

THE PROPOSED RESTORATION OF THE ENCAUSTIC TILE CEILING AT BETHESDA TERRACE, CENTRAL PARK, NEW YORK CITY

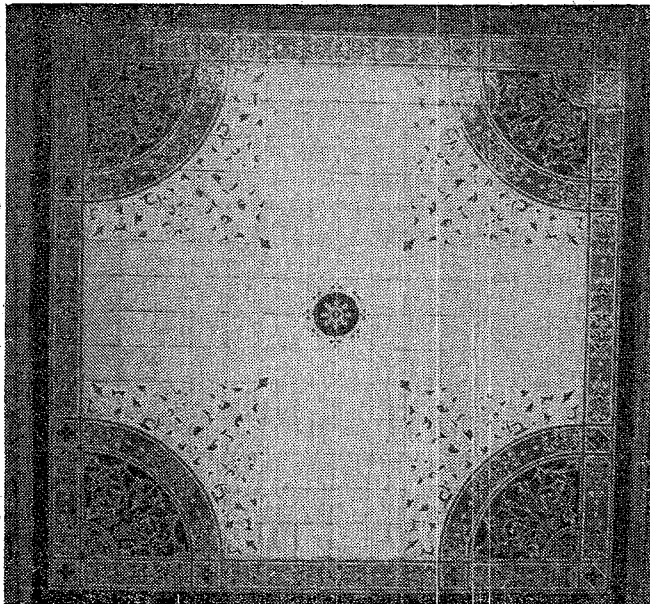
Bethesda Terrace is the architectural focal point of its picturesque setting, Central Park, designed to contrast New York City's 1811 Grid Plan. The park, with its terrace, are a product of the social and technological aspects of the industrial revolution and the artistic and architectural influence of the arts and crafts movement. In the arcade ceiling and ceiling support system, designed in 1868 by Jacob Wrey Mould, we find the seeds of the British Architectural influence that contributed to the character of America's Late 19th Century architectural heritage in full flower. Mould's emigration from England to the United States in 1852 introduced constructional polychromy decoration. It is best seen in his design of the ceiling, in which he synthesized American structural ingenuity with an English aesthetic through his use of American made cast iron for the support of the ceiling in combination with a unique use of British flooring tile for its finish.

Technology, techniques and training in preservation and conservation came together in design of the restoration of the ceiling. Changing uses and altered structural conditions of the arcade and roadway overhead, horse and carriage to automotive, as well as poor maintenance led to the demise of the ceiling necessitating its disassembly and the redesign of the tile support system. State-of-the-art technique required petrographic and mortar analyses to arrive at a temperature for the refiring of the tiles so as to remove the imported Roman cement used to lay the tile, as well as to free them from the phosphor bronze bolts and cast iron backer panels. The cast backer panels were tested for plate thickness and cracking to determine the feasibility of their reuse. They were studied via chemical analysis, metallurgical examination, rockwell hardness and tensile tests. When it was found that they were deteriorated beyond repair, the backer panels were redesigned utilizing modern materials such as stainless steel floor decking to provide for water resistance as well as decrease the weight of the system. In addition, new tile anchoring devices needed to be designed as the tiles could no longer be supported in their original manner due to a loss of section in the clay body of the tile. Those tiles damaged beyond reuse needed to be replaced. This work was proposed with a variety of materials, techniques and finishes which were reviewed for either replication of the original tile or as substitute materials.

Financing of the restoration of the encaustic tile ceiling at Bethesda Terrace, Central Park, New York City has not yet been determined.

Bethesda Terrace was constructed from 1859-1864 in New York's Central Park. Its design was a culmination of the social, historic and architectural forces at work during the period widely known as the Victorian era. The Terraces overall context within the park capitulates to those ideas in landscaping which germinated during the Enlightenment. Socially, as the name Bethesda indicates, the Terrace was designed in response to the Victorian preoccupation with the health and wellbeing of man in an urban environment. However, it is the architectural style of the period, one which spawned an economy of hand and machine crafted elements, that is singularly represented in the Terrace, most notably by the encaustic tile ceiling designed by the British emigrant to America, Jacob Wrey Mould in the organic style propounded by his mentor, Owen Jones.

The ceiling, located beneath the park's main cross road, the 72nd Street transverse road, marks a significant point in the park at which the visitor is first formally introduced to the separation of vehicular and pedestrian traffic for which Central Park is renowned. Here pedestrian traffic goes underground while vehicular traffic passes above.



One of two tile patterns which comprise the ceiling.

The bridge formed by the 72nd Street Transverse Road was in place by 1860 and constructed of wrought-iron box girders spanning 27 feet with intermediate arches, similar to fireproof construction. The ceiling suspended from these girders are described in a contemporary account, written by Clarence C. Cook in a description of the New York Central Park, published in 1869 (republished in 1979, by Benjamin Blom, Inc., New York.). The ceiling is composed of richly gilded iron beams, enclosing large squares of colored tiles, this being the first time, we

believe, that tiles have been used here for the ceiling decoration. It was for a long time a problem how to fix them securely beyond the peradventure of a fall, perhaps upon some luckless pate. By a very ingenious but simple device, the desired safety has been secured, and the whole ceiling is being covered in the following manner. In the first place all tiles used in the Terrace were first designed by Mr. Mould, and the drawings sent over and executed at Minton's works in England...[Something extra] for fastening was needed in the tiles made for the ceiling. In the middle of the back of each of these a narrow slot is sunk, into which a brass key with a projecting end fits, and is secured by a turn. The hole is then filled up with cement, and the removal of the key is impossible, except by using considerable force. The tiles having been all prepared in this way, a plate of wrought iron, fitted into a frame, is elevated by a screw-jack to the top of an iron scaffolding, placed under one of the squares formed by the intersection of the iron beams of the ceiling. This plate is exactly the size of the square under which it now lies. It is pierced with as many holes as there are tiles to be laid upon it, and the projecting ends of the brass keys we have mentioned fit easily into these holes, and are secured by brass nuts screwed upon the opposite side. When the pattern is complete, and each tile firmly fixed in its place, the great iron plate is reversed by a simple machinery and elevated to its place in the ceiling, where it is held fast to the beams by strong screws. So neatly is the work done, that, to all appearances, the tiles are laid upon the ceiling as they are laid upon the floor.

The suspended ceiling is made up of 49 cast-iron plates reinforced with stiffeners and supported on cast-iron ribs with open decorative fretwork. The ceiling support is made up of interconnected parts that are suspended from the box girders in a finely balanced grid network throughout the Arcade and Loggias, similar to a modern exposed-spline suspended-tile ceiling.

The only similar ceilings which research has identified are the cast-iron ceiling designed for the Library of Congress by Thomas A. Walter (which was directly adhered to back-up materials instead of suspended), and the tile ceiling at the Banking Hall of Scotland, in London, dating from 1902. In this application, the tiles were screw-attached to wood forms suspended from the steel structural frame.

The tiles are manufactured from the Minton patent, Stoke-on-Trent, England. The "encaustic" process entailed the use of a plaster mold with a pattern in relief at the bottom. A thin layer of good quality clay called Engobe, about $\frac{1}{4}$ " thick, was pressed into the mold: then a thicker layer of coarse clay containing grog (a burnt-earth product) was added, about $\frac{1}{2}$ " thick, and a second layer of Engobe was applied. The clay sandwich formed a laminated structure, 1" thick. Different colored slip clays were poured onto the face of the tile filling the indentations left by the plaster mold's relief pattern. After coloring, the tiles were then placed in a bottle oven to be fired. The tile, when

removed, was glazed and then refired.

The clay tiles are set in a roman cement (natural cement with a marl-lime body). A phosphor-bronze dovetail bolt, centered in the back of the tile, attaches the tile to the cast-iron support plate. The dovetail bolt penetrates the 1" thick tile to a depth of $\frac{1}{2}$ ". The slot for the bolt was formed by a wood plug which burns out during the firing of the tile: this system is still practiced in England today.

The entire ceiling system was disassembled in 1983. While the ceiling system was disassembled, it was found that water penetration from the road above had caused defects in the original cast-iron material to be made worse by corrosion. Other causes contributing to the ceiling panels' deterioration were condensation, thermal cycling, vibration from increased vehicular traffic on the roadway above, flexing due to the diaphragm motion of the panel over an 8'6" span, and the handling of the panels during installation and dismantling.

Deterioration caused by water resulted in severe pitting of the plates and a general loss of section through the cast iron. Vibration, thermal expansion and contraction, and flexing resulted in increased hairline cracks at random locations, and in serious cracks around the tile which caused the tile-plate stiffeners to snap.

The tile-plate edges also suffered from water penetration and were corroded at the corners, often resulting in complete separation of the tile-plate edges from the plate where heavy rust had developed.

The tile bolts are made of phosphor bronze and have been extremely resistant to corrosion. However, the bolts have been separated from the tile due to the pressure of increased volume from the corroded cast-iron plate pushing against the tile and causing it to come away from the bolt.

The increased pressure on the back of the tiles also caused fracturing around the center of the back of the tile where its section is thinnest due to the presence of the dovetail slot for the bolt. In some cases, the tile has been cracked through to the face. Where water from condensation, steam generated during the Arcade's use as a kitchen, or runoff from the cast iron has been in prolonged contact with the tile or in contact with the tile during freeze-thaw periods, the glaze has been damaged or popped off with subsequent loss of slip clay. In general, however, the tiles are in remarkably good condition, and, of all of the suspended tile ceiling materials, they retain the greatest amount of their structural integrity.

To ascertain the soundness of the existing connections between the plates and tiles, nondestructive methods such as X-ray and fiberoptics were considered, but due to the layering of materials in the ceiling assembly, these were not useful.

Magnetic particle and visual inspection, as well as ultrasonic wall thickness measurement of the cast-iron tile support panels, revealed the presence of cracks and corrosion wastage in the form of pitting and surface scaling. These conditions were found on most of the plates examined. These tests were conducted after dismantling by Lucius Pitkin Metallurgic and Chemical Consultants, and the results reviewed by Geiger-Berger Engineers and The Ehrenkrantz Group. The test results indicated conditions to be worse than originally anticipated, eliminating the possibility of proposed repairs to the existing tile plates.

The original panel construction was considered as a system for reinstallation of the tiles; however, it was eliminated due to the system's weight (35 lbs./sq.ft.) and lack of corrosion resistance, as well as the nonuniform condition of the tiles with regard to the integrity of the bolt-to-tile connection. As a result, a new ceiling system is required. The design parameters include long-term public safety, maximum retentions of tile, and minimum impact on existing ceiling design. The load-bearing capacity of existing girders, the cost of materials, the availability and cost of skilled labor, and approval by City agencies such as the Landmarks Commission were additional factors important in the establishment of design parameters.

Preservation of the ceiling requires maximum retention of tile, salvaging as many tiles as possible with an allowance for breakage. Those tiles that are reusable will be reinstalled in their entirety on new backer panels. The new replacement tiles, either modern encaustic tile or simulated encaustic tile, will make up entirely new panels which will be segregated from the original tile panels. The Arcade, which is tripartite, will have the center aisle of 29 panels restored with the original tiles, while the side aisles or Loggias (each having 10 panels) will be restored using the new tiles. All of the new clay products are required to meet the ASTM standard test methods for ceramic tile, cited earlier, and the American National Standard Specifications for ceramic tile, as well as a load capacity of 30 times their weight.

The need to devise an anchoring system that would have minimum impact on the existing tile design, but still satisfy the long-term public safety requirement led us to explore several options. Direct bonding systems investigated which did not incorporate mechanical anchors included epoxies that bond ceramic to metal, and various polymer adhesives and grouts. The testing program for this application of overhead bonding included freeze-thaw cycling for brittleness, peel strength to indicate load capacity of the mastic itself, and pull-out tests to indicate adhesion of the mastic to the two different materials being joined.

Both exposed and unexposed mechanical anchors were considered in metal and plastic and were required to meet the following minimal requirements:

- Remain unaffected by low and high temperature;

- Maximum 1/16" elongation due to thermal movement or sag;
- Minimum 50-year lifespan with a full load;
- Each point of exposed support to be no less than $\frac{1}{4}$ sq. in. and take a weight of 5 lbs. without deformation
- The material chosen cannot be affected by direct contact with water.

Exposed anchors would cover 1 sq. in. (maximum) of the face of the tile, with design dependent upon the ability of the manufacturer to make an adequate die. Nonexposed anchors could be any one of several types and would entail cutting the tiles' corners or sides: examples include strap anchors, disc anchors or a concealed spline anchor.

It was decided not to use mortar in the new ceiling design since mortar would not be required for the setting or bonding of the tiles and would only retain moisture should moisture penetrate: also, it would make the system more rigid than necessary. Instead, a small dab of caulk will be staggered at the joints to maintain 1/16" joint spacing, cushion the tiles against one another in case of vibration and allow water to pass through the tile joints unimpeded. The new ceiling support system would also be assisted in the absorption of vibration from traffic overhead by its resting on pads such as Korolath®, a Neoprene® product.

The load-bearing capacity of the girders is of concern with regard to the ceiling design since the ceiling panels are supported indirectly from the box girders. The loading on the girders has already been increased by the new design of the transverse road. The original road consisted of a built-up bituminous waterproofing layer and a 5" layer of concrete sandfill topped by asphalt. The load of this roadway was carried by the relieving arches of the Arcade below. The new roadway was designed and is now installed as a metal deck with a 7" structural slab of reinforced concrete on top. The metal deck eliminates one course of brick resting directly on the girders. This increased loading led us to design the new ceiling panels using lightweight backer panels. Those considered were stainless-steel honeycomb and welded stainless-steel deck. Aluminum backing was also considered, but the possibility of corrosion from the concrete deck above caused it to be rejected for long-term use. Stainless-steel deck was selected for its structural adaptability and economy.

The final design was load-tested using a model of the new tile support anchor system. In addition, the removal of tiles from three of the existing foiner panels will be undertaken in order to better estimate tile breakage during removal. The tiles, in the meantime, have been crated as full-size panels and taken off-site. The ingenuity of the original design allows the entire cast-iron ceiling grid to be assembled with the exception of the two cast-iron pieces which directly support the infill panels, the molding strip, and the curved trim. This condition has allowed us to redesign the ceiling panel and to return at a later date and install the restored tile panels.

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1. The author is an architectural conservator with The Ehrenkrantz Group & Eckstut in New York City. She holds a masters degree in Historic Preservation from Columbia University and was a recent American participant in the U.S. ICOMOS Stone Conservation Course, Venice. She was the Project Manager for The Ehrenkrantz Group & Eckstut with Geiger Associates as Engineering Consultant; 2. Excerpts from this article first appeared in the APT Bulletin, "The Rehabilitation of Bethesda Terrace." by Jean Parker Murphy and Kate Burns Ottavino.

LA RESTAURACIÓN PROPUESTA DEL CIELO RASO DE AZULEJOS
ENCAÚSTICOS EN BETHESDA TERRACE, CENTRAL PARK,
CIUDAD DE NUEVA YORK

Kate Burns Ottavino

Bethesda Terrace es el foco arquitectónico de su local pintoresco, Central Park, diseñado para contrastar la Cuadrícula de 1811 de la Ciudad de Nueva York. El parque, con su terraza, son el producto de aspectos sociales y tecnológicos de la revolución industrial y de la influencia artística y arquitectónica del movimiento de "Arts and Crafts." En el cielo raso del portal y su sistema de soporte, diseñados en 1868 por Jacob Wrey Mould, encontramos las semillas de la influencia arquitectónica británica que contribuyó al carácter de la floreciente arquitectura americana del siglo diecinueve. La emigración de Mould de Inglaterra a Los Estados Unidos en 1852 introdujo la decoración polícroma. Esta se evidencia mejor en su diseño del cielo raso, en el que sintetizó la inventiva estructural americana con una estética inglesa a través del uso del hierro colado americano para el soporte del techo interior en combinación con el uso único de azulejos ingleses para el acabado.

Tecnología, técnicas y entrenamiento en preservación y conservación se unieron en el diseño de la restauración del cielo raso. El cambio de usos, y la modificación de las condiciones estructurales del portal y la calle que le sobrepasa, caballo y carruaje a automóvil, y un mantenimiento inadecuado contribuyeron al desgaste del cielo raso, necesitando su desmantelamiento y rediseño del sistema de soporte de azulejos. Técnicas más avanzadas requirieron análisis petrográficos y cementicios para arribar a la temperatura del rehornado de los azulejos, y así poder remover el cemento romano importado usado para instalar los azulejos, como también librarlos de los tornillos de bronce fosforado y paneles de hierro colado. Los paneles sostenedores fueron probados por su espesor de placa y agrietamiento para determinar la factibilidad de su reúso. Ellos fueron estudiados vía análisis químico, exámenes metalúrgicos, de dureza, y tensiles. Cuando se encontró que los paneles estaban permanentemente dañados, fueron rediseñados utilizando materiales modernos con una estructura de acero inoxidable para resistencia contra el agua y disminución de peso del sistema. Además, nuevas piezas de sujeción tuvieron que ser diseñadas porque los azulejos no podían ser sostenidos de su manera original debido al desgaste de la arcilla del azulejo. Los azulejos totalmente dañados necesitaron ser reemplazados. Este trabajo fue propuesto con una variedad de materiales, técnicas y acabados que fueron analizados para replicar el azulejo original o como material sustituto.

El financiamiento de la restauración del cielo raso de azulejos encáusticos de Bethesda Terrace, Central Park, Ciudad de Nueva York no ha sido determinado.