
Matute Díez, Santiago

Architect co-author of the Project, smatute@agenciamedioambienteyagua.es, 606146556

Summary

Every organism and system tends to efficiency. It is part of evolution to achieve better results at a lower cost. In times of recession, we start reflecting on how we build and how we use our resources, which become more valuable as days go by. Concepts such as recycling and usefulness become more important.

This new project is born from rethinking this new reality. We have made a building using obsolete units, in a different place with a different appearance to suit a new necessity, completely adapted to the environment.

The mutable building appears. Its current state is just a phase in its evolution. When the necessity that made it appear changes, it will transform and mute again. It will change its shape, aspect and even physical environment.

A new concept has appeared, a “low cost architecture” with a low impact. It is introduced as a service to society. It adapts, it mutes and it is moved to a different place. It evolves throughout time. It doesn’t intend to be ephemeral, nor eternal. It recycles and reuses. It maximises the life of the materials and minimises the waste. It is a different way of building.

Also, we are doing a study on the reduction of waste is this kind of architecture. We have done a waste management study about a traditional construction model, in two ways, demolition and new building. The results are the high reductions of material waste.

Keywords
Mutable architecture, Reused-recycled, Environment, Modules, Crisis.
1 Introduction

We all like routine, even those who love surprises. I don’t know anybody who enjoys surprises like being made redundant or breaking up with a partner. When our routine varies, we can be sure there will be changes. We will walk into unknown territory. Nevertheless, change is the path to evolution and recession is a good engine.

“Once upon a time there was a globalised world, where recession came to stay…” We could start our project with this sentence, if we wanted a dramatic beginning. And continue by saying “and we had to do our best to make the most out of the current situation” I’ll explain myself:

Andalusia has a network of Natural Parks within its territory. Each of them counts with a Visitor Centre, here visitors are shown the most important characteristics of the area. The buildings tend to be of different types, with their image linked to popular architecture, in which ecologically efficient criteria has not been a priority.

The recession and the consciousness of the value of resources has changed this perception. This project is born with the intention to solve two different problems, with efficiency and with the very limited resources the recession has left us.

On one hand, we have provisional facilities used as offices and bathrooms, made with prefabricated units. Now that the facilities are not being used, they are deteriorating and different animals are threatening a very sensitive environment: Laguna de Fuente de Piedra.

On the other hand, there is a strong need for a Visitor Centre in the Natural Park in Despeñaperros. The current one, for different reasons, is now obsolete. Maintenance costs are increasing and recovering the Centre for its use is not a viable option, not only because of the cost but also because of the new dual carriageway.

We ought to add the recession to our list of problems, which limits the resources we have available. An opportunity for change appears in this situation: the opportunity to explore new alternatives.

We can say that the idea of recycling and reusing the units was the most viable idea we could think of. We had to make the most out of the situation we had, initiating a new concept mutable building.

It has resulted in building the last Visitor Centre with recycled units, in the Natural Park of Despeñaperros, in Santa Elena, Jaen, which is called Llanos de las
Américas. This Visitor Centre shows a new identity due to the characteristics and way it was built.

2 Choice of location.

Once we had reached a decision, we needed a location. There were two priorities established: it must have an easy access and infrastructures nearby. The facilities needed to be connected to the already existing net. That’s why building expenses could be cut down. If we were to make a more graphic analogy, we could say it would be like connecting a laptop to the Wi-Fi.

We found the ideal place, just by the road JA 7102, by the electrical line and to the future supply of drinking water, between Santa Elena and Miranda del Rey. It was a waste ground in the middle of a pine forest, where different paths crossed (Fig.1). This meant there was no need to cut down trees and you could get there walking, which increased the value for a Visitor Centre in a Natural Park.

3 The design

The design was determined by a simple programme, in which space and shape were already determined by the pre-existing units in Fuente de Piedra (Fig. 2).
We have four units of 12 metres x 3 metres grouped in a grid of 2 x 2 units (Fig.3). One of them is for the bathrooms, another is for the porch and the other two for offices. They are all covered with panels of reinforced concrete with fiberglass outside (GRC) with a flat cover.

The programme we need to answer is simple, an area for the bathrooms with adapted toilets, an open area to provide information to the visitors with a shop and an exhibition area.
Taking in mind these premises we place the units to make the most out of the space we have. We study making adjustments with regards to the gaps and the redistribution of the partition walls, adapting to the new accessibility demands. Additionally, the thermal insulation and the resistance to fire in the structures are improved to fulfill the requirements set by law.

We need a transition area, where a group can wait while another group is visiting the Centre. This transition area must help articulate the good running of the Centre and give it flexibility (Fig.4). Besides, we are in extreme climate conditions and a transition area is essential, so there is a difference between being indoors and outdoors.

Fig.5 Constructive section
We keep the cover of the units. However, we decide to provide them with a finishing touch of pine wood, which is the natural resource in this environment (Fig.5). This creates a clear reference to the area where we are located and it helps contextualise the building (Fig.6).

At the stage in which the project was being carried out we appreciate the importance of these details and we pay attention to them and they improve significantly, providing a clean and powerful image to the Visitor Centre.

We had a water supply problem at one stage. It became obvious we could not do it as we had planned, our budget was not high enough to bring water from nearby towns, so finally we decided that the Centre should be self sufficient using rain water in a tank, just for the toilets and for cleaning. This improved the environmental focus of the project because we would be using rain water.

4 Building realization

We initially encountered some disagreement. Unit building has a bad reputation as sub-standard housing or as provisional solutions for additions to schools.
Fig. 7 Unit dismantle in Fuente de Piedra

There is a strong demand for traditional looking buildings with references to the rural environment in which they are set, such as white walls and roofs made with Arab tiles. However, once we overcome this reluctance the project was accepted with a feeling of resignation.

All the reforms that were made to the units (Fig.7) took place in workshops of a specialized company, inside an industrial workshop, limiting this way the waste they produced (Fig.8). Finally, the units were taken to the location and they were assembled in a short period of time.

Fig. 8 Adapting the units in the workshop

Due to the dynamics of building the Visitor Centre, we only lay the foundations on the grounds, which were shallow foundations of small dimensions and the infrastructure of the water tank, the access area and the parking, the electrical connection and the details of the building.

The exterior overlay was made of sustainably certified pine wood, we could track its origin and it was completely traceable.

Finally, people have accepted the new infrastructure and have baptized it with the name of “the fort” (Fig.9), because of its image.

Fig. 9 Back image of the Visitor Centre.
The management, which is operated under government concession, adapts the spaces to its needs, turning the transition area into an area for multiple uses and is reasonably satisfied with the results. The fact that the Centre is different has made it popular to the media, turning its interest into free advertising for the Centre.

Using limited resources we have accomplished quality architecture with an interesting result. The recession is very present in the design of this project.

The result is a powerful, simple building, integrated in a valuable natural environment (Fig. 10).

5 Comparative study waste

5.1 Objective.

We try to know how much is possible reduce the waste in demolition and in new building. We compare between a demolition in a traditional way and this demolition in a mutable architecture. We repeat this work in a new building.

5.2 Study methodology.

We are doing a study about the material waste in a traditional building and mutable building. Both have the same characteristic, one floor, builder surface, situation and use. The parts of the building that we reuse don’t make waste.
We select three real projects and use some parts of them. This part is the measurements and budget. We divide the work in mains parts and there parts are the chapter. Every chapter has a percentage of the global work and we use this information for the distribution of waste.

When we have this information, we made a table and we multiply the chapter and the per cent corresponding. The chapter who reuse don’t made waste and is cero per cent.

5.3 Study

We made a comparison between the traditional model work and the mutable work done. The result is this kind of table (Table 1).

Table 1 Study of every chapter and waste that make about the kind of built.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Waste</th>
<th>Percentage</th>
<th>Waste</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials take</td>
<td>78%</td>
<td>78%</td>
<td>78%</td>
<td>78%</td>
</tr>
<tr>
<td>Labor</td>
<td>22%</td>
<td>22%</td>
<td>22%</td>
<td>22%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2 Study of new building waste and comparison with waste reduction percentage

<table>
<thead>
<tr>
<th>Description</th>
<th>Waste</th>
<th>Percentage</th>
<th>Waste</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalized non-potential</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Potentially to be reduced</td>
<td>95%</td>
<td>95%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Building about 185m2 and comparison between traditional and mutable models.
Table 3 Study of demolition waste and comparison with waste reduction percentage

<table>
<thead>
<tr>
<th>Material</th>
<th>% Waste</th>
<th>% Reduction</th>
<th>Waste</th>
<th>Waste Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>0.057</td>
<td>4.79%</td>
<td>0.09</td>
<td>9.02%</td>
</tr>
<tr>
<td>Stone</td>
<td>0.057</td>
<td>4.79%</td>
<td>0.09</td>
<td>9.02%</td>
</tr>
<tr>
<td>Plastic</td>
<td>0.057</td>
<td>4.79%</td>
<td>0.09</td>
<td>9.02%</td>
</tr>
<tr>
<td>Metal</td>
<td>0.057</td>
<td>4.79%</td>
<td>0.09</td>
<td>9.02%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0.114</td>
<td>10.59%</td>
<td>0.18</td>
<td>18.37%</td>
</tr>
</tbody>
</table>

We have the weight and volume of 185m² new building (Table 2), and the same information of 144m² building demolition (Table 3).

6 Conclusion

In conclusion, we reduce the construction waste when we use this kind of solution, the mutable architecture. When we work in a new building, we reduce about 62.02% of weight and 57.61% of volume. This result is higher in demolition work. In this occasion we reduce about 64.86% of weight and 63.86% of volume.

7 Reflection

This process has made us reflect on a new model of occupying territories, which we will call *mutable architecture* and we will summarise in the following points:

- The infrastructures are a net in which the new building is connected. New infrastructures are not created, the former ones are reused.
- The building is mutable, it appears because there is a specific necessity and it will mute when the circumstances change. It adapts and it can grow.
- The building is mutable, because it can be taken to a different location when the need that made it appear, disappears.
• It minimises the impact made on the location, once the building is gone the location goes back to its previous state without damaging the environment.

• It maximises the use of resources. The building is made with units, product of a standardised production process, carried out in a controlled setting.

• The building is reused once and again, updating its units and changing its configuration.

• It minimises the waste when it is pulled down. When the building is transformed it is done in a workshop, avoiding accidental contamination and pollution, and the material is recycled.

• When there is no longer a need for one of the units, these are completely recycled, because each and every of its parts can be dismantled.

• The environment determines the image of the building. It mutes its skin to integrate and become recognisable. It relates to its environment (Fig.11).

![Environment of the Visitor Centre](image)

Fig. 11 Environment of the Visitor Centre

8 Quotations and references

Online publications

FIDAS Documentation
Estudio de Gestión de Residuos según Real Decreto 105/2008, de 1 de febrero, que regula la producción y gestión de los Residuos de Construcción y Demolición (RCDs). BOE n.38, 13 de febrero de 2008

COAM Documentation
Estudio de Gestión de Residuos según Real Decreto 105/2008, de 1 de febrero, que regula la producción y gestión de los Residuos de Construcción y Demolición (RCDs). BOE n.38, 13 de febrero de 2008

Plan Nacional de Residuos de Construcción y Demolición (PRNC) 2001-2006
Resolución de 14 de junio de 2001, de la Secretaria General de Medio Ambiente.

II Plan Nacional de Residuos de Construcción y Demolición (II PRNC) 2008-2015
Versión preliminar.

Plan Estatal Marco de Gestión de Residuos (PEMAR) 2016-2022
Ministerio de Medio Ambiente. Secretaria de Estado de Medio Ambiente. Dirección General de Calidad Ambiental y Medio Natural

Plan Regional de Residuos de Construcción y Demolición 2002-2011
Plan de Gestión Integrada de Residuos de Construcción y demolición de la Comunidad de Madrid (2002-2011).

Orden 2690/2006 de la Comunidad Autónoma de Madrid.
Orden 2690/2006 de 28 de julio del Consejero de Medio Ambiente y Ordenación del Territorio de la Comunidad Autónoma de Madrid.

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