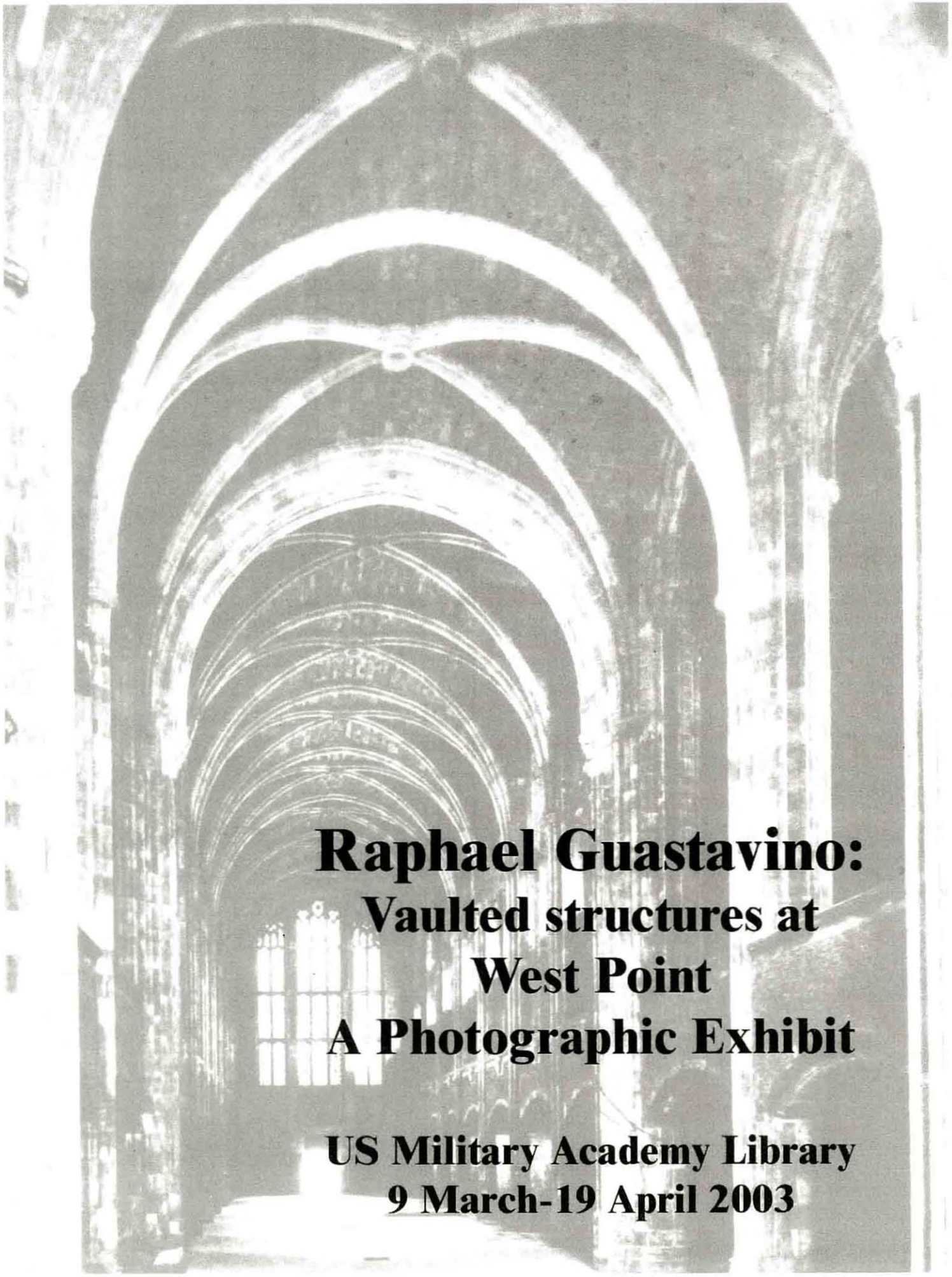


Raphael Guastavino:
Vaulted structures at West Point
A Photographic Exhibit

US Military Academy Library
9 March-19 April 2003

Raphael Guastavino: Vaulted Structures at West Point

A Photographic Exhibit

Exhibition and Catalog compiled by
Paul Waddington

Presented at the
United States Military Academy Library
West Point, NY

9 March to 19 April 2003

Table of Contents

Acknowledgments

Foreword

Introduction, page 1

History, page 3

The Construction Technique, page 5

Architectural Examples, page 8

Vaulted Work at West Point, page 20

Postscript, page 29

Acknowledgments

The USMA Library wishes to thank the following people for their contribution to this exhibition:

Direction: Janet Parks, Curator of Drawings and Archives, The Avery Architectural and Fine Arts Library.

History & Text: Almost all of the text contained in this exhibit, other than specific West Point material, has been pulled from "The Old World Builds the New", by Janet Park and Alan G. Neumann, AIA.

Archival Material: Lou di Gennaro, Assistant Curator, The Avery Architectural and Fine Arts Library. Lou provided many hours of assistance in sorting through the archives and extracting material relevant to Guastavino's construction techniques, and West Point material in particular.

Photography: Dwight Primiano, who provided photographic copies of Avery archival material, as well as some of his own photographs. DOIM, West Point, for current photographs of vaults at West Point. USMA Library, for archival photos of West Point work, and Joseph Barth, Director, who fortuitously discovered & photographed the Basilica of St. Lawrence while on vacation.

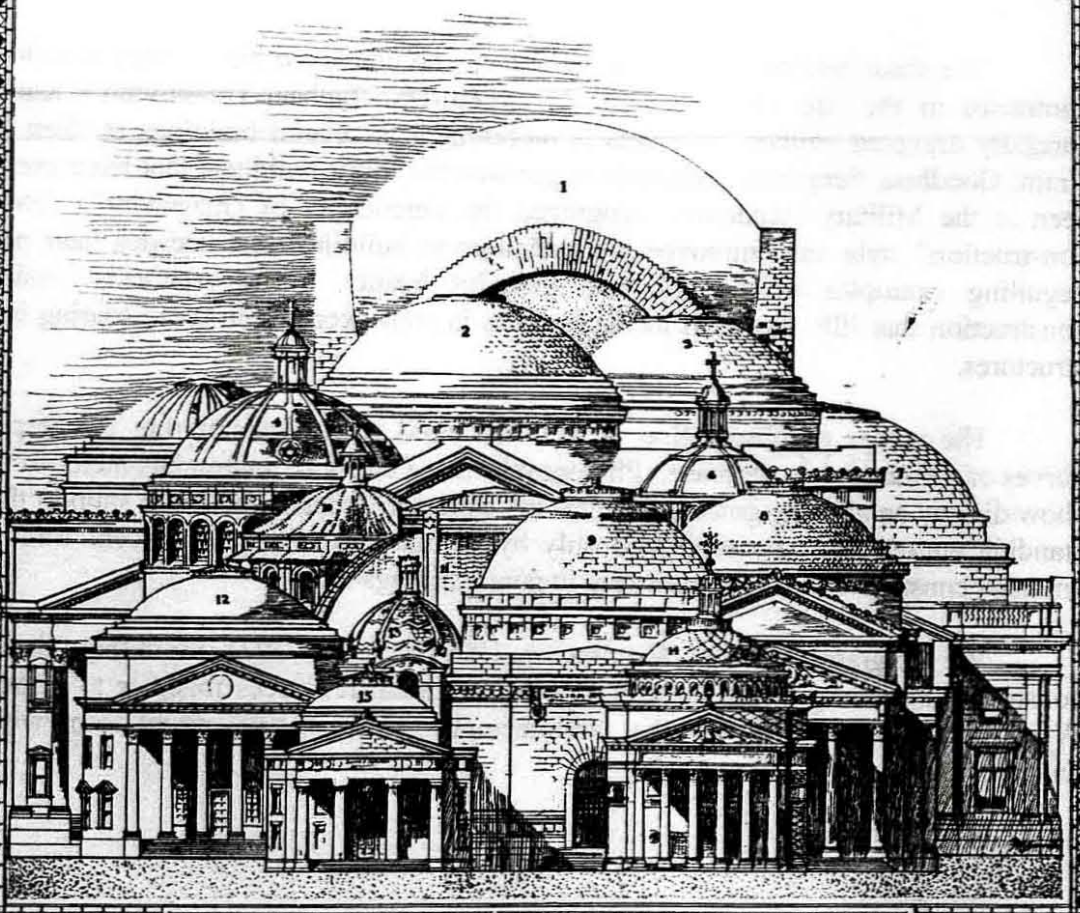
Foreword

Overshadowed by the famous architects who employed his services as a building contractor in the late 19th and early 20th centuries, Raphael Guastavino's legacy of carefully designed vaulted structures is represented in several buildings at West Point. Cram, Goodhue, Ferguson, architects of perhaps the finest buildings that have ever been seen at the Military Academy, recognized the practicality of Guastavino's "cohesive construction" style and employed his technique in buildings that decades later provide beguiling examples of strength and graceful beauty. The architects' vision of construction that lifts the spirit to the heavens is well executed in these soaring interior structures.

The power of observation is well rewarded when encountering the serpentine curves of a Guastavino staircase. Photographs that Paul Waddington has included in this show display an alluring grace that belies the cohesive strength needed to support the free standing curved staircase supported only by its attachment to the adjacent wall. This amazing construction is no longer seen in new buildings today.

We are grateful to Paul Waddington, USMA Class of 1971, for noting this unique construction technique and for bringing the historical resources together to inform the West Point community of the architectural treasure that might otherwise go unappreciated.

Joseph Barth
Associate Professor
Librarian, USMA



SOME DOMES CONSTRUCTED BY
R. GUASTAVINO CO.

BOSTON

NEW YORK

BUILDING and LOCATION	SPAN	ARCHITECTS
1. Cathedral, St. John the Divine, New York City	135 ft. at base	Heins & La Farge
2. National Museum, Washington, D. C.	80	Hornblower & Marshall
3. Institute of Arts and Sciences, Brooklyn, N. Y.	64	McKim, Mead & White
4. St. Francis de Sales Church, Philadelphia, Pa.	61	Henry D. Dagit
5. Bank of Montreal, Montreal, P. Q.	60	McKim, Mead & White and A. T. Taylor
6. Church of St. Barbara, Brooklyn, N. Y.	43	Helmle & Huberty
7. Girard Trust Company, Philadelphia, Pa.	101	McKim, Mead & White and Allen Evans
8. University of New York, New York City	56 ft. at base	McKim, Mead & White
9. McKinley National Memorial, Canton, Ohio	56	H. Van Buren Magonigle
10. St. Paul's Chapel, Columbia U., N. Y. City	52	Howells & Stokes
11. Rodef Sholom Synagogue, Pittsburgh, Pa.	90	Palmer & Hornbostel
12. University of Virginia, Charlottesville, Va.	70	McKim, Mead & White
13. Elephant House, Bronx Park, New York City	34	Heins & La Farge
14. Madison Sq. Presby's Church, N. Y. City	66	McKim, Mead & White
15. J. J. Jermain Memorial Library, Sag Harbor, N. Y.	38	Augustus N. Allen

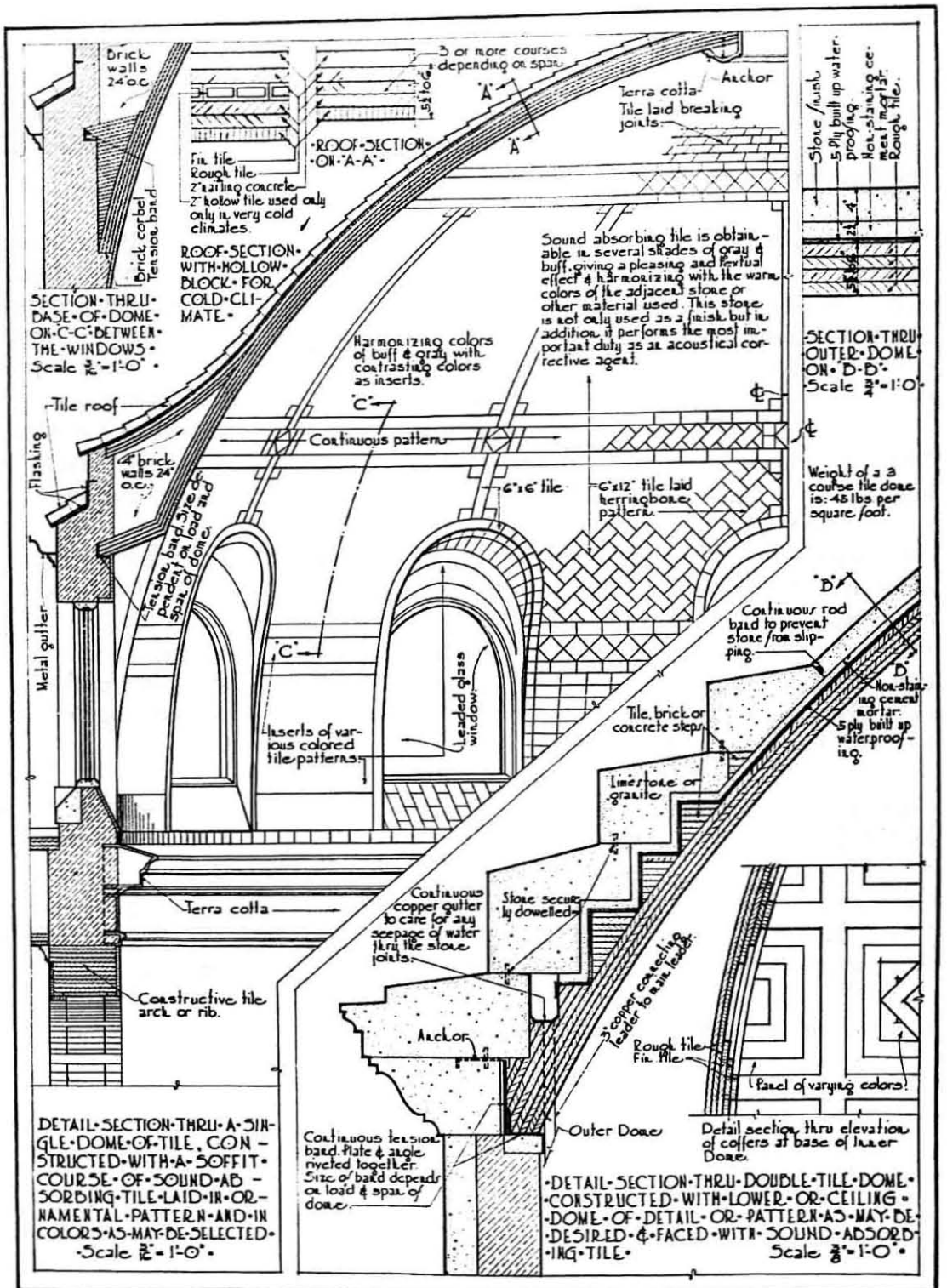
Introduction

Architectural Riddle: Who was the major architectural innovator whose work is in more than 1,000 buildings in North America and whose name means "spoiled wine"? The answer to this riddle is the subject of this exhibition.

The Guastavino Fireproof Construction Company was founded in 1889 by an émigré architect from Barcelona named Rafael Guastavino. He, along with his son, were responsible for many of the most distinctive features of American buildings constructed during the course of the company's history. Born in Valencia in 1842, Rafael Guastavino had an established career as an architect in Barcelona during its great urban expansion. He had re-energized a centuries-old building technology in which offset courses of tile are laminated with mortar. The technique, as old as Roman times, and attributed to Moorish influences, was kept alive in the Catalan area of Spain, and used for the construction of vaults, staircases, domes, arches, and other architectural elements.

The Guastavino system of construction had several key advantages over standard methods. Due to the cohesive strength and relatively light weight of the tile courses compared to stone, greater spans of space with a very low rise could be designed, with much greater safety. The laminate courses were also almost completely self-supporting, thus requiring much less buttressing and support to stand up. The results, as this exhibition shows, are expressive, curved spaces, adaptable to a wide range of building types and construction requirements.

Guastavino's arrival in New York coincided with two architectural trends: the beginning of the grand Beaux Arts-inspired American Renaissance architecture and the early development of steel, Portland cement, and concrete as architectural materials. The Guastavino's client list reads like an architectural Who's Who: McKim, Mead, and White; Bertram Goodhue; Ralph Adams Cram; Henry Hornbostel; Carrere and Hastings; Warren and Wetmore; among many others. It also just happened to be a period of significant expansion here at West Point, and we are quite fortunate to have several examples of this happy marriage of inspired architect and talented contractor.


Brick walls 24" o.c.
3 or more courses depending on span
Anchor
Terra cotta Tile laid breaking joints
Fir. tile
Rough tile
2" setting concrete
2" hollow tile used only only in very cold climates.
ROOF SECTION ON "A-A"
Brick corbel
Tension band
ROOF SECTION WITH HOLLOW BLOCK FOR COLD CLIMATE.
SECTION THRU BASE OF DOME ON C-C BETWEEN THE WINDOWS
Scale 3/16" = 1'-0"
Sound absorbing tile is obtainable in several shades of gray & buff, giving a pleasing and fertual effect & harmonizing with the warm colors of the adjacent stone or other material used. This stone is not only used as a finish, but in addition, it performs the most important duty as an acoustical corrective agent.
Harmonizing colors of buff & gray with contrasting colors as inserts.
Tile roof
Flashing
Continuous pattern
4" brick walls 24" o.c.
Tension band sized & placed on load and span of dome.
6"x6" tile
6"x12" tile laid herringbone pattern
Metal gutter
Leaded glass window
Inserts of various colored tile patterns
Terra cotta
Constructive tile arch or rib.
Stone finish
5 Ply built up water proofing
Non-staining cement mortar
Rough tile
SECTION THRU OUTER DOME ON D-D
Scale 3/4" = 1'-0"
Weight of a 3 course tile dome is: 45 lbs per square foot.
Continuous rod band to prevent stone from slipping
Non-staining cement mortar
5 ply built up waterproofing
Tile, brick or concrete steps
Limestone or granite
Continuous copper gutter to care for any seepage of water thru the stone joints.
Stone securely dowelled
3" copper connecting leader to main leader
Anchor
Rough tile
Fir. tile
Panel of varying colors
Outer Dome
Continuous tension band. Plate & angle riveted together. Size of band depends on load & span of dome.
DETAIL SECTION THRU A SINGLE DOME OF TILE, CONSTRUCTED WITH A SOFFIT COURSE OF SOUND ABSORBING TILE LAID IN ORNAMENTAL PATTERN AND IN COLORS AS MAY BE SELECTED
Scale 3/8" = 1'-0"
Detail section thru elevation of coffers at base of Inner Dome.
DETAIL SECTION THRU DOUBLE TILE DOME CONSTRUCTED WITH LOWER OR CEILING DOME OF DETAIL OR PATTERN AS MAY BE DESIRED & FACED WITH SOUND ADSORBING TILE
Scale 3/8" = 1'-0"
R. Guastavino Company
FACTORY WOBURN, MASS
New York - Boston
DETAIL SHEET

History

Rafael Guastavino was born the son of a carpenter and the fourth of fourteen children in Valencia, Spain in 1842. At the age of nineteen, he registered with the Special School of Builders in Barcelona, affiliated with the Provincial Academy of Fine Arts. In his early career, Rafael worked in the offices of Jesep Nadal, the inspector of Public Works in Barcelona; as an engineering assistant in a foundry; and in the offices of Granell and Robert, architects. In the 1860's, as an architect, he participated in architectural competitions and worked professionally both as builder and architect, an arrangement then customary in Spain.

Beginning in the late 1860's, when industrialization caused the population to soar, city planners in Barcelona reordered and expanded the Gothic city. The overall expansion plan devised by the architect Ildefons Cerda created the new Barcelona and became known as the Cerda plan. The expansion area (the Eixample) became the perfect setting for residences as well as for commercial and private buildings commissioned by the new industrial leaders of Barcelona. Rafael Guastavino received commissions as an architect for many textile factories and owners' elegant new homes. By 1873, Guastavino, now established as an architect, was a member of the jury for several of the architectural competitions held in Barcelona.

Fireproofing was a great issue as the scale of these factory buildings grew. Searching for methods of economical fireproof construction, Guastavino first experimented with poured concrete, but gave up on this material, and to the end of his life insisted that it was inferior to tiles. He argued that a revival of the art of masonry was needed to meet the building requirements of the day, and that cohesive masonry in tile would be the material of the future. In his book *Cohesive Construction* (1893), he discussed the first building to use this method: his own four-story house in Barcelona, built, as he said, much as a physician might experiment on himself with new medicines.

The textile factory for the Batllo Brothers, built in 1869, was the first of many factory projects to use this fireproof method of cohesive construction. It attracted a great deal of attention from architects and instructors at the School of Architecture, who visited often during construction. These tile and mortar vaults were a traditional method of construction, but according to Guastavino's writings, 99 percent of the architects and builders had not heard of it. He revived the technique, along with other architects working in Barcelona in the 1860's and 1870's.

He presented his work on the new fireproof construction techniques, "Improving the Healthfulness of Industrial Towns," at the Centennial Exposition in Philadelphia in 1876, for which he received the Medal of Merit. His lecture followed by only five years the devastating Great Fire of 1871 in Chicago. With the expansion of cities across the United States following the American Civil War, communities were becoming more and more concerned with health and safety issues in these growing urban centers.

Guastavino moved to New York in 1881 with his son, also Rafael, then nine years old. He was prompted by business opportunities to extend the reach of his methods of fireproof construction to the great expansion of building in American cities. He complained to those back in Spain about his difficulties in adjusting to life in New York, saying, "Here there is too much chewing of tobacco, and drinking of gin and whiskey; I am finding it hard to find olive oil and red wine."

In 1883 he won the competition for the Progress Club at 59th Street and Fourth Avenue in New York, and constructed two fireproof tenement buildings on lots he had purchased at Columbus Avenue and 100th Street (now demolished). Bernard Levy was among his early clients in New York, commissioning him to build a series of row houses on West 78th Street. Beginning in 1885, Levy helped him to apply for U.S. patents on his tile construction processes. From that point forward, his work was that of contractor and innovator, as he collaborated closely with other architects on his new methods of fireproof construction. The Guastavinos, father and son, would eventually hold twenty-four patents for these processes, the last one being awarded in 1939.

It is interesting to note that because of the practice in this country to associate a building only with its architect, much of Guastavino's work as a contractor goes unrecognized. This was certainly the case here at West Point, where his name was not associated with any of our numerous vaulted structures. Only through a resurgence of interest in his work, and the valuable archives at Columbia University, have we discovered the hidden legacy he has left for us.

Rafael Guastavino I died in 1908, and was buried in St. Lawrence Cathedral in Asheville, North Carolina. This basilica is the only church both designed and built by Guastavino. The main dome, with a clear span of 58 x 82 feet, is reputed to be the largest elliptical dome in North America.

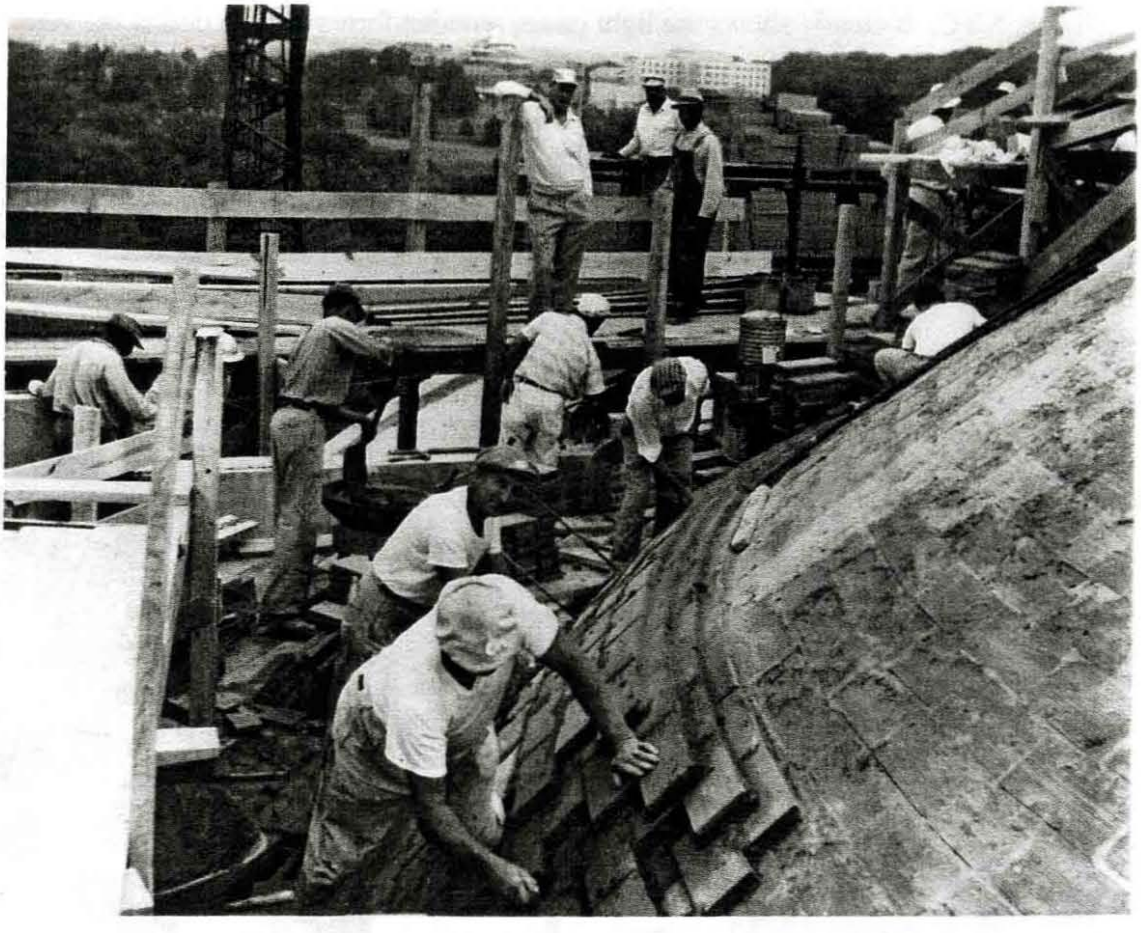
The Construction Technique

Construction of almost any curving masonry project begins with forms. also called centering. These define the curvature at a particular point. and usually have to be substantially constructed to carry the weight of the masonry until cured. It is important to note that with Guastavino's technique, the forms are more guides for regularity of the surface in three dimensions, and less for support. The centering is thus important for only the first couple of laminations, as they, in turn, are the centering for successive laminations. Indeed, a Guastavino vaulted surface can be built without any supporting framework at all! To those familiar with the building trades, the realization of this is usually quite astonishing. All the more so when you consider that the technique is ancient, and was lost to us for centuries until modern cement was re-invented.

The following photograph shows work in progress at the Cathedral of St. John the Divine, NYC. It clearly shows the light gauge wooden forms used to define the vault.

Two offset courses of tile were typically used to complete the first layer of the arch or vault. These were laminated with a quick-setting mortar, for speed of erection and the safety of the masons. Three were required for a reasonably waterproof construction. More laminations were added as required for strength.

The following photo, taken during the construction of the dome on the National Shrine of the Immaculate Conception, Washington, D.C., illustrates the principle. It was common practice on domes such as this to decrease the thickness of the dome from its base toward the apex by reducing the number of courses, with a minimum of three at the crown. Glazed tiles were only used on the visual surfaces. All of the backing tile courses were made with corrugations on the surfaces, to increase cohesion.

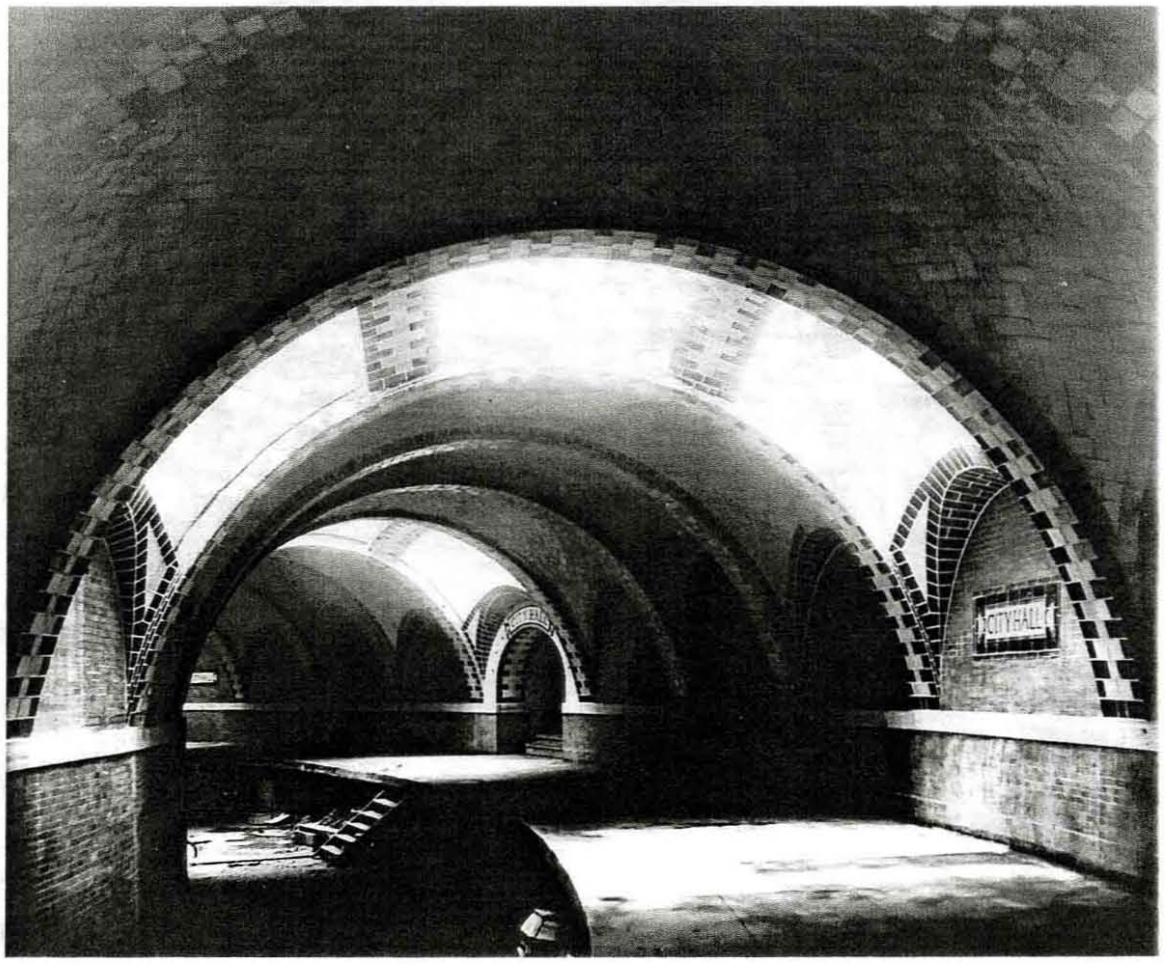


The technique of laminating tiles was also tremendously stronger than the old way of stone voussoirs. When medieval cathedrals were hit by shellfire during World Wars I & II, vaults frequently collapsed when parts of them were damaged. Yet during construction of the Boston Public Library, a four-ton stone fell through a Guastavino vault, leaving a gaping hole, and the vault did not collapse. Part of the reason for this strength is that no joint goes all the way through the thickness of the vault. The rest of it is the cohesion of the cement mortar, bonding as a web between the fired tiles. Between 1897 and 1901, testing was done to prove the strength and fireproofing of the system. The following photo, taken by A. E. Robst in 1901, illustrates the strength of four thin laminations with minimal rise, loaded with over 56 tons of pig iron.

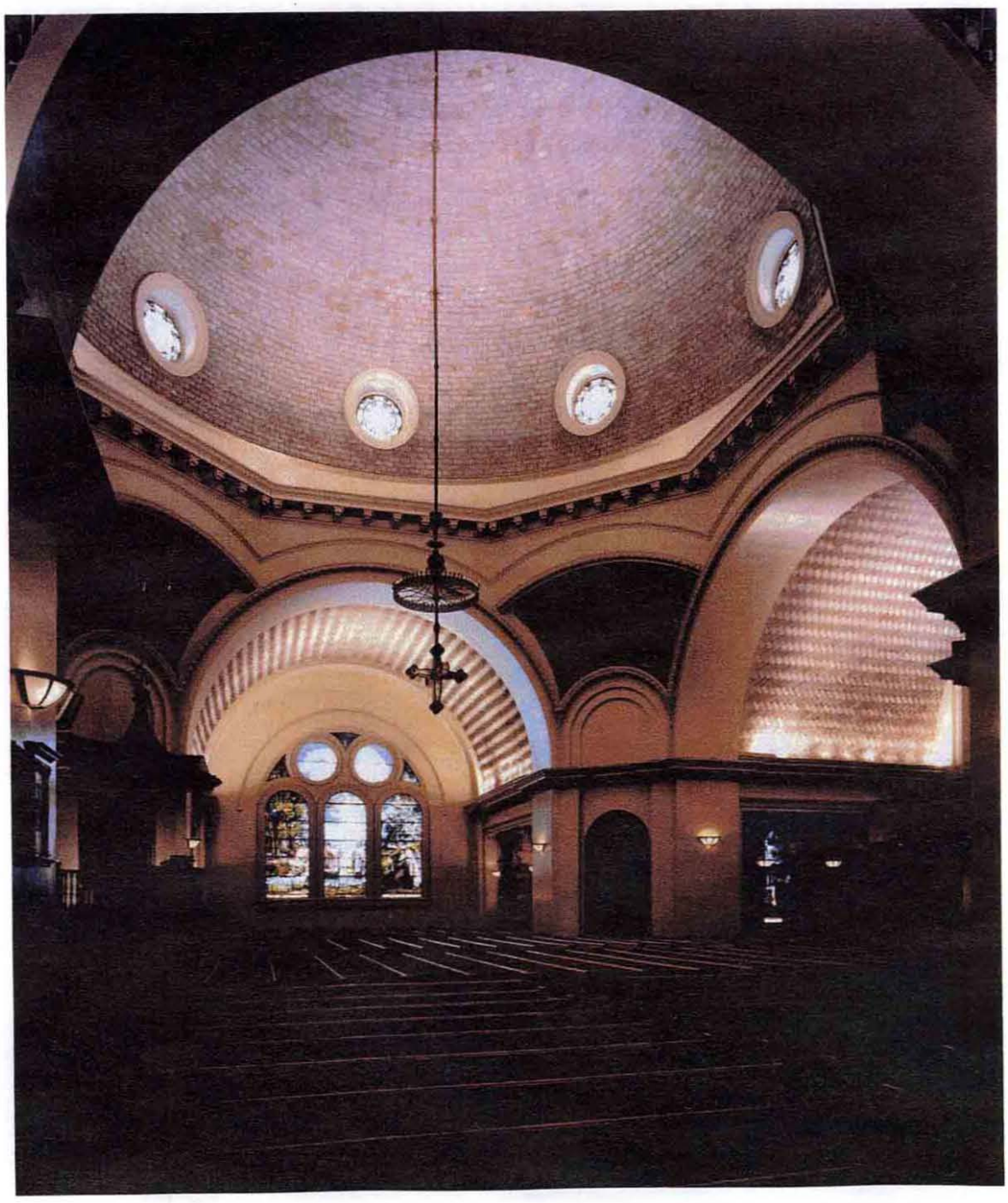
Architectural Examples

While the technique may be deceptively simple, the architectural application of it is nothing short of astounding. The company controlled design, production, distribution, and installation of their products. The options of colors and glazes, tile patterns, and vaulted forms, gave nearly endless variety to these architectural elements. We'd like to take you through a somewhat lengthy overview in order to give you an appreciation of this range of application.

Known as "Station 1, Contract 1", this southern terminus, at the ceremonial front steps of City Hall, served as the showplace of the NYC subway system. Ivory matte-finish tiles with green and brown glazed trim were used in the circular vaults, which mirrored the curve of the tracks and integrated them visually into the large skylights. The curvature of the tracks does not allow it to be used with the new subway cars, and it is now part of the Transit Museum.



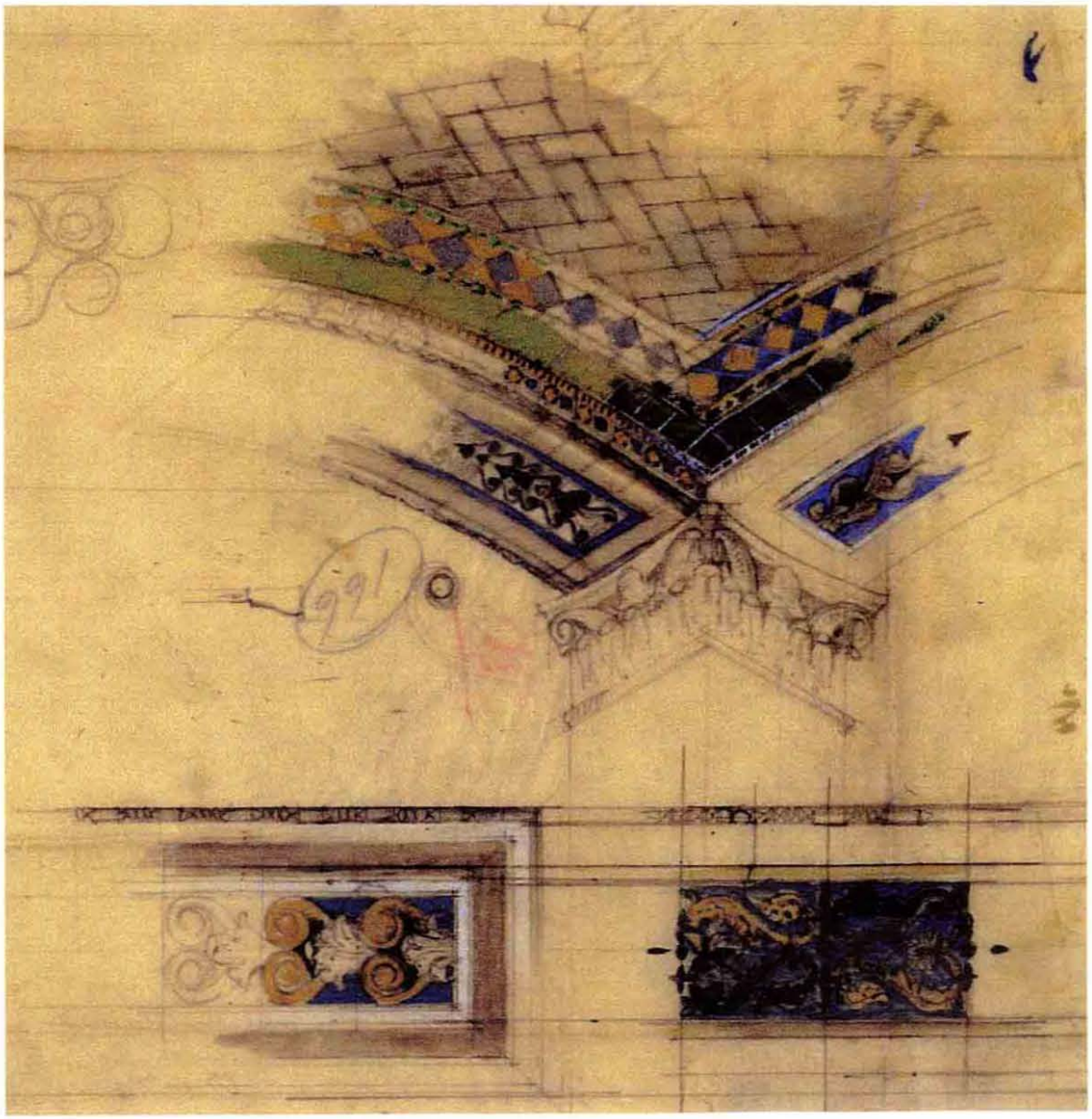
The following photograph of the Central Congregational Church in Providence, RI was taken by Dwight Primiano, and is reprinted by permission. This church is an early Carrere and Hastings building, as well as an important early project by the Guastavino firm. The central dome is flanked by barrel vaults in a herringbone tile pattern.

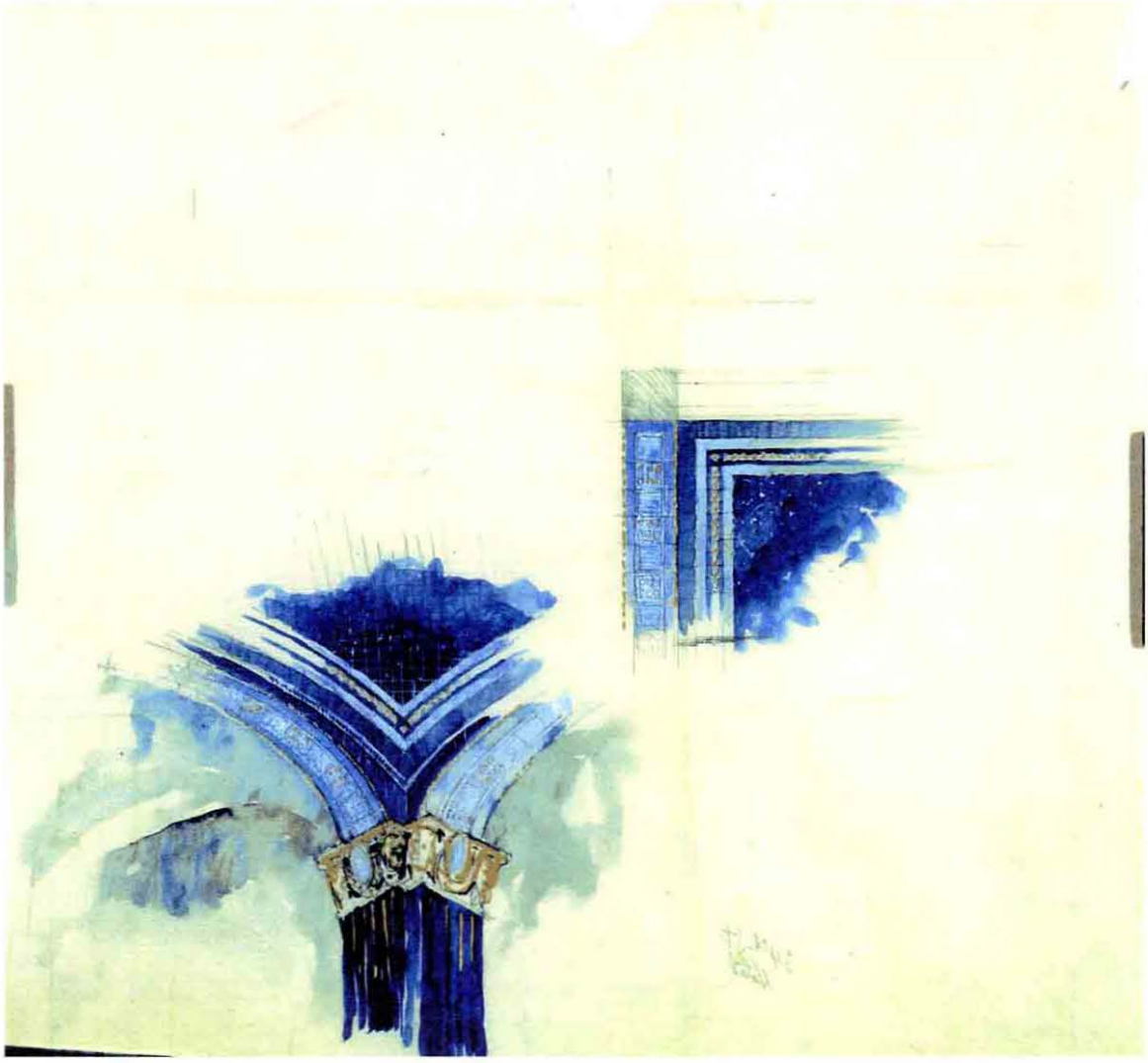


Although many Guastavino drawings specify tile colors by name or number, the following two watercolors are rare surviving graphic representations that actually depict the color and splendor of the glazed tiles. In addition, the firm undoubtedly sent sample tiles to the architects for inspection.

For this project, however, the Guastavino Company worked out the details of their design, perhaps because of the need to coordinate with a subcontractor responsible for the polychrome terra-cotta ornament. There are differences between the design in the drawing and the final product, yet these drawings were prized enough to have been saved in the company's archive.

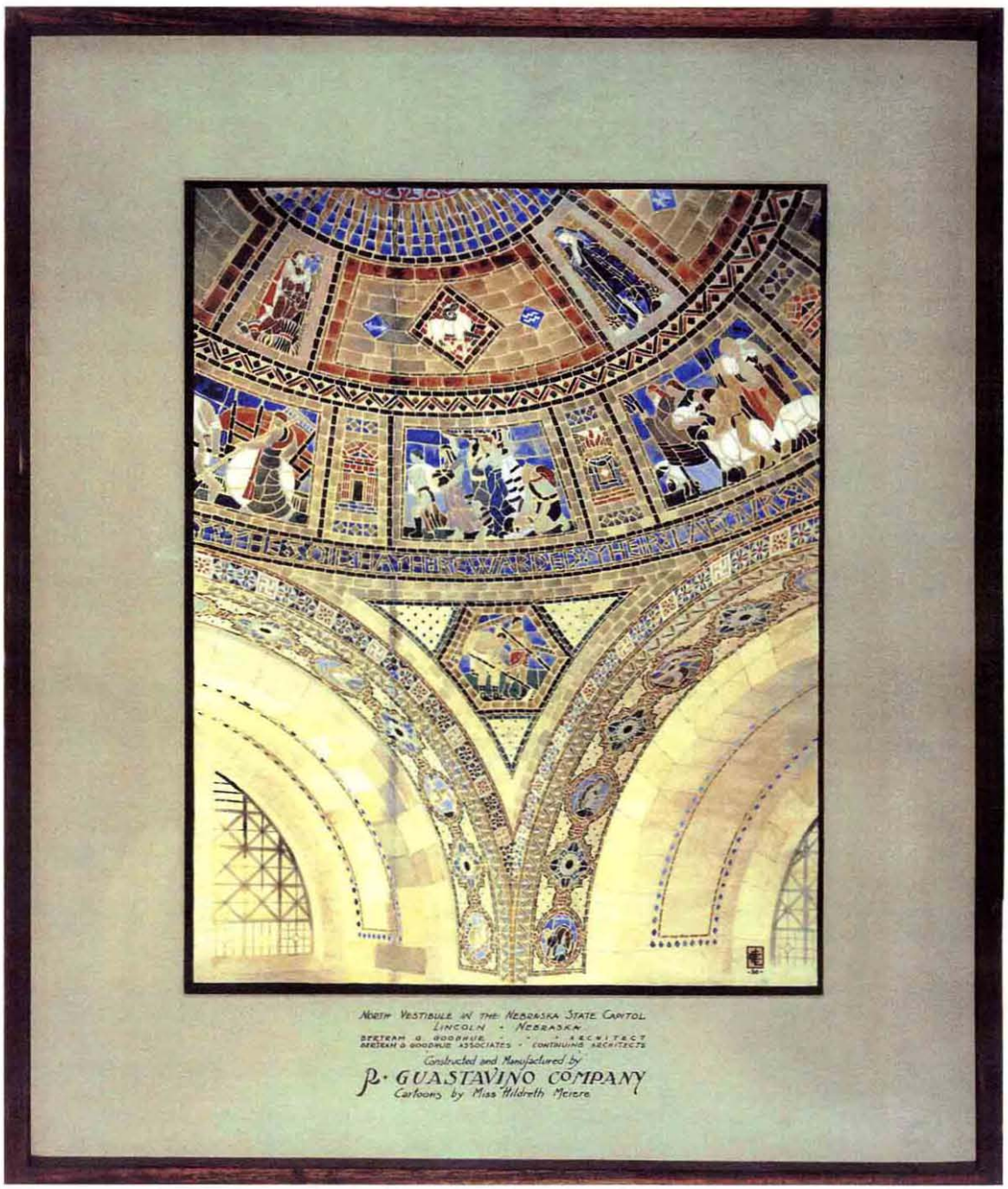
Both drawings are of the Vanderbilt Hotel, 4 Park Avenue, New York. Warren and Wetmore were the architects. The sketches are watercolor and pencil on tracing paper.





The next piece is of the Nebraska State Capitol, North Vestibule. Bertram G. Goodhue Associates were the architects, and this is a watercolor on board by Hildreth Meiere.

Hildreth Meiere, a prominent mural artist, collaborated with Goodhue on this project and on the National Academy of Sciences in Washington, D.C. In accordance with her cartoons, tile was fired, colored, and shaped by the Guastavino firm. This watercolor illustrates the richness of the Goodhue, Meiere, and Guastavino collaboration. The project was probably the most intricate and colorful of all the Guastavino work.

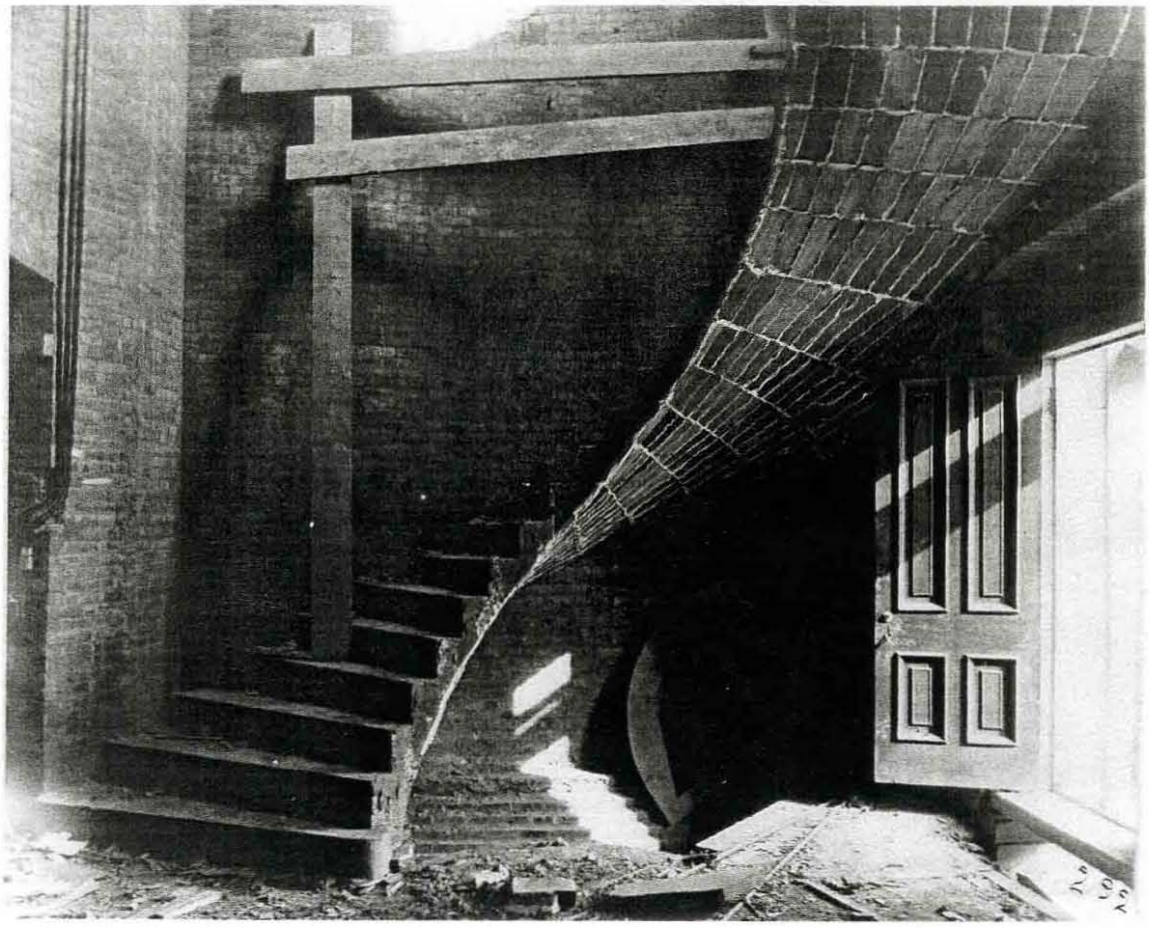


It is common to think of an architectural finish as something separate from a structural backbone. One of the interesting aspects of the Guastavino system is that it is both at the same time. This is most apparent in stairways that were an integral part of the company's designs, some of which are quite astonishing.

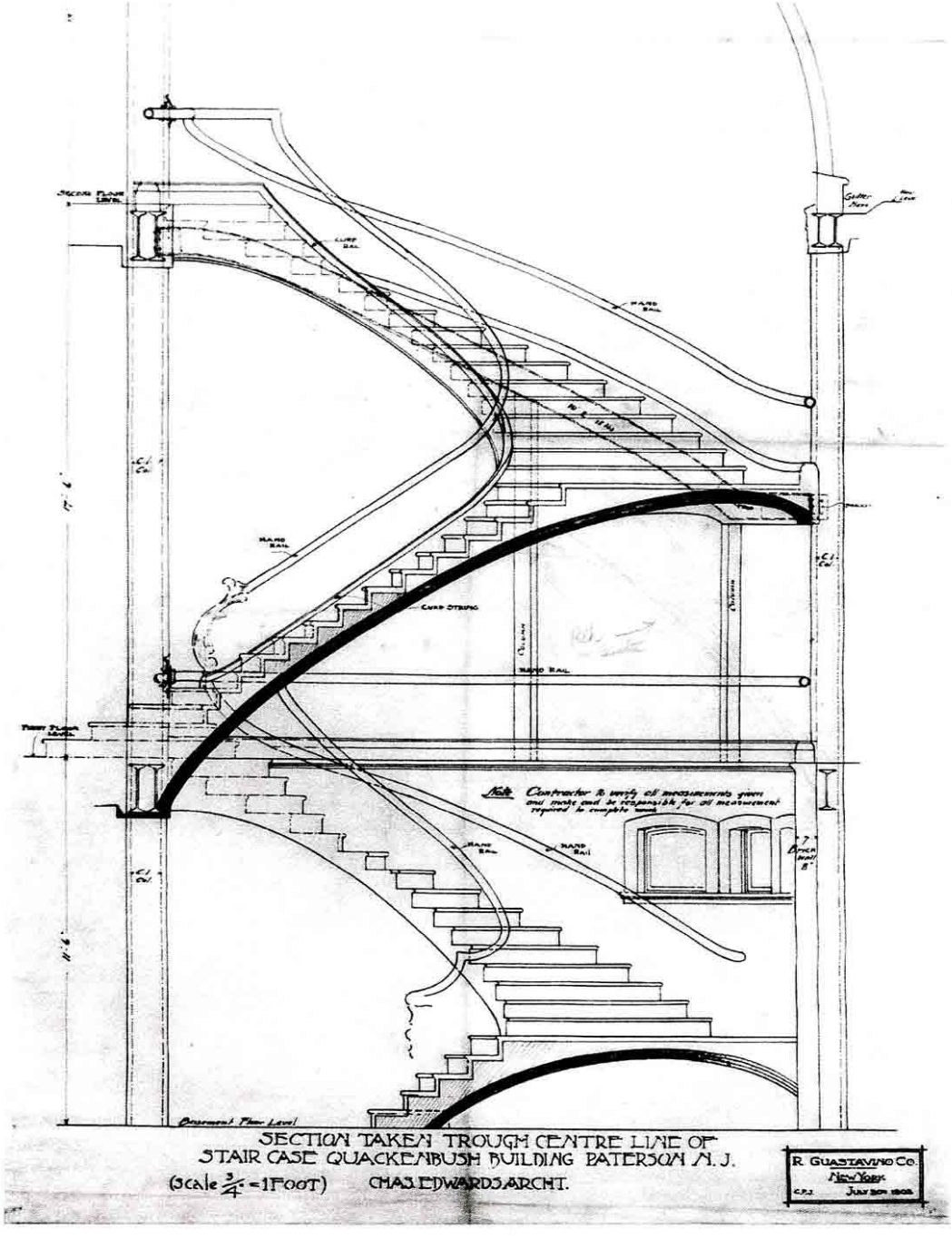
This photograph is of St. Joseph's Seminary in Yonkers, NY. Designed by William Schickel and Company, architects, it was built in 1892. This seminary facility for the Archdiocese of New York makes extensive use of Guastavino products throughout the building complex. This construction photograph shows the structure of the stair, ceiling, and corridor vaults, and steel supporting columns laid only with rough tile.

Next door to the Avery Architectural and Fine Arts Library at Columbia University is St. Paul's Chapel. Designed by Howells and Stokes, architects, and Nelson Goodyear, consulting engineer, it was built in 1904-07. The following photograph by Dwight Primiano shows the spiral staircase in the south tower.

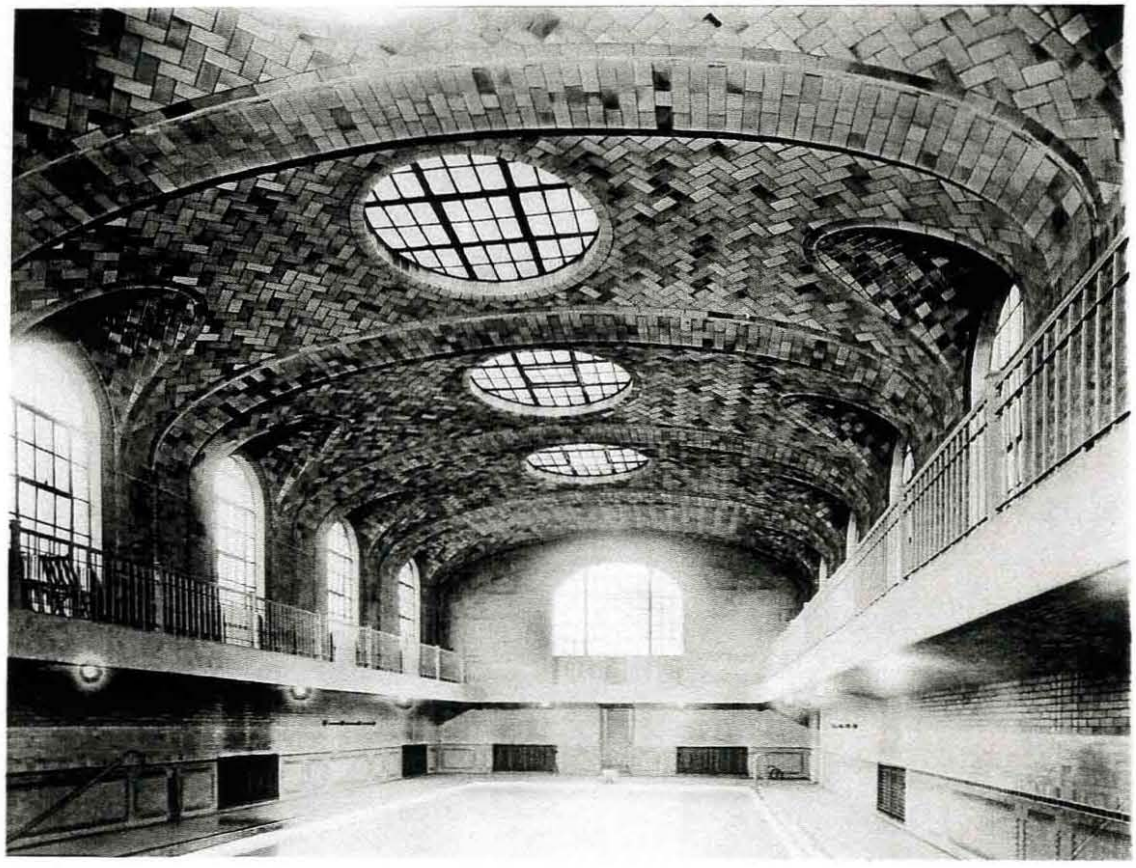
This is another construction photograph of an unfinished tower staircase in St. Lawrence Cathedral, Asheville, NC. These spiral staircases were built with one edge grooved into the adjacent masonry surface. They were freestanding, and usually built without the use of steel. Removable wooden formwork was used to establish an even curvature. Incredibly rigid, they seem to defy the laws of physics.



The next drawing is a section view of a stairwell in the Quackenbush Building in Paterson, NJ. It was built in 1902 by Charles Edwards, architect. The elegant spiral staircase is the only Guastavino element in this office building. The staircase was inserted as a discrete element into the structural steel frame of the building, much like the patented skylight over the staircase. Made of only three layers of tile, the underside of the staircase was intended to be plastered over, as indicated by the shading on the drawing. Covering this tile assimilated the staircase into the conventional interior. In Paterson there are at least five Guastavino buildings, including a bank and the city hall designed by Carrere and Hastings.

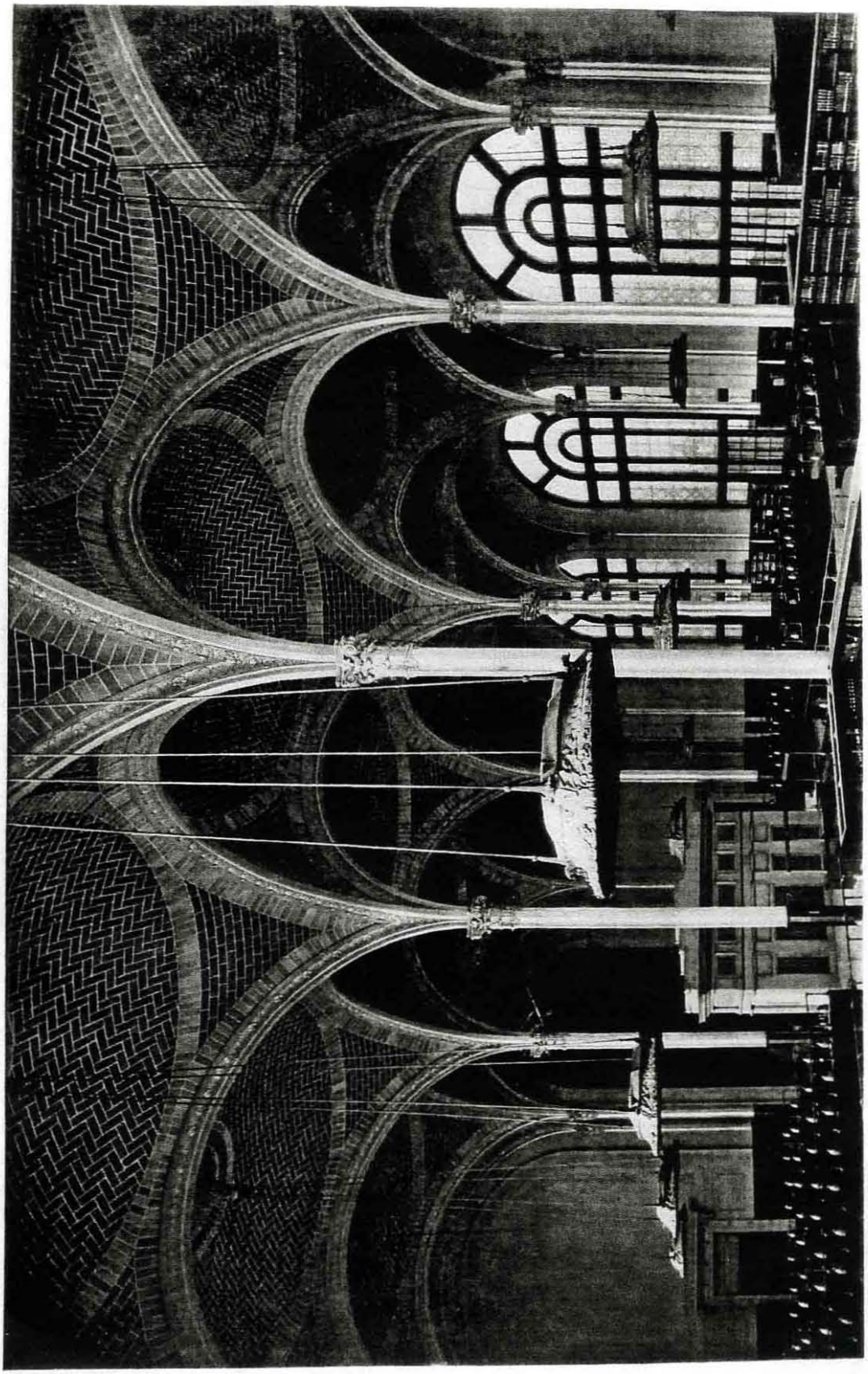


Another advantage of the rigidity inherent in the Guastavino system was that vaults of very low rise could be built in safety, and with very little lateral thrust. This type of vault is sometimes called a "basket handle". The following photograph is of the Jersey City YMCA. It was built in 1924 and designed by John F. Jackson, architect. The photograph is by J. B. Franco and is courtesy of the Avery Library.



This last photograph of our examples is the Albany State Education Building, showing the interior of the Library. This building was constructed in 1910-11, and was designed by Palmer, Hornbostel, and Jones, architects. The photograph is from *Sweet's Catalogue*.

Of all the architects utilizing the Guastavino Company, Henry Hornbostel and his firms used Guastavino building products for exceptionally expressive and innovative forms, pushing the boundaries of what the materials could do. Here the thin columns and rib-and-dome construction, reminiscent of Labrouste's work in Paris, form a rhythmic and repetitive circular system, creating a space unlike any of the other vaulted forms produced by the Guastavino Company.



Vaulted Work at West Point

Several projects involving Guastavino's work were built here at West Point. As mentioned before, because the Guastavino Company was a contractor on these projects, and not the architect, our knowledge of his work was very minimal until just recently.

The first project was Building 600, the Administration building now called Taylor Hall, built in 1909. Architects for the building were Cram, Goodhue, and Ferguson. The great height of its load bearing tower and its salient position at the approach to the Plain make it one of the most prominent of its generation of buildings at the Academy. It is reputed to be one of the tallest structural masonry buildings in the world. In Academy folklore, it was the subject of an imaginative engineering prank. A group of cadets, reputedly led by MacArthur, hauled the reveille cannon to the top of the tower – a feat that took two weeks to undo!

The Cadet Chapel, Building 722, was also designed by Cram, Goodhue and Ferguson, and built in 1910. Its walls are load-bearing stone with concrete floors. Arches are limestone and brick. Vaults are a combination of Guastavino tiles between limestone ribs and groins. The piers are also limestone. Above the Guastavino vaulting of the nave are steel trusses with a copper on wood roof system. The granite for the walls was quarried and dressed locally, and moved to the building site with a cable car system. It is interesting to note that the architects almost had the chapel built on the Plain; its current position was considered too difficult and narrow to allow for construction there. However, the lack of lateral thrusts, inherent in the Guastavino method of vaulting, enables the use of buttresses that are much smaller in width, and totally eliminate the need for "flying" buttresses used on medieval cathedrals. It is possible that as a direct consequence of the Guastavino vaulting technique, we have what has become one of West Point's most famous photographic features.

Also in 1910, construction was started on North Gym, now called Arvin Gym. The gymnasium is part of the Cram, Goodhue and Ferguson ensemble of buildings at the Academy, and along with its additions, it helps define the architectural character of the academic area. This building is also all masonry, with walls up to two feet thick.

The East Academic Building, now called Bartlett Hall, was built in 1914. Also designed by Cram, Goodhue and Ferguson, it is located in the academic area, at the prominent intersection of Thayer Road and the Plain.

Building 606, the old Cadet Hospital, now an administration building, was built in 1923. It was designed by Arnold W. Brunner, with J. F. Musselman, consulting engineer. The Medal of Honor Hall in this building is covered with small Guastavino vaults. This was not realized until a search of the archives at Columbia University uncovered the plans for this hall.

Because our architecture is primarily Gothic, a particular form of vault was used in almost all of our examples. It is distinguished by diagonal ribs, or groins, running between the opposite corners of the main arches. This is called quadripartite vaulting, and was developed in medieval times in order to open up the sides of a vault for natural lighting. It is a complex arrangement, involving four discrete vaults that all meet at the diagonal groins. In the photograph below, from the main entry to Arvin Gym, the groins are made of tile like the rest of the vault, but stone groins were also used, as in the Cadet Chapel.

Barrel vaults were also used, though less common. Perhaps the finest example is the room in Building 600 where the Dean and the Academic Board meet. Note how the variations in the monochromatic tile glazing create visual interest. In the lower right you can see part of the splendid carved stone mantle, depicting medieval warriors.

The following photo, of the south vestibule to Arvin Gym, contains both types of vaults. The smaller barrel vault spans McArthur's famous quote: "Upon the fields of friendly strife are sown the seeds, that upon other fields, on other days, will bear the fruits of victory." This vestibule, with its intersections of vaults and staircase, is a fine example of the mason's art.

The following drawing depicts section views of the old cadet swimming pool, along with the estimate for its construction. Built just after World War II as a series of barrel vaults between reinforced concrete beams, it represents a departure from more traditional methods of construction.

R. GUASTAVINO CO.
225 WEST 34TH STREET
NEW YORK

Date July 15, 1946

Estimate No. 814

Building Addn to Cadet Gym.

Location U.S. Military Academy West Point, N.Y.

Architect Delano & Aldrich, N.Y.C.

Owner U.S. Government

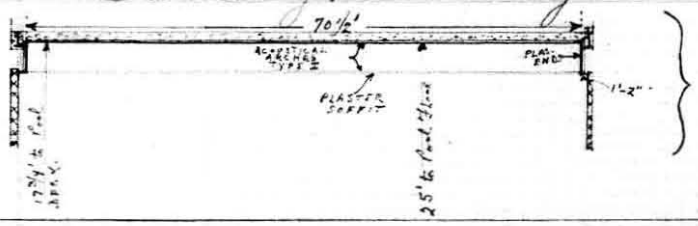
Contr: Grove, Shepherd, Wilson & Kruge, Inc, 247 Park Ave, New York.

Kind of Tile 6"x12"x7/8" Akoustolith. S.A. Coefficient not less than 41 @ 512 cy. P.C.

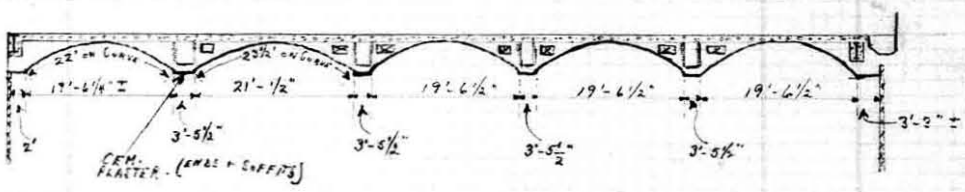
Type of Work Stuck up to plastered barrel arches with Portland Cement mortar with 1/4" Joints. Tile laid breaking joints with length parallel to girders Ends & soffits plastered.

Swimming Pool Ceiling.

Unit Price



SECTION BB



22' x 70½' x 4 = 6204 sq. ft.
23½' x 70½' = 1657 " "
7,861 sq ft @

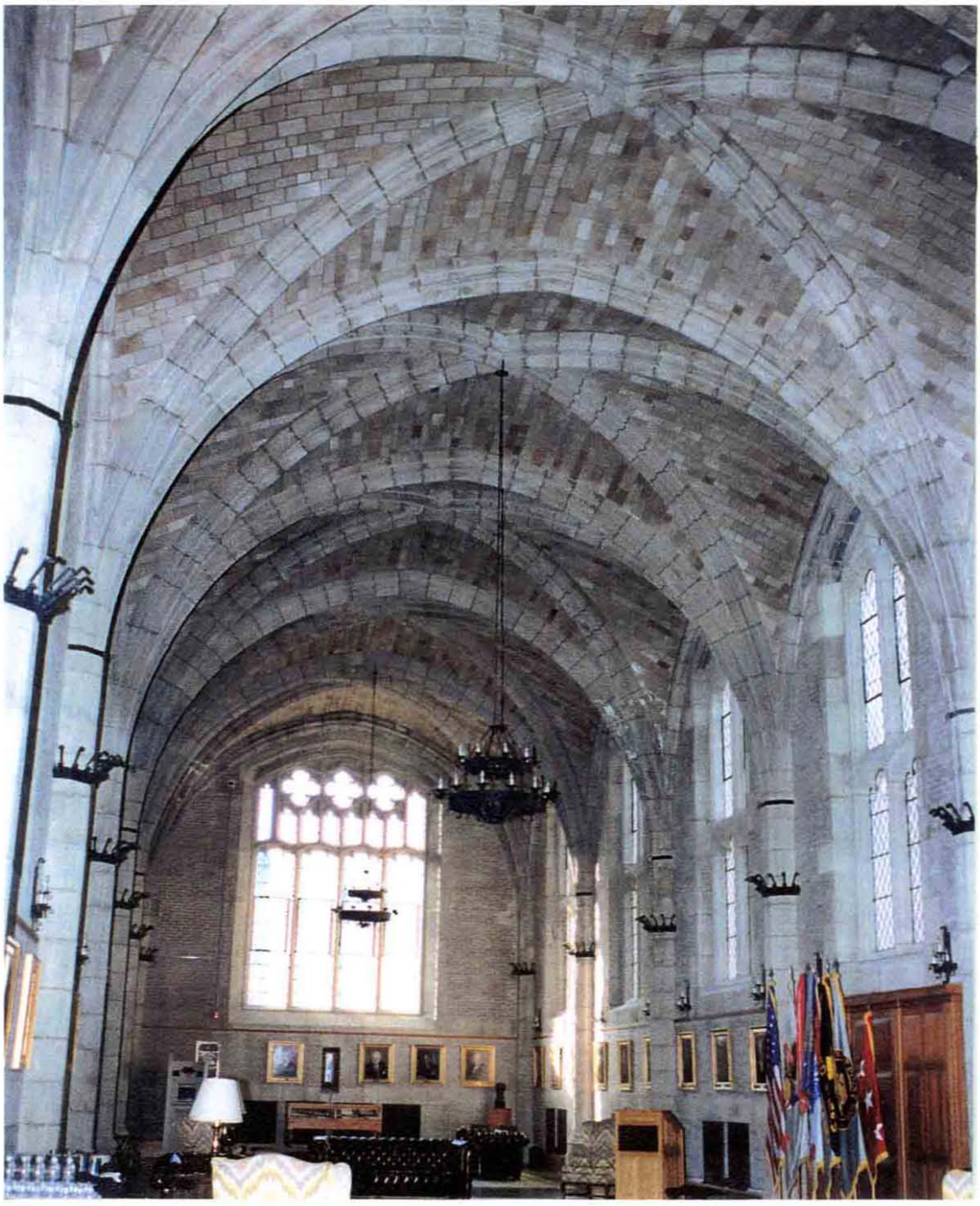
Say 7,810 @ $2.75 sq ft = $21,477.00

22' x 71' x 5 = 7810 ¢
Original figure by Contractor on area by telephone to us
6/26/46 - 7,810 ¢ @ 2.75
without escalator clause
see job file

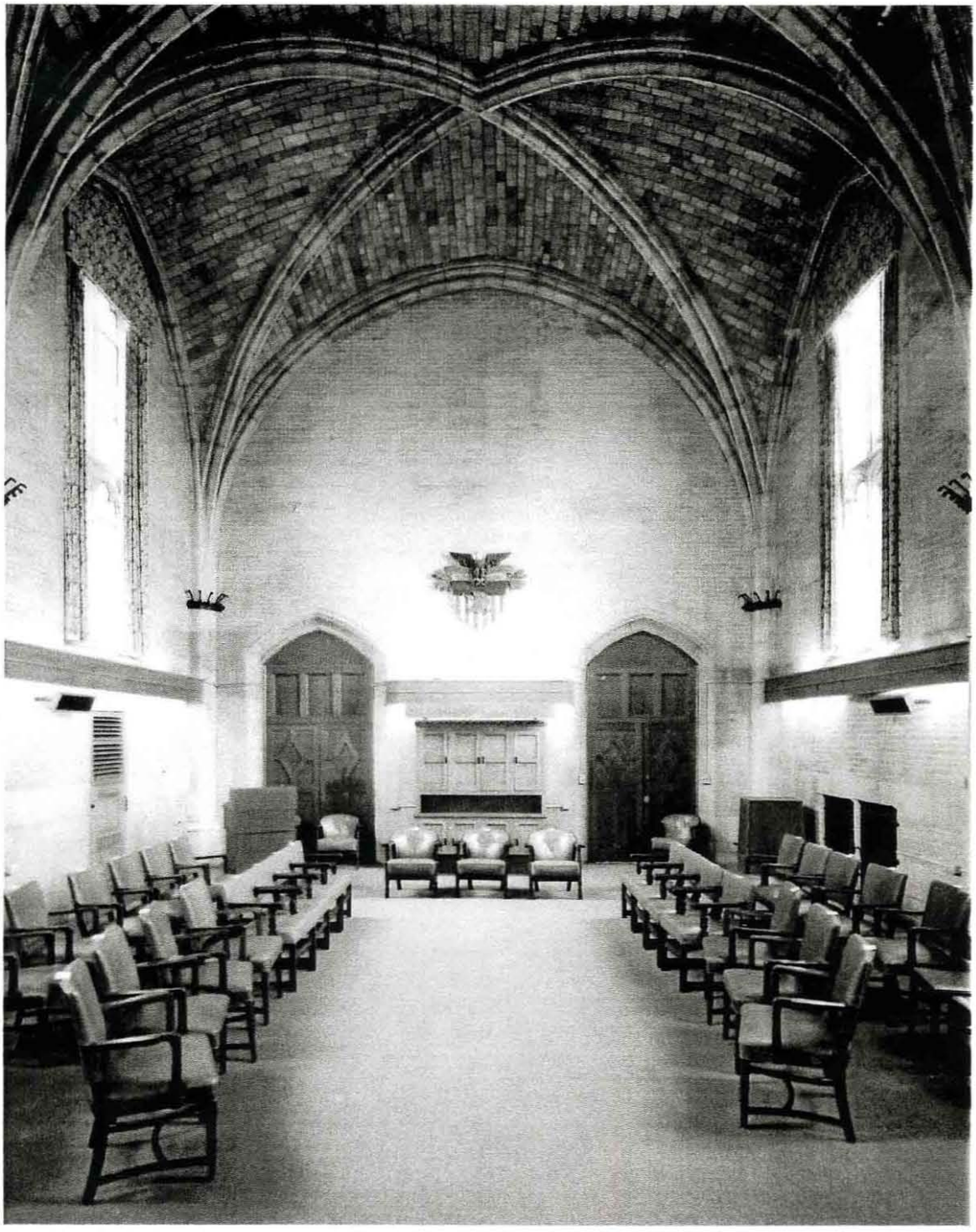
Dwg: #1 thru #10 dated June 12, 1946 - 7512 - 701 thru 710
Specifications dated June 21, 1946.
Rec'd Volume 7/15/46.

This is a photograph of the same area. This pool was an addition to the original North Gym, but it had a relatively short lifespan. It was demolished and replaced with an Olympic sized pool and diving area in the late 60's.

One of the most impressive rooms at West Point is the Thayer Award Room in Building 600. Constructed with quadripartite vaulting on stone groins, it is a magnificent example of Gothic architecture. Note how the side vaults open up the space with natural light from the windows. The vaults are built of random size tiles with a monochrome glazed finish.



The following photograph shows the Superintendent's Conference Room in Building 600, and is provided courtesy of the USMA Archives.



Our most famous example is the nave of the Cadet Chapel. Photographed by thousands of tourists every year, it is a beautiful example of the Gothic Cathedral. This is a current photograph provided by DOIM, USMA. The background photograph on the cover was provided by the Avery Architectural Library, and shows the Chapel just after completion, and before the pews and accessories were installed.

Postscript

Rafael Guastavino Sr. was involved with the construction of the Biltmore House in North Carolina to 1895. While there, he fell in love with the area, bought property in nearby Black Mountain, built a house, and lived there with his second wife.

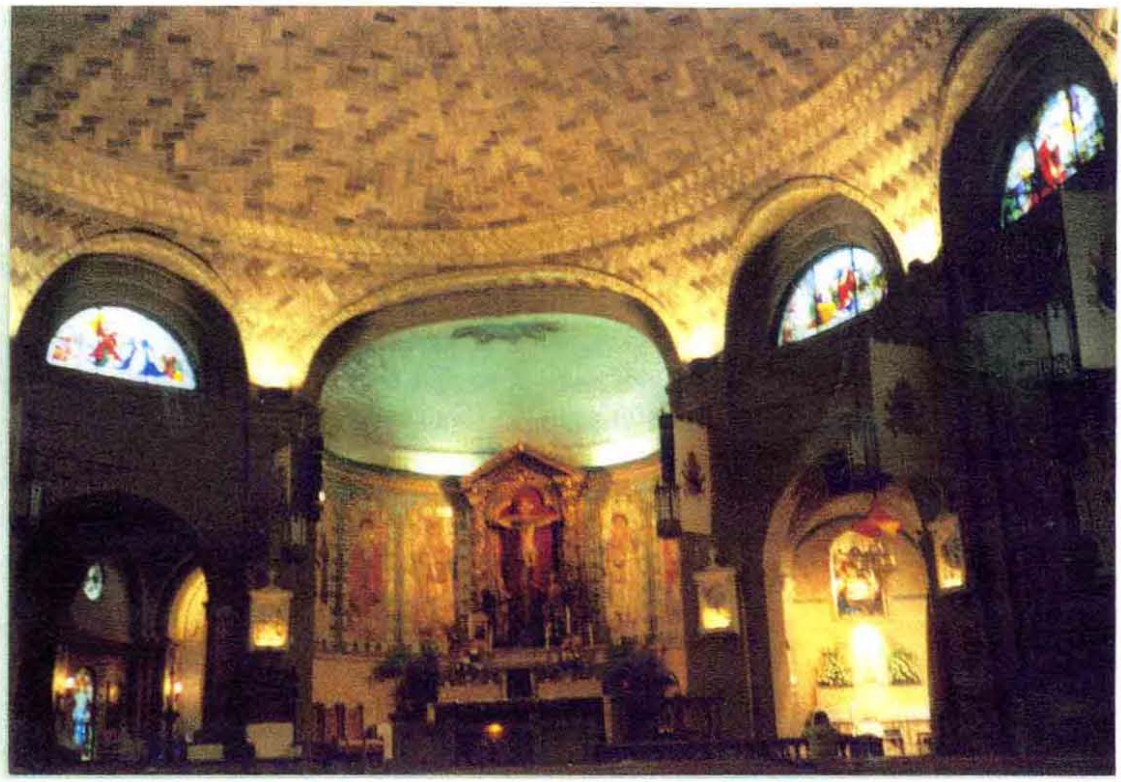
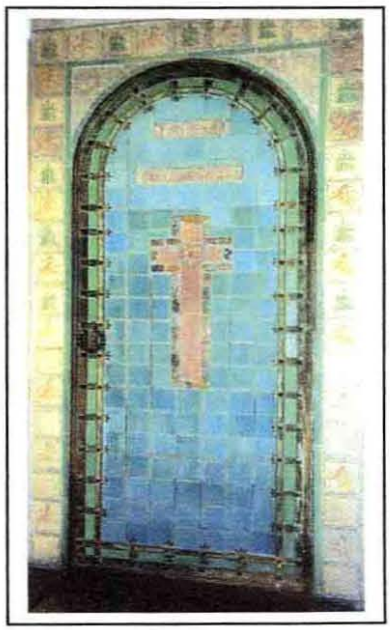
After building his home, he became involved in the construction of a large Catholic church in Asheville, joining forces with the local architect Richard Sharp Smith, who had worked as supervising architect for Biltmore House. This church, now known as the Basilica of Saint Lawrence, may contain the most extensive collection of Guastavino construction in the country, since every horizontal surface in the building is made up of his tile vaults and domes. The church nave is roofed with a large elliptical dome, the floors are all carried on large vaults, and even the stairs exemplify this technology.

In 1908, before the basilica was completed, Rafael Guastavino Sr. died and was interred in a crypt in the unfinished church. His son helped the congregation substantially complete the building, although some small parts of it remain unfinished today.

In a bit of serendipity, just after this exhibit project was started, and before he knew the extent of the Guastavino work, Mr. Joseph Barth, the USMA Library Director, traveled to the Asheville area on vacation. Discovering the basilica, he took some photographs of it, for which we are grateful.

The following photo shows the front of the building. The style, chosen by the architect, is Spanish Renaissance. The central figure on the main façade is that of St. Lawrence holding in one hand a palm frond and in the other a gridiron, the instrument of his torture.

This photograph shows the main altar area and a portion of the large elliptical dome.



The tomb of Rafael Guastavino is covered with specially glazed tiles with a luminous finish, manufactured at the Guastavino kilns in Woburn, Massachusetts. It seems appropriate that he was laid to rest in such a grand place, built to last for centuries – a fitting tribute to the man who brought us such magnificent architecture.