Conditions Assessment and Treatment Recommendations for the Masonry Components of the Johnson Gates Boston

Completed for:
Ms. Marie Fukuda
Fenway Civic Association, Inc.
Box 230435, Astor Station
Boston, MA 02123

Completed by:
Ivan Myjer
Lead Conservator
Building and Monument Conservation
83 School Street
Arlington, Ma 02476
617 834-3908
myjer.ivan@rcn.com

December 6, 2013

Conditions Assessment and
Treatment Recommendations
for the
Masonry Components of the Johnson Gates

Table of Contents

Conditions Assessment and
Treatment Recommendations
for the
Masonry Components of the Johnson Gates
Boston

Introduction

In mid November, Building and Monument Conservation surveyed the condition of the Johnson Gates inclusive of the two piers, two horse troughs and two balustrades with benches that flank the piers. The purpose of the assessment was to document the conditions of the various masonry components of the gates and then develop a set of treatment options and recommendations along with budgets for the recommended treatments.

In order to understand how the piers were constructed, as well as the cause, or causes, of the cracks that are visible in the vicinity of the fountain bowls on both piers, an attempt was made to remove a section of a cracked unit on the north face of the north pier by cutting out the mortar that surrounds the section. The attempt was not successful because, once the mortar had been removed, it was apparent that the angle in which the stone fractured resulted in the two parts of the unit remaining keyed to each other. Despite not being able to remove the section of stone, important information about the construction of the piers as well as the options for repairing the piers was obtained in the process. The probes, however, did not resolve whether the cracks adjacent to the fountain bowls were caused by the expansion of steel plumbing fixtures, as has been surmised, or by the expansion of ice forming between the core and the exterior stones.

In order to determine the cause of the cracking on the north trough, the stone cover was removed and then replaced after the interior was inspected. While not part of the original proposal, the stone cover on the south trough was also removed and reset. When the covers were removed it was very apparent that the walls and edges of the troughs had been significantly reworked with grinders in order to recess the covers into the troughs.

In addition to the probes outlined above, small cleaning samples were carried out on the piers and balustrade to develop methods and budgets for cleaning the stone.

Executive Summary:

Piers:

- The two piers are constructed in an identical manner from Tennessee Pink Marble and Milford Pink granite. The piers are cracked in nearly identical locations above the basins that served as receptacles for the original

fountains. The block that forms the basin on the south pier however is completely cracked and the unit is in two pieces.

- The presence of a masonry core was confirmed by drilling into several wide mortar joints. The drilling established that there is a small gap between the back of the cladding stones and the face of the core. This gap may not exist at every location and it is possible that some units may be keyed into the core in order to integrate the exterior cladding stones and the core into a single masonry unit.
- The location and type of original plumbing could not be confirmed because the cracked fragment on the north elevation of the north pier could not be removed without destroying it.
- There appear to be two causes for the cracking and displacement of the Tennessee Pink Marble units that make up the piers. The first is water freezing in the gaps between the masonry core and the backside of the Tennessee Pink Marble units. The second is the expansion of rusting ferrous plumbing fixtures. The latter has not been confirmed as of yet but the crack patterns on the units above the basins where water used to spout from the mouths of the lion heads are consistent with cracking on other fountains that contain ferrous metal pipes and fixtures.
- A third possibility exists that some of the cracking in the cladding stones is the result of the expansion of the masonry core but the discovery of a gap between the back of the stone and the core in several locations makes this possibility more remote.
- The manner in which the cladding stones were keyed to each other during the original construction prevents the removal of single units from the pier without destroying one or more units in the process. The cracking and displacement of stone units cannot be rectified without taking the piers apart from the top down. This would be an enormous undertaking involving small cranes and a very large lay down area for the disassembled units. Vehicle and pedestrian traffic would have to be diverted during key moments of the disassembly and reassembly of the piers.
- The alternative to taking the piers apart and correcting the causes of the cracking is to stabilize them in place. Stabilization would be aimed at preventing new cracks from developing and limiting the growth of the existing cracks as well as the displacement of units by keeping water out of the masonry. The stabilization approach, as opposed to the rebuilding of the piers discussed above, would necessitate more frequent maintenance of the piers in the future. The mortar and grouts that form the essential defense against water infiltration would have to be inspected and repaired on a periodic basis - roughly every ten years.

Horse Troughs:

- The troughs were fabricated from enormous blocks of Tennessee Pink Marble and set on large slabs of Milford Pink Granite. The foundations and footings for the troughs must be substantial due to the weight of the troughs.
- The Tennessee Pink Marble covers on the horse troughs are not original. The interior walls of the trough were altered using grinders to accommodate the covers.
- The stone covers do not fit perfectly and water flows into the troughs through the gap between the cover and the sides of the troughs.
- The trough were filled with sand - possibly at the time that the covers were installed. The purpose of the sand is not clear but perhaps it was installed to provide additional support for the covers which are relatively thin compared to their surface area.
- The north trough has a major structural crack on the north end. The trough does not contain any corroding ferrous metal pipes or anchors that could be responsible for structural crack. How the troughs were filled with water when they were has not been determined.
- The cause of the cracking of the north trough appears to be the expansion of ice forming inside the trough in the winter. Water flows freely into the trough through the gaps around the cover. The trough is filled with sand and the volumetric expansion of freezing water in the trough is compounded by the presence of the sand in the trough.
- There are holes at the bottom of the troughs that may be original drains or might possibly have been added at a later date to facilitate drainage. The drain holes on the north trough probably became clogged and as a result, water periodically filled the trough.
- The north trough is leaning to the east fairly dramatically. The cause of the tilt appears to be related to the settling of the foundation, which in turn may be related to the utilities well that was constructed adjacent to the north end of the trough. There is a possibility that the construction of the utilities well contributed to the cracking of the north trough. The south trough which as an identical stone lid and is filled with sand does not have any structural cracks.
- After the removal of the lid on the south trough it was apparent that the cracks that were observed on the east edge are the seams of a prior "dutchman" repair that is now failing.
- The south trough is still plumb and does not require the type of structural repairs or resetting that the north trough requires. The south trough has been repeated damaged by impact - probably from cars or trucks backing into the parking places adjacent to the trough.
- The fragment that has completely detached on the north trough could be reattached to the main portion by first removing it and then reattaching it with epoxy and possibly stainless steel setting pins. This process would involve the use of heavy equipment placed on the sidewalk on the north side of the trough.

- The alternative to reattaching the fragment is to leave it separated from the main piece and then grout the seams from the interior and exterior with a tinted mortar. This repair would require periodic maintenance.
- Correcting the tilt of the north trough would require re-leveling the granite slab below the trough. This in turn would require obtaining more information about the size of the foundation and its proximity to the walls of the utility well.

Balustrade and Benches

- The balustrade and benches are in relatively good condition - especially when compared to the piers or the troughs. There are numerous areas of loss in the edges of the granite slabs as well as the Tennessee Marble benches and coping stones.
- There has not been any significant shifting or displacement of the units that make up the balustrades.
- Repair and stabilization of the balustrade and benches is much less involved than the repair of either the piers or the troughs. The recommended scope includes 100% repointing, cleaning, removal of prior repairs and new repairs with patching mortars and stone dutchmen.
- The extent of patching and dutchmen repair is open to discussion as these types of repairs are primarily aesthetic.

Review of Prior Repairs:

Documents pertaining to the repair and maintenance of the Johnson Gates were placed in chorological order and summarized in a report by Sarah Hutt in 2003 when she was director of the Boston Art Commission. This summary, as well as the complete Technical Specifications for the Repair and Conservation of the Johnson Gates completed by Judy Selwyn of Preservation Technology Associates in 1989, were reviewed for this report.

The documents indicate that a lot of work was proposed for the Johnson Gates but not necessarily completed. There were several attempts to clean the stonework with chemicals and sandblasting but the details of many of the repairs that are visible today that pre-date the 1991 work, such the repair of cracks in the balustrade and the grinding of the insides of the troughs to accommodate the installation of the stone covers are not documented. Some work was completed on the balustrades and possibly the piers in the early 1980's, but the full scope of that work is not clear. Some balusters may have been replaced and the existing stonework may have been honed at that time.

While the scope of work completed in 1989 is clear, the conditions of the piers, troughs and balustrade prior to the work cannot be determined from the documents. It is only possible to determine if a crack existed prior to 1989 if the

crack contains a repair mortar that dates from that campaign. Absence of mortar in a crack however is not a clear indicator that the crack postdates the last round of work. For example, it is possible that the structural crack on the north trough existed prior to 1989 but there were not sufficient funds available at the time to repair it.

It is possible that additional information on the care and maintenance of the Johnson Gates as well as photographs of the condition of the various components at different points in the past exists in the files of the Boston Parks Department and/or the Boston Art Commission. Obtaining this information, if it exists, would be very useful because it would provide insights into the rate of cracking and deterioration of the stone.

Discussion of Conditions and Options

Piers

The piers are in good condition overall but are suffering from the effects of deferred maintenance - principally of the mortar joints. The lack of routine maintenance has permitted water infiltration into the interior of the monument which in turn has resulted in the cracking and displacement of some of the Tennessee Pink Marble units. The displacement is more advanced on the south pier than on the north.

The units that make up the original fountain portion of the piers - the projecting basins and adjacent units - are severely cracked, in multiple locations, due to the likely expansion of ferrous pipes and plumbing fixtures. The basin on the south pier is cracked diagonally from west to east. Water that enters the basin flows through the crack and comes out at the mortar joints between the basin and the unit below. the outboard fragment of the south pier basin is displaced from either the expansion of ice or the plumbing fixtures.

Our review of the piers indicates that cracking of and displacement of units is ongoing. The cracks in the north and south pier units have grown substantially wider since the last round of work was completed in 1991. The cracks are now wider than the fragments of mortar that remain in the cracks.

The piers are constructed from thick units of Tennessee Pink Marble set over a masonry core. The core stops below the level of the entablature. The entablature is a single unit of stone that caps the construction below it. The cornice, above the bronze work, consists of multiple units of stone but is in turn capped by a single unit of stone. Water that enters through the skyward facing joints at the cornice cannot enter into the masonry below because the entablature unit functions as a cap for the core below.

It is likely that the core was constructed simultaneously with the placement of the exterior cladding and that some of the cladding units were anchored to the core as the monument went up. Additionally, some of the cladding units may have been anchored to each other with vertically placed pins. The absence of spalls at the top of the units is a pretty good indication that ferrous anchors were not used to attach the cladding units to the core, or to each other. Conservation work on other monuments constructed in Boston at the beginning of the 20th century has revealed bronze, rather than steel or iron anchors, so it is good working assumption that the Johnson Gate piers were constructed in the same fashion.

Given the date of construction, the core inside the piers likely consists of brick and/or stone rubble set in mortar. The foundations for the piers were possibly poured from concrete but, masonry construction from units of hard stone such as granite set in mortar is more likely. The absence of noticeable settlement or tilting indicates that the foundations were properly placed and remain in good condition.

The north and south piers have similar conditions but the cracking and displacement is more advanced on the south pier. The same type of units at the have been displaced at the lower sections on both piers and a number of units have cracked in the same location on the upper sections of both piers - indicating that the manner in which the piers were constructed is a principal factor in their deterioration.

The principal cause of unit displacement and cracking appears to be the expansion of water freezing in the gap between the back of the cladding units and the face of the piers. An additional cause of cracking would appear to be the corrosion and jacking of ferrous metal pipes and fixtures. While it was common at the time to use bronze for the spigots and decorative elements of fountains it was also common to use steel pipes to connect the bronze elements to the water supply. Unfortunately, steel and iron pipes corrode over time and when the corrode they expand. The force of that expansion is sufficient to crack granite and marble.

Not all of the cracks in the piers are the result of expanding ice, steel or iron. Some of the cracks - especially those at the edges of units - are the result of a tearing action caused by the displacement of the heavy units of stone. Still other cracks are the result of internal stresses in the stone that are the result of how the stone was formed. Tennessee Pink Marble is a metamorphic limestone rather than a true marble but it was classified as a marble by the stone industry in the 19th century because it can be polished to a high gloss.

Treatment Options

There are two possible approaches to the long term preservation of the piers. The first is to stabilize the piers without addressing the root causes of the problems that are causing the cracking and dislocation of the units. This approach would entail

100% repointing of the mortar joints, grouting of all of the cracks and the repair of areas of loss with patching materials or "stone dutchmen" followed by cleaning and the installation of lead caps on the skyward facing mortar joints to prevent water infiltration. It would not be possible to reset shifted units of stone, pin cracked units of stone or remove or repair the plumbing with this approach.

The second approach, which entails taking the piers completely apart to remove ferrous elements and correct deficiencies in the cores, would correct the conditions that are responsible for the cracking and displacement of the stone. The piers would be rebuilt around new cores with the original units set in their original locations . The second approach would permit the access to the plumbing either for permanent removal, or repairs that would allow the fountains to function again.

It is unfortunate but the original designers and builders did not anticipate that the plumbing system would cease to function, or that it could be the cause of major cracking in the stone. They simply neglected to provide any access points to the plumbing to maintain it or replace it. Many fountains from this period do contain access points in the form of trap doors or removable units of stone placed in strategic locations.

A half way point between stabilizing the piers as they are and getting to the root causes of the damage caused by the plumbing fixtures would entail breaking through some of the existing units of stone in order to gain access to the plumbing. However, since Tennessee Pink Marble is no longer quarried, replacing the destroyed units would only be feasible if sufficient blocks of matching salvaged material could be obtained. We do not currently have sufficient knowledge of how the piers were constructed to determine if it is in fact feasible to safely remove some units without undermining the structural integrity of the piers. The critical information that is lacking is whether all of the cladding units were placed in front of the core or whether some of them extend into the core. If the units were placed in front of the core, then they can be shored separately from the core. If they were integrated into the core then it would probably be simpler and more cost effective to take the piers apart from the top down.

Discussion of Options and Recommendations for the Piers:

The location of the piers, adjacent to the roadbed of the Fenway exit onto Hemenway Street creates a very difficult working environment for completing any sort of masonry work on the piers much less taking them apart and rebuilding them.

The Fenway exit and entrance onto Hemenway Avenue and Westland Street is a major thoroughfare for cars and pedestrians. Traffic would have to be re-routed around the work site to permit access to the roadbed sides of the piers regardless of which option is selected. This would require a complete buy in by the City of Boston and the cooperation of various departments. The costs of re-routing traffic or providing police details is impossible for this author to calculate without prior

discussions with the city agencies. In addition, if the piers were to be dismantled, the city would have to provide a lay-down area for the dismantled units or the contractor would have to take them off site and store them until they can be reinstalled.

A rough guess of the cost of taking down and rebuilding the piers is $800,000 to S1,000,000 in 2014 dollars. A budget in 2014 dollars for stabilizing the piers without dismantling them is $53,500 per pier or $107,000 for both of them.

The dismantling of the piers would be significantly easier to undertake if the original drawings by Guy Lowell could be located. A quick check on the internet did not reveal if, or where, his papers have been collected. He was a graduate of MIT and it is possible that MIT acquired his papers. Section drawings showing how the cladding units are attached to the core and how the core relates to the foundation would be invaluable. This information would eliminate the need for guesswork or costly non-destructive testing.

Dismantling and rebuilding the piers will be required eventually, but it is possible to stabilize the piers for an extended period of time by maintaining the mortar and grout joints on a periodic basis (roughly every 8 - 10 years) Not all of the joints will have to be addressed in each maintenance cycle.

If the piers were structurally compromised or incapable of being stabilized, then there would be compelling reasons to dismantle them at this time. But that is not the case therefore our recommendation is to stabilize the piers in place.

Recommended Scope of the Piers

General Recommendations:

1. Check Boston Parks Department and the Boston Art Commission archives for documents and photographs pertaining to prior restoration projects.
2. Locate if possible, Guy Lowell's papers and check if there are any original drawings of the piers. Section drawings would be especially valuable. Shop drawings and/or fabrication drawings from the contractors would be a very luck find.

Stabilization Scope:

1. Cleaning to remove biological growths and black sulfate stains.
2. 100% repointing of mortar joints. Deep repointing especially in the vertical (head) joints is required.
3. Removal of existing cement based grouts and replacement with hydralic lime based grouts tinted to match the existing cleaned stone.
4. Reattachment of fragments of stone with epoxy and grouting around seams of the repairs.
5. Installation of lead "T" caps at the short skyward facing mortar joints

Aesthetic Repairs to Repair areas of Loss:

1. Build out small areas of loss with a tinted hydraulic lime based patching material.
2. Remove prior patches and replace with a tinted hydraulic lime based patching material.
3. Repair large areas of loss with 'dutchmen" fabricated from matching Tennessee Pink Marble.
4. Replace the missing granite cover on the east podium of the south pier.
5. Install granite dutchmen repairs at the larger areas of loss in the Milford Pink bases with matching Milford Pink Granite.
6. Ignore small areas of loss and divots in the granite and marble.

South Pier Only:

1. Remove cracked portion of fountain basin and then reattach to section that remains in the wall using epoxy and stainless steel anchors. Grout crack with tinted repair mortar.

Budget for the above: $53,500 for each pier, $107,000 for the pair.

Excluded from the above: Police detail for road closure to accommodate work on the inboard sides of the piers.

Troughs

Conditions:

The condition of the two troughs differs significantly. The north trough is split into two pieces while the south trough remains whole. The south trough has been damaged repeatedly by the impact of cars or trucks while the north trough has remained relatively unscathed. The base of the north trough has settled and as a result the trough is leaning to the east. The south trough remains plumb.

The crack in the north trough does not extend to the granite base - an indication that the cause of the fracturing of the trough is not related to the settlement of the base. The most likely cause of the cracking of the trough is the expansive force of ice forming in the trough when the sand is saturated.

Recommended Treatments

North Trough:

1. Remove stone cover and remove sand and debris inside the trough.
2. Drill out drainage holes at underside of trough. Install screens on the interior of the trough to keep the drainage holes from becoming clogged.

3. Clean out large crack at the north end of the trough and apply a slow setting epoxy to the mating surfaces. Cinch the fragment back into place. Install stainless steel cramp anchors across the fracture on the inside of the trough.
4. Install stainless steel supports for cover and reset cover on plastic shims. Install a tinted flexible sealant (caulk) between the lid and the sides of the trough.
5. Do not correct tilt of base.

South Trough

1. Remove stone cover and remove sand and debris inside the trough.
2. Drill out drainage holes at underside of trough. Install screens on the interior of the trough to keep the drainage holes from becoming clogged.
3. Remove prior stone dutchman repair and replace with matching Tennessee Pink Marble. Grout seams with at tinted hydraulic lime based grout.
4. Fill out areas of loss with a tinted hydraulic lime based patching material and small dutchman.
5. Install stainless steel supports for cover and reset cover on plastic shims. Install a tinted flexible sealant (caulk) between the lid and the sides of the trough.

Budget for the Above Scope of Work on the Troughs: The scope on the two troughs varies slightly. The north trough requires the reattachment of the large fragment and the south trough requires the removal and replacement of the large dutchman repair. The cost however is about the same: $16,000 for each and $32,000 for the pair.

Excluded from the above: Correcting the tilt of the north trough

Balustrade

Conditions:

The two sets of balustrade and benches are in pretty good shape. There are plenty of small areas of loss but the units themselves are not cracked, broken or missing. The mortar joints are open and failing but the units have not shifted.

A large number of small repairs were made circa 1980 with what appears to be a resin based patching material. These repairs are discolored and failing.

The is dirty and stained from use and misuse. There is a thin film of biological growths on the stone and some areas of sulfation staining.

Recommended Scope for balustrades and benches:

1. Clean all stonework to remove soiling and stains. Cleaning techniques will be based on the results of cleaning tests to determine the safest and most effective way to clean the stone limestone without damaging it.
2. Cut and repoint mortar joints using a pointing mortar that replicates the color and texture of the original pointing mortar. Original mortar may have been tinted to match the pinkish hue of the Tennessee Pink marble.
3. Grout cracks and fill areas of loss with a patching mortar tinted to match the cleaned stone. (15 to 20 repairs)
4. Repair losses in Milford Pink granite using matching stone cut and carved to fill the area of loss. (3 dutchmen repairs per side)

Budget for the Above Scope of Work on the Balustrade:

$40,000 to $45,000 per side.$80,000 to $90,000 total for the north and south balustrade/benches.

Included in the above: Site fencing while work is taking place, supply of power and water. Removal of debris and clean up of site.

Phasing and Logistics

The three distinct sections of the Johnson Gates -piers, troughs and balustrade/benches - can easily be broken up into discrete projects. The repairs to the north and south balustrade/benches could be undertaken as a single project in one season or they could be broken up into two projects spread out over two seasons. The same is true about the north and south troughs. The piers on the other hand would have to be undertaken as separate projects due to the temporary lane closures that would be required to access the roadway sides of the piers.

Access to clean, repoint and grout the roadway sides of the piers would be five working days per pier.

Johnson Gates- North and South Piers Construction

The upper section of the piers consists of an enormous cap stone set on top of the cornice which consists of small units. The entablature stone under the bronze work is a single unit of stone.

The mortar joints in the two courses of the cornice are completely open. The entablature stone on each pier is cracked in several locations but the cracks are not structural.

Johnson Gates – North and south Piers Conditions

Crack at fountain basin on the south pier.

Cracks above fountain basin on the north pier.

Pier Basins

The original bronze fixtures that supplied was to the basins have been removed and the holes are plugged with mortar.

The basin on the south pier is cracked. Water has been entering the drain and either flowing into the masonry core and freezing and/or corroding and expanding the plumbing pipes.

North and South Pier Conditions

The lower sections of the piers have many cracked and displaced units. The cracking and displacement is most likely the result of water freezing and expanding between the core and the units.

The granite bases and lower marble units have cracks from impact with vehicles.

North and South Piers Conditions

The undersides of projecting elements such as the volutes have heavy black sulfations stains. These stains can be removed with using a continuous spray of water.

An earlier crack repair is visible on the right. This crack is the result of an inherent weakness in the stone. These old repairs should be removed and replaced with a repair that is tinted to match the stone.

Conditions at Piers

Corner units have been spalled from vehicle impact.

The granite cover is missing at the south pier.

Conditions at Piers

The Milford Pink Granite bases have large spalls (losses) caused by impact with vehicles or construction equipment.

These areas of loss have been patched in the past but the patches did not hold. The most durable repair would be to cut the areas of loss square and then insert a matching piers of granite. This type of repair is called a "dutchman".

Probes at Piers

Mortar was removed from around cracked unit above basin on the north pier in an attempt to remove the smaller section of stone and access the plumbing for the fountain.

Note wide vertical joints where stone cladding at the base of the south pier has shifted and cracked. Holes were drilled through the wide mortar joints to reach the core within the pier.

North Trough

Crack at north end of trough extends through to the other side, effectively splitting the trough into two pieces.

Horizontal crack in troughs are the result of stresses inherent in the stone.

South Trough

View of interior of south trough with dutchman repair.

Exterior view of the same dutchman repair which is now damaged from impact.

Removal of the stone covers from the troughs

Removal of north trough cover

Interior view of north trough with sand scraped away to reveal crack.

Conditions at Troughs

Both troughs originally had holes for drainage. The south trough holes are still draining water but the north trough holes are clogged.

The north trough leans dramatically to the east. The cause of the shift could not be determined but it might be related to sidewalk/road repair or the utility well on the north side.

Conditions at Benches and Balustrades

The north and south balustrades are in good condition overall but have not received any maintenance in several decades.

Cleaning followed by 100% repointing and the grouting of cracks is required to maintain the benches and balustrades.

Conditions at Benches

An old patch that is failing is visible at the edge of the bench. The mortar joints are open there is a small amount of displacement of the units.

The benches have a film of biological growths and other types of stains. The edges of the stone units are spalled at the mortar joints because some of the previous mortars were too hard.

Conditions at benches and balustrades

There are numerous small losses at the edges of the units, some of which have been patched in the past with Portland Cement mortar.

As is the case with the granite bases at the piers, the granite at the benches is spalled from impact by equipment or vehicles.