Flexible Refugee Shelter

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Abstract. In recent years, there has been a great number of disasters such as natural disasters and wars. Wars occur, mostly, due to political, religious and economic confrontations. Calamities or natural disasters, which are considered as inevitable manifestations of Mother Nature, become uncontrollable and unpredictable. When they happen, they leave thousands of people in emergency conditions since they have lost everything they owned and are left without support. The emergency architecture lies in creation of temporary shelters to receive and protect the victims of these limit situations. This happens due to the need of minimum conditions of habitability these people have until being relocated. Disasters/wars, apart from the direct impact they have on the victims, also affect one of the main human factors: The Habitat. This type of architecture is perceived as transitory which requires fast solutions, cost-effective and easy-to-execute systems, thus focusing mainly on prefabricated or standard materials that enable a quick and low-cost assembly. However, in this type of architecture, one cannot only think of the quick solution of building/assembling shelters. Notwithstanding, it is also necessary to take into account that it functions as a humanitarian service, in which human needs must be meticulously thought about. On the basis of this last statement, it is intended to meet, in the best possible way, the needs of the refugees who are victims of the wars that come into their lives and who are not likely to return to their territory. These victims are sent to refugee camps - controlled and delimited spaces with the minimum equipment - usually with random tents provided by the UN which do not provide comfort to these families while they try to organize their lives. The lack of comfortable shelters and the minimum housing conditions are essential for these victims who see their lives change drastically from one day to the other. However, while designing a temporary shelter, one has to take into account the fact that it is temporary, transitory and that people only take advantage of this space for a short period of time. Faced with this primordial factor, the transience, the proposed space corresponds to adequate and comfortable minimum areas which allow a good quality of life for a short period of time. Faced with this primordial factor, the transience, the proposed space corresponds to adequate and comfortable minimum areas which allow a good quality of life for a short period of time. This proposal lies in the creation of an emergency shelter, as previously mentioned, through the development of a modular system that is flexible and temporary. It can be allocated in different ways on the ground, thus allowing the creation and adaptation to different spaces according to the needs of the people. This model unit will have a primordial base structure which will facilitate the adaptation to the terrain and the stability of the shelter. The construction method was designed to be as easy as possible by using lightweight materials, so it can be implemented on the ground and having good thermal and acoustic capacities so that it can be adapted to different climatic scenarios.
1. Introduction

This article has as a main reflection the creation of a model of dwelling for Refugee camps. Initially, it aims at demystifying nomadism, its characteristics, the minimum habitat that results from it, whose influence is impregnated in the present days, and its connection to emergency architecture.

The first people to inhabit the planet were forced to be nomadic, and soon they had to create shelters to protect themselves from the elements. These first shelters had to have specific characteristics so that they could respond, in the best way possible, to their needs.

Centuries have passed since the creation of these first shelters, yet today they are, in a way, still produced with different resources and needs, but the first Men were the ones to indoctrinate the value and the need of shelter, of protection. Today, the shelter is a right because of its importance in the development of humanity. However, there are still many people who, due to different factors, are forced to abandon their homes, their shelters, and their protection. Most of the factors that cause homelessness are the occurrence of calamities, being the Man the main factor, either directly or indirectly.

The development of the Man, the advancement of technology and of resources are "two sides of the same coin", both have favourable and unfavourable factors for the development of the Man and of the World, such as the occurrence of natural catastrophes (earthquakes, tsunamis, among others), pollution and all its direct consequences, as well as catastrophes directly provoked by the human hand, such as wars, which are mainly due to political confrontations.

These are all factors that will be addressed and analyzed in this article, from nomadism, with the main focus being the development of shelters, to the emergency architecture which operates in areas of calamity.

Finally, a model of temporary dwelling, called the Flex Refugee Shelter, will be proposed and presented for use in refugee camps aiming at helping these people to have the dignity and protection of a shelter.

2. Nomadism

Nomadic people do not have a geographic base, even though they travel within a defined territory always associating specific parts of the territory with certain periods of the year. This is due to several reasons: the establishment of migratory sources of food, adaptations to climatic conditions, trade of goods, search for community protection, and the search for the unknown. Of these regionally disparate cultures, many of the challenges generated by the need for shelters are common: they need to be durable, lightweight, flexible and, finally, they must be transported in a simple manner which does not mean that shelters do not have the comfort or are not aesthetically beautiful [1].

The climatic conditions were the reason for the emergence of the first vernacular forms of portable shelters, easy to carry and transport, with durable, flexible and lightweight characteristics, thus varying in materiality and shape, depending on the climate requirements, the culture of the nomadic people and the place where they were, as previously mentioned. The evolution of tribes also led to the evolution of shelters (figure 1). As a rule, most tribes were nomadic and did not have a specific place to settle. Initially, these people sheltered in caves, in places of natural origin that they found: only later did they choose to build their own shelters, using Nature, because they felt the need to have a more stable shelter to stay overnight, where they could be protected from outside agents.
Activities, such as pastoralism and commerce, were also an important factor that made the lack of constant movement to persist. Due to these factors, the development of several types of shelter happened, thus having the "concept" of minimum habitat. All shelters which were developed by the nomadic tribes had relevant characteristics according to their needs: the fact of being detachable or not, the easiness to transport and/or move around, the techniques of construction, among other factors.

With the beginning of this new era, nomadism gained a new concept and its importance became relative. With the emergence of the contemporary age, the sedentary lifestyle became preponderant, the Human Being felt the need to root in some place that could be called "home" due to their professional lives and to the fact that they wanted to start, or already have, a family. However, the postmodern man would be impregnated with wandering which is evident in labour and consumption migrations, in seasonal tourism and travel migrations, and in migration induced by economic inequalities. However, the idea of nomadism and wandering refer mainly to non-attachment to a profession, an identity and a family [2].

Nevertheless, contemporary nomadism is not determined solely by economic necessity or by simple functionality. What moves it is the desire for evasion; it is a migratory drive that incites the individual to change places, habits, friends, and to realize the diversity of facets of his personality, thus having the desire of another place. For modern nomads, the feeling of belonging to a specific geographical space does not matter. For this reason, for a nomad, the definition of a house can be varied. With the reappearance of nomadism, there was a need to create new shelters. Compared with the first nomadic shelters, these have the same basic principles: the easiness to carry, to transport and to access them, the use of sustainable materials, and flexibility. However, despite having the same principles, with the advancement of technology and with the evolution of the Human Being, the needs became other. Therefore, these new shelters would have to respond, directly, to the needs of this "new" Man (figure 2).
2.1 Emergency Architecture

The increasing vulnerability of people to extreme physical events may be considered to be closely related to the continuing process of underdevelopment throughout the world, with the increase of the population with very low living standards and resources being controlled by a minority. For this reason, these people are increasingly vulnerable to environmental variations as this process develops [3]. Therefore, emergency architecture is connected to the need, almost immediately, to respond as quickly as possible to emergent situations such as natural disasters and conflicts caused by religion, politics, and economics [4]. The emergency architecture presents two types of intervention: the immediate one, through temporary emergency shelters used in the period of territorial rehabilitation, or permanent, through the reconstruction of the houses destroyed due to the disaster occurred, which also translates into the territorial reconstruction.

This type of architecture is understood as something transitory, temporary and not conclusive, aiming at not to be prolonged for long. The shelter has to be considered as a process, not as an end [3], thus being inhabited only for a short period of time, somewhere to go to only in a momentary emergency (figure 3). The architect must always bear in mind that people will have to find a place to settle down and reintegrate into society. However, the role of the architect is not only to build a shelter. The architect must have a humanitarian sensitivity, must think about the needs of those who need a shelter, always taking into account the cultural levels, the analysis of the place and the resources in the place where the shelter will be deployed and also make it clear that the shelter, as previously said, is something transient and not permanent.

![Figure 3. Earthquake in Japan (Left); Tsunami in Thailand (Right)](image)

2.1.1 Emergency Shelters. Disasters have, as main consequences, high damage at the territorial level, destruction of infrastructures that directly result in the destruction of dwellings, thus causing large numbers of displaced persons and/or refugees. Therefore, the most important action after a disaster/catastrophe is the distribution of shelters and to provide victims with minimum conditions of safety and health. For that reason, emergency shelters are one of the main and most important post-disaster interventions. According to the Universal Declaration of Human Rights and other documents produced by multilateral organizations such as the UN, the need for a shelter is an implicit right. On the basis of this right, it can be concluded that given the existence of an emergency situation, this should be respected as a duty, since the reality of the need for emergency shelter is the key to the survival of its applicants. The lack of shelter can be understood as the need for protection from external elements, preservation of dignity, guidance and identity. Emergency shelters, used at a later stage of rehabilitation of the territory, provide the protection, security and privacy of the affected populations. They are, mostly, minimal constructions easy to transport, that provide conditions for its users and have as a purpose the return to normality, thus guaranteeing a living space until they reorganize their lives [5]. The most used shelters, in these cases, are campaign tents which for thousands of years have been the basic form of emergency shelter. Although this shelter is economically accessible, easy to transport and to assemble, it presents some flaws that are prejudicial to the well-being of those who live there, namely, their weak capacity to withstand strong winds, extreme temperatures (high other low temperatures) and even their brittleness so that they can collapse easily and/or be damaged. These tents are mostly provided by NGOs.
3. The Flex Refugee Shelter (FRS)
The Flex Refugee Shelter aims to respond directly to the need for temporary shelters in refugee camps. The lack of comfortable shelters and the minimal housing conditions are essential for these victims who see their lives change drastically from one day to the next. A housing shelter, as the tents provided by NGOs, cannot respond to the needs. For that reason a shelter with the minimum requirements it must have will then be proposed. However, when designing a temporary shelter, one has to take into account this: it is temporary, transient, it allows people to take advantage of it only for a short period of time. In turn, people using these shelters will get ready to return to a normal life, to look for a new place to live permanently, to seek employment, or even, if possible, to return to their place of origin and return to their normal lives. Faced with this primordial factor, the transience, the proposed space will correspond to adequate and comfortable minimum areas, thus allowing a good quality of life for a determined and short period of time. However, the main function of emergency shelters is the affirmation of the protection and safety of the people concerned. The prominence of an emergency shelter does not indicate that it is a development strategy; it is the creation of a shelter that is adaptable to the different needs of the victims, thus becoming an exercise in terms of creativity, functionality and humanitarianism.

At the conceptual level and taking into account various studies previously made, these shelters were based on the nomadic shelters from the beginnings and those contemporary, and also on some shelters designed in an emergency context. A previous study allowed the consolidation of a concept, based on the analysis of different types of existing shelters, their shapes, materiality, functions, flexibility, durability, thermal and/or acoustic qualities, the quality of the living space and even its aerodynamic capacity. The study proceeded in a regular octagonal shape. However, in the development of the analysis of this space, it was concluded that this shape did not meet one of the main objectives which was the minimum habitat.

After this initial analysis, we proceeded to a shape planning, also octagonal, but irregular, thus being able to obtain a better use of the spaces, both exterior and interior. With this defined base form, it was divided into three distinct spaces: the interior which would concentrate the housing area, a private area, and two exterior zones (it could be closed by using a canvas structure with a locking door) and the other zone of access to the entrance of the shelter. The functions of the exterior spaces may vary according to the user. However, this is the proposal for its use. In order to stabilize the shelter in the place, since refugee camps normally have only a slight slope to the water flow, a structure adjacent to the plant of the housing module, functioning as a foundation and stabilizing the module on the ground, was developed. This structural base is made of PVC pipes with 106 mm in diameter and 10 mm in thickness (figure 4). When applying and assembling this structure, the housing module can be implemented on top of it with greater ease, since it will be levelled with the terrain. This strategy responds to the need for this module to be flexible to different types of terrain.

Figure 4. Structural basis (Left); Modular Volume Sketch (Right)
However, with the development of the proposal and the measures of the vehicles of transport (figure 5), it was perceived that the base of this module would be too large in relation to the legislated/legal dimensions, since the private zone - the central nucleus of the base - was intended to remain intact, that is to say, without being necessary to assemble, thus being placed directly on the ground. For that reason, it was decided to collect the outer zones, adjacent to the central nucleus, so that everything would be compact and have the smallest dimensions without losing the integral space.

3.1 Flexibility and materiality of the space

The impregnation of materials and the distribution of interior space were also intended to respond to the characteristics and needs of the development of an emergency shelter (figure 6). The module has two separate entrances, i.e., doors with an opening for air circulation and an entrance of natural light (2-by-85-centimetres). All the space works almost in symmetrical mode, being that the central one possesses a circulation and/or social zone, and to its right and left is the zone of resting and storage. Since the walls are tilted (making it an aerodynamic modulus thus being better against strong winds), the space inside has had to be well analyzed, in order to take full advantage of it.

Figure 5. Elevate with closing platforms (Left); FRS module transport scheme (Right)

Figure 6. Plan Cota 0.41; Scheme of the distribution areas

One of the storage areas has a table and four built-in benches that can be easily removed from the place where they are stored and used by the users of the module. The remaining storage areas
are made up of shelves, and, in addition, there is a place under the beds where they can store their belongings. The resting area is protected by a curtain, thus allowing the privacy of each person. Each sleeping area has a bed with 1.40 by 2.00 meters and can be used by one or two people since it has a mean average between double and single beds. Therefore, each module is intended for a maximum of four people.

This model is made with only three main materials: the structure is 50mm in diameter and is made with 5mm thick cardboard tubes and the connection between each tube is made with interior fittings (figure 7). The carton tubes are within sight, coming off the floor, thus having to be protected by a 60mm OSB plate. Both the interior floor and the inner walls are covered with 60mm OSB boards. On the other hand, the outer deck (the folding zone) is made of 10-centimetres-thick OSC. At the lining level, the chosen material was cork agglomerate, since it has efficient thermal, acoustic and rain resistant characteristics. This material is used around the entire module, coating and protecting it entirely. The two entrance doors are coated, as previously mentioned, by the same material, the cork agglomerate, so as to camouflage the entire façade. The mesh created by the agglomerate coincides with the alignment of the doors, allowing, more effectively, their camouflage (figure 8).

![Cardboard tubes (Left); Cork (Center); OSB boards (Right)](image1)

**Figure 7.** Cardboard tubes (Left); Cork (Center); OSB boards (Right)

![Interior structure (Left); 3D representation of the inner materiality (Right)](image2)

**Figure 8.** Interior structure (Left); 3D representation of the inner materiality (Right)

One of the problems identified in relation to the universal architectural typologies is their inadequacy to the varying number of elements of a family. In order to obtain a solution to this problem, a connection system between these modules is proposed, allowing its repetition and thus responding to the adaptation of several models of housing according to the number of people in a household.

Knowing that a model/module corresponds to the use of a maximum of four elements, it can be connected to another, so that when they are interconnected, they will provide shelter for a maximum of eight people. That is to say that the more modules are interconnected, the more people they can lodge. This module replication system is only possible horizontally and in a
straight line, because its connection is planned to be made from the covered outer side, where the structure is placed on the canvas. This method of joining the modules allows refugees to stay close to their families and it is a very important element for their positive psychological development (figure 9).

3.2 Planning
Refugee camps play an extremely important role: these are temporary places to meet the needs of refugees. In view of the importance of refugee camps, it is suggested that planning should be carried out with the models of living developed. This planning can take many shapes, depending on the layout of each module and/or the needs of the refugees themselves (figure 10).
In a first configuration, the planning of connected modules is presented. In this case, three models of horizontal living are joined so that they can lodge a maximum of twelve people. Each "line" of three interconnected modules has two independent inputs. This connection of the modules, being a three in one, is repeated throughout the terrain line. This planning is mainly directed to large families who want to live together. The second configuration presents a planning with a main pedestrian path which gives access to some models to inhabit, while the access to the rest is made through the surrounding ways. This arrangement presents a common area between each of the four models, each having an independent entrance. These may be inhabited by close families, each of which may have its own independent living space, but with a common outdoor area or easy access for all. In the third and last configuration, we can verify the planning of own models of inhabiting with outlined pedestrian paths of access to them. Therefore, one of the outer zones of each module is used as part of the pavement and the access route, while the other can be used as each inhabitant wants; the structure can be applied with canvas. Its application is the choice of the inhabitants of each module. The access to each module is made only through footpaths which, in turn, give access to the main roads (figure 11, 12).

**Figure 11.** Planning proposal 1

**Figure 12.** Planning proposal 2 (Left); Planning proposal 3 (Right)
4. Conclusions
One of the main interventions of emergency architecture today is in cases of armed confrontation, namely during the restructuration of destroyed cities so that they need to plan camps that shelter the victims of these confrontations: the refugees. The refugee crisis is a fairly current issue as more and more victims of these armed clashes are left homeless and without the possibility of returning to their countries of origin. Because of this, the emergency architecture cannot intervene directly in the affected areas. Its intervention is made through refugee camps that aim to provide these victims with essential survival goods. Most refugee camps have shelters with few conditions, most of which are tents that protect victims but do not give them the dignity they need after the onset of these disasters that affects them both physically and psychologically.

In view of this, a proposal was developed to better respond to this type of situation. It has the characteristics of a temporary shelter and minimal habitat, yet it has comfort enough to give the dignity and the respect that these victims need.

Therefore, this article has as a main objective the clarification of the emergence of the first shelters, their characteristics and their relationship with the present which, in this case, applies to the emergency architecture, because besides being similar to the first shelters, they also have to be easy to assemble, easy to carry and be lightweight and easy to acquire. By developing this model of living, it is expected to have responded to this type of situations in the best way possible, thus applying to this concept all the learning acquired through the analysis made previously, the analysis of human needs.

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