Proc. of The Third Intl. Conf. on Advances in Civil, Structural and Environmental Engineering - ACSEE 2015

ISBN: 978-1-63248-065-1 doi: 10.15224/ 978-1-63248-065-1-86

Constructive Tradition becomes Future

Design an educational and professional training establishment in Africa - Tanzania

[Marina Fumo - Luisa Di Nardo]

***Abstract*— This paper presents the final thesis in Building Engineering and Architecture of student Luisa Di Nardo that consist in the design of an educational and professional training establishment in Africa - Tanzania, specifically in the town of Pande - Bagamoyo, a town that I visited and lived in, to better carry out the necessary investigations, thanks to the hospitality of some compatriots now living in Bagamoyo for several years. From research and analysis carried out it emerged that the frequent abandonment of traditional architecture in favor of Eastern and European character construction and materials created nothing but the spread of dysfunctional construction and hardly suited to the African context. Plastics, concrete blocks and galvanized sheets make very little improvement in the quality living of a population that is forced to endure temperatures and climatic conditions very different from those of the countries from which the materials originate. Hence the reflection on "Designing in developing countries" has originated, in order to contribute to improving the level of environmental comfort of the environments created and therefore the quality of life of the people living in these areas by placing, however, close attention also to safeguard the characters traditional architecture. This type of design requires the need to being documented about the place and the environment that we are taking into account with the aim of making the design as environmentally friendly as possible, anthropic, cultural and technical. It is needed to research a new reference system that interprets and meets the needs of a population different from our own, considering it a cultural reality to be protected and not to be modernized at all costs. These are the conditions that predispose to a careful and accurate research of the place, climate, customs and traditions of the local population, of the materials, of construction techniques, of the arrangement of the spaces, resources, associated issues concerning the school system and the habits of the students with the goal of designing an institution that can ensure their psychophysical and environmental comfort, fully respecting the character of their constructive tradition.**

Keywords*— *investigations, design, constructive tradition, quality living

Marina Fumo
Full Professor in technical architecture at University of Naples - Federico II
Italy

Luisa Di Nardo
Degree in building engineering and architecture University of Naples - Federico II
Italy

I. Introduction

Designing in developing countries implies the necessity to gather information about the place and the new environment with the goal of making the design as much friendly as possible to the anthropogenic, cultural and technical environment that we are taking in interest to make improvement in the quality living of a population.

These are the premises that lead to a careful and accurate search of the place, the climate, the habits and customs of the people, materials, local construction techniques, the provision of space, resources and issues that may be present.

The aim of the thesis was to design a school structure that would serve as a "hub of education and socio-cultural development" for the entire community (young and adult) that inhabits the villages of Pande, Bagamoyo │Dar er Salaam │Pwani │Tanzania.

II. Investigations, Constructive traditions

Based on data and information about the climate, the anthropic context, the place, the traditional building techniques, the resources and needs of the place and the study of material collected on the spot (August 2012), the project presents the characteristic areas of a complex school; spaces that preserve the typical features of the traditional architecture, taking into account the number of pupils and of the overcrowding recorded in almost all the schools in Africa (5 students for a desk); spaces appropriately thought to be adaptable and usable for extracurricular activities of general interest, with the ultimate goal to provide as many services as possible in the community that will benefit from these facilities, thus contributing concretely to the cultural emancipation of the population and therefore to its development.

Study Materials - the clay in short Material from the erosion of stony material, consisting mainly of argil, if it has physical and mechanical properties suitable for the construction, the clay can be considered as the building material for excellence.It complies with the principles of sustainability from the extraction, trough the use to the dismissing. It is a organic material construction (with which it is possible to build artifacts respectful of human, mental and physical health, for the environment and the building traditions). During time they have been developed and refined various construction techniques, the most common, that we limit only to mention are: ADOBE, the PISE ', the TORCHIS and BAUGES.Spread above all the world, the clay dwellings constitute the type of houses in which about 50% of the population on earth lives. The clay is identified also as one of the oldest building material, in particular the use of clay bricks, made with adobe technique dates back to 800 BC. Basically this material, until now, has been used mainly by

Proc. of The Third Intl. Conf. on Advances in Civil, Structural and Environmental Engineering - ACSEE 2015

ISBN: 978-1-63248-065-1 doi: 10.15224/ 978-1-63248-065-1-86

the rural population with low incomes, but today, with the advent of bio-architecture raw earth is experiencing a period of strong appreciation, diffusion and practical utilization also aided by the use of clay by many cutting edge architects (i.e. Hassan Fathy, Fabrizio Carola, Martin Rauch).

The Study Of Buildings In Clay In Tanzania - building typologies

In Tanzania the clay buildings are very common. These buildings, however, differ in size and characteristics, depending on the region in which they are located, from the geographical location, the climate (which varies greatly from area to area) and the locally available resources. Most of the traditional houses built in the regions of Dodoma, Singida, Tabora, Shinyanga and Arusha have a rectangular shape with variable size, a total height of about 2m, one entrance of about 60 cm and one or two small windows. The walls are made of bricks baked in the sun (ADOBE) and the roofs are usually horizontal and made of the same material composing the bricks (clay, dung, grass, straw). The brick thickness of about 40cm tapering at the center towards the perimeter walls in order to have a good slope for water runoff. The roofs can also be sloping roofs gable, detached from the perimeter walls to promote natural ventilation. They are made with stuffed banana or palm leaves posed on a light but resistant wooden frame. Sometimes the walls are reinforced by wooden poles with the aim of helping the load-bearing walls to support the weight of the horizontal or very large roofs; In other cases the fully compose the load-bearing walls and the a mix of straw, dung and clay is used only for the completion of the walls but with the function of thermal and acoustic insulation. In spite of the low cost and excellent thermal and acoustic properties, these buildings present different problems in particular related to the erosion of the walls due to water and wind. Other problems are due to the vegetation and the presence of termites and other insects. Most of the structural problems concern the foundations. They are made by a small furrow 30/ 40cm deep from which the walls rise. These foundations often prove not to be efficient since the erosive force of the water dig the walls for higher profundity. The erosion at the base of the walls results in the loss of cohesion between the parties that composes the walls and therefore their slow but steady deterioration. The mixture of clay cannot be attached to wood or metal permanently because basically it is a stable material. Nevertheless, adobe buildings appear to be better than all those that need to respond to thermal, acoustic and decent quality of life at low cost. That is why we are working hard on improving their technical / technological making small changes but necessary to improve durability and strength. The decking of new houses in fact, is made of 30/40 cm above the ground level in order to remove the stagnant water coming from the precipitations form the basis of the walls. In this case the foundations are or in stone or soil very constipated and in any case protected by a row of stones; the roofs are, in the modern view of Tanzania, made mostly with galvanized sheets resting on wooden trusses made ad hoc; to protect the walls from water and wind a sort of plaster also made with the mixture of clay, water, straw or dung is spread over the sheets. This confers proofing wall or termite protection. Droppings appear to be a good binder for this type of dough from the construction. These houses are also being characterized by a particular arrangement of the interior spaces, their organization and distribution reflects the internal social organization of the family.

Figure 1. A *Wamasai house - Nyumba Ya Wamasai. The Wamasai are Nilotic ethnic group of semi-normadic people lives in the Northern part of Tanzania*

Figure 2. A *Kwere e Doe-Bantu house - Nyumba Ya Wakwere Wadoe. Communities resides in Coastal Regions of Bagamoyo and Kibaha districts*

Figure 3. A *Gogo house - Nyumba Ya Wagogo. Gogo lives in Dodoma region in central Tanzania*

III. Design

The school will appear as "a village within the village" in which, all the characteristic traits of the traditional architecture of the region of Pwani will be preserved and protected with particular care to the spatial organization and the choice of materials to ensure a good quality living. It is in them, in their best use, and in some technical contributes by my side that we find the sense of development and modernity of the project in clay. Starting from the existing school, Shule ya Msingi | Pande | Bagamoyo | Dar er Salaam composed of only 3 classrooms but serving approximately 250 students and considering the data collected on the Tanzanian education system, the climate and the environment, the project was developed with the assumption to provide to the students the opportunity to study in classrooms and spaces that enhance their quality of life but at the same time respect the local building tradition and the distribution of spaces according to their hierarchical culture. Identified a form suitable to meet all the necessities and identified the parts that have composed the school (14 primary school classrooms , 8 secondary school classrooms,

Proc. of The Third Intl. Conf. on Advances in Civil, Structural and Environmental Engineering - ACSEE 2015

ISBN: 978-1-63248-065-1 doi: 10.15224/ 978-1-63248-065-1-86

4 laboratories, 1 president, 1 staff room, 2 reading room, 1 computer lab, 1 canteen / multipurpose room, 3 utility blocks with 10 services each, 3 locker rooms blocks / with 8 showers each) the design has then been focused on the spatial organization of these elements within the lot. The Masai village, with its internal distribution, and the trade winds were the factors that have driven the spatial composition of the project. The sun and the rains were the elements for which technical and technological solutions were thought with the purpose to improve the level of comfort of the rooms and the durability of the bearing parts.

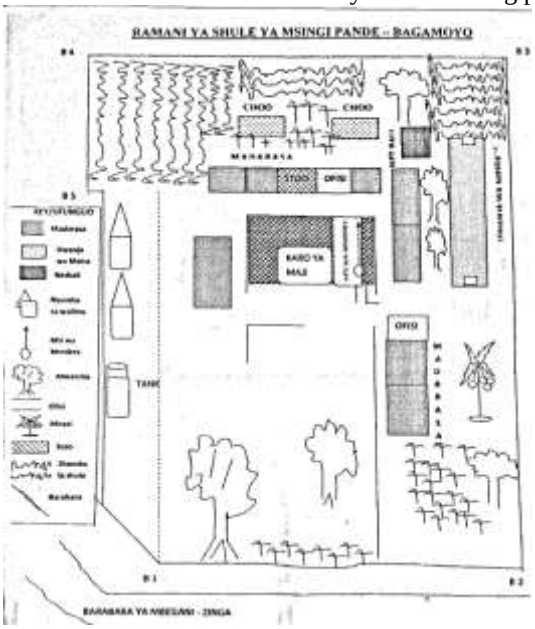

Figure 4. *plan provided by the school guard*

The Masai Village - from the trail of tradition to the design

Form the study of the spatial organization of the Masai villages it raised a precise location of individual dwellings within the lot on the basis of the social order of the group, hierarchies, cultural divisions and roles. Entering the precinct, the first house on the right is the one of the householder, followed by the one of his first wife. Interposed between the two huts there is a second enclosure for animals or a sort of warehouse. On the left of the entrance instead, there is the hut of his second wife and behind the children hut. For the spatial organization of the school it has been followed the same principle and, therefore, idealizing the lot in a circular shape, the building for the presidency and the offices were set on the right of the entrance (head of household), the classrooms of primary school back to the offices (first wife), between the two sides there is the dining room (warehouse, farm animals), to the left the secondary school classrooms (second wife), and behind them the laboratories (children). The routes of access to the classrooms are heavy and harmonic spaces in which to move that follow the natural but uneven expansion of the roots made of mangrove plants. They consist of wooden walkways raised above the ground level of about 30-35 cm, as well as the buildings, in order to prevent the occurrence of flooding during the rainy season ranging from October to December and from March to June.

Figure 5. *design, spatial organization*

winds - The classrooms, consisting of a repeated module, were all oriented in order to have the side wall, which is an opening that allows natural ventilation, as usual, in a direction orthogonal to North-East from where the trade winds (regular and constant winds that blow in Tanzania throughout the year) are blowing towards the south-west.

the sun - Exposed to continuous and significant sunlight, given the height of the position of the sun respect to the equator, almost perfectly perpendicular to it, Tanzania is characterized by very high temperatures which make it necessary to create shaded areas from the projections of the shell for paths to facilitate the shading structures and the removal of the rains. The roofs are capable of holding temperatures perceived within the school environment thanks to the double coverage ventilated. The large number of tall trees with thick foliage already present in the lot, will be increased by the placement of other trees properly integrated within the environment and with the arrangement of the classrooms, thus creating natural and effective shadows.

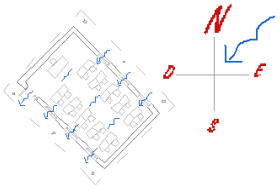

Figure 6. *design, the winds*

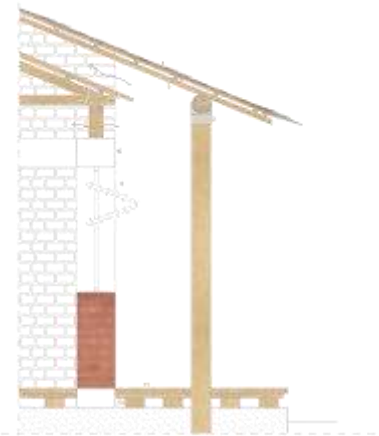

Figure 7. *design, detail of coverage*

the modules - The classrooms, laboratories, offices, reading room, canteen and services. The modules that constitute the project are all made by a load-bearing wall in clay bricks, a not plastered wall considering their thickness equal to 40cm, set on a continuous foundation constituted by a boulder in

Proc. of The Third Intl. Conf. on Advances in Civil, Structural and Environmental Engineering - ACSEE 2015

ISBN: 978-1-63248-065-1 doi: 10.15224/ 978-1-63248-065-1-86

reinforced concrete by the variable thickness depending on the construction requirements, on which a flooring teak wood is arranged, and by a system of double covering consisting of a first inner cover corrugated metal sheet (modernity, availability, ease of assembly, disassembly, efficient against rains) and by a second coverage, totally independent from the first, in breathable banana leaves spaced apart from the metal sheet covering of approximately 30 cm, placed in such a way as to form an air chamber that prevents or slows down the overheating of the said plates due to the solar irradiation. The wall was appropriately tailored to the size of classrooms and bricks clay.

Figure 8. *design, the modules*

The canteen or even multifunctional environment, differs from the other types of constructions that constitute the school because of the lack of distance between the perimeter wall, because of a double saddle roof resting on a double warping of the wooden pillars and beams that form the semicapriata. This system has been necessary to lay the two covers that in this case due to the larger size require intermediate supports, however, the covers are independent of one another as in the other cases.

The internal ventilation is ensured by the open porch along the perimeter walls of the room and by the different inclination of the two flaps of the cover which do not lay on a ridge line but are detached, two covers to the lectern, thus promoting the natural ventilation by 'high. The slope sufficiently contained the highest part of the roof and the short distance between the two covers, in the case of wind a bit 'stronger than steady and constant trade winds, prevents the entry of too much air that can be possibly turn said coverage.

Figure 9. *design, the modules 3D*

Figure 10. *Design an educational and professional training establishment in Africa - Tanzania*

Acknowledgment

Special thanks to our friends Carlo, Stella and ing. Sapone Roberto for welcoming us in Africa

References

[1] Rubaratuka I.A. - “Improving the performance of Adobe Building Costructions” , Departement of Structural and Costruction Engineering University of Dar es Salaam, Tanzania.

[2] Scudo G. , Narici B. , Talamo C. - Costruire con la terra. Napoli, Esselibri 2001

[3] Di Nardo L. - “La tradizione costruttiva diventa futuro”. Progettazione di un istituto scolastico e di formazione professionale in Tanzania, Africa. Tesi di Laurea in Architettura Tecnica. Facoltà di Ingegneria, Università di Napoli Federico II, 2013.

Authors

Marina Fumo

Luisa Di Nardo