

# Prefabricated Shelter for Local Community in Khon Kaen, Thailand

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**Abstract:** Nowadays, rapid development and growth of the economic and social changed the ways of living in the community. For low-income people, they try to adjust themselves to survive in this changing world. One of the main problems for this group of people is lack of living places. A temporary shelter in a rural area as well as in an urban area is socially a direct solution in responding to their fundamental needs. Based on the study of temporary shelter in Khon Kaen, Thailand, the normal space within the shelter includes multipurpose area and sleeping area with size of 6 sq.m. for each area. This information is used for this study. The idea of the study is to make a low cost prefabricate temporary shelter. The process of the study began with transform the information from previous research to be a prototype one. An architectural drawing is made and discuss with local shop base on the requirement of using local materials, suitable for simple transportation, easy for construction and limited budget. The final prefabrication shelter has been built and installed for checking the problem of building. However, this study showed a few problems that have to be noted such as too many elements that need good organize process for example. Also, the study has found that the prefabricated shelter can be built to suit local need of Khon Kaen city and other parts of Thailand as well. Finally, this prototype can be applied for other function beside a shelter for living. It can be temporary site office, shop, or others.

Keywords: Prefabrication, Temporary Shelter, Low-cost house.

## 1. INTRODUCTION

Economic grown affects ways of living in every society. Dwelling is one part that cannot avoid the change. As population rapidly increase, demand for residential becomes very high. Low-income people, especially, need to have an affordable living place or temporary shelter when they set up their new family. In the part, a new couple in Isan, north-eastern of Thailand, traditionally builds their temporary living place in different ways such as extend from their parents' house, extend from rice storage shacks, build a temporary shelter, etc. In addition, a temporary shelter in I-san also is also used for other purposes such as for staying overnight in the rice field during the harvest season or for workers' temporary living shelter in construction sites.

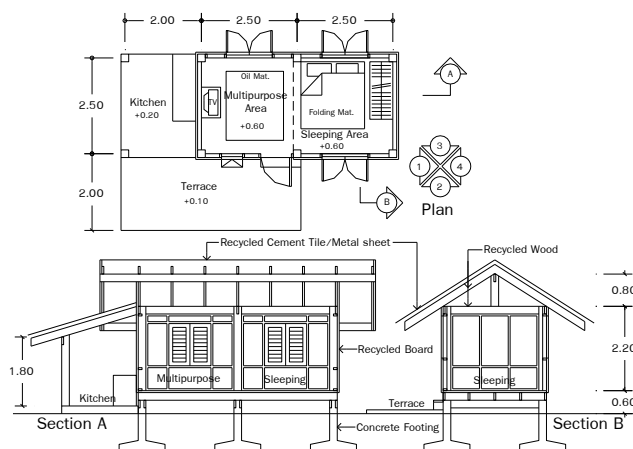
The Isan House [1] is divided into 3 types, which are HaunYai (a big house), Toob (a cabin) and Tiang Na (a temporary shelter for farmers). Srisuro [2] categorized an Isan House to be a permanent house, a semi-permanent house and a temporary house. A temporary living place is traditionally built to serve low-income people, a new family or a farmer in Isan for a long time. Purposely, temporary shelters in Isan community are built to serve their basic needs. Most of their shelters lack the knowledge base in functions organization, construction materials and process, environment effects and others. The low-income people are a big part of I-san community. They live both in urban and rural area. Therefore, their living places, temporary shelters, should be in concern before they cause more problems to their surrounding and within the shelters themselves.

From reviewing case studies within Thailand and other countries, it has been found that temporary shelters for low-income people or people in disaster area normally use low-cost local materials and have a limited space for serving users' basic needs only. [3] [4] [5] [6] [7]

Thai government takes more action in community development. There are a number of studies and projects organize or fund by the government proposed to study and improve a quality of living for poor people. [8] [9] [10]

The research, Temporary Shelter for Isan Community [11][12], proposes to collect information of the temporary shelters, then use this information for analyzing and building a design guideline of temporary shelter for the Isan

community case study in Khon Kaen, Thailand. (Fig. 1.) From this research, the study continues with the idea to develop the design guideline to be a prefabrication one with limited budget and buildable by local people.



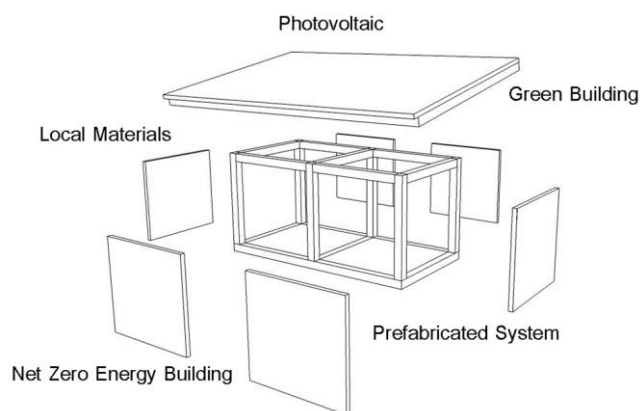
**Fig. 1.** The shelter prototype drawing, Plan and Sections

## 2. IDEA OF THE STUDY

The research focus on making a low-cost prefabricated shelter for local. The idea based on the previous research temporary shelters in Khon Kaen province located in the northeastern of Thailand that concluded the size and function of the temporary shelter. The conclusion of this research guides to a prototype shelter, which suited the simple need of low-income people in the area.

The budget of the shelter is set to be 100,000 bath or around 3,000 USD. The steel frame is used as main structural materials used for this research because it is easy for installation and transportation. Furthermore, this material is recyclable and become familiar with local construction in Thailand, lately. The goal of the study is to build a shelter that can be transported by regular small truck and can be composed by 4 people in one day.

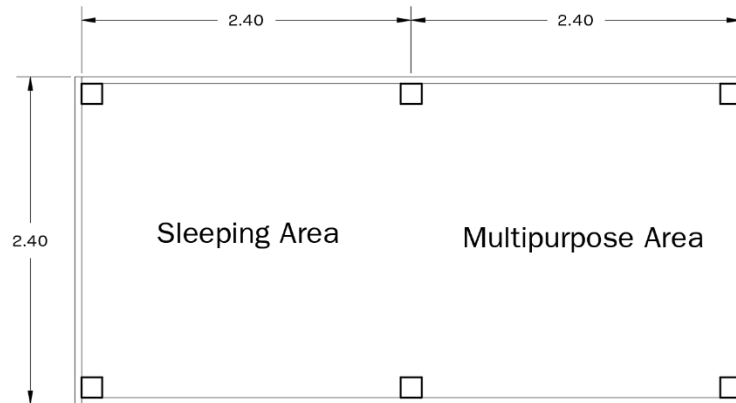
The elements of the shelter can be separated to be column, beam, floor, wall and roof. Each element is designed for simple installation with minimum tools. So, the concept of this shelter, as a tiny house, is designed to be a green building with minimum materials that can be found in local shops. In detail, it can add PV cells to make this small building Net Zero Energy building. Furthermore, the basic idea of the shelter is suitable with tropical climate. (Fig. 2.)



**Fig. 2.** Concept Diagram

From my previous study, it has been found that spaces within the shelter mostly include a multifunctional space and sleeping space. These two main spaces are close to each other. In some shelters, these two spaces are divided by furniture or curtain. The multifunctional space is used as family gathering and dining. This space is connected directly to the front door of the shelter. A kitchen and other facilities are either attached or separated from the shelter. Also, the toilet is built separately from the shelter.

The two main function area of the shelter, multipurpose and sleeping area is about 6 sq.m. (2.3x2.6 m.). Thus, the shelter has an average area of 12 sq.m. For this study, the modular of 2.4 x 2.4 m. are used to match the material size. (Fig. 3.)



**Fig. 3.** The area plan for the shelter

### 3. PREFABRICATION IDEA

Small prefabrication houses in Thailand can be designed in three types:

#### A. Box System

This system is the most popular one in Thailand recently. It is built from the factory. However, the transportation is the main problem for this type, especially for the small road location.

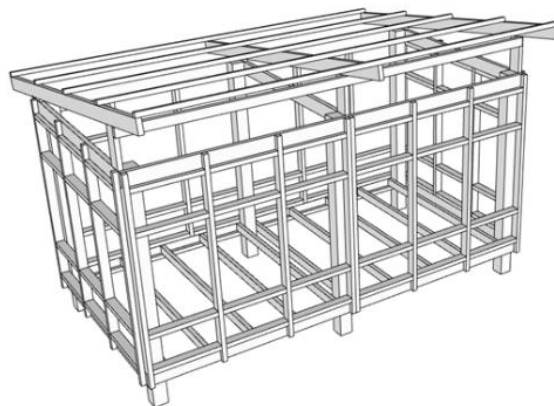
#### B. Panel System

The system separates the elements of the building to be panel such as wall panel, floor panel or roof panel. The panel system reduces size of the prefabrication part that draw to easier transportation. However, it has more construction join on working site. Each panel has to be designed and planned for transportation and construction.

#### C. Element System

The element system is the system that separate the building element to be small piece that can compose by minimum tools. This system is the most convenience for transportation, but it is the most time consume for construction site.

For this study, the element system is selected based on the reason of transportation.(Fig. 4.) It is designed for fit in regular small truck. Also, this system is the one that has minimum cost for factory part. Actually, it can prepare the prefabrication elements by local shop.



**Fig. 4.** The design for element system

#### 4. DESIGN AND CONSTRUCTION PROCESS

This prefabricated prototype is designed to be suitable for transportation by small truck. So, the elements of the building have to be small parts.(Fig. 5.) During the production process, the design has been changed and adjusted the details to fit the materials and budget. The designer designed the building elements and then discuss with the steel shop.(Fig. 6.) The design had changed following local materials available. The main structure, the columns and beams, were installed to check the materials size at the shop.



**Fig. 5.** The elements of the building can be transported by regular small trucks



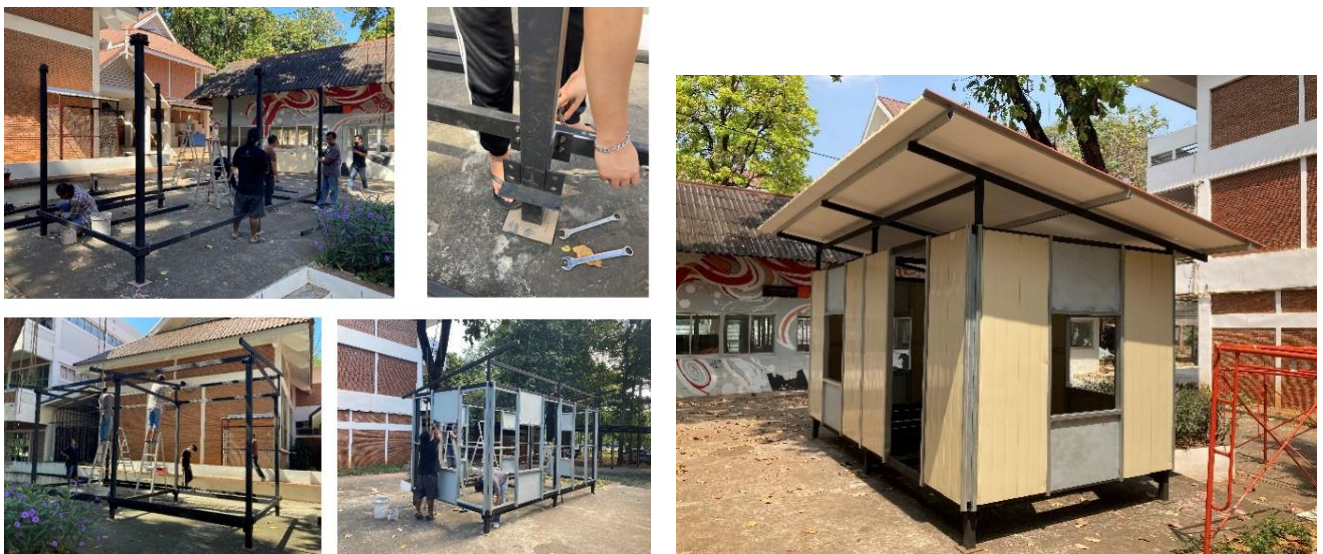
**Fig. 6.** Installation test at the steel shop

After, the main elements are finished by local shop, the surface materials are selected by survey the local shop and factory. It has been found that there is one local factory in Khon Kaen produces metal sheet roof and wall panel. (Fig. 7.) So, these elements are picked and designed to fit with the main structure elements.



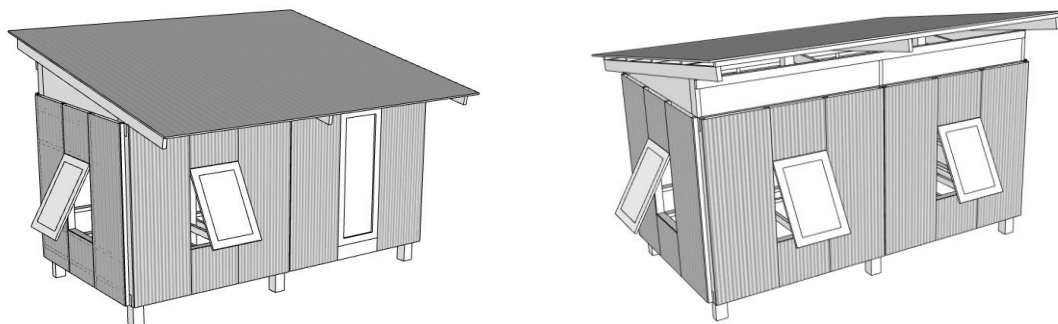
**Fig. 7.** The metal sheet roof and wall panel

The installation begins with setting up the main structure, columns, and beam. Then, the roof structure, floor joints and wall frame are installed before the wall panel, floor plate and metal sheet roof are put in place. There are a few tools for the whole construction process. This prefabrication shelter can be installed by 2-4 people with simple tools within 2-3 hours. (Fig. 8.)

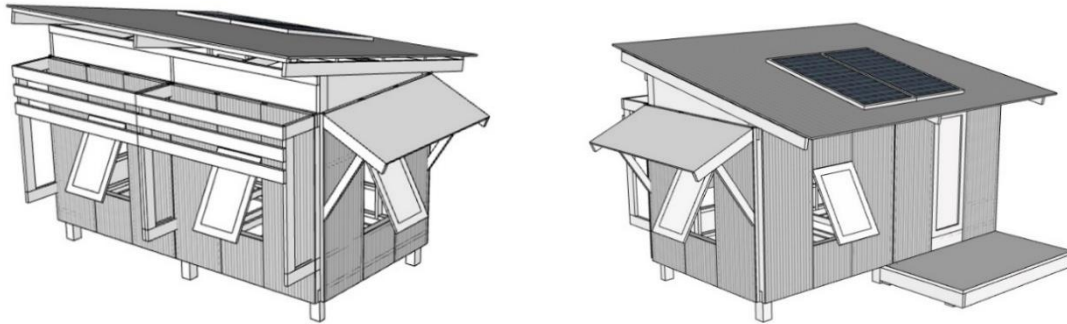


**Fig. 8.** installation process

The final process after finishing the main elements of the building is door and window installation. The window and door are designed to be flexible. It will be an option for owners. However, the study has a design guideline for them.(Fig. 9.) Moreover, the study also designed the add-on elements for future need such as sun shading device or solar cell installation for example. (Fig. 10.)



**Fig. 9.** Guideline for window and door installation



**Fig. 10.** Guideline sun shading device or solar cell installation.

## 5. CONCLUSION

The study has found that the prefabricated shelter can be built to suit local need of Khon Kaen city. This prototype can be adapted to use in other part of Thailand as well. However, there are a few problems that have to be noted. By using element system, each element has to be well managed and signed. (Fig. 11.) Also, labors for construct the building have to be trained for basic skill and prefabricated understanding.



**Fig. 11.** Signed guiding for the installation.

This prefabrication prototype is proofed that it can build under low-cost budget, using local materials, small truck transportation and construct under time and labour limitation. The materials can be changed to suit each local available by using this designed form. The future research needs for building systems and solar cell installation to make this building zero energy one. Also, there is a question in comparison with panel system which may be easier in construction process. Finally, this prototype can be applied for other function beside a shelter for living. It can be temporary site office, shop, or others.

## Acknowledgements

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