

**Reinforced masonry practical booklet: A discussion of the architectural production of the contemporary city and the social and cultural sustainability of Latin American architecture.**

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#### **SUMMARY**

The main work explains the elaboration process of a didactic booklet that details the constructive method of reinforced masonry, final product of an investigation developed by the department of Architecture and Urbanism at Universidade Federal de Pernambuco (UFPE), entitled "Alvenaria Cerâmica Armada: uma cartilha prática"<sup>1</sup>, at 2020. This article presents a discussion concerning urban sustainability, here understood not from its ecological dimension only, but also from its social and cultural. The post-modern Productivism from the 70's decades impels an architectural production which impacts the landscape and life quality of city's population, presenting a homogenization in what concerns architecture. Contrasting this universalized architectural movement, some notably Latin-American architectural offices, using materials and local techniques, started to answer the local demands (and international) under the sustainable directive, intending to use low cost and using resources and rejects from local site to build. Based on the practical experience at one of these offices, the Paraguayan office Gabinete de Arquitectura, it was possible to elaborate a guidebook synthesizing some precepts and building techniques in reinforced masonry, a method easily reached by the most popular layers of society. By this guidebook it is uncovered many possibilities for an architectural low cost production with both social and cultural commitments.

**KEYWORDS:** Reinforced Masonry. Sustainable Architecture. Social Sustainability.

## **1 INTRODUCTION**

During the first decades of the 21st century, different Latin American countries have seen the emergence of an architectural production that incorporates in its design and construction details a logic that is antagonistic to market standards. With a rustic appearance, unrefined finishings, and a production line on the edge of being artisanal, these works make use of raw materials available in the region or raised from the reuse of rubble, emphasizing a picturesque aesthetic. Betting on vernacular elements, sustainability, low cost and accessible labor, there is here a posture that antagonizes the universalized industrial architecture that comes from productivism in architecture.

The post-modernist phenomenon of the 1970s, pointed out by Kenneth Frampton as productivism, became even more potent at the turn of the 21st century. Through the massive repetition of techniques, typologies, forms delimited only by legislative restrictions of the urban block lot, questions begin to be asked about the real benefits of this homogenization of the urban mesh: the repetition throughout the city as well as in most urban centers around the world. Buildings of the same plasticity and criteria do not relate to the pre-existing historical and landscape heritage, leading to a saturation of visual aesthetics by redundancy (FRAMPTON, 1997).

Moreover, social segregation is promoted at the moment when buildings are marginalized by the establishment of structures and materials, tabulated by the market logic inserted in the construction industry, over those considered obsolete, measuring the artwork by the value of the product that was implemented in it (COLIN, 2013).

In this productivist logic, the Latin American city is being shaped by the reasoning of globalized production. From guardhouses and kiosks to school and hospital buildings, the same structural bodies, closures, and coatings are applied. Corporate skyscrapers boast fully glazed facades with no relation to their surroundings, and encourage artificial air conditioning, disconnecting the building from efficient and sustainable energy performance.

In response to this growing urban homogeneity, the search for regional identity as a contribution to socioeconomic and cultural development came to the fore in the discussions of the Argentine theoretical architect Marina Waisman. In the complex panorama that Latin

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<sup>1</sup> Reinforced Masonry Practical Booklet.

America was going through in the 1980s, a period marked by economic crisis and post-military dictatorship redemocratization processes, which further contributed to the worsening of the standardization of cities, Waisman defended the need to look at the "own" regional productions and, with them, find solutions to contemporary challenges of architecture and urbanism.

In reinterpretations of the notions of "identity," "modernity," and "postmodernity," Waisman (1990) coined the term "architecture of divergence," which suggests the development of Latin American architectural production as a result of interactions between international tendencies and local circumstances. Going Parallel to the pressure of the media and the political-economic means that tended to standardize uses and customs across the planet, a reaction that could be observed have emerged in buildings built in the twentieth century by Rafael Iglesias in Argentina; Eladio Dieste in Uruguay and Eduardo Reidy in Brazil, nations located in a part of the world considered "peripheral" (TORRES, 2015).

Setting forward to the context of the 21st century, the productivist city that distances classes and consolidates homogeneous architecture is accentuated in consonance with market logics. Therefore, opposing this model there would be an approach between the initiative of contemporary offices and Waisman's "architecture of divergence", seeking tools to counteract these productivist constructions. The two ideals highlight the heterogeneity of the Latin American context for a constructive appropriation based on local architectural concerns and the social construction of the continent, triggering the idea of architecture that "starts from its familiar search for new courses of action" (WAISMAN, 1990). This time, no longer restricted to the post-modernist clipping of the twentieth century, it goes beyond to contemporary productions. It is through this combination of architecture and context that the Euro-Saxon power model of colonization is confronted (BORDIEU, 1993).

It is important to point out that the contestation of the post-modernist productivism that imposed this homogenization of the urban landscape through construction is inserted in the discussion field of urban sustainability, primarily would minimize the consumption of energy and other material resources by exploiting local flows and reducing the volume of waste (ACSELRAD, 1999).

In this sense, the discussion about the valorization and importance of techniques and procedures conditioned by the regional characteristics of society and culture departs for a look at one of these contemporary offices still active and that condense these good practices of sustainability and architecture. As a case study, the production and technique of Gabinete de Arquitectura is chosen, a notable Paraguayan office that introduces in its works a significant contingent of these actions in its built object.

It is discussed from the panorama of architectural production of the contemporary city, how the diffusion of knowledge of regional constructive techniques contributes to the sustainability of cities in their social and cultural dimensions, using as an example the construction in reinforced ceramic masonry, constructive technique widely diffused by the Paraguayan office. As a final product of this investigation, a material entitled "Reinforced Masonry Practical Booklet" was elaborated, which contributes to the discussion of the constructive technique in Architecture as a key element in counteracting productivism.

## **2 OBJECTIVES**

The objective of the work then approaches the converging point of assigning a catalog of some of the different constructive modalities for reinforced ceramics which Gabinete de Arquitectura, a contemporary Paraguayan office, has been developing over the past years with the impetus of testing these constructive models in their diverse uses and systems, contributing to the knowledge dispersion of regional techniques and constructive materials, under the optic of developing sustainable cities.

## **3 BOOKLET'S CREATION METHOD**

From the Office's philosophy, it's the initiative in always testing at the construction site and reinventing itself through the use and disposition of materials have been kept in tune during the elaboration of a material oriented by pragmatism, with a more active role and in its essence practical. Solano Benítez, the office's titular architect, has an imperative posture when it comes to construction, postulating the inseparability of experimentation on the construction site to the realization of good architecture.

Therefore, it was sought to support this ideal of didactic material, a compendium with the precepts of a narrative that would make evident the manner in which this technique is carried out by the Office. Here is how the booklet format was formally chosen as the final product of the investigative work.

It is worth pointing out here that this sample does not contemplate all the constructive methods or the range of possibilities that the office also implements in its daily routine, but only the clipping of its expertise in the constructive technique discussed in question. Thus, the booklet intends to illustrate by an analytic observational method samples of some of the Office of Architecture's works, seeking to deconstruct it by parts, that is, to take each part as a part of the whole, and then reassemble the structure. At no point does the work seek to "reconstruct" one of the works in its entirety, but rather a collection of constructive models that may, or may not, condense into a whole.

As for the origin of the content, it is made clear here that it is the result, above all, of annotations that were accompanied in loco by observation and peripatetic teaching of the Architectural Office team itself, in addition to meetings in the office, with the civil engineer, the construction supervisor and the architectural team. Thus, it is necessary to understand that all the material inserted in the booklet had to be gathered and elaborated without any predecessor support material other than the experience and experiences of six months of work at the Office, where, with the scarcity of records and publications on how to make structural experiments, the need for a physical approach was crucial. For this reason, the booklet does not cover its functionalist approach to the structural calculations and pre-dimensions, which are the next essential formal step. It is restricted to understanding how it was built and how it operates in the way it was visually presented.

## **4 SUSTAINABLE ARCHITECTURAL PRODUCTION THROUGH REINFORCED MASONRY**

The growth of new questions that are under discussion in the contemporary scenario regarding civil construction and the management of its resources (and waste) is remarkable.

Seen now from viewpoint of a portion of the population that the standard construction market has barely touched. This portion, with lower purchasing power and purchases, ends up not being contemplated, either because they are unaware of the value of the professional or because of the cost of quality and salubrious construction.

In 2015, in a survey conducted in 177 municipalities of different Brazilian regions with more than 2400 interviews, by the partnership of CAU/BR (Architecture and Urbanism Council) and the newspaper Datafolha, pointed quantitatively to where is the presence of the qualified professional in construction in Brazil, in particular the architect, as well as the justifications for the choices, professional attributions, mapping of opinions, etc. The survey points out that in the Northeast region there's a disparity between 7.12% of a group adopting a technically qualified professional and 92.90% of the population who adopts the master builders and bricklayers as unique professionals. The use of materials is another aggravating factor, either due to lack, surplus or waste (CAU/BR, 2015).

This civilian shortage in the dissemination of skilled technicians is not restricted to Brazil alone, this deficit is widespread throughout South America, especially in countries with lower GDP and HDI, in which the poorest regions of the continent are located, as is the case of the Brazilian northeast in relation to the south/southeast, vestiges of a colonial past of compulsory extraction of primary resources, segregationist policies of land ownership and racial hierarchies that have created a social abyss difficult to repair.

In these regions we have the public authorities limited to investing in decent social housing that meets the needs of a family, with the cost of the work and its implementation (ANAGNOST, 2016). Taking in apex the estese of the Venice Biennale, known as the most important architecture event in the world whose 2016 edition, having as its director the Pritzker Architecture Prize winner Alejandro Aravena, it was set up postulating these inquiries about how to reach this needy portion with a sufficient architecture, there gathering different architectural offices that work with the possible conditions for the deferred locality, the use of materials already available there and densely used now under a more rational optics, logistics increase, and mainly, to whom it is built.

We would like to learn from architectures that, despite scarcity of means, intensify what is available instead of complaining about what is lacking. We would like to understand what design tools are needed to subvert the forces that privilege individual gain over collective benefit, in short We for Just Me. We would like to know about cases that resist reductionism and oversimplification and don't give up on architecture's mission to penetrate the mystery of the human condition. We are interested in how architecture can introduce a broader notion of profit: design as added value, rather than as an extra cost or a shortcut to equality (ARAVENA, 2016)<sup>1</sup>.

The choice for Reinforced Ceramic Masonry is guided in much by this moment of convergence, having one of the offices participating in the Biennale and contemplating all the discussion justifies in the technique, the Gabinete de Arquitectura. According to Camerín (2016) The professional praxis and research carried out by Solano Benítez with Gabinete de Arquitectura resulted in a singular, extraordinary and poetic work that goes beyond the apparent simplicity of a material as popular and universal as brick. There is no doubt that the budget limitations, the precariousness of the materials, and the low specialization of the

workmanship are inversely proportional to the inventiveness of the technical solutions, the quality of the compositional operations, and the expressiveness of the forms.

A healthy architecture cannot be produced without a rational and economical use of building materials. I am even speaking of architecture as art at its highest level. In the last analysis there is no essential difference between the economic and the moral. The moral leads us to the final conquest of Man and for this conquest a rational and respectful use of nature's resources is indispensable. This is the meaning of the word economic: careful, and therefore profound, use of the possibilities of nature. This is why the search is justified for those forms that conform most closely to what we do to the laws that govern matter, taking into account also that it is man who must work on this matter, elaborate it (TORRECILLAS, 1996, p. 28).

Therefore, this is a theme that cannot come fortuitously dissociated from the social question or even discussed by tautology, i.e., architecture by itself, after all, it would then be worth presenting any other construction technologies perhaps more effective in the aesthetic or utilitarian parameters of architecture.

The sustainability discussed here is intrinsically related, therefore, to the economic and social sustainability of construction resources and access to materials for the execution of architectural works. Thinking about urban sustainability requires reflection on the construction model of buildings that shape the site and the landscape. Acselrad (1999) complements this by stating that:

In order to reduce the entropic impact of urban practices, technologies that save space, matter and energy and recycle materials should be adopted. The idea of energetic efficiency is intended to extend the scope of economic rationality (ACSELRAD, 1999, p. 82).

The final product of this research, which corresponds to a practical primer on construction methods using reinforced ceramic masonry, will be discussed below, seeking to systematize and synthesize sustainable construction processes that use local, accessible, and reusable resources.

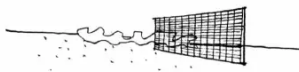
### **CREATING 'CARTILHA PRÁTICA: CERÂMICA ARMADA'**

Concerning the booklet, it is initially highlighted the contribution of two studies, whose support guided the elaboration of this product, being them *Taipa*, by *Acácio Gil Borsoi (1963)* and *Roteiro para se construir no Nordeste*, by *Armando de Holanda(1976)*. Although dated, being literature from the first decades of the second half of the twentieth century, these remain in a timeless didactic where it is noted that the narrative is still preserved in more recent materials.

In a fluid narrative, explaining directives to be followed for the subject in question and its particularities, being the Northeast and its specific type of climate, wind direction, temperature, and materials used, Armando de Holanda summarizes in his book a series of architectural actions that teach the "good occupation" of the house in these Northeastern conformities (Figure 1):

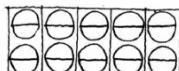
**Figure 1 - Excerpt from the book *Roteiro para Construir no nordeste*, Sketches and text complement each other in a didactic narrative about intervention with cobogó.**

Combinemos as paredes compactas com os painos vazados, para que filtrem a luz e deixem a brisa penetrar.



Mesmo depois de perdida sua função estrutural, as paredes continuaram compactas, como se precisassem guardar o calor dos ambientes...

Tiremos partido das imensas possibilidades construtivas e plásticas do elemento vazado de parede — o cobogó — que pode assumir uma ampla gama de configurações entre filigrana e marcado jogo de relevos.



O cobogó ocorre frequentemente nas construções modestas do Nordeste, com desenhos fantasiosos ou ingénuos, mas sempre um elemento simples, leve, resistente, económico, sem exigências de manutenção e com alto grau de padronização dimensional. Com o estágio de racionalização atingido, num processo natural de seleção, o cobogó é um componente preparado para a grande produção industrial.

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Source: *Roteiro para construir no Nordeste* (HOLANDA, 1976, p.19)

Associated with the tutorial are the sketches elaborated by Armando de Holanda that elucidate the textual part and complement it in a simplified and assertive manner. These sketches denote the power of the image in teaching, detached from the technical need for drawing and yet being legible and palpable in a lay language, as the popular saying goes, "A picture is worth a thousand words."

The unpretentious way and the fact that it proposes a didactic language to a target audience, were the reasons why Armando de Holanda's Script was chosen as reference material for the "Cartilha Prática" prepared as a result of this research, since one of the missions is precisely to have this spirit of an easily absorbed practical material.

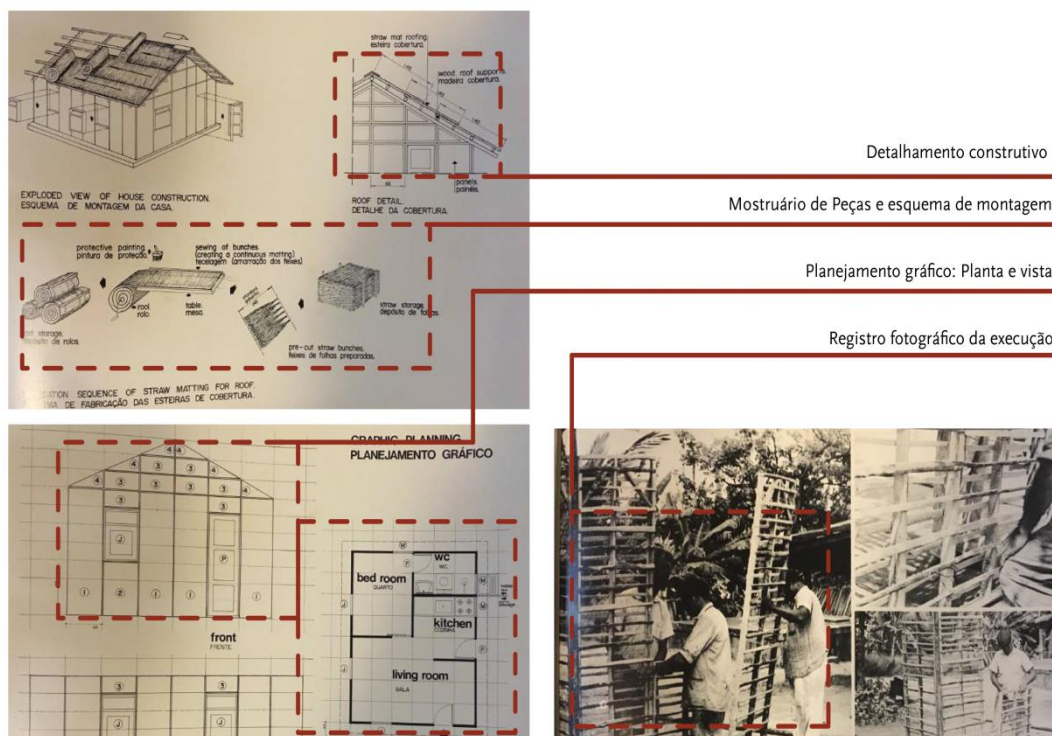
In parallel, *Taipa* by Acácio Gil Borsoi establishes, in stages, the construction of prefabricated buildings for residential use, through the experience obtained from the development of the project in the community of Cajueiro Seco, in Pernambuco. In an excerpt written in the introduction of the book *Taipa*, having stating that:

Our proposal is to rationalize and prefabricate one of the oldest construction processes in the world, which in Brazil still represents, even today, the construction system that translates the knowledge of more than half of the Brazilian population. By verifying that these social groups [low-income communities] have no knowledge beyond that which results from their own needs, within their reality, from their craft knowledge and from the use of their own hands, it was possible for us to develop the work. The system was conceived in two parts: Fabrication and Assembly. The manufacturing represented an industrial line, where the wood would be shredded in the right dimensions, assembled on tables and fixed to each other in the interlacing, by means of staplers, and finally treated and immunized. (BORSOI, 1963, p.4)

As seen above, we have the importance of works that seek to denote and cover as much as possible the existence of construction technology that are nothing more than "hereditary" processes, so to speak, but now being aggregated under a new view and

rarrangement, making them accessible to those who want to explore them. In this, we have well established a practical guide to construction, presenting photographic record, technical drawings, isometries, and textual part with comments (Figure 2):

Figure 2- pages from Taipa's booklet, Borsoi



Source: images taken from the book, edition by the authors.

Unlike Borsoi's work, which has as its driving premise to educate and empower communities with a possibility of qualitative self-construction, the booklet that is the product of this research does not seek to establish a modular and closed proposal for reinforced masonry construction, but rather to create a collection of possibilities by the method of reinforced ceramics, in an attempt to demystify the process and thus allowing it to initiate tests and trials in 1:1 scales.

The booklet was developed with the intention of having a simple reading, consciously visual and with an objective textual production, seeking in this way to become sufficiently legible and of direct understanding. It highlights the materiality through visual and descriptive interface, according to the principles of Universal Design, that is, the creation of products and environments whose aesthetics and usability are offered to everyone in a replicable way, regardless of age, ability or status.

Thus, after choosing the way to guide the information in the booklet, and better saying, its design, the next step was to select what and how the material would be included, in what way to structure the construction types that the Gabinete de Arquitectura had in its collection. The chosen alternative was to start with the functional requirement to categorize the samples. In this way, it was sought to list fundamental elements that were repeated in the office's works in a very characteristic resolution, such as the walls, ceiling, floor, pillar, shell, and panel. Having often in its repertoire more than one form for the execution of the system,



such as more than one type of reinforced ceramic wall, it opted to choose only one for each type of structure.

Next, it was attempted to establish a systematic division of the booklet program's, presenting two models of constructive mode with the technique, by formwork, and by prefabrication, cataloging the means of execution of the above mentioned systems according to the way the Office builds them on site. Thus, wall, floor, ceiling and shell were established as formwork elements, while the panel and pillar belonged to prefabrication (Figure 3).

**Figure3- Booklet's Summary**

<b>SUMÁRIO</b>	
<b>Introdução</b>	<b>04</b>
<b>Especificações</b>	<b>06</b>
<b>Seção 1 - Cofragem</b>	<b>08</b>
Parede	08
Piso	10
Teto	12
Casca	14
<b>Seção 2 - Pré-fabricados</b>	<b>16</b>
Pilar	16
Painel	18

Source: Authors' personal collection.

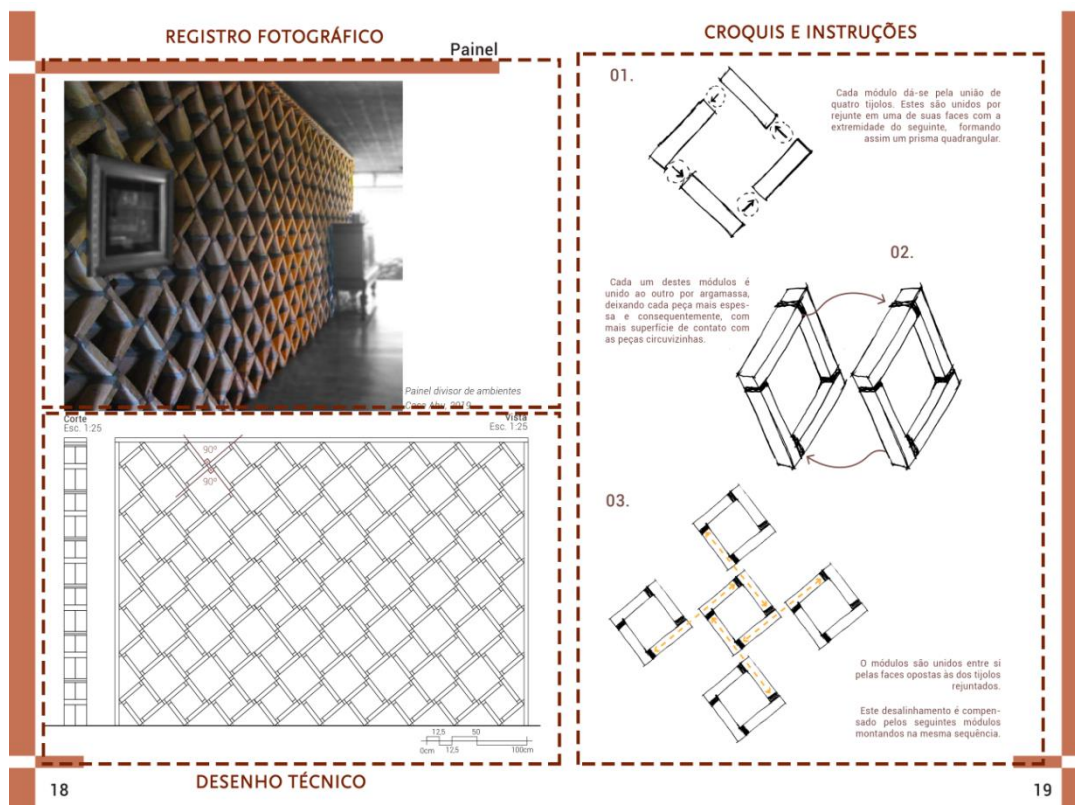
Although less usual, the terminology of formwork was chosen to denominate the assembly by molds or shapes for a semantic reason, in view of the approximation of the term to its equivalent in the Castilian language "encofrado", a word etymologically biased towards the sense of "to put in vaults", to enclose, chosen here to contrast with the sense of "to give form", "to mold" that its synonyms suggest, since these values seem to be more associated with concrete construction and its state of liquid matter, which in turn suggests spreading out depending on how the geometry of the form will be.

As didactic material, it was also important to add in the prelude of the booklet, what would be the different materials to be considered for the tests and systems for the manufacture of reinforced ceramics, brick, steel and mortar, as well as the presence of guiding instruments as support to have a reference, being these graphic scale and human scale.

Once the content and the logical structure of the elements included in the primer were denoted, all that remained was to build an identity that could be repeated in each model.

In this way, each topic consisted of three steps, which were: photographic record, technical drawings and sketches, the latter supported with comments establishing a step-by-step guide (Figure 4).

Figure 4 – Arrange example of a systematic composition page.



Source: Authors' personal collection.

## 5 CONCLUSION

Throughout the research and foundational process for this work, facing and becoming aware of what the technique of reinforced ceramic faced and how it made its way through time, it is fair to place it in a high hierarchical position as a constructive model for Latin architecture.

It is because it goes beyond cultural appreciation, the Latin identification with the clay element and it's population access, that the reinforced masonry also goes to a tectonic revolution intrinsically associated with the economic and sustainable discourse, in view of an American scenario in which building with quality and with the available resources is a differential desired by many. However, either due to lack of expertise or by sticking to the commonplace, there are still barriers to be overcome until a large portion of society has access to quality housing. We point out here that this quality in living goes beyond plastic expression; it is related to health when it comes to salubrity, or comfort when the merit is ventilation, acoustics, and temperature.

The discussion undertaken here and the Booklet as a final product does not cut out or investigate these questions in depth, nor does it try to solve this vast field of opportunities and challenges brought about by the world order and its reflections on each continent. However, as a booklet and by the essence of the Pernambuco school of architecture, which

had producers of expressive materials such as Acácio Gil Borsoi and Armando de Holanda, there is the intention to present in a palpable and didactic way the possibilities that a low cost and widely accessible material that is the ceramic brick.

The production process of a practical booklet is more than anything an invitation to discuss and promote critical reading, in no way deterministic and with an end point, always fitting the questioning, adding and improving its content, not being this a closed material and of unique consultation.

This work still opens doors for the expansion of its content, having been a dummy, that is, the demonstrative object of the graphic work, where only one case of structural reinforcement of each type was approached, having still the possibility to add into the booklet the many other ways of working with reinforced ceramic masonry. Besides, there is the opportunity to deepen the tectonic perspective of the technique and of the systems presented therein, regarding the testing of forces, resistance and pre-dimensioning of the structures.

Finally, it is essential to deconstruct "sustainable" from the purely ecological perspective that has accompanied it since the advent of the great debates about the environment in the 20th century. As a basic premise, sustainability is linked to the different social, economic, cultural, ecological dimensions, among others.

Sustainability is the balancing of these dimensions in order to guarantee the survival of resources, biota, and human life for future generations, ensuring quality of life and well-being for the present ones. In this scope, the urgency of thinking construction techniques and architectural productions beyond productivism and market demands and impositions, has in the valorization of regional techniques a fundamental driver for the transformation of our cities.

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