Lighting Museum Objects

Fiber Optics at Friendship Hill

Larry V. Bowers

Albert Gallatin, an 18th century Swiss immigrant to America, established his frontier home on the Monongahela River in western Pennsylvania. His early life as farmer, manufacturer, and entrepreneur began a career of accomplishments culminating in his service to the United States as, among other things, financier, Ambassador to Great Britain, founder of the American Ethnological Society, and Thomas Jefferson's Secretary of the Treasury. The National Park Service acquired Gallatin's home at Friendship Hill in 1979. As part of the American Industrial Heritage Project, it was restored and opened to the public on October 31, 1992 (see *CRM,* Vol. 15, No. 8, page 23).

The exhibits in the building, produced by the National Park Service's Interpretive Design Center at Harpers Ferry, WV, focus on Gallatin's life, career, and intellectual pursuits. From the beginning, the exhibits were designed so that original artifacts could be integrated into the graphics and text on a series of vertical panels extending across the state dining room of the Gallatin house. In addition, freestanding cases in front of the panels would display Gallatin-associated artifacts.

Photo by Michael Wiltshire.

The nature of the objects chosen—18th and early 19th century paper documents, books, lace, and other sensitive materials—and the method of their display, presented concerns for balancing the long-term artifact preservation needs with exhibit design considerations. A number of the more sensitive objects were to be housed in shallow boxes attached to the vertical panels; the remaining artifacts would be in cases.

The traditional museum lighting technique of using an overhead track with spots and floods was insufficient for highlighting the objects enclosed in the boxes. That fact, plus the low foot-candles required for these types of artifacts, and concerns for ultraviolet and infrared radiation from conventional light sources, led us to develop the Service's first use of fiber optic illumination for a museum exhibit.

Fiber Optics

Until recently, fiber optic lighting has been limited to scientific, technical, entertainment, and decorative arts applications. The museum community, including major institutions such as the National Gallery of Art in Washington, DC, and the Victoria & Albert Museum in London, have begun to use fiber optics to illuminate some of their more sensitive artifacts. A properly designed fiber optic system can help satisfy conservation concerns for object preservation and, simultaneously, be a vehicle for reduced energy consumption.

As an example of this potential, the Los Angeles Department of Water and Power has given a grant to the Gene Autry Western Heritage Museum to replace the exhibit lighting in one gallery with fiber optics. Their analysis showed that these changes could result in a reduction of energy use of up to 75% over existing light sources.

The National Park Service had never before used fiber optics for object lighting, and the Friendship Hill exhibit seemed an appropriate opportunity to test its effectiveness.

We decided to produce the fiber optic lighting ourselves to gain that expertise within Harpers Ferry Center. Because the Division of Conservation had set the lighting requirements for the exhibit, it was asked to develop the system. Although lighting design does not normally fall within our purview, the task gave us an opportunity to evaluate, from a conservation perspective, the pros and cons of fiber optic lighting.

Exhibit design requirements stipulated that we have lighting on demand, that it be dimmable, quiet, have instant on / off, with good color rendering and low maintenance. Conservation requirements stipulated the elimination of UV and IR and the ability to regulate total foot-candle output. Fiber optics were to be used as accent lighting in the freestanding cases and to provide all the illumination for the artifacts in the boxes on the panels.

How Fiber Optics Work

Fiber optics work through a process known as total internal reflection. This is achieved by having a core material (glass or polymer) surrounded by a cladding applied or bonded to that core. The difference in index of refraction between the cladding and core results in light being transmitted down the fiber and not out the sides. The small degree of light loss (attenuation) varies depending on the fiber optic cable chosen, as does color, wave length transmission, and flexibility.

After considerable testing we chose Mitsubishi ESKA optical cable, a polymethyl methacrylate fiber with an integral fluorine cladding. It produces a white light free of harmful ultraviolet and infrared radiation, has low attenuation, and is relatively inexpensive. To reduce the number of cables we would have to handle and because we did not have to negotiate any bends of tight radius, we chose the 3mm solid-core fiber. The U.S. distributor, CALSAK Corp. of Compton, CA, and Mitsubishi Cable

*(**FIber Optics**—continued on page 10)*

(***Fiber Optics****—continued from page 9)*

in New York were most helpful in providing assistance with problems and questions as they developed.

The Illuminator

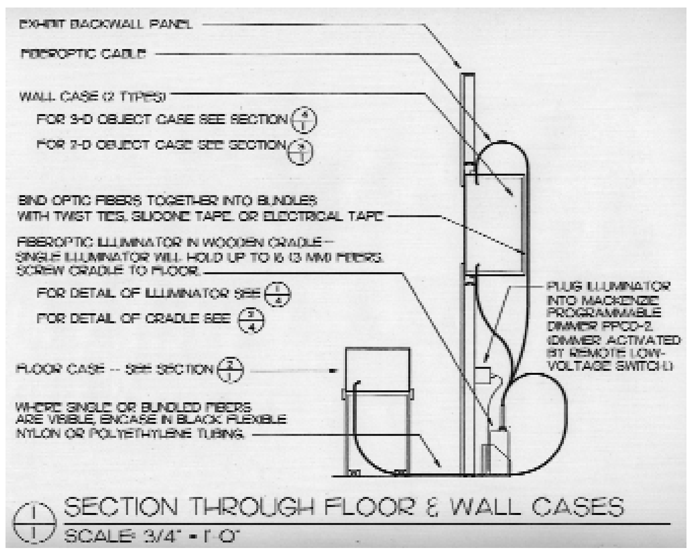
The light source proved to be our biggest hurdle. Fiber optic illuminators are usually designed to produce a maximum amount of foot-candles and are fan cooled to disperse the heat away from the high intensity projection bulbs, making them unsuitable for this lighting application.

Our search for an illuminator led us to Dolan-Jenner Co. of Woburn, MA, a major manufacturer of fiber optic equipment for scientific and industrial applications. After discussions with the firm’s technical representative, Joe DiRuzza, we decided that a microscope illuminator could be modified to meet our needs. Dolan-Jenner agreed to modify and adapt it to carry a standard fiber optic bundle. This would give us a low level light source of variable intensity that was convection cooled and silent.

Design and Fabrication of Lenses

Our next challenge was to find a way to direct light to individual objects. Commercially available light guides and lenses were either unusable or not readily adaptable to our needs without modification and / or significantly higher costs. What we achieved was relatively low tech and low cost.

After experimenting with various techniques we decided to use acrylic lenses for focusing and copper tubing to direct and support the cable as needed. Lenses were made in an assortment of styles that allowed us to both concentrate the light where we wished (within the obvious limitations of space configurations and light output) and to control light levels.



Detail of box construction. Drawings by John Battle, Detailed Concepts.

The System

The exhibit was constructed on contract by EXPLUS, of Ashburn, VA, and installed at Friendship Hill prior to installation of the lighting.

Because the optics in the front cases were designed to accent individual artifacts or label copy and were exposed to view, there was little room for error in placement. To eliminate that possibility and to reduce installation time, we prepared plywood mock-ups of all the case bottoms, placed the artifacts, and adjusted cables and lenses until an acceptable level of illumination was achieved. We then made Mylar templates that could be inserted into the exhibit cases as drill guides.

Drill guides were also made for the exhibit boxes and spaced accordingly. On site, holes for the lenses were drilled in the top or bottom of the exhibit boxes, after which the exposed wood in the hole was coated with Poly Glaze, a water-based aliphatic urethane solution used to minimize outgassing from construction materials into the case. After the artifact, lens, and optic were installed, the lens could then be moved in or out and rotated to provide the illumination desired. For larger boxes we used larger lenses and multiple cables. After focusing the light, the optic and lens were securely taped together and the exterior joint coated with Spraylat, a strippable polyvinyl butyral film, to prevent air entry into the sealed and humidity stabilized boxes.

Installation

The shallow depth of the boxes on the panels did not provide much room to disperse the light evenly. We found, however, that the beveled lenses, properly spaced, proved most efficient for lighting these artifacts.

The fiber optics used as accent light in the freestanding cases had to be more directional. The optics were inserted into copper tubing that projected up through the bottoms of the cases. The tubes were then bent to direct the light. Where necessary, acrylic lenses also were attached, after which the whole assembly was covered with a black nylon tube to match the black case bottom.

The amount of light falling on a given object was adjusted by a combination of lens positioning and treatment. We found that the degree of polish we achieved on the optics and lenses greatly affected the overall foot-candle output. During the developmental stage, our tests had shown that, with a 10' length of cable attached to our light source, we could produce from 5 to 25 foot-candles 12" from the optic end, depending on the treatment of one or both ends, and the lenses used.

This capacity to focus and control the amount of light meant that objects in close proximity to one another could be lit at quite different foot-candle levels. In one exhibit box measuring approximately 2' square we were able to light 5 objects plus label copy at levels of 5, 8, 10, and 18 foot-candles.

The lighting was designed so that one illuminator would be sufficient to light one exhibit panel and the case in front of it as a unit. Fiber optic lighting was activated by an infrared sensor that would turn on and off as the visitor approached and walked away, allowing many of the artifacts to be in darkness a good deal of the time. Additional lighting on the front of the exhibit panels was adjusted so that 4 foot-candles fell on the artifacts in the freestanding cases.

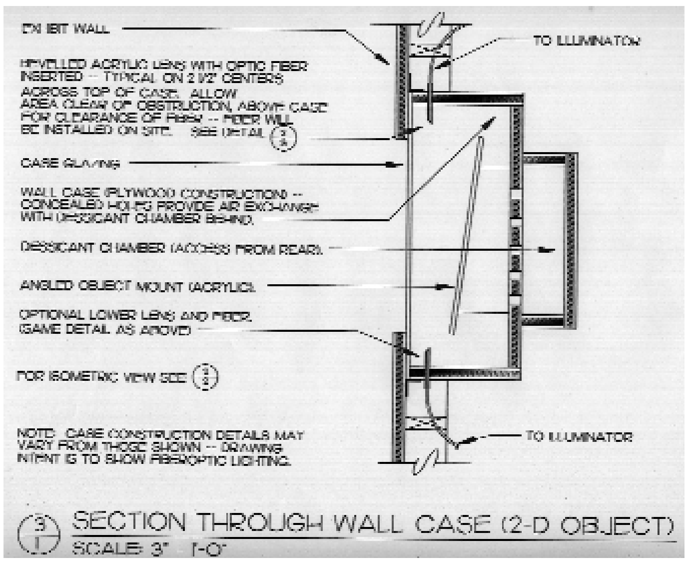
Cables in the freestanding exhibit cases were routed from the exhibit platforms down and out exit holes at the

(***Fiber Optics****—continued on page 19)*

(*Fiber Optics*—continued from page 10)

bottom rear of the cases. The cables then crossed 6"-10" of open floor space, entered through holes at the bottom of the panels, and were then bundled with cables from the boxes at the illuminator. The sections of cable exposed to view behind the exhibit cases were covered with black polyethylene tubing.

The manner of fixing the fiber optics to the light source had to be considered because of the potential for heat build-up and subsequent damage to the optics. Cables were bundled into and supported by a 5"-long aluminum tube held in an aluminum collar with set screws. This provided a method of attaching the fiber optics to the illuminator and allowed sufficient ventilation of heat from the bulb.



Detail of case construction. Drawings by John Battle, Detailed Concepts.

Future Directions

Our research and experimentation demonstrates that a simple and effective system for artifact illumination can be developed using readily available materials. More sophisticated systems may evolve as interest grows within the museum community. Future uses may include fiber optics connected to passive solar collectors, providing UV and IR- free sunlight to museum galleries and visitor areas.

The ability to get safe, effective lighting to museum objects at relatively low cost suggests that the future of fiber optics in museums looks promising.

Our application of fiber optics has allowed us to satisfy the immediate conservation and design objectives at Friendship Hill. It also has given the designers, planners, and other museum professionals at Harpers Ferry Center an additional tool with which to work.

Larry Bowers is a museum technician in the Division of Conservation, National Park Service, Harpers Ferry, WV.

(*Labor*—continued from page 14)

Street, Haledon, NJ 07508; Phone: 201-595-7935). The museum seeks to advance public understanding of the history of work, workers, and the labor movement of the United States, with special attention to the ethnicity and immigrant experience of American workers.

There is little ambiguity regarding the public commemoration of sites associated with leading politicians or business figures in American society. However, sites that focus on working class life, especially those that are connected to harsh strikes culminating in defeat, often are remembered in much more complex ways. When reporter Mel Most tried to interview 1913 survivors and their children for a story in a local paper in 1973, he met with widespread resistance. One neighbor of the Botto family in Haledon was terrified that she might be mentioned in his story. In popular memory the 1913 strike had become associated with the decline of Paterson, with violence, and with un-American radicalism. This was the case despite clear historical evidence to the contrary: the strike was democratic and non-violent in nature, the community had demonstrated widespread support, and the IWW had attracted thousands of Paterson workers to its ranks.

Even Bunny Kuiken's own grandparents did not talk with her about the strike or the role of their own home. Still, she felt something about the house and, with the discovery of an old photo (reproduced here), she began to investigate the history of the workers of Paterson and Haledon, and her own family past. With the Botto House established as a national landmark and hosting the American Labor Museum, Kuiken believes that her commitment to a public commemoration of this significant history has been fulfilled. In "The House on the Green," a video distributed by the museum, she declares: "I want this house to be here for many generations to come—to not forget those 25,000 people that were out of work. And it was forgotten for many years. Many people just wouldn't talk about it. And it bothered me that I had that one picture with all these thousands of people out front and nobody seemed to remember them. And through this I hope they shall be remembered."

The Botto House is one of the National Historic Landmarks featured in the National Park Service's book, *The Great American Landmark Adventure* (see *CRM*, Vol. 16, No. 1). For those interested in learning about this history in greater detail, two books might be of particular interest: Steve Golin, *The Fragile Bridge: Paterson Silk Strike 1913* (Philadelphia: Temple University Press, 1988); and Philip Scranton, ed., *Silk City: Studies on the Paterson Silk Industry, 1860-1940* (New Jersey Historical Society, 1985). If you are interested in a comprehensive overview of labor history throughout the history of the United States, there is the two-volume study by the American Social History Project, *Who Built America? Working People and the Nation's Economy, Politics, Culture & Society* (New York: Pantheon Books, 1992).

Marty Blatt is supervisory historian / chief of Professional Services, Lowell National Historical Park, and is working with Harry Butowsky, Washington Office, History Division, in the administration of the National Park Service's labor history theme study (see *CRM*, Vol. 15, No. 5).