TAFT BRIDGE LIONS: ARCHITECTURAL ASSESSMENT

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February 1996

TABLE OF CONTENTS

LIST OF PLATES

Taft Bridge Lions: Architectural Assessment

Executive Summary

The *Lions*, located on the William Howard Taft Bridge on Connecticut Avenue over Rock Creek Park, have deteriorated and must be replaced. The District of Columbia Department of Public Works has requested Parsons Engineering Science, Inc. to prepare a report recommending a course of action in the replacement of the statues.

The existing lions, which date from 1908, are made of concrete to resemble limestone. Concrete was a new medium for sculpture in 1908 and was received with considerable interest by artists and engineers. Sculptor Roland Hinton Perry, although familiar with other materials, appears to have chosen to sculpt his *Lions* in concrete to complement the Taft Bridge, at that time the longest concrete bridge in the world.

It is the recommendation of this report that the *Lions* be re-cast in concrete using modern technology that would incorporate fiberglass, or some equally durable material, in the mixture that would enable the statues to withstand the debilitating forces that eroded Perry's original *Lions*. Replacing the existing lions with lions made of concrete, or secondarily with those made of limestone, would be in keeping with the sculptor's original intent.

Taft Bridge Lions: Architectural Assessment

Introduction

The Taft Bridge Lions, four sculptures situated on the William Howard Taft Bridge on Connecticut Avenue over Rock Creek Park, are presently in a deteriorated condition and measures must be taken to replace them. This report will assist the Department of Public Works in deciding whether the lions shall be replaced in kind to maintain their historic integrity or whether they may be replaced by lions executed in a different medium. If they are to be replaced by lions sculpted in a different medium, what material would be better? This report will explore various alternatives, and recommend a course of action that best reflects the sculptor's original intent.

Historic Context

The concrete-arched William Howard Taft Bridge carries Connecticut Avenue in a roughly north-south direction across Rock Creek Park in Northwest Washington, D.C. The bridge originally was called the Connecticut Avenue Bridge, or more popularly, the Million Dollar Bridge (Plates 1 and 2). It was authorized by Congress in the March 3, 1897, appropriations act for the District of Columbia. In a competition for the best design, three civil engineers were invited to submit designs, and prizes were offered for the top three designs. New York engineers W. H. Breithaupt and L. L. Buck each submitted two designs. George S. Morison, of Chicago, submitted one (*Engineering News*, January 27, 1898:54).

The bridge was to be located prominently on a wide avenue lined with fine residences, and would be visible from both Rock Creek Park and the National Zoological Park. Because of its prominent visibility, it was decided that the bridge should be a monumental span to "comport with the dignity of the thoroughfare of which it was a part" (*Engineering News*, June 1, 1905). Breithaupt's and Buck's designs were for Melan arch and steel arch spans, with masonry piers and abutments. George Morison's design, which was the one selected, consisted of full-centered masonry arches. Morison prepared cost estimates for the bridge using granite, some unspecified cheaper stone, and concrete. While concrete may have been chosen because it was the least expensive alternative, cost of the bridge does not seem to have been the overriding consideration. Breithaupt's and Buck's designs for the steel arches and the Melan arches were all, except for one, less expensive than Morison's concrete span (*Engineering News*, January 27, 1898:54).

Morison was a firm believer in the use of masonry for memorial bridges. As he wrote in an 1898 paper, entitled "Masonry":

> It is the one material which is available for really permanent work. It should be massive and it must be well done. It is the most expensive form of good construction; it belongs to the class of works which are commonly associated with architecture rather than with engineering. . . . The one material adapted to

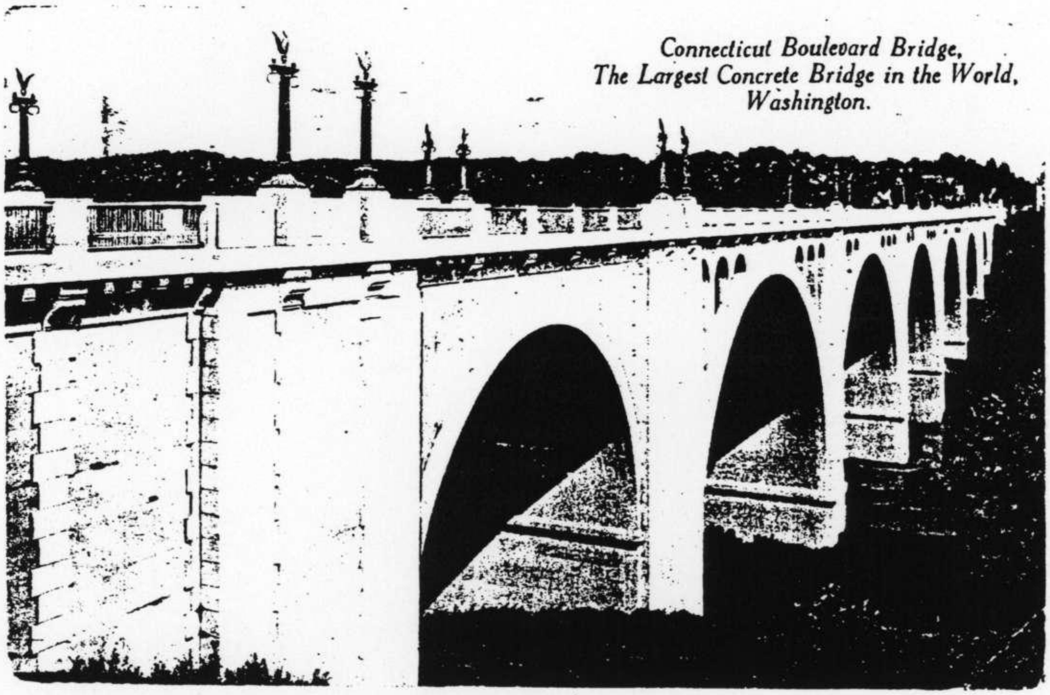

Plate 1. Connecticut Avenue Bridge

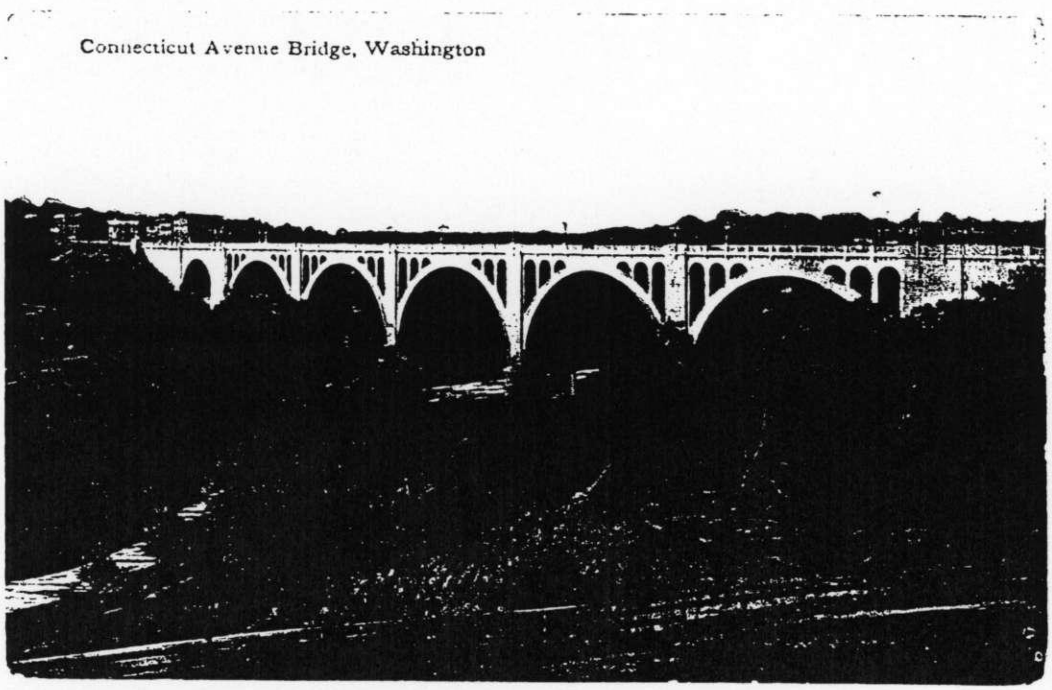

Plate 2. Connecticut Avenue Bridge

> monumental work is masonry; honest substantial masonry; not a veneering of cut stone which covers a skeleton and gives a massive external appearance . . . (quoted in Bird 1991).

Although the ancient Romans had used concrete as a building medium, the technique had been lost. The modern re-discovery of the material was a nineteenth-century phenomenon. However, one nineteenth-century problem with using concrete in arched bridges was that its behavior under live loads was unknown. From 1890 to 1895, the Austrian Society of Engineers and Architects performed extensive experiments on full-sized concrete arches. The results of these experiments were widely reported in engineering journals throughout Europe and the United States, where they were received with considerable interest (Spero 1994: 134-135). Civil engineer, Edwin Thacher, expressed this growing excitement over the medium for bridge-building in an 1899 *Engineering News* article,

> They are more beautiful and graceful in design, architectural ornamentation can be applied as sparingly or as lavishly as desired; they have vastly greater durability, and generally greater ultimate economy; they are comparatively free from vibration and noise; they are proof against tornadoes, high water or fire; the cost of maintenance is confined to the pavements, and is no greater than for any other part of the street; home labor is employed in building it . . . and its cost as a rule does not much, if any, exceed that of a steel bridge carrying a pavement . . . where the people have been more thoroughly educated up to it, there has been no lack of confidence in it for some years . . . . We hear nothing now from intelligent men about mud bridges (quoted in Spero 1994:136).

Concrete offered all of the advantages of masonry without the disadvantages of other forms of masonry such as stone and brick. Stone and brick masonry were expensive and labor intensive. ". . . Each element of a masonry bridge was subject to distinct internal stresses. If one unit failed, the entire structure was endangered. Concrete, however, was inexpensive and the monolithic nature of concrete construction made the bridge one structural unit . . . (Bird 1991).

Construction of the Taft Bridge was begun in 1897, amid enthusiasm over the use of concrete as a building medium. It was completed in 1907. Repeated difficulties in obtaining necessary appropriations from Congress frequently delayed construction. At the time it opened to traffic, it was the largest unreinforced concrete bridge in the world (Fawcett 1908:87). Such decorative elements of the bridge as the arch rings, brackets, dentils, quoins, moldings, and railings were precast concrete. Each piece was separately molded and set in place like cut stone. The aggregate used in the concrete for these elements was made up of diorite, a granite-like material, that was found in a bluff about 500 feet from the south end of the bridge (*Engineering News,* June 1, 1905:572). *Engineering News* called the combination of molded concrete block and monolithic concrete masonry "exceedingly rare" (June 1, 1905:571).

At each of the four corners of the bridge is a concrete lion resting on a granite base (Plates 3 and 4). The lions were sculpted by Roland Hinton Perry. Perry, born in New York on January 25, 1870, was a painter as well as a sculptor. He attended the Ecole des Beaux-Arts

Plate 3. Connecticut Avenue Bridge, ca. 1908, with Lions

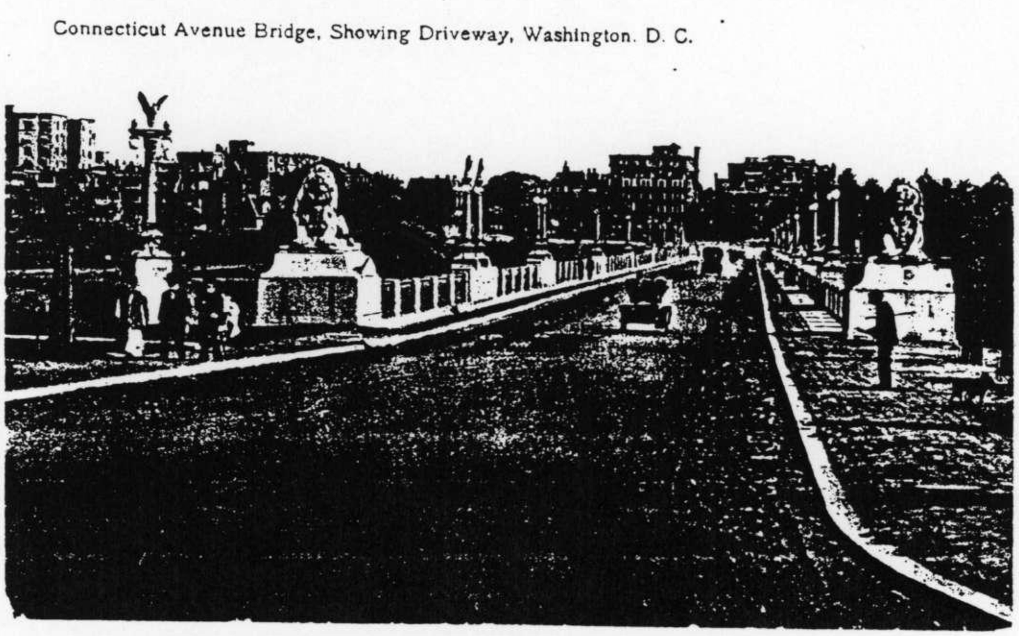

Plate 4. Connecticut Avenue Bridge, ca. 1910, with Lions

and the Academie Julian in Paris for four years from 1890 to 1894, where he studied under Gerome, Delance, Callot, Chapu, and Puech (Opitz 1986:733). Perry returned to New York in 1894, and began his career as a painter. In 1895, he was commissioned to execute four octagonal medallions for the ceiling of the entrance pavilion at the Library of Congress. These medallions were so well received that Perry was awarded a commission to sculpt the *Court of Neptune Fountain* for the front of the library. He alternated between monumental Neoclassical sculpture and portrait painting of fashionable notables and society ladies until 1920, when he confined his work to painting (Goode 1974:585). Other works by Perry include the bronze doors for the Buffalo, New York, Historical Society; *Pennsylvania* for the top of the dome of the state capitol at Harrisburg; the *New York Civil War Memorial*, Andersonville, Georgia; and *Primitive Man and Serpent*, in Brookgreen Gardens, South Carolina, in addition to the Taft Bridge *Lions* (Goode 1974:585). Perry died October 27, 1941.

Roland Perry was certainly familiar with other materials that could be used for casting the statues. That he chose concrete at this time for these particular sculptures suggests that he wanted them to complement the material used in the monolithic bridge. His concrete lions are in two stances, one at rest and one roaring, for the opposite sides of each end of the bridge. They attracted much attention from the engineering world when they were cast. *Engineering News*, in an article describing the process of casting the lions, noted that "the molding of large and intricate figures in concrete is a comparatively recent process, and even now is in the hands of a few specialists, but the highly artistic effects that some of these gentlemen have been able to procure makes it apparent that there is a wide field for this work" (*Engineering News*, November 19, 1908:545).

Prior to casting the actual lions, Perry provided the Engineer Commissioner and the Supervising Architect quarter-size models for their approval, and full-size models for the casting contractor, the Erkins Company, of New York City. The lions are approximately nine feet high and twelve feet long, and are of solid concrete. Within each lion are reinforcing metal rods in each fore leg, in the curled tail, and on a horizontal plane at about the level of the mouth to reinforce the head. Although the lions are currently believed to have been pre-cast in Perry's studio, *Engineering News* in the 1908 article reported that each lion was cast in place on its pedestal, using two plaster molds.

The models were shipped from Perry's Hoboken, New Jersey, studio to the Erkins Company plant in New York, where the molds were made. The molds consisted of about 150 pieces, which ranged in size from 9 inches to 24 inches in thickness and interlocked to create a strong backing. The longer pieces were reinforced with one-inch iron pipe and wooden strips. The pieces were designed so that the last piece placed was a key that had to be taken out first in removing the mold.

In the casting, rough forms were placed inside the mold, about five inches from the face forms so that a surface coating could be cast first and later filled in. The surface layer was approximately eight inches thick and first worked in well by hand, then rammed by small iron rammers about two inches in diameter. A second ramming followed, using wooden mallets, and then a third, using sand bag rammers until no impression could be made in the concrete with the hand. The surface of this first layer was then scratched with a nail or trowel so that the inner concrete filling would bond. The work proceeded this way in two foot, three inch layers up to the top until the keying was made in the head of the lion.

In describing the lions, the Engineer of Bridges for the District of Columbia reported that the desired effect was that of limestone. The amount of material used in making one batch of concrete for the facing layer consisted of:

2 cu. ft. Dexter Portland Cement
1 cu. ft. Blano Stainless Cement
6 cu. ft. Indiana limestone sand
5 qts. refined yellow ochre
1 qt. waterproofing
7-1/2 gals. water (*Engineering News*, November 19, 1908:545).

By 1930, years of alternate freezing and thawing, vibrations from traffic on the bridge, as well, perhaps, as general neglect had seriously undermined the structure of the lions. In that year, the *Washington Star* reported that the Taft Bridge lions were disintegrating and that the disintegration was deeper than merely the surface layer, that the structure itself was affected. The newspaper predicted that if repairs were not undertaken soon, in a few years the lions would be "completely tailless, possibly headless." Criticizing the use of inferior concrete or natural stone, the *Star's* recommendation was to replace them with lions cast in bronze (*Washington Star*, April 25, 1930). Nevertheless, despite the reported disrepair of the lions in 1930, it does not appear that any measures were taken to restore them at that time.

By the 1960s, however, large cracks had formed in the lions, the concrete was crumbling, and chunks of concrete had fallen off. In 1965, the District government decided to restore them. Bids for the work were invited, and the $10,000 contract was awarded to Italian sculptor Renato Lucchetti. Lucchetti worked for several months to develop a concrete that would match the texture and color of the original lions. He first removed all the loose concrete from the lions and their pedestals. Concrete along the cracks was chiseled back several inches to provide a large enough area for the new concrete to bond with the old. Once Mr. Lucchetti had achieved a solid base, he applied the new concrete, reshaping the statues (*Washington Post*, April 5, 1965). He began work on the first lion in April, 1965. By June 18, his work had been inspected and accepted by the Commission of Fine Arts. The second letter of acceptance for the second lion was dated July 29; the third on September 1; and the final lion was accepted on October 6 (National Archives Record Group 66, Box 1).

For whatever reason, Mr. Lucchetti's restoration of the lions has not held up. Once again, the Taft Bridge lions are in a deteriorated state, with cracked and crumbling concrete. Stains have appeared on the surface, indicating that the interior metal reinforcing rods are rusting (Save Outdoor Sculpture! survey 1992). Reportedly, the concrete in the second layer beneath the exterior surface has softened (Renaldo Lopez, sculpture conservator, telephone interview, September 1995). The questions facing the District of Columbia, Department of Public Works concern the most effective treatment for the statues. Many alternatives have been suggested.

Alternatives and Recommendations

The first suggestion, noted in the 1930 article in the *Washington Star* and still put forth by some, is to replace the lions with statues cast in bronze. However, it seems clear from descriptions in the contemporary *Engineering News* that the use of concrete in the bridge was a conscious decision on the part of its designer, George Morison, its architect, and the city engineers responsible for its construction. Concrete was a relatively new material whose introduction for works of art was creating intense interest among engineers and whose properties were only then being appreciated in the construction of monumental bridges. Based on the evidence in *Engineering News*, the use of concrete in sculpting the lions was also a new and challenging medium that would extend the medium of the bridge to the decoration and ornamentation applied to that structure. Those involved in the design of the bridge wanted the sculptures to represent stone. Nowhere in the historical record is it indicated that any thought was given to the use of bronze in the casting of the lions.

A second alternative is to carve new lions from blocks of limestone. Limestone, according to Renaldo Lopez, the conservator; is long-lasting; it hardens over time; and it will drain moisture, thereby alleviating the problem of the alternating freeze and thaw conditions that have undermined the structural integrity of the original concrete lions. According to the citation given in *Engineering News* by the Engineer of Bridges of the District of Columbia, who had charge of the construction, the intent was to get a limestone effect, which was attained in the original sculptures. Carved limestone for the statues is an alternative that would retain the original artistic intention of the sculptor. However, limestones vary considerably in their porosity. Loosely cemented limestones are more porous and do not weather as well as harder limestone (Rosenfeld 1965:112). If it is decided to carve new lions from limestone blocks, a superior grade of limestone should be used to avoid rapid deterioration that might result from the use of an inferior grade.

Richard Livingston, who is team leader for exploratory research in the Highway Engineering Research and Development Department of the Federal Highway Administration (FHWA), suggests that Indiana limestone would be a good alternative stone for replacement statues, although he believes that Georgia marble would be better (telephone interview, January 31, 1996). He also suggests that, if molds are available, robotic carving, as developed by Saint John's Divine in New York City, would cut the cost of the sculpture considerably.

Other experts in the field of conservation recommend the use of alternative stone if the desired result is increased durability. Andrej Dajnowski, conservator with the Chicago Park District, who is presently restoring the concrete *Fountain of Time* in that city, recommends the use of granite or basalt if the decision is made to carve new lions from stone (telephone interview January 31, 1996). He believes that limestone and marble would deteriorate more rapidly than granite or basalt.

Also suggested is the use of stainless steel or aluminum that would resemble pewter (telephone conversation with Charles Atherton, Commission of Fine Arts, September 1995). Either of these materials would be viable options if color were the only consideration. However, in keeping with the artist's original intent, they would probably not replicate the texture of stone or concrete. Moreover, if the object is to adhere to Perry's original design and to re-create the lions in the image he conceived, it makes more sense to use stone or concrete rather than attempt to make metal look like stone or concrete. An additional consideration to weigh in this case is the reception that would be received from the people of the District of Columbia who use the bridge and who have become attached to their lions. Would stainless steel or aluminum inspire the same attachment?

Renaldo Lopez, sculptor and conservator, believes that concrete technology today has advanced, so that sculptures could be made that would last longer than those created in the first decade of the twentieth century. It should be remembered also that Perry's lions, although deteriorated, seem to have lasted for 57 years, from 1908 to 1965, before they required restoration. According to Lopez, fiberglass added to the concrete mixture would provide greater stability and longer life. Other additives also have been suggested. Andrej Dajnowski, of the Chicago Park District, believes that acrylic, if properly emulsified, would produce a long-lasting concrete. However, the difficulty with acrylic, according to Dajnowski, is that if it is not completely emulsified, it may delaminate in the future. Finally, a caveat raised by Richard Livingston, at FHWA, is that the use of such additives in concrete is relatively new, so there is no long-term experience with them that would allow scientists to predict with assurance the durability of these mixtures.

Livingston reports on the use of pozzolan as an additive to concrete that creates a better, more durable material. In his investigations of the concrete used extensively as mortar in the Hagia Sophia in Istanbul, which has lasted 1500 years, Livingston found that rather than the usual carbonated lime mixture, a pozzolanic mixture, using ground brick dust as the pozzolan, made a stronger concrete. Modern pozzolans include silica fume from ferrosilicon refineries, slag from steel blast furnaces, and fly ash from coal-fired electric power plants. The problem inherent in pozzolanic concretes is that they take much longer to cure than Portland cement concrete (Livingston 1993).

All the experts contacted agreed that concrete is a complex material, particularly for sculpture. Because of its complicated requirements, it is rarely ever used for that purpose today. Concrete requires a pH of at least 11 or 12; a pH of 10 or less signifies carbonation, a process by which carbon dioxide in the air penetrates the concrete and converts it to carbonate compounds. This indicates that the concrete is deteriorating. Livingston reported that once concrete dries, the pH balance on the exterior, where it comes into contact with the air, drops to a pH of about 8.5, while on the interior the pH may remain at 12. However, experts disagree on the use of materials to coat a concrete statue to slow the carbonation process and increase the longevity of the concrete. Dajnowski recommends coating a newly cast concrete sculpture with a water repellent material, such as Siloxane Plus. He also reported on a limewash procedure used in Europe, although apparently not yet used in the United States. In this process, lime is mixed with water to create a thick paste about the consistency of sour cream. The paste is liberally applied to the sculpture and allowed to dry before it is removed; then the process is repeated. The limewash penetrates the concrete, raising the pH level, and making the concrete stronger. The process, according to Dajnowski, has been used on sculptures in Germany with some beneficial results, although it does make the concrete lighter in color.

Livingston has reported on a similar process used since the Middle Ages in which limestone is washed with a solution of calcium carbonate and water. When the solution dries, some calcite remains in the pores of the stone. However, the calcite can be washed out when it rains, so this process does not constitute a permanent treatment, but is rather, in Livingston's words "a sacrificial coating." Nevertheless, if the process is repeated often enough that more calcite remains than is washed out by rain, the procedure can protect the sculpture (Livingston 1986:318).

As for the application of some kind of plastic coating to make the concrete waterproof, Livingston warns that these may do more harm than good. They can trap moisture and salts at the interface, thus leading to accelerated deterioration. They also create a hard surface that reacts differently from the underlying material to the freeze-thaw cycles, creating interfacial stress that can result in spalling (Livingston 1994:25).

Opinions differ also on whether a hollow statue is better than one cast solid. Renaldo Lopez believes that a hollow concrete statue, cured in humidity, would withstand better the alternate freeze-thaw conditions that have been so detrimental to Perry's solid concrete lions. Hollow forms would not require the metal reinforcing rods that have rusted and leeched, and that destroy the concrete from within (Lopez:personal communication, September 1995; Dajnowski:personal communication, January 1996). Richard Livingston recommends casting solid statues either without reinforcing rods altogether or, if reinforcing rods are necessary, using stainless steel or titanium reinforcing rods, which would not corrode. However, he acknowledges that both materials are expensive (Livingston:personal communication January 1996). Andrej Dajnowski maintains that there are problems with either alternative. Hollow forms may collapse, or moisture may penetrate the concrete or condense on the inside, thereby presenting a different set of problems.

A final alternative to be considered is that of restoring the existing statues. Mr. Lopez believes that this could be done, although, he states, it would be very expensive. The existing metal rods would have to be removed and replaced with new rods of copper or stainless steel that would not rust. The outer layer of the statues is hard, and with repair, could be re-used. If the lions had not been restored in 1965, with large parts of their original concrete chipped away and new concrete sculpted by Mr. Lucchetti, this would be the recommended procedure. It would accord with the Secretary of the Interior's *Standards and Guidelines for Rehabilitation*, which require that "distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a historic property shall be preserved," "the historic character of a property shall be retained and preserved," and "deteriorated historic features shall be repaired rather than replaced." However, much of the sculpture of the lions today appears to be the work of Mr. Lucchetti and dates from 1965. It is no longer exclusively the work of Roland Perry, done in 1908. To the extent that the lions have been re-sculpted by Mr. Lucchetti, it may be said they no longer retain their historic integrity.

The recommendation of this report, therefore, is, first, that the lions be recast in a modern, more durable, form of concrete in keeping with the artist's original intent and design. Secondly, if modern concrete does not appear to be cost-effective over the long term, to sculpt the new lions from limestone, because limestone will last longer than even the most durable concrete. It is not recommended that the lions be cast in stainless steel, aluminum, or bronze.

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