Academy Hill Monument – Assessment Report

METHODOLOGY

The Academy Hill Monument in Stratford, Connecticut, was surveyed on December 12th, 2014 by representatives of Worcester Eisenbrandt, Inc. and Keast & Hood. This assessment report is a joint effort between engineers of Keast & Hood and conservators of Worcester Eisenbrandt, Inc.

The weather was overcast and wet with intermittent rain showers. The monument's exterior was accessed via a boom lift supplied by the Town of Stratford. The interior was accessed via a hole in the monument's south face, which is currently covered with a piece of plywood and secured with allen head bolts.

The internal stainless steel armature was used as a ladder to climb to the top of the interior of the monument. All portions of the monument were accessed, with the exception of the top at the interior, which is too narrow to reach via climbing.

REVIEW OF PAST WORK/REPORTS

A report dated March 31, 1989 by Carol Grissom and consulting engineer Marion F. Mecklenburg titled "A Conservation Study of the Academy Hill Monument at Stratford, Connecticut" was used as the primary source of information on the past treatments and condition of the monument. It should be noted that the copy referenced contained no photographs.

The Grissom report was written shortly after the complete restoration of the monument performed by Merritt Contractors and Christine Roussel in 1987. It contains a detailed description of the monument's history, construction method, and conditions. It also documents the 1987 work in detail.

To our knowledge, no substantive work on the monument has been performed since the 1987 work.

GENERAL DESCRIPTION

The Academy Hill Monument was dedicated in 1889. It was cast by The Monumental Bronze Company in neighboring Bridgeport, CT. It is composed entirely of sand-cast zinc. The Monumental Bronze Company, founded 1879, was a firm dedicated to fabrication and sales of these types of monuments. The 'Bronze' of their name is derived from the fact that they marketed their zinc statuary as 'white bronze'. The Monumental Bronze Company had developed a specialized process of fabrication for large zinc monuments. Their pieces can be found across the United States.

The Grissom report names seven sections of the zinc monument, proceeding from lowest to highest: Sections 1, 2, 3A, 3B, 4, 5, & 6. The lowest section is called Section 1; the statue and its

selfbase are Section 6. The same numbering system will be used in this report for clarity and consistency. See the half section drawing at the end of this report for reference.

The interior of the monument contains a stainless steel support armature or tower. This tower, installed in 1987, rests on a concrete slab and runs to the top of the interior space, just below the statue. The tower supports sections 3B through 6 via horizontal sections of stainless steel angle welded to the tower and shimmed with stainless steel bar stock to provide contact between the angles and the horizontal flanges of the various sections of zinc.

Conversely, Sections 1, 2, and 3A are not supported by the tower. Section 1 rests partially on the ashlar foundation stones and partially on and within the concrete slab on the interior. Section 2 is held by four original zinc posts, round in section, each supporting a corner of Section 2. Section 3A sits atop Section 2.

The concrete slab on the interior is approximately 11" above grade. Section 1 was used as a form to pour the slab, which has captured the interior plates that stiffen and support Section 1.

Stainless Steel Armature

The armature is a tapered tower composed of various sections of stainless angle iron welded together. It is square in plan to mimic the four sides of the monument. The dimensions of the tower and its various components are as follows:

Base dimensions: 42 ½" square in plan

Top dimension: 16" square in plan

Four primary leg angles, continuous: 3" x 3" x 3/8"-thick in section

Secondary horizontals: 1" x 1" x 1/8"-thick in section

Diagonals: 3/4" x 3/4" x 1/8"-thick in section

The armature is in good condition. The monument is not watertight, as witnessed by the copious amounts of moisture inside on the day of the survey, which was rainy. The stainless material appears to be weathering well.

The armature has minimal contact with the monument's zinc pieces. The connection between the monument and armature is made through the use of stainless shims with no permanent connections. In several locations the shims were easily moved by hand.

As described in the Grissom report on page 17, the zinc and armature (tower) have different rates of thermal expansion which causes them to be in contact only at certain times of the year:

> *In the summer when the monument expands more than the internal tower, the monument joints are required to be more load bearing since the monument tends to "out climb" the tower. In the winter the tower carries a*

higher burden of the monument load. Effectively at any given time the monument load is carried in part by the tower and in part by the monument itself.

Interior view of stainless tower, shim blocks and connection bolt, joint between Sections 3B and

Interior view of stainless tower: typical connection between main vertical 3x3 leg, horizontal and diagonal members.

CURRENT CONDITIONS

Deterioration of Section 1

Section 1 is 8' square in plan and 30" high. It is suffering from extreme deterioration and deformation. The northwest corner of this section is completely torn. The north and west faces are also substantially deformed. There are substantial tears at the other three corners and multiple smaller tears radiating from edges of the Section at all four sides.

Northwest Corner

Southwest Corner

Northeast Corner

Southeast Corner

The Grissom report of 1989 mentions this same cracking, but it was not nearly as advanced at the time of her accounting. Her report, p. 14, states the following:

> *Cracking which has raised the most serious concern on the Academy Hill Monument has occurred principally at three locations in Section 1: adjacent to both corners on the south face and at the front corner on the north side. (northwest corner)… Prior to recent treatment the cracks measured approximately the height of the concrete on the interior.*

On page 15, that report goes on to state:

While the crack at the rear on the proper left side appears approximately 1" longer than in photographs taken in January 1987, there is no evidence that the cracks are unstable at this point.

In the absence of prior documentation, there was no way of knowing that the deterioration of Section 1 would advance as dramatically as it has. This deterioration will continue if Section 1 is not freed from the concrete slab at its interior.

Deterioration of Concrete Slab

As mentioned in the General Description portion above, Section 1 was used as a form for pouring of the internal slab of the monument. This slab envelops the stiffener plates of Section 1 at its rear face. This slab was in place prior to the 1987 restoration.

The 1987 restoration efforts initially called for a concrete repair topping to be installed over the existing concrete and sloped to the outside to encourage drainage. Instead, the new topping was sloped to the center and a 2" diameter hole was cored into the center of the base. At the time of the Grissom report (1989) the depth of the hole was measured at 38". Currently, the hole measures 10" deep and is full of debris.

The concrete of the slab is deteriorated. At the open northwest corner it has begun to spall and crumble, likely due to the increased exposure. The top face is extensively cracked.

View from interior looking northwest, Section 1. Note the deteriorated slab and bound stiffener plates.

View of concrete slab showing drainage hole and extensive network cracking at surface of slab.

Zinc Creep

Statuary monuments constructed of zinc are well-documented in conservation literature. Their behavior and modes of deterioration have been studied extensively. One of the inherent vices of zinc as a material for hollow cast sculpture is known as 'zinc creep'. This phenomenon is characterized by the material's tendency to slowly deflect and deform over time due to an inability to bear its own weight.

Creep is evident at Academy Hill Monument. It has been documented at other monuments, including those fabricated by The Monumental Bronze Company.

In the absence of past documentation it is difficult to determine if the material is still deflecting, but recent documented work on other similar monuments by the same company show evidence of continued movement.

View of south face of joint between Sections 2 and 3A, looking west. Note the bowing of the vertical face of Section 3A at the top of the photo (vertical red line) and the deformation of the long lower edge where it meets Section 2 (horizontal red line). Note that Section 3A bears directly on Section 2, which is supported by vertical posts that bear on its internal corners. One of those corners is in the foreground of this photo.

Tear at Section 3A

At the southern side, the connection between pieces 3A and 3B has produced a tear in piece 3A around the tab that holds the internal connector bolt. There is evidence of a previous repair at this location.

This tear is an indicator of the differential movement in the monument. Note that section 3B is supported by the stainless tower, but section 3A is not. Section 3B is moving with the tower, while the section mated to it (3A) is not. Decoupling of sections will aid in alleviating this type of damage.

Exterior view, south face, joint between Sections 3A and 3B showing tear at connection point.

Foundation Test Pit

A test pit was dug in early April 2015 by personnel from the Town of Stratford. The pit was dug on the north side of the monument, off the northeast corner, immediately adjacent to the ashlar foundation trim stone. The purpose of the pit was to determine the presence and extent of foundation material.

The pit was dug to a depth of five feet. The monument contains a well-laid rubble stone foundation with vertical sides, running to a depth of at least five feet, well below frost depth. The revealed portion of the foundation appeared to be in good condition. The mortar and stone do not exhibit signs of deterioration. While the thickness of the foundation walls is not known due to the presence of the interior concrete, the original zinc posts that support section 2 would have required some base, so it is possible that the foundation extends in to the monument interior at least as far as those posts. The existing foundation is likely sufficient to support sections 1 and 2, and was likely designed to support the entire monument and original armature.

CONCLUSIONS AND RECOMMENDATIONS

Based on the on site assessment, the following conclusions are made:

-- The addition of concrete at the interior of Section 1 has caused extensive deterioration. The concrete has acted to restrain the zinc. Without freedom of movement, the zinc would experience increased level of stress, leading to the dramatic cracking at the corners.

-- It is widely accepted that trapping water against zinc will result in deleterious corrosion products. The concrete is acting as a water trap, causing corrosion of the zinc material in addition to the cracking.

-- In addition to having a deleterious effect on Section 1, the concrete itself is also in poor condition.

-- Certain sections that are unsupported by the internal stainless frame appear to be continuing to creep or deform under their own weight.

Based on the above conclusions, the following recommendations for restoration are made:

I. **Remove existing concrete slab and evaluate existing stone foundation.** Remove concrete above grade in order to determine size and condition of existing stone foundation. Depending on configuration of the stone foundation, install appropriate foundation for the stainless steel armature. Design may incorporate existing foundation, such as a slab spanning the existing foundation walls; or be installed independently, such as a pier and footing placed within the existing foundation walls.

II. **Repair or replace Section 1.** The concrete restraining this section should be carefully removed as part of item I above.

    From a conservation standpoint, we favor repair of the pieces of Section 1 in order to retain as much original material as possible. Repair could be accomplished by welding with zinc rod. Since the north and west sides of Section 1 have been bent outward, a welded repair will be contingent on the ability to bend the massive north and west sides back to straight. A combination of heating and bending may succeed in straightening these faces.

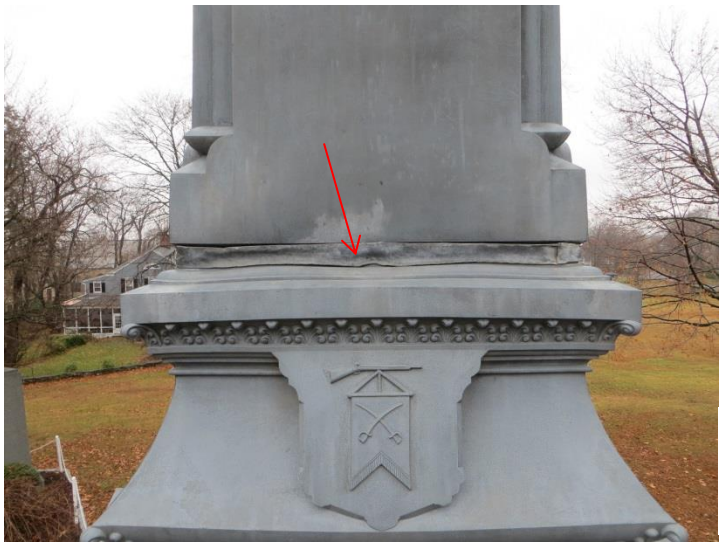
    After welding a repair seam, the weld would be ground. Then, the overall surface of Section 1 would be gently abraded with glass cullet to homogenize the appearance of the weld and parent material. Over time, Section 1 would develop a patina naturally, similar to that of the sections above it.

    As for replacement, it is possible that the north and west faces of the base will not be repairable. There are recent examples of zinc monuments similar to Academy Hill being

restored after extensive deterioration due to filling with concrete. The Civil War Monument in Lowville, NY, is one such monument. This restoration involved casting new elements in zinc and welding them to existing pieces of original zinc, as well as welding mitered corners back together.

Other options for replacement include replicating all or certain faces of Section 1 in ashlar stone. The cost of this option, as well as those stated above, are addressed in the budgetary estimates at the end of this report.

III. **Disassemble and reassemble monument on site, reusing existing stainless steel armature.** Increase support to the monument on the existing armature to lessen the need for the monument to be self-supporting, thereby decreasing the rate of ongoing deterioration. This would entail decoupling the monument sections and installing new stainless steel elements off the existing armature to support each section of the monument separately. Creating an open joint between the sections would allow for the expansion and contraction of the zinc sections independent of one another, thereby eliminating the need for any section to bear any weight but its own, regardless of the time of year. If necessary, existing gaps between sections that create a poor appearance would be covered with lead as is currently done between Sections 3B and 4.



Exterior view, south face, joint between Sections 3B and 4 showing lead used to fill gap

IV. **Provide additional structural support as necessary.** In the absence of original design documents for the stainless steel armature, analysis will be required to determine if the existing armature can withstand additional loading. The armature may require reinforcing to meet current building code standards (International Building Code).

A new foundation would allow for additional independent vertical support members to be added at grade to Sections 1, 2 and 3A, thereby making these pieces non-dependent on those

above and below them. This would aid in minimizing additional creep of the zinc over time and tearing at connection points.

BUDGET ESTIMATE

Base Scope – Repair Section 1:

1. Disassemble sections 2 through 6 of monument (store in secure facility)
2. Remove and reuse stainless steel tower
3. Carefully demolish concrete slab to grade; salvage and remove Section 1
5. Remove existing foundation below grade – as necessary
6. Pour new foundation – as necessary
7. Repair Section 1 off site
8. Re-install Section 1 after repair, with stainless reinforcing at interior side
9. Re-set stainless steel tower
10. Re-install remaining sections

Estimated cost for base scope: $100,000.00

Alternate Scope 1 – Recast Section 1 North and West Faces in Zinc:

The alternate scope encompasses the same items as the base scope, with the exception of the treatment of Section 1. The alternate is for recasting the north and west faces of Section 1 in zinc in lieu of repair.

Estimated cost for alternate scope 1: $140,000.00

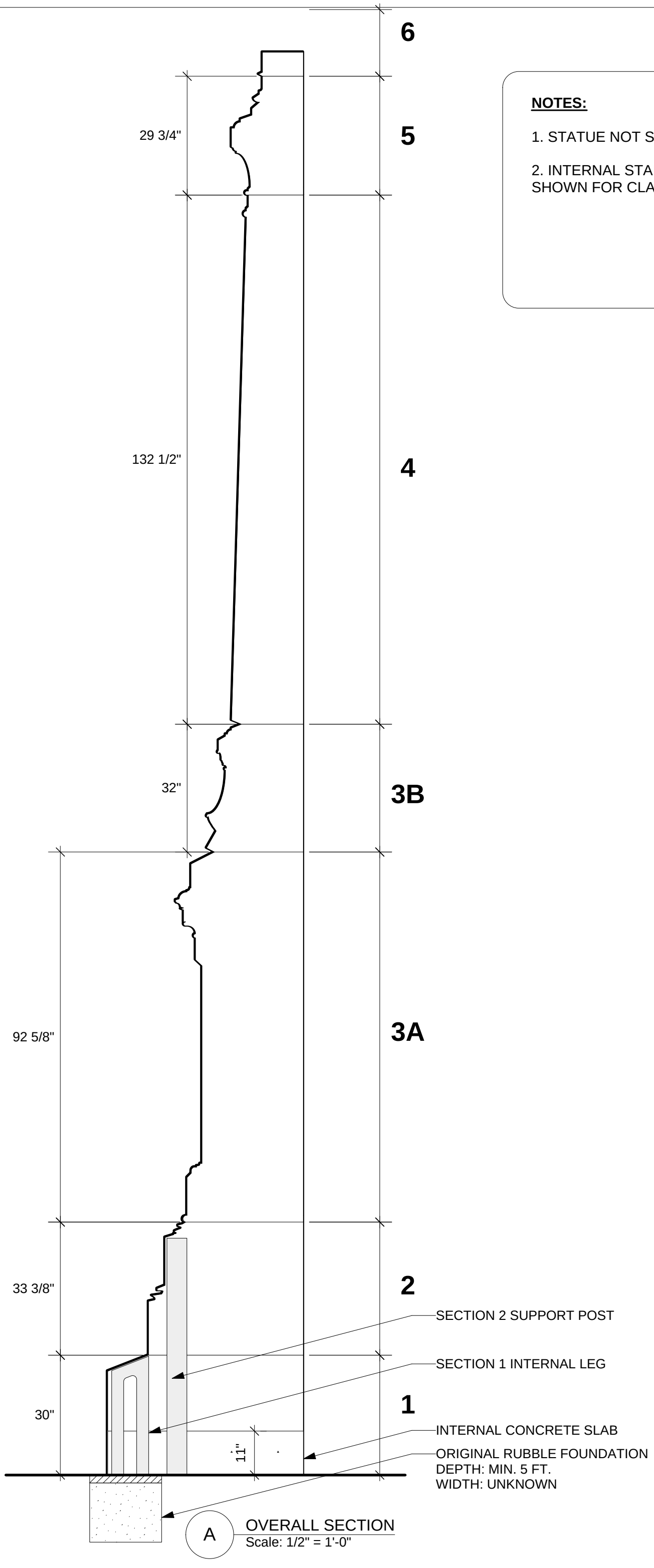
Alternate Scope 2 – Replace Section 1, All Faces, in dimensional stone:

A single monolithic slab of granite would replace Section 1. This block would be cored on its interior to allow placement of the stainless tower at grade. The exterior face would be tooled to mimic the appearance of Section 1.

Estimated cost for alternate scope 2: $170,000.00

Note: The estimates above do not include allowance for reinforcing of the stainless steel tower since the weight of the zinc sections and bearing capacity of the current tower are unknown. Additionally, as mentioned in the Conclusions and Recommendations section, the foundation work cannot be fully scoped and priced until the interior slab is removed and the full extent of the existing foundation is known.

Note: An alternate for replacing Section 1 in GFRC (glass fiber reinforced concrete) was researched but pricing is not included as it was deemed unfeasible by the manufacturer.



NOTES:

1. STATUE NOT SHOWN IN SECTION 6

2. INTERNAL STAINLESS ARMATURE NOT SHOWN FOR CLARITY

WORCESTER EISENBRANDT, INC.

2100 Gable Avenue
Baltimore, MD 21230
Main: 410.644.6580
Fax: 410.644.5895

WEI Job No. 14-1368
ACADEMY HILL MONUMENT
STRATFORD, CONNECTICUT

MONUMENT DETAILS

DATE: MAY 1, 2015

DATE:	REVISION:	APPR.

WEI 01-01