

Track: Fortifications
Session Code: CS04a

Paper: Development of an Architectural Conservation Program for the Historic Fortification City Walls of Old San Juan—From the San Justo Bastion to the City Gate

Presented by

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Speaker(s) Biography

Glenn directs all technical aspects for the his firms' specialized consultative and contracting services on historic structures worldwide. These services include the development of conservation programs for historic structures, specialized project coordination, project management, various implementation and on-site supervisory services. Glenn combines an in-depth understanding of historic architecture, building material conservation, and construction techniques with specialized knowledge of advanced approaches to architectural conservation and restoration to insure that the work provided by the firms meets stringent technical guidelines.

Abstract

This long section of fortification wall from the San Justo Bastion to the City Gate is almost a mile in length and represents the end product of the monumental and complex efforts of the Spanish Crown to transform the City of San Juan into one of the most impenetrable strongholds of its Caribbean colonies between the XVII and XVIII centuries. As with the other sections of the fortification system of San Juan, it took over one hundred and fifty years of construction efforts for this section of the wall to acquire its current configuration. Unlike the remainder of the Spanish Colonial walls and fortifications in Old San Juan this section of the wall falls under the jurisdiction of Puerto Rico Department of Public Works & Puerto Rico Highway and Transportation Authority. This group was dedicated to the implementation of a holistic Architectural Conservation analysis and the development of conservation treatment options that would respect the original chronology of construction, materials used over time and the most important historic nature of the wall system.

Through surveys, sampling, in-situ testing, probes, extensive laboratory testing, the design of conservation treatment options and the implementation of representative large scale mock-ups ICR was able to complete this holistic approach of a very large and complicated section of historic City wall. This work helped define changes in construction technology, locate representative samples as well as the design of physically and esthetically compatible replication stuccos and conservation treatment options.

Samples were chosen from locations considered representative of surviving substrate and finish materials, from the earliest to the most recent. All samples were catalogued according to sample location, material type, and apparent layer chronology. Materials were characterized through the use of microscopic examination of sample surfaces and polished cross sections, and limited chemical spot testing. Representative samples of what are believed to be pre-20th century substrate and finish materials were further analyzed using polarized light microscopy, fluorescence microscopy, infrared microscopy, scanning electron microscopy, x-ray energy-dispersive spectrometry, and gravimetric analysis. Selection of representative samples for analysis was determined by ICR, and was based upon overall project objectives, available project resources, and the potential of a sample to reveal useful information pertaining to chronological sequence of changes in materials and appearance of the walls over time.

The information gained from the materials analysis was used to create compatible replication mixes of the different historic stucco types for use as patching materials in future conservation campaigns. In-situ mock-ups were conducted by ICR in coordination with Edwin Colon and his crew at the National Park Service in Old San Juan to test the field application of the replication materials. The laboratory mixes were adjusted to compensate for differences in materials used and site conditions. Application techniques were also tested at this time and cost estimates for the work provided. One of the most interesting and exciting aspects of this project was the powerful role that detailed analytical testing played in this project.

Session Track: Fortifications

Session Code: CS04b

Paper: The Performance of Traditional Mortars over Three-Hundred Years: Innovation, Success, and Failure at El Castillo de San Cristóbal, San Juan, Puerto Rico

Presented by

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Speaker(s) Biography

Jeremy C. Wells has a M.S. in historic preservation and an Advanced Certificate in Architectural Conservation from the University of Pennsylvania and a B.S. in historic preservation from Southeast Missouri State University. He has published on preservation methods for poteaux-en-terre French Colonial architecture (in APT Bulletin) and the history of hollow clay tile construction (upcoming in the Journal of Construction History). Wells has ten years of experience in architectural conservation, preservation planning, and Main Street. Recent projects include the preparation of a masonry conservation plan for Morrill Hall on the campus of Iowa State University and theoretical investigations into lacunae in historic plant material restoration. He is currently a Ph.D. student at Clemson University in South Carolina.

Abstract

This project addresses the evolution of mortar formulations and their use in the Spanish New World using Fort San Cristóbal, San Juan, Puerto Rico, as a case study. Empirical and documentary evidence leads to the conclusion that while mortar formulations were derivative of ancient and contemporary treatises, the builders of San Cristóbal made local innovations to formulations that did not perform as expected. In several cases, these new formulations resulted in catastrophic failures. Exclusive of these exceptions, mortar formulations were remarkably consistent over time and it was only when masons diverted from these treatises did the potential for material failure occur.

For this analysis, mortars were divided into bedding mortars, renders, and horizontal surfaces representing a period of time from the late seventeenth century to the early twentieth century. The mortars were examined using optical microscopy, X-ray diffraction, FTIR, and SEM/EDS in order to answer questions postulated for this project. Acid digestion and gravimetric analysis were used to characterize aggregates. The results showed that mortar formulations were closely tied to their uses and, with a few exceptions, the formulations closely matched recommendations given by architectural treatises of the day. The evolution of mortars is characterized as a change from lime/clay mortars to hydraulic brick dust mortars during the second phase of construction at the fort in the late eighteenth century. Portland-cement mortars were first used in early-twentieth century sections of the fort. Evidence was found that supports the theory that the Spanish were applying iron vitriol (iron sulfate) as a way to obtain an orange color on surface of renders; more research is necessary to confirm this hypothesis, however.

Although not readily apparent today, the Old City of San Juan is located on an island that has only been recently connected to the main island of Puerto Rico. During the primary period of construction of San Cristóbal in the late eighteenth century, no bridges connected the island of San Juan to the main island of Puerto Rico. Any building materials not located on the island of San Juan would have likely been brought by boat or ship from the main island of Puerto Rico. This limitation has important implications

for the provenance of aggregates and lime used in the construction of the fort. It is logical to conclude that the Spanish used materials immediately available near the fort for construction whenever possible. This limitation would have been especially true for heavy aggregates. Based on optical microscopy and chemical analysis of aggregates, it is reasonable to conclude that only local sands were used. These sands often did not adhere to the recommendation of treatises, but were used anyway. There is no evidence, based on United States Geological Surveys, that limestone was available locally during the construction of the fort; the most reasonable conclusion is that lime was acquired from the Ayamamón limestone deposit located four miles south near the Rio Puerto Nuevo and was transported by boat to the construction site. The logistics of this situation likely lead to the mixing of clay with lime in order to reduce the cost and time of transport.

Session Track: Fortifications

Session Code: CS04c

Paper: Military Architecture in the Caribbean Countries: Recollections from Europe and New Perspectives

Presented by

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Speaker(s) Biography

Graduated in Architecture at the Politecnico of Milano, she has work for 3 years in the same University in Building Environment Sciences and Technology Department as a researcher in the preservation field. She has just obtained her Master in Preservation of Monument at the University of Genova. She is currently working at Thornton-Tomasetti Group, as architect in the Building Technology Department.

Abstract

The interest in military architecture, which all along had involved prominent European architects and engineers, mostly since the XV century, and fascinated eminent people from culture of that time, including Leonardo Da Vinci, Francesco di Giorgio Martini and Baldassarre Peruzzi, has produced over the centuries a considerable quantity of remarkable buildings and interesting treatises on the matter. Though they may look like each other about their main traits, military architectures have developed different characters in each region, producing buildings with distinctive peculiarities. We can find different architectural codes in Sabaudia, Tuscany, Puglia, and in many regions of Spain (Maiorca, Murcia and Estremadura).

After the colonization of the Americas, military architecture issues and the related defensive strategy were exported beyond the ocean applying the obvious modifications regarding technologies, defensive necessities, and materials.

We can find numerous fortifications in the main sites of the Caribbean islands and coasts, such as San Juan in Puerto Rico, Santo Domingo, L'Habana, Cartagena de Indias, etc. Various European architects were recruited by the Spanish government in order to build castles and fortifications along the coasts; most of them were Italian and Spanish. For example, among Italian architects, the Antonelli family, two brothers, one son and three nephews from Bologna, had particular influence; they were the planners of the fortification of Cartagena de Indias in 1595.

This article intends to explore similarities and differences between the architecture of the native land and those adopted in the new lands, with a particular interest for the regional peculiarities and the closeness to the theoretical rules uttered in the treatises.

The knowledge of the technology applied to this kind of architecture wants to have a major aim. In fact the numerous experiences about the restoration and the preservation had in Italy in this specific field could be a valid starting point for countries that do not have such a long tradition and experience in the preservation field. The following collaboration could be about the education of local professionals, to which transfer notions, techniques, experiences and procedures that could be applied to similar buildings.