REACTING AND RECYCLING

M. San Millán Escribano; A. Muñoz Miranda
PhDs in Architecture. Nebrija University. Madrid. Spain.

S. Martínez Cuevas
Architect and Earthquake Engineering Researcher. Polytechnic University. Madrid. Spain.

B. Horta Rial
Architect and Structural Researcher . Polytechnic University. Madrid. Spain.

ABSTRACT: To a certain extent what this research is proposing is a return to local principles or to regionalism, which is able to employ place-specific tools and craftsmanship (local arts and their virtues) promoting and being innovative with traditional elements which belong to a particular place, and using tectonic and stereotomic logic.

You can observe this, in the face of a destructive natural event. An immediate architectural reaction is produced in cooperation with the rest of the not affected territory. The cooperation of certain non-governmental organizations with other groups in the same collaborative cycle improves the recycling of ideas and city planning forms. These organizations cooperate in the development and implementation of cities and settlements that need a fast reaction when facing an unexpected disaster.

1. INTRODUCTION

For Colavidas, the most important problem is not the environment. He proclaims the importance of basic habitability in this way:

[…] Come on, citizens, one last effort, universalise basic habitability! [1]

And, further on, he explains why inhabiting is more important than environmental problems:

[…] Why climate change is not the first problem, neither the most decisive one humankind is facing now? It is purely and simply because, without getting out the immanent material dimension –therefore, from an exclusively instrumental point of view that omits motu proprio any kind of metaphysics- the decisive factor for Humankind is and always will be –for better or worse, in a straightforward way, and point blank- Humankind itself [2]

International cooperation occurs in a double recycling process. On the one hand, knowledge is recycled. Cooperating organizations give those who have been affected their knowledge about emergency habitability, and, in turn, the inhabitants of the disaster area provide local construction systems, in particular, regionalist, traditional, safe, low-cost and easy to execute systems. It is intended both a quick assembly and resilience in time. These proceedings, as shown in the attached Table 1 are fast to build and most of them are finished in less than six

© 2013 ISBN 978-84-616-2005-0

months. Therefore, these actions have three goals: 1.-integration in the local building culture and customs, 2.-low-cost due to the use of recycled materials, and 3.-a quick building of the shelter; these characteristics are the common denominators of an architecture that reacts in a cooperative way in the aftermath of a catastrophe.

The experience resolving situations in which the inhabitants need a home immediately has led non-governmental organisations to provide progressive shelters. The families affected by different disasters –climatic, geologic, war conflicts- are given spaces that allow them to live in a place resembling a home. The cooperation organizations provide immediate facilities called progressive shelters because they create the transition between the temporary and permanent housing, and they are susceptible to get improved. They meet the spatial needs in the lapse of time between camp tents and permanent homes.

The goal of recycling the affected buildings is to restore as soon as possible the unfavourable state of their habitat after a disaster, and to return the settlement to its situation before the catastrophe; that is why they have the minimum components needed to give shelter, that is, vertical walls and installations.

Among those cases analysed where recycling is essential to build quickly, we can find actions carried out after earthquakes, cyclones and volcano eruptions. All these phenomena have devastating effects due to the destructive energy released and the enormous extent of the damage. These are places with minimum facilities. Size is also minimum, because a minimum size reduces both building time and cost. There is certain diversity in size, from the smallest 9m2 one used in Peru in 2007 to the 74 m2 one installed in Italy in 2009. The standard nº3 of the Sphere Project states the indicator of 3.5 m2 per person as the minimum threshold.

In those places where disasters were more important, materials are usually recycled. Those that are not directly recycled during the catastrophes themselves, like the plastic sheets provided by the NGOs, come from a closed transformation cycle which in turn generates another cycle in which they will be recycled as components of other shelters. Iron boards, plastic sheets and shelter repairing kits are the most frequent ones.

In the following examples, the high number of displaced homeless population created an urgent need for shelters due to the total lack of housing.

Haiti has been suffering an economic crisis for the last 20 years, repeated hurricanes, political instability and social violence. The NGOs have been working there for 20 years helping to ensure a minimum of stability to generate a process of social change and economic development. On the 12th of January, 2010, at 16.53 p.m., the earth in Haiti shook violently for 34 seconds measuring 7.0 on the Richter Scale. Several cities were razed to the ground. The 80% of the schools and more than 1,000 dwellings were destroyed, 220,000 people died and 2,500,000 lost their homes in a country that is considered to be one of the poorest nations in the world. In response to the destruction caused by the quake, there was an immediate mass

reaction of the international agencies: 1,300 camps were developed and shelters were built for 1,500,000 survivors.

In Afghanistan, (2009) shelters provided an additional protection against the country's harsh weather conditions; moreover, they can be built by any kind of person in a very short time. These shelters do not include materials that can be considered as permanent to transmit the message they are only temporary lodgings. Agreements were reached with farmers in order to set up camps: they ceded land and the camps could be established. From 2002 to 2010, more than five million people returned to Afghanistan. The needs of 379 families were covered and a 94% of them used the 38.7 m2 shelter. Each of these cost $300 and consisted of a model built with 2410 m. long bamboo pieces and 5x4 m. plastic sheets.

Since 1991, Somalia has been suffering the struggles caused by contending political factions. Since then, there has not been a central government in the country. In 2009, 1.3 million people were displaced due to the chronic insecurity in the cities. Here, plans have been carried out to distribute tents and plastic sheets among displaced families. The most vulnerable ones living in crowded places received progressive or transition shelters. Those families staying for long periods of time in those shelters were given repair materials that, sometimes, were added to some other recycled materials to enlarge the dwellings in an improvised way.

The traditional notion of the Somali Buul house was recycled by PTW Architects[3] at the exhibition Emergency Shelter held in Sydney, was a fund-rising initiative in aid to the areas devastated by the 11 March, 2010, tsunami in Japan. The exhibition presented different construction models that not only gave shelter to people in situations of natural disasters but also provided them a private and safe space during the reconstruction period.. This shelter is built with big sheets of plastic bubble packing material that wrap walls made with carafes of water. The whole shelter is made of plastic that not only prevents water from getting into the building but also accumulates it in the walls. It is not only water-proof, but also the shelter becomes a sort of a big drinking-water tank, something really necessary in places where a water supply infrastructure does not exist. At this very exhibition, Cox[4] subverted the use of hangers, a very common element at home, low-cost and necessary at shelters where there are no closets. He recycled the hanger elements and dispersed them all through the inner façade of the building. In this case, a number of hangers are re-used with two different aims: first as a storing system and for laundry drying, and secondly to provide shadow in those areas where the clothes are hung.

Creating enlargements by repeating components in the case of reaction recycling may be an efficient strategy. Pieces can be transported in small packages which, once assembled, will become habitable spaces. The prototype presented by LAVA[5] at the Emergency Shelter Exhibition, in 2011 showed a reaction space built by transporting wooden boards that are assembled one over the other. Every piece changes its section creating a space slightly adapted to the basic needs of its dwellers. The separation of pieces enables a utterly ventilated façade. In this very exhibition Green Leaf Engineers[6] proposed an agglomerated of three-dimensional patterns. Each pattern is a hollow box whose faces compose a motive, recycling a geometric

© 2013 ISBN 978-84-616-2005-0

tessellation used by the Islamic culture. Each box is piled and attached to another one creating the perimeter walls of the shelter, which works as a great latticework of recycled plastic and, like the previous model[7], allows airing the building without opening windows.

After the disasters in Bangladesh, Republic of Congo, Andhar Pradesh and Managua, citizens began to improvise with the materials they found in the streets and many of them built their own shelters.

In 2007, two years before the Alla, the cyclone Sidr hit the south-west coast of Bangladesh destroying more than 400,000 buildings. In the most affected districts, more than the 50% of the dwellings were damaged. Most families but the most vulnerable ones built their shelters in less than four weeks. A total of 160 local and international NGOs got involved building shelters immediately. The aid programme included the distribution of basic components for the shelters and a tutorial on assembly and do-it-yourself building. Four weeks after, the number of shelters supplied to protect people from the rain and the cold turned out to be insufficient. Those whose homes were completely destroyed built temporary shelters using materials they found in the neighbourhood. Those whose homes were damaged, repaired them the best they could re-using their own materials and those they found in the surroundings. The construction quality and the structural stability of most of these buildings were poor and the damages caused by the cyclone severe. Therefore, it was imperative to repair the affected housing as soon as possible so that it could hold the following cyclone strike. The supply programme of constructive resources included blankets and repair components, tents, asphalt cloth, folded iron plates and tools. To substitute the destroyed houses for inhabitable ones, some transition shelters were built.

In 2002, the volcano Goma in the Republic of Congo began erupting: 15,000 homes were destroyed and 87,000 people were left homeless. Shelters of 24 m2 for $180 were built and distributed altogether with technical support and monitorization.

The cyclone that destroyed Andhra Pradesh in 1977 caused 250,000 displaced people and the damage or destruction of 150,000 homes. As it did not happen during the monsoon season and the weather was warm, shelter building was not considered very urgent and the Government stored tons of bamboo to build improvised shelters and to repair or re-build homes. In 90 days, 7,000 shelters were built.

All these shelters included some sort of customized recycling. Small enlargements, new rooms for other uses or tuned spaces were part of the catalogue of hybrid shelters half prefabricated half self-constructed. Those spaces were of a vernacular typology with orthogonal closings and a sloping roof with an eave to avoid the accumulation of rainwater. At the Emergency Shelter Exhibition in 2011, Fujimori[8] presented a light, prefabricated shelter made of recycled plywood boards and raised above the terrain, recycling the domestic vernacular language and optimizing it for a potential emergency response.

An earthquake measuring 7.5 on the Richter Scale devastated Managua on the 23 December, 1972, destroying 50,000 buildings and leaving 200,000 homeless. However, unlike other cases, most of the population found accommodation at the homes of friends and relatives. Only a small percentage needed temporary shelters. The Government at Managua, after evacuating the city and setting emergency camps, built wooden shelters for 11,600 people. Polyurethane igloos, wooden cabins and tents were used in this emergency.

Since the 60s, Fuller[9] researched optimized Project systems in order to get the maximum volume with the minimum surface. All his prototypes based their space morphology on the sphere, generally triangulated to reduce both manufacturing costs and assembly time. The typology he innovated was based on a technological recycling of the igloo concept he called Domo. In spite of being an optimal object from the economic point of view, the application of this concept to specific cases was not always effective. For instance, when another quake hit Lice in Turkey in 1975, tents did not hold for as long as required. Later, Oxfam built 463 igloos, but 44 got damaged and only 50 were occupied. The high cost of the shelters, long reaction times, the risk of fire in the modules and the exclusion of the cultural characteristics were the main reasons of the failure of this action. After this negative experience, Oxfam stopped building igloos.

Thirty six years later, at the Emergency Shelter Exhibition in Sydney, Ateliers Jean Nouvel[10] recycled the igloo space concept combined with the lightness and the assembly quickness of a tent.

Sometimes the environmental consequences of shelter building are translated into deforestation. In Somalia's case, a major part of their woods was chopped down. The tree trunks around the camps were used as structural elements. A similar example is that of Rwanda, where more than two million people were left homeless during the civil war starting in 1994. Aluminium structural tubes supplied by the United Nations High Commissioner for Refugees (UNHCR) office were sold by the Rwandan refugees themselves. Later, as they needed shelters, they started chopping down trees to substitute the aluminium pillars in the cabins. Ban[11] considers that paper tubes can be cheaply manufactured with simple, small-sized machinery and can be easily transported. This is why he proposes a low-cost alternative: recycled paper shelters, where the structure is constituted by those paper tubes.

Aravena[12] suggests a way of building based on a prefabricated prototype of emergency dwelling. He proposes a system that optimizes the use of prefabricated panels. The façade pieces have thermal insulation. The resulting buildings are small, earthquake-resistant shelters that can be installed quickly in places where a disaster has taken place. When joined these pieces constitute instant settlements or camps in affected areas. They are planned, and therefore, they include recommendations for the urban grouping of the units.

Kéré[13] states that if a project has to be built in Africa, both the manpower and the materials must be local. Regarding beauty, Kéré states that *"perhaps beauty may be, in itself, an objective for those who build without any money problems. However what makes me happiest is for my buildings to function in the best possible way for the least possible cost. That is true beauty"*[14]. The substrate materials are

© 2013 ISBN 978-84-616-2005-0

part of the façades. Every member of the community takes part in the construction process according to their possibilities, as it can be seen in Meti School designed by Heringer[15]. She also writes *"those who believe that having more money is always a good thing are wrong. Sometimes having too much money separates the architect from architecture"*[16].

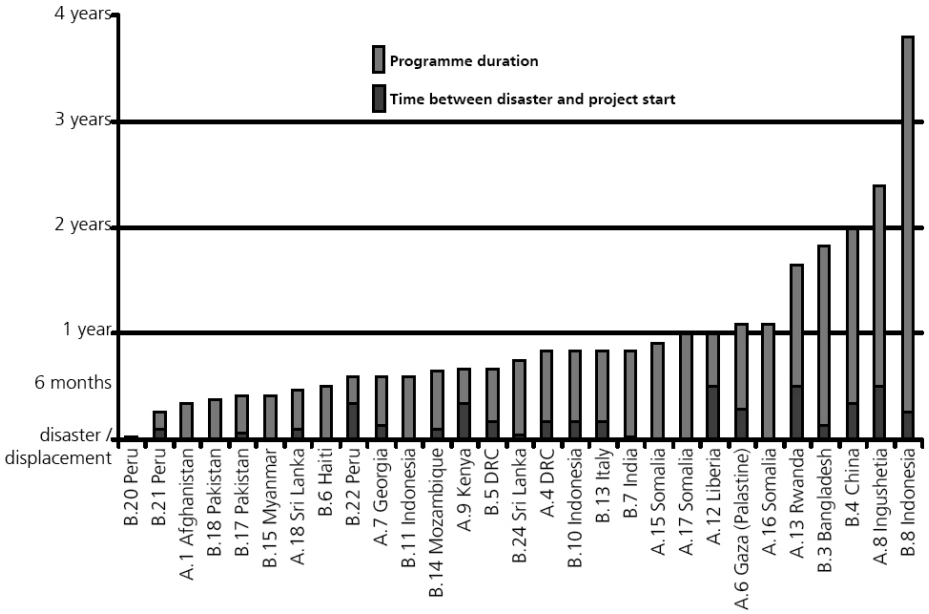

Figure 1. Duration of the different cooperation projects graphic. Font: Red Cross 2011 annual report.

Figure 2. Buul Shelter (1991); self-constructed Shelter based on traditional Buul. Somalia.

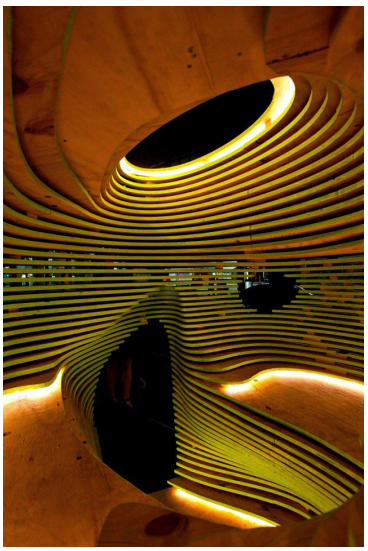

Figure 4. LAVA. (2011.); Emergency Shelter Exhibition. Sydney. Australia.

Figure 5. HERINGER, ANNA (2005); METI School in Rudrapur, Bangladesh.

2. CONCLUSION

Recycling is a reaction consisting of the modus operandi, the performance, the improvisation and, on the other hand, of discovering the constructive potential of a material that is going to be recycled.

A further strategy for fulfilling the criteria of logical construction is that if there is a limited budget, efforts should be focused on the essential elements of the project. Local production and handling should be secured in order to promote a phenomenological perception that is in close contact with regionalism.

Leaving aside this decorative-constructive contradiction, the concept of the "economy of means" should be introduced, which is defined as the maximum performance in return for the minimum input of means or material. This concept is in harmony with structural efficiency which consists of finding the relationship between the maximum strength and minimum weight of the structure.

Perhaps this all began many centuries ago, in those examples of architecture which were merely representative or symbolic, which placed human beings in contact with the gods of the day. So, we must take manufacturing into consideration as a further aspect, although this factor often introduces a contradiction. A particular structure which may be easy to handle on account of being very light, and which is very resistant (having a high structural efficiency overall), might be costly to produce or to develop, or of very complex construction, which

© 2013 ISBN 978-84-616-2005-0

would mean that it is not an architecture which prioritises the economy of means. In this sense, complexity must also be taken into account as a factor. Complexity, as previously explained, goes hand in hand with a difficult (expensive and complex) manufacturing process, in other words, manipulation in the process of building a space. It is probable that a very efficient structure is directly related to a structure which has a highly complex form and which is difficult to manufacture, in other words it has a low technical efficiency.

REFERENCES

(1) COLAVIDAS, FELIPE (2009); Al sector de la construcción en pleno. Arquitectos. sin recursos. CSCEA. 1/2009. Adrid. Spain.

(2) Ibid (1).

(3) PTW ARCHITECTS. (2011); Emergency Shelter Exhibition. Sydney. Australia.

(4) COX, RICHARDSON. (2011.); Emergency Shelter Exhibition. Sydney. Australia.

(5) LAVA. (2011.); Emergency Shelter Exhibition. Sydney. Australia.

(6) GREEN LEAF ENGINEERS. (2011.); Emergency Shelter Exhibition. Sydney. Australia.

(7) Ibid(5).

(8) FUJIMORI, TERUNOBU (2011); Emergency Shelter Exhibition. Sydney. Australia.

(9) FULLER, BUCKMINSTER. (1968); Domo para la comunidad alternativa. Droop city. San Francisco. USA.

(10) ATELIERS JEAN NOUVEL (2011.); Emergency Shelter Exhibition. Sydney. Australia.

(11) BAN, SHIGERU (1999); Refugios de papel reciclado para ACNUR, Japón.

(12) ARAVENA, ALEJANDRO. MONTERO, ALFONSO. CORTESE, TOMÁS. DE LA CERDA, EMILIO.(2010); Casa Elemental Tecnopanel. Chile.

(13) KÉRÉ, FRANCIS (2010); Arquitectura Viva, nº 133. Spain.

(14) Ibid (13), (2011); Small Scale, Big Change: New Architectures of Social Engagement by An-dres Lepik. MOMA. New york. USA.

(15) HERINGER, ANNA (2005); METI School. Rudrapur. Bangladesh. Edited by Andres Lepik and MOMA. New york. USA.

(16) Ibid (14).