

RESTORING THE STATUE OF LIBERTY:

CONSTRUCTION OR CONSERVATION?

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and
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Of the many concerns facing those who began the restoration of the Statue of Liberty none was of greater importance than the organization of the project and its implications to the conservation of the monument. After an initial survey highlighted the major problems within the statue plans were begun to deal with these issues. Along with the correction of problems, a new setting for the statue and an improved experience for the visitor were planned.

Naturally as the scope of the project expanded, the numbers of people and organizations involved expanded as well. With the increase in numbers came an increase in input. This variety of input contained elements both enhancing and detrimental to the preservation of the Statue of Liberty. Control of this growing diversity was a great concern to the National Park Service since not all proposals conformed to the standards set forth by the Secretary of the Interior. Among the proposals offered by the many interested parties were: the cleaning and polishing of the statue's exterior; demolition of the statue, selling of the copper and the use of the funds raised to build an exact duplicate in fiberglass; the application of an epoxy coating to the exterior; and the construction of a competing monument, dedicated one might presume, to the designers of that new monument.

Fortunately for future generations as well as for "Miss Liberty" a more conservation minded approach was taken. The initial survey revealed minor flaws with the copper skin but found extensive problems with the iron grid system (referred to as the armature) supporting the skin. Because of a galvanic reaction between this iron armature and the copper of the skin, the armature, being relatively sacrificial, had lost in many places over half its thickness. This loss was irreversible and necessitated the replacement of the iron grid system. Also of concern was the supporting structure of the raised right arm and the possibility that repairs might require removal of the arm. Replacement of the armature and removal of the arm or any of its parts would require scaffolding as would access to the skin's exterior surface. Rapidly the project was requiring a high degree of engineering.

The design and erection of the scaffolding was a project in itself. In design the scaffold was unique. Normally a scaffold is tied horizontally to a supporting structure at specified heights vertically. Because following this design parameter would require numerous openings in the copper skin an imaginative designer created the highest free standing scaffold used in our country, eliminating the need to puncture the skin. However, the need for

conservation was to cause elaboration in the construction process. Complexity ensued with the design procedures for replacing the iron armature. The need for continued rigidity meant that only 16 bars of a total of over 1800 could be missing within a 36 hour period at any one time. Fabrication of the new bars required a workshop on the island and, because of environmental concerns, the bars were sent over to Manhattan for cleaning with acid before returning for installation.

As the design and engineering for the project proceeded it became obvious that the most practical method of preserving the existing flame was to remove it for conservation and put in its place a new flame. Fabrication of a new flame and upper portions of the torch required a technique little practiced in this day. To obtain people skilled in this technique called repousse, and accomplish the fabrication within the short time frame of this project, a company well experienced in the method, having a large enough working capacity was sought. The final selection fell on a firm from France from whence the original fabrication had come.

With the developing scope of work the project began to expand. To the initial work on the Statue of Liberty was added the construction of improved visitor circulation, a new museum, new landscaping and improved service facilities. Rapidly the statue became part of a larger construction project. To coordinate what was seen as a growing and diverse effort, it was decided to control the project through construction management rather than contract with a general construction contractor. With this step it was clearly seen that the preservation of Miss Liberty would be a major construction effort having all the vicissitudes and complexities normally found therein.

However, the conservation of this monument was not to be abandoned to the constraints of the more prosaic world of construction. Completion of the scaffold gave access for the first time in the project to all of the exterior surface of the copper skin. The surface of the copper was examined for evidence of crack propagation, penetration and erosion. Utilizing an ultrasonic caliper, measurements of the skin thickness were made at the salient compass directions, both low and high on the statue. These measurements were to determine if there had been preferential loss of the copper. The results indicated no loss on any one side more than another. Because of the method used to form the copper, that of hammering the metal into wooden molds, the original thickness of the copper varied. In order to determine copper loss at specific points, use was made of the historical research then being done. Reference had been found of the statue's interior being painted with a coal tar waterproofing in 1911. When applied some of this coal tar had leaked through the seams and had run down the exterior surface in streaks. By cleaning off the coal tar and measuring the metal thickness at specific points, places where the copper had been protected from erosion since 1911, and at adjacent exposed points, a differential was determined which indicated the copper loss for three-quarters of the statue's life. By interpolating, an average loss of 4 mils (0.1 mm) was calculated.

In comparison with local test sites this was found to be a normal loss for copper in the New York area.

Except for minor repairs, the modification of some drain holes and the replacing of certain rivets, the statue's skin was found to be in good condition. There were some areas of cosmetic concern but for the most part these were left untouched since being paint streaks it was felt these would weather off and any attempt to remove them would result in loss of the patina. Maintaining the protective patina was a major concern from the project's beginning. In the design of the scaffold it was specified that the scaffold elements would not be closer than eighteen inches (45.7 cm) to the skin and the material used to construct the scaffold was aluminum so that no rust could stain the green exterior. Because of the enormous size of the Statue of Liberty, about 152 feet (46.33 meters), and the extent of the work most persons who worked on and about the skin were trade workmen and not conservators. This meant a considerable effort in training and supervision. To clean the interior of the skin of its many layers of paint, a simple technique of blasting with pressurized liquid nitrogen was developed. Such methods easily employed in the field brought conservation into the realm of construction.

Removing a coal tar corrosion product, which remained after the liquid nitrogen had removed the paint layers, was more difficult and required additional experimentation. Once again blasting was used to physically remove this material. The unique aspects of this experimentation and resultant solution was to pick a 'grit' that was hard enough to remove the coal tar but not so hard as to produce a copper loss on the one-tenth inch (2.5 mm) thick skin. The grit selected to be used in the blasting was bicarbonate of soda (ordinary baking soda).

The removal of the coal tar by baking-soda blasting evolved from a previous task in removing paint from the structural iron members. The concern for potential explosions and unhealthy (lead) air contamination within the statue's confined interior led the team to some unusual operations. The sand blasting (aluminum oxide) was performed with a vacuum system that collected the particles of paint and aluminum oxide immediately after impinging on the paint surface. Within hours after the paint was removed the iron was sprayed with a water-based inorganic zinc paint. This paint had been developed by NASA and provided a solvent-free application which avoided low flash point explosions.

The total construction on Liberty Island of which the Statue of Liberty restoration was but a part cost over \$60 million. In dealing with the historic material, conservation and preservation principles were followed; this required much effort since at times these principles were in conflict with the construction time table. All of the rivets (about 20,000) holding the saddles which secured the skin to the armature were replaced with virtually no damage to the copper or its patina. A scaffolding was erected around the statue and after two years was removed leaving one small dent as

the result of a hurricane. Hundreds of men and women worked around her with little evidence of graffiti or disfigurement. Without question, the restoration of the Statue of Liberty was a large construction project but, it was more. It certainly contained a successful conservation project. Most of all, it was a project which was part of America and for which the American public generously contributed the funds.

Today, a year after completion, the statue stands almost visibly unchanged from her appearance before work began. The island has changed as have other buildings including the interior of the statue and pedestal but, on the exterior she now holds a torch with a golden flame. Renewed for many anticipated centuries this is what has changed and with her new flame Miss Liberty will continue to symbolize freedom to all the world.

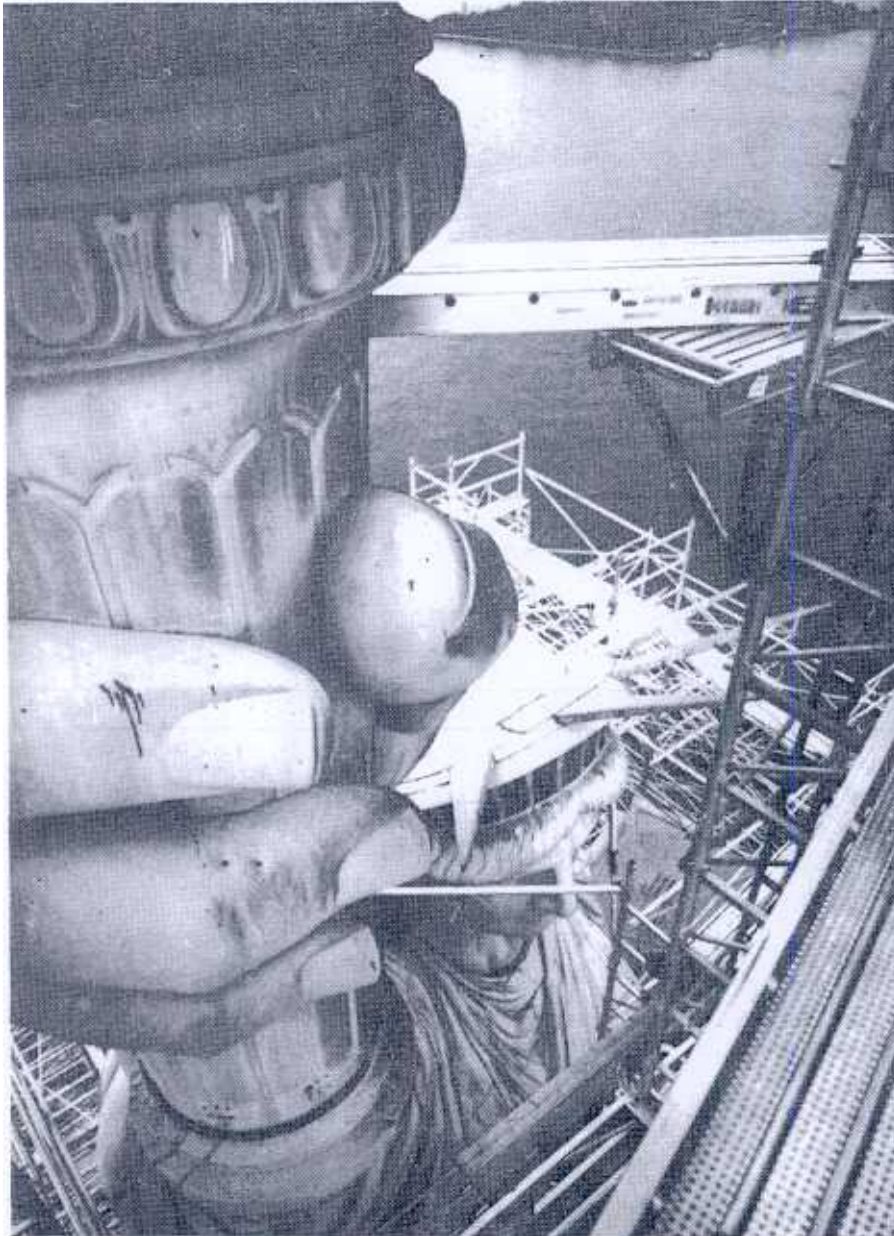


Figure 1
The Statue of Liberty seen from her scaffold
Photo: H.A.B.S. - Jet Lowe

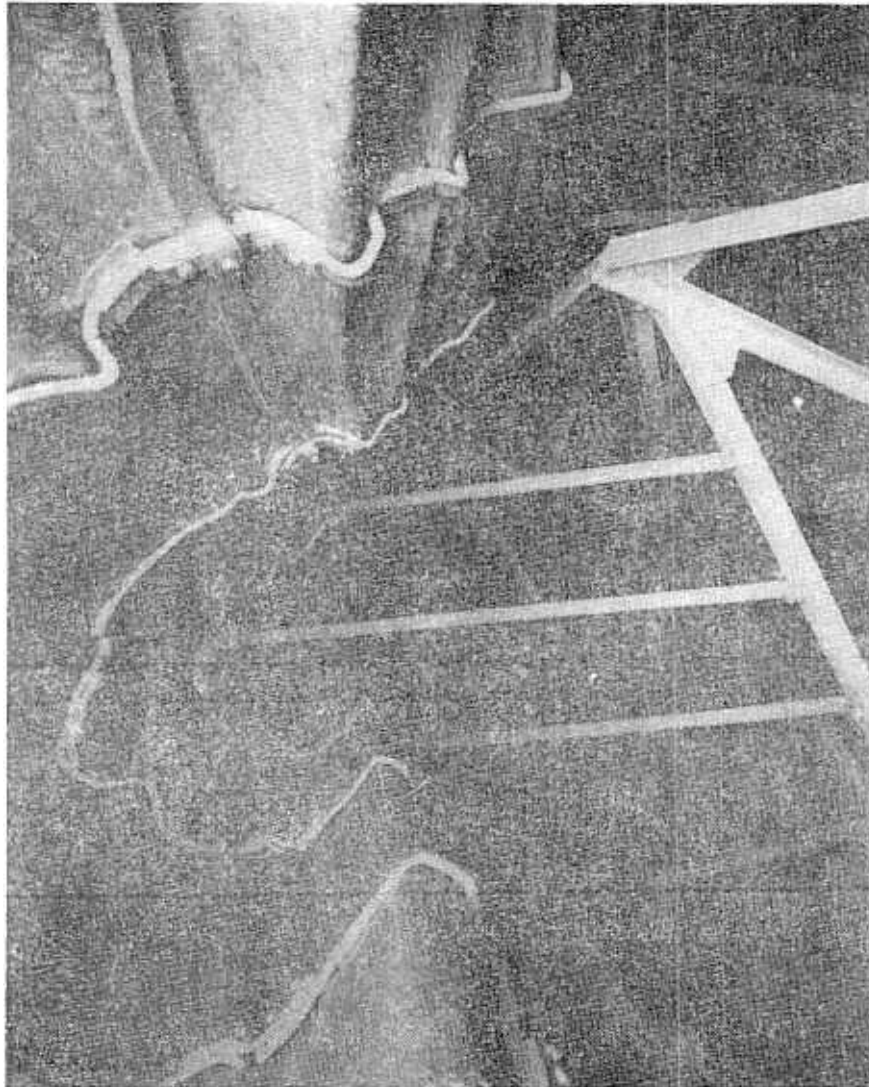


Figure 2
The interior of the skin showing the armature system.
Photo: H.A.B.S. - Jet Lowe

SUMMARY

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This paper looks at the recent Statue of Liberty restoration as a project combining conservation within a larger construction effort. Because the complexities of the construction portion of the project, i.e.: a compressed time frame, engineering design considerations, union labor, and the extensive visitor services and island modifications, meant that most work would be accomplished by trade contractors, close supervision and tight specifications pertaining to the historic fabric were necessary. In one case, fabricating the new flame, the contractor was selected on the basis of their ability to perform and not on price. Fortunately, most of the metal conservation was confined to the exterior skin and was accessible for close supervision.

Although much of the work done on the skin was accomplished by persons not trained in conservation, the completed project reflected a high degree of care and skill. Training, supervision and, in one case, the development of a new technique were responsible for achieving the quality of the work. The new technique involved the use of liquid nitrogen to remove paint from the inner surface of the skin. To reach the exterior surface of the copper, a scaffold made of aluminum was erected around the statue in a manner that would not injure or stain her delicate skin.

After two years of work and extensive changes to her island and support facilities, the Statue of Liberty's appearance has been little altered. The one change the visitor will see is a new golden flame. It is this flame, held so highly, that helps to symbolize freedom to all the world.

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RESUMEN

RESTAURANDO LA ESTATUA DE LA LIBERTAD:

¿CONSTRUCCION O CONSERVACION?

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Este artículo propone darle un vistazo a la restauración de la Estatua de la Libertad, combinando la conservación dentro del aspecto más grande aún de construcción. Debido a la complejidad de la parte de construcción de éste proyecto, como por ejemplo, tiempo muy limitado, problemas de diseño de ingeniería, labor del sindicato, y modificaciones a la isla y a los servicios para los visitantes, con el resultado de que todo el trabajo fue hecho por contratistas sindicalistas, bajo supervisión estricta, y usando especificaciones exactas pertenecientes a la preservación histórica. En un instante, cuando hubo que fabricar la llama nueva, la selección del contratista fue basada por su habilidad para desempeñar la obra, y por el costo de la obra. Por suerte, casi toda la obra de conservación del metal fue limitado a la superficie del exterior, y por consiguiente, muy fácil de supervisar.

A pesar de que mucho del trabajo de la superficie fue hecho por trabajadores no adiestrados en la conservación, el proyecto final refleja un alto grado de esmero y destreza. Entrenamiento, supervisión, y en un caso, desarroyando nuevas técnicas, fueron responsables para lograr una alta calidad de trabajo. La nueva técnica desarrollada consiste en usar nitrógeno líquido para remover la pintura de la superficie interior. Para llegar hasta la parte más alta de la superficie exterior de cobre, se construyó un andamio de aluminio alrededor de la estatua entera, pero de una forma que no dañara ni manchara la superficie tan delicada.

Después de dos años de trabajo y cambios extensos a la isla y a sus servicios de apoyo, la apariencia de la Estatua de la Libertad es hoy casi igual a la de antes. El único cambio a simple vista es la nueva llama dorada. Esta es la llama, alzada tan alta, que sirve como símbolo de libertad para el mundo entero.

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