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RECORD OF TREATMENT

MASSACHUSETTS BAY COLONY TERCENTARY MARKERS



DAEDALUS CONSERVATION

2019



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RECORD OF CONSERVATION TREATMENT

Objects: (11) Tercentenary Markers

Artist/Date: Massachusetts Tercentenary Commission/ Carlisle Foundry 1930

Material: Cast Iron

Owner: Massachusetts Dept. of Transportation

Prepared for: Epsilon Associates (Lead Contractor) & MASSDOT

Overview/Condition Prior to Treatment:

The following parts detail the standard operating procedure for the required tasks. Tasks additional to these procedures are described in the notes sections of each marker. The procedures followed the techniques and materials described in the specifications:

Restoration Specifications for the Mass Bay Colony Tercentenary Markers.

PART ONE: Removal From Site:

Each marker was removed from the site after dig-safe operations were performed and the communities were informed of the pending work.

Traffic details were provided by MassDot for the Removal of two markers (Hadley #1 and Hatfield)

The markers were strapped using nylon slings. The markers were lifted with a manual chain fall on tripod or scaffolding/beam.

The markers and posts were packed using blankets and foam and brought to our studio.



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The majority of the markers were taken off the posts during the removal process





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Removal of Markers



There were a couple of markers where the marker and post were welded together theses were brought to our studio intact and the welds were removed in a controlled setting,



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PART TWO: Paint Removal/ Surface Preparation

The type of paint and the amount of paint on the markers varied. All of the markers appeared to have been re-painted multiple times over the years. The majority of the original paint layers had either been removed (likely during re-painting) or had weathered away (due to the properties of the paint and exposure to an outdoor setting).

We did find a few spots of what appeared to be original gold leaf on the Hadley #1 Marker .

Note: we found more examples of original paint layers, primarily gold-leaf on the WAY TO CAMBRIDGE marker and the BELLINGHAM CARY marker (these markers were treated several years ago). When observed, we documented original paint/leaf, but ultimately in order to apply a durable coating system having the cast iron free of degrading surfacing coatings and rust was needed. This necessitated the removal of the remnants of gold leaf.

The markers were cleaned of paint using commercial paint-removers and organic solvents. The removers were applied per manufactures recommendations, and the residue was rinsed with water from a hot-water pressure washer as needed.

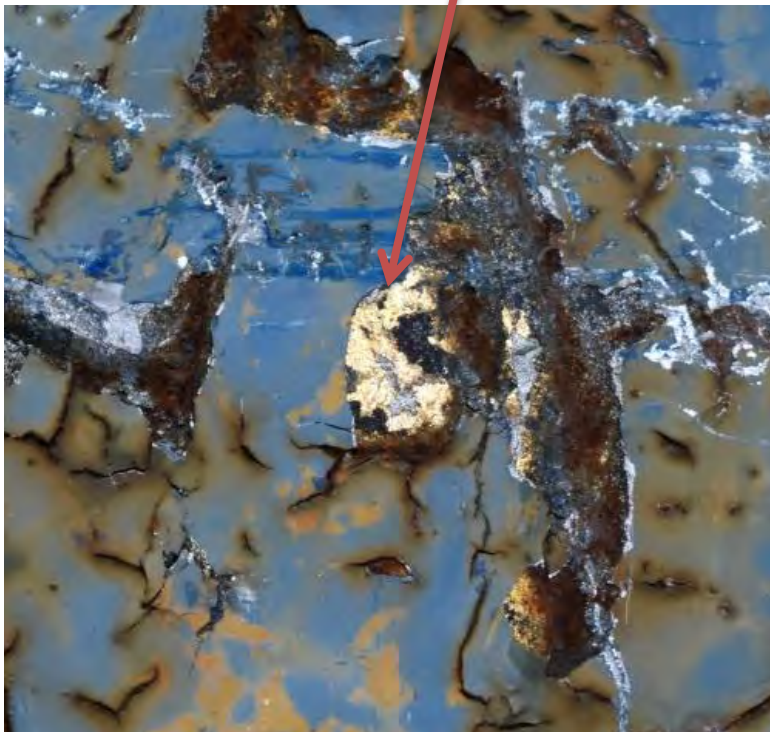
Once the majority of the of the paint was removed and we were able to clearly identify the original surface, the markers were cleaned of rust, and paint stuck in the interstices by blasting the surface with glass beads (AD 70-140 beads using a Nederman SB 750 dustless suction blaster) and mechanical with hand pads and Norton Rapid Blend nx wheels as needed.

Note: We found that because of the inconstancy of the paint (both in types of paint and the amount on the surface) on each of the markers removing the paint in layer chemical (use of strippers and solvents) was the best way to ensure that kept the substrate free from over-cleaning (abrasion to the original surface)



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This appears to be
gold-leaf on the
surface below
layers of over-paint



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Stages of pain and rust
removal: Wheelers Surprise



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Markers and Post,
prepped and ready to
receive the coat of
primer.



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PART THREE: Repair to Collars & Fabrication of New Posts

Based on experience working with these markers and observing many others in the field, there appears to be a defect in the design of how the markers and post connect.

We observed small cracks on every one of the collars (the cylindrical section of the marker which attaches to the post). In four of the eleven markers, the cracks resulted in u-shaped losses. Eight of the eleven original posts were either missing or had structural issues which warranted replacement. These observed signs of degradation and failure can likely be attributed a combination of factors including: material choice, design of the connection systems and environmental conditions.

Note: No analytic testing of the material and no engineering studies were conducted on the markers and posts.

The following observations are based solely on our experience conserving historic objects and were made while developing a solution to repair the markers so they could be re-installed safely.

Material: Cast Iron

“In general properties of cast iron consist of a hard skin, softer beneath, brittle, excellent compressive strength. ...As metal hardness increases toughness decreases. Toughness is defined as the ability of metal to resist fracturing and further failure under stress”

(Conservation of Architectural Ironwork, David Mitchell, 2017, Routledge Press).

Design & Environmental Conditions:

Original Design:

The cylindrical collars appear be cast in the same pour as the inscription section of the markers.

The original hexangular posts are capped (as part of the overall casting) with a round tube (3.25” OD/ .25” Wall/ 4” high) which slide into the collar and appeared to be fastened mechanically.

The method of fastening the collars to the post was inconstant in size, quantity and locations of the bolts; the cracks seem to emanate from the bolt holes and also on the bottom edge of the collars.



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Possible Causes for Failure:

There seem to be two main issues that have led to the damaged noted:

First, the gap between the collar and post-tube was an access point for water infiltration --resulting in rust expansion on the collars, tubes and fasteners. This expansion force could theoretically both create small cracks and turn small cracks in large losses (*Toughness is defined as the ability of metal to resist fracturing and further failure under stress*)

The second issue is that collars don't feel robust (thick) enough to support the weight of the markers (as they absorb the wind, snow, rain, shifting of ground, vibration from traffic) or have enough material to create a solid connection for the hardware to fasten. Again this condition could have led to cracks in the collars and failure in the connection between the markers and post.

These factors could have ultimately led to local communities repairing the markers on their own which would explain many of the inconsistencies we observed in the attachment systems. Many times the well intentioned "fixes" led to more damage and in some case these repairs they were not in-line with the visual intent of the designers

Treatment Performed:

Repair & Stabilization of the Collars

The collars were cleaned of rust and scaling.

A new outer-collar was fabricated from cold-rolled DOM 1020 Steel: 5" OD x 4.500" ID x .250" Wall.

Note: The *Brinell Hardness Number* for this type of steel is about 130. In comparison cast iron is about 400. The higher the number indicates that a material is harder (*As metal hardness increases toughness decreases*). We felt for this application using a compatible material that was "softer" was a good alternative.

The outer-collar was connected (mechanically using 316 stainless steel ½" x13 flat head machine screws) to the interior tube of the hexangular post. The addition of this new outer collar acted to both stabilize and re-inforce the original collar.

The stainless steel fasteners were counter-sunk in the outer collar to limit areas where water could infiltrate (and create a visually smooth profile).



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The top edge of the collar was beveled to match the slope of the top the original collar.

The top and bottom edges at the intersection of the outer-collar and original collar were filled with epoxy resin bulked with stainless steel powder.

On Markers with a broken collar:

Sections of DOM 1020 Steel (4-1/4" OD x 3.250" ID x .500" Wall) were cut to fill in the losses on the collar. These repaired sections were mechanically attached to the outer- collar prior to attaching the outer-collar to the post.

Fabrication of New Posts:

New posts were fabricated from ductile cast iron (Cumberland Foundry, Woonsocket RI). The posts length was 7' (cast in two sections 3' & 4'). The exterior profile matched the original posts; the center bore was 2 .3125" (this is about .25" thicker than the original castings)

An 8' long Mild Steel Round Tube A513-Type 5 Dom (2.125" OD x 0.12" Wall x 1.885" ID) was attached mechanically (using 316 stainless steel machine screws at 6 points per post section) through the interior of the cast post sections. This tube was installed to give added support and durability to the Post and allow for a better connection to the collar above and the ground below---This process allowed the cast iron hexagon to be completely re-enforced with an internal cold rolled steel armature.

An additional section of DOM 1020 steel tube (3-1/4" OD x 2.250" ID x .500" Wall) was attached mechanically to the top of the interior steel post. This section of tube filled the space between the collar and the interior tube. This additional section of tubing allowed for a more robust connection between the collars and posts.

In summary:

The new fastening system has the original cast iron collars sandwiched between three sections of cold rolled steel secured both independently and as a whole with multiple 316 type stainless steel fasteners. The upward and lower facing edges are fully sealed with epoxy resin bulked with stainless steel powder and the surface is coated with durable exterior primer and paint system (see next section). This fastening system should help alleviate some of the stability issues observed in the original design.



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Detail: Broken Collar





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Connection between
Collar and Post (U-
shaped break on
collar)

Previous Repair to collar using a welded steel ring



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Attaching Inner
and Outer Collars



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Repairing broken
collars





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Repairing broken
collars (continued)



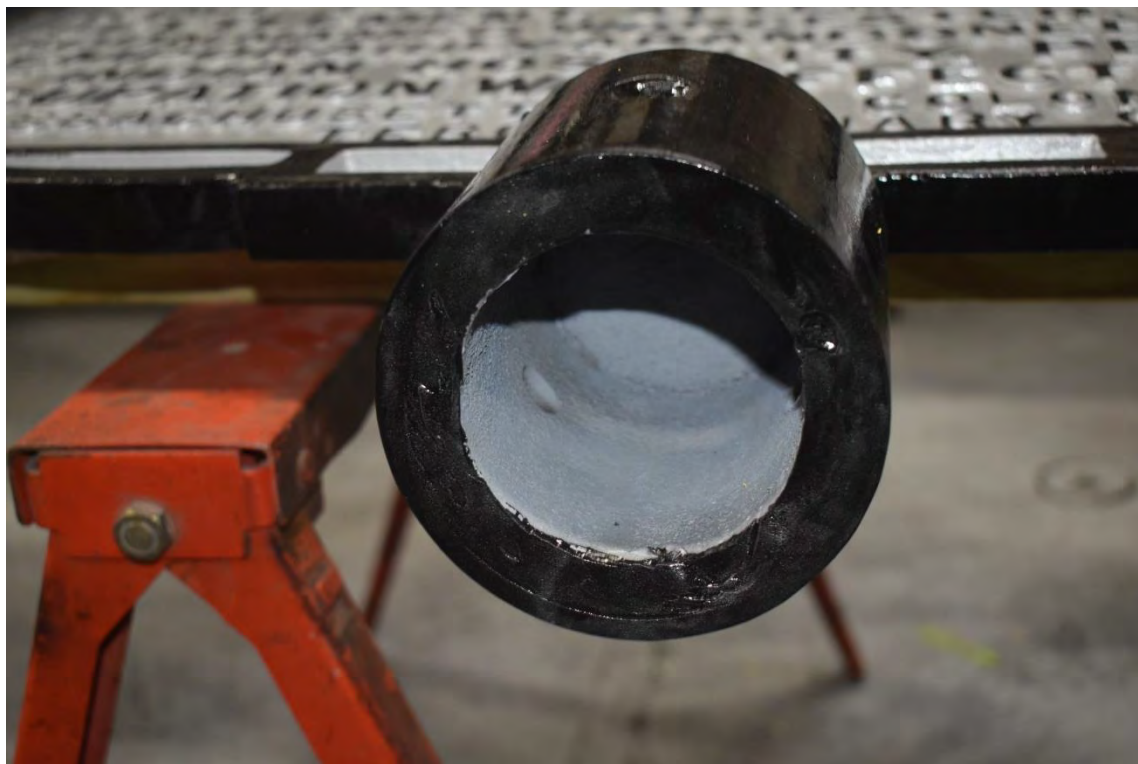


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Filled/Beveled
seam at top of
outer-collar

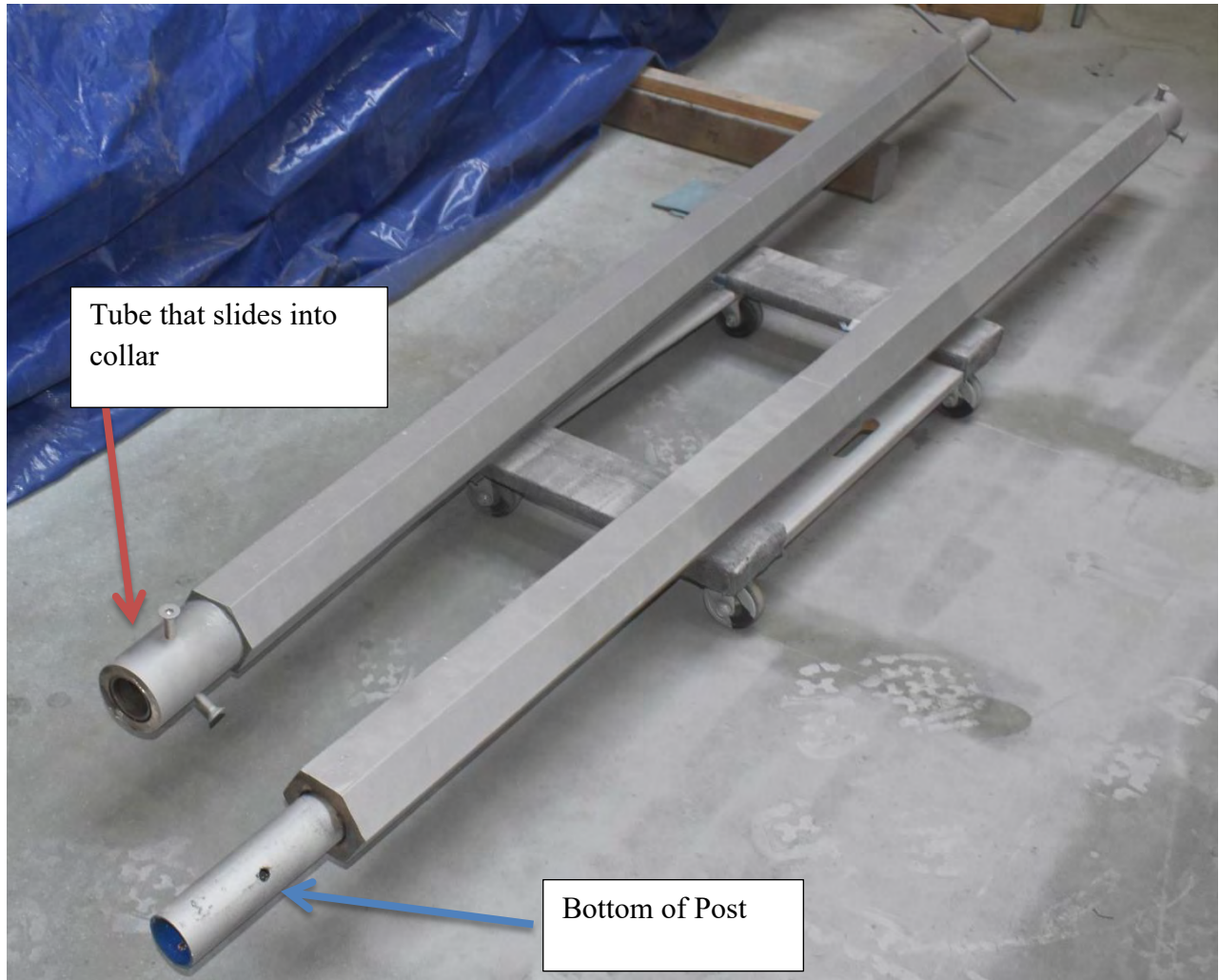


Outer-Collar
sealed and
attached (after
painting)



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Tube that slides into
collar

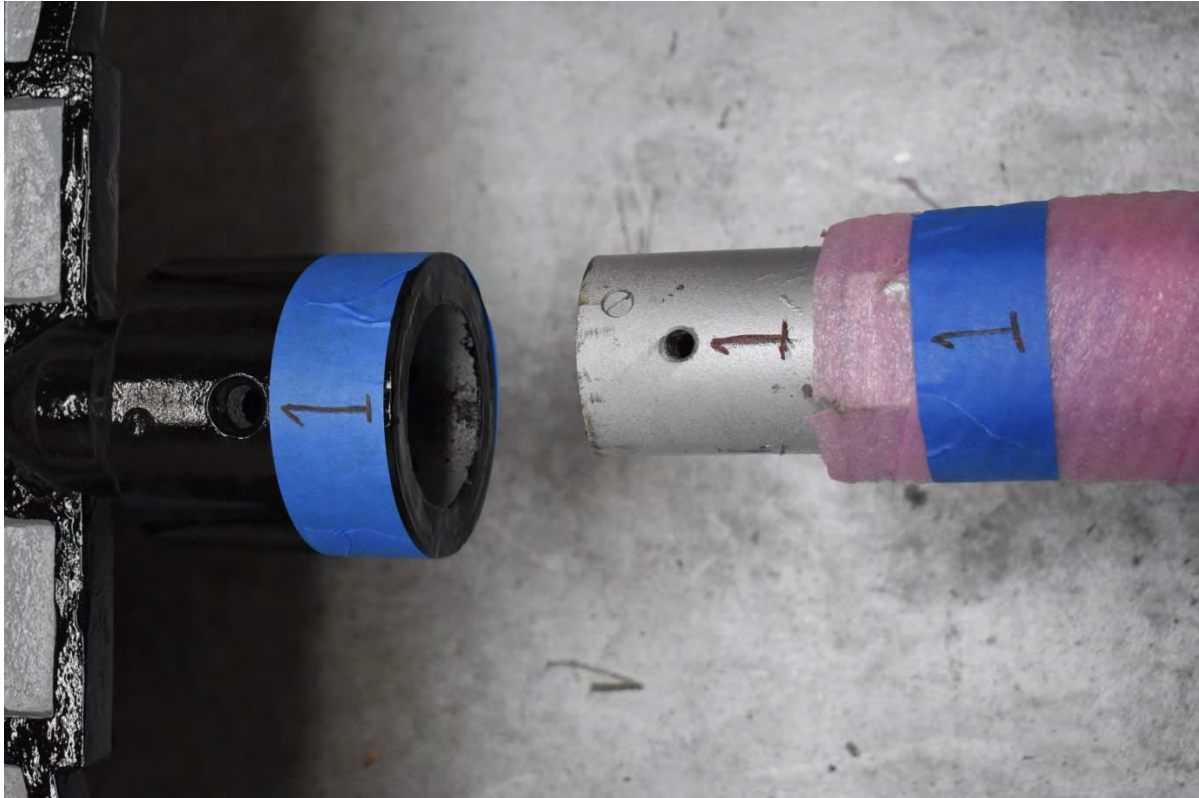
Bottom of Post

New Post, Assembled

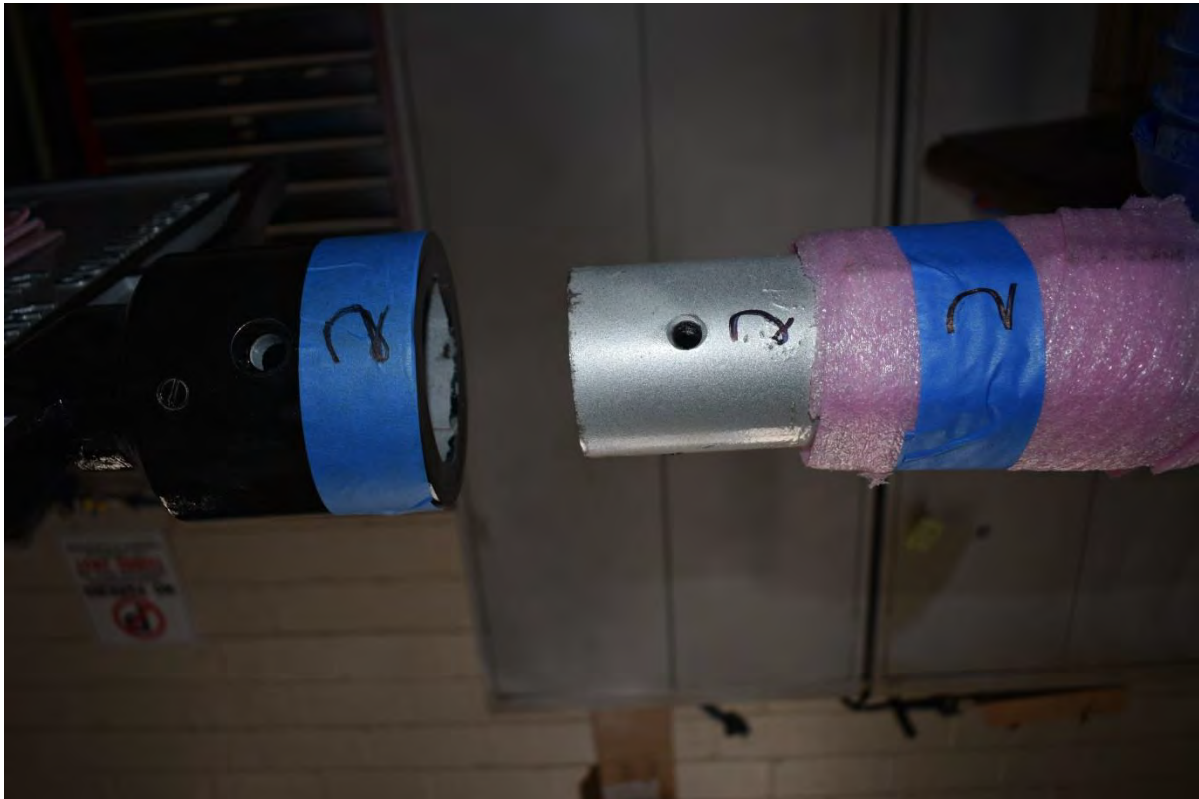


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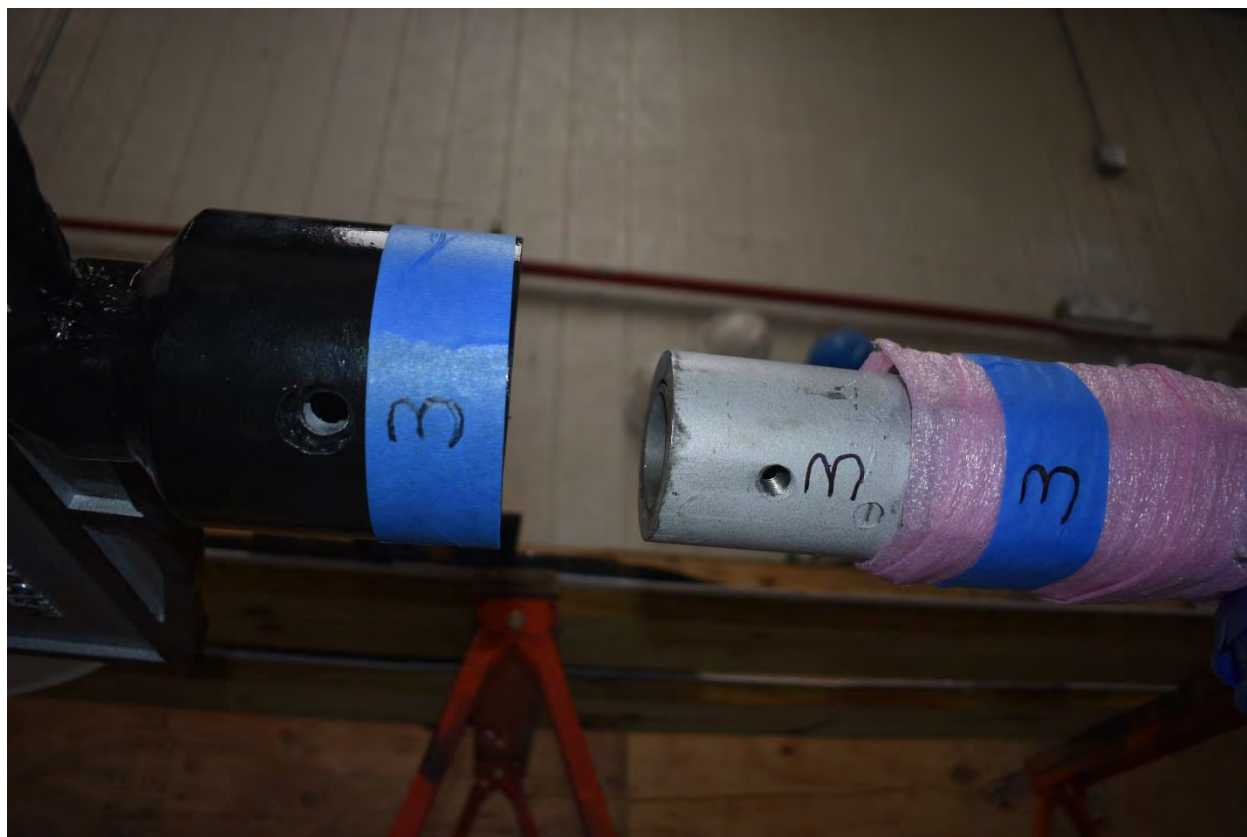
Detail of
Collar to
Post
fastening
system





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Collar to Post fastening system continued/ Holes only fit with corresponding number



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PART FOUR: Painting/Leafing:

The markers were painted using the following methods and paints the color placement were based upon the original marker design. This design was described in clear detail in the specifications provided by MassDot:

Restoration Specifications for the Mass Bay Colony Tercentenary Markers:

The tablets shall be painted in the following manner:

The background panel on both sides of the tablet shall be painted silver.

The letters, dates, and trim on the tablet shall be painted black on their faces only; the collar at the bottom of the tablet also shall be painted black.

The Coat of Arms of the Commonwealth on both sides of the tablet shall be painted blue and gold. The specified gold paint or gold leaf can be used on the Coat of Arms. If using gold leaf, provide MassDOT with the proposed application technique and material for approval.

Details of the Coat of Arms shall be painted in the following manner: the five-pointed star in silver; the shield and ribbon in blue; the lettering on the ribbon, the Native American figure and bow, and the arm with sword in gold; the rope under the arm in gold and blue, with the six sections of the rope alternating in gold and blue, beginning on the left with gold

Primer: Interplus 356 (International Paints) applied using a Graco airless spray system.

Aluminum/Sliver: PPG Essentials ESM 130 (PPG) applied using a Graco airless spray system.

Black: Interthane 990 17038 Black (International Paints) applied using natural fiber brushes and a speed ball (soft) rubber roller

Blue: Interthane 990 C26A State Seal Blue (International Paints) applied using natural fiber brushes.

Gold: 23k double thick gold leaf was applied using traditional gilding techniques



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After 356
Primer was
applied



After application of Silver



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During
Treatment:
Painting
letters and
edges



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During Treatment:
Painting letters and
edges



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During Treatment:
Painting





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Application of
Gold-Leaf



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Details, after
painting and
leafing





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PART FIVE: Packing and Installation:

The markers and posts were packed with foam and shrink wrap to ensure that they were not damaged during transport and installation.

The markers and posts were transported independently and assembled on-site.





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12" sonotube were
cut to ~24" depth



A custom brace
system was
fabricated to
ensure that the
markers stayed
level while the
setting mortar
cured



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Markers were hoisted with lifting C-Clamps. Rubber pads were placed between clamps and markers



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Markers were lifted with scaffolding, manual chain fall and custom fabricated spreader bar. The posts and markers were set plumb (as best we could) side to side and front to back)



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PART SIX: Markers Treated:

1. Brimfield- Indian Hill (#219)

- Removed Marker and Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Re-set Post & Marker as specified



Notes:

Collar had previous welded repair. Original Post was repaired and reused.

BEFORE
TREATMENT



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AFTER TREATMENT



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Collar/Post
Intersection
Before & After

Indian Hill





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#2 Brimfield- Steerage Rock

- Removed Marker and Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Fabricated new Hexagonal Post
- Re-set Post & Marker as specified



BEFORE TREATMENT

Notes:

This marker is a replacement (or it was cast at different time): The marker is significantly heavier (thicker) than the original markers. The lettering is a different font and larger. The State Seal is lacking in definition and the scale of the elements is not correct.



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AFTER TREATMENT



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Detail: Differing
style of details
and font from
original casting





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#3 New Braintree-Wheeler's Surprise

- Removed Marker and Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Re-set Post & Marker as specified



Notes:

This marker is a replacement (or it was cast at different time): The marker is significantly heavier (thicker) than the original markers. The lettering is a different font and larger. The State Seal is lacking in definition and the scale of the elements is not correct. It appeared that the marker's had casting defects (drops and slag on the surface) which were not properly treated prior to the original installation. These defects were treated (chased) by Daedalus prior to painting

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AFTER TREATMENT



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Before &
After Removal
of rust, drops
and slag





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#4 Hatfield- Hatfield (#227)

- Removed Marker and Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Re-set Post & Marker as specified



Note:

Marker was
relocated

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AFTER TREATMENT



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#5 Hatfield- Hatfield (#228)

- Retrieved Marker from Hatfield Museum
- Repaired large loss section
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Fabricated new Hexagonal Post
- Re-set Marker and Post as specified



BEFORE TREATMENT

Notes:

A mold of the missing section was taken from the other Hatfield Marker. A cast of the missing section was made using ductile cast iron. The new section was attached to the original mechanically using blind stainless steel pins. A ¼" thick stainless steel bar was also added to each of the vertical edges of the cast; the bar on the broken side for structure, the bar on the non-broken side was added for continuity of form.



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New cast section,
prior to cuts
made to fit
securely with
original form

REPAIR TO
BROKEN
SECTION OF
HATFIELD #2

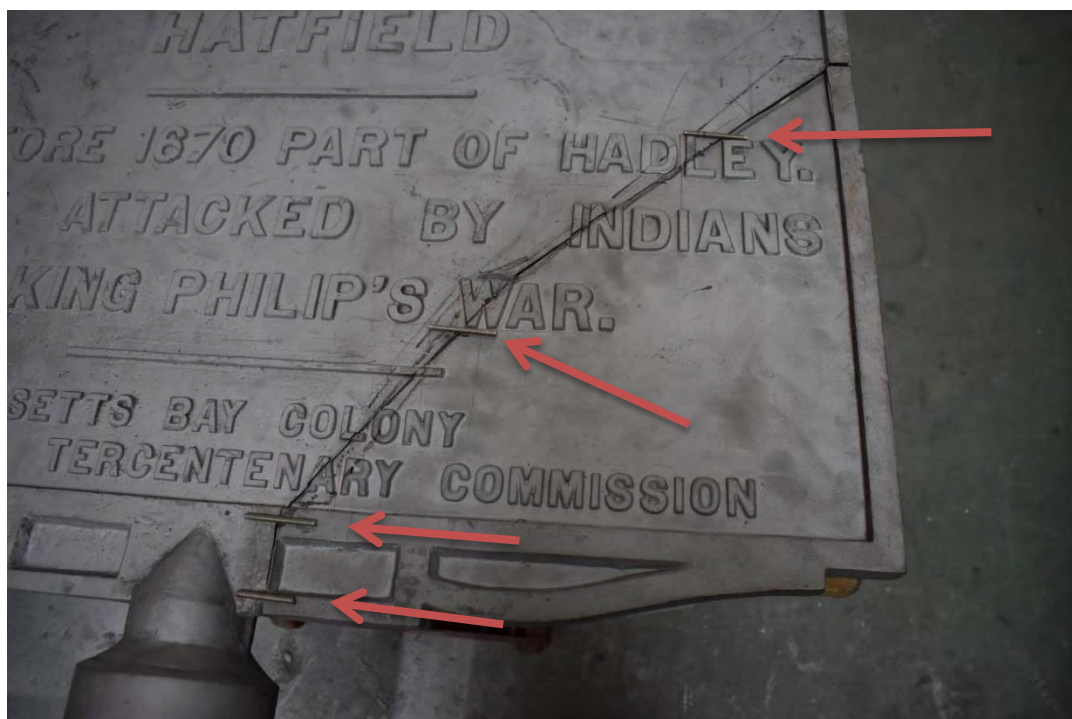


New section after
begin cut to fit the
loss



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Mock-up of new
section and
location of blind
pins





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Tapping holes
for pins



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Mock-up with holes drilled and tapped



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Final chasing,
after sections
were attached
with pins and
epoxy resin





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Repair prior to painting. Red arrows show stainless steel bar which was added for additional structural support on the broken edge and continuity of form on the non-broken edge



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After being
primed &
After
completion of
paint and leaf.





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#6 West Brookfield- Fort Gilbert (#215)

- Removed Marker and Post
- Fabricated new Hexagonal Post
- Repaired Collar/ Post Fastening System
 - Cleaned and Painted Marker as specified
- Re-set Post & Marker as specified



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#7 Worcester- Worcester (#167)

- Marker was retrieved from Mass Dot storage location
- Removed Marker and Post
- Fabricated new Hexagonal Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Returned marker to Mass Dot for installation



BEFORE &
AFTER
TREATMENT



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#8 Hadley – Hadley (#225)

- Removed Marker and Post
- Fabricated new Hexagonal Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Re-set Post & Marker as specified



Notes:

Marker installed in new location

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#9 Hadley – Hadley (#226)

- Removed Marker and Post
- Fabricated new Hexagonal Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Re-set Post & Marker as specified



Notes:

Marker installed in new location

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#10) Indian Village

- Marker was retrieved from Mass Dot storage location
- Removed Marker and Post
- Fabricated new Hexagonal Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Returned marker to Mass Dot for installation



BEFORE & AFTER
TREATMENT



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#11) Second Attempted Settlement

- Marker was retrieved from Mass Dot storage location
- Removed Marker and Post
- Fabricated new Hexagonal Post
- Repaired Collar/ Post Fastening System
- Cleaned and Painted Marker as specified
- Returned marker to Mass Dot for installation



TERCENTENARY SIDE A
MARKER
MASS DOT
BEFORE TREATMENT
DAEDALUS #1

BEFORE & AFTER
TREATMENT





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Worked was conducted between April & November 2019

Treatments Performed By:

Gompo Yarmolinsky

Michael Marston

Richard Brown

Susan Siefer

Joshua Craine

Report:

Joshua Craine/ December 2019