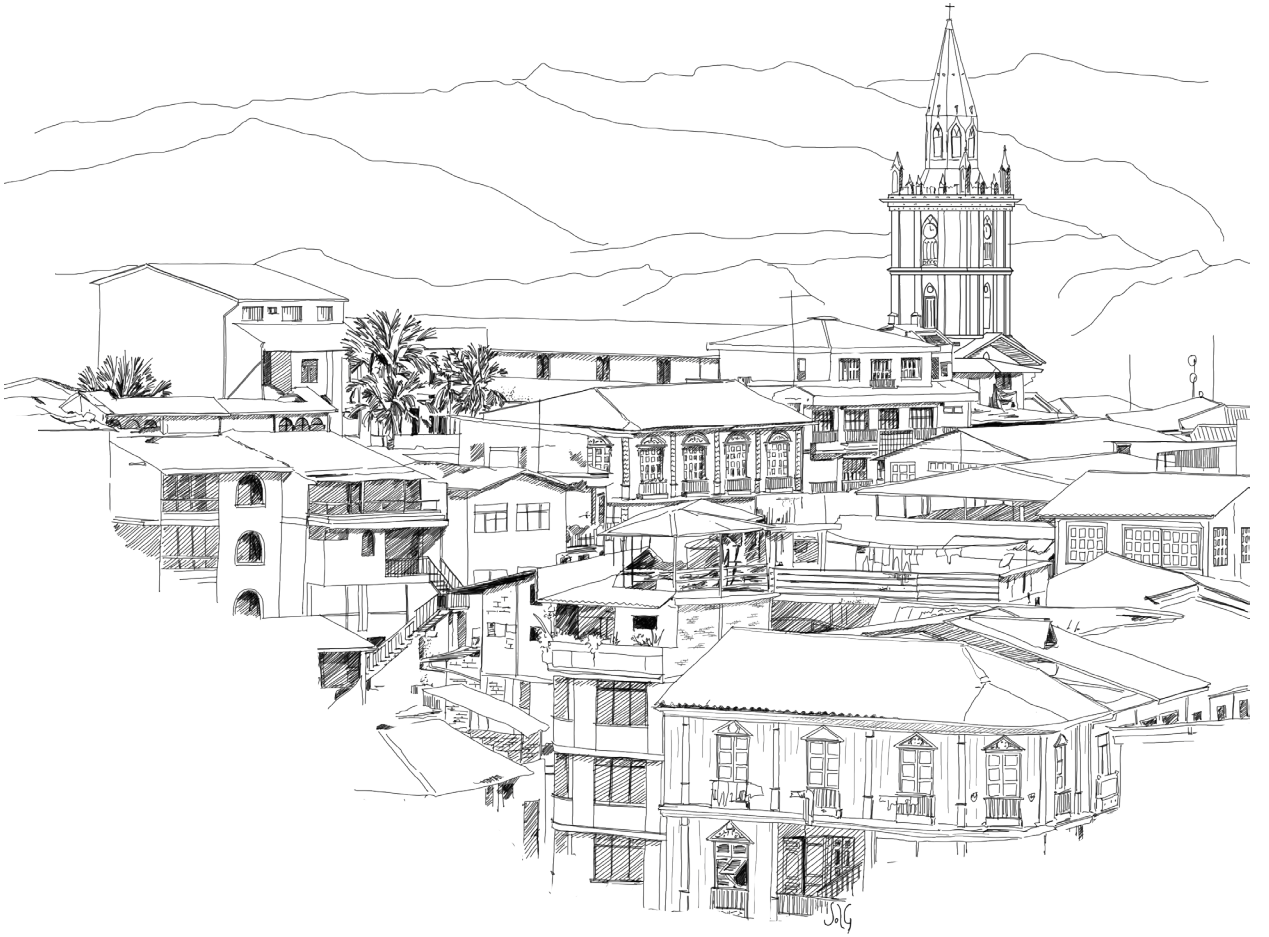
THE HOUSE OF ZARUMA

KNOWING A CONSTRUCTION SYSTEM IN ITS ‘GOLDEN’ AGE

Sophia Gualán Chacón



POLITECNICO DI TORINO
Master's degree program in
ARCHITECTURE HERITAGE PRESERVATION AND ENHANCEMENT

THE HOUSE OF ZARUMA

KNOWING A CONSTRUCTION SYSTEM IN ITS 'GOLDEN' AGE

Sophia Natalia Gualán Chacón

2023

ABSTRACT

Throughout its history, Zaruma has relied heavily on mining exploitation in the region; this was the primary reason for the city's foundation and subsequent urban growth and architectural development. However, at present, this mining activity has become illegally invasive of the urban subsoil and poses a significant risk to the city's structure and its inhabitants, jeopardizing their very existence.

The present study aims to analyze the construction system of historic timber houses built between the late nineteenth century and the early twentieth century when there was the most significant mining boom in the area, also considering the difficulty of the territory where they were built.

A field study was conducted, focusing on the historic houses located within the First Order Zone of the city, using as reference the buildings included in the inventory developed for the nomination as World Heritage at UNESCO, analyzing their urban, constructive, and architectural characteristics. As a result, a model of an "Ideal House" was created by unifying elements common to the houses. In addition, constructive details of each part of the architecture were developed to understand their constructive and operational characteristics.

Furthermore, the study identifies and documents elements that have suffered degradation, accompanied by general recommendations for intervention and preservation, taken from similar cases, that can be used as a starting point to develop a specific process for restoring and safeguarding the historical architecture in Zaruma.

ACKNOWLEDGEMENTS

A mis padres, por su inmenso amor y cuidado, por apoyar mis decisiones y estar siempre conmigo sin importar donde nos encontremos.

Thanks to my professors, for your guidance, your time and availability. To my brother, my syster, my partner and all members of my family that somehow supported me in this journey. To friends, from Italy and Ecuador, for becoming my constant, my little family everytime I need it.

Special gratitude to: Voltaire Medina, Martha Romero, Patricio Gonzalez, Rafael Campoverde, Marcelo Valverde, Luis Valverde, Elio Zambrano, Luis Arias, Dositeo Galvez, Iván Romero, Maria Esther Lara, Dunquer Calderón, Lorena Carrión, Tito Castillo, to the members of the Association of owners of heritage buildings in Zaruma and all the people of the city for welcoming me into their homes and their readiness to help.

To Amada, Rosa, Juvenal & Manuel, who without being present gave me a home and place to go back and learn.

INDEX

FIGURE LIST

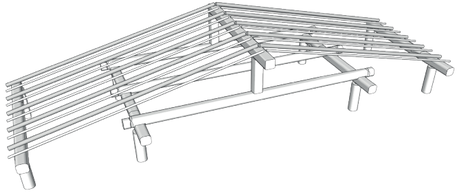
GLOSSARY

NOTES:

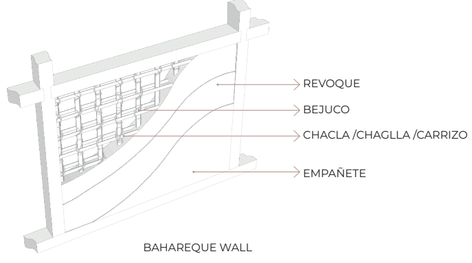
1. Definitions are a self-made translation from the ones provided mainly by the following documents:
   - La Carpinteria de Armar Española (Nuere Matauco, 2000)
   - Manual de Diseño para Maderas del Grupo Andino (Junta del Acuerdo de Cartagena, 1984)
   - Glosario de Arquitectura. (Instituto Nacional de Patrimonio Cultural, 2010)
   - A Visual Dictionary of Architecture. (Ching, 1995)

   In the case of using a different source, it will be indicated next to each definition.
2. The equivalent term used in the region is presented for each term. The key for country names is as follows:
   - BO: Bolivia
   - CO: Colombia
   - EC: Ecuador
   - PE: Peru
   - VE: Venezuela

- **Armadura:** (BO, PE, VE) armadura; (CO, EC, VE) cercha; (PE) tijeral. //1. Set consisting of wooden elements joined together to cover or roof a building or a room //2. Flat structure with polygonal shape perimeter consisting of longitudinal elements and vertical or diagonal elements, mainly subjected to tensile or compressive forces.



- **Bahareque:** (BO, CO, EC, VE) bahareque, (PE) quincha. //1. Wattle and daub. //2. It is a structure of reeds, chonta, or bamboo, interwoven and nailed, covered with mud or chocoto on both sides. Its appearance is of a partition of 5 to 8 cm. thick and with variable height. (Instituto Nacional de Patrimonio Cultural 2010)

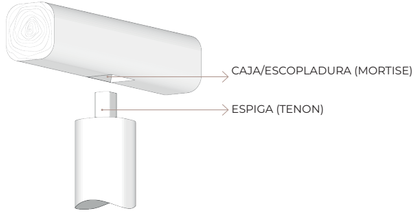


BAHAREQUE WALL

- **Barrote:** Wood placed diagonally in the sheathing from the building's corner to the cuadral.

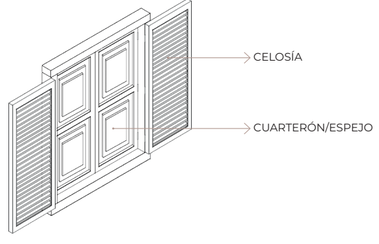
- **Bejuco:** Name of diverse plants with long, thin stems that extend across the ground and run over other materials; they are used for ligatures of elements in vernacular architecture.

- **Caja y Espiga:** (BO, CO, EC, PE, VE) //1. Mortise and tenon joint. //2. Union of two pieces of wood, one of which has a hole (*caja*) used to receive the *espiga* (tenon) from the other.



- **Carrizo:** Cane variety similar to bamboo, with long and creeping roots with flat, linear, and lanceolate leaves. Its diameter varies from 2 to 4 cm. Its stems can be used to build ceilings and bahareque walls.

- **Celosía:** (BO, CO, EC, PE, VE) celosía. // Latticework used in openings allows to sift the light and see from the inside without being seen from the outside

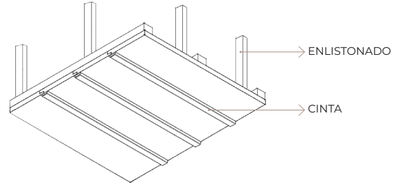


- **Cenefa:** A decorative element that uses geometric or vegetation motives, repeated as stripes on walls, ceilings, floors, or between alfarjías and cornices.

- **Chacla or Pindo:** (EC) Local plant with similar characteristics to the bamboo but with a solid heartwood, used to make partitions and support tile roofs. (Gualán, 2023)

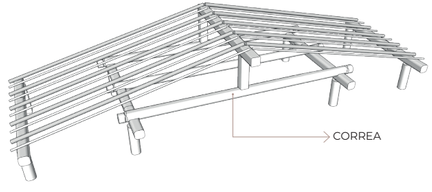
- **Chaglla:** *Carrizo* (Bamboo species) rods used to make columns, roofs, or partitions.

- **Cinta:** Moulding. It is an elongated and narrow strip of wood used for decorative purposes for ceilings or *lacería* (strip work).

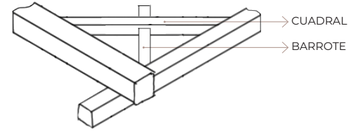


- **Cordel y Regla:** Classic model of the structure of the Spanish-American city, characterized by a geometric layout and straight streets forming trapezoidal, rectangular, or square blocks (Gobierno de España. Subdirección General de Archivos Estatales, n.d.)

- **Correa:** (BO, CO, EC, PE, VE) correa. //1. Tie beam. // 2. The structural horizontal element of a roof structure used to join a *faldón* (sheathing) to the rafters or beams of a roof and has the function of joining said elements. It is placed perpendicular to the longitudinal direction of the *armadura*.



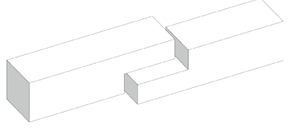
- **Cuadral:** Structural wood arranged in an angle to secure the beams that form this angle.



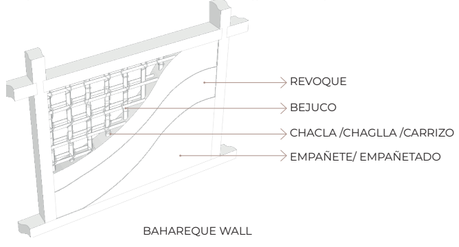
- **Cuarterón:** 1. Used in carpentry to designate the filling between *largueros* (stile) and peinazos (rails) // 2. A distinct division of a wall, ceiling, or door, recessed below or raised above the general level or enclosed by a frame.

- **Dintel:** (BO, CO, EC, PE, VE) Lintel. Beam placed in the upper part of a door opening.

- **Empalmar:** It is to join two timbers along so that they are firm, intertwining with each other.

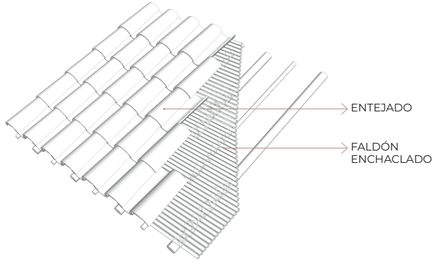


- **Empañete:** Finish coat. A thin layer of protection is placed on the *revoque* (plaster) with 3mm thickness.

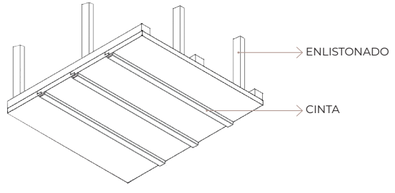


BAHAREQUE WALL

- **Enchacliado/ enchaclado:** *Faldón* (Sheathing) made of *carrizo* or *pindo*, tied with cabuya or bejuco.

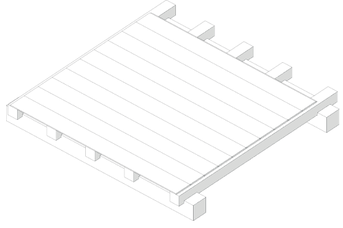


- **Enlistonar:** Construct the structure of joists that support the ceiling.



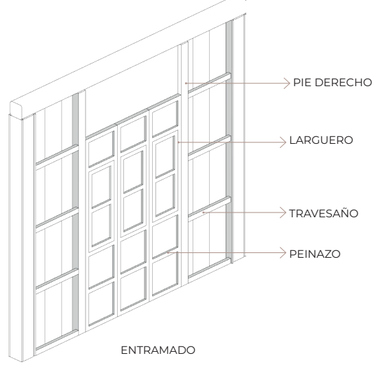
- **Ensambladura:** The union made of the woods in several positions and using different cuts with perfect correspondence for their link.

- **Entablado:** 1. Surface formed with boards gathered by joining their edges. // 2. The wood cladding consists of thin boards, usually joined by their edges, resting on some support: ***a tope. -*** The one placed in such a way that each board meets by its edges. ***- machihembrado. -*** The ones whose boards are placed to assemble their edges to ranura and caja y espiga. ***– traslapado. -*** That is placed so that the edges of the boards overlap.

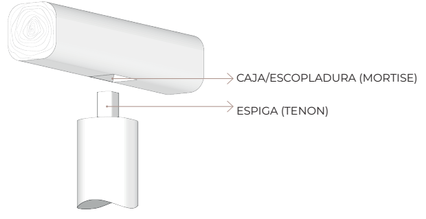


- **Entejado:** Tile roof, placed on top of the *torta de barro* underlayment. It is recommended that these roofs do not have slopes less than 30% so that the rainwater can evacuate quickly.

- **Entramado:** (BO, CO, EC, PE, VE) // 1.Set of woods that form the structural skeleton of a building. // 2. A set of pieces conveniently joined together on which a cladding element is assembled. ***– de pared*** *(of the wall)*. The framework that forms the structural skeleton of a wall. ***– de piso*** *(of the floor)*. Set of elements that make up the structure of a floor. ***– de techo*** *(of the ceiling)*. Set of elements that constitute the structure of a ceiling.

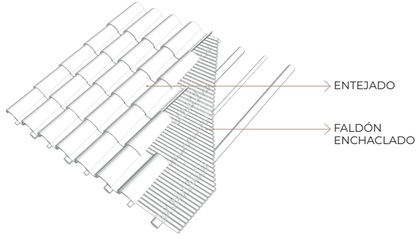


- **Escopladura:** Mortise. A notch or hole. Usually rectangular, cut into pieces to receive a tenon of the same dimensions.



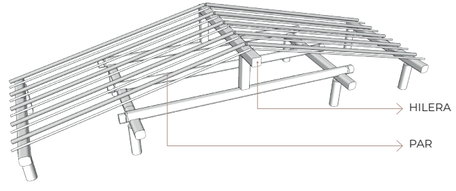
- **Espejo:** Term used in Contract basis for the conclusion of the Municipal house N°.7 (Appendix B) referring to the *cuarterón*.

- **Faldón o Paño:** 1. Sheating. // 2. Is the roof decking made of boards and purlins placed on each side of the *armadura* to receive the tiles or the roof finish. // 3. On a rooftop, each of the inclined planes that cover a room. Depending on the type of cover, the panels will be triangular, square, rectangular, or trapezoidal in shape.



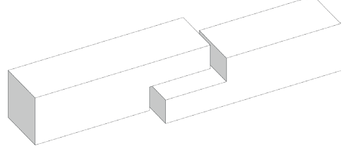
- **Guayacán:** Subtropical Wood. The larger pieces are used for the construction structure: columns, beams, and roof frames. Smaller sections are meant for planks, stairs, ceilings, and furniture.

- **Hilera:** Ridge Beam. Wood element placed horizontally, where lay the top of the heads of the rafters. The roof deck is formed on top of it.



- **Larguero:** 1. Stile. // 2. Vertical piece, usually lateral to a door, window, or frame.

- **Media madera:** 1. Half-Lap joint. // 2. Assemble between two woods of equal thickness, which are crossed, reducing each half of its thickness.

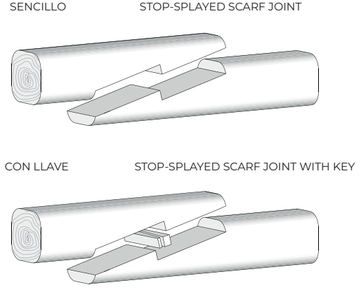


- **Mita:** It was a primary mechanism of economic organization of Inca origin, reformulated by the colonizers, which consisted of a certain time of compulsory work for adult indigenous males. The Crown distributed their working time, reserving part of the mitayos (people who worked in a mita) for public works and handing the rest to Spanish

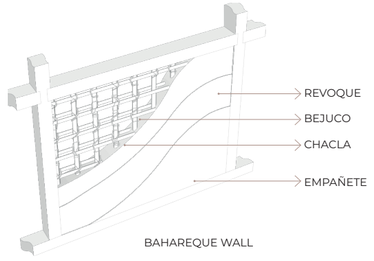
settlers who required labor hands. Although the work was forced, a salary had to be paid, which guaranteed the State that the indigenous had the resources to pay tribute. (Ayala Mora 2008)

- **Par:** (BO, CO, EC, PE, VE) par; (CO) cuchillo. // 1. Rafter // 2. Each of the parts of a truss or armor that have a parallel inclination to the roof on which the straps are supported transversely. // 3. Each of the joists that forms a gable roof.
- **Peinazo:** 1. Rail. // 2. The horizontal part of a door or window that divides the span or the panel into two parts. (Depending on the region, the term travesaño can also be used.)
- **Pico de Flauta:** 1. Nibbed scarf joint. // 2. Is a specialized variation of the scarf joint, has interlocking profiles and a squared “nib” or protrusion at one end; this enhances the joint’s mechanical interlock and alignment during assembly. The nib aids in resisting lateral forces, while the elongated, overlapping design distributes vertical loads effectively. Widely utilized in timber construction when lengthening beams, its design increases the bonding surface and provides additional security against joint separation. Typically, the scarf angle range is of 10 to 30 Degrees. (Dimensions.com, 2023).

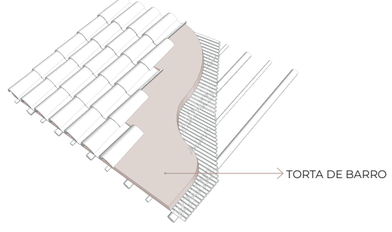
- **Pie Derecho:** (BO, PE, VE) montante; (CO) paral; (EC, PE) pie derecho. // 1. King Stud. // 2. Vertical wood that is used in buildings to support a load. // 3. Vertical part that works mainly in compression and plays a support function.
- **Quincha:** Construction system similar to the bahareque.
- **Rayo de Júpiter:** // 1. Stop-splayed scarf joint. // 2. Union made by joining two pieces of ends in an inclined plane, cut in zig-zag, to complement their profiles. It is common to find reinforced specimens with key. It is used to link elements of large dimensions, demonstrating high tensile strength (Corporación de Desarrollo Tecnológico, 2022).



- **Revoque:** Mud plaster for bahareque walls does not have a polished finish to be able to bind with the finish coat.



- **Torta de Barro:** Underlayment of clay and straw mixture 12 thick that goes on top of the enchaclado (chacla sheathing).



- **Travesaño:** (BO, CO, EC, PE, VE) Travesaño. (PE) Peinazo. //1. Nogging. // 2. Horizontal piece that is intercepted with another vertical.
- **Vara:** Length measurement unit equivalent to 835.9 mm, divided into 3 feet or four palms; its equivalence varied according to eras and regions; in Castilla, the most frequent value was 83.59 cm.

Figure 1: View of Zaruma first half of the 19th century. Engraving by E. Chartón(Gobierno Autónomo Municipal de Zaruma, n.d.)

1. ZARUMA, THE CITY BORN WITH THE MINES.

1.1. Historical framework.

The city of Zaruma dates to pre-Hispanic times as a human settlement, but there is no record or research on this period. Later it was transformed into a Spanish settlement, whose population arrived at the site when exploring the territory in search of gold. Regarding its foundation as part of the Spanish colony, there are different hypotheses about the year which could be between 1549 and 1560. The recognition of this event is important not to mark the beginning of the "civilization" of the population in Zaruma but rather to understand how these changes influenced the creation of a syncretism reflected in the city's architectural style. (Instituto Nacional de Patrimonio Cultural and Miño 1986)

This preliminary approach takes as their reference the study *"Síntesis Histórico- Constructiva de la Ciudad de Zaruma"* (Historical Synthesis. Construction of the city of Zaruma) (Instituto Nacional de Patrimonio Cultural & Miño, 1986) which later served as the basis for the documentation prepared for the Declaration as National Heritage of Ecuador. This document explains two theories about Zaruma's foundation: the first one supported by Juan de Velasco, speaks of its discovery and foundation in 1549 by Alonso de Mercadillo[1], and

1 Spanish conqueror, it is known that he headed to America in 1533 becoming one of the main captains of Gonzalo Pizarro, it is known mainly by the foundations of the cities of Loja and Zamora. Died in 1560. (Avilés Pino 2023)

the second, pointed out by Gonzalez Suarez based on the writings of Victoriano Torres who in turn relied on Francisco Javier Riofrío, points to Captain Salvador Román as the founder in 1560. A posterior study made by Alfonso Anda Aguirre supports this second theory in 1560, further mentioning that this date is relevant given that the Spanish foundation pre-established rules from the Royal Crown for the constitution of the cities and that these were not fulfilled by Román.

In 1591, the settlers sought to upgrade Zaruma, and the Viceroy was ordered to provide the necessary for the foundation of a village in the *Cerro y Minas of Zaruma*. In 1593, the *Real Audiencia de Quito* (Royal Audience of Quito) was ordered to found indigenous populations in Zaruma with the aim of providing men workforce in the *mita*[2] of the mines. After this order was not implemented, in 1594 the Viceroy of Perú appointed a governor whose functions were to control the mines, choose an optimal site for the establishment of the villa, determine its urban layout and distribution considering the main buildings and empty lots distributed among the original inhabitants of the villa, seeking to concentrate the Spanish population, in addition to identifying sites for the indigenous population. Concluding with these provisions, the foundation of "San Antonio del Cerro Rico de Zaruma" was ordered as Villa on December 8, 1595. This arrangement meant giving the town planning through the existing conglomerate of houses (Anda Aguirre 1964).

In 1606, Pedro de Veraza Asuva invented a new method to enrich the gold ore and increase its production, which lasted until 1620, when the Spanish Crown was notified that due to the depth of the sinkholes began to decrease the metal.

In 1743, with the first record on the decline of Zaruma, La Condamine[3] describes a mediocre village with inhabitants who live in poverty despite the wealth of gold; in addition to the mineral at the time being of low quality, the mines were abandoned and finally adding, the difficulty to access the Villa. Later, during the rest of the eighteenth century, although it was possible to reactivate mining to improve social and economic decline, it was necessary to optimize productivity, accessibility, and infrastructure, which at the time was not possible by the Colony, which was in crisis, adding the libertarian environment that was in its beginnings. Finally, however, mining continued on a smaller scale until the beginning of the XIX century.

Zaruma was emancipated from Spain on November 26, 1820, joining the libertarian movement, and supporting Sucre in 1822 with supplies with the new political organization, economy, and social within Gran Colombia but also about Zaruma the need to illustrate its inhabitants, so in 1822 the first school was established, and the population was recognized as a canton.

In 1871, already during the Republic, President García Moreno ordered a study to determine the productivity of mines, but it is until 1878, after the studies of Teodoro Wolf made in 1876, that small-scale works were resumed also using foreign investment. Afterward in 1879, from a visit to Zaruma, Wolf still reported a high level of decline and abandonment of the village.

It was until 1880, when the "Great Zaruma Gold Mining Co Limited" of London acquired permits to work in the mines, that the productivity increased, and road infrastructure was constructed. These actions led to a change in the city's development, meaning an increase in the migratory movement towards the region, with the emergence of the mining town of Portovelo in previous settlements and the consequential development of the urban structure of Zaruma. This company worked until 1896, when Alfaro's government imposed a demand for taxes; the same year, the mines were auctioned to the "South American Development Company" of American origin, which improved mining techniques and exploited mines until 1950.

With this mining boom in these two periods, Zaruma went through intense urban growth, acquiring a larger scale in the late nineteenth and early twentieth centuries; this is visible in the architectural development that we can see today, also marked by the traditional construction of the Colony that used native materials of the place. Thus, the architectural style of Zaruma is a mixture of different techniques and materials such as adobe, bahareque, woods such as guayacán or guayuno in its foundations, cinnamon, or cedar for boarding, among others; and with the economic and technological increase also passed from the initial houses of the ground floor to buildings of two or three levels on the one hand to three to four on the other, this considering its topographical adaptation.

In the 1950s and 1960s, the first reinforced concrete buildings were built corresponding to the city's main buildings: the municipality, the IESS hospital, the Fire Department, and some private buildings.

Later, in 1977, Zaruma was declared a "Site of Tourist Interest," considering the originality of its architectural characteristics; from this moment, the journey towards the protection and valorization of the city and its recognition as heritage began.

1.2. The city as a Cultural Asset

The city of Zaruma has followed a long road to its recognition as a Cultural Heritage, initially aiming to be recognized nationally and then admitted to the UNESCO tentative list as a Cultural Heritage of Humanity. For this purpose, an urban area was delimited developing an inventory with all buildings considered of patrimonial value. (Figure 2)

1.2.1. Cultural Heritage of the State

This section describes the first records of the process of patrimonialization of the city, using multiple documents from the *Instituto Nacional de Patrimonio Nacional*[4] database. The first one dates from 1981, with the *"Delimitación de los Centros Históricos: Ciudad de Zaruma"* (Instituto Nacional de Patrimonio Cultural, Pallares, and Arcos 1981), where the historic center of Zaruma is delimited with the desire to control the aggression to these historical centers and to facilitate the municipality the development of a regulation that follows this end. This delimitation was made following:

- **Historical aspects:** Related to the urban development and the historical cut between the old and new city. In the case of Zaruma, there is no historical documentation on the historical urban development, and the historical cut is determined by the traditional and representative structure of the area of greater constructive density plus the technological change towards the periphery.
- **Physical aspects**: Related to recognizing the urban historical values and morphological identity and characterization of sectors, which for the city was limited to a visual tour at the urban level without a particular study of the buildings.

In conclusion, a Zone of First Order comprising the

2 See Glossary

3 Charles-Marie de la Condamine was a French researcher and scientist, who was part of the French Geodesic Mission. (1736)

4 From this point it will be referred to by its acronym "INPC".

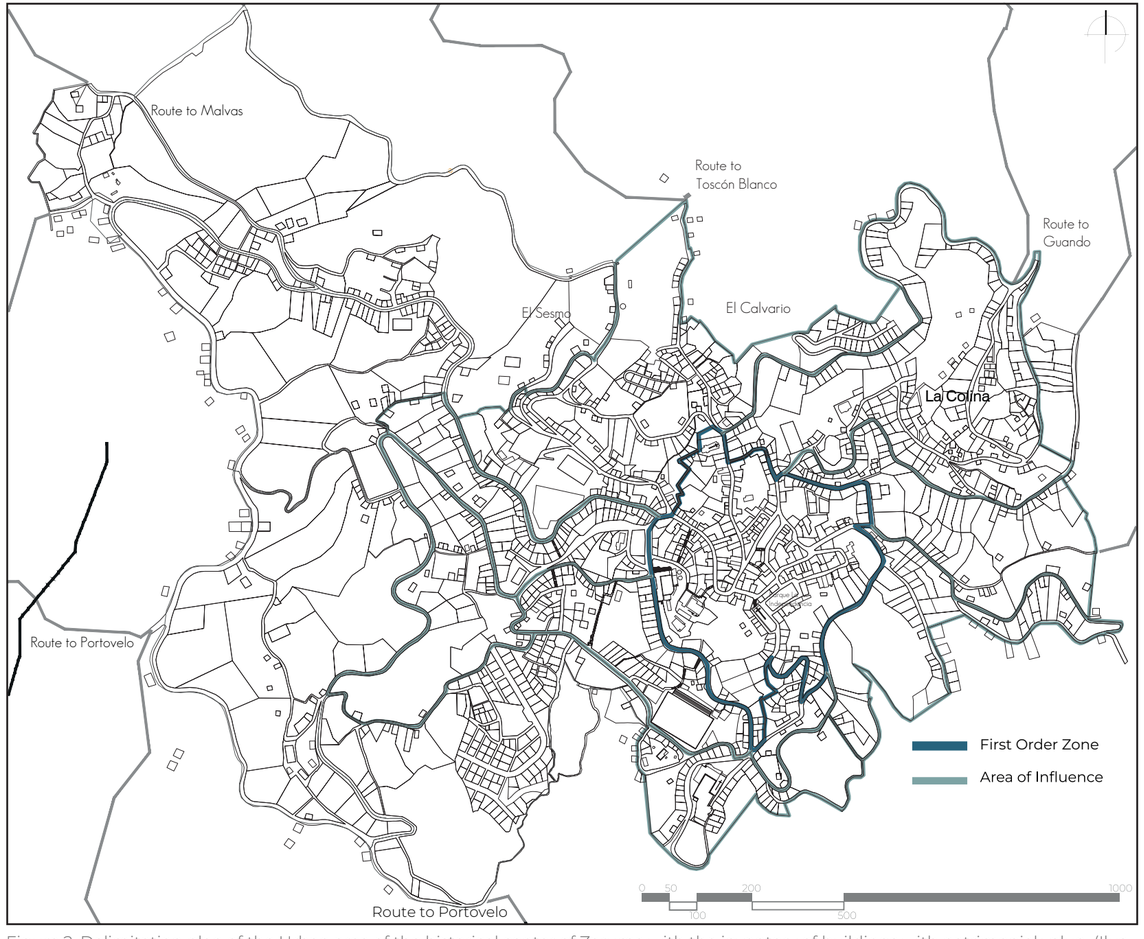


Figure 2: Delimitation plan of the Urban area of the historical center of Zaruma with the inventory of buildings with patrimonial value (Ilustre Municipio de la Ciudad de Zaruma 2004)Graphic re-elaboration by Gualan, S.

sector with the highest content of physical-historical value was noted; and an Area of Influence of lesser historical value has scattered buildings and as an urban landscape framework of the zone of the first order.

In the same document and following this study,, the *Concejo del Municipio de Zaruma*[5] decreed the *"Ordenanza para el centro histórico de Zaruma"* (Instituto Nacional de Patrimonio Cultural, Pallares, and Arcos 1981), to regulate the execution of consolidation, repair, restoration, and maintenance works and aspects of conservation and construction in the historic center. This ordinance includes the delimitation of protection zones by adding to the first-order zone a control or respect zone in the old urban structure and an urban landscape protection zone, standards of performance and control in the protection zones with definitions of technical terminology, and general regulation according to each defined area.

Finally, the same document includes a guide, *"For the drafting of the Ordinance for the Protection of Historic Centers, Areas and Sites belonging to the Cultural Heritage"*, which describes following the current

5 Council of the Municipality of Zaruma.

Figure 3: Delimitation Plan. Area of First Order and Area of Influence. (Departamento de Arquitectura y Centros Históricos and INPC 1986)

Cultural Heritage Law, the chapters, and topics to be included by the municipalities to obtain the approval of the INPC.

As a part of a delimitation study of the Departamento de Arquitectura y Centros Históricos of the INPC in 1986, the delimitation plan shows the edifications protected by the Cultural Patrimony Law and the First Order and Influence Areas mentioned (Figure 3).

In October 1989, the "*Ordenanza para la preservación, protección, control y administración del centro histórico de la Ciudad de Zaruma*" (Ordinance for the Preservation, Protection, Control, and Administration of the Historic Center of the City of Zaruma)(Instituto Nacional de Patrimonio Cultural and Municipio de Zaruma 1989) was issued within which, in addition to the delimitation of protected areas and their levels, a commission of the Historical Center is formed which was to manage the Conservation Plan and request the Declaration as Heritage, keep a register of the buildings to be considered within the Heritage Law, etc. The ordinance also includes regulations on interventions, demolitions, new constructions, and management of spaces intended for commerce, green spaces, public works, and the respective sanctions.

Subsequently, the document "*Delimitación de zonas históricas y edificios declarados bienes pertenecientes al Patrimonio Cultural de Estado*" (Delimitation of historic areas and buildings declared as belonging to the Cultural Heritage of the State) (Instituto Nacional de Patrimonio Cultural 1986) is issued, which includes two versions of the declaration project, the list of properties of the city of Zaruma, to be declared as "Property belonging to the Cultural Heritage of the Nation" and Resolution with the ministerial agreement dated July 17, 1990, where Zaruma was declared as Property belonging to the Cultural Heritage of the nation.

In the above-mentioned document, the delimitation for the declaration is described in the first section considering: the relevance of the habitat-mining nexus and environmental qualities of the area and the need for a comprehensive protection plan that can combat individual interests.

The assessment of the Historical Center is carried out in areas of:

- Historical Value, which considers the buildings built between 1880 and 1930 during the mining economic resurgence but which preserves the continuity of traditional construction techniques such as the *quincha* or *bahareque*[6], the use of traditional materials, and the specific topographic adaptation.
- Landscape environment value, with interest in the natural landscape as a quality since its foundation.
- Urban and Architectural Value, since the city breaks with the checkerboard scheme with its topographic location, the presence of urban elements such as porticoes and staircases, the ornamental wealth in wood, etc., all these characteristics reflect the own typology of Zaruma's architecture.

The second section includes recommendations for interventions in the defined areas, these being:

- For the area of the first order, total conservation, and in the case of non-built areas is required to develop a project integrated into the context,
- In the area of influence, it is impossible to carry out overthrows without the municipality's permission
- At the urban level, the intervention should preserve the traditional character of the layout and the natural environment.
- Landscape management follows the Integral Urban Plan.

6 See Glossary.

The same document includes the Emergent cards for the Inventory of Real Estate Property made in 1986; these consist of the location, schematic planning of the building, state of conservation, type of property, use, and specific observations of each home. All the buildings included in this inventory are marked in Figure 4.

Figure 4: Emergent cards for the Inventory of Real Estate Property map.(Departamento de Arquitectura y Centros Históricos 1986) Re-elaboration by Gualán,S.

1.2.2. World Heritage at UNESCO.

Zaruma, since February 2016, belongs to the tentative list to be considered for nomination as World Heritage at UNESCO under two criteria (Permanent Delegation of Ecuador to UNESCO 2016):

- ***(iv): To be an outstanding example of a type of building, architectural or technological ensemble, or landscape that illustrates (a) significant stage(s) in human history.*** In the case of Zaruma, this corresponds to its organic urban development, atypical for a city of Spanish colonial origin, the wooden construction as a continuity of pre-Conquest building traditions, influenced by the colonial epoch and the 19th century, and that following formal building codes. Another example is the mining galleries such as El Sexmo, representing a unique and significant period of cities and human activity in the 19th century and the first third of the 20th century.
- ***(v): to be an outstanding example of a traditional human settlement, land-use, or sea-use, which is representative of a culture (or cultures) or human interaction with the environment, especially when it has become vulnerable under the impact of irreversible change.*** For Zaruma, it is its identity as a mining city, an exceptional example of a human settlement, plus a mountainous setting with irregular topography. This also becomes the reason for its vulnerability because of the underfoot mines that get in contraposition with the buildings made mainly of wood. This conflicting interaction with the environment and the pressure of new ways of life could confront Zaruma with irreversible changes.

The documentation presented as support for this nomination is developed using as a starting point the Conservation and Management Plan of the historical Center developed in 2004.

1.3. Conservation and Management Plan of The Historical Center of Zaruma.[7]

This plan is developed to protect and preserve the heritage of the Zaruma region through joint work between the local government and its inhabitants. The policies that direct this plan are oriented towards the conservation of the value and special characteristics of the natural and cultural patrimonies through strategies of integral development; its main objective is to preserve and enhance the urban and natural complex of Zaruma as a symbol and reference for the identity of its community, through the recovery and maintenance of its assets and values, aimed at development and tourism, that allow the incorporation of the community as protagonist and co-responsible for the generational transmission of these goods and values.

Regarding the specific policies of action for the conservation and development of historic areas, these determine that the areas identified as natural and cultural heritage are vulnerable and sensitive to their disappearance. Therefore, its development and maintenance fall mainly on public institutions, which must also encourage the community to assume a progressive responsibility to become its heritage's main actor and guardian.

1.3.1. Identification and Zone Division of the Territory.

CANTONAL AREA OF HERITAGE PROTECTION

It has been determined as a protection area to the peripheral territory of Zaruma, bounded by the rivers Calera and Amarillo to the east and west, respectively, and the south and the hills to the north of the canton Portovelo. The extension corresponds with a total of 1892.80 hectares within which the urban and rural areas are differentiated; within these are the Zones of First Order, Second Order, and Expansion (in the urban area); and Agricultural and Natural Protection (in the rural area).

- The URBAN AREA corresponds to the territory within limits established by the municipality with an area of 166,5425 hectares. (Figure 5)
- The FIRST ORDER ZONE is formed by blocks numbered from 1 to 15, whose total area is 13,9629 hectares, constituting an urban architectural complex that needs to be protected integrally.
- The SECOND ORDER ZONE corresponds to eight blocks numbered from 16 to 23 (67,5789 ha), including urban gardens, natural slopes, and riverbeds, where there are several groups and architectural units. The natural area will be completely protected and strengthened, and its architectural elements will be protected and enriched as landscape ensembles.
- ZONE OF URBAN EXPANSION, where the most recent growth of the city has occurred. It is divided into six blocks numbered 24 to 29 (85,0007 ha), most of which still maintain a predominantly forest landscape of species characteristic of the region. This area will strengthen and protect the natural landscape and will preserve the scattered architectural heritage elements.
- The RURAL AREA is the protected territory outside the Urban Areas with 1726.26 Has.
- The AGRICULTURAL ZONE corresponds to 378.62 Has. Due to its topographical characteristics, agricultural and livestock work can be developed, favoring the formation of forest crops.
- The NATURAL PROTECTION ZONE consists of the eastern and western slopes of the area, formed by the rivers Calera and Amarillo (1347.63 Ha), which contain most of the mining activity in the region,

7 "Plan de Conservación y Gestión del Centro Histórico de la ciudad de Zaruma" (Gobierno Autónomo Descentralizado de Zaruma and Guido Diaz & colaboradores asociados 2003)

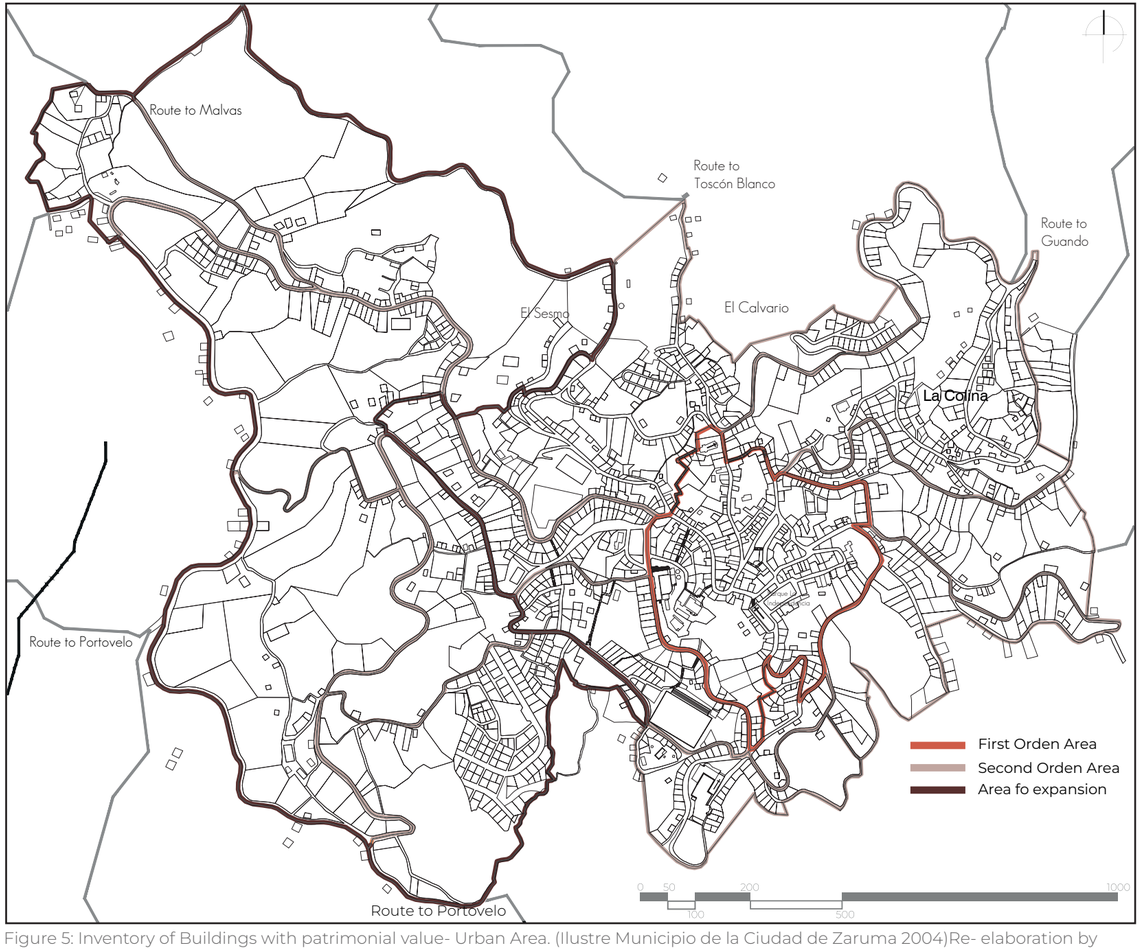


Figure 5: Inventory of Buildings with patrimonial value- Urban Area. (Ilustre Municipio de la Ciudad de Zaruma 2004)Re- elaboration by Gualán,S.

and that is why it receives the most negative impacts on its landscape, both through deforestation and land movements for the construction of roads and facilities, as from the deposit of mining waste and debris.

1.3.2. Survey, Inspection, and Catalogue of Heritage Buildings

Before the development of the conservation plan of the historic center, in 2003, a detailed record of the situation of the heritage buildings was made through an uprising, inspection, and cataloging of these through cards that also allowed access to the individual needs of each building.

MUNICIPIO DE ZARUMA/ PROYECTO PATRIMONIO DE LA HUMANIDAD

FICHA DE LEVANTAMIENTO DE INFORMACION A	CODIGO:L	Z-003	EVANTAMIENTO		REVISO	
DIRECCION	LA INDEPENDENCIA					
NOMBRE DEL PROPIETARIO	VALVERDE LUIS				TELEFONO	

¿VIVE EL PROPIETARIO EN LA CASA? SI [ ] EN ZARUMA [ ] EN LA PROVINCIA [ ] EN EL ECUADOR [ ] FUERA DEL ECUADOR [ ] NO SE SABE [ ]

EL PROPIETARIO ES: P. NATURAL [XE] STADO [ ] PROVINCIAM [ ] UNICIPIO [ ] RELIGIOSA [ ] ASOCIACION [ ] OTRO [ ]

LA PROPIEDAD SE ADQUIRIO POR: COMPRA [ ] OTRA ESPECIFIQUE: HERENCIA

LA EDIFICACIÓN ESTA UTILIZADA EN:				
3 PISO ALTO				
2 PISO ALTO				
1 PISO ALTO	4 BODEGAS	OFICINA		
PLANTA BAJA	CORREO	CONSULTORIO DENTAL	CONSULTORIO MEDICO	
1 SUB SUELO	COMERCIO	BAZARB	ODEGA	
2 SUB SUELO				
3 SUB SUELO				

LA GALERIA O PORTAL ESTA UTILIZADO EN:
LAS AREAS EXTERIORES ESTAN UTILIZADAS COMO:

AÑO APROXIMADO DE CONSTRUCCIÓN

0-1800	
1800-1900	
1900-1925	
1925-1950	
1950-1975	
1975-2000	
2000 - +	

ESTADO

BUENON	
REGULARB	
MALO	
EN RUINASA	

INTERVENCIONES EN LA EDIFICACIÓN

INCUNA	
AJAS	
MEDIAS	
LTAS	

SERVICIOS	BUENO	REGULAR	MALO	NO TIENE	COMENTARIO
CALLE	X				
AGUA POTABLE	X				
ALCANTARILLADO	X				
ENERGIA ELECTRICA	X				
TELEFONOS	X				
RECOLECCION DE BASURAS	X				
SERVICIOS HIGIENICOS PRIVADOS	X				
SERVICIOS HIGIENICOS COMUNES DE LA CASA					
LAVANDERIA PRIVADA					
LAVANDERIA COMUN DE LA CASA					

DATOS SOBRE LA VIVIENDA

NUMERO DE FAMILIAS	13	2		4	5	6	7
TIEMPO DE PERMANENCIA DE LA FAMILIA EN LA VIVIENDA							
VARONES MAYORES DE 15 AÑOS							
VARONES ENTRE 5 Y 15 AÑOS							
VARONES MENORES DE 5 AÑOS							
MUJERES MAYORES DE 15 AÑOS							
MUJERES ENTRE 5 Y 15 AÑOS							
MUJERES MENORES DE 5 AÑOS							

NIVEL DE SATISFACCION DEL USUARIO	SIN	MAS O MENOSN	O	QUIERE IRSE	PORQUE
LE GUSTA LA CIUDAD	X				
LE GUSTA EL BARRIO					
LE GUSTA SU CALLE					
LE GUSTA SU CASA					
LE GUSTA SU DEPARTAMENTO O LOCAL					

Figure 6: Survey Card example, from house code Z-003. Sides A & B. (Municipalidad de Zaruma and Guido Díaz & consultores asociados 2003d)

FICHA DE LEVANTAMIENTO ELEMENTOS ARQUITECTÓNICOS CENTRO HISTÓRICO ZARUMA B

ELEMENTOS			MATERIALES																UBICACION						
			LADRILLO /BLOQUE	BAHAREQUE/TAPIA	TIERRA/ADOBE	MADERA	HORMIGÓN / CEMENTO	CERÁMICA	ALUMINIO	AL ÓLEO	PINTURA CAUCHO	PAPEL TAPIZ	CAL	HIERRO	PIEDRA	TEJA	ASBESTO	ZINC	3 SUBSUELO	2 SUBSUELO	1 SUBSUELO	PB	1 PISO ALTO	2 PISO ALTO	3 PISO ALTO	4 PISO ALTO
FACHADA A LA CALLE PRINCIPAL	ACABADOS	PANO LISO			1																	1	1		
		CON MOLDURAS			1																	1			
		DECORACION			1						1											1	1		
		PINTURA MURAL									1											1	1		
	PORTALES O GALERÍAS	ABIERTA				1																1			
		CERRADA																							
	BALCONES	EMPOTRADOS			1																1				
		SOBRESALIDOS																							
	VANOS	RECTOS/DINTEL			1																	1			
		CON ARCOS			1																		1		
		CHAFLAN																							
		OTROS																							
	REMATES	ALERO			1																	1	1		
		ANTEPECHO																							
		CORNISA			1																	1	1		
		BALAUSTRADA			1																		1		
	CUBIERTA	INCLINADA																							
		HORIZONTAL																				1			
FACHADAS INTERIORES	ACABADOS	PANO LISO	2			1															2	2	1		
		CON MOLDURAS				1																1	1		
		DECORACION				1															1	1	1		
		PINTURA MURAL									1										1	1	1		
	PORTALES O GALERÍAS	ABIERTA					1														1				
		CERRADA			2																		2		
	BALCONES	EMPOTRADOS			1																	1	1		
		SOBRESALIDOS																							
	VANOS	RECTOS/DINTEL			1																1	1	1		
		CON ARCOS			1																		1		
		CHAFLAN																							
		OTROS																							
	REMATES	ALERO			1																	1	1		
		ANTEPECHO																							
		CORNISA			1																	1	1		
		BALAUSTRADA			1																	1	1		
	CUBIERTA	INCLINADA																							
		HORIZONTAL																				1			
ESTRUCTURA	ENTREPISO				1	2															2	1	1		
	MUROS		2	1		1															2	1	1		
	COLUMNAS					1	1														1	1	1		
	VIGAS				1	2															1	1	2		
	ARCOS																								
	CUBIERTA				1																	1			
	ESCALERA				1																	1	1		
ACABADOS	PISOS					1	2														2	1	1		
	TECHOS						1									1							1		
	PUERTAS					1															1	1	1		
	VENTANAS					1																1	1		
	ENLUCIDOS			2		1															1	3			

Simbología		
	Madera	1
	Hormigón/cemento	2
	Mixta	3
	Tierra	4

SURVEY CARD

This card (Figure 6) registers construction, function, typology, and urban image information. It analyzes two aspects, the first is the general data of the property (address, owner, current uses by floors, year of construction, services, etc.), and the second contains the architectural elements adopted most frequently from the buildings.

These elements are indicated according to their material and location and are also classified into four significant components: first, the main façade and the interior or rear façade, both considering specific finishes, galleries, balconies, openings, finishings, and roof, then comes the constructive solution, analyzing mezzanine, walls, columns, beams, arches, ceiling, and staircase; and finally general finishes of the building.

The materials mentioned are related to the appearance of the elements and their mechanical and/or aesthetic characteristics, being considered the ones that are most frequently used like brick/block, bahareque, adobe, wood, concrete, ceramic, oil, paint rubber, lime, iron, stone, tile, asbestos, or zinc.(Municipalidad de Zaruma and Guido Díaz & consultores asociados 2003b)

INSPECTION CARD

This card, (Figure 7) divided into two parts, will serve to qualify the conservation status of the buildings as a starting point to obtain the levels of intervention and costs necessary for the recovery of the property. Objective criteria have been proposed in the card, eliminating aesthetic evaluations; these will be qualified based on scores that will determine the range in which they are.

Initially, 3 aspects are recorded: General data, the current uses, with their distribution and areas, and finally, the physical evaluation of the building where the affectations are divided into decays and typological alterations for each architectural element, also indicated according to the floor in which they are located. This first evaluation assigns a total score representing the state of conservation; this is used as a base to determine the level of intervention with the cost per square meter corresponding to each.

It also records the location and sketches of the evaluated building, indicating specific characteristics of it and its dimensions. The intervention level by plants and exterior areas, the constructed surface to be intervened, and the intervention cost per square meter are specified. (Municipalidad de Zaruma and Guido Díaz & consultores asociados 2003b)

MUNICIPIO DE ZARUMA CENTRO HISTORICO
FICHA DE INSPECCIÓN (1)

01 DATOS GENERALES	CALLE	LA INDEPENDENCIA	No.	17-19
No. DE FICHA DE INVENTARIO	Z-003	NOMBRE DEL PROPIETARIO		FECHA DE INSPECCION
LEVANTADO POR:	MERY IÑIGUEZ	VALVERDE LUIS		14/04/2003

02 UBICACIÓN DE PLANTAS, AREAS Y USOS ACTUALES

	PL. BAJA	USO ACT.	1 PISO ALTO	USO ACT.	2 PISO ALTO	USO ACT.	3 PISO ALTO	USO ACT	TOTAL AREAS POR	SUBSUELO 1	USO ACT.	SUBSUELO 2	USO ACT.	SUBSUELO 3	USO ACT.	TOTAL SUBSUELOS	AREA DE PORTAL	AREA DE PASAJE	AREA DE GALERIA
AREA NETA	103,76		149,29		14,83		-		267,88	73,33		-		-		73,33	66,14	-	-
A.N.C.																	AREA TOTAL CONSTRUIDA	CONSTRUIDA EN SOLAR	AREA TOTAL DEL LOTE
SUB TOTA									267,88							73,33	407,35		

03 EVALUACION FISICA DE LA EDIFICACION

AFECTACIONES — DEFECTOS: DEFORMADO, DESPRENDIDO, PUDRICIÓN, ASENTAMIENTO, OXIDACION, APOLILLADO, HUMEDAD, RAJADURAS, PLANTAS Y MUSGOS, IMPROVISADAS, AUSENCIA DE INSTALA; ALTERACIONES TIPOLOGICAS: SIN CONT. ESTRUCT, AÑADIDOS, MATERIAL, CAMBIO DE FORMA, ALTERACION DIMENSIONAL, PENDIENTE, OCUPACION, CAMBIO DE NIVELES, MODIF DE VANOS, OCULTA, CAMBIO DE UBICACIÓN

ELEMENTOS / EDIFICACION		DEFORMADO	DESPRENDIDO	PUDRICIÓN	ASENTAMIENTO	OXIDACION	APOLILLADO	HUMEDAD	RAJADURAS	PLANTAS Y MUSGOS	IMPROVISADAS	AUSENCIA DE INSTALA	SIN CONT. ESTRUCT	AÑADIDOS	MATERIAL	CAMBIO DE FORMA	ALTERACION DIMENSIONAL	PENDIENTE	OCUPACION	CAMBIO DE NIVELES	MODIF DE VANOS	OCULTA	CAMBIO DE UBICACIÓN
ESCTRUCTURA	MUROS PORTANTES	1 2	1 2					0 1 2	1 2	1 2													
	TABIQUES INTERIORES Y		1 2	1 2			1	1 2	1 2	1													
	COLUMNAS Y PILARES								0 1 2														
	VIGAS								0 1 2														
CUBIERTA	CUBIERTA					2				2													
	CIELO RASO								0 1 2					2						2			
AREA LIBRE	AREA VERDE																						
	GALERIAS																						
ACABADOS	ENLUCIDOS		0 1 2						0 1 2														
	PINTURA DECORATIVA		0 1 2						0 1 2														
	PUERTAS Y VENTANAS	2	0 2	2			2		0 1 2														
	PISOS		1 2	1 2	2		1 2	1 2	1 2														
INSTALACIONES	ELECTRICAS		0 1 2								0 1 2												
	SANITARIAS		0 1						1		0 1 2												
AREA EXTERIORES / AREA ABIERTA	PASAJE											0											
	PORTAL		0				0	0	0		0	0											

EVALUACION POR PISOS

ELEMENTO	P BAJA (0) TOTAL EVALUACION	PUNTAJE	1 PISO (1) TOTAL EVALUACION	PUNTAJE	2 PISO (2) TOTAL EVALUACION	PUNTAJE	3 PISO (3) TOTAL EVALUACION	PUNTAJE	SUBS 1 (-1) TOTAL EVALUACION	PUNTAJE	SUBS 2 (-2) TOTAL EVALUACION	PUNTAJE	SUBS 3 (-3) TOTAL EVALUACION	PUNTAJE
MUROS PORTANTES	1	1	5	2	5	2	-	-	-	-	-	-		
TABIQUES INTERIORES Y	-	-	6	4	4	2	-	-	-	-	-	-		
COLUMNAS Y PILARES	1	2	1	2	1	2	-	-	-	-	-	-		
VIGAS	1	1	1	1	1	1	-	-	-	-	-	-		
CUBIERTA	-	-	-	-	2	5	-	-	-	-	-	-		
CIELO RASO	1	4	1	4	3	4	-	-	-	-	-	-		
AREA VERDE	-	-	-	-	-	-	-	-	-	-	-	-		
GALERIAS	-	-	-	-	-	-	-	-	-	-	-	-		
ENLUCIDOS	2	5	2	5	2	5	-	-	-	-	-	-		
PINTURA DECORATIVA	2	2	2	2	2	2	-	-	-	-	-	-		
PUERTAS Y VENTANAS	2	2	1	2	5	5	-	-	-	-	-	-		
PISOS	-	-	5	8	6	8	-	-	-	-	-	-		
ELECTRICAS	2	2	2	2	2	2	-	-	-	-	-	-		
SANITARIAS	2	2	3	2	1	2	-	-	-	-	-	-		
PUNTAJE TOTAL DE LA EDIFICACIÓN		21		34		40		-		-		-		-
CATEGORIA		R		R		R		-		-		-		-

OBSERVACIONES		PISO BLOQ	M2	PISO BLOQ	M2	POTENCIALIDAD DE CONSTRUCCION
	A DEMOLER					UBICACIÓN
	A RECONSTRUIR					

AREA EXTERIORES						TOTAL EDIFICACIÓN	32 / R
PASAJE	1	21	-	-	21	R	
PORTAL	6	33	-	-	33	R	

ÁREAS EXTERIORES		
PASAJE	21	R
PORTAL	33	R

NOTAS REFERENTE PASAJE Y PORTALES

* DEFORMADO = PERDIA CONDICIONES CONSTRUCTIVAS

MUNICIPIO DE ZARUMA CENTRO HISTORICO
FICHA DE INSPECCION (2)

SIMBOLOGIA 02		03.2 PUNTAJE PARA CATEGORIA
U.A = USO ACTUAL	S= SERVICIOS	1 a 20 Puntos = Bueno (B)
V= VIVIENDA	H= HOTEL	21 a 40 Puntos = Regualar ®
DH = DESHABITADO		41 a 100 Puntos = Malo (M)
B= BODEGA		
COM = COMERCIO		

03.1 PUNTAJE PARA EVALUACION FISICA

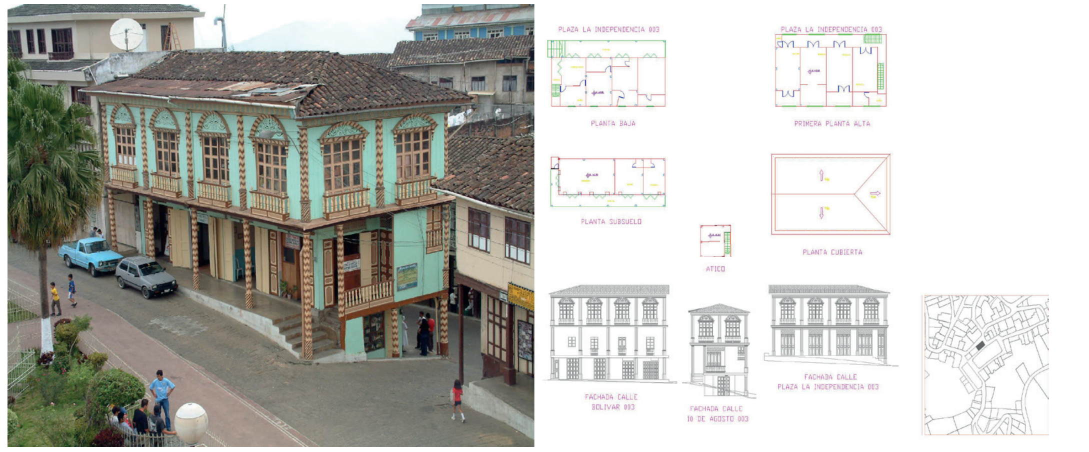
ESTRUCTURA: MUROS N* / P	TABIQUES N* / P	COLUM-PIL N* / P	VIGAS N* / P	CUBIERTA: CUBIERTA N* / P	CIELO RASO N* / P
1 a 3 = 1	1 a 5 = 2	1 a 4 = 2	1 a 3 = 1	1 a 2 = 5	1 a 3 = 4
4 a 6 = 2	6 a 10 = 4	5 a 8 = 4	4 a 6 = 2	3 a 5 = 12	4 a 7 = 9
7 a 9 = 3	11 a 16 = 6	9 a 13 = 6	7 a 10 = 4	6 a 8 = 20	8 a 11 = 15

AREA LIBRE: AREA VERDE N* / P	GALERIAS N* / P	ACABADOS: ENLUCIDOS N* / P	PINT DECOR N* / P	PUERT-VENT N* / P	PISOS N* / P
1 a 3 = 2	1 a 3 = 2	1 a 3 = 5	1 a 3 = 2	1 a 4 = 2	1 a 4 = 4
4 a 5 = 3	4 a 6 = 4	4 a 5 = 9	4 a 6 = 4	5 a 8 = 5	5 a 9 = 8
				9 a 11 = 8	10 a 13 = 12

INSTALACIONES: ELECTRICA N* / P	SANITARIA N* / P	ELEMENTOS EXTERIORES: PASAJE N* / P	PORTALES N* / P	SIMBOLOGIA
1 a 3 = 2	1 a 3 = 2	1 a 3 = 21	1 a 5 = 16	N* NUMERO DE AFECTACIONES
	4 a 5 = 3	4 a 7 = 50	6 a 10 = 33	P PUNTAJE
			11 a 15 = 50	

05 NOTAS GENERALES

04 CROQUIS DE LA EDIFICACION



06 COSTO TOTAL DE LA INTERVENCION EN EDIFICACION

PISO	CATEGORIA B	R	M	NIVEL INTERVENCION L	M	A	SUPERFICIE A INTERVENIR	INTERVENCION EN DOLARES	INTERVENCION DOLARES	COSTO POR METRO CUADRADO DE INTERVENCION
0 PLANTA BAJA	-	X	-	-	X	-	103,76	5.914,32	5.914,32	
1 PISO ALTO	-	X	-	-	X	-	149,29	8.509,53	8.509,53	
2 PISO ALTO	-	X	-	-	X	-	14,83	845,31	845,31	
3 PISO ALTO	-	-	-	-	-	-	-	-	-	
1 SUBSUELO	-	-	-	-	-	-	73,33	-	-	
2 SUBSUELO	-	-	-	-	-	-	-	-	-	
3 SUBSUELO	-	-	-	-	-	-	-	-	-	
DEMOLICION									-	
RECONSTRUCCION									-	
				SUBTOTALES 06			341,21		15.269,16	44,75

06.1 CATEGORIAS DE INTERVENCION Y COSTOS

CATEGORÍA CONSERVACION	NIVEL DE INTERVENCION		COSTOS DE INTERVENCION
B	L	LEVE	19 USD
R	M	MEDIO	57 USD
M	A	ALTO	196 USD
	D	DEMOLICION	23 USD
	RC	RECONSTRUCCION	204 USD
	ON	OBRA NUEVA	

07 COSTO TOTAL DE INTERVENCIONEN AREAS EXTERIORES

	B	R	M	L	M	A	SUPERFICIE A INTERVENIR	INTERVENCION EN DOLARES	INTERVENCION DOLARES	COSTO POR METRO CUADRADO DE INTERVENCION
PASAJE	-	X	-	-	X	-	-	-	-	
PORTAL	-	X	-	-	X	-	66,14	2.447,18	2.447,18	
				SUBTOTALES 07			66,14		2447,18	
08 COSTO DE LA INTERVENCION							407,35		17.716,34	43,49

7.1 CATEGORIA, NIVELES DE INTERVENCION Y COSTOS

B	L	LEVE	17 USD
R	M	MEDIO	37 USD
M	A	ALTO	47 USD

Figure 7: Inspection Card Example. from house coded Z-003. Sides A and B. (Municipalidad de Zaruma and Guido Díaz & colaboradores asociados 2003b)

STATE OF CONSERVATION

As mentioned before the state of conservation is determined by the decays and alterations of the buildings, the value of every item depends on how much it affects the general welfare of the building, thus being the most important de decays present on the rooftop, structure elements like columns, beams, or walls with a 70% weight on the overall score. The other elements are related to the general alteration of the building like exterior elements or finishings that give the visual character to the buildings, the passages, or porticoes.

The final classification determines three levels of conservation, these can be either Good, Regular, or Bad, as represented in Figure 8, implying the possibilities of typological recovery depending on each level.(Gobierno Autónomo Descentralizado de Zaruma and Guido Diaz & colaboradores asociados 2003) A good state of conservation means a well-preserved structure and roof and minor damages on the finishings; then a medium one corresponds with a higher level of alterations but still a good preservation of the structure, which may present some issues with the roofing. A bad state of conservation implies structural damage, instability, and irreversible alterations to the general state of the house.

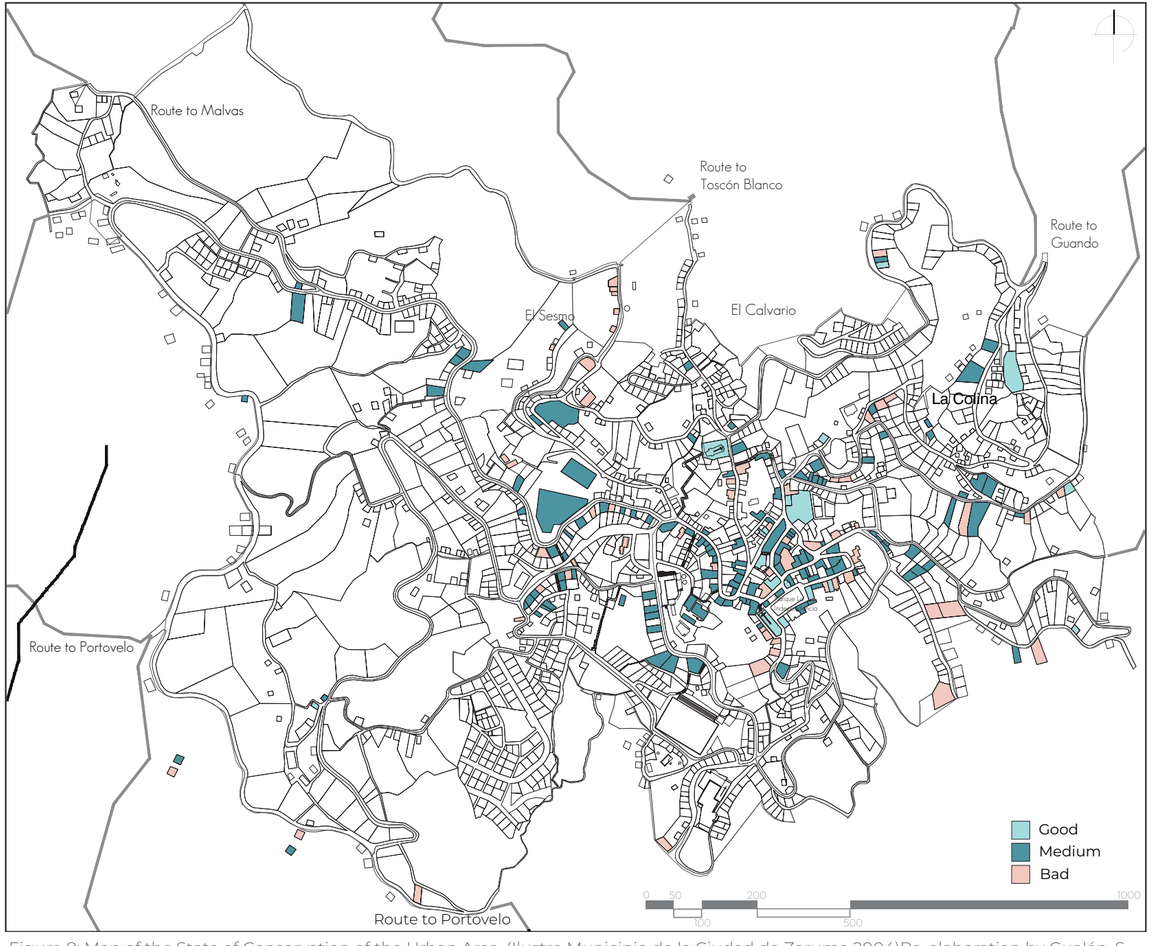


Figure 8: Map of the State of Conservation of the Urban Area. (Ilustre Municipio de la Ciudad de Zaruma 2004)Re-elaboration by Gualán, S.

LEVEL OF INTERVENTION

These levels were established to classify the amount of work and cost by a square meter that each building needs to be restored and rehabilitated. This considers the State of conservation results of the evaluation of the physical decay and typological alterations.

This classification allowed to establish of a protection catalog for the heritage building to limit future interventions, and it is divided into Low, Medium, and High levels (Figure 9), corresponding respectively to the levels of Good, Regular, and Bad of the state of conservation.

The costs established in US dollars per square meter of intervention for the buildings, in the year 2002 are: Low = $ 19, Medium = $ 57, High = $ 196, Demolition = $ 23, Reconstruction and New Construction = $ 204, and for external areas is: Low = $ 17, Medium = $ 37, High = $ 47[8].((Gobierno Autónomo Descentralizado de Zaruma and Guido Diaz & colaboradores asociados 2003)

8 According to the source, the prices obtained in this study come from market research in Zaruma and from information provided by the Municipality of Zaruma (Planning Department) of interventions carried out mainly in new constructions.

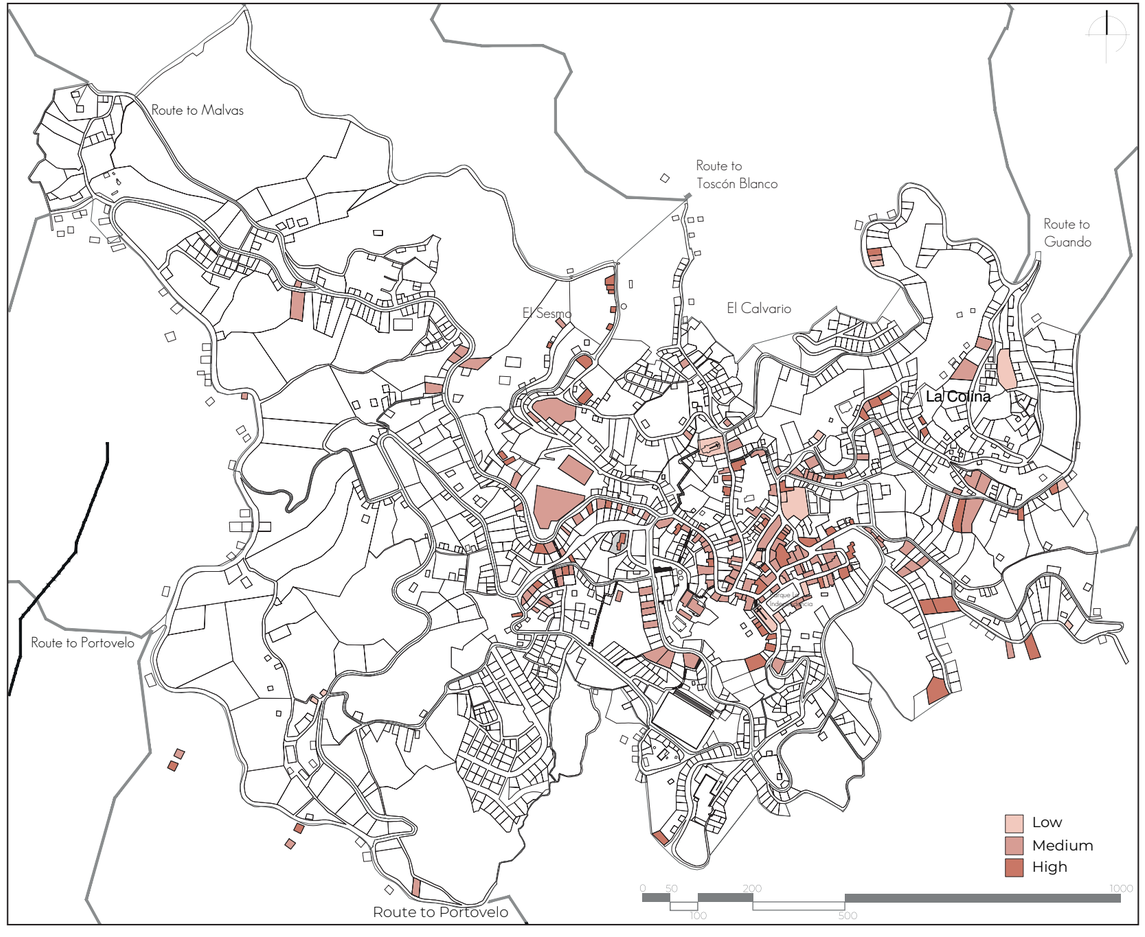


Figure 9: Level of Intervention of Patrimonial Edification Map. (Ilustre Municipio de la Ciudad de Zaruma 2004) Re-elaboration by Gualán, S.

CATALOGUE CARD

The catalog card shall be applied to each property inventoried to determine the degree of protection and the elements and areas to be protected (Figure 10). Considering the characteristics of the facade of the building and its integration with the urban complex as well as the typological value of the architecture of Zaruma either from its constructive system (bahareque and wood), ornamental elements, the color of the painting of the facades and the presence of porticoes, being considered of lesser value if presented a mixture with contemporary materials.

The value by meaning is attributed to being monuments and/or buildings of special interest, which represent a technological testimony, an urban landmark, or due to its location. The dating of the buildings is classified as those built until the 30s, then those between the 30s and 50s, and finally buildings from the 50s, being the oldest considered of greater value.

Four levels of protection are established: Absolute protection (PA), Partial protection (PP), and Overall protection (Grades C and D) for buildings that have lost their characteristics due to being completely transformed, or to maintain only facades that have a value of integration to the whole and buildings without protection (SP).

FICHA DE CATALOGACIÓN

EDIFICIO No	Z-003	Mz	2	PROPIETARIO	VALVERDE LUIS	DIRECCIÓN	LA INDEPENDENCI

ENTORNO							VALOR TIPOLÓGICO																			SIGNIFICADO					DATACIÓN			TOTAL	NIVEL PROT	GRADO
ITAV	ITAVM	N ITAV	ITMV	ITMVM	NITMV	ITB	CP		CP		CP		CP		SP		SP		SP		SP		SP			Mo	TT	HU	TI	NS	30	50 mSD				
6	4	2	5	3	0	1	MT	5	MT	4	MX	3	MX	2	MT	5	MT	4	MX	3	MX	2	MC	3		5	4	3	2	1	4	3	2	20	18-20 PA	X	
X							AED	X	PED		AED		PED		AED		PED		AED		PED		ED			X					X				17-7 PP	-	PA
6	-	-	-	-	-	-		5		-		-		-		-		-		-		-		-		5	-	-	-	-	4	-	-	20	6-0 SP	-	

TIPO DE PROTECCIÓN		ZONAS Y ELEMENTOS A PROTEGER				OTROS (especificar)
ABSOLUTA	X	FACHADA PRINCIPAL	X	puertas	X	
REHABILITACIÓN		FACHADA POSTERIOR	X	ventanas	X	Pintura mural
MODIFICACIÓN CONDICIONADA		PORTAL	X	molduras	X	Sistema de ventilación
PROTECCIÓN FACHADA FRONTAL		GALERÍA		balcones	X	Cielo raso
PROTECCIÓN FACHADA POSTERIOR		ÁREAS VERDES/VEGETACIÓN		aleros	X	OBSERVACIONES
RECUPERACIÓN	X	SISTEMA CONSTRUCTIVO	X	color	X	
CATALOGACIÓN NEGATIVA		CUBIERTA	X	pisos madera	X	
				material fachada	X	

SIGNIFICADO		ENTORNO		VALOR TIPOLÓGICO					
Mo	monumento y edif de interés	ITAV	integ trecho alto valor, única valor arq.	SP	casa sin portal	SP	casa sin portal	CP	casa con portal
TT	Testimonio tecnológico	ITAVM	integ trecho alto valor arq media o baja	MT	mat. Trad.	MX	materiales mixtos	MT	materiales tradicionales
HU	hito urbano	N ITAV	no integrada en trecho de alto valor	AED	elem decorativos valor	PED	pocos elem decorativos	PED	pocos elem decorativos
TI	en trecho de alto sign	I TMV	integ trecho medio valor, única valor arq.	SP	casa sin portal	SP	casa sin portal	CP	casa con portal
NS	sin significado	ITMVM	integ trecho medio valor arq media o baja	MT	mat. Trad	MC	materiales contemporáneos	MX	materiales mixtos
		NITMV	no integrada en trecho medio valor	PED	pocos elem decorativos	ED	elementos decorativos	AED	elem decorativos valor
		I TB	trecho bajo valor, valor arq.	SP	casa sin portal	CP	casa con portal	CP	casa con portal
				MX	materiales mixtos	MT	materiales tradicionales	MX	materiales mixtos
				AED	elem decorativos valor	AED	elem decorativos valor	PED	pocos elem decorativos

Figure 10: Catalogue Inspection Card Example. from house coded Z-003. (Municipalidad de Zaruma and Guido Díaz & colaboradores asociados 2003a)

PROTECTION CATALOGUE OF HERITAGE BUILDINGS.

Four levels of intervention (Figure 11) were established For this area: “0” for buildings out of inventory and “1”, “2,” and “3” for inventoried buildings for which there is specified intervention allowed by their catalog cards.

– **Level 1. Absolute protection Buildings (PA):** This level corresponds to those that by their architectural characteristics are unique examples that become unrepeatable milestones; whose conservation represents a tangible testimony of an era. The interventions allowed in these buildings are maintenance-oriented conservation, restoration, restructuring, consolidation, reintegration, the release of incompatible elements, and adequacy for special uses. The recommended uses will preferably be those of equipment for social and cultural services, and housing.

– **Level 2. Conditioned Protection buildings.** To this level of protection correspond buildings of architectural and urban value that have undergone transformations of certain importance or because it is imperative that these can adapt to other uses or other construction technologies, certain types of works and levels of intervention are allowed according to the following grades:

- **Grade A: Rehabilitable Buildings with Recovery.** In these buildings the permitted interventions are conservation, restructuring, consolidation, reintegration, the release of incompatible elements, and suitability for new uses, being the predominant factor of the intervention the recovery of typological elements of facade, cover, implantation, and volumetric characteristics. It is also possible to carry out new work as a complement to the functional demands, which must be integrated into the characteristics of both the built and the natural landscape.

- **Grade B. Modifiable Buildings with Conditions.** Formal and functional remodeling is allowed, as extensions and new constructions under the conditions established in the catalog card. Must be protected: the frontal and posterior facades, constructive system, site, volume, and/or specific ornamental and constructive elements. The recommended uses will preferably be for housing, commerce, tourist and administrative services, and service equipment.

– **Level 3. Group protection.** This level corresponds to buildings that have lost their characteristics by being completely transformed, or by maintaining only facades that have integration value to the whole. In these buildings, new construction will be allowed inside except for the facade which will be preserved.

The new constructions will have to be designed considering the characteristics of the whole in height, porticoes, side retreats, height between floors, full/empty, and materials. The allowable uses will preferably be for housing, commerce, tourism and administrative services, and service equipment. This category has a C and D degree:

- **Grade C.** New building maintaining the facade and current height. Demolition of its interiors is allowed.

- **Grade D.** New building with conditions of protection to the whole. It applies to buildings that require renovation to integrate into the whole.

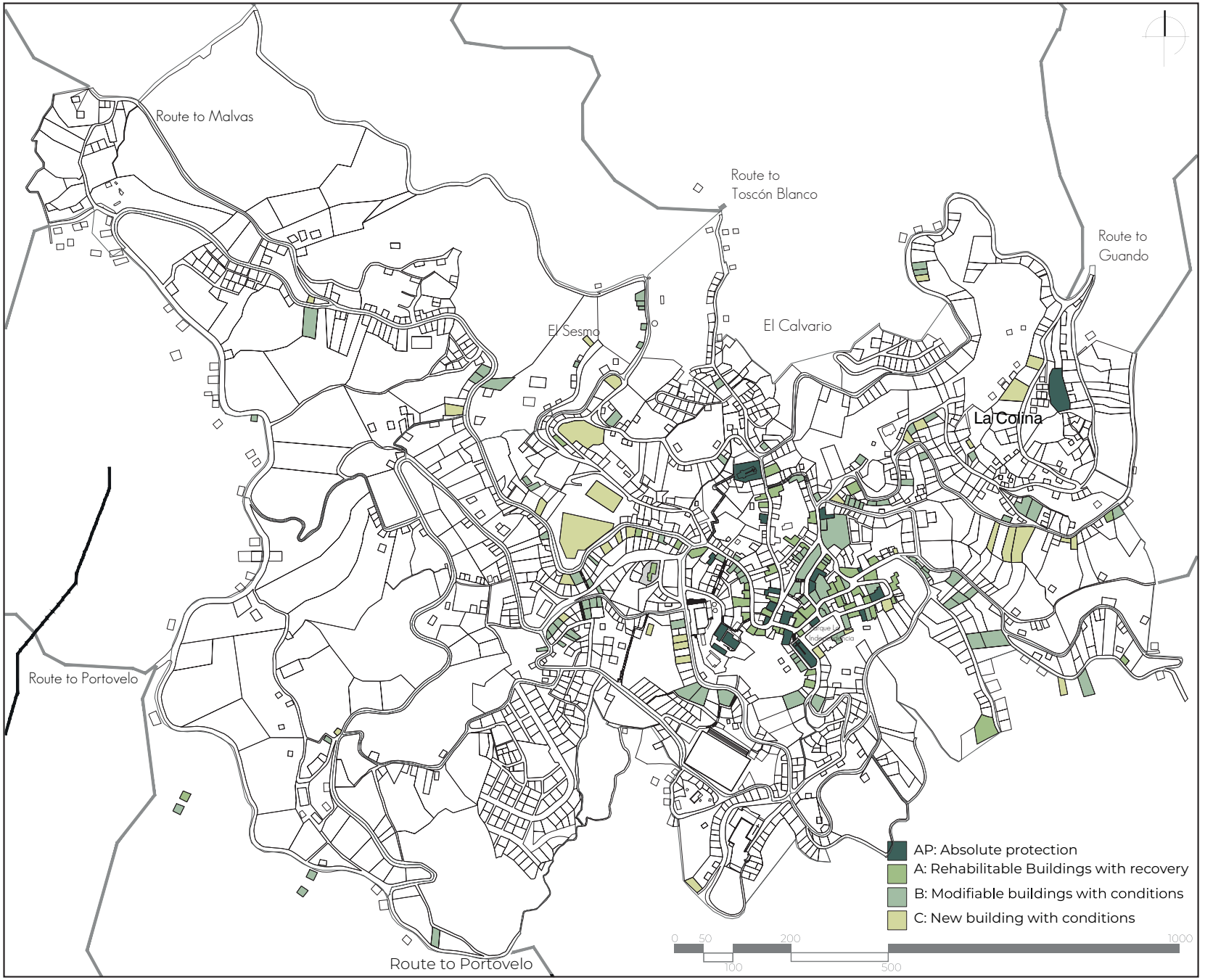


Figure 11: Protection Catalogue of Heritage Building Map.(Ilustre Municipio de la Ciudad de Zaruma 2004) Re-ellaboration by Gualán, S.

2. THE URBAN DEVELOPMENT OF ZARUMA

2.1. Territorial Framework

2.1.1. Seismic Activity

Ecuador is not only a country with very high seismic hazard zones, but its development conditions make the risk of earthquakes very high; the earthquake of April 2016 that mainly affected the cities of Portoviejo, Manta, and Pedernales demonstrated the vulnerability of the country due to the inferior quality of formal and informal construction, the absence of seismic zoning and the lack of preparation from the State to lead an orderly and better reconstruction.

The country is experiencing a rapid process of urbanization in which more than 70% of these dwellings are considered informal construction. This process includes poor construction practices and corruption in the construction sector, both public and private, the use of an unskilled workforce, substandard construction materials, poor quality in control, construction, methods, and practices, in addition to the arbitrary location of buildings in the territories that are not allowed to, without considering the side effects of earthquakes or local effects which increases exposure to danger, increasing risk and vulnerability levels of structures in an unquantifiable manner. It should also be added that formal education and vocational training are often inadequate, deficient, or non-existent in issues related to

the threat and vulnerability of construction and urban planning for seismic environments such as the one the country has (Yepes et al., 2017).

Ecuador is located inside of the “Pacific Ring of Fire”, in this area, the Nazca Plate subdues under the South American Plate at a speed of 60 mm/year and with an approximate East-West direction; this interaction causes forces to accumulate both in the contact zone and the inner part of the continental and oceanic plates, producing very important forces on the edges of both plates[9], , becoming the origin of most of the earthquakes of the country and where fractures occur inside them, producing an extended system of geological faults (Rivadeneira et al., 2007) (Figure 12).

The main active fault system of Ecuador is the Pallatanga- Chingual, which begins in the south in the Guayaquil Gulf, passing through Puná Island, in the valley of Riobamba this path is not evident due to the large amount of recent volcanic material, which covers the evidence of movement; to the north, it goes into the Callejón Andino and continues until it is tied with the Chingual Fault, located to the extreme northeast of Ecuador.

Another system of important faults is located on the sub-Andean edge of the Eastern Andes Mountain range, this one is born of the Chingual fault and goes south passing by the western side of the volcano El Reventador. Then continue to Baeza and continue to the Consanga area.

Towards the east of the Subandean border, there is a system of inverse faults that limit the eastern part of the Andes of the Amazon plain and extends from Colombia, passing through Ecuador and continuing towards Peru composed of a series of faults with different types of movement. Other less extensive fault systems that could affect populated areas are the Quito fault system which shows on the surface a series of aligned hills of low height with an estimated length of 45 km, the Pastocalle- Poaló- Saquisilí system, and the El Angel-San Gabriel fault system (Rivadeneira et al. 2007).

Figure 12 represents also, all the mentioned systems of plates and faults (Instituto Geofísico - Escuela Politecnica Nacional, 2022), along with the registry of earthquakes of Ecuador (International Seismological Centre 2023) that occurred between 1976 and 2018 classified by the magnitude (between 5.0 to 8.0) and depth (from less of 5 km to 400 km), emphasizing the historical earthquakes with a magnitude over 7.0. The most recent earthquakes were in Pedernales-Manabí in September of 2016 with a magnitude of 7.8 and the most recent in March of 2023 with a magnitude of 6.3, while in the cantonal area of Zaruma, the ISC last registry corresponds with the year 1984 with a magnitude of 5.58 and 80.6 km of depth.

2.1.2. Mining Activity

Zaruma canton is part of one of the most productive gold mining districts in southern Ecuador; its exploitation dates from the Spanish Colony. Industrial mining in the Zaruma-Portovelo district began with the foreign company South American Development Company (SADCO), with an exploitation period between 1896 and 1950, which implemented national and international standards required, leaving technically established safety pillars. After its departure, the Ecuadorian government took over the concession with the Associated Mining Industrial Company (CIMA), which operated between 1950 and 1976.

Later, the workspace for the mining activity that left this company was used by inhabitants of neighboring towns, causing the formation of illegal mining groups through appropriations that recovered the still-existing profitable minerals like gold, silver, and copper, which invaded the buffer zone left by SADCO. However, even though since 1980, several of these groups have obtained legalization through mining concessions and grants, anti-technical mining persists, coupled with poor state control, it has allowed the extraction of the mineral resource to ascend indiscriminately to the sur-

9 Annex 2 of *Breves fundamentos sobre los terremotos en el Ecuador* (Brief background on earthquakes in Ecuador) (Rivadeneira et al., 2007) explains in greater detail the types of existing faults using the different fault systems of Ecuador as an example.

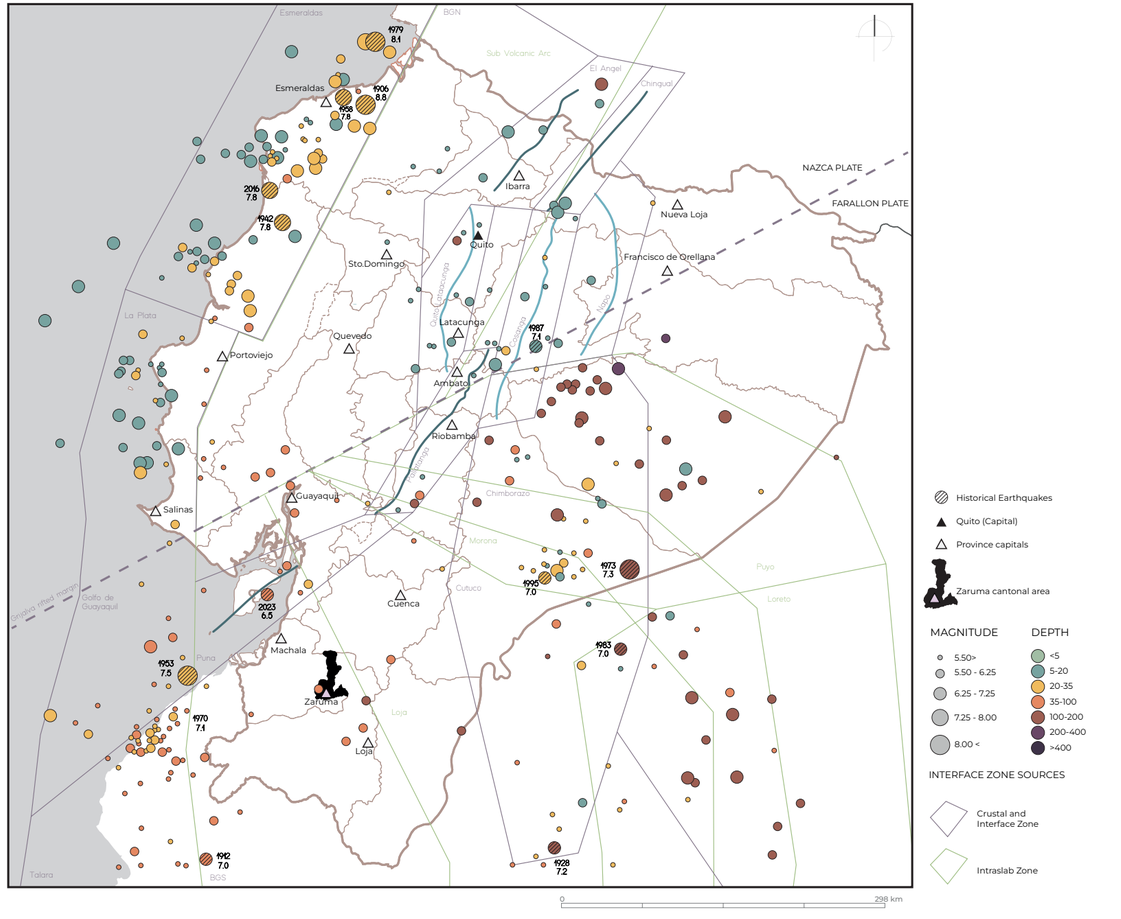


Figure 12: Seismic activity in Ecuador. Elaboration by Gualán, S.(International Seismological Centre 2023; Instituto Geofísico - Escuela Politécnica Nacional 2022)

face, causing the instability of the rock substrate of the city of Zaruma; and associated with conditioning factors (lithology, favorable geological structures, weathering) and triggers (static and dynamic loads by blasts and earthquakes, alteration of the tensional state, infiltration of runoff water), accelerates the phenomenon of subsidence.According to a survey carried out in 2017 by the Mining Regulation and Control Agency (ARCOM), there is approximately 67 Km of mining works that cover the area with galleries located below the Portovelo-Zaruma District (Andagoya et al., 2020).

Due to this high demand for mining activity that was carried out underground in the cities of Zaruma and Portovelo, these began to sink, taking down schools and buildings, this situation has arisen fear in the population about its existence. The rumbling in the cities became more frequent, as part of the phases of prospecting, exploration, exploitation, and smelting carried out in the subsoil for the extraction of mineralized areas. Then the Ministry of Mining of Ecuador (2016) established that this pollution is mainly caused by illegal mining without environmental permits and licenses, which are low technified, and have seriously affected the environment".(Vilela, Espinosa, and Bravo 2020)

Figure 13 represents the galleries and caverns that have been built for illegal mining activity; in addition, the three sinkholes that have affected the

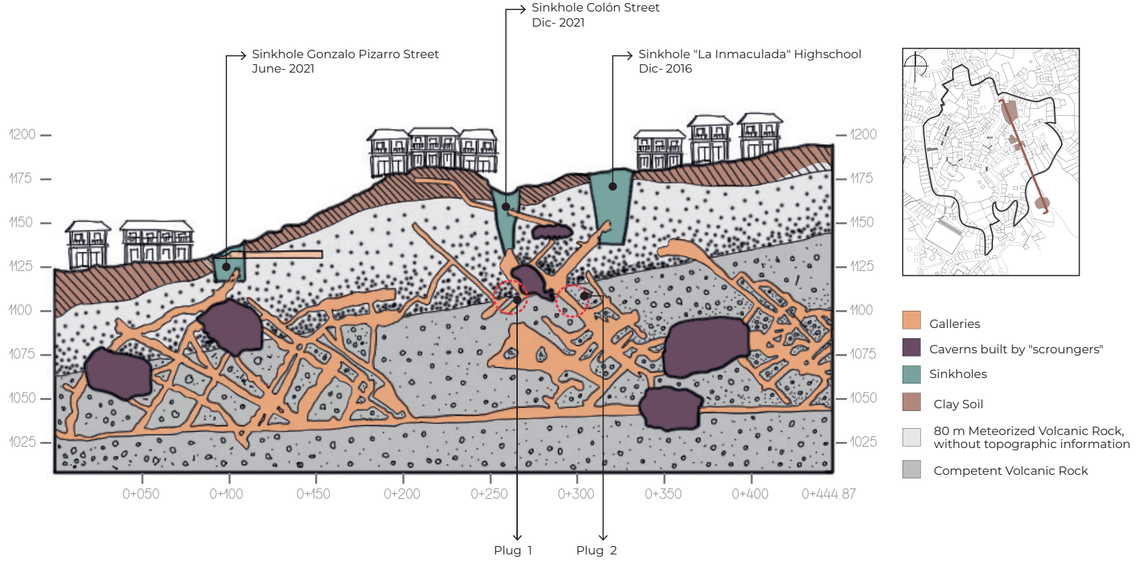


Figure 13: Scheme of the Galleries and Caverns product of Illegal mining.(Vera 2022)

city: the first around "La Inmaculada" high school in December 2016, the second that happened in the street Gonzalo Pizarro in June 2021, and a third on street Colon in December 2021. (Vera 2022) To comprehend the subsidence process in the area it is described the analysis elaborated on the sinkhole from 2016 in "La Inmaculada" High School (Burbano et al. 2021); this considers the factors that led to the situation and the different scenarios since the collapse to its repair.

SINKHOLE OF "LA INMACULADA" HIGH SCHOOL-DECEMBER 2016.

Within the geological-geotechnical investigation of the mining subsidence area of the soil in the high school were analyzed factors that conditioned the ground for the sinking that occurred on October 25, 2016 (Figure 14), and the subsequent collapse of the soil on January 2, 2017. The movement covered about 150 m, considering a total displaced mass of 1050 m² of clay material. It was considered the incidence of superficial and groundwater in the sinking zone and, in the interior of the mine at nearby points to the sinking, water infiltration through geological (faults and fissures) and anthropic structures (mining activity). In addition, approximately 85% of rock weathering was on the surface, so the clay present (9 to 15 m deep) probably did not support the weight of the constructions settled on the surface.

Before the occurrence of the event, residents of the vicinity of the area mentioned that they heard constant detonations in the subsoil and claimed that there was no presence of rain and earthquakes at the time, which supports that the sinking was caused by anthropogenic triggering factors (explosions, vibrations, manual excavations, among other activities), originated by the illegal mining activity located under the city.

In 2017, a two-phase remediation process was carried out by INIGEMM[10], the first involving diagnosis, "IN SITU" data processing, and research to enable the design of

10 Instituto de Investigación Geológico y Energético (Geological and Energy Research Institute)

Figure 14: Aereal photograph of "La Inmaculada" High School Sinkhole of 2016.(Redacción Digital -Ecuavisa 2017)

Figure 15: Photograph of the current state of the land where the school was located.

mitigation works. The second phase corresponds to the remediation, with the construction “IN SITU” of 12 caisson-type piles (structural concrete of 280 kg/cm² with reinforced steel f and:4200 kg/cm²) with an inner diameter of 1.2 m arranged every 3 meters and embedded in the rock on an average depth of 19 m, braced by a fastening beam and a panel of armed structure, which together forms a perimeter structure, whose aim was to stabilize the houses surrounding the sinking zone. Afterward, the interior of the cone is cleaned until it reaches the competent rock, in which a 4 m x 5m plug with armed structure and drainage was built. Finally, the filling of the cavity is with 6,000 m3 of compacted material (sub-base class 3[11]) up to the natural terrain profile.

The proposal does not contemplate the filling of mining excavations with mortar due to the insecurity to build plugs inside the mine because of the illegal work in the mining exclusion zone, the evidence removal of stairs and supporting elements, explosions, and deaths inside the galleries.

Consequently, the development of this research is based on the realization of 4 geotechnical geological models; the first model considers the initial state before subsidence occurs by the presence of excavations of mining galleries. The second model contemplates the morphology of the state of the empty cone. The third model contextualizes the inclusion of remediation works (piles + slab + filling) built by INIGEMM (2017) and the fourth model, configures the filling with mortar based on the mixture of cement and tailings. Figure 15 shows the current state of the area after the intervention.

11 Class 3 sub-base compacted material refers to the andesitic composition box (sterile rock) material, which mining companies dispose of in tailings.

SCENARIO 1: MODEL BEFORE CONE CONFORMATION AND COLLAPSE CHIMNEY (25/OCT/2016).

- **Geological Model:** The spatial distribution of weathering levels is observed together with the principal fracture systems (D1 and D2). In white are represented the mining excavations that ascend from the horizontal gallery “Chorillos L1/3”, with red vectors, the dead load of the school, and with a blue line, the position of the water table (FL) (Figure 16-top).
- **Tenso-deformational model:** Figure 16-bottom shows the behavior of the total deformation, reaching values of 20 mm in the area where the school was located. An advance of plasticization (L: 90 m) is observed from the south gallery (elevation: 1166 m.a.s.l.) to the north gallery (elevation: 1163 m.a.s.l.) with maximum deformations of up to 30 mm on the central gallery (28 x 18 m). The lower central part concentrates a tendency to increase deformation; this corresponds to the geometric configuration of the tunnels excavated in an anti-technical way.

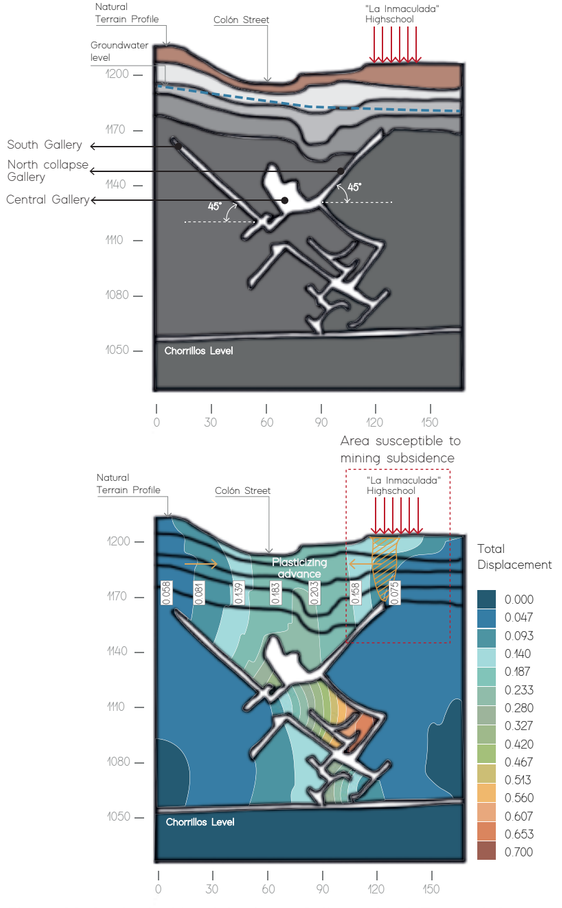


Figure 16: Geological Model prior to Collapse (top). Tenso-deformational model with development of plasticized zones (bottom)(Burbano et al. 2021)

- **SCENARIO 2: MODEL DURING CONE CONFORMATION AND COLLAPSE CHIMNEY (FEB/21/2017).**
  - **Tenso-deformational model:** Shows the behavior of deformation in the sector of the collapsed chimney with displacements of 1.90 m. This model represents the behavior of instability of the cone and collapse chimney, that since its formation developed seven instability events; starting on October 25, 2016, with a cone of 10 m until February 20, 2017, when the cone reached 31 m in diameter. The modification of the state of tension generated an imbalance when the ground collapsed, causing the collapse of chimney walls (Figure 17).

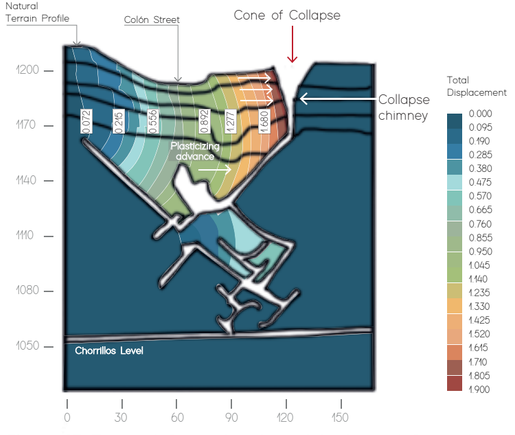


Figure 17: Tenso-deformational model where deformation develops parallel to the walls of the collapse chimney. (Burbano et al. 2021)

SCENARIO 3: MODEL - REMEDIATION INIGEMM (2017) (PILES+SLAB+COMPACTED FILL)

- **Geological Model:** In the Figure 18 -top is observed the remediation works that culminated in October 2017, where it is included; the construction of caisson piles, the perimeter screen in reinforced concrete, and slab stopper and compacted fill to reconstitute the topographic conditions of the natural terrain.
- **Tenso-deformational model:** The behavior of the total deformation is observed after the implementation of the remediation works reaching values of 5 mm evidencing its. The advance of plasticization from the south gallery to the north gallery maintains maximum deformations of up to 30 mm on the central gallery, that is, the area where the school is located maintains an apparent stability, linked to the deformation of the galleries that had no treatment (Figure 18-bottom).

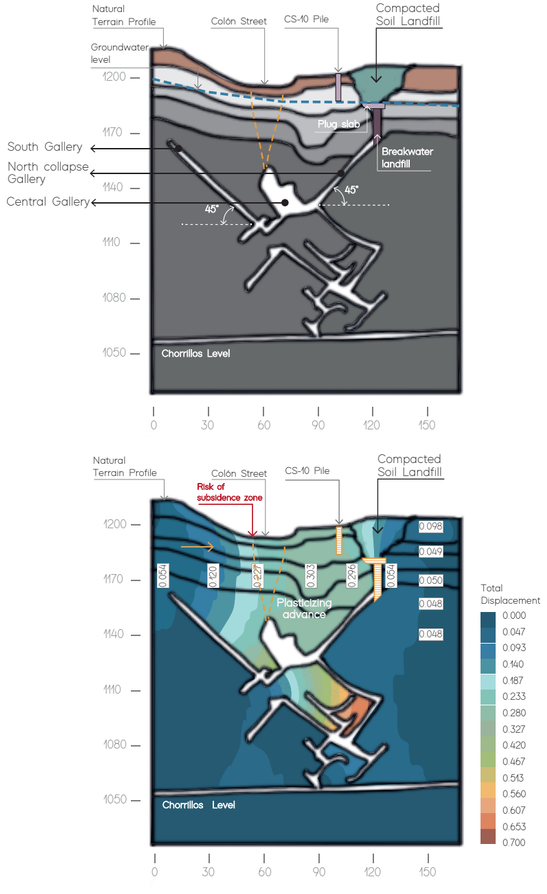


Figure 18: Geological model with the location of mitigation works (top). Behavior of deformation after remediation works (bottom) (Burbano et al. 2021).

SCENARIO 4: MODEL - REMEDIATION INIGEMM (2017) (PILES+SLAB+COMPACTED FILL

Model with filling proposal (Figure 19) with mortar (cement+slurry)

- **Geological Model:** Fig xx shows the geological environment, mitigation works, and the filling proposal with a mortar design (1 cement: 2 tailings). The injection of mining excavations arises from the surface while drilling. Before filling, plugs were built to close the injection system.
- **Tenso-deformational model:** The effectiveness of the mortar filling is observed using sand as a fine aggregate. The general behavior of the deformation in relation to other galleries decreases substantially, that is, the advance of the plasticized zones is attenuated once the upper excavations are stabilized.

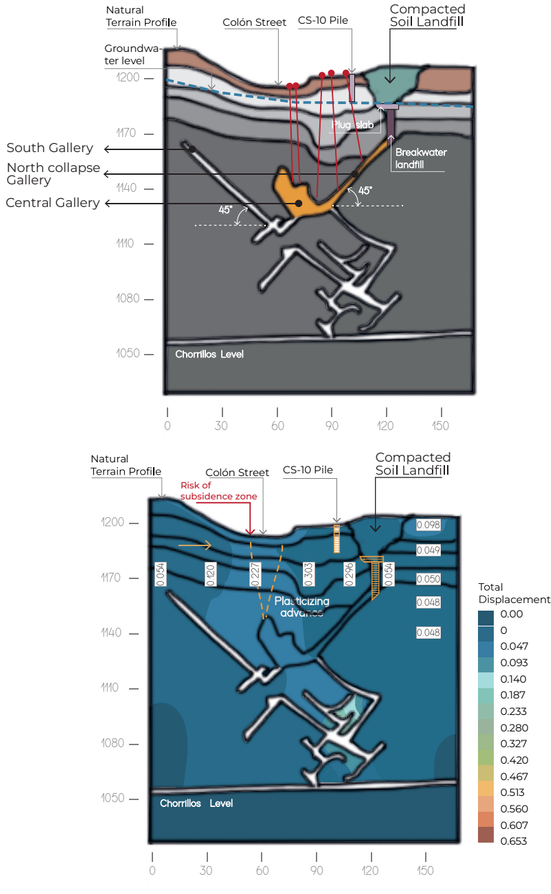


Figure 19: Geological model, mitigation works and mortar fill (top). Behavior of the deformation posterior to the mortar fill. (bottom) (Burbano et al. 2021)

2.2. Area of Study

Considering the distribution of the levels of protection in the urban area of Zaruma, it was decided to delimit the study area to the First Order Zone of the city, given that the buildings corresponding to the categories of Absolute Protection and Rehabilitable Buildings with recovery are located almost entirely within this perimeter which would allow a more precise study of the buildings with fewer modifications to the original construction (Figure 20).

2.3. Urban Structure Analysis

As mentioned above, although Zaruma dates from pre-Hispanic times, its greatest development occurred during the time of the Spanish Colony, its foundation between 1549 and 1560, and its promotion to Villa in 1595. With these data it is understood that its urban structure should respond to the Royal Ordinances issued from Spain in 1523, From these premises we analyze the traditional urban configuration of cities belonging to the colony, studying its general rules, and applying them in case studies with those founded in Ecuador to later contrast them with the characteristics of the city of Zaruma.

2.3.1. Traditional urban layout of the Spanish Colonies

The foundation of the cities during the time of the Spanish colony (late XV C. to early XIX C.) should be understood as one of the fundamental mechanisms employed by the crown to formalize its domain, being a nucleus to promote legal, social, and economic norms on the territory, besides being the central element for the control of the exploitation of the surrounding territory. This process is concretized on legal provisions that sought to regulate the territorial planning and construction of cities and of which an almost definitive urbanization scheme is developed whose most

Figure 20: Protection Catalogue of Heritage Building Map- First Order Zone.(Ilustre Municipio de la Ciudad de Zaruma 2004) Re-elaboration by Gualán,S.

important examples are cities such as Mexico, Havana, Santo Domingo, Bogota, Lima, and, in the case of Ecuador: Quito and Cuenca. (Aguilera Rojas, 1977)

The aforementioned legal provisions are expressed in detail within the "Laws of the Kingdoms of the Indies" of King Charles II(España 1841) and the "Ordinances of Discovery, New Population and Pacification" given by Philip II on July 13, 1573 (Acosta Sol, n.d.)which defines the foundation of cities, towns and villages: *"la planta del lugar, repártanlo por sus plazas, calles, y solares a* ***cordel y regla,*** *comenzando desde la plaza mayor, y sacando desde ella las calles a las puertas y caminos principales, y dejando tanto compás abierto, que aunque la población vaya en gran crecimiento, se pueda siempre proseguir y dilatar en la misma forma"* ("the plant of the place, must be distributed by its squares, streets, and lots to ***cordel y regla***,[12] starting from the main square, and taking from it the streets to the main doors and roads, and leaving so much open compass, that although the population goes in great growth, it is always possible to continue and expand in the same way"). From this text, it follows the choice of a form of settlement not spontaneous, where the planimetric ordering of the city is realized considering three essential urban elements: squares, plots, and streets, thus defining the relationship between building and non-building areas, public-private spaces, full and empty, within a layout with perpendicular and parallel lines within an orthogonal plot.

In addition, to provide that future growth will be carried out steadily according to the directions indicated by the plot, that is, a form of growth is established without indicating the limits the same. The choice of a plot by the crown can also be understood as an intention of "domestication" and dominion established by an urban-rural division.

12 See Glossary

Regarding the main elements of the urban layout, the central element is the main square, *"**donde se ha de comenzar la población** (...), su forma en cuadro prolongada, que por lo menos tenga de largo una vez y media de su ancho, (...) de la plaza salgan cuatro calles principales, una por medio de cada costado; y además de estas, dos por cada esquina: las cuatro esquinas miren a los cuatro vientos principales"* ("where the population is to begin (...), its form in a protracted frame, which is at least one and a half times its width, (...) of the square there are four main streets, one on each side; and in addition to these, two by each corner: the four corners look to the four main winds"), with this arrangement the square is established as the central articulator of the urban whole, in addition to having a value as a symbolic center since around this are located the main administrative and religious public buildings. Being the most attractive space, it also becomes a commercial center where its access and communication routes concentrate a lot of shops.

To understand this dynamic in the case of Ecuador two cities have been chosen considering their level of conservation in comparison to other cities developed during the colony, they are Quito and Cuenca, both are in the Ecuadorian Andean area and are recognized by UNESCO as heritage.

QUITO CASE STUDY

The city of Quito was founded as a Spanish colony in 1534 over existing indigenous settlements, it is located at 2,818 m. of altitude and is extended along the slopes of the Pichincha Volcano and borders the hills of El Panecillo and Itchimbia.

The syncretism of this city can be seen with the "Escuela Quiteña" as an example of the Baroque style, represented by architecture and its decorative elements (altarpieces, paintings, sculptures) mostly along spiritual citadels like San Francisco, San Domingo, La Compañia de Jesús, the Sanctuary of Guápulo and other (UNESCO, 1978).

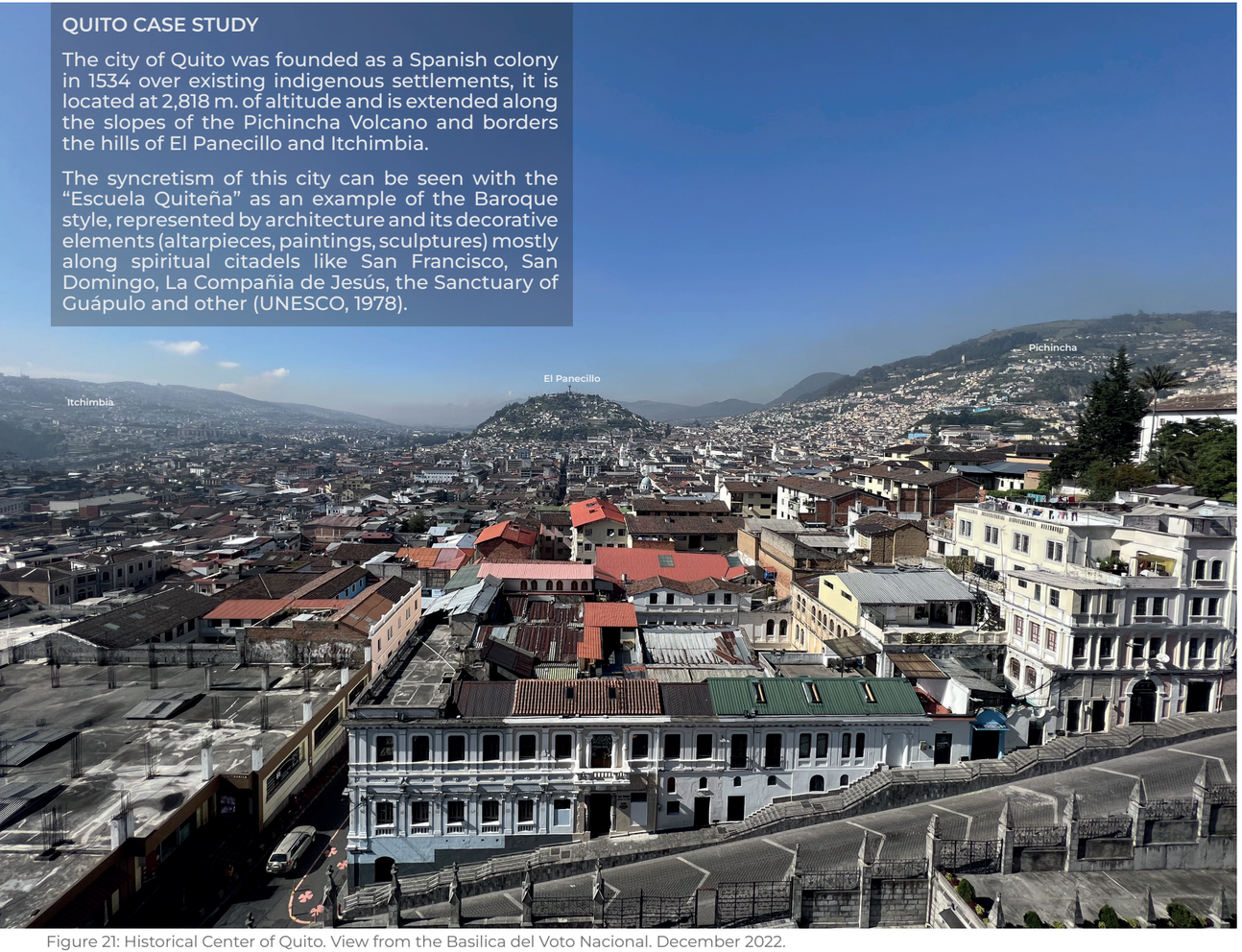


Figure 21: Historical Center of Quito. View from the Basilica del Voto Nacional. December 2022.

URBAN ANALYSIS OF QUITO

The city of Quito followed the traditional urban layout of the Spanish Colonies inside a very complex topographical environment (Figures 22 & 23) with checkerboard-patterned streets that are aligned with the cardinal points of the compass (UNESCO, 1978).

The plan of the villa and city of "San Francisco de Quito" from 1735 (Figure 24) and its urban layout analysis show the original plan of the streets, the blocks of houses and squares, and how the distribution of these in the plateau where are contained all the main blocks and plazas and the adaptation of the exterior squares to the natural elements of the territory but still respecting the orthogonal configuration.

The plateau distribution is characterized by multiple plazas that are surrounded by what were considered milestone buildings, such as churches, convents, or governmental buildings. The streets' directionality is arranged to direct the inhabitants towards these points (Figure 25).

Figure 22: Historical center of Quito, Plaza Grande. Photography by: Marielle Richon. (UNESCO World Heritage Convention 1978)

Figure 23: Historical center of Quito, Venezuela Street. Photography by: Geoff Mason(left.); García Moreno Street. Photography by: Quito Visitors' Bureau. (right) (UNESCO World Heritage Convention 1978).

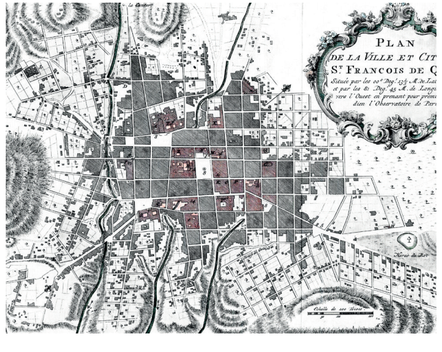


Figure 24: San Francisco de Quito Plan. (De Ulloa 1735)

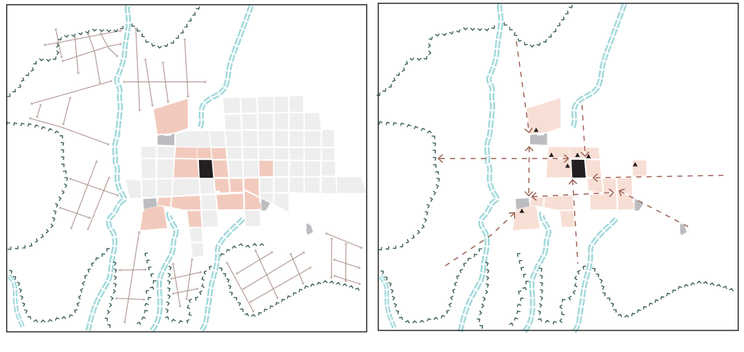


Figure 25: Analysis of the historical Layout of Quito. Based on San Francisco de Quito Plan. De Ulloa- 1735.

CUENCA CASE STUDY

The valley of Tomebamba (Figure 26) is located between the contour elevation readings of 2,694.4 maximum and 2363.5 minimum bounded by mountainous systems with four principal rivers: the Tomebamba, Yanuncay, Tarqui and Machángara

Before its foundation in 1557 as a Spanish city, the area was the indigenous city of Tomebamba and in the Spanish settlement of Santa Ana, formed approximately 20 years before the founding, and at that moment of its creation included 17 blocks inside a surface of approximately 24 Ha. (WHC Nomination Documentation, 1999).

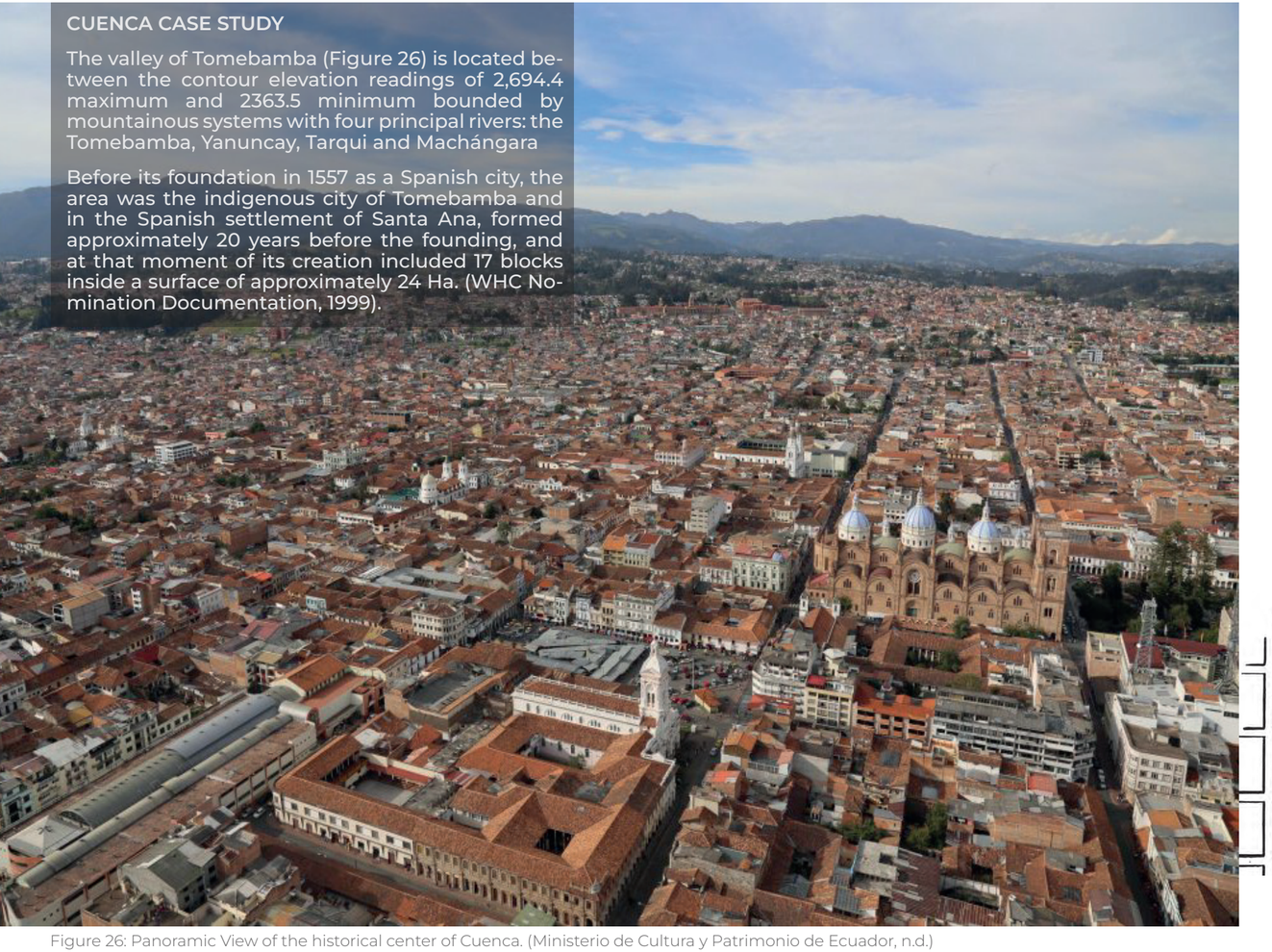


Figure 26: Panoramic View of the historical center of Cuenca. (Ministerio de Cultura y Patrimonio de Ecuador, n.d.)

URBAN ANALYSIS OF CUENCA

The Historical Center of Cuenca (Figure 27 & 28) is organized in a grid design beginning in the Central Plaza with a total of two hundred blocks marked by the presence of a system of parks, plazas, church atriums, and other public spaces. (WHC Nomination Documentation, 1999). The plan of 1557 (Figure 29), at its foundation shows the organization around the plaza with relevant buildings and the names of the owners of the lots.

In the urban layout of 1878 (Figure 30 & 31) can be seen that the expansion of the city still follows the orthogonal grid extended over areas that are slowly being urbanized and still grow crops.

Figure 27: Panoramic View of Cuenca (UNESCO World Heritage Convention)

Figure 28: El Carmen church, and the flower market. (left); Panoramic View of the historical center of Cuenca. (right) (Municipal Government of Cuenca and Universidad de Cuenca 1998)

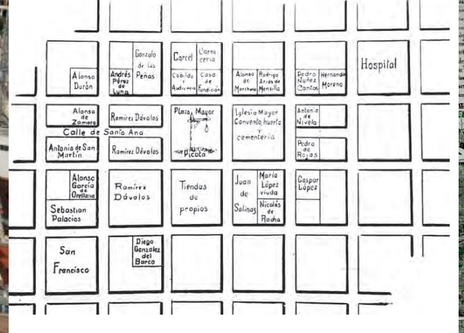


Figure 29: Map of the city of Cuenca- 1557. Municipal Government of Cuenca and Universidad de Cuenca 1998)

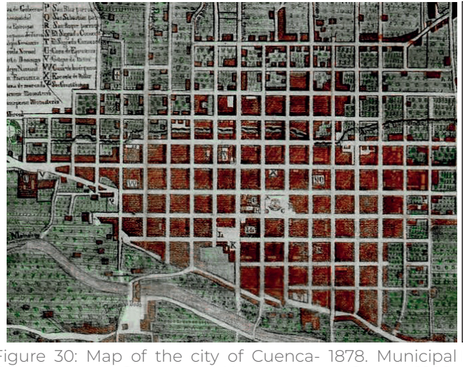


Figure 30: Map of the city of Cuenca- 1878. Municipal Government of Cuenca and Universidad de Cuenca 1998)

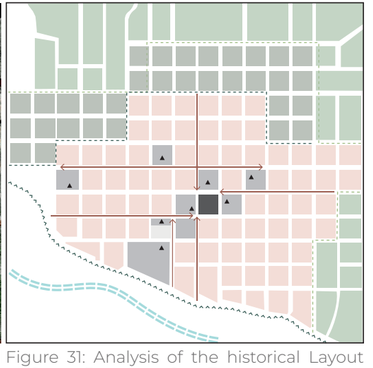


Figure 31: Analysis of the historical Layout of Quito. Based on San Francisco de Quito Plan. De Ulloa- 1735.

Figure 32: Panoramic View of Zaruma- October 2022.

2.3.2. Zaruma's Urban Layout

TOPOGRAPHY

Zaruma is a region that presents extremely steep slopes where the predominant range is a steep slope of over 70% which corresponds to 24% of the cantonal territory. This is followed by what is called an average slope (12-25%) in 16% of the territory and finally, strong slopes (between 40-70%) corresponding to 15% of the cantonal area (Municipality of Zaruma, PDOT. 2014).

The map (Figure 34) shows a general view of the territory, and from this can be understood how the roadways are imposed along the contour lines following the natural lines of the territory. leaving aside the one imposed for the colonies.

Figure 33: Aerial Photography of Zaruma.(Municipalidad de Zaruma and Guido Díaz & consultores asociados 2003a)

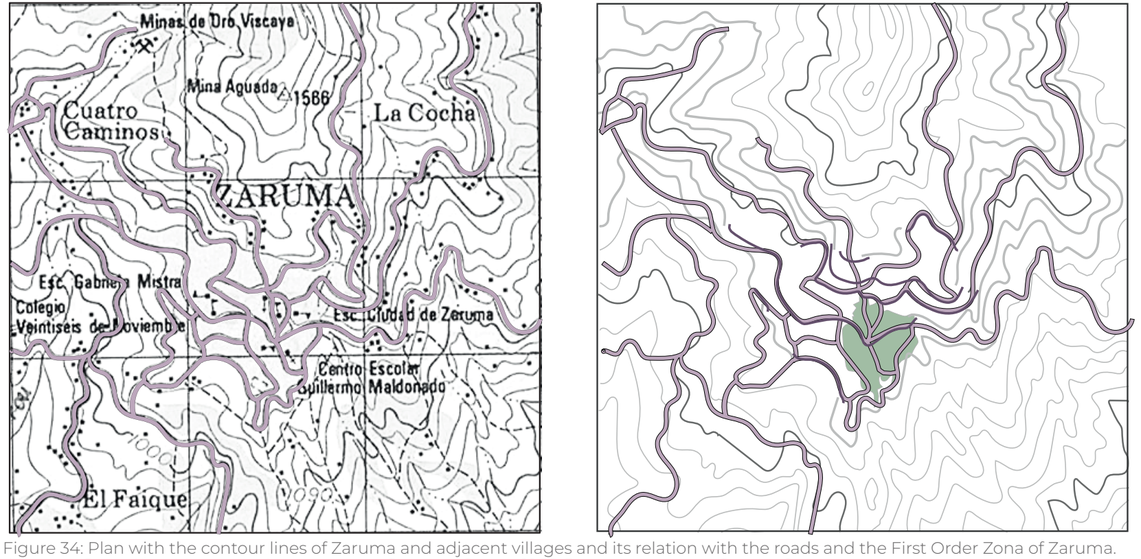


Figure 34: Plan with the contour lines of Zaruma and adjacent villages and its relation with the roads and the First Order Zona of Zaruma. (Instituto Geográfico Militar and Interamerican Geodetic Survey 1988)Re-ellaboration by Gualán, S.

Milestone builings

Milestone builings of historic relevance

Central plaza

Main way to cross the city

Secondary ways to cross the city

Stairways

Figure 35: Main elements of the city & Accessibility Analysis.

MAIN ELEMENTS OF THE CITY

The city center is placed on flat ground territory, its disposition is in correspondence with the rules about the main square disposition of Spanish law preserving the character of a symbolic center where are located the main administrative and religious public buildings and the main square, now the central park (Figure 35).

Other architectural milestones (Figure 36) are the market, which is also located in the historical perimeter, the municipal pool, the San Francisco church, and the municipal coliseum, built in later periods.

MILESTONE BUILDINGS

Figure 36: Milestone buildings: (A) San Francisco church, (B) Zaruma Municipal Museum, (C) Nuestra Señora del CarmenCatholic Sanctuary, (D) Municipality of Zaruma, (E) Municipal Market. (Municipalidad de Zaruma and Guido Díaz & consultores asociados 2003a)

THE ACCESSIBILITY

The accessibility in the city at present has two main characteristics. One corresponds with the general movement around the city; it follows unidirectional paths that allow vehicles to access and exit it. These paths are directed towards and from the city center, which means it is mandatory to pass through this point every time someone crosses the city.

The other characteristic is pedestrian circulation, characterized by stair alleys and stairways (Figure 37) that allow residents to walk around the city on shorter routes without going through the main streets shared with vehicles.

PEDESTRIAN CIRCULATION

PORTICOES

STAIRWAYS

Figure 37: Pedestrian circulation photographies.

MAIN PATH ACROSS THE CITY.

Sucre Street.

Sucre Street.

Bolívar Street.

9 de Octubre Street.

Rocafuerte Street.

Rocafuerte Street.

Figure 38: Photographic analysis of the main path across the city. Figure 35 reffers the location of the photos.

GROWING PHASES OF THE CITY: URBAN AREA

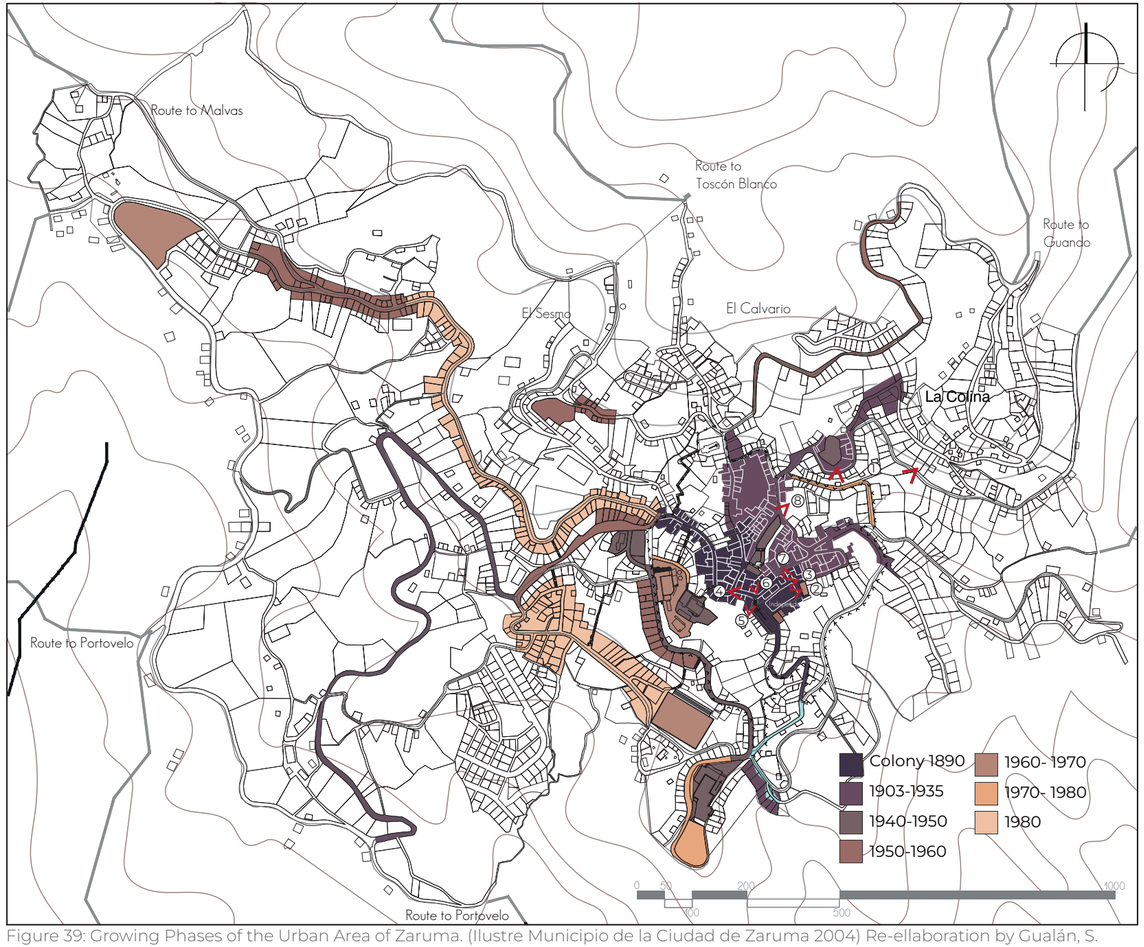


Figure 39: Growing Phases of the Urban Area of Zaruma. (Ilustre Municipio de la Ciudad de Zaruma 2004) Re-ellaboration by Gualán, S.

The numbers in Figure 39 refer to the point of view of the photographs presented below.

HISTORICAL PHOTOGRAPHS

RECENT PHOTOGRAPHS

① Figure 40: Panoramic view of Zaruma. 1910(Castillo, n.d.) (left) October 2022. (right)

② Figure 41: Central Plaza. Old Market Castillo, n.d.)(left) Central Park. Zaruma's Google Street View(Google 2015) (right)

FIRST ORDER ZONE

It may be assumed that the urban layout of the city was born from the pre-existing houses and that the streets were established following this course.

There is no precise registry of the years of construction for many of these buildings but following the data of the Conservation and Management Plan, it was possible to distinguish areas of development plus the identification of the period of construction of certain edifications that enable us to observe that the urban development is closely connected to the architectonic construction (Figure 42).

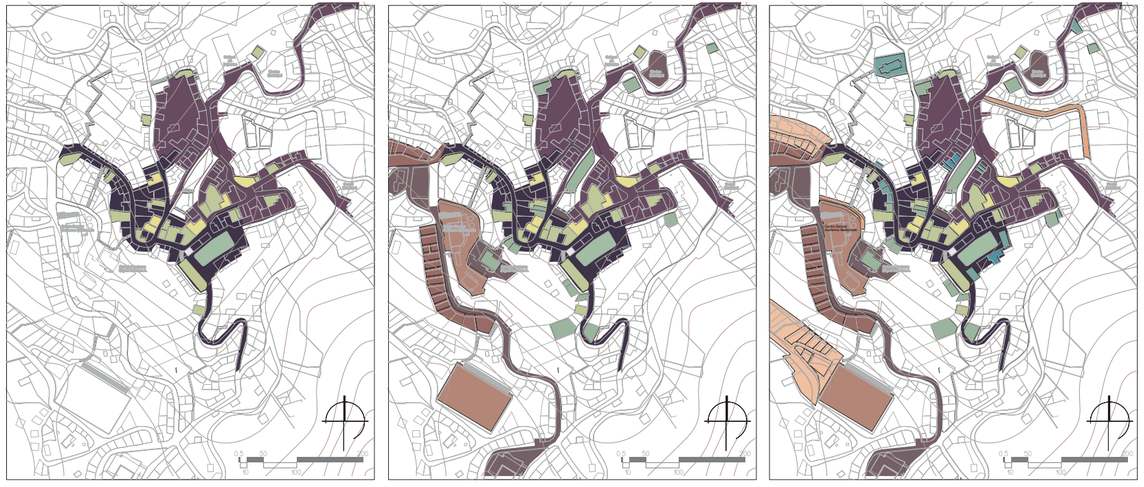
CONSTRUCTION PERIODS

Buildings

- 1800-1900
- 1900- 1925
- 1925-1950
- 1950- 1975
- 1975- 2000
- Without data

Urban area

- Colony 1890
- 1903-1935
- 1940-1950
- 1950-1960
- 1960- 1970
- 1970- 1980
- 1980



Buildings → 1800-1925 | 1925- 1950 | 1950- 2000

Urban Area → 1890-1935 | 1935- 1970 | 1975- 1980

Figure 42: Growing Phases of the First Order Zone. (Ilustre Municipio de la Ciudad de Zaruma 2004) Re-ellaboration by Gualán, S.

HISTORICAL PHOTOGRAPHS

RECENT PHOTOGRAPHS

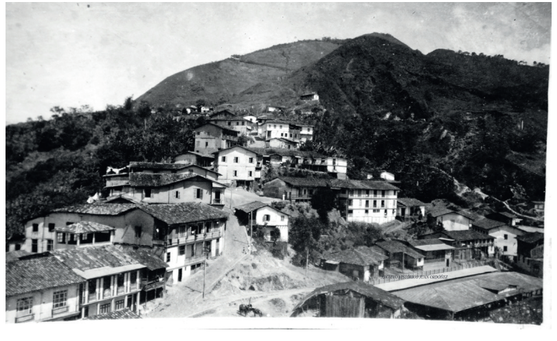
③Figure 43: 9 de octubre Street. Unknown year (Castillo, n.d.)(left) Zaruma's Google Street View(Google 2015) (right)

④Figure 44: Bolívar Street. Unknown year (Castillo, n.d.) (left) Zaruma's Google Street View (Google 2015) (right)

HISTORICAL PHOTOGRAPHS

RECENT PHOTOGRAPHS

⑤ Figure 45: 9 de octubre Street. Unknown year (Castillo, n.d.)(left) Zaruma's Google Street View(Google 2015) (right)



⑥Figure 46: Bolívar Street. Unknown year (Castillo, n.d.) (left) Zaruma's Google Street View (Google 2015) (right)

HISTORICAL PHOTOGRAPHS

RECENT PHOTOGRAPHS

⑦Figure 47: Rocafuerte Street. 1933 (Castillo, n.d.)(left) Zaruma's Google Street View(Google 2015) (right)

⑧ Figure 48: Old Market Lot Unknown year (Castillo, n.d.) (left) 10 de Agosto Street, Market view. Zaruma's Google Street View (Google 2015) (right)

Figure 49: Analysis of Relation House-Orography of the First Order Zone.Map representation.

2.4. Synchronic[13] Analysis of the Relation House-Orography

The relation with the territory is one of the essential features that the houses of Zaruma present due to the mentioned steepness of the territory. The architecture, then, has developed different ways of adapting to it, and this influenced the way of developing new levels of the houses, the relationship with the street, and the accessibility to the houses; Figure 49 represents the distribution of these adaptations in the city. This relation is classified into two main types with three sub-types according to the response to the described characteristics (Figure 50).

13 Synchronic variants are defined in “Architectural composition and building typology. Interpreting basic buildings” as the application of the same type, of the same "concept of house" in anomalous situations compared to those more consonant to the types itself. (Caniggia & Maffei, 2001). In this case, the type responds to the orography as a condition.

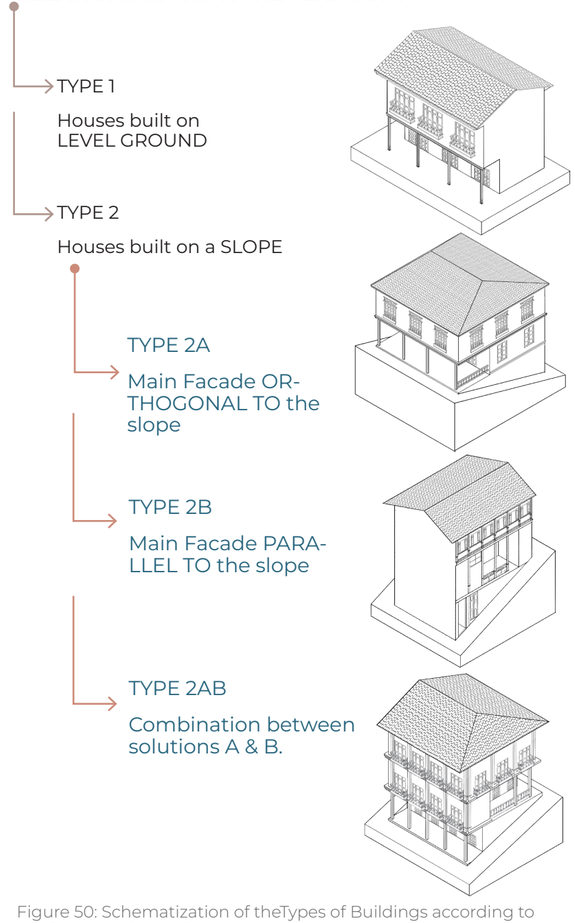


Figure 50: Schematization of theTypes of Buildings according to the Relation House-Orography.

TYPE 1

HOUSES BUILT ON GROUND LEVEL

This is an uncommon case in the city as most houses are placed in a sloped area. These houses are usually of a smaller dimension in depth but instead, the longitude on the facade can vary a lot, with cases that are quite elongated.

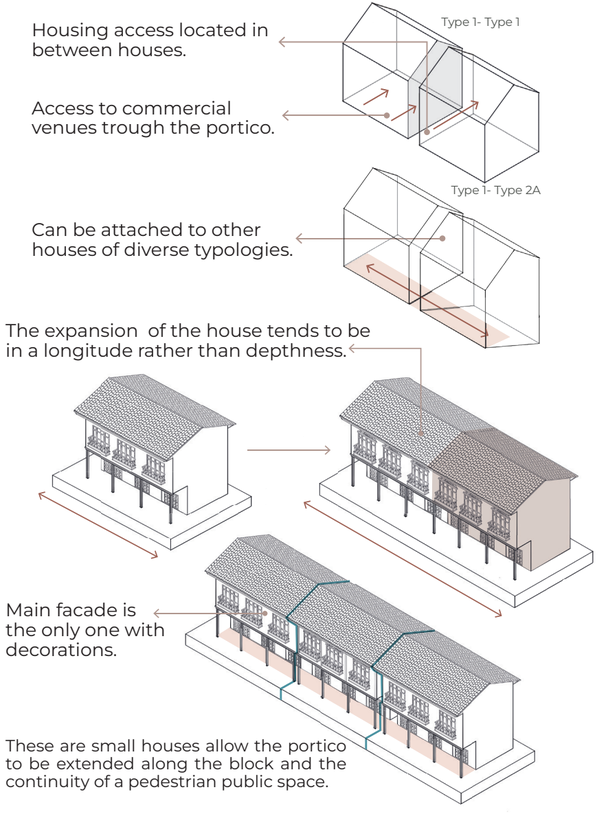


Figure 51: Type 1 Houses examples, according to its relationship with the Territory.

HOUSES BUILT ON A SLOPE

TYPE 2A

MAIN FACADE ORTHOGONAL TO THE SLOPE

This is the most common solution in the city, the house follows the natural steepness of the territory, which allows us to find houses with up to 5 levels in height without exceeding the 2-3 levels in the main facade.

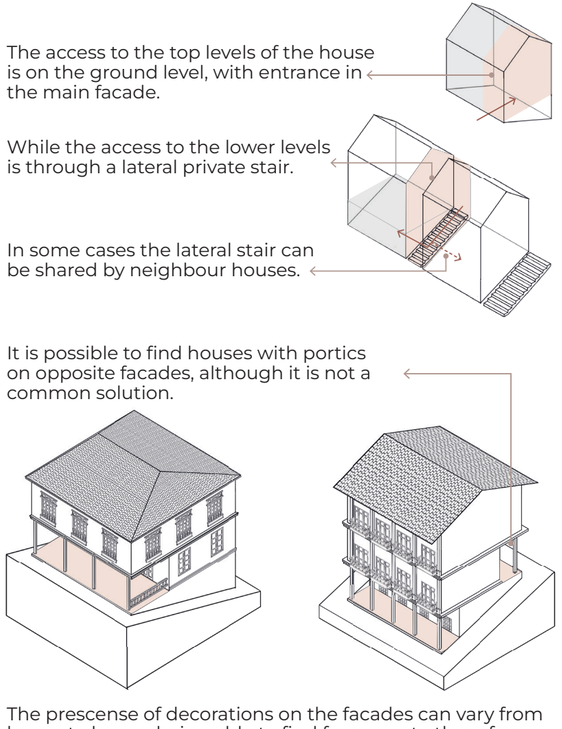


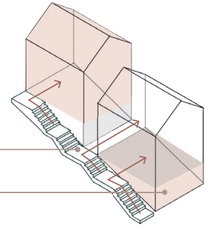
Figure 52: Type 2A Houses examples, according to its relationship with the Territory.

TYPE 2B

MAIN FACADE PARALLEL TO THE SLOPE

In this case, the most important feature is the private characterization of the portico, established due to the steepness of the streets, which does not allow a continuity between the porticoes of the houses.

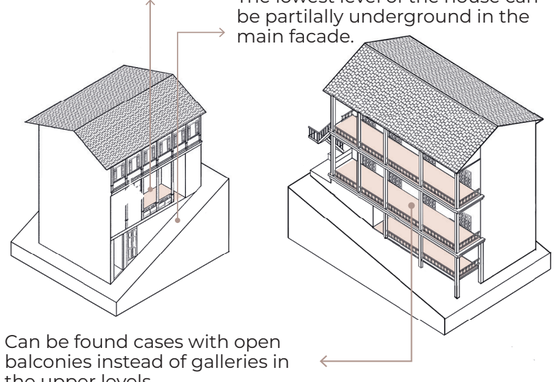
The accesses to each ground level of the house are independent and direct from the street.



The number of levels in the house is related to the length of the facade. The longer, more levels can develop on the basement.

The portico becomes the entrace to the main part of the house.

The lowest level of the house can be partilally underground in the main facade.



Can be found cases with open balconies instead of galleries in the upper levels.

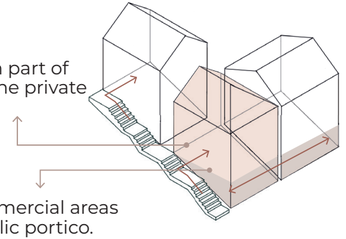
Figure 53: Type 2B Houses examples.

TYPE 2AB

COMBINATION BETWEEN SOLUTIONS A & B.

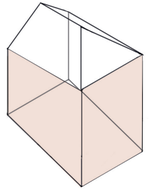
This case can be found in corner houses.

The access to the main part of the house is through the private portico.

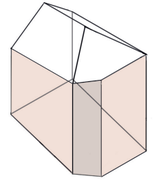


The access to the commercial areas is related with the public portico.

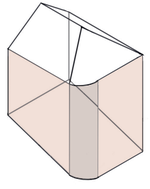
CORNER TYPES



Angle Corner



Chamfer Corner



Rounded Corner

These houses have two main facades which both present decoration elements.

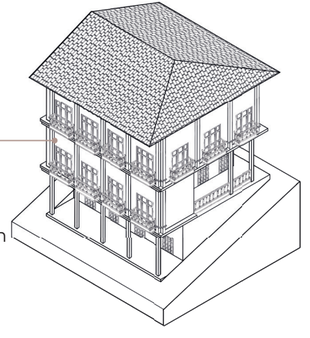


Figure 54: Type 2AB Houses examples.

Figure 55: Panoramic view of Zaruma. 1930(Castillo, n.d.)

3. LA ARQUITECTURA ZARUMEÑA.

This chapter seeks to understand the architectural and constructive characteristics of the house of Zaruma through different tools: archive documents that embrace legislation related to the construction of houses (Section 3.1.), architectural survey (Section 3.2.), the spatial distribution of the buildings (Section 3.3.) and analysis if the architectural development through the years (Section 3.4), as a conclusion an "Ideal" of the House of Zaruma is proposed that incorporates all the typical characteristics identified in the previous analysis.

3.1. Construction Historical Registry between 1900-1935.

The Historical Registry of Zaruma belongs to the Archive of the Patrimony and Culture office of the municipality of Zaruma[14]; it safeguards the reports of the Municipal sessions written throughout the canton's history. These sessions involve different matters concerning the legislation of the area, from which were identified six historical documents that describe in some detail the architectural design regulations and some of the urban guidelines developed in the studied period:

– The *"Minuta para la Construcción de la Casa de Rastro"* (Minute for constructing the Slaughterhouse) from the extraordinary session extended from August 16, 1905.

14 The official name in Spanish is: Gobierno Autónomo Descentralizado de Zaruma

– The *"Ordenanza de Construcción y Ornato de Edificios"* (Buildings Ordinance and Ornament) from the ordinary session extended from June 25, 1910.

– *"Ordenanzas de Ornato y Fabrica"* (The Ordinance of Ornamentation and Construction) from the Ordinary session of June 12, 1912.

– Contract basis for the conclusion of the Municipal house N°. 7 from the ordinary session extended from July 23, 1912.[15]

– *"Ordenanzas de Ornato y Fabrica"* (The Ordinance of Ornamentation and Construction) from the Ordinary session of May 21, 1931.

– *"Reglamento Especial sobre Higiene Domiciliaria"* (Special Regulation on Household Hygiene) from January 20, 1931.

From these documents were highlighted and represented the characteristics of the structural system, dimensions, material, and design characteristics described for the construction or modification of the buildings.

3.1.1. Minuta para la Construcción de la Casa de Rastro. 1905.

The minute for the construction of the *Casa de Rastro* The municipality wrote the minute for the construction of the Slaughterhouse (Appendix A) during an extraordinary session on August 16th, 1905. (Municipalidad de Zaruma, 1905) Some of the characteristics determined are:

– The length of the house will be 12 *varas*[16], the width: on the cajón six *varas,* and in the corridor two *varas*. The height was of 4 *varas*.

– The eaves should have at least one *vara* on the main façade and 2/3 *varas* on the other facades.

– The *cajón* of the house must have wooden flooring.

WOOD ELEMENTS:

– Eight guayacan pieces of 22 inches of thickness and five *varas* length for the center of the house

– For the corridor, five pieces of guayacan, without joint, of 18 inches of thickness.

– The joints of the cajón will be on Amarillo, squared.

– Four *cruceros*[17] of amarillo of 7x7.

– Four *barrotes*[18] of Amarillo of 7 inches in square.

– 18 *cuerdas* of Amarillo of 7 inches (3x4 thickness).

– The wooden boards for the floor deck will be of cedro, 2 inches in thickness. The joints will have two screws of 1 inch in diameter.

MADERA ALTA-ROOF WOOD ELEMENTS

– Four Amarillo or cascarillo beams of 6 inches in square.

– *Cuartones* (rafters) of 10 inches of thickness, distanced proportionally on the roof.

– Zinc metal rooftop. The purlings to support it must be 3x2 inches of cedar wood.

– *Solera* and *cumbrero* of 18 inches of thickness in cascarillo Wood.

– The *Solera* (plate) and *cumbrero* (ridge beam) of 18 inches of thickness, in cascarillo Wood.

15 This document is also included in the book "La Villa de San Antonio", as part of a compilation of historical references of diverse origin, related to Zaruma.(Rodríguez, n.d.)

16 The measurements are in Spanish *vara*. 1 vara= 835,9 mm. See Glossary.

17 The understanding of this term is imprecise, the original text could refer to the diagonals of the structure.

18 See Glossary.

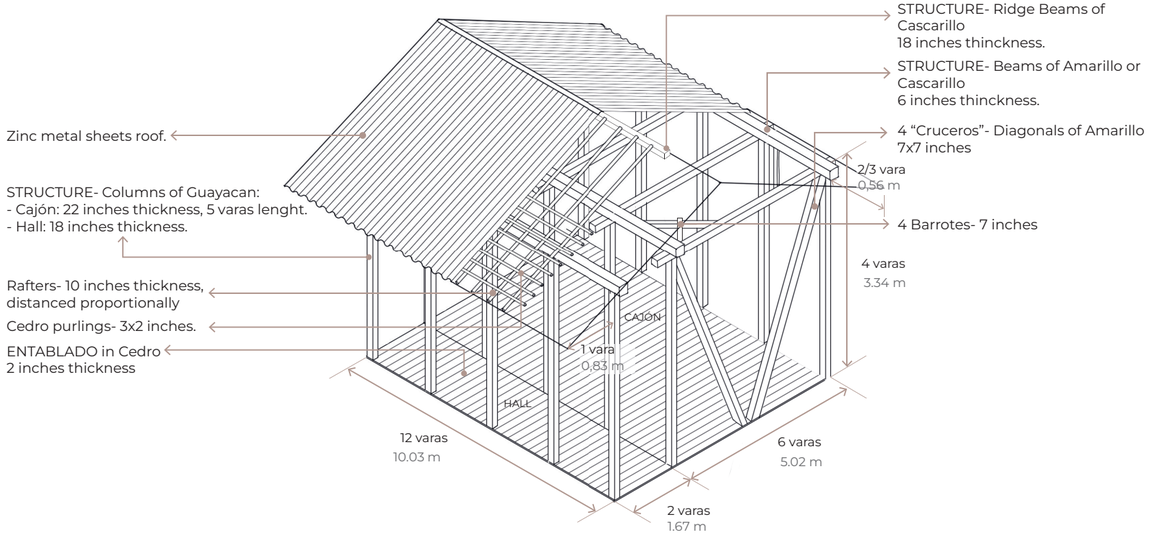


Figure 56: "*Minuta para la construcción de la casa de Rastro*" graphical representation

3.1.2. Contract basis for the conclusion of the Municipal house N°. 7, 1912.

This document refers to the Municipal Building, No. 7 (Appendix B), as a commenced construction that has been halted due to lack of funds and is deteriorating due to the delay in completion. It was formulated a contract for its completion; the main architectural characteristics required are:

- Completing the two upper floors of the building. Both will have ceilings made of pink *Canelo* boards, and the joints will be covered with a molded strip.
- The building will have fourteen pairs of *puertas de salón* (lounge doors) distributed on both floors. The frames for these doors will be four by five inches thick, and each door-panel will have five *espejos* (panels).
- The windows will be seventeen in total, each composed of four panels, including *celosías* (latticework), distributed on both floors according to the dimensions of the already placed frames. The doors will have four *espejos* (panels), the *celosías* two, with continuous molding on stiles and rails, and the rebate of the *espejo* (panel), the same as all the large doors, and the panels will be single-sided.
- The wood used for the frames of the *puertas de salón* will be *cascarillo amargo* or *sara*, sufficiently long to secure them to the sole plate and the nogging; the stiles and rails will be made of *Amarillo, guararó* or *cucharillo*, and the *espejos* (panels) and *celosías* will be made of cedar.
- The *puertas de salón* will have four American reinforced hinges, and the doors of windows and lattices will have three hinges.
- The handrail on the lower floor will be wrought iron, similar to that used on the upper floor, on a frame of *Amarillo* or *guararó*, with the appropriate rebates and suitable moldings.
- The columns will be covered in a square shape with cedar boards, with their corresponding bases at the height of the handrail and topped with the appropriate molding.
- The façade of the upper floor will have two cornices and main balconies identical to those of other houses[19].
- Each doorway will have a four-panel door with *celosía*. These doors will have a louvered section at the bottom made of boards, a blind from the handrail upwards, and the rest will be a fixed lattice. Each door will have four horizontal rails on each side, with moldings and their respective bases at the upper and lower ends. A zinc lining will completely cover the seat of these doors, with a suitable slope, to prevent rainwater from entering.
- The doors above will have four American reinforced hinges, iron knockers, a slight pull ring made of suitable-sized metal, and a latch bolt on each one, round and five inches long, reinforced.
- It is also mentioned the construction material for the walls for both levels, the upper floor's wall is made of double boards, *bahareque* for the two side walls on both floors, the lower floor's wall, the wall on the entrance vestibule in both levels, the posterior nave in the second level with openings to each window with *cascarillo* or sara frames, six partition walls on

19 Original document puts as reference the names on the owners of said houses.

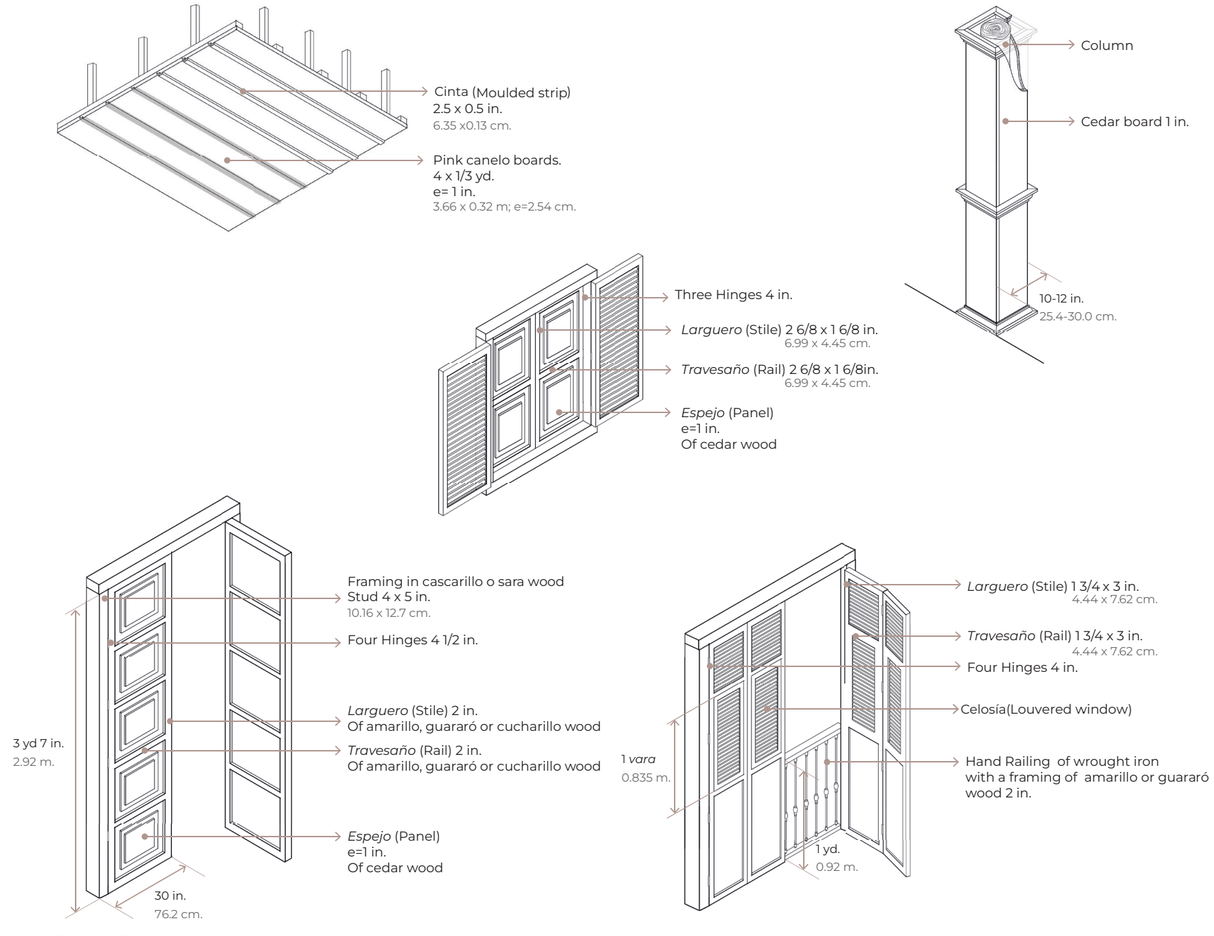


Figure 57: Municipal house details graphical representation.

the same lower level from the posterior wall to the front side wall; a partition wall made of boards will also be constructed on the upper floor from the front side wall facing the street.

- The construction of the *bahareque* walls will use *vaén, Sara, saca,* or *pacaiblanco* wood, with *vejuco barbón de tierra* for binding, *pindo* for the inner structure, a cedar ridge beam, and two horizontal beams of the same cedar wood, spaced proportionally.
- All currently existing and future *bahareque* walls must have a *Canelo* board *cenefa* at their top and bottom with the respective moldings.
- The *pañete* (finish coat) of the currently existing and future walls will be made of selected material, and all walls of the building will be *revocadas y empañetadas* (plastered and finished) both inside and outside and whitewashed on the exterior, the front, and the vestibules.
- The material used for the house's lower and upper facade will be of *Amarillo*, *cucharillo* wood, and good quality cedar boards, one inch thick, will be used.
- All wood used for doors, windows, cornices, and lattices must be thoroughly dry, and the wood used for the ceilings.

3.1.3. Ordenanza de Construcción y Ornato de Edificios. 1910.

The Buildings Ordinance and Ornament from 1910 (Appendix C) is one of the first documents dedicated to regulating the construction, refurbishment, or modification of buildings either partially or totally (Municipalidad de Zaruma 1945). Among the main rules established, are:

- Houses can be only one or two levels that will be called main houses and secondary houses, respectively. These will have 6 meters of facade facing the street.
- The Secondary houses may have a maximum height of nine meters measured perpendicularly from the portal to the eaves.
- For the alignment of the building with the streets it should be considered that: the balconies and architectural ornaments cannot be projected more than 80 cm above the vertical line of the facade.
- Portals are mandatory, and their dimensions should be: 2.30 wide by 3.60 high. It is also forbidden to build more than one row of columns in the portals. The floor finishes of these can be wood, stone, brick, or cement.
- The architecture of the facade is of free design as long as it remains coherent with the character of the context.
- Houses built on areas without alignment with the public road must construct the portal under their roof.
- The construction of any building with thatched roofs is prohibited.

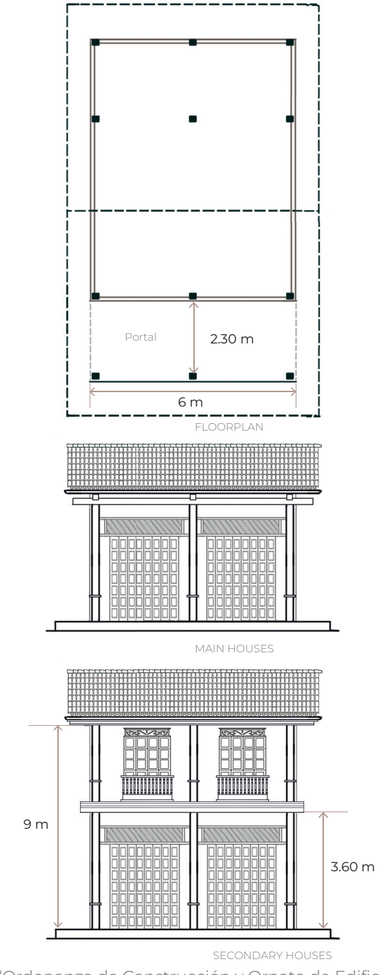
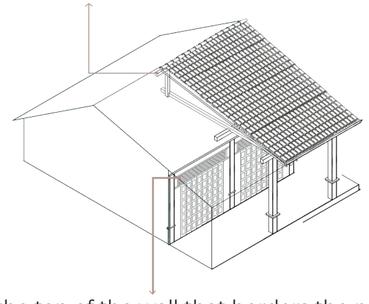
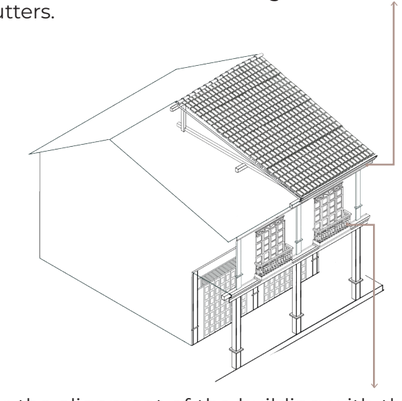


Figure 58: "Ordenanza de Construcción y Ornato de Edificios from 1910 graphical representation.

- In the case of houses with more than 10 meters of depth, the height of the ridge may pass one meter without exceeding two meters.



- At the top of the wall that borders the portal there must be a skylight of at least 20 cm wide that will have all longitude of the wall.
- On both main and side facades, the eaves may not have more than 1m overhang and must have rain gutters.



- For the alignment of the building with the streets it should be considered that: the balconies and architectural ornaments cannot be projected more than 80 cm above the vertical line of the facade.

3.1.4. Ordenanzas de Ornato y Fabrica. 1912 & 1931.

The Ordinance of Ornamentation and Buildings of 1912 (Appendix D) are added some rules about urban planning and height and certain characteristics of the buildings. There is not, among the main rules established, are:

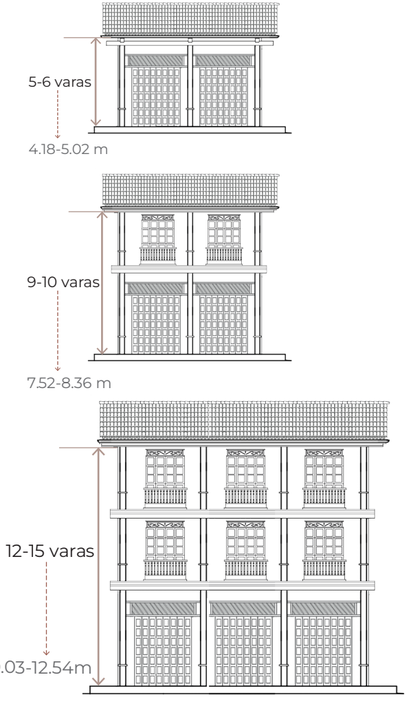
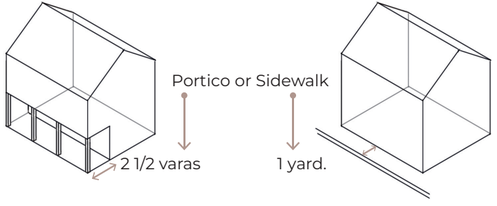
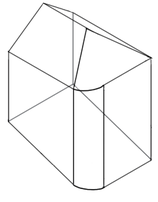


Figure 59: *"Ornenanza de Ornato y Fábrica"* from 1912 graphical representation.

- The height on the main façade must be in those of three levels, between 12-15 varas, in those of two levels between 9-10 varas, and in the house of one level between 5 to 6 varas.
- Buildings must be constructed along a street or a plaza, if it is not possible will seek the smallest distance up to the street or plaza and uniformity with the neighboring buildings. These buildings can have:



- For houses built on a corner lot, the facade corner will be rounded, without exceeding the wall or pillar of the building.

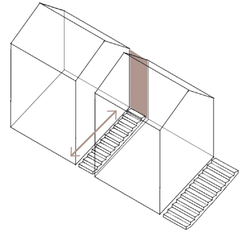


- The houses' doors that open towards the street shall not occupy any space protruding from the vertical line of the wall.
- The facades and walls of all public and private buildings must have a finish coat.

ORDENANZA DE ORNATO Y FABRICA - 1931

The dispositions from the Ordinance of Ornamentation and Buildings of 1931 changed very little since the Ordinance of 1912, the changes noted are:

- Any passage or alley that remains between two houses, will be closed by the side that faces the street by the owners of the two buildings on the sides.



- All houses must be equipped with an adequate system of canals and zinc pipes for the drainage of rainwater, which must be long enough to descend to ground level in streets without collective drainage; and to the respective drain canal if it is already established.

3.1.5. Reglamento Especial sobre Higiene Domiciliaria. 1931.

The Special Regulation on Household Hygiene (Appendix F) includes some adjustments on the house spaces to improve their sanitary conditions, leading to interventions in the original buildings.

The rooms must have enough doors and windows distributed in a way that allows permanent light and ventilation.

The walls of the bedrooms must have any kind of coat finish or tapestry, ensuring that the surface of such walls is as smooth as possible. The floor of such rooms shall also be made of wood, cement, etc., and in no case, it shall be allowed to be soil.

It is forbidden to have laundry rooms or sinks in the house, without being provided with a waterproof pipe that connects directly to the sewage canal of the respective street.

It is mandatory in dwellings, to install clean water and restrooms, in the place and form that will indicate the sanitary authority.

All houses must be equipped with an adequate system of canals and zinc pipes for the drainage of rainwater, which must be long enough to descend to ground level in streets without collective drainage; and to the respective drain canal if it is already established.

Courtyards, corridors, and, in general, any uncovered place of the houses, must be paved with stone or cement or, at least, covered with a layer of rubble or sand; and must be inclined enough to allow the free flow of rainwater to the public drains.

Figure 60: Photographic collection of houses in Zaruma. Houses: z-052, z-019, z-003, z-060

Figure 61: Photographic collection of houses in Zaruma. Houses: z-0611, z-062, z-040.

3.2. Architectural Survey: Study Cases

The architectonical analysis started with the survey of four houses (Figure 62), each of them with its characteristics that allowed us to understand the architectonic and constructive features of the buildings.

The survey focused on the relation with the ground, structural distribution, general distribution of spaces, and circulation, except in the last case which is limited to a facade survey, so it is elaborated in more detail.

Identification according to Municipal Inventory

① House Z-003
② House Z-040
③ House Z-059
④ House Z-031

Figure 62: Location map of surveyed houses.

HOUSE Z-003

House facades with porticoes, built in a traditional technique with a mixture of bahareque and wood, main timber structure, and partial interventions on brick.

At present, the terrace that can be seen in the first photograph no longer exists. Its current use is entirely for commercial venues.

– **Level of Protection:** Absolute Protection Building (AP).

– **Approximate year of Construction:** Without registry

IMPLANTATION TYPE 2A

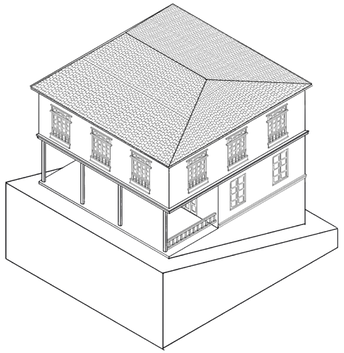
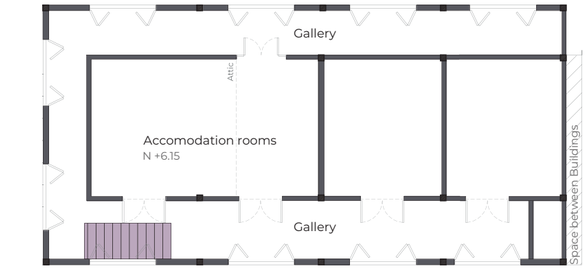
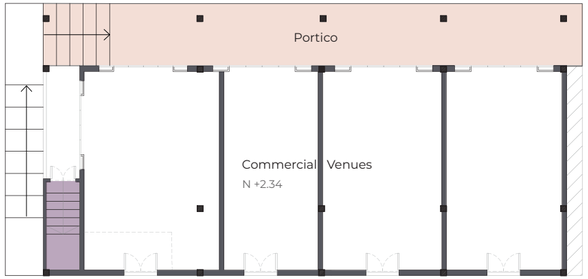


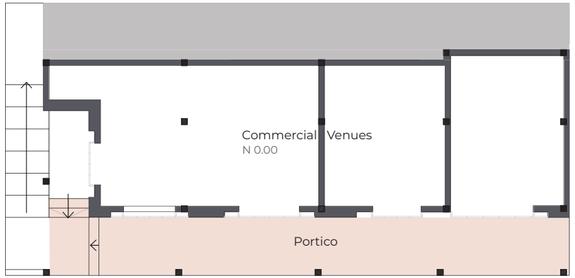
Figure 63: House Z-003 Photographs.



SECOND FLOORPLAN

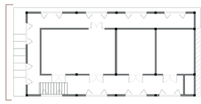


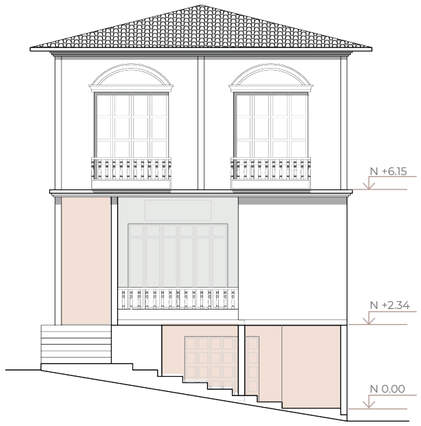
FIRST FLOORPLAN



GROUND FLOORPLAN

Figure 64: House Z-003 Survey.





LATERAL ELEVATION

Stairs
Portico

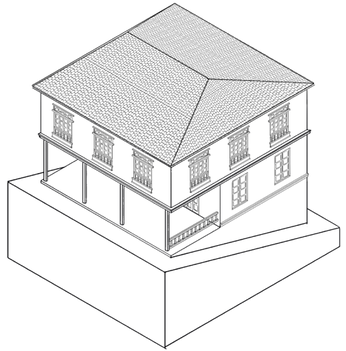
HOUSE Z-040

House with porticoes in the main facade, built in a traditional technique with a mixture of bahareque and wood, a main timber structure. It has a high level of intervention: in the lower levels, the main structure has been replaced by concrete columns, and an expansion built in modern techniques (steel and concrete).

The second level's inner divisions and ceilings were lost due to rot of wood elements; currently, it is possible to observe the structure without any covering. It still works as homeowners' housing.

- **Level of Protection:** Modifiable Building with Conditions (B).
- **Approximate year of Construction: XIX century.**

IMPLANTATION TYPE 2A



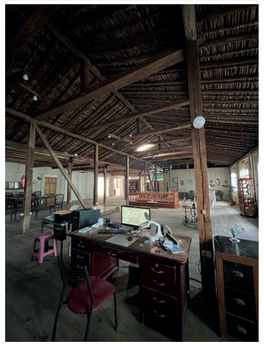
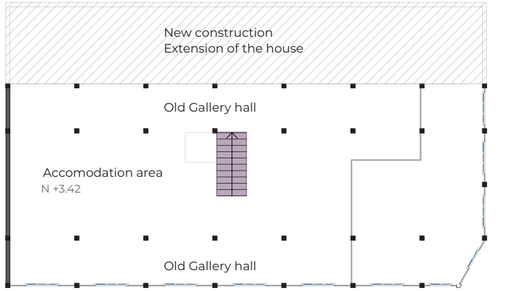
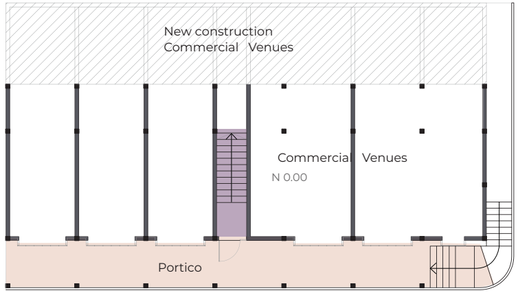


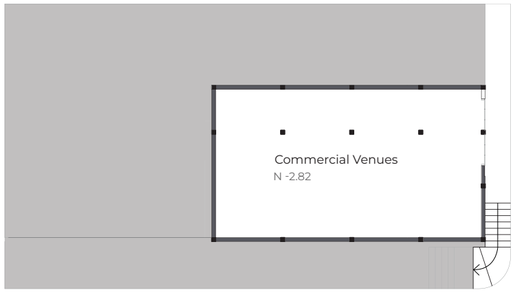
Figure 65: House Z-040 Photographs.



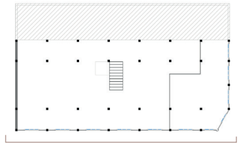
SECOND FLOORPLAN

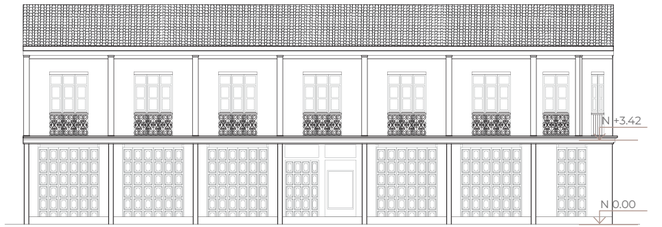


FIRST FLOORPLAN



GROUND FLOORPLAN





FRONTAL ELEVATION

Stairs
Portico

Figure 66: House Z-040 Survey.

HOUSE Z-060

House facade with balconies and, built in a traditional technique with a mixture of bahareque and wood, main timber structure with irregular distribution and lack of continuity, walls in bahareque.

This house does not have any modern interventions or rehabilitation works. It still preserves all the traditional construction techniques. However, its conservation level is quite alarming.

- **Level of Protection:** Rehabilitable Buildings with Recovery (A).
- **Approximate year of Construction:** 1900-1925.

IMPLANTATION TYPE 2B

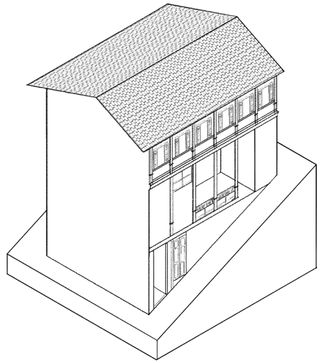
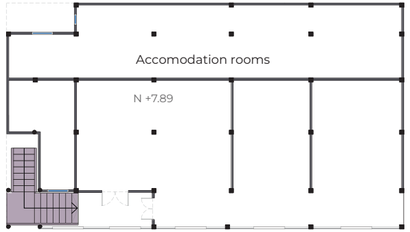
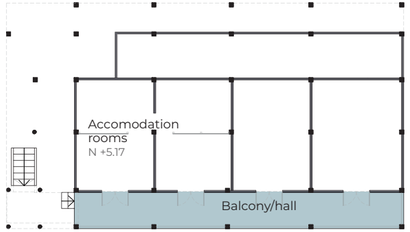


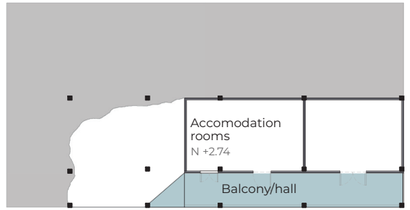
Figure 67: House z-060 Photographs.



SECOND FLOORPLAN

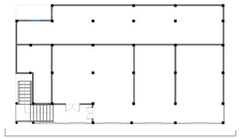


FIRST FLOORPLAN



GROUND FLOORPLAN

FOUNDATION FLOORPLAN



FRONTAL ELEVATION

Figure 68: House Z-060 Survey.

HOUSE Z-031- FACADE SURVEY

In this case, unlike the others , it was only possible to make a survey of the main facade of this house.

House with portico, built in a traditional technique with a mixture of bahareque and wood, main timber structure, walls with partial interventions on brick.

- **Level of Protection:** Rehabilitable Buildings with Recovery (A).
- **Approximate year of Construction:** Without Registry.

IMPLANTATION TYPE 1

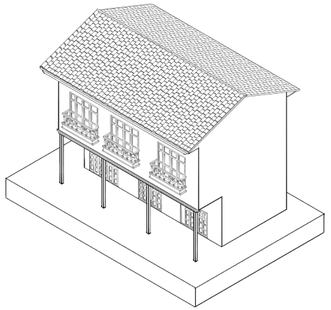
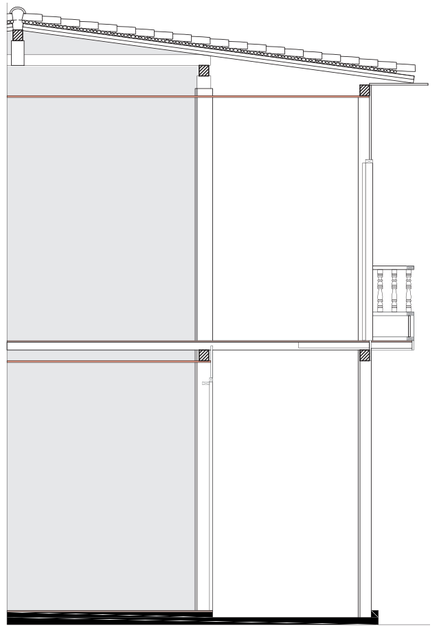


Figure 69: House z-031 Photographs.

FRONTAL ELEVATION



SECTION

Figure 70: House Z-031 Facade Survey.

3.3. Spatial Distribution

The houses in Zaruma are characterized as being mixed-use; their spatial distribution (Figure 71) allows the existence of commercial venues and housing in the same building but with no spatial connection between them.

This means that the commercial venues are located on the lowest level of the house in relation to the public porticoes. The main access to the house is commonly placed on a different level of the commercial venues or with independent accessibility if it is located at the same level, this is characterized by a hall that relates to the start of the staircase. The last floor corresponds with accommodation rooms that are in an inner core of the floor with small galleries surrounding them as a sort of corridors that also serve as a filter between the interior and the exterior life.

Figure 71: Spatial Distribution Schemes.

STAIR DISTRIBUTION

The location of the stairs does not follow a typological distribution (Figure 72) as it is placed in different zones depending on the building; these can be straight or L-shaped and, in most cases, are on the sides of the house supported on its main structure.

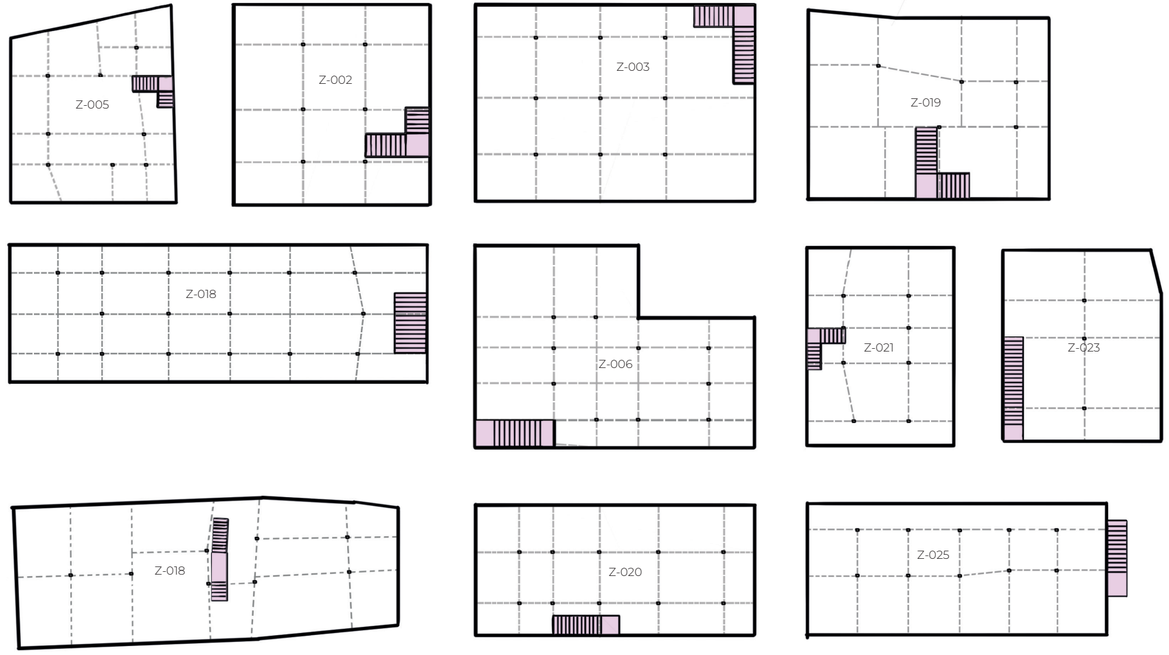


Figure 72: Stair Distribution Schemes.

3.4. Diachronic[20] analysis of the Architectural development

This analysis considers the years of construction of the buildings registered on the Inventory Cards together with the rules of the Historical Ordinances to understand how the houses grew through the years.

There are established then, as base type[21] houses (Figure 73) those mentioned in the Construction Ordinance of 1910, and then three type-growths that could have been applied to each of these houses. The traces of these transformations can be seen nowadays in small details of the facade elements on the houses as these are not perfectly blended between levels.

BASE-TYPE HOUSES

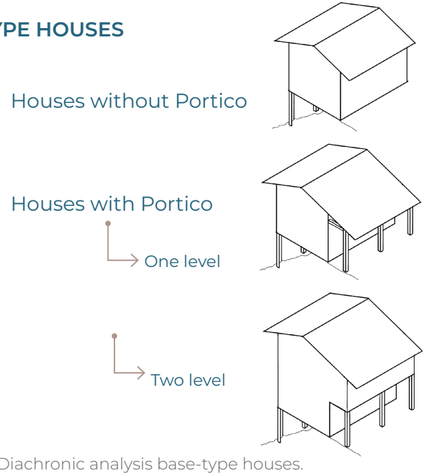


Figure 73: Diachronic analysis base-type houses.

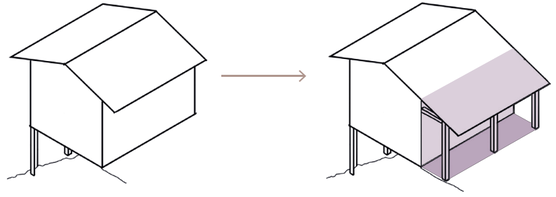
20 Understood as the chronological diversification of types in the same area. (Caniggia & Maffei, 2001)

21 The definitions “Base-type” & “type growth” are taken form: Architectural composition and building typology. Interpreting basic buildings. (Caniggia & Maffei, 2001)

TYPE GROWTH 1

CONSTRUCTION OF THE PORTICO

Following the 1910 Ordinance which established porticoes as mandatory, including on this rule the existing houses.



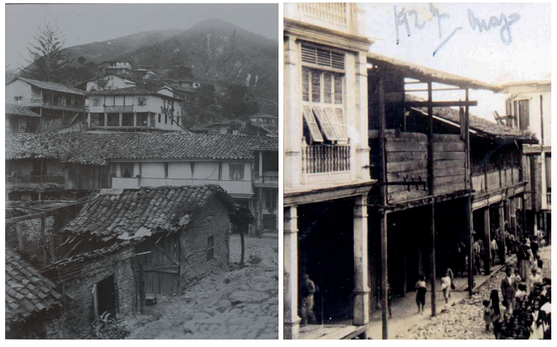


Figure 74: Diachronic analysis- Type Growth 1.

TYPE GROWTH 2

VERTICAL RAISING OF THE HOUSES

Houses have at least one added floor.

Traces show different styles or materials on the facade of each level.

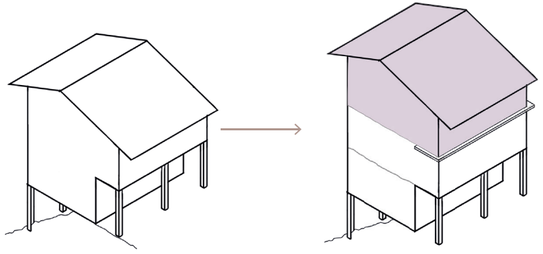


Figure 75: Diachronic analysis- Type Growth 2.

TYPE GROWTH 3

EXPANSION OF THE HOUSE

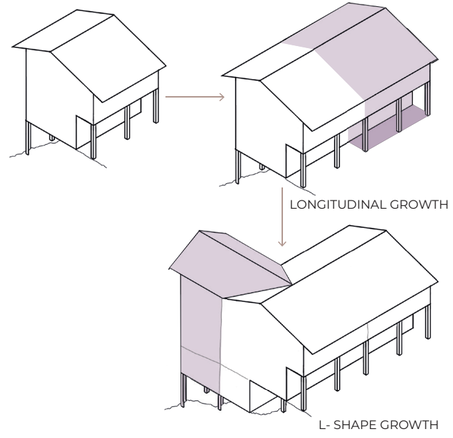


Figure 76: Diachronic analysis- Type Growth 3.

HYPOTHETICAL STRUCTURAL EXPANSION SYSTEM OF THE HOUSE

The expansion of the houses follows an “L” shape, with a regular span structure similar to the span of the galleries.

The space for the courtyard/ garden is always respected during the expansion.

Houses that have reduced size, leaving traces of old columns, can also be identified.

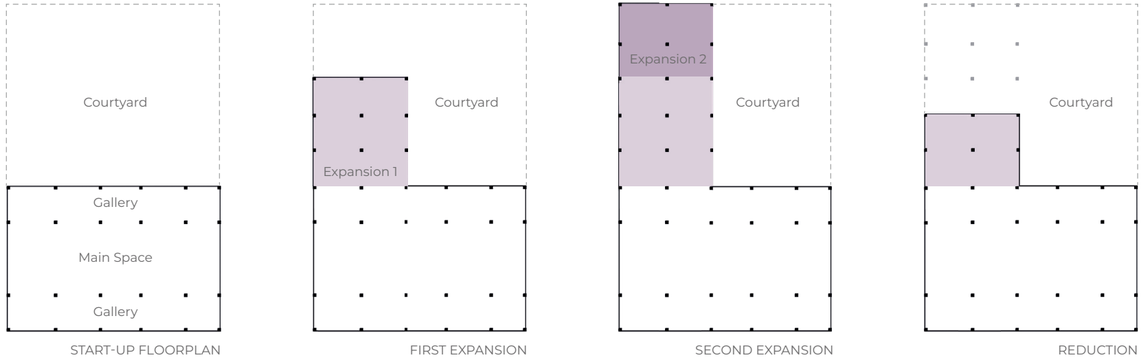


Figure 77: Hypothetical structural expansion system of the house scheme & photographs.

3.5. The House of Zaruma

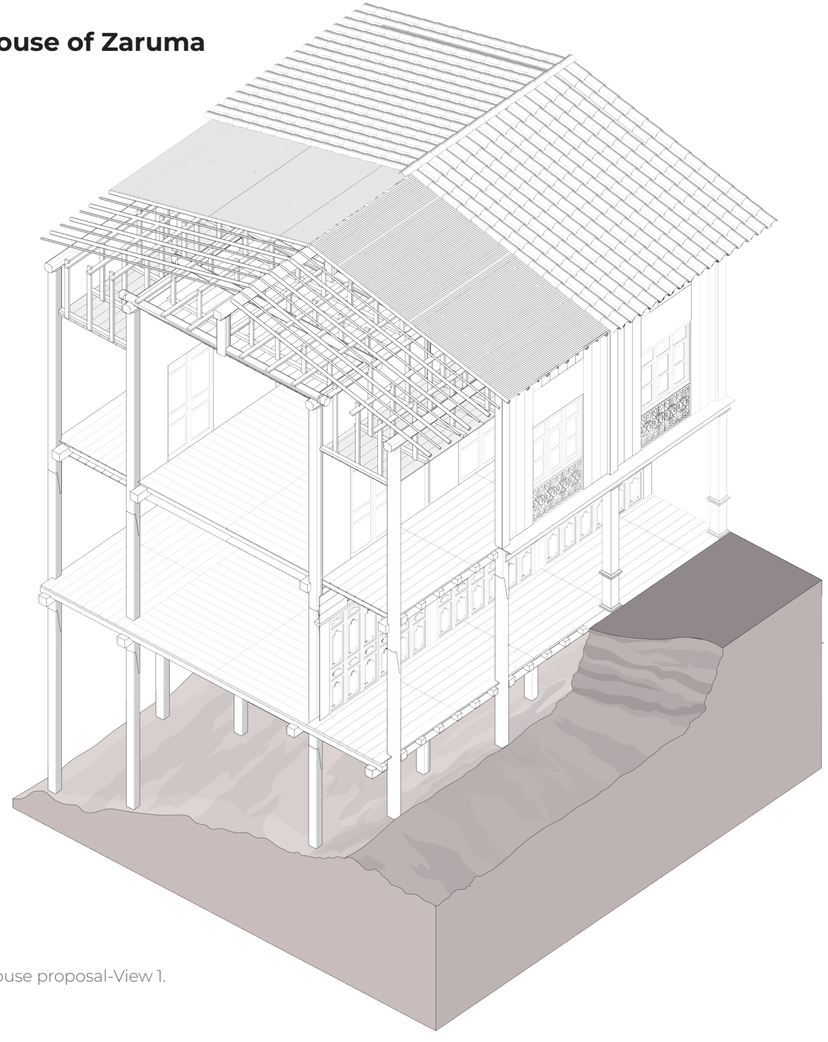


Figure 78: Ideal House proposal-View 1.

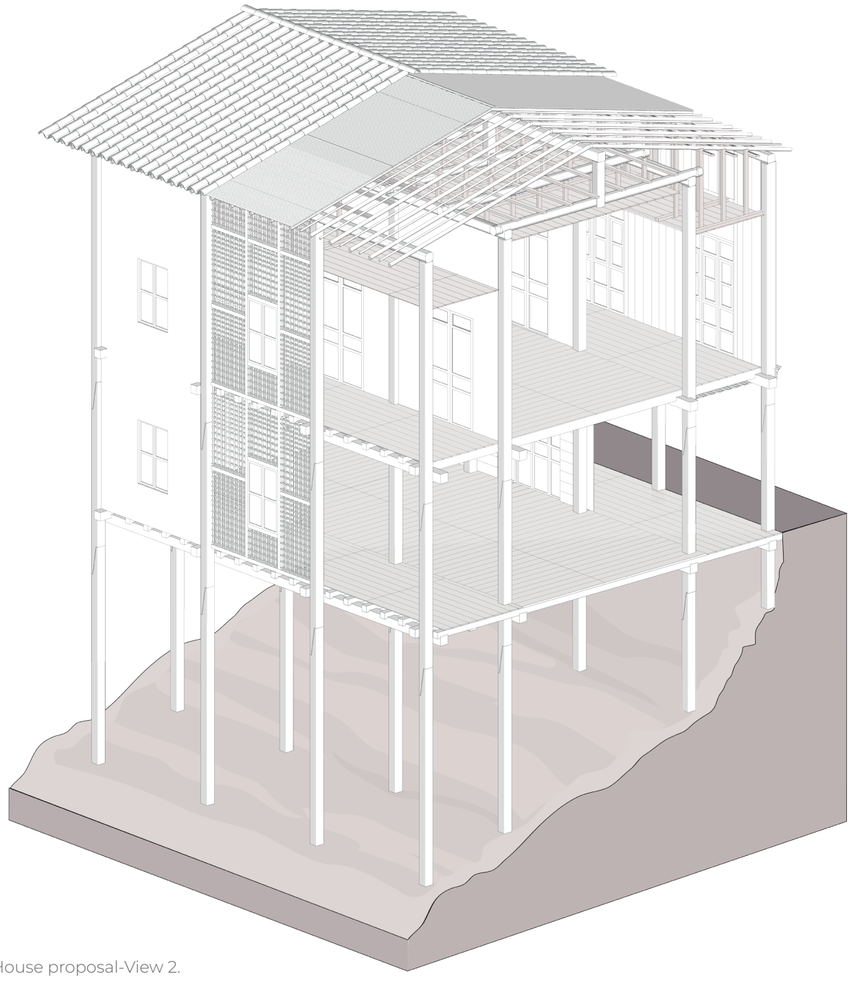


Figure 79: Ideal House proposal-View 2.

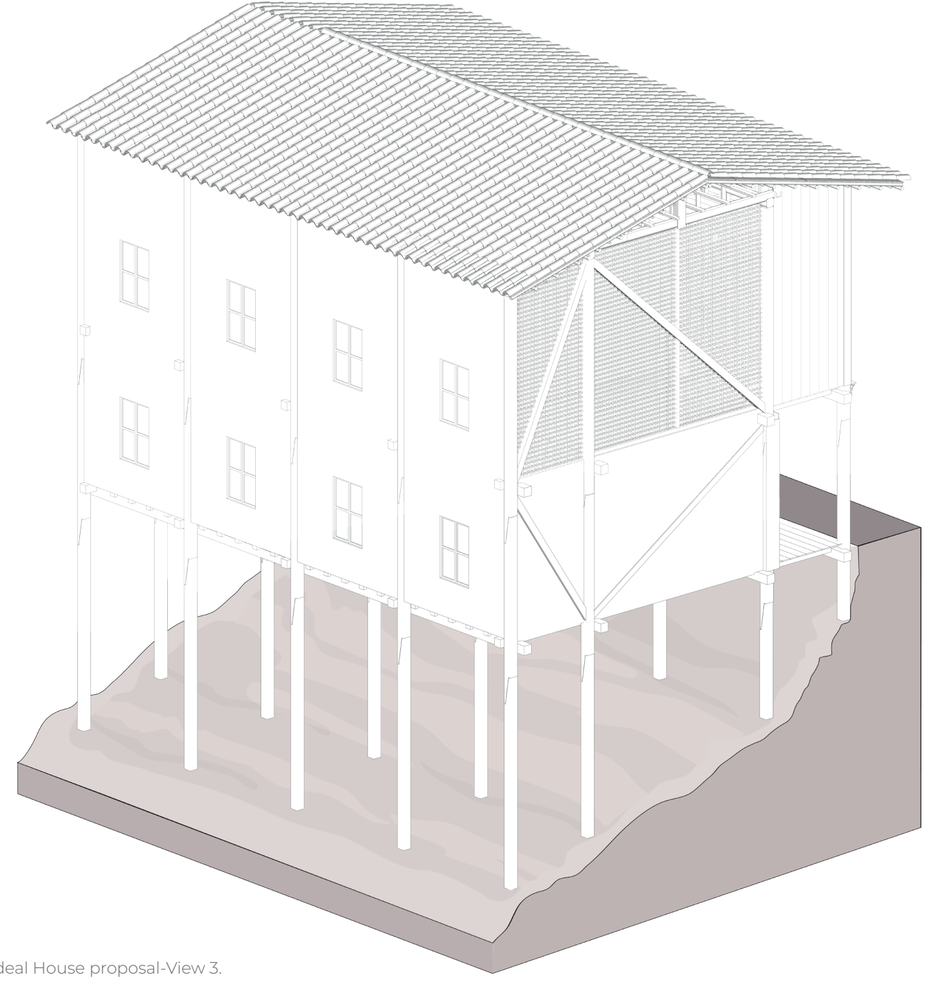


Figure 80: Ideal House proposal-View 3.

Figure 81: Historical photograph of the construction process of a building. Unknown year. Courtesy of Tito Castillo (Castillo, n.d.)

4. THE STRUCTURAL SYSTEM AND CONSTRUCTION TECHNIQUES

Material identification is essential to understand the region's structural system and constructive techniques; archive documents, documentation about the local forest, and an interview with a local worker were used to achieve this objective. The information collected also contributed to the development of the details of the construction system (Section 4.2), which explains the structure and operating system of specific elements of the house.

4.1. Materials Description

The primary material used for the construction of these houses is wood; depending on the quality, it was assigned for different uses, such as structure, walls, rooftops, flooring, and decorations. The second material commonly found is clay soil mixed up predominantly with chacla, a light bamboo structure, and is used in bahareque, a technique used to build walls.

4.1.1. Wood

To determine the species of wood used for the construction of the houses, it was taken as reference the historical documentation that mentioned them along with some studies concerning the forest species of the area.

The historical documents that concern us at this stage are:

- *"Minuta para la Construcción de la Casa de Rastro"* (Minute for the construction of the Slaughterhouse) (Municipalidad de Zaruma, 1905), which refers to woods such as Guayacan, Amarillo and Cascarillo for structural elements, and Cedar for flooring.
- "Bases del contrato para la conclusión de la casa municipal N. ° 7" (Basis of the contract for the conclusion of the municipal house N. ° 7) (Municipalidad de Zaruma, 1912). This document mentions the use of "Canelo rosa" (Cinnamon) in the ceilings; the stud wall framing, facades, and balconies utilized Amarillo, Guararó, and Cucharillo; Cascarillo is for the door and window frames (also Sara for the last one); latticework, doors, cladding of the structure and facades will be Cedar; cenefas and moldings shall be cinnamon.

  For the bahareque is used *Vaén, Sara, Saca* or *Pacaiblando, Bejuco barbón de tierra* as ties, Pindo in the internal structure and framing of Cedar.

Within the *"Ordenanzas de Impuestos a las Maderas"* (Ordinances of Taxes for Wood) (Municipalidad de Zaruma, 1931), from the year 1931 was found a list that, among other names, mentioned the wood species already described. The objective of this document was to regulate the access of wood elements to the city and engrave them according to the characteristics of wood and its dimensions.

ORDENANZAS DE IMPUESTOS A LAS MADERAS

This document classifies as strong woods: Guayacán, Amarillo[22],, Cucharillo, Gualtaco, Zota, Guararó, Guarapo, and Guayruro, with dimensions between 2 to 4 varas of length, and 4 to 8 inches in square and ten or more inches in circumference in the case that is rounded. Other types of Woods mentioned in the document are Cascarillo, Zara, Bellamaría, Cedro, Canelo, Saca, or Zanón.

Therefore, the strong woods mentioned may have been used as structural elements, like guayacan and Amarillo for the Casa de Rastro from 1905, while the other ones are used for other architectural details like Cedar for flooring or decorations.

Some of these species are listed in the Guide of Forest Species of the Dry Forest in Ecuador (Aguirre Mendoza, 2012); this guide provides information regarding the environmental characteristics of the forest where these trees grow and the specific characteristics of the species.

FOREST SPECIES OF THE DRY FOREST IN ECUADOR

Ecuador is one of the 17 megadiverse in the world, and one of the essential ecosystems that belongs to its territory is the dry seasonal rainforests, which are in the center and south of the western Andes region, in the provinces of Imbabura, Esmeraldas, Manabí, Guayas, El Oro and Loja provinces.

These are vegetable formations where more than 75% of their plant species lose their leaves seasonally, which does not imply that a rest period occurs since many species bloom at that time. The largest area of this ecosystem is between 0-1,000 meters above sea level, including the lowlands, low western foothills of the Andes Mountain range, located on hilly and steep terrain. The soils on which dry forests develop are clay, which forms mud in the rainy season and manifests with large cracks in the dry season. Occasionally they can develop in stone and sandy soils.

Dry forests develop under extreme climatic conditions, with an annual rainfall of 400-600 mm, over 3-4 months, usually in February, March, and April; the average annual temperature is 24.9 C. Potential evapotranspiration is 1 783 mm/year. In the area, it is reported the ecological formations of tropical dry forest, arid tropical forest and tropical spiny shrubland (Cañadas, 1983, as mentioned in Aguirre Mendoza, 2012); also there are vegetation formations reported: lowland deciduous forest and piemontane semideciduous forest (Cerón et al., 1999 as mentioned in Aguirre Mendoza, 2012); finally the National Forest Assessment Project classifies as Dry Rain Forest and Dry Andean Forest (Aguirre Mendoza, 2012).

The following species are recorded in the guide and correspond to some types of wood mentioned in the historical record:

- ***Centrolobium ochroxylum***. Amarillo (Loja), Amarillo Lagarto-Amarillo de Guayaquil (Guayas, Los Ríos, El Oro & Esmeraldas provinces) || Semi-deciduous tree up to 25 m tall and 60-80 cm of DBH[23]. This species inhabits dry forest mountains and grows between 0 and 1,000 masl in the provinces of Loja, Cañar, Esmeraldas Guayas, Los Ríos, Manabí, and El Oro.
- ***Terminalia valverdae***. Guarapo (Loja), Roble (Esmeraldas), Almendra (Guayas). || Evergreen tree, up to 18 m tall and 50 cm DBH. Grows in slopes and hollows of the dry forest, between 0-500 masl, in the provinces of Loja, El Oro, Guayas, and Manabí.
- ***Loxopterygium huasango*,** Hualtaco (Loja), huansango, guasango, gualtaco (Guayas, Manabí). Deciduous tree, 15-20 m tall, 40 cm DBH. It lives in plains and mountain areas of dry forest, in the provinces of Guayas, El Oro, and Loja, and grows between 0- 2000 masl.
- ***Maclura tinctoria,*** Sota (Loja), Moral fino (Esmeraldas y Los Ríos). Deciduous trees up to 20 m tall and 50-70 cm DBH. It is widely distributed from Mexico and Central America to South America. It is found in Bolívar, Esmeraldas, Loja, Los Ríos, Manabí, Morona Santiago, Napo, Pichincha, and Zamora Chinchipe.

The main wood used as a structural element is the guayacan[24], from which two species can be identified within the same forest:

- ***Tabebuia billbergii*,** Guayacán negro (Loja), madero negro (norte del Perú). A deciduous tree 12-14 m tall and 20-25 cm DBH. Endemic of the dry forest of the coast of Ecuador and Peru, at altitudes of 0 to 50 masl. It is found in the north of Venezuela, adjacent areas in Colombia, and southeast Ecuador. In Ecuador it grows in Manabí, Guayas, and Loja.
- ***Tabebuia chrysantha.*** Guayacán (Loja), guayacán de montaña, Guayacán de la costa, Oreja de león (El Oro, Esmeraldas, Manabí y Guayas). Deciduous tree, between 12-20 m in height and 20-40 cm of DBH. This species inhabits slopes, plains, and hollows of dry forests. It grows between 0-2000 meters in the provinces of Bolívar, Chimborazo, El Oro, Esmeraldas, Guayas, Loja, Los Ríos, Manabí, Morona Santiago, Napo, Pastaza, Pichincha and Sucumbíos.

22 Wood species such as Guayacan, Cedar, Amarillo, Bellamaria, and Romerillo were also mentioned by Mr. Rafael Campoverde in his interview (Appendix H).

23 Diameter at Breast Height.

24 It is necessary to recognize some observations about the guayacán:

- The Glossary of Architecture (Instituto Nacional de Patrimonio Cultural, 2010)identifies the guayacan with the specie *Caesalpinia paraguariensis* without further detail on its characteristics.
- It is essential to recognize it as a different tree than the *Minquartia guianensis,* commonly known as Guayacán pechiche. Both are registered in the "*Manual de Identificación: Familias y Géneros arbóreos del Ecuador*" (Palacios, 2011). Some of the characteristics of the guayacán pechiche can be found in the "Manual de Diseño para maderas del Grupo Andino" (Junta del Acuerdo de Cartagena, 1984)

Figure 82: Photographs: Guayacan tree. & Guayacan Wood (Maderas Sudamérica 2008).

(Aguirre Mendoza, 2012) This is also distributed in many countries, from Mexico and Guatemala to Panamá, Colombia, and Venezuela (Figure 91).

It has slow growth. It is susceptible to browsing and damage caused by rodents. It has a seed of short viability.

Climate requirements:

- Altitude: 0 - 1500 masl
- Precipitation: 1000 - 2500 mm
- Temperature: 12 - 24 °C

Soil requirements: It is not demanding in soils; it achieves its best development in fertile soils, well-drained, frank to sandy loam, and neutral reaction to alkaline (pH 6.0-8.5).

Uses: It is one of the heaviest and most durable woods. It is used in joinery, carpentry, musical instruments (violin arches), or as parts for bodies, carriages, cart shafts, etc. It is used in silvopastoral systems, borders, shade, and ornamental. It is excellent for honey production. Bark extract is used as medicine.

Properties:

- Dark olive brown heartwood and yellowish or pink sapwood. Streaked from soft to marked.
- Medium and Straight or Crisscross grain texture
- Odor and taste are absent, not distinctive.
- Uneven brightness
- Durable and resistant to termites and salt water.

Workability: It is difficult to brush and cut. Drying moderately easy. (Vinueza, 2012)

Figure 83: Photographs: Cedar tree & Cedar Wood (Maderas Sudamérica 2008).

Cedar is another wood of recurrent use for nonstructural purposes.

– ***Cedrela odorata*,** Cedro (Loja), Cedro de castilla (Los Ríos), Cedro cubano (Esmeraldas). Deciduous tree 20-25 m tall and 80 cm DBH (Figure 92). In Ecuador it is found from 0-2,000 masl, in the provinces of Esmeraldas, Galapagos, Guayas, Los Ríos, Loja, Morona and Napo. (Aguirre Mendoza, 2012)

  Climate requirements:

  - Altitude: 0 - 1,200 masl
  - Precipitation: 1,200 - 2,000 mm
  - Temperature: 18 - 30 °C

  Soil requirements: It is a demanding soil species that requires deep, aerated, well-drained, fertile soils, pH between 5.0 and 7.0, with good availability of significant elements, varying from clayey loam to sandy loam. It tolerates wet sites and supports neutral and calcareous soils.

  Limiting factors of growth: This species is vulnerable to being attacked by Hypsipyla granadilla (termites), which affects both the nursery and the plantation. Damage can occur caused by epiphytic plants. Does not support soils with aluminum content above one ppn[25].

  Uses: Construction of canoes, furniture, plywood, lathing and handicrafts, and musical and domestic instruments. Easy to work with machinery and hand tools: sawing, rabbet planing, lathing, and sanding and finishes are excellent. Easy to glue and retains nails and screws well. It is quick drying.

  Properties: Organoleptic. Freshly cut heartwood color varies from pink to reddish-brown, and exposed turns reddish to dark reddish-brown,

25 Parts-per notation

sometimes with a purple streak. The sapwood can go from whitish or greyish-white to light brown.

- Soft veining, medium texture, and soft to the touch
- Grain is usually straight, sometimes slightly crossed.
- Strong scent characteristic aromatic and astringent taste
- Brightness from medium to high.

Preservation: Low natural durability. Moderately permeable to preservatives due to its low density. (Vinueza, 2012).

Figure 84: Bahareque wall.

4.1.2. Soil

The "*Manual de Construcción en Tierra*" (Manual of earthen construction techniques, (Minke, 2005) refers to soil used as building material when prepared for work and mixed with water and other binders (sand, silt, gravel, straw, etc.) is known as "*barro*" (mud) and can have different names: adobe (clay earth blocks made by hand), "*bloques de suelo*" (compressed clay blocks), raw brick, etc.

Among its most important features is its ability to regulate environmental humidity thanks to the mud absorbs and expels moisture faster than other materials, it is also able to store heat in climatic zones with wide temperature differences, is a reusable and economical material, also suitable for self-construction, since it can be executed by non-specialists with simple tools.

It is important to consider that it is not a standardized material, and its composition depends on where it is extracted, so its characteristics for a correct mixture will change according to its location. One disadvantage is that it is not waterproof, so it needs to be protected against rain (it is commonly protected with eaves, waterproofing barriers, and surface treatments) and it contracts when is dry, so fissures can appear.

The mud preserves wood and other organic materials when they are in direct contact with it due to its low moisture balance (from 0.4 to 6% by weight) and its high capillarity. Insects and fungi cannot destroy wood under these conditions as insects need a minimum moisture of 14 to 18% and fungi more than 20% to live.

ABOUT ITS PREPARATION

An adequate mixture depends on the type of soil, its consistency, and the type of application that is wanted, for example, wet soil with low clay content and high sand content can be used directly in the construction of a rammed earth wall, or this case study, bahareque (Figure 93).

The easiest way to prepare the mixture properly is to remove the mud moistened with a hoe or knead the mixture either with the feet or use animals for work. Straw, sand, and other additives can be mixed during this operation. If there are lumps of soil with high clay content, they cannot be used directly as a building material before they must be crushed or dissolved in water.

- **Dissolve the Mud:** To enrich sandy soil with clay or prepare a relieved mud, it is usually necessary to make a grout that is prepared by dissolving the mud.
- **Cure the Material**: Resting the mixture between 12 to 48 hours is a type of curing called *Mauken* (in German) that allows to increase the cohesion of the mud.
- **Reduction of Clay content**: It is done by adding thick aggregates such as sand and gravel, increasing the resistance of the mud to compression. The aggregates should always be moistened before being added to the mixture. Other materials that can be used are straw, shells, manure, hairs, sawdust, etc., these also serve to reduce retraction and, in some cases, increase thermal insulation (Minke, 2005). In the case of Zaruma, the straw used was the leftover from the rice harvest that was transported from the fields in higher parts of the territory (Gualán, 2023).

In "*Arquitectura tradicional en Azuay y Cañar*" (Instituto Nacional de Patrimonio Cultural et al., 2011), two steps are mentioned for the final finishing of the walls:

COATING: REVOQUE Y EMPAÑETE

The *revoque* (plastering) and *empañete* (finishing coat), aim to protect externally the house but also generate a good finish on its walls.

- ***Revoque:*** For the plastering, the land used in this process must have been sifted so that it does not present stones that prevent a flat surface and without holes. The mud must be rested for at least 48 hours; it is worked in layers, first a layer of approximately 0.5cm is placed, the excess water is allowed to evaporate and, preferably the next day, the second layer is placed.

  Among some traditional builders, it is known the use of glue in a very low dosage that allows a higher resistance; white glue or of animal origin can be used. Regarding dosage, although the measures to be used are not fixed, in all cases no more than 1% of the volume is mentioned.

  It is not recommended to give a very polished finish; this would not help the binding with the finish coat. The mud for the plaster is not always prepared with straw; it can also be placed the same once the first layer of mud has been given. It is advisable not to use dry straw, this becomes very brittle.

- ***Empañete***: It constitutes a thin layer of protection that is placed on the plaster; it is formed by yellow soil and horse manure in equal proportions, gypsum is added at the moment of its placement, in low proportions depending on the quality of the soil, the measure is about 1:20 ratio. Horse urine is a good binder, which can also be replaced by tuna gum. It is allowed to stand for at least 72 hours before use. Its application should be in a layer not exceeding three millimeters.

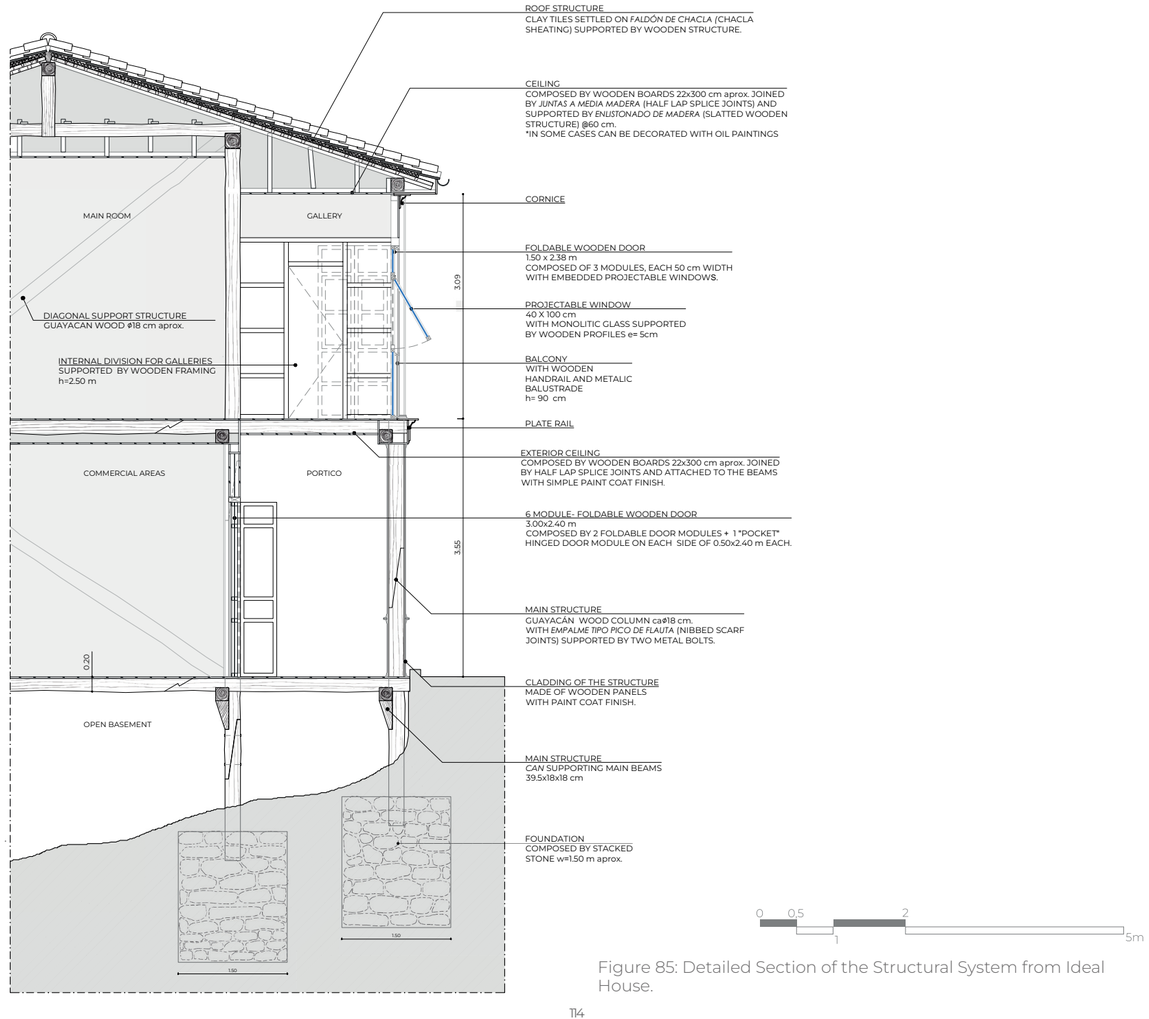
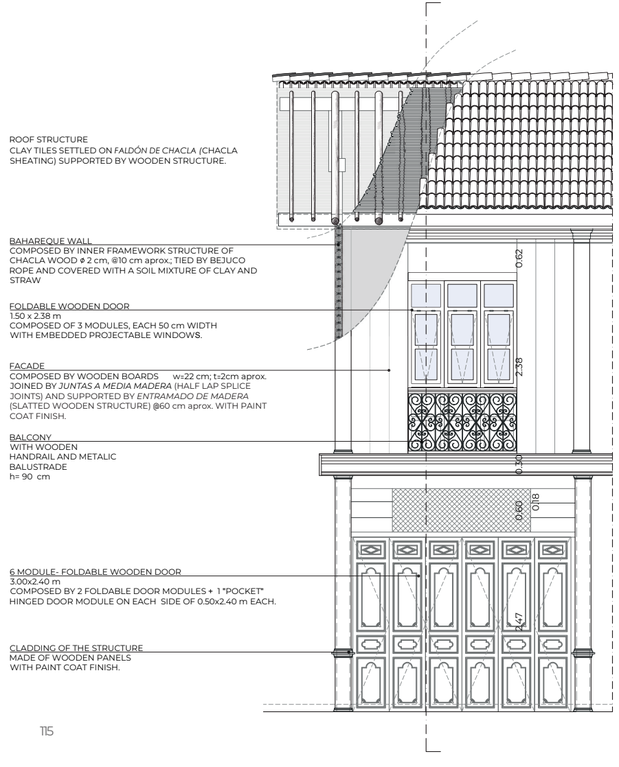


Figure 85: Detailed Section of the Structural System from Ideal House.

4.2. Construction Sytems and Details

The constructive system details are elaborated based on the proposal of the House of Zaruma (Section 3.5.). These take the original elements, following design patterns of the surveyed case studies and other visited houses with similar features as a basis to later develop its detail and understand specific features such as the constructive method and functioning mechanisms, plus the understanding of the regulatory ordinances issued at the time of its construction.

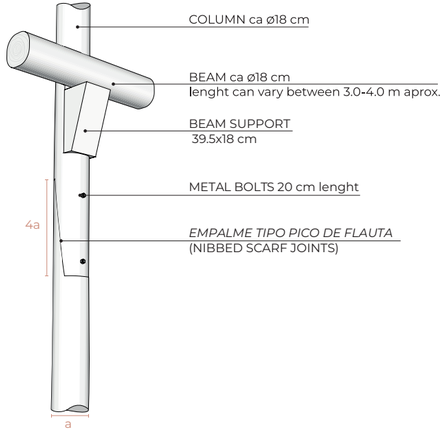
Figure 86: Detailed Facade from Ideal House.



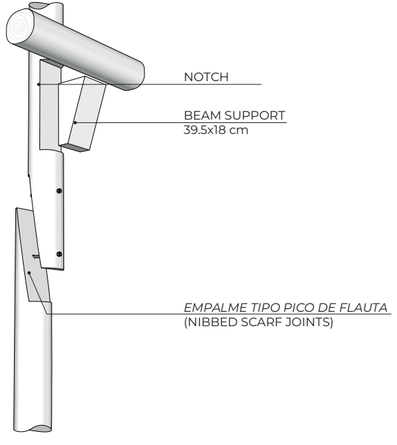
4.2.1. Types of Structural Joints

Figure 87: Basement Level Joints Photographs.

BASEMENT LEVEL JOINTS



EXPLODED VIEW



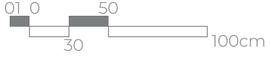
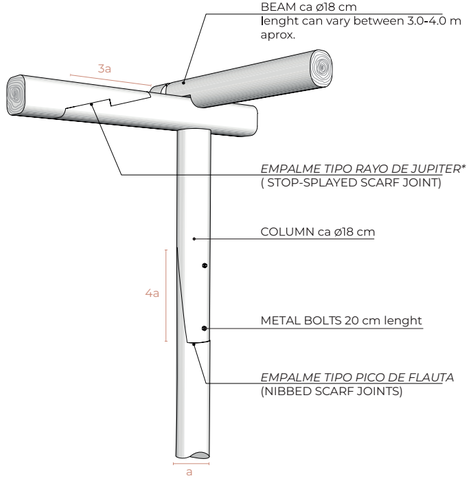


Figure 88: Basement Level Joints 3D detail.

Figure 89: Upper-Level Joints photographs.

UPPER LEVEL JOINTS



EXPLODED VIEW

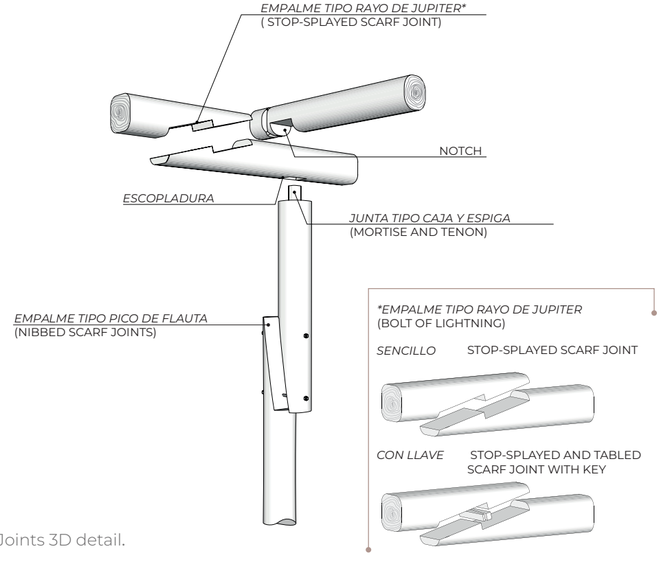


Figure 90: Upper-Level Joints 3D detail.

Figure 91: Photographs of *bahareque* structure.

4.2.2. Bahareque wall

The bahareque is a constructive system of walls. Its main structure consists of a skeleton of studs and noggings that supports a cane network, in the case of Zaruma using chacla, tied with cabuya or bejuco that will support the mud. The *"carrizo", "zuro"* or the *"chacla"* can be placed in pairs or individually, always keeping in mind that the separation between one and the other must allow the compaction of the mud. It is essential that these materials are properly dry to avoid that, when placed, the shrinkage of the cane makes the ties loosen and therefore lose the stability of the net.

The mud is mixed with chopped straw or sometimes with fibers, thrown or compacted on the mesh so that all the elements are covered with at least 2 cm of the mixture, it is recommended that it be rested, not less than 48 hours. If the coating does not have a sufficient thickness and if the cracks are not properly repaired the wall deteriorates quickly.

The consistency of the mud mortar to be used is easily checked by dropping a 10-diameter ball from a height of 1 m on a hard surface. If the diameter of the crushed disc forming is 13 to 14 cm the consistency is appropriate. Once the mud has dried, the process of *revoque* and *empañetado* (Instituto Nacional de Patrimonio Cultural et al., 2011).

In the houses of Zaruma, this technique is applied on the walls that are placed on the main core of the house, conforming the accommodation rooms and in the exterior walls that are adjacent to other buildings, or private facades, while the main façade or the division in the galleries are made of wood.

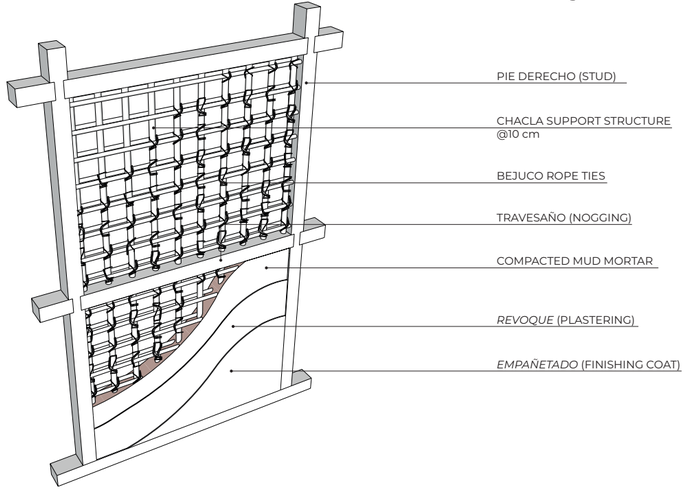


Figure 92: ***Baharaque*** 3D detail.

Figure 93: Upper-level structural system photograph.

4.2.3. Armadura (Rooftop system)

"*Arquitectura tradicional en Azuay y Cañar*" (Instituto Nacional de Patrimonio Cultural et al., 2011)describes a roofing system similar to the one present in the buildings of Zaruma, from it is important to highlight the process of coating the roof structure, which, although not presented in Zaruma's houses nowadays, it can be assumed the use of similar practices for the insulation of the materials.

On top of the roof structure is placed a sheathing of canes called *"carrizo"*, known as *"enchagliado"* or *"enchacliado"*; then an underlayment of mud that will serve to hold the tiles, the traditional finish material. In the case of the houses from Zaruma, the *"carrizo"* is replaced by a variety of cane, known locally as Chacla or Pindo:

- **Enchacliado:** Over the rafters and perpendicular to them, is placed the sheathing of *carrizo* or *pindo*, which is tied with cabuya (or bejuco in the case of Zaruma). It starts at the bottom of the sheathing with a 4x5cms wooden strip. called *"bocacinta"*, which works as a limit when placing the mud underlayment. It can still be observed that in many roofs the peel of the cane is not removed, this would help to provide greater adhesion with the mud that is placed later.

- **Torta de Barro:** Once the *enchacliado* is made, the layer of clay is placed on it; it is important to consider that this clay cannot have excess water, because when it dries the over shrinking can loosen the tiles.

  It is distributed from the bottom of the sheathing towards the top; in strips of approximately 12 cm thick (height of the tile) and 20 cm wide. It is important that in this mixture chopped straw (preferably dry) is placed in proportions not less than 35% of volume; this, in addition to relieving the weight of the coat, contributes to reduce material shrinkage and gives a better grip to the tiles (Figure 100).

- **Entejado**: It is recommended that the roofs do not have slopes less than 30%, so the rainwater can evacuate easily. The tiles must be placed in rows alike to the *torta de barro*, starting from the base of the sheathing upwards.

  Finally, the ridge tiles are placed on the mud underlayment with an overlap not less than 5 cm. This application may have additional limescale to prevent moisture4

ROOF FINISH DETAIL WITH "TORTA DE BARRO" LAYER

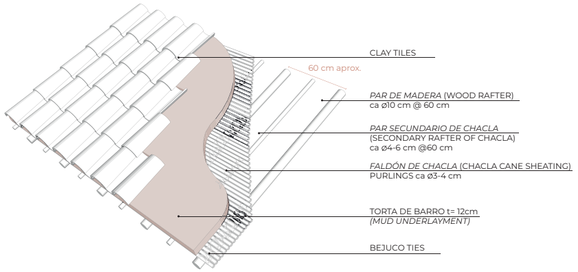


Figure 94: Rooftop 3D detail. *"Torta de Barro"* support system.

① Rooftop Structure

② Central Strut & *Correa* (Tie Beam) Union

③ *Hilera* (Ridge Beam)

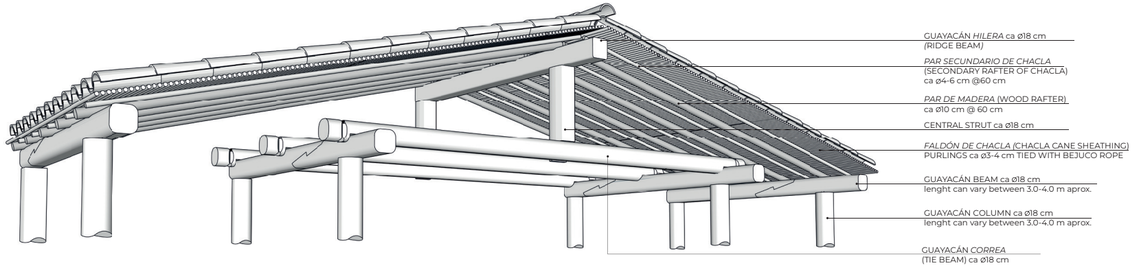
④ Rooftop Structure

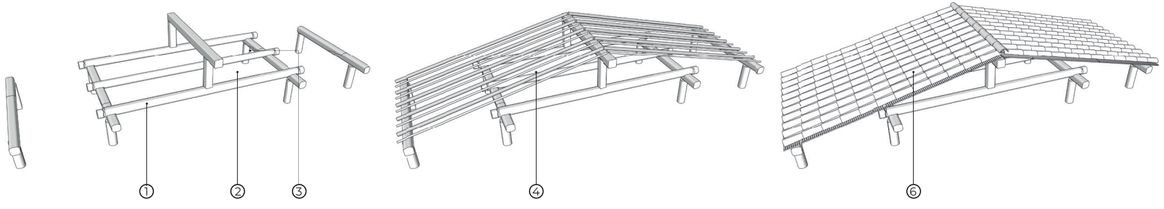
⑤ Bejuco ties

⑥ Tiles

Figure 95: Rooftop structural system photographs.

ARMADURA(ROOF STRUCTURAL SYSTEM) DETAIL





ROOF FINISH DETAIL

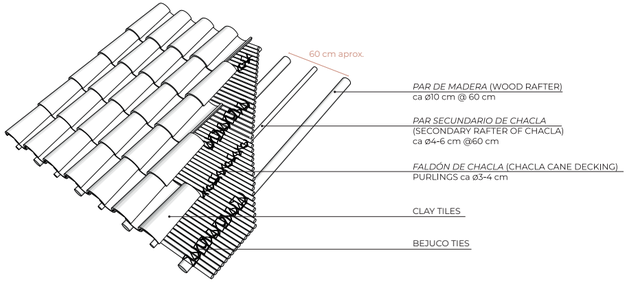
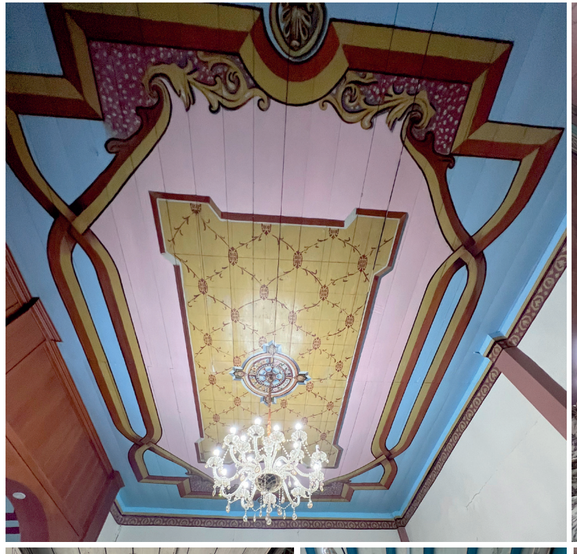


Figure 96: Rooftop structural system 3D details.





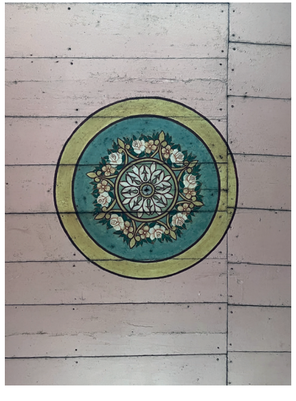



Figure 97: Photographs of different types of Ceilings.

4.2.4. Ceiling

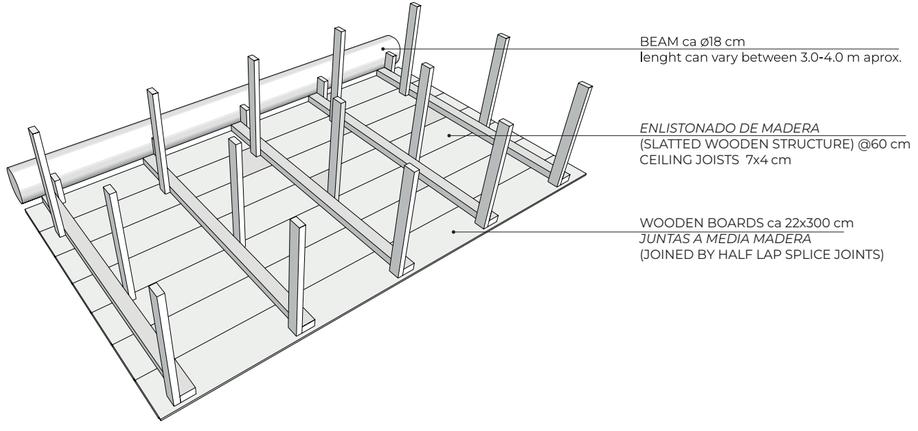


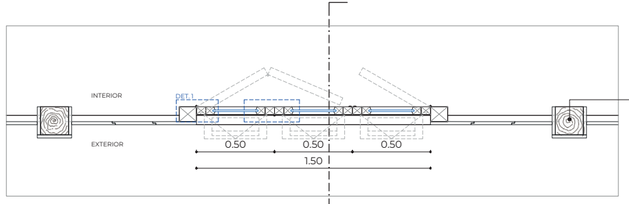
Figure 98: Ceiling 3D detail.



Figure 99: Photographs of ceiling details.

Figure 100: Photographs of different styles of the main façade.

4.2.5. Main façade: Door Type 1 & Wooden wall system



MAIN STRUCTURE
GUAYACAN WOOD COLUMN
ø20 cm aprox.

FLOORPLAN

MAIN STRUCTURE
GUAYACAN WOOD BEAM
ca ø18 cm

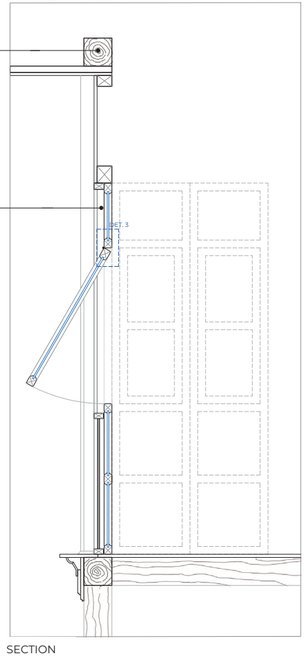
FACADE WOODEN BOARDS
w:22 cm; t:2cm aprox.
JOINED BY HALF LAP SPLICE JOINTS *(JUNTAS A MEDIA MADERA)* WITH PAINT COAT FINISH.

FOLDING DOOR
COMPOSED OF 3 MODULES
2.38x1.50

PROJECTABLE WINDOW
1.00X0.40

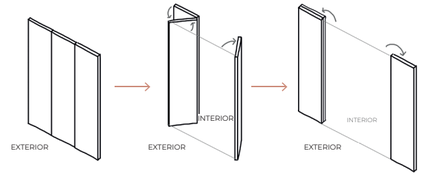
METAL BALCONY
h= 91 cm

EXTERNAL FACADE

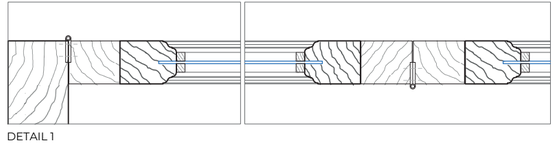


SECTION

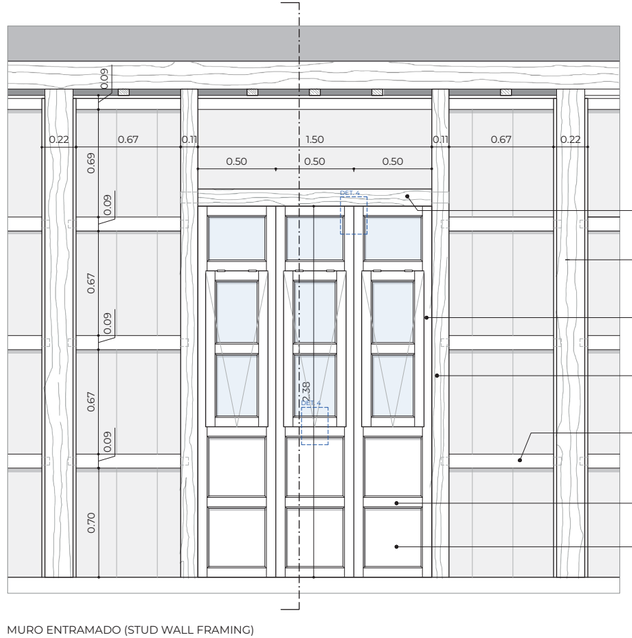
Figure 101: Main facade & Door Type 1 Details.



OPERATING SCHEME



DETAIL 1



HEADER *(DINTEL)*
9.5x11 cm

MAIN STRUCTURE
GUAYACAN WOOD COLUMN
ca ø18 cm

STILE *(LARGUERO)*
5x5 cm

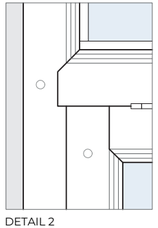
KING STUD *(PIE DERECHO)*
11x9.5 cm

NOGGING *(TRAVESAÑO)*
9x4 cm

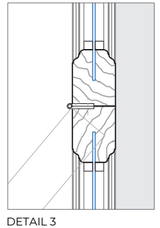
RAIL *(PEINAZO)*
5x5 cm

PANEL *(CASETÓN)*

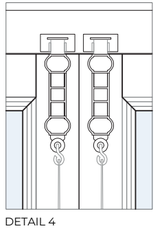
MURO ENTRAMADO (STUD WALL FRAMING)
WITH ENSAMBLADURA TIPO CAJA Y ESPIGA (MORTISE AND TENON JOINTS)
INTERNAL FACADE



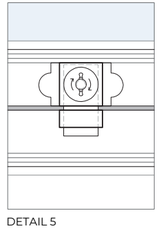
DETAIL 2



DETAIL 3



DETAIL 4

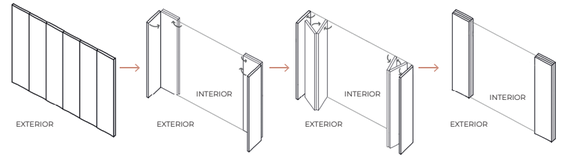


DETAIL 5

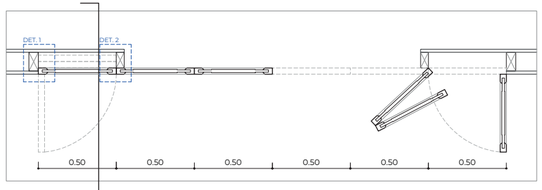
Figure 102: Photographs of Door Type 2.

4.2.6. Door's system

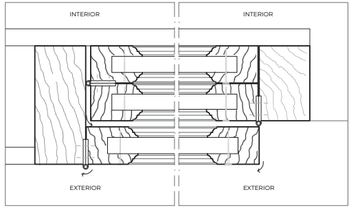
DOOR TYPE 2 DETAIL



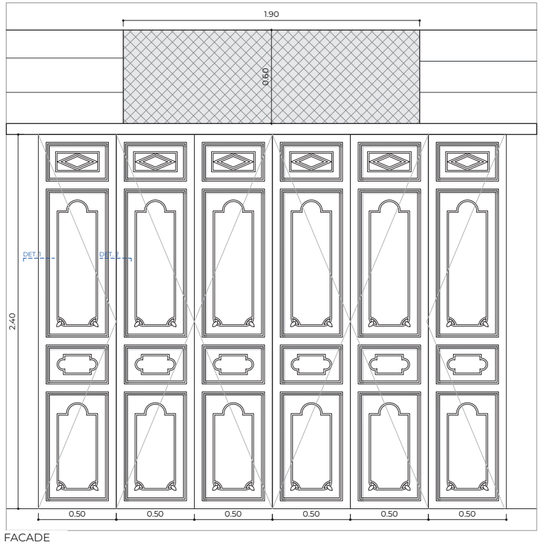
OPERATING SCHEME



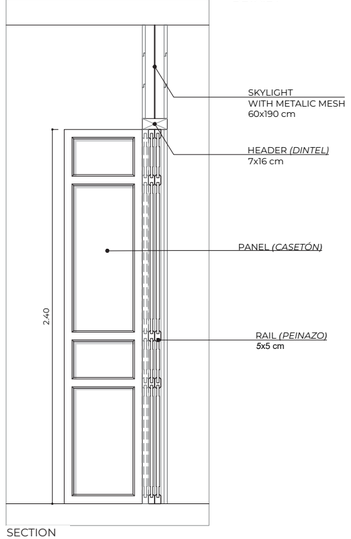
FLOORPLAN



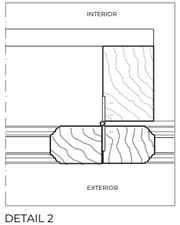
DETAIL 1



FACADE



SECTION

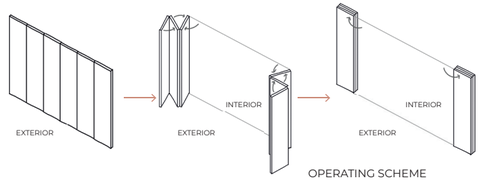


DETAIL 2

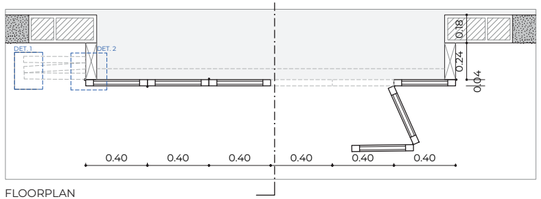
Figure 103: Door Type 2 Details.

Figure 104: Photographs of Door Type 3.

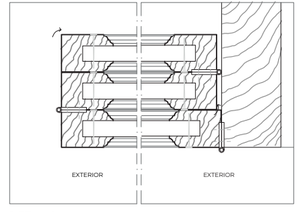
DOOR TYPE 3 DETAIL



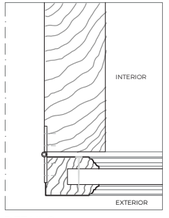
OPERATING SCHEME



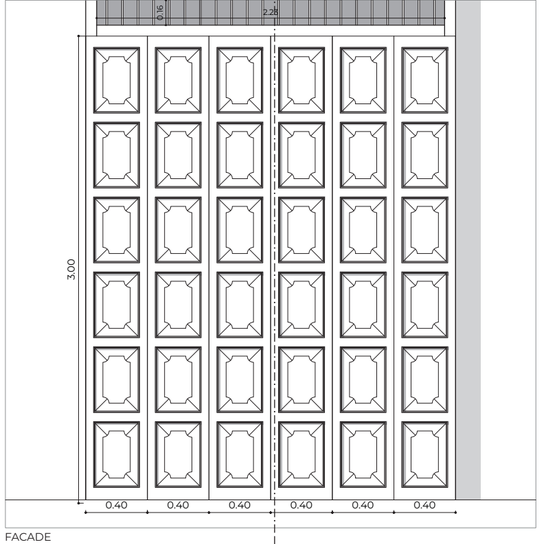
FLOORPLAN



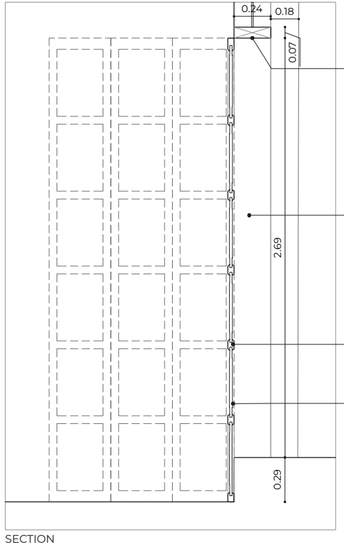
DETAIL 1



DETAIL 2



FACADE



SECTION

HEADER *(DINTEL)*
7x24 cm

KING STUD *(PIE DERECHO)*
7x24 cm

RAIL *(PEINAZO)*
5x5 cm

PANEL *(CASETÓN)*

Figure 105: Door Type 2 Details.

Figure 106: Comparison of the State of Conservation on House z-016, 2022 (left)-2003 (right).

5. DECAY

The State of Conservation Analysis (Section 5.1.) is a tool that helps to understand the decay that has affected the city, evidencing the changes that the First Order Zone has suffered and its causes, plus a general overview of the decay in the houses that have survived the urban changes.

The analysis of the deterioration of the houses aims to identify common problems in the surveyed buildings. This involves evaluating the structural layout (Section 5.2.), connections, and architectural elements (Section 5.3.).

The evaluation of the structural layout considers the distribution, continuity, and proper construction of structural elements. The connections and architectural features also assess the deterioration caused by unforeseen interventions and the preservation of buildings.

Figure 107: State of Conservation Map - First Order Zone- 2022.

5.1. State of Conservation

Figure 107 presents the State of conservation of the city until March 2022. It is based on the map developed for the Conservation and Management Plan of 2003. The modifications inserted are determined by the buildings' decays and alterations, which can be appreciated from the exterior of the edifications.

It also pointed out the dates and location of all the sinkholes that have affected the city and its current state after the subsoil remediation interventions and the possible cavities that, in some cases, were entrances for the illegal minery and that existed below some houses; these were found through studies with georadar and interferometry during the emergency intervention due to the sinkhole of 2021 (Figure 108).

The buildings marked as "Collapsed" were lost during a sinkhole, and those marked as "risk of collapse" have severe damage to their structure as a consequence of a lack of intervention with adequate restoration processes.

SINKOLES

1. La Inmaculada Highschool- October, 2016.
2. Municipal Coliseum- 2016.
3. Gonzalo Pizarro St. proximity- 2016.
4. Gonzalo Pizarro St. proximity- 2019.
5. Colón y Ernesto Castro St. - December, 2021.
6. Ernesto Castro y 10 de Agosto St. - December,2022.

▲ POSSIBLE MINE CAVITIES/ENTRANCES

Figure 108: Mine cavities/ entrances photographs.(Subsecretaría de Gestión de la Información y Análisis de Riesgos and Dirección de Análisis de Riesgos 2021)

1 SINKHOLE OF LA INMACULADA HIGH SCHOOL- OCTOBER, 2016.

Figure 109: Top-bottom photos: La Inmaculada Highschool-2015 (Google 2015) ; Sinkhole-2016 (Diario Correo 2021); Lot after reparation works- 2022.

5 SINKHOLE OF COLÓN Y ERNESTO CASTRO ST. - DECEMBER, 2021.

Figure 110: Top-bottom photos: House z-011- 2003 (Municipalidad de Zaruma and Guido Díaz & consultores asociados 2003a); Sinkhole-2021(Diario Correo 2021); Lot after reparation works- 2022.

Figure 111: Top-bottom photos: House z-046- 2003(Municipalidad de Zaruma and Guido Díaz & consultores asociados 2003a); Sinkhole-2021 (Diario Correo 2021); Lot after reparation works- 2022.

6 SINKHOLE OF ERNESTO CASTRO Y 10 DE AGOSTO ST. - DECEMBER,2022.

Figure 112: Top-bottom photos: Sinkhole-2022(El Comercio and García 2022); Lot after reparation works- 2022.

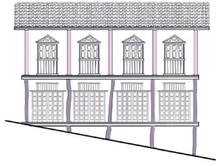
HOUSES WITH RISK OF COLLAPSE

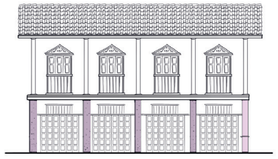
Figure 113: Houses at Risk of Collapse photos.

HOUSES HEAVILY MODIFIED OR RECONSTRUCTED

Figure 114: Reconstructed houses or modifies photos.

5.2. Structural Layout.





DISCONTINUITY OF THE STRUCTURE
① DUE TO THE WARPING OF VERTICAL ELEMENTS

Wooden elements of the structure are twisted, which causes different spans between levels and irregular load distribution.

Figure 115: Structural Layout Decay- Warping of vertical elements.

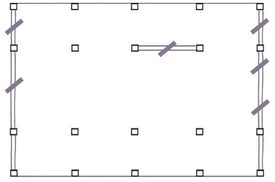
DISCONTINUITY OF THE STRUCTURE
② DUE TO THE REPLACEMENT OF THE ORIGINAL CONSTRUCTIVE TECHNIQUE

1 With the introduction of different structural techniques, being the most common the concrete.

2 With smaller supporting elements

The columns that are on the porticoes are commonly the most affected.

Figure 116: Structural Layout Decay-Replacement of original technique.



③ DISTRIBUTION OF DIAGONALS

Irregular distribution of the diagonal braces.

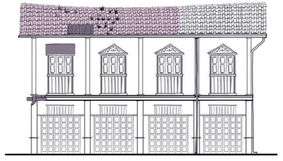
Figure 117: Structural Layout Decay- Distribution of Diagonals.

④ FOUNDATION DEFECTS

1. Lack of stone foundations & wooden elements resting directly on soil.
2. Beams are placed directly on the soil due to the change of slope on the ground.
3. Foundations covered by non-structural interventions.

Figure 118: Structural Layout Decay- Foundations Defects.

5.3. Connections and Elements.



① ASSEMBLY DEFECTS

Deformation of structural joints, caused by lack of maintainance.

Figure 119: Connections & Elements Decay- Assembly Defects.

② EXPOSED ELEMENTS

Decay of the timber structure due to environmental exposure, humidity caused by rain water and lack of maintanance .

Figure 120: Connections & Elements Decay- Exposed Elements.

DAMAGE OF THE EXTERNAL ELEMENTS OF THE FACADE

③ MATERIAL CRUMBLING

Crumbling of: 1 Cornises,

2 Eaves,

3 Decorative coating wood pieces,

Caused by lack of maintenance and absence of protective treatment for the material; humidity caused by rainwater.

Figure 121: Connections & Elements Decay- Material Crumbling.

DAMAGE OF THE EXTERNAL ELEMENTS OF THE FACADE

④ DESTRUCTION OF WALL ELEMENTS AND DECORATIONS

Unplanned installation of sanitary pipes and electrical wiring.

Figure 122: Connections & Elements Decay- Wall Elements and Decorations.

⑤ ROOF ELEMENTS

1 Replacement of damaged pieces with other types of wood or bamboo, not following the original technique.

2 Humidity and mold on wooden/ chacla elements due to lack of maintenance.

3 Replacement of the original tile roof with other materials like zinc or polycarbonate; this can be present in the entire roof or as partial substitution and alters the temperature and relative humidity of the structure.

4 Poor distribution or loss of rafters causing roof buckling.

Figure 123: Connections & Elements Decay- Roof Elements.

⑥ CEILINGS

1 Humidity stains and mold of ceiliings,

2 Deformation of boards,

3 Alteration of color of ceiling decorative paintings, caused by water infiltration from the roof.

4 Boards or mouldings are missing or have been poorly replaced.

Figure 124: Connections & Elements Decay- Ceilings.

⑦ ALTERATION OF ORIGINAL MATERIAL

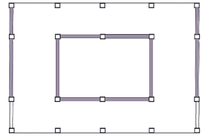
1. Bahareque walls are commonly replace with brick causing alteration of weight distribution and discontinuity on wall system
2. Interior divisions, replacement of wooden or bahareque walls with plywood coated walls.
3. The ceilings are altered by being replaced or covered up with plywood boards:

   - Altering the original height of the spaces which can lead to poor ventilation.

   - Increasing the risk of humidity and mold when there are infiltrations from the roof.

Figure 125: Connections & Elements Decay- Alteration of Original Material.

⑧ BAHAREQUE



BAHAREQUE DISTRIBUTION ON SECOND LEVEL

1. Loss of the empañetado & revoque (plaster and finish coat) can start as small cracks on the plaster until a total crumbling of it.
2. Exposure of the internal structure because of the crumbling of the clay.
3. Decay of chacla structure caused by the exposure to humidity.
4. Deformation of the wall & detachment between the wall and its timber structure.

Figure 126: Connections & Elements Decay- Bahareque.

⑨ WALLS AND FLOORS

1. Wooden floors with signs of damage by xylophagous.
2. Loss of flooring decorations and cracking on mortar pavement caused by lack of maintenance and erosion.
3. Humidity, mold, and loss of coating on floors caused by infiltrations.
4. Wear of the surface layer of the wood by rain and lack of maintenance.
5. Humidity stains of the tapestry caused by infiltrations.

Figure 127: Connections & Elements Decay- Walls and Floors.

6. CONSERVATION AND INTERVENTION RECOMMENDATIONS

This chapter is a compilation of documentation that establishes recommendations for conservation and intervention in buildings with similar materials and construction techniques to those found in Zaruma, as general guidelines were considered, the Charter on the Built Vernacular Heritage and the Principles of the Preservation of Historic Timber Structures from ICOMOS.

Section 6.2. involves specifications for the construction in Bahareque involving the essential materials (wood, cane, and soil), and Section 6.3. describes some intervention strategies that respond adequately to the technique's decay level. It is essential to highlight that these recommendations are not adapted to the specific requirements of Zaruma's region, but suggestions for possible adaptations are provided. However, they are a good reference for the possible development of future interventions.

6.1. ICOMOS' Guides for Heritage

6.1.1. Charter on the Built Vernacular Heritage

The Charter (ICOMOS, 1999a) encourages the acknowledgment of vernacular architecture as a local communitarian manner of construction, with traditional types that follow a coherence in style, form, and appearance, plus the expertise on design and construction that is commonly transmitted informally. The appreciation and protection of the vernacular heritage are strictly related to the community's involvement,

the recognition of rights from the governments and authorities, and the living traditions through legislative, administrative, and financial means.

PRINCIPLES OF CONSERVATION

– *"The conservation of the built vernacular heritage must be carried out by multidisciplinary expertise while recognizing the inevitability of change and development and the need to respect the community's established cultural identity.*

– *Contemporary work on vernacular buildings, groups, and settlements should respect their cultural values and traditional character.*

– *The vernacular is only seldom represented by single structures, and it is best conserved by maintaining and preserving groups and settlements of a representative character, region by region.*

– *The built vernacular heritage is an integral part of the cultural landscape, and this relationship must be taken into consideration in the development of conservation approaches.*

– *The vernacular embraces not only the physical form and fabric of buildings, structures and spaces, but the ways in which they are used and understood, and the traditions and the intangible associations which attach to them."*

In the practice, is also recommended to follow some guidelines, such as:

– Before conducting any physical work on a vernacular structure, it is crucial to thoroughly analyze its form and structure and document the research. This documentation should then be stored in a publicly accessible archive.

– The interventions must respect and maintain the integrity of the site, the relationship to the physical and cultural landscape, and between structures.

– Preserving the techniques and skills used in traditional building systems is crucial for maintaining vernacular structures' unique identity and restoration. Documenting and transferring these skills to new generations of artisans and builders is essential through education and training.

– Consistency of expression, appearance, texture, and form must be maintained when replacing materials and parts to meet modern demands in construction.

– The adaptation and reuse of vernacular structures aims to respect the structure's integrity while being compatible with acceptable living standards. A community's code of ethics can be a tool of intervention in the continuous use of these vernacular forms.

– Changes over time and period restoration should be understood as important aspects of vernacular architecture. The conformity of all parts of a building to a single period will not be the goal of work on vernacular structures.

– In order to conserve the cultural values of vernacular expression, governments, authorities, and organizations must emphasize training like education programs for conservators, training programs to assist communities in maintaining traditional building systems, materials and craft skills, information programs to improve public awareness of the vernacular (especially amongst the younger generation) and regional networks on vernacular architecture to exchange expertise and experiences.

6.1.2. Principles for the Preservation of Historic Timber Structure

The Principles of the Preservation of Historic Timber Structures (ICOMOS, 1999b) intends to define universally applicable practices and principles for protecting and preserving historic timber structures and their significance. These principles are:

- *"Recognize the importance of timber structures from all periods as part of the cultural heritage of the world;*

- *Take into account the great diversity of historic timber structures;*

- *Take into account the various species and qualities of wood used to build them;*

- *Recognize the vulnerability of structures wholly or partially in timber due to material decay and degradation in varying environmental and climatic conditions caused by humidity fluctuations, light, fungal, and insect attacks, wear and tear, fire, and other disasters;*

- *Recognize the increasing scarcity of historic timber structures due to vulnerability, misuse, and the loss of skills and knowledge of traditional design and construction technology;*

- *Take into account the great variety of actions and treatments required for the preservation and conservation of these heritage resources;*

- *Note the Venice Charter, the Burra Charter, and related UNESCO and ICOMOS doctrine, and seek to apply these general principles to the protection and preservation of historic timber structures;"*

There are noted several recommendations, some of the most relevant are:

– The inspection, recording, and documentation of the structure, components, and materials, including samples, information about traditional technologies, reasons for choosing materials, and preservation methods, and elaborating a diagnosis of the condition and causes of decay and structural failure of the structure, based on documentary evidence, physical inspection, and analysis, considering physical conditions and non-destructive testing methods.

– A coherent strategy of regular monitoring and maintenance is essential for protecting historic timber structures and their cultural significance.

– Before any intervention, it is fundamental to recognize as the primary aim of preservation and conservation the maintenance of the historical authenticity and integrity of the cultural heritage. Any intervention should be based on proper studies and assessments, following traditional means, and reversible, if possible, without impeding any other future intervention.

– It aims to achieve minimal intervention, meaning in some cases that the preservation and conservation may require the complete or partial dismantling and subsequent reassembly to allow for the repair of timber structures. All elements (structure, roofs, floors, doors, windows, and others) should receive equal attention, retaining as much existing material as possible.

– Repairing and replacing a historic structure must respect relevant historical and aesthetical values, using the same species of wood or better with similar natural characteristics, marking the new elements so that they can be identified later.

– The establishment and protection of forest reserves allow the obtaining of timber to preserve and repair historic timber.

– Contemporary materials and techniques should be cautiously chosen and used. Considering the historical and aesthetic importance of the building or location is crucial when installing safety measures, such as heating and fire prevention systems.

– Chemical preservatives should be closely monitored, regulated, and only used when there

is a guaranteed benefit and no harm to public health or the environment. Additionally, it should be confirmed before using their effectiveness over a long period.

– Education and training about the regeneration of values related to the cultural significance, protection, preservation, and conservation of historic timber structures is essential for a sustainable preservation and development policy. The programs should address all relevant professions and trades involved in such work, particularly architects, conservators, engineers, craftspersons, and site managers.

6.2. Material Requirements for Construction in Bahareque

The *"Guía de construcción parasísmica"*[26] (Guide for paraseismic construction)(Carazas Aedo & Rivero Olmos, 2002) constitutes a brief theoretical technical support directed to construction technicians, masons and anyone who decides to build in *bahareque*. This guide allows us to understand some requirements and possible applicable tests that the raw materials (wood, bamboo, or any similar species, and soil) must fulfill to be considered optimal for construction.

6.2.1. Soil In- situ tests

It is possible to execute simple field tests to verify whether the earth is suitable for construction, showing its characteristics and quality.

26 This publication is linked to "*Bajareque Cerén: Una técnica con legado constructivo*" (Bajareque Cerén: A technique with constructive legacy)(Carazas Aedo, 2021)where this in-situ test is described along with the constructive design of a building in Bajareque Cerén, a similar technique to the one studied originated in Mesoamerica, plus the construction process of a building following a participative communitarian approach.

TACTILE PERCEPTION TEST - GRANULARITY

It is ideal to locate soil that has a combination of both sand and clay. It is essential to be cautious of silt soils as they are not water-resistant once they have dried out.

Specific characteristics can identify each type of soil; organic soils tend to release an odor, while sandy soil is rough and brittle, not sticky; silt soils are fine, easy to reduce in powder, and little sticky, and clay is difficult to break, slow to get rid in the water, fine with high adherence.

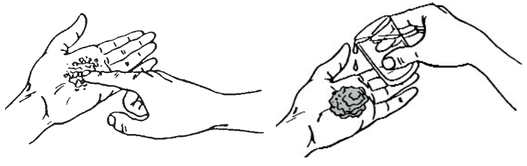


Figure 128: Tactile perception test to verify Granularity. (Carazas Aedo & Rivero Olmos, 2002)

CIGAR TEST- PLASTICITY

Procedure:

– Remove the gravel from the sample.

– Soak, mix, and let the soil rest for half an hour until the clay can react with water.

– The soil should not get the hands dirty.

– On a plate, mould a cigar 3 cm in diameter and over 20 cm long.

– Gently push the cigar out of the plate until a section breaks off.

– Measure the length of the piece that fell off.

Perform this procedure three times and make an average: 7-15 cm can be considered good soil; less than 5 cm is too sandy, and more than 20 cm is too clayey.

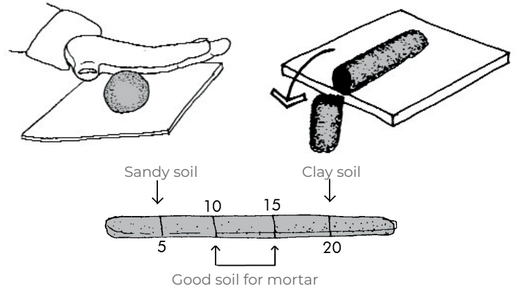


Figure 129: Cigar test to verify Plasticity. (Carazas Aedo & Rivero Olmos, 2002)

TEST OF "LA PASTILLA" - COHESION

– The elaboration of a prototype is recommended to analyze the behavior of the soil after drying (appearance, fissures, resistance). These in-situ essays will help select the best soil if there is a time limitation.In Sandy soil, there is no retraction, and it is easy to turn into dust,

– The silt soils have retraction, but it turns to dust.

– The clay soils have a significant shrinkage, making it very difficult to transform into dust.

It is desirable to obtain less than 1mm retraction, and the difficulty of reducing to dust means it is a good soil.

– Take as base the soil from the Cigar test in its plastic state.

– Shape 2 "pastillas" sample using a piece of PVC pipe (∅5 cm, h=1 cm) or similar.

After the samples are dry:

– Observe any retraction phenomena.

– Evaluate the resistance of the soil crushing by applying pressure between the thumb and index finger.

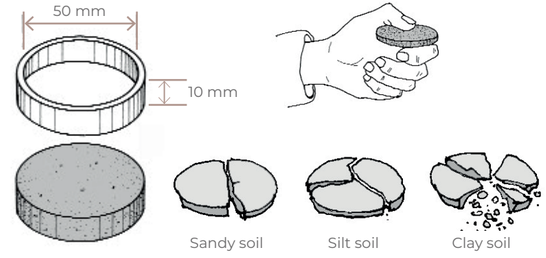


Figure 130: Tactile perception test to verify Granularity. (Carazas Aedo & Rivero Olmos, 2002)

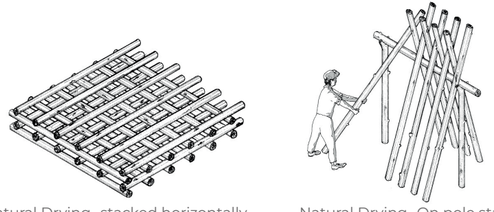
6.2.2. Preparing Wood for Use

– **FELLING:** The wood should be cut in the dry season when the content of sage is the lowest (full moon). This will reduce the chances of insect attacks. After cutting the trunk with its bark, it is left to rest on dry ground for about 30 days, taking care to avoid warping.

– **DRYING PROCESS:** After the felling, the wood must be dried to improve its technological properties dimensional stability, and eliminate the remaining sage. Throughout the process, there could be dimensional changes causing defects in the pieces. Another function of the drying process is to obtain a product where the moisture content is compatible with the one the material will have once installed.

– **DRYING METHODS:**

  - **Natural/Air Drying:** Should not be exposed directly to the sun; it will be made on flat, clean, and well-drained land. Stacking can be done in several ways: horizontally, on a pole stack, and by the ends of the elements.
  - **Artificial Drying:** The temperature, humidity, and ventilation other than natural are obtained utilizing unique installations (ovens). This method reduces the drying periods, and the wood will acquire shallow humidity values.



Natural Drying- stacked horizontally

Natural Drying- On pole stack

Figure 131: Natural Drying methods for wood (Carazas Aedo & Rivero Olmos, 2002)

– **CONSERVATION:** Timber conservation or immunization involves altering the chemical composition of the wood to increase its resistance to biological agents. Preservatives can be single chemical compounds or a combination of them and need to penetrate to a considerable depth. The wood must be already dry and cut.
– **CONSERVATION METHODS:**

  - Through application with brushes, spraying, immersion, or through hot and cold baths
  - By pressure, the preservative is applied using pressures other than the atmosphere inside an autoclave.

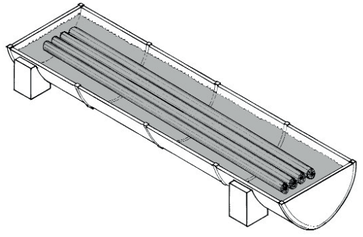


Figure 132: Immersion Conservation Method of wood (Carazas Aedo & Rivero Olmos, 2002)

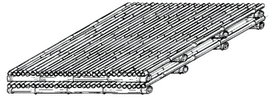
6.2.3. Preparation process of the Cane/ Bamboo

– **FELLING:** The best period is the dry season, in a waning moon, and when the species is fully grown.
– **FELLING RECOMMENDATIONS:**

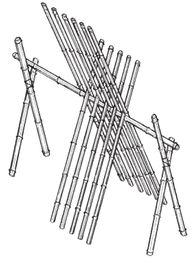
  - The cut should be made between 30 and 40 cm above the ground and after a node.
  - If it is to be used as a structural element, it must be cut in adulthood.
  - To avoid damaging the stem, making a “clean” cut with a well-sharpened tool is essential.
  - After the cut, a curing period is needed to expel the sage inside the stem. To achieve this, the canes should be left vertically, with their branches intact and avoiding contact with the ground. They should be left for approximately 4 to 8 days.

– **DRYING PROCESS:** It is required to avoid deformations, cracks, and dimensional change when working with it. Biological organisms do not live in canes where their humidity is below 15%; the resistance properties increase in a cane with a low moisture content.

Drying can be done outdoors or in non-closed roofed spaces for about 60 days; it is also possible using heat from a stove or moderate open fire, being careful not to produce checks the canes; the estimated time is 2 to 3 weeks.



Natural Drying- stacked horizontally



Natural Drying- On pole stack

Figure 133: Natural Drying methods for cane (Carazas Aedo & Rivero Olmos, 2002)

– **CONSERVATION:** To protect the exposed canes and ensure their durability, germicidal products, fungicides, and insecticides can be deposited in the spaces between the inner fibers. Removing any remaining starches and sugars inside is sufficient for the canes that will be embedded in the wall. To achieve this can be followed several methods:

  - By immersion, you can either submerge it in a preservative solution (salt, limestone, or burnt asphalt) for 5 hours or place it in clean water for a month while changing the water daily.
  - Procedure “Boucherie,” connecting the stems to a raised tank with preservatives.
  - Filling the stems with preservatives, capping them from one end.

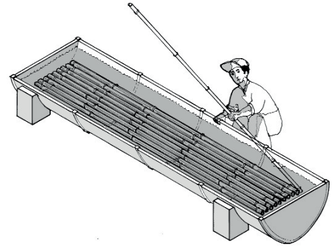


Figure 134: Immersion Conservation Method of cane (Carazas Aedo & Rivero Olmos, 2002)

Most used species in construction in Central America:

– Arundo donax (giant cane, bamboo cane, vara de coheta).
– Gynerium sagittatum (caña brava, caña blanca, caña amarga, vara de tusa).
– Phragmites communis (common aquatic cane).
– Guadua angustifolia (caña de guayaquil, bambú, guadua).
– Chusquea spp (chusque, carrizo suro).

6.3. Intervention Recommendations

The "*Manual de Evaluación, Rehabilitación y Refuerzo de Viviendas de Bahareque Tradicional*" (Manual of Evaluation, Rehabilitation and Reinforcement of Traditional Bahareque Houses) (Asociación Colombiana de Ingeniería Sísmica, 2002)defines an integral intervention strategy for the bahareque to the substitution of decayed material and preventive treatment to those that still can be preserved, considering that the rehabilitation must respond to regulations for design and seismic resistance, also considering the economic situation of the owners. Then, the rehabilitation was classified according to the level of intervention in repair, improvement, and restructuring.

The repair assures the restoration of the safety level of the structure before the damage; the improvement intervention includes repair and improves the level of safety of the building concerning the level that it had before the damage, but that does not provide all the conditions to fulfill the current regulations. Finally, the restructuring includes all those mentioned above, meeting all the requirements of current seismic standards and providing a high degree of safety.

These strategies can be considered as a guide for future intervention in the houses of Zaruma, taking into account that the types of decay identified for them are similar to those presented in this manual; however, an individual evaluation of the conservation state of the houses is required as an analysis of the attributes of the materials in the region as the bahareque is a construction process strongly dependant to the characteristics that the location materials possess.

CRACKING AND LOSS OF "REVOQUE" (PLASTER) AND "EMPAÑETADO" (FINISH COAT)

- **REPAIR:** Replace with new plaster using the original technique and material only in the affected area.

Figure 135: Repair of revoque (plaster) and empañetado (finish coat) (Asociación Colombiana de Ingeniería Sísmica, 2002)

- **IMPROVEMENT:** Plastering the affected wall with cement mortar (1:4 cement-sand proportion), even for walls plastered initially with earth. A chicken coop wire mesh can be nailed to place the mortar
- **RESTRUCTURING:** All *revoques* and *empañetados* (plasters and finish coats), both those on affected and unaffected walls, should be demolished, and all elements damaged by rot, cracking, or other aggressive agents should be replaced.

DETACHMENT BETWEEN WALLS

- **REPAIR:** Repair the cracks of the detached wall with the same type of plaster and technique that the wall had initially been.

Figure 136: Repair of detachment between walls (Asociación Colombiana de Ingeniería Sísmica, 2002)

- **IMPROVEMENT:** Connect the affected walls using bolts (10mm∅) and repair the plaster of the area.
- **RESTRUCTURING:** Demolish existing plasters, replace all deteriorated elements, and connect all walls, both affected and unaffected, using bolts (10mm∅) at thirds of the height. The plasters must be rebuilt with cement mortar on chicken coop wire mesh.

DAMAGE DUE TO THE INTERACTION BETWEEN BAHAREQUE WITH OTHER MATERIALS

This intervention can be applied in cases where the bahareque has been partially replaced with other materials; the replacement with cement or fire brick is the most common in Zaruma's houses, which are much heavier materials. There is no treatment at the levels of repair and improvement.

- **RESTRUCTURING:** The affected wall should be repaired by a new wall of bahareque, connected to the existing walls of the building by bolts (10mm∅) arranged at h/3; the plaster should be of cement mortar (1:4 cement-sand proportion) applied on top of a chicken coop wire mesh; is recommended an integral waterproofing additive with the plaster mortar.

ENVIRONMENTAL EXPOSURE DAMAGE

- **REPAIR:** When there are identified rotten structure elements, these should be replaced by an equal one in good condition, plus searching for the origin of the affectation and fixing it.
- **IMPROVEMENT:** All affected elements must be replaced; if the origin of the damage is due to the attack of xylophagous, the new elements must be immunized, and preventive interventions and the isolation of the structure from humidity are highly recommended.
- **RESTRUCTURING:** Change all the elements affected by environmental agents in the building; both the new and existing parts must be immunized. To prevent the decay from returning, it is essential to determine the source of the decay, such as humidity, filtration, or xylophagous organisms.

SEISMIC DAMAGE

- **REPAIR:** Recover rigidity with connections and stiffeners. A seismic movement can cause a building to lose its rigidity due to a mismatch between elements, cracking, separation of walls, etc.
- **IMPROVEMENT:** The connection between walls must be ensured, and bolts of 10 mm diameter can be used. All the wall structures must be secured and connected using steel plates with not less than 25 cm of overlap on the stud, nailed in zigzag, every 5 cm.

  For optimal reinforcement, it is highly recommended to incorporate stiffener plates at the corners of the structural walls. These stiffeners ought to form triangles with the corner of the wall. It is recommended to use galvanized steel for the plates, but if that is not feasible, these must be meticulously cleaned and coated with anti-corrosive paint before installation.

  In the house of Zaruma, in the case of repair intervention, it is recommended that the reinforcements are X-shaped steel rods placed on the interior side of the walls, as these do not have any stiffening at present. For an improvement intervention, as this can involve the reconstruction of a wall, placing the stiffeners in between the chacla structure is suggested.

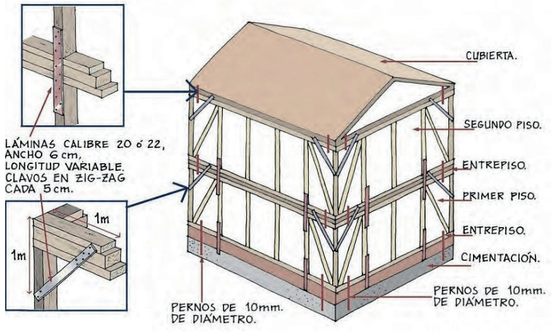


Figure 137: Improvement of Bahareque walls due to seismic damage (Asociación Colombiana de Ingeniería Sísmica, 2002)

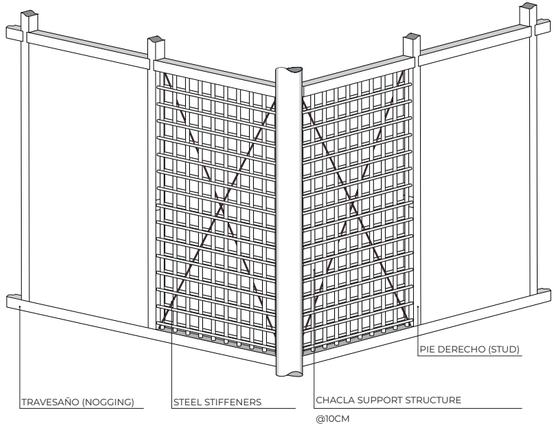


Figure 138: Hypothesis of Improvement of Bahareque walls due to seismic damage.

ROOF COLLAPSE DUE TO ENVIRONMENTAL DAMAGE

- **REPAIR:** In the case of partial or total collapse, the repair must follow the same technique that existed before the collapse.
- **IMPROVEMENT:** If there is a partial collapse, the damaged area is repaired according to the original technique without involving the unaffected area but removing all the tiles. All new elements of wood and bamboo (in this case, chacla) must be immunized against the attack of xylophagous and fungi. The part without damage can be treated with pentaborate (solution in water of 2 % boric acid and 1 % borax, by weight), applied in situ. When the tile is made of clay, an asphaltic membrane is applied to prevent infiltrations and humidity.

Figure 139: Improvement of partial collapse of the roof. (Asociación Colombiana de Ingeniería Sísmica, 2002)

- **RESTRUCTURING:** Total rooftop replacement, following the care mentioned above instructions.

CONCLUSIONS

The present work focuses on the understanding of the house of Zaruma from the late nineteenth century to the early twentieth century; this is a unique solution of the epoque due to the complexity of the territory where it is situated, coupled with a syncretism between the constructive techniques of colonial influence and the local constructive system.

The analysis encompassed a direct examination of the architectural-constructive characteristics of these houses, along with an interpretation of historical archives that facilitated the development of a “type” model aimed at capturing the essential aspects of Zaruma’s houses. From this model were selected critical elements for further study of their composition.

Furthermore, in parallel with on-site surveys of the houses, the research process allowed insights into the inhabitants and their close connection to their homes; this highlighted a sense of pride and appreciation for their historical heritage, as well as an ongoing daily struggle to maintain these homes; implementing interventions that were carried out intuitively, often without professional guidance but driven by the deep care associated with preserving a cherished residence.

This underscores the pressing need to continue education and research on architectural features, construction methods, and material properties, which is crucial for developing practical tools for home restoration and planning future interventions. Training

professionals across various crafts and disciplines can contribute to fostering sustainable conservation and the development of policies. It is imperative that we expand our understanding of history, particularly as it pertains to the city's architecture. Establishing an archive to safeguard all documentation and data related to buildings, including those that may have collapsed, is vital to prevent the loss of valuable knowledge. Additionally, decentralization and making pre-existing knowledge easily accessible for research is fundamental, particularly in a significant situation like Zaruma, where obtaining information was one of the most significant obstacles to overcome.

Recognizing this housing solution's cultural and historical significance is also essential, especially given its current high risk of disappearing if adequate measures for its preservation are not taken. Therefore, there is a pressing need for an intervention program within Zaruma beyond the restoration and rehabilitation of historic buildings, as the city's greatest threat stems from potential collapse due to illegal mining. Thus, comprehensive planning is urgently required to ensure the safety of its residents, improve the quality of life for its inhabitants, and protect their right to remain in their homes.

It is worth considering the importance of this type of housing within the current regional context, not only from a monumental historical perspective but also as a reference point in modern architecture. In Ecuador, informal construction approaches 70%, comprising buildings that do not meet minimum requirements and are constructed by inexperienced workers, making them highly vulnerable to earthquakes (Vizuete & El Comercio, 2011). This contrasts with historic buildings, some of which have survived natural disasters with minimal maintenance.

The contrast between local heritage architecture and its surroundings should be considered an independent subject of study. As mentioned in this thesis, the region was developed due to mining activities between Zaruma and Portovelo, with Zaruma adopting a style influenced by colonial-era architecture and Portovelo adopting an architectural style introduced by American mine managers despite using the same materials.

Finally, studying architectural heritage in this region has unveiled a rich tapestry of history; as we move forward, we must recognize the unique challenges posed by this region's topography, climate, and accessibility. Through a comprehensive analysis of the city's past, construction methods, materials, and structural damages, we have gained valuable insights into the resilience of these historic buildings. The significance of this research extends beyond academic curiosity; it underscores the urgency of preserving and safeguarding our architectural heritage in such remote and demanding environments.

Despite facing adversity, these architectural gems serve as testaments to human ingenuity and endurance. They are not only relics of the past but also sources of inspiration for future generations. Through meticulous preservation efforts and thoughtful interventions, we can ensure that this architectural heritage remains accessible and cherished for years to come.

APPENDICES

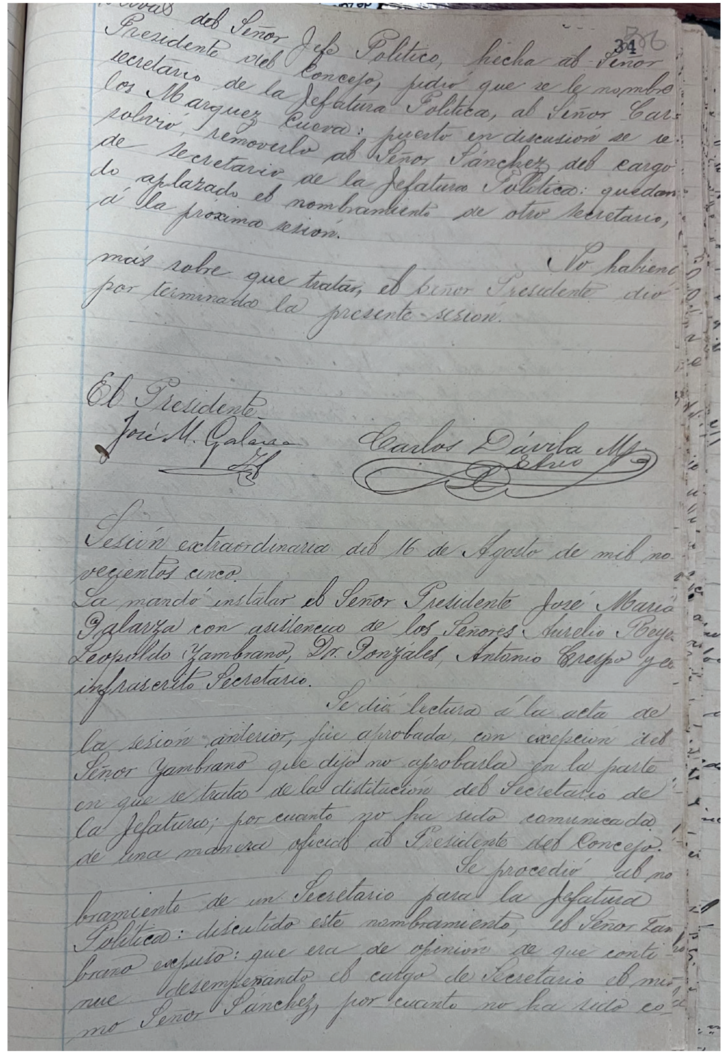
*All translations are property/elaboration from the author. These translation endeavors to adhere to the original document's expression style as much as possible.

Appendix A

Sesión Extraordinaria del 16 de Agosto de 1905: Minuta para la construcción de la Casa de Rastro

Archivo de la Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma: Actas de Sesiones de la Municipalidad de Zaruma 1900-1905. Pág. 36r-38r. (Heritage and Culture Office Archive - Municipality of Zaruma: Minutes of Zaruma Municipal Council Sessions 1900-1905. Pages 36r-38r)

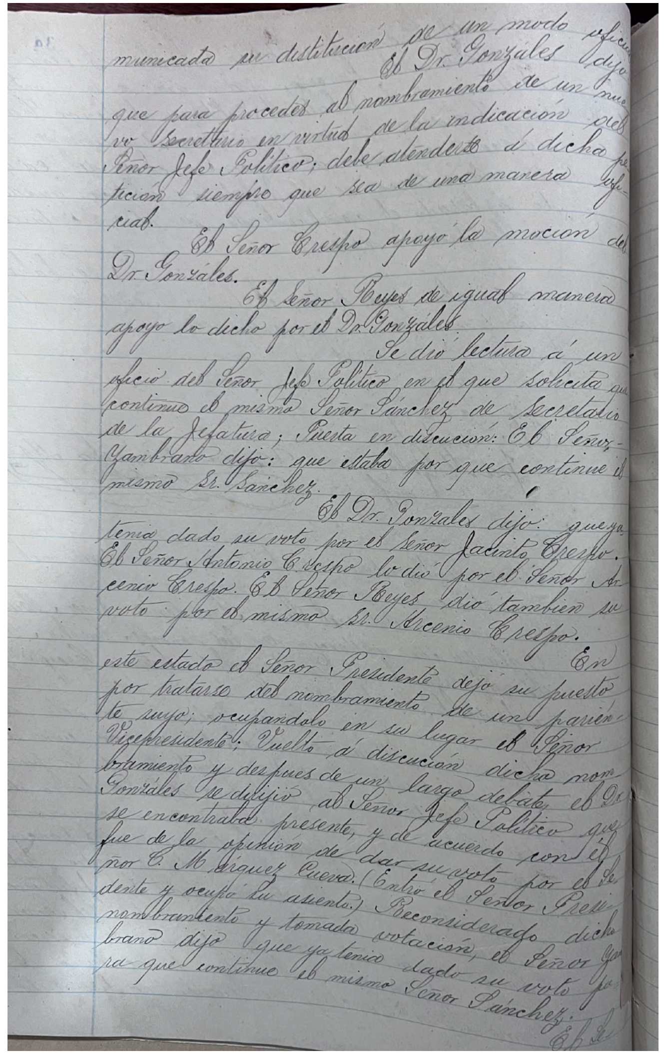
1A. Original Document from the reports of the Municipal sessions 1900-1905



...del Señor Jefe Político, hecha al Señor
Presidente del Concejo, pidió que se le nombre
secretario de la Jefatura Política, al Señor Car-
los Marquez Cueva: puesto en discusión se re-
solvió, removerlo al Señor Sánchez del cargo
de Secretario de la Jefatura Política: quedan-
do aplazado el nombramiento de otro secretario,
á la próxima sesión.
No habiendo
más sobre que tratar, el Señor Presidente dió
por terminado la presente sesión.

El Presidente
José M. Galarza
Carlos Dávila M.
Srio.

Sesión extraordinaria del 16 de Agosto de mil no-
vecientos cinco.
La mandó instalar el Señor Presidente José María
Galarza con asistencia de los Señores: Aurelio Reyes,
Leopoldo Zambrano, Dr. Gonzáles, Antonio Crespo y el
infrascrito Secretario.
Se dió lectura á la acta de
la sesión anterior, fue aprobada, con excepción del
Señor Zambrano que dijo no aprobarla en la parte
en que se trató de la destitución del Secretario de
la Jefatura; por cuanto no ha sido comunicada
de una manera oficial al Presidente del Concejo.
Se procedió al nom-
bramiento de un Secretario para la Jefatura
Política: discutido este nombramiento, el Señor Zam-
brano expuso: que era de opinión de que conti-
nue desempeñando el cargo de Secretario el mis-
mo Señor Sánchez, por cuanto no ha sido co-



municada su destitución de un modo oficial.
El Dr. Gonzáles dijo
que para proceder al nombramiento de un nue-
vo Secretario en virtud de la indicación del
Señor Jefe Político; debe atenderse á dicha pe-
tición siempre que sea de una manera ofi-
cial.
El Señor Crespo apoyó la moción del
Dr. Gonzáles.
El Señor Reyes de igual manera
apoyó lo dicho por el Dr. Gonzáles.
Se dió lectura á un
oficio del Señor Jefe Político en el que solicita que
continue el mismo Señor Sánchez de Secretario
de la Jefatura; Puesta en discución: El Señor
Zambrano dijo: que estaba por que continue el
mismo Sr. Sánchez.
El Dr. Gonzáles dijo: que ya
tenia dado su voto por el Señor Jacinto Crespo.
El Señor Antonio Crespo lo dió por el Señor Ar-
cenio Crespo. El Señor Reyes dió tambien su
voto por el mismo Sr. Arcenio Crespo.
En
este estado el Señor Presidente dejó su puesto
por tratarse del nombramiento de un parien-
te suyo; ocupándolo en su lugar el Señor
Vicepresidente; Vuelto á discución dicho nom-
bramiento y despues de un largo debate, el Dr.
Gonzáles se dirijió al Señor Jefe Político que
se encontraba presente, y de acuerdo con él
fue de la opinión de dar su voto por el Se-
ñor C. Márquez Cueva. (Entró el Señor Presi-
dente y ocupó su asiento.) Reconsiderado dicho
nombramiento y tomada votación, el Señor Zam-
brano dijo que ya tenia dado su voto pa-
ra que continue el mismo Señor Sánchez.
El Se...

2A. Translation of the Original Document.

/ 36r/
Extraordinary Session of August 16th, 1905 (...)

/ 37r/
In accordance with the provisions of the previous minutes (Extraordinary Session of August 16, nineteen hundred and five), the following draft presented by this Municipality for the construction of the slaughterhouse is included herein:

Draft prepared by this Municipality for the construction of the Slaughterhouse, as mandated by the Municipal contract:

Length of the building, twelve "varas" outside of the eaves. Width of the main hall, six "varas," and the corridor, two "varas" outside of the eaves. In the part without a corridor, which faces the street or road, it will have at least one "vara" of eaves, and in the rest, it will have two "*tercias*" of eaves. The main hall of the said building will be boarded.

WOODS

Eight solid "*guayacanes*," for the center, twenty-two inches thick and five "varas" long. For the corridor, five logs of the same wood, without joints, each eighteen inches thick. The joints of the main hall will be made of "*amarillo*," squared. Four "cruceros" made of 7 by 7 "amarillo." Four bars of the same wood, seven inches square. Eighteen ropes of "*amarillo*," 7 inches by 3 and 4 inches thick. The boards for the boarding will be made of cedar, two inches thick. The joints will have two screws, each one inch in diameter.

UPPER WOODWORK

Four beams of "*amarillo*" or "*cascarillo*," six inches square. Rafters, each 10 inches thick, spaced according to the roof, which will be made of Zinc. The base plates and ridgepole will be made of "*cascarilla*," each 18 inches thick. The strips for nailing the zinc will be made of cedar, 3 inches by 2 inches thick.

This building will be erected on the stream located next to the old slaughterhouse. The Municipality will assign the current house used for slaughtering cattle to the contractor.

/ 38r/

Eight "basas" of Guayacán for the cruceros. Two posts of the same wood, twenty-four inches, two in the ground, and two in the ridge. The others that will be buried in the ground will be two "*varas*" deep and one and a half "*vara*" in the post.
The zinc for the roof will be four "*varas*" above the carvings on the main hall.
It is also noted that the measurements are in English inches.

At the request of the Girls' Institution of this town, Miss Mercedes J. Calas was appointed as Assistant Instructor, with the salary allocated for the assistant teacher.

A letter from the Political Chief was read, in which he informs that Mr. Daniel Ramírez has been appointed as Girls' Instructor in Guanazán. After discussion, it was ordered to pay the money allocated to the mentioned Instructor from that date.

The session was adjourned.

The President
José M. Galarza
[Signature]

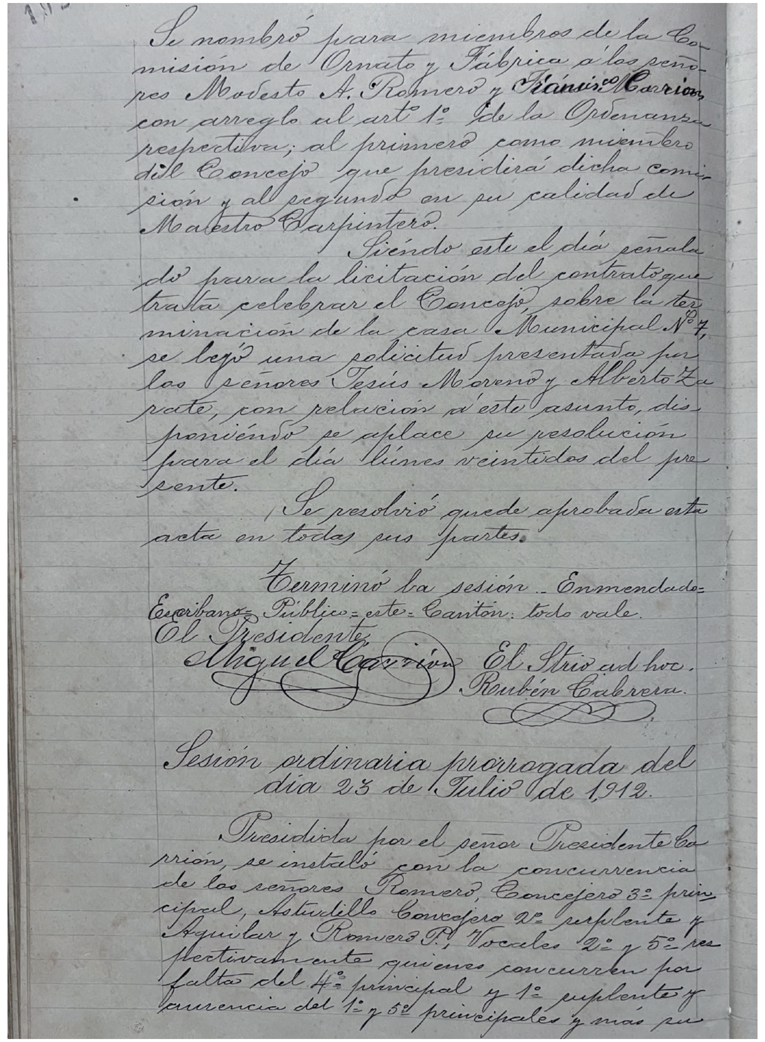
Carlos Dávila M.
Secretary
[Signature]

Appendix B

Sesión Ordinaria Prorrogada del día 23 de Julio de 1912: Bases del Contrato para la conclusión de la casa municipal N° 7.

Archivo de la Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma: Actas de Sesiones de la Municipalidad de Zaruma 1912. Pág. 192-201. (Heritage and Culture Office Archive - Municipality of Zaruma: Minutes of Zaruma Municipal Council Sessions 1912. Pages 192-201)

1B. Original Document from the reports of the Municipal sessions 1931-1935.



Se nombró para miembros de la Comisión de Ornato y Fábrica á los señores Modesto A. Romero y Francisco Carrión, con arreglo al art° 1° de la Ordenanza respectiva; al primero como miembro del Concejo que presidirá dicha comisión y al segundo en su calidad de Maestro Carpintero.

Siendo este el día señalado para la licitación del contrato que trata celebrar el Concejo, sobre la terminación de la casa Municipal N° 7, se leyó una solicitud presentada por los señores Jesús Moreno y Alberto Zarate, con relación á este asunto, disponiendo se aplace su resolución para el día lúnes veintidos del presente.

Se resolvió quede aprobada esta acta en todas sus partes.

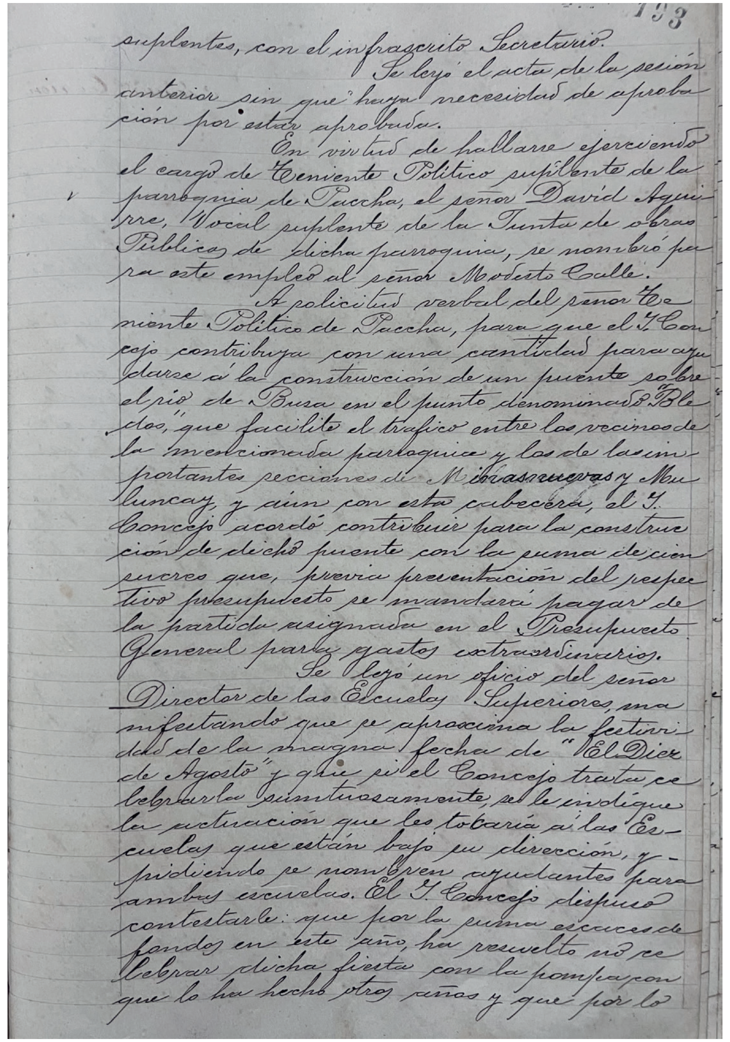
Terminó la sesión. Enmendado: Escribano: Público: este: Cantón: todo vale.

El Presidente,
Miguel Carrión

El Strio ad hoc.
Rubén Cabrera.

Sesión ordinaria prorrogada del día 23 de Julio de 1,912.

Presidida por el señor Presidente Carrión, se instaló con la concurrencia de los señores Romero, Concejero 3° principal, Astudillo Concejero 2° suplente y Aguilar y Romero P., Vocales 2° y 5° respectivamente quienes concurren por falta del 4° principal y 1° suplente y ausencia del 1° y 5° principales y más su-



193

suplentes, con el infrascrito Secretario.

Se leyó el acta de la sesión anterior sin que haya necesidad de aprobación por estar aprobada.

En virtud de hallarse ejerciendo el cargo de Teniente Político suplente de la parroquia de Paccha, el señor David Aguirre, Vocal suplente de la Junta de obras Públicas de dicha parroquia, se nombró para este empleo al señor Modesto Calle.

A solicitud verbal del señor Teniente Político de Paccha, para que el I. Concejo contribuya con una cantidad para ayudarse á la construcción de un puente sobre el rio de Busa en el punto denominado "Bledos," que facilite el trafico entre los vecinos de la mencionada parroquia y los de las importantes secciones de Minasnuevas y Muluncay, y aún con esta cabecera, el I. Concejo acordó contribuir para la construcción de dicho puente con la suma de cien sucres que, previa presentación del respectivo presupuesto se mandará pagar de la partida asignada en el Presupuesto General para gastos extraordinarios.

Se leyó un oficio del señor Director de las Escuelas Superiores, manifestando que se aproxima la festividad de la magna fecha de "El Diez de Agosto" y que si el Concejo trata celebrarla suntuosamente, se le indique la actuación que les tocaría á las Escuelas que están bajo su dirección, y pidiendo se nombren ayudantes para ambas escuelas. El I. Concejo dispuso contestarle: que por la suma escacez de fondos en este año, ha resuelto no celebrar dicha fiesta con la pompa con que lo ha hecho otros años y que por lo

2B. Translation of the Original Document.

/ 192/
Extended Ordinary Session of July 23rd, 1912.

Presided over by Mr. President Carrión, it was convened with the attendance of Messrs. Romero, Third Principal Councillor, Astudillo, Second Alternate Councillor, and Aguilar and Romero P, Second and Fifth Members respectively, who attended due to the absence of the Fourth Principal and First Alternate, and the absence of the First and Fifth Principals and additional / 193/ alternates, with the undersigned Secretary.

The minutes of the previous session were read, requiring no approval as they had already been approved.

Given that Mr. David Aguirre, Alternate Member of the Public Works Board for the parish of Paccha, was currently serving as Deputy Political Lieutenant of the parish, Mr. Modesto Calle was appointed to this position at the request of Mr. Aguirre.

In response to a verbal request from the Deputy Political Lieutenant of Paccha, for the Municipal Council to contribute funds to assist in the construction of a bridge over the Busa River at a point called "Bledos," to facilitate traffic between the residents of the mentioned parish and those of the important sections of Minas Nuevas and Muluncay, the Municipal Council agreed to contribute to the construction of the bridge with the sum of one hundred *sucres*, which, upon presentation of the respective budget, will be paid from the allocated funds in the General Budget for extraordinary expenses.

A letter from the Director of the Superior Schools was read, indicating that the significant date of "El Diez de Agosto" was approaching and inquiring about the Council's plans for the celebration, particularly how it would involve the schools under their direction. Assistance was also requested for both schools. The Municipal Council decided: firstly, due to limited funds this year, not to celebrate the event as lavishly / 194/ as in previous years; secondly, that if the Director wished to organize a small event such as a civic parade of students, the Council's contribution would be limited to providing the Music Band; and lastly, it was suggested that the girls' school did not require additional staff and staffing for the boys' school would be provided when competent teaching personnel were available.

Taking into account that the new Municipal Building, referred to as No. 7, which commenced construction three years ago, has been halted due to lack of funds and that such an important structure is deteriorating due to the delay in completion, it is therefore imperative for its completion, both for the Council's use and to prevent its decay over time. In accordance with the resolution from the meeting on the fifth of the current month, it was resolved to formulate the contract terms for the completion of Municipal Building No. 7, which, upon acceptance by the contractor, will be formalized as a public deed before a Notary Public from the area. The terms of the contract are as follows:

Contract Terms for the Completion of Municipal Building No. 7 that will be entered into jointly with the Municipal Council by Messrs. Benjamín and Ulpiano Valverde, in accordance with the following clauses:

1st. - The contractors commit to completing the two upper floors to leave the building in perfect condition for the Council's / 195/ intended use, providing all the necessary materials and even more if required.

2nd. - The two mentioned floors will have ceilings made of rosewood boards, four yards long, one-third yard wide, and one inch thick. This ceiling will be well joined and the joint will be covered with a molded strip, two and a half inches wide and half an inch thick.

3rd. - The building will have fourteen pairs of large doors, distributed on both floors as deemed appropriate by the Commission responsible for inspecting the work. The dimensions of these doors will be the total length

of three yards seven inches, the total width of each leaf thirty inches, the thickness of the stiles and rails two inches, and the width of the same three and a half inches. The frames for these doors will be four by five inches thick, and each leaf will have five panels.

4th. - The windows, each composed of four panels, including lattices, will be seventeen in total, distributed on both floors according to the dimensions of the already placed frames. The stiles and rails of the doors and lattices of these windows will be two and three-eighth inches wide by one and three-eighth inches thick. The doors will have four panels, the lattices two, with continuous molding on stiles and rails and also on the rebate of the mirror, the same as all the large doors, and the mirrors will be single-sided, with the / 196/ thickness of these boards not exceeding one inch.

5th. - The wood used for the frames of the large doors will be *cascarillo amargo* with fine or *sara* leaves, sufficiently long to secure them to the railing on the lower floor, and to the beam on the upper floor; the stiles and rails will be made of *amarillo, guararo* or *cucharillo*, and the mirrors and lattices will be made of cedar.

6th. - The large doors will have four hinges, each measuring four and a half inches, per leaf, and the doors of windows and lattices will have three hinges, each measuring four inches per leaf, the mentioned American hinges being reinforced.

7th. - The doors and windows will have a jamb made of cedar boards, five inches wide and one inch thick, with their respective moldings.

8th. - The handrail on the lower floor will be wrought iron, similar to that used on the upper floor, on a frame of *amarillo* or *guararo*, two inches thick, with the appropriate recesses and suitable moldings, and measuring ten to twelve inches in height on the upper frame, which will be four inches wide by two and a half inches thick, and the entire handrail will measure one yard in height.

9th. - The columns will be squared, with corresponding bases at the height of the handrail, covered with one-inch-thick cedar boards, topped with the appropriate molding. The square of the columns will not be less than ten inches nor more than twelve inches.

/ 197/
10th. - The facade of the upper floor will have two cornices and main balconies identical to those of the house of Mr. Carlos González, currently inhabited by Mr. Carlos Manuel Astudillo. Note that the upper cornice will be straight, protruding one and a half inches above the main pilasters, which will also protrude three inches from the cladding and will be ten inches wide, with these dimensions being exactly the same in all parts of the cornice, and its base and moldings at the corresponding height. The handrail will be made of the same material as the model and will be one yard high.

11th. - Each hearth will have a four-panel lattice door, which will measure three yards in length by two yards in width, Spanish measurement. These doors will have a louvered section at the bottom made of boards, and from the handrail upwards, a blind that will be about a yard in height and the rest will be a fixed lattice. The thickness of the stiles and rails of these doors will be one and three-quarter inches, and the width will be three inches. Each of these doors will have four horizontal rails, and on each side, there will be a pilaster that is eight inches wide and two and a half inches thick, with moldings and their respective bases at the upper and lower ends. A lining of zinc will cover the seat of these doors completely, with a suitable slope, to prevent rainwater from entering inside; this zinc will be of No. 12 gauge.

12th. - The aforementioned doors will have four hinges of four inches each, reinforced American hinges, iron knockers, a small pull ring / 198/ made of suitable-sized metal, and a latch bolt on each one, round and five inches long, reinforced.

13th. - In addition to the main cornices mentioned in clause ten, there will be another cornice at the top of each window, above the pilasters, in a style and width determined by the Commissioner appointed by the Council.

14th. - The commitment also includes the obligation to construct the two side walls of both floors facing the street, the lower floor's wall made of wattle and daub, and the upper floor's wall made of double boards; the wall of the entrance vestibule of both floors will also be made of wattle and daub; the wall of the rear nave of the second floor will also be made of wattle and daub, leaving an opening corresponding to each window, one yard wide, with their corresponding *cascarillo* or sara frames. There will be six partition walls in the same lower floor, from the back wall to the front side wall, also made of wattle and daub, in the appropriate locations according to the respective Commission. A partition wall made of boards will also be constructed on the upper floor, also from the front side wall facing the street and in the location designated by the Council or its Commissioner.

The construction of the wattle and daub walls will use *vaén, sara, saca,* or *pacaiblanco* wood, and will be twelve inches thick, with *vejuco barbón de tierra* for binding, *pindo* for lathing, a cedar ridge beam, and two horizontal beams of the same cedar wood, four inches wide / 199/ and an inch and a half thick, spaced proportionally. All currently existing and future wattle and daub walls must have a rosewood board frieze at their top and bottom with the respective moldings. The lower frieze will be ten inches wide, and the upper one will be five inches, English measurement. The plaster of the currently existing and future walls will be made of selected material, and all walls of the building will be plastered both inside and outside and whitewashed on the exterior, the front, and the vestibules.

15th. - It is the contractors' obligation to construct a staircase identical to that of the School or the house used as a school for children, with an increase of half a yard in width and the corresponding length to provide access to the upper floor, and it should be varnished similarly to the model provided.

16th. - A street door will be installed to provide access to the staircase, complete with appropriate handles, with a lock number matching the street door of Mr. Modesto A. Romero, with an additional width of one-third yard.

17th. - The material used for the facade of the house, both lower and upper, will be of *amarillo*, *guararo*, and *cucharillo* wood, and good quality cedar boards, one inch thick, will be used.

18th. - All wood used for doors, windows, cornices, and lattices must be thoroughly dry, as well as the wood used for the ceilings.

19th. - The entire work shall be executed with the security, solidity, and architectural aesthetics demanded by the art. Moreover, all / 200/ doors, windows, and lattices not explicitly specified shall have their respective knockers, handles, pulls, or hinges, in the form, quality, and dimensions determined by the relevant Commission.

20th. - The entire work must be carried out to the satisfaction and approval of the Council or the Commission responsible for inspection and acceptance of the work, composed of Mr. Miguel Carrión, Modesto A. Romero, and in their absence, Mr. Juan Agustín Aguilar and Daniel Romero P will act as substitutes.

21st. - The period for the complete delivery of this work shall be two years, counted from the date of signing the contract.

22nd. - For the entire work and related materials, including any unforeseen items, the Council shall pay the Contractors, Mr. Valverde, the sum of five thousand five hundred fifty *sucres,* as follows: one thousand five hundred *sucres* on the day the contract is signed, one

thousand five hundred *sucres* in the month of May 1913, one thousand five hundred *sucres* on the day the contractors complete the delivery of the finished work, and the remaining one thousand *sucres* by the end of April of the following year, as mentioned above, i.e., the year 1915.

23rd. - The contractors, in order to guarantee the faithful fulfillment of their obligations and the money they receive in advance, shall provide a mortgage bond for clear real estate assets, after verifying that they are not / 201/ encumbered in any way, equivalent to the sum of five thousand *sucres* and shall not consist of communal rights and shares; the clause shall specify that the guarantors shall also be jointly and severally liable with their persons, except for Mr. Eliseo Valverde.

24th. - The contractors shall commence work on the project on March 1st of the following year, nineteen thirteen; and in the event of failure to comply with this clause, they shall acknowledge an interest rate of one percent per month on the money received until the day they commence the said work, and until work commences, the Council shall not be able to make the second installment payment without being considered delinquent; similarly, if they fail to complete the work on the stipulated date, they shall continue to acknowledge interest on the money received from that date until completion. Likewise, if the Council does not make payments on the specified dates, it shall acknowledge the same interest on the overdue amount until its settlement.

25th. - The Council commits to providing them with storage spaces within the same buildings to keep the necessary materials and tools for the job.

26th. - The Notary shall be responsible for including all necessary clauses for the style, security, and validity of this contract.

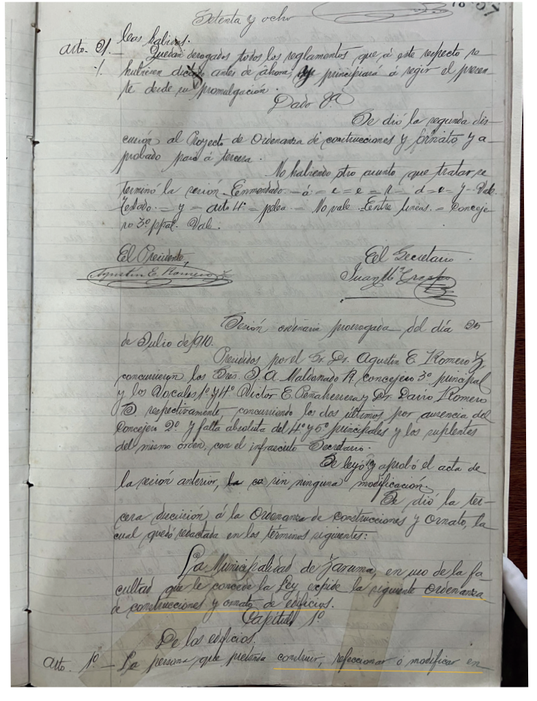
President (Signature) Miguel Carrión, Secretary (Signature) Jacinto Crespo.

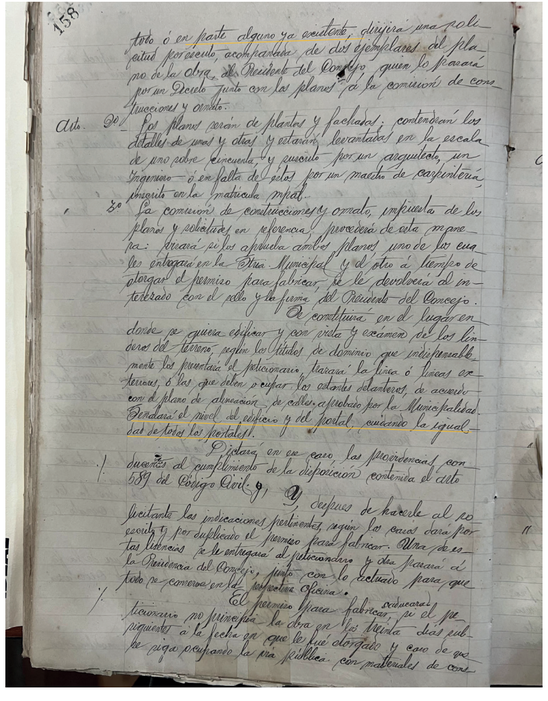
Appendix C

Sesión ordinaria prorrogada del día 25 de julio de 1910: Ordenanza de Construcciones y Ornato de Edificios.

Archivo de la Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma: Actas de Sesiones de la Municipalidad de Zaruma 1910. Pág. 157-164.
(Heritage and Culture Office Archive - Municipality of Zaruma: Minutes of Zaruma Municipal Council Sessions 1910. Pages 157-164)

1C. Original Document from the reports of the Municipal sessions 1910.





2C. Translation of the Original Document.

/ 157/
Ordinary session extended from June 25, 1910.

Presided over by Mr. Dr. Agustín E. Romero Z., the following individuals attended: Mr. D. A. Maldonado R., 3rd principal councilor, and the 1st and 4th members, Víctor E. Peñaherrera and Dr. Darío Romero D., respectively. The latter two attended in place of the 2nd councilor who was absent, as well as the complete absence of the 4th and 5th principal councilors and their respective substitutes, with the undersigned secretary.

The minutes of the previous session were read and approved without any modifications. The third decision was made regarding the construction and ornamentation ordinance, which was drafted as follows:

The Municipality of Zaruma, exercising the authority granted by law, issues the following ordinance on building construction and ornamentation.

Chapter 1 Regarding Buildings

Article 1: Any person intending to construct, renovate, or modify in / 158/ whole or in part any existing structure must submit a written request, accompanied by two copies of the construction plans, to the President of the Council, who will forward it by decree along with the plans to the Construction and Ornamentation Commission.

Article 2: The plans shall include floor plans and facades, providing details for both, and shall be drawn to a scale of one in fifty. The plans must be signed by an architect, engineer, or, in the absence of these professionals, by a master carpenter registered with the municipal registry.

Article 3: The Construction and Ornamentation Commission, upon receiving the plans and related requests, shall proceed as follows: it shall review and approve both plans, keeping one of them in the Municipal Secretary's office and returning the other to the applicant with the seal and signature of the President of the Council.

The Commission shall visit the intended construction site and, based on the property boundaries as stated in the petitioner's title deeds, it shall establish the outer lines or the space to be occupied by the front facades in accordance with the street alignment plan approved by the Municipality. It shall indicate the level of the building and the entrance, ensuring the uniformity of all entrances.

In this case, it shall issue the necessary measures to comply with the provisions of Article 589 of the Civil Code. After providing the applicant with the relevant instructions, it shall grant written permission to proceed with the construction, issuing duplicate licenses. One license shall be given to the applicant, and the other shall be sent to the Presidency of the Council, along with all relevant documentation, to be kept in the respective office.

The construction permit shall expire if the applicant does not commence the construction within thirty days from the date of issuance. In the event that the public space continues to be occupied by construction ma-/ 159/-terials, a daily fine of one *sucre* sixty cents per linear meter of the occupied street shall be imposed.
If the projected building needs to occupy municipal land to maintain street alignment, the Commission shall not grant permission to construct until proof of payment for the lease or purchase of such land has been provided to the Municipality.

Article 4: Houses shall only have one or two floors. The first type, called principal houses, shall have a facade width of six meters facing the street. However, this floor shall be constructed one meter above the level of the

respective entrance. The second type, called secondary houses, shall have a perpendicular measurement of nine meters from the surface of the entrance to the eaves. The exterior height described in this provision shall be observed throughout the entire building, without affecting the natural slope for water flow.

Only in houses with a depth of more than ten meters, the height of the parapet may exceed one meter but must not exceed two.

In two-story houses, the perpendicular line measured between the entrance and the highest point of the building facade shall not exceed nine meters.

Article 5: In aligning the building with the streets and in the facades, the lines given by the commission shall be followed, without obstructing the view of the neighbors. Balconies and architectural ornaments shall not protrude more than eighty centimeters above the vertical line of the facades.

Article 6: Portals shall have a width of two meters and thirty centimeters and a height of three meters and sixty centimeters on all streets. They may be paved with wood, stone, brick, or cement.

The apartments on the first floor intended for habitation shall have, throughout the entire extension of the upper part of the wall that borders the portal, a skylight of at least twenty centimeters in width. Warehouses and storage rooms shall also comply with this provision.

/ 160/
The construction of buildings without the portal described in this article is prohibited. It is strictly forbidden to have more than one line of shelves or columns in the portals.

The protruding eaves of the facades shall not exceed one meter and shall be equipped with gutters that collect rainwater and direct it directly through pipes to the building's or street's drainage system. The same provision applies to the lateral eaves.

Article 7: The courtyards shall be paved and kept in perfect cleanliness.

Chapter 2

Ornamentation.

Article 8: The owner may adapt the architectural style for facades as they please, as long as the result is not a whimsical ensemble lacking relation or character. The commission and the police shall ensure that the facades of public and private buildings are tidy and painted. They shall have disheveled, torn, or damaged curtains or drapes replaced in warehouses and houses where they currently exist.

Article 9: Under penalty of a fine ranging from one to ten *sucres* for each violation, the following actions are prohibited:

- Affixing posters and signs of any kind on the exterior walls, facades, shelves, or pillars of public buildings or private houses. However, owners may display advertisements for the sale or rental of their own houses on their facades.

- Placing boards or signs announcing an industry, profession, or personal names outside the vertical line of the facade, except beneath balconies or on the upper part of the first-floor facade, with the approval of the Municipal Commissioner. Prior to granting permission, the Commissioner shall approve / 161/ the wording and spelling. Wooden signs shall not exceed two meters fifty centimeters in length by seventy centimeters in width.

- Displaying fabrics, clothing, or any object on balconies, bay windows, or windows of exterior walls that protrude beyond the vertical line of the facades.

Finally, all matters are covered by items 39, 41, 112, and 113 of Article 38 of the Police Code.

Article 10: Unbuilt land or vacant lots adjacent to public roads must be enclosed with a fence made of cane or upright poles on crosspieces. The fence shall have a height of three meters and a corresponding roof covering the entire front space. It shall be kept whitewashed or painted, as circumstances require.

Private gardens that also border public roads shall not be without an entrance gate, which shall be protected by a corresponding roof. They may have a fence made of upright poles, cane, or painted iron. In this case, the design must be approved by the commission in advance. Failure to comply with this provision shall be penalized with a fine according to the provisions of the Police Code, without prejudice to obliging the violator to comply with this requirement.

Chapter 3
Common Provisions

Article 11: The construction and ornamentation commission shall consist of the councilor assigned to the field, the Syndic, and the surveyor, engineer, or registered carpentry master.

Article 12: It is prohibited to construct theaters, temples, chapels, or oratories on land adjacent to streets. These structures may be erected facing the plazas, but under no circumstances shall the construction of more than one of the mentioned buildings be allowed on plots adjacent to a plaza.

Article 13: Buildings constructed within plots without alignment with the public road shall be subject to this Ordinance in its entirety / 162/ and shall always be obligated to include a portal beneath their respective roof.

Article 14: The construction of houses, huts, shacks, or barracks with thatched roofs is prohibited. Furthermore, the installation of factories or any other industry that, due to its nature and operating conditions, may be deemed dangerous, unsanitary, and harmful to the neighborhood is prohibited in the town center. Anyone who contravenes any of these provisions shall be subject to a fine in accordance with the provisions of the Police Code, without prejudice to the immediate removal of the thatched roof or the establishment of the facility.

Depot facilities, factories, or industries mentioned in this article shall be located on the outskirts of the town, obtaining the corresponding permission beforehand. In the central parish, the outskirts shall be considered within the limits specified in the respective ordinances, and the same shall apply to other towns.

Article 15: Anyone who occupies or constructs in any space on the streets or roads, or places any obstacle that hinders free traffic, shall be judged in accordance with Article 38, Clause 38 of the Police Code, without prejudice to demolition.

Article 16: Any person may report to the commission, President of the Council, Commissioners, or any member of the Council the construction works that are carried out without compliance with this ordinance. Once the commission verifies the truth of the report, it shall take the necessary measures for the prosecution of the violation.

Article 17: The Commission or Municipal Commissioner shall order the suspension of any work started without a permit to build or in which the observance of these provisions has been omitted or is being omitted, and shall issue the necessary order for the prosecution of the violation and for / 163/ the work to be carried out in accordance with this ordinance, including the obligation to immediately demolish anything constructed in violation of the corresponding provisions.

Article 18: The resolutions of the commission and the Municipal Councilors shall be executed notwithstanding an appeal to the council.

Article 19: The fines specified in this ordinance, as well as those specified in other agreements, shall be imposed by the Commissioner in charge and collected in accordance with the laws of the respective officer. The Municipal Police shall be under the orders of the treasurer, the commission in charge, and the Municipal Councilors to ensure faithful and exact compliance with the resolutions within their competence, as per the ordinances.

Article 20: This ordinance shall come into effect from the date of its promulgation, and from then on, all previous ordinances, even if they do not contradict the present one, are repealed.

Given:

It was ordered that the sum of 200 *sucres* voted for the celebration of August 10th be issued in favor of Mr. Dr. Lautaro V. Loaiza, as he is the General Director of said festivities, appointed by the Council.

Mr. Maldonado verbally stated that in the previous year, he served as a Municipal councilor and held the Political Chief position in this Canton for a period of eleven days due to the owner's leave of absence. He requested that his services be compensated at a rate of 70 *sucres* per month, which was the salary assigned to the Political Chief in the previous year's budget. The Corporation, considering the legality of the reasons presented by Mr. Maldonado, approved the payment of 24.83 *sucres*, which represents the value of the eleven days at a rate of 70 *sucres* per month. This payment will be made from the outstanding debts of the Canton's General Budget.

The first discussion was held on the General Regulations that will govern the Children's Educational Institutions / 164/ in this town, and upon approval, it proceeded to the second discussion.

With no other matters to discuss, the session was adjourned.

Amended: Technical - Op - Between lines - Shall expire - Valid - Crossed out - The - Co - And - Not applicable.

President:
Agustín E. Romero Z.

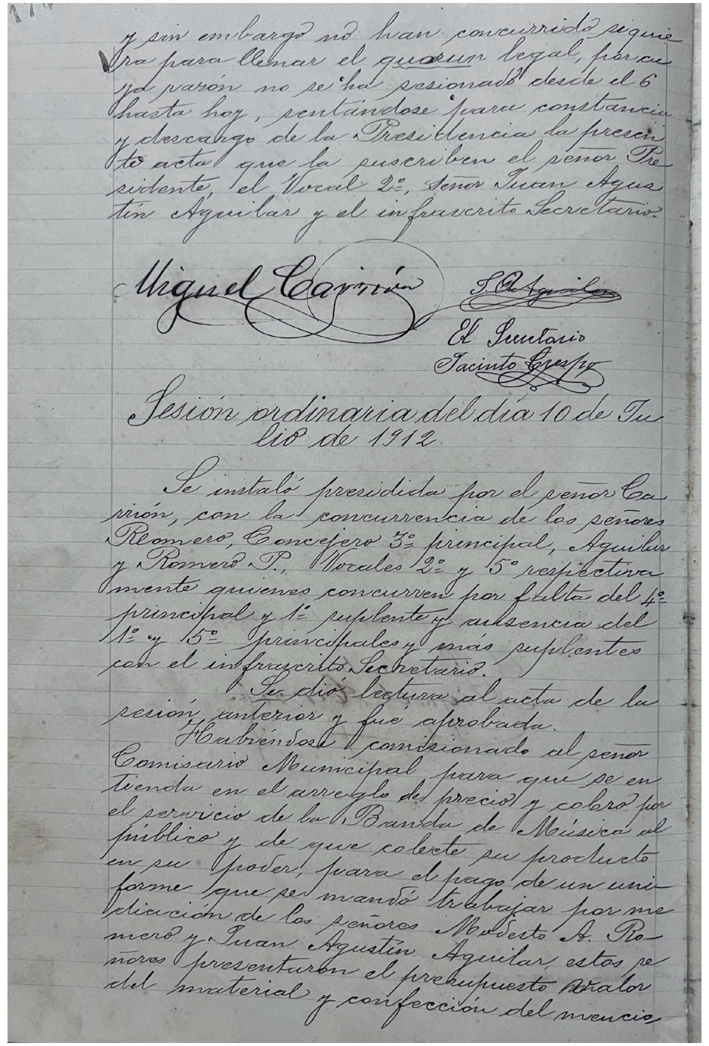
Secretary:
Juan M. Crespo

Appendix D

Sesión Ordinaria del día 10 de Julio de 1912: Ordenanza de Ornato y Fábrica.

Archivo de la Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma: Actas de Sesiones de la Municipalidad de Zaruma 1912. Pág. 174-182.
(Heritage and Culture Office Archive - Municipality of Zaruma: Minutes of Zaruma Municipal Council Sessions 1912. Pages 174-182)

1D. Original Document from the reports of the Municipal sessions 1912.

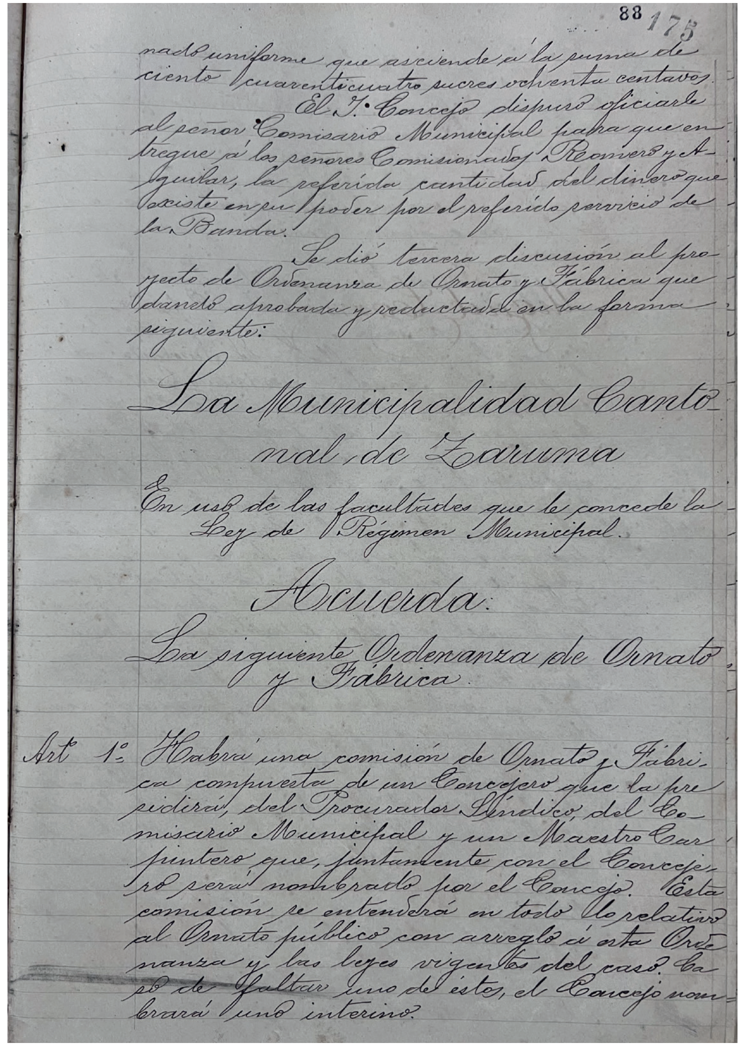

y sin embargo no han concurrido segui-
ra para llenar el quorum legal, por ca-
ya razón no se ha sesionado desde el 6
hasta hoy, sentándose para constancia
y descargo de la Presidencia la presen-
te acta que la suscriben el señor Pre-
sidente, el Vocal 2º, señor Juan Agus-
tín Aguilar y el infrascrito Secretario.

Miguel Carrión   J. A. Aguilar

El Secretario
Jacinto Crespo

Sesión ordinaria del día 10 de Ju-
lio de 1912.

Se instaló presidida por el señor Ca-
rrión, con la concurrencia de los señores
Romero, Concejero 3º principal, Aguilar
y Romero J., Vocales 2º y 5º respectiva-
mente quienes concurren por falta del 4º
principal y 1º suplente y ausencia del
1º y 5º principales y más suplentes
con el infrascrito Secretario.
Se dió lectura al acta de la
sesión anterior y fué aprobada.
Habiéndose comisionado al señor
Comisario Municipal para que se en-
tienda en el arreglo de precios y cobro por
el servicio de la Banda de Música al
público y de que colecte su producto
en su poder, para el pago de un uni-
forme que se mandó trabajar por me-
diación de los señores Modesto A. Ro-
mero y Juan Agustín Aguilar, estos se-
ñores presentaron el presupuesto del valor
del material y confección del mencio-


88 175

nado uniforme que asciende á la suma de
ciento cuarenta cuatro sucres ochenta centavos.
El I. Concejo dispuso oficiarle
al señor Comisario Municipal para que en-
tregue á los señores Comisionados Romero y A-
guilar, la referida cantidad del dinero que
existe en su poder por el referido servicio de
la Banda.
Se dió tercera discusión al pro-
yecto de Ordenanza de Ornato y Fábrica que-
dando aprobada y reductada en la forma
siguiente:

La Municipalidad Canto-
nal de Zaruma

En uso de las facultades que le concede la
Ley de Régimen Municipal.

Acuerda:

La siguiente Ordenanza de Ornato
y Fábrica.

Art. 1º Habrá una comisión de Ornato y Fábri-
ca compuesta de un Concejero que la pre-
sidirá, del Procurador Síndico, del Co-
misario Municipal y un Maestro Car-
pintero que, juntamente con el Conceje-
ro será nombrado por el Concejo. Esta
comisión se entenderá en todo lo relativo
al Ornato público con arreglo á esta Orde-
nanza y las leyes vigentes del caso. Ca-
so de faltar uno de éstos, el Concejo nom-
brará uno interino.

2D. Translation of the Original Document.

/ 174/
Ordinary Session of July 10th, 1912 (...)

/ 175/
THE CANTONAL MUNICIPALITY OF ZARUMA
In the exercise of the powers granted by the Municipal Regime Law,
DECIDES:

The following Ornament and Construction Ordinance

Art. 1.- There shall be a Commission on Ornament and Construction composed of a Councilor who will preside over it, the Legal Counsel, the Municipal Commissioner, the Inspector of Public Works, and a Master Carpenter who, together with the Councilor, will be appointed by the Council. This Commission shall deal with all matters relating to public ornamentation, in accordance with this Ordinance and the relevant laws in force. In case one of them is absent, the Council shall appoint a substitute.

/ 176/

Art. 2.- Anyone who wishes to build a building, rebuild a destroyed one, or partially modify an existing one within the limits of the town shall submit a written application to the President of the Council in order to obtain the respective permit. This application shall be referred to the aforementioned Commission for examination.
The following limits of the town are established: to the north, the pasture of "Canoas" belonging to Mr. Miguel Carrión; to the south, the Fifth called "Bomba" owned by Miss Ángeles Romero; to the East, the house of Mrs. Eduarda Cabrera, on the road to Loja, and of Manuel Orellana, on the road to Jinsao; to the west, the house of the heirs of the late Mr. José Rosa Zambrano.

Art. 3.- The members of the Commission shall visit the site where the construction is intended within four days, after the submission of the application referred to in the previous article, to determine whether the new work will occupy public land, protrude from the vertical plane of adjacent buildings, or in any way damage the regularity or width of the public road. Once this is done, they shall physically mark two lines on the front or fronts of the streets or squares, at a distance of one English yard from each other, indicating that the first line represents the drainage of rainwater and the second line indicates the place where the pillars or bars that support them will be placed. They shall then submit their report along with all the documents to the President of the Council, for the issuance / 177/ of the final approval if, according to the report, the proposed work complies with this Ordinance. The Commission shall submit its report within three days, and the President of the Council shall provide his resolution within the same timeframe.

Article 4: Buildings that are newly constructed, reformed, or rebuilt shall comply with these provisions:

1. Three-story buildings shall have a minimum front height of twelve yards and shall not exceed fifteen yards. Two-story buildings shall have no less than nine yards and no more than ten yards. Single-story buildings shall not exceed six yards and shall have no less than five yards. These heights shall be measured in Spanish yards from the beam or pillars of the upper floor corridor, without taking into account the slopes, which shall be properly enclosed with walls.
2. No building or structure within the town shall be erected unless it faces a street or square, leaving a sidewalk or portico in front of it, at the discretion of the builder, with a minimum width of two and a half Spanish yards if it is a portico, and one yard if it is a sidewalk. If construction facing the street or square is not possible due to the nature of the terrain or insufficient space, the aim shall be to maintain the shortest distance possible between the street or square and the building, while ensuring the greatest uniformity with neighboring buildings.

3. In constructions adjacent to previously erected buildings, the Ornamentation and Construction Commission shall establish the lines, always seeking the greatest uniformity / 178/ with neighboring buildings.

Article 5: Every building owner is obliged to board or pave the sidewalk or portico of their property. Failure to comply with this article shall result in a fine of four to ten *sucres* for the Commission, without prejudice to the Police carrying out the necessary work at the expense of the offender.

Article 6: The Municipality shall pave new streets that are formed, but property owners whose properties benefit from the paving shall pay a tax of one sucre per linear meter. Except in cases where expropriation has preceded the opening of the new street, in which case the tax shall be two *sucres* per linear meter.

Article 7: The Ornamentation Commission or the Municipal Commissioner alone shall ensure strict compliance with the provisions contained in articles 589 and 590 of the Civil Code.

Article 8: When it becomes necessary for the interested party to occupy public land in order to standardize or regularize the construction of a building, they shall request, with the prior report of the Commission, the purchase of said land from the Municipality, which shall comply with the provisions of the Legislative Decree of August 1, 1888.

Article 9: Anyone who begins the construction or repair of buildings referred to in this Ordinance without obtaining prior permission shall incur a fine of fifty to one hundred *sucres*, which shall be imposed immediately by the Municipal Commissioner / 179/, without prejudice to the same authority ordering the immediate demolition of the structure at the expense of the offender, whenever, in the opinion of the Commission, the building does not comply with this Ordinance and the interested party does not agree to rectify it.

Article 10: Any person may report to the Ornamentation Commission, the Police, or the President of the Council any works carried out in contravention of this Ordinance, and may take public action against the offender in relation to such works.

Article 11: During construction, materials may occupy half the width of the street within the limits of the respective property, provided that construction is not taking place simultaneously at the front. In this case, the builders may only occupy one yard of the street, leaving sufficient space in the middle for regular traffic. If construction is suspended for more than sixty days or if the materials remain on the streets or squares for more than six months without being used, it shall be mandatory to remove them. After these periods, the offenders shall pay a monthly tax of five *sucres* in advance to the Municipality until the construction materials are removed from the streets or squares. This tax shall be paid by those who, without ongoing construction, but with the intention to construct, have materials deposited on the streets or squares. Outside the cases provided in this article, it is prohibited to accumulate construction materials or other objects that obstruct traffic on the streets or squares.

/ 180/

Article 12: In new buildings facing two streets or one street or square, and even in those being constructed or reformed, the corners shall be beveled.

Article 13: Within the town limits, every plot of land shall have a decent enclosure with a height of at least one and a half Spanish yards.

Article 14: Doors whose panels open onto the street shall not occupy any space that protrudes beyond the vertical line of the wall, under a fine of four to ten *sucres*, which shall be imposed immediately by the Municipal Commissioner, without prejudice to ordering the removal of the doors at the expense of the offender.

Article 15: The exterior walls of all public and private buildings shall be whitewashed or painted by the respective owners or representatives of said buildings. The paint or whitewash of deteriorated buildings shall be renewed every two or three years by the month of June. Violation of the provisions of the preceding article shall be punished with a fine of one to ten *sucres*, without prejudice to the Police carrying out the necessary work at the expense of the offender.

Article 16: Any construction that poses a danger within the town shall be demolished, following a report from the Commission and a request from the Police. If the owner fails to demolish it after being requested, the Police shall do so at the expense of the offender.

Article 17: Public establishments of any nature are not subject to the height restrictions of this ordinance / 181/.

Article 18: In rural parishes, there shall be an Ornamentation and Construction Commission composed of the Presiding Priest, the Political Lieutenant, and the 1st Civil Judge or their substitutes. This Commission shall oversee everything stipulated in this Ordinance and ensure its strict compliance. However, if anyone feels aggrieved by its provisions, they may appeal to the Municipal Council within six mandatory days of being notified.

Article 19: The permit referred to in Article 2 of this Ordinance shall expire if the petitioner does not commence the construction within thirty days following the date it was granted.

Art. 20: The owners of houses or plots of land within the town shall be obliged to sweep and maintain the part of the street facing their properties in a perfect state of cleanliness every Saturday of each week, and whenever the Municipal Commissioner orders it. Those who fail to comply with the provisions of this article shall be punished with a fine ranging from two-tenths to two *sucres*, without prejudice to the Commissioner ordering the sweeping or cleaning to be done at the expense of the offender.

Art. 21: The fines mentioned in this Ordinance shall be imposed by the Municipal Commissioner, who is empowered to issue provisions aimed at ensuring the cleanliness, ornamentation, and hygiene of the town, and may punish those who disobey / 182/ with a fine ranging from one to ten *sucres*. If anyone feels aggrieved by any of these provisions, they may appeal to the Municipal Council within three fatal days from the date of notification.

Art. 22: Those who violate any of the provisions contained in this Ordinance or fail to fulfill the obligations imposed therein shall be penalized with a fine of four to ten *sucres*, which shall be imposed immediately by the Municipal Commissioner, without prejudice to the same official ordering the necessary work to be done or the damages to be repaired at the expense of the offender.

Art. 23: All previous ordinances, if any, that are contrary to this one, are hereby repealed in their entirety.

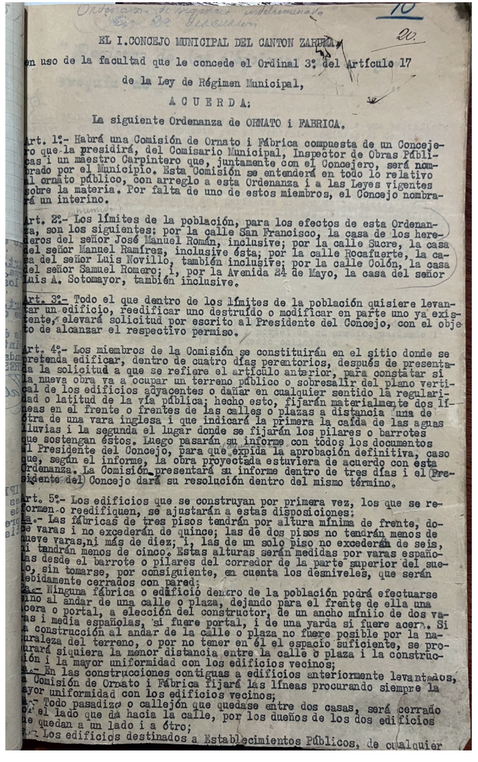
Given in the 8th session hall.

Appendix E

Sesión Ordinaria del día 21 de Mayo de 1931: Ordenanza de Ornato y Fábrica.

Archivo de la Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma: Actas de Sesiones de la Municipalidad de Zaruma 1931-1935. Pág. 20r-22v. (Heritage and Culture Office Archive - Municipality of Zaruma: Minutes of Zaruma Municipal Council Sessions 1931-1935. Pages 20r-22v)

1E. Original Document from the reports of the Municipal sessions 1931-1935.



EL I.CONCEJO MUNICIPAL DEL CANTON ZARUMA,

en uso de la facultad que le concede el Ordinal 3º del Artículo 17
de la Ley de Régimen Municipal,

A C U E R D A:

La siguiente Ordenanza de ORNATO i FABRICA.

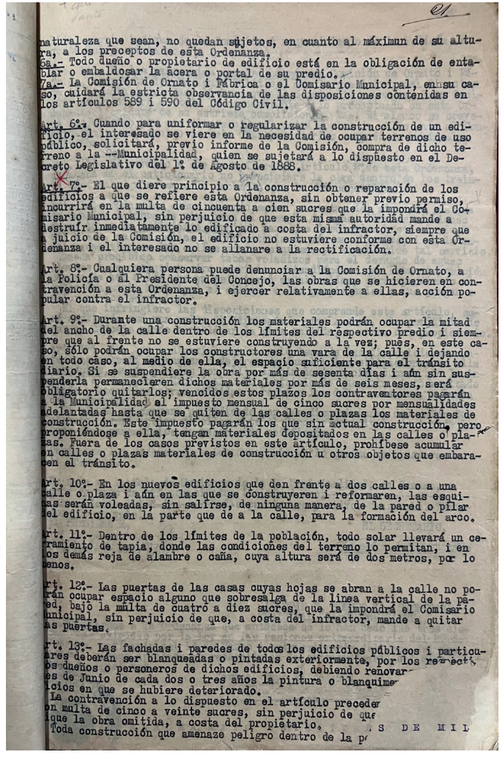
Art. 1º- Habrá una Comisión de Ornato i Fábrica compuesta de un Concejero que la presidirá, del Comisario Municipal, Inspector de Obras Públicas i un maestro Carpintero que, juntamente con el Concejero, será nombrado por el Municipio. Esta Comisión se entenderá en todo lo relativo al ornato público, con arreglo a esta Ordenanza i a las Leyes vigentes sobre la materia. Por falta de uno de estos miembros, el Concejo nombrará un interino.

Art. 2º- Los límites de la población, para los efectos de esta Ordenanza, son los siguientes: por la calle San Francisco, la casa de los herederos del señor José Manuel Román, inclusive; por la calle Sucre, la casa del señor Manuel Ramírez, inclusive ésta; por la calle Rocafuerte, la casa del señor Luis Novillo, también inclusive; por la calle Colón, la casa del señor Samuel Romero; i, por la Avenida 24 de Mayo, la casa del señor Luis A. Sotomayor, también inclusive.

Art. 3º- Todo el que dentro de los límites de la población quisiere levantar un edificio, reedificar uno destruído o modificar en parte uno ya existente, elevará solicitud por escrito al Presidente del Concejo, con el objeto de alcanzar el respectivo permiso.

Art. 4º- Los miembros de la Comisión se constituirán en el sitio donde se pretenda edificar, dentro de cuatro días perentorios, después de presentada la solicitud a que se refiere el artículo anterior, para constatar si la nueva obra va a ocupar un terreno público o sobresalir del plano vertical de los edificios adyacentes o dañar en cualquier sentido la regularidad o latitud de la vía pública; hecho esto, fijarán materialmente los líneas en el frente o frentes de las calles o plazas a distancia una de otra de una vara inglesa i que indicará la primera a cada de las aguas lluvias i la segunda el lugar donde se fijarán los pilares o barrotes que sostengan éstos. Luego pasarán su informe con todos los documentos al Presidente del Concejo, para que expida la aprobación definitiva, caso que, según el informe, la obra proyectada estuviera de acuerdo con esta Ordenanza. La Comisión presentará su informe dentro de tres días i el Presidente del Concejo dará su resolución dentro del mismo término.

Art. 5º- Los edificios que se construyan por primera vez, los que se reformen o reedifiquen, se ajustarán a estas disposiciones:
1.- Las fábricas de tres pisos tendrán por altura mínima de frente, doce varas i no excederán de quince; las de dos pisos no tendrán menos de nueve varas, ni más de diez; i, las de un solo piso no excederán de seis, ni tendrán menos de cinco. Estas alturas serán medidas por varas españolas desde el barrote o pilares del corredor de la parte superior del suelo, sin tomarse, por consiguiente, en cuenta los desniveles, que serán debidamente cerrados con pared;
2.- Ninguna fábrica o edificio dentro de la población podrá efectuarse sino al andar de una calle o plaza, dejando para el frente de ella una acera o portal, a elección del constructor, de un ancho mínimo de dos varas i media españolas, si fuere portal, i de una yarda si fuere acera. Si la construcción al andar de la calle o plaza no fuere posible por la naturaleza del terreno, o por no temer en él el espacio suficiente, se procurará siquiera la menor distancia entre la calle o plaza i la construcción i la mayor uniformidad con los edificios vecinos;
3.- En las construcciones contiguas a edificios anteriormente levantados, la Comisión de Ornato i Fábrica fijará las líneas procurando siempre la mayor uniformidad con los edificios vecinos;
4.- Todo pasadizo o callejón que quedase entre dos casas, será cerrado por el lado que da hacia la calle, por los dueños de los dos edificios que quedan a un lado i a otro;
5.- Los edificios destinados a Establecimientos Públicos, de cualquier



naturaleza que sean, no quedan sujetos, en cuanto al máximun de su altura, a los preceptos de esta Ordenanza.
Art.- Todo dueño o propietario de edificio está en la obligación de entablar o embaldosar la acera o portal de su predio.
Art.- La Comisión de Ornato i Fábrica o el Comisario Municipal, en su caso, cuidará la estricta observancia de las disposiciones contenidas en los artículos 589 i 590 del Código Civil.

Art. 6º.- Cuando para uniformar o regularizar la construcción de un edificio, el interesado se viere en la necesidad de ocupar terrenos de uso público, solicitará, previo informe de la Comisión, compra de dicho terreno a la Municipalidad, quien se sujetará a lo dispuesto en el Decreto Legislativo del 1º de Agosto de 1888.

Art. 7º.- El que diere principio a la construcción o reparación de los edificios a que se refiere esta Ordenanza, sin obtener previo permiso, incurrirá en la multa de cincuenta a cien sucres que la impondrá el Comisario Municipal, sin perjuicio de que esta misma autoridad mande a destruir inmediatamente lo edificado a costa del infractor, siempre que a juicio de la Comisión, el edificio no estuviere conforme con esta Ordenanza i el interesado no se allanare a la rectificación.

Art. 8º.- Cualquiera persona puede denunciar a la Comisión de Ornato, a la Policía o al Presidente del Concejo, las obras que se hicieren en contravención a esta Ordenanza, i ejercer relativamente a ellas, acción popular contra el infractor.

Art. 9º.- Durante una construcción los materiales podrán ocupar la mitad del ancho de la calle dentro de los límites del respectivo predio i siempre que al frente no se estuviere construyendo a la vez; pues, en este caso, sólo podrán ocupar los constructores una vara de la calle i dejando en todo caso, al medio de ella, el espacio suficiente para el tránsito diario. Si se suspendiere la obra por más de sesenta días i aún sin suspenderla permanecieren dichos materiales por más de seis meses, será obligatorio quitarlos; vencidos estos plazos los contraventores pagarán a la Municipalidad el impuesto mensual de cinco sucres por mensualidades adelantadas hasta que se quiten de las calles o plazas los materiales de construcción. Este impuesto pagarán los que sin actual construcción, pero proponiéndose a ella, tengan materiales depositados en las calles o plazas. Fuera de los casos previstos en este artículo, prohíbese acumular en calles o plazas materiales de construcción u otros objetos que embaracen el tránsito.

Art. 10º- En los nuevos edificios que den frente a dos calles o a una calle o plaza i aún en las que se construyeren i reformaren, las esquinas serán voleadas, sin salirse, de ninguna manera, de la pared o pilar del edificio, en la parte que dé a la calle, para la formación del arco.

Art. 11º- Dentro de los límites de la población, todo solar llevará un cerramiento de tapia, donde las condiciones del terreno lo permitan, i en los demás reja de alambre o caña, cuya altura será de dos metros, por lo menos.

Art. 12º- Las puertas de las casas cuyas hojas se abran a la calle no podrán ocupar espacio alguno que sobresalga de la línea vertical de la pared, bajo la multa de cuatro a diez sucres, que la impondrá el Comisario Municipal, sin perjuicio de que, a costa del infractor, mande a quitar las puertas.

Art. 13º- Las fachadas i paredes de todos los edificios públicos i particulares deberán ser blanqueadas o pintadas exteriormente, por los respectivos dueños o personeros de dichos edificios, debiendo renovar-
se de Junio de cada dos o tres años la pintura o blanquimento
dolos en que se hubiere deteriorado.
La contravención a lo dispuesto en el artículo precedente
en multa de cinco a veinte sucres, sin perjuicio de que
que la obra omitida, a costa del propietario. S DE MIL
toda construcción que amenace peligro dentro de la p

2E. Translation of the Original Document.

ORDINANCE OF URBAN ORNAMENTATION AND CONSTRUCTION 1931

/ 20r/
THE I MUNICIPAL COUNCIL OF ZARUMA CANTON,
in the exercise of the authority granted to it by Section 3 of Article 17 of the Municipal Regime Law,

RESOLVES:

The following Urban Ornamentation and Construction Ordinance

Art.1.- There shall be a Committee on Urban Ornamentation and Construction composed of a Councilor who will preside over it, the Municipal Commissioner, the Public Works Inspector, and a Master Carpenter who, together with the Councilor, shall be appointed by the Municipality. This Committee shall be responsible for all matters related to public ornamentation, in accordance with this Ordinance and the existing laws on the subject. In case of the absence of any of these members, the Council shall appoint an interim member.

Art. 2.- For the purposes of this Ordinance, the boundaries of the town are as follows: along San Francisco Street, including the house of the heirs of Mr. José Manuel Román; along Sucre Street, including the house of Mr. Manuel Ramírez; along Rocafuerte Street, including the house of Mr. Luis Novillo; along Colón Street, including the house of Mr. Samuel Romero; and along 24 de Mayo Avenue, including the house of Mr. Luis A. Sotomayor.

Art. 3.- Anyone who wishes to construct a building, rebuild a destroyed one, or make partial modifications to an existing one within the town limits shall submit a written application to the President of the Council in order to obtain the respective permission.

Art. 4.- The members of the Committee shall visit the site where the construction is intended, within a strict period of four days after the submission of the application referred to in the previous article, in order to verify whether the new construction will occupy public land, protrude from the vertical plane of adjacent buildings, or in any way compromise the regularity or width of the public thoroughfare. Once this is done, they shall physically mark two lines in the front or fronts of the streets or squares, a yard apart, indicating the first line for rainwater drainage and the second line for the placement of pillars or bars to support them. Subsequently, they shall submit their report along with all the documents to the President of the Council for the issuance of the final approval, provided that, according to the report, the proposed construction complies with this Ordinance. The Committee shall submit its report within three days, and the President of the Council shall render their decision within the same period.

Art. 5.- Buildings that are constructed for the first time, as well as those undergoing renovation or reconstruction, shall adhere to the following provisions:

1. Buildings with three floors shall have a minimum height at the front of twelve yards and shall not exceed fifteen yards; those with two floors shall not have less than nine yards or more than ten yards; and single-story buildings shall not exceed six yards or have less than five yards. These heights shall be measured in Spanish yards from the bars or pillars of the upper floor corridor, without taking into account any variations, which shall be properly enclosed with walls.
2. No construction or building within the town shall be carried out other than along a street or square, leaving a sidewalk or porch in front of it, at the discretion of the builder, with a minimum width of two and a half Spanish yards if it is a porch, and one yard if it is a sidewalk. If constructing along the street or square is not possible due to the nature of the terrain or the lack of sufficient space, the goal shall be to maintain the shortest distance between the street or square and the construction, as well as achieve the greatest uniformity with neighboring buildings.
3. For constructions adjacent to previously erected buildings, the Committee on Urban Ornamentation and Construction shall establish lines, always striving for the greatest uniformity with neighboring buildings.

4. Any passageway or alleyway between two houses shall be closed on the side facing the street by the owners of the two adjacent buildings.
5. Buildings designated as Public Establishments, regardless of their / 21r/ nature, are not subject to the maximum height provisions of this Ordinance.
6. Every owner or proprietor of a building is obligated to lay down pavement or floor the sidewalk or porch of their property.
7. The Committee on Urban Ornamentation and Construction or the Municipal Commissioner, as applicable, shall ensure strict compliance with the provisions contained in Articles 589 and 590 of the Civil Code.

Art. 6.- When, in order to standardize or regularize the construction of a building, the interested party finds it necessary to occupy publicly used land, they shall request, with prior approval from the Committee, the purchase of said land from the Municipality, which shall comply with the provisions of the Legislative Decree of August 1, 1888.

Art. 7.- Anyone who commences the construction or renovation of buildings referred to in this Ordinance without obtaining prior permission shall be subject to a fine of fifty to one hundred *sucres*, to be imposed by the Municipal Commissioner, without prejudice to the same authority ordering the immediate demolition of the construction at the expense of the offender, provided that, in the opinion of the Committee, the building does not comply with this Ordinance and the party involved does not agree to rectify the situation.

Art. 8.- Any person may report to the Committee on Urban Ornamentation, the Police, or the President of the Council any works carried out in contravention of this Ordinance, and may, in relation to them, exercise public action against the offender.

Art. 9.- During construction, materials may occupy half the width of the street within the limits of the respective property, provided that no simultaneous construction is taking place in front. In such cases, the builders may only occupy one yard of the street, leaving sufficient space in the middle for daily traffic. If construction is suspended for more than sixty days, and even if the materials remain for more than six months without being removed, it shall be mandatory to remove them. After these deadlines, offenders shall pay the Municipality a monthly fee of five *sucres* in advance until the construction materials are removed from the streets or squares. This fee shall be paid by those who, without current construction but with the intention to undertake it, have materials stored in the streets or squares. Outside the cases provided in this article, it is prohibited to accumulate construction materials or other objects that obstruct traffic in the streets or squares.

Art. 10.- In new buildings that face two streets or a street or square, as well as in those being constructed or renovated, the corners shall be chamfered, without protruding in any way from the wall or pillar of the building, in the part facing the street, to form an arch.

Art. 11.- Within the limits of the town, every plot of land shall have an enclosure wall where the conditions of the terrain permit it, and in other cases, a wire or cane fence with a height of at least two meters.

Art. 12.- Doors of houses whose panels open to the street shall not occupy any space that protrudes beyond the vertical line of the wall, under a penalty of four to ten *sucres,* to be imposed by the Municipal Commissioner, without prejudice to the authority ordering the removal of the doors at the expense of the offender.

Art. 13.- The facades and walls of all public and private buildings shall be whitewashed or painted externally by the respective owners or representatives of said buildings. The painting or whitewashing of buildings that have deteriorated shall be renewed every two or three years, no later than the month of June. Violation of the provisions of the preceding article shall be subject to a fine of one to ten *sucres*, without prejudice to the Police verifying the neglected work at the expense of the owner.

Any construction that poses a danger within the town shall be demo-/ 22r/-lished, with prior approval from the Committee and at the request of the Police, at the expense of the owner.

Art. 14.- In rural parishes, there shall be a Committee on Urban Ornamentation and Construction, composed of the Political Lieutenant, who shall preside, the School Director, and the 1st Parish Judge or their substitutes. This Committee shall deal with all matters related to the provisions of this Ordinance and ensure strict compliance. However, if anyone believes they are harmed by its provisions, they may appeal to the Municipal Council within six peremptory days after being notified.

Art. 15.- The permit referred to in Article 2 of this Ordinance shall expire if the petitioner does not commence the construction within thirty days from the date it was granted.

Art. 16.- All houses must be equipped with an appropriate system of zinc gutters and pipes for rainwater drainage. These pipes must have sufficient length to reach ground level in streets that are not yet canalized, and to connect to the respective gutter in streets where such a service is already established.
The use of projecting pipes for rainwater drainage or any other service is prohibited, and this provision applies even to those already in place. The Municipal Commissioner is responsible for requiring owners to install or modify the services.

Anyone who violates the provisions contained in this article shall be punished with a fine of fifty to one hundred *sucres*, without prejudice to the Council ordering the completion of the neglected work at the expense of the owner.

Art. 17.- Those who contravenes any of the provisions of this Ordinance or fail to fulfill the obligations imposed therein shall be fined fifty to one hundred *sucres*, to be imposed by the Municipal Commissioner, without prejudice to the same official ordering the completion of the neglected work or the repair of damages at the expense of the offender.
If anyone believes they are harmed by the provisions of the Municipal Commissioner, they may appeal to the Municipal Council within three peremptory days after being notified.

Previous ordinances are hereby repealed, even to the extent that they do not conflict with the present one.

Given in the Session Hall of the Municipal Council in Zaruma, on the twelfth day of May, nineteen thirty-one.

Amended: -o-l-t-d-i-n-e-n-M-i-e-puertas-respectivos-o-as-vale.-Stricken out: Co-no vale.

THE PRESIDENT
(Signature)

THE SECRETARY
(Signature)

AGUSTÍN E. ROMERO Z., MUNICIPAL SECRETARY OF CANTON ZARUMA, CERTIFIES: That the preceding Ordinance has undergone the three discussions required by law during the extraordinary session on February 27, the ordinary session on March 14, and the extraordinary session on the twelfth day of the current month, with its wording approved during the extraordinary session on the eighteenth of the same month.

Zaruma, May 21, 1931.
(Signature)

ZARUMA, MAY TWENTY-THREE, / 22v/ NINETEEN THIRTY-ONE.
ENFORCE AND PUBLISH BY PROCLAMATION.

THE POLITICAL CHIEF
(Signature)

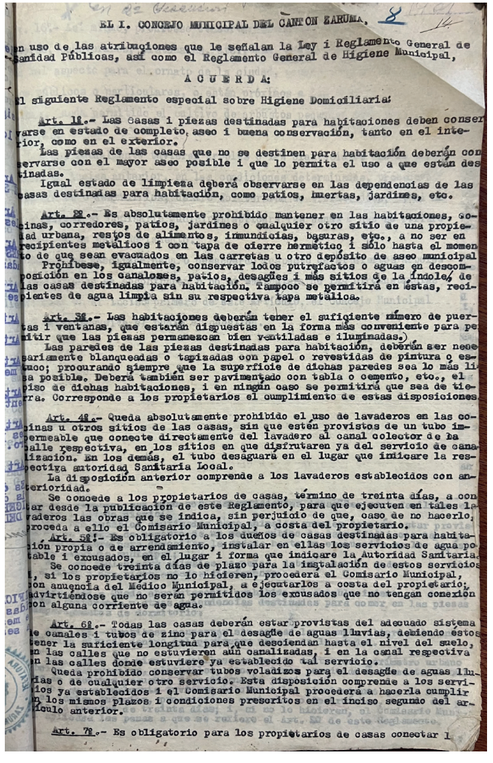
THE SECRETARY
(Signature)

Appendix F

Reglamento Especial de Higiene Domiciliaria.

Archivo de la Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma: Actas de Sesiones de la Municipalidad de Zaruma 1931-1935. Pág. 14r-16r. (Heritage and Culture Office Archive - Municipality of Zaruma: Minutes of Zaruma Municipal Council Sessions 1931-1935. Pages 14r-16r)

1F. Original Document from the reports of the Municipal sessions 1931-1935.



EL I. CONCEJO MUNICIPAL DEL CANTON ZARUMA,

En uso de las atribuciones que le señalan la Ley i Reglamento General de Sanidad Públicas, así como el Reglamento General de Higiene Municipal,

A C U E R D A :

El siguiente Reglamento especial sobre Higiene Domiciliaria:

Art. 1º.- Las casas i piezas destinadas para habitaciones deben conservarse en estado de completo aseo i buena conservación, tanto en el interior, como en el exterior.

Las piezas de las casas que no se destinen para habitación deberán conservarse con el mayor aseo posible i que lo permita el uso a que estén destinadas.

Igual estado de limpieza deberá observarse en las dependencias de las casas destinadas para habitación, como patios, huertas, jardines, etc.

Art. 2º.- Es absolutamente prohibido mantener en las habitaciones, cocinas, corredores, patios, jardines o cualquier otro sitio de una propiedad urbana, restos de alimentos, inmundicias, basuras, etc., a no ser en recipientes metálicos i con tapa de cierre hermético i sólo hasta el momento de que sean evacuados en las carretas u otro depósito de aseo municipal.

Prohíbese, igualmente, conservar lodos putrefactos o aguas en descomposición en los canalones, patios, desagües i más sitios de la índole de las casas destinadas para habitación. Tampoco se permitirá en estas, recipientes de agua limpia sin su respectiva tapa metálica.

Art. 3º.- Las habitaciones deberán tener el suficiente número de puertas i ventanas, que estarán dispuestas en la forma más conveniente para permitir que las piezas permanezcan bien ventiladas e iluminadas.)

Las paredes de las piezas destinadas para habitación, deberán ser necesariamente blanqueadas o tapizadas con papel o revestidas de pintura o esmalte; procurando siempre que la superficie de dichas paredes sea lo más lisa posible. Deberá también ser pavimentado con tabla o cemento, etc., el piso de dichas habitaciones, i en ningún caso se permitirá que sea de tierra. Corresponde a los propietarios el cumplimiento de estas disposiciones.

Art. 4º.- Queda absolutamente prohibido el uso de lavaderos en las cocinas u otros sitios de las casas, sin que estén provistos de un tubo impermeable que conecte directamente al canal colector de la calle respectiva, en los sitios en que disfruteren ya del servicio de canalización. En los demás, el tubo desaguará en el lugar que indicare la respectiva autoridad Sanitaria Local.

La disposición anterior comprende a los lavaderos establecidos con anterioridad.

Se concede a los propietarios de casas, término de treinta días, a contar desde la publicación de este Reglamento, para que ejecuten en tales lavaderos las obras que se indica, sin perjuicio de que, caso de no hacerlo, proceda a ello el Comisario Municipal, a costa del propietario.

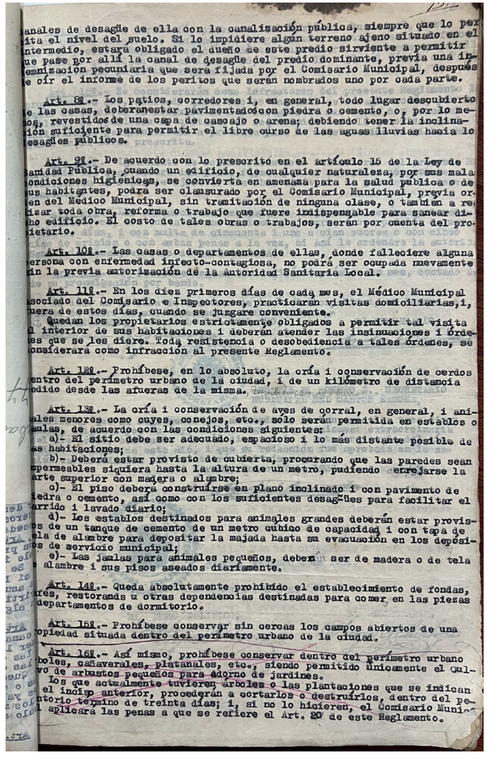
Art. 5º.- Es obligatorio a los dueños de casas destinadas para habitación propia o de arrendamiento, instalar en ellas los servicios de agua potable i excusados, en el lugar i forma que indicare la Autoridad Sanitaria.

Se concede treinta días de plazo para la instalación de estos servicios, si los propietarios no lo hicieren, procederá el Comisario Municipal, con anuencia del Médico Municipal, a ejecutarlos a costa del propietario; advirtiéndose que no serán permitidos los excusados que no tengan conexión con alguna corriente de agua.

Art. 6º.- Todas las casas deberán estar provistas del adecuado sistema de canales i tubos de zinc para el desagüe de aguas lluvias, debiendo estos tener la suficiente longitud para que desciendan hasta el nivel del suelo, en las calles que no estuvieren aún canalizadas, i en la canal respectiva en las calles donde estuviere ya establecido tal servicio.

Queda prohibido conservar tubos voladizos para el desagüe de aguas lluvias o de cualquier otro servicio. Esta disposición comprende a los servicios ya establecidos i el Comisario Municipal procederá a hacerla cumplir en los mismos plazos i condiciones prescritos en el inciso segundo del artículo anterior.

Art. 7º.- Es obligatorio para los propietarios de casas conectar l



canales de desagüe de ella con la canalización pública, siempre que lo permita el nivel del suelo. Si lo impidiere algún terreno ajeno situado en el intermedio, estará obligado el dueño de este predio sirviente a permitir que pase por allí la canal de desagüe del predio dominante, previa una indemnización pecuniaria que será fijada por el Comisario Municipal, después de oír el informe de los peritos que serán nombrados uno por cada parte.

Art. 8º.- Los patios, corredores i, en general, todo lugar descubierto de las casas, deberán estar pavimentados con piedra o cemento, o, por lo menos, revestidos de una capa de cascajo o arena; debiendo tener la inclinación suficiente para permitir el libre curso de las aguas lluvias hacia los desagües públicos.

Art. 9º.- De acuerdo con lo prescrito en el artículo 15 de la Ley de Sanidad Públicas, quedan un edificio, de cualquier naturaleza, por sus malas condiciones higiénicas, se convierta en amenaza para la salud pública o de sus habitantes, podrá ser clausurado por el Comisario Municipal, previo informe del Médico Municipal, sin tramitación de ninguna clase, o también a realizar toda otra, reforma o trabajo que fuere indispensable para sanear dicho edificio. El costo de tales obras o trabajos, serán por cuenta del propietario.

Art. 10º.- Las casas o departamentos de ellas, donde falleciere alguna persona con enfermedad infecto-contagiosa, no podrá ser ocupada nuevamente sin la previa autorización de la Autoridad Sanitaria Local.

Art. 11º.- En los diez primeros días de cada mes, el Médico Municipal asociado del Comisario e Inspectores, practicarán visitas domiciliarias, a fin de estos días, cuando se juzgare conveniente.

Quedan los propietarios estrictamente obligados a permitir tal visita al interior de sus habitaciones i deberán atender las insinuaciones i órdenes que se les dieren. Toda resistencia o desobediencia a tales órdenes, se considerara como infracción al presente Reglamento.

Art. 12º.- Prohíbese, en lo absoluto, la cría i conservación de cerdos dentro del perímetro urbano de la ciudad, i de un kilómetro de distancia medido desde las afueras de la misma.

Art. 13º.- La cría i conservación de aves de corral, en general, i animales menores como cuyes, conejos, etc., sólo será permitida en establos o caballos, de acuerdo con las condiciones siguientes:

a)- El sitio debe ser adecuado, espacioso i lo más distante posible de las habitaciones;

b)- Deberá estar provisto de cubierta, procurando que las paredes sean impermeables siquiera hasta la altura de un metro, pudiendo arrejarse la parte superior con madera o alambre;

c)- El piso debera construirse en plano inclinado i con pavimento de piedra o cemento, así como con los suficientes desagües para facilitar el barrido i lavado diario;

d)- Los establos destinados para animales grandes deberán estar provistos de un tanque de cemento de un metro cubico de capacidad i con tapa de tabla de alambre para depositar la majada hasta su evacuación en los depósitos de servicio municipal;

e)- Las jaulas para animales pequeños, deben ser de madera o de tela de alambre i sus pisos aseados diariamente.

Art. 14º.- Queda absolutamente prohibido el establecimiento de fondas, cafés, restorands u otras dependencias destinadas para comer en las piezas o departamentos de dormitorio.

Art. 15º.- Prohíbese conservar sin cercas los campos abiertos de una propiedad situada dentro del perímetro urbano de la ciudad.

Art. 16º.- Así mismo, prohíbese conservar dentro del perímetro urbano potreros, cañaverales, platanales, etc., siendo permitido únicamente el cultivo de arbustos pequeños para adorno de jardines.

Los que actualmente tuvieren arboles o las plantaciones que se indican en el inciso anterior, procederán a cortarlos o destruirlos, dentro del perentorio término de treinta días; i, si no lo hicieren, el Comisario Municipal aplicará las penas a que se refiere el Art. 20 de este Reglamento.

2F. Translation of the Original Document.

[Front: page 14]
/ 14r/

THE MUNICIPAL COUNCIL OF ZARUMA CANTON
exercising the powers granted to it by the Law and General Regulations of Public Health, as well as the General Regulations of Municipal Hygiene,

DECIDES:
The following special Regulation on Household Hygiene:

Art. 1 - Houses and rooms intended for habitation must be kept in a state of complete cleanliness and good condition, both inside and outside. The rooms of the houses not intended for habitation must be kept as clean as possible, considering their designated use. The same level of cleanliness must be observed in the dependencies of habitable houses, such as patios, gardens, etc.

Art. 2 - It is absolutely forbidden to keep remnants of food, filth, garbage, etc., in the rooms, kitchens, corridors, patios, gardens, or any other place within an urban property, except in metal containers with a hermetically sealed lid, and only until they are disposed of in the municipal carts or other designated garbage receptacles. It is also prohibited to retain putrid mud or decomposing water in gutters, patios, drains, or other areas of habitable houses. Containers of clean water shall not be allowed without their respective metal lids.

Art. 3 - Habitable rooms must have an adequate number of doors and windows, arranged in a suitable manner to allow the rooms to be well-ventilated and illuminated. The walls of the rooms intended for habitation must be whitewashed or covered with paper or painted, ensuring that the surface of the walls is as smooth as possible. The floors of these rooms must also be paved with wood, cement, etc., and under no circumstances should they be earthen. Compliance with these provisions falls on the property owners.

Art. 4 - The use of sinks in kitchens or other places in houses without an impermeable pipe directly connecting the sink to the street's drainage system, where such service is available, is strictly prohibited. In other cases, the pipe will discharge into a location determined by the respective Local Health Authority. This provision also applies to sinks already established. Homeowners are granted a thirty-day period from the publication of this Regulation to execute the necessary works on these sinks, and in case of failure to comply, the Municipal Commissioner will proceed to carry out the works at the owner's expense.

Art. 5 - Owners of houses intended for their own use or for lease must install potable water and toilet facilities in them, in the manner and location indicated by the Health Authority. A thirty-day period is granted for the installation of these services, and if the owners fail to do so, the Municipal Commissioner, with the approval of the Municipal Doctor, shall proceed to install them at the owner's expense. It should be noted that toilets not connected to a water source will not be allowed.

Art. 6 - All houses must be equipped with an adequate system of zinc gutters and pipes for the drainage of rainwater. These pipes should be long enough to descend to ground level in streets that are not yet channelized, and into the respective gutters in streets where such service is already established. The conservation of projecting pipes for rainwater drainage or any other service is prohibited. This provision applies to services already established, and the Municipal Commissioner shall enforce it within the same deadlines and conditions prescribed in the second clause of the previous article.

Art. 7 - Homeowners are required to connect the drainage / 15r/ pipes of their houses to the public sewer system, whenever the ground level allows it. If the passage is hindered by adjacent private land, the owner of the serving property must allow the drainage

pipe from the dominant property to pass through, subject to a pecuniary indemnity to be determined by the Municipal Commissioner, after hearing the report of the experts, one appointed by each party.

Art. 8 - The patios, corridors, and, in general, all uncovered areas of the houses must be paved with stone or cement or, at the very least, covered with a layer of gravel or sand. They must have enough slope to allow rainwater to flow freely towards the public drains.

Art. 9 - According to Article 15 of the Public Health Law, when a building, of any nature, due to its poor hygienic conditions, becomes a threat to public health or to its inhabitants, the Municipal Commissioner may close it down, following an order from the Municipal Doctor, without any further proceedings, or require all necessary works, reforms, or actions to sanitize the said building. The cost of such works or actions shall be borne by the owner.

Art. 10 - Rooms or departments where someone dies from an infectious or contagious disease cannot be occupied again without prior authorization from the Local Health Authority.

Art. 11 - On the first ten days of each month, the Municipal Doctor, together with the Municipal Commissioner and Inspectors, shall conduct home visits, and at other times when deemed necessary. Property owners are strictly obliged to allow such visits to the interior of their rooms and must comply with any suggestions or orders given. Any resistance or disobedience to such orders shall be considered a violation of this Regulation.

Art. 12 - The breeding and keeping of pigs within the urban perimeter of the city, and within a kilometer measured from the outskirts of the same, is absolutely prohibited.

Art. 13 - The breeding and keeping of poultry, in general, and smaller animals such as guinea pigs, rabbits, etc., shall only be permitted in stables or sheds, subject to the following conditions:

a) The location must be appropriate, spacious, and as far away as possible from the living areas.
b) It must be covered, and the walls should be waterproofed, at least up to a meter high, with the upper part either made of wood or wire mesh.
c) The floor should be constructed with an inclined plane and paved with stone and cement, with enough drains to facilitate daily sweeping and washing.
d) Stables for larger animals must be equipped with a tank for depositing the manure until it is evacuated to the municipal service deposits.
e) Cages for smaller animals must be made of wood or wire mesh and cleaned daily.

Art. 14 - Establishments of inns, cafes, restaurants, or other places intended for eating in rooms and sleeping quarters are absolutely prohibited.

Art. 15 - Keeping open fields of a property inside the urban perimeter of the city without fences is prohibited.

/ 15v/
Art. 16 - Likewise, the cultivation of trees, sugar cane fields, banana plantations, etc., which, due to their location, present a poor appearance for the ornamentation of the city, cause damage to public or private buildings, or are close to streets or public thoroughfares, is prohibited within the urban perimeter. The cultivation of small shrubs for garden decoration is permitted. Those who currently have trees or plantations as indicated in the previous clause under specified conditions must cut or destroy them within a thirty-day period; otherwise, the Municipal Commissioner will apply the penalties referred to in Article 20 of this Regulation. In case of doubt or disagreement about whether certain trees or plantations fall within any of the circumstances indicated in the first clause of this article, the Municipal Council will resolve the matter.

/ 16r/

Art. 17 - The Municipal Commissioner, until a Sanitary Commissioner is appointed, has exclusive authority to judge and punish violations of this Regulation, subjecting himself, for this purpose, to the procedures set forth in Articles 16, 17, 18, 19, and 20 of the Code of Sanitary Police currently in force.

Art. 18 - Owners who, by preventing the slope, oppose the connection of their house's drains to a common channel, as required by the local health authority, shall be considered offenders of this Regulation. They will be required to contribute pro-rata for the construction of the common channel in the prescribed manner.

Art. 19 - Likewise, those who fail to comply with the order to execute a sanitary work not provided for in this Regulation, within the time frame established by the competent authority, shall be considered offenders of this Regulation.

Art. 20 - Violations of this Regulation shall be punished, for the first time, with a fine ranging from one to fifty *sucres*, or with imprisonment from one to four days, and with a fine ranging from fifty-one to one hundred *sucres*, or imprisonment for five days, or both penalties at once, as ordered by the local Health Authority in the event of a repeat offense.

Art. 21 - This Regulation shall come into force one month after its promulgation by public announcement.

Given in the Session Hall of the Municipal Council, in Zaruma, on the twentieth of January, one thousand nine hundred and thirty-one.

THE VICE PRESIDENT ACTING AS CHIEF
[Signature]

THE SECRETARY
[Signature]

AGUSTÍN E. ROMERO Z., MUNICIPAL SECRETARY OF ZARUMA CANTON, CERTIFIES:

That the preceding Regulation has undergone the three discussions required by law in the following sessions: extraordinary session on the thirteenth, ordinary session on the sixteenth, and extraordinary session on the twentieth of January of this year, and that its wording was approved in the extraordinary session on the twenty-third of the same month.

Zaruma, January 27, 1931.
[Signature]

[Seal: CANTON POLITICAL HEADQUARTERS - ZARUMA - ECUADOR]

ZARUMA, FEBRUARY 6, 1931
OBJECTED.

THE POLITICAL CHIEF
[Signature]

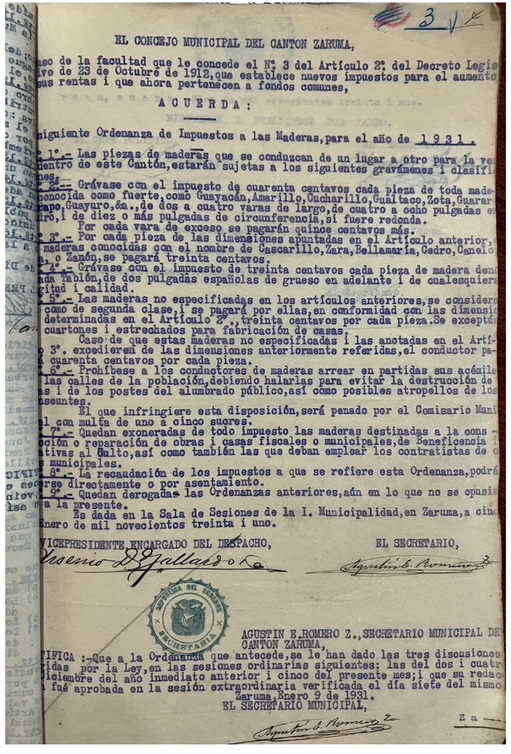
THE SECRETARY
[Signature]

Appendix G

Ordenanza de Impuesto a las Maderas

Archivo de la Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma: Actas de Sesiones de la Municipalidad de Zaruma 1931-1935. Pág. 3r. (Heritage and Culture Office Archive - Municipality of Zaruma: Minutes of Zaruma Municipal Council Sessions 1931-1935. Page 3r)

1G. Original Document from the reports of the Municipal sessions 1931-1935.



EL CONCEJO MUNICIPAL DEL CANTON ZARUMA,

uso de la facultad que le concede el Nº. 3 del Artículo 2º. del Decreto Legis
vo de 23 de Octubre de 1912,que establece nuevos impuestos para el aumento
us rentas i que ahora pertenecen a fondos comunes,

A C U E R D A :

siguiente Ordenanza de Impuestos a las Maderas,para el año de 1931.

e 1º.- Las piezas de maderas que se conduzcan de un lugar a otro para la ve
dentro de este Cantón,estarán sujetas a los siguientes gravámenes i clasifi
ones.

2º.- Grávase con el impuesto de cuarenta centavos cada pieza de toda made
conocida como fuerte,como Guayacán,Amarillo,Cucharillo,Gualtaco,Zota,Guarar
apo,Guayuro,de...de dos a cuatro varas de largo,de cuatro a ocho pulgadas e
ro,i de diez o más pulgadas de circunferencia,si fuere redonda.
Por cada vara de exceso se pagarán quince centavos más.

3º.- Por cada pieza de las dimensiones apuntadas en el Artículo anterior,
maderas,conocidas con el nombre de Cascarillo,Zara,Bellamaría,Cedro,Canelo
e, o Zanón,se pagará treinta centavos.

4º.- Grávase con el impuesto de treinta centavos cada pieza de madera dem
da Tablón,de dos pulgadas españolas de grueso en adelante i de cualesquiera
ridad i calidad.

5º.- Las maderas no especificadas en los artículos anteriores,se considera
como de segunda clase,i se pagará por ellas,en conformidad con las dimensi
determinadas en el Artículo 2º.,treinta centavos por cada pieza.Se exceptú
cuarrones i estrechados para fabricación de casas.
Caso de que estas maderas no especificadas i las anotadas en el Artí
3º. excedieren de las dimensiones anteriormente referidas,el conductor pa
cuarenta centavos por cada pieza.

6º.- Prohíbese a los conductores de maderas arrear en partidas sus acémila
las calles de la población,debiendo halarlas para evitar la destrucción de
as i de los postes del alumbrado público,así como posibles atropellos de los
seantes.
El que infringiere esta disposición,será penado por el Comisario Muni
al con multa de uno a cinco sucres.

7º.- Quedan exoneradas de todo impuesto las maderas destinadas a la cons
cción o reparación de obras i casas fiscales o municipales,de Beneficencia
ativas al Culto,así como también las que deban emplear los contratistas de
municipales.

8º.- La recaudación de los impuestos a que se refiere esta Ordenanza,podrá
erse directamente o por asentamiento.

9º.- Quedan derogadas las Ordenanzas anteriores,aún en lo que no se opusie
a la presente.
Es dada en la Sala de Sesiones de la I. Municipalidad,en Zaruma,a cinc
nero de mil novecientos treinta i uno.

VICEPRESIDENTE,ENCARGADO DEL DESPACHO, EL SECRETARIO,

AGUSTIN E.ROMERO Z.,SECRETARIO MUNICIPAL DE
CANTON ZARUMA,

IFICA :-Que a la Ordenanza que antecede,se le han dado las tres discusiones
idas por la ley,en las sesiones ordinarias siguientes: las del dos i cuatr
iciembre del año inmediato anterior i cinco del presente mes;i que su redac
fué aprobada en la sesión extraordinaria verificada el día siete del mismo
Zaruma,Enero 9 de 1931.
EL SECRETARIO MUNICIPAL,

2G. Translation of the Original Document.

[Cover]
Municipal Regulations
From 1931 to 1935

/ 3r/
THE MUNICIPAL COUNCIL OF ZARUMA CANTON,
In the exercise of the authority granted to it by No. 3 of Article 2 of the Legislative Decree of October 23, 1912, which establishes new taxes for the increase of its revenue, now belonging to common funds,

DECIDES:
The following Wood Tax Ordinance for the year 1931.

Art. 1 - Pieces of wood transported from one place to another for sale within this Canton shall be subject to the following taxes and classifications.

Art. 2 - A tax of forty cents shall be levied on each piece of wood known as strong wood, such as *Guayacán*, *Amarillo*, *Cucharillo*, *Gualtaco*, *Zota*, *Guararo*, *Guayuro*, measuring from two to four "*varas*" in length, four to eight inches square, and ten inches or more in circumference if it is round. An additional fifteen cents shall be paid for each extra "*vara*."

Art. 3 - For each piece of wood with the dimensions mentioned in the previous article, known as *Cascarillo*, *Zara*, *Bellamaría*, *Cedro*, *Canelona*, or *Zanón*, thirty cents shall be paid.

Art. 4 - A tax of thirty cents shall be levied on each piece of wood called *"Tablón,"* measuring two Spanish inches thick and beyond, regardless of length and quality.

Art. 5 - Woods not specified in the previous articles shall be considered as second-class and shall be taxed accordingly, following the dimensions determined in Article 2, thirty cents per piece. An exception is made for beams and boards intended for building houses. If these unspecified woods and those listed in Article 3 exceed the aforementioned dimensions, the transporter shall pay forty cents per piece.

Art. 6 - Wood transporters are prohibited from herding their pack animals through the streets of the town in groups. They must pull them to prevent the destruction of the streets and public lighting posts, as well as possible harm to pedestrians. Anyone violating this provision shall be fined by the Municipal Commissioner with one to five *sucres*.

Art. 7 - Woods intended for the construction or repair of public or municipal buildings, charity works, and those related to religious worship are exempt from all taxes, as well as those to be used by municipal contractors.

Art. 8 - The collection of taxes referred to in this Ordinance may be made directly or through settlement.

Art. 9 - All previous ordinances, even those not in conflict with this one, are hereby repealed.
Given in the Session Hall of the I. Municipality, in Zaruma, on the fifth of January, nineteen hundred and thirty-one.

ACTING VICE PRESIDENT
[Signature]

THE SECRETARY
[Signature]

AGUSTÍN E. ROMERO Z., MUNICIPAL SECRETARY OF ZARUMA CANTON,
CERTIFIES: That the preceding ordinance has undergone the three discussions required by law in the following ordinary sessions: those of December 2 and 4 of the immediate previous year and January 5 of the current month. Its wording was approved in the extraordinary session held on the seventh of the same month, Zaruma, January 9, 1931.

MUNICIPAL SECRETARY
[Signature]

Appendix H

Interview to Rafael Campoverde Mora, construction worker of Zaruma.

Audio No. 1

Sophia: What is your name? Rafael? What's your last name?

Rafael: My name is Rafael Campoverde Mora.

S: What do you work in exactly?

R: I am a mason, a painter, and a roof leak repairman. In other words, I work on multiple (things), but mostly on constructions.

S: You've been working a lot on wooden houses, right?

R: Yes, of course.

S: And, roughly, how long have you been working on houses?

R: It's been many years. I've been doing this for at least 20 years.

S: And you, having worked on houses, what have you seen about them? How are they constructed? When you've had to do repairs or something like that, how have you done it?

R: Are you referring here to the mixed-construction houses that are of colonial type?

S: Yes.

R: Well, there are many houses that need repairs. Most of them have already been repaired with new materials... They are old, very old... Many houses are over 100 years old. As for the material of the houses, most of them are of mixed construction. And now, most of the houses here in the center of Zaruma are of the colonial type. At least that's what it refers to in the urban area.

S: And the houses are made of what kind of wood?

R: The majority are... Well, people in the past looked for the best wood to build with, such as Guayacán, Cedar, Amarillo... Engineer, the other wood we use for...?

Engineer: Well... Bella María, Romerillo.

R: Yes, Bella María. Those are such old constructions that the wood, at least the bases of the old houses, have been made only of Guayacán. And those have lasted for hundreds of years and still endure.

S: So, the structure, the columns, the beams, has always been Guayacán. And, for example, the other woods, how do you use them?

R: The other wood is used in a plank style, like Cedar.

E: The yumbingue.
R: The other plank is also called yumbingue.

E: Good wood, as they say. The seique.

R: The seique. That's for making plank-style elements, at least. Seique is for the planking. Well, those are good woods. They have known how to take care of them because there are woods that last for many, many hundreds of years and still look great. At least Amarillo, yumbingue, those are everlasting woods.

E: Like Guayacán is almost (the same as) yumbingue.

S: I see. I hadn't heard of that wood.

E: We use it a lot here. It's almost like Guayacán, and even a bit lighter. But it's not exactly light either.

R: So, regarding the roofs, that wood that's used to place the tiles, that's the chacla. The other one is the wood called chonta.

S: What is chonta?

R: Chonta is a very hard wood. The plant looks like a coconut plant, but they are very tall.

S: And where is it used?

R: In the roof beams. So, that's another wood that lasts many years and doesn't deteriorate.

S: I've seen the Chacla on several roofs already, and they also use it for tying, it's tied with strips.

R: Yes, that's called "amarre." They use vejuco for that. Now, that vejuco is a special one they get from the field, but it's a very hard vejuco that they use for making bahareque houses.

S: Inside the bahareque, are they tied as well?

R: Tied with vejuco, yes.

S: Have you ever seen how bahareque is made?

R: Yes, they build it... it has to be a special mud, not just any mud. They mix it with straw, with the straw from the field.

E: Which is the "flecha."

R: They prepare it, knead it with their heels, with boots. Well kneaded. Then they add the straw. Once it's ready, they start using it on the walls. First, they build the walls, the chacla is used in the chinking. The chacla goes first, right?

S: Chinking?

R: Yes, the chinking goes first, both upright and crossed.

S: Yes.

R: And tied with vejuco. Then, they keep building, adding the bahareque, like baked mud. Not actually baked, let's say it's mud mixed with straw.

S: And what does the straw do?

R: I'm not sure, because our ancestors get it from the highest part of the field. You can only find it in the mountains, not here. It's tough.

S: But it's a different type of soil?

R: No, straw is a type of grass.

E: It's a grass.

R: This specifically has a name, that material that they mix with mud to use it. It's like if you said, when they harvest rice, that's very tough, what's left over from the rice harvest. So, they mix it, chop it up, and mix it because that's how it crumbles, it's not consistent. Our great-grandparents have known how to use that material. So, most of the houses here in Zaruma have been built with bahareque. Then they've been renovating them, to the point that the Municipality, in order to preserve the colonial style, has had to prohibit repairing or remodeling the houses, always ensuring that the colonial style of the houses must prevail.

S: Apart from your personal experience working directly, have you been trained in any way to intervene?

R: No. The most capacity I've been able to acquire is the experience, the work, working with good masters who have taught me. I mean, they haven't taught me directly, but I've learned by watching them. So, it's little by little, with experience and practice, I don't know, with determination to get better at it. So, with experience and practice, one becomes more skilled.

S: I have a question about the chacla. What dimensions does it have for bahareque or for the roof? Does it need a specific thickness? Because this morning you were talking about needing thicker chacla, not the very thin ones. How do you classify them, more or less, to know which ones are more useful to work with?

R: Our ancestors have known how to build because that chacla is very hard. Previously, it's evident that they used a very hard chacla, especially the thick chacla. The thin one, the delicate one, it wears out very quickly, it doesn't have much consistency based on the weight of the tile. So, most chacla has to be not too thin. Not too thin, because if it's too thin, it rots and doesn't match well with the thick one. If we're going to lay a row of (tiles), maybe laying one tile, one after the other, there it would match. And from there, they don't match (because) for placing a tile, it needs the chacla to be properly aligned, otherwise the tile won't match, it will wobble. So, you have to be very careful with that, at least from my experience.

S: So, as I understand it, you arrange the chacla so that the tile falls onto the chacla and settles onto it.

R: Yes, and the chacla not only needs to have a thicker consistency, but also straightness. The chacla can't be crooked, because a crooked chacla makes it more difficult to... (fit)

S: And how is the tree? I'm not familiar with it.

R: El Pindo. It's similar to a cane, but thinner and taller. The core of a chacla is similar to the core of a cane, just that this one is thinner and it grows taller. It reaches about five or six meters high.

S: And regarding, for example, the floors, when you've had to work on those, how do you approach your work?

R: Regarding the old houses in this area of Zaruma, the floors have been, how should I put it? How can I explain it? Properly placed and with the bases settled in solid houses, on a solid floor where there's no fill, because when there's fill, the house is at risk. And most houses, you can see that they've placed the wood, the bases of good wood, like Guayacán, which is the most popular and the hardest. They've buried it at least, according to the height of the house. There are houses with bases that are over two meters deep and even three meters deep.

S: So, the foundation, the Guayacán, isn't at ground level, it's embedded.

R: Most houses are built with an elevated foundation, an elevated platform. It's not directly on the foundation, they place it about... always leaving a space below.

S: Yes, I understand.

E: Do they go on top of stone or on dirt?

R: No, they create the elevated platform using wood, good wood. Good wooden beams.

S: Of course, but for example, here we can see that there are stones.

R: Yes, of course. And below there's always an elevated platform, like you see, there's always a kind of storage space to put anything...

E: Where the tip is placed, is it on dirt or do you use cement?

R: No, the ancient people have known to use a flat stone or, if not, stone material, cement, whatever it may be, but the base has to be securely placed on something solid. And if it's placed on a flat stone, that's even better, because then the column doesn't have sediment.

S: What else could you tell me about the houses you've seen, know about, or worked on?

R: There's one more common thing I've seen in most of the houses I've worked on. At least when I've had to go up to fix leaks. That's the problem here with tile roofs, there are always leaks. So, when you go up to fix the leaks, you start lifting the tiles and you discover that there are chaclas that are already rotten, but there are still chaclas that are in good condition. And as for chonta, that almost lasts forever, because chonta is almost like a lath, a thick board... and it's tough.

S: So, the tile comes first, then the chacla, the bed of tied chacla.

R: The chacla comes after, yes.

S: And then come the chonta boards?

R: No, first the weaving of the boards.

S: And those are made of chonta wood?

R: Then comes the chacla.

R: And from there, the tile comes in. And now with the chacla, it's not tied with vejuco anymore. The chacla is secured with nails. It's nailed down well.

S: And it doesn't crack when you nail it?

R: You have to be careful to place the nail in the center of the chacla so it doesn't crack.

S: Interesting. Thank you very much.

VIDEO

R: This is a "chacla." This is just a piece, (with) a normal thickness.

S: This one, for example, has the same knots as bamboo but it's not hollow, right?

R: No, it's not hollow. Bamboo is hollow. Bamboo, as I believe, can only be used for crafting work. Isn't that right, engineer?

I: It doesn't last long (bamboo), but this "chacla" does.

R: This "chacla" can indeed bear the weight. It's because our ancient ancestors used this "chacla" to weave the roof and place the tiles.

I: If it's well-preserved, the roof can easily last up to a hundred years.

Audio No. 2

R: And with those screws that are over half an inch thick, the houses have been well screwed, so they don't even move.

E: Of course, these are screws. Look, these are old ones.

S: Yes, of course.

E: There's a thicker one.

ARCHIVE SOURCES

Municipalidad de Zaruma. (1905). Sesión Extraordinaria del 16 de Agosto de 1905: Minuta para la construcción de la Casa de Rastro. In *Acta de Sesiones de la Municipalidad de Zaruma 1900-1905*. Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma.

Municipalidad de Zaruma. (1910). Sesión ordinaria prorrogada del día 25 de Julio de 1910: Ordenanza de Construcciones y Ornato de Edificios. In *Acta de Sesiones de la Municipalidad de Zaruma* (pp.157–164). Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma.

Municipalidad de Zaruma. (1912a). Sesión Ordinaria del dia 10 de Julio de 1912: Ordenanza de Ornato y Fábrica. In *Acta de Sesiones de la Municipalidad de Zaruma 1912*. Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma.

Municipalidad de Zaruma. (1912b). Sesión ordinaria prorrogada del día 23 de Julio de 1912: Bases del contrato para la conclusión de la casa municipal N. 7. In *Acta de Sesiones de la Municipalidad de Zaruma 1912*. Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma.

Municipalidad de Zaruma. (1931a). Ordenanza de Impuestos a las Maderas. In *Acta de Sesiones de la Municipalidad de Zaruma 1931-1935*. Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma.

Municipalidad de Zaruma. (1931b). Reglamento Especial de Higiene Domiciliaria. In *Acta de Sesiones de la Municipalidad de Zaruma 1931-1935*. Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma.

Municipalidad de Zaruma. (1931c). Sesión Ordinaria del día 21 de Mayo de 1931: Ordenanza de Ornato y Fábrica. In *Acta de Sesiones de la Municipalidad de Zaruma 1931-1935*. Oficina de Patrimonio y Cultura - GAD Municipal de Zaruma.

BIBLIOGRAPHY

Acosta Sol, E. (n.d.). Sistema urbano en la época colonial. *Esencia y Espacio*.

Aguilera Rojas, J. (1977). Teoría Urbanística en la Colonización Española de América: Las Ordenanzas de Nueva Población. *Ciudad Y Territorio Estudios Territoriales*.

Aguirre Mendoza, Z. (2012). *Especies Forestales de los Bosques Secos del Ecuador* (O. Jadán, M. Añazco, & K. Cueva, Eds.). Ministerio del Ambiente del Ecuador.

Anda Aguirre, A. (1964). *Zaruma en la Colonia*. Casa de la Cultura Ecuatoriana.

Andagoya, E., Alquinga, D., Andrade, F., Pinzón, F., & Bedoya, R. (2020). Geological-geotechnical investigation of the area of soil subsidence in the "La Inmaculada Fe y Alegría" Educational Unit - Zaruma city. . *Geolatitud Revista Científica*, *3*. https://190.152.45.26/ojs/ojs/index.php/GeoLatitud/article/view/88

Asociación Colombiana de Ingeniería Sísmica. (2002). *Manual de Evaluación, Rehabilitación y Refuerzo de Viviendas de Bahareques Tradicionales Construidas con Anterioridad a la Vigencia del Decreto 052 de 2002*. Presidencia de la república de Colombia, Red de Solidaridad Social.

Ayala Mora, E. (2008). *Resumen de Historia del Ecuador* (Corporación Editora Nacional, Ed.; 3rd ed.). Biblioteca General de Cultura.

Burbano, Danny, Aldrin Cerón, Andrés Rivadeneira, and Tania García. 2021. "Stress-Strain Analysis of Works Remediation Implemented To Stabilize The Mining Subsidence Under La Inmaculada School, Zaruma-Ecuador." *FIGEMPA: Investigación y Desarrollo* 12 (December): 1–14.

Caniggia, G., & Maffei, G. L. (2001). *Architectural composition and building typology. Interpreting basic buildings* (Alinea, Ed.). Alinea.

Carazas Aedo, W. (2021). *Bajareque Cerén: Una técnica con legado constructivo*. Cooperación Comunitaria.

Carazas Aedo, W., & Rivero Olmos, A. (2002). *Bahareque: Guía de construcción parasísmica* (CRATerre, Ed.). MISEREOR.

Castillo, Tito. n.d. "Personal Archive of Historical Photographs." Zaruma.

Ching, F. (1995). *A Visual Dictionary of Architecture*. John Wiley & Sons, Inc.

Corporación de Desarrollo Tecnológico. (2022, June 23). *Uniones carpinteras: Métodos tradicionales que otorgan estabilidad y rigidez a las estructuras en madera*. CDT. https://www.cdt.cl/uniones-carpinteras-metodos-tradicionales-que-otorgan-estabilidad-y-rigidez-a-las-estructuras-en-madera/#:~:text=Abarcando%20los%20empalmes%2C%20uno%20de,zag%2C%20para%20complementar%20sus%20perfiles.

El Comercio, and Alexander García. 2022. “Ejército Investiga Causas de Nuevo Socavón En Zaruma.” 2022. https://www.elcomercio.com/actualidad/ecuador/ejercito-investiga-nuevo-socavon-zaruma.html.

Departamento de Arquitectura y Centros Históricos, and Instituto Nacional de Patrimonio Cultural. 1986. “Centro Histórico de La Ciudad de Zaruma: Plano de Delimitación: Área de Primer Orden y Área de Influencia.” Quito.

Diario Correo. 2021. “Socavones En Zaruma Por Minería Ilegal Se Originaron Hace Seis Años.” 2021. https://diariocorreo.com.ec/64927/cantonal/socavones-en-zaruma-por-mineria-ilegal-se-originaron-hace-seis- anos.

Dimensions.com. (2023). Wood Joint - Scarf, Nibbed. Dimensions.Com. https://www.dimensions.com/element/wood-joint-scarf-nibbed

España. (1841). *Recopilación de leyes de los reinos de Indias : mandadas imprimir y publicar por la Magestad Católica Don Carlos II*. (Vol. 2). Alicante : Biblioteca Virtual Miguel de Cervantes, 2017. https://www.cervantesvirtual.com/nd/ark:/59851/bmc738s8

Gobierno Autónomo Municipal de Zaruma. n.d. “Nominación de Bien Para Inclusión En La Lista de Patrimonio Mundial.” Zaruma.

Gobierno Autónomo Municipal de Zaruma. Actualización del Plan de Desarrollo y Ordenamiento Territorial del Cantón Zaruma, El Oro., (2014).

Gobierno de España. Subdirección General de Archivos Estatales. (n.d.). *Paisajes urbanos de América y Filipinas: El Modelo de la Ciudad*. Https://Www.Mcu.Es/Archivos/CE/ExpoVisitVirtua l/Urbanismo/Box-Model.Html.

Google. 2015. “Zaruma Google Street View.” 2015. https://www.google.it/maps/place/Zaruma,+Ecuador/@-3.6878699,-79.6237135,15z/=!3m1!4b1!4m6!3m5!1s0x9034a741091664d1:0x2169a4d0da63865c!8m2!3d-3.6873033!4d-79.6109049!16zL20vMDZnbGx3?entry=ttu.

ICOMOS. (1999a). *Charter on the Built Vernacular Architecture*. https://www.icomos.org/images/DOCUMENTS/Charters/vernacular_e.pdf.

ICOMOS. (1999b). *Principles for the preservation of historic timber structures*. https://www.icomos.org/images/DOCUMENTS/Charters/wood_e.pdf

Ilustre Municipio de la Ciudad de Zaruma. 2004. “Zaruma Patrimonio de La Humanidad: Documentos Para Sustentar La Solicitud a La UNESCO Para Declarar a Zaruma Patrimonio de La Humanidad.” Zaruma: Ilustre Municipio de la Ciudad de Zaruma.

Instituto Geofísico - Escuela Politécnica Nacional. 2022. “Mapa Digital Interactivo de Peligro Sísmico Para Ecuador.” Https://Www.Igepn.Edu.Ec/Mapas/Peligro-Sismico/Mapa-Peligro-Sismico.Html. December 2022.

Instituto Geográfico Militar, and Interamerican Geodetic Survey. 1988. “Zaruma.” *Instituto Geográfico Militar*.

Instituto Nacional de Patrimonio Cultural. (2010). *Glosario de Arquitectura*. Instituto Nacional de Patrimonio Cultural.

Instituto Nacional de Patrimonio Cultural, & Miño, L. (1986). *Síntesis Histórico-Constructiva de la ciudad de Zaruma*. Instituto Nacional de Patrimonio Cultural.

Instituto Nacional de Patrimonio Cultural, Pallares, R., & Arcos, L. (1981). *Delimitación de los Centros Históricos: Ciudad de Zaruma*. Instituto Nacional de Patrimonio Cultural.

Instituto Nacional de Patrimonio Cultural, Pesántez, M., & González, I. (2011). *Arquitectura tradicional en Azuay y Cañar: Técnicas, creencias, prácticas y saberes*. Instituto Nacional de Patrimonio Cultural.

International Seismological Centre. 2023. “ISC-GEM Global Instrumental Earthquake Catalogue.” ISC-GEM Catalogue.2023.

Junta del Acuerdo de Cartagena. (1984). *Manual de Diseño para Maderas del Grupo Andino* (Junta del Acuerdo de Cartagena, Ed.). Junta del Acuerdo de Cartagena.

Maderas Sudamérica. 2008. “Guayacan-Caesalpinia Paraguayensis.” 2008. https://www.maderasde-sudamerica.com/guayacan-caesalpinia-paraguayensis/.

Ministerio de Cultura y Patrimonio de Ecuador. n.d. “Cuenca.” Https://Www.Culturaypatrimonio.Gob.Ec/Cuenca/. Municipal Government of Cuenca, and Universidad de Cuenca. 1998. Proposal for the Inscription of the Historic Center of Cuenca-Ecuador in the World Heritage List. Edited by Fausto Cardoso Martínez. Cuenca: Municipal Government of Cuenca.

Minke, G. (2005). Manual de Construcción en Tierra.Fin de Siglo Editorial.

Municipal Government of Cuenca, & Universidad de Cuenca. (1998). *Proposal for the inscription of the Historic Center of Cuenca- Ecuador in the world heritage list* (F. Cardoso Martínez, Ed.). Municipal Government of Cuenca.

Municipalidad de Zaruma, and Guido Díaz & colaboradores asociados. 2003a. “Inventario de Edificaciones Patrimoniales: Fichas de Catalogación.” In Plan de Conservación y Gestión Del Centro Histórico de Zaruma. Zaruma: Municipalidad de Zaruma.

———. 2003b. “Inventario de Edificaciones Patrimoniales: Fichas de Inspección.” In Plan de Conservación y Gestión Del Centro Histórico de Zaruma. Zaruma: Municipalidad de Zaruma.

———. 2003c. “Inventario de Edificaciones Patrimoniales: Colección Fotográfica.” In Plan de Conservación y Gestión Del Centro Histórico de Zaruma.

———. 2003d. “Inventario de Edificaciones Patrimoniales: Fichas de Levantamiento.” In Plan de Conservación y Gestión Del Centro Histórico de Zaruma. Zaruma: Municipalidad de Zaruma.

Nuere Matauco, E. (2000). *La Carpintería de Armar Española* (Munilla Lería). Instituto Español de Arquitectura, Universidad de Alcalá.

Redacción Digital -Ecuavisa. 2017. “Nuevo Socavón En Zaruma, El Oro, Afecta a Una Escuela de Esta Localidad.” 2017. https://www.ecuavisa.com/binrepository/1024x576/0c0/0d0/none/11705/LMMU/img-20170220-wa0015_EC243431_MG754450.jpg.

Rivadeneira, F., Segovia, M., Alvarado, A., Egred, J., Troncoso, L., Vaca, S., & Yepes, H. (2007). Breves fundamentos sobre los terremotos en el Ecuador. In Corporación Editora Nacional (Ed.), . Instituto Geofísico de la EPN.

Rodríguez, G. (n.d.). *La Villa de San Antonio*.

Subsecretaría de Gestión de la Información y Análisis de Riesgos, and Dirección de Análisis de Riesgos. 2021. “Anexo 7: Identificación de Posibles Cavidades Debajo de Casco Urbano.” In *Gestión Del SNGRE Ante La Emergencia En Zaruma: Informe de Cumplimiento de Declaratoria de Estado de Excepción Dispuesta Por Los Decretos Ejecutivos 296 y 341*. Zaruma: Subsecretaría de Gestión de la Información y Análisis de Riesgos.

Ulloa, Antonio y Jorge Juan De. 1735. “Plano de San Francisco Del Quito.” *Fondos Bibliográficos (Sección Siglo XVIII o Etapa Colonial) Del Archivo Histórico Del Guayas*. Guayaquil.

UNESCO World Heritage Convention. 1978. “City of Quito.” Https://Whc.Unesco.Org/En/List/2/. 1978.

UNESCO World Heritage Convention. (1999). *Historic Centre of Santa Ana de los Ríos de Cuenca*. Https://Whc.Unesco.Org/En/List/863/.

Vera, Xavier. 2022. “On-Line Appearance of the Deputy Minister of the Ministry of Energy and Non-Renewable Natural Resources.” *Acciones Emergentes «Remediación En El Casco Urbano de Zaruma» Https://Www.Recursosyenergia.Gob.Ec/Acciones-Emergentes-Remediacion-En-El-Casco-Urbano-de-Zaruma/*. Zaruma: Secretaria de Gestión de Riesgos del Ecuador.

Vilela, W., Espinosa, M., & Bravo, A. (2020). Environmental Pollution as a Result of Mining in the Province of El Oro. *Estudios de La Gestión: Revista Internacional de Administración*.

Vinueza, M. (2012). *Fichas técnicas de Especies Forestales*. Ecuador Forestal. https://ecuadorforestal.org/category/fichas-tecnicas-de-especies-forestales/

Vizuete, V., & El Comercio. (2011). La Informalidad en la Construcción es el mayor riesgo en un Terremoto. Víctor Vizuete - El Comercio. https://www.igepn.edu.ec/servicios/noticias/381-la-informalidad-en-la-construcci%C3%B3n-es-el-mayor-riesgo-en-un-terremoto

Yepes, H., Palacios, P., Marrero, J., Ramon, P., Celorio, J., García, J., Zambrano, J., & Pilligua, G. (2017). *Evaluación de efectos del suelo y los daños registrados en la ciudad de Portoviejo, Ecuador, a causa del terremoto Mw7.8 del 16 de Abril de 2016*.

RELATED THESIS

Galarza Gallardo, Gabriela Elizabeth. (2006). La Casa del Pueblo, Zaruma: proyecto urbano-arquitectónico. Bachelor’s thesis. http://repositorio.puce.edu.ec/handle/22000/3833.

Wilches Jácome, Gabriela Alexandra, and Pedro Sebastián Alvarez Cordero. (2018). “Diseño a nivel de anteproyecto del Centro de Convenciones para la ciudad de Zaruma.” Bachelor’s thesis. http://dspace.ucuenca.edu.ec/handle/123456789/30724

Cobos Cobos, Juan José. (2018). “Anteproyecto del nuevo mercado municipal de Zaruma.” Bachelor’s thesis. http://dspace.ucuenca.edu.ec/handle/123456789/28678.

Camacho Castillo,Milady Rosario. (2018). Diseño arquitectónico de la terminal terrestre para el cantón Zaruma, provincia de el Oro. Facultad de Arquitectura. UIDE. Quito. 152p. Bachelor’s thesis. https://repositorio.uide.edu.ec/handle/37000/2460.

Jaramillo Valdivieso, Iovana Lizbeth. “Paisaje histórico urbano PHU del centro histórico de Zaruma: estudio, lineamientos y estrategias para la conservación.” Master’s thesis. (2016-10-31). http://dspace.ucuenca.edu.ec/handle/123456789/25811.