The Abbey Memorial, Enfield, Connecticut

Condition Assessment and Conservation Recommendations June, 2011

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Introduction

View of pavement from East entrance

The marble sculpture of Thomas Abbey was carved by the sculptor Sherry Fry, and stands atop an inscribed base. Erected in 1916, the monument is in the center of a patterned limestone and brick paving surrounded by a white marble exedra, approximately 35 feet in diameter with four openings. Within each paving section there are alternate inlaid panels of oval and diamond shaped serpentine marble. The entire ensemble was designed by McKim Mead and White. The sculpture shows minor signs of weathering and biological soiling.

The original base was replaced c. 1987 in granite and is level. However because of ground conditions, the surrounding pavement has shifted perhaps due to differential frost heaving. There is evidence of at least three different replacement mortars. There are numerous fractures to the limestone radii and noticeable movement of two of the exedra sections on the North side of the monument.

Based on the displacement of materials, and replacement of pointing mortars, this movement appears to have been active for some time. However there has been no apparent recent damage or repointing, which may be related to the later installation of two storm drains. The drains are located outside the Eastern exedra perimeter immediately towards the church and have helped to prevent water accumulation and related damage.

Existing Conditions– Condition of Paving

View from West entrance looking towards church

Of major significance is the differential settling of the stone and brick paving. This condition creates a trip hazard and a continued failure of the joints. The lack of evidence of frost shattering to the bricks suggests that they were well chosen high fired pavers. However there has been considerable movement and fracturing of many of the paving elements, primarily on the Northern half. This seems to be associated with cyclical frost heaving, associated with excessive water which may have entered the paved area due to the surrounding topography. See page Appendix 23 for topography map detail of the area.

Frost heaving on brick pavers

Stone displacement

Existing Conditions– Brick Pavers

Loose paver bricks

Detail of loose brick. Note setting mortar

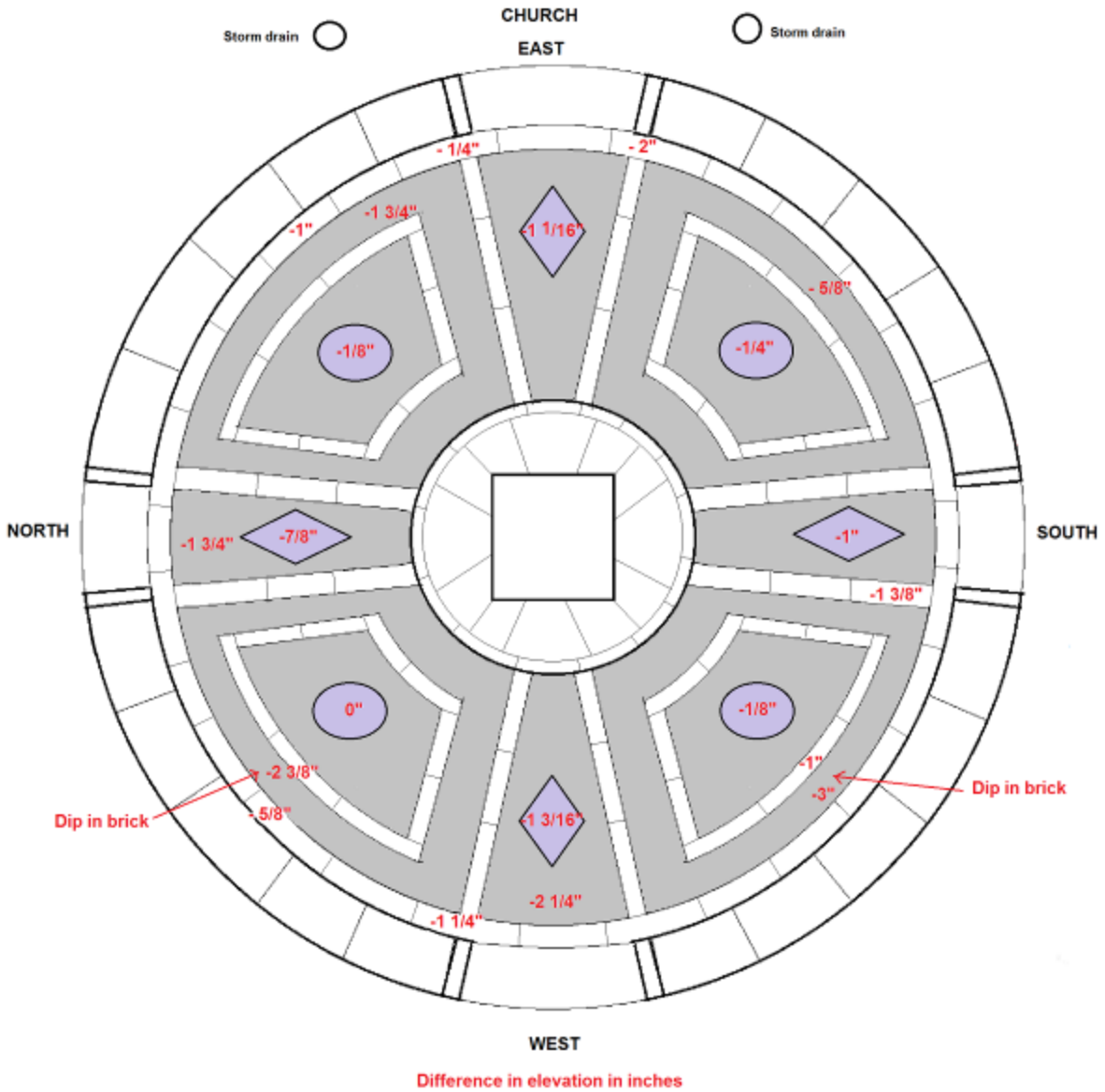
A loose brick sample was removed from the North-West perimeter and examined. It was apparent that the paving bricks were originally mortared in two stages. First the bricks were set onto a conventional mortar base laid onto what appeared to be loose pieces of stone, difficult to discern without full excavation, the original base mortar can be seen in the photo above right.

After all the bricks were laid out they were then set with a white pointing mortar. Excavated samples of the assumed original mortar were taken from the SE area and ranged from 3/4" to 1" in depth. Mortar analysis as described on page 11 was performed on the pointing mortar. The range of aggregate size is shown on page 16.
The loose brick sample was placed back as found.

The spacing of the joints and appearance of the mortar in the South-East paving surrounding the oval plaque appears to be original.

Detail of joints assumed to be original

Existing Conditions– Elevations



Elevations of the pavement were recorded by laser level and it was found that the oval plaque in the NW quadrant was at the highest elevation of the paving. Differences relative to this oval are noted on the above plan. The difference in elevation of the 4 oval serpentine inserts in the center of each quadrant is only a maximum of 1/4". In an approximate 15 foot distance, this difference is negligible. These ovals are the high points of each quadrant, and were set onto stone slabs which appear to be set onto a concrete foundation. These inserts are most likely still at their original elevation.

From this high point, each quadrant slopes down towards the diamond shaped inserts, dropping in elevation approximately 3/4" to just over an 1". The sections of paving with a diamond insert all slope towards the openings in the exedra. All the inset plaques appear to be still at or close to their original elevation. Thus all paving surfaces were initially designed for surface water to run off towards the perimeter exits in the exedra.

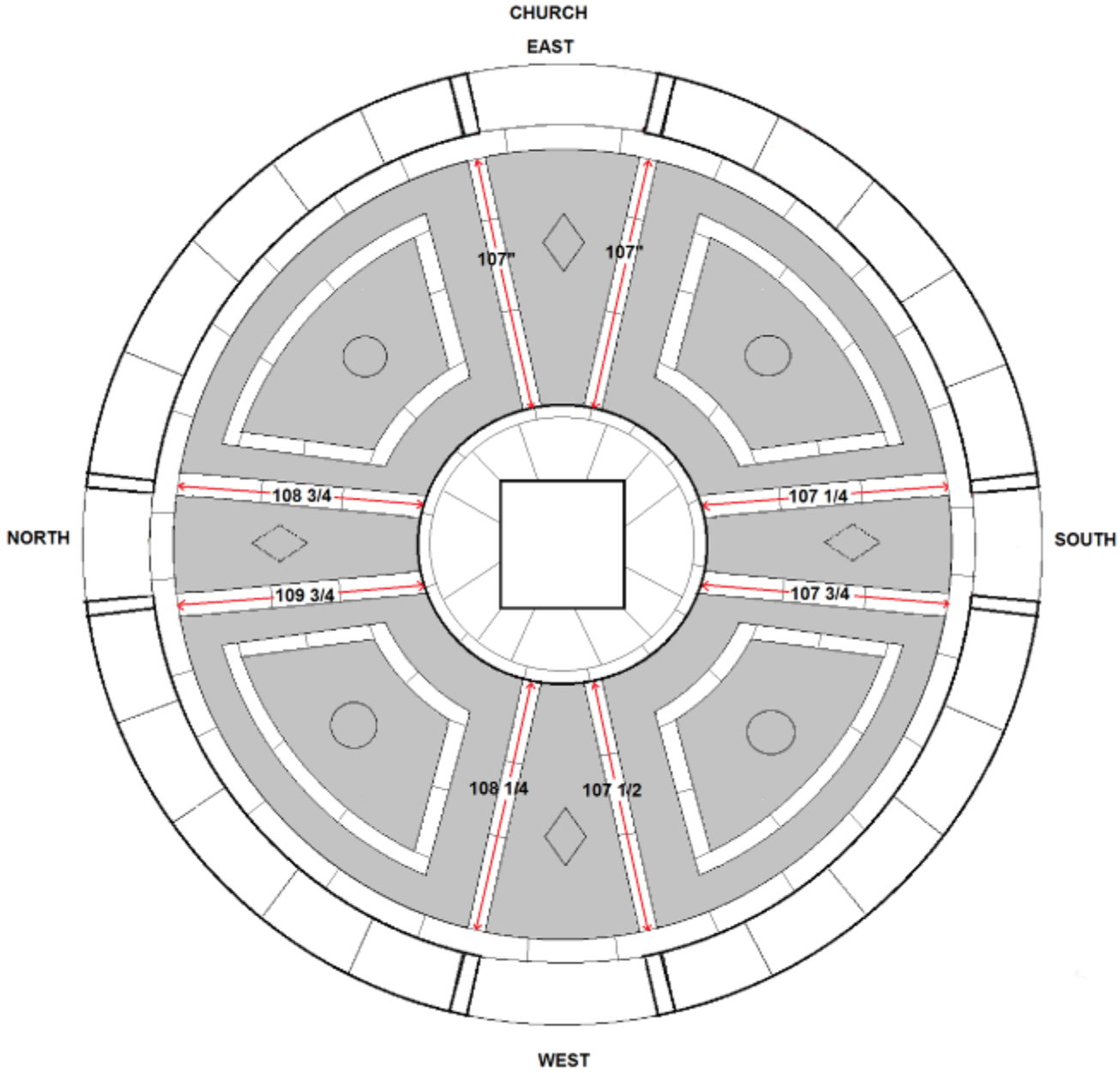
Existing Conditions– Plaque Foundation

Removal of oval plaque in center of Southwest quadrant to examine setting area. Note stone slab for setting.

Underside of serpentine plaque

All plaque surfaces, ovals and diamond are extremely weathered. The serpentine plaque in the Southwest quadrant that was removed for inspection is approximately 2” thick. The underside exhibits much less weathering than the exposed surface. While this unexposed surface could be honed and the stone reset with the un-weathered side up, the condition of all the plaques should be inspected to determine if honing all ovals and diamonds is feasible, keeping the final appearance consistent.

Existing Conditions– Length of Radii

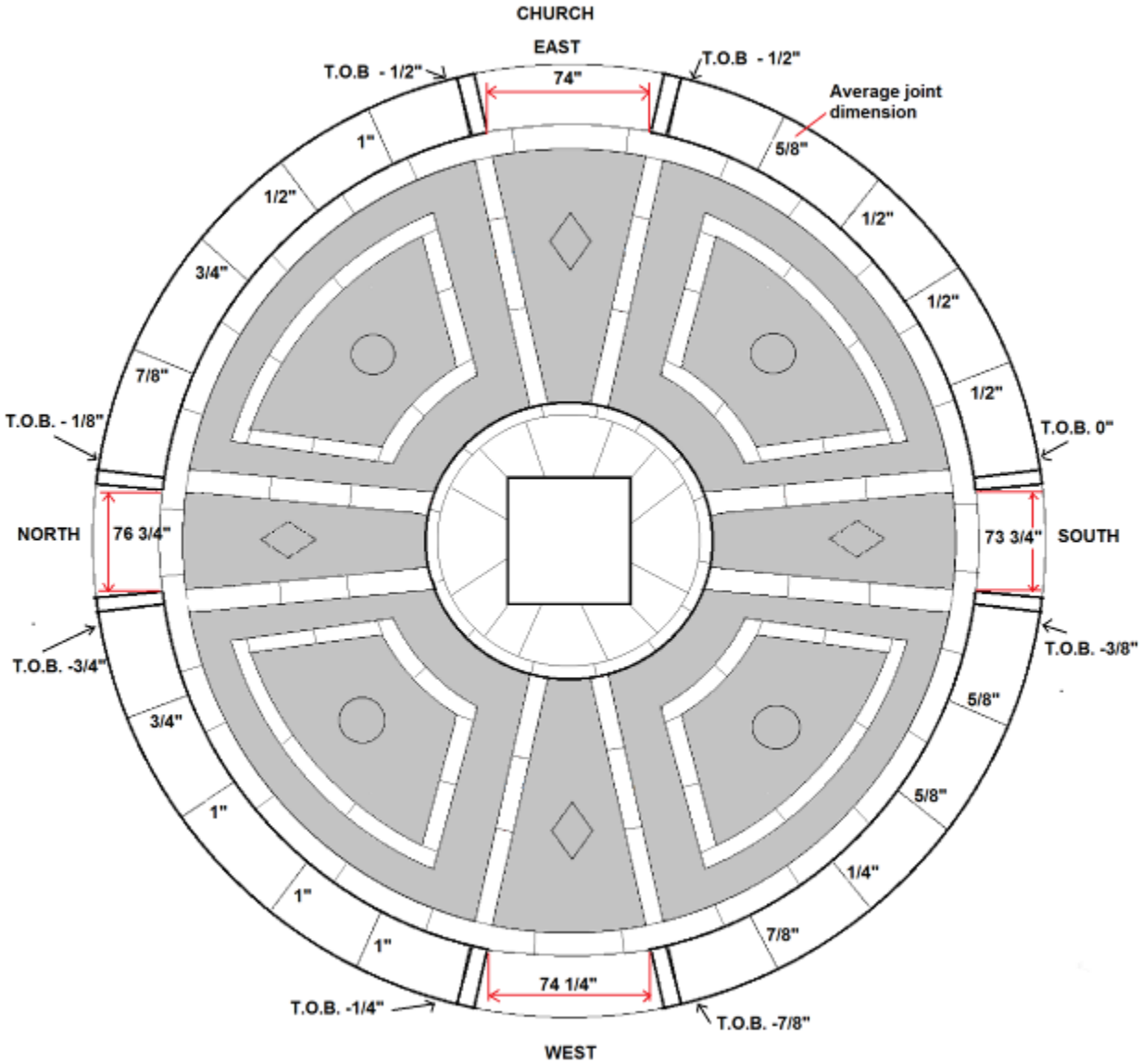


Existing dimensions of total length of radii

To determine the approximate amount of movement of the pavement and exedra the lengths of the limestone radii were measured and compared. All limestone radii are comprised of 3 separate stones, and the total dimension measured individually, not including joints, only varies approximately 3/8" (105 7/8" to 106 1/4").

The above plan notes the total length of the radii including joints. Three of the four radii on the Northern half (including the joints) are 1 1/4" to 2 3/4" greater than the other radii. This would indicate that the whole Northern side (pavers and exedra) has been displaced approximately this distance.

Existing Conditions– Joint Dimensions



The movement of pavers also caused the exedra units to be displaced. The exedra appears to be set onto a concrete base. The average joint dimensions of the exedra are noted in the above plan. All the units have spread and have wider, open joints than originally planned. The joints on the Northern half are in the 1" range while joints on the Southern side are in the 1/2" range. While all of the exedra units have been displaced outwards, the movement of the Northern half has also caused the North opening of the exedra to be considerably greater then the other 3 openings, approximately 2 3/4" larger than the other openings.

Elevations at the ends of the exedra benches were recorded by laser level and it was found that the Eastern side of the South entrance was the highest point. Differences relative this point, T.O.B. (Top of Bench) varies a maximum of 7/8" with little consistency. Slate shims have been used in the past in an apparent attempt to correct the differences.

Existing Conditions– Open Joints

Open joints

The large open joints in the marble exedra and displacement of units is considerable.
Each of these units weighs approximately 3000 pounds. There are five units that make up each section of the exedra.

Stone movement and replacement mortar

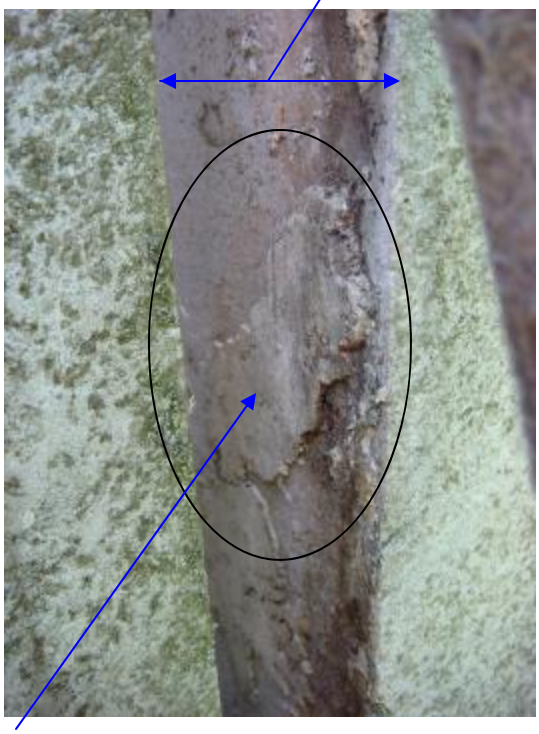
Enlarged joint

Existing Conditions– Joint Details

Open joints in exedra with lettering

Detail of existing open joints with failed replacement caulking and fibrous backer material.

Existing joint opening



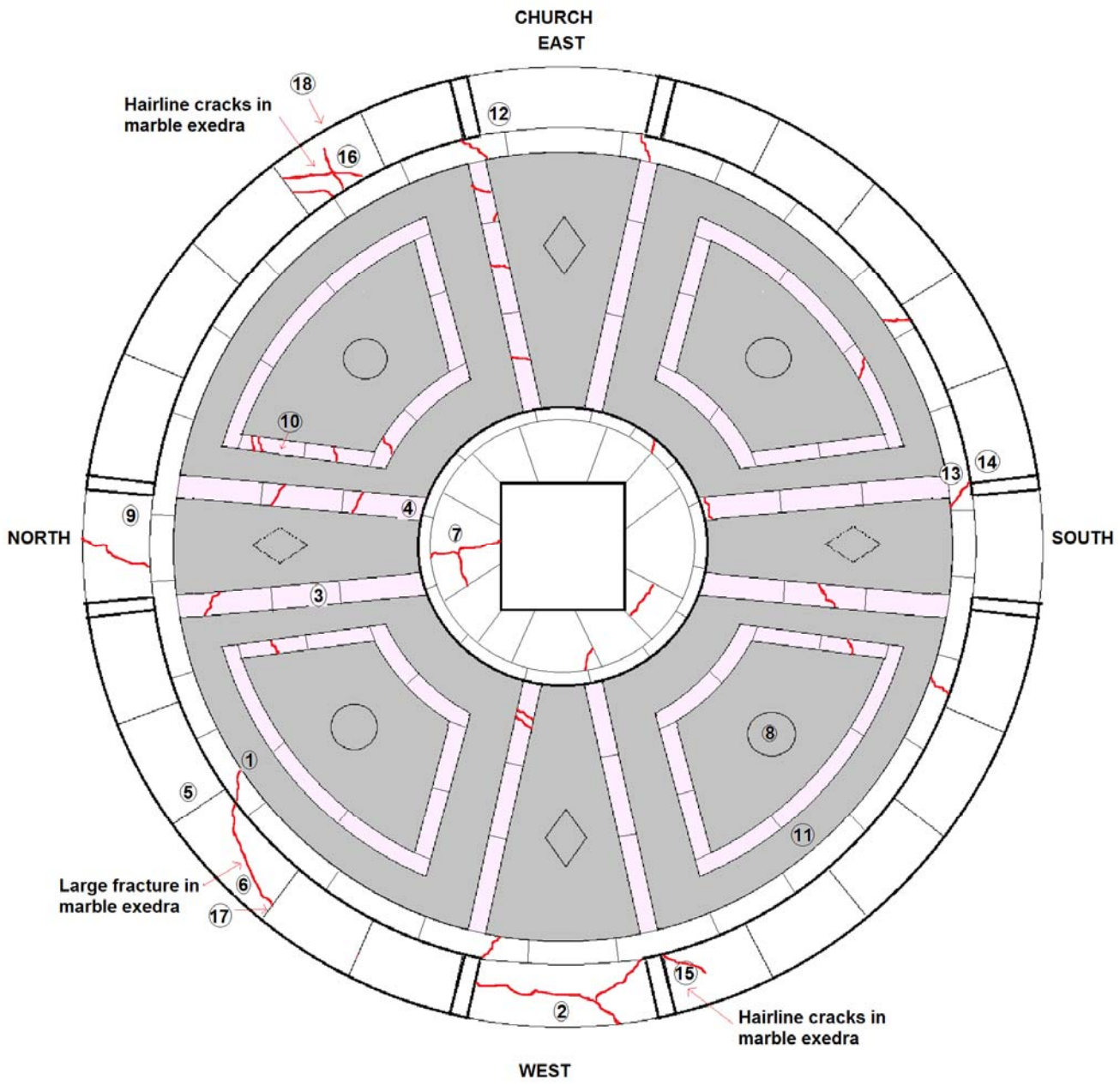
Detail of original thin joint mortar

Examples of original joint mortar from the exedra were scarce; the few pieces found were very thin, ranging from 1/16” to 1/8” in thickness. The spacing of the lettering at the joints would also indicate that the original joints were very thin.

The original mortar was very white and the aggregate not visible to the naked eye. A crushed sample was examined with a variable magnification (7 to 70X) stereobinocular microscope.

Mortar analysis was performed by acid reaction with considerable evolution of gas indicating large amounts of carbonate material. The range of the aggregate size is shown on page 17.

Existing Conditions– Location of fractures and photo locations



The above plan notes the approximate location of fractures (in red) and photo locations. A sample of the Ross Quarry limestone (pinkish radii and related pattern) at location 13 was removed and found to be 4" thick. It is unlikely that all the fractures were caused by frost heaving.

There are a number of hairline fractures in two of the exedra units and one substantial fracture. The cause of the large fracture to the marble exedra in the North-West quadrant is not known (possible tree or branch damage?)

Existing Conditions– Setting Bed

Loose limestone fragment

Limestone fragment removed. Note depth of trowel under corner of exedra.

Probing the setting bed

A portion of the Ross Quarry limestone was removed for inspection at the South entrance and was found to be 4” thick. The setting bed was comprised of solid stones with evidence of a decomposed mortar
The loose sample was placed back as found.

Detail of setting area

Conservation Recommendations

Note: All masonry work is to be done by contractors having experience in historic masonry restoration. When possible, existing material is to be restored and re-used to the maximum extent possible.

Removal of brick pavers and stone borders

1. Marble exedra to be kept in place while restoring pavers.
2. Disassembling and re-assembling brick and stone pavers to be done in quadrants. Bricks along edges of pattern should be documented and stored in original setting position until ready to reset.
3. All existing mortar to be removed from pavers with hand tools
4. Temporary (removable) marks and measurements of the location and pattern of existing radii to be well established before disassembly.

Photos above and below are details of the same location in each section containing an oval serpentine plaque. While it appears that the perimeter bricks and pattern are identical with minor variations, every effort should be made to reset the bricks in their original position.

Conservation Recommendations

Drainage

Apart from frost heaves and dips, the elevations of the pavers appear to conform to the original design for surface water to drain towards the openings in the exedra. The movement and resulting damages (and related re-pointing) may have all taken place before the storm drains were installed. The drains would help in removing excessive water pooling at the monument due to the adjacent topography of the site. It would be interesting to see if the date of the last re-pointing work coincides with the installment of the storm drains.

Improving the drainage of the site can only be best determined when existing pavers and stones are removed and the setting bed is examined. Of paramount importance is the sloping of the final surface to drain water. Detailed drainage plans are beyond the scope of this report.

If general, an adequate drainage bed would be approximately two feet deep consisting of approximately 12" of tamped, crushed 2" stone, followed by 6-8" of compacted 3/8" crushed stone. The stone would be covered by a filter fabric or a drainage composite such as Sure Drain HD by Carlisle, with a final 3– 4" setting bed of fine compacted sand or stone dust. Final determination of drainage bed to be done upon excavation of pavers.

If feasible, an interior perimeter "French" drain can be installed at the interior foot within the exedra. This can be drained into the storm drains located towards the church on the Eastern side. Storm drains should be inspected and be in working order. (Federal law requires water sent to storm drains to be free of certain contaminants and sediment).

Structural adhesion of fractures.

Note: Attachment of fragments must be done by an experienced historic stone conservator.

1. All surfaces of fractured stones should be cleaned with water and stiff natural or nylon brushes.
2. When fully air dried, fractures should be attached with structural adhesive, Abatron 55-22 (Abatron, Kenosha WI) or equivalent and clamped until cured. A tight fit keeping the elements in the same plane is necessary for a successful adhesion.
3. Excess cured epoxy to be carefully removed with hand tools.
4. When moving stone elements after full cure, stress at adhesive joints should be kept to a minimum. The use of wood planks can be used to provide extra support.

Conservation Recommendations

Note: All mortars shall use a high calcium lime, VitaCalH Calcium hydroxide (in powder form) manufactured by Mississippi Lime Company. (Available from D.N. Lukens, Inc, Westboro MA. 800-358-5367). This product should be kept sealed until ready for use.
Mortar for re-pointing the brick and limestone pavers is made with a larger aggregate size than the mortar for re-pointing the exedra units. Details below.

Resetting of Brick Pavers and Borders

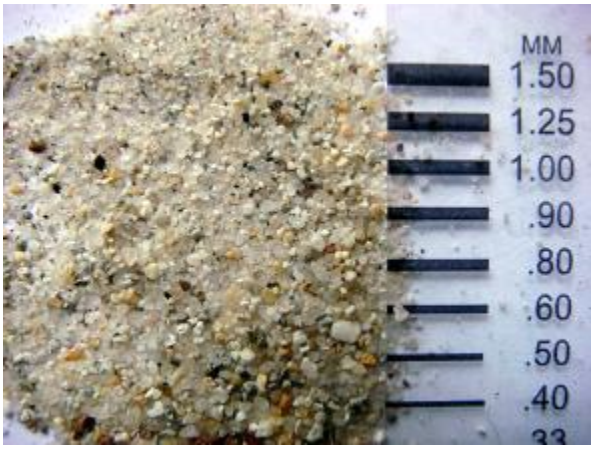
All existing mortars to be removed with hand tools.
Original brick pavers and Ross Quarry limestone borders should be set onto a bed of mortar approximately 3/4”- 1” deep (1 w.pc, 2 high calcium lime, and 7 masonry sand). After partial cure, pavers and borders should be repointed as below.

Repointing of Brick Pavers and Borders

New repointing should be done with a Type O lime rich mortar, 1 white Portland cement 2 high calcium lime, and 7 white quartz sand. Brushed finish to appear weathered.
Aggregate sand to be comprised of the following approximate range in size:

% retained on #16	22%
% Retained on #30	40%
% Retained on # 50	25%
% passing #50	12%

Graded aggregate should be fully rinsed with water to remove any dust and dried before using.



Range of aggregate size of exist pointing mortar in mm. for pavers.

Cross section of existing pointing mortar

Conservation Recommendations

Resetting Marble Exedra

Marble elements of exedra appear to be dry set onto a concrete base. Once the pavers, border and radii elements have been reset the exedra elements can be carefully moved into position and when required, can be leveled with slates shims. Ideally the joints should be as close as possible.

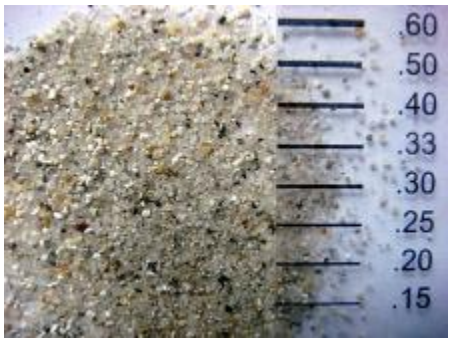
A field inspection during the conservation work will be necessary to determine the most feasible way to restore the fragmented exedra unit. Because of the massive size and the stability of the fragments of this exedra unit, structural attachment is desirable but not necessary. The debris in the void caused by the fracture should be removed with air pressure and the two fragments moved together as tightly as possible. The crack can then be re-pointed with mortar described below.

Repointing of Marble Exedra

1. All existing pointing material to be removed with hand tools
2. New repointing should be done with a Type O lime rich mortar, 1 w.p.c, 2 high calcium lime, and 7 white quartz sand. Aggregate sand to be comprised of the following approximate range in size:

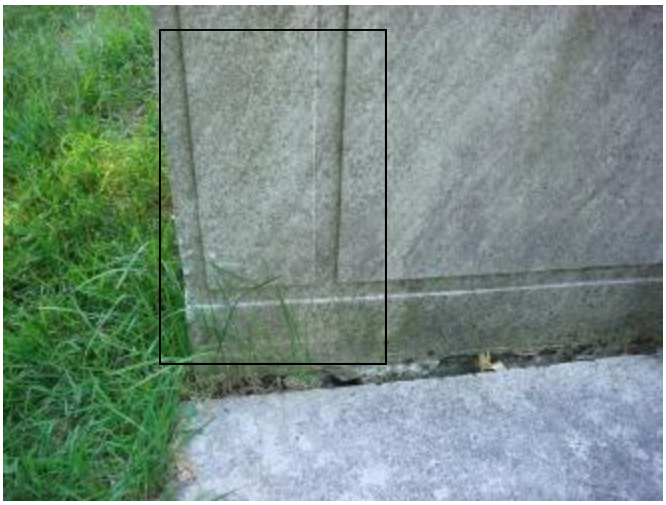
% Retained on #30	5%
% Retained on #50	65%
% passing #50	30%

Graded aggregate should be fully rinsed with water to



Range of aggregate size of existing pointing mortar in mm. for exedra.

Conservation Recommendations– Cleaning



Test area for cleaning.

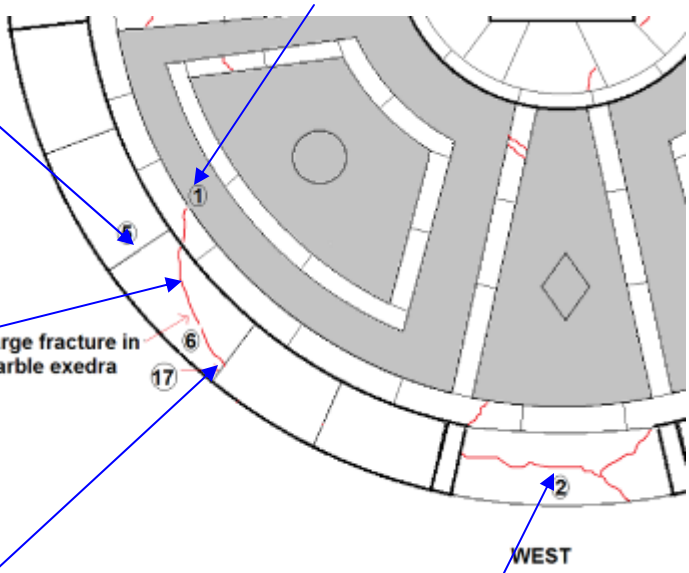
After cleaning

Cleaning of Marble Exedra and Statue.
Cleaning tests were done with D/2 Biological solution (Cathedral Stone, Hanover MD). A contact time of only 1 to 2 minutes will loosen most fungal and algal deposits. It is non-toxic and biodegradable: No special precautions required for handling and storage. Follow manufacturers recommendations for application and disposal.

Area to be cleaned is saturated with D/2 Biological Solution with a pump sprayer. Allow the undiluted D/2 to remain on the surface for 1 or 2 minutes, then apply additional D/2 to maintain a wet surface. Scrub wet surface thoroughly with a non-metallic, short fibered scrub brush. Best results are scrubbing onto wet surfaces, if necessary lightly mist with water and continue scrubbing. Rinse thoroughly with clean water.

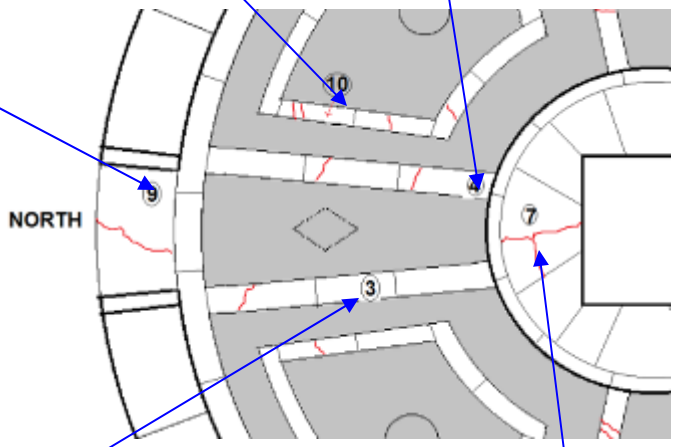
Rinsed areas will appear to be immediately cleaner, and with time, will appear whiter as the dead biogrowth slowly detaches from the stone.

Appendix- Photo locations of existing conditions



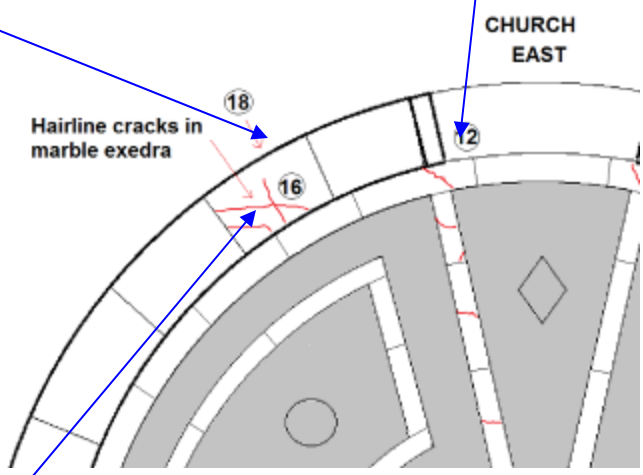
NORTH–WEST SECTION

Appendix- Photo locations of existing conditions



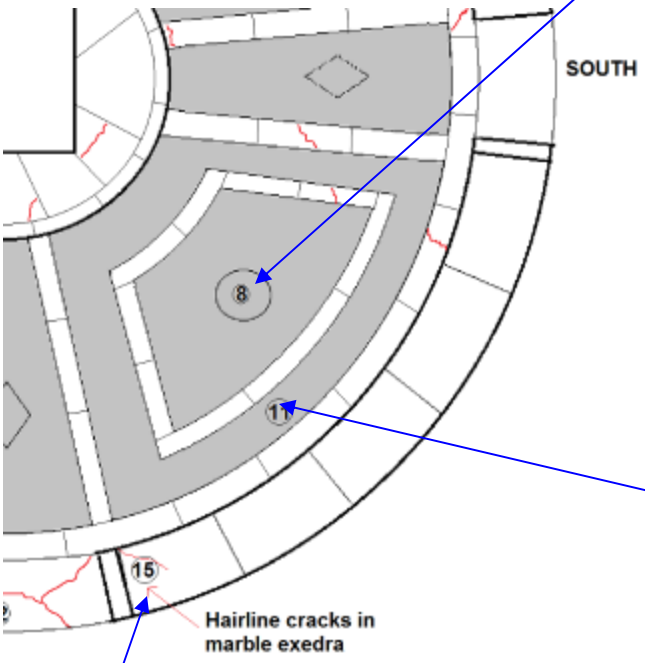
NORTH SECTION

Appendix- Photo locations of existing conditions



NORTH–EAST SECTION

Appendix- Photo locations of existing conditions



SOUTH-WEST SECTION

Appendix- Topography detail

Monument location