Unsettling Climate: The Consequences of Domestic Buildings Technologies Across the Spanish Empire

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UNSETTLING CLIMATE:
The Consequences of Domestic Building Technologies
Across the Spanish Empire

Alberto Martinez García

A thesis submitted to the faculty of the School of Architecture in partial fulfillment of the requirements for the degree of: Master of Environmental Design (M.E.D.)

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ABSTRACT

Upon their arrival in the Americas in the sixteenth century, Spanish colonizers encountered a tropical climate previously unknown to Europeans. In the four hundred years of their empire, the colonizers set themselves on a collision course of maladaptation, violence towards Indigenous people, and erasure of their knowledge. *Unsettling Climate* investigates the domestic constructions of Spanish colonization in the tropics during the colonization of the Americas and the Philippines. Using case studies from patio houses in Cartagena in Colombia and *bahay na bato* (houses of stone) in the Philippines, this project analyzes the relationship between the natural environment, domestic space, and social hierarchies in the colonial realm. Two transitional chapters accompany these case studies. In the first one, I describe the evolution of patio houses in the Iberian Peninsula and the spread across the Spanish Empire. In the second, I investigate the influence of early modern colonization in the construction of new climatic epistemologies. Historical chronicles, maps, ordinances with paleoclimate information, floor plans, building sections, and environmental simulations constitute some of the evidence assembled to reconstruct these histories and track environmental dynamics in relation to building technologies. The unsettling urban climate constructed by the Spaniards fixed the spatial imaginaries in the contemporary imaginaries but also highlights the potential to disrupt this colonial entanglement in the future.
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PROLOGUE:

Amid ongoing debates about climate change and architecture, my project seeks to travel back in time to offer a close analysis of the role of Spanish colonization in the destruction and reconstruction of building technologies, as well as the attendant impact on the environment. Years of working in architectural practice exposed me to many competing discourses of what vernacular architecture means and how to use this knowledge to create sustainable buildings. Often, I saw both corporate offices and small-size design studios based on cultural and financial centers of power looking at local architecture in faraway contexts as precedents for new projects in those places. This attitude was sometimes simply naïve, and others just a branding decision based on cultural (mis)appropriation. Moreover, it all took place within a cacophony of arguments about how such projects can adopt a sustainable approach to help mitigate climate change. I wondered, when did imposing architectural constructions and building methods in other parts of the world start? What happens to the existing vernacular architecture of those places when an alien urban realm is imposed? How do these foreign-imposed buildings perform concerning climate and the environment?

In my thesis, Unsettling Climate, I attempt to address these questions within the early modern colonial context of the Spanish Empire. In some places, cultural transfers, misunderstandings, and stubborn choices in the architectural realm created climatic miscalculations in entire territories with long-lasting consequences. However, in other locations, far from centers of European power, challenging or dissenting positions
generated new architectural forms that overcame and adapted the original colonial imprint. This thesis looks into the histories of Spanish colonial building technologies to ultimately suggest that we may still be following the same patterns of logic: imposing building standards from centers of powers that regulate how to build in many regions worldwide. Similar to Spanish laws indicating how to build in the Americas and the Philippines during the early modern colonial period, current mechanisms like the LEED systems stimulate and disincentivize specific construction techniques and materials over others. Through careful historical, material culture, and environmental analysis, I explore the consequences of the past and the implications for our future.

*Unsettling Climate* is both macro and microscopic, encompassing deep histories alongside specific moments that changed the course of history. Broadly, it looks at the Spanish Empire from a planetary perspective. It attempts to understand the consequences of simultaneously using a standard set of building laws and ordinances on three continents and in many different climates and environments. Repeating the same urban grid, architectural forms, and construction details in Spain, the Americas, and the Philippines made “the European model city” a global project. In parallel to this endeavor of homogenization, the environmental transformations caused by Spanish colonization and the near-extermination of Indigenous societies contributed to unprecedented human-made temperature changes on the earth. Using domestic projects in Cartagena, Colombia, and the Philippines, I attempt to take a granular look at the colonizers' reactions, building technologies, and impositions and adaptations in relation to the natural environment.
With these ideas as starting points, I developed this thesis with two objectives in mind: First, I wanted to explore the role of architecture in shaping the environment and the ramifications of building with Mediterranean prototypes in a tropical context. Second, I sought to describe how the entanglement between legal and architectural decisions made during the Spanish Imperial period influenced the field of contemporary construction. Looking at this building technologies’ entanglement and the erasure and appropriation of Indigenous knowledge, we can see how Spaniards imposed a colonial framework fundamentally maladapted to the environment and climate while weaponizing it against their subjects in the colonial realm. It was a small-scale version of similar dynamics occurring on continental and planetary dimensions, where the spread of empires has had irreversible effects on ecologies. The beginning of a practice that continues through today.
INTRODUCTION:

As Small as a Brick, as Large as the Planet.

The arrival of Christopher Columbus into the Americas in 1492 sparked an environmental transformation of the continent. The infrastructural and architectural mechanisms used by Spaniards over the following centuries to exploit natural resources, settle territories, and control large Indigenous populations with different cultures and languages had several disastrous consequences. Conquest and colonization decimated existing societies and cultures. European wars, epidemics, and enslaved labor eliminated 90% of the Indigenous population of the Americas in the 16th century, leading to the largest human population replacement in the past 13,000 years and, as a result, a reduction in land use1. This human massacre affected the CO2 levels of the atmosphere, decreasing the global surface air temperatures on the continent over the 16th and 17th centuries, and likely contributed to the Little Ice Age process that had started around the 1300s.2 The regeneration of forests and field areas increased terrestrial carbon sinks as they reverted toward earlier states, with local, regional, and potentially global consequences for the planet. Among other records, pollen in lacustrine sediments shows vegetation regeneration, and proxies indicate anomalous Arctic sea-ice, suggesting 1600 as the coldest moment of the Little Ice Age and the lowest point of CO2 in glacier ice.3

In parallel with the climate shift, Spanish colonization flattened nature’s complexity. As a result of trading routes, the exchange of flora and fauna between both sides of the Atlantic and Pacific oceans reduced diversity in Earth’s biota. On the one hand, Europeans brought, among other things, squirrels, turkeys, guinea pigs, cacao, tomatoes, avocados, tobacco, strawberries, and potatoes. On the other hand, the Americas incorporated cows, pigs, sheep, horses, goats, chickens, cats, rats, dogs, ducks, honeybees, pears, and garlic. In parallel, from Asia, traders sent goods like rice, silk, tea, lentils, cinnamon, eucalypts, and cotton. 4 In general terms, American nature was more benevolent in importing fauna and flora, which easily took root in the colonized territory. Furthermore, cows replaced the decimated human population, and livestock and weds from Europe performed similarly to invading microbes.5 Environmental historian Shawn Miller describes how “with fewer people, the land’s evolution was driven by natural processes instead of human aspirations. This change formed an elemental aspect in making the New World new.”6

Climatologists Simon Lewis and Mark Maslin have defined these natural transformations as the ‘Orbis Spike,’ and marked 1610 as a turning point in history where human activity started to impact the environment significantly. In their own words, “the impacts of meeting Old and New World human populations— including the geologically unprecedented homogenization of Earth’s biota – may mark the beginning of the Anthropocene.”7 And the onward effects of the arrival of Europeans in the Americas also

5 Ibid., 60.
6 Ibid., 57.
7 Ibid.
highlight “a long-term and large-scale example of human actions unleashing processes that are difficult to predict or manage.” The global scale of the Spanish Empire had consequences of a similar magnitude.

Temporal Boundaries: The Spanish Empire in Three Acts

The period of this research, from the 16th to the 19th centuries, aligns with what scholars have described as an emerging modernity. Fredric Jameson argues that the beginning of ‘Modernity’ tends to move around in chronological time, and the colonization of the Americas can be considered one of the starting points. It was a phase of transformation that included in Europe, among other things, the conversion from feudalism into capitalism and the transformation of the aristocratic social order into castes by a new bourgeois order. From an environmental perspective, the Spanish colonial period also triggered the first global-scale transformations on the planet caused by human activities. These dynamics, particularly those related to the exchange of biota, started on Christopher Columbus’s second trip into the Americas when the first conquistadores brought the first disease from Europe together with animals into the Island of Hispaniola. The long history covered in this project can be divided into three acts or phases. The contours of these three acts are blurred; they gradually transition from one to the other rather than having abrupt

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10 Ibid., 39.
11 Cook, Noble David. Born to Die, Disease and New World Conquest 1492-1650. Cambridge: Cambridge University Press, 1998. 28–32. From Cook’s book we know that, on this second trip, Spaniards already sailed with pigs, chickens, dogs, cats, cattle, horses, sheep, and goats. Men and animals started to feel sick when they stopped in the Canary Islands, and when they arrived in the Caribbean, they likely passed the diseases among Indigenous peoples.
boundaries. They differ by a few decades from some territories to others. Nevertheless, these divisions mark the shifts between the environment and the building realm over time.

The first act, dating from 1492 to the end of the 16th century, was characterized by the conquest of most of Central and South America and the foundation of most Spanish colonial cities. Before the arrival of the Spaniards in America, the land was populated by settled, semi-settled, and nomadic peoples. Within the sedentary category, the Aztecs in Mexico and the Incas in Peru likely had the most extensive empires: hierarchical and well-organized, wealthy societies that generated surplus, mainly based on intensive farming. Aztec and Inca inhabitants were linked through stable connections made by agriculture, even if they lived in nucleated villages or dispersed in the countryside. After conquering these empires, settlers replicated pre-Hispanic hierarchical systems. They put themselves on top of the hierarchical pyramid, which let them exploit natural and human resources. Spaniards based their colonial economy on replicating these models through the Encomiendas – an enslaved labor system that rewarded conquerors with the labor of Indigenous peoples in the Americas. From a social perspective, Indigenous and Hispanic communities were fully divided in this first act: While the Spaniards mainly lived in urban areas (Pueblos), indigenous peoples remained in the countryside. Latin American historians James Lockhart and Stuart Schwartz explain that “[Indigenous] corporate power had fallen precipitously from its preconquest heights, but the basic mechanisms remained

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12 According to Susan Migden Socolow and Lyman L. Johnson, most of the cities were created between 1530-1540 and 1550-1560. By 1600, virtually all of the major urban centers of Spanish America had been founded. Migden Socolow, Susan, Johnson, Lyman L. “Urbanization in Colonial Latin America.” In Journal of urban history, 11/1981, ISSN: 0096-1442, (Volume 8, Issue 1), 31.

in excellent working order, traditional internal authorities were readily obeyed, and the limited nature of the *Hispanization* of the bulk of individuals was itself an insulating factor.14

Although the social structures remained, this first century reshaped the continent territorially with the founding of new towns, approximately from the 1520s to the 1550s. Then, from the 1570s to the turn of the century, Reducciones and Congregations (*Congregaciones* and *Reducciones*) resettled Indigenous communities for further control. The result was shifting demographic densities within the American continent: Some regions on the ocean coastlines, near the rivers and the mountainsides, were about to become heavily populated by Spaniards, while other territories, particularly those perceived as hostile by settlers, were disregarded. To extract labor from existing societies, the Spanish establish their main cities near existing populations (such as Puebla and Oaxaca, both in Mexico) or even on top of them (Mexico City and Cusco).15 These towns followed different ordinances, summarized in the 1573 *Ordenanzas de Descubrimiento y Poblacion*, later named Laws of the Indies. resulting in similar urban forms despite different climate locations.

The Spanish transformation of American territory came at a devastating cost. Wars, enslaved labor with inadequate diets, the forced movement of Native populations, and two major disease epidemics in 1545-1546 and 1575-79 decimated existing population. The destruction of Indigenous population contracted the economy of the Spanish Empire

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14 Ibid., 166.
15 Ibid., 88–90.
because of the lack of workers.  

16 The drastic reduction of the labor force led to what has been called the “New Spain’s Century of Depression.”  

17 The lack of labor, in turn, significantly increased the slave trading market. Enslaved people taken from Africa into the Americas between the 16th and 17 centuries grew from 119,400 to 145,900 in Spanish vessels and from 154,000 to 1,012,000 in Portuguese ships. 

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On the other side of the Pacific, the Philippines suffered a similar fate a few decades later. The Spaniards arrived for the first time in the Asian archipelago on March 16, 1521, during the Magellan–Elcano expedition around the world. This initial colonization attempt failed. The Kedatuan of Mactan defeated the Spanish forces and killed Ferdinand Magellan in the Battle of Mactan. More than 40 years later, in 1564, another expedition led by Miguel Lopez Legazpi and Fray Andres Urdaneta successfully conquered the islands. Urdaneta, with expertise in ocean currents and the atmosphere, found a relatively easy route to return to the Americas, using the North Pacific Gyre around the ocean.

19 This route made controlling the archipelago easier and link the East Indies with the Viceroyalty of New Spain. Soon, the Spanish city of Cebu was founded in 1565, and Manila in 1571. Before the arrival of the Spaniards, the Philippines already had a large and complex farming system. Nonetheless, land was not the primary source of wealth for Spanish settlers, and

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17 Elliott. *Imperial Spain*, 286–287.


the colonial project was not as profitable in Asia as it was in the Americas. The reasons for maintaining the archipelago were political and religious rather than economic.²⁰

The second act, lasting approximately from the beginning of the 17th to the middle of the 18th century, has been defined by historians James Lockhart and Stuart B. Schwartz as a “mature colonial period,” a long phase of relative stability and slow change.²¹ This act, because of New Spain’s Century of Depression, brought with it a disengagement between Spain and its American possessions as their economies started to move apart. Other Europeans started to arrive in the Americas, such as the British and French to North America and the Caribbean, and the Dutch to the Lesser Antilles, Guyana, and the north coast of Brazil, bringing new factors into the equation and a more competitive trading business.²² Furthermore, the expansion of trade and capitalism from the 17th and 18th centuries, unprecedented until that time, accelerated environmental changes on the planet.²³ In the Philippines, the Manila Galleon, which connected the capital of the archipelago with Acapulco, sent, among other things, porcelain, ivory, silk, honey pineapple, and fabrics from Asia to the American continent. In return, silver was received and distributed around Southeast Asia to pay for these goods. While the household commodities usually came from China, perishable foods were produced in the Spanish colony, in large, landed estates mainly owned by religious orders.²⁴

²¹ Lockhart, Schwartz. Early Latin America, 122–125.
²² Elliott. Imperial Spain, 287.
²³ Grégory Quenet, “Environmental History.” In Debating New Approaches, 75–100.
²⁴ Cushner. Landed Estates in the Colonial Philippine, 27.
From the architectural perspective, domestic architecture started to consolidate, from temporary constructions to permanent buildings that would come to define colonial identity. Materials and construction techniques established in the Americas started to have their own identity during this period. The Golden Age of Talavera de la Puebla tiles in Mexico is a case in point. The Cartagena and Philippines case studies of this thesis are divergent. In Cartagena, the ordinances issued in the 1550s and 1580s froze the town’s architecture. Houses built before the beginning of the second act defined the way construction would be for the rest of the colonial era. There was no evolution or blend with pre-Hispanic techniques after the end of the 16th century. On the other hand, the architecture of the Philippines followed similar imaginaries to the one built in Mexico during the first decades of colonization. Nonetheless, after the earthquake of 1645 destroyed most of Manila, over time, builders incorporated influences from Chinese and Tagalog architecture.25

In Spain, cultural and artistic manifestations were at their peak under this period, known as the Spanish Golden Age which coincided with the decay of the House of Habsburg. Cervantes published Don Quixote in 1605 and 1614, and Diego Velázquez painted Las Meninas in 1656. The artistic and academic rise was also significant on the other side of the Atlantic with the proliferation of the baroque, the construction of the universities in the colonies under royal auspices, and the work of intellectuals such as Don Pedro de Peralta

Barnuevo, Don Carlos de Sigüenza y Góngora, or José de Acosta. 26 Within the European context, this second act coincided with the scientific revolution and a deeper understanding of climate. And these factors set the stage for the third period.

The beginning of the third period starts with the growth of scientific activity and botanic expeditions between 1777 and 1816 in Spanish colonies of the Americas and Asia. These expeditions aimed to construct a botanic taxonomy and plant collection, and create profit from trading these plants as goods. 27 While the first two targets were achieved, the Spanish Empire could not replace the revenue from mining extraction—on which it had long relied—with plant trading. 28 These expeditions defined a scientific moment when climate science became a coherent research program seeking empirical evidence and a causal understanding of the past and present distribution of climatic conditions across the surface of the Earth. 29 Besides the scientific expeditions, the Military Engineer Brigade – which had been founded in 1710 by Philip V – made a series of analyses of the wood materials used for construction in the Americas and the Philippines, such as Francisco de Requena.

27 The Natural history expeditions were the following:
- Royal Botanical Expedition to Chile and Peru (1777-88) to Chile and Peru, led by the naturalists Hipólito Ruiz, and José Pavón, among others.
- Royal Botanical Expedition to the New Kingdom of Granada (1783-1808 under Mutís, and 1808-16) to New Granada (Colombia, Venezuela, Ecuador, Peru, and Panama), led by the naturalists Jose Celestino Mutís.
- Royal Natural History Expedition to New Spain (1787-1803) to Mexico, Guatemala, Cuba, and Puerto Rico, led by the naturalists Martín de Sessé, José Mariano Mociño, Vicente Cervantes, and José Longinos.
- Malaspina Expedition (1789-94) to South America, Central America, North America, Australia, and the Philippines, led by the naturalists Thaddeus Haenke, Luis Née, and Antonio Pineda.
in 1774 in Guayaquil (Ecuador), and Nicolás Valdés in 1858 in the Philippines and the Antilles, and in 1866 in Cuba, Santo Domingo, and Puerto Rico.\textsuperscript{30}

The end of this period is defined by the independence of the colonized territories from Spain at the beginning of the 19\textsuperscript{th} century and the Spanish-American War in 1898, which would transfer Cuba, Puerto Rico, and the Philippines to the United States. The occupation of the Philippines by the Spanish Empire until the turn of the 20\textsuperscript{th} century resulted in more precise studies of the tropical climate with local and global mechanisms, like the construction of the Observatory of Manila in 1865 and the cross-pollination of information between outposts worldwide. These studies provided enough data to start forecasting the weather of each town and knowing the intensity of wind currents that could compromise buildings.\textsuperscript{31}

**Physical Boundaries: Pacific vs. Atlantic**

Instead of drawing conclusions from a singular case study or episode. This thesis describes the entanglement between several factors, such as climate, knowledge, and racial hierarchies, in different territories. Rather than focusing on a particular trading route, region, or architectural outcome, I aim to broadly compare what happened to architecture when the centers of powers, Spain, and peripheries switched between the Atlantic and Pacific colonies—Cartagena, Colombia, looking at Spain, and the Philippines, looking at Spain through the filter of the Viceroyalty of New Spain (currently Mexico), the institution

\textsuperscript{30} Cerezo y Sáenz, Rafael. *Estudio sobre la Resistencia de los Edificios Sometidos a Huracanes y Terremotos*. Centro de Estudios y Experimentación de Obras Públicas, 1992. V.

\textsuperscript{31} Ibid., 6–9.
managed and controlled the Spanish East Indies. Thus, this is a global history project constructed by analyzing the imposition or transformation of colonial building technologies in different parts of the world, the erasure or assimilation of Indigenous techniques into the Spanish buildings, and the effects of climate on them.

The collision between the architecture Spaniards brought to the colonies and the existing conditions was particularly revealing in the tropics (Figure 1). Tropical climate was still unknown to Europeans in the 15th century. Their understanding of weather conditions was limited to their own latitude. Europeans divided the Earth into three climatic zones associated with the hemispheres: frigid at the poles, temperate at mid-latitudes, and torrid at the equator. Focusing on the tropics allows us to analyze how colonizers responded to unknown climatic conditions, the protocols they used in their settlements, and the role of Indigenous construction knowledge that Spaniards rejected or adopted. Cartagena and the Magdalena River in Colombia (formerly part of the New Kingdom of Granada) and the Philippines (part of the Spanish East Indies during the colonial period and governed by the Viceroyalty of New Spain) each rendered different results in the construction of the urban realm and the domestic space. In Cartagena, colonizers repeated the same systems from Spain, disregarding the architecture of the tropical climate. However, in the Philippines, colonial architecture used Indigenous and Chinese construction techniques to protect from earthquakes and typhoons and adapt to tropical conditions.

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Spatial Laws and Leaks

The orthogonal grid, coming from Renaissance models and Army camp towns, defined the representation of colonial imposition in the urban realm. In colonial towns, the grid was disseminated in three continents simultaneously and extended across rivers, marshes, and mountains without respect to differences in these terrains (Figure 2). However, as a tool of territorial expansion, the grid also had a certain degree of adaptability toward the environment when it was used to select sites based on specific climatic conditions. Theoretically, the orthogonal grid, explained in the Laws of the Indies, could be applied everywhere. This ambiguous approach, which was rigid and adaptable to the environment, also occurred with building technologies. In some colonized regions, spatial and material techniques rigidly followed Spanish conventions, erasing the local knowledge that had emerged and evolved there. But in other territories, colonizers merged their architecture with the knowledge of Indigenous and enslaved peoples to adapt to high levels of heat and humidity, hurricanes, and earthquakes. The two proposed case studies of this thesis, Cartagena and the Philippines, show this dual approach of Spaniardsconcerting building construction. This dual attitude of self-destruction and self-preservation by colonizers can be traced through ordinances that dictated how to build. Emphasis on the homogeneity of the Laws of the Indies has overshadowed the importance of these “building codes.” They had the same importance in creating a homogenous empire that reached the global scale. Similar to the description by Lewis and Maslin regarding trading routes, mandates regulating construction materials had long-term and large-scale consequences for the building realm.

This thesis builds upon the recent work of scholars who have considered the environment as a crucial aspect of architectural and urban history. Architectural historian Esther da Costa Meyer states that “In architectural practice, the Anthropocene has served as a catalyst, as professionals have attempted to grapple with the issue, re-evaluate widely held assumptions, cogitate the design of sustainable buildings and urban projects that are energy efficient, address urban ecosystems and save natural resources.” She asks, “What heuristic models does the Anthropocene have in store for us? How might it affect, interrogate, confirm, or disavow the usual forms of knowledge production within our field?” Within this thesis, where environmental and colonial history converge, Costa Meyer's perspective resonates with theories of coloniality and decoloniality in Latin America, particularly with the work of Anibal Quijano and Walter Mignolo. Fernando Luiz Lara has summarized and developed the work of these authors within architectural history. In the foreword of the book *Decolonizing the Spatial History of the Americas*, Luiz Lara pays particular attention to recovering knowledge within the colonial period that goes

34 Colonization and the environment within the context of the Spanish Empire have been analyzed in a wide array of texts, such as *Landed Estates in the Colonial Philippines, El Contacto Hispano-Indigena en Filipinas* (Prieto Lucena, 1993), *Born to Die, Disease and New World Conquest 1492-1650, Nature, Empire, and Nation: Explorations of the History of Science in the Iberian World* (Cañizares-Esguerra, 2006), *The Tropics of Empire* (Wey Gómez, 2008), *An Environmental History of Latin America, Mosquito Empire* (McNeill, 2010), and *Sea of Storms* (Schwartz, 2015).


36 Ibid., 2.

beyond the imposition of the colonizers. Following his method, we can find leaks or fractures in the attitudes and legal frameworks that dictated how to build. Relating these leaks to the climatic performance of buildings, we can describe quantitative data that supports theories, narratives, and speculations, otherwise incomplete in official records.

Unsettling Climate: The Consequences of Domestic Building Technologies Across the Spanish Empire reflects the overlap of different technologies within a colonial context. Technologies imported from foreign contexts destroyed previous epistemologies, which were improved over centuries. In many colonial buildings, such as the first case study of Cartagena patio houses, architecture went through a process of standardization through a series of ordinances. Architectural historian Nader Vossoughian describes how standardization is a process that transforms not only the object but also the subject. It shapes our thoughts, not only our things. The last step of standardization is the homogenization of the urban environment, which happens at the expense of the erasure of the pre-existing. Homogenization is a form of epistemicide. However, in the Philippines, the lack of legislative control triggered processes that merged the architecture of the colonizers with other methods and knowledge that came from Indigenous and migrant builders. Bahay Na Bato (Houses of Stone) in the Asian archipelago represented this mixture or mestizaje. The lack of regulations, the peripheral contexts, and the necessity of labor that could not be fully transformed created a diverted construction method that, paradoxically, adapted to the tropical climate. These were leaks in the legal system constructed by colonizers. Leaks

simultaneously describe a form of knowledge extraction and the recovery of the methods by those who were silenced and exterminated.

**Approach: Assemblage**

Reconstructing colonial history, particularly in the domestic realm, is a labor of assemblages between the official and recorded narrative and the hidden subjects behind it. It requires finding a series of sources and evidence that can construct new documentation and reveal the missing parts. In her work examining the effects of radioactivity that occurred with the French nuclear weapons program in the colonized Algerian Sahara during and after the Algerian Revolution for Independence (1954-62), the architectural historian and theorist Samia Henni uses the word assemblage to define the act of recomposing a story where many sources are undisclosed, have been lost or were never directly created. Henni juxtaposes various sets of visual accounts to reveal the causes, symptoms, and effects of acts of violence in colonized territories. Overlaying different methodologies and layers of information can create enough evidence to reconstruct a story or at least speculate about it.

In *Unsettling Climate*, my assemblages consist of the combination of historical chronicles, maps, and ordinances, with contemporary climate data and paleoclimate information, photographs, technical reports, diagrams, floor plans, building sections, room sizes, wall thicknesses, material weights, and environmental simulations. The goal is to offer enough

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evidence to track the environmental dynamics in relation to the building technologies at the domestic scale that occurred during the Spanish colonial period.

**Buildings as Living Archives**

To understand the outcome of legal impositions in the urban realm, I confront colonial buildings within the climate in which they sit. Structures that remain standing with minimum changes from the colonial period can give rich information about whether or to what extent they adapted to the tropics. In this way, buildings become primary sources, living archives that depict the consequences of Spanish technologies and spatial hierarchies in different regions. Buildings are as important to my project as the documents stored in the General Archive of the Indies in Seville, the General Archive of the Nation in Bogotá, and the National Archives of the Philippines in Manila. I focus on the analysis of colonial houses of Spaniards who were slave traders, merchants, and other powerful figures for two reasons. First, these houses have been better preserved than others over centuries with minimum changes in their forms and materials. Colonial technologies are still discernible. Second, they directly depict the relations of power between the masters, servants, and enslaved people found in the colonial domestic realm while also allowing us to measure the thermal conditions each of the individuals received.

**3D Environmental Simulations**

The development of computerized environmental analysis software and available data in the last decades has opened the door to new visual methods of historical analysis. Software programs such as ArcGis, Climate Studio, Butterfly, HoneyBee, or LadyBug allow us to
revisit historical urban and architectural projects through different lenses. With the assistance of these programs, we can depict how each room of a house responds externally to its climatic context and internally to its hierarchical position. In this methodology, as art historians Paul B. Jaskot and Ivo Van der Graaff argue, process mediates between evidence and analysis and gives form to that relationship.41 Environmental analyses provide images of the internal environmental conditions of these houses based on scientific metadata. Rather than transforming a particular narrative, the result depicts the performance of architectural systems under a set of controlled conditions (defined in the model). These simulations complement what is described in written form, as well as give room for possible glitches in the arguments.

Room Sizes and Wall Thicknesses

Room Sizes, Wall materials, and thickness determine how the material absorbs or insulates from heat and humidity. This methodological approach, which could be described as a “domestic dimension of spatial history,” adds an extra layer of information to an analysis based on historical documents and maps. The spatial and thermal analysis of domestic spaces reveal acts of violence, particularly to enslaved peoples, connected to the spaces they had to inhabit within colonial houses. The American historian Richard White describes in his text What is Spatial History? that “Historians, by definition, focus on time. Chronology will always remain at the heart of a discipline that seeks to explain change over time, but this has left historians open to the charge from geographers that they write

history as if it took place on the head of a pin.”42 The same argument could be made for architectural history: the performance of technology concerning the environment can expose hidden conditions. Moreover, as the architectural historian Albert Narath describes, the “materiality of buildings has stimulated particular historical narratives concerning the connection between architecture and ecological issues.”43 In Spanish colonial houses, climate and building technologies interacted on several levels, from epistemological reinforcement and extractivism to thermal discomfort.

While this thesis focuses on the houses built in Cartagena around the Magdalena River and the different variations of Bahay Na Bato in the Philippines, similar exercises could be done in different climate classifications. Constructions in Bogota (Cfb – Oceanic), Cusco (Cwb – subtropical highland), Lima (BWh – hot desert), Oaxaca (Aw – tropical savanna), and Mexico City (Cwb – subtropical highland) could show different outcomes in the transformation of Spanish architecture in colonial regions based on the environment circumstances and local knowledge (Figure 3).

**Forecasting Backwards**

As we are increasingly aware, global temperature has changed significantly over the centuries. Past climates have been reconstructed with paleoclimatology, a discipline that studies these transformations through indirect evidence called proxy records. This

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information can come from tree ring data, rocks deposited by glaciers, lake and ocean sediments, layers of ice, corals, fossils, and historical records from ship logs and early weather observers. Several studies have concluded that, in the 16th-18th centuries, the temperature was, on average, around 1.0-1.5°C cooler than it has been since 1960. The environmental simulations produced in this thesis thus need to be examined with this deviation or margin of error in mind. To understand more closely, I have crossed this quantitative information with primary texts from the 1600s that describe how colonizers confronted climate and the natural environment. The environmental simulations produced in this thesis thus need to be examined with this deviation or margin of error in mind. To understand more closely, I have crossed this quantitative information with primary texts from the 1600s that describe how colonizers confronted climate and the natural environment.

Mass

*Unsettling Climate* is a historical analysis of architectural weight. An architecture that quickly became heavier, more solid, and opaque versus another that, through a slow evolution, got thinner, lighter, and more porous. In Cartagena, colonizers prioritized fired bricks over *bahareque* (a Taino term to define walls made of bamboo and soil) and tiles.
over nipa hut, increasing the thickness of walls, floors, and roofs and the load of buildings. Conversely, colonial constructions had an inverse process in most parts of the Philippines. After a short period where the architecture imitated the one built in Mexico, houses in the Asian Archipelago started to slenderize: second-floor walls transformed from stone to wood, the structure became independent from the envelope, and finally, the roof passed from tiles to metal sheets. The genealogy of lightness in Filipino colonial architecture moved it closer to Chinese and Indigenous models while detaching it from colonial mindsets.

Although architectural technologies in Cartagena and the Philippines diverged over time in relation to weight, they both attempted to detach from the ground. In the mentality of Spaniards, closeness to the soil was considered a human demotion. The separation from the floor happened in different domestic forms beyond architecture. Miller narrates that while Indigenous ate, sat, and slept on the ground, Iberians used pots and forks, wore shoes, and utilized beds. Architecture, particularly from these power figures, followed a similar approach. Colonizers had their living spaces and bedrooms on the upper floors and relegated their servants to the rooms on the ground floor or mezzanine, which were shared with animals and crops. In both cases, it seemed colonizers longed to levitate off the ground. Not understanding the natural environment made them reject it.

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The thesis is divided into two case studies visiting two locations of the Spanish Empire and the opposite outcomes of the building technologies, and two supplementary chapters, which speak more broadly about the relationship between climate, architecture, and territory. The case studies describe antagonistic results in the architecture executed by Spaniards and the role of Indigenous technologies in it. The division of this thesis into case studies and accompanying chapters is conceived with the idea that it does not need to be read linearly. Each of them can be read independently, and the reader can go through the thesis without following the table of contents.

The first case study, *Colonial Impositions and Environmental Disregard in Cartagena* analyzes the erasure of the Kalamari technique of bahareque—a construction method using a system of interwoven sticks or reeds, with a covering of mud—and the imposition of fired bricks tiles. Following the legal ordinances of 1555, which forbade Indigenous materials and imposed the architecture of the Iberian Peninsula, settler buildings got stranded in the first decades of colonization. Among other consequences, the maladaptation to the tropical lasted centuries and is still present. Laws came first, and architecture followed it. Instead, in the second case study, *Climatic Adaptation and Knowledge Appropriation in the Philippines*, I investigate the reverse consequences of the interlock of Indigenous and Spanish construction technologies. I argue that the lack of legal control in the Spanish Archipelago, because of its distance from Spain, and Chinese Builders as the third players in the colonial realm, transformed the original constructions proposed by Spanish settlers. The outcome was an architecture that appropriated different
epistemologies to adapt to the common earthquakes of the region and the tropical climate. These resultant constructions, the *bahay na bato* (house of stone), were organically transformed over a period of more than 200 years. Nevertheless, in 1880, less than 20 years before Spain lost the Philippines against the United States in the Spanish–American War, the architecture was frozen in a set of ordinances that described how they had to be built. Architecture came first, and the laws followed it.

The case studies are supported by two supplementary chapters that broaden the relationship between architecture and climate. The first one, *The Spanish Domestic Patio House*, traces a genealogy of the domestic courtyard constructions of the Iberian Peninsula and their origins in Roman and Muslim architecture. Then, I speculate the causes behind the spread of patio houses in different contexts across the Spanish Empire from the 16th century onward. In the second auxiliary chapter, *Climate Epistemologies and Patterns of Conquest*, I explain how Europeans understood climate on their first arrival to the New World and the influence of early modern colonization in the construction of new climatic epistemologies. I also describe the environmental determinist theories developed at the turn of the 17th century and how climate became an act of contestation. Finally, focusing on the Laws of the Indies and the *Relaciones Geograficas*, I analyze how the Spanish Empire approached urbanization in different territories and climates, seeking the most suitable conditions to create new settlements. I pay special attention to the expansion of conquest that followed certain environmental factors – sometimes contradictory – and how climate played an important role in different successes and failures.

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47 A set of mechanisms and documents that attempted to control the Indigenous population in the first century of colonization by resettling them in newly founded towns designed by Spaniards.
The thesis as a whole is a compilation of evidence that portrays the unsettling climate constructed by Spaniards in the tropics during 400 years of colonization. It depicts violence, stubborn decisions, racism, misunderstandings, extraction techniques and their masking, destruction of the environment, etc. However, it also provides hints and possibilities assembled in the past and in recent times to unsettle this colonial entanglement.
INTRODUCTION – Figures

Figure 01: Worldwide Tropical Regions. SOURCE: Own elaboration.
Figure 02: *A Scenographic Plan of the City of the Kings, otherwise called Lima, the capital of the Kingdom of Peru ... as it was before the late earthquakes.* SOURCE: Beinecke Rare Book and Manuscript Library (1755).
Figure 03: Psychometric chart showing the different locations of Spanish and Imperial Spanish Houses around the world. SOURCE: Own elaboration.
The Spanish Domestic Patio House

Courtyards are an effective configuration for cooling in hot-arid climates with a large diurnal temperature swing. These conditions are common in the Iberian Peninsula, particularly in some regions historically held by the Kingdom of Castile (the plateau in the center and the south where Andalusia is located) and many constructions in the Mediterranean coastline, which was part of the Kingdom of Aragon (these areas have a cold semiarid climate – BSk, and a hot-summer Mediterranean climate – CSa). In this environment, courtyards provide shade from low-angle sun in the morning and afternoon. When the constructions that enclose the patios are tall enough and have a certain degree of porosity, wind can also lower the heat perception. High walls prevent the exterior window from disrupting the air in the court, which can be cooled through plants and water bodies. This condition can be further altered through operable windows and doors, which incorporate cross-circulation into the environmental dynamics of the courts.

Courtyards houses were not uniquely Spanish or Mediterranean. Examples can be found in ancient cultures around the planet, including the yaodong, or "house cave," in the Loess Plateau in China's north; the Imperial Japanese villas; or the Kanchas in the Wari

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1 BSk climates usually feature warm to hot dry summers, though their summers are typically not quite as hot as those of hot semi-arid climates. Temperatures in this season usually go from 38°C to 22°C (100°F to 71°F). On the other hand, winters tend to be freezing but also dry, with temperatures ranging between 2°C and 15°C (35°F and 59°F).

2 In CSa climate, summers are very dry with minimal cloud average, and temperatures vary between 19°C and 30°C (66°F and 86°F). Winter temperature usually ranges between 7°C and 19°C (44°F and 66°F). This climate receives almost all its precipitation during the fall and spring seasons.

settlements before the Inca Empire, in the valley of Cuzco. Within the Iberian context, patios were the main element that organized domestic space by the end of the Reconquista in 1492 and the beginning of the colonization of the Americas. Then, these constructions were transferred from Spanish settlers into the colonized territories and repeated in a wide variety of climates, from tropical and subtropical to hot and cold deserts. They constituted the imposition of an empire onto an offshore environment.

This global implementation of patio houses across the Spanish Empire, regardless of location, climate, or environmental surroundings, created a planetary architecture built simultaneously on both sides of the Atlantic Ocean first and in the Spanish East Indies shortly after, following the cultural representation of the building realm of southern Spain. The increasing connection between the ocean brought a rising homogeneity despite differences in location, climate, or supply of materials. Patio houses followed the same routes as spices, gold, or poultry throughout continents, not only metaphorically but also physically: Brick, ceramics, and labor were sent back and forth from one side of the Atlantic to the other, replicating the cultural models of the conquistadors in Spain. So, too, were enslaved peoples, who were usually the builders of these houses after the decline of the Indigenous American population at the end of the 16th century. Consequently, the slow expansion that had transformed the architecture in the Mediterranean Sea throughout a millennium—during the Roman Empire first, as a previous evolution of Greek constructions, and Al-Andalus later—experienced a process of acceleration: By the turn of the 17th century, less than 100 years after the beginning of American colonization, Spanish
settlers were building patio houses in Mexico, Colombia, Manila, Cuzco, among other locations, simultaneously, using the same spatial parameters in all cases.

Before patio houses were transferred by settlers to the colonies, however, they experienced a long development on the Iberian Peninsula, first during the Roman Empire (in the Iberian Peninsula, Roman Hispania lasted from 218 BC to 472 AD) and then during the Al-Andalus period (711-1492). Through this transformation, they came to form the foundation of the domestic architecture of the kingdom of Castile, which created the foundations of the domestic architecture in the Crown of Castile. The regions around the Mediterranean Sea, which are located between the latitudes 45°N and 32°N (excluding the Gulf of Lybia), and 8°W and 36°E, primarily have a hot semi-arid (Bsh, under the Koppen climate classification), Cold semi-arid (Bsk), hot-summer Mediterranean (Csa), and warm-summer Mediterranean climates (Csb). The temperatures in the coldest month average above 0 °C (32 °F), and at least one month in the summer has an average temperature above 22 °C (71.6 °F). Precipitation can range from 35 to 90 cm but is highly variable, with less rainfall at more inland sites (Figure 1). Within these conditions, courtyard houses attempted to protect from high temperatures, particularly during summer, while collecting water in the rainy months to persist in periods of drought. Culturally, patio houses were the rational architectural solution, creating an exterior, private, and safe space within the boundaries of the house.

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4 Source: Mindat.org.
5 Source: UC Davis Global Soil Health Portal
**Domus House**

The *Domus*, which evolved from the Greeks and developed during the Roman Empire, depicts the environmental and cultural mechanisms around its patios. Taking as an example the St. Trebius Valens (40°45'05.3"N 14°29'27.6"E), built in Pompei between 30 BC and AD 300, we can describe the main features of the houses of this period. This house (whose ruins remain in the ancient city of Pompeii) is a 32 m. long by 16 m. wide structure (104 ft. by 52.5 ft.), is oriented NW/SE and divided into two parts: the atrium in the front and the peristyle in the back (Figure 2). It offers a precise model of how the courtyard worked as a thermodynamic regulator of the adjacent spaces while becoming the heart of the home.

The *Domus* of St. Trebius Valens closes the rooms to the exterior street and opens them to two courtyards. The first one, of less significant dimensions, is an atrium where the family received clients and honored their gods; the importance of the atrium as a threshold between the public and domestic spaces is emphasized by its centrality within the house and the axis formed with the hall or *vestivulum*. Moreover, the atrium opens to the main public rooms of the house, such as the kitchen (*culina*), living room (*sala*), and dining room (*sala da pranzo*). This axis continues in the peristyle. This second backyard, with more generous dimensions, is surrounded by a portico commonly used as a garden, has a more private character, and hosts more formal rooms, including the principal hall or salon (Oecus), an entertainment room named exedra, and an exterior portico. The access to the Domus was majestic: From the street, it was possible to see the sequence of courtyards and covered thresholds that revealed their wealth to the public.

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From an environmental perspective, the central courtyard of the Domus regulated the temperature of its rooms and provided sunlight and ventilation. The thermal inertia of the exterior walls, in combination with the lack of windows facing the street, gave a heat sink insulating the interior spaces during the day and becoming a heat source at night. Heat gain by the interior walls of the room facing the courtyard was prevented using a ‘compluvium’ red clay roof shading device. The atrium served as a source of ventilation and natural sunlight. Nevertheless, the airflow was compromised in the rest of the bedrooms, particularly those with a dividing wall that did not enjoy the same ventilation. With only an opening to the courtyard, a high percentage of moisture and odors would likely accumulate at certain times of the year. The division and privacy of these rooms and the atrium were made through curtains that enclosed and thermally insulated them during the colder days.7 Regarding water storage, the slope of the roofs, or *compluvium*, directed the rainwater to the cistern, or *impluvium*, through a small pool or slot on the floor in the center of the atrium. The water was accessible through a well and cooled the adjacent space through convection, inducted from the second courtyard and garden in the back of the house.

The Domus house strongly influenced the architecture of the Iberian Peninsula, mainly through the cultural implications of its courtyard and its environmental potential to regulate the temperature and humidity of the house. The archaeological ruins of these houses in cities such as Palencia and Merida show how these buildings were part of the urban realm.

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7 Ibid., 316.
of Roman towns. However, the Muslim conquest of the Iberian Peninsula between 711 and 1492 –commonly called the Al-Andalus period – would further shape Iberian homes in the ensuing centuries.

**Muslim House**

These domestic constructions had a similar organization to the Domus, with several rooms (also known as *salas*) around a central courtyard (Figure 3). Usually, the entrance on the ground floor was located on a corner to prevent intruders from looking in from the street. Once the owner or visitor made a 90-degree turn, they accessed the courtyard, having the *makad* in front of them. The *makad* had similar proportions to the rest of the rooms, but its primary function was receiving guests (similar to what could be considered a living room today). In front of the *makad* was the staircase to access the upper floors, the kitchen, and a water fountain, which was connected to an impluvium and a well, located in the center of the courtyard. The rest of the rooms or *salas* did not have a precise function but could act as bedrooms. The second floor had an open gallery that gave access to different *salas*, which were also used as bedrooms. Between the first and second floors, there was a small mezzanine, less than two meters high (6 ft), where the servants’ bedrooms were located. Space for storage was located on a second mezzanine with lattice screens for ventilation.

This house responded to its environment through different interconnected mechanisms for the hot-summer Mediterranean climate (CSa) of the south of Spain, similar to most of the

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The first of these environmental mechanisms was the patio, which provided controlled natural shading and ventilation in all the spaces. Through its vertical proportions and the use of screens in the openings to the salas, which controlled air and light to the interiors, the environment was cooled. The second mechanism was the proportions of the salas and makads. These rooms were usually less than 2.5 meters wide but could reach 6 meters high (8 ft by 20 ft). Through convection, the rooms achieved a lower temperature at a human height. Finally, thick masonry, finished with lime and tiles, created enough insulation through high thermal mass values, and its surfaces absorbed moisture.

The houses built during the Al-Andalus period incorporated several spatial and construction techniques that would be exported to the colonies. One of them was the vertical stratification of the houses. The space used to welcome visitors on the entry level, the location for servants on the mezzanine, and the private life on the second floor produced a gradient from the semipublic to the private space, with servants in the middle, providing labor on both worlds without having a visual presence in the homes. However, Roman Domus also played an essential role in the resultant Iberian houses exported into the Americas, particularly in the relationship between a courtyard and a backyard and the visual relationship between the patio and the street. Furthermore, environmental design techniques within domestic space were also transferred to the Americas, using similar

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10 Based on current meteorological data that possibly have had variations in the 15th and 16th centuries, this meant a dry-bulb temperature possibly reaching 45 °C in Summer and an average temperature of around 15°C in Spring and Autumn. The lowest temperatures throughout the year barely went below 10°C. In terms of relative humidity, it oscillated between 50 and 80% in Autumn and Winter and lowered to between 20 and 70% in summer.

approaches around the Mediterranean Sea: The courtyard, in conjunction with shallow pools and vegetation, created a microclimate that could be adjusted to adapt the interiors to the Mediterranean. When this architecture was transported to the Americas, and the temperature and humidity levels significantly varied, it endured a rapid process of maladaptation. All the mechanisms that previously regulated its interior conditions started to work in the opposite direction.

**Homogenization Patterns Across the Spanish Empire**

Patio houses with little variations were again and again built in many locations around the Americas during the colonial period, which started in 1492, impervious to the existing environmental conditions, as a stamp of colonial imposition. Though no single cause can explain this homogenization, three factors may be considered particularly relevant: the Laws of the Indies, the social origins of early settlers, and the representation of urban constructions on colonial maps.

The Laws of the Indies roughly describe how colonial houses should be built, paying particular attention to tactics to enhance cross ventilation from the south and north and constructing a dense urban fabric for defense purposes.\(^\text{12}\) The ordinance also requested that each house have patios and backyards to separate the animals from the people.\(^\text{13}\)

\(^{12}\) Further information about the Laws of Indies can be found in the interval chapter between Case Studies 1 and 2, Construction of Climatic Epistemologies and Patterns of Conquest. In the Laws of Indies, this ordinance focuses on *Vientos del mediodía y del norte*, meaning in Spain, winds coming from the south that is usually accompanied by rains and cold winds from the north.

\(^{13}\) Translation made by author of the thesis from the *Ordenanzas* 133 and 134 of the *Ordenanzas de descubrimientos, nueva población y pacificación de las Indias*: *Plots and buildings shall be arranged in such a form that the rooms can have southern and northern wind directions since these are the best. Make the houses be connected between them to increase their defense and strength against those that want to*
engagement with existing environmental conditions came through a discussion of wind directions and could not have been enough to mandate the construction of a single type around the colonized territories. Nevertheless, they gave a first indication of how houses had to be built in an underway colonization. And while most of the towns were founded before these laws were passed, permanent constructions started to be built at the end of the 16th century when they were already circulating.

Mirroring the existing architecture of the Iberian Peninsula was more important than the Law of Indies, and the origins of the settlers indicate a more substantial cause for this architectural homogenization. Early colonizers were Hidalgos (the gentry, usually an impoverished class below the upper aristocracy) from the regions of Andalucia and Extremadura in the Kingdom of Castille, who attempted to upgrade socially and economically in the Americas. They wanted to replicate the finest standards of the dominant social classes back in their homeland, and building similar houses may have been a strategy to accomplish their status aspirations. Based on this premise, even the departure point for their expedition may have influenced them. Most ships had to leave Seville, where

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attack or hinder the population; Each house shall be arranged to have its own horses and cattle, with patios and poultry yards, the widest possible space for health and cleanliness.

Original Ordinance in Spanish: Dispongan los solares y edificios que en ellos hizieren de manera que en la avitación dellos se pueda gozar de los ayres de mediodia y del norte por ser los mejores del. Ponganse los edificios de las casas de toda la población generalmente de manera que sirban de defensa y fuerza contra los que quisieren estorvar o ymfectar la población; y cada cassa en particular la labren de manera que en ella puedan tener sus cavallos y vestias de servicio, con patios y corrales y con la más anchura que fuere posible por la salud y limpieza.

The Ordinance from the Laws of the Indies made in 1680, under Charles II Kingdom differs slightly from this original version. Nevertheless, I have decided to translate the original since it was more relevant in the development of the 17th century.

the House of Trade (*Casa de Contratación*) was located. This was a mandatory stop since the institution oversaw the purchase, transport, warehousing, and sale of merchandise exported and imported from the Kingdom of Castile into the American territories.\textsuperscript{15} Patio houses had become fashionable in Seville during the Al-Andalus period, and it is unsurprising that they strongly influenced colonizers departing from its port.

If the Laws of Indies began to create the legal framework and the origins of the settlers’ social aspiration, the representation of patio houses in colonial maps might have helped to consolidate this type of construction. We can find in several colonial maps, from Oaxaca and Mexico City to Lima Santiago de Chile, the repetition of patios in conjunction with the prototypical orthogonal grid that organized the urban space, with different gradients of abstraction and simplification in their depiction (Figure 4). If the grid imposed the colonial understanding of the urban space on top of natural settings or prehispanic settlements, the patios molded the private realm. These towns mentioned above are located in a wide variety of climates, from tropical and subtropical to hot and cold deserts. Although they may not have been the original root of their repetition, colonial maps may have re-instantiated and solidified the construction of patio houses as the leading domestic element.

This architectural homogenization was not a neutral process. As seen through the lens of coloniality and environmental design, it raises the following questions: Which elements from Roman and Muslim architecture were continued or discontinued in the Americas? How did they perform, both culturally and climatically, and why did they prioritize the

status of the settlers over climatic adaptation to the sites? And finally, within these houses, what hierarchies were implemented within the different subjects of the colonial realm? Houses in Cartagena and the Philippines can respond to these questions from different angles and inform colonial history using the domestic space as the core of the investigation.
Figure 01: Koppen Classification map around the Mediterranean Sea, highlighting the main climates: BSh (Hot semi-arid climate), BSk (Cold semi-arid climate), Csa (Hot-summer Mediterranean climate), and Csb (Warm-summer Mediterranean climate). Source: Own elaboration.

Figure 02: Domus House of St. Trebius Valens, Pompei, Italy (40°45'05.3"N 14°29'27.6"E), 30 BC - AD 300. Source: Prieto, Eduardo, *Historia Medioambiental de la Arquitectura* (Madrid: Catedra, 2019), 314.
Figure 03: Typical plan and section of a Islamic House as they are currently in the Rif Area. Source: Sierra Ochoa, Alfonso de., *Vivienda Marroqui: (notas para una teoría)*, (Ceuta: Editorial Cremades, 1960).

Figure 04: *Map of the city of Antequera de Oaxaca and its surroundings*, 1777. Source: Archivo General de Indias, Seville, Spain.
CASE STUDY I:
Colonial Impositions and Environmental Disregard in Cartagena

Can a material like brick, which seems innocuous in the urban realm, inform us about a process of epistemicide in Spanish colonial Latin America? How is this process of erasure directly related to environmental history? In Cartagena, the architecture of settlers masked the complexity of the climatic conditions of the colonized territories. It denied thermal adaptation to colonized Indigenous communities, enslaved peoples, and the settlers themselves. By replicating architectural models from the Iberian Peninsula, Spanish colonies imposed an architecture incompatible with the existing ecologies, climatic conditions, available materials, or previous constructions. Colonial houses in Cartagena, or Cartagena de Indias (tropical savannah – Aw/As), analyzed as the first case study of this thesis, manifest the misunderstanding of the tropical climate and the disregard for Indigenous construction knowledge. Through a series of pronouncements and ordinances, conquistadors and colonizers erased pre-Hispanic technologies and imposed Iberian models that predominate even today, despite being ill-suited to the tropical environment.

In this chapter, I investigate two of the dominant architectural features of colonial Cartagena: the use of patios or courtyards as the predominant construction in private houses and the incorporation of fired bricks and tiles in place of palm leaf roofs, adobe walls and bahareque (the Taino term for walls made of bamboo and soil, renamed Bajaraque in Spanish). Divided into two sections, the first part of the chapter focuses on the architecture before the arrival of the Spaniards and the conquest of Cartagena. First, I examine the
Indigenous architecture on the northeast Caribbean coast of South America (corresponding mainly to modern-day Colombia) and the conquest by Spanish settlers that developed into the New Kingdom of Granada, a crucial part of the Viceroyalty of Peru in the 16th century. I continue by conducting a forensic analysis of the *Ordenanza de Cabildo, Cartagena* (Ordinance of Cartagena), passed by the local Spanish authorities in 1555, which mandated the use of fired bricks and tiles in the city. Third, I examine supplemental written records from Spanish settlers and their descendants that consider their life in the tropical climate, their maladaptation, and the consequences of colonialism in the local ecology. The second section of this chapter concentrates on the patio houses of Cartagena and the different transformations along the Magdalena River in Colombia. I analyze distinctive types of houses, paying particular attention to *Casas Altas*, a three-level construction common amongst the colonial elite, many of them slave traders. In particular, I focus on *Casa las Damas*, the house of Alonso Alvarez de Armenta, a Spanish settler who arrived in Cartagena at the turn of the 17th century. Through environmental analysis and data, I show how this case exemplifies the maladaptation of colonial houses and how the different hierarchies of colonial life and social injustice were reflected in the thermal conditions of the domestic realm. I questioned the similarities and variations of colonial architecture in other towns of the New Kingdom of Granada with both comparable and dissimilar climates. In particular, I draw comparisons to colonial houses in Mompox, which share a similar tropical climate to Cartagena (tropical savannah – Aw/As) but with a higher apparent temperature because of their inland location.
I finalize drawing several conclusions in the epilogue subheading. First, building on the concept of colonality and decoloniality, developed by Anibal Quijano and later Walter Mignolo and Catherine E. Walsh, the destruction of pre-Hispanic societies included the demolition of Indigenous knowledge about technology and thermal adaptation. ¹ The misalignment of the cultural patterns of the oppressors with the existing climate created dysfunctional spaces. Nevertheless, those were projected as essential to a process of assimilation as part of the protocols of homogenization. Looking at the architectural figures of Rogelio Salmona and Simón Vélez, and the work done in the palenque town of El Nispero in María La Baja, we can see how the endurance and challenging of the colonial mentalities in the past decades.

The connections between environmental history and colonial architecture in Cartagena reflects the intricacies of the power dynamics – racial, economic, social, and cultural—Colonizers weaponized architecture and, consequently, climate conditions in domestic architecture. Colonial houses echoed the structures of this hierarchical society, reinforcing brutality toward enslaved and Indigenous peoples, as they were relegated to less-than-acceptable spaces within already climatically inappropriate colonial constructions. Patio houses had a significant role in the physical and psychological power of the settlers toward the Indigenous and enslaved peoples.

Bahareque

Cartagena, located at the latitude line 10th parallel north (10°25’N 75°33’W) and six meters (20 ft) above sea level, has a tropical savannah climate (Aw/As). Its average high and low temperatures are 30°C and 25°C (86°F to 77°F) throughout the entire year, with an average humidity of no less than 80% in any month (Figures 1, 2, and 3). These climatic conditions differed significantly from those on the Iberian Peninsula, particularly the humidity levels and the range of temperatures in each season. For instance, in Seville, where most Spanish ships to the Americas departed in the early modern period, temperatures ranged between 5°C and 20°C with a relative humidity (RH) of 50-70% in winter and between 20°C and 40°C with a RH 30-80% in summer. Indigenous architecture had several techniques that mitigated the high levels of temperature and humidity.

Before the Spaniard conquest, the Caribbean was mainly occupied by the Tainos and the Karib, or Caribes. The Tainos occupied the largest Caribbean islands, such as Cuba and Hispaniola, while the Karib controlled the Lesser Antilles and the coasts of what would become Venezuela and Colombia, including the Bay of Cartagena. Karib peoples were called differently depending on the region. The societies that lived around what the Spanish called the Cartagena Province, which is today part of the Department of Bolivar (a geographic triangle formed by Cartagena Bay, the mountain range of Ayapel, and the Magdalena River), were divided into different towns and communities such as the Yurbacos, Turbas, Galapas, Malambos, Kalamaris, Karex, Zampas, among others (Figure 4). Particularly, the Kalamari had their village on the island that is today home to the city of Cartagena, halfway between Panamá and Venezuela and less than 900 kilometers from
the island of Jamaica.\textsuperscript{2} This island corresponds to what is known today as the historical center, or Walled City (\textit{Ciudad Amurallada} in Spanish). It is situated between a large bay, more than 15 kilometers wide, and a marsh (\textit{Ciénaga De Tesca}). Separated by the San Atanasio Canal, there was a second island named Getsemani by the Spaniards, where the colonial city of Cartagena expanded in the 17\textsuperscript{th} century (Figures 5 and 6).

Unlike other Mesoamerica and South American Indigenous towns with imperial regional organizations (mainly the Aztecs in Mexico and Incas in Peru), the Karibs were organized in towns governed by local powers and usually independent. A cacique or chief ruled each town, and some had secondary authorities. The Kalamari, considered peaceful by the first Spanish conquistadors, had a strong influence in the region and, through diplomacy, were able to control other towns around them.\textsuperscript{3} As with other towns in the regions, their economy and sustenance were based on farming, specializing in cassava and yuca, hunting, fishing, and trading. As coastal people, they were superb sailors with canoes that could transport up to fifty people. This advanced transportation system allowed them to go far beyond the limits of what would be the Cartagena region. They also traded with gold that they got from the Tayronas (on the east coast of Colombia, in the Saint Martha Mountain range) and the Zenues (in the valleys of the Sinú and San Jorge) and became masters in goldsmithing.

\textsuperscript{2} As Miguel Camacho Sanchez describes in the book \textit{Karmairi} (published by Instituto Tecnologico Comfenalco-Cartagena in 2003, page 57), the name Kalamary comes from Kar-Mai-Ri and was assumed to mean squid in the native language. However, the terminology means \textit{Kar} – meaning something that is important or has an extraordinary character, \textit{Mai} – which means territory or country, and \textit{Ri} – meaning water bodies. The entire word, thus, meant important shoreline territory or village.

\textsuperscript{3} Alcalá Alcalá, Javier E. "Los Yurbaco. La Cultura de un Pueblo Indígena a la Llegada de los Españoles en el Siglo XV." In \textit{Revista Cambios Y Permanencias} (Bucaramanga), December 9, 2013.
Based on the chronicles of the period and the techniques that have endured for centuries, we also know how the Kalamari constructed their houses. Their village was built with circular-shaped *bohios* (huts), made of *bahareque* walls – a wall construction system used in many pre-Hispanic regions of Central and South America, fabricated with a bamboo structure and soil covering them – and had palm leaf roofs.\(^4\) *Bohios* were likely developed over time as part of the geographical conquests and cultural transfers within the Caribbean Sea to become increasingly suited to the environment, including climate, hurricanes, and material resources.\(^5\)

The first adaptation occurs in how the material alleviates the humidity of the environment. *Bahareque*, like other types of raw earth architecture, possesses high thermal inertia, low water vapor diffusion resistance, and highly hygroscopic behavior. A high hygroscopic behavior means the material tends to absorb moisture from the air and excels at buffering environmental moisture even with low thicknesses. Hence, *bahareque* can regulate indoor relative humidity even under very different circumstances.\(^6\) Second, *bahareque* keeps interior temperatures almost constant, which happens simultaneously with the control of the humidity. Raw earth behaves as a thermal and hygrometric regulator that slows and attenuates temperature swings, taking latent heat from the atmosphere during hot times of the day and releasing the same heat during cold times. The same process stabilizes indoor relative humidity through evaporation (an endothermic process) and condensation (an

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\(^4\) This construction system is still used in rural areas of the Department of Bolivar along other parts of Latin America.


exothermic process). The main reason for this behavior is that raw earth contains fibers that, due to their biochemical composition in association with the clay matrix, increase water absorption. They also have a high level of porosity, decreasing the thermal conductivity and providing better insulation.\(^7\) Therefore, *bahareque* in Cartagena could alleviate the high temperatures during the daytime by releasing them at night and absorbing part of the humidity within their structure.

This long tradition in the adaptation of creating an architecture that fit the environment and reflected the cultural patterns of societies was not significantly different from the process that occurred around the Mediterranean Sea with the different empires that dominated it over centuries. *Tainos* and *Karibs* exchanges can be compared with those between Romans and Muslims, and the *bohios* of *Kalamari* on the Atlantic Coast of Colombia may not have deferred from the patio houses in the Iberian Peninsula.

**Conquest**

In January 1533, Pedro de Heredia, a conquistador born in Madrid who had been exploring the northern coast of Colombia, disembarked in the *Kalamari* village and defeated them within a week, enlisting them as laborers for the Spaniards. Using an agreement between Pedro de Heredia and the Crown (*Capitulaciones de 1532*) that framed and limited the new conquests, Spanish settlers forced Indigenous people to provide a part of their provisions and transport them throughout the region.\(^8\) Pedro de Heredia also founded the city of

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\(^7\) Ibid. Thermal conductivity is defined as the ability of a material to conduct heat from one side to the other, and usually, the lower the value, the better isolation the material can provide.

\(^8\) This agreement was the origin of the *Encomiendas* in Cartagena, which established the distribution of the Indigenous population among the colonial elites. *Encomienda* was an enslaved labor system that rewarded
Cartagena on top of the *Kalamari* village, using the *bohios* as initial homes for himself and his men.\(^9\) This choice of location faced challenges from the beginning. The island did not have potable water, agricultural land, or what the Spaniards would recognize as construction materials.\(^10\) Additionally, the thick tropical vegetation of mangroves constantly grew within the boundaries of the town, necessitating regular street cleaning from the weeds that invaded them.\(^11\) Also, the lack of space available on the island became a problem almost from the beginning. Already in 1539, settlers were compelled to build the San Francisco Bridge, which connected the town with the adjacent island known as the Getsemani neighborhood.\(^12\)

Why did the Spaniards decide to stay in such a challenging, environmentally hostile location for them? Security and military strategy made the difference. Cartagena

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Spanish conquerors with the labor of conquered Indigenous peoples in the Americas. The *Encomendero* (owner of the *Encomienda*) had to provide, in return, protection and Christianity. The *encomienda* was canceled shortly because the Crown wanted to limit the amount given to any individual to prevent the accumulation in the New World of vast states on the Andalusian Model. Indigenous people working at *Encomiendas* were not considered enslaved people since they worked and lived in the same lands before the arrival of the Spaniards (although it is considered similar nowadays). However, Spaniards also had Indigenous enslaved people who were kidnapped from other regions or had resisted Spanish invasion. In the case of the northeastern coast of Colombia, the army of the Governor of Santa Marta (the region next to Cartagena province limiting with the Magdalena) used to cross the river to kidnapped Indigenous people from the other province, perturbing even more the relationship of the Natives with Spanish settlers in the first century of colonization. The *Encomiendas* lasted in different forms until the end of the colonial period. More information about *encomiendas* at Elliott, John Huxtable. *Imperial Spain, 1469-1716*. New York, St. Martin's Press: 1964. 63; and Lockhart, James, Schwartz, Stuart B. *Early Latin America*. Cambridge, Cambridgeshire; New York: Cambridge University Press, 1983. 68–73, 92–96.


\(^12\) Ibid., 22.
succeeded because of the protection provided by its large bay, with only two entrances (Boca Grande and Boca Chica), one of them with such a shallow depth that it was usually represented on maps as solid land. This condition made the port one of the safest in the world.13 Second, Cartagena had a privileged location that served as a link between Europe, the Caribbean, and the New Kingdom of Granada through the Magdalena River, the infrastructural spine that connected the coast with its capital, Santafé de Bogotá. Over the XVI century, Cartagena achieved a position of dominance in the region and became the capital of the province of Cartagena.14

The lack of construction materials familiar to the Spaniards meant that, after the first colonizers claimed the Kalamari bohios, bamboo-and-soil bahareque continued to be used as a construction material during the first decades of colonization along with palm leaf roofs. This was somewhat unique: In other regions of the Americas, such as Mexico City or Cusco, Spanish settlers used stone as the primary material for construction. However, the only available rock in the Bay of Cartagena was Carex, extracted from the Island of Carex (now Isla Tierra Bomba). Although this very porous stone can be easily cut and joined with lime, the swamps of Cartagena Bay made it difficult and expensive to transport to the newly founded town. On the other hand, the materials used in bahareque were easy to find and transport from nearby locations. Indigenous people, subjugated by the Spanish colonizers, used their expertise as sailors and carpenters to bring timber from the village of Turipana and cane from Bahaire (in the Baru Peninsula) and Matarapa.15 They also

13 Ibid., 39.
14 Ibid., 39.
15 Ibid., 18.
performed construction labor: Building *bahareque* by interweaving a combination of wood and reed to create a structural frame, which was then filled with soil and straws, creating a monolithic wall. While the bamboo frame kept houses structurally stable – improving their flexural strength and protecting them from falling in case of hurricanes – the clay thermally insulates the interior space. The roofs of these dwellings, built with the techniques of palm leaves and timber frames, also provided high thermal insulation due to their thickness based on overlaying the material several times and protecting the interiors from direct sun rays.

1555

The use of Indigenous construction techniques on the northeast coast of Colombia ended in the 1550s. In 1552, a fire that probably started in a house spread through colonial Cartagena, destroying most of the town.16 The destruction of this fire provoked the transformation of the colonial built environment through a series of law ordinances that limited the use of *bahareque* and promoted Iberian-style construction with bricks and tiles. The fear of new fires was the main reason behind the change of the ordinances and the promotion of construction with fired bricks. However, eager for the power and wealth they did not have in Castile, conquistadors likely used the new ordinances as an opportunity to replicate the domestic constructions they aspired to when they traveled to the Americas. The first legal transformation was the standardization of the sizes of construction materials. An ordinance from the *cabildo* (town council) in 1553 stated that all the molds for brick and tiles needed to align with the sizes commonly used in Castile. Furthermore, all new

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16 Ibid., 18.
brick walls were also required to be sealed with lime. This effectively marked the beginning of a constructive hierarchy between the exterior and interior of colonial buildings, differentiated by the use of lime. Broadly, the 1553 ordinance created the beginning of the Spanish buildings of the Americas to look similar to those in Castile.

Two years later, on January 17, 1555, a new ordinance from the cabildo became more categorical regarding bahareque and fired brick use. To avoid future fires, this ordinance banned the use of candles in existing bahareque houses unless lit in the center of the rooms or on the floor, away from firewood or straws. The same ordinance also mandated that, in those houses, cooking could only be done by using a hole in the middle of the kitchen or the house. For those that broke the rules, there was a significant fine. The 1555 ordinance also instructed that all the palm leaves that covered the existing bahareques houses be removed, with a similar financial penalty attached. Regarding new constructions, it required all new buildings to be constructed with stone, tapia (kneaded and flattened soil), adobe, or brick for the walls and tiles for the roof. If contractors refused to follow the ordinance, the new buildings would be demolished, and a penalty would be added. The cabildo also banned importing, distributing, and constructing with materials previously used in Indigenous architecture, such as straw, palm leaves, and bijao (a term from the Taino language referring to the Calathea lutea or Marantaceae plant type, which grows in the tropical regions of the Americas and was used to cover food and fabricate roofs). Those who broke this rule would be sanctioned and physically punished. While fear of fire was the major motivation for the ordinance, it simultaneously marked a legal rejection of

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architectural knowledge through physical punishment, building a second fear of what native constructions meant.

Four weeks later, on February 25, 1555, the cabildo issued another ordinance that required fabricators of bricks, limes, and tiles (señores de horno de ladrillo, cal y teja) to announce and advertise their products. They could not sell these products to foreigners and outsiders unless the local demand had already been supplied. A set selling price for these products was established, and those fabricators who failed to fulfill these obligations would lose their goods.\(^\text{18}\) The regulation of the cost of bricks and the restrictions on supply was likely an attempt to make the approved materials readily available at an affordable cost, which would support the growth of the construction industry and lessen the need for reliance on Indigenous materials.

Besides reducing fire risk, these ordinances had several consequences for the urban environment. The first effect was the elimination of a possible blend between Indigenous and colonial architecture, which might have continued throughout centuries of colonization. Instead, bahareque became a minor construction technique only used by the lower class and in the rural areas. The ordinances created a web of protocols and requirements that made Castile-style fired bricks inescapable.\(^\text{19}\) This material, never before used in the region and not developed for its specific climate,\(^\text{20}\) represented a new era of

\(^{18}\) Ibid. 482-483.

\(^{19}\) As mentioned before, the difficulty of transporting Carex stone caused it to be used only for specific details such as door frames.

\(^{20}\) Although there is a common belief that brick was not known in the Americas before the arrival of the Spanish Empire, there are enough pieces of evidence that it was used in several regions of the Valley of Mexico, particularly in Tula, Tizatlán, Coixtlahuaca, Itazalpa, and the Valley of Mexico. Hernán Cortés, in
building homogenization and simplification that assimilated the architecture of the northern coast of Latin America with that of the other side of the Atlantic. The architecture of Cartagena, as happened in other regions of the Americas, came to follow the construction techniques of the Kingdom of Castile with little variation, linking its future to the vision of the colonizers for centuries. Bricks and tiles replaced *bahareque* and palm leaves roofs in less than fifty years, and not just through a natural process, but one that was urged on by legal ordinances. This technological transformation enhanced the repetition of a similar way of thinking on both sides of the Atlantic. A new decree from the city council in 1585 ordered all empty lots to be built up, or else they would be confiscated by the city council. This ordinance, in combination with the rising wealth the city had by growth in trade, accelerated the construction of colonial houses.  

By the end of the 16th century, the transformation of colonial domestic architecture was complete, and *Bahareque* had disappeared from most colonial homes in Cartagena.  

The second consequence of this set of ordinances was the maladaptation of construction materials to the existing climate and the neglect of available resources that seriously compromised the thermal comfort of inhabitants—and, therefore, colonial perception of the tropics. But how did *bahareque* or clay and fired brick differ in terms of thermal

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his letter to Carlos V in 1522, described that he had seen this material in the garden of a house in Iztapalapa, in some Aztec defense constructions, and being sold in one of Mexico City’s main squares, along with adobe (Cortés, Hernán, *Cartas y relaciones de Hernán Cortés al emperador Carlos V*, (Paris: Imprenta Central de los ferrocarriles A. Chaix y ca., 1866), 83, 104, 133). However, no physical records describe the use of fired bricks in the Caribbean region. Moreover, the cultural context and the hygrothermal properties suggest that it would not have made sense to develop the construction technique before the arrival of the Spanish conquistadors.  

21 Borrego Plá, “Urbanismo y poder en la Cartagena indiana de Felipe II.”  

comfort, and why did this apparently simple transformation of technique so strongly affect environmental conditions in the domestic realm?

**Bricks and Tiles**

When the clay is fired as part of the brick-making process, most of the qualities of earthen architecture (including *bahareque*) change, including its highly hygroscopic behavior. The natural fibers between the clay, which facilitate sorbing and releasing moisture to buffer humidity swings effectively, are burned off in the kiln and stop the moisture buffering. Moreover, firing brick increases its thermal conductivity, which usually varies from 0.1 (W/mK) in clay techniques to 0.27-0.55 (W/mK) in fired bricks. 23 The result is that fired brick has a poor performance in a tropical climate with high levels of humidity and temperature.

In some colonial Cartagena houses, lime was used not only as mortar but also as whitewashing, which produced mixed effects from the thermal perspective. On the one hand, lime mortar walls (especially if they have not been pigmented during fabrication) only absorb between 0 and 10% of radiation, reducing the heat in the interior. Moreover, after the lime mortar is applied to the façade, it dries and hardens by reacting with CO2 in the atmosphere. This reaction opens microscopic pores or penetrations in the surface of the mortar that allows natural transpiration. A technical study should be done using the environmental conditions of Cartagena to precisely know the results, but it is likely that

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the vapor transpiration would be stopped when it reaches the brick, creating condensation within the façade and, therefore, increasing the humidity of the interiors. Additionally, as it is heated in a kiln at around 1000°C to produce quicklime (calcium oxide – CACO), lime does not have any fibers that could improve its hygrometric conditions to regulate the interior humidity. Hence, although whitewashing walls with lime could help to lower the temperatures of the interior spaces, the relative humidity of these spaces would remain high, diminishing the thermal adaptation of the houses.

The transformation in the construction of roofs, from the use of palm leaf roofs to tiles, triggered a similar thermal outcome as the switch to fired brick walls. Leaf roofs, which were supported by canes or other light timber structures, had a low thermal capacity, held little heat during the day, and cooled down at night.24 Furthermore, their pitched shape facilitated water drainage outside during the rainy season while moving hot air to the upper heights on the inside, thereby keeping the lower space cooler. In contrast, fired tiles have a similar behavior to brick, although their thermal conductivity is higher (around 0.84 W/mK). This means that it transmits more heat to the inside than the fired bricks. The change in the materiality of the roof, as happened with the walls, compromised interior space insulation and made interior spaces warmer.

In the 1550s, in Cartagena, the council ordinances transforming these construction techniques were initially an attempt at self-preservation. The council may have initially sought primarily to avoid the propagation of major fires throughout the city. The adoption of brick, however, fundamentally maladapted the city’s architecture, operating against the existing climate and ultimately condemning an entire region to thermal discomfort for

24 Kamal, Kamarul Syahril, Lilawati Abdul Wahab and Asmalia Che Ahmad. “Climatic design of the traditional Malay house to meet the requirements of modern living.” (2014). 175
centuries. Long beyond the colonial period, the domestic realm, influenced by colonial practices, remained disconnected from thermal comfort. The ordinances also set the foundations for the spread of Iberian constructions based on the fantasies of colonizers who longed for the luxuries left behind or aspired in Castile on a planetary scale. In doing so, they simultaneously represented the rejection of indigenous architectural knowledge and the desire for the social class above. These foundations would expand in the following centuries to create a domestic empire made of patios, as the main organizer of the hierarchical private space of Spanish settlers, many of them slave traders—replicating on a small scale the social injustices occurring in colonial Cartagena.

Colonial Life

Tropical climate conditions were not unnoticed by Spanish settlers who arrived in Cartagena from the Iberian Peninsula: High temperatures and humidity became common grievances in the colonial realm. Pablo Gomez has compiled some of these colonial testimonies in The Experiential Caribbean, which offers an insightful view of the domestic aspects of Cartagena’s colonial life.25 One of these testimonies came from Juan de Villabona Zubiarre, the oidor (judge) of the Audiencia of Santa Fé, New Kingdom of Granada. He alleged that the hot temperatures caused a decline in Indigenous peoples’ capacity to work and believed the climate, in combination with the poor labor conditions of the encomiendas, might erase the native population of the surrounding regions.26 Furthermore, in 1650, the bishop Francisco Rodríguez de Valcarcel wrote to the King

26 Ibid., 21.
requesting to be transferred to another location because the city was “fire,” meat and fish could not be eaten from one day to the following, and the many circulating diseases were a danger to people’s health.27

Another testimony came from José Fernández, a Jesuit priest who lived in the city in the first half of the 17th century and published the book Apostolica y penitente vida de el V. P. Pedro Claver de la Compania de Iesus in 1666. Fernández literally described how Cartagena was poorly perceived by Spaniards from the climatic perspective. After claiming that Spaniards were able to “adapt and defeat all the possible inclement weathers,”28 Fernández described being outdoors in Cartagena as unbearable. He considered the sun harmful the entire year but defined the months from April to November as blazing. This sun “introduced the heat energy into the more protected rooms within the houses and turned them into stoves, where one is constantly sweating.” Fernández explained that newcomers to Cartagena were weak, had no appetite, and became seriously ill, which he attributed to “the high temperatures and the humidity” of the city. These factors were also the reason for the abundance of insects, flies, and mosquitos. Furthermore, José Fernández’s account also described colonists’ perception of lack of food and other goods because of the climate conditions. He described how settlers had to import most of their provisions, and the risks

28 This passage and the following ones of the Apostolica y penitente vida de el V. P. Pedro Claver de la Compania de Iesus were translated and paraphrased by the writer into English. This testimony could mean the climatic differences between the north and south of the Iberian Peninsula, but also the architecture that was used in all the colonial territories in the 16th and 17th centuries.
associated with Caribbean storms drove up prices, thereby making the available gold and silver in the city useless. \(^{29}\)

The relationship between Caribbean settlements and diseases in the early modern period is worth mentioning. Particularly in the case of yellow fever, it is known that it was present in Africa during the Middle Ages, and historians believe that it was carried by slave ships into the Americas during the 16\(^{th}\) and 17\(^{th}\) centuries. Once in the Americas, the virus found the perfect environment to propagate: the combination of stagnant water in the plantations with higher density cities let the virus propagate and transmit easier and faster. \(^{30}\)

In José Fernández’s chronicle, slavery is discussed immediately after the difficult climatic conditions for the colonizers, drawing a direct connection between these two elements and suggesting that enslavement was a necessary system to develop a society in the Caribbean. In particular, he focused his attention on the lucrative slave trading market of 17\(^{th}\)-century Cartagena. Cartagena was a “global market where people traded from everywhere.” Much gold and silver from the Americas ended up in the Caribbean town, as it was used as an almost mandatory stop to access “Mexico, Peru, Potosi, Quito, and the adjacent islands.” \(^{31}\)

Fernández described that a large portion of this trade consisted of trafficking enslaved peoples, which fueled not only the town, but also the global empire: “Sweat, and many times the blood of those miserable [slaves] is what enriches the world and sustains

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\(^{29}\) Fernández, José. *Apostolica y penitente vida de el V. P. Pedro Claver de la Compania de Iesus: sacada principalmente de informaciones juridicas hechas ante el Ordinario de la Ciudad de Cartagena de Indias*, (1666). 101–104.


\(^{31}\) Fernández, *Apostolica y penitente vida de el V. P. Pedro Claver de la Compania de Iesus*. 1666. 104.
everyone in those regions. Slave traders went to Guinea, Angola, and other lands where [slaves] were sold by those that captivated them in the wars, …and they are given for the cost of wine, oil, and food, and other goods missed there. The more expensive [slave] is four pesos, and in Cartagena is sold for 200 [pesos] and more. The cost of taking them is very little, and the profit is exorbitant. Every year, between ten to twelve thousand [slaves] are brought [to Cartagena].” 32

The excerpt by José Fernández brings us closer to the life of Black enslaved people when they arrived at the colonial city. The Spanish Empire and Catholic Church’s justification of the brutality of slavery was that Africans were enslaved to give them an opportunity to save their souls, and their masters’ main objective was supposedly to facilitate their conversation with physical punishment. In exchange, enslaved peoples were told to understand their brutal punishments as the only means of purifying themselves from their old beliefs.33 Therefore, particularly in the early period of colonization, the lives of enslaved peoples were restricted to encomiendas, mining extraction, and the domestic space. By the 17th century, however, many enslavers began ordering their slaves to start looking for jobs outside the colonial houses and return to their houses only at night. Thus, they started to work as bakers, butchers, fishermen, innkeepers, healers, food providers, surgeons, sex workers, sailors, dockworkers, blacksmiths, sailmakers, carpenters, and

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32 “El fudor, y muchas veces la fangre deftos miferables baña lo que enriquece al mundo, y lo que fultenta a todos en aquellas partes. Van los mercaderes a comprarlos a las coftas de Guinea, Angola, y otras tierras donde los venden los que los cautivan en las guerras, que traen unos con otros; y los dan a percio de vino, aceite, y baftimentos, de que fe carece por allá. El que mas cueta de primera compra, ferá valor de quatro peños, y en Cartagena fe vende por docietos, y mas. El falto en llevarlos es poco, y la ganacia exorbitate. En el difcurso de cada año, fon de diez a doce mil los que fe traen. – Fernández, José, Apostolica y penitente vida de el V. P. Pedro Claver de la Compania de Iesus. 1666), 105.
33 Garrido. “Vida Cotidiana en Cartagena de Indias en el Siglo XVII.” 461.
more. Some were able to buy their freedom and succeed in their own professions, while others were brutally exploited, murdered, or even prosecuted for killing their masters. Thus, Cartagena, like other Caribbean towns, had a population that was more than three-quarters African or African-descendant Black people. Although not all Black people were enslaved, almost all free people had slaves—even the poorer people usually owned at least one enslaved person, and some wealthy residents could own more than 300, including those working for them at home and their encomiendas. As Pablo Gomez explains, enslaved people were indispensable to preserving the Spanish Kingdoms in the Americas. For this reason, it is necessary to unfold domestic colonial architecture and environmentally analyze it not only from the side of the masters but also from the enslaved inhabitants.

**Domestic Architecture**

Colonial Cartagena social classes were broadly divided into three groups, each of them with a corresponding housing construction. In the lower stratum of the pyramid were the poorest residents of Cartagena, as well as some enslaved people, who lived in the neighborhood of Santo Toribio, in Getsemani, in their own workshops, or in homes made of bahareque and straw. The middle classes usually in one-level casas Bajas, in the east part of Ciudad Amurallada, scattered among Casas Altas (Figure 7), and in the neighborhoods of Getsemaní and San Diego, in lots laid out when the city expanded during

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35 The chapters “Arrivals” and “Landscapes” of the book, *The Experiential Caribbean*, describes in detail the lives of some black citizens in Cartagena, including the examples mentioned above. Furthermore, the chapter “Vida Cotidiana en Cartagena de Indias en el Siglo XVII,” by Margarita Garrido, in the book *Cartagena de Indias en el Siglo XVII* provides an overview of the town in this century.
the 17th and 18th centuries. These houses were built with brick and tiles and had a modest spatial organization, with a commercial area in the front, facing the street (usually sharing the door with the access to the home), and two or three bays of windows facing the street. The bedrooms were located around a central or lateral courtyard surrounded by a covered gallery. If they had a backyard, it was used for farming, storage, or toilets. Finally, the elites of the colonial town lived in *Casas Altas*, which had three stories, a courtyard and a backyard, and balconies facing the street. *Casas Altas* occupied the oldest plots of the town, in the north and east areas of the main island, facing the Atlantic Ocean. *Casas Altas*, in combination with *Casas Bajas* and the constructions of *bahareque* and straw, represented how the social structures worked in Colonial Cartagena within the Domestic realm. Nevertheless, *Casas Altas* also rendered the local dynamics of the town within their own walls, based on the people from different groups that inhabited them.

Furthermore, this representation in *Casas Altas* embraced how thermally uncomfortable colonial construction practices and materials were in relation to the social hierarchies. Those houses were usually the homes of landowners, *encomenderos*, and traders, who also ruled the city’s government. With the rise of the Spanish Empire in the 16 and 17th centuries, Cartagena settlers were becoming key players in the new Atlantic world and wanted to flaunt it. Unlike in many British American settlements, where landowners lived

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40 *Encomenderos* were owners of an Encomienda, the enslaved system that rewarded Spanish conquerors with the labor of conquered Indigenous peoples.
41 Borrego Plá. “Urbanismo y poder en la Cartagena indiana de Felipe II.” 914.
42 Ibid.
on plantations and urban settlements were of less importance, in Spanish colonies, *encomenderos* typically had their main homes and headquarters in the cities. Their main profit was derived from Indigenous and enslaved labor in Indigenous settlements, where they had a second residence or estancia, overseen by a second-in-command. This pattern was common in most Spanish colonies, but in Cartagena, an important portion of the elite were slave traders since the town’s port was one of the main entry points for imprisoned Africans brought into the Americas. Thus, although the traders’ urban *Casas Altas* were not their main source of revenue, they typically had commercial space in the front rooms on the ground floor beside the main entrance.

At the main entrance of Casas Altas, a zaguan or threshold connects the street to the courtyard. This narrow space led into the vestibule first and then the patio (Figure 8). Guests were usually only allowed to access these three spaces, where the homeowner would meet them to discuss business or entertain. The rest of the house became dedicated to the family. This public/private separation of the spaces followed a similar organization to Muslim architecture: The entry vestibule, with narrow and vertical proportions, is reminiscent of the makad in its function (receiving guests). The patio, as the only space easily accessible to guests, linked the exterior and interior from a spatial and political perspective.

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Since the Spanish King set up an Inquisition Tribunal in Cartagena in 1610, the inhabitants of the town – colonist, Indigenous, and Black – lived in a state of fear of being accused of unlawful practices. Thus, domestic life was not completely private since it could be targeted at any moment. Within this context, the patio, with all the different windows and doors facing it and as the only semiprivate space of the colonial house, represented a panoptic authoritative eye that extended from the public street into the different levels of the domestic space. Homeowners not only received their visitors there but also used it to represent their roles within society. Around this courtyard, an open corridor covered by the gallery on the second floor led into different private rooms used as storage (Figure 9). On the opposite side of the zaguan, a second vestibule transitioned the courtyard into the backyard. The kitchen was located in this area so that the cooks of the house would have easy access to the main patio and to the backyard, which was usually dedicated to raising poultry and planting vegetables (although, in some cases, the dorms of the servants were also located here). The main division of the spatial arrangement in two patios resembled the Roman houses, although with key differences. While in the Roman house, both patios were used by the owners, in Cartagena, there was a clear division between the courtyard dedicated to the family and visitors and the backyard used for food production and labor.

45 In order to maintain catholic orthodoxy in Spanish Kingdoms, the Catholic Monarchs established the Spanish Inquisition in 1478 – a sort of collective judge who oversaw their citizens’ public and private behaviors. Philip II established three tribunals in the Americas: in Peru (1570), Mexico (1572), and Cartagena de Indias (1610). The Inquisitorial Court in Cartagena lasted until 1821 when the first Republican Constitution finally abolished it. The Inquisition Tribunal in Cartagena punished around 900 people in the 200 years it was active. Among other practices, the tribunal punished witchcraft, reading forbidden books, adultery, bigamy, and practicing other religions like Judaism.

46 Around the 17th century, colonial houses in Cartagena started to have kitchens on the second floor, near the living room.

Another important distinction of Cartagena colonial houses was the vertical hierarchical organization within the home, which clearly delineated the semipublic spaces on the ground floor, the private rooms on the second floor, and the enslaved peoples in between.

Continuing a tour through a Casa Alta, one would find a staircase located 90 degrees from the zaguan and blocking the direct view from the street connecting the first and second floors. Between these two levels was a mezzanine where enslaved people and servants lived. This was a space with a minimum height space – sometimes less than two meters – that minimized its presence within the house (Figure 10). Sometimes, mezzanine rooms had small balconies facing the street and the courtyard, and others had only windows. The bridge that usually connected some of the mezzanine rooms above the zaguan was designed to let the servants know if the master or some guests were coming to the house and start preparing the welcome without being seen (Figures 11 and 12). Some of these constructions were built by slave traders, connecting this horrific global market and the domestic space. Several examples are easy to identify, such as the case study described in the next section of the chapter. Another example is Casa Marques de Valdehoyos (10°25'32.0"N 75°33'07.6"W), built by Fernando de Hoyos y Garcia Hoyos in 1756. (Figure 13). Fernando de Hoyos y Garcia Hoyos arrived in Cartagena in the middle of the 18th century to trade in flour and enslaved peoples. The quick success of his business in Cartagena allowed him to build, shortly after his arrival, a Casa Alta in one of the prominent streets of the Walled City with a mezzanine space for enslaved people. Another example of a Casa Alta with a mezzanine space for enslaved people is the Casa Gaston de Iriarte (10°25'22.7"N 75°33'07.7"W), next to Plaza Mayor. These two examples, among
others located in the city center, are easily identified by looking at their facades, paying particular attention to the small windows or balconies located between the first and second floors. They demonstrate, in physically visible ways, the tightly intertwined relationship between this type of construction and slave trading in colonial Cartagena.

The second floor contained the main private spaces for the settler family (Figure 14). The living room, right on top of the zaguan and the commercial space, was the only private space that faced the street, with a balcony that projected the domestic into the public realm. These balconies were an expansion of the living room, an interior for seeing and being seen.\footnote{Borrego Plá. “Urbanismo y poder en la Cartagena indiana de Felipe II.” 921.} This is one of the main differences between Cartagena and Muslim houses. While houses in the Iberian Peninsula barely had any exterior balconies or windows, and all the rooms faced inward, Cartagena houses started to unfold into the street, particularly the living room, which expanded the interior to the street through a long wood balcony and large doors opening into it. The house also had a second living room on the opposite face of the patio. This space had an informal character, opening to the backyard as well and sometimes featuring a balcony facing the backyard in a symmetrical situation to the front bay of the house.\footnote{Téllez Castañeda, Moure. Repertorio formal de arquitectura doméstica. 29-31.} The domestic space of Spanish settlers was mainly organized around the main patio, with the public rooms facing both this open-air space and the street – including the natural ventilation associated – and the bedrooms facing only the interior.

The different locations, materials, and sizes of the Cartagena houses reflected the hierarchies in the colonial environment. The semipublic and private spaces of Casas Altas,
in particular, describe on a micro scale the relationship between the owners and their servitude. For instance, the courtyard – the most impressive space of the house – was used to entertain guests and demonstrate the prestige and power of the owners. If they looked up, they could see the different galleries that enclosed the courtyard with decorated balustrades. This openness contrasted with the concealment of enslaved peoples and servants between floors. The use of the mezzanine as a bedroom for the servants was also typical in Arabic architecture but represented, within the American context, the separation between Indigenous and enslaved peoples from settlers and Creoles. In the domestic realm, the invisibility of the servitude mirrored the hierarchical system of the urban context. Indigenous and enslaved labor was essential to fuel the settlements through agricultural and mining work but was obscured through its relegation to the outskirts of the city or the encomiendas. In colonial houses, this was reflected in the distinctions between public and private spaces and in other markers of spatial hierarchy, such as the relationship between enslaved peoples and their masters. Spanish settlers dominated the public areas of the house, forcing the others to move through obscured and concealed spaces.

Case Study: Casa las Damas

While the architectural layouts of Casas Altas instantiated colonial hierarchies, their environmental performance tells a different story. Colonial building materials and techniques impacted thermal adaptation in a way that reinforced these hierarchies but contradicted colonial dynamics in particular cases. To analyze these thermal dynamics, I

50 Saldarriaga Roa. Hábitat y arquitectura en Colombia. 114.
51 The complete isolation of enslaved peoples in settler homes started to fade in the 17th century when their masters ordered some of them to find jobs in the city during the day and return home at night. More information in: Garrido, Margarita. “Vida Cotidiana en Cartagena de Indias en el Siglo XVII.” 451–498.
Martinez Garcia 69

will examine Casa las Damas, also known as Casa Virgen de la Candelaria, a two-level and mezzanine house built by D. Alonso Álvarez de Armenta at the end of the 16th century (Figures 15 and 16). 52 This still-extant-house was located on a prominent street during the colonial period (10°25'20.4"N 75°33'06.2"W), 53 inside the Walled City, halfway between the two main squares: Plaza Mayor and Plaza del Mar (currently known as Plaza de Bolívar and Plaza de la Aduana).

The owner of this house, Alonso Álvarez de Armenta, as well as his family, were involved in the slave trading business between Africa and the Americas, as has been traced by the historian Rafael María Girón-Pascual. 54 His father, Juan de Armenta “el Viejo,” lived on the island of Santo Domingo and traded 380 enslaved peoples between 1543 and 1156. His sons Alonso, Gonzalo, and Juan de Armenta continued this business between Seville and Cartagena de Indias, making a considerable profit for the brothers. 55 Based on his will dating in 1609, the slave trader did not have descendants, and the house was donated to a religious order. 56 In the following centuries, Casa las Damas was used by different elite families of the city. 57

55 Ibid., 335-340.
56 Agi, Contratación, 284, n.1, r.2, cc. 21r-33r; “Casa Marques de Valdehoyos.” 382–388.
57 “Casa Marques de Valdehoyos.” 382-388.
*Casa las Damas* has several mechanisms to avoid excess humidity and heat, but these need to be understood within the physical context of a dense urban fabric. Looking at the surroundings (Figure 18), one can see that any design to mitigate the tropical weather is impacted, for good and bad, by the nearby constructions with similar heights, narrow streets, and backyards separating them.58 *Casa las Damas* is a 30 m. long by 18 m. wide construction (104 ft. by 52.5 ft.), with a backyard of another 22 m., and N/S orientation (Figure 19). Thermally speaking, the house had three main strategies to alleviate high temperatures and humidity: cross ventilation, shading, and convection (Figures 20 and 21).

Regarding cross ventilation, the house's orientation was aligned with the main wind directions, which primarily came from the north and south (Figure 5).59 Nevertheless, the dense urban fabric of Cartagena only allowed them to ventilate through the front and rear facades. Furthermore, the tall buildings on the opposite front and back facades of *Casa las Damas* compromised the ventilation of the lower floor and mezzanine. Thus, the only rooms that fully benefit from the cross ventilation were the primary and secondary living rooms on the second floor. This configuration made the air get stuck within the patios, impeding free movement and creating domestic hierarchies regarding access to airflows and thermal comfort. The living rooms were the most exposed to the wind, followed by the bedrooms on the second floor, and finally, the enslaved rooms and the ground floor spaces.

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58 On the west side of *Casa las Damas*, there is another *Casa Alta*; on the east side, a *Casa Intermedia* (two floors without mezzanine space), and on the opposite of the street, a *Casa Alta*. Behind *Casa las Damas* is a large building that used to be a Jesuit college and was converted in 1992 into the Naval Museum of the Caribbean. The streets are around 6 meters wide.

59 The case of *Casa las Damas* does not correspond to the rest of the Cartagena. The grid of the town did not favor any particular direction, with houses facing the four cardinal points. Therefore, only those houses where the front façade faced north or south fully benefited from the cross ventilation.
To maintain a certain degree of privacy while keeping the air moving throughout the rooms, colonial houses used screens and balconies in the exterior openings.\textsuperscript{60}

Although patios did not help cross ventilation, they were a powerful mechanism to provide sun shading while allowing natural light into the spaces. In Figure 22, we can see how the narrowness of the open space impedes direct light into the internal walls or inside the rooms, avoiding overheating these surfaces but letting in enough natural light into the useable spaces, particularly in the primary rooms on the second floor. Looking at spatial daylight autonomy (SDA) and Point-in-Time illuminance (Figures 23 and 24), we can see how more of the spaces have an amount of daylight larger than 300 lux, which is considered enough for most activities.\textsuperscript{61} The efficient entry of light, however, did not happen in the mezzanine enslaved rooms. Looking particularly at the cross sections of Figure 24 the gray area of the mezzanine clearly shows the lack of enough natural light.

For convection, most rooms on the ground floor had a clear height of at least 5 meters, letting the hot air rise while the space below stayed cool. The elevation of the rooms was even greater in the main spaces of the second floor, such as the living rooms, with a height of more than 7 meters. On the other hand, the miserable conditions of the enslaved servants continued within the house. Their bedrooms, located in the mezzanine and only two meters

\textsuperscript{60} Those were already used in some regions of the Iberian Peninsula, particularly the Canary Islands. In Cartagena, the handrails and frames of these balconies and screens were made of wood to resist the corrosion of the marine atmosphere.

\textsuperscript{61} SDA depicts the areas that have illuminance levels of at least 300 lux, using daylight alone for at least 50% of occupied hours during the days. Such locations are said to be 50% daylight autonomous. SDA calculations are based on annual, climate-based simulations of thousands of different sky conditions throughout the year. Per LM-83 guidelines, dynamic shading devices such as blinds or electrochromic glazings must be specified for all exterior window units.
high, were not only poorly ventilated through small balconies but also could not benefit from the convection process.\textsuperscript{62}

Patio houses represented the uneasy entanglement between social structures, architectural spaces, and environmental performance during Spanish colonization. The hierarchies of power in the urban realm were replicated within different spaces of the colonial house, with the central patio simultaneously creating a vertical stratification and a panoptical apparatus where the master, sitting in the central space, could receive guests and police enslaved people looking through the balconies of the mezzanine. At the same time, the destruction of thermal comfort in domestic space from the 16\textsuperscript{th} century onward preceded—and perhaps reflected—the impending devastation of the natural environment on the regional scale through disease and deforestation.

**Vectors of Spread: Magdalena River**

Colonial architecture spread from Cartagena to the inland at a similar speed as the patterns of conquest, using the Magdalena River as the main network of connection through the territory. The multiplication of this architecture in these new climates, however, did not generate substantial transformations in the construction techniques or spatial apparatus. Fired bricks and tiles became the materials for walls and roofs, and patios were repeated in domestic constructions around colonial towns. One of these settlements was Mompox, 180 km (110 miles) from Cartagena in the Caribbean Plain, where the Magdalena River diverts into two branches (\textit{Brazo de Loba} and \textit{Brazo de Mompox}).

\textsuperscript{62} The enslaved rooms in \textit{Casa las Damas} had balconies, but in other cases, such as Casa Gaston de Iriarte (Figure 14), they only had porthole windows.
Mompos is an interesting case study of the spread of Spanish colonial domestic architecture in the Caribbean region of Colombia. It is also a good comparison with Cartagena Houses for two main reasons. First, Mompos lies in a similar climatic region as Cartagena (tropical savannah – Aw/As), but the geographical conditions are different: as an inland location next to the Magdalena River, the town did not lack space in the way that coastal Cartagena did, which affected the environmental conditions and the layouts of the house. Second, Mompos flourished during the colonial period, becoming a major trading port along the Magdalena River. However, the city rapidly decayed in the 19th century, after the independence of Colombia and with the introduction of steamships. These boats’ engines needed large amounts of timber, causing massive deforestation in the riverbanks that triggered a sedimentation process in the river branch where Mompos is located. This, in turn, reduced its flow and made it unnavigable. As a consequence, the town was practically undeveloped from the middle of the 19th century to the present. Unlike Cartagena, therefore, its colonial houses have been maintained without major transformations and can be analyzed as preserved material culture.

The physical connection between Cartagena and Mompos was the Magdalena River, a 1528-kilometer-long water infrastructure that travels from the Colombian Massif into the Caribbean Sea. Before the arrival of the Spaniards, the river was named differently by Indigenous societies: Kariguaña and Karakalí (great river of Caimans) by the Caribes, Guaca-Hayo (River of the tombs) by the Quechus, or Yuma (River of the friendly country)
by the Muiscas.\textsuperscript{63} Long used for Indigenous societies to trade between them, the river became the environmental fracture for Spaniards to penetrate the Caribbean Plain and the mountain ranges, which otherwise had to be crossed by walking or horse. Rodrigo de Bastidas, a Spanish conquistador who located the river's estuary for the Spanish Crown, renamed it Magdalena River based on the calendar of saints' days. The river allowed settlers to spread across the northeast side of the South American continent during the colonial period, and several towns and villages, including Mompox, were founded along it.\textsuperscript{64} From this point, the river continued inland until arriving at the town of Honda, the last navigable point near Bogotá.\textsuperscript{65} Although the expedition routes to conquer Bogotá in 1539 began from three different points (Quito in Ecuador, Santa Marta in Colombia, and Coro in Venezuela), the Magdalena quickly became the main infrastructure that linked the coast with the capital of the viceroyalty (Figure 25).

Before the Spanish conquest, the shoreline of the River where Mompox is currently located was inhabited by the Malibu together with the Macanáes, Urabaes, and Zenúes Indigenous peoples. They adapted to the territory using a complex system of canals that let them store water during periods of drought and resist the initial expansion from Spanish settlers coming from Cartagena and Santa Marta.\textsuperscript{66} In 1537, the governor of Cartagena, Pedro de


\textsuperscript{64} Barrios Amórtegui, Sergio Iván. “Un río que cambia el lugar de las ciudades, el río Magdalena de Mompox a Magangué.” In \textit{Revista Credencial Historia}, 288, (diciembre 9 de 2013).

\textsuperscript{65} Founded in 1939, Honda was the last main point where the Magdalena River was navigable. Honda was separated 140 kilometers from the capital of the New Kingdom, a distance that had to be made walking or by horse.

\textsuperscript{66} Barrios Amórtegui. “Un río que cambia el lugar de las ciudades, el río Magdalena de Mompox a Magangué.”
Heredia, gave orders to subjugate the Malibu after intense hostilities with them and founded the town of Santa Cruz de Mompox (or, simply, Mompox). The Magdalena River connected Mompox with the rest of the region, and settlers used it to transport goods, including the official mail from Bogota and precious metals from the mines in the north of Antioquia, into the ports of Cartagena and Santa Marta to be shipped to Europe.

Although the Magdalena River was the main reason Mompox flourished between the 16th and 18th centuries, the town depended on Cartagena as the access point to the New Kingdom of Granada on the Caribbean coast. The connection between the two towns was reinforced with the construction of Canal del Dique. This canal connected the trading port of Cartagena to the Magdalena River and from there to Mompox without having to navigate through the Caribbean coast. This was first done in 1571 by the opening of a trench that joined different swamps and could be navigable during high tides. The success of this connection between the city and river led to the reconstruction and improvement of this precarious infrastructure in 1650, covering a total distance of 129 kilometers, which took about three and four days to cross. This close link between Cartagena and Mompox would be reflected in domestic architecture, particularly in the repetition of construction systems.

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67 Herrera Ángel, Marta. *La organización político-administrativa de los asentamientos*, at *Ordenar para controlar*. Universidad de los Andes: Colombia, 2014. 177.
68 Barrios Amórtegui. “Un río que cambia el lugar de las ciudades, el río Magdalena de Mompox a Magangué.”
69 Mompox was part of the *Gobierno de Cartagena* (Government of Cartagena), a territorial division that was limited by the Caribbean coast on the north, the Magdalena River on the east, the Atrato River on the west, and the mountains of Ayapel and San Lucas on the south. Additionally, all the goods that passed by Mompox came from Cartagena, or Cartagena was the destination point.
71 Ibid., 10.
Nearly since its founding, the economic prosperity of Mompox was managed by *Encomenderos*. Unlike other areas of the New Kingdom of Granada, the environmental conditions of Mompox – with swamps, streams, and rivers that frequently changed the flow of the river – made the land difficult to farm. Instead, the settlers of Mompox focused on trading and cattle raising, and the Indigenous population was forced to work for the *encomenderos* in the carriage of goods along the Magdalena River, such as the mail from the capital or gold from nearby mines. The goods were transported on *champanes* – a canoe-like vessel roughly 12 meters long, 1.5 meters wide, and 0.8 meters deep with a half-arch roof in the center made of palm trees – by rowers called *Bogas* (Figure 26). Navigating the Magdalena upstream was dreadful work that lasted 12 hours per day.\(^{72}\) The brutality of the work accelerated the erasure of the Indigenous population, who was then substituted by enslaved people and *Zambos* (a racial term historically used to name people of mixed Indigenous and African ancestry).\(^{73}\) *Encomenderos* in Mompox also took advantage of the declining Indigenous population at the end of the 16th century to confiscate lands, expand an incipient cattle industry, and begin the establishment of Haciendas. This transformation in the industry, together with the development of the mines in the nearby regions of Simití

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\(^{72}\) Even if the river eased the connection between the coast and inland, the trip was arduous and lasted around three months between the coast and Honda, a town founded in 1539 that was the closest point from the River to Bogotá. The 140 kilometers in distance and almost 2,500 meters in altitude (86 miles and 8,000 ft) that separated Honda from Bogota had to be crossed by walking or with a horse.

and Guamocó, kept fueling the wealth of Mompox until the independence of Colombia in the 1810s.74

**Mompox**

Using the orthogonal grid of colonial urbanism, Mompox has a linear structure along the shore of the Magdalena River. In 1716, the town had a length of two and a half kilometers and a depth of 400 meters (Figure 27).75 A main street in front of the river connected the three main plazas (*Plaza de Santa Barbara*, *Plaza Mayor*, and *Plaza de San Francisco*). Similar to Cartagena, early Mompox settlers decided to establish their colonial town where the Chief of Mompox lived, and Indigenous people had the ceremonial center and the cemetery; this is the site of *Plaza Mayor* or the main square.76 The largest colonial houses were built on the first two streets parallel to the streets from the shoreline, where settlers built a series of walls (*albarradas*) to protect them from flooding.77 These homes – most of them still remaining today – have one floor only and a courtyard and backyard. These patios are densely planted with ornamental vegetation and vegetation patches. As a result, from above, the natural environment of the Caribbean plain seems to have been divided into small portions, while from the eye level, we can observe a small sample of the full potential of native and imported ecologies (Figures 28 and 29).

74 Barrios Amórtegui, *Un río que cambia el lugar de las ciudades, el río Magdalena de Mompox a Magangué*.
76 “Análisis urbano de Santa Cruz de Mompox,” 123; Moreover, during the renovation of the pavement of *Plaza Mayor* in 2013 and 2014, archaeological work was carried out on the site, revealing prehispanic human bodies, ceramics, and other utensils that revealed the location of the Indigenous town.
77 Ibid., 123.
Mompox has a similar tropical savannah climate (Aw/As) as Cartagena, with temperatures over the year ranging between 35°C and 25°C (95°F and 77°F), and its relative humidity is around 80-85% (except from February to April when it decreases to 75% - Figure 30). Nonetheless, the windspeed, because it is in an inland location, is significantly smaller than in Cartagena (Figures 5 and 31). While in the coastal town, because of the ocean air, windspeed reaches a speed of 15 m/s, in Mompox, it barely ranges half of this number. The flatness of the land around Mompox, in combination with the river and nearby swamps, makes this town’s apparent temperature even higher.

**Casa Germán De Ribón**

One of the surviving colonial Mompox houses is Casa German, built at the beginning of the 18th century and owned by one of the most powerful families of Mompox, the trader Ramon del Corral and his wife María de los Santos Alonso-Carriazo y Masdeu. The house was later purchased by the family of Gabriel Germán Ribón Teran – a Spanish creole, son of a Seville settler – and Agustina Bartola de Segura y Choperena. The current name of the house reflects these later owners because they were the parents of Pantaleon Germán de Ribón y Segura, a martyr in the Independence of Colombia and the independent movements that emerged in Mompox at the turn of the 19th century.

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78 Del Corral and Alonso-Carriazo were the parents of Juan del Corral – president and dictatorship of the Antioquia, and Marcelina del Corral de German. The house was later purchased by the family Gabriel Germán Ribón Teran – a Spanish creole, son of a Seville settler - and Agustina Bartola de Segura y Choperena. Their son Pantaleon Germán de Ribón y Segura, a martyr in the Independence of Colombia, was married to Marcelina del Corral, the daughter of the first owners of this house. The independent movements that emerged in Mompox at the turn of the 19th century were prepared in this house.
Casa German is an exemplary depiction of the spatial organizations of Mompox colonial domestic architecture. Like the Cartagena houses, this house is mainly organized with a patio in the center of the house and a backyard at the end, which organizes the three main sections or uses: an area for its owners to receive public events, a personal space for the family, and a back of the house where storage, kitchen, animals, and enslaved people shared space (Figure 32). However, distinct from the common architecture of Cartagena, which had a vertical stratification, in Mompox, the domestic constructions only had one level and were horizontally divided. Casa Germán de Ribón – with larger dimensions than other homes in the town – is, therefore, a one-story construction with an orientation NE/SW and an overall dimension of 85 m. by 28 m. (279 ft. by 91 ft.), divided into three parts. The first section was for the house owners and to receive guests, with the central patio attached. The kitchen and the garden were located in the second section – in the first backyard. The bedrooms for enslaved peoples, the latrines, and the barns were placed at the back of the house, in a second backyard.

If you stood in front of Casa Germán de Ribón, your first view would be a large room facing the street and the main entrance through the zaguan with a direct visual connection to the courtyard. The zaguan would lead you into a double gallery space (Figures 33 and 34), which organizes the relationship between the home's public and private spaces, giving access to the event room in the front of the house and the bedrooms around the central courtyard, following a cloister layout. Thus, the space is simultaneously an entrance hall and a public living room. The gallery, connected with the cloister around the courtyard on the one side and the event room facing the front façade on the other, was a darker space.
From the gallery, one could turn left and enter a sizeable public living room with four large windows that face the street and a vaulted ceiling with rafter tie beams (Figure 35). The configuration of the living room and the double gallery space is specific to colonial Mompos houses. Moreover, this public part of the house was essential to the social status of these powerful families: Because guests were invited through the zaguan and entered the event room, the space had to be grand and hospitable, reflecting the social relevance of the hosts.

The second part of the Casa de Germán de Ribón contained the courtyard and the family’s bedrooms. All the rooms had similar widths, high-pitched ceilings, and windows and doors facing the courtyard with a covered gallery in between (Figure 36). The patio was enclosed with a volume that separated from the backyard and contained a second living room – more private than the one in front of the house. Then, the backyard would be divided with a brick wall to separate two different functions. The first one accommodated a vegetable patch, a water well, and a kitchen, providing the necessary infrastructure for cooking (Figure 37). The kitchen, located in an enclosed brick structure attached to the main house, had openings in the upper part of the bearing walls to let the smoke leave the space. The second part of the backyard contained the room for enslaved people on one side, the latrines in the center, and the stables on the other (Figure 38). Following a similar attitude as in Cartagena, enslaved peoples were treated as inhuman and were expected to live in the same space as the animals and human excrement, with the resulting odor and health consequences. While

79 Some of Mompos’s colonial houses have similarities with Casas Bajas (Lows Houses) of Cartagena. Nonetheless, the duplicity of the gallery space is more noticeable in Mompos than in the coastal city.
in Cartagena colonial constructions, this treatment was reflected in the low height of their rooms, in Mompox, it was designated by their location.

Mompox colonial houses thus had a horizontal stratification. Guests only accessed the front of the house; the house owners lived in the center, in front of the courtyard; the production space (kitchen and vegetable garden) happened in the first backyard; and the enslaved people occupied the second backyard with the horses. However, these layers did not particularly relate to the environmental design features of the different spaces of the house and the negotiation between social status and thermal adaptation was inconsistent in some situations. This contradiction can be analyzed by surveying the different rooms and their response to high temperatures and humidity.

First, the event room – the space next to the street that hosted social events for the family owners – had window openings to the street, and the gallery provided enough cross-ventilation due to the slow-speed air in the town. Furthermore, the high ceilings of this public space contributed to reducing the low temperatures. The second area, adjacent to the event room, was the double-bay gallery. This space, besides continuing the cross-ventilation, transitioned from the sunny and heated courtyard into a dark, open area. Buffered from the street and courtyard, it was likely the most temperate space within the house.

In the second part of the house, bedrooms only had doors and windows on one of their sides, impeding any ventilation and decreasing thermal comfort. On the other hand, the
generous size of the courtyard allowed cross ventilation to circulate through the covered gallery, open spaces, and the room that divided the main patio from the backyard. A similar situation from the thermal perspective happens in the last backyard of Casa Germán Ribón, where the rooms allocated for the servitude face the same heating problems as the bedrooms for the masters: lack of natural ventilation. These similarities do not imply a correlation between both spaces: One had the visual pleasure of having a designed courtyard in front of the bedrooms, while the other inhabited the space next to the latrines and the stables. Nevertheless, it does reflect the contradictions and priorities of colonizers and Spanish Creoles of giving preference to the continuity of spatial techniques from Spain to maintain their social status rather than transforming the architecture in order to adapt to the tropical environment.

Their maladaptation was likely aggravated by the use of brick, which, as in Cartagena, overheated the interiors. This material, together with the use of courtyards, showed an obdurate approach to architecture, both in the spatial organization and in the building technology, which has continued since 1555 for centuries, during and after colonization. Its imprint can still be seen in colonial and contemporary architecture.

**Epilogue**

By exploring the historical evolution of the region in the colonial period, we can consider Colombia's modern and contemporary architecture from a different perspective. Spanning more than 400 years, from 1555 to the second half of the 20th century, we see how many of the apparently minor decisions made at the beginning of colonization were carried over
architectural generations and profoundly affected thermal comfort even within modern architecture. At the conclusion of this chapter, I explore how colonial building technology affected the construction of a contemporary imaginary in Colombia, mainly through the well-known architect Rogelio Salmona. Then compare his work with the antithesis figure of Simón Vélez, another Colombian architect on the margins of the mainstream who turned back colonial precedents and internationalist style and embraced construction through biobased materials. Finally, as a third possibility that moves beyond male and authoritarian architectural figures, I describe how bahareque has been used in collaborative projects in some regions on the northeastern coast of Colombia as a sign of future construction directions aligned with a decolonial attitude.

Rogelio Salmona (París, 1927 – Bogotá, 2007) was the architect who mastered the use of fired brick, a construction technique that became an aesthetic feature of Colombian architecture and received international attention during the development of the country in the second half of the 20th century.80 Salmona was born in Paris but moved to Bogota during his childhood, where his parents settled down permanently. Like many other peers of his generation, after studying architecture in his country (the National University of Colombia in his case), he moved in 1948 to Paris to work for Le Corbusier. He traveled through several Mediterranean countries, including Spain, France, and Italy, before moving to Bogota, opening his firm and becoming a symbol in the architectural narrative of Colombia.81 Salmona built most of his projects using exposed-fired brick, except for some

minor examples that used concrete.\footnote{Among these projects built by concrete, the ramp system of Gabriel Garcia Marquez Cultural Centre, and the houses Altazor, in Torca, Cundinamarca, and Casa en el Norte de Bogota, stand out in the architect’s work.} Although the majority of his work – both public projects and private residences – was built around the Bogota metropolitan area, he led three projects in Cartagena that resonate with theories of coloniality in the building realm: Casa de Huéspedes, the “Bahia de Cartagena” Apartment Building, and more importantly, a private house for the Nobel prize-winning writer Gabriel Garcia Marquez. In this house, colonial and coloniality accounts – factual and fictional – an architecture that misaligns from its environmental context and uses patios in the domestic spaces intertwine in a complex narrative.

Gabriel Garcia Marquez (1927 – 2014), born in Aracataca, near the Magdalena River and the Caribbean coast of Colombia, moved to Cartagena to work as a journalist in 1948 for more than a decade, and some of his writing reflects the history and architecture of Cartagena, particularly the book \textit{Love in the Time of Cholera}. In this book, he describes the social hierarchies of the city in the 19\textsuperscript{th} century and, mainly, the domestic spaces of the colonial house owned by the primary character, Florentino Ariza.\footnote{For instance, Garcia Marquez describes colonial houses in the following terms: “Dr. Juvenal Urbino’s house stood in another time. One-story, spacious and cool, it had a portico with Doric columns on the outside terrace, which commanded a view of the still miasmic water and the debris from sunken ships in the bay. From the entrance door to the kitchen, the floor was covered with black and white checkerboard tiles, a fact often attributed to Dr Urbino’s ruling passion without taking into account that this was a weakness common to the Catalanian craftsmen who built this district for the \textit{nouveaux riches} at the beginning of the century. The large drawing room had the very high ceilings found throughout the rest of the house, and six full-length windows facing the street, and it was separated from the dining room by an enormous, elaborate glass door covered with branching vines and bunches of grapes and maidens seduced by the pipes of fauns in a bronze grove. The furnishing in the reception rooms, including the pendulum clock that stood like a living sentinel in the drawings room, were all original English pieces from the late nineteenth century, and the lamps that hung from the walls were all teardrop crystal, and there were Sèvres vases and bowls everywhere and little alabaster statues of pagan idylls. But that European coherence vanished in the rest of
Nobel Prize in 1982, Garcia Marquez decided to have a residence in Cartagena. Because of his connection with the city and its history, people believed he would buy and transform a colonial house to his needs. Nonetheless, apparently advised by his wife, Mercedes Barcha, he decided to commission the house from Rogelio Salmona instead. It is at this time that the project becomes a hyperbole of colonially: The most acclaimed Colombian architect, who based his career on the use and alteration of fired bricks and patios, designed the house for the most acclaimed Colombian writer, who described the consequences of colonization in social hierarchies and everyday life.

In the 1980s, the walled city of Cartagena already had regulations to preserve the neighborhood’s historical character, and the building code required a pseudo-colonial style. Then, the architect and the municipality started a back-and-forth to get approval. Rogelio Salmona designed a two-level construction (three levels on the southwest side) with a central patio. Additionally, secondary courts in the four corners of the volume break the enclosure of the central space, and a large backyard with a pool on the north side of the property faces the wall of the city. The entire house was enclosed by a wall that protected intrusive views from the street into the ground floor. Like the rest of the house, this wall was built of fired brick and veneered with lime plaster on all its surfaces. Exposed bricks, which reveal the material behind the stucco, appear in minor ornamental details, such as

the house, where wicker armchairs were jumbled together with Viennese rockers and leather footstools made by local craftsmen. Splendid hammocks from San Jacinto, which multicolored fringe along the sides and the owner’s name embroidered in Gothic letters with silk thread, hung in the bedrooms along with the beds.” García Márquez, Gabriel, El amor en los tiempos del cólera, (Barcelona: Bruguera, 1985), 33-34. English translation by Edith Grossman, for Random House, Inc.


Ibid., 460.
the lintel of doors and windows (Figure 39). The same construction technique is used for
the house, and brick also paves the different patio floors. Saliena did not need to adjust
his design to follow the city regulations to match the existing architecture because he was
already influenced by colonial architecture: patios, balconies, galleries, etc., were recurrent
in many of Saliena’s houses, including the one for the writer.

Nevertheless, the hyperbolic situation of this house did not end with its colonial influences.
Shortly after the house was finished, Garcia Marquez complained the house was not
protected from the prevailing winds and the currents from the ocean, which in turn
disturbed its comfort in certain areas. A glass balustrade to protect the house was added,
which upset the architectural critics.86 As had happened hundreds of years earlier with
Spaniard settler builders, it seems Rogelio Saliena had forgotten to pay attention to the
context and adapt to the environment.

A generation younger than Saliena, Simón Vélez (Manizales, Colombia, 1949) based the
beginning of his career on an opposite approach. Vélez is also a dominant figure in the
architectural panorama of Colombia, coming from a privileged background of architects
and builders.87 Although he was educated at the University of the Andes in Bogota, under
the Bauhaus influence, he rejected the modern movement and got influences inspired by
natural forms.88 Describing his architecture as *vegetarian*, Simón Vélez developed the use
of bamboo as a structural material by filling it with cement mortar, aiming to reduce the

86 Ibid., 459-60.
88 Ibid., 27.
“overdose of minerals in the construction industry.” He has built several constructions in Colombia (as well as in other countries like Germany, Mexico, and Brazil), where the main materials are wood and bamboo, fired bricks and tiles barely exist, and in the case of domestic architecture, they are open to the landscape, instead of looking inwards. Projects like the *Tropical House* in Anapoima, *Casa Cartagena*, and *Oceanfront Bungalow* in La Guajira depict this opposite approach.

In an interview with Shigeru Ban for the:12 issue of *A+U*, Vélez explains how this building technology faced resistance from Colombian authorities while building abroad. According to Vélez, when he designed the ZERI Pavilion for the Expo Hanover 2000, the Columbian ambassador in Germany attempted to sabotage the project because “they hated that their country was represented by bamboo” and accused the architect of “using the bamboo to fill them with cocaine inside.” Only using the source of the architect, it is difficult to know if this episode was completely true. Nonetheless, it exposes how the use of materials that go beyond the colonial legacy can be perceived as dangerous or deviant from how architects are supposed to build and how a country wants to be represented.

More interestingly than this anecdote in relation to the Spanish heritage and material culture, it is the first project Vélez built —his own house in the historic colonial neighborhood of *La Candelaria* in Bogotá. Vélez’s father gifted him a small colonial-era construction in 1973 when the neighborhood was unsafe and in decay. He maintained the façade facing the street, demolished everything else in the lot, and built a small house.

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surrounded by a pond and a garden. Through different purchases on adjacent lots over the last 50 years, Vélez has continued building different pavilions for his daughters and grandchildren on a property larger than 2,000 sqm. (21,500 sqft.).\textsuperscript{91} Instead of building a house around courtyards, he has built pavilions within a large garden. (Figure 40). Scattered throughout the garden, old architectural features from demolished colonial houses remain in the garden as archeological ruins of a past that has been almost forgotten for the architect. As his house shows, the distinction between Salmona and Vélez goes beyond a specific building technology used: In Salmona’s publications, all the projects have been redrawn with shiny blueprints, while Vélez only shows hand sketches in grid notebooks. Salmona described the open spaces of his houses as patios and Vélez as gardens. Salmona was inspired by colonial architecture; Vélez literally destroyed it.

Beyond these two authoritative figures, we can see a reclamation occurring in the use of bahareque. Several collaborative approaches are currently underway in Colombia, where houses are built using Indigenous techniques as part of community work.\textsuperscript{92} In the case of Montes de María, an isolated group of small mountains near the northern coast of Colombia in the Caribbean Region, bahareque has become the spatial manifestation and cultural identity of Afro-descendant communities in the region.\textsuperscript{93} These mountains were the location of many palenques, towns founded in the 17\textsuperscript{th} century by Black escaped enslaved peoples (also known as maroons), and symbols of African-descendant resistance in the

\textsuperscript{91} “Architect’s House, Casa La Candelaria.” In \textit{A+U}, 2020:12, June 15, 2021, 15.
\textsuperscript{92} Organizations like \textit{Fundación Con Las Manos En la Tierra} in Raquira, Boyacá, use the construction of houses to render new ways of living, and bahareque is used to value ancestral knowledge.
Caribbean region. For instance, in the town *El Nispero*, in María La Baja, building houses in bahareque has become the link between ancestral traditions, the construction of a collective identity, and a strategy of belonging to the territory (Figure 41).\(^{94}\) In these examples, bahareque is not only a building technology that better adapts to the tropical climate but also has a lower carbon footprint than fired brick. It can also be a starting point to reimagine and reconstruct new forms of domesticity that acknowledge previous Indigenous climatic adaptations, recognize the violent past of erasure, and have the potential to build new futures. It is the construction of a new vernacular technique.

\(^{94}\) Ibid., 131.
CASE STUDY I - Figures

Figure 01: Diagrams showing Dry Bulb Temperature (°C), Diffuse Horizontal Radiation (Wh/m²), Relative Humidity (%), Global Horizontal Radiation (Wh/m²), Direct Normal Radiation (Wh/m²), and Total Sky Cover (tenths). Source: Own elaboration based on information of Santa Marta in Bolivar, SRC-TMYx.

Figure 02: Wind Rose of Santa Marta, Bolivar, Colombia. Source: Own elaboration based on information of Santa Marta in Bolivar, SRC-TMYx.
Figure 03: Psychometric Chart. Source: Own elaboration based on information of Santa Marta in Bolivar, SRC-TMYx.

Figure 04: Diagram of Indigenous Towns and Societies around Cartagena at the Arrival of the Spaniards in the 16th Century. Source: Own Elaboration
Figure 05: Topographic Map of Cartagena. Source: Own elaboration.
Figure 06: Diagram of the town of Cartagena in 1594 and 1716, showing the extension from the main island to Getsemani Island. Source: Own elaboration based on “Planta de la Ciudad de Cartagena de Yndias y sus Fortificaciones” and “Plano de la Ciudad de Cartagena de Yndias, situada en 10 grados y 26 minutes de latitud septentrional y en 304 de longitud.” (both from Archivo General de Indias).
Figure 07: Martinez Garcia, Alberto (2023). Facade of Casa Baja in Cartagena.

Figure 08: Martinez Garcia, Alberto (2023). Zaguan of Inquisitor Chief House.
Figure 09: Martinez Garcia, Alberto (2023). Patio of Gaston de Iriarte House.
Figure 10: Martinez Garcia, Alberto (2023). Room of enslaved peoples of Gaston de Iriarte House.

Figure 11: Martinez Garcia, Alberto (2023). Bridge at mezzanine level above the zaguan entry of Gaston de Iriarte House.

Figure 12: Martinez Garcia, Alberto (2023). Bridge at mezzanine level above the zaguan entry of Gaston de Iriarte House.
Figure 13: Martinez Garcia, Alberto (2023). Façade of Casa las Marques de Valdehoyos in Cartagena.

Figure 14: Martinez Garcia, Alberto (2023). Patio of Gaston de Iriarte House.
Figure 15: Urban Map of Cartagena, Colombia, showing the location of Casa las Damas. Source: Own elaboration.

Figure 16: Martínez García, Alberto (2023). Façade of Casa las Damas in Cartagena.
Figure 18: Axonometric view of *Casa las Damas* within the urban context. Source: Own elaboration.

Figure 19: Floor plan of *Casa las Damas*. Source: Own elaboration.
Figure 20: Long axonometric section of Casa las Damas. Source: Own elaboration.

Figure 21: Short axonometric section of Casa las Damas. Source: Own elaboration.
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Figure 26: Ramón Torres Méndez (1878). *Champán en el río Magdalena*. Source: Museo Nacional de Colombia
Figure 27: Topographic Map of Mompox. Source: Own elaboration.
Figure 28: Martinez Garcia, Alberto (2023). *Patio view of Casa in Cra. 1 No.15-27/33*

Figure 29: Martinez Garcia, Alberto (2023). *View from above of Casa in Cra. 1 No.15-27/33.*
Figure 30: Diagrams showing Dry Bulb Temperature (°C), and Relative Humidity (%), Source: Own elaboration based on information of San Marcos in Bolivar, SRC-TMYx.

Figure 32: Plan and section of Casa de la Cultura.
Figure 33: Martinez Garcia, Alberto (2023). *Casa de la Cultura*, view from the double space gallery.

Figure 34: Martinez Garcia, Alberto (2023). *Casa de la Cultura*, view from the double space gallery.
Figure 35: Martinez Garcia, Alberto (2023). *Casa de la Cultura*, view of the public meeting area.

Figure 36: Martinez Garcia, Alberto (2023). *Casa de la Cultura*, view from the open gallery to the courtyard.
Figure 37: Martinez Garcia, Alberto (2023). *Casa de la Cultura*, view of the kitchen.

Figure 38: Martinez Garcia, Alberto (2023). *Casa de la Cultura*, view of the second backyard with latrines and stables.
Figure 39: Unknown photographer. Casa Gabriel Garcia Marquez, exterior wall.

Figure 40: Velez, Simon (2023). Casa la Candelaria.
Figure 41: Huertas Nadal, Daniel (2020). Barrio de Abajo. Consejo Comunitario de El Níspero. Montes de María.
Latitude was crucial when Columbus sailed to the Americas for the first time. He had been forbidden to sail below the Canary Islands when traveling west to avoid breaking the peace signed between Castile and Portugal a decade earlier at the Treaty of Alcaçovas (1475-79). When he arrived in the West Indies, he refused to disclose the exact location of the islands, which were below the Canaries, thus skewing the maritime chronicle to avoid punishment.¹ This anecdote explains how important latitude was in sailing and political affairs and how it may have affected the construction of environmental narratives in the early modern period.

The first part of this chapter starts by explaining how Europeans understood climate on their first arrival to the Caribbean Islands and the influence of early modern colonization in the construction of new climatic epistemologies. Spaniards’ settlement of territories they considered inhabitable in unexpected latitudes was a challenge during colonization. And it played a political role in creating racial divisions within the colonies, which prompted a response from the other side of the Atlantic by Spanish Creoles and Indigenous intellectuals. In the second section, I evaluate Spanish colonizers’ approach to the environmental conditions of the Americas and how they affected the process of conquest on the continent.

Clime

As Europeans started to spread through the Americas, they realized their idea of Clime (from Greek κλίμα klima), which divided the Earth into three climatic zones by geographic latitude, did not work. The science historian Deborah Coen explains in The Advent of Climate Science that in the early modern period, “climate” was based only on the Sun’s inclination or latitude, following the theories of Aristotle. The philosopher divided the world into three climate zones associated with the hemispheres (Figure 1): frigid at the poles, temperate at mid-latitudes, and torrid at the equator.² Historian Nicolás Wey Gómez expands on this in The Tropics of Empire by noting that Europeans considered the inhabited world too restricted to a “narrow ‘temperate’ and, therefore, ‘civilized’ corridor. This geographic area was threatened on the north and south by the extreme cold and heat of the ‘wild’ arctic and tropics.”³ However, as Coen explains, the discipline of cosmography had a broader approach to the environment and the differences between regions, “using a concept of place defined by terrestrial and cosmic circumstances rather than simply by latitude.”⁴ Within this context, it is not surprising that finding temperate environments in torrid latitudes or freezing winters in temperate regions, as well as unknown natural phenomena such as hurricanes, would transform Europeans’ entire idea of climate during the first two centuries of colonization.

³ Wey Gomez, The Tropics of Empire Why Columbus Sailed South to the Indies.
Wind Patterns and Hurricanes

The Spanish Empire was able to sail to the Americas thanks to an understanding of the ocean wind patterns that tend to direct ocean circulatory systems. Historical geographer Greg Bankoff explains in the essay *Aeolian Empires* that Christopher Columbus had lived in the Azores and knew the winds blew firmly from the east between 28-30°N (approximately the height of the Canary Islands). This knowledge led him, on his first expedition to the Americas in 1492, to travel from these islands into the west until reaching the Bahamas. This permanent east-to-west prevailing winds pattern, called easterlies (also trade winds), returns to Europe in a loop around the Atlantic Ocean on a northern latitude, approximately 30-60°, called westerlies (Figure 2). Columbus used this return wind pattern to sail back to Spain on his first and consecutive trips.5 This understanding of easterlies and westerlies was used to travel through the Atlantic Ocean, as well as the Indian and Pacific, between the 16th and 19th centuries.6

While colonizers and sailors understood wind patterns concerning travel, it took time to relate them to the construction of different climates. We currently know that the seasonal variation of solar heating depends on the tilt of the earth’s rotation, making areas of high pressure tend to build up over cold continental masses in winter. At the same time, low-pressure development takes place over the adjacent, relatively warm oceans. Opposite conditions occur during summer to a lesser degree.7 Along with latitude and topographical

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6 Ibid., 164.
7 Ibid., 167.
elements, this seasonal global north-south flow of air movements shapes the world’s climate and creates variations that do not depend solely on the position of the equator line.\(^8\) However, it was not until the end of the 17\(^{th}\) and 18\(^{th}\) centuries that this parameter started to be included as a determining factor for the climate.

The lack of a holistic understanding of environmental conditions also played against the settlers in the first colonial encounters. Several Spanish towns founded in the Americas had to be moved at least once based on natural disasters, particularly hurricanes.\(^9\) As Stuart Schwartz writes in *Sea of Storms*, unlike other natural disasters, such as earthquakes, droughts, or floods, hurricanes were unknown in Europe at that time: Spanish settlers were unprepared for this natural hazard that could be explained by existing natural philosophy, astrology, and meteorology, as well as previous practical experience.\(^10\) Schwartz described the hurricane that hit Veracruz in 1552 and how the city had to be moved to the other side of the river in 1559 to mitigate the damage caused by future disasters. Through trial and error and the assimilation of indigenous epistemologies, settlers included hurricanes as part of their lives and beliefs by the middle of the 17\(^{th}\) century.\(^11\)

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\(^10\) Ibid., 1-11.

\(^11\) Stuart Schwartz defines this shift to approach hurricanes with the following quote: “By the mid-seventeenth century, the reading of natural signs was no longer a skill reserved to the indigenous peoples of the islands or to the mariners. It had become a local or creole knowledge, a necessary skill practiced by all. Over time, colonist observations and mariner experience were joined with the clues learned from the indigenous peoples and developed into a kind of local wisdom on each island of the signs to look for. Indians had watched the behavior of certain birds and fish, and the colonists learned from them.” *Sea of storms: a history of hurricanes in the greater Caribbean from Columbus to Katrina*, (Princeton, NJ: Princeton University Press, 2015), 24.
Climate misunderstandings were not unique to the Spanish colonizers since the British Empire faced similar challenges upon arriving in North America at the beginning of the 17th century. English people also came with the preconception that climate would be constant at any given latitude around the world and that New England would have temperatures similar to those of Spain or Southern France. However, they faced a land that was very hot in summer and extremely cold in winter. While one of the Spaniards’ main problems was resisting natural disasters and assimilating to tropical conditions, Englishmen had to understand how to cultivate land with overwhelming temperatures: summer season droughts that withered corn in the fields and winters that were, at times, deadly.

Environmental Determinism

Once Spanish colonizers realized the three-climate zone division was no longer valid in the Americas, they attempted to explain why what was supposed to be a torrid zone was in fact a temperate environment. Jorge Cañizares-Esguerra, in *Nature, Empire, and Nation*, describes the principal attempts to understand this deviation from Aristotle’s theory. For instance, Gonzalo Fernández de Oviedo, a Spanish soldier, historian, writer, botanist, and colonist, suggested in 1526 that a series of cooling mechanisms, including days and nights

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having the same length year-round in the tropics, could mean that longer nights would give
the land enough time to cool off in the summer, in comparison to Europe. He also claimed
that high mountain ranges and vast oceans surrounding the American continent contributed
to cooling the ground. Girolamo Gardiano, an Italian physician, biologist, physicist,
chemist, astrologer, astronomer, and philosopher, contended in 1555 that the height of the
land relative to the sea could determine the temperatures; in that case, he considered that
the torrid zones of the Americas were below sea level and attracted water from the poles,
creating tropical lands. Surprisingly, none of these scientists or cosmographers thought that
the wind currents, such as the easterlies and westerlies, strongly affected climate.

By the end of the 16th century, the climate became a basis for the construction of racial
theories about Indigenous and Amerindian inhabitants of the continent, particularly
targeting the tropical environment. Among the Spaniards who constructed these theories
was the Jesuit missionary and naturalist José de Acosta. Born in 1540 in Medina del
Campo, a small village in the Northern part of Castille, Acosta traveled to the Americas in
the 1570s. In 1589, he speculated that large water bodies made the American continent
uninhabitable.15 This was a paradoxical statement since he lived on the same continent he
claimed to be unbearable. His reasoning was that the strength of the sun drew up the vapors
of the ocean and, in the cool of the afternoon, brought about their condensation into the
rain, which poisoned the environment.16 More explicit in his racial ideologies was
Franciscan Diego Valadés. He argued in 1579 that indigenous people were “stupid because

15 Ibid., 68-69.
16 Gerbi, Antonello, The dispute of the New World; the history of a polemic, 1750-1900, (Pittsburgh, PA:
they are born in thick air.” Similar arguments were used by other intellectuals, such as Juan de Cardenas in 1591, who claimed that humidity weakened the strength of the population. These theories moved quickly through the rest of Europe from the 16th century, elaborated by intellectuals such as Thomas Gage, who in the early 17th century claimed that the food in the Americas was “false and hollow-hearted” inside. Eugenic theories continued during the Enlightenment through figures such as the jurist and political philosopher Jean Bodin (France, 1529/1533-1596), the naturalist Georges-Louis Leclerc, Comte de Buffon (France, 1707-1788), and the philosopher David Hume (Scotland, 1711-1776), among others. In the case of Bodin, he connected “the nature of the place... to its natural laws.” For Bodin, the territory influenced race and, consequently, the political system that should be implemented. The ideologies of these classical writers reveal their ignorance of the globe’s geography, in their attempts to establish scientific relationships or consistent laws linking the environment of each race with its civil and religious institutions.

In the Americas, Indigenous and Spanish Creoles responded to this negative view of the American climate. The Amerindian Felipe Guamán de Poma stated that the land of Peru was richer and better because it was closer to the sun, according to “philosophers, astrologers, and poets.” Spanish descendants living in the Americas, meanwhile, had to be sensitive with their responses: they had to create a theory that would not challenge their European legacy and, at the same time, would contest the environmental determinist

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17 Valadés, pars. 2, ch. 27, 94 [228], “sint stupidi, ta[m]q[ue]; in crasso aere nati.” – Quote extracted from the book Nature, empire, and nation, 69; by Cañizares-Esguerra.
19 Gerbi, The dispute of the New World, 37.
20 Ibid., 37.
21 Ibid., 83.
theories developed at the turn of the 17th century. For instance, Antonio de la Calancha, a friar, anthropologist, and son of an Andalusian holder of an encomienda, claimed that within each racial group, Aristotle’s hypothesis that peoples of warmer climates were more intelligent than those from colder regions supported the idea that people from the warmer regions of the Americas had a higher intellect than those from Spain. As Cañizares-Esguerra describes in *Nature, Empire, and Nation*, for Calancha, coastal Amerindians were more intelligent than those in the Andes because they lived in warmer areas, and Black people born in Lima were more intelligent than their African parents, and Creoles sharper than people born in the Iberian Peninsula.22

In parallel to these racial theories, empirical studies became important in the 17th and 18th centuries.23 Possibly influenced by the studies done in the Americas during the 16th century, factors such as the distribution of oceans, topography, wind, humidity, and sunlight started to be taken seriously and included as factors that defined the climate. The thermometer, invented in 1625, popularized “weather diaries” in bourgeois homes as part of a new culture of weather observation.24 By the middle of the 18th century, climate as a science started to be consolidated. This period was also the point of departure for the Spanish, and more notably the British Empire, to attempt to garner profit from the American environment in terms of botanic taxonomy and plant collection, considering them commodities that could be traded as they had silver and gold in the past two centuries.25

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22 Gerbi, *The dispute of the New World*, 85-86.
24 Ibid., 6-7.
Contested Imaginaries

Looking at the images published by Georg Braun, a German topo-geographer, in *Civitates Orbis Terrarvm* in 1572 (Figure 3) and by the previously mentioned Felipe Guamán de Poma de Ayala in *Nueva Crónica y Buen Gobierno* in 1613 in Peru (Figure 4), we can start to draw some conclusions about how the urban realm played an important role in constructing imaginaries regarding the natural environment. Braun's image shows an idealistic aerial view of Cusco on a flat area surrounded by mountains in the back of the town. For Braun, the city had the prototypical colonial orthogonal grid; it was oriented toward what seemed to be a government building, and a wall protected it. This aerial perspective, one of the few images representing Cusco during the early modern period, was published in the first book of Braun's six-volume work *Civitates Orbis Terrarium* between 1572 and 1617. The book represented mainly European cities but included some examples from other parts of the world, such as the aforementioned Cusco, Mexico City, Cairo, and Casablanca. In the case of Cusco, the town is represented next to Mexico City. Both blueprints represent their natural context with a certain degree of accuracy – the valley and lake that surrounded Mexico at the arrival of the Spanish army, for instance, and the prominent mountains around Cusco. However, in terms of the urban layout, the drawing of Mexico City depicted the character of the island that Mexico had before the lake was dried. Although the architecture hardly represented the scale and building aesthetics at the end of the 16th century, the urban layout kept a certain degree of accuracy. On the other hand, the painting of Cusco was completely imagined by the geographer and does not relate to the actual town the Spaniards built on top of the Inca buildings. From the existing grid of
Cusco, we know the settlement had the same urban layout as the one from the Incas. But in this painting, neither the urban layout nor the architectural constructions differ from the paintings of Mexico City or even other aerial views of European cities such as Seville, Venice, or Strasbourg. Braun never traveled to the Americas and was unlikely to have seen many other cities he depicted. However, it is still surprising that the architecture depicted does not differ from other European cities rendered in the same book, as if the constructions were autonomous from the environmental context. The representation of the colonial realm followed a pattern similar to that of the actual constructions. While settlers and builders were imitating the architecture from their hometowns in the Iberian Peninsula, painters were doing a similar task in their renderings. Buildings and paintings were not alike, but they were both inspiring from the same origin, Europe, while replacing existing materials, labor, natural resources, and landscapes. The final goal was to construct a collective imagination of the urban realm of the Spanish Empire.

The image by Poma de Ayala offers an Indigenous perspective on the urban and building environments from the other side of the Atlantic. His illustration shows two aerial perspectives; one is a view of Peru, and the other is of Castille. At the bottom, we see a series of pueblos or towns in the Castilian Plateau. At the top of the drawing, similar-looking villages occupy the Peruvian territory. The landscape is different in each case: In Peru, a series of mountains or hills create an abrupt topography between the towns, and a powerful sun dominates the landscape and suggests a different climate in the upper part of the drawing. Castile lands suggest a flat plateau where towns are roughly equally distributed. The drawing is divided by a line that could represent the Atlantic Ocean: a
similar territorial approach under two different climatic conditions. The blueprint is completed with the following quote:

_The Indies of Peru on top of Spain / Castille at the bottom of the Indies._26

Although the drawing suggests that the Peruvian and the Castilian territories have different environmental conditions, the towns are depicted similarly: a main urban square in the center, surrounded by other domestic, religious, and governmental constructions, and a series of arcades that suggest a cover gallery around it. These constructions do not offer much differentiation between both territories, showing pitched roofs in both cases. Like Georg Braun, Felipe Guamán Poma de Ayala never saw the Castile landscapes, but he depicted them as those from Peru that had been before imitated based on the architecture of the Iberian Peninsula. This inspiration from the previous inspiration suggests that even Intellectual Indigenous imaginaries were already erasing their own past by those imposed by the colonizers.

Looking at these two images and other drawings from the same period provokes the following questions: If climatic differences between Europe and the Americas created such intense controversy, how did it affect the urban realm and domestic constructions, and why was it not represented in the renderings produced in the colonial period? How did climate (particularly in regions very different from those on the Spanish Peninsula) affect the construction of settlements? Moreover, why was the urban realm represented similarly

26 _Las Indias del Peru en lo alto de España / Castilla en lo abajo de las Indias._ Own translation.
regardless of the location, roughly a century after the first century of colonization, on both sides of the Atlantic and from the European and Indigenous perspectives? The last question can be easily answered: Europeans, from the beginning, had a clear agenda of how colonization, cities, and civilization should look in the Americas and how Indigenous people had to live even if the result was against their own perceptions of the environmental conditions of the Americas.

More disturbing is the comparison of these two images and the assimilation of Castile constructions, not only from Europe but also from the Americas. Guamán de Poma de Ayala made his drawing roughly eight decades after the conquest of Peru, which shows that the Spanish settlers had already succeeded in imposing their urban models – the erasure of pre-Hispanic settlement conditions in the Americas was likely homogenizing the imaginary of Indigenous people regarding the architecture. Simultaneously, Braun's drawing showed the limitations of Europeans in adapting their built structures to the environment, instead replicating the same European models in America, even in the imaginary.

Vecinos

During the first century of colonization, many Spanish conquistadors’ techniques to settle in the Americas related to the urbanization and construction of towns. That was uncommon in early modern colonial procedures and set the Spanish empire apart from others, such as the Portuguese and British. In the case of the English Empire in the Americas, they primarily envisioned New England as land for farming upon their arrival. J. H. Elliot
explains that for “the English in the age of Tudors and Stuarts, ‘plantation’ – meaning a planting of people – was synonymous with ‘colony,’ […] simulating the original coloniae of the Romans – simultaneously farms or landed estates, and bodies of emigrants, particularly veterans, who had left home to ‘plant,’ or settle and cultivate (colere), lands elsewhere.” In contrast, the Spanish settlers did not have much intention to farm or work the land themselves, and this attitude was even reflected in the terminology of the period. Particularly after the revolt of Luis Roldán against the Columbus Brothers on Hispaniola in 1498, Spaniards wanted to call themselves vecinos (householders) and not colonos since this term also related to a laborer who worked the land for which he paid rent. Instead, they wanted the same rights as people in Castille and, therefore, had the same social structures as in the kingdom. This attitude from the first decades affected the terminology of the conquest: the territories were divided into virreinatos (viceroyalties), Spaniards were called conquistadors, and their descendants, pobladores (settlers). This approach became essential in the territorial advance and spread through the Americas, with the construction of towns and centers of power-holding jurisdictions that extended far into the surrounding countryside so as to control and obtain profit from the indigenous population living outside them.

The legal document that framed this terminology was the Laws of the Indies, which abstracted and codified the terms Poblador and Pueblo from Iberian settlements and traditional constructions into colonial urbanism. Those created the legal framework that

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28 Ibid., 9.
built this urban and architectural abstraction from the Iberian Peninsula into the Americas. Similarly, as Cortes described the new continent in his letters to Carlos V, the Spanish Crown projected rules to export Iberian architecture from Manila to Santo Domingo and Oaxaca to Lima. Poblador is related to pacificacion, which was used instead of Conquista (conquer). This was shown in several parts of the Laws of the Indies.²⁹ One example was the Title I-Law vi, shown below:

> [...] to avoid the word Conquista, and in its place, to be used the word pacification and population, since it has to be done with all the peace and charity, it is our will, that even this name interpreted against our intention, does not cause to practice either a strength or an injustice against the Indians³⁰.

Nevertheless, the idea of Poblador and Pueblo (villages or towns) was not only used for towns by Spaniards. Indigenous populations were also forced to live in towns, particularly during the Reducciones in the second half of the 16th century. Historian Daniel Nemser explains in the book *Infrastructures of Race* that Pueblo was the instrument to forcibly resettle “dispersed” indigenous communities into centralized towns under the watchful gaze of the colonial authorities.³¹ This statement is supported by the letter the Franciscan friar Toribio Benavente sent to King Carlos V on May 15, 1550:


³⁰ [...] Se excuse la palabra conquista, y en su lugar se use de las de pacificación y población, pues habiéndose de hacer con toda paz y caridad, es nuestra voluntad, que aun este nombre interpretado contra nuestra intención no ocasion, ni dé color á lo capitulado, para que se pueda hacer fuerza ni agravio á los indios. At: Recopilacion de Leyes de los Reynos de las Indias. Volumen II, 2. Own translation.

This could be partly remedied by making them live in towns similar to those in Spain. It would be an excellent benefit for the doctrine and human police because, currently, many of them live more like savages than like men, and we do not know what we can do to teach them and inform them about the things of God.32

Centers and Peripheries

Colonizers wanting to be settlers and Indigenous peoples forced to live in towns created the basic territorial scheme of colonialism, which was based on urban centers of power and peripheries under their control. This strategy to keep the center in populated urban areas while controlling the farming land through Repartimientos was extrapolated from the Iberian Reconquista against the Muslims. Then, each town had the same buildings: a church, a town hall, a prison, a plaza mayor (main square), and private residences.33 This “Procedure of Reconquista” first became a conquest model in the Canary Islands as a laboratory for experimental colonization before traveling into the Americas. However, the transmission between the Reconquista, the Canary Islands, and the Americas was carried out territorially, politically, and economically through public and private operations. The Crown created a document to let private, organized, and financed individuals and companies run expeditions in lands not part of the Castille. The occupied land became part

32 [...] Esto se podría remediar en parte con hacer que se juntasen en pueblos como están en España, y no sería pequeño provecho para la doctrina y polecía humana, porque como agora están muchos de los más viven como salvajes que como hombres, y no sabemos cómo de otra manera ellos pueden ser bien instruidos e informados en las cosas de Dios. Cuevas, Documentos Inéditos del siglo XVI para la historia de México, (México: Museo nacional de arqueología, historia y etnología, 1914), 166. Own translation.
of the Kingdom, although the conquistadors would have privileges to exploit the land and its inhabitants. This became the base of Capitulaciones, the customs form of agreement to colonize the Americas. With this form, the Spanish Kingdom created a political construction of the different realms with different centers of power and periphery. The main center was Castile, and the periphery was the colonized territories. However, within the colonial realm, the capitals of the Viceroyalties became the centers (mainly Mexico City and Lima), and the rest of the colonial towns were peripheries. Finally, other important towns were centers (Puebla, Cartagena, Bogota, Manila, etc.), and the Indigenous towns and plantation areas were peripheries.

These different hierarchies were bureaucratically organized through viceroyalties, audiencias, and cabildos as gradients of power. American geographer D. W. Meinig, in the first volume of his book Atlantic America, 1492-1800, describes the same idea of center and periphery in several gradients, such as colonial ports, heavily colonized areas, and Indigenous countries. For Meining, the spatial organization of the peripheries in terms of “a spectrum showing gradations in power, the intensity of interaction, and social character,” in which “imperial power declined with distance from the European capital until it became feeble and indirect in the interior.” From his reading of colonization, we can deduce that the most effective form Spaniards had to control the American continent was by creating towns with enough power to expand their influence into the countryside without destroying all the internal organization and hierarchy of the Indigenous

34 Elliott, John Huxtable, Imperial Spain, 46-47.
communities that had to continue creating revenue through labor. In other words, changing the top of the pyramid of power and having minimal positions of control in the intermediate stratum allowed them to keep creating a profit by labor.

**Palimpsests**

The effect of the Spanish intention to colonize existing urban areas evolved in a palimpsestic way. Conquistadors, particularly in the first century of colonization, expanded outwards, looking for other empires to conquer and use their existing infrastructures and modes of production. The viceroyalties of New Spain and Mexico supplanted the Aztec and Inca empires, the largest societies in the Americas, before the arrival of Columbus.

By overlaying maps of existing prehispanic settled societies with the maps of conquest in the 16th century, we can understand the directions for spread. Figure 5, based on Lockhart and Schwartz’s diagrams from their book *Early Latin America*, shows how Spanish settlers chased the treasures and power of other empires. Aztecs and Incas had intensive agriculture, stable towns and villages, robust tribute mechanisms, and dense populations. Some people were dependent on others with different duties and rights. This organization system had similarities with European models, so it was easier for Spanish settlers to sit themselves in the positions of command without fully transforming all the intermediate hierarchies.36

To attempt this purpose, climate was crucial. The Aztec Empire's capital and most important city was Mexico-Tenochtitlan (subtropical highland climate - Cwb). In the case of the Inca Empire, some of the more remarkable cities were Quito (Oceanic Climate - Cfb), Cajamarca (subtropical highland climate - Cwb), Tomebamba (subtropical highland climate - Cwb), Ollantaytambo (Tundra climate - ET), and Cusco (Subtropical highland climate - Cwb). All of them, except Ollantaytambo, had subtropical highland or oceanic climates. These climates have cool summers and mild winters for their latitudes, with average temperatures no lower than 2°C in the colder months and 14 and no higher than 27 °C in the warmest period of the year. These temperatures did not differ much from those in the Iberian Peninsula, and relative humidity was in similar standards. Beyond looking for silver and gold, the Spanish empire looked for urban areas to conquer where precious metals were stored, and the dense populations could be used for labor (Figure 6). Then, Spaniards found that the existing empires with a more hierarchical structure coincided with the climates they could better acclimatize.

One possibility worth further exploration is that the speed of conquering the Incas and Aztec Empires during the 16th century was partly achieved because they found climatic conditions similar to the ones they knew. More broadly, there were other examples of colonization where the climate was unfavorable for the colonizers, and the outcomes depended on each case. One of the unsuccessful results was the case of Florida. Sam White explains in the book *A Cold Welcome* that Spanish explorers and conquerors went to North America, from the tropics through Florida, expecting a climate similar to Europe and with

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37 The Iberian Peninsula mainly has four climatic conditions: Hot summer Mediterranean – Csa; Cool Summer Mediterranean – Csb; Cold semi-arid – Bsk; and Oceanic Climate – Cfb.
the intention of repeating the same conquest as Hernán Cortés in Mexico. At that time, the southeast coastline was much colder than it is nowadays because of the Little Ice Age. The expeditions from 1527, 1537, and 1557 failed, draining invested fortunes and demoralizing their members, suffering cold rains, snows, hunger, and sickness.38

Within tropical climate, three other examples are worth mentioning: The Yucatan Peninsula, Colombia, and the Philippines. At the Yucatan, Spaniards faced similar results as in Florida when they attempted to subjugate the Maya society — not only were they unsuccessful in achieving a political division among tribes, but the thick, challenging growth and scrubby landscape of the Yucatan impeded mapping or understanding the territory. Also, the hot and humid weather became a challenge to penetrate the land. Inge Clendinnen describes in *Ambivalent Conquests* how the forest growth along the paths distorted the sound and the vision and sealed away any breath of wind to release the sweating of colonizers.39 The conquest period of the Yucatan thus lasted more than fifty years.

Despite facing similar climatic conditions, the conquest around the Magdalena River Valley (Colombia) was more effective because the river was the infrastructure for conquest. Although the landscape was also thick and tropical temperatures and humidity made the environment challenging, a stable route such as a navigable river made it possible to penetrate the territory until the foundation of Bogotá in 1538. In the Philippines, on the

other side of the Atlantic, the climate was similar to Colombia – Tropical rainforest (Af), Savannah (Aw), and Monsoon (Am). In that case, the conquest and colonization around different bays, channels, and estuaries and the maritime route found by San Pedro con Urdaneta following the Kuroshio Current connected Acapulco with the archipelago and allowed accessible communication with the viceroyalty of New Spain and its center of power.

These colonization patterns thus simultaneously used and disregarded climate factors. On the short-term and continental scale, conquistadors relied on existing demographic densities within the American continent, using the just-overthrown imperial societies for labor. As James Lockhart and Stuart Schwartz explain, Indigenous “corporate power had fallen precipitously from its preconquest heights, but the basic mechanisms remained in excellent working order, traditional internal authorities were readily obeyed, and the limited nature of the Hispanization of the bulk of individuals was itself an insulating factor.” These societies based their economy on intensive farming. Even if inhabitants lived in nucleated villages or dispersed in the countryside, they were linked through stable connections made by agriculture. Spaniards needed labor from Indigenous societies, so they replicated pre-Hispanic hierarchical systems and founded some of the main cities near existing populations (such as the case of Puebla or Oaxaca) or even on top of them. The construction of these cities would become the center of economic and institutional life. Nonetheless, this reproduction of pre-Hispanic systems mainly happened in the economic

40 Lockhart, Schwartz, *Early Latin America*, 166.
41 Ibid., 37-49.
42 Ibid.), 88-90.
and political realm but barely in the urban forms, except in Mexico City and Cusco, where
the grid was used for early colonizers. Nevertheless, the set of laws, created in the first two
centuries of colonization, showed an ambiguous connection to the environmental
conditions unknown to Spaniards in the newly conquered territories.

**Protocols**

Two main Spanish ordinances that shaped the American landscape environmentally and
socially were the Laws of the Indies and the *Congregaciones*. The Laws of the Indies was
a pre-established approach to the region with mandates that, among many other things,
organized where and how to create new towns. *Congregaciones* in Mexico (*Reduciones*
in Peru) was a mechanism to resettle Indigenous communities into new towns (pueblos) to
achieve political, administrative, and cultural control. It aimed for a more robust religious
conversion. *Congregaciones* and *Reduciones* were made after studies of the physical
conditions of the ground, summarized in the *Relaciones Geograficas* – questionnaires
distributed by the King to the American viceroyalties to understand the physical and
demographic conditions of the Americas. These two protocols aimed to reconfigure the
territory and the colonized inhabitants, adapt and take advantage of the environment, and
get profit from the extraction of the land such as the mines in Bolivia or Colombia, the
plantations in the Caribbean Islands, and the system of encomiendas as a form of labor
exploitation from native people into a foreign land. While the Laws of the Indies attempted
to translate the Iberian physical and social structures into different contexts, *Congregaciones*
were made based on an ethnographic work of the existing conditions.
Although they had completely different starting points, they had the same target: extract resources and get profit from labor and land.

Laws of the Indies

The Ordenanzas de descubrimiento, nuevas poblaciones y pacificaciones of 1573 (Ordinances for discoveries, new settlements, and pacifications), later summarized in the Laws of Indies, had already been tested in most of the cities before their elaboration. Most significant cities were founded between the 1520s and 1540s, including Veracruz, La Habana, and Ciudad de Panamá in 1519, Mexico City in 1521, Lima in 1535, and Potosí in 1545. The Laws of the Indies mainly recorded established protocols rather than policies made beforehand. It resulted from Spanish attempts to reconstruct the Americas in their image and the imposition of their patterns in the prehispanic urban realm. The construction of new villages started in 1503 when Isabella and Ferdinand ordered founding towns for native people in the Caribbeans to gather them together outside the countryside. In 1512, with the Leyes de Burgos (Laws of Burgos), the Crown ordered the destruction of the ‘Indians’ old villages and the building of new ones near Spanish settlements. The Laws of Burgos already set the basic dimensions of the grid: for every fifty families, there were to be four buildings 5 x 10 meters (15 x 30 feet) in size. The Laws of Burgos were reassessed and amended four times until they consolidated in the Compilation of the Laws of the Kingdoms of the Indies (Recopilación de las Leyes de Los Reynos de las Indias) in 1680.

The origins of the grid have been long debated with different theories over time.\textsuperscript{46} It is believed that it could have been influenced by the Renaissance models and the urban model of Santa Fe de Granada. In this orthogonal camp, the Catholic Monarchs and Christopher Columbus signed the Capitulations of Santa Fe, a document signed in 152 regarding the expedition the sailor would undertake through the Atlantic. Recently, the grid has been approached as a tool of hegemony and exploitation, following Henri Lefebvre’s vision. The rectilinear grid encapsulated the cultural values brought by the Spaniards into their colonies.\textsuperscript{47} However, beyond looking at its origins, it seems more relevant to discern how they were disseminated in three continents simultaneously and what they represented. The Laws of the Indies and the orthogonal grid were an urban project to colonize a flat earth. A grid that extended indefinitely and could cross rivers, marshes, and mountains. Any abruptness could be overcome by geometry. Within the rectilinear grid, Iberian architecture – a grid that encapsulated the cultural values brought by Spaniards into the rest of the world.\textsuperscript{48}

The Laws of the Indies divided land based on three categories: geographical location, namely coastal and Mediterranean;\textsuperscript{49} climate, with the division of cold and hot areas;\textsuperscript{50} and altitude, namely mountain or low sites.\textsuperscript{51} To construct new seacoast settlements, the Laws

\textsuperscript{47} Mumford, \textit{Vertical Empire}, 47.
\textsuperscript{48} Ibid., 47.
\textsuperscript{49} \textit{Recopilacion de Leyes de los Reynos de las Indias. Volumen II}, 19, 21.
\textsuperscript{50} Ibid., 15, 21.
\textsuperscript{51} Ibid., 19.
of the Indies ordered finding sites in elevated locations from the sea level without wetlands, marshes, or similar features. These sites were named healthy and robust. It also instructed them to protect the settlement from the sea for defense purposes. Looking at colonial maps, most of the coast’s new towns were located in protected waters like bays, river deltas, or gulfs. In the new settlements not built in coastal areas, the main concerns were altitude and the proximity to rivers or water sources. The Laws of the Indies instructed finding sites in intermediate regions, avoiding the higher locations because of the wind speed and lower places because they could easily transmit diseases to the Pobladores. If they had to be in high places, such as mountains, the new settlers were instructed to find locations without fog. Either way, these new settlements needed access to potable water and, if possible, to be located near navigable rivers.

Wind was also a driving factor in the selection of sites and the orientation of new towns. The Laws of the Indies ordered settlers to choose sites with predominantly south and north winds. If the settlements were going to be built on a hill or a mountain, they needed to be located on the east or west slopes so the predominant wind could still be from north and south, possibly to heat the towns in the cold months and cool them during them in summer, as it occurred in Spain. In a rustic form, three relevant environmental factors were already addressed in these laws: temperature (warm and cold sites), relative humidity

52 Ibid., Ley j, 19.
53 Ibid., Ley j, 19; and Ley ii, 20.
54 Ibid., Ley j, 19.
55 Ibid., Ley j, 19.
56 This condition was not always followed which suggests the settlers took decisions once they conquered territory. In the case of Manila, the city is oriented, taking advantage of east-west winds since those were dominant in the territory.
(fog places and marshes), and wind directions. The wind was also a matter of health. For instance, hospitals for infectious diseases had to be located on high sites, and the wind directions could not blow toward the main settlements.57 Also, butchers, fish shops, and other facilities that created dirt and smell had to be located near rivers or the sea to throw the waste into the water.58

Similar climate-based decisions were made in the architectural and spatial design within the settlements. For the dimension of the streets, the Laws of the Indies ordered colonists to build wide streets in cold climates and narrow in warm ones.59 Houses also had to be oriented to receive north and south winds. Other architecture regulations included connecting the houses for defense purposes and providing both a courtyard and a backyard (one for household activities and the other for horses and other animals).60 Significantly, these two requisites were not based on the American environment – instead, they activated the morphology of the Andalusian and Mediterranean towns. Mediterranean society embraced construction density and seclusion of domestic activities as passive thermal mechanisms of environmental control. While the previous orders attempted to adapt to the existing climatic and geographic conditions, introducing courtyards created an architecture of gradients; galleries and courtyards created threshold spaces that transitioned between different thermal zones.

57 Recopilacion de Leyes de los Reynos de las Indias. Volumen I, Ley ij, 23.
58 Ibid., 20.
59 Ibid., Ley x, 21. The design of the streets also followed other directions, such as narrowing their width to defend them from possible enemies.
60 Ibid., Ley xviij, 23.
There is an ironic paradox in the attempt at the selection and adaptability of Spanish colonial towns. Despite understanding that different sites would have unalike environmental conditions, the use of orthogonal grids, dense construction settlements, courtyard houses, etc., barely varies from one town to another. Consequently, some of those towns had unbearable living conditions for the Spanish settlers, particularly in tropical climates where the urban and architectural forms erased previous forms of inhabitation.

Besides neglecting tropical settlements, the urban grid was ambiguous when Spanish settlements were on top of prehispanic urban grids and cities. On the one hand, it disregarded the previous grid. On the other, it used the main layout as the basis for the new urbanism: a partial erasure of the existing to trace a new condition. The destruction of a previous society while transforming its own. This was the case of Mexico City and Cusco, the capitals of the Aztec and Inca empires, which had different results.

In the case of Mexico, the city was founded on top of Tenochtitlan's ruins. Before the arrival of the Spaniards, Tenochtitlan was located in the middle of Lake Texcoco, a high-water table impermeabilized with a layer of clay underneath that pooled and spread the water during rainy seasons (Figure 7). Aztec peoples lived on the land using hydraulic engineering to maximize food production, prevent floods in urban centers, segregate types of water, and ensure navigability.61 After Tenochtitlan was conquered and destroyed by the Spanish army in 1521, Hernan Cortes decided to build the new capital in the same place

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for several reasons: First, Tenochtitlan was in the geographical center of the just-created Spanish Empire and had the largest concentration of the area. Second, the water around the city could serve as a natural defense. It has been suggested that Cortes used the island as a tool for spatial discipline for his mutiny-prone cohort. Finally, the Spanish conquistadors wanted to avoid the bad weather conditions of the Caribbean coast. The newly founded Mexico City used the Tenochtitlan grid that was partially orthogonal, with minor variations, particularly on the outskirts of the city. In doing so, it is suggested that encountering prehispanic cities with orthogonal grids emphasized its use in constructing future towns around the American continent. Nonetheless, choosing a location in a lake did not follow an environment similar to Spain’s with the well-known consequences. The obliviousness of the hydraulic infrastructure erected by the Aztec Empire and their knowledge about living within the lake resulted in the floods of 1555, 1580, 1604, 1607, and, mainly, the flood of 1629, which put the city under two to six feet of water, depending on the section they lived in. As a result, colonizers started the construction of the *Desagüe* (a large drain infrastructural project to dry the Texcoco Lake). The consequences of transforming the environment and infrastructural work are persistent today.

In Cusco, colonizers attempted to turn it into the capital of the Viceroyalty of Peru. However, the topographical location of the city (3400 meters above sea level) and its distance from Mexico, the center of power at that time, made colonizers decide to convert

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62 Ibid., 26.
63 Lockhart, Schwartz, *Early Latin America*, 89.
65 Candiani, *Dreaming of Dry Land*, 318, 322.
the city of Lima into the capital of viceroyalty.\textsuperscript{66} Lima is located on the coast of the Pacific Ocean, with a mild climate (desert climate – BWh, with subtropical temperature ranges), similar to some regions of the Canary Islands and the Sahara. The desert climate in Peru is a narrow stripe running parallel to the ocean before the beginning of the Andean Mountain range. Cuzco was still an important city, and its Spanish foundation was similar to Mexico City. After overthrowing the Inca Empire, they occupied the homes of the previous elite and built the city using the grid, buildings, and materials. Unlike the case of Mexico City, most of the urban grid and building foundations remained. Nonetheless, besides a minor deviation in the 90-degree grid, most of the features of ideal Spanish towns remained, including the main central plaza and the similarity in the lot sizes. (Figure 8). This suggests that the prototypical Spanish grid could have been based as much on the Renaissance ideas and the encounters with existing urbanisms. These empires had similar structures to the ones designed by Spanish settlers. The second implication is to ask which cities the Spanish urban settlements environmentally performed well and for whom. The orthogonal grid worked particularly well in areas with desert climates, particularly in cities where the grid was denser, such as Lima, while it created discomfort in the tropics, mainly when air did not circulate between buildings, such as Cartagen, Mompox, or La Habana. With continuing flooding, Mexico City also reflects the disregard for the existing natural conditions and social adaptation. The urban similarities between cities provided a living laboratory for testing a single grid model in all the possible climates of an entire continent, with the correlated consequences of such an experiment.

\textsuperscript{66} Lockhart, Schwartz, \textit{Early Latin America}, 90.
Relaciones Geograficas

Besides the Laws of the Indies, colonizers surveyed regions to build new towns and resettle indigenous populations. Relaciones Geograficas was the result of the failure to control and group Indigenous populations in towns in the first decades of colonization.67 Started in Peru in the 1550s and New Spain between 1579 and 1585, it was mainly an ethnographic work, as defined by Jeremy Mumford in Vertical Empire.68 The commissioners traveled around the viceroyalties of New Spain and Peru, described the land and its population, and chose the best places to build new settlements. Relaciones surveyed climate, resources, defense, and modes of transportation and registered the existing Indigenous population’s race, culture, language, and relationships in a series of documents and maps (Figure 9). The final locations for new towns needed access to water, good local resources, and healthful breezes.69 The goal was to resettle Indigenous communities into new towns to achieve political, administrative, and cultural control, financial vigilance, and continuing with religious conversion while extracting resources.70

If the Laws of Indies projected an adaptive urban system in written documentation, the Relaciones registered the environment in maps to take advantage of the existing conditions.

67 In the last decades, there have been arguments against the statement that Spanish colonizers failed to congregate indigenous communities in Pueblos in the first 100 years of colonization. One of the papers that attempt to challenge the failure is Congregaciones de Indios en la Nueva España antes de 1570, written by Peter Gerhard in 1977 at Historia Mexicana, Jan. - Mar. 1977, Vol. 26, No. 3 (Jan. - Mar. 1977), pp. 347-395. However, it has been documented that in Peru, before the Reducciones, it was usual that Amerindians lived in the highlands, far from Spanish towns. The chapter “Mountains” in the book Vertical Empire by Jeremy Mumford describes in detail the relationship between Spaniards and Indigenous during the first decades after the fall of the Inca Empire.

68 Mumford, Vertical Empire, 34.

69 Ibid., 87.

70 Torre Villar, Ernesto de la, Las congregaciones de los Pueblos de Indios, Faste Terminal: Aprobaciones y Rectificaciones, (Mexico: Universidad Nacional Autonoma de Mexico, 1995), 24, 25.
Looking at Figure 9, we can see this abstraction system to map the territory. A single map depicts geographical elements such as mountains, rivers, flora and fauna, existing churches built during colonization’s first century, paths, and more. Everything was codified to support the new Congregaciones. This resettlement project created a second traumatic experience when Indigenous were forced to move: Existing communities, constructed after the first decades of colonization, were destroyed again. Historian Ernesto de la Torre Villar explains how this distress was aggravated in Mexico since some of the displacements happened during the rainy season, and entire Indigenous communities had to move from their homes into lands that did not have any construction raised yet, having to build their own homes.71 The apparent meticulousness in the Relaciones geográficas became another exercise of violence, and the colonial documents focused the climatic adaption on the self-preservation of the conquerors rather than the oppressed.

In the viceroyalty of Peru, from an ethnographic perspective, Spanish settlers had a particular interest in how the Aztecs organized the territory before their conquest. Under the Inca Empire, Andean society was a machine for generating surplus production for its rulers in a harsh climate; Andeans were accustomed to serving their elite.72 With settlements at different elevations of the mountain range, Andeans took advantage of the diverse ecological zones. There was not a single place that supplied all the necessary goods for a living, and communities generated what they could at different heights: llamas and alpacas on the high plateau, potatoes at a lower elevation, then maize, and finally, vegetables and coca leaves in the hot climate near the coastline. A network between these  

71 Ibid., 36, 37.  
72 Mumford, Vertical Empire, 27-29.
communities linked them to exchange their goods. Anthropologist John Murra described this model as a vertical archipelago: a series of different landscapes vertically connected within the Andean mountains to supply all the necessary goods for the Incas.73 This system was maintained during the first decades of colonization until the arrival of Francisco de Toledo as viceroy in 1570, who ordered native farmers near the fields to move to compact agricultural villages or reducciones with favorable climatic conditions for the colonizers.74 These areas were the temperate valleys and basins of the Andes between 2500-3500m elevation. This rule attempted to imitate the peasant-nucleated settlements of Castille, Extremadura, or Andalusia, implanting the values of European cities in the Andes.75 The image of the villages, projected from the Spanish Crown and inscribed in the Laws of the Indies, became a trap for indigenous people and a mechanism of suppression to the Spanish conquest.

Nonetheless, Reducciones did not work as expected. Historian Daniel W. Gade explained in Landscape, System, and Identity in the Post-Conquest Andes that indigenous farmers resisted this urbanization and left the pueblos to resettle in the fields. They moved to puna grasslands76 – regions over 4000 meters above sea level, which Spaniards could not easily reach. In the end, the Pueblos envisioned by the Spaniards in the Andes became mestizo villages rather than native ones.77

73 Ibid., 3-4.
76 Gade, Landscape, System, and Identity in the Post-Conquest Andes, 472.
77 Ibid., 473.
The natural environment played different roles in Peru. First, colonizers analyzed it to reshape the existing societies. Second, it was a space for transformation, a laboratory to superimpose a foreign way of life. Finally, it became a space of resistance for indigenous communities. A battlefield between two cultures with different levels of climatic adaptations. This resistance was seen in the failure of the ethnographic work of the Relaciones Geograficas. The surveys did not achieve the colonizers’ target since the selection of environments was based on European standards rather than Indigenous ones. Spaniards attempted to take advantage of territories similar to those in the Iberian Peninsula, using similar tools for conquest and resettlement. Relaciones Geograficas repeated the same pratfall as the Laws of the Indies: an analytic study of existing situations intended to apply the same models imported from the centers of power. This blind spot toward the unknown was a repeated pattern from misunderstanding climate to territorial imposition into the architectural realm.

In this chapter, I first focused on analyzing the perception of colonizers toward unknown climates in the 16th and early 17th centuries, particularly in the tropics, and how those created environmental determinist theories. Second, I have analyzed the environmental parameters used to conquer the Americas, such as the selection of sites and resettlement of the Indigenous population. This initial analysis has been supplemented by some maps that cross-reference patterns of conquest and different climates. Further analysis would be necessary to deeply understand how climate shaped conquest on a territorial scale and how the search for natural resources and labor reorganized the densities of the Americas. Similar
to the work elaborated in the two case studies proposed in the thesis, where archival and
fieldwork are accompanied by environmental analysis, simulations, and other graphics, we
could analyze how the different climates transformed the natural and urban regions.
Figure 01: Zonal mappamundi. *From "Quinta figura" in Pierre d'Ailly and Jean Gerson, Tractus de ymagine mundi et varia ejusdem auctoris et Joannis Gersonis opSuscula (1480-1483), Tabula Americae, facs. no. 852 (Madrid, 1990).*

Figure 03: *Cusco Regni Peru in Novo Orbe Casyf*. SOURCE: Braun, Georg, *Civitates Orbis Terrarvm*, (Coloniae Agrippinae: apud Petrum à Brachel, sumptibus auctorum, 1572-1617).
Figure 04: Pontifical Mundo, *Las Indias del Peru en lo Alto de España / Castilla en lo Abajo de las Indias*.

SOURCE: Guamán Poma de Ayala, Nueva Crónica y Buen Gobierno (ca. 1613).
Figure 05: Overlapping of Prehispanic sedentary societies with maps of Colonization in the 16th century.

SOURCE: Own elaboration based on diagrams from Early Latin America: a history of colonial Spanish America and Brazil, (Cambridge, Cambridgeshire; New York: Cambridge University Press, 1983).
Figure 06: Overlapping of Colonization in the 16th century with arid and Temperate/mesothermal climates. SOURCE: Own elaboration based on diagrams from *Early Latin America: a history of colonial Spanish America and Brazil*, (Cambridge, Cambridgeshire; New York: Cambridge University Press, 1983).
Figure 07: Map of Tenochtitlan, printed 1524 in Nuremberg, Germany. Author: Friedrich Peypus (1485–1534), probably after a drawing made by one of Cortes' men. SOURCE: Wikipedia.

Figure 08: General map of Inca Cusco with the Hanan and Hurin sectors. SOURCE: Canziani Amico, José, *Ciudad y territorio en los Andes: contribuciones a la historia del urbanismo prehispánico*, (Lima: Fondo Editorial, Pontificia Universidad Católica del Perú, 2009).
Figure 09: Map of Cempoala, Mexico, from the Relaciones Geográficas collection in the Benson Latin American Collection at the University of Texas at Austin. DATE: November 1st, 1580. SOURCE: Library of Congress.
CASE STUDY II:
Climatic Adaptation and Colonial Appropriation in the Philippines

Can a building section summarize three hundred and fifty years of colonization in the Philippines or encapsulate the transformations it caused for society and the environment? Does this section, which shows a range of influences and construction methods, reflect the accumulation and extraction processes attempted by the Spanish Empire or the lack of regulations about the building environment? Unlike Cartagena in Colombia, where Spanish ordinances shaped the architecture from the first decades of colonization, in the Philippines, architecture underwent a progressive transformation, based on failures and natural disasters, without a legal frame directing it.

In the first century of colonization of the Philippines, the natural environment was incompatible with the architecture of Spanish settlers. Materials, natural events, and climate refused to conform to colonial technology. The resulting houses revealed an unsettling adaptation process achieved through consecutive failures. Their process of transformation was triggered by a slow search for lightness, which was rendered in the main domestic construction of the Philippines, known as bahay na bato (house of stone), Ancestral House, or Casa Mestiza.¹ The few remaining examples of these houses show that colonial domestic constructions lost mass over time to suit the tropical environment. Using several case studies from different towns and islands across the archipelago, one

¹ Fernando Zialcita explained in a personal conversation how the term bahay na bato was decided between him and the editor of the book Phillippine Ancestral Houses, but he believed a better term would be Casa Mestiza since the house constitutes the blend between the different cultures in the archipelago.
can trace a speculative genealogy of the building section of the *bahay na bato*. This
genealogy starts from the Indigenous *bahay kubo* (Nipa Hut) to the prototypical
courtyard house implemented in the first decades of colonization, to finally, the progression of the
*bahay na bato* as a blend between these two techniques, which also incorporated Chinese
labor.

In this unsettling adaptation process, the three players of the colonial realm overcame the
colonial dichotomy between colonizers and Indigenous societies, challenging conceptions
of colonial dualism. In particular, the key role of Chinese laborers complicates the way
we can describe, theorize, and criticize these houses. As art historian Elizabeth Kassler-
Taub states, these are spaces “of methodological friction, where existing interpretive
models limit our ability to describe the connections and disconnections that defined a
global experience of early modernity […] [They] confront our disciplinary discomfort
with places that defy easy categorization.”² In the *bahay na bato*, this methodological
friction confronts a dearth of information about the house before the 19th century. The
lack of archival sources before that time challenges scholars seeking to trace its roots.
Thus, the use of assemblages and multiple narratives, as well as focusing on the
remaining architectural examples, became essential to restoring this fragment of colonial
history.

For this reconstruction, the chapter builds upon the work of Filipino scholars, like the
anthropologist and cultural historian Fernando Zialcita, the historian Resil Mojares,

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architectural historians Erik Akpedonu, Gerard Lico, Luis Merino, and Fatima Nicetas Alonzo, and architects Rino Fernandez and Michael Manalo; and Spanish historians such as Pedro Luengo and Ana Maria Prieto Lucena. The houses analyzed are mainly in Bohol (Clarin Ancestral House), Cebu (Yap-San Diego House, Casa Gorordo, and Jesuit House), Manila (Jose P. Laurel Ancestral House and the documents from the National Archive of the Philippines), Taal (Casa Villavicencio as the main case study, along with the Wedding Gift House), and finally Vigan as a village that produced different building technologies (Villa Angela). By drawing on these scholars and architectural examples, I aim to contribute to a growing body of work tracing the evolution of the bahay na bato in relation to the natural environment and how it affected its hierarchical organizations.

In this chapter, I trace the transformation of colonial architecture in the Philippines using these buildings as material culture. After analyzing the Prehispanic bahay kubo, I describe how the colonization of the archipelago was deeply marked by global trading and the incorporation of non-autochthonous materials, goods, and biota into the natural environment and construction realm simultaneously. Then, I describe the bahay na bato transformation, beginning after the earthquake that destroyed Manila in 1645. I offer a possible genealogy before analyzing the different elements of these new building technologies and how they affected interior colonial life. I continue with the ordinances that in 1880 made this architecture mandatory and analyze the 1890 work of Spanish engineer Rafael Cerero y Sáenz on environmental performance of these turn-of-the-century houses. After examining the environmental conditions of the main case study,  

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3 Secondary houses in Taal were Villa Tortuga, Don Domingo Ylagan and Maria Martinez-Ylagan Ancestral House, Villa Severina, and Casa Punzalan. In Vigan, Quema House, Singson Ancestral House, Syquia Mansion, and Casa Padre Burgos were also studied.
Casa Villavicencio, I conclude the chapter with the architecture of Vigan, a town in the northern part of Luzon Island. These constructions show an opposite approach to architecture, more influenced by Chinese constructions but visually similar to Spanish technologies, which paradoxically also worked to prevent earthquakes and alleviate the tropical climate.

Besides reproducing the configurations of the hierarchical society and concealing the servants of the houses in the worst thermally adapted rooms, bahay na bato also repeated the struggle of Spanish colonization toward the assimilation of climate and natural environment and the failure of its constructions. The unsettling evolution of the bahay na bato took place incrementally, with changes often only occurring after natural disasters destroyed the urban realm. Thus, these houses are paradoxical because they only adapted by extracting the construction knowledge from the oppressed societies. Bahay na bato mirrors the trend of architectural appropriation of the architectural patterns of local populations while maintaining the same societal hierarchical structures rooted in histories of colonialism and classism. The achievement of physical and thermal comfort for some occurs at the expense and knowledge of many others.

Bahay Kubo

Before the Spaniards’ conquest of the Asian archipelago, the settlement where Manila currently sits was occupied by around 2,000 people, a combination of Muslim missionaries and native Tagalog people. It is believed that Rajah Soliman, Sultan of

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Brunei, was the authority of Manila, and trading with Malay, Bornean, Chinese, Japanese, Siamese, Cambodian, and Portuguese was constant. The Manila Bay, a large natural harbor, served as the port for merchants who traded with Malacca (the southern region of the Malay Peninsula), Brunei, the Moluccas, and other ports in Southeast Asia and South China. Tagalogs cultivated wet rice using the slash-and-burn technique, which consisted of cutting and burning patches in the forest and planting for two or three years before moving to another land. This provoked settlements to be dispersed and temporary. To the southeast of Manila, the settlement of Cebu spread linearly along the shore and extended six to eight kilometers on the island with the same name). This town was slightly smaller, and its economy was based on trading, fishing, farming, and craftsmanship (mainly smelting, blacksmithing, pottery, and wearing).

Outside these two main towns, smaller settlements of 100-500, called Barangays, created the forms society organized. Urban geographer Robert Reed describes how decentralization and isolation among towns influenced the settlement patterns: Some villages were parallel to the sea, rivers, and streams; others were clusters of houses in productive lands or defended by hills or headlands. Their homes, constructed with materials from nearby forests, adapted to their ecological context through the use of wood

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6 Reed, *Colonial Manila*, 3.
and bamboo and covered with nipa-palm leaves. The pre-Hispanic architecture of the Philippines, found in Manila, Cebu, and the smaller barangays, is well recorded and still visible in many rural areas of the archipelago. Furthermore, Spanish chroniclers left documentation of their impressions of Indigenous constructions and forms of living during the 17th century. These domestic constructions varied significantly from region to region, but the common feature is light structural and envelope elements.

Starting from the northern point of the Archipelago and the Island of Luzon, in the Apayao province, houses are raised around one meter (3 ft.-3 in.) from the ground floor and sit on logs. The structure continues to the roof, which has an arched form with several layers of thick cogon grass or nipa leaves. The interior space is undivided and enclosed by wooden panels, which can be removed for natural ventilation. The roof extends over these panels to protect the interior from direct sunlight and rain. The access to the main floor is through a ladder leading into a secondary room that is used as a

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9 Reed, Colonial Manila, 9.
10 Antonio de Morga – established in the Philippines between 1595 and 1603 and published Sucesos de las Islas Filipinas in 1609; Francisco Colin – lived in the archipelago from 1626 until he passed away in 1660, and his chronicle Labor Evangelica was published in 1663; and Francisco Ignacio Alcina – writing La Historia de las Islas e Indios Visayas, published in 1668, after the author lived in the Philippines from 1632 until he died in 1674; Prieto Lucena, El Contacto Hispano-Indigena en Filipinas, 268-272.
11 In Batanes, an archipelagic province formed by ten islands 162 kilometers (101 miles) north of the main island of Luzon, some houses have historically been built with stone walls. However, the roof is covered with nipa, supported by cane interwoven strings and a log structure. Batanes, nonetheless, also had a house mainly built with wood and cogon grass, including the roof. More information:
12 For the descriptions of the following pre-Hispanic houses, I am using the present tense since these constructions, including the following explanation of the bahay kubo, still exist and are inhabited in several regions of the Philippines. However, I must mention that this architectural construction has shifted over time, and in some ways, the people inhabited have changed. Nevertheless, since the focus of this thesis is the building technology, and in terms of simplifying the description, I have decided not to clearly make a differentiation between the evolution of the space uses.
kitchen extension. South of the Apayao province, in the central mountain range of Luzon, the predominant domestic constructions are the Bontoc, Ifugao, Sagada, Kankanay, and Ibaloi Houses. Bontoc House is a three-level construction divided by domestic, productive, and storage functions. The envelope of the ground floor is covered by hand-hewn wooden planks laid horizontally, protecting the living space from the outside. All the living and productivity activities happen within this level, including cooking, eating, and sleeping areas on one side and a space for pounding rice with a stone pavement floor on the other. The second and third levels store the grain away from ground dampness and pests.

In the south of the archipelago, Badjao houses are located within water bodies and connected through footbridges and boats in the Zamboanga Peninsula. The structure that elevates the house is made of thick bamboo (buried 0.60 meters under the seabed – 2 ft.) and goes up to the roof to support its ridge beams and the final layer of thatch from palm or coconut leaves. This second space is undivided and usually does not have windows. In the Zamboanga Peninsula and the southern regions of Palawan, Mindanao, and Sulú, Samal, and Tausug constructions are variations of Badjao houses. The Samal house's structural and spatial elements are similar, although the envelope is built with nipa thatch on bamboo or wood purlins. Unlike the Badjao House, these constructions

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13 Fernandez, A visual dictionary on Filipino architecture, 2-4.
14 Bontoc and Sagada are regions of Mountain Province; Ifugao is a province in the Cordillera Administrative Region in Luzon; Kankanay is an ethnic group located in the western part of the Mountain Province and to the east of Ilocos Sur. Ibaloi refers to the ethnic groups located in Itogon, Tuba, La Trinidad, Bokod, Baguio, and Atok, in the province of Benguet.
15 Fernandez, A visual dictionary on Filipino architecture, 10-12.
16 Badjao, also referred to as Bajao or Bajau, refers to an ethnic group found mostly in the Sulu Sea and the Southern Philippines, living the sea and with a sailing-oriented lifestyle.
17 Fernandez, A visual dictionary on Filipino architecture, 5-6.
have windows, and the roof extends over the perimeter to protect it from the sunlight. The Tausug house has a similar configuration, although the walls are bamboo, and the elevated platform extends beyond the roof.\textsuperscript{18}

However, the construction that appears in most environments and islands of the Asian archipelago is the \textit{bahay kubo} (Figure 1).\textsuperscript{19} \textit{Bahay kubo} is also raised on stilts, but its main difference from other pre-Hispanic houses is the enclosure of the space underneath. Called \textit{silong}, it stores harvests, tools, and livestock.\textsuperscript{20} The enclosure of this silong is made of a permeable bamboo screen, which allows the air to flow through and keeps the ventilation constant. On top of the silong, this construction is typically a one-room dwelling with verandas on one or several sides.\textsuperscript{21} The kitchen is usually located at the rear of the house, and there is a table called \textit{Bangahan}, used for drying and storing pots, pans, plates, etc.\textsuperscript{22}

Filipino anthropologist Fernando Zialcita and art historian Martin Tinio explain in the book \textit{Philippine Ancestral Houses} that public and private realms are a continuous whole in the \textit{bahay kubo}. The main space is transformed at night by unrolling mats and spreading pillows on the floors. Children sleep on the same mats with their parents and spreaders.\textsuperscript{18}

\textsuperscript{18} Ibid., 32-34.
\textsuperscript{19} A variation of the \textit{bahay kubo} is the Kalinga House, located on the northern side of Luzon. This is an elevated rectangular one-room house of timber materials, and thick roofing made from 8-10 layers of cut bamboo laid above the other. More information at: Fernandez, \textit{A visual dictionary on Filipino architecture}, 20.
\textsuperscript{20} Fernandez, \textit{A visual dictionary on Filipino architecture}, 8.
\textsuperscript{21} Over time, the Bakay Kubo layout evolved into different rooms, including a \textit{Bulwagan} – an area reserved for entertaining guests; a \textit{Silid} – a private room used for sleeping, and a \textit{Paglutan or gilir} – the kitchen or cooking area within the house. See at Alarcón, Norma, \textit{Philippine architecture during the pre-Spanish and Spanish periods}, (Manila: Santo Tomas University Press, 1991), 29.
\textsuperscript{22} Alarcón, \textit{Philippine architecture during the pre-Spanish and Spanish periods}, 23-32.
grandparents until they get married. The ritual of sharing the same space – one that could transform from an improvised community room to a bedroom – is also the ritual whereby interior and exterior spaces are continuously interconnected.\textsuperscript{23} Instead, the \textit{bahay kubo}'s vertical detachment from the ground separates the public and private realms. When someone is meeting a member of the \textit{bahay kubo}, they must remove their clogs and wash their feet in a basin of water before going up through a bamboo ladder.\textsuperscript{24} The staircase connects the exterior and interior spaces. The air between them physically divides them while letting these houses engage with the existing environment. \textit{Bahay Kubos} were built using resources from the nearby environment and performed according to the local contexts.

\textbf{Air and Shadows}

Excluding the mountain region of Bontoc, where the climate is categorized as Temperate, the rest of the Philippines has a tropical rainforest – Af, and tropical savannah – Aw, according to the Köppen classification. (Figure 2). The archipelago ranges between the 18\textsuperscript{th} and 5\textsuperscript{th} parallel north. Particularly, the city of Manila, located at the latitude line 14th parallel north (14°35'N 120°58'E) and two meters (9 ft) above sea level, has average high and low temperatures of 32°C and 26°C (90°F to 79°F) and relative humidity of 82% in August and 66% in April. (Figure 3).

To adapt to these heat and humidity conditions, the \textit{bahay kubo} uses cross ventilation, convection, insulation, and underlighting as the primary mechanism to alleviate high heat.

\textsuperscript{24} Ibid., 18.
and humidity, as the psychometric chart shows (Figure 3.2).\textsuperscript{25} Houses are usually oriented to the direction of the prevailing wind, fostering cross ventilation throughout the interiors. Furthermore, raising the floor from the ground avoided interruptions in the wind patterns, let the breeze flow underneath the floor (preventing condensation on the interior spaces), and allowed the home to be ventilated through the cracks on the floor.\textsuperscript{26} Regarding convection, the indoor temperature is usually higher than the outdoors, and the stack effect makes the hot air ascend to the double-height space and leave through small openings in the ridge of the roof.\textsuperscript{27} The same roof, made of nipa leaves, is an excellent thermal insulator and protects the interior from the sun’s rays. Nipa leaves are collected from their palms, plait in the form they will use, and dried before they are placed on top of the buildings (Figure 4), improving their performance and life span. The same roof is expanded with large eaves to effectively sunshade the interior, excluding the open skies from the visual field and reducing the glare in the interior, producing a cooling effect on the inhabitants of the space.\textsuperscript{28} Finally, while these houses adapted to the tropical climate, their leading quality was withstanding earthquakes, thanks to the skeletal bamboo frame. The \textit{bahay kubo} minimizes the breakdown between the interior and exterior with thin walls and allows the air to go through while dimming the rooms. These components would later be replicated in colonial architecture through a slow process of assimilation and several trials and errors.

\textsuperscript{25} These strategies are similar to other traditional settlements in Southeast Asia, like the Traditional Malay House; Kamal, Kamarul, Syahril, Lilawati, Wahab, Abdul, and Ahmad, Asmalia Che. “Climatic design of the traditional Malay house to meet the requirements of modern living.” (2014).
\textsuperscript{26} Kamal, Syahril, Wahab, and Ahmad. “Climatic design of the traditional Malay house to meet the requirements of modern living.” 175.
\textsuperscript{28} Kamal, Kamarul Syahril, Lilawati Abdul Wahab and Asmalia Che Ahmad. “Climatic design of the traditional Malay house to meet the requirements of modern living.” (2014), 178.
Conquest

In 1518, fifteen years before Pedro de Heredia conquered the northern coast of Colombia that would become Cartagena (case study I), Ferdinand Magellan and Ruy Falero had already signed an agreement with the Spanish Crown to conquer the Maluku Islands (the Moluccas, and currently part of Indonesia), and Islas del Poniente (West Islands, which became the Philippines). Those two sets of islands were both considered part of the Spanish Empire based on the Treaty of Tordesillas signed with Portugal (Figure 5).

One year later, in 1519, Magellan sailed from Seville to Brazil and the La Plata River in Argentina before rounding the American continent and crossing the Pacific to Asia. He and his crew arrived in the Philippine archipelago on March 16, 1521. During their initial colonization attempt of the Philippines, Magellan died in the Battle of Mactan, where the Kedatuan of Mactan defeated the Spanish forces. After Magellan’s death, Juan Sebastián Elcano, the new leader of the expedition, fled the archipelago and continued the route around the world in the well-known Magellan–Elcano Expedition.

A few decades later, in 1565, conquistador Miguel López de Legazpi, with the help of Fray Andres de Urdaneta, returned to the archipelago. Urdaneta had convinced Luis de Velasco, second Viceroy of New Spain, and Phillip II, king of Spain, that there was an easy route to return from the Asian continent to Mexico using atmosphere patterns and ocean currents. Their expedition departed from New Spain on November 21, 1564, and

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30 The expedition returned to Sanlucar de Barrameda on September 6, 1522.
arrived in Sebu (now known as Cebu) five months later.\footnote{Prieto Lucena, \textit{El Contacto Hispano-Indigena en Filipinas}, 122.} When Legazpi and his army arrived on the shore, they attacked Cebuanos with artillery, making them abandon their homes and run to the mountains. Spaniards then moved to occupy the town and started constructing a wall to protect it from future attacks. Soon, they subjugated the Indigenous population of the whole island of Cebu, making them pay taxes as a sign of servitude, and used the town as a trading port.\footnote{Prieto Lucena, \textit{El Contacto Hispano-Indigena en Filipinas}, 136-37.} The Spanish city was officially founded in May 1565, marked by the construction of a triangular fort and a church. With approximately 400 Spanish settlers, this was the first permanent Hispanic settlement in Southeast Asia and, for the next four years, served as the base of operations of the Spanish Crown in the Philippines.\footnote{Mojares, \textit{Casa Gorordo in Cebu}, 16.} The conquest of Cebu, which became the first port of the Spanish Empire, began an international trading system under their rule that extracted resources from the Americas and Asia.

In 1571, six years after the foundation of Cebu, Legazpi conquered Manila Bay in Luzon Island, 550 kilometers away (350 miles) from the first founded city. There, he founded Manila, which would become a new center of the Spanish Empire in Southeast Asia. Initially, Spanish settlers lived within the new city boundary, and the rest of the subjects, including the inhabitants of the Tagalog Manila, were expelled to the outskirts, to what is now Bagumbayan, Tondo, and Quiapo. These neighborhoods quickly came to house not only the Indigenous population but also Black and mestizo residents, who labored in the plantations of the region.\footnote{Luengo Gutiérrez, Pedro, \textit{Manila, 1645}, (New York: Routledge, Taylor & Francis Group, 2021), 11-12.}
The existing land system surrounding the newly founded Manila let conquistadors exploit agricultural resources—as they had done with most of the territories they conquered in the Americas—by inserting themselves at the top of the social pyramid. The main difference between the Americas and the Philippines in the resettlement of Indigenous people was who led it. While in the American continent, reducciones (reductions) was a joint effort between the church and state, in the Philippines, barangays were compacted by Spanish missionaries only in settlements varying from 2,400 to 5,000 inhabitants.

With this strategy, the church became the main landowner of the archipelago. Before the Spanish conquest, local chiefs had determined the size of the land to be farmed and how to move it; Spaniards introduced private ownership, deeds, tax systems, and sales. As historian Nicholas Cushner described, “The European concept of private ownership of land, in opposition to the pre-Hispanic practice of land use, was a major factor in the dispossession of native Tagalogs of their land.” The Spanish settlers pursued cattle and agriculture, which required extensive grassland and labor, and most of the work was done by Tagalog people. Although slavery was prohibited in 1591, this did not apply to Muslims (either Filipino or not) or those accused of having been captured in wars or not paying tributes. Therefore, evidence shows that labor in those large estates or haciendas was racially divided. While Spaniards and Spanish mestizos occupied the highest

37 Cushner, Landed Estates in the Colonial Philippines, 27.
38 Ibid., 1.
39 Ibid., 2.
hierarchical positions, the land was mainly cultivated by often enslaved or otherwise unfree laborers.\footnote{Ibid., 37, 47}

The urban center of Manila was founded in 1571, two years before the first Laws of the Indies were published, but the influence of American town layouts was repeated in the capital of the Asian archipelago.\footnote{Named Ordenanzas de descubrimientos, nueva población y pacificación de las Indias (Ordinances for discoveries, new settlements, and pacifications).} The location and layout of the Filipino archipelago had many similarities with other Spanish American colonial cities, such as Cartagena. Both cities are located on a large bay with a narrow entrance, on a small island, and have an orthogonal grid protected by a wall (called \textit{Intramuros} in Manila). Art historian Pedro Luego suggests that conquistador Miguel López de Legazpi may have known the outlines of the Laws of the Indies from his prior residence for two decades in Mexico.\footnote{Luengo Gutiérrez, \textit{Manila, 1645}, 35.}

Because most Spanish American towns were founded before the implementation of these laws, the question is if the Manila colonizers had learned from the failures of other Spanish settlements in the Americas concerning the relationship between the natural and urban environments. The response is likely no. Regarding orientation, Manila is aligned with the NW-SE axis, while the main wind patterns are east-west.\footnote{See the wind pattern diagram in Figure 51.} Furthermore, although the Laws of the Indies ordered settlers to find sites in elevated locations, \textit{Intramuros} is barely 3-4 meters (12-15 ft.) above the sea level. The extreme priority placed on selecting sites to avoid attacks and invasions led to a disregard in terms of environmental protection.
Manila Galleon

From an economic perspective, Spaniards considered keeping the Philippines under the Crown's control unsuccessful business. Its distance from Spain and the Americas and the lack of silver or large amounts of gold made it an unpromising colony. However, the Crown finally decided to maintain the archipelago for several reasons. First, the Spanish Empire aimed to enhance the Christianization of Southeast Asia, both within their colonized territories and by sending Catholic missions into China to compete with a growing Islamic presence there. Second, the Philippines had a strategic position in Asia. Given that the Portuguese Empire already had some port cities in nearby locations like Macau and Malacca, the towns of Manila and Cebu helped to protect the Crown's interest. Spaniards also considered the islands strategically positioned to defend the western coasts of the Americas from their enemies. They believed the Philippines could become to Asia what the Caribbean Islands were to the Americas.

Despite ultimately being perceived as an economic failure, the conquest of the Philippine archipelago instantiated an intense trading system between Manila and Acapulco through the Pacific Ocean with the Manila Galleon. Importantly, before the arrival of the Spaniards, the Philippine archipelago was already immersed in a trading network with other Asian regions. As early as the Ming Dynasty (1368-1644), there was an established dong-yang zhen-lu (Eastern Ocean trading route). Between 30 and 40 sampans sailed

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45 The subsoil in the Philippines had gold and steel, among other minerals. However, during the 16th and 17th centuries, there was no large strip mining, and the gold was obtained by Indigenous from river shorelines. At: Prieto Lucena, Ana Maria, *El Contacto Hispano-Indigena en Filipinas*, 222.
46 Prieto Lucena, *El Contacto Hispano-Indigena en Filipinas*, 82-83, 122-123.
from South China through the Sulu Sea (the sea between the Philippines and Indonesia) to Borneo and the Moluccas every year around March, using the northeast ocean currents, and returned in June. Chinese goods included silk, porcelain, pottery, domesticated buffalo, hardware, and farm implements. At the same time, the Philippines exported, among other things, swallows’ nests, tortoise shells, sea cucumbers, sharks’ fins, mother-of-pearl, wax, and gold dust. After the Spanish conquest, while the Crown was still considering abandoning the region, the first settlers emphasized vast natural resources that could be exploited. Chronicles from the 17th century documented how the archipelago, despite being in a hot zone, had mild temperatures and, in some areas, a year-round spring season with crops growing throughout the year.

Based on these conditions, the Spanish Manila Galleon—also known as La Nao de China and Galeón de Acapulco, a series of ships that crossed the Pacific Ocean from Manila to Acapulco twice a year—became a planetary trading project carrying different materials worldwide. Using the ocean currents in the Pacific Ocean previously explored by Urdaneta, from 1565 to 1815, the system shipped from Acapulco to Manila and then to Shanghai and Macau. Porcelain, silk, and ivory were transported from China to the Philippines. To bring these goods, Spaniards relied on the cargo from Chinese sampans in exchange for silver, which was brought from Mexican mines. Honey, pineapple, and fabrics were loaded from the Philippines and returned to the Americas. In parallel to the biota change, the trading network also included slavery. According to Mexican historian José Luis Chong, Portuguese traders captured enslaved people from different parts of

47 The information regarding the trading routes before the arrival of the Spaniards has been collected from the information displayed at the Bahay Tsinoy Museum ('Chinese-Filipino House') in Intramuros, Manila.
Asia, named *indios-chinos*, who were sold in Manila before being sent to Acapulco, mostly as plantation laborers.49

Similar to the architectural constructions, the import and export of plants from Mexico obscured native resources and blurred the limits of what was autochthonous. *Anonas*, *zapotes*, *chirimoyas*, *papayas*, and *guayabas*, among other fruits, were imported from Mexico. Notably, *papaya* quickly spread around the archipelago because ravens ate them without digesting the seeds, and thus distributed them in fields and forests. They multiplied so fast that many Spaniards believed they were native plants of the Philippines.50 The margins between autochthonous and colonial were blurred both in ecology and architecture.

However, the trans-geographical circulation of goods through the Pacific and the South China Sea contrasted with the fierce prohibitions from Spanish institutions that impeded foreigners from accessing Manila Bay to trade.51 The paradox between open market networks and closed physical borders was particularly notorious for the Chinese population. Financially, Chinese peoples and Chinese mestizos with Filipino ancestry (described during the colonial period as *Sangleyes*) became essential players in the economic chain of the archipelago, with an ambiguous situation within the colonial realm.52 They retained their pre-Hispanic networks and settlements in Manila and lived

52 *Sangley* is a term that derives from the word *seng-li* and means merchant.
as intermediaries between the continent and the archipelago. Among other things, they provided the cargo for the Manila Galleon and supplied the city with goods and labor. For Spaniards, the Chinese population was a double-edged sword. On the one hand, they were an essential source of permanent income, paying taxes for the goods they imported, licenses, stores, and even gambling. On the other hand, their population was drastically larger than the Spaniards', which they saw as a threat to the survival of the colonizers, particularly following several revolts during the 17th century. Nevertheless, their importance in the local and global flows was large enough that Spaniards could never seriously consider expelling them from the Philippines. Alternatively, they decided to confine the Chinese populations in the *Pariáns*, a term in Spanish that means market or bazaar.

In Manila, this confinement started in the 16th century, when Governor Gonzalo Ronquillo de Peñalosa ordered the construction of a custom house within *Intramuros* (the Walled City) to assemble the Chinese population in a single building where they had their homes, workshops, and stores. This *Parián* was controlled by the Spanish mayor. After two fires in 1583 and 1588 that burned down the market, followed by a revolt in the 1590s, the governor decided to move the *parian* outside the *Intramuros* on the other side of the river. The location of the *parian* changed a few times during the 18th century. These market buildings or neighborhoods were the point of connection between the

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54 The most important link between the Philippines and Mexico as part of the Viceroyalty of New Spain was the Manila Galleon, a system of trading ships used for more than 250 years between the capital of the Philippines and Acapulco, Mexico.
56 Ibid., 218.
trading routes and the colonial cities in the Philippines. They symbolically became the access and departure point of goods into and from Asia. The Chinese population provided the goods to be transported to the Manila Galleon, as well as the craftsmanship that allowed the transformation of the colonial houses to the development of the *bahay na batos*.

1645

Before the 1645 earthquake that destroyed Manila, its architecture remained similar to that of Spain and other colonial settlements in the Americas. As Luengo pointed out, in the first century of colonization, Manila had stone houses in the Spanish tradition alongside wooden construction using Indigenous techniques, and Spaniards initially rejected any construction type that had Asian patterns. The isolation in architectural constructions reflected the racial segregation of the three groups physically separated in the town: Spaniards were mainly in stone *Intramuros*, together with Indigenous and mestizo populations, who worked for them, while Chinese peoples resided in the *Parians*. In particular, it revealed a clear division between the architecture of the colonizers and those of the native inhabitants.

Within *Intramuros*, prior to the 1645 earthquake, most Spanish houses were either *Casas Principales* (Principal Houses) or *Casas Comúnes* (Common Houses). Principal houses, built by the elites, had two floors and at least one courtyard in the middle, and Common houses, for the middle classes, had only one level and a backyard. These houses were

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58 Ibid., 64, 66-67.
likely similar to those built in the viceroyalty of New Spain with a central courtyard, as
described by the Florentine merchant and writer Francesco Carletti after visiting Manila
in 1596.\textsuperscript{59} Also, from chronicles from the same period, we know that before the 1645
earthquake, Spanish models did not acclimatize well to the Philippines. The writings of
Fray Juan de Medina, a Spanish theologian who lived in the Philippines in the 17\textsuperscript{th}
century, revealed that these houses did not perform as those from Indigenous peoples. In
an excerpt from his manuscript about the history of the San Agustín Order, Medina wrote
the following description:

“At the beginning, [Spaniards] used the style of the [islands’] inhabitants
to build their houses because they were more experienced, and God gave
them better knowledge in the places they were born and raised. The
islands are very humid and if you dig two palms into the soil, can find
water, thus you cannot make caves as in Spain or living on top of it.
Nature give Indians large and strong logs on where they build their houses
raised on the ground. These logs or columns are called \textit{harigues} and […]
become the columns of the buildings where those are built. With these
logs, we have built large houses and churches. […] The walls, called
\textit{dingding}, are made of high-quality wood boards. Indian houses since they
do not have enough wealth are made of cane. The roof is made of palm,
called \textit{nipa}, and instead of nails, the natives use strong ties made of
leathery roots, called \textit{bejuco}. These houses are healthier; Since the islands
are usually hot, the houses remain cooler because the winds cross them

more easily; When Manila had wooden houses, the city was healthier. They are currently made of stone, and it is very rare to see houses not built with these materials. Outside Manila, there are already many houses and churches also built in stone; all things considered, and if we do not look to the financial aspects, there is a necessity to build them this way [in stone] because there are not enough hills [with forests] to provide logs and bring them would cost a lot. Then, Chinese [people] make the construction work in the form they want and paint to their liking.”

Medina’s writing reveals that the history of Spanish architecture in Manila originally followed a similar pattern to that seen in Cartagena and other Spanish-American colonial cities, moving from appropriating Indigenous existing constructions and then transitioning to building with Spanish methods. Nevertheless, the landscape was more

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60 Medina, Fray Juan de, Biblioteca histórica filipina: Historia de los sucesos de la Orden de N. Gran P. S. Agustín de estas Islas Filipinas, desde que se descubrieron y poblaron por los españoles, con las noticias memorables (1630), 125-6. Fernando Zialcita mentions this source in the Philippine Ancestral Houses, (page 27). Original text in Spanish: “A los principios se usó fabricar las casas según la uzanaza de los propios habitadores de ella; porque al fin, son los que de sus costelaciones saben más, como más experimentados, y a quien Dios dio el conocimiento más capaz de las cosas, que en ellas se crían y nacen, para que de ellas se aprovechasen. Las islas son de suyo humidísimas; a dos palmos que se cave, se halla el agua, de modo que humanamente no se pueden hacer cuevas, como en España, ni vivir sobre ella, porque se pelaría uno. Para esto proveyó la madre naturaleza á estos índios de unos maderos tan grandes y dúros, que levantados en tierra, fundan sobre ellos sus casas, altas como braza y media y dos brazas y tres, que en eso no hay tasa. Llámense estos maderos ó columnas harigues, y […] vienen a ser las columnas del edificio y sobre qué se fabican. De este modo de edificar hemos usado todos en estas islas, haciendo casas grandiosas é iglesias de estos maderos […] Las paredes, que llaman ding ding, son de tablas muy buenas. Las de los indios, como no tienen tanto caudal, son de caña. La cubierta es de palma, llamada nipa, y en lugar de clavos usan los naturales unas ataduras fuertes de unas raíces correosas, llamadas bejuco, donde nosotros echamos clavázón. Estas casas así se tienen por más sanas; porque, como las islas son de ordinario calientes, andan con más fresco, que los vientos las bañan con más facilidad; y cuando Manila tenías las casas de madera, era más sana. Ya han dado en labrarlas de piedra: y las casas que no lo son, muy raras. Y por fuera de Manila se van labrado de piedra, y hay ya muchas casas é Iglesias labradas así; y bien mirado, cuando en eso no se mirara al ahorro, al necesidad había de obligar; porque no habría montes que diesen tantas columnas, y el arrastraras había de costar mucho. Así, allegando dinero que á los naturales les es más fácil, llaman chinos, que hacen la obra que quisieren, y como la quieren pintar.
complex in the Philippines when Chinese laborers started to build the urban realm after natural disasters hit colonial cities. They brought their own techniques and had a certain agency in how constructions had to be made. Unlike in Cartagena, colonial architecture in the Philippines cannot be told as a story of erasure since Indigenous and Chinese epistemologies were integrated into the colonial realm. This was a third step into colonial constructions that did not occur in other territories.

Although the Philippines experienced several earthquakes before 1645, this year’s tremor became a turning point. On November 30, the earth shook from Manila to Cagayan and Ilocos Norte with destructive results. In Manila alone, 600 people died, and 3,000 were injured. In addition, churches, palaces, public buildings, and most of the private houses of Intramuros fell. At that time, the town had approximately 3,000 people, so the devastation was significant. For Fernando Zialcita, this event marked the beginning of colonial houses' imitating the Indigenous bahay kubo. This was the third step in the architectural transformation, where colonial houses started to integrate Indigenous structures and Chinese craftsmanship.

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63 Tinio and Zialcita estimate 3,000 people living in the city (Zialcita, Tinio, op. cit., 28); Nevertheless, more precisely, Luengo dates 600 people living in Intramuros in 1636, and 7,350 in 1650 (Luengo Gutiérrez, ops. cit., 42).
On the whole, little information remains about the houses that surged right after the earthquake and in the following centuries until the 1800s. Archives have no documents about this period concerning domestic architecture; most constructions have been demolished or transformed over time, making it difficult to trace the remaining pieces from this period, and no ordinances can provide clues of such transformation. Thus, a speculative genealogy toward lightness is only an attempt at how this architecture may have appeared. The first modifications likely started after the earthquake, as settlers began separating the structure from the façade and using wood logs instead of arches or masonry elements. At the turn of the 18th century, most of the constructions already had the entire upper-level façade built with wood and detached from the first-floor stone wall. It is also at this time that the windows already include *capis* (a translucent element fabricated with a windowpane oyster shell). The final changes were slightly raising the first interior level from the floor, creating an air chamber, and, after the 1863 earthquake, substituting the roof tiles with metal sheets. These changes revealed a process of adaptation to the environment by integrating the technologies provided by the other subjects of the colony.

There is at least one remaining house from the 18th century, where the internal walls of the second floor were built with wood panels and screens, which supports this theory.

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64 Talking with experts in Filipino architectural history, they are unaware of houses dating from the second half of the 16th or the 17th century. The National Archives of the Philippines does not have any collections regarding domestic architecture before the 19th century, and the General Archive of the Indies in Seville does not collect architectural records of this period. The owners of Yap-San Diego Ancestral House, in the Parian district of Cebu, claim the construction was built in the second half of the 17th century. Nevertheless, the architectural historian Fernando Zialcita remains skeptical because it cannot be determined if the project was heavily modified after. The earliest example of domestic construction is the Jesuit House, also in the Chinese neighborhood of Cebu, which dates from 1730. Historians recognize this house as a remarkable case study.
This is the Jesuit House, a construction built in 1730 in the Parian district of Cebu. The Jesuits arrived for the first time in Cebu in 1593 for their mission assignment to the Moluccas. At the beginning of the 18th century, their missionary work in the Eastern Visayas Islands of Leite, Samar, and Mindanao grew, and this house was established as an auxiliary headquarters.65 The Jesuit House shows an intermediate stage of the bahay na bato, a construction where Indigenous and Chinese technologies are hidden in a colonial envelope. Its façade, approximately 90 centimeters thick (3 ft), is composed of two layers of coral masonry blocks and rubble stone in between. The free-standing wall is reinforced with buttresses (figure 6) and separated from the wood internal structure. Built with logs and timber, boards, the columns and beams resemble a bahay kubo. Nevertheless, looking more carefully, Chinese labor is visible in the joints between the vertical and horizontal elements. Dado and mortise-and-tenon joints are designed to minimize the use of nails (Figure 7), and some have Chinese ornamental forms (Figure 8). These columns reach the top of the second level, supporting a tile roof.

The transformation from the architecture of Spain and New Mexico is not only at the structural level. The interior board and batten walls on the second floor incorporate a louver system, letting the air flow between different rooms, but this stops at the exterior boundaries with the masonry façade. (Figure 9). Thus, a heavy envelope with semicircular arches masks a lighter structural system behind it. The house shows an intermediate stage with a light interior and a heavy exterior appearance modeled after the Iberian style – an exterior that, in case of an earthquake, could still collapse inward.

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65 The information on the Jesuit House was collected while visiting the construction site on January 3, 2024. The house was analyzed by the United Architects of the Philippines Sugbu Chapter (UAP-Sugbu) in collaboration with the owner.
Although the Jesuit House is only one example of many others lost over time, it can become a key assemblage to speculate about a possible transformation.

The next evolutionary step to achieve a re-imagined *bahay na bato*—namely, partitioning the entire façade with brick or masonry on the ground floor and timber panels and screens on the second—likely happened shortly after the Jesuit House, possibly at the turn of the 19th century, as some paintings from the period depict (Figure 10). Already from the 19th century onwards, several *bahay na bato* depict the final stage of the houses.

**Colonization within a Building Section**

The building section of the *bahay na bato* encapsulates the complexity of colonization and the different frictions in knowledge, climate adaptation, labor, and social hierarchies. The methodological frictions and the difficult categorization schema that characterize the colonization of the Philippines suddenly become depicted in a two-

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66 Some of these paintings are part of a series called the *Basi Revolt* (Figure 10). In these illustrations, one can see that the second floor has already transitioned into wood, putting the colonial envelopes aside. The *Basi Revolt* began on September 16, 1807, when the Spanish colonial government started to monopolize the manufacture and sale of *basi* (a wine made with sugarcane), effectively banning private businesses of this wine, which also came with the expropriation of the land. The revolt was led by Pedro Mateo and Salarogo Ambaristo and planned in Piddig, Badoc, and other towns of Ilocos Norte (Nort of Luzon). Spanish stopped the revolt on September 28 of the same year with the assassination of the revolt members. The *Basi Revolt*, currently stored in the National Museum of the Philippines – Ilocos, was depicted in 1821 in 14 canvas by the Filipino artist Esteban Villanueva. The author assisted the revolt, but the reasons for making these paintings remain unclear.

67 Although the *bahay na bato* came to define the individual homes of the colonial elite (either Spanish descendants or mestizos), its architecture was, in fact, applied indistinctively to many building types. In the 19th century, we can see that it was not only used in free-standing construction houses but also in individual row houses (Figure 11), collective housing (Figure 12), party halls (Figure 13), and monasteries (Figures 14 and 15). Even if, in some cases, the masonry of the first floor supports the wood structure, in all these projects, we have a light timber frame on top of a heavy colonial podium. There is a transfer of a building section from private houses of the elite to other constructions—public and private, domestic and international. Fernando Zialcita situates Manila as the original site of the *bahay na batos.* (Zialcita, Tinio, *Philippine Ancestral Houses*, 11). However, there is no clear evidence of when and why the construction transformed from individual domestic architecture to institutional buildings. These architectures, excluding monasteries, have disappeared, and the only records are in the National Archives of the Philippines.
The transformation of architecture, in turn, breaks down a sharp dichotomy between colonizers and Indigenous societies. The simple way that the constructions of other parts of the Spanish Empire, such as Cartagena, can be explained in a technology squashing and destroying the other does not work in the East Indies. Nor can this architecture be considered a palimpsest that records the narratives imposed on top of the others, describing several distinct layers of struggles, including racial erasures, to create broad and complex narratives of memory. In the bahay na bato, the masonry colonial wall hides the bahay kubo structural system, but the Chinese systems both craft the prehispanic construction and sit on top of the colonial materials. And the entire structure is then enclosed by a metal sheet roof, representative of an emergent global market.

In domestic architecture, in particular, the multilayer system found in Manila did not challenge the social hierarchies of the interiors. Instead, they were used to reinforce divisions between settlers and servants. Concerning the climatic performance of these houses, each of the elements worked toward the adaptation of a particular room of the house while disregarding another. The environmental adaptability of native building technologies is used by the upper classes (Spaniards, Spanish Creoles, and mestizo elites), while the ill-suitability of the colonial materials and systems is experienced by the servants and animals. The colonial entanglements and inconsistencies regarding climatic adaptation all converge in the bahay na bato. All the different elements described below

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68 Kassler-Taub, "Inconvenient Globalism: Method Making at the Margins of Art History."
reflect these contradictions and hierarchical agencies in the colonial Filipino domestic space.

**Structure, Envelope, and Walls**

The main attribute of the colonial *bahay na bato* is the free-standing wood structure made from logs connected to a stone foundation and isolated from the ground floor envelope (Figure 16). On the second level, the structure has two elements. First, the interior columns of the house continue to support the roof. Second, the structure next to the façade, particularly when it has a cantilever on this upper level, transitions from logs to a timber cage that makes the frame of the envelope (Figures 17 and 18). These conditions show little variation across islands and regions: colonial envelope on the ground floor, Indigenous structure, and Chinese construction system on the second and roof. But paradoxically, the main changes between territories occurred in the ground floor envelope. Unlike the other two systems, which maintained similar materials across the islands, the masonry façade adapted to available resources. Around the town of Cebu, the façade was built with porous coral stone (Figure 19); in Taal and the Province of Cavite, with volcano rocks (Figure 20); and with bricks across different locations like Ilocos Sur and Vigan, and even with wood in some examples of the island of Bohol (Figure 21).70 Usually, these masonry walls hid the structure behind them, masking the technology that made these houses resist earthquakes. From the exterior and ground level, the constructions seemed to blend or hybridize Spanish and Chinese systems. Art historians Carolyn Dean and Dana Leibsohn approach the term hybridity when particular kinds of

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70 In Bohol, Timan House, Clarin Ancestral House, Lagura House, and Bastes House are examples of wood-framed ground floors. Bohol also has examples of houses, such as the Alfonso Castino House and the Cerdan House, where the upper floor is made of wood, but the ground floor is made of bamboo screen.
things and practices that are brought together challenge presumptive norms. The authors divide the term between visible and invisible hybridity. Visible hybridity is conceived as an opposition between colonizing and colonized cultures that confront one another, while invisible hybridity presses different forms of mixing that are less potent and more difficult to trace.\footnote{Dean, Carolyn, Leibsohn, Dana. 2003. "Hybridity and Its Discontents: Considering Visual Culture in Colonial Spanish America." \textit{Colonial Latin American Review, 12:1}, (2003): 5-35. Accessed December 14, 2022. DOI 10.1080/10609160302341, 13.}

In the \textit{bahay na bato}, visible hybridity allows one to easily distinguish the roots of each element from the outside. Nevertheless, the Indigenous knowledge, the use of logs, timber structures, and light roof systems that allow these houses to resist earthquakes and typhoons and adapt to the tropics is, at least, hidden from the outer world. The masonry wall on the first level and the Chinese screens on the second floor prevent us from understanding the structural logic of the \textit{bahay na bato}. In the interior realm, this hidden condition was revealed for a period of time. In the beginning, logs were visible in the rooms, completely independent from the interior divisions. Nonetheless, over time, especially in the 19th century, they started to be encased within partition walls, particularly on the second floor. This encasement also made the structural elements illegible from the interior.

Dean and Leibsohn describe this obscuring process as “invisible hybridity,” where different forms of mixing are difficult to trace.\footnote{Ibid., 15-16.} In the interior spaces, the denial of the Indigenous structural systems may have also put the owners at risk. Not allowing the
different construction systems to move freely would have likely threatened the stability of the house in case of a situation of stress. Moreover, the seamless and smooth interior surfaces would make it difficult for the air to move between rooms. After a process of transformation and blending, by the end of the colonial period, the architecture once again leaned toward maladaptation against the existing environment.

Although Dean and Leibsohn's hypothesis generally works to define the bahay na bato, their theory can also be challenged in some examples across the archipelago. The methodological friction of these colonial constructs possesses different interpretations and contradictions. There are some cases where these houses departed from the structure and envelope described above. One example is the case of Bohol, and specifically the Clarin Ancestral House. Built in the 1840s and partially destroyed because of recent floods (Figure 22), Bohol bahay na bato can barely connect with Spanish colonial architecture. Besides a short podium made of coral stone, the ground floor is made with wood board-and-batten siding and a circular lattice screen that lets the air move through it, in addition to the cracks between the timber. The same wood board system can be seen on the second floor, with more screens on the upper part, having different patterns, and

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73 For instance, in Manila, in several buildings of San Fernando St. in the neighborhood of Quiapo, the ground floor façade is pushed back, creating an open arcade underneath (Figure 21). Exposing the structural system of the bahay na bato in this way replicated the arcade urban pattern of Castilian towns in a cyclical, unsettled condition, in which the colonial ended up prevailing over the other systems. The façade transformation, which reveals the structure behind it, ended up replicating a model from the Castilian models. For examples of arcades in Spanish vernacular architecture, see the different volumes of Arquitectura popular española (Madrid: Aguilar, 1973) by Carlos Flores.

74 Besides the Clarin Ancestral House, Bohol has similar constructions like the Timan House, Lagura House, and Bastes House. In other cases of this island, such as the Alfonso Castino House and the Cerdan House, the upper floor is made of wood, but the ground floor is made of bamboo screen.

75 Architectural historian Erik Akpedonu and Saloma Czarina traces the possible construction date of the house in 1841, and it was the only house in the town of Loay that the American troops did not burn down during the Filipino American War in 1901. See: Akpedonu, Erik; Saloma, Czarina, Casa Boholana: Vintage Houses of Bohol, (Manila: Ateneo de Manila University Press, 2011), 205-6.
allowing ventilation on the upper level, too. And finally, the same wall system occurs on the interior partitions and finishing. The result is architecture in which the colonial influence completely vanished. The only way to trace the influence of colonial architecture was through the building technologies used in other bahay na batos, which came from non-Spanish cultures. In this case, the masonry walls have disappeared, and the construction is still considered an Ancestral House or bahay na bato because of the building technologies used before the arrival of the Spaniards.

Moving from the envelope to the interior walls and exploring further the search for seamless surfaces in the later bahay na batos, in contrast with porosity and fissures that occurred in the 18th century colonial houses and the prehispanic bahay kubo, the tabique pampango can be a relevant source. Tabique pampango refers to a thin wall of interwoven wooden or bamboo stakes finished with a coating of lime plaster. It was developed between the late 17th to mid-19th century and became particularly relevant in the 1800s. The term tabique means “partition wall” in Spanish, and Pampango refers to the region of Pampanga on the north coast of Manila Bay, although this building technology was not specifically used in this part of the Island of Luzon. Tabique pampango was mainly used in churches and resembles other ‘wattle and daub’ construction systems around the world, including Europe, but also to bahareque in the prehispanic Caribbean architecture. Wattle walls, consisting of screens made of rods interlaced with bamboo twigs and branches, were already common in the Southeast Asian archipelago before the arrival of Spaniards (Figure 23). Originally, the daub had been

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76 Regalado Trota, José, “The Search for Tabique Pampango in the Philippines,” Archivo de la Universidad de Santo Tomás.
77 Ibid.
made of different fiber porous materials such as clay and earth. Colonizers introduced lime plaster into the *tabique pampango* as the daub sometime in the late 17th century (Figure 24). The reason lime was used mixed with sand and water instead of mud was that this material better resisted water in a rainy climate. Nevertheless, the erasure of roughness and irregularities in the walls caused by the substitution of materials prevented those from absorbing moisture. Paradoxically, the repetition of a process of maladaptation in the 19th century, when *tabique pampango* reached peak popularity, occurred simultaneously with a better understanding of the differences in the environment and its impact on climate. Nonetheless, architecture continued its task of simplification, removing imperfections in its surfaces.

*Ventanas and Ventanillas*

Visually, the most powerful transformation of the *bahay na bato* in relation to the prototypical colonial house, at least from the exterior, was the different *ventanas*: windows and screen openings in their second-floor façade. Those screens, likely integrated at the turn of the 19th century, in broad strokes, are made of timber frames filled with a *capis* grid; they can open half of the upper floor elevation or fully close it (Figure 25). *Capis* is a translucent natural material that allows natural light to enter the rooms. The *bahay na bato* screen windows appeared across most colonial houses on different islands, even if the structure was not wood. They ranged from two-panel, three-panel, and four-panel windows in most buildings to fourteen-panel and full opening

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78 Ibid. Regalado Trota explains that the daub has three basic materials: binders, aggregates, and reinforcement. While the reinforcement was the bamboo screen, binders could be clay, lime, chalk dust, or limestone dust, and aggregates could be earth, sand, crushed chalk, or crushed stone.

79 See subhead “Contradictions: Vigan—Thicker Walls, Thinner Bricks” where the houses are built with bricks, but they still have screen windows with *capiz* finishing.
of the street façade in the Casa Villavicencio, later introduced in this chapter. This façade system provided a transformative adaptability to different atmospheric and environmental scenarios, converting the main rooms—usually master bedrooms and living rooms—into canopy terraces or completely enclosing them to gloom the interiors. Then, the volada, a cross passage on at least one side of the façade, could either be part of the interior or a balcony by opening and closing the slide windows and/or the doors that connected this space with the rooms (Figure 26).

Capis, called kapis in Tagalog, Laimpirong in Visayan, and Oh Cho Wa in Chinese, is made with Placuna placenta oyster shell. It is believed that the technique came from China, and was already implemented in the Philippines before the Spaniards occupied the archipelago (Figure 27). Portuguese settlers in Macau were also familiar with this technique and used it as a substitute for glass. These shells are found in bays, coves, and estuaries of Philippine rivers, in regions like Ilocos Sur, Negros Occidental, Iloilo, Palawan, and Mandguindanao, as well as in the Gulf of Aden, India, the Malay Peninsula, the southern coasts of China, and the northern coasts of Borneo. Placuna placenta grows in marine environments with saline water and reproduces sexually by external fertilization. Fishers collect them, and after being dried, they are processed in a two-step process: first, they are sorted and cleaned, and then cut in a square shape, around

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80 The information regarding the capis was mainly obtained by the exhibition of this material at Gallery XX of the National Museum of the Philippines in Manila. The exhibition uses different sources and references, including primary sources such as Report on Proposed Improvements at Manila by Daniel Burnham (Washington: Government Printing Office, 1906) and Biblioteca Historica Filipina. Historia General Sacro-Profana, Política y Natural de las Islas del Poniente Llamadas Filipinas by Juan Jose Delgado (Manila, 1892); scientific papers like “Exploitation of the Window-panel Shell Placuna placenta in the Philippines,” published at Biological Conservation by Wenresti Gallardo (Great Britain: Elsevier Science Limited, 1995) and “A Study on the Biology and Ecology of Placuna placenta Linne,” published at Natural and Applied Science Bulletin 31(3-4) (1979); and newspapers and magazines from The Manila Times and Philippine Magazine.
6x6 centimeters (2¼ x 2¼ in.), to be used in different craft products like lamps and shades, and the windows of ecclesiastical and private buildings (Figures 28 and 29). The final effect of the *capis* was diffusing the exterior light without blocking it and creating a dim space without completely blocking the natural light (Figure 25).

Besides the metamorphic *capis ventanas*, a supplementary opening, called *ventanillas*, or little windows, allowed further flexibility of the façade. Those are second sliding opaque panels at the bottom of main windows and are usually protected by an iron or wood balustrade. *Ventanillas* provide a further opening system to increase the ventilation of the façade. The final result of *ventanas*, *ventanillas*, and *capis* translucent panels is the imitation of the atmospheric airy and shadow interiors of the *bahay kubo*. While the structure made of logs replicated indigenous knowledge to adapt to earthquakes, Chinese building technologies reproduced prehispanic interior conditions through lightness. The *bahay na bato* substituted the Mediterranean courtyard for an ambivalent space, which could include the *volada*, to either embrace exterior environmental conditions or protect the inhabitants from them.

**Roof, Ceilings, and Batalan**

A third element is the composite construction that arranges the roof system of the *bahay na bato*. This system was formed by the roof materials, the false ceiling, and the structural beams or trusses between these two. As mentioned, the exterior layer was initially built with fired roof tiles but was changed to metal sheets after the earthquake of 1863 (Figures 30 and 31). Fire tiles had high thermal insulation with a temperature
oscillation between two to three Celsius degrees (1.8 to 3.6°F). Even if they likely performed worse than the nipa hut roof, fire tiles provided better insulation than metal sheets, which could have an oscillation of more than 10 Celsius degrees (18 °F).\(^8^1\) Nevertheless, the fear of earthquakes provoked this last transformation in the *bahay na bato*: tiles were banned in 1880, and metal sheets became the main roof material, even during the American colonial period, from 1898 to 1946. Metal sheets likely came from France in an early industrial global material market, as some archival evidence has recently demonstrated.\(^8^2\) Thus, in the case of the roof, the search for lightness also returned to a maladapted architecture.

Ironically, the ceiling construction system developed in Filipino domestic architecture revealed an opposite process with the same effect. Originally, *bahay na bato* ceilings were made of timber boards, approximately 15 cm. wide (6 in. – Figure 31), or *plafon*, a wicker screen subdivided into rectangular panels (Figures 32 and 33).\(^8^3\) In both cases, but particularly with the *saquizane*, the materials were light and easy to fabricate, and the cracks and screens let the hot air go through during the convection process, cooling the interior spaces. Nevertheless, in some examples of the second half of the 19\(^{th}\) century, the wood and *plafon* were substituted by smooth plaster ceilings, impeding the hot air from

\(^{8^1}\) See Figure 40 and subhead “1890,” where a diagram made in the second half of the 19th century describes the different temperature oscillations of the materials used in the *bahay na bato* at that time. Further studies should be developed for the nipa hut temperature oscillations, which will always depend on the qualities of the nipa as well as the thickness of the roof materials.

\(^{8^2}\) In a conversation with Michael Manalo, architect specialized in the conservation of the built environment and member of ICOMOS Philippines since 2008, he mentioned this information. Particularly, his team found sheets material documents in the renovation of a lighthouse in Luzon.

\(^{8^3}\) *Plafon* is also called *saquizane*. Both names were mentioned by Fernando Zialcita in a phone conversation, after finding this material in the Yap-San Diego Heritage House.
moving within the false ceiling and reducing the height of the room from an environmental perspective to this flat surface.

Besides the composite of the roof, the *Batalan*, a back porch that served as a cleaning or washing area or even a bathroom, played an important role on the second floor of the *bahay na bato*. This space was connected to the kitchen. Originally, it was built with timber as a light structure with wood slats on the floor and attached to the main as a cantilever. Nevertheless, over time, particularly in larger houses, it became a permanent structure built with the same materials as the first-floor envelope (Figure 34). In the domestic Filipino house, the patio was exchanged for a transformable façade, and the backyard was replaced by the *Batalan*.

**Interior**

While the different building technologies provided mechanisms for adapting to and maladapting to the tropics, the interior spatial configuration of the *bahay na bato* also played a role in the environmental performance of the domestic interiors. Even if they had particular functions for each space, a certain degree of ambiguity, especially on the second floor and for the owners of these houses, allowed different uses for each room.

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84 The description was found at Luego, *Manila 1645*, 84; and belongs to Maria Cristina Valera Turalba *Philippine Heritage Architecture before 1521 to the 1970s* (Pasig City: Anvil, 2005).
Most of the colonial houses in the Philippines had two levels. The main entrance was on the ground floor through a zaguan, similar to those in Spain and other colonies. The zaguan was connected to the main staircase of the second floor. However, guests had to wait in a waiting area before they were allowed access to the main floor. This waiting area could be open as in Casa Gorordo (Cebu, 1850s), or an independent room, visually connected to the door and the staircase through screens as in Wedding Gift House (Taal, 1870s —Figures 35 and 36). This staircase leads into a caida, a second lobby on the upper floor. Usually, the second-floor bahay na batos had a similar configuration with minor variations: The caida, connected to the staircase, is in the center of the layout. On one side, the kitchen with the azotea attached to it, and sometimes a dining area. On the other side, a living room connects to a bedroom and the volada. And a second bedroom behind the staircase. Second-floor layouts do not have corridors or galleries, as the circulation around the patio has been eliminated. All rooms are adjacent, connected with doors, which have a screen on top of them to let the air circulate even when those are closed. However, on some occasions, the walls are substituted by callados, a lattice framework with natural forms that subtly mark off areas that certain guests cannot access. It is a subtle demarcation between the semipublic rooms for meetings and the private

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85 As further explained in Case Study I, a zaguan is a covered space next to the main entrance that provides access to the house's staircase and other private spaces. It works as a threshold between the street and the home.
86 The term Caida derives from the way women grabbed their skirts when they went up the stairs. Once they reached the second floor, they let the skirt drop (caer) to the floor.
87 This configuration responded to many houses around Manila and its surroundings, including Balagtas and Taal. The remaining houses in Cebu, Yap-San Diego, and Jesuit houses have a similar configuration, but Casa Gorordo has a larger configuration. Nevertheless, the basic division of the house with the staircase in the center, living area on one side, and cooking and dining on the other also remain in this construction. In Manila, the drawings from the National Archive of the Philippines show a similar configuration, sometimes with one bedroom only. A built example, the Josep P. Laurel Ancestral House has a similar configuration, although the living room is larger, and the secondary bedroom is on the side of the kitchen. Houses in Vigan, as will be explained at the end of the chapter, have different configurations and did not strictly follow the layouts of other towns in the archipelago.
space (Figure 37),\textsuperscript{88} as this configuration was used to differentiate the space inhabited by the owners of these houses. A good example of this can be seen in the chronicles by English engineer Frederick Sawyer. He depicted the interior conditions of the bahay na bato in 1900 and how the house was inhabited:

You will have noticed that the natives universally build their houses upon piles. So do the Malays all over the Far East. This is the expression of centuries, and you will be wise to conform to it by never sleeping on the ground floor [...] It is essential to live in a good-sized house, so as to escape the heat by moving to a different part as the sun goes round. Thus you will have your early breakfast in one corner of the balcony; your tiffin, perhaps, on the ground floor; your tea in the open corridor looking on the garden, and your dinner, at 7:30 P.M., in the dining-room under the punkah [...] The furnishing of a tropical house is much simplified because no carpets or curtains are needed. The floors are of polished hardwood, and they take a good deal of work to keep them in good order. A few rugs can be put down here and there, if a little colour is required. Where the floor is bad, Chinese matting can be laid down at small expense. Some of the Mestizos import costly furniture, but few of the European residents attempted to follow their example. Vienna bent-wood furniture, with cane seats, was commonly used, and was very suitable, also bamboo or rattan furniture, brought from China or made in the country.\textsuperscript{89}

\textsuperscript{88} Information provided at Casa Gorordo in Cebu.
\textsuperscript{89} Sawyer, Frederic Henry Read, \textit{The inhabitants of the Philippines}, (New York: Scribner, 1900), 176-7.
The elite that enjoyed the mixed technologies adapted to the tropics in the light side of the houses were so-called *ilustrados*. It was formed by Spanish settlers, the *principia*, landowners and merchants, wealthy shipowners, powerful elite mestizos, and clergymen. On the other hand, the servants occupied the rooms enclosed by heavy materials on the lower floor and around the kitchen. Relatively little is known about how the way the ground worked was used. Besides the waiting area adjacent to the *zaguan*, the rest of the level was used for parking the carriages and storing the crops, probably in the front, and the bedrooms of the servants in the back, sometimes connected to the kitchen by an additional staircase. The lightness and transformative interior walls and enclosure disappeared in those spaces. Instead, the closeness to the humid ground floor and the heat stored in the brick and masonry walls sabotaged the thermal conditions of these domestic spaces. Sometimes, as shown in *Casa Gorordo*, the stone walls were extended to the service areas of the second floor, clearly demarcating the improved interiors for the owners from the unsuitable spaces of the servants. With this social organization within the interior of the house, there was a full reverse of where the building technologies came from and who used them. The hierarchical reinforcement worked when the owners of the house extracted and enjoyed the building technologies from their servants. What the *bahay na bato* section did was to render the social and environmental dynamics of Spanish colonization in the Philippines.

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91 The term *principia* refers to the ruling class and nobility in Spanish pueblos of the Philippines. It was formed by the governor or town mayor, the justice court, and the head of the *barangay*.
92 This information is based on the visit of Casa Gorordo and other houses in Taal and Vigan, and from the records of Manila houses in the 19th century.
The transformation of the bahay na bato was frozen in 1880, less than two decades before Spain lost the archipelago to the United States. On July 16 of that year, another earthquake shook the island of Luzon, destroying many buildings in Manila, Cavite, Bulacan, La Laguna, Pampanga, and Nueva Ecija. As the reviews of the earthquake in El Diario de Manila described, many clerical buildings within Intramuros suffered severe damage, including the Monastery of San Agustin, the Tower of the Cathedral, the church of Recoletos, and the Lantern Tower of the Church of San Francisco. Many private houses in the walled city also endured various levels of damage, although human losses were higher in the Indigenous and Chinese populations who lived outside the center of the town. The population in Manila sought shelter in the nearby villages, and the nipa houses were in high demand for city residents to spend the night. As the local journals described: “Although [families] lived in palaces, they gratefully accepted and recognized the hut of the Indian.” Even though colonial houses were adapted to the earthquake movements, nipa huts still had more robust resistance because of their wood structure and the roof's lightness that prevented them from falling.

Local authorities responded by distributing a circular law on 18 August 1880, intended to prevent destruction in future earthquakes and describing how houses had to be built. These ordinances codified the existing architecture that had been evolving over centuries.

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94 Ibid., 26.
95 In Spanish, “aunque (estas familias) vivieran en palacios, aceptan con gratitud y reconomiento la humilde choza del indio.” At: Los Terremotos en Filipinas en julio de 1880, 4, 15-16, 18, 20-21.
Unlike Cartagena, where the set of laws came first, and the architecture followed then, the ordinances rendered the outcome of the colonial period in the Philippines. Architectural trial and error came first, and ordinances later.

All construction in public buildings (new constructions or reparations) was mandated to follow the new regulations, get approved by local authorities before starting construction, and be examined by a representative of the Inspector General of Public Works before being put into service.\textsuperscript{97} The same inspection had to occur in houses, but only in Manila, and any owner who occupied or rented a building without passing the inspection would receive a fine.\textsuperscript{98} While the first part of the laws focused on the quality control and submission regulations of buildings, the second one described how public and private buildings had to be constructed. Those ordinances were extremely precise in the required construction systems and the dimensions of some of the elements. Starting with the foundations, the 1880 circular requested that the weight of the buildings be carefully considered to prevent displacements caused by earthquake vibrations. If the ground was spongy or had any unstable surface, the foundation should include strengthening measures and specifications for the piles, planks, and more. Finally, the foundations should be water-resistant with proper mortar. The ordinance recommended using concrete (a rising material in the architectural industry in the 19th century). However, volcanic rock was allowed if “trimmed and set in cross-bonded horizontal rows, with the thickness of the blocks, in its upright position aligned with the wall axis, not jutting out

\textsuperscript{97} Ibid., Decrees 1 to 5: Lico, 88-89.
\textsuperscript{98} Ibid., Decrees 7-8, 89.
from the broad outlines of the walls.°° Regarding the walls, in private buildings, the circular restrained the height of stone walls to the lower floors, which could include the mezzanine (figure 38).°° Furthermore, masonry walls were limited to no more than twice their height without any specific reinforcements, and the thickness of these walls had to be at least one-fifth its height. The ordinance also described that masonry with the greatest number of joints and uniformity had better resistance to earthquakes and required using concrete blocks, bricks, cut stone reinforced with brick, cut stone, and coursed stone/stonework.°°

Regarding the structural element, vertical trusses could be either made of wood or iron, but those had to be triangulated (Figure 39).°° These trusses had to rest on the ground floor posts, which could not be embedded or attached to the walls. The space between the masonry/brick wall and the carpentry could never be less than ten centimeters. This structure skeleton had to be protected by a gallery or sheaths from the exterior and interior. Finally, galleries and balconies had to be strong, light, and well-connected to the main structure.°°

°° Ibid., Decrees 2 to 6 from “The main regulations apply to public and private buildings to be constructed or repaired in the Philippine islands,” 90.
°° Figure 38 shows a residential project in Binondo, Manila, issued to the municipality. This house had a second floor, considered a mezzanine, and was designed with stone.
°° Lico, Regulating colonial spaces. Decrees 7 to 12 from “The main regulations that apply to public and private buildings to be constructed or repaired in the Philippine islands”: 91.
°° Figure 39, a project issued in Azcarraga Street, Manila, in April 1883, shows the internal structure or trusses of the wood walls and their triangulations.
°° Lico, Regulating colonial spaces. Decrees 19 to 22 from “The main regulations that apply to public and private buildings to be constructed or repaired in the Philippine islands,” 92. More information about the structural elements in the ordinances 28-34.
The ordinance made a note to describe an essential feature of the *bahay na bato*: the constructions had to avoid “as much as possible the use of mixed materials, since the different elasticity of its components (caused) the deterioration of different parts and partial damage to the rigid portions of the construction.”\(^\text{104}\) Avoiding mixing materials had been essential for the environmental performance of the *bahay na bato* building technology because it allowed each element to move freely in case of an earthquake, avoiding collapsing one after the other and creating cracks and gaps to let the airflow between the different materials. Regarding the interior of these houses, the 1880 circular forbade the use of bricks or *pampangos* for the interior walls. Instead, those had to be made of iron sheets or boards. Following the same logic of splitting the different materials and building systems, wooden floorboards could not rest within the masonry walls but in the internal wood (*molave* tree) structure.\(^\text{105}\) The last element of the *bahay na bato* building codes was the roof. They ordered that “galvanized iron, zinc or tin roofing may be used in private buildings or any other non-combustible material of similar weight.”\(^\text{106}\) Because the metal roofing could overheat the interiors, the roofs should have vents to let the hot air flow through the building.\(^\text{107}\) On the other hand, ordinary roof tiles, presumably made of fire clay, could only be used in detached single-floor structures with particular limitations.\(^\text{108}\)

\(^{104}\) Ibid. Decree 24 from “The main regulations apply to public and private buildings to be constructed or repaired in the Philippine islands,” 92.

\(^{105}\) Ibid., Decrees 26-27 from “The main regulations that apply to public and private buildings to be constructed or repaired in the Philippine islands,” 92-93.

\(^{106}\) Ibid. Decree 35 from “The main regulations apply to public and private buildings to be constructed or repaired in the Philippine islands,” 93.

\(^{107}\) Ibid. Decree 41 from “The main regulations that apply to public and private buildings to be constructed or repaired in the Philippine islands,” 94.

\(^{108}\) Ibid. Decree 36 from “The main regulations apply to public and private buildings to be constructed or repaired in the Philippine islands.” These limitations included a particular inspection that could show that
The institutionalization of the *bahay na bato* in 1880 marked the completion of its transformation. The last change in this type of construction was the recommendation to introduce concrete for the foundations and metal for the roofs. Paradoxically, the abrupt freeze in the architectural evolution, with its input from various societies, occurred in parallel with the Philippine economy opening to the world. The Spanish Crown's strict control of the trading economy was about to end. The Manila Galleon shut down in 1815 after the loss of the Spanish American colonies, and the Royal Company of the Philippines (Real Compañía de Filipinas), created under the framework of the Bourbon Reforms in 1785 to promote the Philippines’s productive economy and intra-Asian trade, was ceased just 19 years later. The Philippines was entering a global market with fewer restrictions than in the past 300 years, and the domestic architecture would start losing the last features of its Indigenous architecture. Concrete and iron became affordable construction materials, parts of the global supply chains, and were about to substitute stone, timber, and tiles. If Indigenous Filipino and Chinese technologies endured the imposition of Spanish colonization, new global trends started to impose a new and challenging construction logic.

1890

As an epilogue of the *bahay na bato*’s unsettling transformation, the 1890 analysis by Rafael Cerero y Sáenz quantitively studied the environmental performance of the

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codification produced in 1880 concerning these houses.\textsuperscript{110} Born in Cadiz, Cerero was a general and civil engineer of the Royal Military Brigade, who, before traveling to Manila, had worked in developing the overhead cables of the railway system in Cuba.\textsuperscript{111} His work about the constructions in the Philippines was titled \textit{Analysis of the Resistance of Buildings to Hurricanes and Earthquakes} (\textit{Estudio sobre la Resistencia de los Edificios Sometidos a Huracanes y Terremotos}). He used the information from the newly built Manila Observatory to analyze the strength of colonial buildings to hurricanes and earthquakes and the demands of the tropical climate in these structures.\textsuperscript{112} The construction of East Asian observatories coincided with the global growth of scientific activity. Thus, the data collected locally in each observatory was exchanged and studied with the information provided by many other stations worldwide.\textsuperscript{113} Like biota, goods and building technologies were exchanged from different continents from the beginning of colonization, and the 19th-century consolidation of climate data transfer was the next step in globalization.

\textsuperscript{110} A few decades earlier, in 1852, Scottish merchant and engineer Robert MacMicking, who visited Manila, had already described how these houses responded to earthquakes. Nonetheless, Cerero not only described these constructions but also provided formulas to design and calculate them under different parameters.

\textsuperscript{111} Cerezo y Sáenz, Rafael. \textit{Estudio sobre la Resistencia de los Edificios Sometidos a Huracanes y Terremotos}, (Centro de Estudios y Experimentación de Obras Públicas, 1992), VIII.


\textsuperscript{113} Cerero y Sáenz described this scientific approach by describing how, first, the studies are made in an observatory located in a specific town over a number of years with the required equipment. After this data has been analyzed and classified, scientists can learn about the climate conditions of a particular town or region. For the second part of the work, it is necessary to have a large number of observatories distributed in a region and interconnected so that the information can be gathered simultaneously. This second part of the study allowed scientists to understand general patterns of climate circulation. At: Cerezo y Sáenz, \textit{Estudio sobre la Resistencia de los Edificios Sometidos a Huracanes y Terremotos}, 6.
Cerero started his research by examining which materials should be used in Filipino construction roofs. He investigated three of those already common in the urban landscape: ordinary clay tile, flat clay tile, and metal sheet.\textsuperscript{114} His analysis considered three aspects: lightweight (considering the forces that occurred during earthquakes and the collapse of the roof structure is related to the weight of the material they support); waterproofing (considering the heavy rains at some times of the year); and poor heat transfer (avoid an excess of heating in the upper floor).\textsuperscript{115} Concerning the weight of the tiles, Cerero showed in a chart that the ordinary tile was much heavier than the other two, but the flat tile did not have a substantial weight increase compared to the metal sheet.\textsuperscript{116} The engineer also described how the tiles could create leaks in the interior rooms after eight to ten days of heavy rains since the water could “pass through the clay […] even if those have been carefully fabricated.” Nevertheless, he explains that it “could be easily amended by enameling or glazing as they are fabricated in Europe.”\textsuperscript{117}

Still, the more remarkable work by Cerero concerning the roof materials was the test carried out in the Manila Observatory that depicted how they reacted to the sun over an entire day. In a chart provided by the engineer (Figure 40), one can see how a masonry building with an ordinary tile had the most minor temperature change during the entire day and never reached 30°C (86°F). On the contrary, the wood building with metal sheets had a much higher temperature difference, with a maximum temperature of 34°C (93°F)

\textsuperscript{114} Ibid. \textit{Capítulo 1: Resistencia y Estabilidad de los edificios sometidos a los esfuerzos que se desarrollan en los hurcanas y terremotos}; 13-19.
\textsuperscript{115} Ibid., 14.
\textsuperscript{116} Ibid. Ordinary tile (\textit{Teja Ordinaria}: 230 kg/sqm. roof material + 60 kg/sqm substructure + 55 kg/sqm additional load); Flat tile (\textit{Teja Plana}: 45 kg/sqm. roof material + 50 kg/sqm substructure + 55 kg/sqm additional load); and Metal sheet (\textit{Plancha Metalica}: 20 kg/sqm. roof material + 40 kg/sqm substructure + 55 kg/sqm additional load), 14.
\textsuperscript{117} Ibid., 15.
at 2 PM and 24°C (75°F) at 5 AM. The first chapter of this analysis concluded with Cerero promoting using flat tiles instead of regular ones or metal sheets since those were the most effective building technologies to protect against heat, rain, and earthquakes.\textsuperscript{118} To avoid movements in earthquakes, he proposed to nail them to the wood substructure with cramps (Figure 41). The contradiction in Cerero, an engineer from the Royal Military Brigade, promoting a construction system banned ten years before by an official ordinance suggested that trial and error in Filipino constructions continued even after the laws had already frozen them. Unlike the case of Cartagena, where architecture did not experience any substantial transformation in centuries, the construction systems in the archipelago kept evolving.

Chapters II and III focused on studies about hurricanes and earthquakes and how they affected different types of buildings.\textsuperscript{119} Regarding hurricanes, Cerero explained how buildings are exposed to horizontal loads whose maximum effects correspond when the wind direction runs perpendicular to its long side.\textsuperscript{120} He stated that well-built masonry buildings have enough strength to resist hurricanes, but wood structures require lateral reinforcement structures and deep foundations in stone to avoid collapse.\textsuperscript{121} The chapter about earthquakes started by discussing the work, \textit{The First Principles of Observational Seismology, London 1862}, developed by Sir Robert Mallot, which described the earthquake of Napoli. In this study, Mallot's four different zones of destruction ranged from total devastation to light damage, such as cracks in the façade, and how they related

\textsuperscript{118} Ibid., 19.
\textsuperscript{119} Ibid., \textit{Capítulo 2: Huracanas}; 21-31; and \textit{Capítulo 3: Terremotos}; 33-44.
\textsuperscript{120} Ibid. The engineer describes the horizontal load is up to 250 kgm/ sqm., 22
\textsuperscript{121} Ibid., 22-24.
to the isoseismal maps, which described the intensity of earthquakes.\textsuperscript{122} Second, he described the movement of the earthquake in Manila in 1880 using the pendulum seismometers of the Manila observatory (Figure 42). Then, Cerero went deeper into construction behavior to earth vibration, particularly the material tension loads: While masonry buildings (cales gruesas) do not resist it, and the adhesiveness between stones is very low, wood and steel perform in the opposite form. Moreover, reducing the height of the building and the weight of the roof also helped to increase their strength. However, the research also described how the new cement mortars could resist horizontal loads if the roofs were lightweight. The same type of resistance was achieved in Manila buildings with mortars fabricated with volcanic rocks. The tolerance to earthquakes was thanks to the pozzolan-lime mortar (a broad class of siliceous and aluminous material with a volcano origin). Thus, for Cerero, the destruction of the earthquakes in Manila was not just caused by the construction types but also the poor construction execution and the lack of maintenance in many buildings.\textsuperscript{123}

Nonetheless, the most revealing part of his book is the last chapter, where he investigates the performance of different materials and structural systems to the previously mentioned natural forces.\textsuperscript{124} Focusing on the buildings with stone on the ground floor and wood on the second level, Cerero made a division between two building types, even if it is not visually visible from the outside. This variation relied on how each structural system related to the other one. In the first case, the wood structure sat directly on the masonry walls (Figure 43). In this type, Cerero explained how both elements have different

\textsuperscript{122} Ibid., 35.
\textsuperscript{123} Ibid., 41.
\textsuperscript{124} Ibid., \textit{Cápítulo IV: Cálculos de Resistencia}; 45-76.
densities, and the movement of an earthquake would create a lack of synchronism between them, moving at different speeds and enhancing the collapse of the building (Figure 44).\textsuperscript{125} In the second case described, the \textit{bahay na bato}, the performance of the building technology is different. Cerero explains that “there is a construction system used in Manila residential buildings from a long time ago, as the most suited to resist earthquakes, and which already recommended by the Engineers of the Army in their report of 1863 […] This system consists on having a structural frame to support the roof of the building that may have two floors, and it is enclosed by a masonry wall, which only has one level and a thickness from 80 to 90 centimeters (2.5-3 ft.) and a distance between the structure and the wall of 15 to 20 centimeters (6-8 inches). Finally, “there is a horizontal structure one meter above the ground floor (3 ft.) that rests on a strut,” and “on the upper floor a parallel horizontal frame is similar to the one on the ground floor, but the joists extend beyond the exterior wall 0.50 to 1 meter (1.5-3 ft.) to create a cantilever corridor […] which surrounds the entire building. On the edges of the joists, connected with a beam, there is a very light timber continuous enclosure with large openings made of two layers of sliding doors. The first is a blind system, and the second imitates glass with small shells six centimeters wide (2 ¼ inches). In some buildings, a second timber wall is on top of the masonry wall and next to the wood posts, creating a corridor around the house's rooms. In other cases, this wall is eliminated to increase the dimensions of the bedrooms located on the main level. (Figure 45).”\textsuperscript{126}

\textsuperscript{125} Ibid., 57.
\textsuperscript{126} On June 3, 1863, an earthquake destroyed much of Manila, including the cathedral. The quote is found at Cerezo y Sáenz, Rafael. \textit{Estudio sobre la Resistencia de los Edificios Sometidos a Huracanes y Terremotos}, 59.
Cerero made a precise description of the *bahay na bato* to continue expressing that “this system is the best proposal to the date for the constructions exposed to the earthquakes. Compared to the two-floor masonry buildings, the problem of thick walls and the necessity to use cement disappeared, limiting the cost of building. (The *bahay na bato*) reconciled strength and economy.”127 A series of calculations supported this statement. Pages and pages of formulas to describe the adaptation of the *bahay kubo* to earthquakes, enclosed by a colonial podium. If the Laws of 1880 legalized architecture, Cerero depicted its performance. Precolonial building technologies were not only absorbed by the Spanish Imperial project but also codified and abstracted to be used as a formula—a similar formula employed to repeat the same construction over and over in different contexts. The lack of regulations that achieved the development of a colonial construction based on Indigenous and Chinese epistemologies over two hundred years was suddenly codified – as it had happened before, over and over, in many other overseas territories.

**Case Study: Casa Villavicencio**

There are no domestic constructions in *Intramuros* Manila from the Spanish colonial period. The remaining *bahay na bato* houses in the capital are not easily accessible, were built after Spain ceded the archipelago to the United States, or are in a semi-abandoned stage. Thus, the main case study of this chapter is Casa Villavicencio in Taal, a town that keeps many colonial constructions maintained by private owners in a stage that does not differ from the 19th century.

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127 Ibid., 60.
Taal, located 80 kilometers from Manila (50 miles), was founded by Fr. Agustin de Albuquerque in 1572. During the early years, Taal was located next to Lawa ng Taal Lake, today considered Old Taal. In 1578, a system of encomiendas was established in the region, granting power and land to local nobility and forcing the Indigenous population to work in an enslavement regime. At various points from the 16th to the 18th century, Taal served as the capital of the region of Batangas. In 1749, the violent eruption of the nearby volcano destroyed the town, prompting its transference to its current location in 1754 (Figure 46). Finally, an earthquake in 1849 hit the town again with more destruction. Nevertheless, Taal's Spanish colonial buildings resisted the destruction during American colonization and World War II, and the town maintains many bahay na batos from the 19th century (Figure 47).

Two of these houses are Casa Villavicencio and the Wedding Gift House, located in the same complex (13°52'49.2"N 120°55'16.6"E—Figure 48). The former was built before 1850 and owned by Eulalio Villavicencio, a wealthy shipowner born in 1842. In 1871, he married Gliceria Legaspi Marella, the granddaughter of Sebastian Marella, the wealthiest man in the region of Batangas. As a gift to his new wife, he built a second house in the garden, the Wedding Gift House, which was connected to the main construction through a bridge which no longer exists. The marriage combined a successful empire of tobacco, rice, and sugar plantations in the region with a steamship business system, which

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delivered the crops to Manila.\textsuperscript{130} Moreover, in the second half of the 19\textsuperscript{th} century, during the Propaganda Movement to achieve independence and the revolutionary forces against Spain, the houses played an important role.\textsuperscript{131} Insurgents hid on the ground floor, which also hosted revolutionary meetings. Because of his insurgence role, Eulalio Villavicencio was arrested, tortured, and imprisoned by the Spanish authorities in 1897. Although he was released a year later, his health deteriorated, and he ended up dying the same year.\textsuperscript{132}

Both houses have similar layout configurations and structural systems, although the Wedding Gift House is missing the front façade \textit{volada}. However, because \textit{Casa Villavicencio} is older, it offers an ideal case study to examine its environmental and thermal conditions. Although the town of Taal follows an orthogonal urban grid (Figure 47), unlike what happened in Cartagena, the houses are free-standing and have windows on the four facades (Figure 49). \textit{Casa Villavicencio} is a 25 m. long by 12 m. wide construction (82 ft. by 39 ft.), located on the corner of a lot and surrounded by spacious gardens on both sides (the Wedding Gift House is located in one of these gardens). The house has a straightforward layout organization (Figure 50). Like most of the colonial houses, it has two levels. The main access from the ground floor is on the street side, with a large zaguan that also likely served to store at least one carriage. A subtle height difference of three steps divides the carriage parking and zaguan from the lobby of this level and the landing of the staircase. The lobby also has an entry door to the east garden and gives access to two other rooms that were waiting areas for the guests before they

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were invited to go upstairs. Walking underneath the staircase, one could enter the back of the house. The purpose of each room in these spaces is unclear. However, it is likely that the servants’ rooms, a secondary kitchen, and the bodegas, or crop storage, were here. Once on the second floor, the layout is very similar to other bahay na batos: caída in front of the staircase; a bedroom behind it; the living room and master bedroom on one side, facing the street; and dining, kitchen, bathroom and azoteas on the other, facing the back of the lot.

The three main strategies to alleviate heat and humidity at Casa Villavicencio are cross-ventilation, good shading devices providing a penumbra interior, and the use of porous timber materials that absorb humidity and decrease thermal conductivity (Figure 51). Regarding cross ventilation, the house experiences a paradoxical situation. It has sliding windows and screens on the four facades, and the house is oriented to take full advantage of the main wind directions, which primarily come from the east and, secondarily, from the west (Figure 52). Nevertheless, the layout configuration, which accommodated the family structure with independent rooms for the parents and grandparents (Figure 50, Room 10), included beds against the walls, which made it impossible for the screens to function on the east façade. Behind the screens of the east façade, an interior wall was built, making those ornamental (Figure 53, left wall). Then, as shown in the axonometric figure 54, the main winds cannot cross through the short side of the house, as happens with the long side (Figure 51).

133 From architecture to furniture and clothes, the domestic space in the colonial Philippines was oriented toward perspiration. In figures 53 and 54, one can see the furniture made of rattan, screens on the walls, and linen curtains.
Nonetheless, blocking the east façade enhances shadow interiors even more, particularly in the bedrooms. The gloomy interiors are enhanced by the dark wood floors, black-painted ceilings, and ochre walls (Figure 55). The extra layer of protection on the east façade against direct sun was not necessary since the roof eaves were enough to darken the interiors. Looking at figures 56 and 57, which depict the sun hour analysis in hours when the screens are opened and closed, respectively, one can see that the amount of direct natural light in the rooms does not vary from one case to another. In both cases, it is present less than three hours a day at any time of the year and the day. However, the screen system provides enough illuminance in the interiors when opened, especially in the southeast area where the bedrooms are located (Figures 58 and 59).\textsuperscript{134} A more precise depiction of the illuminance can be seen in figures 60 to 63, describing the potential of the screens providing enough light or darkness when these mechanisms are opened and closed. These diagrams only show two stages (fully closed and partially opened), but the range of light in the interiors is even broader when the screens are completely opened.

The final strategy for adaptation to the tropical climate is the use of timber materials with hygroscopic properties. These materials improve occupant comfort by regulating indoor relative humidity due to their highly porous microstructure. They retain a considerable amount of moisture and exchange water in vapor form with their environment.\textsuperscript{135} Walls, ceilings, floors, structural columns, and furniture buffer the humidity in the atmosphere.

\textsuperscript{134} This information is based on the spatial daylight autonomy (sda) which depict the areas that have illuminance of at least 300 lux, using daylight alone for at least 50% of occupied hour during the daytime.\textsuperscript{135} Bakkour, A., Ouldoukhitine, S., Biwole, P., Anziane, S. (2024). A review of multi-scale hygrothermal characteristics of plant-based building materials. \textit{Elsevier}, 412, 1.
The hierarchical division in the spaces also applied to the three adaptive mechanisms—cross-ventilation, shading, and porosity.

The servants, sleeping on the back side of the ground floor and working in the rooms with a stone wall on the upper level, experienced different thermal conditions and did not enjoy the flexibility of the main rooms. First, these rooms barely had windows, decreasing the cross ventilation of the rooms. Consequently, these were gloomy rooms, but at the expense of lack of visibility and having to use candles to light the spaces. And, finally, these rooms were enclosed by thick masonry walls, increasing the thermal conductivity and providing worse insulation. The agency of colonial domestic architecture, creating contrasting adaptation and maladaptation, encapsulated the complexity of mixed building technologies into two social categories. Settlers and their elite descendants experienced Indigenous, Chinese, and mixed technologies, while the servants inhabited the untransformed and maladapted colonial construction techniques.

**Contradictions: Vigan—Thicker Walls, Thinner Bricks**

While the envelope of the typical bahay na bato got thinner over time, in the town of Vigan, Northern Luzon, these walls became thicker. This occurred by reducing the thickness of the brick and increasing the amount of mortar between them. Paradoxically, this building technology allowed buildings to not only resist earthquakes but also offer an efficient response to heat and humidity. It was a solution that recalled the first

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136 This is particularly relevant in the servants’ bedrooms on the ground floor, as one can see in the floor plans. The kitchen on the main level had larger openings, although they were not oriented toward main wind patterns.
architecture imported by the Spanish Empire, but was simultaneously influenced by Chinese craftsmanship.

The Spanish settlement of Vigan was founded in 1572 on the northwestern coast of Luzon Island by the Spanish conquistador Captain Juan de Salcedo after subjugating the confederation of Ilocano barangays. In 1758, a royal decree declared the town the new seat of the Diocese and ranked it as a city, making it one of the most important settlements of the Spanish East Indies. The town started to flourish after this time, particularly because the elite class formed by Chinese Mestizos—born of a Chinese father and an Indigenous mother. They had a monopoly over the production of hand-woven inabel, cotton fabrics, indigo dye, tobacco, and gold, which was shipped in the Manila Galleon. This elite cadre of ilustrados sought to flaunt their status with large houses, and from the beginning of the 19th century onward, Chinese mestizos started to become the country's national leaders.

In Vigan, houses were first built around the central plaza, although they later spread through the entire town. Many of these colonial-era houses still remain. Unlike other regions, where domestic constructions evolved in the ground-floor masonry and second-floor wood, Vigan saw the evolution of a heavier structural type. This was a two-level full brick construction with thick walls and a tile roof. They proliferated between 1800

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137 Florendo, Las casas bajo de las campanas, 15; This information was also retrieved at Vigan City Museum.
The town was originally named “Villa Fernandina”. In 1758, it changed its name to “Ciudad Fernandina de Vigan.”
139 Florendo, Las casas bajo de las campanas, 24, 29.
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and 1850 and were built in compliance with a 1797 official decree, which required buildings near the cathedral to be made of masonry to avoid spreading fires.\(^\text{140}\) This situation harkens back almost 250 years to a similar situation in Cartagena when a fire triggered an ordinance that erased Indigenous, or mixed, knowledge and replaced it with epistemologies and logics coming from the Iberian Peninsula. It also recalled an early process in the Philippines, when the first colonial constructions appeared in Manila in the first decades of coloniziation.\(^\text{141}\) Nevertheless, unlike the case of Cartagena, the role of Chinese workers and, in the case of Vigan especially, the *Chinese mestizo* elite generated a different result. In this northern part of the Philippines, bricks had Chinese and Spanish origins simultaneously. Architectural historian Fatima Rabang-Alonzo describes that kiln fire bricks with dark gray color were brought by the Chinese through pottery and open-fire clay covered with reed, a Spanish tradition.\(^\text{142}\) The shape of the bricks and the form used to build walls significantly differed from previous examples in Colombia and the rest of the Philippines.

In Vigan, brick sizes are particularly large and thin, ranging from 2.50 x 15.25 x 20.3 cm to 5 x 15.25 x 20.25 cm (1 x 6 x 8 in. to 2 x 6 x 8 in.), and are made with handmade wooden molds sprinkled with sand to prevent the clay from sticking.\(^\text{143}\) The houses' walls are usually sixty centimeters to one meter thick, with an internal rubble core between the blocks. Moreover, the space between bricks is more than usual, with proportions 1:1

\(^{140}\) *World Heritage City of Vigan Philippines*, 24, 29.

\(^{141}\) As interior designer and historian Raquel Baltazar-Florendo describes, Jesuit father Antonio Sedeno erected the first Spanish prototypes in Manila as early as 1586. Florendo, *Las casas bajo de las campanas*, 27.

\(^{142}\) Rabang-Alonzo described the differences in brick in a personal conversation at the School of Architecture of the University of Northern Philippines on January 8, 2024.

\(^{143}\) *World Heritage City of Vigan Philippines*, 88.
between the bricks and mortar (Figures 64 and 65). Thus, the wall composition is formed by two layers of brick on the side and approximately thirty to seventy centimeters of rubble in between and covered with lime plaster on the exterior. Nevertheless, the mass of the houses does not rest only on these walls. In some areas, there are protrusions to accommodate wood logs embedded between the two layers of brick, which are then fixed in shallow foundations to support the second floor and roof. This new building technology offers an interesting result. The inherent weakness and deformability of lime mortar allow the houses to flex and absorb energy during earthquakes, contributing to their resilience.

Furthermore, the way these walls are built contributes to the thermal adaptability of the Vigan houses through a combination of two factors. First, the mass of the walls, and more likely the large space of mortar between bricks, absorbs the heat during hot hours and releases it at night. This is done in combination with the exposed wood ceilings, floor, windows, and door frames, which help to reduce the humidity in the interior spaces. An example of this adaptability to the environment is the Villa Angela Heritage House, located at Quirino Boulevard (17°34'10.3"N 120°23'21.8"E) and built in 1870 by the gobernadorcillo Agapito B. Florendo and Maria Villanueva (Figure 66-68). Besides the combination of heavy brick masonry walls and light floors and ceilings, the house continues the elements of the bahay na bato, with capis sliding windows, gloomy interiors, cracks between wood boards, and calados on top of partition walls allowing air

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144 From the same conversation with Rabang-Alonzo on 01.8.2024.
145 World Heritage City of Vigan Philippines, 88.
146 Gobernadorcillo was a municipal judge or governor in the Philippines during the Spanish colonial period.
to circulate between rooms. Awaiting further studies, particularly related to earthquakes, Vigan’s thick walls with a fluctuating mortar between bricks seem to resist the movement of the earth. Even houses abandoned decades ago remain intact and have barely shifted or leaned during the last two centuries of seismic activity.147

In many ways, Vigan houses represented the completion of a global circle of colonial constructions. Chinese craftsmanship evolved a building technology that adapted to the environment of the Philippines but used similar materials to those imposed by the Spanish Empire centuries before—materials already used in the Al-Andalus period and the first centuries after the Reconquista, and materials that, with a layer of lime plaster, resembled the walls of the Iberian Peninsula. In Vigan buildings, it is not only difficult to pinpoint the origins of particular technologies but also to distinguish why they were built in this particular form in this particular region. The 1:1 proportion of bricks and mortar can be found both in Vigan or Al-Andalus architecture of the south of Spain, even if the form was developed through a completely different process or historical context. The case of Vigan domestic architecture is thus both different and similar to the other bahay na batos: In both examples, the architecture is already a global project that has multiple influences and epistemologies imposed and stolen from one culture to others to adapt to the natural environment. The Vigan distinction is that in the bahay na bato, the final building technology shows its different parts openly, while the thick Vigan walls mask the differences. Nonetheless, in both cases, architecture in the Spanish colonial

147 In a private conversation with Michael Manalo in Manila on January 13, 2024, he believes that further studies will reveal if the mortar/brick combination has been the cause to bear earthquakes.
Philippines tended to homogenize its final form by absorbing different conditions under the vertical social hierarchy of domestic life within the Spanish Empire.

**Epilogue**

During World War II, the bombs dropped by Japanese troops against the United States in Manila destroyed the entire walled city of *Intramuros* and other historical neighbors like Ermita. The result was the destruction of most colonial material culture, particularly its domestic architecture. Thus, while Spanish colonization did not wholly erase Indigenous constructions—*bahay kubos* are still present in the countryside across many islands—the war and then the growth of the Manila population changed the urban landscape and eliminated the colonial layer.\(^{148}\) Only the external wall and churches remained in *Intramuros*, and its reconstruction has not yet been fully completed (Figure 69). The result is a mix of postmodern buildings ornamented with Spanish colonial and Chinese styles between empty lots and impoverished constructions.

The *tabula rasa* and consecutive erasures are clearer in the neighborhood of Ermita. There, WWII destruction was replaced with mid-rise brutalist buildings and a variety of sun-shading louver systems serving the nearby universities, museums, and government buildings. The neighborhood's postwar decay turned many of these buildings into abandoned structures, and they have been substituted by glass towers that achieve thermal comfort through window AC units (Figure 70). The same redevelopment is occurring in other areas of the city, like Binondo Quiapo and San Nicolas (historically the

\(^{148}\) Manila went from 1.5 million to 9.4 million between 1950 and 1995. Source: [macrotrends.net accessed April 6, 2024.](https://macrotrends.net)
centers of Chinese trading and living). And similar glass towers can be seen in different cities around the world, either in the tropics or other climatic regions, including Cartagena in Colombia—representing the homogenization of architectural forms and their environmental design strategies. If the Spanish colonial project made thermally dysfunctional constructions widespread across many regions, the popularization of air conditioning systems made the same strategy thermally feasible into the 20th and 21st centuries.

This homogeneous maladaptation runs parallel to the standardization of sustainable options and metrics. Today, Leadership in Energy and Environmental Design (LEED) green building certification, run by the non-profit U.S. Green Building Council (USGBC), operates in 186 countries and territories around the world, including the Philippines. In 2023 alone, more than 1,500 projects in Mainland China, 240 in India, 119 in Brazil, and 160 in Spain achieved one of the LEED certifications.149 With its series of checklists, charts, and design solutions, LEED certification fabricates environmental innocence for development projects with massive carbon footprints, complex sourcing and finance problems, heavy demands on municipal infrastructure, and complicity with displacement.150 A similar global method used to deal with anxiety toward environmental degradation is the United Nations Climate Change Conference (COP), which has happened in different cities around the world every year since 1995,
Homogenization and standardization occur simultaneously in the architectural industry and in environmental design solutions, although the solutions proposed for the latter rarely achieved their goals in the construction of new buildings. More disturbingly, the solutions proposed to face climate change are still imposed by the national and transnational centers of power. These global players define how to build on a planetary scale and set the protocols to mitigate global warming and material extractions. Then, although more refined, scientifically based, and with optimistic directions, these protocols are in a manner reminiscent of the same patterns started in the 1500s. They keep constructing climatic and environmental epistemologies from a specific places and positions and mandating it to the rest of the world.

Even if this approach toward climate change mitigation is the right one, these global powers are moving in an unknown environment. A deep analysis published by Plos One in 2019 and broadcasted in international media revealed that even in an optimistic climate scenario, by 2050, 77% of future cities are very likely to experience a climate that is closer to that of another existing city than to its own current climate. For instance, Madrid, Spain, will have a climate similar to Fez, Morocco, and a mean annual

151 The COP28 UN Climate Change Conference in Dubai, the United Arab Emirates, was the biggest of its kind. Some 85,000 participants, including more than 150 Heads of State and Government, were among the representatives of national delegations, civil society, business, Indigenous Peoples, youth, philanthropy, and international organizations in attendance at the Conference from 30 November to 13 December 2023; COP28: What Was Achieved and What Happens Next? | United Nations Climate Change. https://unfccc.int. January 12, 2024.
temperature increase of 2.1 °C; Cartagena, Colombia, will be like Maracaibo, Venezuela, with an increase of 1.3°C, and Manila, Philippines, will be most similar to Rangoon, Myanmar, with an increase of 1.5 °C.

Moreover, these comparisons hide the complex conditions expected in the tropical regions. The future of major cities in this part of the world remains highly uncertain because many tropical regions will experience unprecedented climate conditions, with both increases in extreme precipitation events and in the severity and intensity of droughts.153 Thus, both the individual use of cooling systems and the global protocols to thermally adapt building interiors, particularly in the tropical climate, becomes a journey of innocence tainted by environmental disasters and a lack of empathy for those who do not have the power or influence to make choices. How should we build in a way that contends with global warming and environmental degradation? The standardization of environmental knowledge, which started in the 16th century when colonization became a global project, has not responded to the questions for those creating laws to adapt to it. Architects and policymakers alike still navigate an unsettling climate without knowing how to address it, too often ignoring or omitting the consequences of their actions.

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GLOSSARY OF TERMS:

**Historical Terms:**

**Cabildo:** or town council. This body exercised administrative, political, and regulatory functions in an area far beyond the city. In cases such as Mexico City, the cabildo represented the interests of *encomenderos* and old conquerors that formed a socioeconomic elite.


**Capitulaciones:** This was a legal term that ordered the conqueror to pay the costs of the conquest. In return, they could take all the profit made except 20% of the loot. With *Capitulaciones*, the lands belonged to the Crown.

**Casa de Contratacion:** Established in Seville in 1503, it was the institution that had to register all the trades and commodities sent from and to the Americas. This institution provoked most ships to pass through this institution before sailing to the American continent.

**Casta:** In the context of the Spanish and Portuguese Empires, the system of *castas* (caste) was a mechanism used as a social identifier that hierarchically positioned individuals based on their race.

**Clima:** From Greek κλίμα klima, it was a medieval and early modern scientific concept that divided the Earth into three climatic zones by geographic latitude. These zones were frigid at the poles, temperate at mid-latitudes, and torrid at the equator.
Congregaciones (Reducciones): The outcome of Relaciones Geograficas was to resettle Indigenous communities into new towns (pueblos) to achieve political, administrative, and cultural control, financial vigilance, and a more decisive religious conversion. This movement of Indigenous peoples was done through Congregaciones in Mexico and Reducciones in Peru.

Consejo de Indias (Council of the Indies): Established in 1524 by Charles V, it was the central administrative and advisory organization to the king of the Spanish Empire for the Americas and the Philippines. From 1561 onward, it was established in Madrid.

Encomienda: Enslaved labor system that rewarded Spanish conquerors with the labor of conquered Indigenous peoples in the Americas. The Encomendero (owner of the Encomienda) had to provide, in return, protection and Christianity. The encomienda was canceled shortly because the Crown wanted to limit the amount given to individuals to prevent the accumulation in the New World of vast states on the Andalusian Model. Indians working at Encomiendas were not considered enslaved people since they worked and lived in the same lands before the arrival of the Spaniards (although it is considered similar nowadays). However, Spaniards also had Indigenous enslaved people who were kidnapped from other regions or had resisted Spanish invasion. The Encomiendas lasted in different forms until the end of the colonial period.

**Hacienda:** In Spanish America, a large, landed estate is one of the traditional institutions of rural life. Originating in the colonial period, the hacienda survived in many places late into the 20th century. Laborers, ordinarily American Indians, who worked for *hacendados* (landowners) were theoretically free wage earners, but in practice, their employers were able to bind them to the land, especially by keeping them in an indebted state;

Definition from Britannica.

**Hidalgo:** Professional soldiers from Castile who were schooled to war and came from the gentry class and below to initiate the conquest of the Americas.


**Palenque:** Towns founded in the 17th century by Black escaped enslaved peoples (also known as *maroons*), and symbols of African-descendant resistance in the Caribbean region.

**Repartimiento:** Founded in 1499 in La Hispaniola, this organization provided settlers with the labor and profit of land (including the Indigenous peoples), but they did not own the land.


**Relaciones Geograficas:** Documents summarizing the fieldwork to adapt new settlements to existing environments. Developed between 1579 and 1585 by Spanish commissioners following orders from the Spanish Crown, this endeavor was
prompted by the previous failure to control the Indigenous population in the first century of colonization.

**Requerimiento:** Indians were requested to accept Christianity and Spanish Rule before starting hostilities.


**Royal Audiences:** were courts created by the Crown of Castile to distribute justice and oversee the different governments’ administration and the settlement of a specific territory. There were royal audiences in Spain (both in the Crowns of Castile and Aragon) and in the conquered territories (Americas and the Philippines),

**Zaguan:** In domestic architecture, it refers to a covered passageway between the entrance and the courtyard that worked as a threshold between the public and the domestic.

**Zambo (or Zambaya):** Racial term historically used to name people of mixed Indigenous and African ancestry.

**Environmental Terms:**

**Conduction:** is the transfer of heat through a solid material without any movement of the material itself.

**Convection:** is the heat transfer in buildings results from the movement of air of different temperatures and can be used to maintain internal comfort, either through heat
exchange between the air and the internal surfaces of a building, or by heat exchange with sources of heating or cooling.

Hygroscopy is the phenomenon of attracting and holding water molecules via either absorption or absorption from the surrounding environment, usually at average or room temperature.

Hygrothermal refers to the movement of heat and moisture through buildings. Repeated wetting, drying, freezing, and thawing of the fabric of a building can cause problems such as dampness, condensation, mold growth, and loss of thermal performance and may even result in premature failure.

Specific heat capacity is the amount of heat supplied to an object to produce a unit change in its temperature. It is measured in joules per kilogram kelvin (J.kg⁻¹.K⁻¹).

Thermal conductivity is defined as the ability of a material to conduct heat from one side to the other, and usually, the lower the value, the better isolation the material can provide. Thermal conductivity is measured in watts per meter kelvin (W/mK).

Thermal diffusivity: describes the rate of temperature spread through a material. Thermal diffusivity, α, is calculated from the thermal conductivity and the heat thermal capacity.

Thermal effusivity, also known as thermal permeability, measures how well a material can exchange heat with whatever substance it comes into contact with.

Thermal mass: It is the ability of a material to absorb, store, and release heat. This is particularly effective in a temperate, dry climate when it is warm during the day and
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