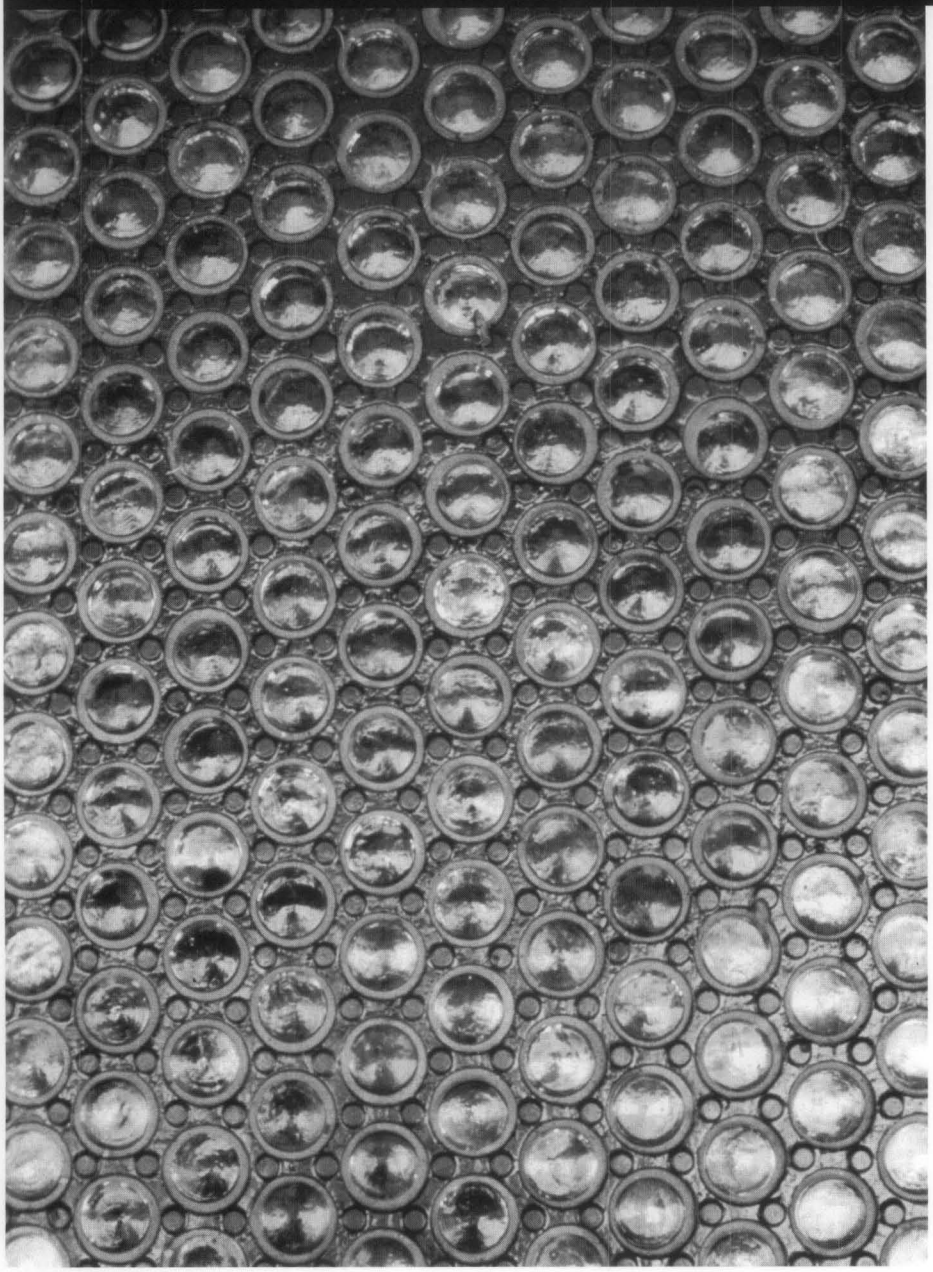

552-554 BROADWAY
New York, New York

National Park Service
U.S. Department of the Interior
Technical Preservation Services

Preservation
Tech Notes

HISTORIC GLASS

NUMBER 2

Repair and Rehabilitation of Historic Sidewalk Vault Lights

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National Park Service

Introduction

Beginning in the 1850s, sidewalk vault lights became a common feature amidst the burgeoning manufacturing districts of America's urban streetscapes. These cast-iron panels, fitted with clear glass lenses, were set into the sidewalk in front of building storefronts. They permitted daylight to reach otherwise dark basements (or "vaults") that extended out beneath the sidewalks, creating more useable or rentable space for building owners.

Each panel was screwed to a cast-iron saddle and the iron framework that spanned the basement vault. They were cast with molded iron knobs around each lens to protect the glass and improve the footing of passers-by. Originally simple glass lenses were set in the panels, usually with a cement grout. Advances in daylighting technology including the development of prismatic glass pendants that refracted the sun's rays further into basement areas, and the

Deteriorated historic sidewalk vault lights should be repaired wherever possible. Missing panels can be replicated with new panels that match closely the detail and overall appearance of the historic vault lights.

use of reinforced concrete panels made vault lights popular through the 1930s.

Located in New York City within the SoHo Cast-Iron Historic District, 552-554 Broadway is a six-story loft building detailed with Italianate ornamentation on the upper floors *(see figure 1)*. Designed by the architect John B. Snook and originally constructed in 1855 as two separate buildings, 552 and 554 Broadway were joined internally and unified in 1897 with a new two-story, cast-iron storefront and sidewalk vault installation. It is likely that the building's basement was used historically for a combination of light manufacturing and storage.

The original vault lights stretched approximately fifty-four feet across the full width of the ground-floor storefront. They were made up of twenty-one individual panels extending five feet from the building line and varying in width from 1'10" to 2'8" *(see figure 2)*. The cast-iron panels were fit with 1-1/2" diameter glass lenses, typical for historic vault lights. Raised lettering on the panel frame, "Jacob Mark, 7 Worth Street, New York," indicated the foundry's name and address in Manhattan. Over one hundred years of pedestrian traffic, deliveries and environmental exposure took a toll on the vault lights at 552-554 Broadway. With use of the basement for merchandise storage, the current ground-floor retail tenant initiated a vault-light restoration program in 2002 to return this historic sidewalk feature to its original function and appearance.

Figure 1. A cast-iron storefront was added to 552-554 Broadway in 1897. The storefront included a fifty-four foot long assembly of cast-iron vault lights set in the sidewalk. Glass lenses in the panels allowed light to enter the basement area, increasing rentable space for the building owner.

Figure 2. At the outset of the restoration project, the original cast-iron and glass vault lights in front of the building's storefront were in poor condition.

Problem

At the outset of the project, the vault lights at 552-554 Broadway were in poor condition *(see figure 3)*. As with many old vault light installations, broken glass lenses and deteriorated seals allowed considerable water infiltration through the individual panels and the surrounding framework. A majority of the glass lenses were either cracked, missing or replaced with a variety of materials including wood, concrete and asphalt *(see figure 4)*. Of the twenty-one cast-iron panels, six sections had areas which were cracked or missing altogether. Two original vault light panels had been replaced with steel diamond-plate hatchway doors to the basement and a variety of materials had been applied over the remaining panels in repeated attempts to prevent further leaks. Worn and lacking a protective coating, the cast-iron panels were exposed to the elements. Displaced panels and uneven asphalt and concrete patches presented trip hazards at sidewalk level.

Repairing and restoring the historic vault lights presented a number of obstacles. These included finding an experienced contractor, locating suppliers and fabricators for the glass lenses and missing cast-iron panels, and keeping the overall cost of the restoration program reasonable.

Consideration of building codes, and load requirements in particular, is part of any vault light restoration project. At 552-554 Broadway, loading issues were addressed in 1995 when the current retail tenant took over the space and installed a supplemental steel framing system beneath the deteriorated vault lights. This system involved the installation of a series of beams set beneath the edges of the individual panels and supported by a large girder running parallel to the storefront. To meet stringent New York City loading requirements, other vault light projects have included pulling up the panels for restoration, pouring a recessed concrete slab and setting the restored vault lights on top of the slab at the sidewalk level. This treatment minimizes water infiltration and maintains the historical character of the sidewalk but removes the daylighting function.

Improving performance, safety and appearance were the main goals of the current restoration program. Water leakage into the basement and trip hazards at the sidewalk had produced a dangerous and unacceptable situation. Meanwhile, the deteriorated condition of the vault lights presented an unattractive entrance to the storefront and building.

Solution

An investigation of the vault lights and their support structure indicated that the assembly was repairable. Despite the appearance of the vault lights, physical deterioration was limited and the steel structure beneath was in excellent condition. The project architect and preservation consultants contacted a specialist experienced in rehabilitating cast-iron who developed a plan to return the lights to their historic appearance and function.

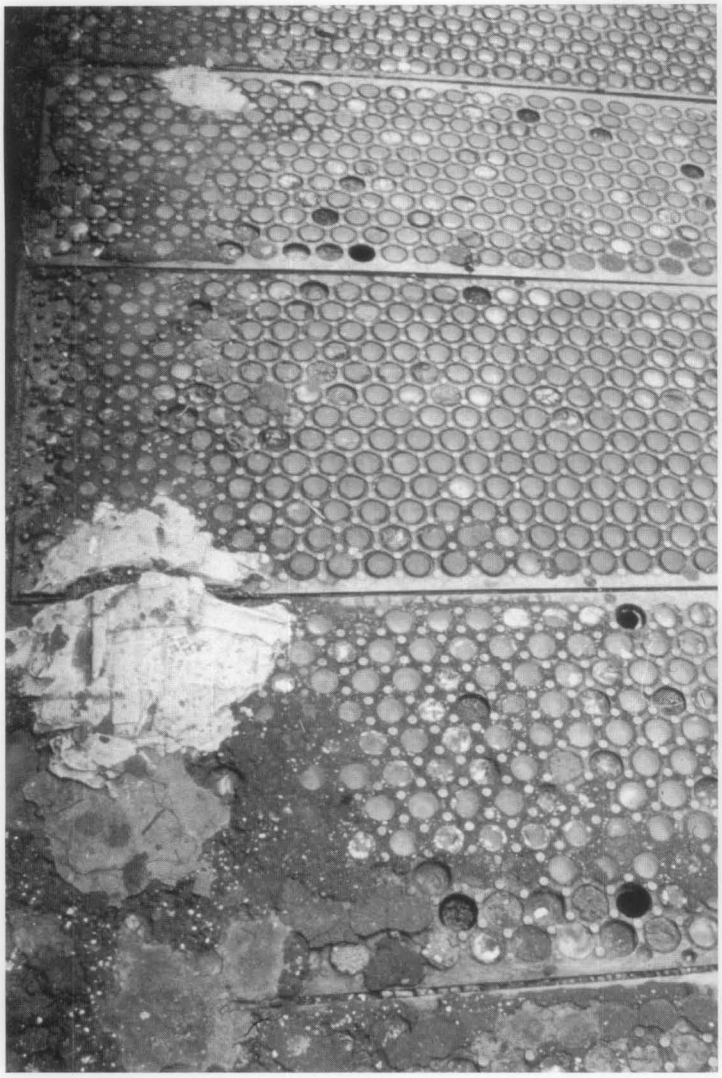

Figure 3. The individual cast-iron panels were displaced and coated in some areas with asphalt and concrete. A number of glass lenses were missing, allowing water to enter the basement of the building.

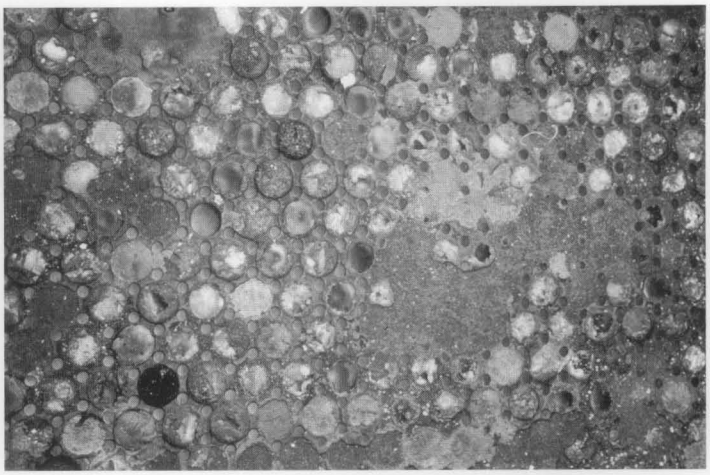

Figure 4. A detailed view of one of the panels illustrates the typical conditions prior to work. Although the original cast-iron knobs were still visible through the asphalt and concrete, many of the round openings were covered over or infilled. Nearly all of the remaining glass lenses were cracked.

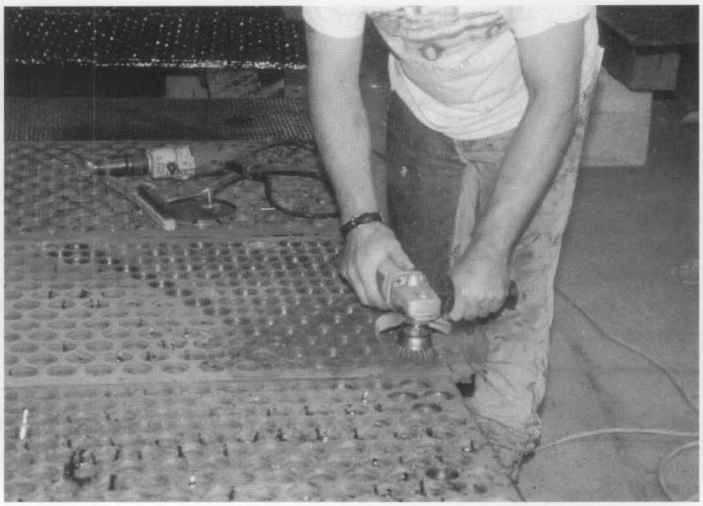

Figure 5. Workers removed any remaining corrosion, grout and other contaminants with hand chisels and power-operated wire brushes.

To facilitate treatment and allow the sidewalks to remain unobstructed, the panels were removed and temporary steel plates were installed over the vaults. In the cast-iron contractor's workshop, the surviving deteriorated glass lenses were removed, the cast iron stripped, cleaned and repainted, and new lenses set into the openings. Replacement lenses were cast by a specialty glass manufacturer, Blenko Glass Company. The company had created glass molds for a vault light restoration several years prior and were now a regular supplier of various sized lenses for similar projects. A cast-iron foundry was contracted to fabricate two new panels to match the missing historic panels. Both new and repaired panels were delivered to the building site where the cast-iron specialist reinstalled them.

Repair Work

The first step in repairing the vault lights at 552-554 Broadway was to dismantle and remove the panels from the sidewalk. Over two days, a crew of five experienced workers drilled the heads off of the panel bolts and gently pushed them through the holes in the cast-iron framing. After the bolts were removed, one corner was loosened by inserting a chisel between the saddle and the panel. Other chisels were worked around the other sides of the panel. Then, two workers raised the panels, each weighing approximately three-hundred and fifty pounds. Each panel had to be lifted straight up out of its frame because any uneven pressure could have cracked the cast-iron. A tag with an identification number keyed to a drawing was secured to each panel to ensure reinstallation into the same opening after repair. The twenty-one panels were packed upright into the back of a truck and delivered to the repair shop.

The sidewalk at 552-554 Broadway had to remain accessible to pedestrians while the vault lights were restored off-site, so a 3/4" thick plywood sheet topped with 3/16" steel diamond plate was placed over the openings. The temporary covers were tack welded into the corners of each hole and the seams were sealed with a flexible polyurethane-based caulk.

When the vault lights arrived at the repair shop they were placed upside down and the surviving glass lenses were knocked out by hand. A variety of materials, used in the past to fill holes where lenses were broken or missing, were also removed. Next, each panel was sandblasted. This

Vault Light History

Cast-iron vault lights were originally patented by Thaddeus Hyatt in 1845. As envisioned by Hyatt, the system incorporated small glass lenses set into cast-iron panels. The panels were modular, allowing for installation over large areas. Vault lights, sometimes referred to as "Hyatt Patent Lights," became widespread through the second half of the nineteenth century, paralleling the rapid development of cast-iron architecture *(see figures a and b)*. As detailed in numerous historical trade catalogues of the time, vault lights were marketed to building owners and architects as a safe, inexpensive daylighting system that allowed for the conversion of previously "unusable" basements into "rent-earning, productive work space." Prismatic pendant (or "saw-tooth") lenses were often used in place of the basic lenses because the angled projections on the underside of the prism bent light rays, directing them to the inner reaches of the lower levels *(see figure c)*.

Vault lights were also widely employed in the early 1900s construction of New York City's first subway system *(see figure d)*. Purposefully employed by the designers of the Interborough Rapid Transit Company's (IRT) subway, vault lights were constructed in the ceilings above the platforms to create an inviting underground space for a public unaccustomed to subterranean travel. Along with decorative amenities and the promise of rapid transit, the subway depended largely on pure, natural light to attract its riders.

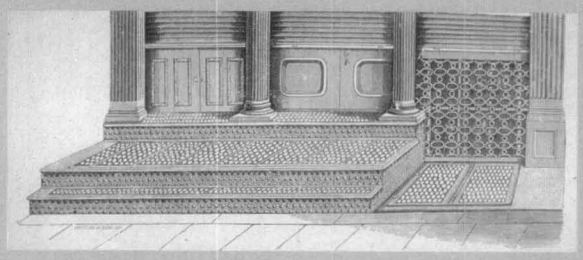

Figure a.

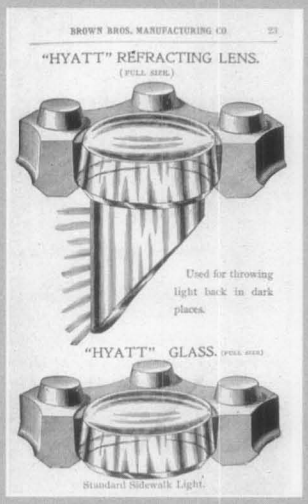

Figure b.

With the emergence of Portland cement as a new building material at the end of the nineteenth century, vault lights were increasingly constructed with round, translucent glass lenses set into reinforced concrete. The new concrete-and-glass version improved durability, waterproofing and slip-resistance while producing the same illuminating effect.

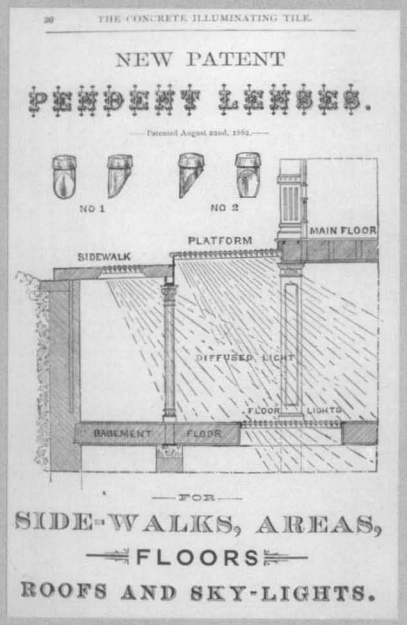

Figure c.

Figure d.

cleared off the paint, chewing gum, tar, asphalt, concrete, corrosion, grout and other grime that accumulates on a New York City sidewalk over the course of a century, without pitting or otherwise damaging the cast-iron. Then, workers cleaned each of the panels with small chisels and drills fitted with wire brush attachments to remove any material missed during sandblasting *(see figure 5)*.

At the outset of the restoration program, six of the twenty-one vault light panels were found to be cracked. Rather than replace them with newly cast panels, the contractor chose to repair the damaged units using two different techniques: welding cracked sections and splicing in replacement pieces. Due to inconsistent heating and the presence of impurities in the blast furnace mixture, historic cast-iron is a notoriously brittle material. This brittleness makes historic cast-iron susceptible to cracking and a challenge to weld properly.

The contractor had developed a system for repairing cracked or damaged vault covers. Primary considerations were to ensure that the pieces to be welded were correctly positioned and level and that the cast-iron was properly preheated. Then, using a wire-feed MIG (metal inert gas) welder, the two pieces were joined together *(see figure 6)*. The welded seam was ground down to the level of the adjacent panel surface so that the repair would not be visible after painting. The result was a strong, durable and complete cast-iron panel. When replacement sections were required, the contractor drew from a small stockpile of salvaged panels identical to those at 552-554 Broadway.

When repairs to the cast-iron were completed, two coats of primer were applied, followed by three coats of gloss black paint to match the existing paint color *(see figure 7)*. The contractor used a Benjamin Moore system including an "ironclad" oil-based metal primer and alkyd gloss enamel (Impervo) top coat that offered high abrasion resistance. A rust conversion

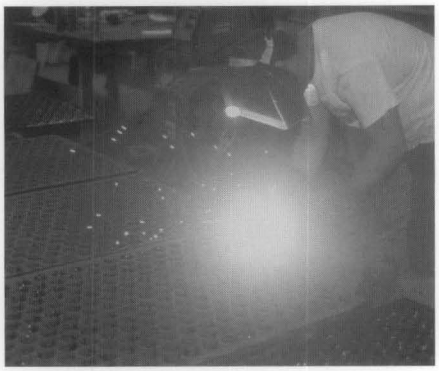

Figure 6. Cracked panels were repaired by welding in new material from a stock of salvaged panels maintained by the cast-iron contractor. The welded seams were then ground down before repainting.

Figure 7. Cleaned and repaired panels were painted with two coats of oil-based metal primer and three alkyd gloss enamel top coats.

Figure 8. Before the glass lenses were set, a ring of silicone was placed along each flange on the lower edge of the opening. The silicone kept the lens centered in the cavity while a waterproof grout was used as the main sealer.

coating system would also be suitable. Painting was followed by the resetting of new glass lenses.

After ensuring that the panels were dry and free of oils, dirt, dust and other contaminants, a bead of silicone was applied at the bottom of each of the round openings *(see figure 8)* . This preliminary seal would keep the glass centered during the grout application. Replacement lenses were obtained from a specialty glass manufacturer that has supplied new lenses for a number of vault light rehabilitation projects. The glass lenses were set into place and a two-part epoxy grout was used to seal them in the panel and waterproof the joint *(see figure 9)*. The gray, chemically-resistant material was the same used for grouting floor brick, quarry tile pavers and ceramic mosaics. Workers mixed the compound, placed it in a caulk gun and squeezed it into the areas adjacent to the lenses. Before it hardened, excess grout was removed using a dampened sponge *(see figure 10)*. After twenty-four hours, the grout cured sufficiently to complete the reglazing process. The panels were turned over and workers used a razor blade to cut away excess silicone that had dripped out of the space between the lens and the cast-iron along the underside of the panel. Then, the panels were shipped back to New York City.

Replacement Panels

Because vault lights are no longer in regular production, new custom panels had to be fabricated to replace the two missing when the project began. The contractor chose a surviving panel that was in good condition and sent it to a foundry in Alabama for use as a pattern. The foundry, which had worked on a number of vault light projects in the past, cast two new panels using techniques that had changed little in the past century. The original sample was packed in a bed of casting sand to make a three-dimensional mold. To account for shrinkage in the casting process (1/8" per foot), the mold was made slightly larger than the pattern ensuring that all panels, original and new, would be the same size. Vents and gates were created in the mold to allow the flow of molten iron and gas.

Although the method of casting new panels was nearly identical to the historical process, the composition of the cast-iron was altered to improve the material's tensile strength. To produce what is referred to as ductile iron, the iron was combined with a slightly higher percentage of carbon (+/- 3.75% in the new cast-iron versus +/- 3.5% in the historical). Very small amounts of magnesium and graphite were also added to produce a material two to four times stronger than that of historical cast-iron.

Following fabrication, the new panels were shipped to the contractor who set the new glass lenses and transported them to New York City for installation alongside the repaired panels *(see figure 11)*.

Reinstallation

The reinstallation of the panels at 552-554 Broadway was straightforward because the substructure that supported the vault lights and saddles had been reinforced with steel members approximately seven years earlier. Where leaking panels had led to the deterioration of the original stringers and support structure, the previous contractor shored up the substructure by replacing the deteriorated stringers with T-beams

Figure 9. A caulk gun helped workers apply the waterproof epoxy grout around the lenses.

Figure 10. The grout remained water-soluble until it hardened, enabling workers to remove excess material and smooth the joint between the lens and cast-iron with a sponge.

Figure 11. Just prior to installation, each panel was lifted by hand from the back of a truck and stacked on the sidewalk.

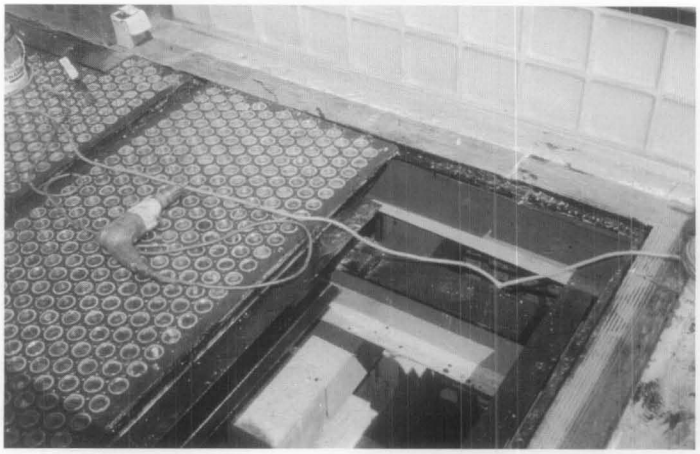

Figure 12. During the installation, each panel was set onto the supporting T-beams that span the vault. A steel supporting girder, running perpendicular to the beams, is visible within the vault opening.

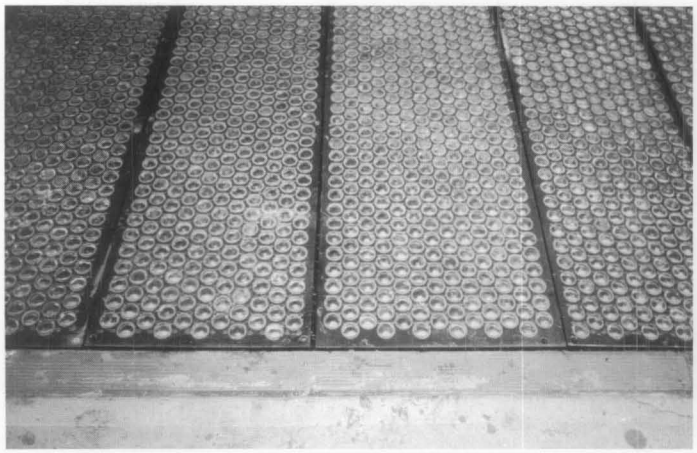

Figure 13. The restored and reinstalled panels prior to repainting the saddles.

Figure 14. The restored panels after work was completed.

spaced beneath each joint between adjacent panels *(see figure 12)*. Additionally, newly cast frame sections were bolted together and installed beneath the sidewalk surface. As part of the current restoration, the contractor examined the substructure at 552-554 Broadway and determined that the previously rebuilt assembly did not require additional strengthening or modification.

To reinstall the panels, a bead of flexible polyurethane caulk was applied around the perimeter of the support frame. The panels were positioned on top of the sealant, in the same order they were set before removal, ensuring that the bolt holes would align *(see figure 13)*. Four stainless steel flat-headed machine screws secured each panel to its framework. A flexible foam backer rod was inserted into the seam around each panel filling much of the gap. The same grout that was used to seal the glass lenses was also applied to the top of the backer rod to form the final surface seal. Again, excess grout was carefully cleared from the joint. The last step was to touch up paint on any area that was scratched during transportation or reinstallation.

Evaluation

Historically, when vaults lights deteriorated, a building owner would often cover them over with asphalt or steel diamond plate or replace them with a standard concrete sidewalk. By obscuring or removing vault lights from the sidewalk, an owner eliminated a significant architectural feature from the streetscape.

The project at 552-554 Broadway suggested another, more appropriate alternative: the sensitive repair and replication of the historic vault lights *(see figure 14)*. The result was the return of a historically significant feature that exhibited a high degree of craftsmanship and complimented the building and streetscape. Furthermore, the repaired vault lights once again serve their original function of illuminating basement space beneath the city's sidewalk.

Similar projects that included restoring vault lights have been able to recapture the basement beneath for restaurant, office and storage space, providing additional leasible floor area for the owner. This work shows that proper installation techniques and periodic maintenance can ensure the long-term performance of vault lights.

Vault lights can be repaired using relatively simple, traditional technology. The tools and materials are commonplace: sanders, brushes, glass, paint and grout. The cast-iron, though often appearing beyond repair when covered with asphalt and rust, is usually

sound and capable of restoration. Cracked historic panels, can be welded back together or new patches seamlessly introduced. Damaged lenses can be replaced with new lenses cast in custom molds by specialty glass manufacturers. When historic panels are missing, new ones can be fabricated, utilizing the same methods used to cast ornamental iron features and replacement pieces for cast-iron facades.

Stripping the cast-iron and reinstalling the hundreds of glass lenses are labor intensive undertakings that, depending on the size and condition of the panels, can be expensive. Additional costs would be incurred if the substructure of the installation requires reinforcement, repair or replacement. When part of a building rehabilitation, costs associated with the vault light work may be eligible for state or federal tax incentives.

The project described here took eight weeks including removal and reinstallation. It involved a crew of three men to restore the panels offsite and a crew of four to reinstall them onsite.

Part of the reason that the fabrication of cast-iron-and-glass vault lights was discontinued was their propensity to leak. This problem was exacerbated by infrequent, misguided or nonexistent maintenance programs. After any vault light assembly is rehabilitated, it requires regular inspection and periodic maintenance. A small stock of lenses should be kept by the building superintendent. When a lens is cracked, the glass should be removed, the remaining grout cleared from the hole, the surface repainted and a new lens set in the same way as described above. Leaks that develop along the edge of the panel should likewise be repaired with the old material removed and new backer rod and grout applied. Lens and waterproofing repairs can often be completed without removing the panel from the sidewalk, and are neither expensive nor time consuming.

Conclusion

Vault lights are an important architectural feature frequently overlooked and under maintained. Considered beneficial for the way they manipulated light and improved dark, potentially usable space, vault lights were also a visual

Concrete Vault Lights

Although this publication focuses on cast-iron vault lights, it is also possible to replace deteriorated or even missing historic reinforced concrete vault lights. Beginning in the early 1900s, this type of installation supplanted cast-iron panels. When three existing concrete panels in the sidewalk in front of Smith Tower in Seattle, Washington, were damaged by a construction truck, owners turned to a local concrete precaster to replicate the panels. The two inch thick, 4' x 9' panels dated to the first decade of the twentieth century and contained 180 Luxfer glass lights with saw-toothed prisms extending below. To cast new panels, measurements were first taken of the surviving panels and used to build a wood formwork *(see figure a)*. Styrofoam cubes were set in the form to act as block outs for the square glass lights. A quarter inch, twisted square, steel rod was embedded in the original panels to reinforce the concrete. To obtain even greater strength in the new panels, a grid of steel reinforcing bars and standard 4" x 4" wire mesh was secured between the styrofoam blocks. Then concrete was poured into the mold. After the concrete set, workers removed it from the form and dug out the styrofoam placeholders *(see figure b)*. New 1-3/4" square by 1" thick glass blocks with a pinkish tint to replicate the historic solarized lenses, were obtained from a local glass caster and set in the square voids with an epoxy. Then, the panels were transported to the building site and installed with a backer rod and caulk *(see figure c and d)*.

Figure a.

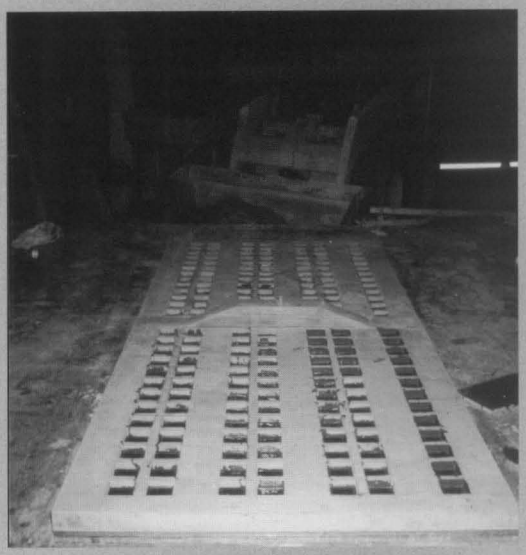

Figure b.

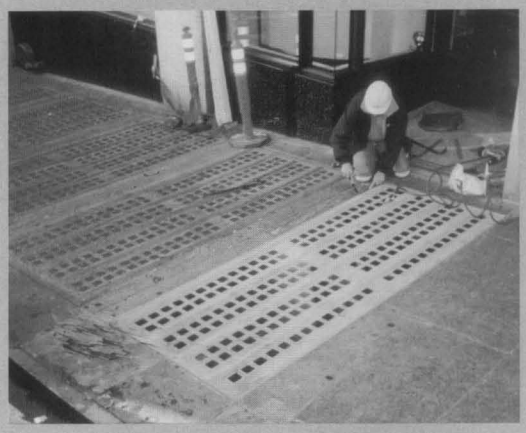

Figure c.

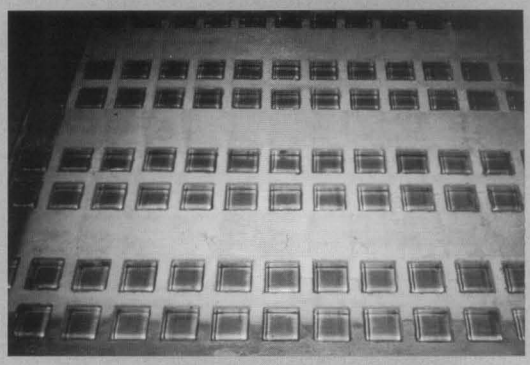

Figure d.

complement to a building's entrance and facade. Today, whether severely deteriorated, buried under layers of asphalt or missing altogether, this feature need not be lost. As the restoration project described in this *Preservation Tech Note* shows, sensitively rehabilitated vault lights can continue to provide architectural and historic character to the urban streetscape while serving their original function of naturally illuminating basement spaces.

PROJECT DATA:

Building:
552-554 Broadway
New York City, New York

Project Date:
2002

Contractor:
Rocco V. DeAngelo
Antique Cast Iron, Inc.
Cherry Valley, New York

Replacement Glass Supplier:
Blenko Glass Company
Milton, West Virginia

Replacement Panel Fabricator:
Talladega Foundry and Machine Company
Talladega, Alabama

Cost:
The total cost of the vault light rehabilitation project at 552-554 Broadway was approximately $70,000 or about $318 per square foot. Forty-five percent of this total was attributed to labor costs for sandblasting, hand cleaning, repainting, resetting glass lenses, grouting, touching up the panels, as well as welding the cracked or damaged panels and the two newly cast panels. Thirty percent of the total cost was for dismantling and reinstalling the panels, including transportation. The remaining twenty-five percent was for materials, primarily new glass lenses. This project did not include structural work, which would have added to the overall cost of the project.

Photo of Bleecker Street station in "Vault Light History" sidebar is courtesy of New York Transit Museum Archives, Brooklyn, New York.

Photos in "Concrete Vault Lights" sidebar are courtesy of Fred R. Beyers, Master Precaster Inc., Puyallup, Washington.

All other photos by the authors unless noted.

THIS PRESERVATION TECH NOTE was prepared by the National Park Service. Charles E. Fisher, Heritage Preservation Services, National Park Service, serves as the Technical Editor of the PRESERVATION TECH NOTES. Information on the 552-554 Broadway vault light project was generously provided by Rocco V. DeAngelo of Antique Cast Iron, Inc. Special thanks are extended to Elise Quasebarth of Higgins and Quasebarth, David M. Look at the Pacific Great Basin Support Office of the National Park Service, and Jo Ellen Hensley, John Sandor, Shannon Dodge and Sharon C. Park of the National Park Service's Heritage Preservation Services for their review and comments. Thanks also go to Alan Weiskopf of Perfido Weiskopf Architects.

PRESERVATION TECH NOTES are designed to provide practical information on traditional practices and innovative techniques for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act, which direct the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

Comments on the usefulness of this information are welcomed and should be addressed to PRESERVATION TECH NOTES, Technical Preservation Services, National Center for Cultural Resources, National Park Service, 1849 C Street, NW, (2255) Washington, DC 20240.

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