

Critical Approach to Define the Architectural Structure of a Health Prototype in a Rural Area of Brazil

Domenico Chizzoniti, Monica Moscatelli, Letizia Cattani, Luca Preis

Abstract—A primary healthcare facility in developing countries should be a multifunctional space able to respond to different requirements: Flexibility, modularity, aggregation and reversibility. These basic features could be better satisfied if applied to an architectural artifact that complies with the typological, figurative and constructive aspects of the context in which it is located. Therefore, the purpose of this paper is to identify a procedure that can define the figurative aspects of the architectural structure of the health prototype for the marginal areas of developing countries through a critical approach. The application context is the rural areas of the Northeast of Bahia in Brazil. The prototype should be located in the rural district of Quingoma, in the municipality of Lauro de Freitas, a particular place where there is still a cultural fusion of black and indigenous populations. Based on the historical analysis of settlement strategies and architectural structures in spaces of public interest or collective use, this paper aims to provide a procedure able to identify the categories and rules underlying typological and figurative aspects, in order to detect significant and generalizable elements, as well as materials and constructive techniques typically adopted in the rural areas of Brazil. The object of this work is therefore not only the recovery of certain constructive approaches but also the development of a procedure that integrates the requirements of the primary healthcare prototype with its surrounding economic, social, cultural, settlement and figurative conditions.

Keywords—Architectural typology, Developing countries, Local construction techniques, Primary health care.

I. INTRODUCTION

THE primary health centers must be able to promptly respond to social, economic and health changes, especially in the weak and strongly marginalized contexts. In order to react to rapid changes, a healthcare facility located in developing countries has to provide a multifunctional space complying with the flexibility, modularity, aggregation and reversibility requirements. The ability of a building to respond to its functional changes, to the transformation of its spaces and its size in a short time, is one of the features that compose the guidelines of a first aid center.

The methodological approach to defining a primary health care prototype, especially through good architectural qualities, cannot forget certain aspects related to the intervention context analysis. The context-building connection should be examined

D. C. is with the ABC Department (Architecture, Built environment and Construction engineering), Politecnico di Milano, Italy (phone: +390223995734; e-mail: domenico.chizzoniti@polimi.it).

M. M., L. C., and L. P. are with the ABC Department, Politecnico di Milano, Italy (e-mail: monica1.moscatelli@polimi.it, letizia.cattani@polimi.it, luca.preis@polimi.it).

through the typological and figurative local aspects, materials and construction techniques.

The aim of this work, focusing its attention on the relationship between analysis and project, is to find some constants in the constructive and settlement tradition of the place, in order to consciously extend some susceptibility to the architectural aspects in general, from settlement to figurative ones.

In the application context, some elements still contain an unexpressed figurative potential that is the collective heritage of the architectural research. In particular, some places are the result of a fusion between canonical cultural contributions, imported and transplanted in an environment which is mainly rural, based on the application of a vernacular culture rather neglected by the historical research of architecture. It is therefore important to try to observe the whole built environment in order to operationally adopt certain figurative impulses that are determined by all of these cultural, autochthon and import contamination, in order to consistently detect the experimental figurative potential contained therein.

The attention to the context, especially in developing countries, is important from the cultural and social point of view. It is necessary to recognize the value of this local culture related to the habits of living, to the spaces and, more in general, to the definition of the construction methods of these spaces. Often, we tend to pay more attention to the climatic and technological aspects than to the socio-cultural ones, the first being responsible for the shape, the meaning and the cultural significance of the building. The project, therefore, sets out preliminary conditions that concern the attention to some peculiar aspects of the context:

- the cultural and social conditions;
- the local building techniques;
- the typological aspects and the functional categories;
- to be easily recognizable by the user [1].

The characteristics of the health center (flexibility, modularity, aggregation, reversibility), considered as the primary requirements to comply with certain performance features of the project, could be better met if deduced from the compositional principles that inspired the structure of spaces arising from the local culture, the settlement arrangements, as well as the uses and needs of the local population. These peculiarities are the basis for the study of the new health prototype.

II. CRITICAL APPROACH

To define the architectural structure of the health prototype in the rural areas of developing countries, it is necessary to analyze the types of collective buildings and the local construction techniques that have characterized the history of the intervention context through a critical approach.

The analysis of the typology of the social and aggregation spaces reveals the existence of different types of buildings belonging to the area considered. The performance of a useful analysis for the identification of building standards is essential to the appropriate definition of the prototype and the possibility to experiment with some aspects of the architectural language. The historic heritage, and thus the analysis of the types of buildings, is not meant here as a model or as a mechanical reproduction of previous examples, but rather as an experience available to an operative translation in the search for new forms of expression. It is necessary to understand the reasons for the affirmations of certain archetypes and the ways of their application, the reason for the affirmation of certain figurative and settlement characters.

Without a conscious historical awareness, the new design reality cannot be fully formed. Through this approach, the project investigates some potentials of form and expression in the full historical awareness, otherwise avoided in the mechanical inception of the project as an instinctive adaptation of the space form to the functions. Therefore, the relationship between analysis and project is certainly a very important link because it urges the new to acquire its constitutive rules from the historical comprehension of constructed forms. Similarly, the study of materials and constructive techniques takes the same approach, that is to analyze the constructive methods starting from the historical tradition of the place to assume - in the design process of a sustainable prototype - all the attributes and properties recognized to the application of certain traditional techniques, rather than of some local materials.

The identification of the local constructive culture is translated into a precise knowledge of the material resources that are offered by the territory. The traditional materials should be promoted in terms of community production and reproduction. Therefore, a criterion that the project assumes is the community's involvement in the construction phase of the prototype, to generate economies of scale but above all to train the population to use traditional construction techniques. Therefore, a useful assumption for the examination of constructive systems is the analysis of materials. In fact, they are "live" materials and constructive systems used by the different levels of the population who know all of the constructive potentials.

On one hand, developing countries are negatively influenced by the lack of financial resources and the overabundance of unskilled labor. On the other hand, they are owners of raw materials that with a low investment can be transformed into excellent construction materials perfectly suited to replace imported ones, the latter being inadequate or too expensive [2]. This critical approach allows us to have a clear view of the cultural context of the intervention area, first

analyzing those typological and figurative elements belonging to past buildings on the basis of local social and environmental conditions, and subsequently the relevant building materials and constructions. The analysis of historic buildings results in the definition of the prototype in typological, figurative and constructive aspects.

III. GENERAL ASPECTS THAT AFFECT THE USE OF SPACE

Through a critical approach, the research analyzes a particular context of Brazil in the municipality of Lauro de Freitas. The area chosen as a case study is the district of Quingoma, a rural area predominantly inhabited by the *Quilombola* population (descendants of former African slaves escaped from their persecutors in the colonial period) and by the indigenous families. In this specific context, for the purpose of defining the health prototype and the relevant architectural elements, we started analyzing the types of rural buildings in the Northeast of Brazil and in the state of Bahia, so as to extrapolate those significant architectural elements that can be applied to the new health prototype. The typological aspects are directly linked to both social conditions, which define the uses and the dimensions of the different spaces, and to environmental conditions, such as sun, temperature, humidity, rain as well as local materials and construction techniques.

The Brazilian architecture is influenced by the key factors affecting public and private spaces, such as the territory, the historical dependence, the social duality, and the concentration in recent years of new urban centers in the big cities.

- *The territory*: In the Brazilian territory, a humid tropical climate prevails, with low altitude, high humidity, rain, vegetation and prolonged exposure to sunlight; these features of the territory have always influenced the architecture, leading to preferring a traditional architecture related to the context and environmental issues.
- *Historical dependence*. Brazil was colonized more than five hundred years ago; this historical influence of Portuguese, Dutch and English cultures in the colonial era is still visible today in architecture. In the buildings, there is an architectural syncretism with typological and constructive elements typical of Europeans, which less integrate with the Brazilian context.
- *Social duality*. The result of the Portuguese colonization process, with the establishment of a stable agricultural model, has created an example of economic and social development depending on the interests of the Portuguese and European bourgeoisie. At the same time, the landlords, the Army and the Church, representing those interests in Brazil, based the conquest of the territory and the productivity of their property on the submission of indigenous and black slaves. This led to the social duality and subsequent strong social inequalities still existing in Brazil.
- *The concentration of the population in urban centers*. The persistence of the sugar and coffee production model in

the large agricultural landfills during the XVI-XIX centuries defined a rural territorial model. The transition from the territorial model to the urban one took place in the second half of the XX century when the industrialization process of the country brought manpower into cities. As a result, the spaces and living habits changed with more urban architectural typologies, bringing together the infrastructures and the collective services. The industrial and speculative city is fragmented into territories separating the popular classes from the rich ones. Illegal settlements, *favelas*, popular homes are the responses to the lack of initiatives by the competent public entities. This urban disorder is still present and is one of Brazil's major problems [3].

IV. TYPOLOGICAL AND FIGURATIVE ASPECTS

The rural world, in its near-landscape organization, is in a border area between human culture and nature. It is in the rural architecture that this connection is highlighted. The predominant buildings in rural areas, during the colonial era, were the *engenhos*, structures in which sugar production took place. At the beginning, *engenho* was the name given to the machines used for making sugar, then it referred to an architectural complex made up of several buildings, as shown in Fig. 1, including the *casa-grande* (home of the owner of the *engenho*), the chapel (place of prayer and religious celebrations), the *casa-de-engenho* (where sugar was produced), and the *senzala* (the slave home). The *engenho*, therefore, had its own spatial organization related to the process of sugar production, which influenced the initial structure of the territory. The buildings were usually arranged to form a large central court, see Fig. 2. The choice of location of buildings, one with respect to the other, reveals a social hierarchy and a system of values of this society, founded on the patriarchal family. As a result, the *casa-grande*, considered to be the most valuable building, was built with noble and lasting materials and it occupied the highest part of the territory; on the contrary, the *senzala*, built with precarious materials, occupied the lower part. For this reason, few of these homes came to this day.

Over time, the *engenho* became a closed and complex system, almost self-sufficient, and increased its size to reach the dimension of a town; the *engenho* was at the same time a place of production, a home, a prayer and socialization place [4].

A. The Dwelling Place: *Casa-grande e Senzala*

The *casa-grande* was the seat of the *fazenda*, which hosted the owner of the *engenho*, his family and the guests. It was the irradiation center of the entire economic and social life of the property. The *casa-grande* was generally eastward-oriented and built on the upper part of the property's land, near sources of water supply. One part of the building was usually raised on a plan to accommodate the owner's bedrooms, while service rooms were located at the lower part. Unlike other buildings, the construction type of *casas-grandes* could vary according to the financial conditions of the owner.

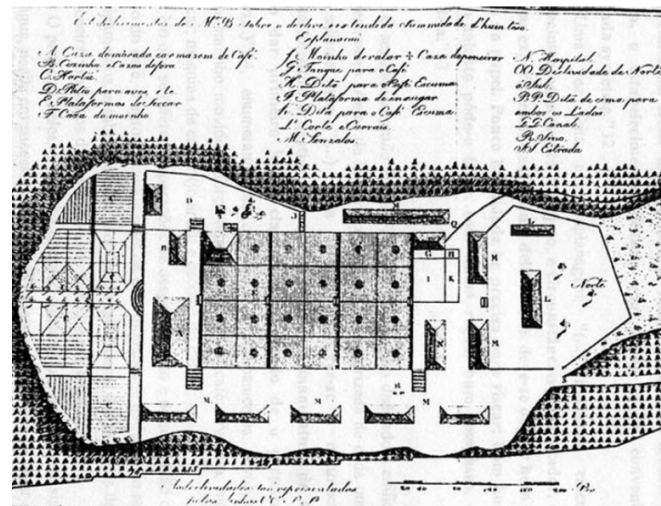
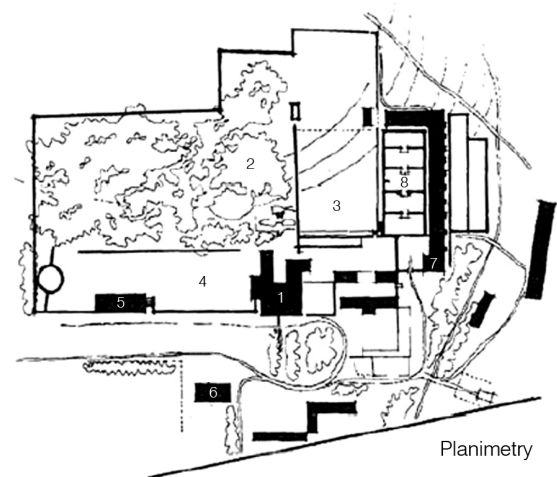


Fig. 1 Rural architectural of coffee plantation, Laborie, 1798 [13]



- 1 Casa-Grande
- 2 Garden
- 3 Orchard
- 4 Yard
- 5 Engine room and storage
- 6 Old storage
- 7 Slave accommodation
- 8 Plot of land

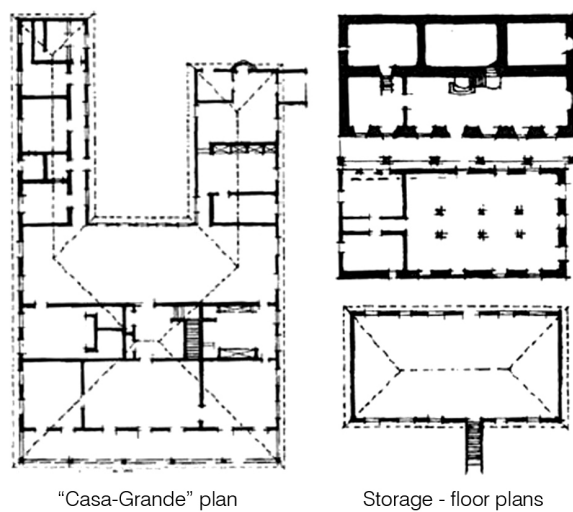


Fig. 2 Planimetry and buildings of the Engenho, century XIX [14]

From the architectural point of view, the houses, adapted to the natural landscape in which they were located, were built with local materials, in line with tropical climate requirements. In addition, the lifestyles and the local customs influenced the organization of the building's spaces. The planimetry, in fact, reflected the colonial family structure according to a subdivision by sectors. The house consisted of verandas, rooms, bedrooms, guest rooms, chapels and large kitchens. The main service environment was the kitchen, attended by the patriarchal family, which appeared as a large space, which in some cases it occupied 1/3 of the house, and in turn was subdivided into other rooms with the service function.

In most North-Eastern homes, or rather in the Sertão semi-arid region, the architectural plan follows a horizontal development, where circulation is predominant on one level. The planimetry mainly has a rectangular configuration, although there are other more articulated plan typologies. In the case of linear architectural plans, we can see the clear division between the social and intimate areas from the secondary service areas, normally located in a place adjacent to the main area. The entrance of the rural houses takes place through a porch or from a hall. The internal distribution takes place through a central corridor and/or through the halls. The recurring spaces in the rural houses are the living room, the bedroom, the dining room, the kitchen and the pantry.

Despite the heterogeneity of the planimetry configurations shown in Fig. 3, there are many similarities in the distribution of paths and the division of space into three functions: reception, rest, service. The reception has the function of receiving and staying, and corresponds to porches and halls. The rest includes the most intimate bedrooms and rooms. Finally the service space brings together the kitchen, the dining room and the pantry in the back of the building.

In fact, we can find a veranda dedicated to the dining room in the back of the house. However, sometimes it is possible to find services in a space outside the main house [5]. Therefore, one of the main features that we find in the *casas-grandes* is the constant presence of a porch. The porch was mainly on the front, with windows and doors to access to the house; it had a function of hospitality and social relationship, but it was also a place of vigilance and rest. It also had a cooling function, such as a filter protection from sunlight and tropical rain.

Other architectural elements that we find in the house are the presence of internal patios (mid of XVIII century) and, later, the verandas (early XIX century) that guaranteed privacy and served as a filter between interior and exterior space. The bedrooms, on the other hand, had no contact with the outside, as they usually had no openings. Medical care equipment was of utmost importance throughout the *engenho*; initially in the form of pharmacies that were part of the *casa-grande*, and later as real hospitals.

The *senzala* was the space dedicated to the slaves' rest. There were two types of *senzala*: one located inside the building, which could be placed on the ground floor of the *casa-grande* and was used by the slaves responsible for the domestic activities of the house; and the other one located outside in the courtyard.

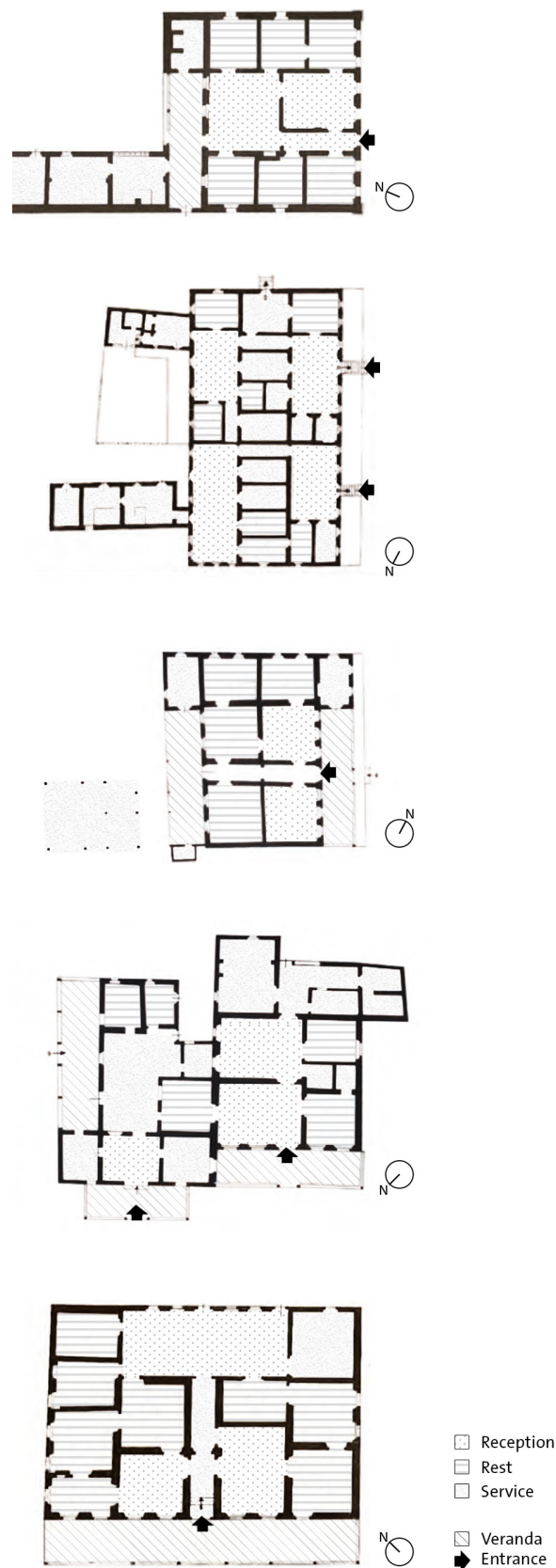


Fig. 3 Typologies and functional analysis of *Casas-Grandes*.
 Author's elaboration [5]

In the XVII century, the slaves dwelling was grouped into one building. It was a rough construction generally with a linear plant with rooms in a battery of about three square meters, with inadequate lighting and ventilation. Each room hosted an entire family or two or three slaves. The only opening was the door to access each room that opened to a covered gallery facing the internal [3].

B. The Place of Prayer and Socialization: The Chapel

In rural areas of Brazil, even today, it is customary to practice one's religion through domestic prayer. This attention to prayer arose in the past, in the colonial era, when Catholicism had a very strong presence in the Portuguese society. Therefore, the spaces devoted to prayer were created in the rural properties, influencing the architectural typology of the house.

The *Recôncavo baiano*, the geographical area located around *Baía de Todos-os-Santos*, was one of the first areas where the colonization process began and also the place where most chapels were located, some of which came to our day with a good degree of conservation. The first chapels were found in the *engenhos* of sugar in the XVI century. In the XVIII century, the architectural system followed an evolution from simple to more complex. These places of worship had architectural influences from Portugal, and this is visible in the one-nave plant, which prevailed in the colonial period. However, this Portuguese influence on both civil and religious architecture was not translated as a copy of the European monuments, but it adapted to the local environment, both in terms of materials and in the climate of Brazil.

The chapel of the *engenho*, better the *casa grande*, was considered, in the colonial period, the symbol of the patriarchal life system.

It is not a coincidence that among the buildings of the *engenho*, the architectures that came to this day were chapels rather than *casas-grandes*. The reason for their survival is not only due to the use of more durable materials and the better constructive and decorative treatment that received the civil architectures but more to their social function. Weddings, baptisms, communions as well as funerals were celebrated therein; consequently, in addition to performing religious rites, the chapel was also a meeting point and socialization.

Analyzing the chapels in the *Recôncavo baiano*, it is possible to notice how these little places of worship all came from the XVI to the XVIII century as a result of three main factors. The need to have the religious spaces, due to the lack of nearby churches, was one of the reasons to build the chapel of the *engenho*. Another important factor was to demonstrate how important would have been the Church and its activities in the period of the Inquisition. Finally, in the XVIII century, the owners of the *engenho* made great investments in their residences.

In these centuries we identify four types of chapels, which affect the space of living: the independent chapel, the one annexed to the building, the one overlooking the porch of the house and finally the chapel inside the building.

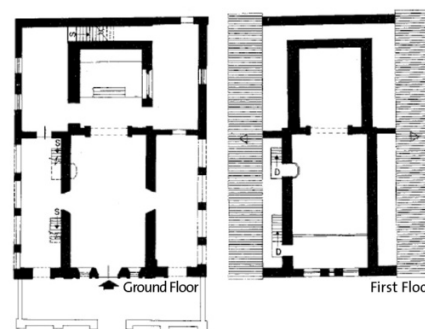


Fig. 4 The independent Chapel [6]

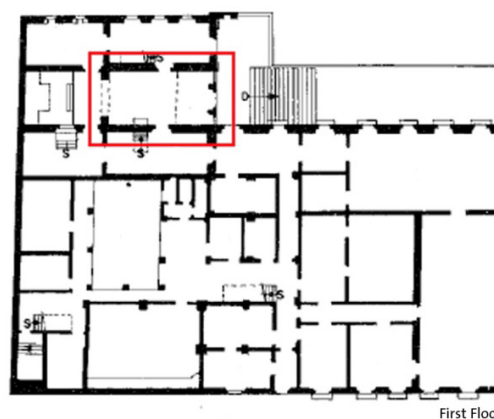


Fig. 5 The Chapel annexed to the building, first floor plan [6]

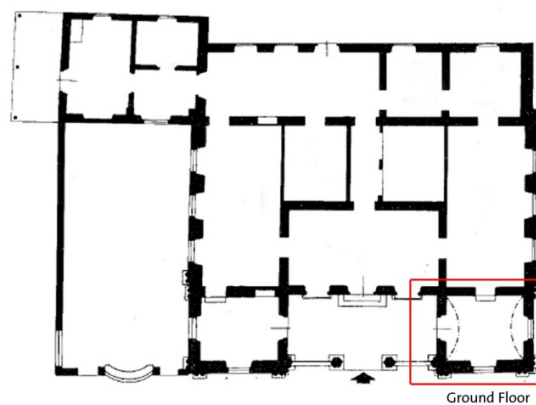


Fig. 6 The Chapel overlooking the porch of the house [6]

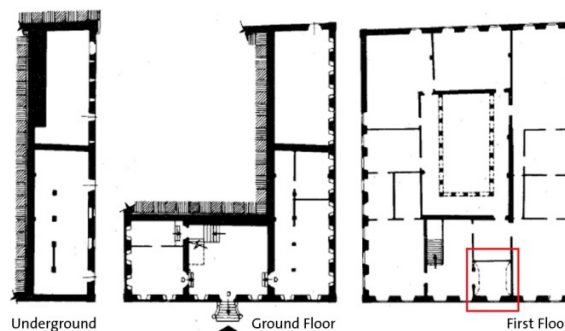


Fig. 7 The inner Chapel on the first floor plan [6]

- The Independent Chapel

The independent chapel was present in most of the *engenhos* of the Bahia region since the XVI century as a strong outsourcing of the Catholic faith and as a space for daily prayers. These places, with an interesting architectural layout, were independent of the *casa-grande* and consequently did not interfere with the living space. The chapels were placed in the most prestigious part of the *engenho*, i.e. on the highest part of the ground, and usually had a rectangular plan with a single nave, see Fig. 4. Even the chapels could be surrounded by porches, not only on the main facade but also on the side of the building. The direct connection between the presbytery and the sacristy was a common feature in the chapels of the *Recôncavo* due to the system of women segregation in a patriarchal society. In the independent chapels, it is also possible to observe the octagonal or square nave planimetry.

- The Chapel Annexed to the Body of the Building

The chapel annexed to the house interfered with its volume keeping the dwelling privacy of the house, since the place of worship had an independent access for visitors (the slaves of the *engenho*) and one inside for the family. In addition, liturgical services could be assisted without leaving the living space. The chapel attached to the house differed in its form in the architectural structure, see Fig. 5.

- The Chapel Overlooking the Porch of the House

Another interesting type is the chapel that overlooks the porch of the house, see Fig. 6. It differs from the inner chapel for the porch, an indispensable element for socializing among the employees of the *engenho*. In this way, the public space is increased, allowing its use also to slaves, but maintaining at the same time the privacy of the family life.

- The Inner Chapel

The inner chapel began to appear in the *Recôncavo* since the XVIII century, but there are few examples that have been preserved exactly as they were. Sometimes the interior space of the chapel consisted mainly of altar or religious icons, which with time have been removed.

In the house, there are two types of the inner chapels: The chapel with its own space or a non-exclusive place of the home for liturgical services. The chapel that uses a proper space is distinguished in the architectural structure for its location and access. In fact, it can be directed towards the inside of the house with restricted access to family members or access through it with an entrance hall, see Fig. 7.

The different position of the chapel influenced the use of the space of the house. If in the XVI century, the chapel was a fundamental place for the *engenho*, from the XIX century, the attention to the prayer space decreased for the new habits of society. The owners of the *engenho* moved from the rural area to the city in search of a new comfortable lifestyle; consequently, in rural areas, homes of smaller dimensions than the previous ones began to emerge, creating multifunctional spaces within it. The chapel, if external, began to be very simple; the prayer space moved into the house even through

the installation of small altars or religious symbols. The indifference of the use of space is typical of rural areas, where the separation between man's life, work and religious space is lacking [6].

V. MATERIALS AND CONSTRUCTION TECHNIQUES

The colonial era was characterized by the use of local construction techniques, simple materials and qualified manpower thanks to the presence of numerous slaves. The houses had almost all the same constructive features:

- The *foundations* were structural walls in clay and rough stone. Rarely, wooden foundations were used for sandy soils with little resistance. The houses were slightly raised with respect to the ground;
- The most recurrent *flooring* on the ground floor was covered with clay or tiled tiles; only on the higher levels the floor consisted of Brazilian wooden boards leaning directly onto the supporting beams;
- The simplest walls were *pau-a-pique*, adobe or *taipa de pilão*. Usually, the most important residences were built by stone and clay and seldom by bricks.

The *pau-a-pique* construction technique, also called *taipa de mão*, was largely used in rural areas. The walls were made of a wooden armor with a woven pattern of branches to form squares. Once the entire structure was built, the openings were positioned and then the weave was filled inside by clay. The *pau-a-pique* technique allowed building walls on several levels, even building two-floor houses.

The constructive system adopted in the walls of *taipa de pilão* used instead a removable wooden armor. This construction technique consisted of inserting, into wooden boxes called *taipais*, some soil that was compressed with *pilões* and dried. In general, the walls ranged from 30 to 120 cm thick. This constructive system had less resistance and, therefore, was used for single-floor houses. Structural walls, as well as interior walls were made of the same materials. The dividing partitions were half-height so that they could glimpse the roof and allow ventilation in the upper part of the house.

- The window fixtures were made of wood. The architraves could be straight, low or full arch. At the same *fazenda*, all three types of lintels could be observed, although the most used one was the lowered arch. What distinguished the windows was the opening solution (French or guillotine) and protection (jealousy or glass);
- The *covering* was mainly with two or four slopes because the flat roof construction technique was unknown or in any case not suitable for strong tropical rainfall. The sloping roof was one of the elements that characterized the Brazilian home, and was made of noble wood beams, forming simple structures of beams, trusses and slats with final roofing in ceramic tiles. The roof was sticking out from the walls from 50 cm to 1 m to protect them against sun and rain. The structure of the roof drained its efforts on self-supporting masonry. The porch roof was supported by wooden pillars [3]-[5].

The roof with one sloping was mainly used for the service spaces, such as the kitchen, or to create the verandas attached

to the house. The two-sided roof was the most common case for house construction, while the four-sided roof was the one most used to cover larger areas such as the pavilions, which had a skylight roof to provide more lighting and ventilation.

The constructive techniques used in this era were very simple and adapted perfectly to the colonial life. The northeastern worker, dependent on the activities in the Bahia region, such as fishing, trade, agriculture and livestock, felt the need to build their own buildings with materials found locally. In this way, around the complex of the sugar economy, with its commercial and financial branching, housing for the rural population was built, which was the cultural fusion of white, indigenous and black people. Among the constructive influences in the Northeastern region, from an ethnic point of view, we are able to highlight the indigenous constructive technology developed with plant-derived materials, the use of the covered veranda to the shelter from heat, the elevated buildings to escape from ocean or river flooding, the rectangular plan, the covering with dried straw layers and the absence of the home internal divisions to create a multifunctional space.

Among the contribution of the black population there are influences regarding the construction with the earth, the rectangular plan (about 6 m x 8 m), the single-family houses without internal division, the use of the *taipa* construction technique, the protruding roof protecting the *taipa* walls against weather conditions, the veranda annexed to the house and small openings.

Finally, the whites influenced the buildings by placing the verandas in front of the main facade of the house, dividing the space with different functions, inserting the window fixture and ceramic tiles, and intensifying the private spaces of the house [7]. Therefore, more generally, the study of building typologies and construction techniques is to be sought in history and in the cultural aspects in the backcountry, that is in areas where traces of local culture have been preserved, unlike the coastal areas dominated by a strong construction speculation with buildings that do not respect the context in which they are located. In addition, the climate and landscape of the Northeast have influenced the typology and materials used in the buildings, from the simplest architectures in *taipa* and clay, to the *fazendas* with a better construction quality and the presence of verandas that protect the house and collective spaces against sun and rain.

VI. DESIGN APPROACH OF LINA BO BARDI IN RURAL AREAS

"The realistic research of the modern world ... has brought the architecture back to the relationship SOIL, CLIMATE, ENVIRONMENT, LIFE, a connection that, with wonderful primitivism, we see come from the most spontaneous forms of architecture: the rural architecture" [8]. In this article, the architect Lina Bo Bardi expressed her interest in the relationship between architecture and nature, a fusion of the home and a simple and functional way of living close to the environment in which the architecture was built, detached from modern trends and ornamental. Lina Bo Bardi highlighted the value of rural architecture for its perfect

correspondence with the environment in which the life and work of people take place. "Mountains, forests, seas, rivers, rocks, meadows and fields are the determining factors of the shape of the house; the sun, the climate, the winds determine its position, the surrounding earth offers the material for its construction; the home is born so deeply bound to the earth, its proportions are dictated by a constant, the meter of man and uninterruptedly, with deep harmony, flow into his life". The rural architecture is therefore for Bo Bardi, the result of a pure, astonishing and functional construction [8]. The minor architecture, the popular one linked to tradition, is one of the themes that go with her during her life in Brazil; in which she showed a strong interest in Northeast, the universe of popular culture. In her architecture, modernity and tradition were not antagonistic, they were well-established in the popular, black and indigenous experience; introducing poetic and irrational elements on an extremely rational and functional basis.

Bo Bardi discovers in Brazil, and especially in Bahia, the raw material to achieve a new synthesis between modern influences and popular culture; a synthesis that deals with every population with which she comes into contact. Her projects in rural areas are influenced by the history of the site, with the origin of their inhabitants, with the life that is happening around these architectures. In her studies on the Brazilian houses, the attention is focused on the rich vegetation of the *Mata Atlântica*, both in ground-based constructions and those raised on *pilotis*, where nature is an integral part of the home.

Particularly interesting are the prototype studies: The shed house, the modular home, the circular home. They are repeated in series to create a quality dwelling within the reach of the less well-off. Her projects in rural areas are characterized by the use of geometric and regular figures, such as the square, the rectangle and the circle. These figures are found in the projects of the economical houses of 1951 [15] as depicted in Fig. 8, in the study of the popular home in 1983 [16] and in the rural project of Camurupim, 1975 [17]. These houses are small in size, are the minimal residence for primary needs with a modular system and spaces of socialization. They are, therefore, called open houses for their reception function, such as the *Casa de Vidro* (its home) built to receive people.

In the proposals of the economic houses, she develops five different housing solutions, with different characteristics, to specify her numerous studies on the popular home. In these houses, the relevant elements that characterize them are the use of a single volume, the modular subdivision of the space, the hospitality function, the spatial flexibility, the internal-external relationship, the use of poor materials. The economic homes, defined by different typological solutions, are designed to be built with local materials, they are homes designed for the people or real constructive hypotheses [9].

Among the economic housing proposals, an interesting case is the project for the establishment of the agricultural cooperative in Camurupim in Propriá, Sergipe (Northeast of Brazil); an example of close contact between the architect and its recipients, through the work done directly on the site. The proposal for the residential settlement with traditional

technologies and materials includes a community acropolis surrounded by low-density landing. From her drawings, we can see the deep connection between the environment and the project that follows the level curves of the land, see Fig. 10.

The proposal consists of an organized parceling that has a circular cell as a unit, consisting of a single-family house and a plot of land where agricultural activities could take place. In addition to the settlement proposal, Bo Bardi provides three residential proposals that are the result of a deep research on the houses in the Bahia region. In the drawings and in her annotations it is possible to recognize the materials, the construction systems, the spatial organization of the house with its relationship with the outside, as well as the local living uses. In all three residential solutions, attention is paid to the living space with the living room or the kitchen always connected to the outside and the presence of a veranda, see Fig. 12. The residences are designed to be made of local materials: wood for the structure, straw for covering the verandas and the clay for the ground floor, see Fig. 11. But the search for the integration of the house with the context has gone beyond the study of local materials, seeking primarily to know the habits and the daily life of the rural community [10].

In the community complex of *Espírito Santo do Cerrado*, built in Uberlândia (Fig. 13), in the state of Minas Gerais between 1976 and 1978, the participatory premises elaborated for the rural settlement of Camurupim come to fruition. The Church, a place of prayer and socialization, is a clear example of popular architecture. Lina Bo Bardi began the project aware of the limits she would have to face due to the lack of the community resources, so the project had to be devised with the use of local materials and labor. However, the limits were not an obstacle for her; on the contrary, they were the basis for this new project, where she could put into practice her studies and her knowledge of the local construction.

One of the fundamental aspects of *Igreja do Espírito Santo do Cerrado* was the active collaboration between the architect and the people, with whom she shared the knowledge, the techniques and the constructive traditions for the realization of the parish complex; therefore, many details were directly made on site. Among the materials used for the construction, in addition to the reinforced concrete structure, the bricks and tiles produced in the region, as well as the local wood for the structures, were also used. The project was not a simple chapel, but it consisted of three circular bodies of hierarchical dimension and with different functions: reception, dwelling and prayer. Already from the functional subdivision, we can see the architect's approach to the tradition of the colonial house, mainly divided into three parts, and the attention to the "índios" huts for the circular form. The first space is the chapel, located in the highest part of the ground and with a larger dimension than the other two ones. But this makes clear, as we have explained in the paragraph of place of prayer and socialization, that Lina Bo Bardi pays attention to locating the place of worship in the most prestigious part of the land as in the historic Brazilian colonial tradition, where the chapel was placed in the highest part of the *engenho's* property to emphasize its importance.

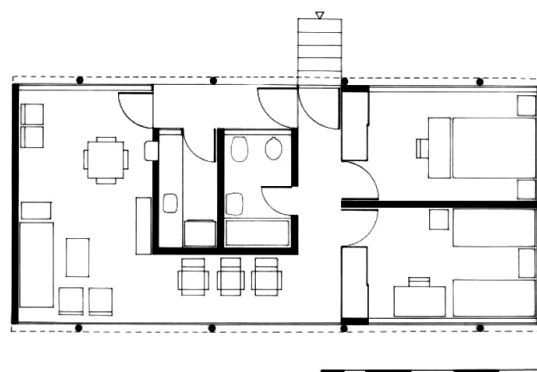


Fig. 8 Project of economic house, 1951 [15]

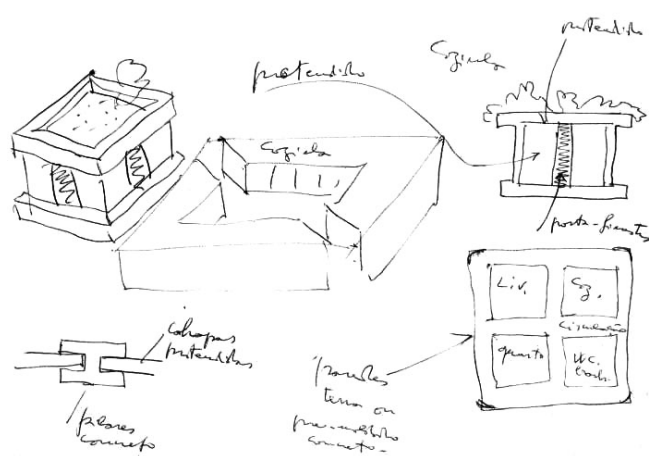


Fig. 9 Popular House Project, 1983 [15]

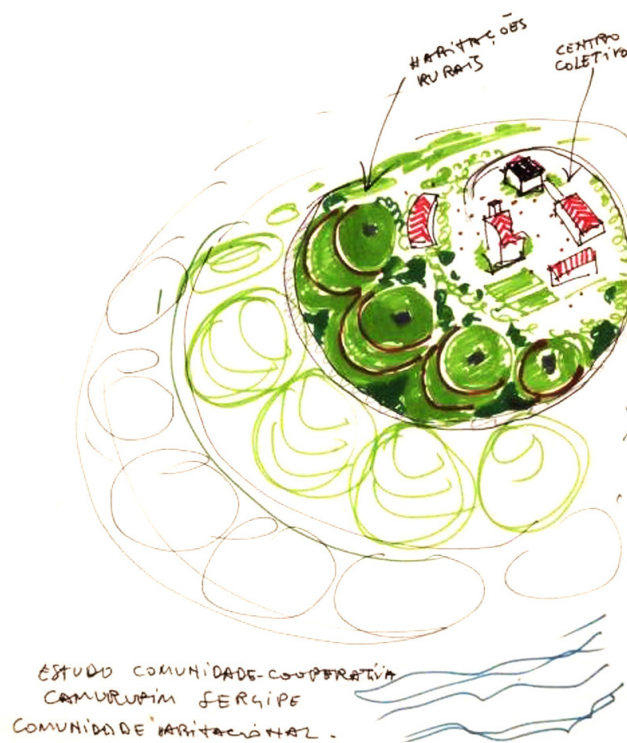


Fig. 10 Planimetry with circular lots of Camurupim, 1975 [15]

The chapel did not only host religious celebrations but also activities needed for the community, such as meetings or presentations; for this reason, the religious site was a multifunctional and flexible space. Since the beginning of the project, the roof was designed without a central support to give space a variable configuration. The last circle, the smaller one, hosts a community hall extending outside with the adjacent soccer field: a functional sequence that moves seamlessly from the sacred space to the playful space. The central cylinder is instead the pivot of the union between the hospitality and the prayer space and is dedicated to religious people, with small rooms, the kitchen and the service areas positioned around a central patio [11], [12]. The inner patio is a significant element used by Lina Bo Bardi, which resumes from the historical tradition. It is present in almost all of her works, especially in the houses, although she interprets it in a different way. In this case, it is a small garden dedicated to the isolation of the religious, a meeting place, but mainly a break for self-reflection, a look inside themselves. The whole complex thus consists of three gears, a mechanism that works thanks to the reciprocal help of each part. In this project, as in many others, Lina Bo Bardi recovers lost forms, reworked and adapted to the new reality, without losing its original meaning. According to Bo Bardi these forms, currently abandoned, had to be recovered, as well as the patio and the veranda. In an illustration of 1942, she represents the lost forms joined together by a sinuous lake: the staircase, the pavilion, the wall with vegetation, the fence/patio, the tower, and so on. This design confirms the hypothesis that the architect looked at past forms and processed them mentally by applying them to her designs. In her architecture, the modern, the traditional, the local and popular coexist with dialectics.

VII. CONCLUSION

The analysis carried out so far in the Northeast of Brazil, from the study of typologies and figurative aspects, from the materials to the constructive techniques of the historical colonial tradition, to the approach of architect Lina Bo Bardi in rural areas of Brazil, make it easy to identify some operational criteria to define the architectural structure of the health prototype.

The prototype is an alternative, architecturally and constructively, to the existing health centers in the municipality of Lauro de Freitas. The health facility intended to be built in the rural area of *Quingoma*, which is a low-income population belonging to the *Quilombola* community, will have to take on some features that facilitate the integration into the context and the recognition of the buildings as an integral part of the tradition, the uses and the habits of users, in a particular peripheral context characterised by social fragility.

From a typological and formal point of view, the inspirational principles of the project assume certain local characters regarding the structure of the elementary forms typical of rural architectural works. Simple shapes, therefore, obtained from the connection of modular elements of minimum size.



Fig. 11 Prospect of the residential project, Camurupim, 1975 [18]



Fig. 12 Detail of the veranda, Camurupim, 1975 [19]

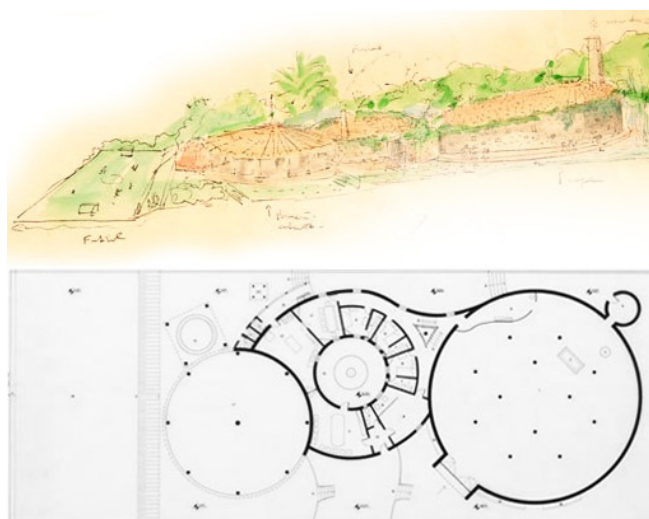


Fig. 13 Church of *Espírito Santo do Cerrado*, Uberlândia, 1976 [20]

REFERENCES

- [1] A. Rapoport, *House form and culture*, Englewood Cliffs, N.J.: Prentice-Hall, 1969.
- [2] G. Laganà, *Culture e sistemi costruttivi nei paesi in via di sviluppo: il caso dell'America centrale*, Torino: CELID, 1996.
- [3] L. D. Zorraquino, *A evolução da casa no Brasil*, Universidade Federal do Rio de Janeiro – UFRJ, Faculdade de Arquitetura e Urbanismo, Departamento de História e Teoria, Programa para Análise de Revalidação de Diplomas, July 2016.
- [4] F. Santos Gentil Araújo, and J. Diniz Miguel, “Arquitetura rural e cultura sertaneja no Rio Grande do Norte”, in *IV Encontro de História da Arte – IFCH / UNICAMP*, pp. 43–54, 2008.
- [5] N. M. Montenegro Diniz, *Um Sertão entre tantos outros: Fazendas de gado nas Ribeiras do Norte*, FAUUSP, São Paulo, 2013.
- [6] M. H. Silva Santos, *O Espaço de Rezar: a Religião Católica doméstica na casa rural do Recôncavo Baiano – séculos XIV a XIX*, Universidade Federal da Bahia, Faculdade de Arquitetura e Urbanismo, Programa de Pós-Graduação em Arquitetura e Urbanismo, Salvador, 2006.
- [7] A. Eduardo, D. Leal, M. A. Endo, M. Rodrigues, R. Ferreira, and A. Arruda, *A Arquitetura Vernacular das 5 Regiões Brasileiras*, Universidade Federal de Mato Grosso do Sul – UFMS, pp. 1–19.
- [8] L. Bo Bardi, “Architettura e Natura. La casa nel paesaggio”, in *Domus*, vol. 191, November 1943, pp. 464–471.
- [9] A. Criconia, *Lina Bo Bardi: Un'architettura tra Italia e Brasile*, Milano: FrancoAngeli, 2017.
- [10] M. T. Pereira, *As casas de Lina Bo Bardi e os sentidos de habitat*, Universidade de Brasília, Faculdade de Arquitetura e Urbanismo, Brasília, 2014.
- [11] A. L. Lazzarin, *A Igreja Divino Espírito Santo do Cerrado e suas alternativas à arquitetura brasileira*, Universidade de São Paulo, Instituto de Arquitetura e Urbanismo, São Carlos, 2015.
- [12] L. Miotto, and S. Nicolini, *Lina Bo Bardi: aprirsi all'accadimento*, Torino: Testo & Immagine, 1998.
- [13] M. J. Carrilho, “Fazendas de café oitocentistas no Vale do Paraíba”, in *Anais do Museu Paulista*, São Paulo, vol.14, n.1, January – June 2006, pp. 59-80.
- [14] A. P. da Silva, “Engenhos e fazendas de café em Campinas (séc. XVIII–séc. XX)”, in *Anais do Museu Paulista*, São Paulo, vol.14, n.1, January – June, 2006, pp. 81–119.
- [15] L. Bo Bardi, 024ARQd0033, Casas econômicas, 1951, Instituto Lina Bo e P.M. Bardi.
- [16] L. Bo Bardi, 108ARQd0007, Casa Popular, São Paulo, SP. Plantas/ Perspectivas, 1983, Instituto Lina Bo e P.M. Bardi.
- [17] L. Bo Bardi, 090ARQd0014A, Camurupim - Comunidade Cooperativa, Propriá, Sergipe. Planta: esquema de implantação de los núcleos residenciais, 1975, Instituto Lina Bo e P.M. Bardi.
- [18] L. Bo Bardi, 090ARQd0094, Camurupim - Comunidade Cooperativa, Propriá, Sergipe, 1975, Instituto Lina Bo e P.M. Bardi.
- [19] L.Bo Bardi, 090ARQd0044, Camurupim - Comunidade Cooperativa, Propriá, Sergipe, 1975, Instituto Lina Bo e P.M. Bardi.
- [20] L. Bo Bardi, 092ARQd0016, 092ARQd0123, Igreja Espírito Santo do Cerrado, Uberlândia, MG, 1976, Instituto Lina Bo e P.M. Bardi.

D. Chizzoniti graduated in 1996 at the Faculty of Architecture of the Politecnico di Milano (100/100 with honor). He obtained a Ph.D. degree in Architectural Composition in 2001 at IUAV of Venice. He has been an Assistant Professor at the Department of Architectural Design of the Politecnico di Milano since 1996. Between 2002 and 2005 he worked as a Lecturer at Faculty of Architecture of the Università degli Studi Parma and at the Faculty of Civil Architecture of the Politecnico di Milano.

In 2008 he became an Assistant Professor in Architectural Composition at the Department of Architectural Design, Politecnico di Milano and in 2015 Associate Professor. He is a coordinator of the publications of TECA “Teorie della Composizione Architettonica”. He has published more than 80 scientific papers in the field of Architectural Design. He took part as an author in several books and his work has been published in catalogues and magazines.

The design of the typological structure will have to take into account those architectural and constructive elements that have characterized the settlement tradition of the northeastern architecture, such as the patio or the veranda, which will be used, as in the past, with a hospitality function and socialization space. The relationship between the interior and exterior parts of the building will, therefore, be one of the fundamental aspects that will be taken into consideration. The feature of flexibility will be found in the creation of a multifunctional space, in which we mainly identify three functions: hospitality in the veranda, the space dedicated to the medical examination, and service rooms.

The prototype will also be part of a feasibility program with a low environmental impact, including the reduction of construction costs, of the local materials adopted, and the use of constructive techniques derived from popular tradition. One of the most interesting and performing techniques both from a constructive and figurative standpoint is the *Taipa*, used in colonial Brazil, using onsite wood and earth.

For the use of these local materials and construction techniques, it is necessary to involve and educate the population in accepting these modalities and knowledge of rural tradition, which is often confused by them as of poor quality techniques; but if treated and used in a proper way they can lead to constructions that are as durable as the conventional ones, with the non-secondary advantage of an adequate integration into the Brazilian rural landscape. The conventional materials, used today in the rural areas, are mainly chosen for the competitive cost or simply because they are often interpreted as elements of social and economic emancipation compared to traditional materials, particularly in the most disadvantaged neighborhoods in the Brazilian cities.

The adoption of sustainable practices in the construction process contributes to the achievement of several benefits; from initial low design costs to the life cycle management of the building, verifying how the required investment may be even lower than that of a construction with conventional materials.

The characteristic of the modularity of the first aid structure will be present not only from a typological point of view but also from a constructive point of view. The walls, in fact, could be realized through the prefabricated *taipa*, the technique proposed by Acácio Gil Borsoi in the rural area of Cajueiro Seco, Pernambuco between 1960-64, to create modular homes that facilitate and speed up the construction of the building.

Finally, we can conclude that the characteristics of flexibility, modularity, aggregation and reversibility of the socio-sanitary structure can be fulfilled in the predisposition of a prototype that meets these sustainability requirements and that carries on the local cultural aspects, from awareness of the tradition of the built form, in which modernity and memory blend in search of those qualitative features that integrate into the northeastern rural landscape.