CONSERVATION OF AMERICAN ZINC SCULPTURE: HISTORY OF THE USE OF THE MATERIAL AND CASE STUDIES OF TREATMENT

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Introduction

This paper covers the three main types of zinc monuments found in the U.S.: statues sandcast in small pieces, assembled with lead-tin solder, and painted to imitate bronze, stone, or polychromed wood; stamped sheet-zinc statues mainly for architecture, often painted to imitate stone but sometimes gilded, especially for civic buildings; and sand-cast "white-bronze" monuments made by joining large thick castings with zinc and sandblasting completed sections to imitate stone. Many zinc works have suffered from deterioration specific to the nature of the material, the different fabrication methods, and exposure. Case studies will illustrate the production of the three types of monuments, causes of deterioration, and methods and materials used for treatment.

History

The majority of American zinc statues of the first type – those sandcast in small pieces and assembled with lead-tin solder – were made by a German immigrant, Moritz J. Seelig, who arrived in New York in 1851. Trained as a sculptor, he established the first zinc art foundry in the U.S in Williamsburg, Brooklyn. There he copied zinc neo-classical statues imported from Berlin, probably disassembling them and using the pieces as patterns, as well as casting American-made designs. M.J. Seelig & Co.'s products were sold both directly to customers and retailed through larger ornamental iron firms, such as J.W. Fiske and the J.L. Mott Iron Works. While the American Civil War (1861-1865) effectively halted production of artwork during the following decade, demand exploded afterward for Civil War memorials and new construction during a period of the nation's rapid growth; distribution was enabled by the development of the country's rail system. The Seelig Company remained in the family until it closed in the late 1920's.

Stamped zinc statues began to be produced by architectural metalwork companies in 1871 with the importation of samples, equipment, and labor from France and Germany. The same items were available in a variety of metals: based on the cost of the sheet metal, items in copper were the most expensive and those in zinc the least expensive. The zinc was invisible, however, since stamped zinc statues were invariably coated. The largest purveyor was W.H. Mullins and its antecedents, conveniently located at the intersection of a number of rail lines in Salem, Ohio (Fig. 1). Statues were modeled in clay, then cast in plaster from which dies were made for hot stamping in sections; stamped sections were then joined with solder (Fig. 2). While the company promoted Civil War statues for memorials, most of those were stamped in copper; nearly all zinc statues were instead made for architectural use. Later the company pioneered the manufacture of thin-skin metal boats and stamped automobile parts, gas masks, washing machines, and ultimately kitchen sinks and cabinets.

Fig. 1. W.H. Mullins with 52 statues for the Cotton States and International Exposition in Atlanta. *Public domain, reprinted from the company's 1896 catalog.*

Fig. 2. W.H. Mullins' modeling room, with portions of sheet-metal bas-reliefs in the foreground and clay models in the background. *Public domain, reprinted from the company's 1896 catalog.*

The first two types of zinc statue stem directly from European prototypes developed decades earlier, but the third type – white bronze statues and monuments made by the Monumental Bronze Company and its affiliates – are an entirely American phenomenon first developed for cemetery memorials in the mid-1870s. Instead of assembling small cast pieces with lead-tin solder, large castings were joined by pouring zinc in thick short segments measuring more than 10 cm in width along the entire joint between pieces. Joins were carefully located so that they would not be obvious, e.g., at corners. Assembled works were sandblasted at the foundry to create matte gray, stone-like surfaces matching the more expensive stone monuments they imitated. Another unique aspect of white bronze was that very large monuments were created– some more than 10 meters in height. Separate sections were assembled at the foundry for transport and bolted together on site by local workmen.

Vulnerabilities

When properly fabricated, zinc is an effective and relatively stable material for the creation of outdoor sculptures, but some general vulnerabilities must be addressed during conservation treatments. Castings are brittle and susceptible to cracking and breakage; thus, impacts will shatter rather than deform them. Metal creep is a major factor for large monuments, especially for the heavy metal skins of white-bronze monuments, since original support structures were almost always insufficient; minimal foundations exacerbate the problem (Fig. 3). For all types of statues, the joining material or its adhesion to the zinc weakens over time, and seams separate. During stamping, light-weight sheet-zinc is stretched to create forms and becomes very thin where relief is highest, contributing to vulnerability to damage. Although stamped zinc statues have the advantage of flexibility, they are subject to denting and deformation, and they can be damaged by wind, given their frequent location atop architecture, especially domes.

The majority of statues were meant to

Fig. 3. Zinc plinth of Confederate Monument, Bardstown, KY, showing cracking and deformation from metal creep. Note rustication on zinc intended to match stone base. *Conservation Solutions, Inc.*

be painted, and corrosion is obviated when coatings are well maintained. Only those made of white-bronze were not painted, and they develop an even light blue-grey patina through exposure (Fig. 3), in contrast to the disfiguring streaky green and black coloration of contemporary bronze statues. Pitting also occurs far less than on bronze statues. Exposure to sulfur-containing environments causes the most severe zinc corrosion; salt causes less damage, except when there is direct exposure to marine environments. Trapped moisture can cause catastrophic perforation of zinc, often referred to as white rust. Both high and low pH solutions corrode zinc.

Zinc is sacrificial to most other metals in electro-conductive conditions; thus, its common use as a protective galvanizing coating for iron and for anodes to protect underground piping and tanks or submerged metals on boats such as bronze propellers and drive shafts. Only one plated zinc monument is known from the XIXth century, the copper-plated *City of New York Civil War Monument* (1869) in Brooklyn's Green-Wood Cemetery. In 1913 the Daprato Statuary Company introduced copper-plated religious statues for Roman Catholic cemeteries and continued to produce them into the 1950s. In contrast to other types of zinc statues, severe pitting of zinc occurs on these plated statues.

Case Studies

Restoration of a zinc figure assembled from small sand cast elements

The Soldier's Monument (1890) stands near the Atlantic Ocean in Oak Bluffs, Massachusetts, on the island of Martha's Vineyard. It consists of a ¾-scale zinc figure of a soldier mounted on a cast-iron base that holds dedicatory plaques and drinking fountains. The statue is one of nearly 20 replicas of an iconic citizen-soldier standing at picket, produced by M.J. Seelig & Co. and sold by J.W. Fiske. It's separately cast components, such as the fronts and backs of limbs, were butt joined with lead-tin solder. The statue's structure relied solely on the strength of the skin, since there was no internal armature. The cast-iron base was similarly fabricated of shells but assembled mechanically. Both parts were originally painted to imitate bronze, as confirmed both by paint analysis and press reports from the dedication.

During a devastating hurricane in 1938, the statue was severely damaged: the figure was broken at the ankles and blown off the base. It was rebuilt, reportedly by a local plumber, who used lead pipe soldering techniques to re-attach and reinforce the legs and filled the plinth with concrete. Sections that were presumably found to be too severely damaged, such as the right hand and gun, were replaced with wood carvings. A thick accumulation of at least 15 paint layers testified to regular repainting of the monument.

In 2000, the first author began restoration by removing the fragile zinc figure from the base and shipping it off site for treatment along with the base. All paint was removed from the monument, and previous repairs of the zinc were reversed. Since the statue's skin had been weakened, an internal stainless steel (type 304) armature was designed that could be fitted into the figure and assembled with minimal disturbance to sound parts. The stainless steel was isolated from the zinc using neoprene pads and nylon washers to avoid galvanic corrosion. Severely deteriorated elements, such as the concrete-filled plinth, the right foot, the hand, and gun, were modeled and recast in zinc. The new castings were fitted around the armature and mounted with zinc pins and lead-tin solder (Fig. 4). Minor losses were filled with a commercial automobile body repair bulked resin applied under the finish coat. A high performance paint system was applied,

Fig. 4. Oak Bluff, MA, figure after restoration, before painting. The right hand, foot, rifle zinc and base are new castings recreating losses dating back to the 1930s. *Conservation Solutions, Inc.*

consisting of a high zinc primer, epoxy barrier coat, and aliphatic urethane top coat. The client chose a dark brown color for the top coat in order to imitate the monument's original 19th century bronze-like coating. The coating held up well in a harsh marine atmosphere for more than ten years. In 2011 a new top coat of the same type was applied using a faux finishing technique to more closely reflect a bronze-like finish.

Restoration of two zinc figures made from thin stamped sheets

Sheet-zinc statues are significantly lighter in weight than cast statues, and because they are stamped from fine-grained rolled sheets, they are more resilient and were thought to be more suitable than cast-zinc statues for installation atop buildings. Nonetheless, W.H. Mullins's statues of *Justice and Liberty* on the roof of the 1902 City Hall in Goldsboro, North Carolina, suffered losses from high winds, which tore away *Liberty's* arm and flag. They also had inept repairs, which are not uncommon for zinc statues, since so many are located in small towns where there is little access to professionals. Losses of the skin were attributed to corrosion of the thin metal, especially from bird deposits; entrapped water where the figures were bonded into the roofing system; and aggressive cleaning using sand blasting.

The statues were removed from the roof with cranes and treated off site. Careful microscopic study of remaining coatings showed that the works had originally been gilded. After testing, the surfaces were cleaned with ultra-high pressure water jetting (138 MPa) using *#8*-jewel tips on rotating heads. Areas of major loss were replicated by modeling in clay directly on the figures, including *Liberty's* arm and flag and *Justice's* scales (Fig. 5). New zinc sheets were hammered in sections into glass fiber-reinforced resin molds made from the clay models. Then the new pieces were soldered to each other and to original elements (Fig. 6). Numerous small dents were reshaped, small losses were repaired with zinc sheet patches, and broken edges or joins were soldered.

The original armatures, which consisted of galvanized sheet-metal tubes (stove pipes) soldered to the skin at flanges, were repaired with solder. The tubes inside the figures were also modified to provide a threaded connection at the top of each head; this would allow an eyebolt to be attached to the connection so that the statues could be hoisted in place without abrading finished surfaces. The structure inside *Liberty's* flag was strengthened with galvanized steel piping (schedule 80) bolted and soldered to the skin like the original tubes.

Finally, the figures were cleaned and degreased in preparation for regilding. An acid etching primer was applied followed by a layer of zinc chromate. Twelve-hour size and German patent leaf (23.75 kt.) were applied to gild each figure completely. Upper surfaces were double gilded to increase service life of the treatment. When cured, the figures were crated, transported to the site, and hoisted to their original locations using the eye bolts. The tops of the heads were then sealed with previously prepared small gilded caps.

Fig. 5. ***Liberty*** **from Goldsboro, NC, with replacement arm and flag model. These were then molded, re-created in zinc sheets using the repoussé method and soldered to the original before gilding.** *Conservation Solutions, Inc.*

Fig. 6. **Detail of *Justice* from Goldsboro, showing new zinc sheet soldered to remaining original hand. Note galvanized pipe reinforcing within thumb later attached to similar piping within sword.** *Conservation Solutions, Inc.*

Restoration of white-bronze monuments and statues

The third type was fabricated from thickly cast sections joined with cast-in zinc slugs – the uniquely American method known as "white bronze" employed by the Monumental Bronze Company of Stratford, Connecticut, and its affiliates throughout the country. Ranging in size from small cemetery markers to large monuments, they were sandblasted to resemble stone despite the company name. The designs generally mimic contemporary stone cemetery monuments, including details such as rusticated architectural bases that resemble stone ashlar. A few include inscriptions referring to themselves as marble. Figures were made in the same manner and often appeared atop larger monuments. Examples include a *Confederate Monument* (1903) topped by a soldier in Bardstown, Kentucky; a similar *Union Soldiers Monument* (1883) in Lowville, New York; a marker in The National Cemetery in Pensacola, Florida; and the *Defender's Monument* (1891) to the Dakota Indian Wars in New Ulm, Minnesota.

While white-bronze monuments were well made using nearly pure zinc, the weight and size of the grander monuments have resulted in significant problems from creep. Larger monuments relied mainly on thick-sectioned faces to bear their weight, and original support structures were skimpy. The lowest section typically had internal stiffening diaphragms at intervals, and the section above it, posts at each corner. Over time, zinc has often slumped around these supports, and fractures regularly appear adjacent to stiffer corner joints. Deformation also affects statues, which are thickly cast and heavy as well. For example, the more than 100 examples of a union soldier at parade rest now lean backwards with the same heel sinking into the plinth. Further damage has been caused by inappropriate remedies, especially the invariably disastrous filling of monuments with concrete (Fig. 7). Since the majority of white-bronze monuments are located in cemeteries, damage from falling trees or branches is a common problem, nearly destroying the *Confederate Monument*. Restoration often requires disassembly, removal to a workshop, reversal of previous repairs, repair of breaks and other damage,

Fig. 7. Lowville, NY, monument showing a typical white-bronze base, with damage from inappropriate repair by filling it with concrete (since removed). *Conservation Solutions, Inc.*

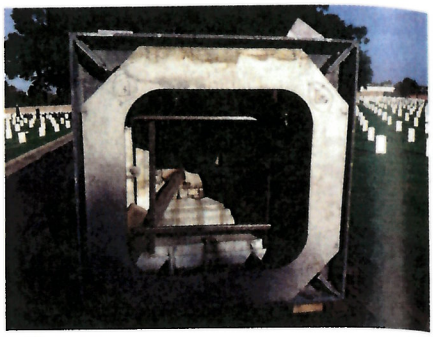

Fig. 8. Underside of Pensacola, FL, monument showing new zinc base with new stainless steel internal armature before installation. *Conservation Solutions, Inc.*

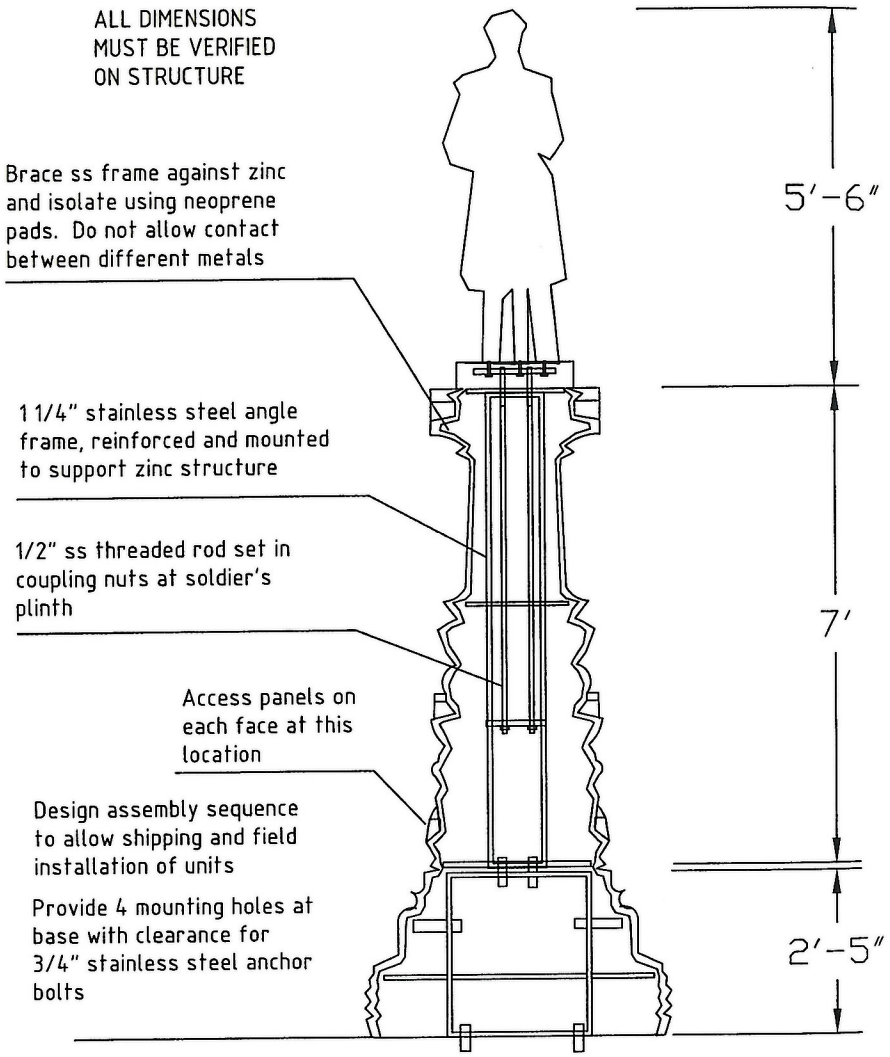

Fig. 9. Section of Bardstown, KY, monument showing internal armature design. *Conservation Solutions, Inc.*

and re-creation and casting of missing elements. For large zinc monuments, installation of custom-made stainless-steel armatures is generally necessary for support.

The sections of larger monuments were disassembled by removing bolts at the center flanges between them. When monuments were smaller, this was accomplished by lifting the monument whole and accessing the bolts from the bottom on the hollow interior. When they were larger, the interiors were accessed through removable panels, caps, or statues at the top, depending on the original design.

The design and fabrication of new armatures were adjusted to cope with the idiosyncrasies of different monuments (figs. 8, 9). Where feasible, a single armature was fabricated within the monument, attached to the original flanges and bolt holes. For larger monuments, new foundations were poured, new independent frames were bolted to each original section, and sections were stacked atop each other. Allowance for the irregular inner faces of the castings was found to require pre-fitting supports prior to on-site installation (Fig. 10). Since armatures take up considerable interior space, it was also essential to allow adequate clearance to provide a worker access for bolting sections together. Other repairs followed the same methods as described for the previous case studies, except that breaks were welded rather than soldered, and repaired surfaces were treated with dilute oxalic acid solution to develop the white oxide patina, to integrate repairs visually with weathered surfaces.

Conclusion

Zinc has proven generally resilient and well suited for outdoor monuments and statues. The decline in its use took place primarily because of a change in taste that valued authenticity in materials and avoided imitation. Many art foundries now in existence have no experience working in zinc, which can make finding a firm willing to cast replacement parts a challenge.

As a series of treatment methods were developed and implemented over the last few decades to address the inherent vulnerabilities of zinc, it seems likely that zinc monuments will have a good likelihood of remaining outdoors for another century. ■

Fig. 10. Monument in New Ulm, MN, during re-assembly on supporting armature. *Conservation Solutions, Inc.*

Bibliography

GRISSOM, C. -- *Zinc Sculpture in America: 1850-1950*, University of Delaware Press, Newark, 2009.

GRISSOM, C., MACK, A., WACHOWIAK, M., AND BIENIOSEK, G, "Imitation-bronze paints on American zinc sculpture", *Metal 2010*, Proceedings of the Interim Meeting of the ICOM-CC Metal Working Group, October 11-15, 2010, Charleston, South Carolina, edited by Paul Mardikian *et al.* (Clemson, South Carolina: Clemson University, 2010), p. 225-232.

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Mark Rabinowitz is an accomplished conservator, sculptor, author, and lecturer with over 25 years of experience in the treatment of outdoor monuments. His work has received numerous honors, including from the AIA (Honors Award), DC Preservation, NY Landmarks Conservancy (Preservation Awards), New York Art Commission (Awards for Excellence), Heritage Preservation/SOS, Dade County Preservation Trust, and the Florida Trust for Historic Preservation. He holds a BFA degree in Sculpture from the Rhode Island School of Design in Providence, RI (1975). Mark has been a Fellow with the American Institute for Conservation (AIC) since 2004 and a Fellow with the American Academy in Rome since 2011.

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Résumé

Trois grands types de sculptures et éléments d'architecture en zinc exposés en extérieur sont répertoriés aux États-Unis. Ils ont été élaborés selon différentes techniques de fabrication et illustrent chacun des traitements de conservation-restauration qui leur sont propres. Le premier groupe se caractérise par les objets obtenus grâce à la technique de la fonte au sable. Chaque pièce est coulée séparément puis assemblée par soudage en alliage plomb/étain. Les sculptures sont ensuite peintes afin d'imiter le bronze, la pierre ou encore le bois polychrome. L'estampage constitue la seconde technique, laquelle est utilisée principalement pour les éléments architecturaux qui sont ensuite souvent peints pour imiter la pierre et même dans certains cas la dorure, comme pour les bâtiments publics. Enfin, les « bronzes blancs », obtenus par moulage au sable et par assemblage d'épaisses pièces de zinc sablées pour imiter la pierre, font référence au troisième groupe.

Abstract

From the mid-XIXth through the early XXth century, outdoor zinc statues proliferated in the United States. These sculptures, often multiples made from the same patterns, continued to be produced until mid-century, a few even commemorating World War II. Most were created for smaller towns or organizations without the financial resources to purchase unique and more expensive bronze statues that they were often intended to resemble. While zinc can be remarkably stable in outdoor environments, deterioration of statues and monuments has occurred from structural failure and accident. The authors draw on knowledge of the history of these works and numerous treatments that they have been involved with to demonstrate the specific engineering and manufacturing methods used in their creation, the deterioration and losses that they are subject to, and the successful restoration means that have been developed to treat them.

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