

The Laboratory of Natural Building

The Laboratory of Natural Building is located into the Educational Farm of the upper secondary School for Agronomists "Agricultural Institute Ciuffelli", on the proximity of the city of Todi, in central Italy, in the Umbria region.

It is a rural building, built recovering traditional building techniques and using local materials, zero kilometre, available within the same Educational Farm.

The region of Umbria is called the "green heart" of Italy, for its hills and verdant mountains and for its flourishing agriculture, characterised by the cultivation of cereals, corn, tobacco, olives and vines, as well as all type of vegetables (Figure 1).

Over the centuries, the relationship between man and territory has changed and from vernacular architecture, characterised by "borghi", villages perched on the top of the hills, built with local materials – such as stone and bricks for the bearing walls, and wood and

canes for horizontal structures – is gradually passed to the massive use of concrete structure with infill walls made in shoddy building materials. This process led to a loss of architectural and living quality, and above all to the interruption of the dialectical relationship between the built and the environment, both in urban and rural context.

In 2012 it occurred the opportunity to work on an existing building, newly built, on the agricultural holding of the "Agricultural Institute Ciuffelli". This possibility has been seen as an opportunity, not only to respond to a need of the farm, but also to trigger a regeneration process of the relationship between man and environment, so important especially in rural areas (Figure 2).

Given the nature of the client has been chosen to maximise the use of materials locally produced, closely linked to agricultural production – as earth and straw –, putting in place a "virtuous cycle" where

Fig. 1 View of the Umbrian landscape from Monte Tezio





Fig. 2 View of the existing building on the educational farm of the “Agricultural Institute Ciuffelli”

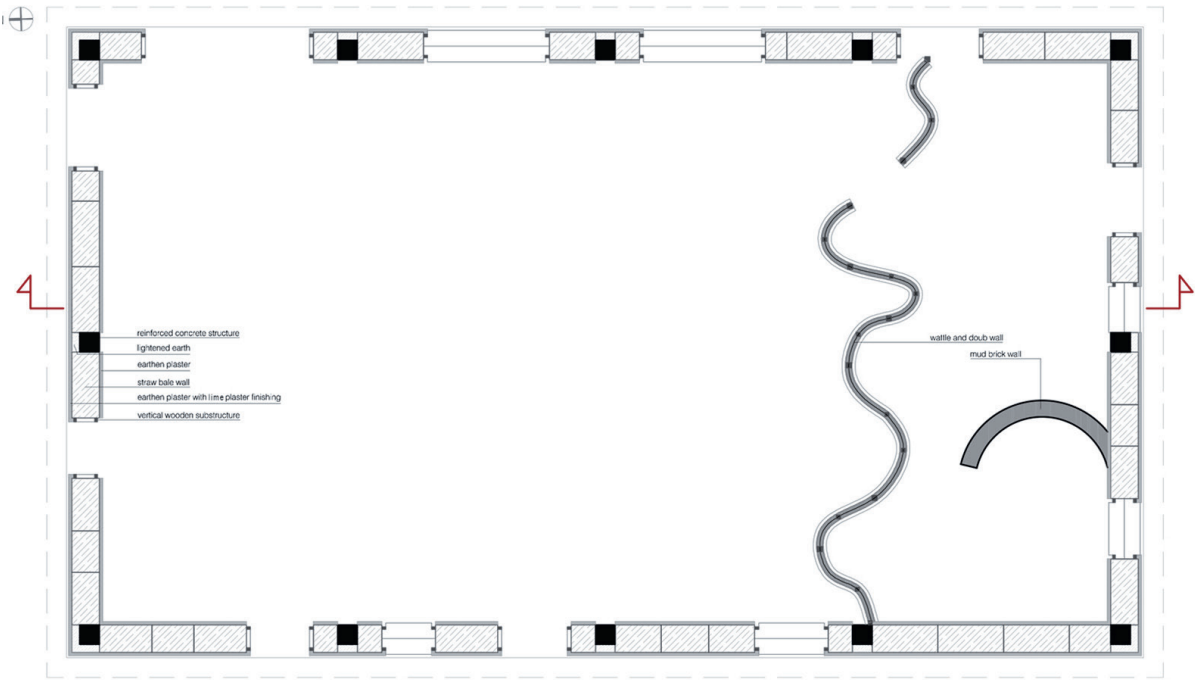
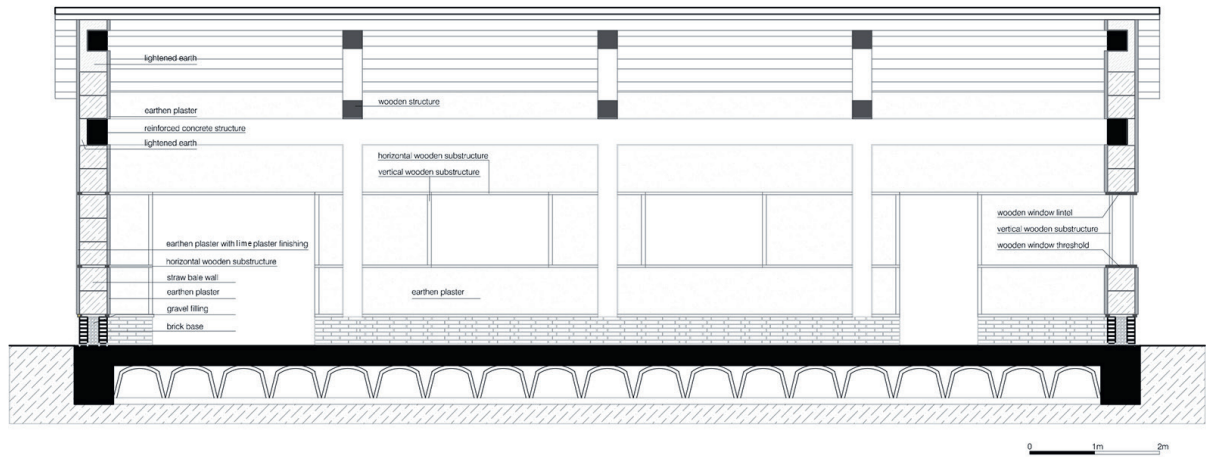


Fig. 3 Floor plan of the Laboratory of Natural Building

Fig. 4 Cross-section



some wastes of the production of the farm, are re-used to building purposes, generating a natural and healthy built, with a very low environmental impact, which well fit into the surrounded landscape.

Another fundamental choice has been to carry on the building by a schoolyard, in order to create both a training that an awareness, related to the issues of available resources, environmental impact and green architecture.

The managers and guarantors of this process have been the "Agricultural Institute Ciuffelli", the Centre of Experiences for the Education at the Sustainable Development "Panta Rei", and the Architect Eliana Baglioni, which have fielded their respective skills and experiences, integrated them in a multidisciplinary work.

The "Agricultural Institute Ciuffelli" of Todi is the oldest Institute of Agriculture of Italy; it was founded as an agricultural colony in 1864 and it became Royal School of practical agriculture in 1883. The school has maintained its distinctive approach to training, both theoretical that practical, performed inside the farm, and it is very active on the territory, selling his products and organising cultural events open to the public.

"Panta Rei" is a Centre of experience for the education and training at sustainable development, an ecological village located on the hills overlooking the Trasimeno Lake in Umbria region, founded in the late 90 of the 900. The experience in the education field has shown that "do" is the best methodology to acquire that "environmental culture" without which it is impossible to guide our actions in terms of sustainability and teaching.

The Architect Eliana Baglioni, who has collaborated in the past with the Centre "Panta Rei", boasts professional experience both on natural architecture – with the use of raw earth, straw bales and other building techniques – that on self-construction, supported by technical and teaching knowledge.

The local administration "Province of Perugia", as head of school buildings, has welcomed the proposal of the building School-Yard.

The School-Yard has been structured in various training modules. Each one of them alternated building work, theoretical sessions and moments of confrontation on issues of sustainability in architecture and agriculture, thereby increasing the awareness of the participants, with the hope of change of the behaviours towards a more sustainable development model.

The educational method used has been the "school of doing", where learning and skills transfer takes place directly in the field, under the guidance of experts, with an approach similar to that of ancient artisan workshops.

Doing (also wrong) and experimenting, you have the possibility to approach the learning at different levels (technical, theoretical, practical, sensory and emotional). You can acquire skills and abilities, you can leave a track of your work and you have the possibility to monitoring, in the aftermath, your operated.

The School-Yard has been open to all types of users (students, professionals, artisans), as all those who were interested in the topic of green building and who were eager to experience the feasibility of some theories.

The objectives of the School-Yard have been:

- sensitise people about issues related to the impact of the built on the environment;
- re-evaluate traditional building techniques;
- broadcast the production processes that underlie the green building;
- acquire more familiarity with the issues related to sustainable development and especially with the chain of traditional agriculture as innovative materials in green building;
- recover the know-how in the educational processes through the direct experience of a self-built yard.

Design and Building

Inside the Educational Farm of the "Agricultural Institute Ciuffelli" there was a building, newly built, where there were only built the bearing structure – consisting of foundation, pillars and beams in reinforced concrete – and the roof, supported both by reinforced concrete trusses in correspondence of the gables, that by wooden trusses inside (Figure 2).



Fig. 5 The different stages of the construction: concrete structure, timber substructure, straw bale wall and clay plaster

The design had been drawn up by the technical department of the "Province of Perugia" and had been built through public funding. The original design had been conceived with bricks masonry, both for the perimeter walls that for the internal partitions, to host a laboratory for the squeezing of the olives and the production of oil. The interruption of the building due to the lack of budget, has encouraged to re-think both the use of the building that the construction techniques for its completion.

The decision to build the walls with materials available on the farm – straw bales coming from the field adjacent to the building, and earth coming from near lands – had involved a double adaptation: of the materials to the existing design, of the design to the new materials.

Architect Eliana Baglioni has carried out the executive design during the months of May and June 2012. The building techniques that she chose were straw bales infill walls, resting on a base in brick masonry; inserts in lightened earth; earthen plasters, both internal and external; natural lime finishing at the exterior (Figures 3 and 4).

The interior partitions have been subject of a next design phase, using different earthen techniques as wattle and daub and adobe masonry (Figure 3).

The yard has been realised in several stages that led to the completion of the walls, the plasters and some interior partitions.

The first phase of the building – 2 weeks in July 2012 – has been realised with specialised labourers: two masons to build the base in brick masonry and one carpenter to realise the wooden carpentry used inside the straw bales walls.

Afterwards has been started the School-Yard, which has lived three main construction phases.

During the first phase of the School-Yard from October to December 2012, theoretical and practical courses of natural building were organised, thereafter volunteer camps to realise the straw bales walls and the first layer of the earthen plaster. The courses have been directed by Architect Eliana Baglioni and Mr Sanni Mezzasoma with the support of Miss Sara Lucietto and Mr Andrea Zanchetta, and it have had not only participants from all over Italy, but also the integration of persons with little mental health problems and African refugees, accommodated in a local reception centre.

The nine theoretical-practical courses have been held on weekends from August to September 2012 – about 27 working days – with the presence of 38



Fig. 6 External lime render



Fig. 7 Interior partition as a wattle and daub structure

participants. The seven volunteer camps have been held from September to December 2012 and from May to June 2013 – about 22 working days – with the presence of 32 volunteers. Being of the unskilled labourers, the work has been variable for number of hours for days, for number of participants in each course and for work rate (Figure 5).

The second phase has been aimed to realise the finishing plasters in clay and lime, and has been performed by workers, which were specialised in the first phase of construction – Miss Sara Lucietto and Mr Andrea Zanchetta, led by Sanni Mezzasoma. This phase has consisted in 25 working days from July to August 2013. The experience of this yard has given



Fig. 8 In construction: the straw bale walls, clay plaster and light earth in the framework of the concrete structure



Fig. 9 The three layers of the plaster

rise to the craft business named “TerraPaglia”, specialising in earthen plasters (Figure 6).

The third phase have saw the participation of the NGO Building Trust Italy, a section of the NGO Building Trust International. A group of 10 persons, from all over the world, have designed the interior partitions and then they have building them during a workshop of 10 days under the guidance of “TerraPaglia” team, moreover the participant have studied the earthen building techniques with the lecture of the Architect Eliana Baglioni (Figure 7).

Building techniques

The building’s structure consists of pillars and beams in reinforced concrete with a double pitched roof supported by reinforced concrete and timber trusses.

The perimeter walls have been realised in straw bales coming from the field adjacent to the building produced in different lengths to fit in the best way possible to the pre-existing architectural design, which conceived in conventional materials as brick masonry.

To limit the phenomenon of damp rising has been built a hollow base of brick, 40 cm in high, filled inside with gravel as a drainage material.

Fig. 10 Detail of the wattle and daub wall



Fig. 11 Interior screen made of adobe blocks





Fig. 12 View of the Laboratory of Natural Building

In correspondence of doors and windows have been positioned vertical timber elements leaned above the brick base. This timber sub-structure had constituted by two vertical uprights held together by transverse elements, each about 6x4 cm in section.

In order to hold in place the straw bales and exert a compression on them – useful to stabilise the wall –, the timber sub-structure has also been positioned horizontally, respectively above the 2° and 5° course of straw bales. The position of the horizontal timber elements corresponds to the threshold and the architrave of the openings.

The straw bales have been put in place staggering vertical joints, as big bricks, and we had joining them, in vertical direction, by metal bars already available in the yard.

The straw bales were about 45 cm wide and they have been aligned to inner side of the concrete structure, therefore they protrude about 15 cm towards the outside of it.

To correct the “thermal bridge” and fill these gaps on the wall, in correspondence of the reinforced concrete structure has been laid a mixture of lightened earth, held in place with a formwork of rope or timber (Figure 8).

Towards the inside, both the reinforced concrete structure that the timber sub-structure have been left exposed, in order to they can be used to hook both

the partition walls – than can will realise in a next time – that any furnishings (Figure 5).

The walls have been plastered, both internally and externally, with earthen plasters in several layers, using earths selected by the land of the farm of the “Institute Ciuffelli”.

The first layer has been made with a mixture similar to cob, which is very rich in straw, and has been implemented by hand directly on the straw bales, with a thickness about 5-6 cm.

The second layer has been achieved without straw, with a mixture of fine earth and sand (1:3 in volume), with a thickness of 5 to 10 mm. This layer has been implemented in different way, by hand, by brush and by trowel.

During the first phase of the School-Yard all earthen mixtures have been made manually, without machinery, while during the working phases with specialised labourers has been used a muller.

The exterior finishing has been made with a third layer of plaster in natural hydraulic lime and sand, shuffled on site and lying out with a trowel (Figure 9).

Inside the building, a sinuous wattle and daub wall divides the space into two rooms. The wall structure has been made of vertical wooden posts with a canes tangle, filled with a mixture of earth and straw prepared with the muller. The shape of the wall makes it self-supporting by form, and the tapered section

has been designed to better support the loads of the earthen mixture (Figure 7 and 10).

In the south room, a semi-circular adobe wall divides the space, in order to create a more reserved area. The adobe have been produced manually on site (Figure 11).

Conclusions

The building (Figure 12) is used as a laboratory for sustainable architecture and environmental education for children of the primary schools who visit the farm. As a Laboratory of Natural Building it regularly hosts School-Yards and workshops for training about natural architecture.

All photos by Eliana Baglioni