

# Integrated environmental response of shaded transitional spaces in hot climates: the design of the Brazilian veranda

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## ABSTRACT

Protection from the sun is widely considered to be one of the main bioclimatic strategies in hot climates or during warm seasons. One of the alternatives to shading is the use of covered transitional spaces, which have appeared in the architecture of different countries over time and include the Greek and Roman *porticus*, the Japanese *engawa*, the Renaissance loggias, canopies and verandas. This paper examines how verandas have always been present in the architecture of Brazil, whose climate is mostly tropical. The veranda has passed through various phases: indigenous constructions, adaptation to a different climate by the Portuguese in colonial times, the incorporation of the veranda into the vocabulary of modern architecture and even as a traditional element, and its survival to the present day as a typical area in Brazilian houses. The presence of a veranda has a direct impact on the creation of shaded areas and the protection of exterior walls from the sun. However, verandas also affect other aspects, such as daylighting and ventilation. Despite the recognition of their environmental contributions, verandas are not usually the determining factor in design, and they are sometimes ignored or secondary to the functional and aesthetic aims that are almost always prevalent. Through questionnaires and design analysis, this paper examines the attitudes of Brazilian architects to the design of the veranda, and assesses how different design strategies affect houses' responses to climate. Moreover, the research speculates on the potential for reducing energy consumption through the proper use of the veranda, and the possibility of characterizing it as an important strategy for sustainability.

## 1. INTRODUCTION

In tropical climates, warmth is usually due to a combination of high air temperature, humidity, and rainfall combined with considerable action of solar radiation. The general term "tropical" is used to describe a range of situations, as tropical climates are not homogeneous. However, in tropical zones, there is a predominance of seasons with the above characteristics. The rigorous climate of the tropics can be mitigated by two essential strategies: blocking solar radiation and ensuring air movement, in

other words, by providing shade and fresh air. Shade also acts as an umbrella during heavy rainfall. *Brise-soleils*, eaves and other devices are very useful and desirable for creating shade.



Figure 1. Map of tropical climates and the metaphor of the shaded spaces.

However, one specific type of transitional space is adapted to the climate and even extends the area of sky that is protected when it is overcast: the veranda. People in tropical climates tend to do many activities outside. They stay outdoors longer to take advantage of breezes and, therefore, they need protection from the sun and rain.

Verandas as transitional covered spaces directly meet the need for shade and rain protection. As they are spaces that are open at least on one side, they also provide fresh air and natural light that is less intense and different to that of the interior.

Ninety-two per cent of Brazil is in the tropical zone. In this country, verandas were introduced by the Portuguese colonizers as a result of their experience in the Mediterranean. The colonizers were also influenced by contact with Eastern architecture, mainly from Japan and India, and by the early solutions adopted by the indigenous peoples. Over time, the veranda was transformed to adapt to the climate and culture in each region of the country.

Although the veranda is considered a typical solution of traditional architecture, it has been introduced and widely used in the vocabulary of modern Brazilian architecture, mainly in response to the use of large glass surfaces. Even today, the veranda is an almost obligatory area of Brazilian houses. However, precisely because of its recurrence, it is often considered a banal solution to environmental challenges, and is more highly valued for its contributions to aesthetic and functional aspects.

## 2. SHADED TRANSITIONAL SPACES

Many recognized authors agree that the high levels of solar radiation, the illuminance of the sky and the abundant rainfall in tropical climates make it imperative to protect the building envelope from the sun and highly desirable to create covered and shaded spaces next to buildings (Olgyay, 1963; Givoni, 1969; Konya, 1981).

"Space is just a terrible outside-inside" (Bachelard, 2000). However, between the inside and the outside, the open and closed, there is a boundary that can be defined as consisting of a wall or something softer, as what occurs over an interval of time, as what happens in transitional spaces. In architecture, these kinds of spaces cannot be classified as interior or exterior and their existence cannot be explained in terms of a precise and specific function. They are found worldwide, and constitute an important element of different architectural typologies (Coch, 2003).

Transitional spaces interact with the interior and exterior, and are also known as interstitial or intermediate spaces. They are categorized according to their spatial characteristics as semi-outdoor, semi-open or semi-closed. They are also classified in relation to the degree of integration into the

main part of the building, i.e. they are attached or added (Cadima, 2000). For some authors, the transitional space is a "mediator, a link between the interior spaces with their controlled light and climate, and the natural environment with its uncontrolled climate, sun, wind and rain" (Kapstein, 1988).

Shaded transitional spaces, such as courtyards, porticos and balconies, were used in the first centres of population that led to the first cities. In particular, they can be found in the civilizations of the great rivers, such as the Mesopotamian, Egyptian, Chinese and Indian cities. Later, in Mediterranean civilizations that had a less rigorous climate, buildings could be more open to the outside. Thus, the sun became a factor to be controlled, and spaces were available to take advantage of the sunbeams in winter, while they were shaded in summer. The Megaron, which was described by Socrates in the fourth century BC, was one of the main prototypes of this solution. It consisted of a main floor space closed to the north and opened to the south with a sort of front veranda.

Throughout the history of architecture, innumerable solutions of transitional spaces have been used worldwide, especially in warm regions. Arcades, porticos, cloisters, loggias, large eaves and even some shading devices with the extra protection of lattices have been present in the Mediterranean and in Islamic, Eastern and Indian culture.

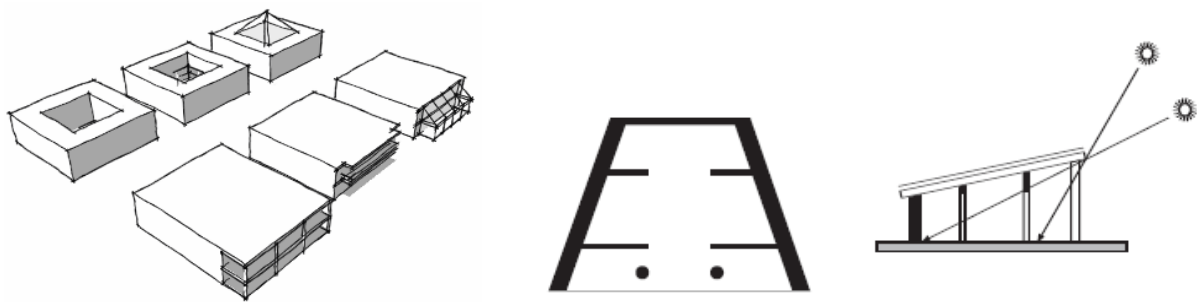


Figure 2. Types of transitional spaces and the Megaron.

### 3. THE BRAZILIAN VERANDA

Verandas are a specific type of transitional space. In addition to acting as a filter between indoors and outdoors of countless environmental conditions, they represent a specific place in dwellings. While they are not an architectural element that is unique to Brazil, their considerable presence in buildings in almost all Brazilian regions and periods of history has had a significant impact on Brazilian architecture.

From an environmental perspective, the veranda can be summed up as a habitable, covered transitional space that is added to a building and open to the exterior on one or more sides. It protects both the building envelope and the space that it creates from rain and unwanted radiation. The veranda is ventilated with fresh outside air and illuminated with less intense light than the exterior. This light is different to that found in the indoor areas to which the veranda is linked.

The veranda was brought to Brazil as a result of colonization by the Portuguese. It is possible to distinguish various sources of inspiration in the veranda: aspects inherited from Greek and Roman architecture adapted to the Mediterranean climate; Arab influence, due to the long period in which the Iberian Peninsula was under Arab rule; and, particularly in the case of Brazil, contact with Eastern cultures, above all those of India and Japan, during the period of great sea voyages. When the veranda was introduced into Brazil, it was also influenced by the architecture of Brazilian indigenous peoples, who created spaces to protect themselves from the sun and rain.



Figure 3: A shaded space built by indigenous peoples, a colonial veranda and a modern veranda in Brazil

The climate is considered the physical factor that has had most impact on Brazilian architecture (Bruand, 1981). This is probably why the veranda has been present in virtually all ages and stages of the country's architecture. In addition to this main function of responding to the climate, the veranda has acquired many other functions that have given it particular value and meaning. It has survived countless cultural, social and economic transformations, and even changes in aesthetic appreciation.

Although the veranda is a typical feature of traditional architecture, it was widely used during the period in which modern architecture spread in Brazil in the first half of the twentieth century. It became a specific, almost indispensable place in Brazilian houses that is present in all social classes. Obstacles such as limited space and budgets tend to be overcome. Today, the veranda can be found in homes and flats and its size is increasing. It often constitutes the real living area of a dwelling.

#### 4. ENVIRONMENTAL EFFECTS OF THE VERANDA

Due to the fundamental impact of solar radiation on buildings' thermal balance, and consequently on their heat gain, shading is a primary strategy for obtaining comfort in hot climates. The veranda shades the building envelope and thus eliminates the action of sunlight on it, in the same way as a brise-soleil or other shading devices. However, the space created by the veranda itself also prevents sunlight from acting directly on people and thus reduces the uncomfortable sensation of heat that this causes. Therefore, verandas constitute a type of pavilion used to generate useful shaded spaces, in which important functions of the dwelling can be carried out due to the protection from sunlight and rain and the major advantages of natural ventilation and lighting.

Felt temperature can be taken as the average of air temperature and radiant temperature, under the same ventilation conditions. Shaded spaces significantly decrease the proportion that corresponds to radiant temperature. Consequently, verandas reduce the felt temperature, which is further decreased by the action of the ventilation.

The radiation that is incident on a building consists of a sum of different elements. Direct solar radiation is the most obvious and important factor, especially when the sky is clear. However, diffuse and reflected radiation also provides heat, as does the radiation that is emitted by surfaces and objects in the vicinity due to warming under the action of solar radiation. The veranda always has an impact, as it reduces the area of solar radiation exposure. Some aspects of its location and design, such as its latitude, orientation, degree of insertion into the building mass, the relationship between its height and depth, and other factors, may make it more or less effective at providing protection from solar radiation. Rainfall is usually abundant in tropical climates, so verandas also act as large umbrellas. Their effectiveness is dependent on the relationship between their height and depth and the angle of the rainfall.

In many tropical climates, the direct cause of discomfort is the high humidity combined with high temperature, which leads to a feeling of extreme mugginess (Serra 1999). Air movement near the body alleviates discomfort, as it increases heat loss by convection and reduces the sensation of heat. The veranda plays an important role in air movement, as it enables fresh air to enter the house, allows windows to remain open even when it is raining, and creates its own shaded and ventilated space.

Similarly, as a transitional and perimeter space, verandas affect the distribution of daylight from outside to inside. However, we often forget that visual comfort depends more on the relationship between the different sources of light in the visual field than on the amount of light. Therefore, the veranda plays an essential role in tropical climates, where there is an extremely high amount of light. It stops direct sunlight from entering buildings and reduces the absolute amount of light, which helps to reduce contrasts and unwanted glare. The depth of the veranda and the reflective characteristics of its surfaces are the main design factors in these aspects.

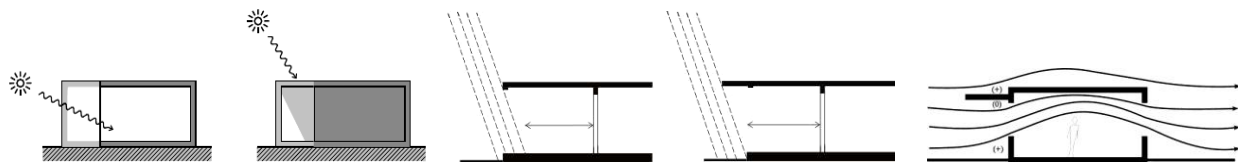


Figure 4: The environmental impact of verandas: solar radiation, rainfall and air movement.

Verandas can also affect sound radiation, although their impact on this aspect is limited by the fact that they are open spaces. A veranda can be equipped with screens that reflect sound back outside or back inside, depending on which sounds are undesirable or desirable. Combinations of depth and the use of surfaces materials that absorb sound can help to absorb noise.

Verandas have many effects on environmental aspects, which essentially vary according to design factors.

## 5. DESIGN AND USE OF VERANDAS IN BRAZIL

The period in which modern architecture spread in Brazil, from 1930 to 1950, was marked by constructions that took climate needs into consideration. However, in the following years, this attention to climatic factors diminished and adaptation to the climate response became the exception rather than the norm in Brazilian architecture. The current generation of architects is progressing with new languages and the incorporation of innovative materials and structural solutions. However, this generation is also influenced and inspired by the modernist projects of the aforementioned period.

An environmental approach has again been used in many designs, although often empirically or as a result of other intentions, such as the creation of spaces for living and leisure and aesthetic solutions. To a greater or lesser extent, it is possible to interpret the design of verandas as a call to be in contact with nature and, increasingly, a search for aesthetic qualities associated with sustainability. Nevertheless, strong concepts of sustainability have not yet been effectively incorporated into practice.

Decisions related to the aesthetics of a building have an impact on environmental aspects. We studied the presence and characteristics of the design of the veranda in recent Brazilian architecture. The buildings we analysed were based on two books about recent production of Brazilian architecture: *Brazilian House* (Segre, 2006), *Ainda Moderno: arquitetura brasileira contemporânea* (Cavalcanti & Lake, 2005), and 2008-2009 editions of the two most prestigious

Brazilian architectural magazines: *AU* and *Projeto*. We also carried out a qualitative study, on the basis of interviews with Brazilian architects, and a quantitative study, through surveys of architects from around the country and ordinary users of verandas.

The study of the buildings allowed us to identify eight basic strategies employed by architects in the design of verandas. These are: increasing the amount of covered area, adding new covered areas, reducing the built area, setting the walls back, pilotis, structural interspaces, interconnection and verandas that can be opened up or closed. A ninth general strategy is related to verandas in vertical apartment blocks. Some strategies facilitate the generation of verandas that jut out from the main building, while others create embedded verandas. In addition, each strategy provides shade, ventilation and lighting, to varying degrees.

The qualitative study highlighted the presence of the veranda in Brazilian architecture and the fact that verandas are designed without a suitable study of environmental factors. Although architects acknowledge their role in this area, they are much more focused on aesthetic and functional aims than on adaptation to the climate. In addition, many of them are not aware of the role that verandas play in their constructions, and are even surprised by this finding.

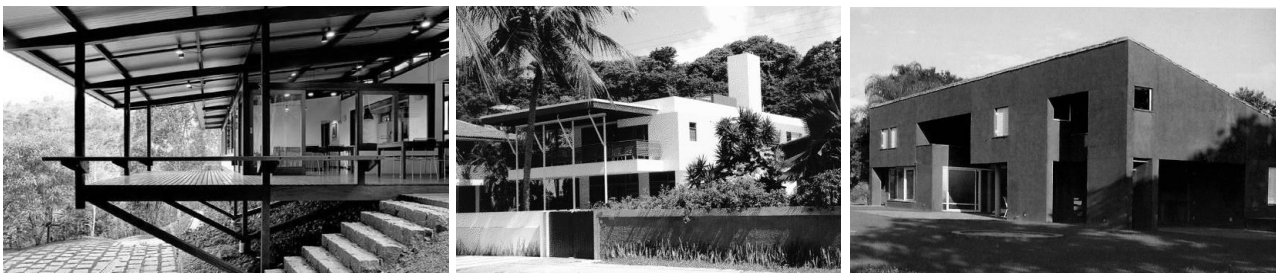


Figure 5: Veranda design strategies: increase of covered area, adding new covered and reducing the building area.



Figure 6: Veranda design strategies: setting the walls back, pilotis and structural spaces



Figure 7: Veranda design strategies: interconnection, verandas that can be opened out or closed and verandas in vertical apartment blocks.

The quantitative study highlighted the importance of the veranda in Brazil, both for its users and the architects. All the users considered that the veranda was important or very important to the houses. The study also noted that there was an overlap in the activities planned by architects for verandas and those actually carried out by users. It was emphasized that this is a great space to live, rest and spend free time in Brazilian homes.

## 6. CONCLUSIONS

The results of the survey, along with the contents of the interviews and the collection of works that were analyzed, confirm the presence of the veranda and its importance to users and architects. However, the architects are not always clearly aware of its role, even though they use this element frequently in their projects. Its multiple functions, the apparent simplicity of construction and its banality due to repetitive use somehow mask its key role in the play of light and shadow, which is also embodied in its dual nature: visual aspects and thermal-lighting aspects.

The shade generated by verandas make spaces more habitable in hot climates. Verandas also intensify or diminish aesthetic effects, emphasize or hide volumes, evaluate solutions, provide lightness and depth, among other factors. In addition, we should consider their environmental performance: the protection of the building envelope and consequently the interior, and the protection of the space created by the veranda itself.

Verandas have an impact on solar radiation, rain, air movement, lighting and acoustics. The veranda interacts with each of these factors, although it can only control sound to a certain extent, due to the fact that it is an open space. As architects devote more attention to an environmental approach and integrate these aspects into their designs, the contribution of the veranda to the environmental conditions of Brazilian houses should increase and, consequently, lead to greater sustainability.

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