THE NEW VERNACULAR BASED ARCHITECTURE

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ABSTRACT
The basic principles of constructive mechanisms are lost. One solution is to develop a series of structures that can be manipulated as fast as possible, through manual work, making use of easily accessible natural materials. The idea is to go back to inherited values and to transform vernacular principles which do not have a negative impact on the environment but cooperate with it. Studying vernacular morphology, structure, technique and materials, one can develop a new system, compatible with contemporary reality but paying tribute to the principles and proportions of traditional buildings. The new constructions are intended to be technically more accessible, faster to build, cheaper, more ecological and strongly related to the existing environment.

Keywords: rammed earth, vernacular, natural materials

INTRODUCTION
The contemporary builder is very familiar with the industrial techniques when working with building materials. This comes as a preconception in dealing with any kind of construction material so even when working with natural based materials he applies the same approach. In time were developed various methods of achieving high quality finishes in constructions in spite of working with rough natural materials. Other benefits from taking this approach is the creation of hybrid materials based on a mixture of both natural and industrial materials and techniques.

In the beginning, this preoccupation was based on the study of traditional vernacular architecture. This is the first level for investigating the local natural materials in a building approach. Vernacular architecture, also called “architecture without architects” [2], can be traditional or contemporary. Everything must be thought in historical context. In the past the building patterns were generated by an anonymous craftsman that became today’s architect who studies in schools and generates new patterns for contemporary builders. Than the common builder takes these ready made solutions and using his own creativity develops his unique construction. This article is focused on the research that aims at efficiently combining vernacular building principles (related to technical matters,
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aesthetics, design, location on the plot and framing in the built site) and contemporary architectural principles. The goal is to elevate constructions in a short period of time with unqualified labour and ecological materials, by enhancing traditional principles with new modern techniques [1].

In different parts of the world the vernacular architecture and the use of local materials for house building, are slowly replaced with the new materials on the market. Materials used today are basically the most affordable on the market, but not always the best in quality. The abandonment of vernacular building methods in the process of building production was first realized by using rather cheap and abundant concrete and reinforced concrete instead of stone and wood which were the vernacular structural materials. This is the point where we have to draw a line and go back to natural or hybrid materials that implies low pollution energy saving building techniques [2].

MATERIAL

1. Rammed Earth technique

1.1. Precast elements

In Austria, the building Printshop Gugler (Fig.1), built by a former sculptor, Martin Rauch, follows the old principles of the greek hypocaust = „heating from below“. This consists in a warm air heating system (Hypokaustenheating), which can be characterized by a flow of warm air that streams the entire building, but which presents a lower surface temperature when comparing this to radiator heat [3]. The system works as an ensemble, so the floors, walls and solid seating benches become all warmth-carrying objects. The building has a rectangular prism shape, with a circulation space oriented on the main axis, that helps to the optical and thermal light circulation, mainly because of the continuous glass roofing. The structure presents combined wooden stilt structure with 160 pre-cast elements of rammed earth in the format of 1,7 x 1,3 x 0,4m (Fig.1).

This system works as a temperature regulator all year because the fresh air travels through earthen air channels and gives a cooling effect because of the soil temperature in the summer and the pre – heating effect in the winter.

Fig.1. Inside detail from print shop building and a sample of pre-casted element
After changing the floor temperature, the air works his way up through the Pise-walls functioning as hypocaust (Fig.2).

Avoiding the exclusive use of energy consuming heat appliances, the new building has a low cost efficiency and thus is Eco friendly. Also the short time in erecting an earthen building, the natural integration and minimal pollution (due to the natural assimilation of the construction waste) are qualities that make these techniques affordable and indicated in general use.

1.2. Earth cast into formworks

The chapel of Reconciliation is designed by Berlin architects Rudolf Reitermann and Peter Sassenroth, and has the same earthen builder, Martin Rauch. The building is located on the site of a former church, demolished in 1985 to clear the area between the walls separating East and West Berlin. The plan of the building consists in two ovals. The interior wall is made of rammed earth and it defines the prayer room, the exterior wall is made of wood planks. The wood planks are hanging from the ceiling, filtering the light coming from outside and creating a interstitial space between the church and the exterior. The 7 m high oval of the chapel is the first new construction in pise technique in the last decade and at the same time the first rammed earth structure in Berlin (Fig.3).
The first trial mixtures were tested in January 1999. In order to have a good tensile, compressive and shearing strength, materials similar with the ones used in concrete mixtures were chosen. The mixture consists in a conglomerate of clay and different grain sizes of stone aggregates, combined with flax fibres. When tested, the mixture had the compressive, tensile and shearing strength similar to concrete. The building required 160 m³ and 390 tonnes of rammed earth that were mixed according to the lab results. Using the Building Material Test Hammer (BMTM), the strength development of the rammed earth could be controlled after elevation, without harming the structure, revealing a lower compressive strength than the one tested before.

Table 1. Material characteristics of the used rammed earth

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content at time of placing</td>
<td>8.2%</td>
</tr>
<tr>
<td>Measure of shrinkage</td>
<td>0.15%</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>3.3 N/mm²</td>
</tr>
<tr>
<td>Compressive modulus of elasticity</td>
<td>650 N/mm²</td>
</tr>
<tr>
<td>Tensile bending strength</td>
<td>0.63 N/mm²</td>
</tr>
<tr>
<td>Shearing strength</td>
<td>0.79 N/mm²</td>
</tr>
</tbody>
</table>

In his book, Gernot Minke describes more structures built with earth. Every time he has a different approach. There are more techniques available.

There are more techniques available. Normally, a 30 cm rammed earth wall has a U value of 1.9 – 2.0 W/m²K. In many European countries with cold climates, in order to achieve a value of 0.5 W/m²K, the wall needs to be 1.6 – 1.8 m thick. The author presents different isolation suggestions for the walls of rammed earth. This will slim the thickness of the wall and it will make it faster, lighter and easier to build [4].

Fig.4. Rammed-earth wall with thermal insulation
2. Bale system

2.1. Straw bale

Another vernacular method that is also eco-friendly as it is easy to apply is the straw bale house. Straw is a sustainable, easy to find, and easy to build, material which allows the builder to have a ludic approach. But in a society that is based on consumerism, the quality of being a waste product, makes straw and the whole technique of stacking different kinds of used materials, a great recycle-based resource and a cheap building material. In many countries, the straws, considered waste, are burned after being stripped of the food portion of the plant. Judging from a chemical point of view, straw is virtually identical to wood in composition. There are many kinds of straw that can be used: of wheat rice, oats, rye, flax, barley, grass and perhaps sugarcane waste.

<table>
<thead>
<tr>
<th>Material</th>
<th>R – Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep’s wool</td>
<td>2.1-2.7</td>
</tr>
<tr>
<td>Fibreglass</td>
<td>2.0</td>
</tr>
<tr>
<td>Rock wool</td>
<td>2.5</td>
</tr>
<tr>
<td>Cellulose fibre</td>
<td>2.3</td>
</tr>
<tr>
<td>Polyester</td>
<td>2.3</td>
</tr>
<tr>
<td>Extruded polystyrene</td>
<td>3.5</td>
</tr>
<tr>
<td>Expanded polystyrene</td>
<td>2.6</td>
</tr>
<tr>
<td>Straw bale (rendered 450mm wide bale)</td>
<td>5.6</td>
</tr>
</tbody>
</table>

The straw bale walls are:
- loadbearing – in this case the straw bales are built like bricks and a long wooden stick pinnes them together;
- Mortared, loadbearing – when mortar is used between the the straw bale bricks;
- bale wrap – the house has a wooden or metal structural system and the straw bales are used as an in-fill material (Fig.5);
- hybrid structures – combines different type of structures with the straw bales;
- light clay straw walls – when clay is mixed with straws in order to form a new in-fill material.

The main problems with straw bale walls are: rodents or insects (that can enter the wall), umidity and combustibility. A foil is installed over the bales and then the walls are plastered with a mixture of clayey loam that needs to cover the entire wall inside and outside. The eaves of the roof need to extend at least 75 cm in order to protect the wall.
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Fig. 5. The construction of a straw bale house

2.2. Baled waste

Also a good example is even the baled waste – plastic, cardboard or paper, which have been proved to provide great resistance and thermal isolation.

A team of students from Auburn University built a student housing in order to prove that waxy corrugated fiberboard bails are viable when used as a construction product. Their idea is ecological, low budget and practical. The building has a wooden structure and the bales are the in-fill of the walls. Their idea points out that recycled materials are a good resource for building (Fig. 6).

Fig. 6. Corrugated fiberboard house

3. Hybrid materials

The architecture in the Eastern Black Sea Region, Turkey, has specific vernacular characteristics. In that area, new buildings which are ignore the importance of local characteristics and the professional architectural point of view, started to emerge. The premise of this study was the need to improve the negative aspects which caused the degradation of the specificity of the vernacular houses in the Eastern Black Sea Region. The target of this study is to design model houses which are in accord with the vernacular architecture and climatic – topographic conditions, and will answer varying needs of the modern life [2].

A number of criteria were considered when building:
- the topography of the region was steep and perpendicular to the sea,
- the moist climate,
- the need to build efficiently a resistant insulated structure,
- the need to use wood in the structure as a replica of the wood used in the vernacular houses in the area,
- the need to synthesize the architectural characteristics of the local architecture in order to translate it into a new structure that can be applied in the area, but under different forms.

The prefabricated system of structural insulated panels SIPs were the chosen solution that could reflect the characteristics of the vernacular houses from the region (Fig. 7). The panels were easy to handle, easy to build with, and can be applied to a different type of models basically embodying the way of the vernacular principles. The SIPs are composed of three components: the OSB facings, the EPS foam core and a water-based adhesive. The structural compositions of the SIPs make them function like an I beam [2].

CONCLUSIONS

Apart from all the techniques described above there are other ways of dealing with the vernacular principles in our architectural context. The return to nature’s richness and to the building ability of the common people, is the only way now for a diminution of the industrial impact, the exploitation and the pollution of our environment that has reached the greatest level of degradation in history.

The vernacular concept has changed over years, evolving in contemporary time along with a whole new kind of materials and building techniques, but preserving the human and natural point of view that determined our forefathers to build their homes. Many people are very
susceptible in using the new emerged materials like OSB, those of plastic origin or simply the hybrid mixture of all of these and natural ones. But in terms of resistance, thermal insulation and pollution, this new opportunity in using all kinds of materials and the latest technological improvements, is a unique step in the history of architecture and a first true chance in finding a solution for the natural, human and economic crisis that dominates our environment and way of living.

ACKNOWLEDGEMENTS

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