

# Study for Construction of Temporary Housing for Refugees in the Border Cities of Northern Brazil

Alessandra Bueno, Bruna Gomes, Larissa Rocha, Luciana Bonvino Figueiredo, Patrick Carvalho, Paula Fernanda Scovino de C. R. Gitahy, and Sara Noguera

*Faculty of Architecture and Urbanism, Federal University of Rio de Janeiro, Brazil*

**Abstract:** The concern with developing projects that have a clean construction characteristic, which generates less waste in the construction process is a constant nowadays. Thinking about innovative solutions and the use of sustainable materials, the subject of Constructive Processes III from the undergraduate course in Architecture and Urbanism at the Federal University of Rio de Janeiro, requested students for project proposals that presented some differential. Therefore, a group of five students developed the design of a model for temporary housing for people experiencing homelessness. This project meets a social demand, since the number of refugees has grown in recent years, and the environmental aspect, as it uses local materials. The article exposes a brief research on Shigeru Ban's temporary housing construction. Taking this information as a reference, the temporary housing project designed by students uses low-cost materials and easy assembly to attend to the growing population in a situation of refuge in Brazil.

**Key words:** sustainability, temporary housing, innovation, green building

## 1. Introduction

The definition of the refugee situation, in the currently adopted standards, emerged in the 20th century, under the guidance of the Nations League, predecessor of the United Nations (UN). This action came as a response to the problems originating in World War I, when thousands of people were in complete lack of state protection and started a movement of displacement in search of a country that had favorable political and economic regimes. In the destination country, this great migratory flow caused political, economic and social problems, such as unemployment and immigration restrictions. Therefore, the Nations League identified the need to establish a juridical statute to normalize the situation and reduce the difficulties faced by refugees.

Subsequently, this International Refugee Statute had several versions throughout time, adapted to the needs

of each era, mainly during World War II. In 1984, the Cartagena Declaration on Refugees was created which defined the concept of a refugee as: “[...] people whose countries of origin had gone through a process of political and social degradation, and had allowed widespread violence, violation of human rights and other circumstances of serious disturbance to public order.” [1].

Currently, Latin America has three documents: the 1994 San José Declaration on Refugees and Displaced Persons; the 2004 Declaration and Plan of Action of Mexico; and Brazil's Declaration and Plan of Action from 2014. Participating countries began to “[...] share responsibilities in the protection of refugees from humanitarian conflicts and tragedies.” [1].

Brazil has always been a pioneer country in the international protection of refugees, and has one of the most modern legislation in the world when it comes to this subject. Refugee requests have increased in recent years and this growth can also be seen in Europe. Conflicts in the Middle East, and economic crises in

both Latin America and the African continent are some of the reasons for the growing movement of refugees on a global scale [2].

Even with favorable and receptive legislation, there are still difficulties for the refugees to integrate into Brazilian society, such as problems with work, health, education and housing. According to Conare (2018) [3], Brazil recognized 1,086 refugees from different nationalities, reaching a total of 11,231 people. This number is representative of those who are legal, but there are still more people in an irregular situation.

Brazil's regional role is very strong, welcoming citizens from neighboring countries in conflict, such as Venezuela and Colombia. Cities like Pacaraima and Boa Vista are no longer able to receive refugees, so the Government identified the need to create opportunities for those who were already in several cities across Brazil. Generally, those who arrive in the country stay in shelters for some time before settling in a job, and when they get their autonomy, they leave for a house that they can maintain and give the opportunity to another refugee.

Therefore, through reflections on the difficulties for these people in the country, this article aims to propose a temporary housing project for refugees in Brazil using local and low-cost materials. For this, a bibliographic research of examples of temporary housing was carried out with a focus on construction cost, possibility of easy reproduction, materials used, and structural elements. This project was carried out by a group of students who attend the discipline of Constructive Processes III of the undergraduate course of Architecture and Urbanism at the Federal University of Rio de Janeiro. All the development was guided by the professors of the subject.

For the development of the work, issues of the current political, economic and social scenario were considered to directly address the human rights of refugees, which make up a scenario of migratory exodus to Brazilian cities in search of work, housing and quality of life. Thus, a review based on the news

published by the current media, such as newspapers, blogs and audiovisual, in order to understand this population as the protagonist of the proposed project, was solidified before any practice.

Issues related to Venezuela and the crisis facing the country have constantly been reported. The current government, of Nicolás Maduro, intended to continue the government of his predecessor, Hugo Chávez. In the year of 2013, when Nicolás Maduro began his term, the country was in a devastating scenario of high inflation, and immersed in economic discontent, which generated a humanitarian crisis in the country. In the country, social programs have already been cut, there is a lack of medicine, and food prices continue to rise, generating a migratory flow of people to Colombia and Brazil. Therefore, Venezuela was identified as the country of origin of most refugees in Brazil.

According to the Federal Police of Roraima, in 2017 more than 30 thousand Venezuelans moved to the city of Boa Vista, the state capital. A similar number would be in Manaus (AM). This population already represents the largest migratory flow in the Amazon region since the arrival of Haitians in 2011 [4].

Besides the main goal of producing a physical shelter prototype for refugees in Brazil this paper presents the following specific objectives: theoretical framework with the approach of low-cost and sustainable types of emergency constructions, presentation of the architectural framework with the projects of the architect Shigeru Ban (whose characteristics are temporary structures) and the presentation of the project developed by the group.

## 2. Theoretical Foundation

In this section we will talk about the Shigeru Ban's architecture and examples of temporary housing by the architect will be presented, which served as a basis for the development of the project.

### 2.1 Shigeru Ban's Architecture

Bibliographic references on temporary housing are

generally related to buildings intended for victims of natural disasters. It is known that these phenomena cause human, material, economic and environmental losses, in such a way that those involved cannot react positively with their own resources.

The causes of these disasters can be of biological origin (epidemics, for example), meteorological (storms), climatological, geophysical and hydrological. In Brazil, due to its location, there are no records of disasters such as earthquakes or volcanic eruptions, however, there are numerous examples of floods, landslides, droughts and gales. These events also generate losses, especially in the most vulnerable societies. Civil defense agencies from different states of Brazil provide guidance on how to organize shelters. In Santa Catarina, for example, there is a “CEPED UFSC” (University Center for Disaster Studies and Research), in Rio de Janeiro, cities like Petrópolis, Nova Friburgo and Teresópolis also have agencies prepared to act in disasters.

For the development of the model that will be presented, some projects were analyzed and used for reference, among which Shigeru Ban’s projects stood out, since the construction of temporary housing is a field widely explored by the architect throughout his career. In these existing projects, the items observed were: low construction cost, possibility of easy reproduction, materials used and structural elements.

Shigeru Ban is a Japanese architect known for his humanitarian projects built in several countries, the most striking features of his works are innovation and philanthropy. It was observed that he works in different contexts and uses basic knowledge associated with unconventional techniques and materials. One of the strategies adopted by his office is to always work with local architects who understand the regulations and climate of the region. Besides that, these professionals facilitate communication with the beneficiaries, which is extremely important, since Shigeru’s work methodology consists of creating a prototype that can be replicated by the local population.

This relationship between the architect and the cause of people in a situation of vulnerability began in 1995, when the Hanshin earthquake hit the city of Kobe, in Japan. At the time, he started a partnership with UNHCR, which is the United Nations agency for refugees, and offered to rebuild a church using paper tubes, however the parish priest refused the proposal. Then, Shigeru Ban began the construction of temporary housing, a model called *Paper Long House*, developed for the victims of the disaster using simple and cheap materials, such as paper tubes and plastic cases of beer bottles. After seeing the result, the priest reversed his decision and allowed the paper tubes to be used in the reconstruction of the church, which was carried out with the help of volunteers. Fig. 1 shows this model.

Following the earthquake in 2001, in Gujarat, India, he was requested to design housing for the victims, financed by the company “Kartikeya Shodhan Associates”. In this project, the debris of the affected buildings were used in the foundations, while the vertical seal was made by paper tubes. Vaulted ceilings were made with bamboo and laid with woven sugar cane rugs and transparent tarp. Figs. 2 and 3 show the exterior and the interior of this habitation, respectively.

In 2017, he signed an agreement with UM-Habitat (United Nations agency) to design twenty thousand refugee houses in the Kalobeye settlement, in Kenya. Recently, Ban worked on the design of a temporary structure to receive visitors and religious events at



Fig. 1 The model of Shigeru Ban, Long Paper House.



Fig. 2 Temporary housing in India.

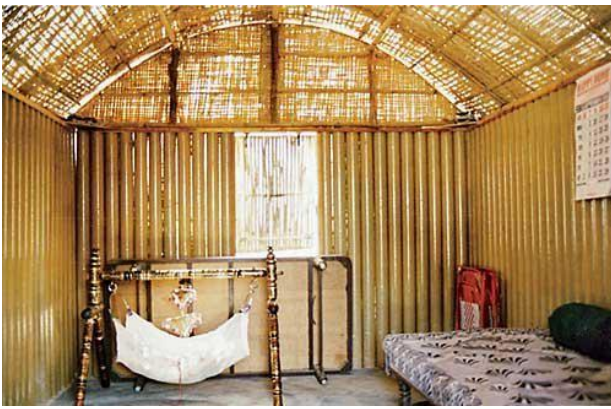


Fig. 3 Internal image of the room.

Notre Dame Cathedral in Paris, which in 2019 was partially destroyed by a fire. Following the characteristics of the designs of his office, Shigeru Ban Architects, the structure will consist of used containers, tube columns made out of cardboards and a tensioned coverage.

Currently, Shigeru Ban works with non-governmental organizations (NGO's), because he realized that the government aids the majority of people, but there is always a portion that is left destitute.

### 3. Temporary Housing Project

The proposed project seeks to assist refugees in exodus to Brazilian lands on the border of the northern states of Brazil, in a fast and cheap way. For this, priority was given to the use of low-cost materials associated with simplicity and that responded in a sustainable manner to construction technology, making this architecture easy to replicate.

The materials selected for this construction were: bamboo for the structure, concrete blocks for the superficial foundation, cardboard tubes for vertical sealing, and naval plywood plates for the floor and roof. After the project was conceived, the group executed a model.

Bamboo was chosen as a support element because it was necessary to have a structure that was both resistant and economically accessible, thus, a visible structure that surrounds the entire perimeter of the building was designed.

Horizontally, two longitudinal and five transverse bamboos are distributed both to the base and to the roof, the last ones being screwed directly into the plywood boards that act as the floor and roof of the building. Around the walls, there are three bamboos upright on each of the longest sides of the volume, in addition to two other tubes arranged diagonally, performing a bracing function.

This entire structure is supported by shallow concrete blocks, which act as spread footings, receiving the load of each of the six vertical structural bars. Fig. 4 shows the model's floor plan.

The internal part of this element previously described is composed of a rectangular base prism of 30 m<sup>2</sup> (7.5 m × 4 m), made out of plates of naval plywood that act both as a floor and as a covering. Frames made out of wood are also attached to these plates, where the cardboard tubes are fitted, which perform the function of vertical sealing and are repeated on three of the four sides of the block. The front facade is formed by a six-panel bi-fold door made of cardboard. This element helps ventilation inside the room and also creates a connection with the outside.

The choice of using cardboard tubes, in addition to being a direct reference to Shigeru Ban's projects, also responds to the reality of the national industry. According to the Brazilian Association of the Textile and Clothing Industry, Brazil is the fifth largest textile producer in the world. This is directly associated with the management of waste produced by this industry [5].

In the purchase process of small and large fabric and clothing merchants, the cardboard tubes are usually discarded. In this way, a new function for the material

is created, transiting between the fashion industry and architecture. Figs. 5 and 6 show the views of the model.

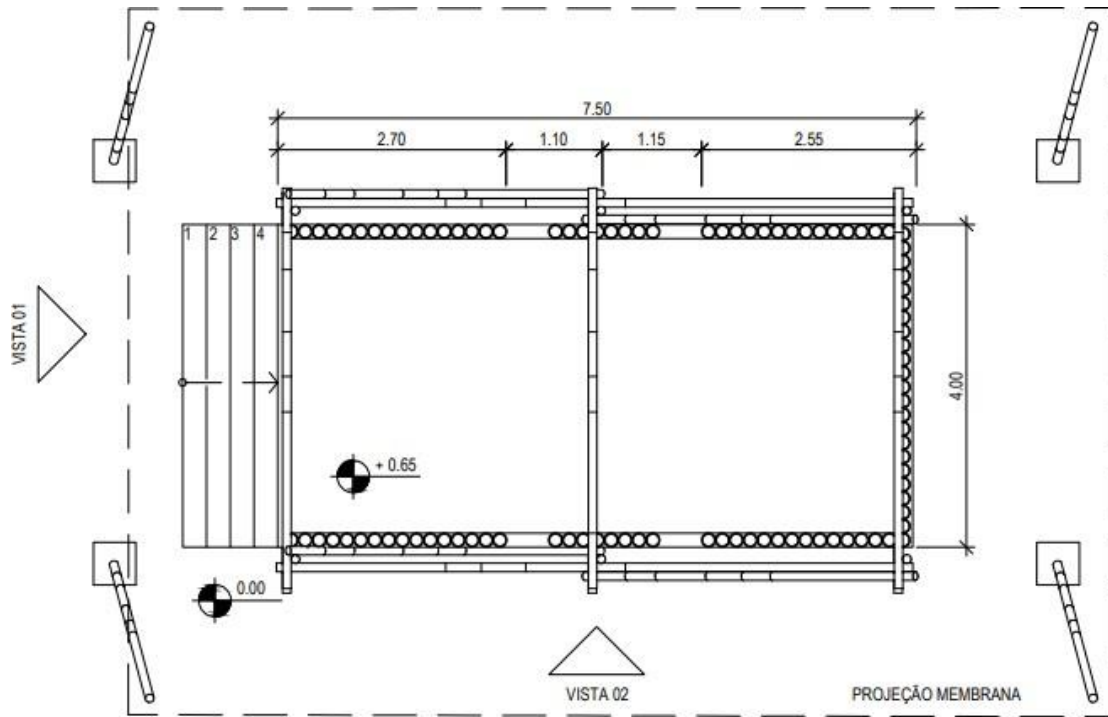


Fig. 5 Floor plan (unit in meters).

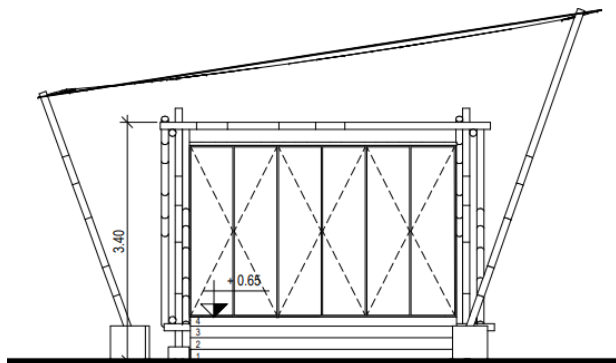


Fig. 5 View 01 (unit in meters).

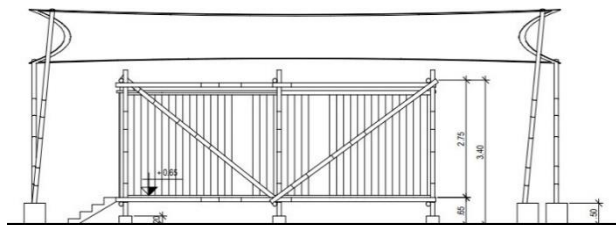


Fig. 6 View 02 (unit in meters).

During the conceptual process, an independent structure that was designed to function independently from the main block was drawn, creating a membrane

that could act as a kind of protection against rain for the cardboard tubes that form the walls of the shelter. This structure would also receive a social function because as it extends beyond the limits of the construction, allows the creation of a balcony, connecting the internal and external environments. For the execution of this element, the materials that were discarded were considered. Plastic bags were heated under a sheet of wax paper using an iron. This process makes the plastic sheets fuse into a few layers joined together, turning into a resistant waterproof material. To support this membrane, the possibility of tensioning the fabric is thought with the use of flexed bamboo pillars in two different sizes, in order to create a slope to allow water to drain. To fix the pillars, a brace was made at the bottom of the membrane and a spread footing.

During the development of the model, it was seen that the lack of elasticity in the plastic material and its fixation in bamboo made it impossible to create an

independent and efficient cover, leaving room for further studies with other professionals for the development of a coverage model that responds to the needs studied.

As part of the creation process, materials were tested and a model was created to check the feasibility and its volumetry. The steps in this process are described below:

1) The search for bamboo — Initial stage of the project, characterized by the search for material for the structural portion, found in an area of open vegetation in Petrópolis, Rio de Janeiro. Subsequently, the bamboos were hydrated and cut to be used in the project;

2) Assembly and structural fixation — During this process, ways of creating moorings and connections between the bamboos were studied, with the sisal being chosen to join the independent parts. However, screws were also used in order to prevent the movement of the axes at the base (floor) and ceiling in the structure;

3) Base (floor) and ceiling — The next step was the search for the element that would work as the base and cover for the project. The specific size of plywood is cut and inserted into the structure using screws, as it was already mentioned;

4) Fixing the cardboard tubes - The tubes are cut to the dimensions of the studied ceiling height and joined using a wooden frame at their ends;

5) Door — Six sheets of cardboard of equal sizes are created, which could be articulated allowing full opening of the smallest side of the prism, in addition to allowing air circulation and amplitude of the environment;

6) Membrane — Union of plastic bags, using wax paper and iron, posteriorly fitted to the pillars in flexion;

7) Spread footing — For the model studied, a square base mold filled with mortar was made to create the support for the bamboo.

Fig. 7 shows a photo of the model created by the group.



Fig. 7 Scale model.

#### 4. Final Considerations

This article has an exploratory characteristic and tried, through the execution of a prototype, to present a project that would meet the premises of sustainability and easy execution for temporary housing. Some deeper discussions were left out according to the need for simplification.

The architect Shigeru Ban has a history of building housing for people in vulnerable situations (such as victims of natural disasters). The way in which he deals with the need for fast and easy replication constructions is unique, and that's why the study of his work was of great technical support for the development of the project presented here.

It is important to ratify the temporary character of these buildings, when assuming the function of permanent housing. These spaces can present as low quality housing. That is because the materials used in these constructions provide a short term quality standard, but this quality can be changed when used for an extended period.

During the research, other parameters and references that could contribute to the formal design of the project were also considered. Thus, the thesis "Building with cardboard tubes: A study of the technology developed by Shigeru Ban", carried out by Gerusa de Cássia Salado for the State University of São Paulo, in 2006, was a guiding act to identify technical questioning

about the feasibility of the proposal. From it, it was possible to discover the use of elements such as paraffin and polyurethane coating to increase the durability and water resistance in cardboard tubes. However, due to the chemical composition, they can be highly flammable, bringing a question about new sealing and coating solutions. The thesis also brings a result of a humidity absorption test carried out during the research that proposed three types of commercial varnish paintings to assess the water absorption potential, resulting in a non sufficient percentage for the practice of construction, requiring further research that can make the process feasible.

Regarding the proposed model, for future studies, research on the appropriate material that can be used as coverage is recommended. The choice of bamboo and cardboard rolls were believed to be adequate and met what was initially expected. An important factor is that these shelters need to be adapted to our climate, hence the initiative to develop this project. It is hoped that this initiative can contribute with other researches on this topic.

## References

- [1] Belelli, Anna Cláudia Oliveira; Borges, Júlio César. Direito internacional dos refugiados e sua proteção no Brasil. *Novos Direitos – Revista Acadêmica do Instituto de Ciências Jurídicas*; jan. jun. 2016; 3 (1). Available at: <https://revistas.unifan.edu.br/index.php/RevistaICJ/articledownload/321/263>.
- [2] Silva Hannah Waisman Motta da and Munanga Kabengele, *Os Direitos dos Refugiados(as) no Brasil: Reflexões Sobre a Grave e Generalizada Violação de Direitos Humanos na Prática do Reconhecimento da Condição de Refugiado(a)*, University of São Paulo, São Paulo, 2017.
- [3] Conare Comitê Nacional para os Refugiados, *Refúgio em Números 2018*, available online at: [http://www.acnur.org/portugues/wp-content/uploads/2019/07/Refugio-em-nu%CC%81meros\\_versa%CC%83o-23-de-julho-002.pdf](http://www.acnur.org/portugues/wp-content/uploads/2019/07/Refugio-em-nu%CC%81meros_versa%CC%83o-23-de-julho-002.pdf)
- [4] Cunha Carolina, *Crise migratória – cresce fluxo de migrantes e refugiados venezuelanos no Brasil*, 2018, available online at: <http://vestibular.uol.com.br/resumo-das-disciplinas/atualidades/crise-migratoria-cresce-fluxo-de-migrantes-e-refugiados-venezuelanos-no-brasil.htm>.
- [5] Dino, *Brasil é o quinto maior produtor têxtil do mundo*, 2016, available online at: <http://www.terra.com.br/noticias/dino/brasil-e-o-quinto-maior-produtor-textil-do-mundo,3f9ae0049406fdd8e3cf105ef23a7f294ez9hrpt.html>.