CONCRETE BLOCK AND HYDRAULIC CEMENT FLOOR TILE IN THE TROPICS: *advent, history, conservation*

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Foreword

This research project was started during the month of April 2014 thanks to the generosity of the James Marston Fitch Charitable Foundation Mid-Career Grants who provided the seed money and initial funding to make the project possible. The final document was submitted to the Fitch Foundation on June, 2015.

Interest in the two "imitation" building materials (hydraulic mosaic tiles in lieu of carpets; concrete block instead of ashlar masonry or cut stone) which are the focus of this work, commenced when as a Conservation Architect practicing in Puerto Rico, I received the commission to rehabilitate a 1910's concrete block residence with hydraulic mosaic tiles as principal paving materials. The project converted the residence into the headquarters of the Architect's Association in Puerto Rico and the project was carried out from 1993-1995. More than a decade later, as founder and director of the Architectural Conservation Laboratory of the School of Architecture of the Polytechnic University of Puerto Rico, and as docent for various Preservation Praxis courses, the topic selected for a three-trimester academic exercise was the first uses of Portland cement in Puerto Rico, and the building technologies associated with this material, such as early concrete block and reinforced concrete. This led to interest in the manufacturing processes of other pre-fabricated and molded Portland cement architectural elements and the inclusion of hydraulic cement tiles used during the early 20th century in Puerto Rico. The scope of the initial interests expanded to include the Puerto Rican initiatives with those of other countries in the Spanish Caribbean such as Cuba and the Dominican Republic. The common denominator was that these lands had been colonies of the Spanish Government since the 16th century and therefore had shared many construction experiences as well as climate and geographical realities. The three islands have been coined as the Spanish Caribbean in this report.

Research Methodology

During a 14 month period between 2014 to 2015, visits outside Puerto Rico (its principal cities and towns) included the United States (New York City; Madison, New Jersey; and Philadelphia), the cities of Santo Domingo and San Pedro de Macorís in the Dominican Republic; and Havana, Mariel, Cienfuegos

and Trinidad in Cuba.

The investigations originated in **Puerto Rico** when specific buildings that had been constructed using early 20th century (or the earliest examples of hydraulic cement tile and rock-faced or plain-faced concrete block), were inventoried and photo-documented during multiple field visits. Local surviving examples of the early concrete-block building technique were mostly religious buildings or temples that had been constructed by Protestant missionary groups that settled in Puerto Rico after the Spanish American War of 1898. Public school buildings from the same period (1908-1914) were also constructed using this type of masonry. Both building types were scattered throughout the island of **Puerto Rico**.

With regards to the hydraulic cement tiles, it was initially found that this technology was first imported by businessmen from Barcelona, Spain during the last decade of the 19th century. This paving material was sometimes incorporated into concrete block structures, even when such distinct building materials had been imported to the Caribbean from two completely separate places of the world within 10 years of each other. Together or separately, these technologies revolutionized, accelerated, and beautified Puerto Rican architecture.

These initial leads guided investigation towards specific local depositories, collections, libraries and archives. Original primary documents such as historic construction drawings, specifications and photographs as well as secondary source material such as trade catalogs, advertisements in technical magazines, building material catalogs, telephone directories, social journals and periodicals from these historic periods were researched. Yearbooks, Official Minutes, and magazines from the Methodist as well as Presbyterian Missionary groups which settled in Puerto Rico were also consulted. Government, as well as private depositories for these materials were visited and accessed. Most of the original documents, or relevant sources found were photographed, scanned or copied for use in this project.

Acknowledgments

It is important to note that many people aided or oriented these investigations and the names of these persons will be included individually or under each resource in each country.

Field work included locating extant representative examples of both materials in the three island-countries of Cuba, the Dominican Republic, and Puerto Rico and to physically document when possible its building fabric in field notes and, if not, with field photography (sometimes using graphic scales). Former architectural students, (presently graduate architects or architects in training), also provided important assistance identifying, measuring, and photographing relevant examples of these materials. These were Estelí Capote, Yaritza Hernández and Cristina Salvensen.

Successive work included multiple visits to principal archival resources in **Puerto Rico**:

- *Archivo General de Puerto Rico* (National Archive of Puerto Rico)
  José Flores - Former Director of the Archive and Marly Ferrer - Former Reference Archivist
- *Biblioteca General de Puerto Rico* (General Library of Puerto Rico)
- *Colección Puertorriqueña* (Puerto Rican Collection) of the Lázaro Library, Principal Library of the University of Puerto Rico, Río Piedras campus
  Prof. María E. Ordóñez Mercado - Director
- *Archivo de Arquitectura y Construcción* (Architecture and Construction Archive), located at the School of Architecture of the University of Puerto Rico, Río Piedras campus
  Dr. Enrique Vivoni-Farage - Director and Elena García - Reference Archivist
- Centro de Investigaciones Históricas de la Universidad de Puerto Rico, Río Piedras campus
  Josué Caamaño - Director
- *Seminario Evangélico de Puerto Rico* (Evangelical Seminary) - private library
  Milka T. Vigo - Head Librarian
- Robinson School of Puerto Rico - private collection
  Nicholas Karahalios - Director of Institutional Advancement
- Museo Histórico de la Universidad Interamericana de San Germán, Rev. J. Will Harris Collection,

San Germán campus

Felicita Díaz-Dávila - Director

Dr. Héctor R. Feliciano-Ramos - Historian, former professor and author, Universidad Interamericana P.R.

Dra. Ramonita Vega - Historian and Director, Social Sciences Department, University of Puerto Rico, Mayaguez campus

- *Archivo Histórico Municipal de Ponce* (Ponce Historic Municipal Archive)

  Attorney Gladys Tormes - Director
- Periodicals' collection in Ponce of:

  Main Library at Potificia Universidad Católica de Puerto Rico

  Main Library at the University of Puerto Rico.

Due to the fact that the building technology required to construct the earliest examples of the concrete-block buildings found in Puerto Rico (metal forms and stands) was most likely of North-American design and brought by the American missionaries, it was decided early on that visits to specific archives in the United States would clarify and confirm some of the initial hypothesis. Extensive correspondence with the United Methodist Church and the Presbyterian Historical Society archives and depositories proved that both entities kept within their collections important primary (and sometimes un-catalogued) historic material regarding Puerto Rico that could be of use to these investigations.

Documents related to cement imports and the creation of the first cement plant in Puerto Rico, as well as publications that dealt with these formative decades in Puerto Rico, Cuba and the Dominican Republic, were also investigated in various depositories of the **City of New York**. Technical publications also provided important leads. Orientation in the United States was also provided by colleagues or professionals specialized in architectural conservation who also were essential in that they provided important leads into the different sources which could provide significant information for these investigations.

The following archives, centers or libraries were visited in **New York City**:

- The National Archives at New York, New York City branch

Gregory J. Plunges - Archivist

- Avery Library - School of Architecture, Columbia University

  Janet Parks - Curator of Drawings and Archives - Avery Architectural and Fine Arts Library

  Lena Newman - Assistant, Avery Classics

- New York Public Library, Main Branch

Other depositories visited in the **United States**:

- General Commission on Archives and History - The United Methodist Church - Drew University Campus, Madison, New Jersey

  Frances Lyons-Bristol - Reference Archivist

- Presbyterian Historical Society, Philadelphia, Pennsylvania

  Lisa Jacobson - Senior Reference Archivist

Amongst many individuals, colleagues and professionals within the architectural conservation and historic preservation fields from the United States which oriented or provided important guidelines for material within these investigations were:
Eng. Robert Silman P.E., Mr. Kent Diebolt, Prof. Sara Wermiel, Prof. Jeffrey W. Cody, Prof. Thomas Peters, and Dr. Christopher Gray and Ms. Samantha Hightower from the Office of Metropolitan History. Special thanks to Architectural Conservator Rosa Lowinger, who served as my sounding board regarding conservation issues for both building materials. Many others have been cited within the Endnotes of each section of this report.

The **Dominican Republic** was the first country visited outside American territory. Through the investigation of extant publications and the assistance of Dominican colleagues, I knew of the existence of both building materials on the island of Hispaniola and particularly in the Dominican Republic. Haiti, which forms the western part of Hispaniola and has French building traditions, was not part of the present investigations.

Similar to the construction history in Puerto Rico, it was initially found that the hydraulic cement tiles

had also been first imported to the Dominican Republic by businessmen from Barcelona (sometimes through transit from Cuba) during the last decade of the 19th century. This paving material was sometimes incorporated into concrete block structures as well, even when it is hypothesized that the concrete block technology arrived in this country approximately two decades or more later.

Appointments were made with the Director and Reference Archivists of the *Archivo General de la Nación* (General National Archive) who provide custody for important historic drawings, specifications, legislation, invoices of building materials, advertisements in technical and social magazines, newspapers and periodicals, as well as extensive photographic collections with regards to these building technologies and their corresponding manufacturing plants throughout the Dominican Republic. Extensive field photography was taken in various neighborhoods of the capital city of Santo Domingo as well as the towns of San Pedro de Macorís and La Romana. Visits were carried out to present-day manufacturers of the hydraulic cement tile in San Cristóbal, where copies of original early 20th century historic trade catalogs were obtained as important reference materials.

The following archive was visited in **Santo Domingo, República Dominicana**:

- *Archivo General de la Nación* (General National Archive), Santo Domingo, República Dominicana
  Pedro de León - Director of Reference Room
  Angel Viterbo de Oleo-Rodríguez - Reference Archivist

The following manufacturing plant was visited:

- *Industrias Aguayo de Construcción* (Aguayo Construction Industries), San Cristóbal, República Dominicana [Aguayo Mosaicos (tiles)]
  Eng. Jorge Aguayo-Saladín - General Director

Amongst many individuals, colleagues and professionals in the Dominican Republic which oriented or provided important guidelines for material within these investigations were:

Arch. Gustavo Moré, Arch. Mauricia Domínguez, Arch. Virginia Flores-Sasso, and Arch. Linda Roca. Others have been cited within the Endnotes of each section of this report.

Entrance permits and visas to **Cuba** were difficult to obtain and almost took a year. Only Cuban scholars are allowed into the National Archives, so as a Cuban-born, I had to obtain a new Cuban Passport which complicated the process and delayed travel plans. After much email correspondence with Cuban historians and architects which helped identify the sources which were essential to these investigations, and letters with the different depositories holding historic materials, I was able to obtain the permits to access the National Archives as well as the National Library in Havana. Original historic documents of the first buildings constructed with concrete block in Cuba by the North American firm of Purdy & Henderson were important finds. Historic magazines and periodicals contained the most important information required, specifically with regards to historic graphics (photographs and advertisements of the two building materials topic of these investigations and their corresponding manufacturers).

The following archives were visited in **Cuba**:

- *Archivo Nacional de la República de Cuba*, (National Archive of the Cuban Republic) La Habana
  Lic. Yorlis Delgado-López - Legal Advisor
- *Biblioteca Nacional de Cuba José Martí*, La Habana (José Martí National Library of Cuba)
  Dr. Tomás Robaina and Lic. Aracelys García-Carranza
- *Archivo Histórico Provincial* (Provincial Archive, Cienfuegos)
  Lic. Bárbara Rojas-Matsoda - Director
- *Biblioteca Provincial* (Provincial Library - Rare Book Collection, Cienfuegos)
  Lic. Alicia Martínez-Lecuna - Director

Special appreciation to Ms. Gladys M. Collazo-Usallán - President of the Cultural Patrimony Office of the National Council of Cuba, National Monuments Commission, who provided the letters of invitation required to enter Cuba officially as bonafide researchers. Others colleagues have been cited within the Endnotes of each section of this report.

Amongst many Cuban individuals, colleagues and professionals which oriented or provided important guidelines for material within these investigations were:
Dr. Alicia García-Santana, Arch. Nelson Melero-Laso, Historian Yamira Rodríguez-Marcano, Rev. Dr. Héctor Méndez - Pastor of the First Reformed Presbyterian church of La Habana, Dr. Lilia Martín-Brito, Conservator David Liestter-Martínez, Historian Victor Echenagusía, Conservator Nancy Benítez, Arch. Marcela de Lara-García, Arch. Manuel R. Sanzo, and Eng. Diego J. Cortizo.

I am greatly indebted to Architects and colleagues Cristina Puglisi, Deputy Director of the American Academy in Rome, and Andrés Mignucci, FAIA, of Andrés Mignucci Arquitectos, and Professor at the School of Architecture of the University of Puerto Rico, who believed in this research project from its outset and provided the important letters of support required to obtain one of the James Marston-Fitch Charitable Foundation Mid-Carreer Grants for 2014-15. The seed money provided by this grant made the project possible. I am grateful to Professor Theodore H. M. Prudon - my assigned Trustee Advisor of the Fitch Foundation, and to Seri Worden, the Executive Director of the Foundation in 2014 for facilitating the administrative process of the grant. I would also like to thank Cristiana Peña, Executive Director of the Foundation in 2015 for helping achieve the grant extension period due to the delay in the trip to Cuba and the final administrative processes of the grant.

And last but not least by any means, my appreciation to my husband **Dr. Agamemnon Gus Pantel** who as an Anthropologist and Archaeologist specialized in the Caribbean, as well as Heritage Manager, served as my principal consultant and editor to these investigations in all respects; accompanying me during field visits in all four countries, and archival research as well, expediting work in every respect. Dr. Pantel was also the main editor for the texts and graphics of this report, as well as the main photographer for a large number of the photographic files gathered during the James Marston Fitch grant period. I am greatly indebted to him for helping me pull it all together at the end.

A research project is never finished. The opportunities provided by the Fitch Grant to investigate the early examples and use of hydraulic mosaic tiles as well as concrete block in the Spanish Caribbean - (cement products still manufactured today, even if with different designs, formulations, and

manufacturing processes), has enticed my curiosity. Future investigations in the region might include other early 20th century molded and pre-fabricated Portland cement architectural elements and products that have survived and which would benefit from appropriate preservation and conservation recommendations and procedures.

Concrete blocks and hydraulic cement tile at an entrance porch (ca. 1910) in Ponce, Puerto Rico.
(Photo by the author, 2014)

Introduction

"...*me dormía tan fuerte como el cemento a los tres meses*." (I slept as hard as three month old cement) Testimony of Josep Aixalá Casellas in reference to the hard labor experienced upon arrival at the promised land of the New World and compared it with the hardness of cement.[1]

As a rule, port cities usually benefit from innovative design ideas at a faster pace than inland settlements. As important trading places for maritime traffic and commerce, ports served as important testing grounds and laboratories for the technical construction feats of different historical periods. This was certainly the case for the building technologies which are the focus of these investigations.

In our region, the fabric and building stock of port cities facing the Caribbean Sea and the Atlantic Ocean were important exponents of technological evolution and revolution, specifically from the mid 19th through the early 20th centuries when the Industrial Revolution and several civil and international Wars would mark the period. At the time, intense maritime traffic in the Caribbean and global experimentation probably led designers to revisit previous building technologies that had been in use, such as hydraulic mortars, as well as test new structural methods in their quest to obtain permanent masonry buildings. "The use of lime, especially with such hydraulic additives as crushed brick and tile, produced permanent masonry buildings that could withstand the tropical storms and extremely wet maritime climate of the West Indies...due to their fast-setting properties in spite of the presence of water and high ambient humidity in the subtropical Caribbean."[2] These materials would prove extremely useful in Europe and directly benefit their colonies in the New World. Yet, to the colonizers' benefit, the new territories provided a relatively un-regulated scenario that afforded creativity in the re-interpretation of imported construction concepts.

For the purposes of this study, the geographical parameters are the Circum-Caribbean region, which includes the islands and countries that were once Spanish colonies and border the Caribbean Sea. Common denominators to this specific region are geography and geology (including earthquakes, tsunamis) as well as climate (hot, humid, hurricanes, tropical storms) and the flora and fauna (fungus, termites, wood-eating insects) - all contributing factors to design decisions made regarding its building stock. As an initial testing ground for the present study, the specific area selected will include the formerly Spanish Greater Antilles: Cuba, the Dominican Republic (eastern part of Hispaniola), and

Puerto Rico which will be coined in this work as the **Spanish Caribbean**.

This research focuses on the late 19th and early 20th century Portland cement building technologies that have been understudied, specifically in the tropics. Structures from this period that have survived have been mostly neglected and/or partially demolished for lack of historic relevance or as a result of ever-changing architectural tastes. This has occurred in spite of the durability and relatively un-scathed survival of some of these structures, precisely, due to their building components which were made with Portland cement.

This investigation strives to promote a better understanding of the significant role these architectural elements played in changing the face of tropical architecture, particularly that of the Spanish Caribbean and will serve to generate consciousness for the appropriate and compatible preservation of extant examples.

Early Portland cements

As progressive building materials, the use of lime-based hydraulic mortars evolved into the use of Portland cements of the 19th century. This material brought about important and permanent changes to the construction industry world-wide.

An interest in hydraulic materials, somewhat dormant since the Roman empire, began in northern Europe, especially England and France, during the last quarter of the 18th century. Notable efforts included the research work of two engineers, John Smeaton and Louis Vicat. More significant were the investigations of Joseph Aspdin, who created a patent in 1824 for "Portland cement" named so because the mix was similar in appearance to the color and texture of the limestone from Portland, England.

> The need for increased infrastructure world-wide during the Industrial Revolution such as canals, roads, bridges and other civil engineering works, demanded high performance materials such as hydraulic mortars. Cement mortars, or artificial stone, *piedra plástica* or *piedra*

> *artificial*, as they were commonly called in Spanish settlements, became increasingly popular. There was a need for a product that would set rapidly, harden under water, attain early strength, and help water-proof and fire-proof buildings, therefore resolving many construction problems with an efficient building material. Cement mortars also helped accelerate the pace of building or construction during this period of rapid urban growth.[3]

Once Aspdin's patents became known, inventors started to crop up in various European countries. Leading the way, amongst others, were patents from Belgium, Denmark, England, France, and Germany. Since the 1850s (and specifically the late 19th and early 20th centuries) the building trades were transformed by cement products that promised "quick" beauty and efficiency, and required relatively no previous experience in their manufacture or installation. Industrialists who produced these building materials took advantage of the high energy levels and changing tastes in design of the period and introduced innovative and pre-fabricated products made possible with the use of Portland cement as one of its raw materials. The fast-setting qualities of cement matched the fast pace and changing sensibility of the time. In most large cities these changes had meant urban expansion and specifically, a new housing stock, accessible to all social classes, which included bolder decoration and satisfied an increasing sensibility to ornament, texture and color. The standardization and easier manufacture of building or architectural elements made with Portland cement had made the dream possible. The stage was set for the evolution of design concepts and a bolder architectural expression at all levels.

Portland Cements as protagonists for innovation in the Spanish Caribbean

Even if various European brands of Portland Cement were imported to the Spanish Caribbean as early as the 1860s, mainly as an innovative product that would permit fast and strong construction of aqueducts, repair of military installations, new railroad infrastructure and street sidewalks, it was not a generally accepted building material, or imported in large quantities into the Spanish Caribbean region until the 1890s. Apart from the cement itself, most products made possible by Portland cements were initially advertised, and gained popularity through, European exhibitions in cities like Paris, London and

Barcelona, and were brought to America by the late 1800s. By then, the new materials were actively advertised as permanent, water-proof, and fire-proof in the catalogs of important large enterprises. These were important characteristics which more than met 19th century existing building ordinances in Cuba, the Dominican Republic and Puerto Rico. As a consequence, highly ornamental and molded hollow-core concrete block and hydraulic cement floor tile, amongst many other cement products and architectural elements, would become part of the vocabulary for residential, religious, and institutional architecture in the tropics during the first three decades of the 20th century.

The innate characteristic of Portland cement of setting especially well in an extreme wet and humid climate as well as in hot weather, made it the perfect material and set the stage for innovative cement products in tropical regions. Structural components, building facades, as well as interiors were immensely impacted by architectural elements made possible through the moldable characteristics of the Portland cement mix. The new material provided infinite possibilities, specifically with the use of molds allowing any and all shapes, forms, and could even allow for color in the mix. Pre-fabricated and rapidly-produced building components, manufactured within molds by less experienced hands (ie. than those of an experienced stone-cutter) facilitated installation and price-competitiveness with traditionally-used building materials such as natural stone. These procedures opened the door to new building trade specialties, that of the cement mold-maker, the colorist, and that of the Reinforced Cement Ornament Workshops.[4]

The relative simplicity of the manufacture of the first concrete blocks and hydraulic cement floor tiles, which required no ovens, artificial heat, nor large manufacturing areas, facilitated the local production of these building materials. The requisite and rather small metal molds and presses needed for both structural and decorative architectural elements, could therefore be easily imported and set up almost anywhere, custom-fit, and to everyone's advantage in large projects on the building site itself.

Since the mid-19th century, businessmen and specialized craftsmen, particularly from Spain and the United States, emigrated to the Caribbean due to war or lack of economic opportunities in their homeland, always perceiving the region as an optimistic solution. The raw materials to prepare some

of the Portland cement products, specifically the cement itself, was imported from the Old World until the first Portland cement plants were established in the West Indies wherein the local industries prospered.

In 1898 the United States entered into war with Spain. As a consequence of what became known as the Spanish-American War, Cuba, Puerto Rico, and the Philippines became territories of the United States. The U.S. Department of War set up a temporary Military Government on the islands of Cuba and Puerto Rico where the U.S. undertook, as a priority, a construction program of roads and bridges as well as schools. Most of these were built using imported Portland cement products and/or reinforced concrete following models brought by the U.S. Government, Protestant religious groups, and the military. They included prototypes for institutional buildings, schools and housing.[5] In addition, private buildings of importance such as banks, hotels and housing of all types, were also built using innovative technologies made possible by the new materials.

After the war, during a period of increased economic wealth and growth, also due to an increment in sugar production and sales, the construction projects of these island-countries (including the Dominican Republic) would benefit from the fast-setting properties of Portland cement. "In 1901, imports of Portland cement to Puerto Rico from Germany alone amounted to 8,807,585 pounds or 23,425 barrels, in addition to 7,500 barrels coming from other countries, including the United States."[6] Amongst the cement brands imported to Puerto Rico were Lehigh, Alpha, Alsen, Atlas, Columbia, Dragon, Vulcanite and Whitehall, as well as Berkshire white cement. There is also evidence of imported bags and barrels of "roman cement" to the Dominican Republic as early as 1894, when it cost $4.50 per *quintal* (100 pounds) or approximately .04 cents per pound. In local newspaper ads of the Republic from 1909, registered imports included Teutonia cement from Germany and Lehigh cement from the United States. According to records of the Dominican Department of the Treasury from 1905 to 1911, cement imports (in 170 kilogram or 375 pound barrels) was considerable. Between these years cement consumption increased seven times the amount in six years.

Leading the list of most cement imports into the Dominican Republic between 1905-1911 was the United States with a total of 8,230,900 barrels, with 3,014,734 barrels having been imported from Germany. Other countries providing their cement were Belgium, England, France, and Spain.[7] The new building material had come to stay.

Piedra plástica o piedra artificial y cemento, were advertised in Puerto Rico as "true artificial stone, more resistant than natural stone, which was sometimes destroyed by continuous blows from wagons and carts, and rough atmospheric changes." Due to this, extensive advertisements for the product were an integral part of the newspaper and magazine advertisements of the time in the three islands. Mostly, the Portland cement was imported in 376 pound water-tight barrels and needed no prior preparation. This was so even if in an article written by Civil Engineer Albert W. Buel for the 1900 issue of The Engineering Magazine - an International Review warned that "...cement for export over sea must be coopered..."[8] and indeed presented the major problem of hardening or solidifying if improperly handled or stored, making it useless prior to use. The local high ambient humidity of these tropical islands and the little knowledge the first operators had regarding the raw material itself aggravated the situation.

The First Cement Factories in the Tropical Caribbean

Cuba

The first cement factory in the Caribbean to produce Portland cement was called Cuba and was owned by the brothers Ladislao and Fernando Díaz, accredited business traders in construction materials from Asturias, Spain. Located in the capital city of Havana, this factory was inaugurated in 1895. "It had a daily production capacity of 20 tons or 6,000 tons a year. The production would be marketed as 'CUBA' and sold in 130 and 150 kilogram (287-330 pound) barrels and 75 kilogram (165 pound) bags." A fifty horsepower steam engine provided the energy required for the plant's equipment. The factory compound had an area of 3,000 square meters, and in addition to the factory buildings, included five warehouses: four were used to store raw materials, and one was used for the finished product, with a

storage capacity of 10,000 barrels. Other departments were carpentry and cooperage. The Cuba Cement Factory was in operation for fifteen years until 1910.[9]

The second cement factory in Cuba was *Fábrica El Almedares*, also located in Havana near excellent lime quarries. It started cement production in 1901 and had a 50,000 ton yearly capacity. Its cement brand was called 'VOLCÁN' (volcano). Their product was advertised at the Cuban National Exposition of 1911 as "...possessing the superiority to resist the sun, fire, sea water, storms and therefore, more than anything else, the devouring effects of time."[10] The popularity of this manufacturer grew when it became the Portland cement used by the Public Works Department of Cuba for their national projects. It however went bankrupt in 1921.

In spite of the existence of these two Cuban cement factories, Portland cement continued to be imported into the 1920s, especially from the U.S., since the three first decades of the 20th century were marked by extensive public and private building throughout Cuba which needed the new product. Between 1905-06, cement brought into Cuba through the important southern seaport of Cienfuegos was considerable,

> ...31,749 barrels of Portland cement were imported...29,389 barrels coming from the United States, 1,279 barrels from France, 639 from Germany and 442 from Spain. Concrete is not yet extensively used in the construction of buildings. It is becoming popular, however, in bridge building and in the construction of pavements, sidewalks and sewers... The present selling price per barrel ranges from $3.74 to $4 Spanish gold, worth 91 % at present...[11]

Dominican Republic

"The Fábrica Dominicana de Cemento, C. X A." (Dominican Cement Factory) was the first national enterprise of its kind in the country. It was inaugurated in 1947.[12] along the banks of the Ozama river near the capital city of Santo Domingo. For approximately two decades it produced the Portland cement named "Colón". The growth of the city and the depletion of its lime quarries caused the

eventual shut-down of the plant during the local economic crisis of 1965. The plant remains were demolished in 1996.

Advertisements published from 1909-1928 in the *Listín Diario,* a major Dominican newspaper, included Portland cement brands mostly imported to the Dominican Republic from Denmark, Germany and the U.S. These cements were given names in Spanish which were descriptive of the product's emblem or brand. Such was the case for *León* (lion), *Caballo* (horse), *Llave* (key), *Oso Blanco* (white bear) and *Faro* (lighthouse). Other brands imported were Alpha, OK, Teutonia, and Atlas cements, the last one having been imported from Puerto Rico.

Puerto Rico

The first cement plant established in Puerto Rico was government-owned and built during 1936 under the Puerto Rico Reconstruction Administration (PRRA), which became its first name. This was a New Deal initiative of United States' President Franklin Delano Roosevelt to create jobs and promote development on the island-commonwealth through important construction projects during the Great Depression years of the United States. The cement plant was built in the Guaynabo-Cataño area near natural limestone and karst formations required for the production of cement. By 1940, the name of the plant had changed to the Puerto Rico Cement Corporation. Its initial production capacity was 1.5 million cement bags per year which doubled with the installation of a second furnace in 1941.

A second cement plant, the Ponce Cement Corporation, came into being in 1941 during the II World War. It was founded in the Playa de Ponce, a beach sector of the second largest city in Puerto Rico. Ponce Cement bought its second furnace in 1943 with the help of the U.S. Army in order to increase its yearly production capacity to 3.5 million cement bags. Having two working cement plants on the Island during this period guaranteed a sufficient supply for local building demand in a period of marked economic growth.

[1] Joan M. Ferrán-Oliva, *La saga de los catalanes en Cuba* [The saga of the Catalonians in Cuba]. (Catalunya: Fundació Casa América, 2009): 25 - Translations from Spanish by the author.

[2] Beatriz del Cueto, "The Development of Hydraulic Mortars, Cement, and Concrete in Puerto Rico", APT Bulletin International, the Journal of Preservation Technology, Vol. XLII, No. 1. Mt. Ida Press. Albany, New York, (Spring 2011): 45.

[3] del Cueto, 46.

[4] Maria Victoria Zardoya-Loureda, "Ornamento por Encargo" [Commissioned Ornament]. Revista Opus Habana No. 3 (2001): 1-8; and Felicia Chateloin-Santiesteban, "De la Arquitectura del Molde o la Identidad de la Ciudad Cubana" [From Architecture of the Mold or the identity of the Cuban City]. Trocadero No. 19 (2007): 251-264 - Translations from Spanish by the author.

[5] del Cueto, 46-47.

[6] del Cueto, 47.

[7] Enrique Penson. *Arquitectura Dominicana 1906-1950* [Dominican Architecture 1906-1950]. Tomo I: Textos, Tomo II: Planos, (Santo Domingo: Mediabyte, S.A., 2005): 67 - Translations from Spanish by the author.

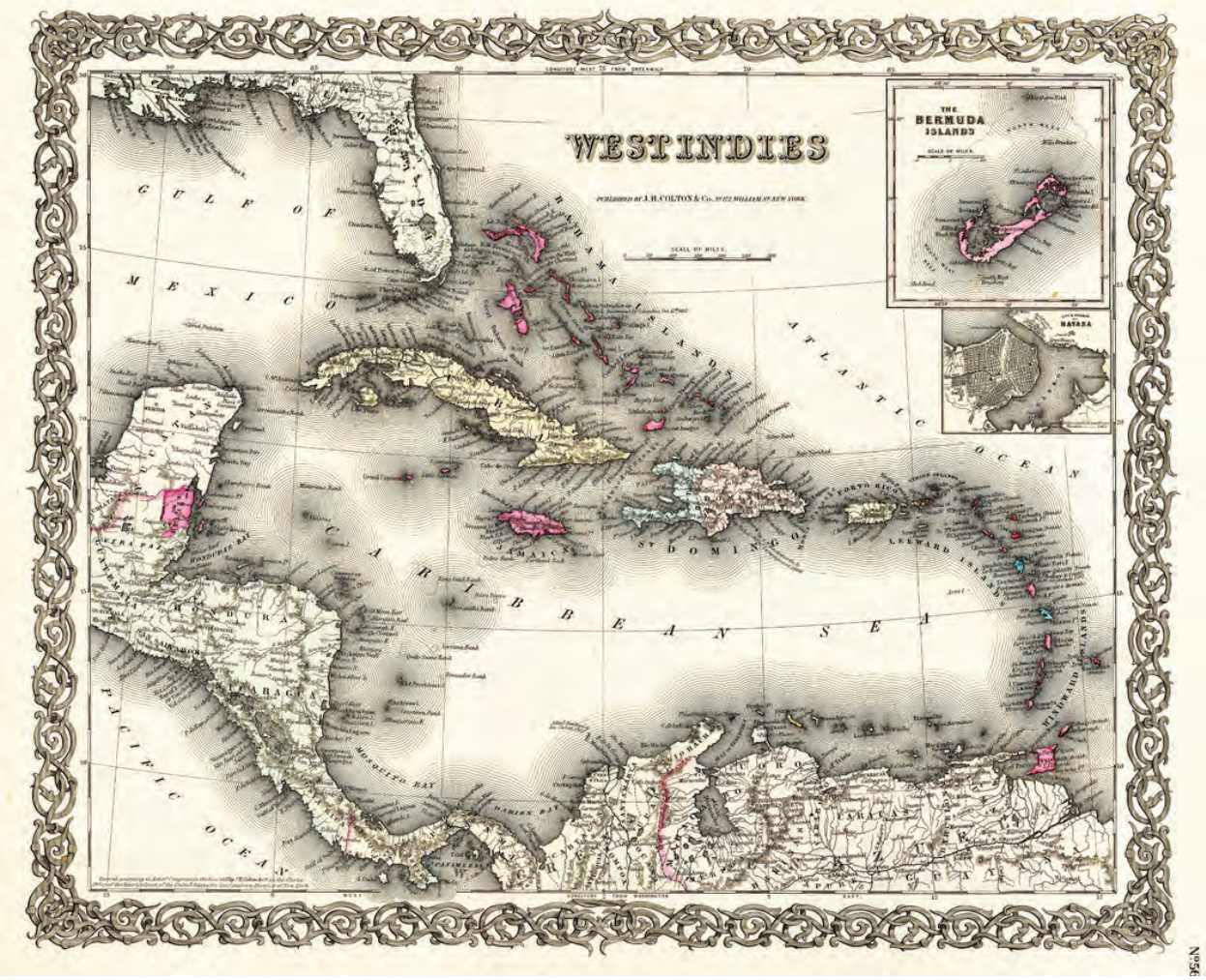
[8] del Cueto, 47.

[9] Juan de las Cuevas-Toraya, *500 Años de Construcciones en Cuba* [500 Years of Construction in Cuba]. (La Habana: Chavín, Servicios Gráficos y Editoriales, S.I., 2001): 116-117; and Juan de las Cuevas-Toraya, *100 años del cemento en Cuba* [100 years of Cement in Cuba]. (La Habana: Ministerio de la Industria de Materiales de Construcción, 1995): 15 - Translations from Spanish by the author.

[10] "Una Industria Poderosa - Fábrica de Cemento 'El Almendares'" [A Powerful Industry - 'El Almendares' Cement Factory], El Fígaro - Revista Universal Ilustrada, (February 29, 1911), La Habana: 139 - Translations from Spanish by the author.

[11] "Demand in Cuba for Cement", The Cuba Review and Bulletin, Vol. V No. 6, (New York: Munson Steamship Line, May 1907): 14.

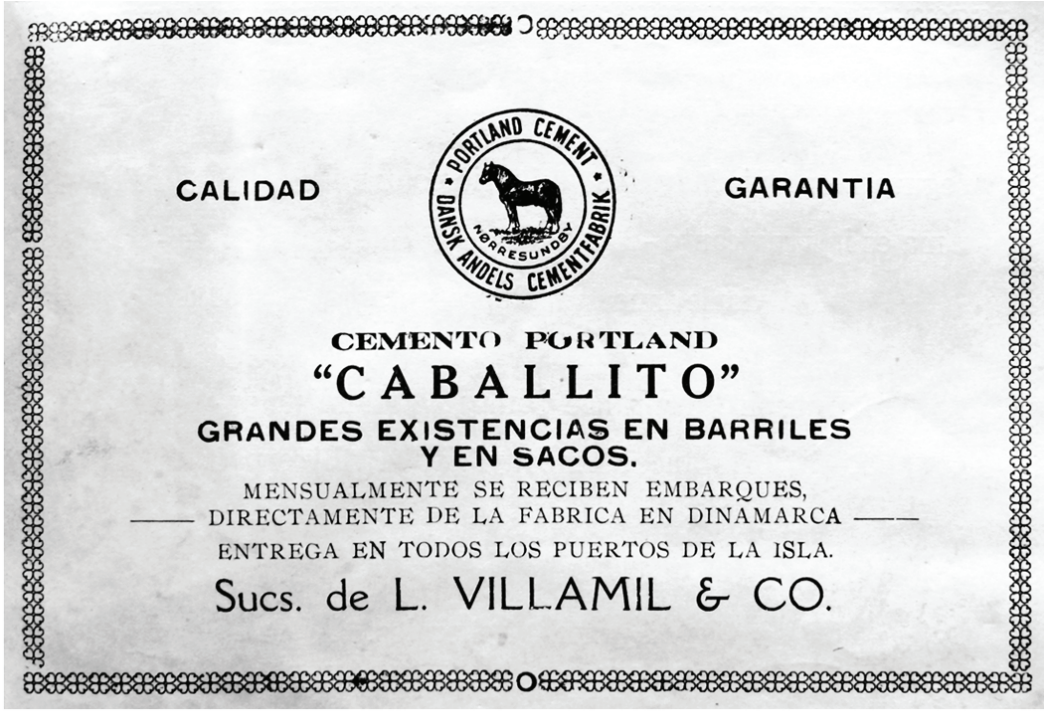
[12] Penson, 68 - Translations from Spanish by the author.



Map of the West Indies which includes the Spanish Caribbean (once Spanish colonies): Cuba, the Dominican Republic (eastern part of Hispaniola) and Puerto Rico.
(Internet Source)

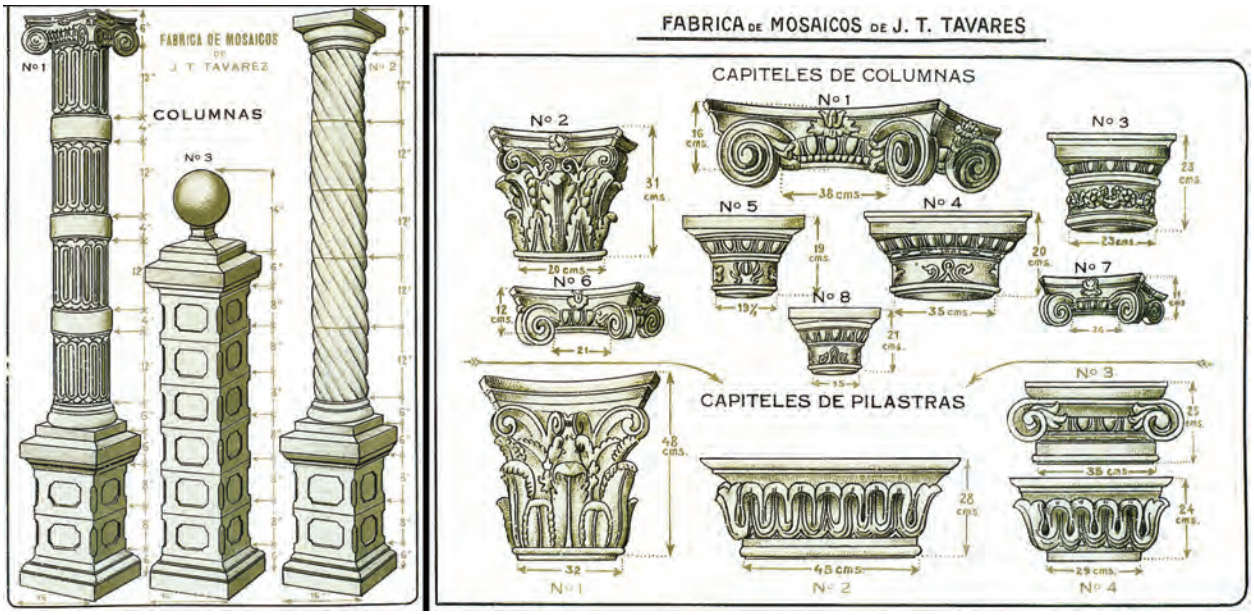
View of Miramar near San Juan, Puerto Rico representing the urban expansion and housing accessibility made to all social classes that occurred from 1905-1915 in the region, which was greatly facilitated by the use of Portland cement as a building material.

(*Archivo General de Puerto Rico*, *Archivo Fotográfico* - Department of Education Collection)



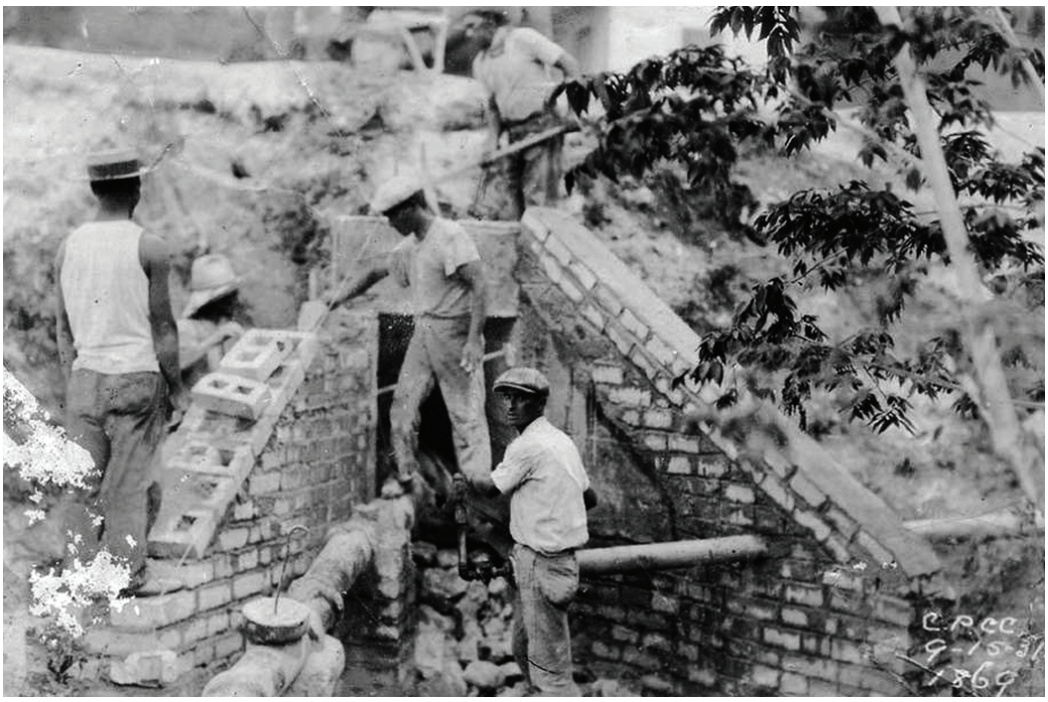
Portland Cement and Hydraulic Cement Tiles gained popularity through European Exhibitions later brought to America. Advertisements paved the way.

(*Guía de Teléfono* – Porto Rico Telephone Company 1928 , *Archivo General de Puerto Rico*)

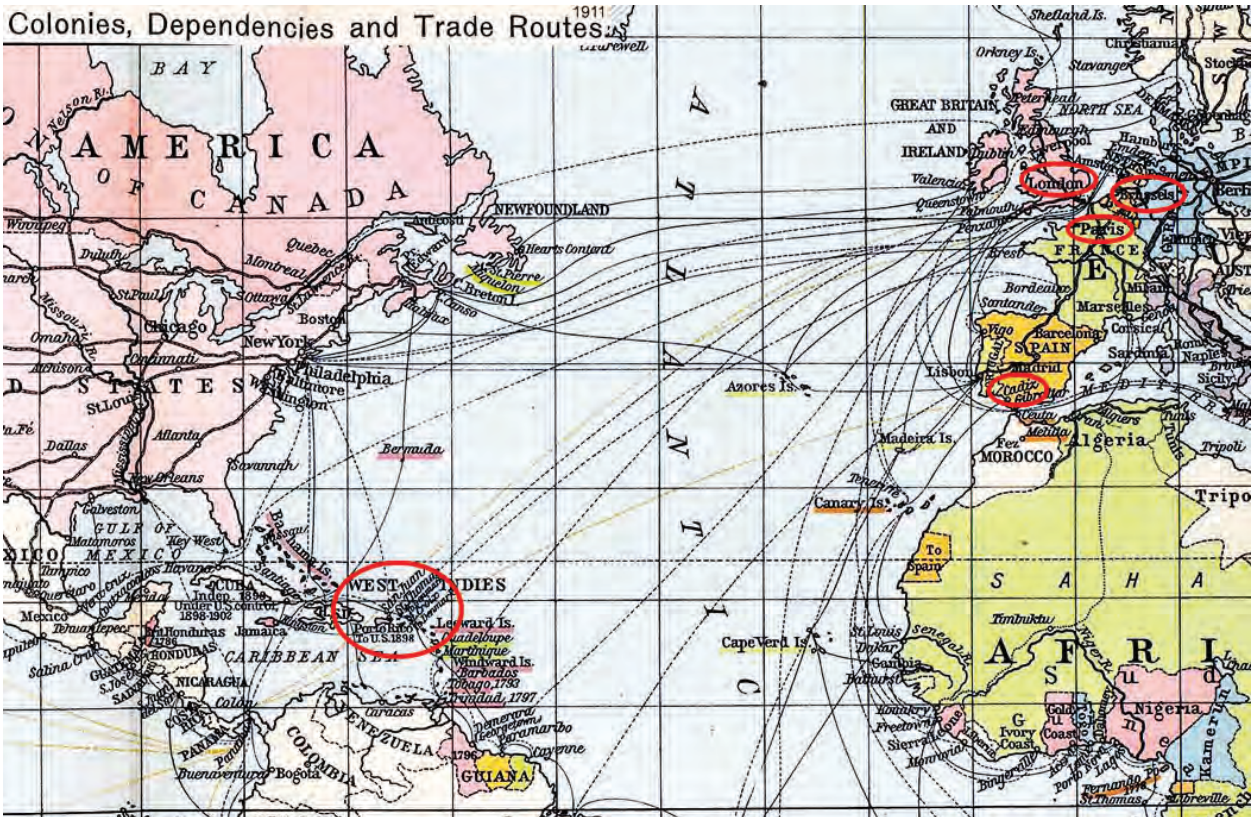


Molded and pre-fabricated architectural elements of all kinds were made possible by Portland cement.
(Tavares, J. T. *Fábrica de Mosaicos de J. T. Tavares, Catálogo No. 2* [Mosaic Factory of J. T. Tavares, Catalog No. 2]. Santo Domingo: Litografía Ferrua, 1931)

Portland Cement importation throughout the Spanish Caribbean from the mid 19th to the mid 20th centuries.
Penson, Enrique. *Arquitectura Dominicana 1906-1950* [Dominican Architecture 1906-1950] (Volume I), Santo Domingo: Mediabyte, S.A., 2005; and *Album del Centenario de la República Dominicana* [Centenary Album of the Dominican Republic]. La Habana: Artes Gráfi as, S.A., 1936.

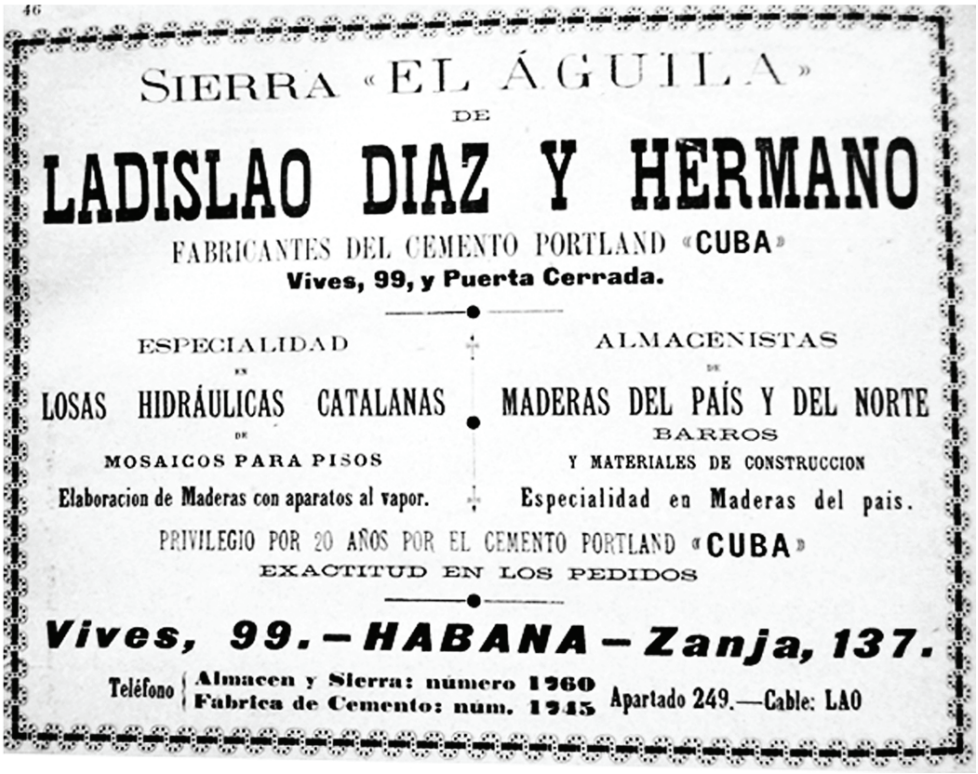


The relative simplicity in the manufacture of the first concrete blocks, as well as their reduced size and weight, facilitated their use.
(Harris, Dr. J. Will. Riding and Roping: The Memoirs of J. Will Harris. Maryland, Port City Press, Inc., 1945 and Internet Source of a building site in Mariel, Cuba)

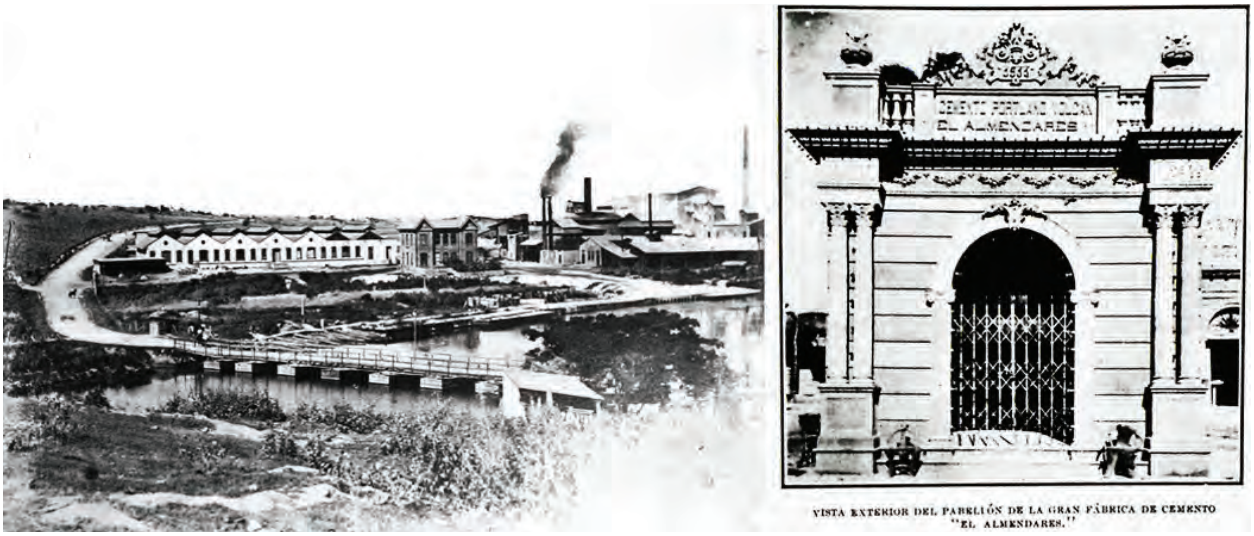


Trade Routes from Europe to the Spanish Caribbean.
(Internet Source)

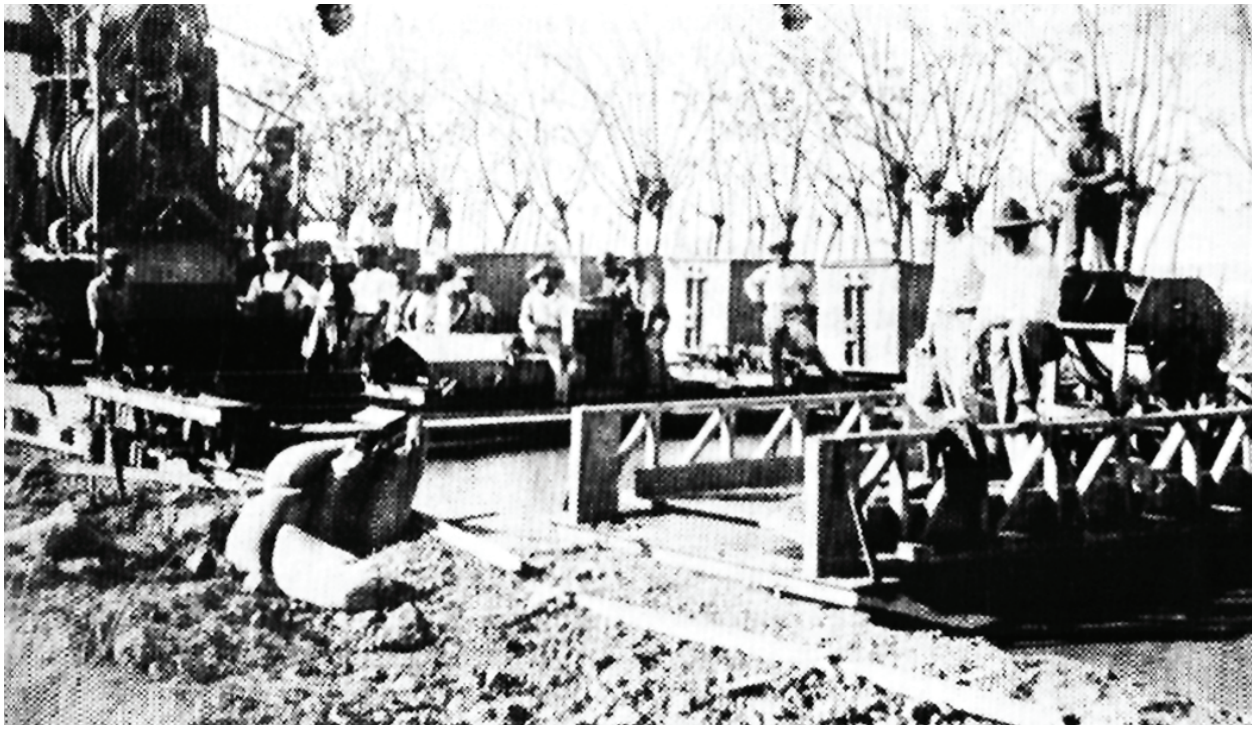
Anuncio en la revista Construcción y Agrimensura. La Habana, 1904



Advertisements for the first cement factory in Cuba founded in 1895 and named *Ladislado Díaz y Hermano*, producing "Cuba" brand cement.
de las Cuevas-Toraya, Juan. *100 años del cemento en Cuba* [100 years of Cement in Cuba]. (La Habana: Ministerio de la Industria de Materiales de Construcción, 1995)



VISTA EXTERIOR DEL PABELLÓN DE LA GRAN FÁBRICA DE CEMENTO "EL ALMENDARES."



The second Portland cement factory in Cuba was *El Almendares* and produced "Volcán" cement. The factory supplied material for the construction of the *Carretera Central* (central roadway of Cuba) which popularized its use.

(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba), "Una Industria Poderosa - Fábrica de Cemento 'El Almendares'" [A Powerful Industry - 'El Almendares' Cement Factory], (February 29, 1911): 139)

PAGINA 3 SABADO Marzo 1º, 1947

LA NACION

INFORMACION LOCAL

En el transcurso de solemne ceremonia celebrada ayer fué inaugurada la Fábrica de Cemento construída en esta ciudad

Las razones del canciller

Escribe: JOSE VICENTE PEPPER

Ciudad Trujillo, 1947.—El Canciller venezolano, doctor Carlos Morales, se dirigió al Cuerpo Diplomático acreditado en Caracas y con su vocería de tipo de Capilla Sixtina, habló de esta manera: "La señora Graciela Rincón Calcaño de Pepper dió a la prensa de Cuba y a las Agencias Noticiosas extranjeras que el Gobierno de Venezuela estaba suministrando dinero y armas a revolucionarios de diversas regiones del continente, violando en este forma los pactos de Chapultepec y San Francisco".

"El Gobierno de Venezuela no apoya ni apoyará actos que se dirijan a perturbar el orden público de ningún país y menos con el suministro de armas y dinero. Por lo tanto carecen de base las imputaciones hechas por la referida señora Rincón Calcaño de Pepper".

No se atrevió a más el pobre Canciller, pues él sabe que en la Junta de romulete Carlos Morales no es sino un segundo violín y recuerda con tristeza cómo allá en Ciudad de México, betancourt lo dejó en ridículo, al suplantarlo por el degenerado Andrés Eloy Blanco en un acto oficial donde en su carácter de Canciller a él le correspondía hablar, después de betancourt, una vez que en la ceremonia tomaron la palabra el Presidente de México y el Canciller de dicho país.

El Canciller no se atreve a irse a fondo en una refutación, porque él conoce muy bien que rómulo betancourt tiene sus agentes en el exterior y éstos agentes pesan siempre por sobre el Cuerpo Diplomático. Y que además, betancourt viene organizando "su Cuerpo Diplomático" a base de elementos incondicionales a su persona. El Canciller teme que lo desmientan y por eso calla bajito. Teme que le digan que en Venezuela se echaron las bases de la revolución que piensa arrojar por tierra el Gobierno del Dr. Ospina Pérez, en Colombia. Algo historia.

La presente fotografía muestra la presidencia del acto de inauguración de la moderna fábrica de cemento. De derecha a izquierda el señor don B. Paino Pichardo, secretario de Estado de la Presidencia; monseñor Octavio A. Beras Rojas, arzobispo coadjutor de Santo Domingo; doctor Luis F. Thomen, secretario de Estado de Sanidad y Asistencia Pública; licenciado Rafael F. Bonnelly, secretario de Estado del Trabajo y Economía Nacional; licenciado José Ernesto Garrin Aybar, subsecretario de Estado del Trabajo y Economía Nacional, así como otras distinguidas personas

Están organizándose en el Distrito grandes revistas agrariopolíticas

La primera de éstas será celebrada en Guerra el 9 del corriente mes. Estos actos serán patrocinados por la Junta del Partido Dominicano en el Distrito y por la Junta Protectora de la Agricultura

En el transcurso de una interesante reunión celebrada recientemente, la Junta del Partido Dominicano en el Distrito de Santo Domingo y la Junta Protectora de la Agricultura, como parte de la campaña política que tienen en proyecto, organizarán conjuntamente marzo hasta pocos días antes de las elecciones del próximo 16 de mayo, en que será celebrada la última.

Ambos organismos han empezado a desarrollar toda clase de actividades a fin de que estas revistas agrariopolíticas constituyan éxitos sorprendibles en la carrera política presidencial de la Junta del Partido Dominicano en el Distrito de Santo Domingo, señor José Angel Savión, el vicepresidente del Consejo Administrativo del Distrito de Santo Domingo señor Francisco Lhuberes V., y por el vicalcalde del señor secretario de Estado del Trabajo y

El discurso inaugural fué dicho por el secretario Huberto Bogaert

Conceptuoso discurso pronunciado por el secretario Rafael F. Bonnelly. La ceremonia de la bendición. Presidencia del acto. Características de la obra

Ayer, a las cuatro de la tarde, fué solemnemente inaugurada la moderna fábrica de cemento construída en la margen oriental del río Isabela por patriótica disposición del Honorable Presidente Trujillo en interés de dar mayor impulso al acelerado ritmo de progreso que caracteriza esta era tan pródiga en realizaciones.

Esta nueva industria, que dejó iniciadas sus actividades ayer en la tarde constituirá sin duda una de nuestras principales industrias y será factor importante en la prosecución del grandioso programa de gobierno que desde hace diecisiete años viene desenvolviendo el ejercicio forjador de la Nueva Patria libre, progresista y democrática, el Generalísimo Doctor Rafael Leónidas Trujillo Molina.

La significativa inauguración formó parte de las grandes celebraciones con que fué conmemorado el 102º aniversario de nuestra Independencia. Asistieron altos funcionarios de la Nación, los miembros de la Misión Especial del Gobierno de Haití, que nos visita; los miembros del Cuerpo Diplomático acreditado en el país, representantes de todas las actividades de esta capital y numeroso público que recorrió admirando las dependencias de esta moderna planta con capacidad para satisfacer todas las necesidades nacionales.

Desenvolvimiento del acto

El significativo y lucido acto se inició con las notas del himno del Partido Dominicano, ejecutado por la Banda de Música del Consejo Administrativo del Distrito de Santo Domingo, a continuación del cual el secretario de Estado Bogaert dijo el siguiente discurso, con el cual dejó inauguradas, en nombre del Honorable Presidente Trujillo, las labores de producción de esta moderna fábrica de cemento.

"Altos funcionarios del Estado, Señores:

En mi condición de secretario de Estado de Fomento, Obras Públicas y Riego, y por enaltecedor encargo del ilustre Jefe del Estado, me cabe la honra de dejar inauguradas, este día, las labores de producción de esta Fábrica de Cemento, una importante industria que el patrio-

Un sector de la fábrica de cemento inaugurada ayer

Brillante discurso pronunciado por el secretario Báez Soler

DISCURSO

pronunciado por el doctor J. M. Moscoso Cordero en el acto efectuado anteayer en homenaje al doctor Fernando Alberto Defilló

Honorable señor Rector;
Señor presidente de la Asociación Médica Dominicana;
Profesores y estudiantes;
Damas y caballeros:

Solamente a título de fiel discípulo de un amado maestro, y a nombre de la Asociación Médica Dominicana, de la cual nació el Comité Organizador que he presidido por mi entusiasmo, es que me permito tomar la honrosa venia de nuestra Alma Máter para tener la satisfacción de expresar uno de los encomios que en este acto constituyen nuestro tributo espiritual a don Fernando Alberto Defilló, el querido profesor de las aulas que hoy enaltecen su nombre, el digno representativo de los médicos dominicanos que estudian y difunden su saber con profundo amor a la ciencia, y el ejemplar Doctor que investigando, experimentando y enseñando con ansias altruistas, ejerce su profesión como un sagrado ministerio de humanidad.

Creo que no me corresponde, ni a ningún otro joven discípulo del Doctor Defilló, el consagrador panegírico que algún día será pronunciado, con elocuencia, al inscribir las dotes de su personalidad en el libro histórico de los compatriotas notables; porque el juicio ponderativo, de una figura aureolada, es atribución que recaa en quienes habían autoridadmente para la posteridad, como acaban de hablar aquí los doctores don Manuel Emilio Perdomo y don Heriberto Pieter, uno con su respetable voz de Decano de la Facultad de Medicina, y ambos con la autoridad de profesores que han contemplado, admirándolas, las plausibles consagraciones y las triunfales labores de un compañero de quien también han recibido enseñanza.

Nosotros, los médicos de una reciente generación, alumnos del Doctor Defilló, solo podemos ofrecer una relación somera de hechos culminantes que asaltaron en su honra-

LA COMPAÑIA DISTRIBUIDORA, C. POR A.

Isabel la Católica No. 70 - Apartado No. 894 - Ciudad Trujillo, D. S. D. - Teléfono No. 1295

DISTRIBUIDORA DEL CEMENTO DOMINICANO

COLON

SE COMPLACE EN PARTICIPAR AL PUBLICO QUE DESDE MAÑANA ESTARA A LA VENTA EN TODO EL TERRITORIO NACIONAL EL INSUPERABLE CEMENTO

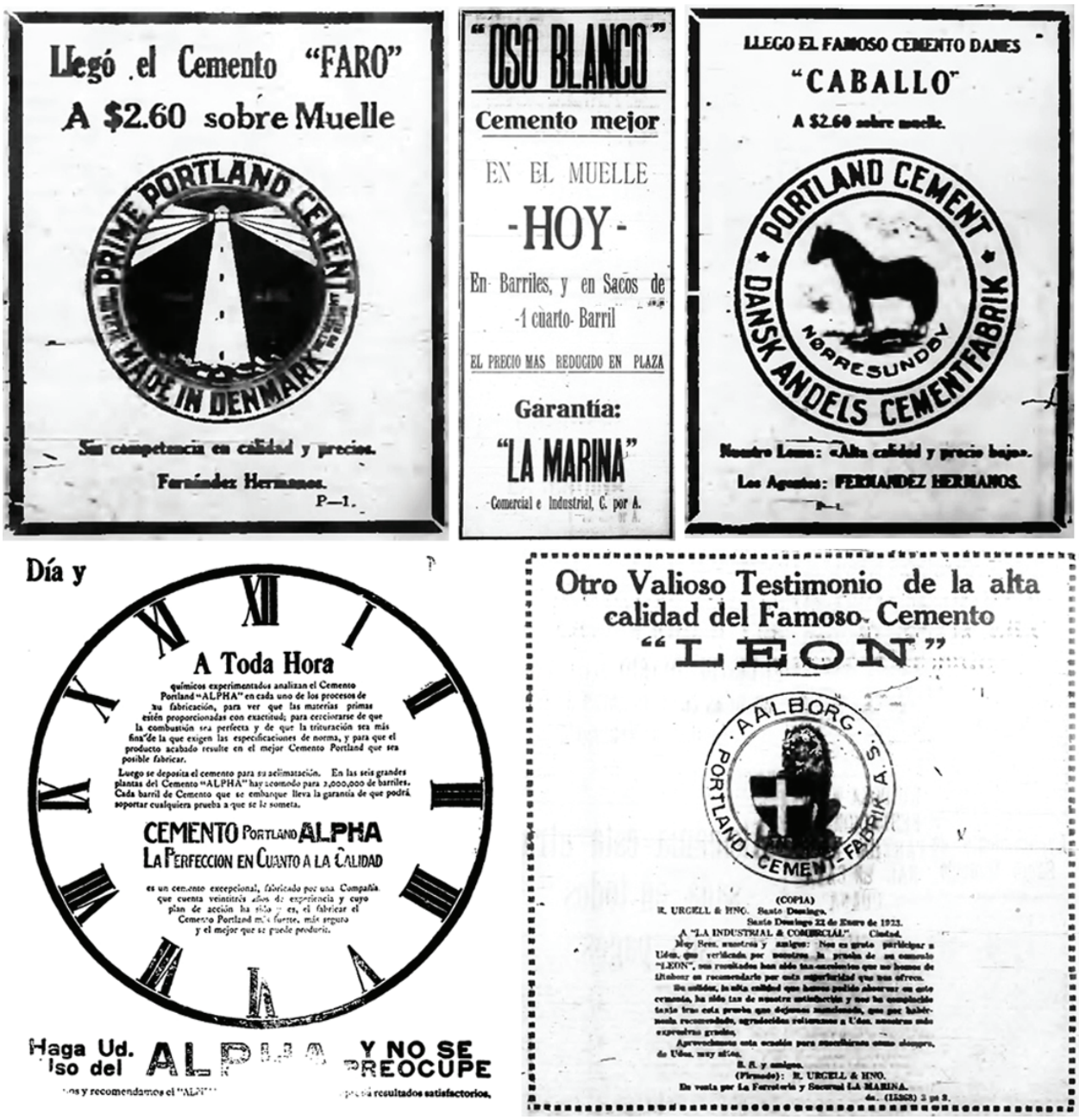
COLON

COOPERE AL ENGRANDECIMIENTO DE LA INDUSTRIA NACIONAL UTILIZANDO CEMENTO "COLON"

ESTABLECIMIENTOS QUE TENDRAN A LA VENTA EL CEMENTO "COLON" EN CIUDAD TRUJILLO:

Inauguration of the first Portland cement factory in Santo Domingo, Dominican Republic in 1947, and advertisement for their cement brand "Colón".

(La Nación newspaper, March 16, 1947, pg. 10)

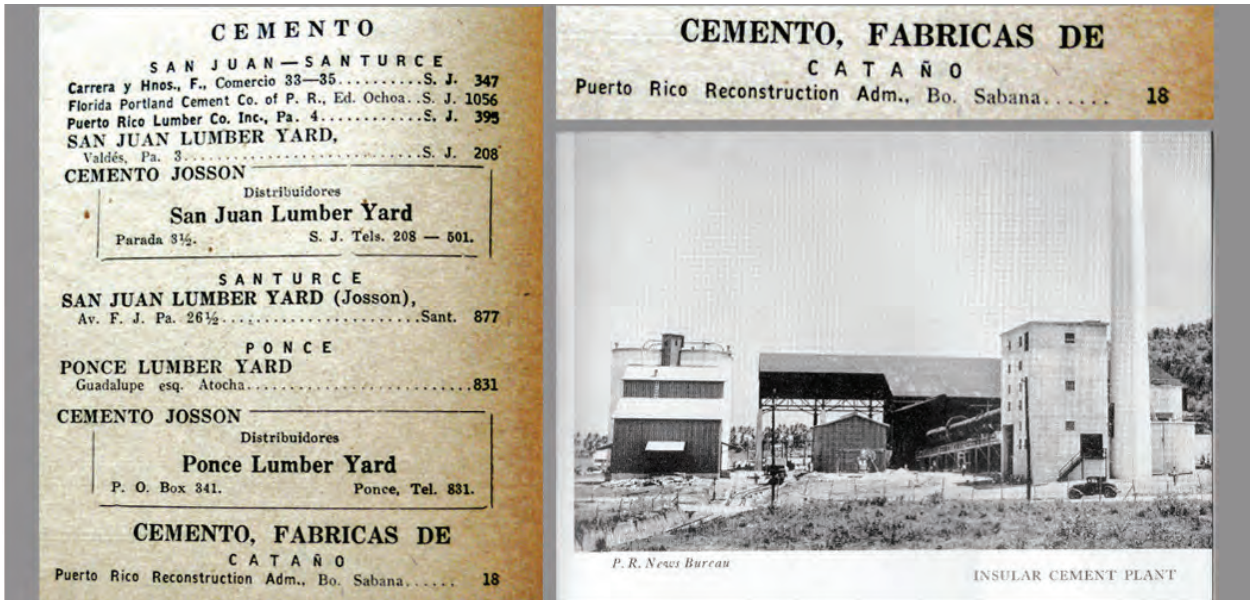


Various brands of Portland cement imported to the Dominican Republic, primarily from Germany and the United States.

(Advertiseme ts included within issues of the Listín Diario newspaper from 1906-1928)

Portland cement advertisements in Puerto Rico from the early 1900s through 1936 when the first local cement plant was established.

(Puerto Rico Ilustrado, 1927; *Guía de Teléfono* – Porto Rico Telephone Company 1928 , *Archivo General de Puerto Rico*; and *The Commercial Guide and Business Directory of Porto Rico - Illustrated*. (New York: F. E. Platt, 1910)



CEMENTO

SAN JUAN—SANTURCE

Carrera y Hnos., F., Comercio 33—35.....S. J. 347
Florida Portland Cement Co. of P. R., Ed. Ochoa..S. J. 1056
Puerto Rico Lumber Co. Inc., Pa. 4.....S. J. 395
SAN JUAN LUMBER YARD,
Valdés, Pa. 3.....S. J. 208
CEMENTO JOSSON
Distribuidores
San Juan Lumber Yard
Parada 3½. S. J. Tels. 208 — 501.

SANTURCE

SAN JUAN LUMBER YARD (Josson),
Av. F. J. Pa. 26½.....Sant. 877

PONCE

PONCE LUMBER YARD
Guadalupe esq. Atocha.....831
CEMENTO JOSSON
Distribuidores
Ponce Lumber Yard
P. O. Box 341. Ponce, Tel. 831.

CEMENTO, FABRICAS DE
CATAÑO
Puerto Rico Reconstruction Adm., Bo. Sabana..... 18

CEMENTO, FABRICAS DE
CATAÑO
Puerto Rico Reconstruction Adm., Bo. Sabana..... 18

P. R. News Bureau

INSULAR CEMENT PLANT

First cement factory established in Puerto Rico was owned and operated by the Puerto Rico Reconstruction Administration in 1936. The second cement plant on the Island was The Ponce Cement Corporation, established in 1941 during the Second World War.

(Gaztambide Vega, Francisco and Pedro P. Arán. *La Isla de Puerto Rico*. New York: Rand McNally & Company, 1945; and Internet Source photos)

Hydraulic Cement Tiles - an imported technology from Catalonia

"The pavement becomes a metaphor for the textile carpet."[1]

Catalonian Interior Spaces (1850s-1890s) as important precedents

Art and design, mostly from the Modernism, Art Nouveau, and Eclectic styles of Barcelona, heavily influenced the last decade of the 19th century in the Spanish Caribbean. This was due to a large Catalonian migration into the Spanish territories of the New World, beginning in the late 18th century, in search of new opportunities. The Catalan immigrants, mainly composed of merchants as well as the working classes, sometimes provided the capital, but mostly the knowledge and the experience to support and set up new industry. Many of them came motivated by the motto: "*cinco años de privación y una fortuna*" (five years of deprivation for a fortune) which meant that the initial sacrifice would yield a prosperous future in the new land.[2] The design fields would benefit from the Catalonian presence - particularly the building trades.

According to Dr. Maribel Roselló i Nicolau (author of significant articles regarding the history of housing in Catalonia), architectural interiors of the upper class in Barcelona had been re-interpreted by the mid-nineteenth century in direct response to the role the merchants and manufacturers' class played in the economic development of their region. These homes evolved into comfortable apartments that exhibited "...access to a world sensitive to the arts, fashion and standards of taste." In particular, the appreciation of pavements evolved, since up to then, floors had been mostly understood "as a strictly functional surface" that you covered over with different types of carpets in order to obtain color, richness, warmth, and comfort. "Pavement materials were (then) granted specific values that had only been provided by carpets. The pavement is understood not only from its criterion of strict functionality but its formal and qualitative aspects begin to be appreciated and valued..." It is then that **hydraulic cement mosaics**, as important architectural elements, became one of the protagonists of interiors; specifically in the Barcelona of between 1886 and 1916, when in addition to the evolution of design tastes, the industrial revolution, together with the general availability and use of Portland cement, facilitated their invention. With the introduction of hydraulic mosaics, "The carpet covering the entire floor surface is the pavement itself, which is capable of providing the required sensory richness."[3]

The Hydraulic Cement Tile - a definition

Hydraulic cement tiles, oftentimes called *mosaicos hidráulicos, baldosas de cemento, losa criolla o isleña* (hydraulic mosaics, cement tiles, creole or island tiles) in the Spanish Caribbean, refer to an 20 cm. square by 2-2.5 cm. thick cement tile, with ornate colorful surfaces. The tiles are composed of three layers which are compressed within a mold by a press: a top thin decorated surface (mix of fine sand, marble dust, cement, and pigments, that serves both, as a durable and artistic layer); a middle joining layer (mix of equal parts of sand and cement that bind the other two layers and absorbs the moisture); and a support or bottom layer where the manufacturer's seal is placed (mix of sand, gravel, and Portland cement, approximately four to one).

> By hydraulic mosaic we understand a product that serves to cover surfaces, generally used as interior flooring. The hydraulic mosaic tile is composed of hydraulic cement mortar, pressed and molded, formed by several layers of material, of which the upper part, apt to be walked-upon, presents a fine finish, often with drawings that form sets of regular geometry...The most common format tile has a 20 cm. square profile... Others have hexagonal, octagonal, etc. forms. Generally, these forms are always regular polygons.[4]

The final tile's composition was the result of master recipes and much experimentation using local lime as well as cement and pigments imported from France and Italy during the early manufacturing processes. Italian pigments were preferred for their excellent performance and long-lasting characteristics.

The origin of this pavement material has been attributed to Catalonian (i.e. Barcelona) as well as French inventors, even though most of the available technical literature credits the Catalonians for the design of the product itself, even if the raw materials and equipment to produce them were manufactured and brought from southern France, including the Portland cement itself. The first public presentation of the *Mosaic hidráulic* was in the Paris Universal Exposition of 1867 when it was introduced by Barcelona

merchants Garret Rivet i Cia. as a building product. The tiles generated heated discussions as an "imitation" material - not true to those original (carpets) or natural (ceramic, brick or stone) flooring materials. The product would not be fully accepted until ten or fifteen years later as the Modernist, Art Nouveau and Eclectic periods took root.

Immigrants from Barcelona to the New World between the 1880s and the 1900s not only brought with them the taste for these pavements, but the technical know-how regarding their production as well, since previous craftsmen and laborers from the Catalonian companies continued working their trades in the Spanish Caribbean.

Manufacturing

The "hydraulic" nomenclature which forms an integral part of the *mosaico o baldosa hidráulica*, is not necessarily a result of the use of hydraulic mortar or Portland cement as a primary raw material of the manufacturing process. According to available literature on the subject, the name is more directly associated to the hydraulic press, an indispensable equipment for the tile manufacturing process invented and perfected in France by the company Guilhon & Barthelemy during the 1850s. The hydraulic press considerably improved the original hand-press method and contributed to a better-quality end product.

> The most important step in the improvement of the manufacturing system was the application of the hydraulic press, which allowed the multiplication of the manual force and controlled the intensity of the pressure on all the tiles. The wide acceptance of this type of machine has done more for the popularization of the hydraulic adjective applied to the mosaic, than the hydraulic (capabilities) of the cement which composes it.[5]

Its manufacturing process consists of a careful set of hand-crafted and highly tested steps which were passed from generation to generation of cement tile makers, and, which have been specifically collected by Catalonian engineers Jaume and Joan Ramon Rosell in several general articles and a major

exhibit covering all aspects of the hydraulic cement tile production. The following text is a direct quote from one of their articles[6]:

> Generally accepted guidelines for the manufacture of hydraulic mosaics present, countless small variations that are brought about by the possibility of combining various aspects of the process. Indeed, the intensity of the pressure exerted; the geometry of the piece, its thickness and width dimensions; its chemical composition, the measure of each layer and the amount of water used, are interrelated elements that allow each tile a variation margin based on the correctness of the others.
>
> These characteristics, and the fact that the molding process is completely manual, make the hydraulic mosaic a transition product between the pre-industrial and the industrial eras, ie, as a building material between craft and industry.
>
> During manufacturing, the operator works facing the press, with recently-prepared color pastes and the mix materials for the joining and support layers on one side, and the drying rack on the other. On the press, and on hand, he has all the tools needed for the manufacturing process: the *muñeca* or poppethead on a glass or glazed tile, oil cans and brushes, cleaning brushes, etc.
>
> - Grease the mold plate [in contact with tile top] with the *muñecas*.
> - Place the square box mold, on top, adjusting its screw.
> - Introduce the tin *trepa* [stencil or design within the] mold.
> - Pour colors with spoon or scoop (from lightest to darkest).
> - Shake the mold, or punch with fist, so that the color paste [completely] fills each cavity.
> - Extract the *trepa* [or mold] with a quick and deft movement using the handles, to prevent the colors from mixing during the extraction [process].
> - The joining or middle layer is applied to absorb the moisture of the fine layer.

- The *trepa* is meticulously cleaned, while the middle joining layer absorbs the moisture.
- Manually pour the thick support [or back] layer.
- Make support layer flush with the top edge of the mold frame.
- Place lid on mold.
- Clean the mold and the stand with the brush.
- Drag the mold beneath the press.
- Activate the press [and compact tile material; compaction should be at least 120 kg. per square centimeter for best quality tiles].
- Remove the mold.
- Loosen the mold screw and extract the box.
- Clean the inside of the box (occasionally with some primer or a release agent).
- Remove the mold lid.
- Remove tile with fingers [in vertical or inclined position pushing from its reverse side].
- Place tile in drying rack [vertical or horizontal position], which when full, will be moved to the warehouse.[7]

Additional steps included by other manufacturers (some contradict others):

- Make sure that the tiles do not touch one another during the initial curing period.
- Soak or submerge the tile racks in water for a few minutes so that the tiles acquire the necessary water for the complete hydration of the cement.
- The hardening process must extend to six months, must take place indoors, and avoid drafts and high ambient temperatures. Duration of the storage process represented serious problems when there was a high demand for the product.
- Place tiles on an airing rack for a minimum of 28 days before distribution.[8]

Installation

Installation specifications were reproduced in the tile catalogs that advertised the paving material. The general recommendations were very similar amongst the different tile companies and basically required no specialized installers but an experienced mason, since the 20 cm. square, or large- format size tile, facilitated its installation. As advertised in the tile catalogs themselves: "*Cualquier oficial de albañil, por poco inteligente que sea, los coloca fácilmente.*" (Any mason, even if not too intelligent, can install them easily).

The following installation and maintenance recommendations were included in the Falcó y Vilella Hydraulic Mosaics Catalog from Barcelona, dated 1921, under the segment titled: Instructions and Observations. It represents an example of the typical and very common technical literature included and distributed with these tiles:

> Installation (*colocación*)
> The cement and sand mortar for the installation of the mosaics is that preferred to others (hydraulic lime and Portland), especially on ground floors, which are generally more humid than the higher levels... The floors in which the hydraulic mosaic is to be installed must be previously prepared with a concrete [layer] made of coarse sand and cement in the proportion of four parts of very clean sand to one of cement, so that the mosaic is laid on a completely firm and flat floor.
>
> The thickness of such concrete layer can vary from 4 to 8 centimeters, as permitted by the floor conditions. The tiles must be soaked in water for three hours, after which ten hours should elapse prior to their installation.
>
> Once these operations are completed and starting from the center of each room, you proceed with the installation, for which it suffices that the responsible mason take care not to leave some tiles higher or lower than the others, and with the least possible joint

> [separation between the tiles].
>
> Six or seven hours after placement, wash with clear water and immediately pour over them a slurry of Portland cement, fine and fairly liquid, so that with a broom the slurry can be made to penetrate the joints until completely filled. After an hour of this operation, place a layer of white wood sawdust (pine or poplar) on the pavement and with a dry cloth or rag rub [surface] until it is completely clean. [Dark sawdust could stain tiles.]
>
> During the first four days following installation, transit over the floor should be avoided.[9]

The tiles were commonly laid utilizing a technique called "*a truco de maceta*" which fixed the tiles one by one by tapping over it a few times with the handle of a mallet, to level them. Every tap "was like a nail that fixed it to the ground." A string, placed perpendicular to the base line and to the wall, would guide every two rows, so that two of the four sides of each tile had an immediate reference to the string or to the previously placed tiles. These tiles had to be laid perfectly level from the start, since the finished decorated cement surface could not be abraded to make it level.

The Hydraulic Mosaic Catalogs

In addition to Garret Rivet i Cia., other early hydraulic mosaic companies in Barcelona who helped promote the growing industry included Orsola Solá i Cia. founded in 1876, and Escofet Fortuna i Cia. founded in 1886. Early on, company catalogs included individual tile designs as well as the proposed composite designs for individual rooms. The attractive catalogs of these companies were printed in full-color. In addition to advertising, these brochures included installation as well as maintenance recommendations; all in all, an excellent form of commercializing the product. The Escofet company included the designs of famous artists and architects of the period to their collection, promoting good design for flooring and pavement materials, a practice absent in previous periods.

Tiles could be used individually or to create a floor pattern, since it was common to have different pavements for distinct spaces in a building, and oftentimes depended on each room's hierarchy. Tile manufacturers recommended the selection of a minimum of three tile designs per space to create a design. These would originate from a central design motif that was surrounded by a quadrilateral frame, and a final border of monochromatic tiles that would serve to conceal spatial irregularities and provide a transitional band between rooms, and make it seem like a carpet over a solid color floor.

In addition to the catalogs, the hydraulic mosaic industry promoted their products at Universal, International, National and Regional Expositions of their time where the tiles themselves were the exponents of progress and innovation. Commercial advertisements in the press and magazines of the period would promote the hydraulic tile as "a fashionable pavement with unlimited aesthetic possibilities, adapted to all the era's artistic tendencies; the resplendent quality and easy care of the surface floor finishes; ease of production; ease and speed of installation due to the larger size of tiles (in comparison to other traditional flooring materials); and the prestige attained with designs from the best artists."[10]

During the 1890s many large and small companies started their manufacturing centers in Spain, France and Italy "indicating the demand has grown and is a profitable business: production costs are assumable, production does not require large initial investments, and the most relevant equipment is the press...The installation process is considerably simpler than that for other flooring of the time..." There are improved designs and colors at the end of the 19th century. The hydraulic mosaic floor "stops being only valued for its technical properties to become a material with the desired sensory expressiveness."[11]

During the last decades of the 19th century, Catalonian immigrants and their building products, especially the hydraulic cement tile, traveled to the only remaining Spanish colonial settlements in the Americas: Cuba and Puerto Rico. Hispaniola had severed ties with Spain in 1821 and by 1844 the island was divided into Haiti on the western side and the Dominican Republic on the eastern side.

The fame and acceptance in Europe, and particularly in Barcelona, of the hydraulic cement tile would be brought to the New World as early as the 1890s, particularly to the Spanish Caribbean, through exports of the catalogs and the tiles themselves, together with the experienced Catalonian manufacturers and laborers who ventured into the insular settlements.[12]

The New Industry immediately found its way into the Spanish Caribbean

Cuba

La Habana, capital city of Cuba, was the first place in the Spanish Caribbean where a hydraulic mosaic or cement tile factory was established. Quírico Gallostra and Bielsa founded the first hydraulic mosaic factory in 1886. However, strong competition between the local product and tile imports from Barcelona caused the prompt failure of the company. Regardless, the construction boom of the period, prompted by the economic benefits of a healthy sugar industry, "...led to an increased demand and the emergence of new manufacturers."[13]

La Balear factory, also in Havana, was founded in 1894 by Severo Redondo. It manufactured an excellent product that by 1909 had increased its tile production from 1,000 to 40,000 tiles per month, winning fame at the Palatine Exhibition, Cuba's premier industrial and agricultural Fair. These paving materials represented "modern construction" due to their hygienic conditions (easy to clean), solidity (well made) and varied decorative combinations (patterns and colors). *El Fígaro* magazine stated:

> ...La Balear's beautiful mosaics are equal to the best imported tiles at a price impossible to match by foreign companies who have to pay shipping and custom duties...Their factory can make mosaics following the standards of any drawing, no matter how complicated.[14]

Ladislao Díaz, one of the owners of the first cement factory "Cuba" (founded in 1895), had added an annex to his building for hydraulic cement tile production. Its sign read: *La Cubana: Fábrica de*

Mosaicos (La Cubana: [hydraulic tile] Mosaic Factory). The first establishment burned down, but by 1903 Díaz had founded a second factory with Agapito Cagiga and Ramón Planiol as partners. Historic photographs show that the factory's structures were constructed with rock-faced concrete block. It was advertised as "the largest in the world" with a total area of 10,000 square meters and employed 200 workmen. "It (the factory) honors Cuba as a sign of industrial progress and feeds numerous Cuban families."[15] A 1907 census and inspection report by the Department of Agriculture, Industry and Commerce, created to learn about production methods and equipment of local enterprises, reported that this factory had a weekly output of 100,000 tiles and had facilities and personnel for an even larger production capacity.[16] One of the original *La Cubana* catalogs (date unknown) exhibits approximately 100 different tile patterns or designs in its elegant, full-color format. Its tiles paved floors throughout Cuba and not only those of Havana, as was documented when the tiles were found in two historic residences of Trinidad.[17]

> It had an edge over its competitors because it was equipped with the latest tools and used mined sand consisting only of silicates free of the salts that could affect the colors...many of its employees had previously worked for Escofet, Orsola and Butsems, three leading tile producers in Barcelona.[18]

La Cubana's products were granted the Grand Prize at the 1909 Palatine Exposition of Havana. After its tiles had been scientifically examined and analyzed by French and German industrial engineers, it had been determined that "...due to the quality of the materials and their craftsmanship, they could not be better...they were as good as any similar hydraulic tiles known to date."[19] Tropical Caribbean flora patterns, as excellent examples of original Cuban designs for the hydraulic cement tiles, were amongst the drawings within La Cubana's catalog. Early 20th century photographs of the interiors of one of Havana's grand mansions exhibits hydraulic mosaic pavements with the large green and red leaf of the *malanga*, a common edible plant of the humid Caribbean region. The decoration of the space met the exuberant design tastes of the period which were richly ornamented and extremely colorful.

Public Sanitation and Hygiene also played an important role in promoting the cement tile industry in the

Spanish Caribbean. A concern for the spread of the Bubonic Plague, present in all port cities of the time due to the generally unclean condition of harbor facilities, led to strict regulations regarding merchandise storage spaces. "Owing to the fear of the plague, the Department of Sanitation will enforce certain rules regarding the storing of merchandise upon all merchants. The goods must be kept out of reach to rats and to this end the construction of all floors must be of cement or hydraulic brick, at least four inches in thickness...The floors must be washed daily, disinfecting solutions freely used..."[20] These regulations made concrete slabs and hydraulic mosaic pavements the ideal solution.

Other early hydraulic mosaic factories in La Habana included *El Nuevo Almendares*, founded in 1910, which was associated with the second Portland cement plant established in La Habana; and *La Artística*, founded in 1915 by Joaquín Bosch, who also sold stained-glass shop-windows. During the Cuban National Exposition of 1911, Bosch was praised for his factory's exotic floral Cuban-motif hydraulic mosaics, and particularly for the extremely rich color schemes employed by his company on the tiles which had been impossible to obtain by other local enterprises.[21] Both companies were famous for their premium-quality tiles, and these were used to pave important institutional buildings of the capital city such as hospitals, churches, banks, schools, and principally, the contemporary suburban homes of Havana. Like the tiles themselves, the names of some of the hydraulic mosaic factories reflected a colorful and patriotic vocabulary: *La Habanera, La Lira Cubana, La Rosita, El Modelo Cubano, El Clavel, La Cubana, El Trianón, La Flor de Cuba, La Castellana, La Perla, El Morro* and *La Luz*, amongst others.[22]

Since the first decade of the 20th century, the hydraulic mosaic industry had become a competitive market that quickly spread throughout the main cities of Cuba.[23] The heavy weight and weak edges of the individual tiles also contributed to the "decentralization of the industry"[24] since oftentimes it was more practical to take the small (semi-portable) presses and materials nearer to the project site than to transport the tiles over the uneven and oftentimes unpaved roads of the early 20th century.

When well-to-do families and the middle classes decided to remodel or update their interiors, "the artistic upholstering of their pavements" was unavoidable. A particular case in point were the private residences of the town of Trinidad (a major sugar-producing, south-central region of Cuba) where in

spite of having suffered an economic crisis during the early 1900s, most of the 19th century rowhouses had their interiors remodeled in order to reflect evolving design tastes. During the period, this was mostly accomplished by replacing wooden floors with the colorful and bright hydraulic mosaics. Oftentimes, the new patterned pavements were complemented by wainscots formed by extremely ornate glazed ceramic tile as well, creating a distinct contrast between the sober and simple facades of Trinidad buildings/homes and the dramatic and surprising interiors.[25]

In Cienfuegos, a southern port city of importance, *La Industrial* founded by Francisco Diego Madrazo i Cia. in 1909 (later owned by Hernández y Ortega), and *El Arte Industrial* (1924) produced excellent hydraulic mosaics. *El Arte Industrial* boasted having received the Gold Medal at the First Exposition in Rome in 1924 and the same award at the Cienfuegos Fair of 1925. Most tile factories throughout Cuba flourished during the 1920s when there was a high demand for the product island-wide.

By 1926, hydraulic cement tile factories were included in the *Guía Comercial e Industrial de Cuba* [Commercial and Industrial Guide of Cuba] under the heading *Fábricas de Mosaicos Hidráulicos* [Hydraulic Mosaic Factories]. In this list, a total of 32 companies were included for the area of La Habana alone. Proof that the industry in Cuba had grown considerably was the fact that the directory also included two businesses exclusively dedicated to selling the products needed for the tile manufacturing process. Tile pigments, a product previously imported by each company from Europe, and *maquinaria para mosaicos* [equipment for mosaics] which implied selling of the hydraulic presses as well, were advertised by *La Inglesa*, and businessman Juan Llambes Aguilera.[26] "Marble, cement tiles or ceramic mosaics are used almost entirely for floors...Cement tiles are manufactured on the island, although some are imported. Such floors are found very satisfactory on account of their coolness, cleanliness and durability."[27]

Even if the first patterns and designs copied those produced in Barcelona, the local markets "quickly developed a style of their own and evolved into more colorful designs with more complex and ornamental floral motifs."[28] The vivid color collection of the Cuban hydraulic mosaic reflected the natural scheme of the Caribbean landscape's flora and could include up to eight colors in one tile. The

tropical weather allowed for the use of hydraulic tiles in outdoor spaces as well, and these were used to pave entrance porches, courtyard galleries and balconies, amongst others.

Dominican Republic

Imported Catalonian hydraulic mosaic tiles made their entrance into the Dominican Republic during the last decade of the 19th century where they were adopted as part of the architectural vocabulary of institutional and residential buildings. The new product brought controversy, when "Sanitation inspectors blamed their cold temperature for the appearance of yellow fever...Because of this, the tiles were accused of being harmful to health....very cold to the feet: harmful to the eyes."[29] Government officials insisted that the tiles not be used in public buildings due to continued protests from the population. This was a questionable posture, since precisely one of the virtues of these pavements is its constant coolness which helps ameliorate the tropical warm temperatures and heat of the Caribbean's building interiors.

As a consequence of the Cuban war for independence from Spain at the end of the 19th century, some Catalonian immigrants who had been established in Cuba moved to the Dominican Republic in search of new business opportunities. Amongst these was José Turull Vilanova, who is credited with having established the first hydraulic mosaic factory in the capital city of Santo Domingo in 1896 which was rightfully named *La Primera* (The First). A half page Ad published in the Commercial Directory of 1925 reads: "...*primera fábrica en la isla fundada en el año 1896* (first factory on the island founded in the year 1896)".[30] Portland cement imports to the Dominican Republic had been present in the local press from the last decade of the 19th century, since their first local cement factory was established in 1947. It is assumed that the other products necessary to produce the hydraulic tiles, such as fine sand, could have been found and quarried locally, but the pigments were most likely imported from Europe.

Advertisements in Turull's professional letterhead included a description of his business and the multiple Portland cement products they fabricated:

> Manufacturer of hydraulic mosaics and artificial granite. Desired drawings are prepared. Stairs, restrooms, tables, pillars and other artificial granite objects with inlaid marble. Special Portland tiles for sidewalks, galleries, stables and garages. Stucco specialty.[31]

This seems to have been a profitable business, exporting its tiles and products from the capital city of Santo Domingo to other principal towns of the country such as San Pedro de Macorís and La Vega. A few years later, another Catalonian, Jaime Malla Shalom, is credited with having established the first hydraulic tile manufacturing establishment in San Pedro de Macorís, an important seaport on the South coast of the Dominican Republic. He was listed in the Commercial Guide of 1923 as a mosaic manufacturer and also as a building contractor of that city. The same publication includes a brief description of the hydraulic mosaic tile industry in the Dominican Republic, "...other factories of minor importance but which speak highly in favor of the industrial capacity of the country are as follows...floor tiles or mosaics."[32] Other early factories included *La Catalana, Borrás & Vidal*, *Francisco Rivera Martínez* and *La Española* (as part of Ricart, Ocaña & Co.). By 1920, local Dominican industrialists began to control hydraulic mosaic tile production through ownership.

Juan T. Taváres Juliá established a factory to produce hydraulic mosaics, artificial stone and other Portland cement architectural elements in the city of Santiago during 1921. The factory moved to Santo Domingo in 1922 when he bought Turrul's establishment in order to create *Fábrica de Mosaicos Tavares.* He was listed in the 1925 Commercial Directory as the only "mosaics" (hydraulic cement tiles) manufacturer in the capital city of Santo Domingo.[33] Tavares eventually also bought out Jaime Malla's factory, consolidating the hydraulic mosaic industry in the Dominican Republic under one owner. Regardless, in the Commercial Directory of 1923, José Turull had a half page Ad where he still advertized himself as building contractor and mosaic fabricator. "In 1925 Tavares published the first catalog of cement tiles in the Dominican Republic...he advertized in the 1931 edition (or second catalog): Cement tiles are recognized throughout the world as being superior to all types of flooring, including ceramic. In many countries...and in the Antilles; tile is considered to be the ideal flooring, which is proven by its extensive use and popularity..."[34] It is important to note, that the 1931 catalog included other (also

molded), Portland cement architectural elements as well, such as, columns, blocks, garden tiles, balusters, acroteria, and column capitals. Other products by the same company, manufactured from "artificial granite or terrazzo", included tomb decoration and cemetery artifacts, flat roof tiles, park benches and stairs.[35]

Puerto Rico

Even though imported hydraulic mosaics from Barcelona had made their way into Puerto Rican buildings since the 1890s (particularly those from the Orsola and Escofet enterprises), the first local tile factories would not be established until 1906 and mostly by the end of the first decade of the 20th century. During this period of economic growth, grand residences, as well as important institutional buildings exhibited *losa criolla* or *losa isleña* (creolle or island tile) pavements, as these were known locally, once the industry established itself in Puerto Rico. "The buildings are principally of brick and stone very thick walls usually plastered inside and out, painted in showy colors and frescoed. The mosaic tile floors are seldom carpeted, except by a large rug or mat here and there."[36] The new tastes had entered the local market aided by the dissemination of the Catalonian company catalogs, as well as the desire of a new wealthy upper class influenced by the latest styles and fashion from Europe. Likewise, a new generation of architects who had studied abroad and had been enticed by innovative building materials used outside the Spanish Caribbean propagated the use of these materials. An issue of *Puerto Rico Ilustrado*, a social magazine, included the Ad for General Agents Sucs. de M. Lomba & Co. in San Juan who boasted that it was "*La fábrica mas importante de mosaicos de cemento...*(the most important cement mosaic factory)" their products being inexpensive, durable and having superior hardness. Lomba was apparently the local representative, and not the owner of a Spanish enterprise (which remained unnamed) and claimed that its flooring materials had received the highest awards in the International Expositions of Cairo, Suez, Manila, Chicago, Vienna, Paris and Barcelona.[37]

Possibly among the first Puerto Rican enterprises which produced hydraulic cement tiles were two manufacturers in the western town of Cabo Rojo, Gumersindo Lluch, and Severiano Ramírez. This information was listed under a singular classification within the complete 1910 Commercial Guide of

Puerto Rico: "Brick and Tile Mfgrs."[38] Another manufacturer, the Mosaic Tile Factory of Jiménez Del Valle & Co., founded in 1906, was located in Santurce near the capital city of San Juan. It advertized high quality material, and un-fading colors for floors and baseboards because their colored tints were imported from Germany. They boasted that their product had been used by reputable contractors for twenty years (since 1886).

Porto Rico Mosaics of Yauco (later known as Puerto Rico Mosaic Co. - Yauco) was another early local manufacturer of hydraulic tiles and Portland cement ornamental architectural elements such as columns and moldings. An early (ca. 1910-14) large advertisement sign placed along the railroad route which encircled the island of Puerto Rico read: "*Puerto Rico Mosaic of Yauco - Losas y Fábrica de Mosaicos Hidráulicos, Mármoles y Granito Artificial*" [Hydraulic Mosaic, Marble and Artificial Granite Tiles Factory].[39] The company was founded ca. 1910-11 by Alejandro Franceschi as an enterprise that would aid the remodeling and expansion of his family home, utilizing innovative building technologies of the period, such as reinforced concrete. The residence, located in Yauco, a southern Puerto Rican city, was the location of prosperous sugar and coffee haciendas owned by the Franceschi family, amongst others.[40]

Other early manufacturers in Puerto Rico followed in quick succession and included "Jiménez, Ribot & Co." also founded in Santurce ca. 1911, and the "Ponce Mosaic Co.", established in 1912.[41] Ponce Mosaic Co. became one of the largest local hydraulic mosaic cement tile manufacturers, and its owner, Felipe Salazar-Palau, received the company's patent in 1915. Their hydraulic mosaic tiles were being advertized in Ponce's newspapers (*El Águila de Ponce,* 1913) and Puerto Rico's social magazines (*Puerto Rico Ilustrado,* 1914), Puerto Rico's Telephone Books (1916), Commercial Guides, as well as in the 1919 editions of the Dominican Republic's newspaper *El Listín Diario*. This indicates that the tiles had a good market there as well, since Ponce and Santo Domingo are southern seaports both located on the Caribbean Sea with frequent shipping interchange. The Ponce Mosaic company had distributors throughout the island of Puerto Rico.

Many houses - besides embodying issues of urban importance - also showcase the wide array of

> materials, finishes, and details in common usage at the turn of the century...Concrete tile (known as *losa isleña, losa nativa* or *mosaico hidráulico*) was also extremely popular. Variety in patterning and color made it possible to achieve personalized effects in floor design. Borders, friezes, and accent pieces were available from widely circulated catalogues. The most popular and sophisticated supplier of [imported] concrete tiles was Escofet Tejera & Cia., from Barcelona. Its products and designs...were copied all over the Caribbean...[42]

Imported tiles from Orsola, Solá i Cia., also a 19th century Barcelona factory, have been documented as paving materials for mausoleums in the Old (19th century) Catholic Cemetery located on de la Torre Street in Ponce. This confirms the fact that hydraulic mosaic tile imports to Puerto Rico came from more than one factory in Catalonia.

In 1914, a publication written mainly for the visitor from the United States, Porto Rico Past and Present and San Domingo of Today, two entries make reference to the local production of hydraulic cement tile. The enthusiastic author, who lived throughout Puerto Rico before writing about it, describes what seemed to be one of the building materials that had impressed him the most: "In concrete work they produce wonderful results, and the native-made Porto Rican tiles and mosaics are highly artistic and ornamental." In the chapter related to "Manufacturers, Exports and Finance" he reported "...There are numerous lime, brick and tile factories...and the beautiful floor tiles and mosaic work cannot fail to attract the attention of the visitor..."[43] These tiles were unusual paving materials in North America and the northern visitors must have been impressed by their exotic appearance.

Newspaper and magazine ads were also important forms of disseminating new building products as in the 1917 issue of *Patria*, a bi-weekly magazine of the Instituto Universitario José de Diego. Within its ads was that of the Fábrica de Mosaicos Hidráulicos Ramón Torres and Eduardo Beniza located in Miramar, another suburb of the capital city of San Juan.[44]

In addition to serving as pavements for new construction, hydraulic mosaic tiles were also used for remodeling and reconstruction work, specifically that required following several natural disasters of

great magnitude that occurred during the first three decades of the 20th century in Puerto Rico (several hurricanes and major fires, as well as a significant earthquake). These events not only had destroyed large segments of the building stock throughout Puerto Rico, but also brought about the revision of the local building ordinances. The new regulations promoted cement products and materials and building technologies that would be appropriate and safe for structures in Puerto Rico. During 1912, "Ponce Mosaic" would advertise "no more wooden floors"[45] in direct reference to the vulnerability of wooden floors to any and all natural disasters and which would be resolved with hydraulic mosaic tile pavements set on a reinforced concrete slab.

Significant proof of the general acceptance of the tiles is found in a 1920 version of The Atlas Portland Cement Company catalog, published in Spanish for the benefit of the Spanish-speaking population of the Americas who had proven to be avid users of the product. As one of its segments, it included information on the *baldosas de cemento* (hydraulic mosaic) as a cement product, proof of the wide acceptance of the hydraulic tiles during this period. "The compressed cement tile floors...are without a doubt more appropriate for their beauty, simplicity, durability, ease of cleaning, for its sanitary properties and, as important point, for its reasonable price."[46] The same catalog was found within the private collections of two important local architects: Pedro de Castro and Rafael Carmoega, who in fact, utilized these tiles as paving materials in their projects.[47]

Many more manufacturers appeared in Cuba, the Dominican Republic and Puerto Rico from the 1920s-1930s when the industry reached its highest popularity and optimum wealth, and up to the 1950s. The industry lost steam by the 1940s when much simpler patterns and designs of the tiles, mostly simulating marble, would serve to pave large housing projects. By the 1960s, most of these companies had given way to *terrazzo* floors, which had become popularized throughout the Spanish Caribbean for their yet simpler installation possibilities and the changes in style of the time.

[1] Maribel Roselló i Nicolau, *La Casa Escofet - Mosaics per als Interiors: 1886 1900 1916* [Mosaics for Interiors]. (Barcelona: Escofet, 2009): 2 - Translations from Catalan by the author.

[2] Joan M. Ferrán Oliva, *La saga de los catalanes en Cuba* [The saga of the Catalonians in Cuba]. (Catalunya: Fundació Casa América, 2009): 26 - Translations from Spanish by the author.

[3] Roselló i Nicolau, (2009), 2; and Maribel Roselló i Nicolau,"Revestiments per als interiors de l'arquitectura: algunes aportacions de la industria" [Facings or Finishes for Architectural Interiors: some industry contributions]. Proceedings of the X Congres d'Historia de Barcelona - Dilemes de la fi de segle, 1874-1901, Arxiu Historic de la Ciutat de Barcelona, Institut de Cultura, Ajuntament de Barcelona. 27-30 November, 2007 - Translations from Catalan by the author.

[4] Jaume i Joan Ramón Rosell, "La Técnica del Mosaic Hidráulic i el Modernisme" [The Hydraulic Mosaic Technique and Modernism]. Ciencia 51, Vol. V (Nov. 1986): 25 - Translations from Catalan by the author.

[5] Jaume i Joan Ramón Rosell, El Mosaic Hidráulic [The Hydraulic Mosaic]. (Barcelona: Colegio Oficial de Aparejadores y Arquitectos Técnicos de Barcelona, 1985); and Rosell, (Nov. 1986), 27 - Translations from Catalan by the author.

[6] The material encased within brackets [ ] has been included by the author as clarification of the technical terminology presented. In some cases, the original Catalan text has been paraphrased for the same reason.

[7] Rosell, (Nov. 1986), 29 - Translations from Catalan by the author.

[8] Institut de Promoció Cerámica. "El Mosaico Hidráulico" [The Hydraulic Mosaic]. Diputación Provincial - Centro de Documentación: Biblioteca del Museo de Bellas Artes de Castelló (Castellón, España, N.D.): 6-8 - translations from Catalan by the author. [Website: www.ipc.org.es]; and Carmen Ortega and Ana Mitila-Lora. *El Mosaico Hidráulico: Arte en Evolución* [Cement Tile: Evolution of an Art Form]. (Santo Domingo, Dominican Republic: Industrias Aguayo de Construcción, C. x A., 2008): 187-188.

[9] *Mosaicos Falcó y Vilella - Embaldosados Hidráulicos* [Falcó and Vilella Mosaics - Hydraulic Tiles] - Design Catalog. (Barcelona, 1921): 3-6; and Ladislao Díaz y Hno. y Planiol y Cagiga. *Fábrica de Mosaicos La Cubana* [Mosaics Factory La Cubana] - Design Catalog. (La Habana, N.D.): 3-6 - Translations from Spanish by author.

[10] Institut de Promoció Cerámica, 2-3; and Rosell, (Nov. 1986), 27 - Translations from Catalan by the author.

[11] Roselló i Nicolau, (2009), 14; and Roselló i Nicolau, (November, 2007), 5 - Translations from Catalan by the author.

[12] Examples of hydraulic cement tiles from Orsola, Solá i Cia., stamped with the factory's name on the rear of the tiles, have been found and documented in Cuba and in Puerto Rico. Examples of original tiles from Escofet, Fortuna i Cia. have been found (during this project) in Cuba, the Dominican Republic and Puerto Rico and seem to have been a product more aggressively exported into the new territories due to the large pavements from this company which are still extant. This confirms, without a doubt,

that the original paving materials from both companies, established in Barcelona during the 19th century, made their way into the Spanish Caribbean since the late 1800s up to the 1930s, in spite of the existence of the large amount of local hydraulic tile factories in each island-country.

[13] Mario Arturo Hernández-Navarro and Yamira Rodríguez-Marcano, introduction. *Havana Tile Designs.* (Amsterdam: The Pepin Press BV, 2007): 16.

[14] "Mosaicos La Balear" [Balear Mosaics], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (March 7, 1909), La Habana: 144 - Translations from Spanish by author.

[15] "Las Grandes Industrias de Cuba" [Great Cuban Industries], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (September 6, 1908), La Habana: 466-468; and *El Libro de Cuba* - Obra de Propaganda Nacional, (La Habana, 1925): 790-792 - Translations from Spanish by author.

[16] "Tile and Shoe Factories", The Cuba Review and Bulletin, Vol. V No. 11, (New York: Munson Steamship Line, October 1907): 15.

[17] Ladislao Díaz y Hno. y Planiol y Cagiga. *Fábrica de Mosaicos La Cubana* [Mosaics Factory La Cubana] - Design Catalog. (La Habana, N.D.).

[18] Yamira Rodríguez-Marcano, "Mosaicos Hidráulicos en La Habana" [Hydraulic Mosaics in Havana]. Un-published manuscript and audio-visual presentation (La Habana, 2010): 2 - Translations from Spanish by the author.

[19] "Kiosko de la Gran Fábrica de Mosaicos 'La Cubana' [Kiosk of the Grand Mosaic Factory 'La Cubana'], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (February 29, 1911), La Habana: 144 - Translations from Spanish by author.

[20] "To Investigate Cuba", The Cuba Review and Bulletin, Vol. X No. 9, (New York: Munson Steamship Line, August 1912): 9.

[21] "Vidrieras y Mosaicos" [Shop-windows and Mosaics], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (February 29, 1911), La Habana: 151.

[22] Cámara de Comercio, Industria y Navegación de la Isla de Cuba. *Guía Comercial e Industrial de Cuba* [Commercial and Industrial Guide of Cuba]. (La Habana: La Prueba Press, 1926): 51.

[23]Amongst the most important and earliest (first two decades of the 20th century) hydraulic mosaic tile factories throughout Cuba were:
In 1914: Eduardo Fernández at Sagua la Grande, (imported white cements Atlas and La Farge brands)
In 1915: La Santiaguera at Santiago de Cuba
In 1918: Rodríguez y Martínez in Caibarién
In 1921: La Modernista in Bayamo
In 1926: La Villalareña in Santa Clara

[24] Anna Joynt, "Cuban Mortar Tiles - International Cooperation and Regeneration through Rediscovery of a Lost Craft", independent research supported by The British Academy in London (London, 2009): chapter 5.

[25] Personal communication with historian Victor Echenagusía, Office of the Conservator of the city of Trinidad, Cuba, March, 2015.

[26] Cámara de Comercio, Industria y Navegación de la Isla de Cuba. *Guía Comercial e Industrial de Cuba* [Commercial and Industrial Guide of Cuba]. (La Habana: La Prueba Press, 1926): 51.

[27] "Architecture in Cuba - Prevailing Styles", The Cuba Review and Bulletin, Vol. XV No. 12, (New York: Munson Steamship Line, November 1917): 15.

[28] Mario Arturo Hernández-Navarro and Yamira Rodríguez-Marcano, introduction. *Havana Tile Designs.* (Amsterdam: The Pepin Press BV, 2007): 16.

[29] Carmen Ortega and Ana Mitila-Lora, 95.

[30] Peynado, Luis O. (ed.) *Directorio Industrial y Comercial de la República Dominicana* [Industrial and Commercial Directory of the Dominican Republic]. (Santo Domingo, República Dominicana, 1925): 78.

[31] Penson, Enrique. *Arquitectura Dominicana 1906-1950* [Dominican Architecture 1906-1950] (Tomo I: Textos, Tomo II: Planos), Santo Domingo: Mediabyte, S.A., (Santo Domingo, 2005): 70-71 - Translations from Spanish by the author.

[32] Peynado, Luis O. (ed.) *Directorio Industrial y Comercial de la República Dominicana* [Industrial and Commercial Directory of the Dominican Republic]. (Santo Domingo, República Dominicana, 1923): 20, 133, and 151.

[33] Peynado, (1925), 121.

[34] Carmen Ortega and Ana Mitila-Lora, 98.

[35] A copy of the 1931 Tavares catalog still exists and was facilitated for these investigations by Mr. Jorge Aguayo of Industrias Aguayo de Construcción in the Dominican Republic.

[36] *The Commercial Guide and Business Directory of Porto Rico - Illustrated*. (New York: F. E. Platt, 1910): 177.

[37] Puerto Rico Ilustrado magazine, 1910.

[38] *The Commercial Guide and Business Directory of Porto Rico,* 146.

[39] Personal communication and historic photo provided by Dr. Jerry Santiago - January, 2015.

[40] Jerry Torres Santiago, "Une folie bourgeoise: arquitectura y valores sociales en Yauco y Ponce a principios del siglo XX" [A page from the bourgeoisie: architecture and social values in Yauco and Ponce at the beginning of the 20th century]. *Ilusión de Francia: arquitectura y afrancesamiento en Puerto Rico*. (San Juan: Archivo de Architectura y Construcción de la Universidad de Puerto Rico, 1999): 133-35, 143.

[41] Ponce Mosaic Co. Patent file granted on March 15, 1915 to Felipe Salazar Palau. Archivo Histórico Municipio de Ponce, Tesorería Municipal, Fondo: Ayuntamiento, Subsección: Tesorería, Serie: Patentes 1915, Caja: F-471, Legajo: 471-12.

[42] Jorge Rigau. *Puerto Rico 1900 Turn of the Century Architecture in the Hispanic Caribbean - 1890-1930*. (New York: Rizzoli, 1992): 155, 158.

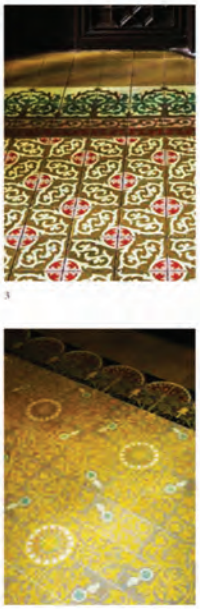
[43] A. Hyatt Verril. *Porto Rico Past and Present and San Domingo of To-day*. (New York: Dodd, Mead and Company, 1914): 109, and 155.

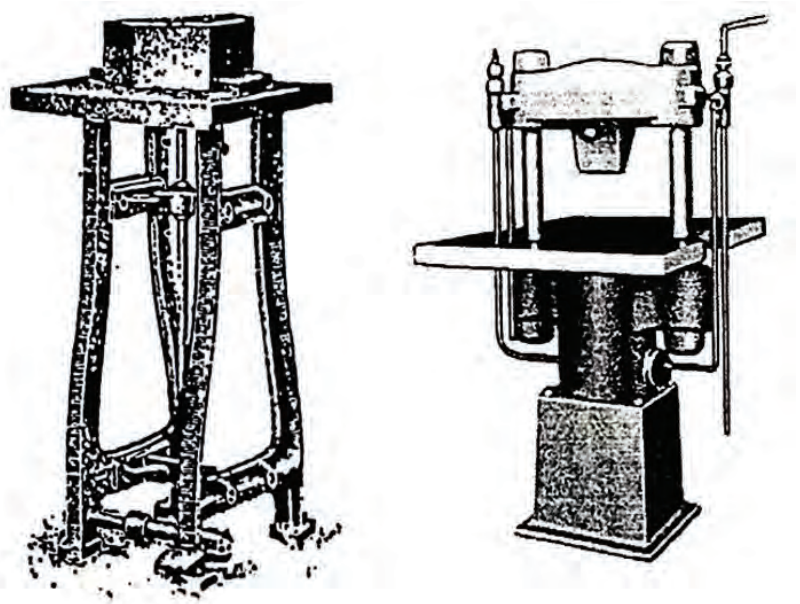
[44]Archivo General de Puerto Rico, Historic Newspaper collection, San Juan.

[45] Hernán Bustello Morán, "La 'losa criolla': Historia del mosaico hidráulico en Puerto Rico". Patrimonio, Vol. 3, (Año 2011): 22 - Translations from Spanish by the author; and Zuleyka Hernández-Miranda, "Curriculum vitae del mosaico hidráulico: orígenes de la losa criolla" [Hydraulic Mosaic curriculum vitae: origins of the creole tile]. Conserva Vol. 3 (San Juan, 2007).

[46] Murchison, K.M. *El Cemento Blanco Portland Atlas y sus Aplicaciones* [Atlas White Portland Cement and its Applications]. (New York: The Atlas Portland Cement Co., 1920): 15 - Translations from Spanish by the author.

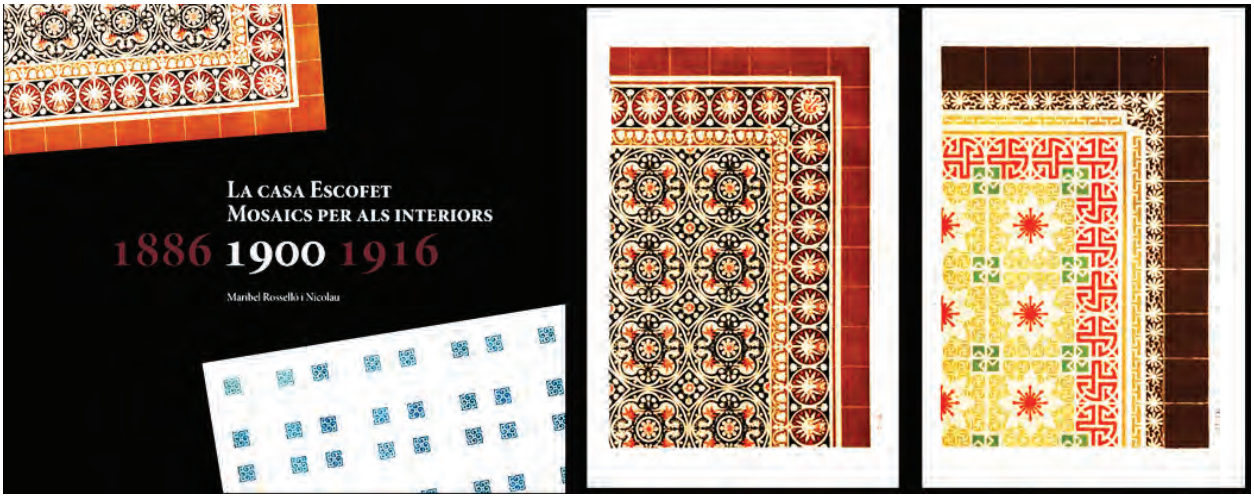
[47] The *Pedro de Castro and Rafael Carmoega Collections, Archivo de Arquitectura y Construcción de la Universidad de Puerto Rico* [AACUPR] (Architectural and Construction Archive of the University of Puerto Rico, Río Piedras campus.





Barcelona is credited as the origin for the technology to produce hydraulic cement tiles. Historic graphics illustrate the iron bench where tiles were first manufactured and pressed by hand, and one of the earliest models of the hydraulic press.

(Hernández-Navarro, Mario Arturo. *Barcelona Tile Designs.* (Amsterdam: The Pepin Press BV, 2006);
and Rosell, Jaume i Joan Ramón. El Mosaic Hidráulic [The Hydraulic Mosaic]. (Barcelona: Colegio Oficial de Aparejadores y Arquitectos Técnicos de Barcelona, 1985)



Imported hydraulic mosaic design catalogs, the cement tiles themselves, as well as the craftsmen trained at the Catalonian factories of *Orsola, Solá i Cia.* [1876] and *Escofet, Fortuna i Cia.* [1886], traveled and spread throughout the Spanish Caribbean from the 1880s on. The tiles became important protagonists of interiors, and pavements became carpets.

(González-Nouvelles Farrús, Natalia. "El Mosaic Hidráulic i la Casa Orsola Solá i Cia." [The Hydraulic Mosaic and Orsola Solá i Cia.] Vol. I, End of career project, Escola Politécnica Superior d'Edifi ació de Barcelona, Universitat Politécnica de Catalunya, Barcelona, Octubre 2010; and Roselló i Nicolau, Maribel. *La Casa Escofet - Mosaics per als Interiors: 1886 1900 1916* [Mosaics for Interiors]. (Barcelona: Escofet, 2009)

El Mosaic hidràulic, el procés de producció

El procés de producció de les rajoles hidràuliques l'hem de situar entre la producció artesana i la producció mecanitzada.

Les rajoles es produeixen una a una amb uns mitjans que es limiten al motlle, la trepa i la premsa, a més de les matèries primeres com són el ciment, els àrids i els pigments.

Visualitzar la senzillesa d'aquest procés al costat de la qualitat dels resultats obtinguts és un bon exercici que ens permet valorar els moments incipients de la industrialització.

1. **La placa ha de ser ben llisa i ha d'estar ben greixada.**
   Es col·loca el marc del motlle damunt de la placa i es cargola.
2. **S'introdueix la trepa dins el motlle.**
   S'aplica una capa fina (arena, pols de marbre, ciment artificial i pigments), amb cada un dels colors, a les diferents cavitats de la trepa, les quals han de ser tancades.
   Se sacseja el motlle perquè s'estengui la pasta de color.
3. **Es treu la trepa del motlle.**
   S'hi espurgeix el brasatge (sorra i ciment a parts iguals) amb el purgador. El brasatge xucla la humitat de la capa fina.
   S'hi aboca el gros (sorra i ciment en una proporció de 4 i 1) amb les mans i es galga.
4. **Es posa el tap del motlle. Es col·loca el motlle sota la premsa.**

PROCESO DE FABRICACION
Losa de Hormigón Hidráulico

La trepa es colocada al interior del molde. El relleno de la cámaras de la trepa puede comenzar, cada color es pasado en la parte que le corresponde en la trepa

Se retira la trepa y la primera capa es recubierta por otras dos capas de mortero, una seca la ultima capa que aun esta húmeda.

El conjunto es introducido en una prensa hidráulica.

24 h después los mosaicos son sumergidos en un baño de agua durante una hora.

La losa es cuidadosamente extraída del molde y controlada por los artesanos.

Los mosaicos son almacenados en una sala grande y sin luz durante 4 semanas para que se puedan secar adecuadamente.

Foto 55 Foto 56 Foto 57

1 molde de acero 2 trepa y dibujo

3 cemento pigmentado 4 capa de estructura

5 prensado hidraulico 6 Remover del molde

"*Mosaicos hidráulicos*" refer to a 20 cm. square x 2.5 cm. thick cement tile with ornate colorful surfaces. Their 3 layers composed of local lime, cement, and pigments are still manufactured today by hand and compressed within a mold by a press. They are air dried for 28 days before they are ready for installation.

(Rosell, Jaume i Joan Ramón. El Mosaic Hidráulic [The Hydraulic Mosaic]. (Barcelona: Colegio Oficial de Aparejadores y Arquitectos Técnicos de Barcelona, 1985)

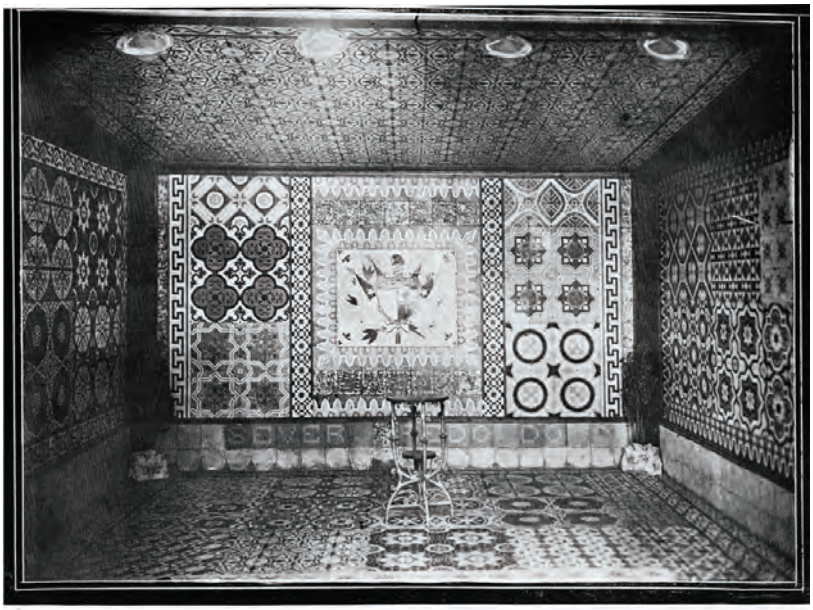
The hydraulic mosaics were laid starting from the center of the room and working outwards usually utilizing three tile designs: a main central motif, a border, and a neutral surrounding band. These had to be laid perfectly level since the finished surface could not be abraded.

(Institut de Promoció Cerámica. "El Mosaico Hidráulico" [The Hydraulic Mosaic]. Diputación Provincial - Centro de Documentación: Biblioteca del Museo de Bellas Artes de Castelló, Castellón, España. Website: www.ipc.org.es)

The final hydraulic mosaic tile composition was the result of master recipes and experimentation. Different tile patterns in Trinidad, Cuba.
(Photos by the author, 2015)

Havana was the first place in the Spanish Caribbean to establish a hydraulic mosaic or cement tile factory (1886) in spite of continued tile imports from Catalonia, such as those from *Orsola, Solá i Cia.* found in the 1905 Rubens Palace in Mariel, Cuba.

Hernández-Navarro, Mario Arturo and Yamira Rodríguez Marcano, introduction. *Havana Tile Designs.* (Amsterdam: The Pepin Press BV, 2007); "To Investi ate Cuba". Vol. X No. 9, (New York: Munson Steamship Line, August 1912): 9, and Photos by the author, 2015)



LA EXPOSICIÓN EN PALATINO.—MUESTRARIO DE LA GRAN FÁBRICA DE MOSAICOS "LA BALEAR."
De nuestro fotógrafo especial, Sr. Sanz Calero.

MOSAICOS DE "LA BALEAR"

Local industrial expositions such as the "Palatino", held in Havana during 1909, exhibited innovative building products on the market. Such was the case of La Balear factory, which in 15 years had increased its production from 1,000 to 40,000 tiles a month.

(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "Mosaicos La Balear" [Balear Mosaics], (March 7, 1909): 144.)

GRANDES INDUSTRIAS DE CUBA.—VISTA GENERAL DE LOS DIVERSOS DEPARTAMENTOS Y TALLERES DE LA FÁBRICA DE MOSAICOS "LA CUBANA."
Fotografía de Alfonso López.

LAS GRANDES INDUSTRIAS DE CUBA

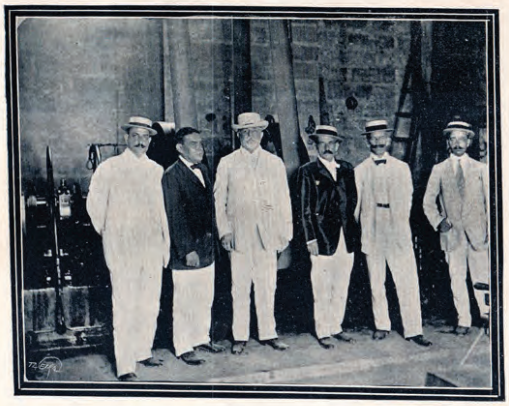
FÁBRICA DE MOSAICOS "LA CUBANA"

EL pueblo de Cuba apenas conoce sus grandes industrias. Sabe de ellas por sus productos, por lo que se transparenta al exterior, pero pocas veces se da cuenta del esfuerzo gigantesco que se necesita para la producción. Estas consideraciones nos las hacíamos al recorrer los diversos departamentos de la gran fábrica de mosaicos *La Cubana*, una de las más poderosas industrias de la República. ¿Qué cosa es la gran fábrica de mosaicos *La Cubana*? Siga leyendo el lector curioso.

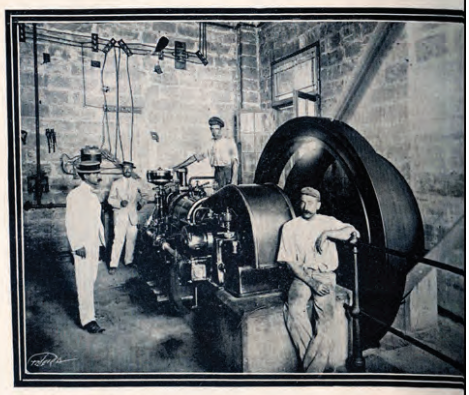
Algo de historia

Hace 20 ó 25 años, D. Quirico Gallostra instaló una fábrica de mosaicos en la calle de Inquisidor y Oficios. Este fué el primer ensayo de fabricación de mosaicos en Cuba. Más tarde, el Sr. Bielsa abrió otra en la calle de Monserrate. La falta de elementos y el arraigo que el crédito del mosaico importado había obtenido en esta Isla, causaron el desaliento entre los entusiastas iniciadores de esta industria; pero sembrada la semilla y en campo fértil, surgieron otras fábricas que fueron progresando constantemente, hasta llegar á contar como cuenta hoy Cuba, con cuatro grandes fábricas y una docena de pequeñas, calculando una producción diaria entre todas, de unas 30 mil losas.

La Cubana, que hoy produce más que todas las fábricas juntas, data solamente de cinco años. Nació en la calle de la Zanja, con cuatro prensas de mano, y antes del año mu-



GRANDES INDUSTRIAS DE CUBA.—EL ALCALDE DE LA HABANA DOCTOR CÁRDENAS, CON EL ARQUITECTO SR. MARTÍNEZ Y LOS SRES. R. PLANIOL Y LADISLAO DÍAZ, EN EL DEPARTAMENTO DE MAQUINARIA DE "LA CUBANA."



GRANDES INDUSTRIAS DE CUBA.—EL MOTOR DE "LA CUBANA" VERDADERA MARAVILLA DE LA MECÁNICA. TIENE UNOS 60 CABALLOS DE FUERZA SISTEMA ES BIEN CONOCIDO, LLAMADO VULGARMENTE DE GAS POBRE.

A much larger factory, La Cubana, was established in 1903. Employing 200 workmen, they had a <u>weekly</u> output of 100,000 hydraulic mosaic tiles and were granted the Grand Prize at the 1909 Palatino Exhibition. [1 of 3 pages, show images of La Cubana.]

(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "Las Grandes Industrias de Cuba" [Great Cuban Industries], (September 6, 1908): 466-468; and Ladislao Díaz y Hno. y Planiol y Cagiga. *Fábrica de Mosaicos La Cubana* [Mosaics Factory La Cubana] - Design Catalog. (La Habana, N.D.)

Images of La Cubana [2 of 3 pages]
(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "Las Grandes Industrias de Cuba" [Great Cuban Industries], (September 6, 1908): 466-468; and Ladislao Díaz y Hno. y Planiol y Cagiga. *Fábrica de Mosaicos La Cubana* [Mosaics Factory La Cubana] - Design Catalog. (La Habana, N.D.)

Images of La Cubana [3 of 3 pages]
(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "Las Grandes Industrias de Cuba" [Great Cuban Industries], (September 6, 1908): 466-468; and Ladislao Díaz y Hno. y Planiol y Cagiga. *Fábrica de Mosaicos La Cubana* [Mosaics Factory La Cubana] - Design Catalog. (La Habana, N.D.)

EL LIBRO DE CUBA

FABRICA DE MOSAICOS "EL NUEVO ALMENDARES"

ESTA muy importante fábrica de mosaicos, ocupa un extenso perímetro en la Calzada de Infanta, cerca de la calle 23 del Vedado, en la ciudad de la Habana.

Es propiedad del señor Ramón García Rodríguez, conocido Jefe de Ventas que fué del Cemento "Almendares". Sus conocimientos en esta clase de negocios, le animaron a fundar esta fábrica de mosaicos, que viene trabajando con éxito creciente, desde el año 1910.

Su producción actual es, de unos 6,000 mosaicos diarios, empleando en su fabricación un número de obreros que pasa de cincuenta.

Muy importantes casas han consumido mosaicos de esta fábrica, y entre otras, podemos citar los pisos del Palacio Presidencial, Iglesia de los R. P. Jesuítas en la calle de Reina, la Estación de Policía de Zulueta y Dragones y muchos de los modernos *Chalets* del Vedado y de otros Repartos, así como muchas construcciones del interior de la República, pues a todas partes ha llegado la fama de sus productos, elaborados con el mayor esmero y con los mejores materiales.

Se puede asegurar que los mosaicos de "El Nuevo Almendares" poseen todas condiciones necesarias para llenar los requisitos que exija el más cuidadoso Arquitecto. De ahí su fama, cada vez mayor.

Podemos recomendar a tan importante fábrica y felicitar a su propietario y fundador, el señor Ramón García y Rodríguez por sus éxitos.

Frente de la Fábrica "El Nuevo Almendares"

Oficina y Salón de Exposición

Talleres

Depósito de Materiales

***El Nuevo Almendares* was founded in 1910, their premium quality tiles were used to pave important institutional buildings, hospitals, banks, schools and the contemporary homes of El Vedado, Cuba.**

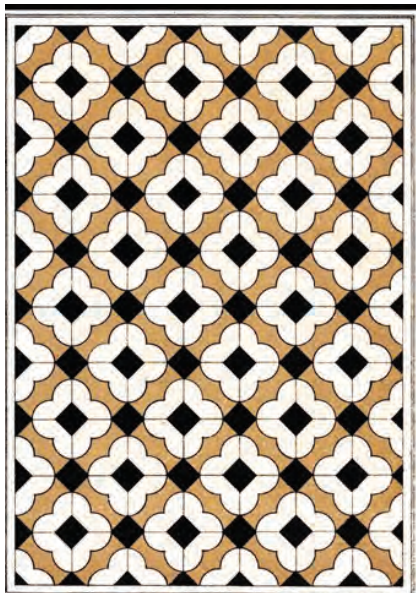
(El Libro de Cuba - Obra de Propaganda Nacional, (La Habana, 1925): 790-792)

In Cienfuegos, Cuba, El Arte Industrial [1924] received the Gold Medal at the First Exposition in Rome and at the Cienfuegos Fair of 1925 for their excellent hydraulic mosaics.

(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "Oficina de la Cinema Films" [Offices of Cinema Films], (September 6, 1919): 547); and Photos of Cienfuegos pavements by the author, 2015)

Imported Catalonian hydraulic mosaics, as well as businessmen and craftsmen from Barcelona, reached the Dominican Republic by the late 19th century establishing "La Primera" factory in 1896.

Ortega, Carmen and Ana Mitila-Lora. *El Mosaico Hidráulico: Arte en Evolución* [Cement Tile: Evolution of an Art Form]. (Santo Domingo, Dominican Republic: Industrias Aguayo de Construcción, C. x A., 2008).

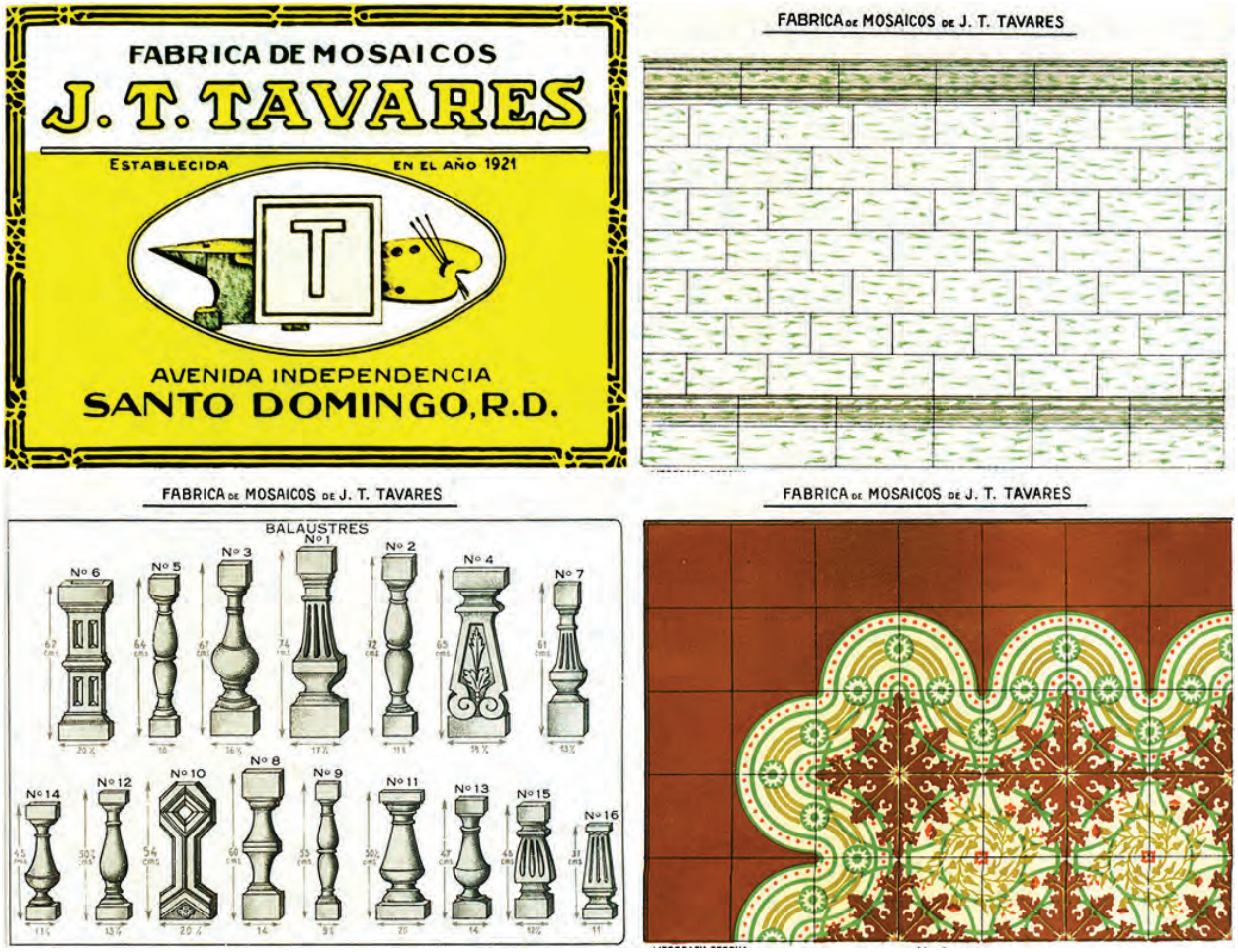


Hydraulic mosaic tile pavements from Catalonia, such as those from *Orsola, Solá i Cia.,* were found in early 1900s' interiors of the capital city of Santo Domingo.

(The United Methodist Church, General Commission on Archives and History, Record Group: United Methodist Church General Board of Global Ministries, Mission Education & Cultivation, Box location: 2195-3-2: 01 - Dominican Republic and BFCW Scrap Book 1920-1924, Mission Education

By 1920, Dominican industrialists began to control hydraulic mosaic tile production and these were present in all types of buildings.

(El Libro Azul de Santo Domingo (The Dominican Blue Book). New York: Compañía Biográfi a, subsidiary of the Pan-American Publicity Corporation, 1920, re-edited in 1976; and *Album del Centenario de la República Dominicana* [Centenary Album of the Dominican Republic]. La Habana: Artes Gráfi as, S.A., 1936)

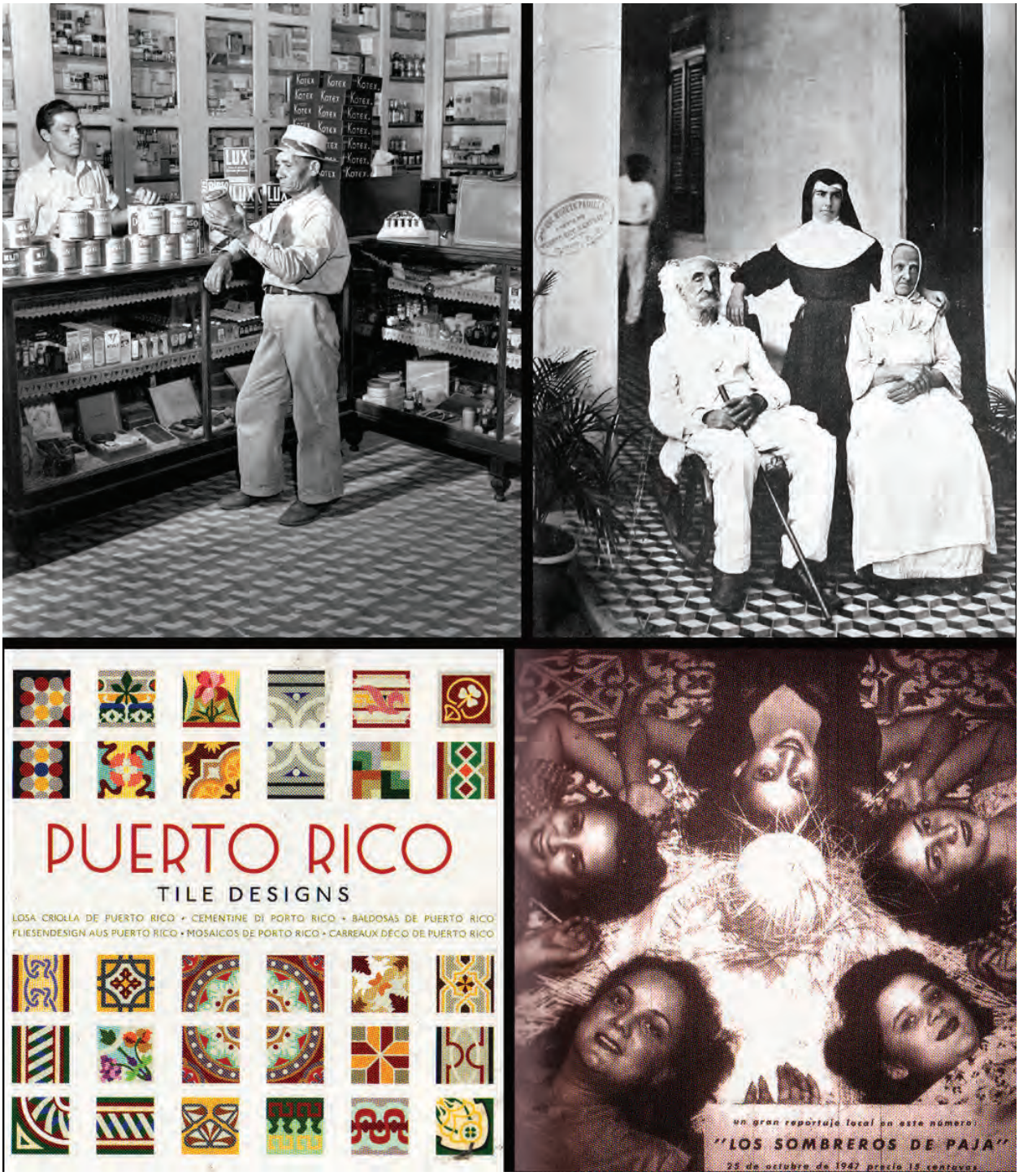


By 1925 hydraulic mosaic tile catalogs in the Dominican Republic included other pre-fabricated molded Portland cement architectural elements such as columns, capitals, blocks and balusters.

(Tavares, J. T. *Fábrica de Mosaicos de J. T. Tavares, Catálogo No. 2* [Mosaic Factory of J. T. Tavares, Catalog No. 2]. Santo Domingo: Litografía Ferrua, 1931)

The Tavares factory, established in 1921, eventually bought out other tile manufacturers in Santo Domingo, consolidating the hydraulic mosaic tile industry under one owner.

(Peynado, Luis O. (ed.) *Directorio Industrial y Comercial de la República Dominicana* [Industrial and Commercial Directory of the Dominican Republic]. Santo Domingo, República Dominicana, 1925)



Hydraulic Mosaic tiles from Barcelona were imported to Puerto Rico since the late 19th century where they paved all building types until the first local factories were established ca. 1906.
(*The Commercial Guide and Business Directory of Porto Rico - Illustrated*. (New York: F. E. Platt, 1910).

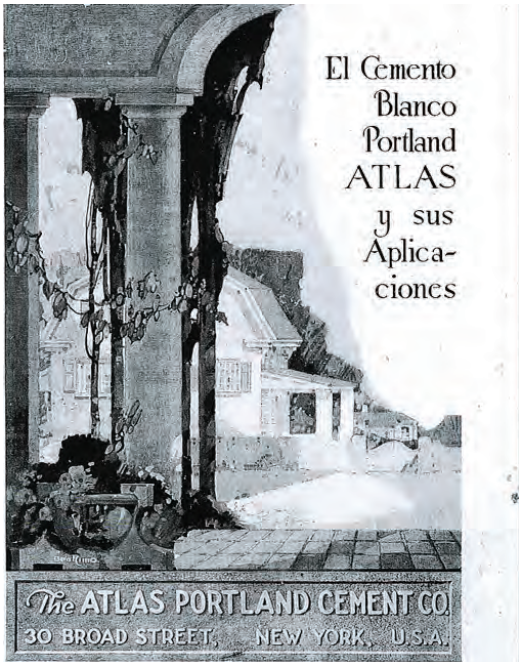
New tastes had entered the local market aided by the dissemination of the Catalonian company catalogs, as well as the desires of a new upper class influenced by the latest styles and fashion from Europe.

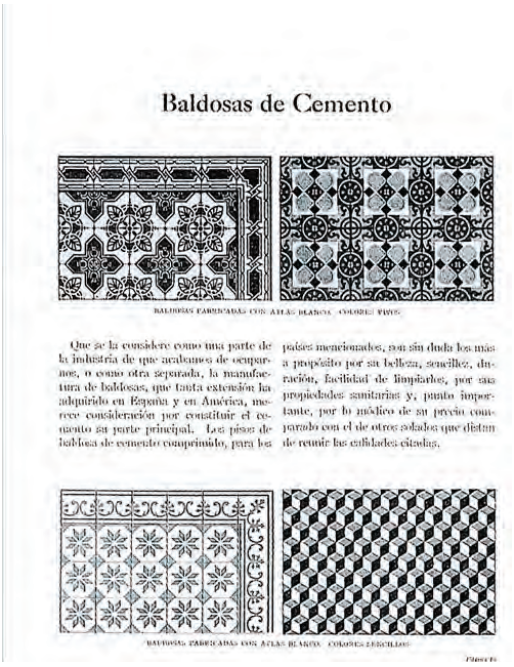
(Anónimo. *Puerto Rico Ilustrado*, Año X, no. 468 (15 de febrero, 1919); Archivo General de Puerto Rico, Archivo Fotográfi o, Álbum Departamento de Educación, Photos no. Bca1-U3, Cf11-X660R; and Archivo Histórico de Ponce, Revista El Gráfi o, 1929)

The cement tiles were used in interiors as well as exteriors, and advertized extensively in Puerto Rican newspapers and magazines.

(Bustello-Morán, Hernán. "La 'losa criolla': Historia del mosaico hidráulico en Puerto Rico" [The 'creole tile': History of the hydraulic mosaic in Puerto Rico]. Patrimonio, Vol. 3, (Año 2011): 20-27; Photos by the author, 2014; and Archivo Histórico y Fotográfi o de Puerto Rico, Rodríguez Archives, LLC, Jose Luis Rodríguez: http:/ archivofotografi odepuertorico.com/)

Hydraulic mosaic cement tiles of the Casa Sorrentini in Santurce, Puerto Rico.
(Photos by the author, 2015)





Baldosas de Cemento

BALDOSAS FABRICADAS CON ATLAS BLANCO COLORES VIVOS

Que se la considere como una parte de la industria de que acabamos de ocuparnos, o como otra separada, la manufactura de baldosas, que tanta extensión ha adquirido en Europa y en América, merece consideración por constituir el cemento su parte principal. Los pisos de baldosa de cemento comprimido, para los países mencionados, son sin duda los más a propósito por su belleza, sencillez, duración, facilidad de limpiarlos, por sus propiedades sanitarias y, punto importante, por lo módico de su precio comparado con el de otros sobados que distan de reunir las calidades citadas.

BALDOSAS FABRICADAS CON ATLAS BLANCO COLORES DELICADOS

A 1920 version of the Atlas White Portland Cement Company catalog, published in Spanish, included information on the *baldosas de cemento* (hydraulic mosaic tiles) as a cement product, "...for their beauty, ease of cleaning, sanitary properties ... and reasonable price."

Murchison, K.M. El Cemento Blanco Portland Atlas y sus Aplicaciones [Atlas White Portland Cement and its Applications]. (New York: The Atlas Portland Cement Co., 1920; and photos by the author 1980s).

The hydraulic mosaic tile industry lost steam by the 1940s when much simpler patterns and tile designs, mostly simulating marble, would pave large housing projects.
(Rodríguez-Marcano, Yamira. "Mosaicos Hidráulicos en La Habana" [Hydraulic Mosaics in Havana]. Un-published manuscript and audio-visual presentation; and Archivo General de Puerto Rico, Archivo Fotográfi o, Álbum Departamento de Educación, Photos no. Bc5-X9259 and Ce51-X9)

The Cement or Concrete Block - true artificial stone

"Within the past five years a new building material, the hollow concrete block, has come rapidly into use, and the industry has grown almost as surprisingly as the manufacture of Portland cement. Concrete building blocks were practically unknown in 1900, but it is probably safe to say that at present (1906), more than a thousand companies and individuals are engaged in their manufacture in the United States."[1]

Speed, economy and effectiveness marked early Portland cement products. This was specifically the case with cement or concrete block, which according to several contemporary authors regarding the early use of this building technology (1906), was a genuine American invention "..the home of the hollow block industry is the United States...".[2] Even though its use spread throughout the United States and the world like the wild fires the builders were trying to avoid in their edifices through the use of concrete block as a building technology, the industry had a difficult start and detractors at all levels. Statements such as, "...that the wall as made is too artificial; that, if made of 'rock faced' blocks, the patterns adopted are too much alike...that this makes the wall look as thought it were faced with galvanized iron, stamped to imitate rock faced blocks...that in any case, a concrete wall cannot be made to look like cut stone work..."[3] were often given by the design profession. Regardless the heated criticism, more than anything of the face-plate that imitated rock or stone, it was accepted as a quick, economical and reliable 'imitation' building material adaptable to any and all building types. The "well-traveled, American building material"[4], "essentially a product of the twentieth century"[5], was the topic of many technical articles where detailed specifications would describe the product. "The names "artificial stone" or "cast stone", commonly used by the manufacturers and builders, emphasized that the block was an imitation of stone...this imitative quality turned the architectural elite against the material...In 1907, a special committee of the American Institute of Architects had concluded that while reinforced concrete had much to recommend it, concrete block did not and should be avoided...because the imitations of rock face masonry so frequently seen were so depressing and distasteful."[6] And so, the first five years of the 20th century were characterized by much experimentation, testing and the race for patents.

Even if test molds and manufacturing trials of concrete block had taken place during the 19th century, (resulting in the earliest patents for this material), it is Harmon S. Palmer who is credited with the first manufacturing concrete block process that became feasible and widespread. His "...invention of a cast-

iron machine with removable core and adjustable sides..."[7] became an instant hit. His U.S. patent was granted in 1900 and his company, established in 1902, produced and sold his block manufacturing kit at $200 each. The technology had immediate imitators, and thus, the concrete block had clearly established its place in construction history.

> To produce a block, one shoveled a mixture of Portland cement, water, sand and stone or gravel aggregate into the machine and tamped it down to compress the mix and eliminate voids...the general recipe was one part cement to two or three parts sand to four or six parts aggregate...The advantage of Palmer's new machine was that the block maker could throw a lever and release the block as soon as it had been made. He then carried the block away on a pallet or board to dry. After a day, the workmen stacked the block in a covered shed, where, with a periodic sprinkling with water, the block dried for at least several weeks. Some advisers recommended that the block 'cure' for a month before use. Promoters claimed that two men, one mixing and one tamping, could make some eighty to one hundred blocks a day.[8]

Due to the high demand for information about concrete blocks and the absolute lack of it, during 1905 two magazine companies in New York, Engineering News and Cement Age, created a competition "for money prizes" that would collect a series of technical articles by authors who were experienced in concrete-block technology. This resulted in a book, published in 1906, which was titled The Manufacture of Concrete Blocks and their use in Building Construction. It would gather the two main winners' articles in addition to the abstracts of the other competitors. This publication's preface read: "Altogether the papers and abstracts form a practical treatise on the manufacture of concrete blocks and their use...that at present stands alone in the literature relating to cement and concrete."[9] Both prize winners continued to write about the subject and had articles or a major book published the following year.[10]

As word spread, a large amount of technical literature became available from 1905-1910, yet the book, Cement Houses and How to Build Them would include the most complete analysis and recommendations for "Concrete Block Architecture". Written by William A. Radford and published in

1909, the book included extensive explanations, specifications and drawings of construction details using this technology. Contrary to what large manufacturing and commercial institutions of the time (like Sears), would promote, the author warned about manufacture by inexperienced hands, or defective formulations for the blocks, and included "Standard Specification for Concrete Hollow Blocks as adopted by the National Association of Cement Users".[11] These specs provided information as basic as, the materials needed (cement, sand and stone or coarse aggregate), their proportions, mixing, molding, curing, aging, thickness of walls, and laying. A total of twenty four line items listed more complicated activities such as testing of the blocks prior to installation. These important specifications lead to changes in building ordinances and regulations throughout the United States. In this respect, those established by the cities of Philadelphia and Denver by 1906 were important precursors which lead the way.[12] The industry had organized under professional associations as early as 1905, and by 1919, block-size standards had been set by the Concrete Block Manufacturer's Association.[13]

Fire-proofing structures of all types was one of the main concerns of builders after the catastrophic great fires in Chicago, New York, San Francisco, Boston and other U.S. cities from the 1870s through the early 1900s. Reinforced concrete and concrete block were seen as an answer, and a great deal of faith was placed on the fire-proof qualities of these innovative building materials.

Research indicates that the first building in the United States to use concrete blocks as a structural material, was the Hughes Residence in New Dorp, Staten Island New York, erected during the summer of 1905. According to Miller, the two-story house, was also credited "as a pioneer in fireproof residence construction...is believed to be the first in which hollow concrete blocks were used as supporting walls." It was designed by Robert W. Gardner, an Architect from New York. The previous use of concrete block had been as a facing material to other building technologies. The blocks were manufactured on the building site by a first-class mason. "Three sizes were used, 12-inch for the basement walls, 8-inch for the walls above the basement, and 6-inch for the interior partition walls." The walls were fabricated with a mixture of one part (Atlas) cement to four parts course sand. The article also included interior and exterior photographs.[14] The same magazine also included four large ads regarding concrete block in general. One advertized the book Concrete Block Houses, a pattern

book that included plans as well as cost estimates. The other three ads were about the block machines themselves and included their slogans: The Century Cement Machine Co. - 'The World's Greatest Cement Stone Machine' which produced the 'Hercules' block; The Ideal Concrete Machinery Co. 'You want the best'; and The Winget Concrete Machine Co. which boasted 'the only concrete machine to receive an Award at the latest World's Fair'.[15]

The new building components could be quickly hand-made on site, required no ovens or large equipment to manufacture, were easily stored, and ready for installation within a month. Promotional material sent out to the public in general by large companies like Sears, Roebuck & Co., by 1907 advertized several concrete block machine models and tools in their catalogs, clarifying that "No Experience is Necessary to Operate Our Concrete Machinery...what others have done you can do."[16] These ads converted the building material into a household name, since it was more economical than wood, brick or stone construction, it was fireproof, and therefore, ideal. The concrete block catalogs particularly recommended their use for agricultural buildings, residences and small-scale commercial structures. Small industries, mainly run by masons or people that were already part of the construction industry, flourished from the use of these machines due to their continuous promotion and the ready availability of the equipment provided through large corporations like Sears: "The most complete and up to date outfit for manufacturing hollow concrete building blocks ever offered to the building public."[17]

The initial triumph of concrete block manufacture and use in the U.S. would serve to promote it as a successful building technology which rapidly spread throughout the country as well as to countries with which it had commercial ties. This was the case of the Spanish Caribbean, where there is irrefutable evidence that American concrete block machines arrived as early as 1901 wherein the new building material was adopted, modified, developed, and used together with other innovative construction technologies such as steel framing and reinforced concrete in order to make it their own. As stated in 1906 by Rice, as a recognized authority, "...concrete blocks have a place of their own in building construction, that they are capable of such artistic finish that the may rest upon the merit of their own beauty, and that they are not dependent for their popularity upon imitation of any other material

commonly used in construction of buildings..."[18]

Cement Blocks in the Spanish Caribbean

Cuba

"When Leon Cogniet invented concrete, a revolution was produced within construction, he artificially fabricated blocks that were as solid as stone itself; these blocks had all imaginable forms since they were molded and could replace, in the majority of cases, granite and sandstone."[19]

Cuba seems to be the first country in the Spanish Caribbean to have used concrete block as a building material. "The advent of the republic in 1902 was an incentive for investment, both local and foreign, and businesses in the city multiplied, stimulated by the economic climate...Export-import companies and financial firms spread their networks all over the country, as did railways and construction companies..."[20] The stage was set for experimentation with new imported building materials.

Proof that the concrete block's use was a United State's initiative, is found in the establishment in Havana of a branch of the renown firm Purdy & Henderson, an important design and construction firm from New York. Their earliest projects, which coincided with the founding years of the Cuban Republic, included several steel frame and concrete-block edifices in the capital city built as early as 1901.[21] These included a Vedado House (1901), the Miramar Hotel (1903), the first Cuban branches of the Royal Bank of Canada (1903-05) and the National Bank of Cuba (1904), as well as various residential and institutional projects.[22] Further proof is the existence of published photos which show the concrete blocks stacked in front of one of the residences under construction at the time. The firm had:

> ...invented a process which will allow the use of 'dry' concrete in blocks made on a machine of the Palmer type, and yet make blocks that will not allow the passage of water or frost from front to rear...the waterproof mixture, of which the stratum is formed, is poured into the opening, and it becomes homogeneous with the balance of the concrete at once...The inventors are using this process largely in Cuba at the present time and, patent being applied for, have no competition there. Patent rights on same will no doubt be for sale locally in this country soon.[23]

Some of the rock-faced concrete blocks used for the building base of the first branch of the Royal Bank of Canada (1903-05) in Havana measured on site, have the dimensions: 30" long X 9.5" high X 14" wide (76 cm. X 24 cm. X 35 cm.), and another type measures 22.5" or 57 cm. long with the same dimensions in height and width.

In a 1910 article published in the local magazine, *Sociedad Cubana de Ingenieros* it was reported that "Blocks (were) fabricated in the city of La Habana by Purdy Henderson, with 1 part Portland cement, 2 ½ (parts) limestone sand and 2 ½ (parts) siliceous rock, after 55 days from fabrication...75kgm."[24]

The town of Mariel, located towards the West of La Habana, seems to be the second Cuban location where concrete block was used as a building material, this time for a monumental four-story high mansion on a hill overlooking the impressive harbor. The "magnificent residence of Horatio Rubens" was completed between 1905-1906, an early date even for contemporary concrete-block counterparts in the United States. The eclectic residence, included sentry boxes or watch towers as significant decorative elements of the ornate parapets. In the September 1906 edition of the Cuban social magazine *El Fígaro*, the residence was described as "...the best and most splendid building of our Republic..."[25] Although the architect is unknown, it seems that the Cuban construction workforce was under the direction of two Catalonian foremen. Its unusual design could have been imported from the United States together with the equipment to manufacture the blocks and other molded pre-fabricated Portland cement architectural elements used at this remote site. It is not clear wether Mr. Rubens, a wealthy American industrialist of the Cuba (railroad) Company and a New York lawyer, ever lived in the 26 room house which at the time cost $250,000 to build. The building's exuberance was marked by various Portland cement molded and pre-cast architectural ornaments such as a completely Moorish-themed interior patio that still includes colored inserts of the cement elements, curved balustrades, elaborate column capitals and arches. The exterior facades remain mostly embellished by various types of extremely ornate window and door surrounds, balustraded porches on all four building sides, and the top building's parapets and sentry boxes are crowned with distinct crenelations.

In 1907 Ruben's Palace or Castle, as it was commonly known, was being considered for use as a Casino,

and when denied the permit, the property was sold to Havana's San Lázaro Hospital (1909) to be used as a Leper's Asylum, which was later built at an alternate site. In 1915, the apparently still un-used structure was confiscated by the Cuban Government to be used as the Naval Academy of Cuba, who completed its construction, and inaugurated it in January 1917.[26] Remarkably, the building remains, and although in an abandoned state, it is still part of the military installation on the original site. Impressive due to its monumental height and structural integrity, the present investigation has concluded that it is the tallest, largest, and most massive building completely built of rock-faced and plain concrete block that survives in the Spanish Caribbean found to date 2015. The blocks diminish in size as the building rises, from 39" long X 16" high and could have been 14"-16" in width (1 meter X 40 cm.) at the ground level, to 30" long X 9.5" high (76 cm. X 24 cm.) at the upper levels. The walls were vertically reinforced with steel rods as can be appreciated in a photograph taken during its construction in 1906, and this reinforcement has probably guaranteed its survival through time in an tropical area on the North coast of Cuba that is constantly affected by tropical storms and hurricanes and where its location and siting are completely exposed to the natural elements.

Other early concrete-block structures in Cuba were directly associated with the Protestant religious groups that came from the United States at the end of the Spanish-American War of 1898, and who built impressive temples that still remain. That was certainly the case for La Habana's Presbyterian Church inaugurated during 1906, which from the outside, seems to be three-stories tall with an even higher two-story belfry. The building still boasts three distinct face-plate designs for its concrete block walls. In addition to the main nave, other interior spaces included "...living apartments for the missionaries and an infant class room." Its original cost was $50,000, which included the purchase of the urban lot as well.[27] Some of the ornate concrete blocks used for the temple in Havana measured on site, have the dimensions: 30" long X 9.5" high X 14" wide (76 cm. X 24 cm. X 35 cm.), and another type measures 24" or 61 cm. long with the same dimensions in height and width.

The Methodist Church in the city of Cienfuegos, inaugurated in 1908, still stands on a prominent corner of the city. It was built with panel-faced concrete blocks, as well as other molded Portland cement ornaments such as friezes and moldings for doors and windows.[28] The concrete blocks measured on

site for this temple have the dimensions: 24" long X 12" high X 12" wide (61 cm. X 30.5 cm. X 30.5 cm.) It is hypothesized that the Protestant missionary groups could have easily brought with them the equipment necessary to fabricate the necessary architectural components for both structures, since this would have facilitated the permanent establishment and rapid spread of their missionary work. This seems to have similarly been the case for Puerto Rico.[29]

Both buildings possess the institutional eclectic qualities that characterized the design preferences for Protestant temples in the United States during this period. Even if these building types had been previously constructed in the U.S. using brick, stone and wood as their primary building materials, most of the traditional designs could have been adapted to the concrete-block technology. This was the case for the construction of a Methodist Church in Artesia, New Mexico as early as 1904.[30] Research at the Presbyterian Historical Society Archives (PHS) in Philadelphia USA, resulted in finding a recurring section within the annual Board of Home Missions Reports titled "Board of the Church Erection Fund". This segment, which was part of every annual report since 1875, included suggested models for temples and manses as part of a major collection referred to as "The Book of Designs". The Presbyterian Board apparently secured appropriate sketches for these buildings and later distributed them through this book to small communities that requested these for lack of funds to hire an architect or designer. Nevertheless, the Board emphasized that "...where a building is to cost more than $5,000 a competent architect be selected and the work entrusted to his hands." Building layouts, sizes, suggested materials, and final costs were also provided as important guidelines by the Board.[31] The copy of the complete Design Book was never located in the PHS. One example, the blueprint of a bell tower designed by the firm Ludlow & Peabody Architects of New York, found within the historic documents at the PHS and titled "Presbyterian Church Porto Rico - Cuba", could have meant that this was one same design used multiple times and for different missions in various countries.

"Molded architecture" with pre-fabricated components converted artificial stone manufacture into a profitable businesses throughout Havana. Innovative decorative schemes could be multiplied through the use of molds which facilitated portable architecture elements, "...the mold was a proper element of industrialization applied to an infinite series of architecture, repeatable and combinable, an architecture

to be consumed and assimilated by the social masses that marked the 20th century..." You could consult a catalog and rapidly select the preferred combination of ornaments and building components for your design. The large variety of Portland cement elements produced in the early workshops included "portable structure" as well, which meant, hollow columns and concrete block which when filled with reinforcement and cement mortar would serve as the structural supports.[32]

Venegas points out that "...a number of Spanish businessmen, especially Catalonians, had established construction companies or sold building materials and were, in fact, responsible for introducing new techniques and services to the building industry. The so-called workshops for decorative detail in Havana were small, and made 'artificial stone' prepared from cement and sand. They mass-produced columns, friezes, staircases, cornices, banisters, and corbels - even funerary monuments and water tanks - made in every style imaginable, and these found ready markets..."[33]

Amongst the more modest concrete-block projects in Cuba, were those for factories, warehouses and housing for the working class. By 1907, the Cuba Company, one of the American railroad companies, was building "...eighteen new cement block houses, and contracts have been let for ten. The houses are for the use of the employees of the company..."[34] Two years later, the caption of a published photo of rock-faced, concrete-block one-story houses would announce: "A group of cement houses for working men erected in the Vedado, Havana. These houses each contain six rooms and a bath room, and are beautiful to look at and well constructed."[35] These rented for $20 a month and were also offered for purchase to working men who could arrange to pay for them through a monthly installment plan.

As the concrete or cement block technology spread, it became a relevant and highly published topic in the technical and professional magazine literature. This was especially true between 1905-1910 when the industry was trying to establish itself. Cubans were accustomed to building in lime, brick and rubble masonry since the 16th century, and the Portland cement materials were easily substituted to produce roofs, walls and floors using similar building procedures. A two-page long article titled "Making Concrete Blocks in Cuba - A Good and Profitable Business" made reference to the Cuban practice of

using wood molds for concrete-block manufacture instead of the metal molds used in the United States, even if, "...some block makers are in possession of these machines...". Its author, George Rice, described the block manufacture process as very similar to that specified by companies from the U.S. and used a mixture one part cement, and four parts sand, which was tamped by hand. The article included interesting drawings of the molds, the equipment, the tools, and the finished block as well as "...the system (gripping device of iron) usually employed in Cuba for supporting a beam on a block wall."[36] Hence, during the first decade of the 20th century's building bonanza in Cuba, concrete-block making was definitely a profitable business.

Cuban Industrial Fairs and Expositions also marketed the molded and pre-fabricated Portland cement architectural elements since the Palatine Exposition of 1909 and the National Exposition of 1911 presented the companies producing the ready-made building materials. Amongst these enterprises, that most notable regarding the production of Cement Block was *El Arte Industrial* owned by Architect Antonio Gelabert. Its exhibit presented all kinds of Portland cement architectural elements "...without competition in block fabrication and architectural ornament in cement...(it is) the only factory (of this kind) with a Cuban patent." Its products were also described as "...improving public ornament and refining national taste."[37] Proof regarding the popularity of Gelabert's cement blocks was the fact that these had been used to build other exhibit pavilions at the 1911 National Exposition grounds.[38]

School construction in Cuba also included concrete blocks as building materials. Blocks were used to build the *Escuela Ricardo de la Torre* in Caibarién, inaugurated in 1910, at the height of production and use of the block industry in Cuba and the Spanish Caribbean.[39]

Advertisements regarding the cement industry in Cuba, or equipment directly related to cement production and the concrete block industry, were found as early as 1911 when Galbán & Co. (who had representatives in Havana and New York), advertised in bi-lingual terms: "*Máquinas para hacer Bloques de Cemento y Mezcladoras de Hormigón* (Cement Block Machines and Concrete Mixers)" and promoted the 'Climax' machines as the best in the world.[40] Yet the importance of cement and its products was included within published commercial articles of the time which emphasized, for example, that "The

Sampson Company is installing a complete plant of machinery for making cement and cement blocks and bricks...near Cuneira. The railroad company is erecting a new station and putting in the necessary tracks for the business of the cement plant".[41] This meant that the railroad was an integral part of the innovation process by facilitating the products distribution throughout the island. A definite promotion for the concrete block industry was that the technology was being used by the government, as was the case for the Governor's Palace in Santa Clara which was "built of cement block" and inaugurated in 1911,[42] confirming once again, that Portland cement, as well as its products, were accepted materials for building on the Island. From 1900 to 1916 most Cuban companies producing concrete block were located in Havana's neighborhoods. The Las Villas region was the second area of Cuba where three related industries prospered from 1922 to 1926.[43]

The 1926 Commercial and Industrial Guide of Cuba included a category titled "*Bloques de Cemento* (Cement Blocks)". In Havana alone, it listed 23 companies that, by then, manufactured cement (or concrete block). Some of these industrialists fabricated other concrete products as well, such as concrete tanks and even hydraulic cement tile. Some company names were in English: American Concrete Co. and Latta & Pujals Contracting Co., but the list also included names that were highly descriptive and made direct reference to how contemporary and new these materials were: *El Arte Moderno, El Moderno Invensible, El Bloque, La Moderna,* and *El Arte de la Época.*[44]

Dominican Republic

One can be easily fooled by early 20th century architecture in the Dominican Republic. What to the normal visitor would appear as cement or concrete block facades, are actually simulated or imitation representations of stone masonry. This was corroborated on multiple occasions not only in the capital city of Santo Domingo, but in other important cities like La Vega. This practice probably precluded the importation of the molds for the artificial stone examples which were proliferating through Cuba and Puerto Rico during the first decade of the 20th century. Even though Portland cement imports to the Dominican Republic date back to 1894, traditional Spanish brick construction prevailed in institutional as well as high-class residential architecture, and was made to look like stone masonry or block with a

distinctive lime and sand plaster surface. Another technique found was that of surface finishes created by "stamping" or molding imitation stone masonry on a thick lime and sand plaster.

Even though there is no certainty or proof regarding the date when the first block machines and molds arrived in the Dominican Republic, it seems to have been an industry directly tied to that of hydraulic mosaic tile manufacture and cement-molded (artificial stone) products.[45] Owners of the residences of the upper industrialist and merchant classes, usually attune to the progressive and fashionable building materials utilized in other countries, and specifically their neighboring Greater Antillean Cuba and Puerto Rico, would have been interested in the architectural expressions and technologies promoted abroad. This had been the case in the previous decade with the development of a true taste for the hydraulic mosaic pavements. Due to business dealings of the industrialist class with the United States, there is a high probability that during the early periods of the industry, the cement/concrete-block technology could have been imported to the Dominican Republic by building contractors, when the blocks were made on the project site one by one by the builders themselves.

The original rock-faced concrete block Dominican residence of a prominent Puerto Rican banker and financier Santiago Michelena Belvé, designed by Architect Antonin Nechodoma and built in 1912, is an excellent case in point. Nechodoma had been producing very similar residential architecture throughout Puerto Rico four to six years before. Michelena, being Puerto Rican, probably requested the most up-to-date styles being employed in his country resulting in the use of concrete blocks as the structural and ornamental elements for his imposing residence in the sister island.[46] This seems to be the first concrete block building constructed in the Dominican Republic, and although it still exists, it was completely transformed during the 1930s, when any evidence of the original concrete-block building technology was destroyed and concealed. The participation of Nechodoma as a designer and the possible inclusion of Frank B. Hatch as the builder of this residence is possible, since as a team, both professionals had vast experience using this technology in Puerto Rico.[47] Hatch would in fact establish himself as a building contractor in the Dominican Republic approximately a decade later when his company was advertized as: "Hatch & Carbia Construction Co. - *Contratistas y Constructores Generales* [General Contractors and Builders]".[48]

Various rock-faced concrete-block residences followed during the 1920s[49], specifically in the suburban area of Gazcue. This was most probably due to the establishment in Santo Domingo of a Portland cement molded and pre-fabricated product industry by Juan Tomás Tavares Juliá since 1925. In the second catalog printed by the company in 1931, a complete segment of the introduction is dedicated to Concrete blocks as important building products of the Factory:

> The concrete block is a universally used construction material due to its many desirable advantages. As these are made of concrete, the blocks have the intrinsic qualities of this material. However, it is not monolithic reinforced concrete, as the block is essentially masonry construction. It does not have the iron of reinforced concrete, and it is important to keep this in mind, especially in those countries where earthquakes and cyclones occur in which cases the iron plays an important role. To counteract this deficiency in building with blocks, it is important that the walls are properly joined and bonded. It is also highly recommendable to complete the height of a block wall with a concrete beam as a general anchor (to the structure). Furthermore, since the blocks are hollow, it is possible to install vertical iron rods (within their cavities), and filling these (with cement mortar), in order to obtain superb reinforcement. We recommend placing these vertical rods at the corners, and if the wall is very long, also at intermediate points.
>
> Taking into consideration the above-listed indications, a solid and well built structure is obtained from every point of view. In terms of strength if compared to monolithic concrete, it has the advantage that the blocks walls will not crack very easily. A crack in a wall is unquestionably a weak point. Block construction is economic. One of the most important factors is that as the blocks are hollow, there is great economy of material, while at the same time it is possible to manufacture large and light units which greatly reduces site labor. Block construction requires no form-work, one of the most expensive factors of monolithic concrete construction. Nor is plastering required on the exterior (surface), which also presents a significant economy.

> Block construction is practical. For it you only need the blocks and a very little amount of mortar for their placement. Therefore the control of materials is very simple. In a few minutes the interested party can count the blocks placed, and know, with certainty, the material used. Manpower is also very commonly paid per unit. How different this is from concrete, where so many different materials are required and their control is normally so difficult!
>
> Another advantage of block construction is that it results in very cool houses. The (hollow block's) cavities constitute air chambers that effectively isolate exterior heat.
>
> Apart from the considerations we have made regarding block construction, it is of course of utmost importance that the blocks themselves are of good quality. A structure is as strong or as weak as its constituent parts. Concrete blocks are made with a semi-humid mix (and not liquid or semi-liquid as monolithic concrete) and is therefore of utmost importance that the material is well compressed. Blocks that are not well pressed are porous and weak. With hand-manufacturing, even if more care is taken, it is difficult to guarantee a uniformly strong product, since the pressure depends on the efforts of the workmen or labor force. However, with mechanical pressure it is always equal and much greater. Our entire (concrete block) production is all based on mechanical pressure, having obtained the most powerful machines for their manufacture.[50]

Among the extant examples of the concrete block residences in the capital city of Santo Domingo are the original Juan O. Vázquez residence, (presently the Babeque Primary School, 1926) the Vicens residence (ca. 1928), and the Betances residence (ca. 1930). "The Tavares industry produced a rusticated or wart-type concrete block, as designated locally. Its width was 8", with a height of equal measure; length 15.5" and two chambers 5" X 4.5"..."[51] Even though Tavares did not publish his first catalog until 1925, his business office was located in a concrete-block building, probably the best advertizing possible. As previously stated, his 1931 catalog included rock-faced or 'wart-type' cement blocks as part of the "artificial stone or granite" products offered by the company.

Contrary to the hydraulic mosaic advertisement campaigns of the early 20th century in the Dominican Republic, the only promotional material found specifically regarding concrete or cement blocks, besides the Tavares catalog and the building themselves, were ads placed in several 1928 issues of the *Listín Diario*, an important newspaper in Santo Domingo. The ads boasted: "Concrete Blocks -machine and not hand pressed- extremely strong blocks at very reduced prices"[52] which meant that until then, previous concrete blocks had been locally produced only by hand-techniques.

An extremely destructive hurricane hit the Dominican Republic during September 1930 and leveled most of the capital city, primarily composed of wooden buildings. Photographs taken just after the disaster show, that several concrete-block buildings (built during the 1920s) survived. These were located within the newer neighborhoods, part of the urban expansions developed outside the city walls, which included *Ciudad Nueva, San Carlos and Villa Francisca*. Impressively so, even a three-story tall, mixed-use (commercial space on the ground floor and two levels of apartments) concrete-block structure, presently known as *Barra Payán* (ca. 1929), survived the storm. Historic photos documented reinforcement bars or rods extending vertically from inside the hollow cores of the concrete-block building corners during construction, which if filled later with concrete, would have adequately formed structural building columns. These would then serve as lateral support, indispensable protection for buildings against hurricanes or earthquakes. As a new government initiated the reconstruction process of these sectors during the 1930s, the concrete-block, as well as other Portland cement architectural elements such as columns, capitals and balustrades, would become protagonists for new housing within Santo Domingo. Important to this study is the fact that most of the new housing stock also incorporated reinforced concrete slabs for floors and roofs, and hydraulic mosaic pavements, still present in the entrance porches and throughout house interiors - both technologies being the focus of the present study. It must have been a period of economic bonanza for the Tavares factory, which at that date, was the only producer of these molded and pre-fabricated Portland cement architectural elements within the capital city. These neighborhoods and concrete-block buildings still exist today in excellent condition.

San Pedro de Macorís, the second most important port in the Dominican Republic, was a city which

developed during the early 1900s mostly due to the establishment of prominent sugar centrales and other agricultural initiatives in its fertile lands. The new buildings and port facilities were primarily built utilizing the innovative technologies made possible by the use of imported Portland cement: "Nearly all the commercial houses are built of cement or re-enforced concrete, as are also the newer residences. These buildings are generally two stories, but a great many are now being run up to three stories, containing all modern conveniences."[53] In 1920, various steamship lines provided regular and direct service from and to San Pedro from Cuba, Puerto Rico, the United States and Europe. These vessels most likely served as important providers of new materials and technology.

The first cement-block buildings could have been constructed probably by 1915, when distinctive structures in the harbor area would have housed the busy port's activities. Within town, highly decorative Portland cement molded ornaments embellished landmark buildings such as the Fire Station (1911), the Marketplace (1912), and the impressive neighboring two and three story edifices. Worthy of special mention for the present research is a two-story corner building with distinctive cement-block facades which incorporated at least three different face-plate designs for its blocks and a *fleur-de-lis* motif frieze. For this reason, we can safely deduce that there must have been a small local cement-mold business in town, or individual manufacturers of blocks for their own projects, during the first decade of the 20th century, for these building components did not travel well in the yet un-paved roads of the time. It was not until 1923 that Jaime Malla would establish his hydraulic mosaic and cement product business in San Pedro de Macorís.

The complete cement or concrete block kit could have been imported more or less at the same time that these arrived in Cuba and Puerto Rico, between 1902-1910, through the main seaports of Santo Domingo and San Pedro de Macorís. Therefore, the commonly accepted idea that these ornamental/structural elements were absent from Dominican Architecture until the 1920s is probably incorrect.

Puerto Rico

As a result of the Spanish American War ending in 1898, North Americans from all walks of life came to Puerto Rico. The U.S. Department of War set up a temporary Military Government on the island until May 1900, when the Civil Administration, undertook an ambitious island-wide construction program of roads and bridges as well as schools. Most of these were built using imported Portland cement and/or reinforced concrete following models brought by the civil, U.S. Government, Protestant religious groups, and the military. They included prototypes for institutional buildings, schools and housing.[54]

Circa 1904-05, metal molds for the fabrication of hollow-core cement or concrete blocks were brought to Puerto Rico through the Protestant Missionaries who came from the United States in order to expedite the construction of new churches, schools, universities and hospital buildings for, and by, their congregations. The earliest blocks mostly simulated ashlar-masonry or cut stone. They were inexpensive to manufacture, much lighter in weight as a building material, and fireproof, which together, popularized their use locally. The first molds made concrete blocks one by one on the building site itself utilizing the aggregates that were found in the vicinity of the different projects.[55]

Current investigations have singled out the George O. Robinson Orphanage for girls as the first concrete-block structure built in Puerto Rico during 1906 at a cost of $11,000. The Collins Memorial Methodist Episcopal Church in Aibonito, built from 1906-1907 was apparently the first Methodist Chapel built in Puerto Rico and the second concrete-block structure built on the Island at a cost of $4,457.50. The first two buildings were erected with funds provided by the Woman's Home Missionary Society of the Methodist Episcopal Church. The third concrete-block building erected in Puerto Rico seems to have been the *Escuela Santiago Palmer* or Salinas Graded School built during 1907 at a cost of $7,599. This structure was designed and built under the Commissioner of Education for Puerto Rico, and brings a completely different group of owners into the initial analysis. All three structures have unfortunately been demolished through time, the first and last were lost during the 1940s for their small size, and the Chapel was destroyed by the San Felipe hurricane of 1928 and subsequently demolished as a consequence.

The selected concrete block type-face for the three buildings in Puerto Rico, was mostly that simulating ashlar masonry, with some areas of plain-faced blocks, which together, granted the institutional character required, or most desired, for religious and school buildings of the period. The concrete-block, as a substitute for real stone, had been successfully used as construction material for contemporary schools and religious architecture in the United States[56] and was brought to the Island with the new designs for institutional architecture, an important precedent for projects on the Island. Not only were the building materials new to the Puerto Ricans, but the building-types where these elements were used were new as well. Nevertheless, "Local masons coming from a Spanish-based building tradition were already familiar with preparing and applying mixes and utilizing products similar to hydraulic mortar (or Portland cement) and reinforced concrete as they had done for the past 400-some years in Puerto Rico."[57] Permanent buildings on the island had been built with *mampostería* or rubble-masonry since the 16th century, and local masons quickly adopted the use of the new Portland cement materials.

Relevant information to this study has been afforded by other temples of the same period built by the Methodist Episcopal Church in Puerto Rico. From the building plans of an almost identical sister chapel to the one in Aibonito, also designed by the same architect, and built exactly a year afterwards, we know the building materials and sizes for the McCabe Memorial Church in Playa de Ponce to have been: "ROCK FACE 8" X 20" CEMENT BLOCKS".[58]

The concrete block information for the "six-room , one story ...cement block School Building..." in Salinas or the Graded School in Salinas has been extracted from the original 1907 construction specifications as follows:

> ...For exterior wall blocks: Length of Stretcher Blocks, not more than two (2) feet nor less that (1) foot; height, not more than (1) foot, nor less than six (6) inches. Closers, not less than four (4) inches in either direction. Corner blocks not less than six (6) inches in either direction. Thickness of blocks for outside foundation walls, twelve (12) inches; for walls of building, eight (8). Partition wall blocks to conform in dimensions to outside wall blocks, except that they are

> to be only ten (10) inches thick for foundations and six (6) inches thick for partitions. The walls of all the hollow blocks are to be not less than two (2) inches thick and connected by lateral webs of not less than two (2) inches in cross-section and not more than twelve (12) inches between centers of webs.

With regards to the "mixtures" or mixes accepted for the manufacture of the block units themselves, the same document specifies two formulations:

> Number One.- One (1) part cement; three (3) parts sand; six (6) parts broken stone.
> Number Two.- One (1) part cement; three (3) parts sand
> The materials for these mixtures are to be combined in the manner prescribed under "Mixing Concrete" in the regular specifications, sufficient water being used to thoroughly moisten the mixtures, but not so much as to prevent their being solidly tamped into the moulds. Blocks and Forms must be protected from sun and wind and kept thoroughly moist for at least five (5) days; then allowed to season for at least ten (10) days before being laid in walls...

Mixture no. 1 was to be used for the body of the "outside" or structural-supporting blocks. These units were to be "faced on the surface exposed to the weather" by mixture no. 2 "...of no less than one inch in thickness; facing and body block to be moulded at one operation, so that they will be thoroughly united...the out-or weather-side faces of blocks are to be moulded into the form known as 'panel face' and the inside, or posterior faces to be plain..." The installation mortar required was one part cement and three parts sand and the walls were to be worked in regular bond. The wall finish for exterior walls was two coats of a cement wash composed of one (1) part Portland cement to three (3) parts of water.[59]

The specifications for the Vega Baja Public School (1908), referred to the use of plain-face concrete block, "...Blocks to be made of mix no. 3, in suitable moulds and in the most workman like manner; plain faces, left rough for better adhesion of plaster coat; covered and kept thoroughly moist for at least three (3) weeks before being placed in the walls..." This document also detailed the plastering work

required as follows:

> "PLASTERING. Exterior walls, gallery piers, to be finished with a plaster coat one quarter (1/4) inch thick, coat of mix no. 5, floated to smooth surface." Mixture no. 5 stated: "Cement 1 (part), Sand-all grades 3 (parts), lime paste 1 (part) The lime paste to be made at least ten (10) days before use, and properly protected from the weather until used."[60]

Based on this information, the same block molds could have been used for the first three buildings if these belonged to the same client and had been built by the same contractor, but that was not the case. Most of the early Methodist buildings in Puerto Rico were designed by Architect Antonin Nechodoma and built by Frank Bond Hatch. As a professional team, this duo of foreigners living and working on Puerto Rican soil, was un-matched in the high-quality work they produced together during more than two decades of great buildings of all types. Even though Hatch built for other architects, rarely did Nechodoma have his structures built by anyone else, which might justify the reduced amount of plans and details prevalent in this famous designer's projects. Hatch, was a parishioner and almost the exclusive builder for the Methodist Church of Puerto Rico and is believed to have been the contact through which the first block molds were brought to the Island.[61] Concrete block had become the building material of choice for Protestant temples throughout Puerto Rico as demonstrated by photographic collections from the early 20th century.[62] As many as fourteen Methodist and Presbyterian concrete-block temples and other Protestant missionary related buildings, such as Manses[63], were built during the first decade of the 20th century in Puerto Rico.

In contrast to this, the schools of Puerto Rico, as public projects, were designed by architects working for the Commissioner of Education's Office, under the Department of the Interior. The schools were to be constructed "in accordance with plans drawn in the Office of the Commissioner of Education and approved by the Commissioner of the Interior." By 1906, the general directive issued by this entity was "The abandonment of wood (as building material) for graded buildings and the substitution with cement block is strongly urged..." since the experience of using native Puerto Rican woods for rural schools had proven unreliable due to "the lack of dealers who carried sufficient stock of good seasoned

timber to supply even one building."[64] This in itself was an incentive to use the innovative concrete-block technology on local school buildings. Concrete block would also provide "permanent" masonry structures in a tropical region plagued by wood-eating insects, hurricanes and earthquakes.

There is no information regarding the designer for the Palmer Graded School, but the Commissioner at the time was Edwin G. Dexter, and L. D. Lindsley was the Chief of the Division of School Buildings, both government representatives who had signed the construction documents found in the project file. Antonio Higuera of San Juan, a known experienced builder, was the contractor awarded this, as well as other public school projects of the time. In the file of the 1907 Vieques Graded School Building, (another public school also built of concrete-block and constructed simultaneously to the Salinas structure) a page torn out from what appears to have been a concrete block trade catalog shows a photograph of the finished school which reads: "Public School at Viequez (sic), Porto Rico. F. B. Hatch, Builder. 'Hercules' Stone is used exclusively by the Porto Rican Board of Education."[65] Important facts from this text are that Antonin Nechodoma was the Architect and Hatch[66] was the builder for the Vieques school. The above-referenced advertisement named Hercules Stone as that utilized by the Division of School Buildings of the local Department of Education for their edifices, which could have been the same equipment Hatch used for the Methodist projects he was building at the same time.

Imported from Rochester New York, 'The Hercules Cement Stone Machine', manufactured by the Century Cement Machine Company, advertised it could produce "every shape and kind of (artificial) stone". It was probably brought to Puerto Rico on any of the frequent steamships traveling from New York to the principal ports of San Juan, Ponce, and Mayaguez. A 1907 block machine advertisement from the same company boasted various reasons why this was the equipment that would facilitate concrete-block or artificial stone-making and which could have convinced the local entities of their purchase:

> The Hercules Concrete Block Machine is still 365 days ahead of them all. It makes more sizes and larger variety of blocks than any other machine. It makes two blocks of the same size and design or of different sizes and designs on the one machine at the same time. It is the simplest

> machine in the world - no pins, cogs, chains, springs or levers. In strength, durability and adaptability it leaves all others far behind.[67]

In Puerto Rico, private residences also formed a large part of the early 20th century concrete-block building stock. A large number of these houses were designed by Architect Antonin Nechodoma and built by Frank B. Hatch between 1909-1914. They were usually one story high "raised cottages", their foundation and regular walls were concrete block of rock-faced plate design, their pavements were mostly wood, but sometimes hydraulic mosaic cement tiles, and their four-way sloped high roofs (some including dormer windows) were structural wood covered over by shingles of some kind, which could include aluminum or tin. These houses would eventually prove to be fireproof indeed, when one of the best exponents, popularly known as *La Casa del Francés* in Vieques (built ca. 1911 and more than 100 years ago) burned down. Ten years after the conflagration and the complete abandonment of the property and the ruins of the residence, even if the wood architectural elements are long gone, the concrete block walls simulating ashlar masonry and the hydraulic mosaic floor tiles remain totally intact, proof that the materials were indeed high quality and truly fire-proof, even if hand-fabricated at the time.

Newspaper, magazine and telephone books of the first two decades of the 20th century included commercial advertisements which listed pharmacies, cigars, cement, hardware stores, paints, and professionals, amongst many others; however, The Commercial Guide and Business Directory of Porto Rico, published in 1910, was the official government source and included the businesses of each town. A unique entry for Ponce, the second largest city in Puerto Rico, listed 'Cement Block Mfgrs.' (manufacturers) and included the names of Narciso Arabía, who also had a brick manufacturing business, and Isidoro Texidor. Arabía's business included two very different products, unless the "bricks" he advertised were also made from Portland cement. Patents for Narciso Arabía are listed in documents from 1903-1905. A Patent is also granted to the Succession of Narciso Arabía in 1915 for a brick factory, with an added note that mentions that the company had been established "40 years ago" (or 1875) by Narciso Arabía.[68] No patents or records have been found for Texidor to date, and it is unknown how long this industry survived or for whom or for what projects they produced the cement

blocks.[69]

Felipe Salazar-Palau, also owner of Ponce Mosaic, ended up buying Narciso Arabía's business. This could have possibly resulted in his new factory manufacturing both products, hydraulic mosaics or cement tiles and concrete blocks. From circa 1910 onwards, institutional as well as residential architecture in Ponce (hometown of Ponce Mosaic) exhibited, a varied and rich assortment of molded, pre-fabricated Portland cement architectural elements which were probably manufactured locally. No specific records were found regarding a competing manufacturer for these materials, and Ponce Mosaic could have been the sole producer for the Portland cement building materials of this important port city as well as for the southern region of Puerto Rico.

As the Presbyterian Mission established the Polytechnic Institute of Porto Rico in San Germán circa 1910, hand-manufactured cement blocks and the construction of the campus buildings themselves were required activities of the young men, as part of student training. Reverend J. Will Harris, who established the Institute, had used the technology since 1907 when he himself, with the aid of members of his mission, had erected two rock-faced cement-block buildings in town, the Presbyterian Church and the Manse.[70] Harris could have possibly imported the molds and machines to the western part of the Island when the Presbyterian communities were establishing themselves in the region and needed to construct buildings for their missionary work. There is documented evidence that in 1916, when most of the Polytechnic Institute's buildings were under construction, he himself had placed large cement orders (3,000 barrels) from the Atlas Portland Cement Company of New York. Due to his entrepreneurial spirit and his position as head of the Presbyterian Community, he most likely brought the concrete block equipment with him on one of his frequent trips to the United States, or imported it prior to 1907, when he would first use this technology in San Germán. Non-confirmed information suggests that the machine and molds were later sold to a local contractor who utilized the technology to build many concrete block structures within the town of San Germán and included the *Teatro El Sol*, the first movie theater in town.

The use of concrete or cement blocks had their heyday in Puerto Rico during the first decade of the 20th

century when their fashionable ornamental qualities, as well as their simple fabrication and quick installation, were an asset. Research has proved that the equipment needed for block fabrication must have quickly spread throughout the Island, since mostly from 1906-1910, a great number of all types of buildings were constructed with the use of concrete block. As was the case in the United States, the preferred type-face was the one that simulated rock or stone masonry, but historic photos indicate that usually, more than one face-plate design was used in order to create highly ornamental facades. In spite of this, numerous historic documents make reference to structures built with plain-faced block that would require a cement plaster coast as surface finish. Specifically this was the case for larger public schools, for which rapid construction was preferred, and building ornament was relegated to architectural elements such as cornices, pediments, friezes, and imposing entrance columns, not the walls themselves. No references have been found regarding specific Puerto Rican industries that would have manufactured ornamental molded materials made with Portland cement, unlike the Cuban and Dominican markets for these products. Yet these businesses probably existed from the 1920s onward. Molded architectural ornamentation was very much present since the early use of concrete-block and reinforced construction on the Island. The earliest examples of the molded ornaments were probably fabricated using purchased molds, on the building site itself, as recorded on the specifications for the schools of Puerto Rico.

In Puerto Rico, the earliest buildings which used concrete block as exterior structural walls, also utilized concrete block for interior partitions which were usually specified as a minimum 6-8 inches wide. Amongst the building types which used this building material were single family residences, electrical substations, commercial buildings, tobacco curing sheds, two-story apartment buildings, warehouses, university dormitories, Manses, and offices, as well as two, three and four-story hotels.

Passion for the use of these materials quickly died down principally due to the local preference for reinforced concrete, a technology contemporary to the blocks, which was quickly adopted by the local building industry accustomed to building masonry structures and using form work for earlier rubble-masonry structures. Another contributing factor was the high magnitude earthquake of 1918 which affected buildings of all types throughout Puerto Rico. As a consequence of site inspections by

representatives of the Department of the Interior of Puerto Rico, a series of technical evaluations by building material type were prepared. A year later, needed changes in building regulations would specify materials and building technologies that would be appropriate and safe for structures in Puerto Rico. The report concluded that reinforced concrete construction offered resistance to hurricanes and earthquakes, and was an economic way to build since the materials could be easily found in the Island's natural resources as well as in its commercial outposts. Hollow-core concrete blocks were considered a very weak method of building since most of the structures which had used them had been destroyed by the earthquake. Our theory is that these units were used without any lateral reinforcement[71], and failure was also caused by the poor quality of the blocks themselves (use of inappropriate aggregate, de-lamination, and inadequate cement mix, among other factors) and the "small amount of surface area [of the block] in contact with the mortar" itself.[72]

Few detailed cost references exist in Puerto Rico for concrete block during their early use as building materials. Public schools, as government projects, required Contractor's Estimates as part of the contract documents, some of which have been located in the project files of some of the earliest prototypes, such as the Salinas School (1907) and the Vega Baja School (1908). Apparently built on the project site itself, (since there is no shipping amount included within the estimates) the blocks cost 17-30 cents each. Cornice and frieze elements were listed at $0.40 each, and 8 meters of concrete lintels were charged at $10.00 a piece. The price difference between both markets could possibly be attributed to the higher cost of the imported Portland cement to Puerto Rico at $1.25-$1.50 per barrel.

[1] S. B. Newberry, "Hollow Concrete Block Building Construction in the United States", Concrete and Constructional Engineering I, no. 2 (May 1906): 118.
The term cement block rather than concrete block, was found by the author in the earliest construction documents of the buildings cited in this article. In theory, since cement was the manufactured binder in the mix, and the new product during the first decade of the 20th century, the terms were used interchangeably. "Concrete block is produced from a mixture of Portland cement and aggregates." Jester, Thomas C. editor. Twentieth Century Building Materials – History and Conservation. Washington, DC, Archetype Press, Inc., 1995.

[2] William M. Torrance, "Types of Hollow Concrete Block used in the States and their patents", *Concrete and Constructional Engineering* I, no. 3 (July 1906): 206.

[3] William M. Torrance. *The Manufacture of Concrete Blocks and their use in Building Construction,* Second Prize in Engineering News Competition of 1905. (New York: The Engineering News Publishing Company, 1906): 52.

[4] Jeffrey W. Cody, *Exporting American Architecture 1870-2000.* (London and New York: Routledge, Taylor & Francis Group, 2003): 34.

[5] Pamela H. Simpson, *Cheap, Quick & Easy - Imitative Architectural Materials, 1870-1930.* (Knoxville: The University of Tennessee Press, 1999): 11.

[6] Simpson, 24.

[7] Simpson, 11.

[8] Simpson, 13.
For detailed information regarding these discussions see Torrance and Newberry, (above). In addition, see Harmon Howard Rice, *The Manufacture of Concrete Blocks and their use in Building Construction,* First Prize in Engineering News Competition of 1905. (New York: The Engineering News Publishing Company, 1906); William A. Radford, *Cement Houses and how to build them*. (Chicago, Illinois: Radford Architectural Co., 1909); and Charles Pallister, *Practical Concrete-Block Making*. (New York: Industrial Publication Company, 1908).

[9] Rice and Torrance, 1905: Introduction.

[10] Torrance, 1906.

[11]Radford, 13-18.

[12] For the reproduction of these specifications see Rice, 134-144.

[13] Simpson, 21.

[14] Miller, Jr., Charles A. "A Concrete Residence", Architects' and Builders' Magazine, Vol. 33 No. 2 (November 1905): 336-337.

[15] Architects' and Builders' Magazine, Volumes 22, 29, 30 and 41. (New York: William T. Comstock Publisher).

[16] Sears, Roebuck and Company. *Catalogue of Cement block machines : cement brick machines, concrete mixers, etc. sold exclusively by Sears, Roebuck & Co., Chicago, Illinois.* (Chicago, Illinois: The Co., 1907).

[17] Sears, Roebuck and Company Catalogue, 53.

[18] Rice, 22.

[19] "El Cemento Armado" [Reinforced Cement], Revista de Construcciones y Agrimensura - Publicación mensual dedicada a los Ingenieros, Arquitectos, Maestros de Obra y Agrimensores, Año I (La Habana: Tipografía de "Los Niños Huérfanos", 1899): 56 - Translations from Spanish by the author.

[20] Carlos Venegas-Fornías, [translated by Narciso G. Menocal and Edward Shaw]. "Havana between Two Centuries". *The Journal of Decorative and Propaganda Arts*, Cuba Theme Issue, no. 22 (1996): 22.

[21] Purdy and Henderson Projects' original Drawing Files (microfilm), Office for Metropolitan History, New York. I am truly grateful to Eng. Robert Silman who suggested I contact this Archive, and to Dr. Christopher Gray and Ms. Samantha Hightower from the Office of Metropolitan History who provided unlimited access to these microfilm collections. Their orientation regarding the Purdy and Henderson collection of original drawings led my investigations towards their projects in Cuba and the construction details needed to reconfirm initial hypothesis on their work.

[22] Hotel Miramar: Alina Castellanos-Rubio, "Hotel Miramar". Dirección de Investigación y Desarrollo, Oficina del Historiador de la ciudad de La Habana, 2014; and "Crónica" - Hotel Miramar, El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (October 18, 1903), La Habana: 523.
The Royal Bank of Canada, Havana Branch: "Vista Exterior del Edificio del Royal Bank of Canada", El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (January 31, 1904), La Habana: 61; and *El "Libro Azul" de Cuba (The "Blue Book" of Cuba).* "Cuba 1917-1918". (La Habana: Compañía Biográfica, S.A., 1918): 159.
Banco Nacional de Cuba (National Bank of Cuba), Havana Branch: *El "Libro Azul" de Cuba (The "Blue Book" of Cuba).* "Cuba 1917-1918". (La Habana: Compañía Biográfica, S.A., 1918): 159; and Yamira Rodríguez-Marcano, "Estudio Histórico Antiguo Banco Nacional de Cuba". Dirección General de Proyectos de Arquitectura y Urbanismo, Oficina del Historiador de la ciudad de La Habana, 2012.

[23] William M. Torrance. *The Manufacture of Concrete Blocks and their use in Building Construction,* Second Prize in Engineering News Competition of 1905. (New York: The Engineering News Publishing Company, 1906): 39-40, 54 and 56.

[24] Juan de las Cuevas-Toraya. *La Industria de Materiales de Construcción* [The Construction Materials Industry]. (La Habana: Ministerio de la Industria de Materiales de Construcción, 1993): 222 - Translations from Spanish by the author.

[25] Rodríguez, Eduardo Luis. *La Habana: arquitectura del siglo XX* [Havana: 20th century architecture]. (Barcelona: Art Blume, S.L., 1998): 53; and "El Palacio de Mr. Horacio Rubens en el Mariel" [Mr. Horatio Rubens Palace in Mariel], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (September 9, 1906), La Habana: 461 - Translated from Spanish by the author

[26] "Magnificent Residence of Horatio Rubens now building in Mariel" (photo). The Cuba Review and Bulletin. Vol. IV No. 2, (New York: Munson Steamship Line, January 1906): 7; "Naval School at Mariel" (photo). The Cuba Review and Bulletin. Vol. V No. 2, (New York: Munson Steamship Line, January 1907): 10; and "Excursión al Mariel" [Mariel Excursion], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (March 30, 1909), La Habana: 278-279.

[27] Board of Home Missions Annual Reports. New York: Presbyterian Church in the United States of America, 1898: 9-10; 1907: 47.

[28] In the book: *Impresiones de la República de Cuba en el Siglo Veinte* [Impressions of the Cuban Republic in the Twentieth Century]. (London: Lloyds Greater Britain Publishing Company, Ltd., 1913): 409 and 460; there are photographs of both temples as important buildings of the period.

[29] See segment in this section related to Puerto Rico.

[30] Simpson, 25.

[31] Board of Home Missions Annual Report, 1898: 9-10. Special thanks to Senior Reference Archivist Lisa Jacobson at the Presbyterian Historical Society Archives in Philadelphia, who was instrumental in locating this important reference.

[32] María Victoria Zardoya-Loureda, "Ornamento por Encargo" [Commissioned Ornament]. Revista Opus Habana, No. 3 (2001); and Felicia Chateloin Santiesteban, "De la Arquitectura del Molde o la Identidad de la Ciudad Cubana" [From Architecture of the Mold or the identity of the Cuban City]. Trocadero No. 19 (2007): 253-254 - Translations from Spanish by the author.

[33] Venegas-Fornías. 31.

[34] "New Buildings and Construction Work", The Cuba Review and Bulletin, Vol. V No. 3, (New York: Munson Steamship Line, February 1907): 13.

[35] "Cement houses for working men in Vedado", The Cuba Review and Bulletin, Vol. VII No. 9, (New York: Munson Steamship Line, August 1909): 19.

[36] "Making Concrete Blocks in Cuba", The Cuba Review and Bulletin, Vol. VI No. 8, (New York: Munson Steamship Line, July 1908): 15-16.

[37] "El Arte Industrial" [Industrial Art], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (March 7, 1909), La Habana: 143 - Translations from Spanish by the author.

[38] "Blocks de Cemento - Gelabert" [Cement Blocks - Gelabert], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (February 29, 1911), La Habana: 133 and 135.

[39] "Progresos de la Instrucción Primaria - Inauguración de la Escuela 'Ricardo de la Torre' en Caibarién" [Primary Education Progress - Inauguration of the Ricardo de la Torre School in Caibarién], El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine], (June 12, 1910), La Habana: 285.

[40] Advertisement: Máquinas para hacer Bloques de Cemento [Machines to make cement block], The Cuba Review and Bulletin, Vol. IX No. 7, (New York: Munson Steamship Line, June 1911): 28.

[41] Advertisement: Sanson Company, The Cuba Review and Bulletin, Vol. XII No. 12, (New York: Munson Steamship Line, November 1914): 31.

[42] "Governor's Palace in Santa Clara", The Cuba Review and Bulletin, Vol. VIII No. 3, (New York: Munson Steamship Line, February 1910): 9.

[43] Juan de las Cuevas-Toraya. *La Industria de Materiales de Construcción* [The Construction Materials Industry]. (La Habana: Ministerio de la Industria de Materiales de Construcción, 1993): 223, and 401-403.

[44] Cámara de Comercio, Industria y Navegación de la Isla de Cuba. *Guía Comercial e Industrial de Cuba* [Commercial and Industrial Guide of Cuba]. (La Habana: La Prueba Press, 1926): 13-14.

[45] See Tavares, J. T. *Fábrica de Mosaicos de J. T. Tavares, Catálogo No. 2* [Mosaic Factory of J. T. Tavares, Catalog No. 2]. (Santo Domingo: Litografía Ferrua, 1931), and direct reference to their first catalog published in 1925 or six years prior to that dated 1931.

[46] *El Libro Azul de Santo Domingo (The Dominican Blue Book)*. (New York: Compañía Biográfica, subsidiary of the Pan-American Publicity Corporation, 1920, re-edited in 1976): 41.

[47] See following segment regarding Puerto Rico.

[48] Listín Diario, (4-19-1921): 5 - Translations from Spanish by author.

[49] It is possible that these residences could have been built at an earlier date or from 1910-1919 for the same reasons stated previously in this article, but no proof has been found to substantiate the theory.

[50] See Tavares, J. T. *Fábrica de Mosaicos de J. T. Tavares, Catálogo No. 2* [Mosaic Factory of J. T. Tavares, Catalog No. 2]. (Santo Domingo: Litografía Ferrua, 1931): 7-9 - Translations from Spanish by author.

[51] Penson, Enrique. *Arquitectura Dominicana 1906-1950* [Dominican Architecture 1906-1950] (Tomo I: Textos, Tomo II: Planos), (Santo Domingo: Mediabyte, S.A., 2005): 72 - Translations from Spanish by author.

[52] Listín Diario, (5-28-1928) - Translations from Spanish by author.

[53] *El Libro Azul de Santo Domingo (The Dominican Blue Book)*. (New York: Compañía Biográfica, subsidiary of the Pan-American Publicity Corporation, 1920, re-edited in 1976): 84.

[54] Beatriz del Cueto, "The Development of Hydraulic Mortars, Cement, and Concrete in Puerto Rico", APT Bulletin International, the Journal of Preservation Technology, Spring issue, 2011, Vol. XLII, No. 1. (Mt. Ida Press. Albany, New York, 2011): 47.

[55] del Cueto, 52.
During research work and detailed field observation of the concrete blocks in various historic structures

dating to the first decade of the twentieth century, the author noted that the aggregates used in the block manufacture of each building differed considerably from one another. Some aggregates were very fine beach sands and others were courser and darker river sand. In some specific cases, the aggregates had not been cleaned of dirt or sieved from larger stone particles, which caused surface failures and irregularity of the units themselves. Some of the building sites were in close proximity to, or directly situated on the sources for these aggregates, which led to the conclusion that the fine aggregates near a building site were used in the manufacture or production the blocks. This practice was likely due to the fact that since these blocks were hand-packed and compressed within individual metal molds, they were relatively fragile and not easy to transport by the vehicles of the time or on the rudimentary road system of that period in Puerto Rico.

[56] Harmon Howard Rice. *Concrete-Block Manufacture Processes*. (New York: John Wiley & Sons, 1906): 101 and 115.

[57] del Cueto, 50-51.

[58] Antonín Nechodoma, "Plans for the McCabe Memorial Church in Playa de Ponce, Porto Rico," U.S. Dept. of the Interior, National Park Service, National Register of Historic Places Nomination, c. 1907-1908, on file at the State Historic Preservation Office of Puerto Rico, 2008.

[59] Graded School at Salinas - Construction Specifications (1907), Archivo General de Puerto Rico: Fondo: Obras Públicas, Serie: Edificios Escolares, Caja: 1047.

[60] Eight Room Public School in Vega Baja - Construction Specifications (1908), Archivo General de Puerto Rico: Fondo: Obras Públicas, Serie: Edificios Escolares, Caja: 1071.

[61] "In 1902, Robert McCarrel came to Jacksonville [Florida]…to serve as contractor for Snyder Memorial Church. A masonry expert and inventor of 'Compo Stone', a concrete formula used in making [hollow-core] concrete blocks… Nechodoma's first structures in the islands were made of Compo Stone blocks and artificial stonework. Frank Hatch, the contractor that built all Nechodoma's first buildings in Puerto Rico, was supposedly the owner of the Compo Stone manufacturing plant in Puerto Rico…" in Thomas S. Marvel, *Antonin Nechodoma, Architect, 1877-1928, The Prairie School in the Caribbean* (Gainesville: University of Florida Press, 1994): 25-32. Hatch and Nechodoma could have met McCarrel during the early-twentieth-century construction boom in Florida, having both worked there as well. The introduction to the Methodist groups that established themselves in Puerto Rico during these early periods could have happened then and there, forming a ready-made list of potential clients. There is no known record or evidence of a concrete-block plant on the island between 1906 and 1910. Physical evidence on the temples themselves -see note 55- point to the manufacture of the blocks on their individual building sites.

[62] In general see: The Methodist Archives' Mission Albums of Puerto Rico, and the Presbyterian Board of Home Missions' Annual Reports.

[63] Manse: "the house of a minister" - Merriam-Webster Online.

[64] Government of Puerto Rico, Annual Reports of the Department of the Interior, Fiscal Year ended June 30, 1906, pag. 461.

[65] Vieques Public School - Construction Specifications (1907), loose file sheet, Archivo General de Puerto Rico: Fondo: Obras Públicas, Serie: Edificios Escolares, Caja: 1074.

[66] According to the 1900 Military Census of Porto Rico -civilians, residents of the United States at Military or Naval Stations- Frank B. Hatch was a 29 year-old carpenter from Maysville, Maine, who probably came to Puerto Rico as part of the military personnel that established themselves on the Island after the Spanish-American War. He actively promoted himself five years later, through advertizing in the local press: "F.B. Hatch - Contractor and Builder; Motto: promptness and neatness" - (San Juan News, March 8, 1904 pg. 7). Biblioteca General de la Universidad de Puerto Rico, Rio Piedras campus, Colección Puertorriqueña, Historical newspapers and periodicals collection.

[67] Century Cement Machine Co. Advertizement, internet source.

[68] Narciso Arabía and Patent file granted to Succession (or Inheritors) of Narciso Arabía - Brick Factory in 1915. Archivo Histórico Municipio de Ponce, Tesorería Municipal, Fondo: Ayuntamiento, Subsección: Tesorería, Serie: Patentes 1915, Caja: F-472, Legajo: 472-10.

[69] *The Commercial Guide and Business Directory of Porto Rico - Illustrated*. (New York: F. E. Platt, 1910): 83.

[70] Harris, Rev. J. Will. "A Concrete Case - A New Industry and the Kingdom of God in a Porto Rican Town." Stories of the Field no. 1. - San Germán, Puerto Rico. New York, Board of Home Missions of the Presbyterian Church in the U.S.A. (May, 1910): 1-2.

[71] In a preservation project by the author, it was discovered that a ca.1910s residence built of ashlar-faced cement blocks had no lateral metal reinforcement, crown beams or tie-backs. The individual blocks were set one on top of the other without any columns or vertical re-bars set within the hollow block cells of the building corners, which when filled with concrete, would serve the same purpose. This type of reinforcement, or corner and lintel bracing, became a requirement for any type of cement block construction after the 1918 earthquake proved that using blocks by themselves was very unstable and unsafe.

[72] del Cueto, 47-48.

Ideal Model "A16" Block Machine
The World's Standard

Ideal Block Machines have ever been the basis of the Successful Block Manufacturing Plants.

Ideal Model "A16" Block Machine, as shown in illustration above, is shipped complete, including face plates and all parts necessary for making blocks.

The Ideal Block Machine makes all the blocks for a house.

There are more Ideal Block Machines in use than of all other kinds combined.

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They are the fastest machines to be had.

They are portable and convenient.

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They are complete units — all parts are interchangeable.

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Through the Service Department of the Ideal Concrete Machinery Company, new manufacturers are given valuable assistance which enables them to manufacture a product equal to that of the large and long established plants.

They help you to select the most suitable machine and equipment necessary for the making of any kind of block or brick, as well as ornamental shapes.

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What Others Have Done You Can Do

GENERAL INFORMATION ON The Making of Concrete Building Materials
Sears, Roebuck and Co. Chicago, Illinois

THIS General Information Book which we furnish free with our concrete machinery tells you everything you need know to successfully make concrete products. Furthermore, our expert will cheerfully answer any questions you may want to ask in reference to this subject, so you may feel doubly sure of successfully making perfect products. The letters and pictures shown below and many others shown throughout this book demonstrate what inexperienced men have done.

We receive a great many orders from our customers who already have this General Information Book and we therefore furnish the book only when asked for, merely as a matter of economy. If you wish a copy please mention in your order that you would like a General Information Book on Concrete Product Manufacture and it will be included free of charge.

Our Wizard Block Machine Entirely Satisfactory

Coon Rapids, Iowa.

Sears, Roebuck and Co., Chicago, Ill.

Gentlemen:—The Wizard Concrete Block Machine I got of you some time ago was entirely satisfactory. Enclosed you will find a photograph of a house I built from blocks I made with the Wizard Block Machine.

Yours truly,
H. BRUTSCHE.

This Nice Home Built by Amateurs

You Can Do as Well by Following Our "Easy to Follow" Directions.

Moscow, Idaho.

Sears, Roebuck and Co., Chicago, Ill.

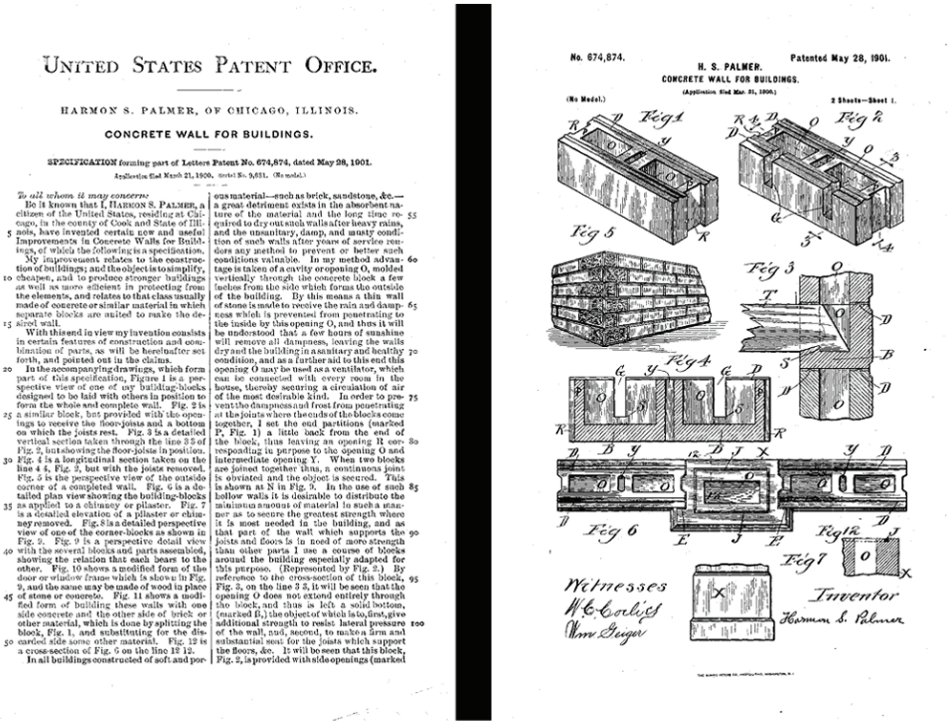
Gentlemen:—I am sending photograph of concrete block house made with your Wizard Concrete Block Machine. I am disappointed in the photograph, as it does not show the blocks as they are. The light was too bright in front of us when it was taken and shadows the blocks. This house was built by amateurs, as my sons and I had never before worked with cement in any way. We made our own blocks and also laid them up. We haven't our steps and walks in yet as we are farmers and have other work to do.

Yours respectfully,
H. W. MALLERY.

SEARS, ROEBUCK AND CO., CHICAGO, ILLINOIS.

Speed, economy and effectiveness marked early Portland cement products, such as the concrete or cement block, a true artificial stone; an economical and reliable 'imitation' building material.

(Ideal Concrete Machinery Catalog, Cincinatti, Ohio, ca. 1908; and Sears, Roebuck and Company. *Catalogue of Cement block machines : cement brick machines, concrete mixers, etc. sold exclusively by Sears, Roebuck & Co., Chicago, Illinois.* (Chicago, Illinois: The Co., 1907).



UNITED STATES PATENT OFFICE.

HARMON S. PALMER, OF CHICAGO, ILLINOIS.

CONCRETE WALL FOR BUILDINGS.

SPECIFICATION forming part of Letters Patent No. 674,874, dated May 28, 1901.

Application filed March 21, 1900. Serial No. 9,631. (No model.)

To all whom it may concern:

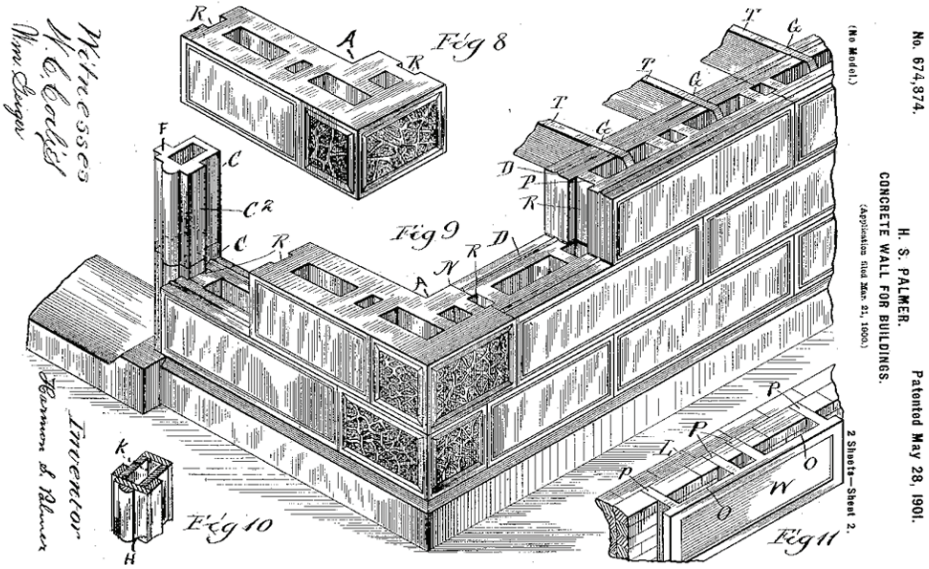
Be it known that I, HARMON S. PALMER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Concrete Walls for Buildings, of which the following is a specification.

My improvement relates to the construction of buildings; and the object is to simplify, cheapen, and to produce stronger buildings as well as more efficient in protecting from the elements, and relates to that class usually made of concrete or similar material in which separate blocks are suited to make the desired wall.

With this end in view my invention consists in certain features of construction and combination of parts, as will be hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, which form part of this specification, Figure 1 is a perspective view of one of my building-blocks designed to be laid with others in position to form the whole and complete wall. Fig. 2 is a similar block, but provided with the openings to receive the floor-joists and a bottom on which the joists rest. Fig. 3 is a detailed vertical section taken through the line 3 3 of Fig. 2, but showing the floor-joists in position. Fig. 4 is a longitudinal section taken on the line 4 4, Fig. 2, but with the joists removed. Fig. 5 is the perspective view of the outside corner of a completed wall. Fig. 6 is a detailed plan view showing the building-blocks as applied to a chimney or pilaster. Fig. 7 is a detailed elevation of a pilaster or chimney removed. Fig. 8 is a detailed perspective view of one of the corner-blocks as shown in Fig. 9. Fig. 9 is a perspective detail view with the several blocks and parts assembled, showing the relation that each bears to the other. Fig. 10 shows a modified form of the door or window frame which is shown in Fig. 9, and the same may be made of wood in place of stone or concrete. Fig. 11 shows a modified form of building these walls with one side concrete and the other side of brick or other material, which is done by splitting the block, Fig. 1, and substituting for the discarded side some other material. Fig. 12 is a cross-section of Fig. 5 on the line 12 12.

In all buildings constructed of soft and porous material—such as brick, sandstone, &c.—a great detriment exists in the absorbent nature of the material and the long time required to dry out such walls after heavy rains, and the unsanitary, damp, and musty condition of such walls after years of service renders any method to prevent or better such conditions valuable. In my method advantage is taken of a cavity or opening O, molded vertically through the concrete block a few inches from the side which forms the outside of the building. By this means a thin wall of stone is made to receive the rain and dampness which is prevented from penetrating to the inside by this opening O, and thus it will be understood that a few hours of sunshine will remove all dampness, leaving the walls dry and the building in a sanitary and healthy condition, and as a further aid to this end this opening O may be used as a ventilator, which can be connected with every room in the house, thereby securing a circulation of air of the most desirable kind. In order to prevent the dampness and frost from penetrating at the joints where the ends of the blocks come together, I set the end partitions (marked P, Fig. 1) a little back from the end of the block, thus leaving an opening H corresponding in purpose to the opening O and intermediate opening Y. When two blocks are joined together thus, a continuous joint is obviated and the object is secured. This is shown at N in Fig. 9. In the use of such hollow walls it is desirable to distribute the minimum amount of material in such a manner as to secure the greatest strength where it is most needed in the building, and as that part of the wall which supports the joists and floors is in need of more strength than other parts I use a course of blocks around the building especially adapted for this purpose. (Represented by Fig. 2.) By reference to the cross-section of this block, Fig. 3, on the line 3 3, it will be seen that the opening O does not extend entirely through the block, and thus is left a solid bottom, (marked B,) the object of which is to, first, give additional strength to resist lateral pressure of the wall, and, second, to make a firm and substantial seat for the joists which support the floors, &c. It will be seen that this block, Fig. 2, is provided with side openings (marked



The period from 1900-1905 in the United States was marked by experimentation, testing, and the race for patents such as those by Harmon S. Palmer, credited with the first concrete block manufacturing process that became feasible and widespread. His U.S. patent was granted in 1900.

(Simpson, Pamela H. *Cheap, Quick & Easy - Imitative Architectural Materials, 1870-1930.* (Knoxville: The University of Tennessee Press, 1999).

PRACTICAL CONCRETE-BLOCK MAKING 17

facing, so as to effect a bond to prevent its peeling off.

In the wet process, the amount of water used is such as will produce a plastic or flowing condition in the concrete, but not enough to wash the cement from the other material. When placing this material in the molds, fill the

Fig. 4

entire mold with one pouring. It is well to cover the face of the mold with shellac, crude oil, or a solution of gasoline and paraffin, so that the block may be easily removed from the face of the mold without injury, as when the cement is mixed

18 PRACTICAL CONCRETE-BLOCK MAKING

Through the kindness of the Miracle Pressed Stone Company of Minneapolis, Figs. 4, 5, 6, and 7 are given,

Fig. 5

which show the operations very clearly.

Concrete blocks are most economically made by employ-

PRACTICAL CONCRETE-BLOCK MAKING 19

ing three men, one to do the mixing and the other two to attend to the making of the block. However, the process is simple enough, so that two or even one man can do the job.

The mixture is shoveled into the mold as shown in Fig.

Fig. 6

4, and tamped as shown in Fig. 5. As soon as the mold is full, it is floated off, that is, all the surplus material is pushed off as shown in Fig. 6, so that the top is level.

After this operation the block has set enough so as to

20 PRACTICAL CONCRETE-BLOCK MAKING

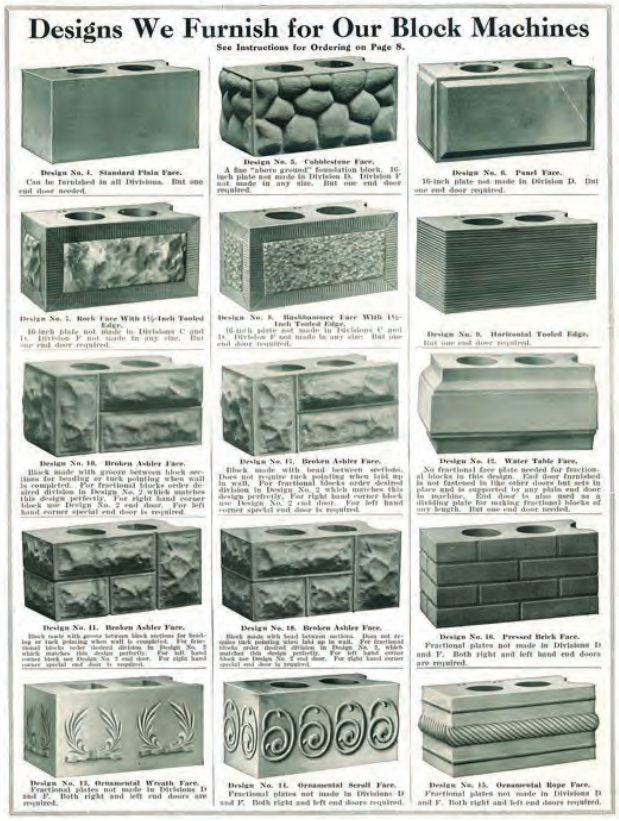
removed from the mold. To do this the cores and sides are removed and the block allowed to rest on the bottom.

Fig. 7

The sides are then formed together again and placed on a new bottom, and the process repeated for the next block.

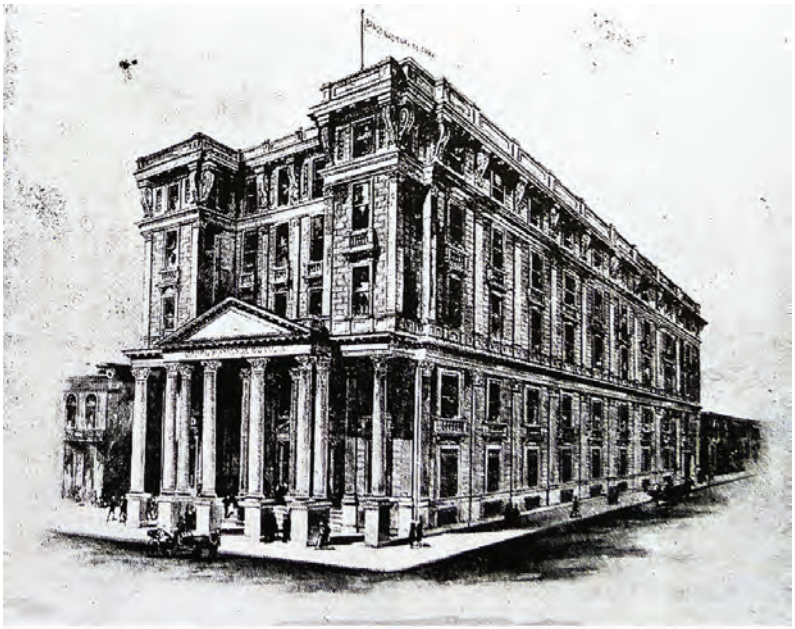
The new blocks could be quickly hand-made on the project site within metal molds, (by inexperienced hands) required no ovens or large equipment, were easily stored, and ready for installation within a month.

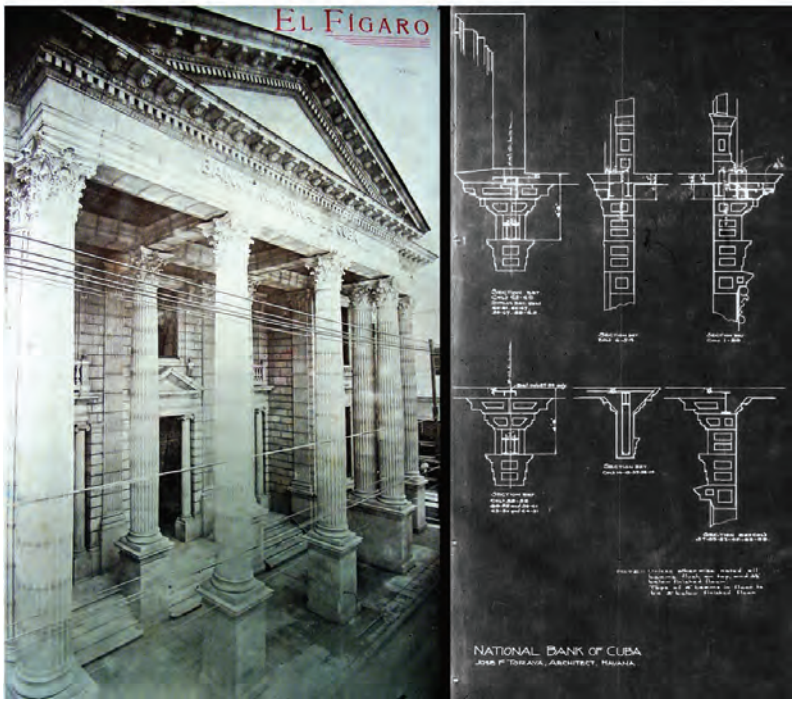
(Torrance, William M. *The Manufacture of Concrete Blocks and their use in Building Construction,* Second Prize in Engineering News Competition of 1905. (New York: The Engineering News Publishing Company, 1906); Radford, William A. *Cement Houses and how to build them*. (Chicago, Illinois: Radford Architectural Co., 1909); and Pallister, Charles. *Practical Concrete-Block Making*. (New York: Industrial Publication Company, 1908).



4 - **By 1907, Sears Roebuck & Co. boasted several concrete block models and tools. These ads converted the concrete block into a household name, being advertised as more economical than wood, brick or stone, and more importantly, a fireproof building material.**

(Sears, Roebuck and Company. *Catalogue of Cement block machines : cement brick machines, concrete mixers, etc. sold exclusively by Sears, Roebuck & Co., Chicago, Illinois.* (Chicago, Illinois: The Co., 1907)





Cuba seems to be the first country in the Spanish Caribbean to have used concrete block as a building material with the establishment of a Cuban branch of the New York firm of Purdy & Henderson. Amongst their earliest projects using this building material were several steel frame and concrete block structures in La Habana built as early as 1901. The National Bank of Cuba, Havana branch, 1904.
(*El "Libro Azul" de Cuba (The "Blue Book" of Cuba).* "Cuba 1917-1918". (La Habana: Compañía Biográfi a, S.A., 1918): 159; El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba), 1907; and Microfilm collection of the Purdy & Henderson construction drawings of Cuban projects, Office of Metropolitan History, New York)

Purdy & Henderson were the structural engineers and builders for the first Cuban Branches of the Royal Bank of Canada (throughout Cuba)and the Banco Nacional de Cuba. The Royal Bank of Canada, Havana Branch, 1903.

(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba), "Vista Exterior del Edificio del Royal Bank of Canada de La Habana" [Exterior View of the Royal Bank of Canada building in Havana], (January 31, 1904): 61)

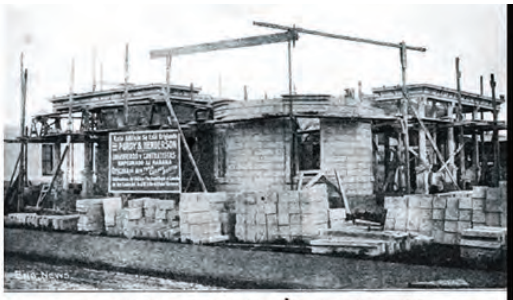


PLATE XVI. Havana Residence Under Construction of Concrete Blocks.

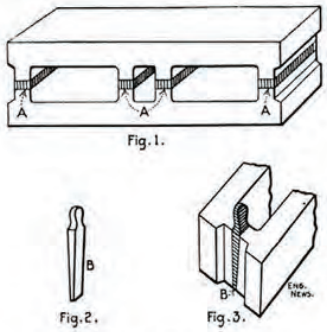


PLATE IV. Purdy & Henderson's Plan for Making Waterproof Blocks.

PLATE XIV. Miramar Hotel, Havana, Cuba. Built by Concrete Blocks by Purdy & Henderson.

THE CUBA REVIEW

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IVE STOCK

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The Miramar Hotel (1903) was one of their earliest steel frame and concrete block buildings in Cuba. The firm had invented an innovative concrete block which included a central water-proof barrier and used it for their projects in Cuba procuring a patent there as well.

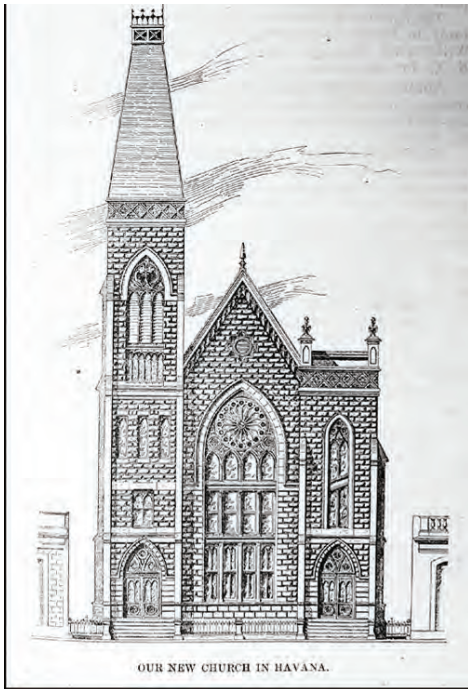
(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "Crónica" - Hotel Miramar, (October 18, 1903): 523; Torrance, William M. *The Manufacture of Concrete Blocks and their use in Building Construction,* Second Prize in Engineering News Competition of 1905. (New York: The Engineering News Publishing Company, 1906); The Cuba Review and Bulletin Advertiseme t: *Máquinas para hacer Bloques de Cemento* [Machines to make cement block]. Vol. IX No. 7, (New York: Munson Steamship Line, June 1911): 28; and Photo by the author, 2015)

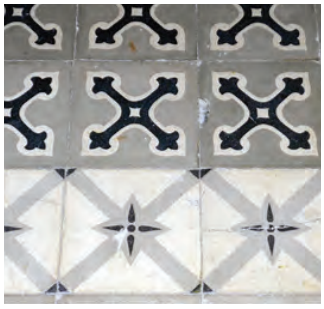
The Rubens Palace was completed ca. 1905 on a prominent hilltop in the town of Mariel, Cuba.

(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "El Palacio de Mr. Horacio Rubens en el Mariel" [Mr. Horatio Rubens Palace in Mariel], (September 9, 1906): 461)

The monumental height and volume of the Ruben's building, which was composed of Portland cement molded and pre-fabricated architectural elements, included concrete block as structural walls which were reinforced internally with steel rods. The blocks diminish in size as the building rises in height.

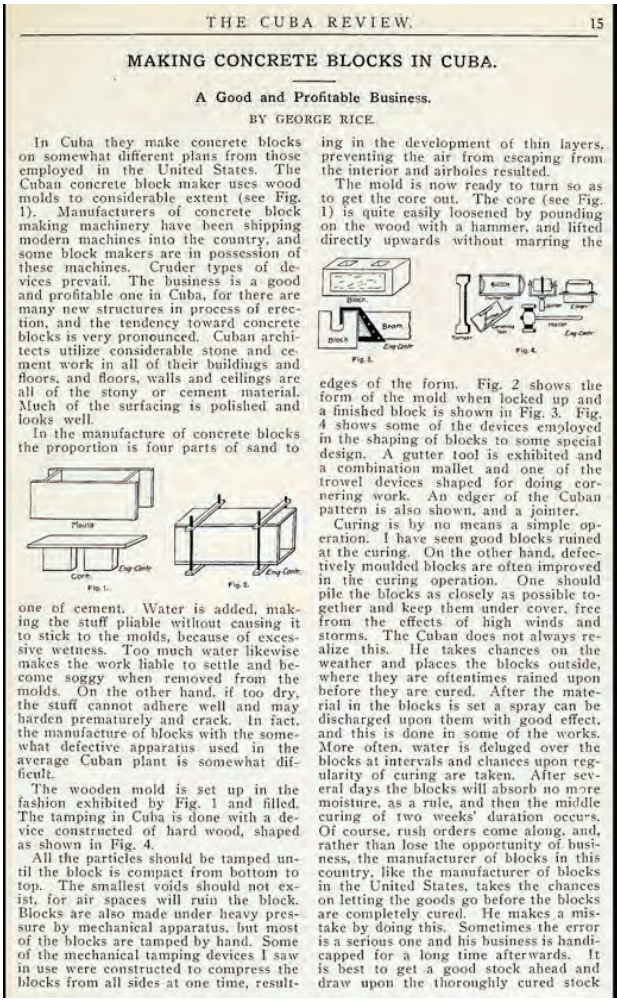
(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "The Leper Hospital's New Site". Vol. V No. 11, (New York: Munson Steamship Line, October 1907): 15; and "Excursión al Mariel" [Mariel Excursion], (March 30, 1909): 278-279; and Rodríguez, Eduardo Luis. *La Habana: arquitectura del siglo XX* [Havana: 20th century architecture]. (Barcelona: Art Blume, S.L., 1998)





Other early concrete-block structures in Cuba were directly associated with the Protestant religious groups that came from the U.S. such as La Habana's Presbyterian church inaugurated in 1906, and the Methodist Church in Cienfuegos, inaugurated in 1908.

(Melero-Lazo, Nelson. "La Iglesia Presbiteriana de La Habana" [The Presbyterian Church of Havana]. Unpublished manuscript, La Habana, 2014; *Impresiones de la República de Cuba en el Siglo Veinte* [Impressions of the Cuban Republic in the Twenti th Century]. (London: Lloyds Greater Britain Publishing Company, Ltd., 1913): 409, 460, 482, 512; and Board of Home Missions Annual Reports. New York: Presbyterian Church in the United States of America, 1898: 9-10; 1907: 47)



THE CUBA REVIEW. 15

MAKING CONCRETE BLOCKS IN CUBA.

A Good and Profitable Business.

BY GEORGE RICE.

In Cuba they make concrete blocks on somewhat different plans from those employed in the United States. The Cuban concrete block maker uses wood molds to considerable extent (see Fig. 1). Manufacturers of concrete block making machinery have been shipping modern machines into the country, and some block makers are in possession of these machines. Cruder types of devices prevail. The business is a good and profitable one in Cuba, for there are many new structures in process of erection, and the tendency toward concrete blocks is very pronounced. Cuban architects utilize considerable stone and cement work in all of their buildings and floors, and floors, walls and ceilings are all of the stony or cement material. Much of the surfacing is polished and looks well.

In the manufacture of concrete blocks the proportion is four parts of sand to one of cement. Water is added, making the stuff pliable without causing it to stick to the molds, because of excessive wetness. Too much water likewise makes the work liable to settle and become soggy when removed from the molds. On the other hand, if too dry, the stuff cannot adhere well and may harden prematurely and crack. In fact, the manufacture of blocks with the somewhat defective apparatus used in the average Cuban plant is somewhat difficult.

The wooden mold is set up in the fashion exhibited by Fig. 1 and filled. The tamping in Cuba is done with a device constructed of hard wood, shaped as shown in Fig. 4.

All the particles should be tamped until the block is compact from bottom to top. The smallest voids should not exist, for air spaces will ruin the block. Blocks are also made under heavy pressure by mechanical apparatus, but most of the blocks are tamped by hand. Some of the mechanical tamping devices I saw in use were constructed to compress the blocks from all sides at one time, resulting in the development of thin layers, preventing the air from escaping from the interior and airholes resulted.

The mold is now ready to turn so as to get the core out. The core (see Fig. 1) is quite easily loosened by pounding on the wood with a hammer, and lifted directly upwards without marring the edges of the form. Fig. 2 shows the form of the mold when locked up and a finished block is shown in Fig. 3. Fig. 4 shows some of the devices employed in the shaping of blocks to some special design. A gutter tool is exhibited and a combination mallet and one of the trowel devices shaped for doing cornering work. An edger of the Cuban pattern is also shown, and a jointer.

Curing is by no means a simple operation. I have seen good blocks ruined at the curing. On the other hand, defectively moulded blocks are often improved in the curing operation. One should pile the blocks as closely as possible together and keep them under cover, free from the effects of high winds and storms. The Cuban does not always realize this. He takes chances on the weather and places the blocks outside, where they are oftentimes rained upon before they are cured. After the material in the blocks is set a spray can be discharged upon them with good effect, and this is done in some of the works. More often, water is deluged over the blocks at intervals and chances upon regularity of curing are taken. After several days the blocks will absorb no more moisture, as a rule, and then the middle curing of two weeks' daration occurs. Of course, rush orders come along, and, rather than lose the opportunity of business, the manufacturer of blocks in this country, like the manufacturer of blocks in the United States, takes the chances on letting the goods go before the blocks are completely cured. He makes a mistake by doing this. Sometimes the error is a serious one and his business is handicapped for a long time afterwards. It is best to get a good stock ahead and draw upon the thoroughly cured stock

Wooden molds were used to fabricate concrete blocks in Cuba instead of the metal molds used in the United States.

The Cuba Review and Bulletin "Making Concrete Blocks in Cuba". Vol. VI No. 8, (New York: Munson Steamship Line, July 1908): 15-16.

BLOCKS DE CEMENTO GELABERT

Nuestra Exposición Nacional ha tenido la magia de ser reveladora, para el inmenso público, de notabilísimos progresos realizados en nuestro medio y de más de una industria artística que se ha mantenido hasta ahora sin ser admirada por el país entero y por el gran nucleo de extranjeros que son nuestros habituales huéspedes en determinadas épocas del año.

Entre estas industrias, una de las que más han llamado la atención por sus méritos é importancia, consiste en la fabricación de blocks de cemento y adornos arquitectónicos fundidos en arena y á presión, con patente cubana, que en nuestra era, que pudieramos llamar del vértigo de la piedra, por el notabilísimo incremento que ha tomado la fabricación entre nosotros, resuelven un importantísimo problema, cual es el de aunar el arte y la economía puestos al servicio de los conocimientos profesionales de un distinguido arquitecto, pues el Sr. Antonio Gelabert, dueño de la importante industria á que nos referimos, goza de grandes prestigios como tal.

Obras de dicho señor, y que garantizan lo que dejamos dicho, son construcciones tan bellas como el pabellón de las Villas de la propia Exposición, de 72 metros cuadrados de dimensión; el edificio de la Colonia Española de Sagua, é infinidad de preciosos chalets en el Vedado y en la Víbora.

Los materiales con que han sido construidos el pabellón del Consejo Provincial de la Habana y otras varias obras de la Exposición, han procedido igualmente de la fábrica mencionada.

Y como complemento de sus labores en nuestro Certamen, figura en él una notable instalación del propio señor Antonio Gelabert, en que se exhiben los materiales de su fábrica, tales como tubos y tanques de cemento de varias formas y tamaños, figuras de ornamentación de gran realce y una hermosísima colección de fotografías de los diversos edificios construidos por el citado laborioso arquitecto y con materiales de su importante y muy acreditada industria.

INSTALACIÓN DE MUESTRAS DE BLOQUES Y ORNAMENTACIÓN DE CEMENTO DEL SR. ANTONIO GELABERT.

La enorme concurrencia que ha desfilado por las hermosas avenidas de la Exposición, ha tributado sinceros y entusiastas elogios, tanto á la instalación del señor Gelabert como á las obras por él realizadas en aquel bello recinto.

El Fígaro se hace eco de esos entusiásticos elogios y á ellos une los suyos á la vez que desea al notable arquitecto Sr. Antonio Gelabert que siga obteniendo, como hasta ahora, los mayores éxitos con sus blocks de cemento y demás productos de su acreditada fábrica.

The 1911 Cuban National Exposition presented ready-made building materials such as concrete block. Amongst the most productive manufacturer was Architect Antonio Gelabert who described his enterprise "as the only factory (of its kind) with a Cuban patent".

(El Fígaro - Revista Universal Ilustrada [Universal Ilustrated Magazine] (La Habana, Cuba) "Blocks de Cemento - Gelabert" [Cement Blocks - Gelabert, (February 29, 1911): 133)

Chalet propiedad del Sr. Amadeo Rodriguez, que obtuvo el premio ofrecido por nuestro Ayuntamiento.

Simulated or imitation lime-plastered representations of stone masonry in a Dominican Republic where brick residences were often interpreted as ashlar masonry construction to the untrained eye.
(Photos by author, 2014; and Archivo General de la Nación Photographs collection

The Michelena residence seems to be the first concrete block building in Santo Domingo (1912). It was designed by Architect Antonín Nechodoma and possibly built by Frank B. Hatch, both firms from Puerto Rico.

(*El Libro Azul de Santo Domingo (The Dominican Blue Book)*. New York: Compañía Biográfi a, subsidiary of the Pan-American Publicity Corporation, 1920, re-edited in 1976; Archivo General de la Nación Photographs collection; and the Listín Diario newspaper editions of 1919 for the advertiseme ts)

Various concrete block residences and institutional buildings followed closely behind, as Portland cement molded architectural element manufacturers became established throughout the Dominican Republic during the 1920s.

(Archivo General de la Nación Photographs collection

A major hurricane destroyed nearly all building types in the capital city of Santo Domingo in 1930, except those built in concrete block, which further promoted their use.

(Archivo General de la Nación Photographs collection

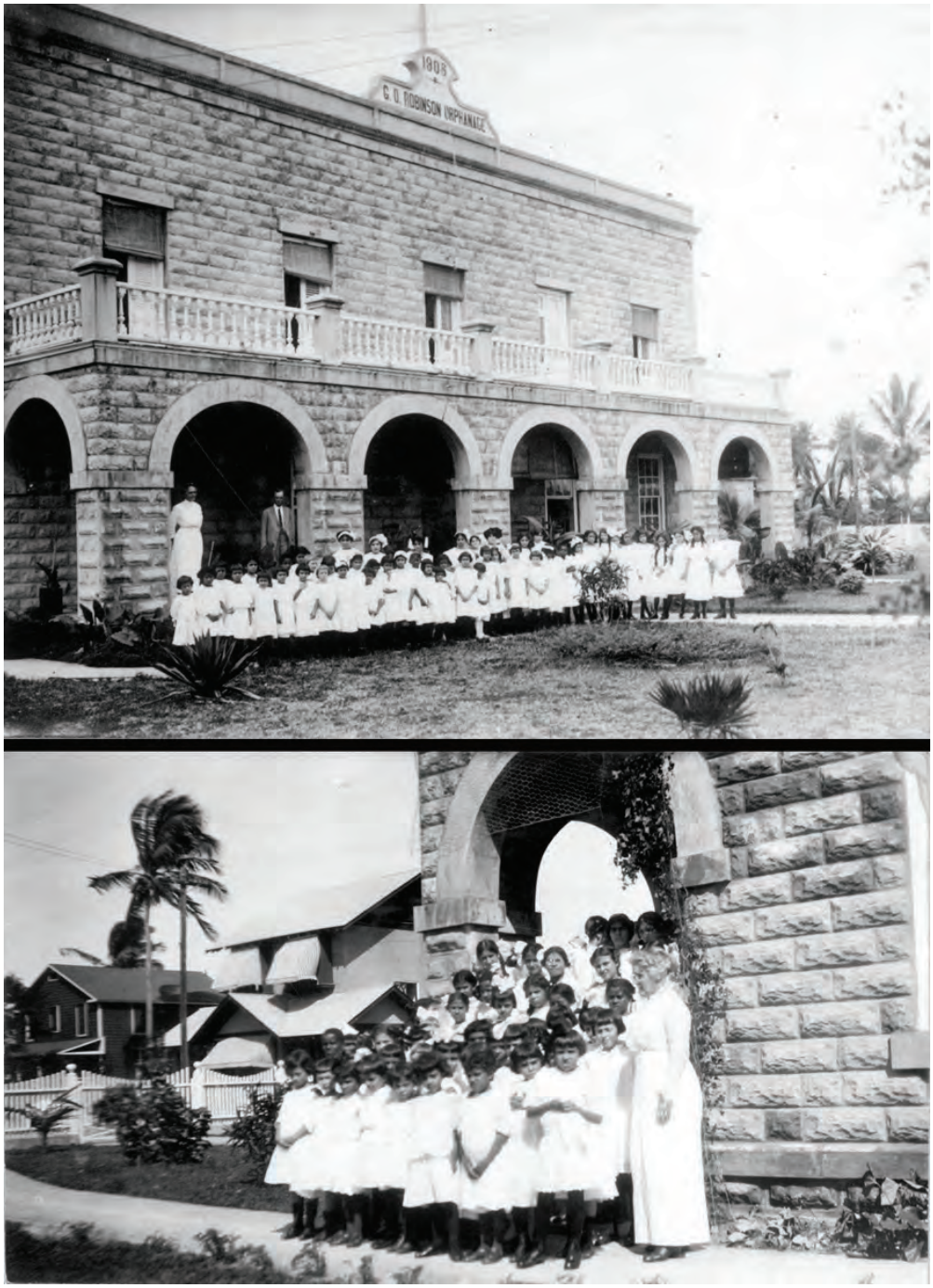
Reconstruction housing after the hurricane's destruction incorporated iron-rod reinforced concrete block walls, reinforced concrete slabs for floors and roofs, as well as hydraulic mosaic pavements.

(Photos by the author, 2014)

Reconstruction housing after the hurricane's destruction incorporated iron-rod reinforced concrete block walls, reinforced concrete slabs for floors and roofs, as well as hydraulic mosaic pavements.

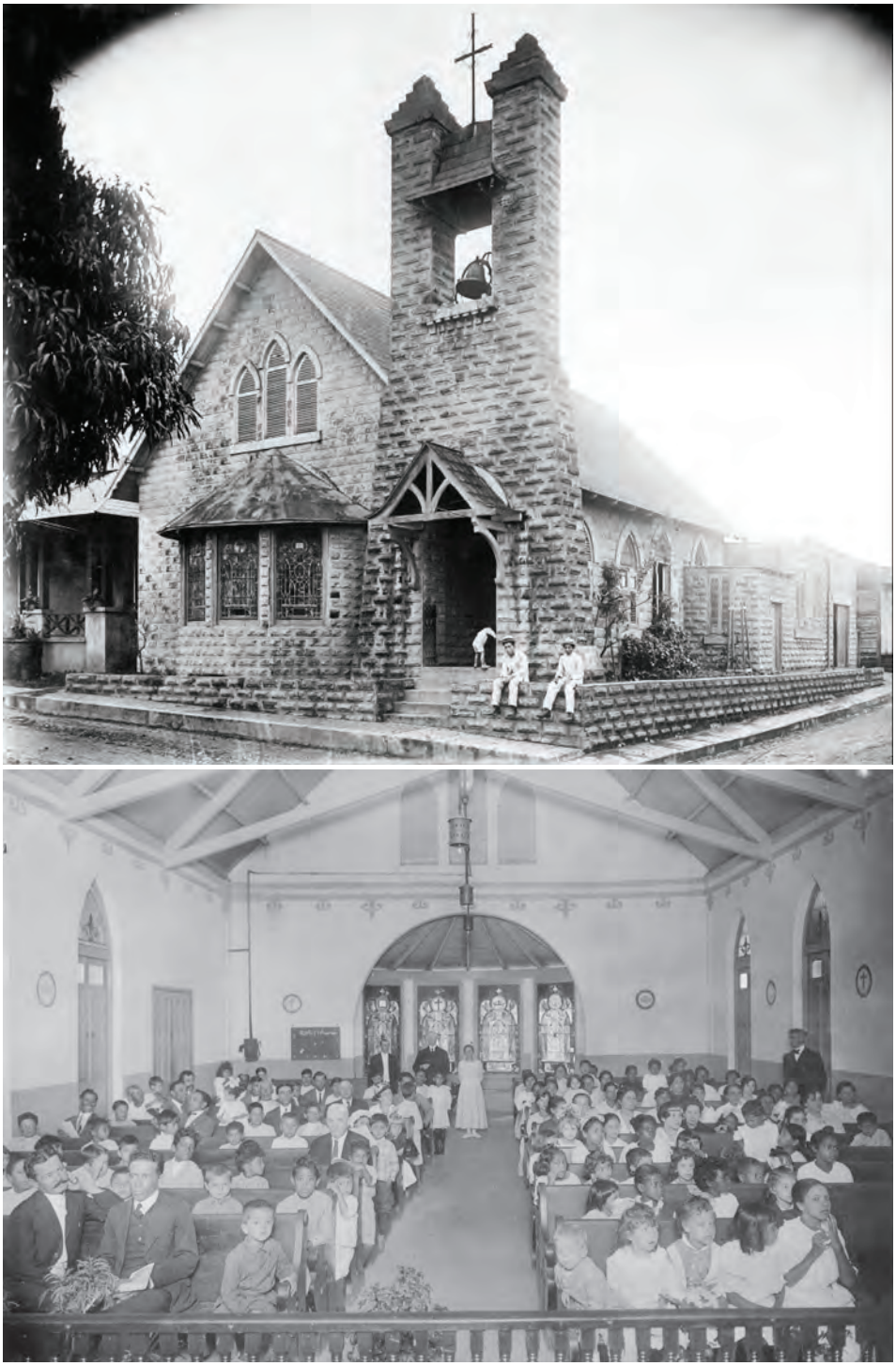
(Photos by the author, 2014)

After the Spanish-American War, North-Americans came to Puerto Rico and undertook an island-wide ambitious construction program of roads, bridges and schools. Around 1905, metal molds for hollow-core concrete blocks were most likely brought to the Island by Protestant Missionaries in order to expedite the construction of their new churches and hospitals.
(National Archives and Records Administration, Photograph and Prints Division, Records of the Bureau of Insular Affairs – General Photographs of Cuba and Puerto Rico, 1899-1928: Box RG 350-PR-44A-1-9, College Park, Maryland; and the Methodist Archives' Mission Albums of Porto Rico)

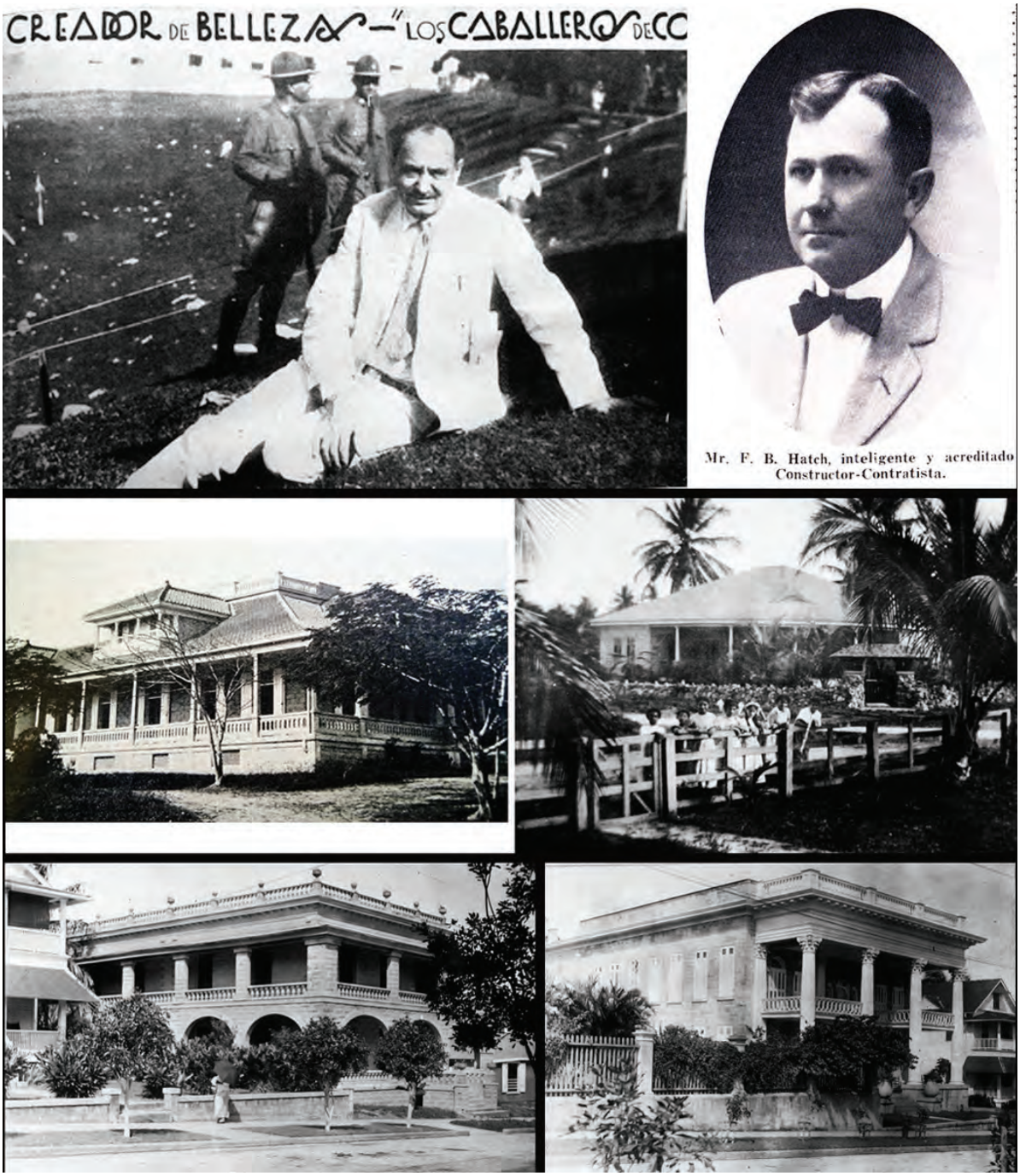


The Robinson Orphanage for girls was the first concrete-block structure built in Puerto Rico during 1905-06 at a cost of $11,000.

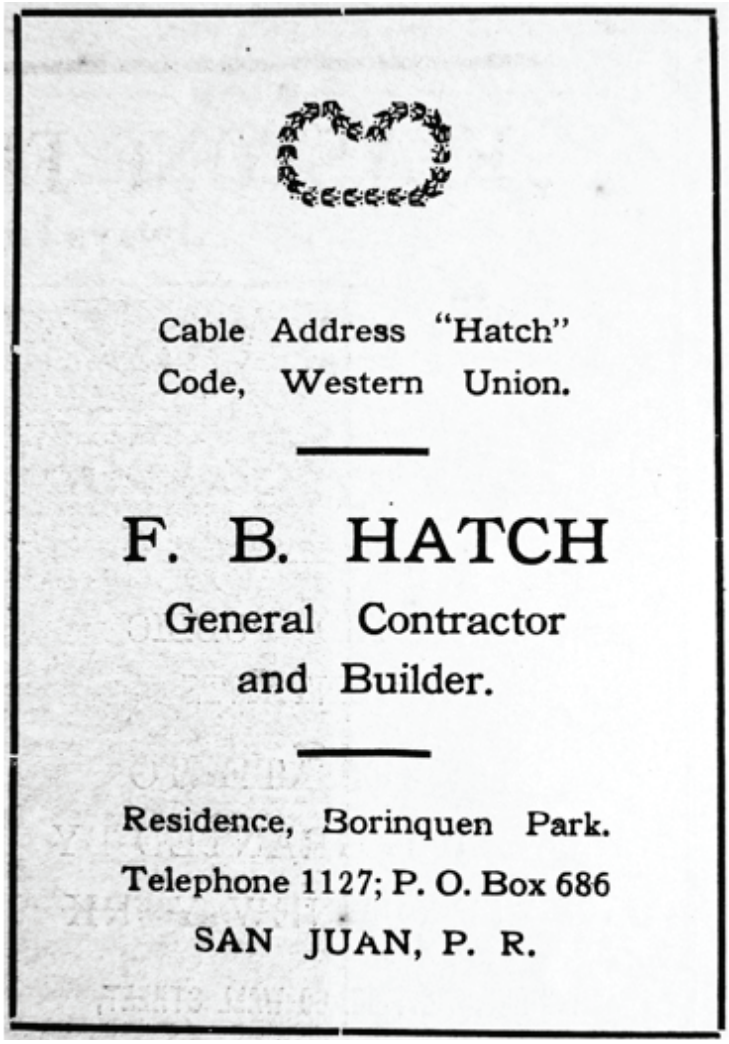
(The Methodist Archives' Mission Albums of Porto Rico)



The Collins Methodist Episcopal Church in Aibonito built during 1906-07 was the second concrete-block structure constructed in Puerto Rico.
(The Methodist Archives' Mission Albums of Porto Rico)



Most of the early Methodist buildings in Puerto Rico were designed by Architect Antonín Nechodoma and built by Frank Bond Hatch. As a team, they produced most of the types of concrete-block structures between 1906-1915.

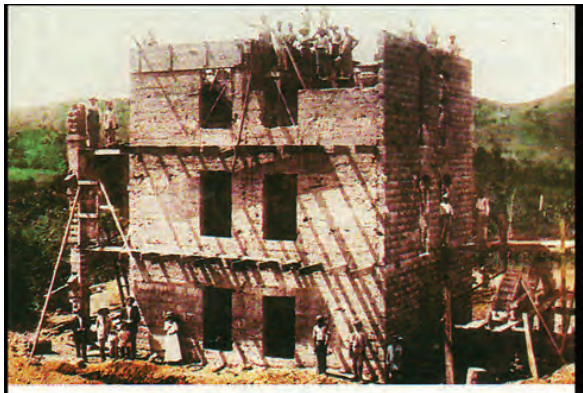


Most of the early Methodist buildings in Puerto Rico were designed by Architect Antonín Nechodoma and built by Frank Bond Hatch. As a team, they produced most of the types of concrete-block structures between 1906-1915.

(Anónimo. *Puerto Rico Ilustrado*, Año XVI, no. 719 (diciembre 8, 1923) and Año XIX, no. 946 (abril 21,1928) ; Fernández y García, Eugenio. El Libro de Puerto Rico - The Book of Puerto Rico. (San Juan: El Libro Azul Publishing Company, 1923); Archivo General de Puerto Rico, Archivo Fotográfi o, Photos no. PR AGPR Adq.91-18-32 ; San Juan Porto Rico in the Isle of Enchantment, 1916; and Archivo Histórico y Fotográfi o de Puerto Rico, Rodríguez Archives, LLC, Jose Luis Rodríguez: http:/ archivofotografi odepuertorico.com/)

Public School at Viequez, Porto Rico. F. B. Hatch, Builder.
"Hercules" Stone is used exclusively by Porto Rican Board of Education.

Public Schools of Puerto Rico were designed by architects from their Department of the Interior. Amongst the earliest school buildings to use rock and plain faced concrete block were the Salinas Graded School and the Vieques Public school, both dating from 1907.
(El Gráfi o illustrated magazine, 1914; and Vieques Public School Construction Specifications (1907), Archivo General de Puerto Rico - Fondo: Obras Públicas, Serie: Edificios Escolares, Caja: 1074)



Construcción de la primera residencia de varones (Harris Hall)

No. 1 *STORIES OF THE FIELD* No. 1

A CONCRETE CASE

A New Industry and the Kingdom of God in a Porto Rican Town

By Rev. J. WILL HARRIS
San German, P. R.

Presbyterian Church and Manse, San German, P. R.
Extreme dimensions of church, 44 feet wide, 80 feet long
Seating capacity, 475. Built of concrete blocks

"He is *loco!*"
"Who?"
"That Protestant priest. He says he is going to make a church out of sand and cement. He made some big bricks today and they are soft! He is crazy."

"No," I replied, "not till to-night."
His face fell.
"I came from that mountain side over there. The road is so bad no one can pass after dark. Will you sing here Sunday night?"
"Yes."
"Good! Then I shall come Sunday and spend the night here so I can go to service. We are in the darkness up where

Presbyterian Church and Manse, San German, P. R.
Dimension of manse, 42 feet long, 34 feet wide. Nine rooms and bath

I live. I am searching for light and I wish to hear what you have to say here."
Another—a lady of high standing in the Romish Church who has renounced the evils practiced therein—said to us one evening as we were returning from a cottage prayer-meeting:

The Presbyterian Mission established the Polytechnic Institute of Porto Rico in San Germán circa 1910. Hand-manufactured cement blocks and the construction of the campus buildings themselves were required activities of the young men, as part of student training.

(Feliciano-Ramos, Héctor R. *Historia de la Universidad Interamericana de Puerto Rico, Primera Parte - El Instituto Politécnico, 1911-1956* [History of the Interamerican University of Puerto Rico, First Part - The Polytechnic Institu e, 1911-1956]. (San Germán, Universidad Interamericana de Puerto Rico, 1993; The Methodist Archives' Mission Albums of Porto Rico; and Harris, Rev. J. Will. "A Concrete Case - A New Industry and the Kingdom of God in a Porto Rican Town." Stories of the Field no. 1. - San Germán, Puerto Rico. New York, Board of Home Missions of the Presbyterian Church in the U.S.A. (May, 1910): 1-2)

The use of concrete block had its heyday in Puerto Rico from 1905- 1915, since a significant number of building types were constructed with blocks during this period.

Archivo Histórico y Fotográfi o de Puerto Rico, Rodríguez Archives, LLC, Jose Luis Rodríguez: http:/ archivofotografi odepuertorico.com/)

PONCE MOSAIC CO.

Ponce, Puerto Rico. Oficina: Sol St. extremo Este.

INDUSTRIA GENUINAMENTE PUERTORRIQUEÑA

Fabricantes de Mosaicos, Piedras Artificiales, Imitaciones de Marmol, Esculturas y toda clase de OBRAS DE CERAMICA.

¡NO MAS PISOS DE MADERA!

Empleamos los mejores materiales alemanes y Cemento "Edison" que esta reputado como el mas excelente.

No compre para el piso y adornos de su casa otros productos que los nuestros. Son los mejores del mundo.

ESCOJA SUS DIBUJOS Y COLORES.

Resistencia, Elegancia y Baratura: Ese es nuestro lema.

The Ponce Mosaic Company has been the only reference found regarding Puerto Rican Industries that would have manufactured ornamental molded architectural materials made with Portland cement.

(*Puerto Rico Ilustrado*, Año XIX, no. 946 (abril 21,1928); and Photo in Ponce by author, 2014)

Passion for the use of concrete block quickly died down in the Spanish Caribbean after 1915, due to the preferred use of reinforced concrete.

(Photos by the author, 2014-2015)

Present State - Preservation / Conservation

"It's not good because it is old, it's old because it's good."[1]

Turn of the (19th-20th) century building technologies have been understudied, specifically in the tropical Spanish Caribbean. Structures from this period that have survived have been, for the most part, neglected, ignored, or ultimately demolished either for lack of historic relevance or as a result of the ever-changing architectural tastes. This has occurred in spite of the durability and relatively un-scathed condition of many of these structures, precisely due to their building components which were manufactured with Portland cement. Common building materials of that period, such as the rock-faced concrete block, have sometimes unfortunately been either stuccoed-over or completely engulfed by "remodeling". The "old-fashioned" pavements with intricate patterns provided by the hydraulic cement mosaics have also been covered-over with newer flooring materials such as rugs or ceramic tiles of all sorts. Most often, the discovery and salvage of these distinctive architectural elements has been a consequence of work during contemporary interventions into historic buildings.

From a very general point of view, most of the cement tile pavements, as well as concrete-block structures from these dates, appear to be intact due to their continued use and maintenance. Nevertheless, without the benefit of a detailed inspection and a thorough Existing Conditions Survey one cannot assess, with exact precision, the present state of a building or its materials. Maintenance procedures, however, could be as simple as those specified when the materials were installed: continued cleaning and the seasonal repair of obvious problems with uncomplicated procedures. Reinforced concrete structures of the same dates exhibit rapid disrepair in the tropical climates and salty ocean air prevalent in our region, mostly due to the deterioration of reinforcement rods (sometimes installed too close to the surface) and subsequent cracking and spalling of the cement surfaces. Unlike temperate climates in which the freeze-thaw cycle has significant effects on building conservation, the tropics benefit from a relatively more constant thermal condition. Clearly, the hydraulic mosaic tile and concrete block also weather much better if the original fabrication methods and raw materials used were appropriate, and if these were installed correctly.

Historic Specifications - maintenance and cleaning procedures

The present research project has found that original documents still exist which specified the procedures to clean, protect and maintain or conserve the finished surfaces of the two Portland cement architectural elements which are the focus of this research - the hydraulic cement tile and cement or concrete block. These historic texts have been included, and cited as follows, in order to compare what was specified at the beginning of the 20th century and their present-day relevance in the conservation community.

Hydraulic Mosaics

Maintenance or conservation recommendations were reproduced in the original tile catalogs that advertised the paving material. The general recommendations were very similar amongst the different tile companies and did not require specialized installers. The following guidelines were included in the *Falcó y Vilella* Hydraulic Mosaics Catalog from Barcelona, dated 1921, and *La Cubana - Fábrica de Mosaicos Hidráulicos* catalog from Cuba (no date) under the segment titled: "Instructions and Observations". It represents an example of the typical technical literature originally included and distributed with these tiles in the Old as well as in the New Worlds:

> Conservation
>
> The main basis for the conservation of hydraulic flooring is cleanliness.
> Newly laid pavements generally appear uneven in color with white spots, which are produced by greater or lesser moisture which is initially retained by the tiles and the Portland cement salts which purge themselves [effloresce] on the surface. It must therefore be sought, especially at first, to wash these as often as possible with only clean water and soap, refraining absolutely from the use of any acid or bleach.[2]

An additional recommendation for the maintenance of these floors dealt with its final appearance, since

the tiles promised a brighter and resplendent appearance in comparison to other pavements. Once the floors had been washed and completely dry, "a light coat of linseed oil or olive oil, if the first one was not available..." would promise increased color vitality and shine. Monthly "waxing" (wax watered-down with turpentine) was also recommended as the best conservation method, but was a coat to be applied only after several months had passed following installation and after there had been multiple washings of the pavement. Once waxed, the floors could be dry-cleaned by rubbing with a rag to keep them bright and shiny.

Concrete Blocks

The wall finish specified for the exterior rock-faced concrete-block walls of the *Escuela Santiago Palmer* or Salinas Graded School were two coats of a cement wash which was composed of one (1) part Portland cement to three (3) parts water.[3] The finish specified for plain-faced blocks in other schools was a cement plaster coat.[4]

A project Memoir prepared in 1917 by Adrian Finlayson, Architect for the Department of the Interior of Porto Rico, Division of Public Buildings, listed the "urgent repairs" required for the Salinas school building a decade after its construction. The scope of work described that after careful inspection, one of the main items was to repair and paint the exterior and all surfaces of the entire building.

As is common in the Caribbean, constant warm weather combined with the high humidity produced by frequent rain, can cause extensive dark stained areas and biological growth on the surfaces of all types of buildings and structures in the tropics. The dark stains are fungus and the greenish biological growth may include plant material as well as lichen. The following 1917 specifications detail the cleaning and maintenance or conservation work specified for the exterior, rock-faced concrete-block walls of the Salinas Graded School:

EXTERIOR WALLS:-

- All surfaces of exterior walls are to be washed down with a solution, diluted, of muriatic

acid to remove all moss and fungus growth. Dilute solution to be composed of one (1) part muriatic acid to ten (10) or twelve (12) parts water.

- The exact proportion to be determined at the building and to be strong enough to remove fungus growth.
- Keep the acid in wooden buckets and under no circumstances shall the same be placed in metal pails. Use an ordinary brush to place the acid solution over the walls and on the following day go over the walls with a fibre scrubbing brush and clear water to remove the acid and fungus growth.
- Clean and brush the walls well so as to obtain a surface that will hold the cement wash.
- The above treatment of walls applied to all exterior walls, all cornices, parapets, etc. which are to receive cement wash as specified herein.

CEMENT WASH:-

- All exterior walls are to receive two coats of cement wash. Cement shall be an approved brand. The cement wash shall be made of neat cement mixes with sufficient water to form the consistency of paste and applied to the building in such a manner as to leave same complete and of a uniform tone.[5]

Contemporary Preservation/Conservation

As in all conservation treatments, it is necessary to first determine the present condition of the building and its construction materials. In the particular case of the two Portland cement materials which are the focus of this paper, the hydraulic cement tile and the concrete block, their proper condition assessment and analysis is required to ensure adequate long-term maintenance and repairs. Any products on the market considered appropriate should be field-tested on the building fabric surfaces to corroborate compatibility and any potential adverse reaction of the product resulting from the local tropical climate of the region or specific site. Compatible matching of any patch materials to the existing tiles or blocks “for effectiveness and aesthetics” is critical for both appearance and durability.

Hydraulic cement tile

Common problems may include loose or cracked tiles, joint grout loss, staining, and general opaqueness of the surface. The last condition may be due to having been covered-over with a different flooring material, or to a lack of maintenance or regular cleaning.
Tile substitution of damaged or missing units requires a full analysis and commercial reproduction of the units or in-fill by a professional conservator.

The following general guidelines have been gathered from contemporary literature and technical data available, however these should not be viewed as a substitute to a proper conservation procedure by a qualified conservator who has studied and analyzed the tiles of each specific project. Sources are indicated as endnotes.

- Prior to general cleaning work, any loose tiles must be re-set or re-installed.
- Wash pavement surfaces with water and mild or neutral soap.
- The use of mild abrasive pads or wadding can be considered as a method to help remove stubborn stains. It is important that the cleaning procedure be kept on the tile surface only in order to protect the tile's decorative surface which sometimes has been worn thin.
- Once completely clean and dry, re-grout the floor surface using a product, fluid enough, to completely fill the narrow joints that separate each tile. Grouting could also correct any minor separations or cracks on damaged tile. Colored grout should be a color that is the same, or lighter than the lightest color used in the (tile) pattern to avoid staining.
- When grout has dried, wash pavement surfaces with plenty of water and mild or neutral soap.
- Once tiles are completely dry, consideration may be given to applying a penetrating sealer using a sponge (test in a small area prior to general application). Sealing and crystalizing are processes recommended by contemporary installers and restorers of the hydraulic mosaic tile pavements in order to restore or maintain vividness and brightness of original tile designs and protect them against staining, **however this should be discussed with the project conservator**.
- To maintain restored floors in good condition, mop tile floors with clean water often. A capful

of floor wax may be added to the water to improve the tile's sheen. Never use acids or abrasive cleaning materials.[6]

Concrete Block

Some of the more common problems that historic concrete blocks may have in the tropics include erosion, efflorescence, cracking, joint mortar loss, bio-growth, and displacement. Other problems may include inefficient or inappropriate previous repairs and patches. Of these, two conditions could indicate structural instability, which may imply major restoration procedures - these are diagonal cracks or block displacement.[7]

Initial cleaning techniques for non-painted concrete blocks may range from washing the block surfaces with low-pressure water and mild or neutral soap, to chemical and/or poultice cleaning methods. Always test small unobtrusive areas with the different techniques being considered and observe the long-term effects. Bio-growth such as lichens, fungus, as well as efflorescence can usually be removed by these minimally aggressive methods.

In order to protect the blocks from water infiltration and damage, re-point block joints, minor cracks, and eroded areas with a compatible (in color and texture) cement mortar. Jester recommends "A typical patch mix consists of dry masonry sand, cement, and an admixture to improve bond...Stainless steel pins, set in epoxy and covered by the patch surface, can be used to anchor large or deep patches to the concrete block substrate."[8] A protective surface finish or coat may help watertight the concrete blocks.[9]

In summation, any intervention of these Portland cement architectural elements should always be done in a scientific procedural manner in which the condition (in each case) of the original materials and their proper analysis is done prior to the consideration and/or specification of any conservation/preservation procedures. In all cases, architectural or engineering interventions into the restoration or conservation

of hydraulic mosaic cement tile pavements or decorative cement block buildings should always be done in close coordination with a trained Conservation Architect and an Architectural Conservator.

[1] Anonymous quote.

[2] Institut de Promoció Cerámica. "El Mosaico Hidráulico" [The Hydraulic Mosaic]. Diputación Provincial - Centro de Documentación: Biblioteca del Museo de Bellas Artes de Castelló, (Castellón, España): 18. Website: www.ipc.org.es ; and Ladislao Díaz y Hno. y Planiol y Cagiga. *Fábrica de Mosaicos La Cubana* [Mosaics Factory La Cubana] - Design Catalog. (La Habana, N.D.): 5.

[3] Graded School at Salinas Construction Specifications (1907), Archivo General de Puerto Rico: - Fondo: Obras Públicas, Serie: Edificios Escolares, Caja: 1047.

[4] See details under Cement block segment of these investigations.

[5] Graded School at Salinas (1907), Repairs Memoir, Archivo General de Puerto Rico: - Fondo: Obras Públicas, Serie: Edificios Escolares, Caja: 1047.

[6] See "Aguayo Tiles Guidelines for installation, care and maintenance" provided by *Industrias Industrias Aguayo de Construcción, San Cristóbal, República Dominicana: www.aguayo.com.do*) (Mosaico Art, Madrid www.mosaicoart.es

[7] See: Steve Jordan, "Concrete Possibilities", Old House Journal, Vol. XII No. 8, (October 1984, August-September 2013): 35-41.

[8] See: Thomas C. Jester, editor. *Twentieth Century Building Materials – History and Conservation*. (Washington, D.C.: Archetype Press, Inc., 1995): 84-85.

[9] For additional details see: Jester, Thomas C. editor. *Twentieth Century Building Materials – History and Conservation*. (Washington, D.C.: Archetype Press, Inc., 1995); Gaudette, Paul and Deborah Slaton. "Preservation of Historic Concrete", Preservation Briefs 15 National Park Service. Washington D.C.: Government Printing Office; and Coney, AIA, William B. "Preservation of Historic Concrete", National Park Service, Preservation Briefs 15. The Old House Web, www.oldhouseweb.com

Common problems of historic hydraulic mosaic tiles may include loose or cracked tiles, joint grout loss, staining, efflorescence, bio-growth, and general opaqueness of the surface.
(Photos by author, 2014-2015)

Deterioration to historic concrete block in the tropics might include structural or surface cracking, block displacement, staining, joint mortar loss, eroded surface finishes, and bio-growth (including fungus and lichens).

(Photos by Dr. Agamemnon G. Pantel and the author, 2015)

Conclusion

"...the marvelous is found enveloped at the turn of every corner, in the disorder, in the picturesque of our cities...in nature...as well as in our history..."[1]

The beginning of the 20th century in the Spanish Caribbean was a moment when everything and anything seemed possible. The recovery of the region after long periods of war and economic depression had set the stage for an era that would embrace new trends with non-restrained passion. That passion, a natural and innate characteristic of the region's inhabitants, would result in architectural expressions that were like the islands themselves: exuberant, colorful, audacious and exciting.

Both building materials -the hydraulic cement tile and the concrete block- would meet face to face or coincide in Cuba, the Dominican Republic and Puerto Rico, within a tropical region that represented the crossroad between worlds, concurrently accepting all influences. These imported building technologies from Catalonia and the United States, blended in the Spanish Caribbean, where they were used together or independently. As unique examples, the resulting Architecture would exhibit new ways to use imitation, molded, and pre-fabricated Portland cement building materials that would survive indefinitely.

[1] Quote by Alejo Carpentier, Cuban novelist and writer. Translations from Spanish by the author.

Exuberant Interiors of the late 19th century houses of Trinidad, Cuba, and the Rehabilitation Project for the Architects' and Landscape Architects' Association of Puerto Rico (a ca. 1910 residence). Creative ways for the use of hydraulic cement tile and concrete blocks in the Spanish Caribbean are expressed in both instances.

(Photos by Dr. Agamemnon G. Pantel and the author, 2015 and 1995)

The vivid color collection of the Cuban hydraulic mosaics reflected the natural scheme of the Caribbean landscape's flora. Pattern shown was created by the Hydraulic Mosaic Factory "La Villareña" from Santa Clara, Cuba.

The last image shows the author with her sister at their 1927 Almendares home in La Habana standing over the same pavement design.

(Photo by the author, 2015 and by Eng. José Alberto del Cueto, 1957)

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