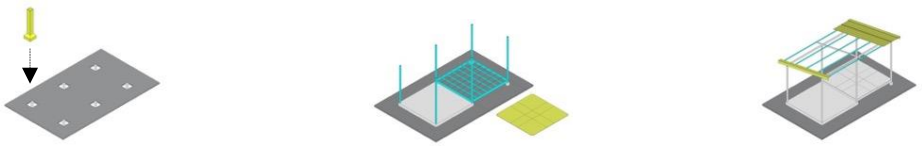
(d) Haiti 2010 (e) Philippines 2013

Figure 05. Case studies

The studies showed that the area of the shelter space is divided into 2 parts, external and interior. The external space is used for daily activities while the other is for bedroom and storage. The building model in the case study are 1 or 2 floors with a gable roof and lean-to roof, the building has an area around 18 - 52 square meters. Nonetheless, using of less structure system could save duration construction efficiently.

6.1. Design and construction

From the study, the proposed house is a one-story rectangular building with lean-to metal sheet roof; the house size is 3.00 x 6.00 meters. The house can be divided into 2 parts, which are the interior space for sleeping and storage, and the external space for other activities. Cold rolled steel placed on precast column is selected to be the main structure. The exterior floor is built by the reinforced concrete, while a steel structure topped with a layer of fibre-cement board is proposed to be an elevated interior floor. A steel frame lining with fibre-cement board is also be used on the wall (Figure 6). Once the design of the building has been completed, the researcher experimented with building construction in the study area, which is a landfill in Vientiane.



(a) Foundation (b) Floor (c) Roof structure

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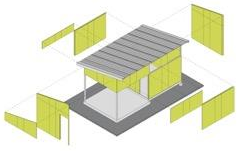
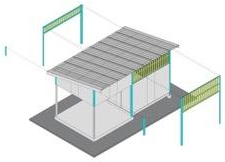
(d) Wall structure



(e) Wall plate



(f) Ventilation

Figure 06. Building elements.

When the construction has been completed (figure 7), the construction process is divided into 23 steps. The period began from the leveling the construction area until the completion of the project that spends time 24 days. Divided into working 9 days and 15 days off due to rain. If work on 8 hours per day, it will complete within 7 days (table 1). The total budget is 2,327 USD which is separated into 1,660 USD baht for material and 660 USD for 2 labor.

Figure 07. The proposed house.

Table 01. Show the construction time ☐ Work time ☐ Rainfall time.

Date	Time		Date	Time	
	8:30-12:00	13:30-17:00		8:30-12:00	13:30-17:00
1	1) Leveling the construction area 2) Make the layout 3) Start digging 4) Pouring rough concrete		13	Raining	
2	5) Install the footings	Raining	14	Raining	
3	6) Pouring of reinforced concrete floors 7) Welding of steel plates with columns 8) Install steel columns 9(Install the beam		15	Raining	
4	Raining		16	Raining	
5	10) Install the Rafter 11) Install Batten 12) Install metal sheet roof	Raining	17	17) Install the wall plate fibre-cement board	
6	Raining		18	Raining	
7	Raining		19	Raining	
8	Raining		20	Raining	
9		Raining	21	Raining	
10	Raining		22	19) plaster for plasterboard joints 20) Install ventilation	
11	Raining		23	Raining	
12	15) Install wall steel frame 16) Install door		24	21) Painted building 22) Painted floor 23) customize the surrounding areas	

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6.2. Problems arising in the construction process

The weather problem leads to delay in the construction time such rain. So, the construction. As a result, it was unable to complete on time. This problem makes the land sank by flooding that is hard to dig. Installation of stanchions when pouring concrete into the pit requires a period of waiting for the concrete to harden longer than usual because the ground has moisture. Also, the installation of fibre-cement sheets was quite slow, because the technician still had lacked the experiences to install the wall plan at the beginning (Figure 8).

The roof style problem was quite short (Figure 8); it could make rain leaking into the house. Besides, small ventilation was not enough to give light into the house. Also, the lath was vulnerable to broke.

Figure 08. Problems encountered in the construction process.

6.3. Revision and building model development

Modification of the design victim house could solve the problem in order to meet the needs of the victim (Figure 9).

- Adjusting the roof: The roof of the experimental building has a length of 4 meters, therefore increasing the length of the roof to 6 meters.
- Adjusting the ventilation: Using the install the cross lath as a new model to prevent damage.

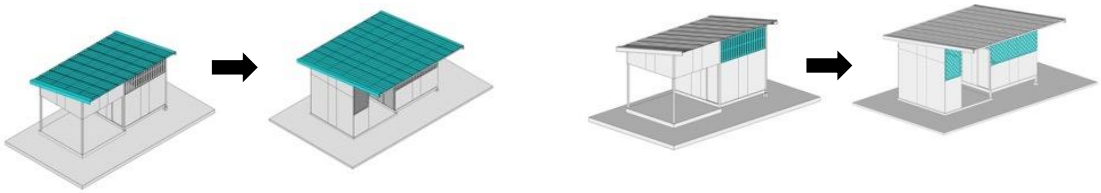

Figure 09. Adjusting the roof and ventilation.

7. Conclusion

The design modification of Lao People's Democratic Republic victim is adjusting the roof and ventilation. The design is a one-story rectangular building; the house size is 3.00 x 6.00 meters. The house can be divided into 2 parts and also offered additional bathrooms. The researcher improved the problems

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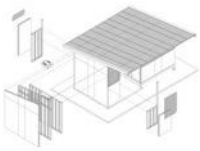
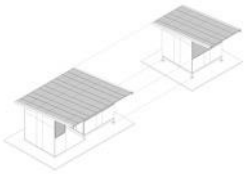
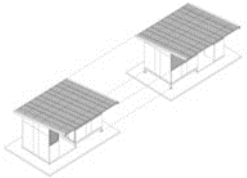
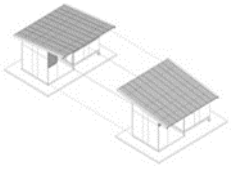
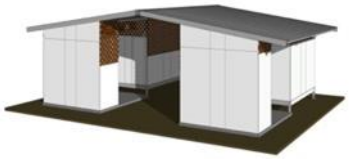
which was encountered and occurred during the construction period in order to meet the needs of the residents. In addition, modified manner, the proposed house is a one-story rectangular building; the house size is 3.00 x 6.00 meters. The house can be divided into 2 parts and also offered additional bathrooms (Figure 10).

Figure 10. The proposed house model.

The house could load more victims by making adjustment and development of it. The total of construction budget is 2,739 USD which is divided into material cost at 1,912 USD and wage at 827 USD. It will spend time longer than 7 days if there is problem related to weather or workers number. Lastly, this study shows the guideline of building extension on the below (Table 2).

Table 02. Guidelines for building extension.

No	Building types	
1		
2		
3		
4		

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