CADERNOS
PROARQ 18

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Industrial Architecture: technique, detail and significance[1]

1. This paper summarizes the results presented in the master thesis entitled "Industrial Architecture in Recife: the face of modernity", by Renata Maria Vieira Caldas, supervised by Fernando Diniz Moreira. It results also from the research "Architecture Values in Pernambuco", 1970-2000, coordinated by Prof. Moreira and funded by National Council for Scientific and Technological Development (CNPq) e by the Foundation for Research Support of the State of Pernambuco (FACEPE). The authors are thankful to these institutions for the financial support essential for the conclusion of this research.

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ABSTRACT

Buildings designed to accommodate production processes (production, storage, distribution and marketing) are closely related to two phenomena of modern era: mechanization and industrialization, which made them an expression of modernity. Architects thought these buildings as a way of solving design deadlocks of technical order. These solutions resulted in remarkable engineering achievements, such as technical calculations, advanced techniques using iron, steel or concrete and the rationalization and standardization of building processes, which were also used in buildings other than factories. On the other hand, it can be said that such achievements affected architectural quality in artistic terms, since most of the building form was neglected in favor of techniques or attendance of fluxes or other internal demands. However, there are singular buildings in which principles and techniques of modern construction were used, particularly the prefabricated ones. We attempt to show how these principles are able, depending on the way they are managed, to provide identity and meaning to buildings. This article aims to analyze industrial buildings through their techniques and building systems, having a case-study three buildings in the metropolitan area of Recife, built between 1960 and 1980.

Keywords: Industrial Architecture. Modern Architecture. Building Techniques. Architectural Theory. Architectural Detail

"Architecture is an art because it deals not only with the primary need of shelter, but also for joining spaces and materials, in a significant way. And this is done through formal and real junctions. It lays in the junction, that is, in the fertile detail, the occurrence of both the physical building (constructing), and the significance building (construing)." (FRASCARI, [1983] 2008, p.552).

Introduction

Usually industrial buildings[1] demonstrate the use of principles as rationalization and constructive truth no matter where it is located. Factories developed as part of the industrialization phenomenon, and subsequent mechanization. Along their dissemination, significant changes on building modes, with the experimentation of resources and technologies appropriate to their necessities, could be observed. Not only the machines contained in their interiors went through changes, but also the building itself progressively assumed its pragmatism more and more, expressing its condition as a modern artifact. With its forms reducing process to the strictly necessary, the industrial building started to serve as a Modern Architecture reference. Such buildings became fundamental for the modern architectural rationale, to the point where industrial machines and equipment inspired architects as Walter Gropius and Le Corbusier, who, in the height of the 20th century, praised north-American industrial buildings and demonstrated their enthusiasm on the machine age. [2]

The building techniques advances, starting in the 19th century, involved not only the application of materials but also of building processes, which consisted both of the constructive element pre-fabrication, and also of their assemblage schemes. The construction became a large system, articulating other subsystems. Parts of the buildings gradually started to be produced off the building site and assembled there. This dynamics characterized the mechanization of the building industry by preparing its main elements industrially, considering sequence, standard and scale matters.

Nevertheless, this new dynamics caused a series of questionings in a profession like Architecture, historically marked by the search on creativity in works that should not be supposedly reproduced in a large scale. How can a building have a meaning to a specific society and be appropriate for a specific region conditions, if it is a result of its parts assemblage? As questioned by David Leatherbarrow, how can a building be original, when its parts supposedly produced in other places existed even before the start of the design? (LEATHERBARROW, 2000, p.119). Does the use of pre-fabricated solutions imply the loss of architecture status as an art? These questions motivated this work, since

1. Parts of this group are: factories, warehouses, plants, assembly lines buildings, among others.

2. As seen in different parts of Le Corbusier's *Toward an Architecture* (1923) previously published in the journal L'Esprit Nouveau, and Walter Gropius, in 1913, in his article *Die Entwicklung Moderner Industriebaukunst* (The development of modern industrial building) (GIEDEON, [1928], 1995, p. 51; GEIDEON, 1954, 1992, p.25-26).

the research interest was to reveal aspects that could qualify industrial nature buildings as architectonic works.

This paper intends to analyze industrial buildings through an approach on the techniques and building systems applied on them. It presents as cases studies three buildings of 1960 to 1980 built in the Metropolitan Region of Recife. They were chosen out of a larger group of local industrial buildings. The period was of great optimism in Brazil and the Northeast, when many industries were installed in the region, demanding a large number of projects by local architects.[3]

Despite the theme's range, these buildings' analysis was accomplished through reflection on two thematic approaches: on the technique, and on the construction details. The investigation's starting point consisted in the election of authors who address the building techniques theme, as inductors of the creative process in the architecture design. Moreover, reflections were done on the role of construction details as factors of the buildings' identity formation. Gevork Hartoonian, Vittorio Gregotti and Marco Frascari authored some of the texts chosen for the analysis.

For a more comprehensive understanding of the theme, a brief review was done on the emergence and evolution of buildings meant for production and commercial purposes, among them, warehouses, manufactures, factories etc. In this revision are: the relevant transformations in the productive and, consequently, building processes; the buildings' dynamics and its own methods; and, especially, the changes on the derived aesthetic order became focus of the following speculations.

The secularization and rationalization processes that hit architecture starting in the last decades of the 18^{th} century, provoked a disruption in the classical composition system. During the 19^{th} century, engineering advents, such as steel structure and reinforced concrete, together with the specialization of the productive chain functions and industrialization, caused the obsolescence of the classical architecture constituting elements. The classical language lost its tectonic sense, while its function became the disguise of the modern structures supposed uncertainty and poverty. According to Gevork Hartoonian, the old concept "make/build", meaning the double attribution composed both by aesthetic values and by the empirical building aspects, was named by the Greek with the word *techné*. I was lost, primarily by the rationalization introduction, and by the use of modern techniques and materials in buildings. Thus, technology substituted *techné* (HARTOONIAN, 1994 p.6)

3. The offices of Maurício Castro & Reginaldo Esteves, Acácio Gil Borsoi, Delfim Amorim & Heitor Maia Neto, Armando de Holanda, Glauco Campello & Vital Pessoa de Melo, Marcos Domingues and Sena Caldas & Polito, among others - the majority of their members graduated at the Architecture Course of the School of Fine Arts in Recife, or at the transition of this school to the School of Architecture - during the period, got many contracts for industrial architecture design. In their projects, we can observe the presence of such principles of industrial building, associated to the aesthetic and climatic adaptation experiments.

Nevertheless, this verification, that is known and accepted in the theoretical architecture field, does not mean an absolute evil to Hartoonian. He admits that it is possible to foresee in modern architecture the reconciliation between “to make” and “to mean”. Thus, we intend to show that even when modern principles and building techniques are not used, particularly the pre-fabricated systems, it is possible, depending on its manipulation, to engender identity and meaning to the buildings.

In relation to the role of technique in the architectural design conception, Vittorio Gregotti, argues that this participation happens in three levels: the structural determination, or the building’s skeleton; addressing flows, and details experiments (GREGOTTI, 1995, p. 51). These three possibilities in the technique role, that perform as guidance for the project, were identified with different design strategies, and were considered as criterion for the selection of the three buildings studied here. Each corresponds to a strategy. Such resources are related to many techniques, such as: drawing; building assemblage; climatic adaptability; and architectural composition; while these, in turn, address functional and aesthetic senses.

After the examples were picked based on Gregotti’s considerations, the buildings’ analysis was grounded on the idea that every single architectural detail is always a junction; that is, the place where the interface between elements happens. It becomes necessary to resort to a procedure or technique that recognizes the intrinsic properties of each involved party. Marco Frascari (FRASCARI, [1983] 2008) also mentioned the idea of junction as a definition for detail in Architecture.

We may affirm, though, that every architectonic element defined as a detail is always a junction. The details are sometimes “material joints”, as is the case of a capital, which is the joining part between the shaft of a column and the architrave; sometimes they are “formal joints”, such as a gate, which is the link between the interior and the exterior space. Thus, details are the direct result of the functions diversity that exists in Architecture (FRASCARI, [1983] 2008, p.541).

Later on, in the same text, Frascari refers to a “negative junction” that would be the interval between spaces, a type of (imaginary) joint, which instead of separating, integrate them. These three “conceptual junctions” are part of a practice for revealing the building from a constructive perspective, and at the same time, making it meaningful, since they help clarify each element. Therefore, articulations between spaces and materials were elected as the focus of analysis for the elected buildings.

The first building, TCA - an old Willys assemblage plant (1962-66), had its guiding principles based on its structural scheme. Designed by Maurício de Castro and Reginaldo Esteves, it is located in the vicinity of BR-101-South, Km 19. The second building, AGTEC (1974-76), authored by Glauco Campello and Vital Pessoa de Melo is located within the city of Recife urban fabric (Av. Profesor Morais Rego, Cidade Universitária) and had its form determined by its essential functional flows. The third, Bombril factory (1979-83), also located in BR-101, km 52 North, in the municipality of Abreu e Lima, Recife metropolitan region, was based on the detailing of an unique construction system, reproduced in the building as a unity, was designed by Acácio Gil Borsoi, Janete Costa and Rosa Aroucha.

FIGURE 1
Location of studied buildings in Recife Metropolitan Region.

Image captured in Google Earth, 2009.

TCA: form follows structural system

In the first strategy, the structural system defines the form. Normally, after this system is chosen, the main layout of the building, its modulations, articulations between spaces, and roof solutions, are established. Therefore, such a strategy can be divided in two alternatives. The first is the one in which the building's volume is defined by design and sequence of its elements in a explicit way. Two famous industrial buildings in Brazil can be cites as examples: Duchen (Presidente Dutra Road, at São Paulo and Guarulhos border line, in the direction of Rio de Janeiro, 1950-51); and Sotreq (Av. Brasil, 7200 – RJ, 1949), designed by Hélio Uchoa and Oscar Niemeyer, and Roberto Brothers, respectively. In the second alternative, the structural system, despite defining the conception guidelines, is involved by walls, which subtly hide or reveal the main structure configuration.

In both cases, this mechanism is generally used for the conception of open spaces, which favors flexibility; and it has been a recurrent requirement for industrial buildings that need solutions for machinery and the production line layout changes.

The second alternative, or a version of it (the subtle structure revealing), was associated to the current automobile electric and electronic components factory, TCA, the old assemblage plant for Wilys Jeeps, designed by architects Maurício do Passo Castro and Reginaldo Esteves.

FIGURE 2
Aerial view of TCA captured with Google Earth, 2009. Red contour: production unit, green: administration; blue: cafeteria; and yellow: access control sector.

Located at BR-101-South, km 19/20, in Prazeres, municipality of Jaboatão dos Guararapes (PE), this large assemblage unit for cars was inaugurated in 1966. It was built by Construtora Norberto Odebrecht. Initially, it was meant to automobiles assembling for Ford do Brasil, but currently, it produces electric and electronic components for automobile plants, under the administration of TCA (Tecnologia em Componentes Automotivos S.A.). Distributed in a 191,232.10 square meters site, this complex consists of a large warehouse, meant for the production line, an administrative block, a block for the cafeteria, and another one, smaller and closer to the entrance, where the control and management sectors are located. The blocks are spread out through the site and connected through covered and open walkways, or simply by the gardens' mediation.

FIGURE 3
TCA. Panoramic view of the factory in the time of the inauguration.

Source: TCA collection

The production warehouse connects to the administration building through a small footbridge, covered by a slab suspended by unilateral concrete pillars. The complex presents an agreeable and uncommon environment, in comparison to most of the existing examples in the region, due to its large separations, transformed in gardens.

Meant to accommodate the production line, the larger warehouse has concrete pillars with large dimensions. They are arranged in a rigid modulation (24 x 12m) to support the transoms, also in concrete. The pillars distribution had the purpose of covering large clear spans and supporting the upper structure (aided by a wireframe and metallic trussed beams), with asbestos-cement roof tiles intermediated by translucent ones in a shed system, the main source of natural light.

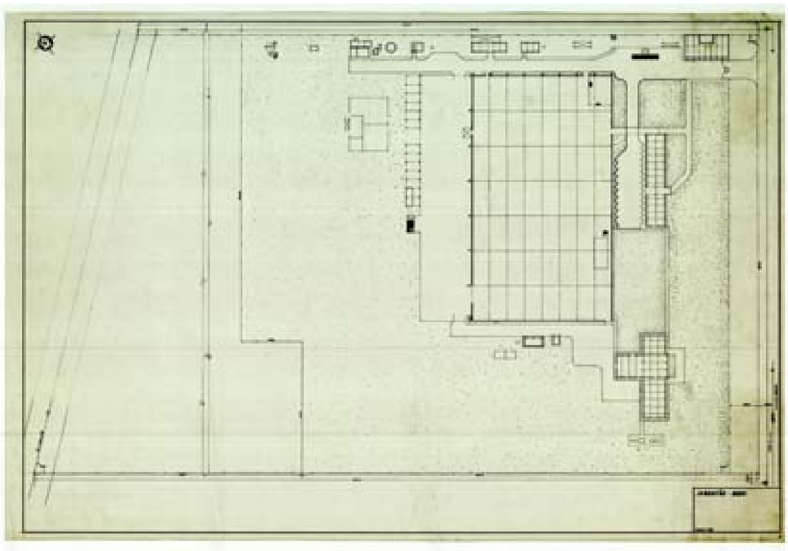


FIGURE 4
Image of an original plan.

Source: TCA collection.

The peripheral enclosure presents a secondary structural system, that also consists of concrete pillars and beams, as well as intervals filled with ceramic bricks in the bottom part, hollow concrete blocks in the intermediate parts, crowned by an opaque and continuous plat band. This enclosing surface follows a modulation scheme that articulates to the main structure, in which the façade informs and references the internal modulation.

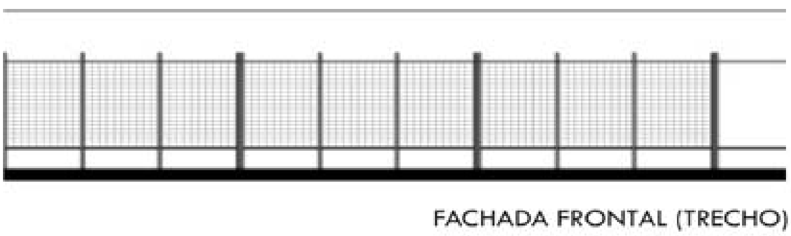


FIGURE 5
TCA. A portion of the main building façade

Drawing: Renata Caldas

The enclosing surface that involves the huge prismatic warehouse has its lightness emphasized by porosity and translucency, since hollow concrete blocks compose the central part of the façade, which, at the same time, provide ventilation and light, and are the source of texture to the surface's composition. [4]

This project presents an extensive use of concrete (pillars and main beams). It is noticeable the intention of utilizing prefabrication and assemblage schemes, despite most of the forms were prepared in the construction site. Due to its dimensions and its constitutive elements repetition, and by its permanence in space, we may observe a sense of infiniteness, perhaps similar to the one experienced by the Chrystal Palace visitors.

We can also observe a simplification of forms, transforming the buildings in large prismatic elements located in the extensive site. It refers to a set of isolated buildings that can be observed from distinct angles. Most of the materials were used in their natural forms, and the textures were set in matching combinations.

Regarding the concern with climatic adequacy, three main measures were taken: the use of hollow concrete blocks, the rooftop openings for airflows and the location of the buildings in a large green area. Those procedures, suggested by Armando de Holanda in his book *Steps for building in Northeast* (1976), were already part of Castro and Esteves' concerns in this project. According to Esteves,[5] experiments were done with the purpose of improving the performance of hollow concrete blocks and sheds for air circulation and escape, and for rain protection. Such experiments consisted on simulating rain by means of water jets combined with fans, in one side of a hollow concrete block opening, in order to verify the water reach pushed by wind. However, it becomes clear that the importance of using these devices (hollow concrete blocks and sheds) was also linked to a plastic intention. The preference for some materials, such as the ceramic block, in its natural state, carries both aesthetic attributes, as well as advantages for climatic comfort, since it is a good thermal insulating material.

Both the complex as a whole, and the production warehouse presented an inexpressive number of what was defined by Frascari as a "formal junction", that is, an element that promotes an articulation between spaces in a continuous way. This junction happens in TCA only in the exterior circulation, under the slab with unilateral supports. This walkway connects two blocks and also serves as a place for permanence, as a terrace. Its structural distinction, the pillars that hold up the slab, evidences its role mildly, and at the same time, strongly, because of the supporting structure's design.

Since the whole complex is composed by prismatic blocks that are well defined and with no cuts or indentations, this type of articulation is rarely present. The

4. In the design, there was also a concern on the insertion of a large embossed concrete panel, authored by an artist, Carybé, a proposition present in the industrial buildings designed by Castro and Esteves, according to information provided by Reginaldo Esteves, in an interview to the author in November 2009.

5. Information provided in an interview with the Architect in November 2009, at his office located in Casa Forte.

FIGURE 6

TCA, interior view: hollow concrete blocks in the entire perimeter of the production block.

Source: photo by Mafra.

openings, in turn, are direct and do not involve intermediate points, what could be interpreted as this type of connection.

In the main warehouse, the interfaces between elements and materials are present in three aspects: in pillars and beams design; in the sheds structure; and in the façade plan materials changes. However, such material junctions are present in a more objective than significant way, and its role in the composition is discreet.

The logic of a structural system that is independent of its envelope was used in this building; however, in this case, there was an inversion of the systems densities, if compared with precursor Modern Movement buildings, such as the Saint Geneviève Library, by Henri Labrouste (1838-1850), and the Amsterdam Stock Market, by Hendrik Petrus Berlage (1897-1903). Their peripheral enclosure systems were built in masonry, which gives these buildings an evident exterior density, while the interiors present light metallic structures in a sharp contrast with the exterior (FRAMPTON, 1995, p. 46-48). The density inversion applied in Willis assemblage plant was obtained by means of a strong internal structure, composed by big concrete pillars and beams, and by a light and translucent enclosure surface.

The contrast between the building's silent exterior and the monumental interior, identified in TCA, is due to the same principle present in the Library and the Amsterdam Stock Market, despite the inversion of densities. Neither of them have "silent" exteriors. The secluded structure of the interior "envelope" consists of a well-used resource in 20th century's large proportions industrial buildings, such as Glass Plant, in the industrial complex of River Rouge, Dearborn, 1922, and Chrysler Corporation Tank Arsenal building, Detroit, 1940, Both projects, designed by Albert Kahn, clearly reveal the dialog between different techniques and materials.[6]

6. Even in different periods, this has been a well-used option. It is possible to find similar examples, before, during and after the building of Willys assemblage plant in 1964, in different places.

The separation of the building's two structural systems performed as an important advance, and it heavily influenced modern architecture further manifestations. Approximately, after one century, Castro and Esteves, in the Willys Assemblage plant design, seem to have reinterpreted Labrouste and Berlage's strategy, inverting densities for reasons of climatic comfort (with hollow concrete blocks in the walls and sheds in the rooftop), which characterizes the permanence of important values, such as rationality, absolutely relevant to industrial buildings.

Agtec: the uniqueness

The second strategy considers the role of technique in the design project, in face of addressing necessary flows within a building, as it happens in the famous Factory Van Nelle, in Rotterdam. Such a strategy was capable of defining the uniqueness of Agtec's design.

In this mixed-use building, the adopted solution privileged the movements and flows of products and equipment. It is noticeable that this strategy has also two basic options: the first is used in flexible spaces, adaptable to its variations, such as large clear span plans, generally with only one floor. The second appears when addressing the flows has to be adapted, either in relation to the site's limitations, or when it needs to be done not in one story only, but in different floors; or else, when the production scheme involves very singular requirements, feasible only by means of a specific design. The second option was identified in Agtec, where it was necessary to articulate different plans and flows directions, a condition that directly influenced the design solution.

The structural question was also very important in this case. The building's development follows a uniform structural disposition, which was conceived with its won design to perform its function. However, the enclosure plans and articulations between floor through stairways, voids and slabs cuts, to form mezzanines, make the spaces more dynamic and correspond to the necessities of the building's internal movements.

Agtec Industry was designed by Glauco Campello and Vital Pessoa de Melo, in 1974, to shelter a workshop and a foundry for agricultural equipment, an irrigation systems design offices, and a sales and representation office. Its location in an expressway, Av. Professor Moraes Rego (BR-101), within the urban fabric, favors its commercial and services purpose. It occupied primarily a lot measuring 50x50 meters, which was later reduced to 35 meters in the west side with the opening of BR-101.

According to the report by the company's owner, the agronomy engineer Crinauro Vellozo, one of the main design requirements was to find a solution to

FIGURE 7

Agtec: aerial view, captured with Google Earth. The building is signaled in yellow.

protect it from the frequent flooding that occur in that region of the city. The answer was to make the building vertical to guarantee a way of escaping the flooding.

This vertical solution in three levels had necessarily to establish at least one vertical circulation. Still in relation to the possible flooding, another requirement emerged: there should be also the possibility of moving equipment and products from the ground to the upper floor. Starting from this requirement, a second vertical circulation was created then, exclusively for machinery and products, which received a load elevator, in order to provide this flow. Its structure was calculated to support, in the second story, the machinery, exposed in the ground floor, which would be lifted up in the case of flooding.

Two vertical circulation axes were established in the building, thus: one for people, through the stairway, and the other for machines, through a load elevator (never installed). This determining factor of two main circulation vertical axes indicates that the primary concern in the building's conception was given to flows, defining its form.

The horizontal movements are most intense in the ground floor, because of the shop and workshop. In the first floor, there is an office located between the workshop and the shop (mezzanine) and some small offices. The company's

FIGURE 8

Agtec : main façade

Photo: Fernanda Mafra.

administration office location allows visualization of both sides of the ground floor (shop and workshop). This level has a smaller occupied surface. In the second floor, there is a subdivision by sector, one meant for offices, facing south, and another that serves as storage and receives the machinery in the event of a flooding, facing north.

Despite the attention to flows had been chosen as the building's conception strategy, its structural system is highly significant and can also be considered as a design guideline. A series of concrete column pairs forms a sequence involved by enclosure partitions, either in masonry, or in hollow concrete blocks or glass, creating an open structure. Over this series of pillars with double height ceiling (required due to the region's flooding), there is a compact mass, the second floor that emphasizes the building's horizontality. The structure is all built in exposed concrete and its forms were made in the construction site. There was no use of pre-fabricated structural elements and the building was entirely shaped *in situ*.

The building presents a longitudinal composition distributed in three horizontal stripes, corresponding to each story (ground floor, first and second floor). The inferior two thirds differ of the superior third part, both in terms of proportions and in the surface treatment.

The partition walls, which involve the pillars independently, not touching the slab or the structure in the totality of the perimeter, softened the rigidity of the structural arrangement. Besides the subtlety of not entire fencing off the ground floor, this enclosure includes a variation of density and texture by utilizing plastered masonry, hollow concrete blocks, and glass in the lower part (windows). Such variation emphasizes the game of lights in the building's interior, as well as protects is from the direct sunset exposition that hits the main façade.

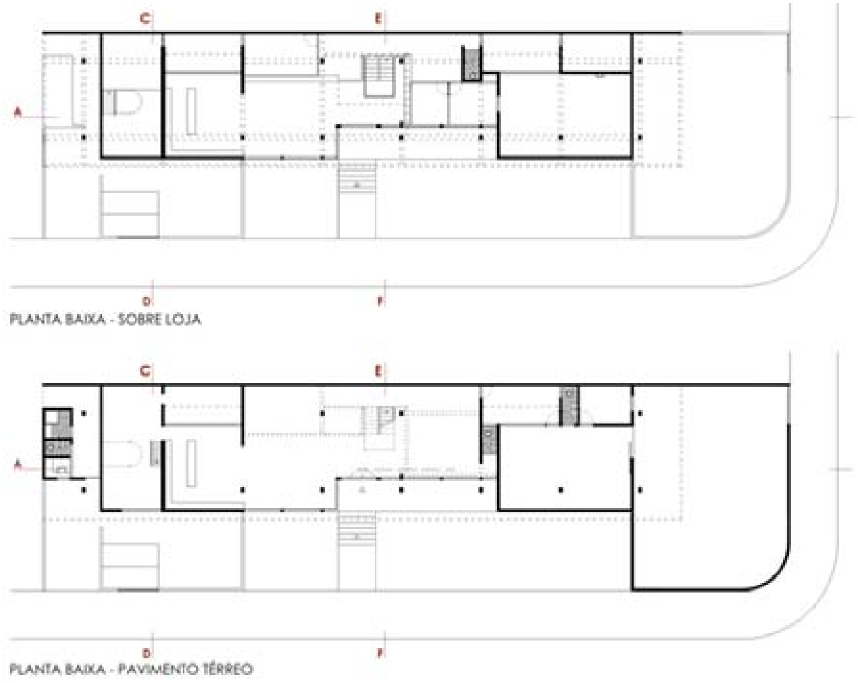
The beams cross-section design suffers a declination in their endings. This decrease also occurs in the cut of the superior volume in two smaller sides, facing north and south, forming a trapeze, and the inclination that leads to the internal part of the volume accommodates roof tiles and facilitates rainwater drainage.

The role of technique, here, can be also attributed to the search of climatic comfort with the use of some Armando de Holanda's (1976) recommendations, as well as to the design with strange proportions that makes this work an uncommon example. Some of Holanda's recommendations are very evident in the building, such as separations between walls and slabs; cantilever facing west, to create shade; recess of the inferior walls; use of hollow concrete blocks; some windows' protection; and the austerity in the choice of materials. However, the first floor prismatic volume denies those principles, since it clearly exposes the façades to bad weathers, as well as its own unfavorable orientation, facing longitudinally west.

FIGURE 9

Agtec: Plans for the ground floor and second floor, show the independent structure and partitions, as well as differences in materials and textures.

Drawing: Marília Alheiros.

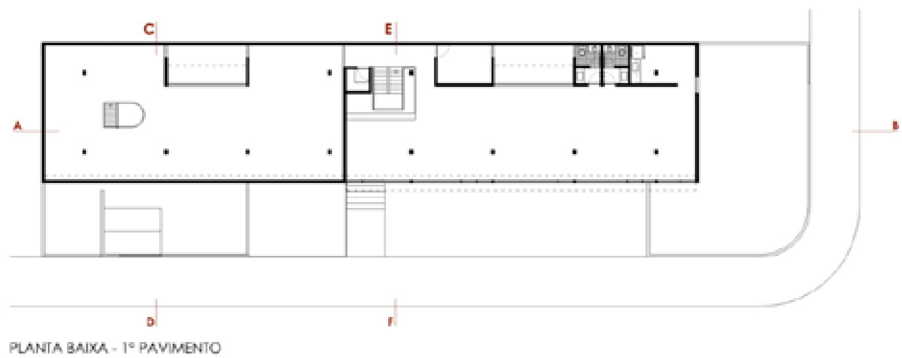


Because of their fragmented nature, the articulations occur intensively in this building. Marco Frascari considerations on different junction types (material, formal and negative or virtual) offer a clue for the building's reading (FRASCARI, [1983] 2008, p.538). In Agtec building all of them can be found. In various moments there are junctions that, many times, have double meanings types or definition. This means that the same connection can be of two kinds (formal and material, for example).

FIGURE 10

Agtec: first floor plan

Drawing: Marília Alheiros



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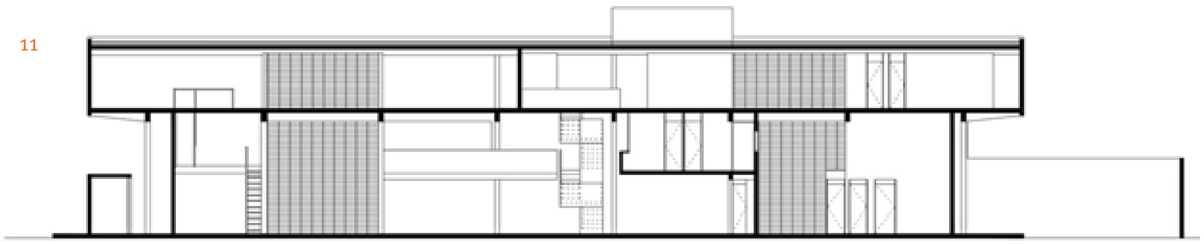

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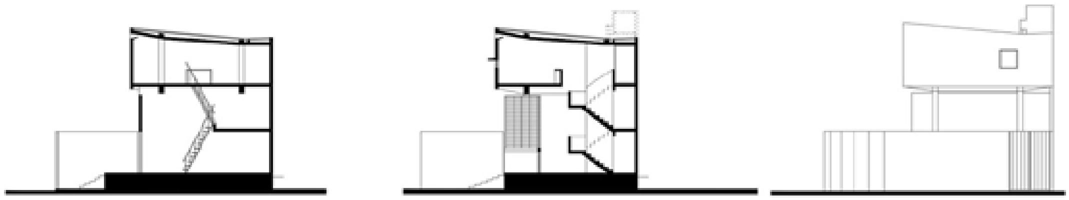

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FIGURE 11

Agtec: first floor plan

Drawing: Marília Alheiros

FIGURE 12

Agtec: Front façade

Drawing: Marília Alheiros

FIGURE 13

Agtec: transversal cross-section and side façade

Drawing: Marília Alheiros

The junction of spaces occurs, in this case, in the vertical circulations, mainly in the stairway. By crossing the floors, the stairway is naturally a joining element, and it is especially interesting for its freestanding nature in front of a double height space. Other example of formal junction in this building is the window shop, a horizontal opening that starts in level zero of the ground floor and has a very low height. This artifice allows an integration of the exterior with the interior, due to a necessity of visualizing exposed products in the shop interior and, at the same time, protects them from direct sunlight.

The double tee junction in the head of the pillar that unites it to the slab, even sharing the same material makes the constitutive elements (pillar, beam and slab) to be perfectly distinguishable. The friezes between the different surfaces are also an example of material junction, besides all the plans connections with different textures, colors and materials (concrete, plastered masonry, iron and hollow concrete block). The negative junctions are visible mainly through the cuts in the floors, both in the mezzanine and the floor slab cut reserved for the installation of the load elevator.

The space between the ground floor and the first floor partitions in relation to the second floor slab is significant. This interval is important both for the volume and for the space, since it informs the separation between the higher third and the lower two-thirds of the building, besides allowing the separation of each element to be understood. The stairway opening can also be considered as a negative or virtual junction, since it stands free in the continuous void between the floors.

There are as many details in the work as the possible experiences while walking through it. Among its cuts and junctions a building full of surprises is formed; a curious and strange composition on the arid theme of the industrial nature building.

FIGURA 14

Agtec: acesso principal no qual observa-se o recuo de parte da fachada que, por sua vez, é composta de elementos vazados e não toca na laje, atendendo, assim, simultaneamente às três recomendações de Armando de Holanda

Foto: Fernanda Mafra

Bombril Factory (NE): the design guided by the detail

The third strategy addresses the role of the technique in the architectural design production, through the exercise of detailing. In this exercise, the construction detail concurrently guides the building materialization and gives it significance, a quality already predicted by Kalk Bötticher in the mid 19th century. Bötticher distinguished the Kernform, the nucleus or functional and structural part, and the Kunstform, the artistic finishing with the purpose of representing and symbolizing the work's institutional condition (BÖTTICHETR, [1846] 1992, p.159-165). This property has the constitutive architectural element of containing operative or functional aspects associated with aesthetic aspects. It was reclaimed by authors such as Frampton, Gregotti and Fracari, and addresses tectonic values, which are not limited to revealing the building's constructive truth, but also in identifying aesthetic attributes originated on the technical resources used.

FIGURE 15
Pillar head double tee junction.

Photo by Fernanda Mafra

FIGURE 16
AGTEC: friezes between distinct surfaces

Photo by Fernanda Mafra

Bombril factory (NE) was the chosen work to be examined within this perspective. This building assumes principles of reproducibility and assemblage (concerning to the modernist paradigm) in an integral and unique way. As a whole because the main systems (structure, envelope, cover and installations) are composed by minimal units that repeat in the building; and, in a particular way, because both design, and assemblage of components were developed according to the work's specificity. Within the uniqueness of this project's components' design (minimal units) a strong sense of functional and aesthetical value exists, which reestablishes the old technique attribution as a mechanism to solve a construction problem, and at the same time, to make the architectural object meaningful.

Bombril factory is located at BR-101-Norte, municipality of Abreu e Lima, Metropolitan Region of Recife. The industrial complex has 20,295 square meters of built area, composed by three main buildings meant initially to the production of steel wool. Acácio Gil Borsoi, Janete Costa and Rosa Aroucha did the design in 1979, and the building was concluded in 1983.

The buildings' location was defined with separate volumes, which are settled in the slightly sloped terrain, and concurrently address the production logic. The three volumes serve to different functions: the first holds the administration; the second was meant for the production; and the third for storage, stock and distribution center.

According to Aroucha and Amorim, there was a first solution that consisted in a simple warehouse. However, the company's representatives rejected the initial proposal and asked for something different. Thus, a new and definitive alternative was proposed.

Two main characteristics of this project were the arguments defended by its author. The first was its enclosure system with pre-fabricated concrete panels, designed exclusively for the building; and the second was covered with a three-dimensional steel structure.

The façades enclosure, using modulated panels that are completely independent from the rooftop supporting structure, shows its elements autonomy and reaffirms the building as an “assemblage”. Those panels were disposed according to their need in large surfaces, and form a perceivable game in all its sides. The design of those enclosing panels was done considering the measurements/modulations of the other systems (cover and structure), in a clear intention of coordinating them with each other.

The rooftop was subdivided in two parts: the first part lays on the two first blocks, and has large openings over an internal street that separates them. The second cover is located over the storage block.

For the fact of being flat and distributing uniformly the loads, this reticule or three dimensional grid was sustained in a large recess in relation to the buildings perimeter, projecting beyond the enclosure and creating, thus, large overhangs. With such a cantilever, the intention was to protect the walls from sunlight and rain, promoting a climatic comfort to the building. The rooftop supporting three-dimensional steel structure creates an interstice or “air cushion’ in its width, which helps heat dispersion. Besides this protection, this cover system served also as a connecting element with the blocks, and promotes in the building the balance its volumes, giving the whole set a continuous and at the same time light look, because of its wide cantilever.

Some of the factory’s secondary components, such as the air escape tubes also become part of the buildings composition. The exposition of all its elements, an option very common in industrial buildings, was adopted here and added to an exclusive design. In the building there was also a place meant to an artistic mural, with concrete plates forming a three dimensional mural. This mural was applied as a connecting partition between two blocks of the complex.

The Bombril factory seems to be the continuation of a principle previously explored by its author, Borsoi, when he designed the houses for the Cajueiro Seco complex, in 1962 (CAJUEIRO, 1984). It refers to panels structured on vertical elements, with the vertical mounts linked by plates, in adobe, in the caso of the Cajueiro Seco houses, and in the factory, with pre-molded concrete. The materials, proportions and functional purposes are naturally different, but the principle or strategy is the same: its minimal unit (panel and openings) provides identity to the building.

The grid rationale is present in the whole building. A notion that manifests in two dimensions, when the grid or chess board pattern is launched, coordinating the modules; and in three dimensions, when both the enclosures and the roof are conceived together, with coordinated dimensions; and, finally, with the formal articulations between blocks or volumes, between the top layers and their intervals. The modular coordination “allowed the combination of materials, in a meeting point of feet-inches and metric system scales, the 1,25 m modulation” (AMARAL, 2001). Such a procedure, applied in Bombril Factory, corresponds to the minimum half module for the industrial buildings universal modulation standard.

Its “cells” that contain the design’s generative information in this building, provides to it harmony and identity. The structure that receives the spacial trellises pyramids, the partition panels and their combining covers, all the elements that work together, give the impression of a complete work that does not allow additions or subtractions. All the “knots” or connections proposed in this design promote its identity. Through the geometric coordination, notches, links of parts, the building presents itself and becomes comprehensible.

This large proportions complex is an example that presents a correct coordination between enclosure elements, lighting, ventilation and structure; part of them similarly pre-fabricated and with their own modules. It presents itself as a large junctions complex, and that is why the exercise of detailing is its major ally in the production of meaning. The spatial trellises system itself is structured in the connecting points, called knots, and works through the compression or traction axial forces.

The enclosure is structured by notches and also demands a design that favors this mechanism. A total of amount of pieces (7) was defined for reproduction and combination with each other and other systems, particularly the structure and rooftop. The number includes vertical pieces, the closed and open horizontal pieces, as well as the upper and lower endings.

Regarding the articulations between the buildings of the complex, they occur by means of large cuts or intervals, and by the joining wall between two blocks with an artistic mural.

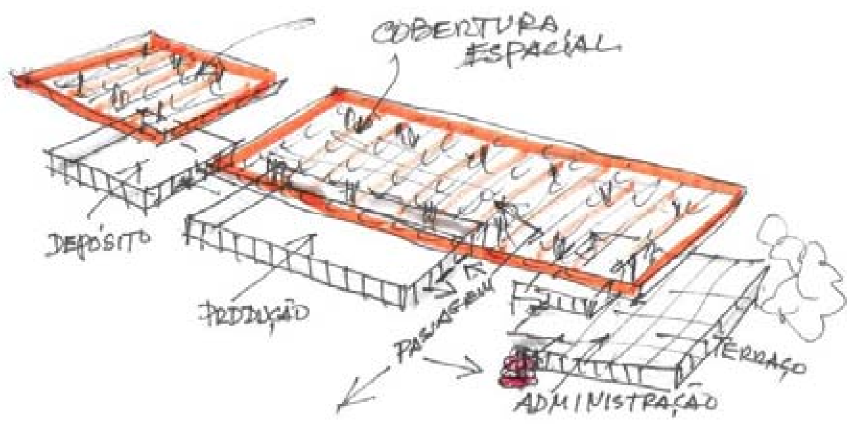


FIGURE 17
Bombril Factory (NE): sketch by Acácio Gil Borsoi

Source: Borsoi Arquitetos Associados office collection

The links between spaces through elements of continuity or demarcation are, according to Frascari, the formal joints so well represented by the gate. In Bombril, the part of the cover that lays between the two blocks (administration and production) is not a gate, but performs as a great landmark that integrates three spaces: the two blocks and the street between them. The street itself can also be considered a formal joint.

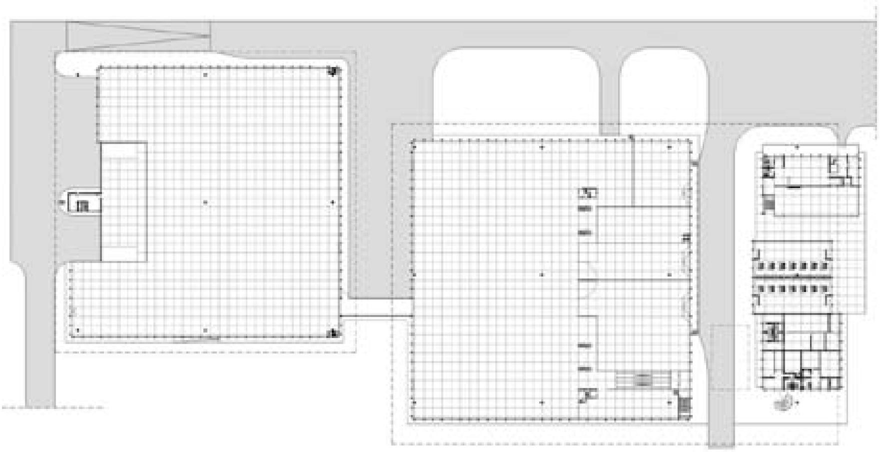
The panels and side mounts connections, between pillars and the trellises main supports, can be considered as knots or junctions; all of them are details. Uniting different materials and systems, these knots demonstrate clearly their functions and aesthetic attributes, which are evidenced by the fact that the materials were utilized in their exposed natural form.

The intervals that address the building's integration are present in Bombril in two skylight openings over the street located between the two administrative and production blocks, in the void or setback of these blocks, necessary for the street flow; and also in the cutouts, such as the two big gates for the raw material supplying. This building exemplifies the conception proposition through uniting similar elements, the layout of which gains strength and significance. It is an example of positive interaction between different systems, presenting an idea of unity and harmony.

FIGURE 18

Bombril Factory (NE): Ground Floor Plan

Drawing: Renata Caldas



Concluding Remarks

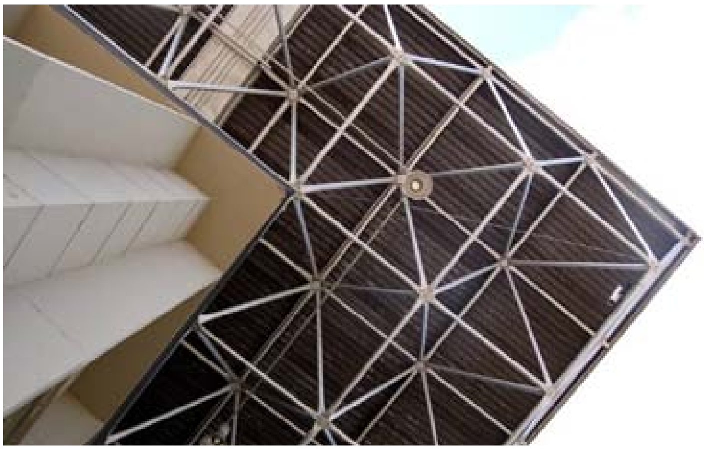
The three works presented synthesize three techniques application possibilities during the design conception, according to Gregotti (1996), which are considered here as marks for the analysis direction. In his argument, the author states that there exist three possibilities of technology serving as starting point for the architectural design conception: in its substantial structure (skeleton), in its physiology (flows), and in the detail. However, he stresses that these three aspects happen simultaneously, with the prevalence of only one of them.

The first possibility can be identified in TCA factory, old Willys automobiles assemblage plant, in which the basis of the design lays in its structure, or skel-

FIGURE 19

Bombril Factory (NE): view of the roof, showing the coordination of the envelope and cover systems

Photo by: Fernanda Mafra



eton. However, this structure treatment occurred as a kind of dissimulation, that is, its exterior aspect subtly reveals its interior.

The second possibility can be found in Agteg building, which mixed nature (industrial and commercial) induced a very specific solution: addressing people, products and equipment flows. This strategy has also some unfolding; on one side, serving the flows of a industrial building may be obtained through an absolutely flexible space, adaptable to its possible variations. On the other side, this condition becomes more complex when there are limitations on the site, and when those flows need to occur in different levels.

The third possibility is represented by the case of Bombril factory, in which the detailing emerges as the design generator. In this case the elements that form the enclosure system are the design generators. The detailing in Bombril is not a major principle's consequence; it is the principle itself. Besides the enclosure system, the design coordinates other systems, trough a plan ordering pattern that articulates several modulations (cover support structure, the rooftop itself in three dimensional structural trellises).

We conclude that, firstly, in a universe apparently arid, such as the industrial buildings, creative variations are possible. Even when these are conceived based on values as economy and building speed, some works prove consistent and significant. Such buildings are born from the ability of reflecting both in the constructive options, and in the layout compositions; these aspects clearly differentiate them from the majority of their similar works. Secondly, we may observe that these creative possibilities and the design guiding principles of the projects presented go beyond the industrial buildings range. The formal and technical investigation (within the rationalist standards and as an industrialization heir) may be found in many programs, as well as the permanence of values, such as constructive pragmatism, independently of the building's nature. Finally, the qualification of a building as architecture has as one of the paths the observation and application of principles and strategies that move through time and that, despite the formalisms, are still relevant.

FIGURE 20

Bombril Factory (NE): part of the cover that links two blocks and demarcates the access, performing as a portal.

Photo: Fernanda Mafra

FIGURE 21

Bombril Factory (NE), two intervals: opening for the production precinct (gate) and skylight opening

Photo by: Fernanda Mafra

FIGURE 22

Bombril Factory (NE): opening in the rooftop over the interior street and between the administrative and production blocks.

Photo by: Fernanda Mafra

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