



REFUGEE SHELTERS FOR ETHIOPIA

>> MARTA WISNIEWSKA | BISRAT KIFLE | ADDISALEM FELEKE

The border with Somalia, Eritrea and Sudan accommodate a number of refugees, with temporary, improvised shelters that are often destroyed quickly. The Danish refugee council, UNHCR and EiABC signed a memorandum of understanding in December 2010 for three prototype refugee shelters. Out of these projects, the Chair of Basic Architectural Design engaged itself in developing two prototypes for the Tigray and Somali regions. The design team organized a one-day workshop at EiABC with students where the Gabion and Sand Bag prototypes were conceived as two options.

Refugee centers are usually seen as transitory, makeshift shelters. However, some findings prove that refugees could stay from decades to lifetime in the shelters. Even though the design has to offer simplicity, ease of construction and adaptability, the fact that the shelters are used longer became a turning point to re-think the material and spatial organization. Taking this into account, the conceptual approach focused on the design, material and structure of the shelters.

Refugees usually leave most of their belongings behind, but not their cultural, traditional and religious values. Therefore, it is crucial to provide these spaces both indoor and outdoor.

With this understanding, the Gabion and Sand Bag prototypes are developed, as a response to the internal spatial needs, efficient use of communal areas, cost efficiency and simplicity of construction. In both prototypes, a combined use of local and industrial materials is applied to maximize potential use in mass production.

GABION SHELTER

The end of the Ethiopian- Eritrean conflict in May 2000, resulted in a big number of Eritreans fleeing to neighboring countries. According to UNHCR Global Trends 2011 (c>>), in 2008 Ethiopia was a host to 83,600 refugees, while by the end of 2010 this number grew to 154,300, making it the 19th largest refugee hosting country in the world at that time. The latest statistics show more than 50,000 Eritrean refugees living in 3 camps: Shimelba, My Ayni, Adi Harush; all in the northern Ethiopia (a>>).

Tigray region, located in the northern part of Ethiopia and bordering Eritrea is facing profound challenges in its' climate and landscape. Due to the world's climate change and local deforestation, the average temperature of the area is increasing while shade and shelters are dramatically reduced.

DESIGN PROCESS

The main reason for developing the shelter prototype is to create a cost effective, local solution for shelters in existing and future crises. The new proposal combines traditional building aspects with cultural and social questions to answer the needs of the refugees. To test materials, as well as construction techniques first hand, EiABC gave trial space for shelter prototypes in its compound at the beginning of the project. This allowed students and academic staff to be engaged in the given topic thoroughly and contribute to the design evolution at the site.

The northern Ethiopians use local stones accompanied by sticks, straw, textile and mud to build their houses (b1, b2>>). The local craftsmen are skilled in shaping the stone and constructing the walls without any binding material. As the final step the walls are covered with mud, which, creates a very natural and local image. Stone, as well as mud have good cooling and ventilating properties, which are essential in a tropical climate. During the daytime stones collect the heat, preventing the interiors' temperature from rising significantly. At night however, the heat from the stones warms the interior, as the outer temperature drops rapidly.

RESEARCH TEAM:

Instructors

Bisrat Kifle
Addisalem Feleke
Marta Wisniewska

Students [Gabion Shelter]

Alpha Jacob
Aklile Bayou
Hayet Abay
Earmias Almwaw
Ermias Mulugeta

Students [Sandbag Shelter]

Tewodros Tesfaye
Kidus Wubshet
Abel Assefa
Adil Fedlurahman
Elias Jemal



a >>



b1 >>

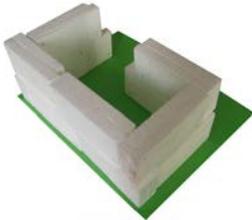


b2 >>

a >> Tigray region.

b1 >> Building materials in Tigray.

b2 >> Building materials in Tigray



d >>

c>> UNHCR data 2011
 (<http://www.unhcr.org/pages/49e483986.html>)

d >> model pictures

e >> examples of floor plan

2011 UNHCR PLANNING FIGURES FOR ETHIOPIA					
TYPES OF POPULATION		JAN 2011		DEC 2011	
		TOTAL IN COUNTRY	OF WHOM ASSISTED BY UNHCR	TOTAL IN COUNTRY	OF WHOM ASSISTED BY UNHCR
REFUGEES	SUDAN	21,400	21,400	9,100	9,100
	SOMALIA	91,100	91,100	126,300	126,300
	ERITRIA	46,400	46,400	61,000	61,000
	VARIOUS	470	470	0	0

c >>

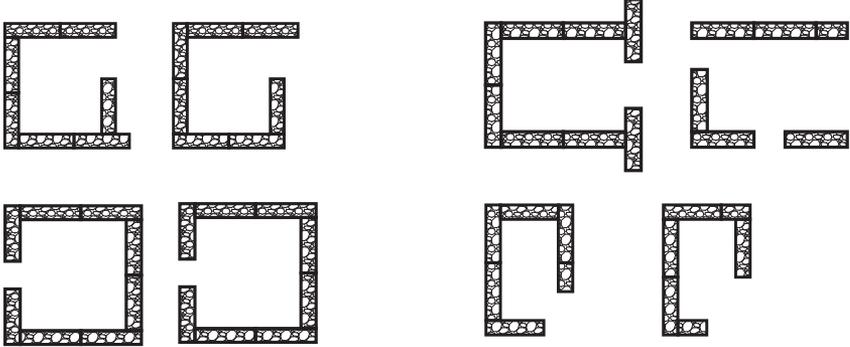
In order to facilitate the building process and, most importantly, to not require skilled laborers on site, the team decided to envelope the stone walls with a wire mesh construction. The so-called gabions are understood as cages, boxes or cylinders and were first applied by the military as fortification elements in medieval times. Nowadays, however, they are mainly used in civil engineering and road constructions. The most common need for gabions in the difficult topography of Northern Ethiopia is prevention of slope erosion. But gabions are not only found in landscape design. Today, a wide range of options can be found for walls, foundations or even roof constructions. The stones within the wire cubes meet all static requirements, whereas the wire is used as a frame work, extra protection and connection tool in between the metal cages. In this shelter design, the application of gabions allows a bigger margin for construction mistakes, unskilled laborers and a fast, predetermined construction process.

Gabions are also easy to transport, as they are brought to the building site flat and at their destination are unfolded quickly to their rectangular form. Moreover, one of the biggest gabion providers in Ethiopia is located in Wukro, Tigray region, which makes purchasing and bringing metal cubes to the construction spot even faster and simpler.

AFFORDABILITY

Even though certain building materials are usually provided by sponsors or the government as an aid, a cost efficient prototype would give better opportunities to reach everyone in need. Since three walls can be shared with neighboring units, the price decreases. Refugees are usually engaged in the construction process, including the interior works and site works of the shelter, in order to customize the space to their interest and needs.

With labor of refugees, a single prototype costs less than 500birr/m2 (20€). Considering that stones are available on site, Gabion is the major expense, taking around 60% of one unit cost. In the future, with reduced prices, government tax exemptions and further negotiations with suppliers, the Gabion might be seen as one of major building materials in the construction of affordable housing units.

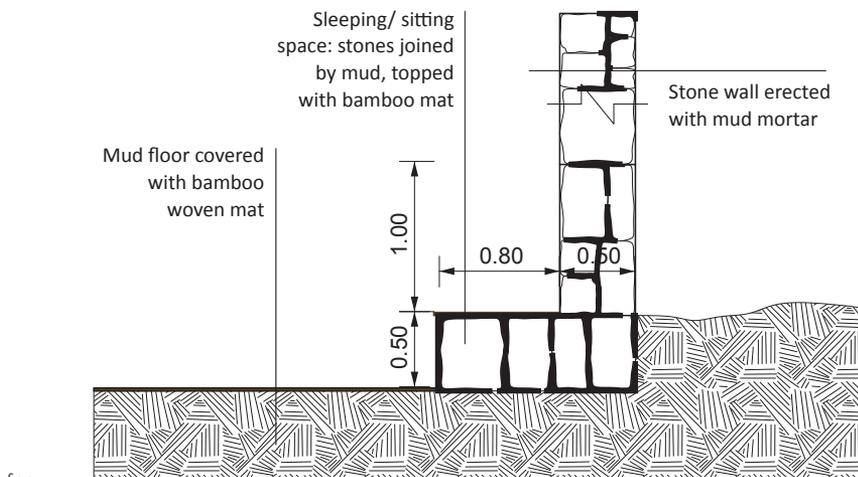


e >>

CONSTRUCTION PROCESS

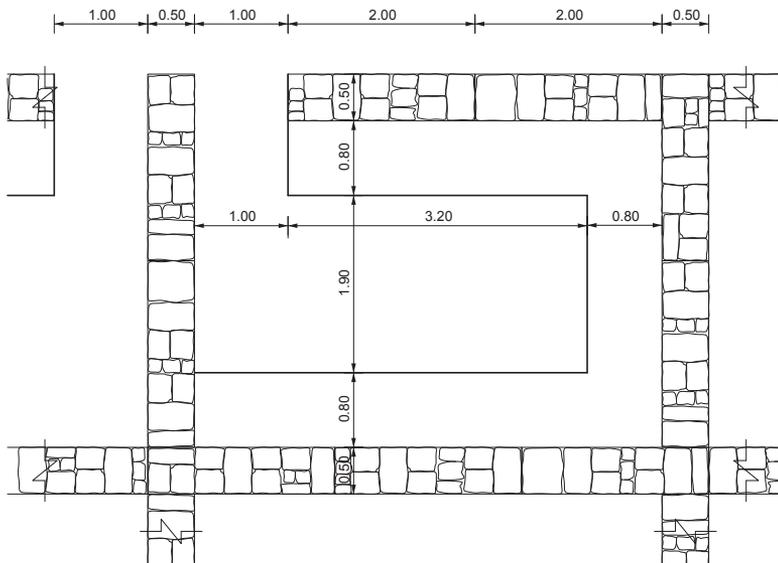
Due to proportions, gabion shelters do not require foundations as they can stand by themselves. Therefore, stonewalls can be raised directly on the flat land. However, the design provides a lowered entrance to the units, which handles privacy and security matters as well create cooler interior [f]. Ground works are reduced to digging a 0.5m deep hole of 4.5x6m size.

A bottom of the excavation is an actual level of the shelter's interior. Stones, supported with the mixture of mud and cactus juice, which has waterproofing properties, are then placed on the ground forming a 0.5m high frame. In time, such blend turns into a thick, strong crust, able to hold rocks together and carry heavy loads. In order to provide a sitting or sleeping area, mortar base is extended 0.5 or 0.8m, towards interior [h3].. As soon as this is accomplished, the first gabions can be settled on the "foundations" and filled with stones [h4]. Similar to ground works, stone blocks are braced by mud.



f >>

Working with gabions offers a great number of advantages. First of all, modularity of components allows for various arrangements both in floor plans [d,e] and elevations. By shifting one or two elements horizontally along the outer wall, an opening is created, which is later used as the door. In the same method a window is constructed. Although, the design team worked with ready-made gabions for the prototype (2.0m length, 1.0m height, 0.5m width), ordering individual parameters according to design requirements is possible. Furthermore, purchasing gabions of diverse dimensions will accelerate already efficient construction process.



g >>



f >> 'foundation' section

g >> final floor plan

h₁ >> preparation of stone blocks

h₂ >> 1st layer of stones

h₃ >> stone-mud mortar base

h₄ >> filling out gabions with stones.



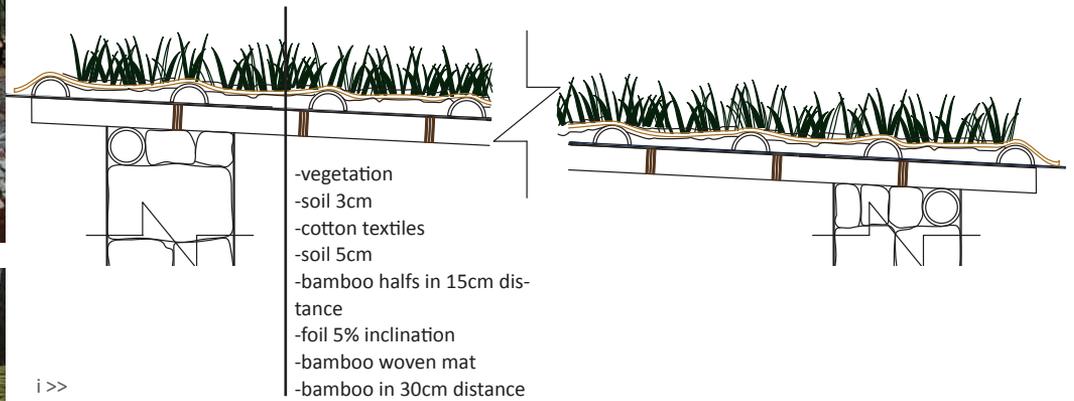
h₅ >>



h₉ >>



h₆ >>



i >>



h₇ >>



h₈ >>

h₅ >> Filling out the gabions with stones.

h₆ >> Rising gabion-stone walls

h₇ >> Preparation of bamboo for the roof construction

h₈ >> Close up of the roof

h₉ >> Construction of the roof

i >>Section of the roof

There was an attempt to build a uniform cube, where gabions also compose the roof. Unfortunately this procedure requires an extremely precise preparation of the stones in the covering gabions. This cannot be guaranteed for refugee shelters, in a place where a mass production and time plays a great role. As the substitute for the stone roof another local material was taken into consideration. Bamboo is known to be one of the cheapest and easily accessible building materials in the world. Statistics show that Ethiopian bamboo is even stronger than the Asian counterpart. Nevertheless, only 4% of the yearly harvest is used for the construction sector.

Moreover, branch type roof constructions have a long, successful tradition in the region. By attaching a bamboo stick with a bigger diameter to the top of one wall, the inclination of the roof can be achieved. Alternatively, this can also be accomplished by controlling the stones' level when being stacked inside the highest gabions (i>>). As the next step, bamboos are located in 30cm distance between each other, covered by a woven bamboo mat. This construction base is extended 50cm from the wall for shading and the protection from rain. The upper layer is a plastic sheet of minimum 5% inclination, preventing the rainwater from entering the shelter. Such method allows for a green roof, which works as another cooling element. In order to provide additional reinforcement against lateral movement and a terracing of the sloped roof, a layer of split bamboos tops a lower structure perpendicularly. Additionally, in between two layers of soil, an organic cotton fabric is spread. This traditional, recycled textiles, called "Gabbi" or "Natella", decompose in time and prepares proper ground for vegetation. Overtime the cloth is exchanged by plants' roots and holds the soil together.

As the final step windows and doors are closed with interwoven bamboo mats.



h₁₀ >>

5 DAYS OF CONSTRUCTION

DAY 01: Site Preparation and substructure works. Site clearance, setting out, ground and masonry works using soil as mortar.

As each unit is attached to three adjacent ones, the construction can happen simultaneously in all shared directions.

DAY 02: Walls construction.

Gabions are filled with stones.

DAY 03: Roof construction.

DAY 04: Roof finish.

Day 05: Finishing and site works.

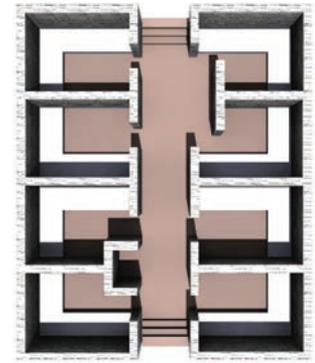
CLUSTER PLANNING

The design tries to answer the social need as well as individual spatial requirements by offering different levels of privacy, while creating public areas as essential part for social interactions. Common spaces can also solve security and protection problems. Clusters of eight units (j>>) form separate entities, each grouped around a depressed courtyard. This visual barrier evokes a feeling of privacy and shared ownership. Each cluster is furnished with a cooking space and sanitary installations shared by 2-4 shelters. A rectangular grid, underlying the cluster system, allows the refugee camp to grow by adding shelter modules in an organized manner.

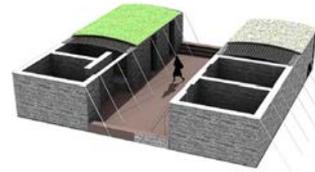
The interior space of a shelter fluctuates between 12- 18 m² and is designed for maximum 5 persons. Due to space shortage, one room accommodates all necessary programs. But, multi-functional living areas are strongly attached to the Ethiopian tradition, where sleeping arrangement turn into living and eating areas during the day.

SUMMARY

The realization of the Gabion Shelter met with very positive reactions from the EiABC staff and gave hope a future mass production as an answer to humanitarian needs. It's therefore important to mention a number of advantages a construction of a gabion type refugee village offers. It is a labor-intensive and job-generating program, which emphasizes local building culture and combines it with the prefabricated elements. The construction process is simple and does not require specialized equipment or skilled workers. Modularity of gabions gives a wide range of arrangements. Furthermore, flexibility of adding new modules to existing structures allows for a future expansion of the settlement. Finally, the construction is durable which makes a long-term use of the realized units possible.



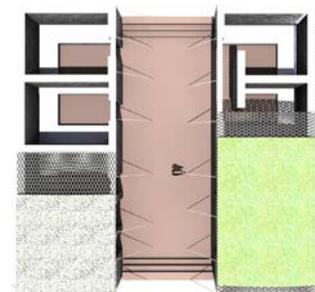
j₁ >>



k₁ >>



k₂ >>



j₂ >>

h₁₀ >> final stage of the construction

j₁ >> cluster plan

k₁ >> cluster axonometry

k₂ >> cluster axonometry

j₂ >> cluster plan



l >>

SANDBAG SHELTER

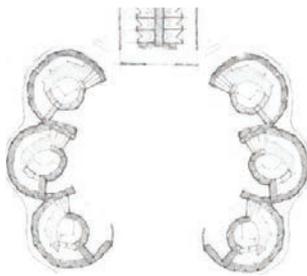
The civil war within Somali has resulted in a big number of its residents fleeing to neighboring countries. According to the 2011 UNHCR figures (c>>) Somali refugees have the highest rating the country is currently hosting in the Eastern part of Ethiopia (Ogaden Region). As a response, UNHCR provided temporary shelters made of plastic sheets as the main construction material and utilize wooden sticks as structural support. The refugee center is located in one of the areas where temperature reaches 40 degrees. With such kind of environment and the construction material limited to plastic sheets, it has necessitated to fashion shelters, which are human friendly by employing local materials. The sandbag design is developed by the team as a response to these facts and was so far experimented only on 1:5 prototype model.



m₁ >>



m₂ >>



n >>

UNIT DESIGN

The main factors influencing the design for this context are climate adaptation and ease of construction. The depression from the natural ground level and the sandbags keep the harsh exterior to a moderate room temperature. The concept evolved into the same line of thought as the stone built shelters, where they are cost effective, time conscious and expected to be built by the refugees themselves. The circular shape of the units originates from the need to minimize the lateral load of the strong wind. This shape can be deformed to an ellipse and still be buildable. It also creates the freedom to construct the house even if measuring instruments are not available.

In the unit design, a continuous flow of levels begins from entry point. Each activity within the shelter is given varied privacy qualities by providing different elevations from the ground (q>>). Specific functions are assigned for each of the platforms where the lowest serves as sitting and sleeping.

l >> Render of the unit

m >> Conceptual sketches

n >> Cluster plan

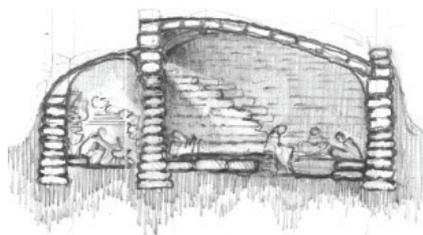
o >> Unit section

p >> Unit plan

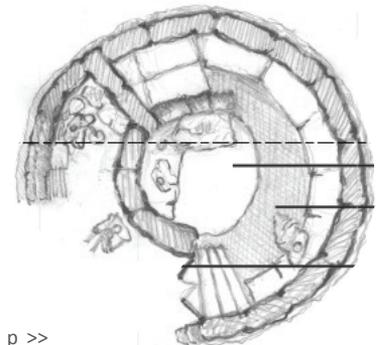
q >> Filling out the designed

sandbags with sand

r >> Cluster section



o >>



p >>

Similar to the structures from stones, also the sandbag shelters embody the local context (in material selection). Since sand is the most abundant material of this region, the design team used it for the main structure of the unit. Local sticks come in to play for tying the bags tight to one another, both vertically and horizontally. This sticks have the advantage of flexibility and lightness in weight. Their role as a building element is to keep the shape of the structure intact and at the same time sustain the lateral wind load. By running from top to bottom of the stacked sandbags they also act as joints. To strengthen their efficiency they are buried below the ground floor finish for firm attachment. The roof consists of three main layers: The upper skin is a plastic sheet pinned to cans which create a gap between this skin and the ceiling. This space allows air ventilation, either from units' interior or the exterior heat wave. A bundle of sticks is utilized to tie the cans to each other (o>>).



q >>

CLUSTER DESIGN

The Somalis have a strong tradition to entail in communal gatherings. Being the center of social activities like playing, cooking or similar tasks, the open space usually is designed to protect the inhabitants from the severe environment (t>>). This aspect was taken into the cluster design where every unit is arranged to create a communal space for social gatherings. Six housing units create the intended arrangement (p>>). Their visual connection also provides a sense of security. The public space created by the individual units continues into the single households, forming a semi/private zone that can be used as cooking and sitting area (r>>). Sanitary services are provided for each cluster in close proximity.

REFUGEE SHELTERS FOR ETHIOPIA

The Gabion and Sandbag shelters proved to be important research topics. Moreover, they could be seen as an alternative in affordable housing program for the majority urban poor as well as for rural housing. The construction does not require skilled laborers and meets the available manpower and local resources. The typologies are labor intensive, easy for construction and flexible to modify or even transform into another function. Finally, it is important to note that more researches need to be done in this direction, especially on combing traditional building construction skills with certain input from industries. With the population growth in developing nations, increasing at an alarming stage, alternative building materials, innovative designs and sustainable approaches should be encouraged. >>



r >>