

FROM MUXARABI TO BRISE-SOLEIL: BRAZILIAN ARCHITECTURE ADJUSTING TO CLIMATE.

DO MUXARABI AO BRISE-SOLEIL: A ARQUITETURA BRASILEIRA AJUSTA-SE AO CLIMA.

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In memoriam: Ladislao Pedro Szabo¹ (deceased in July 2007)

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PALAVRAS-CHAVE: Brazilian modern architecture, history, solar shading, comfort.

ABSTRACT

Brazil's territory displays a wide climatic diversification due to its large territory. Its major architectural problems are to deal with the intense solar radiation and humidity. The search for shading devices that allows cross ventilation is affected by technical solutions according to cultural features, as the Moresque ones that became a condition of good design.

Islamic influence in Brazilian architecture left remarkable signs, and is a natural consequence of the historical process during the country growth. After centuries of Moorish occupation, the first Portuguese settlers brought Arab architecture's culture to Brazil.

This paper looks forward to contribute with an analysis of architectural solutions inherited from Islamic culture by Brazilians through Portuguese colonization. It shows how much these elements were and are still important for its own cultural identity.

The paper also shows examples of contemporary architecture that uses mainly glasses associated to internal air conditioning systems.

1 CLIMATE IN BRAZIL

Sailing across the South Atlantic Ocean toward west in search of new routes to India, five centuries ago, the first Portuguese navigators discovered more than 7.500 km of shores, between longitudes 32°25' West and 48°44' W east (Ross, 2000). As they began colonization, they settled on a narrow stripe of land along the coast extending from beneath the equator line to below the Capricorn tropic, having to cope with a very hot and humid climate to which they were not adapted.

At the very beginning, with scarce exceptions, few incursions were undertaken through inner lands, partly due to natural geographical accidents such as the high and steep slopes that handicapped any access attempt.

Brazilian territory larger dimensions range between Equator and Capricorn Tropic, holding 90% of the national ground, shaped as a triangle, the country has its base geared up to the north and its vertices are sensibly at the same huge distance: 4.394,7 km in the north-south orientation and 4.319,4 km in the east west one.

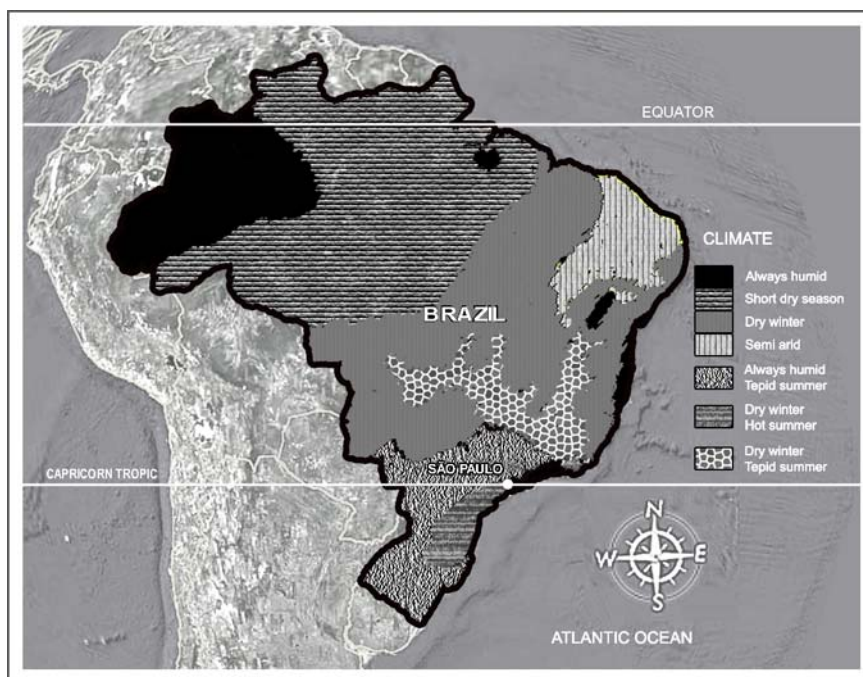


Figure 1 - Brazil's Climatic map. Drawing by Dominique Fretin

Thus, Brazil has continental proportions, covering an area of 8.547.403,5 km² (including oceanic islands), and bringing forward a wide climatic variety (Figure 1), that ranges from humid equatorial to both humid and dry tropical, and even to humid subtropical in Brazil's Southern Region (Tarifa, 2001).

A great amount and variety of natural light is available all through the country: for instance, at Natal, a city close to the Equator, 100 thousand lux can be measured during summer, at noon, while in São Paulo, on the Capricorn tropic, 45 thousand lux can roughly be afforded at the same time and season (Szabo, 2005)

The Northern region, that includes the Amazon forest, has an equatorial climate that provides the area with overflowing rainfalls, high temperatures and low thermal amplitude during the whole year. In those regions, buildings should be very open so that the natural cross ventilation allows indoors comfort conditions.

The Northeast region displays several climates, ranging from equatorial to semi-arid, typical by the "Caatinga", a sort of savanna that covers a large part of the region, and even tropical in certain areas. Sky light is brighter and thus, buildings and its openings should be shaded in order to provide cozier indoors.

The Center-west region of the country depicts a semi-humid tropical climate, with streaming precipitations during the rain season, feeding the Pantanal area characterized by its swamplands. Building design should foresee cross ventilation, shading devices plus thermal control through building materials' inertia.

The south-east region, which is the most populated one, displays a pleasant tropical climate, although with four very distinct seasons, with some areas depicting a temperate climate due to altitude, such as São Paulo city area.

The Southern region is peculiar by its subtropical climate. During winter months, low temperatures occur, causing frequent frost and, sometimes, snow. Hence, buildings should have thicker walls and use heaters during winter.

As shown, Brazil's territory shows a climatic diversity due to natural factors such as geomorphology, other geographical features and air masses dynamics. Each region, according to its natural characteristics, requires architectural responses.

This paper focuses the city of São Paulo which climate is described below.

2 SÃO PAULO'S CLIMATE

The city of São Paulo sits on the Capricorn tropic (Latitude: 23° 30' South), 60 km far from the Atlantic shores, on a plateau which altitudes array from 750 m to 900 m above the sea level. The very first settlement was close to the Tietê River that flows to the west.

Geographers classify São Paulo city climate as Tropical of Altitude (Tarifa, 2001) being under direct influence of tropical and polar air masses, and thus showing accentuated thermal variations. It displays two well characterized seasons: a hot rainy summer and a cool dry winter (Figure 2).

Today, the widespread urbanized area brings out an irregular density of buildings with variable heights, forming zones of high rise concentration of buildings and few green areas.

Average annual maximum temperatures reach 25° C and the minimum, 7,5° C. The average daily temperature amplitude ranges around 8,5° C. Such thermal conditions require building designs able to deal with large differences of daily temperature and affect the building materials choice and project details.

Predominant winds blow mostly from south south-east and east, as a result of the high and low pressure cells over the tropical Atlantic Ocean and over the equatorial continent. However they are neither constant nor strong. Occasionally, stronger blasts may blow from west. Topography and urbanization also have some influence on this system (Tarifa, 2001).

Considering the average cloudiness, from 10 AM until 2 PM, daylight availability for the city of São Paulo can be estimated in 33.000 lux during summer's solstice, 28.150 lux in the equinoxes and 18.050 lux during winter's solstice (Szabo, 2002).

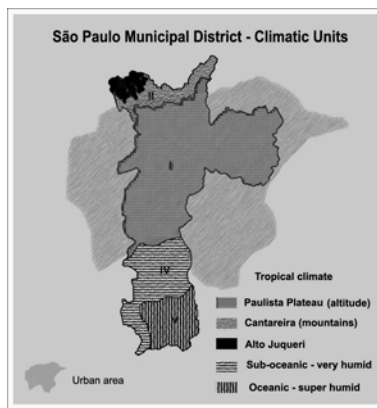


Figure 2 - Natural climate units amidst São Paulo District (Tarifa, 2001)

3 TERRITORY OCCUPATION AND ARCHITECTURE

São Paulo and its surroundings remained isolated from the rest of the colony, due to its difficult access from the ocean and, despite its pleasant climate, similar to Mediterranean countries, it only attracted fearless adventurers eager to conquer the hinterland to the west. As a matter of fact, the Tietê River, navigable in most of its path, takes source near the Atlantic Coast and runs toward the west, reaching the Paraná river in the inner land: this was a strategic way in times of conflict against the Spaniards. The Portuguese Adventurers enlarged their territories beyond the limits set by 1494 Tordesilhas Treaty. This enlarged area was confirmed by the Madrid Treaty signed in 1750, establishing Brazil's actual territory. São Paulo remained a small town for three centuries and became a strong commercial center as routes toward the mining regions and other productive zones were established.

This reclusiveness of almost three centuries made this settling acquire features and characteristics of its own, demonstrating its sustainability. Above all, its peculiar clothing and architecture revealed a creative adaptation to the local climatic circumstances.

Weighted clothes were adequate to the thermal amplitude and to the sudden chills upside the plateau as did the rammed earth thick walls, covered by vast roofs that shaded the facades (Fretin, 2002). The constructive techniques, although rudimentary, were brought by the first Portuguese settlers, who also carried all the influences received during centuries from Romans, Arabs, Germans and other cultures in Portugal.

These skilled navigators also evidenced to be great urban designers and builders. Their architecture clearly expresses the Moorish influence that Portugal received during the Iberian Peninsula occupation by the Moors between the 8th and 15th

centuries. Nevertheless, they demonstrate an enormous ability in transferring these solutions to the new world, adapting their spaces to the new environmental realities, without hurting their cultural roots.

The hot and humid climate, so uncomfortable and different to these European bound them to build architectural devices, which softened the harsh conditions. Therefore the buildings' architecture stressed the use of verandas to shade the façades and openings, as seen in farmhouses and many urban dwellings. In moister areas, ceramic tiles decorated according to Portuguese traditions, wrapped conveniently the facades damaged by marine air and excessive humidity.



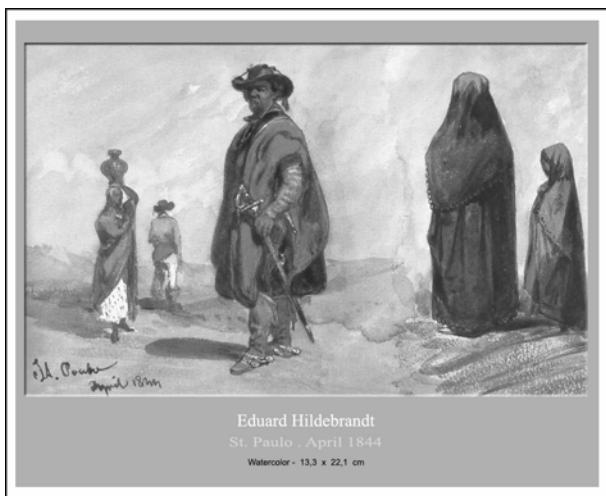
Figure 3 - A street downtown São Paulo in the 19th century displaying a façade with Muxarabi. Painting by Edmund Pink (Lago, 1998).

Windows had to be larger in order to enforce cross ventilation, indispensable in these climates. Nevertheless they also needed protection against intense brightness, excessive and inconvenient solar radiation, and even against indiscreet and unwished alien glances. The use of wooden lattice works inspired in muxarabis and similar artifacts became very convenient to control climate as to enable privacy with aesthetic purposes. All these architectural details were broadly appropriated and spread all over Brazil. (Figure 3).

However, the Moorish influence in Brazilian architecture did not come exclusively from Portugal: there was another relevant course brought down by the navigators and dealers routes: as they returned from East and India, after contouring Cape of Good Hope, they sailed toward Brazilian coasts, a necessary halt for food supplies and drinking water. Thus, a link of mercantile and cultural changes was established between Brazil and Eastern cultures, without any European intermediation.

Brazilian Modern Architecture incorporated many traditional architectural solutions to its works due to their unquestionable functionality in climatic issues, although it

always seek for simplification of shapes, leaving the aesthetic result to the whole composition of the building. Since Modern Movement's debut, these Muxarabis devices had been transformed into industrialized simple elements, like bricks with symmetric holes that enabled a peculiar Brazilian design, as seen in the "Parque Guinle" buildings' façades or in Oscar Americano House in São Paulo. In that way, the Islamic influence was transformed into a typical Architecture impregnated with Moorish traces and became an authentic Brazilian characteristic. And one may recognize this pure Brazilian Architecture without even be aware of its Arabic roots.



Figures 4 - Costumes of São Paulo during the 19th century. Aquarelle by Eduard Hildebrandt (Lago, 1998).

The influence from east, particularly in the city of São Paulo during the whole colonial period until the mid 19th century is remarkable, as most of the façades displayed Muxarabis. Even the common vestures of women who crisscrossed the streets reminded the silhouette of Muslim women: all covered with dark heavy clothes; they had been called the "tapadas" which means "covered" (figure 4).

These population daily habits, so much in the way of dressing as in architecture, disappeared at the end of the 1870 decade, when the major cultural influence came from England (in 1865, a new railway, built by an English Company, was inaugurated linking the harbor of Santos toward the hinterland to enable the coffee production exportation).

Bowler hats, umbrellas and the grey and black colors invaded the everyday life in São Paulo. New concepts from European hygienists, claiming dwelling health as well as urban sanitary conditions, condemned muxarabis because they understood they retarded ventilation, got dirty very often and had little maintenance. In terms of urban quality, the main problems at that time dealt with public health. A public

Code of behavior in public (posture code) was approved by the Municipality in 1874, and among its articles, there was one forbidding the use of muxarabis on windows. As a result, authorities commanded their withdrawal. Militão Augusto de Azevedo's Photo taken in 1862 of a house with muxarabi, site on Rosario's Street (today November XV Street) is a rare document of one of the last muxarabis remaining at that time (figure 5).

At the first half of 20th century, São Paulo was known as the wealthy coffee Capital, modernizing itself looking at Europe, its habits, tastes, manners and fashions, thus banishing the old eastern uses.

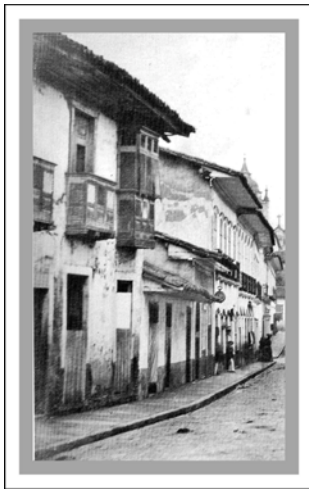


Figure 5 - House with Muxarabi at Rua do Rosário, 1862. Photo by Militão Augusto de Azevedo. Iconografia Paulista do século XIX (Lago, 1998)

Gears and other solutions throughout Brazilian colonial architecture only were resumed at the beginning of the 20th century, by the first actions with national character like the modern movement in 1922. The Moorish influence was then acknowledged and reintegrated to a new architectural vocabulary, as it displayed throughout its unquestionable qualities regarding its adaptation to local climate, to aesthetics and to meanings that such solutions brought to this new architecture.

Avant-garde architects, such as Lúcio Costa, Rino Levi, Affonso Eduardo Reidy, Oswaldo Bratke, among others, adopted the features of this Moorish gear in architecture, now considered authentically Brazilian, and applied them to their designs.

Synthesizing, it can be said that the Moorish influence in Brazilian architecture, occurred in a slow way along centuries, being absorbed and incorporated by Portuguese and Brazilian cultures, without causing shocks or ruptures with the well-grounded models.

Shading devices inspired on Islamic architecture and applied in Brazilian modern architecture.

In tropical countries like Brazil, the search for building gears able to promote protection against heatstroke and excessive brightness, should be an architects' constant target - even when inspiration comes from another culture. Such solutions become essential to good building design.



Figure 6 - Santo Antonio's Chapel main entrance. Details of latches, São Roque district, SP (Image: Szabo).

Barberot (1891), for instance, refers to balconies "*Moucharabys*" from Algeria and from Spain, shuttered with wooden lattice works that enabled air penetration but attenuated the sunlight. (Figure 6) It was a fence allowing aeration but blocking sun excesses and indiscreet eyes. It was conceived especially in areas most ragged by the tropical heat and where the habits did not allowed women to appear in public without covering their faces.

Architect, engineer and archaeologist Ricardo Severo (1869 -1940) in his article "*Velha Arquitetura*" (Old Architecture, 1916) reports that "*gelosias*" or "*rótulas*" (Portuguese terms for lattice works), also called "*adufa*", in Portugal, are summarily the model that the Roman employed and designated as "*transenae*", absolutely similar to Arab "*addafas*" and to "*moucharabiehs*" from Cairo.

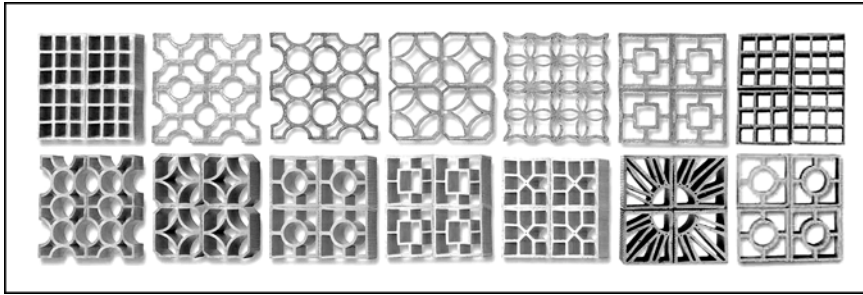


Figure 7 - Most ordinary hollowed tiles in fireclay used nowadays in Brazil. (image: Dominique Fretin)



Figure 8 - Parque Guinle Project by Lúcio Costa. Rio de Janeiro, 1948. (Costa, 1995)

In 1948 Lúcio Costa's projects for a residential buildings within the Parque Guinle, in Rio de Janeiro, the facades were treated with hollowed elements (Figure 8). This important building was conceived according to Le Corbusier's modern principles. Settled amid a pleasant public park, the building had been a model to the "superquadras" design in Brasília.

In São Paulo, architect Oswaldo Bratke protects the facades of his houses and buildings with hollowed tiles in fireclay. The solution acquired an ornamental character in the project and became a mark of the local modern architecture. The hollowed artifacts manufactured in industrial scale had been disseminated and employed in countless apartment buildings, although in many examples they worked out as a screen that hid the services areas, while allowing permanent ventilation. This was a convenient solution for drying clothes within the building. (Figure 7)

The need for protection against a hot sun stimulated the development of other kind of protection: shading devices, known as "brise-soleil" or simply "brise". This

gave a quality leap to Brazilian architecture that gained national and international recognition.

As an example, the Education and Health Public Department building, also known as “Palácio Gustavo Capanema” displays the modern architecture in its very first monument, as depicted by architect Carlos Lemos. It was designed by architects Afonso Eduardo Reidy, Carlos Lion, Ernani Vasconcelos, Jorge Moreira and Oscar Niemeyer, under architect Lúcio Costa's Coordination and with the consultancy of Le Corbusier. (Figure 9).

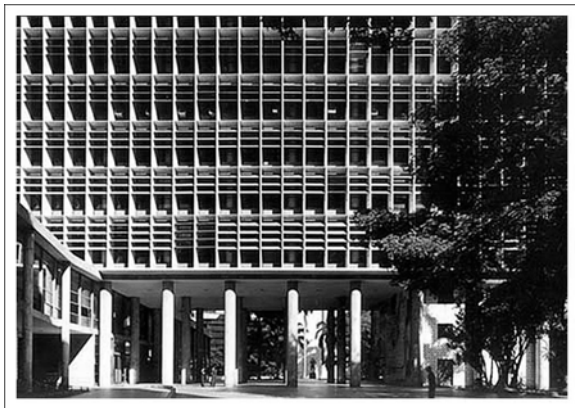


Figure 9 - Education and Health Public Department Building. Rio de Janeiro, 1935/1945 (Costa, 1995).

Beside the wonderful panels decorated with painted tiles, by modern artist Cândido Portinari (Figure 10), another Moorish heritage, the northwest façade shows a brise-soleil that was surely inspired on the proposals of Le Corbusier in Argel's urbanization project. These “brises” used movable horizontal blades in fibrous cement, fixed on large vertical concrete blades. Many scholars say that Brazil's major original contribution to modern architecture is the domination of heat and light, by means of shadow devices or external shutters”, writes Goodwin (apud Szabo, 2002) in the introduction of his book on Brazilian architecture.

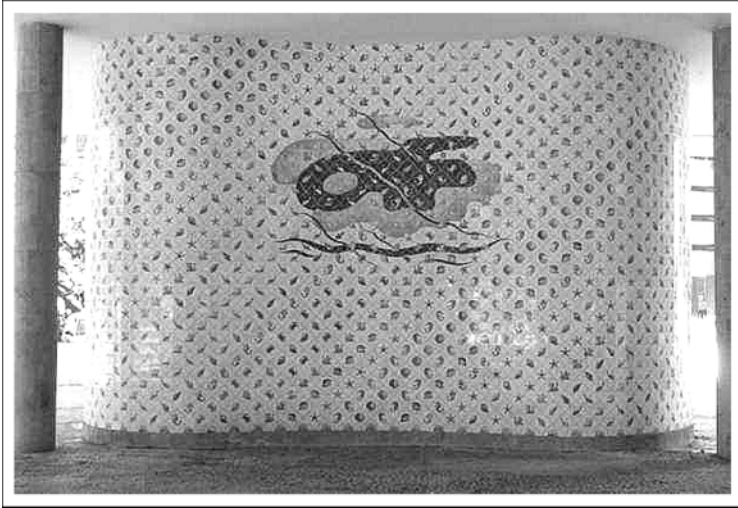


Figure 10 - Education and Health Public Department Building. Decorated tiles panel at the main entrance, painted by Cândido Portinari. (Costa, 1995)



Figure 11 - South American Bank Building, designed by architect Rino Levi, São Paulo, 1963. (Photo by Rechilene Maia)

The South American Bank Building, today Itaú Bank, located on the commercial and financial Paulista Avenue was designed by architects Rino Levi, Roberto Cerqueira César and Luís Roberto Carvalho Franco in 1963 (Figure 11). It displays horizontal movable aluminum louvers (brise-soleil) shading the northeast facade, thus molding a continuous panel (Figure 12). The southwest façade reveals the same principle, but the louvers only cover the top of each pavement's windows. It is important to detach that the brises overcome functional issues and imposes themselves as a most-valuable composition element of the design. The main façade (northeast) does not face the avenue, but a perpendicular minor street, to achieve a better sun orientation as to avoid the inconvenient noises from the avenue.



Figure 12 - South American Bank Building Detail of shading devices system on Northeast façade. (Photo by Rechilene Maia)

4 CONCLUSION: CHANGING PARADIGMS.

From 1920 to 1960, sunstroke, natural lightning and internal heat control of environments brought significant changes in buildings and cities architecture. Brazilian modern architects provided to achieve such controls through architectural solutions that percolated light. These control issues, *ab initio* with practical means, were soon transformed imprinting a new character to Brazilian architecture as well as it guided architects toward innovations regarding environmental matters. Nevertheless, search for brightness, so distinctive in the Modern Movement, was never cast aside. This fact is seen in São Paulo architecture where many building components like “brise-soleil”, movable panels, shutters, lattice works, sun blinds, grills, hollowed tiles, shading overhangs, internal courts and zenithal light, among other proposals, became widely used due to their adaptability to local environments, their technical performance and thanks to their undeniable aesthetic qualities.

Besides, since 1970 decade, architecture in large Brazilian cities adopted new paradigms. In times of industrial boom, São Paulo witnessed globalized architecture invasion. This is typical of the international style contemporary

architecture. It detaches the idea of financial power in opposition to modern architecture style that always sought to emphasize cultural and environmental values.

Adjustments to local climate was suddenly relegated to a secondary plan, and often forgotten, since mechanical gear, like central systems of air conditioning did not need the performance of any constructive solution. Architects and designers felt themselves liberated from environmental restrictions, relying mostly and exclusively on façade design. Indoors environmental climate, as promoter of users' comfort, was now supplied by technological, far from the architectural traditions, although highly depending on energetic resources.



Figure 13 - Commercial buildings from 90's in São Paulo. (Images from Internet).

Glass facades, directly exposed to the sun beams are totally inadequate at these tropical latitude even though they intend to print a building with a “wealth status” similar to those of richer countries (Figure 13).

Imported architectural models, without worrying with the local constraints and needs takes to a gradual loss of worthwhile technical knowledge. Because of this paradigms change, it seems that there is a competition between buildings of the international style and those of local character. Most probably, the energy needs for the 21st century will direct the new perspectives.

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