The window in the building tradition of the sub humid tropic

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ABSTRACT

The window is one of the most important elements in architecture. It has a complex character and fulfills multiple functions but it is a privileged device to connect the interior with the exterior.

Architecture is frequently defined as an artificially delimitate space. These limits can be relative or absolute, depending on the environmental conditions. Some of these conditions are vital to human beings and require controlled elements. The window fulfills this role.

The window, of the building tradition in Colima, suits this wide architectural description, and its function as a climatic control element in a hot and humid climate is outstanding

1. SEPARATE WORLDS

The window as part of the building tradition in dry and extreme climates of non-tropical areas demanded insulating and massive constructions. These constructions, however, became the norm in tropical climates due to the cultural enforcement imposed by the Spaniard and Portuguese conquest of America and Southeast Asia.

Before European expansion, the building tradition in tropical America and Asia was different to the one established during the Domination and Independent periods.

In a separate article written by Adolfo Gomez and Armando Alcantara,[1] the characteristics of these building practices are detailed. These practices still subsist in both the urban and rural environment. While the European building tradition is peripheral and adjacent, the Native-American and Native-Asian are central and isolated. While the development outline for the European is centripetal, the indigenous is centrifugal. In addition, while the imposed is massive and rigid, the original is light and articulated. One is inert the other is organic. In other words, one is analogous to the cave; the other is analogous to the tree.

Applying this in our atmosphere, the European enclosed architecture is a product of a cultural imposition while the native tropical architecture comes from a holistic development. The first one isolates the individual from the environment, while the second one integrates the individual into the environment.

The building tradition in a tropical environment interacts with the atmosphere because the air is more humid and allows more thermal stability. The buildings produced in cooler climates do not allow this exchange. The open architecture does not require windows because it is defined by the roof.

2. THE WINDOW IN THE BUILDING TRADITION IN COLIMA

The precedent concepts are the bases to understanding the window phenomenon in the building tradition of the sub humid tropical climate (SHTC). We are focusing particularly in the building tradition, original from Spain and found nowadays in Historical Downtown Colima (HDC). This tradition is similar to a majority of urban centers located within the State of Colima and surrounding west Mexico. This particular architecture is very different from the

[1] Alcántara Lomelí, y Gómez Amador. Tradición Constructiva de Colima, Anuario de Estudios de Arquitectura, 2000. Universidad Autónoma Metropolitana.

neighboring rural communities of Colima.

This study involves buildings with academic typology since outside of Historical Downtown Colima there are buildings with traditional typology of popular origin, with different patterns and different proportions. The windows in these constructions are smaller, square and with a different building system. Sometimes these buildings do not have windows at all.

We are not taking into account that these windows are very different to the more contemporary and conventional buildings —the proportions of the windows, the building procedures and the architectural program that generates assorted uses of space and life styles.

2.1 Proportions

The windowsin the building tradition of the sub humid tropical climate do not exceed 140 centimeters wide on the outside frame and are only 90 centimeters on the inside.

Because of this building limitation, forced by a relatively small inside frame compared to the solid mass, the window preserves the proportions of the door. Measured from the outside, the average height of our cases is 60 centimeters while the style is 45 cm. Taking in account that the inside floor has an average difference of 30 cm the interior elevation could go from 0 to 40 centimeters.

Since the window keeps the measurements of the door, we could state the anthropomorphic origin of the window’s height and width. The intention and use of the window in these cases is different to the contemporary windows.

$$\text{Exterior frame width} = \text{wall depth} + 0.5 \quad (1)$$

$$\text{Interior frame width} = 2 \text{ frame width} - 0.75 \quad (2)$$

$$\text{Frame height} = 0.85 \text{ width} + 1.50 \quad (3)$$

2.2 Functions

The window maintains a direct relationship with the door because they are counterparts in terms of building design. Their proportion is ergonomic. Their origin is anthropomorphic since the dimensions of the door allow people to pass through and the dimensions of the window allow people to have a visual link. The vertical proportion the traditional window has is different from the contemporary window in terms of the arrangement. The traditional window demands a total access while the contemporary window does not require access to the environment.

The difference in accessibility gives the immediate surroundings of traditional windows freedom from furniture or permanent components. This also allows for more functions that are versatile. The light and wind concentration of the interior creates a high demand of the space. This demand is similar to the one corridors have. The window, as a transition space, becomes a favorite area thanks to its privileged micro weather conditions that put it closer to the comfort zone in terms of luminance and body temperature.

2.3 Performance

The window design depends not only on ergonomics; it also works as a ventilation mechanism. It optimizes the separation of cold and hot airflow, performing a more efficient convective movement for the inhabitants of the house. The air circulates expelling hot airflow through the superior part of the window and incorporating cooler airflow through the inferior part. This factor is very convenient when there is little to no air movement.

We can presume there was an intention on modifying the speed and distribution of airflow channeled inside by reducing the interior sides of the jambs.

To determine how the design and proportion of the windows affect the air circulation, we monitored the speed of the wind on both a vertical and horizontal plane. To measure the vertical plane, we divided the window’s height into thirds and placed sensors at the center of each third.

To measure the horizontal plane, we placed digital anemometers at the middle point of the height of the interior frame, the central frame

Table 1: Climatic data of Colima city at 19° lat, 105 long.

Colima

Dominant winds	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dic
Direction (degrees)	97	109	121	134	145	159	172	178	170	150	131	119
Velocity (m/s)	2.77	2.77	2.82	2.46	1.99	2.22	2.16	1.98	1.90	2.58	2.75	2.75

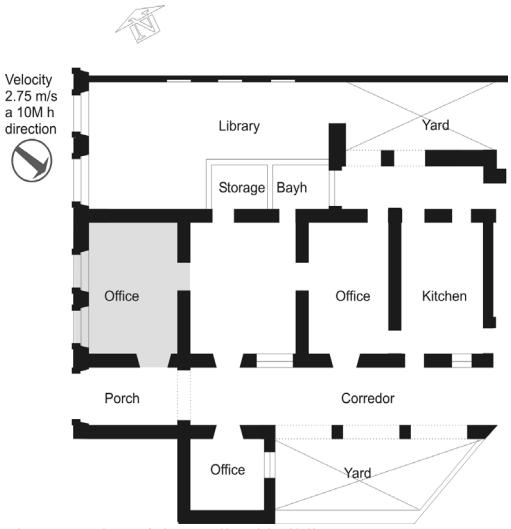


Figure 1: Plan of the analized building.

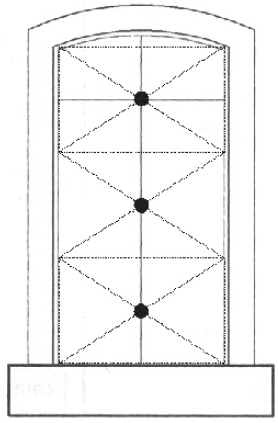


Figure 2: Anemometers localization in the vertical window plane.

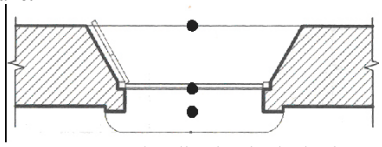


Figure 3: Anemometer localization in the horizontal window plane.

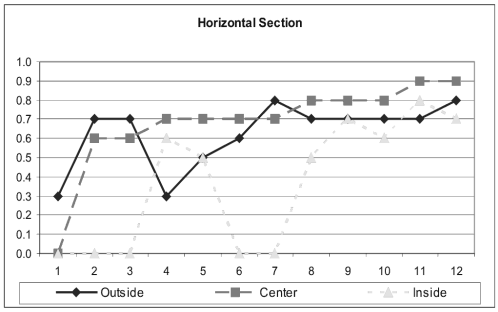
and the exterior frame.

We registered the data every ten minutes within three periods of ninety minutes each. We monitored each sensor simultaneously. Therefore, we obtained data of the airflow for the superior third, the middle third and the inferior third. At the same time, we obtained data for the interior frame, the central frame and the exterior frame area.

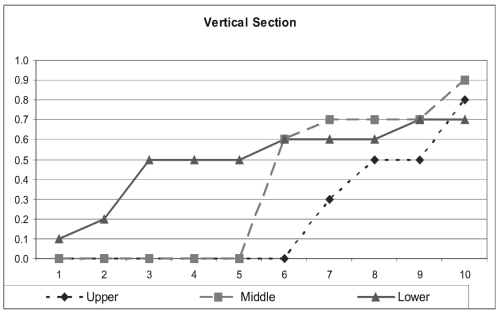
The results show a higher speed of airflow within the lower third of the vertical plane of the window. The average speed for the lower third is 0.50 m/s, 0.36 m/s for the middle third and 0.21 m/s for the upper third. On the horizontal plane, we obtained the following data, 0.63 m/s for the exterior frame area, 0.68 m/s on the central frame and 0.37 m/s for the interior frame area. This implies a speed reduction of almost 40% between the inward airflow and the outward airflow. We also registered a small increase of speed at the middle frame area of around 10%.

Considering the distance between each sensor -1.10 m for the exterior and central area and 1.89 m for the interior-, the airflow was constant at both the entrance and exit. It increased slightly at the central plane of the window frame. It is evident that the design of the window does not modify the speed of the wind into the house. Its function is to amplify the distribution of light and air.

The results of monitoring the vertical plane are more significant. The average of the air speed at the inferior third is 58% higher than the



Graphic 1: Velocities registered on the horizontal window plane.



Graphic 2: Velocities registered on the vertical window plane.

superior third. It is also 29% higher than the central third. Keeping in mind the difference in density between cold airflow mass and hot airflow, this implies that air with less temperature is flowing at a higher speed. We also presume the air flowing through the superior third has a higher temperature.

This information forces us to reevaluate the use of wickets and their significance as mechanisms to control and regulate airflow. Wickets allow the exit of hot air and avoid the lost of cooler air by opening the upper part of the window and closing the lower part.

We can conclude that the window in the building tradition of the sub humid tropical climate generates a transition space to the immediate environment. Its function as a ventilation mechanism has greater significance than its European counterpart. Air circulation is important in tropical climates in order to reach thermo physiological comfort.

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